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First National Communication under The UN Framework Convention on Climate Change

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1.1. Introduction

The greatest environmental challenge faced by humankind is the mitigation of climate change. Human activities have increased concentrations of greenhouse gases in the atmosphere. In its Third Assessment Report (2001) the Intergovernmental Panel on Climate Change (IPCC) presented new and solid evidence that in the last 50 years global warming has, by and large, been the result of human activities - activities whose impact will continue to be the main cause of climate change in the centuries to come. Projections show a rise in global temperature and sea level according to all IPCC emission scenarios - the expected increase in global temperature ranges from 1.4 to 5.8 ^{0}C, while that in the average sea leves ranges between 9 and 88 cm in the 1990-2100 period.

The UN Framework Convention on Climate Change (Rio, 1992) is the first internationally binding instrument that addresses the issue of response to climate change. The ultimate objective of the Convention is to achieve stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

By ratifying the Convention in late 1995, Slovenia became one of the Parties to the Convention. In October 1998 Slovenia signed the Kyoto Protocol, within the framework of which it assumed the commitment to achieve an 8 % reduction in greenhouse gas emissions in the first target period between 2008 and 2012, with 1986 as the base year.

The preparation and submission of national communications is one of the basic commitments of the Parties to the Convention. All Annex I Parties were obliged to submit their Third Communication by the end of 2001, which is why Slovenia will skip preparation of the Second Communication and begin drawing up the Third Communication as soon as it submits the First Communication. For this reason, we have updated the methodology and content of the First Communication and will incorporate the remaining elements of the Second Communication in the Third Communication.

1.2. National Circumstances

Slovenia became an independent state on 26 June 1991 following the break-up of the former Socialist Federal Republic of Yugoslavia. The National Environmental Protection Programme, adopted in 1999, makes air protection, including greenhouse gas emissions, one of the priority environmental protection tasks. For the purpose of addressing the problem of climate change more effectively, a special governmental expert body was founded in 1997, namely Slovenian Climate Change Committee, presided over by the Minister of the Environment and Spatial Planning.

By deciding to undertake the process of accession to the European Union, the Republic of Slovenia elected to adopt and enforce the EU acquis communautaire. One of its short-term priorities and negotiating positions is ratification of the Kyoto Protocol. In November 2000 the government adopted the Strategy and Short-Term Action Plan of Reduction of Greenhouse Gas Emissions.

Though small, Slovenia is an exceptionally diverse country. The coastal zone of the Adriatic Sea is separated from the mainland by the northern slopes of the Dinaric mountain range. To the northwest it stretches to the Alps, its central region also being mountainous and strewn with numerous valleys and basins. To the northeast, Slovenian territory progressively flattens, and ends in the Pannonian Plain. As much as 55 % of the national territory is covered with forests, making Slovenia one of the most heavily forested countries in Europe. Slovenia boasts exceptional biotic diversity. This diversity is the result of climatic, orographic and pedological variability, large forest areas subjected to co-natural management, and the preservation of traditional methods of management of part of the cultural landscape.

Slovenia is characterised by dispersed settlement, reflected in the fact that only slightly over half the population live in urban areas. Population density is moderate, with two million people living on 20,000 km^2. The average housing space per inhabitant in Slovenia measures 25 m^2. Households mostly live in their own housing units.

In the late 1980s the Slovenian economy was disrupted by political and economic transformations, exacerbated by the loss of markets in the former Yugoslavia. As early as 1993, economic growth was restored, the average annual rate exceeding 4 %. In 1999 Slovenia reached 71 % of the average EU per-capita GDP in terms of purchasing power. The service sector accounts for more than half of the total GDP, the industrial sector holds a one third share and the agricultural sector 3 %. The small size of the domestic market has forced the Slovenian economy to become firmly embedded in international economic flows.

Energy supply in Slovenia relies chiefly on imported gas, liquid and nuclear fuels, and on domestic coal, hydroelectric power and wood biomass. Production and consumption of coal are on the decline. The increase in consumption of liquid fuels can be ascribed primarily to the growth in road traffic. In the 1980-1998 period, the total consumption of fossil fuels grew from 150.4 PJ to 192.3 PJ. Coal-fired power plants account for more than one third of total electricity generated. The share of renewable resources, particularly hydroelectric power and wood biomass, in the total consumption of primary energy is 8 %. Since 1997 a CO_2 emission tax has been charged for the use of fossil fuels.

Slovenia has a high and increasing level of motorisation. In 1999 there were 417 cars per 1,000 inhabitants, or 1.26 vehicles per household. Dispersed settlements, the relatively low price of engine fuels and low parking costs have all contributed to the high average annual mileage of cars. In addition to domestic traffic, Slovenia has to cope with substantial levels of transit traffic - Slovenian territory represents the crossroads of important European east-west and north-south routes.

The transformation of the political and economic systems in the late 1980s resulted in a temporary decline in industrial production and the standard of living in Slovenia. This in turn temporarily reduced greenhouse gas emissions. All this resulted in Slovenia, as a country in transition, and pursuant to Article 4.6 of the Convention, selecting 1986 as the base year for its commitments to reduce emissions.

1.3. Inventories of Greenhouse Gas Emissions

Anthropogenic greenhouse gas emissions were calculated on the basis of IPCC methodology, mostly using default IPCC emission factors. A short overview of emissions according to the IPCC nomenclature is shown in Tables 1 and 2.

The main sources of CO_2 emissions have been the supply of electrical and heating energy from thermal power plants and combined heat and power plants (CHP), and transport, accounting for shares of 32 % and 27 % respectively in 1996. In the 1986-1996 period, industry-generated emissions of CO_2 nearly halved, while emissions discharged by transport more than doubled. Due to the increase in wood biomass in existing forests and the overgrowth of agricultural land, sinks of CO_2 represent one third of anthropogenic emissions of CO_2.

Emissions of CH_4 are discharged chiefly in waste management, the enteric fermentation of cattle, and coal mining. The reduction in the number of livestock and in coal mining have re-

Table1: Total greenhouse gas emissions, by sector

Sector	**1986**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**Share 1996**	**Index 1996/ 1986**
					Gg CO_2 equiv.					**%**
Total Emissions	20,181	18,599	17,988	17,755	18,371	18,516	19,310	20,042	100	99
1 Energy	15,221	13,854	13,296	13,309	13,971	13,968	14,717	15,471	77	102
2 Industrial Processes	1,241	1,217	1,100	950	883	1,049	1,111	1,069	5	86
3 Solvent and Other Product Use	127	81	71	61	49	51	49	52	0	41
4 Agriculture	2,597	2,477	2,453	2,396	2,388	2,354	2,329	2,305	11	89
6 Waste	996	970	1,067	1,041	1,080	1,094	1,105	1,145	6	115

Source: MOP-ARSO

Table 2: Total emissions, by greenhouse gas

Sector	**1986**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**Share 1996**	**Index 1996/ 1986**
					Gg CO_2 equiv.					**%**
Total Emissions	20,181	18,599	17,988	17,755	18,371	18,516	19,310	20,042	100	99
CO_2	15,553	14,293	13,591	13,513	14,126	14,259	14,983	15,737	79	101
CH_4	2,527	2,385	2,442	2,393	2,385	2,360	2,358	2,370	12	94
N_2O	1,819	1,663	1,651	1,606	1,609	1,615	1,626	1,647	8	91
PFC, HFC, SF_6	283	258	303	244	251	282	343	289	1	102
Sinks*	-2950	-4334	-4748	-5086	-5173	-5331	-5677	-5560	-	188

*Sinks are not included in total emissions

Source: MOP-ARSO

duced CH_4 emissions, despite the growth in emissions resulting from waste management.
The main source of N_2O emissions is agriculture, accounting for more than 80 % of all emissions of this gas. Emissions have fallen mainly because of the lower input of nitrogen into the soil via organic fertilisers. Emissions of N_2O have risen only in transport - the result of the larger number of vehicles equipped with catalytic converters.
Due to the modernisation of aluminium production processes, emissions of PFCs have remained at approximately the same level despite the fact that the production of aluminium has increased. Since 1993, HFCs have also been used as a CFCs substitute in cooling technology and as a foaming agent in the production of polyurethane products in Slovenia. SF_6 is used in high-voltage facilities for the transmission and distribution of electricity and as a filler in soundproof windows. Total emissions of PFCs, HFCs and SF_6 greenhouse gases in Slovenia are a little over 1 %.

1.4. Emission Reduction Policies and Measures

The Slovenian government drafted Strategy and Short-Term Action Plan of Reduction of Greenhouse Gas Emissions and, following a public debate, adopted it in November 2000. The Strategy's main objective is to prepare bases for fulfilling the provisions of the Kyoto Protocol applying to the reduction of greenhouse gas emissions in the first commitment period 2008-2012, and to set forth policies that will enable the effective management of greenhouse gas emissions after this period as well.

The Strategy sets forth the objectives and basic starting points for reducing emissions. It contains more than 120 measures aimed at reducing greenhouse gas emissions. However, at the moment it does not contain a timetable of individual measures, nor an indication of the intensity of their implementation. The reason for this is that the envisaged reduction of greenhouse gas emissions will call for substantial changes in the production and consumption of goods and satisfying of vital needs. This will in many respects affect the course and method of economic development, as well as other important aspects of Slovenia's development (these will therefore have to be reassessed). The Strategy is therefore an interim stage until the preparation of the National Programme of Reduction of Greenhouse Gas Emissions.

The Strategy sets out the following criteria applying to the reduction of greenhouse gas emissions:

- minimisation of the costs of reducing greenhouse gas emissions at the national level;
- positive effects on the national economy;
- international competitiveness of the national economy;
- action coordinated with financial capabilities;
- reduction of excessive local and regional environmental burdens;
- contribution to the fulfilment of other already-adopted and anticipated international environmental commitments of Slovenia and obligations arising from Slovenia's approximation to the EU in the area of environmental protection;
- reliability and competitiveness in the supply of energy, food and other strategic resources;
- social fairness and acceptability;
- adaptability and viability of solutions;
- long-term applicability of solutions.

The National Environmental Protection Programme aims to achieve a reduction in greenhouse gas emissions mainly using economic instruments. The Strategy's basic instrument for reducing greenhouse gas emissions takes the form of "green" tax reform. In addition to economic instruments, plans have been made for the greenhouse gas emissions reduction potential to be activated by regulatory instruments, indirect promotional activities such as model and promotional projects, voluntary agreements between commercial associations and the state, and the promotion of research and education.

As part of preparations for the Programme of Reduction of Greenhouse Gas Emissions and within the framework of developmental programmes, different sectors will draft sectoral programmes for the reduction of greenhouse gas emissions in compliance with the starting points and criteria contained in the Strategy. The coordinated sectoral programmes will, at the same time, form an integral part of the National Programme of Reduction of Greenhouse Gas Emissions and centrally-operated programmes. For the purpose of achieving positive synergistic effects, the Air Protection Strategy will be drafted in parallel and uniformly with the Programme of Reduction of Greenhouse Gas Emissions.

The operational gap that will exist until the adoption of the comprehensive National Programme of Reduction of Greenhouse Gas Emissions will be bridged by the Short-Term Action Plan of Reduction of Greenhouse Gas Emissions, which is a constituent part of the Strategy. It includes a summary of 30 measures and activities that the Slovenian government was supposed to begin to implement in 2001.

Even before the adoption of the Strategy of Reduction of Greenhouse Gas Emissions, Slovenia had begun to carry out certain measures aimed at reducing greenhouse gas emissions. The most important measure was adopted in 1996, namely the CO_2 tax charged for the use of fossil fuels; Slovenia was the first country in central and eastern Europe to introduce this. At its introduction the tax amounted to SIT 1/kg CO_2; in 1998 this was increased to SIT 3/kg CO_2 (15 EUR/t CO_2). The increase was followed by the introduction of partial exemptions for the purpose of enhancing the competitiveness of industry. The CO_2 tax contributes approximately 1 % to total budgetary income.

Other already-implemented measures that have contributed to the management of greenhouse gas emissions were introduced primarily for the purpose of enhancing economic efficiency through the introduction of new technologies, efficient energy use, and the reduction of burdens on the atmosphere, water and soil. For example, the Agency for Efficient Use of Energy, which operates within the Ministry of the Environment and Spatial Planning, has developed an extensive network of advisory, informational and model activities for companies, the public sector and households. Loans with a subsidised interest rate for investments by legal persons are granted by the Efficient Use of Energy Investment Fund, while households have the possibility of taking out loans from the Environmental Development Fund of the Republic of Slovenia.

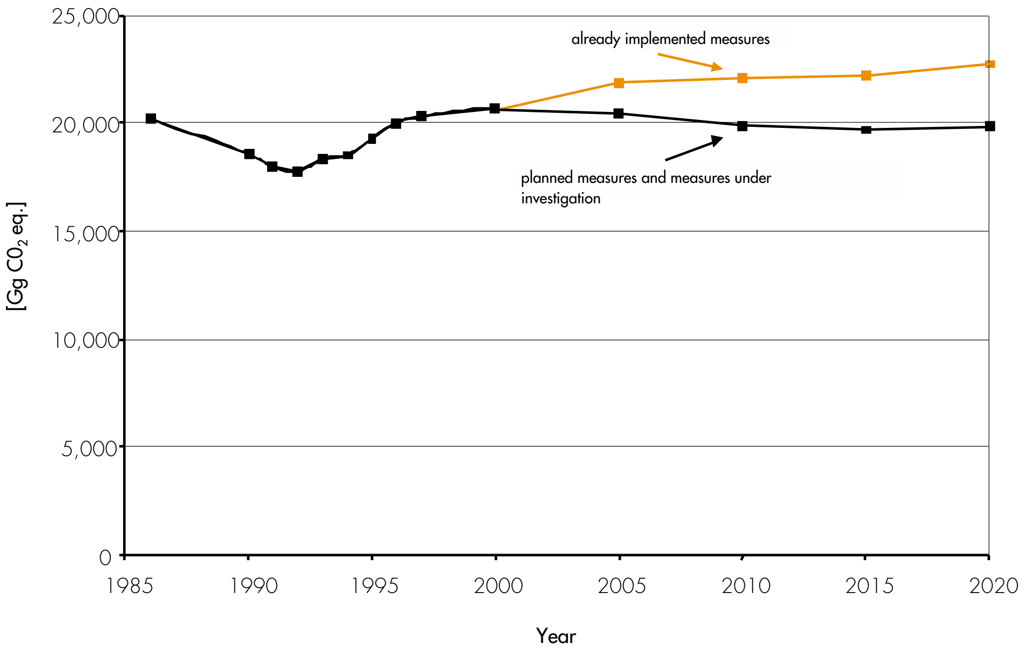
Planned measures include those specified in the Short-Term Action Plan of Reduction of Greenhouse Gas Emissions. Plans include the intensification of advisory, informational and model projects and the inclusion of new players, including the relevant power supply companies. A study is also being carried out relating to the injection of equity capital into the Efficient Use of Energy Investment Fund and the Environmental Development Fund of the Republic of Slovenia, and the allocation of funding contained in the two Funds targeted specifically at reducing greenhouse gas emissions. In addition, plans have been made for the standards applying to heat conductivity and heat gains in buildings to be made more stringent, in addition to those applying to the minimum efficiency level of combustion plants. An investigation is underway into the preparation of systemic measures for promoting the combined heat and power production, and into the use of renewable energy. Both areas will be supplied with definitions of minimum progressive shares regarding energy supply. Promotion of the use of wood biomass will be set forth in the Programme, which is about to be adopted and which is expected to reduce total greenhouse gas emissions by 1.5 % in the period leading up to 2010. The CO_2 tax will be expanded to cover electricity use, where, in the case of households, the level of the tax will depend on consumption. Plans are also underway to introduce an excise duty, which will be linked to fuel consumption norms and which will apply to the purchase of new cars. Regular supervision of the engine settings and composition of motor vehicle exhaust gases will also be introduced, supervision of violations of speed limits on motorways will be stricter, accompanied by the introduction of measures for promoting public transport. Elements for the reduction of greenhouse gas emissions are also planned in agricultural policy. A new tax will soon be adopted in relation to waste management, bringing about charges for emissions of methane in accordance with the latter's global warming potential (GWP), at the same rate as the tax applying to CO_2 emissions.

The government is committed to promoting the introduction of environmental management systems compliant with ISO 14000 and EMAS into companies and state institutions. The process of the preparation of voluntary agreements with different industries on the reduction of specific emissions of CO_2, PFC in the production of aluminium and SF_6 in the area of electrical distribution is also about to begin. The government will also promote the preparation of programmes of reduction of greenhouse gas emissions in local communities. In addition, the government is investigating the possibility of preparing a programme of energy rehabilitation of buildings in its ownership, as well as of legal and organisational bases for contractual investments in measures for the efficient use of energy by third parties in the public sector.

The most significant measures currently still under investigation include the introduction of a general excise duty on energy consumption. Consideration is also being given to mechanisms that would ensure the use of that part of budgetary income generated by CO_2 tax for the promotion of measures for reducing greenhouse gas emissions, primarily for subsidizing the interest rate of investments.

1. 5 Projections of Emissions, and Assessment of the Impact of Policies and Measures

The assessment of greenhouse gas emissions up to 2020 will be made on the basis of two basic scenarios. The first Scenario (A) describes the development of emissions in the event of already-implemented measures, including CO_2 tax, without their intensification, and the introduction of new measures aimed at achieving a reduction in emissions. The second Scenario (B) is targeted specifically at the reduction of emissions. Scenario B thus stipulates the intensive implementation of both the planned measures and the measures still under investigation. In addition, Scenario B envisages the introduction of measures, within the framework of which the cost of reduction exceeds SIT 5/kg CO_2 (25 EUR/tonne CO_2). Scenario B has not yet been made inter-sectorially consistent, since specific sectors (agriculture, waste management and transport) have not yet assessed and balanced the marginal costs of reduction and do not take into account the other criteria specified in the strategy of reduction of greenhouse gas emissions. This means that Scenario B does not represent the final decision on the method and extent of reduction of greenhouse gas emissions in Slovenia.



Source: MOP-ARSO

Figure 1: Projections of emissions of greenhouse gases according to the scenario of already-implemented measures and the scenario of planned measures and measures under investigation

The projections of emissions according to the scenario stipulating already-implemented measures show a growth in emissions, although at a smaller rate than in the 1993-1997 period, due to the impact of the measures (Figure 1). According to this scenario, CO_2 emissions would increase by 12 % with respect to 1986, while total greenhouse gas emissions would increase by two percentage points less. On the other hand, the scenario containing the intensive introduction of costlier planned measures and measures still under investigation shows that, by the end of 2010, total greenhouse gas emissions would be reduced by 1 % with respect to 1986. According to this scenario, CO_2 emissions would increase by 4 %, while emissions of other direct greenhouse gases would fall.

1.6 Vulnerability Assessment

Due to its orographic and climatic features, Slovenia falls within the group of countries highly vulnerable to climate change.

The sphere expected to suffer most seriously is agriculture; this is because of the expected higher frequency and intensity of dry periods, particularly if temperature increases are accompanied by reduced rainfall during the summer months. In the last decade, droughts have several times caused a substantial reduction in crop yields. The conditions for agricultural cultivation may be further exacerbated by the probability of extreme weather events, frost, hail and extreme rainfall levels. On the other hand, we can also expect positive effects in the form of fertilising effects resulting from increased concentrations of CO_2, prolongation of the growing period, and the possibility of agricultural cultivation at higher altitudes above sea level, although the positive effects will not weigh out the negative ones. Agricultural cultivation is therefore expected to become more expensive.

As a result of climate change, most forest habitats, which cover as much as 55 % of Slovenian territory, will become exposed to stress. Low and medium-high habitats are particularly vulnerable, given that the composition of forests in past centuries has been modified, as a result of anthropogenic interference, through the introduction of spruce, which normally inhabits colder regions. In addition, the protective function of forests will also be threatened, especially in exposed habitats. The advantage of Slovenian forests in adapting to climate change lies in traditional co-natural forest management methods, which have avoided vulnerable monocultural compositions.

Climate change poses a serious threat to Slovenia's above-average biotic diversity. Numerous specific, smaller, geographically isolated ecosystems, which constitute shelter for endemic species, will not be able to shift in order to adapt to the changed climate zones.

Climate change will also substantially affect areas of water. On the one hand, the expected intensified rainfall will increase the already-high risk of rapid flooding; on the other hand, longer dry periods may give rise to water supply difficulties, especially in the Primorska region and in northeastern Slovenia.

The coastal region is also at risk, associated with both increased sea level and potential impacts on sea plants and animals resulting from increased water temperatures and biochemical changes. In the event of climate change, the Alpine world and other mountainous regions may also become high-risk regions, affecting both natural ecosystems and a number of human activities. The increased possibility of intensive rainfall and the protective function of forests undermined by climate change may contribute to the escalation of unfavourable geomorphological processes, including landslides, mudslides and torrential floods.

Climate change can also be expected to be accompanied by both direct and indirect adverse effects on the health and wellbeing of human beings. Direct effects are likely to include increased temperatures and the potentially higher frequency and intensity of extreme weather events. The photo-chemical smog season will be extended; at the same time we can expect synergistic stress effects caused by heatwaves. Climate change may also cause spatial escalation and an increased population of hosts and carriers of diseases, for example ticks, which carry Lyme disease and tick-borne meningitis.

1.7 Adaptation Measures

Slovenia has hitherto not carried out measures targeted at adaptation to climate change. Until the adoption of the relevant strategy that will address the adaptation to climate change, this Communication is deemed to represent the government's starting points for the management of measures for this area.

The planning and implementation of measures must first and foremost address areas where vulnerability caused by the natural climate variability is already evident. In addition, priority must be given to segments that will require the longest period for adaptation and whose current developmental trends show that future conditions may deteriorate. Due to the long lifespan of trees, forests take a very long time to adapt. In addition to the reduction of stress caused by air pollution, the already-established practice of co-natural forest management must continue to be pursued, while the efforts of forestry professionals to increase the share of deciduous trees must be supported with intensive research and monitoring of current conditions. Water management needs to be furnished with more robust infrastructure planning, which should no longer be based solely on the direct use of data from past periods. One of the most important things will be to include the issue of climate change in spatial planning, where changes are most enduring and virtually irreversible. Construction on regions exposed to flood risk must be avoided, as must construction in regions which may serve as catchment areas for flood waves and as water reservoirs for agricultural irrigation. Protected water supply regions must be placed under strict supervision. For the purpose of reducing heat deviations, urban planning must be aimed at mitigating urban heat island effects. The appropriate tackling of the adverse effects of climate change will call for increased quantities of information for decision-makers, experts and citizens.

1.8 Research and Systematic Observation

In Slovenia, research into the problem of climate change has been conducted by the University of Ljubljana and certain other institutions. Some of this research has been completed in recent years, though most of it has been carried out within the framework of the programme of compilation of this Communication. The research covers both an analysis of vulnerability to climate change, and the possibilities and developmental, economic and social aspects of the reduction of greenhouse gas emissions in Slovenia.

Slovenia has carried out meteorological observations and measurements since 1850. The data obtained on the basis of these measurements is invaluable in light of the fact that Slovenia has very diverse climate conditions: a continental climate to the northeast, an Alpine climate in the Alps, and a sub-Mediterranean climate in the Primorska (coastal) region. The Environmental Agency plans and manages the measurement network, currently consisting of 13 synoptic, 185 rainfall, 41 climatologic, 30 automatic meteorological and 321 hydrological stations (for surface water and underground water), 19 of the latter of which are automatic, one radio sounding station and meteorological radar, and investigates climate conditions on the basis of measurement sets collected over the years. The Environmental Agency is also involved in international data exchange.

There are no so-called "reference climatological stations" in Slovenia, since invariability of the observation site surroundings and uninterrupted measurements and observations, which are supposed to ensure homogeneous climatological data that would faithfully reflect substantial climate change, have not yet been provided.

1.9 Education, Training and Public Awareness

Awareness of the causes and potential effects of climate change in Slovenia has not been raised to a sufficient extent. This is partly the result of the late inclusion of Slovenia in the negotiating process within the Convention on Climate Change, partly the excessive occupation of administration with tasks arising from Slovenia's independence, transition and membership of the European Union, and partly the initial lack of interest on the part of the media. And while some of these reasons are still in place, the situation in certain other areas has improved, which is why the awareness of both the general and professional publics and decision-makers has been enhanced. This has been the result of public debates on the preparation and adoption of the Strategy and Short-Term Action Plan of Reduction of Greenhouse Gas Emissions, the media's growing interest in this problem and, above all, the intensification of activities by non-governmental organisations in this area.

2. Introduction

Climate change mitigation is one of the greatest environmental challenges facing humankind. Human activities have boosted greenhouse gas concentrations in the atmosphere, including carbon dioxide, methane and nitrous oxide. Though these gases are not toxic, they affect the global heat balance. In its Third Assessment Report of 2001, the Intergovernmental Panel on Climate Change (IPCC) stated the following:

- An increasing body of observations gives a collective picture of a warming world and other changes in the climate system - the global average surface temperature has increased over the 20th century by about 0.6 ^{0}C.
- Emissions of greenhouse gases and aerosols due to human activities continue to alter the atmosphere in ways that are expected to affect the climate.
- There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities.
- Human influence will continue to change atmospheric composition throughout the 21st century.
- Global average temperature and sea level are projected to rise under all IPCC SRES scenarios - the expected range of the increase in global average temperature is between 1.4 and 5.8 ^{0}C, while that of the increase in the average sea level is between 9 and 88 cm over the period 1990 to 2100.
- Anthropogenic climate change will persist for many centuries.

The expected effects of climate change on agriculture, water sources, ecosystems and the health and wellbeing of people, as well as their economic and social aspects, have triggered demands for an immediate response by the international community. The UN Convention on Climate Change is the first internationally binding instrument addressing this issue. The Convention was signed in Rio de Janeiro in 1992, entered into force in 1994, and represents the basis for further international cooperation in the elimination of the causes and mitigation of the adverse effects of climate change. The ultimate objective of the Convention is to achieve stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a timeframe sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner.

After the Convention's ratification, Slovenia became a Party to the Convention in late 1995. In October 1998 Slovenia also signed the Kyoto Protocol, within the framework of which it assumed the commitment to achieve an 8 % reduction in greenhouse gas emissions in the first commitment period 2008 to 2012, with 1986 as the base year. Slovenia actively participates in the international political process of mitigation of climate change. It is Slovenia's position that bases need to be prepared as soon as possible that will enable the ratification and full implementation of the Kyoto Protocol.

The preparation and submission of national communications is one of the fundamental commitments of the Parties to the Convention. The First Communication was supposed to have been submitted within six months of the entry into force of the Convention. By now most countries listed in Annex I have submitted their Second Communication. When other developed countries were preparing their First and Second Communications, Slovenia was busy drafting and adopting its national legislation, which is why the delay in the preparation of its national communications is understandable. Parties to the Convention are obliged to submit their Third Communication by the end of 2001, which is why Slovenia will skip preparation of the Second Communication and will begin to draw up the Third Communication as soon as it completes and submits its First Communication. For this reason, we have supplemented the methodology and content of the First Communication, and we will incorporate the remaining elements of the Second Communication in the Third Communication.

Pursuant to the provisions of the Convention, the government prepared and, following the public debate in November 2000, adopted the Strategy and Short-Term Action Plan of Reduction of Greenhouse Gas Emissions. Measures targeted at reducing greenhouse gas emissions were in place even before that. So, for example, in 1996 Slovenia was one of the first countries to introduce a CO_2 tax. As a Party to the Convention, Slovenia is aware of the common but differentiated responsibilities for the global climate, especially because it is itself greatly threatened by climate change. In the last decade Slovenia has experienced extreme floods, severe droughts and other extreme weather events, which have caused immense damage and also claimed a number of lives. Slovenia believes that the management of greenhouse gas emissions is an essential component of sustainable development. As a result, Slovenia is committed to pursuing an effective internationally coordinated campaign aimed at mitigating the adverse effects of climate change. At the same time, Slovenia is committed to intensifying its active policy of reducing emissions and, to the best of its ability, do whatever is necessary to achieve the long-term reduction of greenhouse gas emissions. In so doing we will endeavour to integrate the aspects of reducing greenhouse gas emissions into our developmental policies in order to take maximum advantage of its strategic, social, environmental and other synergistic effects.

Janez Kopač, MSc
Minister of the Environment,
Energy and Spatial Planning

3. National Circumstances

3.1. Political and Administrative Bases for the Implementation of the Convention

The Republic of Slovenia became an independent state on 26 June 1991, following the disintegration of the former Socialist Federal Republic of Yugoslavia. The political system of Slovenia is parliamentary democracy. The Slovenian National Assembly, which consists of 90 deputies with a four-year term in office, elects the prime minister, at the proposal of the Slovenian president. The prime minister proposes members of the government (ministers), who must be approved by the National Assembly.

Pursuant to the Ratification of the UN Framework Convention on Climate Change Act, responsibility for its implementation falls within the competence of the Ministry of the Environment and Spatial Planning, in conjunction with the Ministry of Transport and Communications, the Ministry of Economic Affairs, and the Ministry of Agriculture, Forestry and Food.

The National Environmental Protection Programme, adopted by the National Assembly in 1999, following a public debate, ranked air protection as one of the priority areas within environmental protection. The related objective is to continue already-introduced air protection programmes and to supplement these programmes with programmes of reduction of tropospheric ozone and greenhouse gas emissions.

For the purpose of addressing the problem of climate change more effectively, 1997 saw the establishment of a special government expert body, the Climate Change Committee. The Committee is chaired by the Minister of the Environment and Spatial Planning, and consists of state secretaries from the Ministry of the Environment and Spatial Planning, the Ministry of Economic Affairs, the Ministry of Transport and Communications, the Ministry of Agriculture, Forestry and Food, and senior state officials from other departments. Other members of the Committee include representatives of the Chamber of Commerce and Industry of Slovenia, the academic sphere and non-governmental organisations. The Committee is, as a rule, convened twice a year. The government has also set up the Sustainable Development Council, which is presided over by the prime minister and consists of departmental ministers and representatives of interest groups.

Slovenia is divided into 192 municipalities, which have their own administration and own income. Local communities have jurisdiction over different areas that have an impact on greenhouse gas emissions. Their jurisdiction includes spatial planning and local transport arrangements, public passenger transport, the preparation of local energy concept designs, and compulsory public utility waste management services. Certain local communities have already voluntarily assumed commitments towards reducing greenhouse gas emissions. Local Agendas 21 are in the course of preparation.

With its decision to begin the process of accession to the European Union, Slovenia opted for the adoption and enforcement of the EU acquis. The short-term priorities and negotiating position of Slovenia have included ratification of the Kyoto Protocol, adoption of a suitable national regulation and establishment of a system for monitoring greenhouse gas emissions, and the formulation of a long-term strategy for reducing these emissions.

3.2. Population

Two million people were living in Slovenia in 1990; in 1998 this figure was 1,978,000. We are expecting a two per cent increase in the population figures by 2020. Life expectancy is 71 for men and 79 for women. The population is slowly ageing, where the share of people over 60 is approaching one-fifth. In 1991 the average household had 3.1 members; in 1998 this figure was 3.0.

Population density is moderate, amounting to 98 inhabitants/km^2. Slovenia is characterised by dispersed settlements, as only around half the population lives in urban settlements. 14 % of the total population of Slovenia live in the Slovenian capital Ljubljana.

In 1998 the average housing area per inhabitant in Slovenia was 25 m^2. Of the total number of housing units, half are over 30 years old. 65 % of all housing units are furnished with a district heating system. Nearly 50 % of all units are located in houses (as opposed to housing blocks). Households mostly live in their own housing units, which is favourable for the adoption of decisions on investment in the renovation of heating systems and heat insulation.

3.3. Geographic Profile

Slovenia is situated in central Europe, at a latitude of approximately 46^0 North and a longitude of 16^0 East. Slovenia's total surface area is 20,273 km^2. Slovenia has borders with Italy, Austria, Hungary and Croatia.

Though small in size, Slovenia is a very diverse country. The coastal region of the Adriatic Sea is separated from the mainland by the northern hills of the Dinaric mountain range. To the northwest it reaches the Alps, while the central part is also hilly, strewn with countless valleys and basins. To the northeast, Slovenian territory gradually flattens into the Pannonian Plain. The average height above sea level of the entire territory is 550 m, while the mountainous structure of the land gives it an average incline of 25 %.

Slovenia is one of the most heavily forested countries in Europe (around 55 % of the total surface area). Agricultural areas cover 38 % (0.39 ha/inhabitant). Built areas account for 2.5 % of the total area, and transport infrastructure covers 0.5 %. Forested areas have been increasing at the expense of agricultural land.

Slovenian territory represents the crossroads of three climate zones: Mediterranean, moderate-continental and Alpine. Due to the complex orography and cross-border impact region of the Genova cyclone, weather disturbances have different effects on individual regions of the territory. The complex orography is also the cause of substantial microclimatic differences, dictated chiefly by the pronounced surface and elevated inversions in basins and valleys. The average temperature deficit for heating equals 1,500 on the coast to more than 4,000 degree-days in higher-lying settlements, with a representative value of approximately 3,200 degree-days. The climatic diversity is also reflected in the substantial differences in rainfall volumes. The coastal region receives approximately 1,000 mm of rainfall annually, certain Alpine regions more than 3,000 mm, the central part of Slovenia between 1,000 and 1,500 mm, and the extreme northeast region merely 800 mm. The average number of hours of sunshine is between 1,700 and 2,300 hours a year.

Slovenia boasts exceptional biotic diversity. The latter is the result of climatic, orographic and pedological diversity, large forest areas, which are subjected to co-natural management, and of the preservation of traditional methods of management of part of the cultural landscape. Slovenian territory hosts a number of endemic species, where a special place is occupied by fauna living in the underground Karst world. Protected natural regions cover 7.3 % of the total territory. There are plans for this share to be gradually expanded to 30 % of the total area. In accordance with the National Environmental Protection Programme, the preservation of biotic diversity is one of the priority objectives of environmental policy. Climate change may pose a threat to the biotic diversity of Slovenia.

3.4. Economic Development

In the late 1980s the Slovenian economy was confronted by a variety of shocks caused by the transformation of the political and economic systems; these were exacerbated by the loss of former Yugoslav markets. All this resulted in a fall in GDP, a fall in the employment rate and investments, and a high inflation rate. As early as 1993 the Slovenian economy began to revive, on average exceeding an annual growth rate of 4 %, facilitated by well-balanced public finances. In 1995 Slovenia achieved 64 % of the average GDP per capita, in terms of purchasing power, of the EU; in 1999 this percentage rose to 71 %. Due to the small size of the Slovenian market, the Slovenian economy is firmly embedded in international economic flows.

Table 3: Basic indicators of economic development

Year	GDP [10^9 USD]	Annual growth rate	GDP/ capita in terms of purchasing power parity [USD]	Inflation	Share in GDP			Share of exports in GDP
					Agriculture	Industry	Services	
1990	17.4	-4.7		549.7	5.0	37.8	47.8	90.8
1991	12.7	-8.9	9,878	117.7	5.2	39.9	45.4	83.5
1992	12.5	-5.2	8,847	201.3	5.2	35.9	48.2	63.1
1993	12.7	2.8	10,900	32.3	4.5	33.4	49.9	58.0
1994	14.4	5.3	11,800	19.8	4.0	33.4	49.0	60.0
1995	18.7	4.1	12,600	12.6	3.9	32.6	50.2	55.2
1996	18.9	3.5	13,200	9.7	3.9	32.7	50.6	55.8
1997	18.2	4.6	14,000	9.1	3.7	32.9	51.5	57.4
1998	19.6	3.8	14,800	7.9	3.6	33.0	51.2	56.6
1999	20.0	5.0		6.1	3.2	32.8	51.4	52.7

Source: Human Development Report, UMAR, 2000

3.5. Energy

In Slovenia, energy supply is based primarily on imported gaseous, liquid and nuclear fuels, and on domestic coal, hydroelectric power and wood biomass. The production and consumption of coal has been falling. Of the six coal mines that were in operation in 1990, most are in the process of closure; in 2007 only the Velenje lignite mine will still be in operation. The share of coal consumption outside thermal energy facilities has been shrinking, from 15 % in 1990 to 5 % in 1998. In industry and general consumption, coal has been increasingly superseded by natural gas and liquid fuels. The increasing consumption of liquid fuels has been the result chiefly of the growth in road traffic. Between 1980 and 1998, the total consumption of fossil fuels grew from 150.4 PJ to 192.3 PJ.

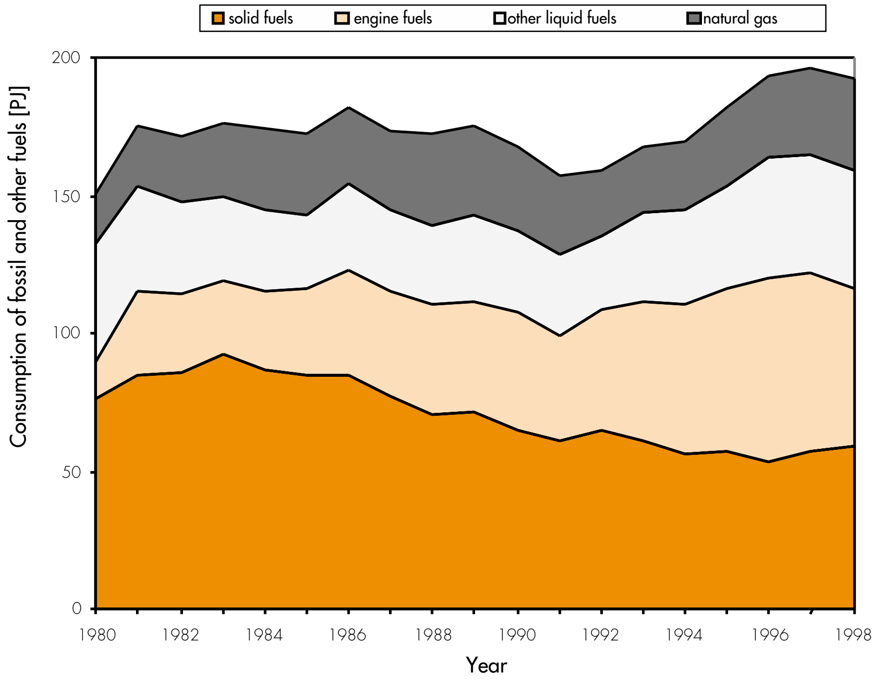
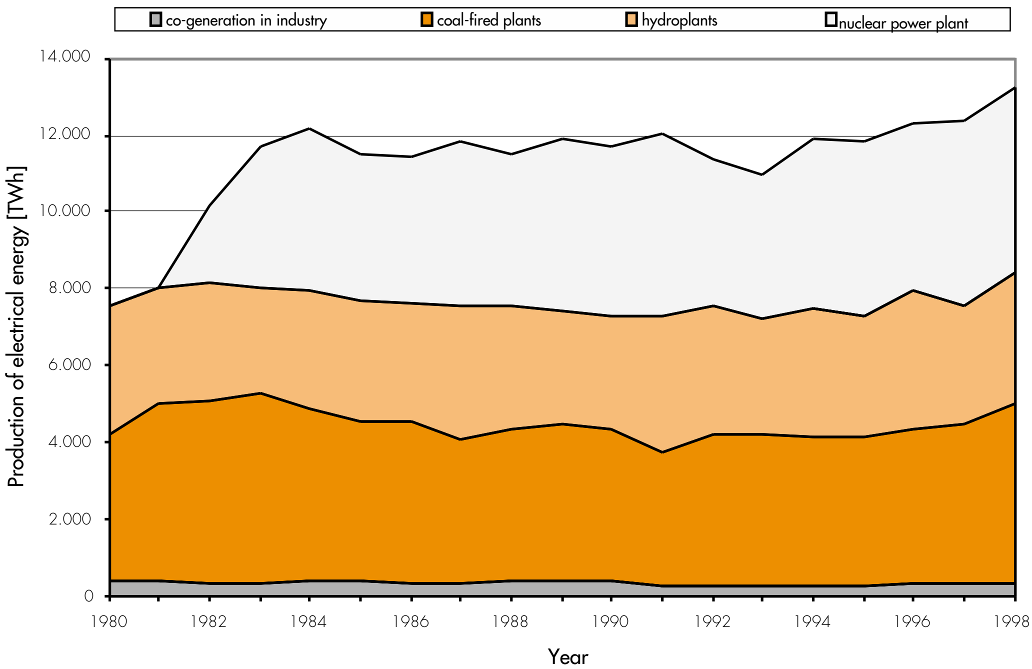


Figure 2: Consumption of fossil fuels in Slovenia

Source: Statistical yearbooks of the energy supply sector

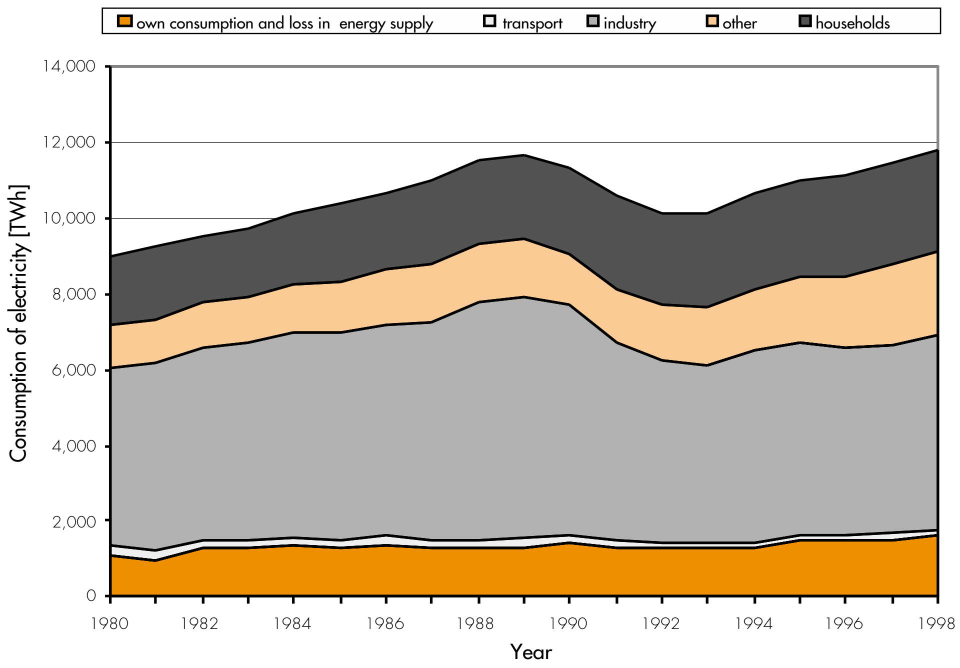
In the production of electrical energy, an important share is contributed by hydroelectric power which, depending on the hydrological conditions, accounts for 25-30 % of annual electricity production. The remaining electricity is produced, in approximately the same shares, by coal-fired power plants and Krško nuclear power plant. The average heat efficiency of the coal-fired power plants is 33.6 %. The share of electricity production in industry is approximately 2 %. Since the commencement of operations at Krško nuclear power plant, which was constructed jointly with neighbouring Croatia, Slovenia has been a net exporter of electricity.



Source: Statistical yearbooks of the energy supply sector

Figure 3: Production of electrical energy in Slovenia

Electricity consumption has been both absolutely and relatively increased by households, and even more so by the public and service sectors. The average annual consumption per household totalled 4,000 kWh in 1998. Since 1950, total net electricity consumption has increased tenfold, equalling 5,585 kWh per capita in 1998.



Source: Statistical yearbooks of the energy supply sector

Figure 4: Consumption of electricity, by sector

As for renewable resources, by far the greatest share is held by hydroelectric power (12 PJ, of which 7 % is accounted for by small hydroelectric power plants) and wood biomass (11 PJ). Geothermal energy accounts for 1.2 PJ, and the exploitation of solar power and bio- and deposited gases up to 0.1 PJ yearly each. The utilisation of wind power and the production of bio-fuels is in the planning stage in Slovenia. The share of renewable resources in the total share of consumption of primary energy is 8 %. The greatest developmental potential lies in wood biomass, since its exploitation can be doubled. Technically it is also possible to double the exploitation of hydroelectric power, though its development will be restricted by local environmental and economic criteria.

3.6. Transport

Slovenia has a high level of motorisation, which is further increasing. In 1990 the number of cars per 1,000 people was 289; by 1999 this figure had increased to 417. This year there was an average of 1.26 cars per household, where 80 % of all households possessed at least one car. The proportion of diesel cars is low, which is chiefly the result of low prices of fuels in the past and small differences in the prices of petrol fuels and gas oil. In 1996 a mere 7.9 % of all cars used gas oil.

Table 4: Number of registered road motor vehicles

Year	Motorcycles	Motorcars	Buses	Freight vehicles	Combined vehicles	Special vehicles
1985	39,261	501,538	3,369	33,883		13,494
1990	15,842	578,268	3,077	30,767	8,836	8,677
1991	14,344	594,289	2,855	30,772	8,595	8,592
1992	13,586	606,820	2,676	31,281	8,911	8,391
1993	9,967	632,563	2,527	32,167	9,130	8,456
1994	8,786	657,287	2,486	34,121	9,964	8,751
1995	8,430	698,211	2,467	37,739	11,403	9,262
1996	8,022	727,554	2,408	40,239	13,303	9,665
1997	8,342	764,788	2,372	42,520	13,490	10,067
1998	9,213	797,855	2,327	44,060	15,559	10,361
1999	9,978	829,674	2,319	46,162	18,630	10,622

Source: SURS

The dispersal of settlements and the relatively low price of engine fuels, as well as low parking costs, have caused the high average annual mileage travelled by motor vehicles, which in 1996, according to various sources, was between 15,200 and 16,300 km a year. With respect to 1990 the average annual mileage travelled by cars rose by 50 %. The growth in the number of cars can be accounted for by the increased need for mobility; in addition, car traffic grew at the expense of public rail and bus transport. The highest rate of growth was indicated in the use of urban car traffic.

Table 5: Development of public passenger transport and car traffic

Year	Rail passenger transport	Public road transport	Public city transport	Cars on Slovenian roads
	Kilometres travelled [10^6 km]		Passengers transported [10^6]	Mileage [10^6 km]
1985	1,677	6,416	201	4,955
1990	1,429	6,444	168	7,500
1991	814	4,282	188	7,352
1992	547	3,377	169	7,729
1993	566	2,751	159	8,901
1994	590	2,595	155	9,976
1995	595	2,507	155	10,827
1996	613	2,348	159	12,508
1997	616	2,195	159	
1998	645	2,098	151	
1999	623	1,940	148	

Source: SURS, Transport Technical Institute, Studio Okolje

In recent years the railways have seen a substantial decrease in freight traffic. The volume of freight traffic on roads has returned to its 1990 level. In addition to domestic transport, transit transport through Slovenia forms a substantial share of total transport, given that Slovenia is the crossroads of two important European transport routes, i.e. east-west and north-south. The features of transit transport have changed significantly in the last decade. Due to instability in the Balkans, the formerly dominant north-south route has nearly died out, while road transport on the east-west route has flourished. In the future we can expect a further growth in transit freight transport, as a result of the stabilisation of conditions in the Balkans and the completion of the construction of the Slovenian motorway network. If an appropriate share of transit fails to be redirected to the railways, this will substantially boost CO_2 emissions. In 1996 the proportion of foreign vehicles, mostly in transit, accounted for 15 % of the total consumption of fuels in freight transport by road.

Table 6: Development of freight transport

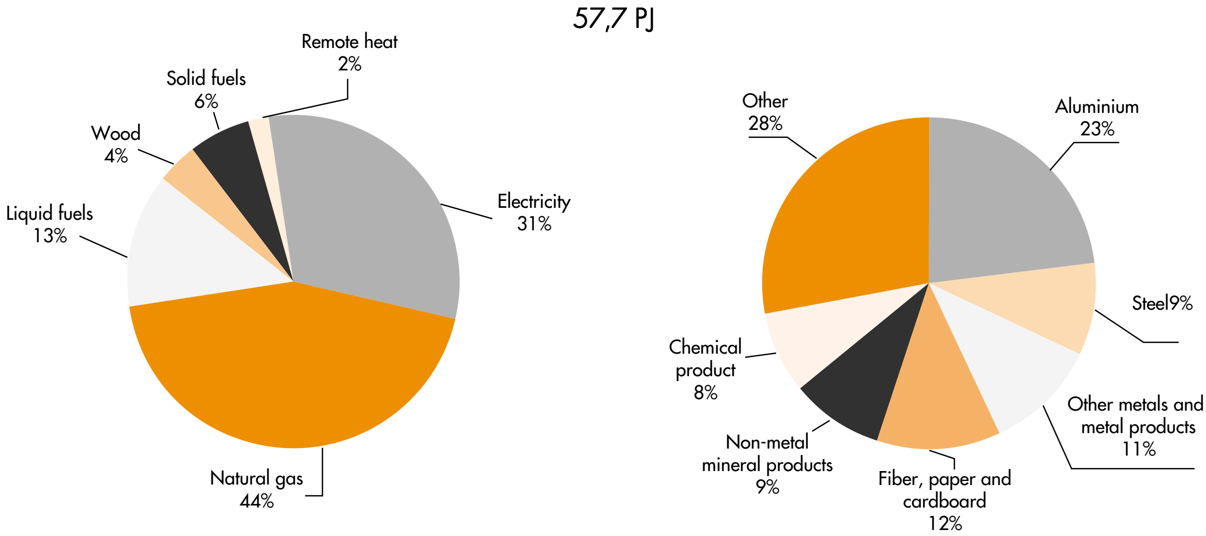
	Railway freight transport Net tonne km	Mileage travelled by medium and heavy freight vehicles 10^6 km
1985	4292	380
1990	4209	589
1991	3246	509
1992	2573	419
1993	2262	463
1994	2448	504
1995	3067	531
1996	2550	553
1997	2852	
1998	2859	
1999	2784	

Source: SURS, Transport Technical Institute, Studio Okolje

Motor road transport in Slovenia accounts for an above-average share of CO_2 emissions (over 25 %). Restriction of the growth in car traffic and at least the partial redirection of transit transport to the railways in particular are also essential in order to meet the requirements for reducing toxic emissions into the atmosphere.

3.7. Industry

Even before Slovenia's independence, the change in the political and economic system, the loss of markets in the former Yugoslavia and, as a result, greater involvement in international trade made economic conditions harsher. Between 1990 and 1993, the volume of industrial production fell by 34 %, after which it grew by 14 % (1999). Even after attempts to revive industrial production, the restructuring and modernisation of production, particularly in energy-intensive industries, was hindered by the high cost of capital and limited access to it. The conquest of the industrial sector by natural gas, which began in the 1980s, was to a large extent the result of demands for better air quality, though, as a corollary, it also contributed to curbing the growth in greenhouse gas emissions. The most energy-intensive industries (production and processing of metals, production of non-metal mineral products, production of pulp and paper) account for the consumption of as much as two-thirds of total energy in the industrial sector. Aluminium production is a particularly large consumer (more than 10 % of all electricity in Slovenia).



Source: Institut Jožef Stefan

Figure 5: Shares of energy consumption in industry, by fuel and by sector (1997)

3.8. Waste

Waste management is one of Slovenia's most pressing environmental issues. Waste management practices employed hitherto have been more or less confined to the mere disposal of waste. The largest disposal sites are fitted with a system for retrieving deposited gas, which at the Ljubljana Barje waste disposal site has already been used for the combined heat and power generation. The quantities of disposed waste have seen moderate growth. In 1995 the quantity of disposed waste totalled as much as 470 kg per capita. The National Environmental Protection Programme ranks waste management as one of the priority environmental issues. In accordance with the National Environmental Protection Programme, one of the waste management objectives is to enhance the substance and energy efficiency of the utilisation of waste, while reducing greenhouse gas emissions.

3.9. Agriculture

60 % of Slovenia's agricultural land is made up of pastures, 34 % of fields and gardens, and 6 % of permanent plantations. More than 90 % of all land is owned by family farms. The dominant agricultural branches include animal husbandry, particularly cattle breeding, which enjoys the best natural features for development. Production per capita totals 87 kg of meat, 310 l of milk, 60 kg of wheat and 150 kg of corn. The number of cattle is slowly falling; however, due to the greater intensity of this activity, the production of milk and meat is not substantially affected. Agricultural practice is, on average, moderately extensive. Due to the use of mineral fertilisers in the last decade, the input of nitrogen into the soil has more than doubled, amounting on average to approximately 70 kg per hectare of arable land. Agricultural production is subsidised both directly and indirectly. The basis for granting subsidies has gradually been shifted from unit produced to unit of arable land. Very little land in Slovenia is suitable for intensive cultivation, which is why Slovenia is a net importer of food.

Agricultural production relies substantially on climate variability. Extensive damage is occasionally caused, chiefly by droughts and frosts.

3.10. Forestry

Forests cover 55 % of Slovenia's total surface area, making them among the country's most important natural resources. Slovenia has established a model of co-natural forest management which, in addition to the direct economic aspect, takes into account other functions of forests. Slovenian forests are characterised by exceptional diversity due to a mixture of altitude conditions, climate conditions and soil properties. Most forests in Slovenia are of the mixed type. The structure of forests has gradually changed, as the result of an increasing proportion of deciduous trees. In 1953 coniferous wood stock exceeded deciduous wood stock by one third; the share of deciduous trees in wood stock has now reached 51 %. Protected forests and forest reservations cover 7 % of the total forest area.

The forest area has increased, chiefly at the expense of areas less interesting for agriculture. In the last 50 years the total area covered by forests has grown by 30 %. In the same period the wood stock per area unit has nearly doubled, currently amounting to 213 m^3/ha. The Forest Development Programme stipulates further increases in wood stock.

Due to the increase in wood mass and forest area, Slovenian forests bind one third of anthropogenic CO_2 emissions. At least in some regions, climate change poses a potential threat to the vitality or even existence of current forest structures.

3.11. Flexibility

In the late 1990s industrial production and the standard of living in Slovenia went into temporary decline; this was due to the transformation of the political and economic systems. This resulted in the temporary reduction of greenhouse gas emissions. For this reason Slovenia, as a country in transition and pursuant to Article 4.6 of the Convention, selected 1986 as the base year for its commitments to reduce emissions.

In terms of base year emissions, the disintegration of the former Yugoslavia puts the Republic of Slovenia in a specific position. In 1986 Slovenia was a constituent part of the Socialist Federal Republic of Yugoslavia. In the Yugoslav era it invested in thermal power plants based in the territory of Bosnia-Herzegovina; Slovenia thus became a co-owner of these facilities and in accordance with contracts received a proportionate share of the electricity produced. For this reason Slovenia did not construct the corresponding thermal power plants on its own territory, and greenhouse gas emissions in the base year were accordingly lower. Within the framework of succession negotiations, the Slovenian government will highlight this fact and propose the transfer of an appropriate share of emissions from these facilities to the Slovenian Inventory of Greenhouse Gas Emissions with respect to the base year.

4. Greenhouse Gas Emissions Inventory

4.1. Introduction

Carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4) are greenhouse gases that affect the global heat balance. These gases are natural components of the atmosphere, where the recent increase in their concentrations has mainly been caused by human activities. The atmosphere today contains also greenhouse gases that were not present in the pre-industrial period, their single source being human activities. These gases include halogenated hydrocarbons (CFC, HCFC, HFC in PFC) and SF_6.

Emissions of carbon monoxide (CO), nitrogen oxides (NO_x) and volatile non-methane organic compounds are also the consequence of human activity. These are the so-called indirect greenhouse gases; they do not have direct greenhouse effects but participate in the photochemical processes involved in the formation of tropospheric ozone (O_3), which is a greenhouse gas. Sulphur dioxide also forms part of the group of indirect greenhouse gases. The latter contributes to the formation of sulphates and aerosols, which have negative greenhouse effects.

Greenhouse gas emissions have been assessed for 1986, which is the base year for Slovenia regarding commitments to reduce emissions, and for the 1990-1996 period. This chapter sets out a brief description of the trends in emissions and the reason for changes thereto, while a summary of the total inventory for the period under examination is given in the Appendix.

4.2. Methodology of the Preparation of Emission Inventories

Greenhouse gas emission inventories[1] have been prepared in accordance with IPCC methodology (IPCC 1997) for all gases and sectors, except for certain cases, which are specified separately. Inventories and assessments have also been made for certain other sources of emissions not included in IPCC methodology. With respect to the importance of a source and the available data, different approaches (Tier) have been used within the IPCC methodology. The assessment of emissions has generally been based on default IPCC emission factors.

The IPCC defines the energy sector as the production, distribution and exploitation of energy generated by fuel. We have additionally incorporated into this sector the consumption of coke in ironworks, thus avoiding a division into exploitation for energy purposes and as reduction means, which using the available data we could not appropriately accomplish. The quantities of fuels and the used energy values of fuels have been based on energy yearbooks, compiled by the ministry responsible for energy. In addition we have obtained data on the energy exploitation of specific types of waste (waste tyres and solvents). Data on the consumption of fuels in agriculture and forestry applies solely to mobile sources, while the remaining consumption of fuels in these subsectors has been included in the public and services subsectors.

In the energy exploitation of fossil fuels, we have generally used IPCC default emission factors and oxidation shares. Due to the bigger share of methane in natural gas, which is used in Slovenia, we have used a corresponding CO_2 emission factor somewhat smaller than the default factor. Emissions of CH_4 and N_2O in road traffic were determined on the basis of a more accurate methodology and CORINAIR emission factors. In the case of diesel vehicles we have deduced from the potential emission the carbon contained in emitted solid particles, while in the case of petrol fuels we have used the assumption of 100 % oxidation of fuel. For emissions of CO_2 in the energy sector we have also taken into account the energy exploitation of

[1] Pursuant to the provisions of the Convention, emission inventories do not contain emissions of CFC and HCFC, which are subject to the Montreal Protocol.

waste substances produced on the basis of fossil fuels. For leaking emissions of CO_2 in the energy sector we have taken into account the emissions released in the desulphurisation of smoke gases in thermal power plants and, on top of the IPCC methodology, emissions of CO_2 released during the airing of mines. Due to the lack of data on desorption, emissions of CO_2 in post-mining activities have not been assessed. It appears that they are greater than those released directly by coal mining. In the case of leaking emissions of CH_4 in mining activities, the emission factors have been determined on the basis of measurements of methane concentrations in ventilation mineshafts and assessments of the quantities of methane released. The emission factor calculated in this manner is lower than the IPCC default values. The regional default emission factor of the IPCC in the transport and distribution of natural gas does not correspond with the conditions in Slovenia. For emissions of CH_4 in the transport of natural gas, we have used the data supplied by the company that manages the transmission network. Losses during distribution have been assessed on the basis of the length of individual types of gas pipe, relying on the use of specific losses per unit of length as they were set out in the German Communication to the Convention, which is sensible given the level of maintenance and the short average age of the gas pipe network.

Emissions in industrial processes have been assessed on the basis of data on the consumption of resources provided by the Statistical Office of the Republic of Slovenia, supplemented with information provided by companies. In the production of metals we have observed only the contribution of carbon electrodes, while emissions resulting from the consumption of coke have been classified under the energy sector. In the production of aluminium, emissions of PFC have been assessed on the basis of the number and duration of anodal effects. For the assessment of potential and actual emissions of HFC, we have obtained data from those companies that use these substances, and data on the export and import of cooling devices. In the case of emissions of SF_6, we have assessed the release of this gas from soundproof windows and switching facilities in the energy sector. Emissions of HFC and SF_6 have been assessed only for 1995 and 1996.

Emissions of NMVOC resulting from the use of solvents and diluents have been assessed chiefly on the basis of the CORINAIR methodology. In accordance with the principle of intentional double counting, we have assigned to emissions of NMVOC of fossil origin the corresponding emissions of CO_2, since after a few months in the atmosphere these substances convert into CO_2.

In the agricultural sector, emissions of methane resulting from the enteric fermentation of cattle have been assessed with particular accuracy, by upgrading the Tier 2 approach with the division of a herd into 18 categories with respect to intensity of breeding. For emissions caused by manure management, we have used the Tier 2 approach in pig and cattle breeding. For the breeding of other animals, which account only for a minor share in total emissions of methane, we have used the Tier 1 approach. For emissions of N_2O in manure management and indirect emissions caused by fertilisation using animal fertilisers, we have used the input data obtained on the basis of the assessment of methane emissions. For emissions of N_2O we have used the IPCC default factors, which determine the conversion of nitrogen into N_2O.

Emissions of methane generated by solid waste management have been assessed using the IPCC default methodology, which does not take into account the time dynamics of methane release. Emissions of N_2O resulting from wastewater have been assessed with respect to the use of albumin in human nutrition, which according to estimates has not changed in the period under examination.

4.3. Emissions of CO_2

Emissions of CO_2 make up four-fifths of the aggregate greenhouse gas emissions in Slovenia. The largest share (over 90 %) of emissions of CO_2 is the consequence of fuel combustion. Emissions of CO_2 generated by industrial processes and the use of solvents make up only a small share. The CO_2 sink in forests is considerable in Slovenia.

Table 7: Emissions of CO_2

Sector	1986	1990	1991	1992	1993	1994	1995	1996	Index 1996/1986
				Gg CO_2					%
Total Emissions	**15,553**	**14,293**	**13,591**	**13,513**	**14,126**	**14,259**	**14,983**	**15,737**	**101**
1 Energy	**14,552**	**13,300**	**12,764**	**12,775**	**13,464**	**13,461**	**14,189**	**14,927**	**103**
A Fuel Combustion (Sectoral Approach)	14,462	13,192	12,671	12,697	13,386	13,374	14,054	14,804	102
1 Energy Industries	6,308	5,911	5,330	5,869	5,850	5,472	5,729	5,362	85
2 Manufacturing Industries and Constr.	4,112	3,011	2,895	2,534	2,353	2,460	2,456	2,361	57
3 Transport	2,004	2,660	2,514	2,589	2,990	3,361	3,624	4,199	209
4 Other Sectors	2,037	1,610	1,932	1,705	2,193	2,081	2,246	2,883	141
B Fugitive Emissions from Fuels	90	108	93	77	77	87	135	123	136
2 Industrial Processes	**954**	**956**	**794**	**706**	**632**	**765**	**764**	**777**	**81**
A Mineral Products	725	678	565	488	394	505	520	539	74
B Chemical Industry	120	93	73	52	69	83	83	87	73
C Metal Production	109	185	155	166	169	177	160	150	137
3 Solvent and Other Product Use	**46**	**37**	**34**	**33**	**31**	**33**	**30**	**33**	**72**
International Bunkers*	**98**	**79**	**28**	**34**	**48**	**54**	**58**	**53**	
1 A Energy (reference approach)	14,356	13,238	12,941	12,889	13,457	13,421	14,377	15,068	105
5 Land-Use Change & Forestry*	**-2950**	**-4334**	**-4748**	**-5086**	**-5173**	**-5331**	**-5677**	**-5560**	**188**

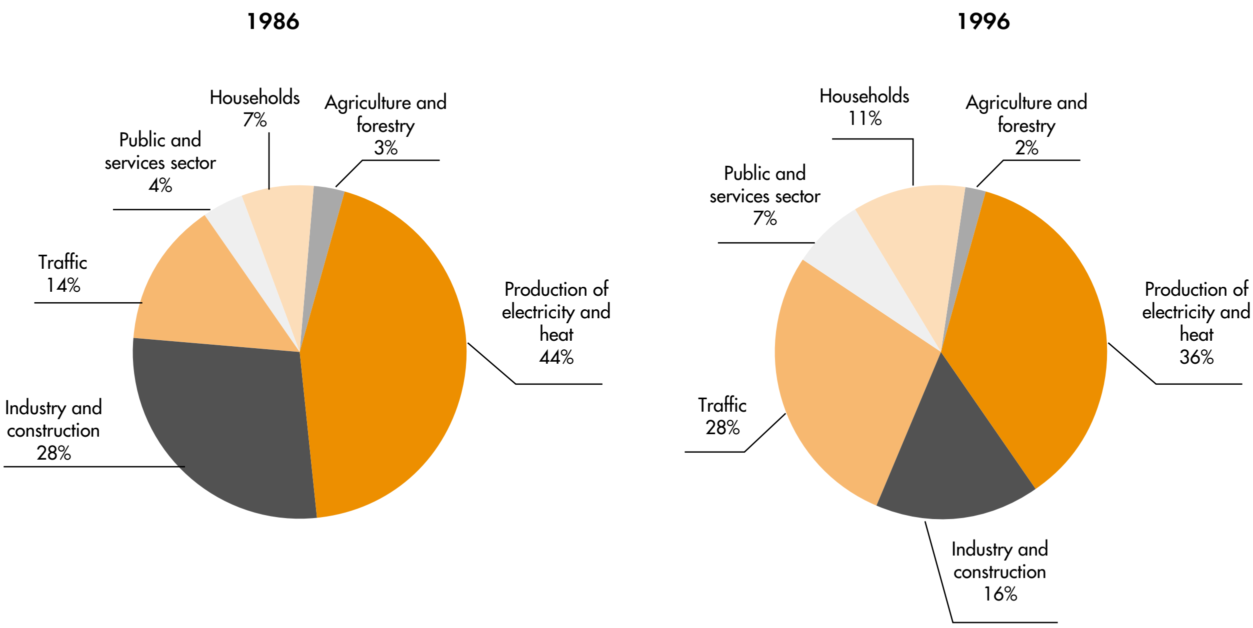
* Emissions generated by international bunkers (air and marine transport), and sinks in land use change and forestry are not classified under total emissions.

Source: MOP-ARSO

4.3.1 Emissions in the Energy Sector

In accordance with the IPPC nomenclature, emissions in the energy sector include emissions of CO_2 released in the production, processing and fuel combustion. Emissions of CO_2 in the energy sector have been assessed using the sectoral (bottom-up) and reference (top-down) approaches. The assessment of CO_2 emissions in the base year according to the sectoral approach was higher by 0.7 % than that carried out according to the reference approach. The difference is chiefly the result of somewhat different emission factors in primary and secondary liquid fuels, and of the more generalising approach of the reference method regarding the non-energy exploitation of fossil fuels and the energy exploitation of waste.

Emissions of CO_2 in the energy sector increased slightly in the period under examination (1986-1996). The substantial reduction of emissions in the early 1990s was the consequence of the economic shock associated with the transition and Slovenia's independence process. The period under discussion saw substantial structural changes in emissions. As a result of restructuring, emissions substantially fell in the industrial sector and in energy supply, while they grew in transport (206 %), households (60 %), and the public and service sectors (71 %). The increase in transport has been accounted for primarily by the growth in the number of cars on the road.



Source: MOP-ARSO

Figure 6: Structure of emissions of CO_2 in the acquisition and consumption of fossil fuels in 1986 and 1996

4.3.2 Industrial Processes

Emissions of CO_2 generated by industrial processes fell from 954 Gg in 1986 to 754 Gg in 1996. This reduction can be ascribed chiefly to the reduced production of cement and lime. In industrial processes, emissions grew only in the production of metals, mostly due to increased aluminium production. This increase is not proportionate with the production of aluminium, as specific emissions fell.

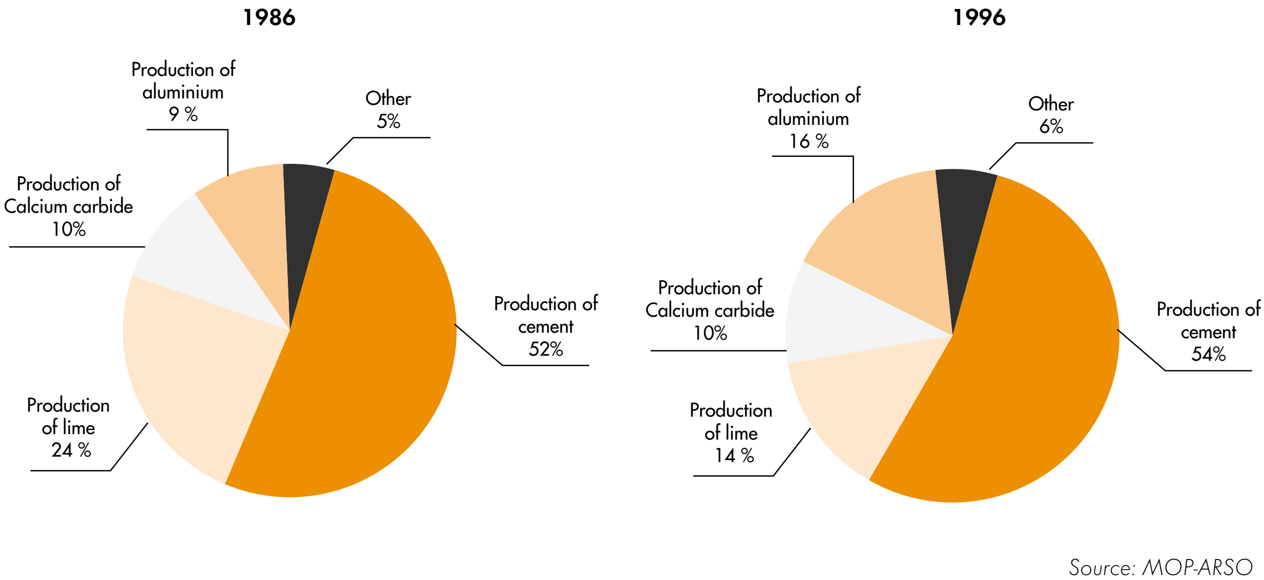


Figure 7: Structure of emissions of CO_2 in industrial processes in 1986 and 1996.

4.3.3 Sinks

The quantity of biomass in Slovenian forests has been growing, making forests in Slovenia a CO_2 sink. The increasing quantity of biomass can be accounted for mainly by the growth in wood stock in existing forests, and to a smaller extent by the deterioration of abandoned agricultural land. The growth in the Net sequestration of carbon dioxide has increased primarily as a result of the less intensive exploitation of forests. As a consequence, the net sink of CO_2 rose from 2,950,000 tonnes in 1986 to as much as 5,560,000 tonnes in 1996 in the land-use change and forestry sector.

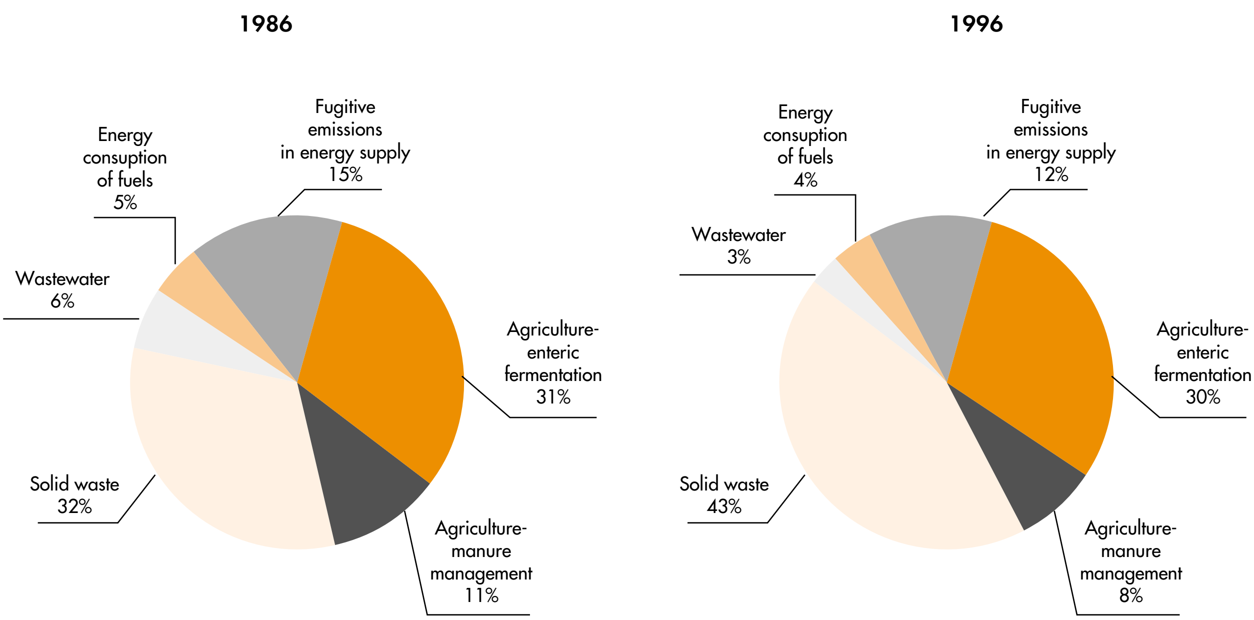
4.4 Emissions of CH_4

Between 1986 and 1996, total emissions of CH_4 fell by 6 %. Emissions were reduced in all sectors, with the exception of waste management. This sector experienced a growth in emissions due to the increasing quantities of waste disposed, while at the same time the method of management did not change significantly. Emissions in the fuel combustion were reduced mainly because of the decreased use of solid fuels in households and the service sector. The reduction of fugitive emissions in energy supply has been the result of the reduced volume of coal mining, as well as of the full replacement of cast-iron pipes in gas distribution. In agriculture, emissions have fallen chiefly due to the falling number of cattle, where the production of milk and meat have remained at the same level due to greater production intensity.

Table 8: Emissions of CH_4

Sector	1986	1990	1991	1992	1993	1994	1995	1996	Index 1996/ 1986
					Gg CH_4				%
Total Emissions	120.3	113.6	116.3	113.9	113.6	112.4	112.3	112.8	94
1 Energy	24.3	19.9	19.1	20.0	18.7	17.9	18.1	17.6	73
A Fuel Combustion	6.0	4.9	5.1	4.8	4.8	4.6	4.5	4.6	77
B Fugitive Emissions from Fuels	18.3	15.0	14.0	15.1	13.9	13.3	13.6	13.0	71
2 Industrial Processes	0.2	0.1	0.2	0.0	0.0	0.1	0.2	0.2	92
4 Agriculture	50.6	49.6	48.4	46.6	45.6	44.5	43.6	42.7	84
6 Waste	45.2	44.0	48.6	47.4	49.2	49.9	50.4	52.3	116

Source: MOP-ARSO



Source: MOP-ARSO

Figure 8: Structure of emissions of CH_4 in 1986 and 1996

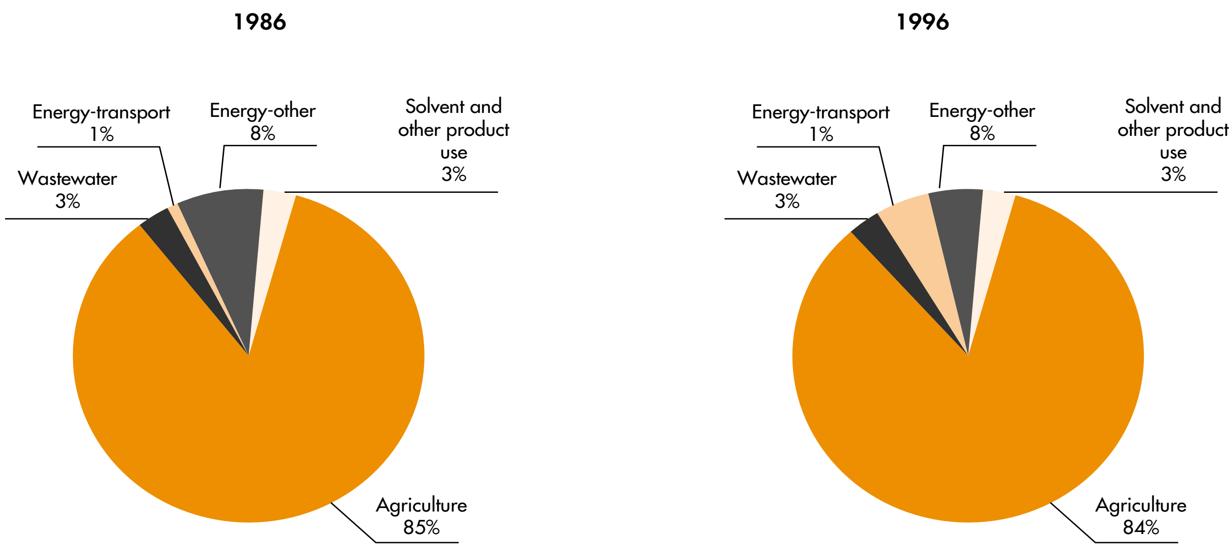
4.5 Emissions of N_2O

Between 1986 and 1996 the largest reduction of greenhouse gas emissions was seen in total N_2O emissions. Agriculture contributes more than four-fifths of emissions. In this area, emissions have fallen due to the lower quantities of organic fertilisers used and reductions in the number of papilionaceous plants planted, which symbiotically bind nitrogen from the atmosphere, which in turn has more than balanced the somewhat greater consumption of mineral nitrogen fertilisers. Emissions in the fuel combustion have increased due to growing consumption in transport and the introduction of vehicles with catalytic converters for exhaust gases.

Table 9: Emissions of N_2O

Sector	**1986**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**Index 1996/ 1986**
					Gg N_2O				**%**
Total Emissions	5.87	5.36	5.33	5.18	5.19	5.21	5.24	5.31	91
1 Energy	0.51	0.44	0.42	0.37	0.37	0.42	0.48	0.56	110
3 Solvent and Other Product Use	0.26	0.14	0.12	0.09	0.06	0.06	0.06	0.06	23
4 Agriculture	4.95	4.63	4.64	4.57	4.61	4.58	4.56	4.54	92
6 Waste	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	100

Source: MOP-ARSO



Source: MOP-ARSO

Figure 9: Structure of emissions of N_2O in 1986 and 1996

4.7 Emissions of PFC

The single recorded source of emissions of PFC in Slovenia between 1986 and 1996 was aluminium production. Though the production of aluminium increased, emissions were reduced as a result of enhanced technology. Despite the small quantities released, because of their high GWP (CF_4 6500 compared to CO_2) emissions of PFC account for a share of more than 1 % of total greenhouse gas emissions in Slovenia.

Table 10: Emissions of PFC in the production of aluminium

Industrial Processes Production of Aluminium	1986	1990	1991	1992	1993	1994	1995	1996	Index 1996/ 1986
					Gg				%
Emissions of CF_4	0.0372	0.0347	0.0408	0.0328	0.0338	0.038	0.0385	0.0323	87
Emissions of C_2F_6	0.0037	0.0035	0.0041	0.0033	0.0034	0.0038	0.0039	0.0032	87

Source: Institute of Metal Materials

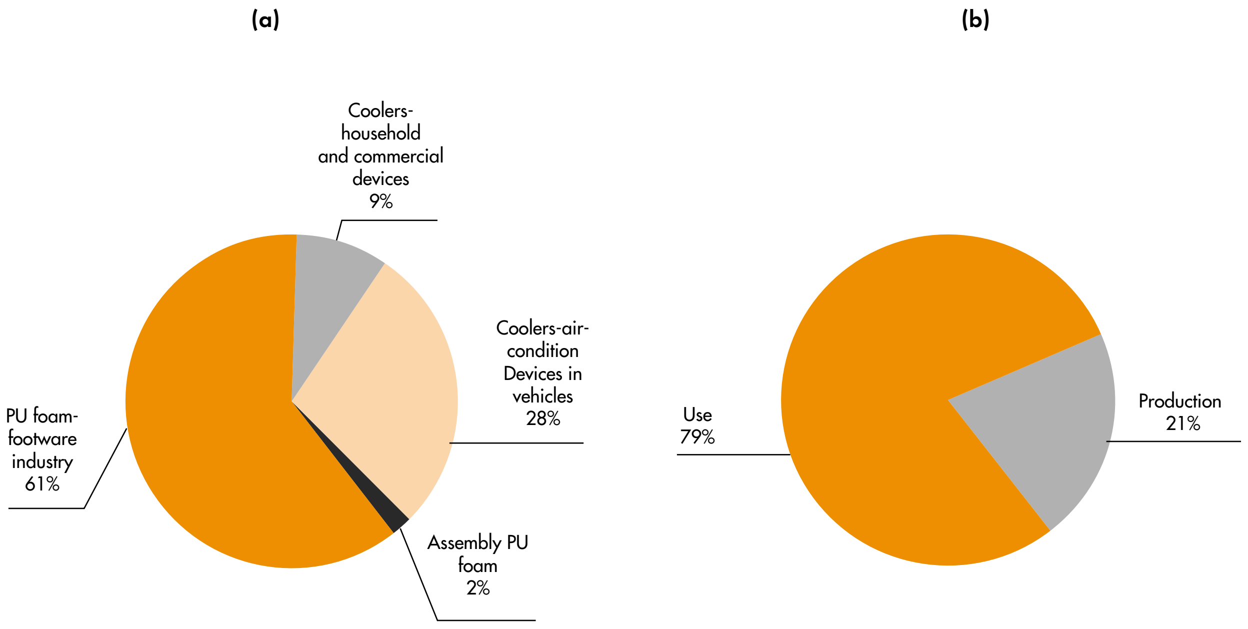
4.7 Emissions of HFC

HFC began to be used in Slovenia in 1993 as CFC substitutes. They became established as coolers in cooling and air-conditioning devices, and as foaming agents in the production of polyurethane products. Emissions of HFC were assessed on the basis of statistical data on the import and export of HFC, which was supplemented with data obtained from producers, importers and exporters of devices containing HFC. Assessment was made of potential emissions on the basis of the Tier 1a and Tier 1b approaches, and actual emissions on the basis of the Tier 2 approach of the IPCC methodology. As potential emissions we list emissions assessed using the Tier 1a approach, taking into account the mass balance of imports and exports of HFC. The considerable difference is the result of the fact that Slovenia is a large exporter of cooling devices. More than 95 % of potential and actual emissions of HFC take the shape of HFC-134a, which has a GWP of 1300 with respect to CO_2. Emissions of HFC were assessed only for 1995 and 1996.

Table 11: Emissions of HFC

Industrial Processes	1995	1996
	Gg	
Potential Emissions	0.2823	0.1523
Actual Emissions	0.0236	0.0233

Source: Chamber of Commerce and Industry of Slovenia



Source: Chamber of Commerce and Industry of Slovenia

Figure 10: Structure of sources of emissions of HFC (a), and share of emissions in the production and use of cooling and air-conditioning devices (b) in 1996

4.8 Emissions of SF_6

Emissions of SF_6 were recorded in the production of soundproof windows, the majority of which are intended for export, and for switching devices in the energy sector. The major share is held by switching devices (90 % of actual emissions), which are not produced in Slovenia. This is why actual emissions according to the Tier 2 approach are greater than those recorded according to the Tier 1a approach. Though we have received no reports on the use of SF_6 in the filling of motor tyres, we cannot claim with certainty that this gas has not been used for this purpose.

Table 12: Emissions of SF_6

Industrial Processes	**1986**	**1995**	**1996**
		Gg SF_6	
Potential Emissions tiers 1A)	0.0003	0.0015	0.0015
Actual Emissions	0.0003	0.0011	0.0008

Source: Chamber of Commerce and Industry of Slovenia

4.9 Total Emissions of Direct Greenhouse Gases

Total emissions of direct greenhouse gases, expressed in Gg CO_2 equiv., have been assessed on the basis of the GWP of individual gases, which apply to a 100-year time horizon and which were specified in the IPCC Second Assessment Report. For HFC, GWP 1300 was used, which belongs to HFC 134a, which in turn is the potential used most frequently.

In the period under examination, the share of CO_2 in total greenhouse gas emissions increased somewhat, while emissions of CH_4 and N_2O fell, particularly in agriculture. The impact of the transitional processes in Slovenia has been less visible in the case of these gases.

Table 13: Total emissions of direct greenhouse gases, by sector

Sector	**1986**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**Share 1996**	**Index 1996/ 1986**
					Gg CO_2 equiv.					**%**
Total Emissions	**20,181**	**18,599**	**17,988**	**17,755**	**18,371**	**18,516**	**19,310**	**20,042**	100	99
1 Energy	15,139	13,757	13,211	13,240	13,901	13,888	14,615	15,378	77	102
2 Industrial Processes	1,241	1,216	1,101	950	883	1,049	1,111	1,070	5	86
3 Solvent and Other Product Use	127	80	71	61	50	52	49	52	0.3	41
4 Agriculture	2,597	2,477	2,455	2,395	2,387	2,354	2,329	2,304	11	89
6 Waste	996	971	1,067	1,042	1,080	1,094	1,105	1,145	6	115

Source: MOP-ARSO

Table 14: Total emissions, by greenhouse gas

Sector	**1986**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**Share 1996**	**Index 1996/ 1986**
					Gg CO_2 equiv.					**%**
Total Emissions	**20,181**	**18,599**	**17,988**	**17,755**	**18,371**	**18,516**	**19,310**	**20,042**	100	99
CO_2	15,471	14,196	13,508	13,444	14,057	14,180	14,880	15,645	79	101
CH_4	2,526	2,386	2,442	2,392	2,386	2,360	2,358	2,369	12	94
N_2O	1,820	1,662	1,652	1,606	1,609	1,615	1,624	1,646	8	90
PFC, HFC, SF_6	283	258	303	244	251	282	343	289	1	102

Source: MOP-ARSO

4.10 Emissions of Indirect Greenhouse Gases

Emissions of the indirect greenhouse gases CO, NMVOC and NO_x increased in Slovenia in the 1986-1996 period, mainly due to the increase in road vehicle traffic. The reduction by more than half of SO_2 emissions is the consequence of the systematic implementation of programmes targeted at enhancing air quality by replacing fuels, improving their quality, and constructing desulphurisation facilities in electrical power plants.

Table 15: Emissions of indirect greenhouse gases

Indirect Greenhouse Gas	1986	1990	1991	1992	1993	1994	1995	1996	Index 1996/ 1986
					Gg				%
CO	237.2	238.7	234.4	245.5	268.3	272.7	277.2	287.7	121
NMVOC	55.9	56.2	53.3	54.5	58.3	60.7	60.9	64.2	115
NO_x	63.1	63.5	57.7	56.8	61.7	64.6	62.9	67.0	106
SO_2	246.9	193.7	180.8	189.5	182.8	176.5	124.0	111.6	45

Source: MOP-ARSO

5. Policies and Measures for Reduction of Greenhouse Gas Emissions

5.1. Strategy and Short-Term Action Plan of Reduction of Greenhouse Gas Emissions

Purpose and objectives

The main objective of the Strategy is the preparation of bases for meeting the provisions of the Kyoto Protocol for the reduction of greenhouse gas emissions in the first commitment period of 2008 to 2012, and of policies enabling the effective management of greenhouse gas emissions after this period as well. The formulation of the Strategy is one of Slovenia's commitments as a Party to the UN Framework Convention on Climate Change. In addition, the Strategy was drafted within the framework of the adoption of the EU acquis (Council Decision 1999/296/EC). The Slovenian government adopted the Strategy and Short-Term Action Plan of Reduction of Greenhouse Gas Emissions in November 2000.

The Strategy of Reduction of Greenhouse Gas Emissions sets out the objectives and points of departure for the reduction of emissions. It also includes a raft of more than 120 measures aimed at reducing emissions, while the timetable and intensity of the implementation of individual measures have not yet been specified. The reason for this is that the planned reduction of greenhouse gas emissions will call for substantial changes in the production and consumption of resources and satisfying of vital needs. This will in many ways affect the course and method of economic development, as well as other important aspects of Slovenia's development, which need to be additionally evaluated. The Strategy of Reduction of Greenhouse Gas Emissions is therefore an interim stage in the preparation of the National Programme of Reduction of Greenhouse Gas Emissions, which will set forth quantitatively the sectoral objectives in this area, lay down in more detail individual measures, and financially evaluate the entire programme. The reduction of greenhouse gas emissions requires modifications to the methods of production and consumption and adjustments of lifestyle that are more radical than those tackling other environmental protection issues. It is of strategic importance that one recognises, in an appropriate manner and on time, the changes in the conditions of economic development brought about by the requirements to reduce greenhouse gas emissions. The Strategy also has the purpose of formulating basic policies of economically successful development that will facilitate the reduction of greenhouse gas emissions. Given that the requirements for the reduction of greenhouse gas emissions are expected to be made more stringent in the second commitment period, the Strategy also addresses the spheres in which significant results cannot be achieved in the first commitment period, but the development of which will in the long run considerably facilitate the possibilities for reducing greenhouse gas emissions. The reduction of emissions needs to be achieved using a method that will be most effective for the national economy, where advantage must be taken of the synergistic effects of a reduction of emissions.

The reduction of greenhouse gas emissions must therefore meet, to the greatest possible extent, the following criteria:

- minimise the costs of reducing greenhouse gas emissions at the national level;
- generate positive effects on the national economy;
- provide the economy with international competitiveness;
- act in compliance with financial capacities;
- reduce excessive local and regional burdens on the environment;

- contribute to the fulfilment of other already-adopted and stipulated international environ mental commitments of Slovenia and commitments arising from Slovenia's membership of the EU in the sphere of environmental protection;
- achieve reliability and competitiveness in the supply of energy, food and other strategic resources;
- exercise social fairness and acceptability;
- achieve flexibility and viability of solutions;
- develop long-term solutions.

5.1.1 Instruments for Reducing Emissions and Green Tax Reform

The complexity of the issue of the reduction of greenhouse gas emissions, and the related comprehensiveness and complexity of measures, will call for the use of a broad spectrum of instruments for their optimal activation. The National Environmental Protection Programme aims to achieve a reduction of greenhouse gas emissions chiefly through the use of economic instruments. The magnitude of the problem has given rise to a strong initiative for moving in the direction of, as it were, green tax reform. This means that the major share of budgetary income should be collected in the form of environmental burden fees while, as a countermeasure, reducing tax on labour costs. The Strategy sets out green tax reform as the fundamental instrument for the reduction of greenhouse gas emissions.

The first step towards tax reform was made as early as 1996, in the form of the adoption of the Decree on Fees Charged for Air Pollution with CO_2 Emissions (CO_2 tax). The effective application of economic instruments within the framework of green tax reform will call for the modification of budgetary expenditure. The promotion of measures for efficient energy use, greater exploitation of renewable resources, the selection of alternative means of transportation, and other activities relating to the reduction of greenhouse gas emissions will require a substantial increase in budgetary funds. For this reason, it has been envisaged that part of CO_2 tax will be used specifically for promoting these activities and, first and foremost, for subsidising the interest rate of investments.

The introduction of an emission permits market is a measure that may contribute to reducing the total costs of emission reductions. For Slovenia, an interesting alternative to the emission permits market is the introduction of trade in exemptions as part of CO_2 tax. Upon accession to the EU, Slovenia plans to join the EU system of emissions trading, currently being set up.

In addition to economic instruments, the Strategy envisages the use of regulatory instruments, indirect promotional activities, including model and promotional projects, voluntary agreements between commercial associations and the state, and the promotion of research and education.

5.1.2 Providers of Reduction of Emissions

The important changes called for by the mitigation of climate change require the support and participation of the largest possible share of active entities in society. In addition to direct government activities, a successful response to the requirements for reducing greenhouse gas emissions will require participation by various interest groups, business entities and, last but not least, individuals.

The government and state administration are responsible for the formulation of a suitable strategy and programme of climate change mitigation, and of systemic frameworks enabling their implementation. The government must ensure that individual sectoral development programmes are not in conflict with the objectives of emission reduction at the national level, or with the principles of sustainable development. To this end, clear objectives must be set for individual areas, and monitoring of current conditions must be ensured in order to assess the progress made. Within the limits of its competencies, the government will contribute to providing other organisations, for example local communities, with appropriate jurisdiction and conditions in order to enable them to make an active contribution to reducing greenhouse gas emissions in their own areas of operation. The government will facilitate the development of environmentally-sensitive lifestyles through information campaigns and economic instruments. A special mission of the government and state administration is to set an example for the reduction of greenhouse gas emissions through their own operations - reducing the consumption of energy in state buildings and vehicle fleets for example. On behalf of the government, the Ministry of the Environment and Spatial Planning is responsible for directing and coordinating activities relating to climate change.

The Strategy underscores the role of local communities, which within the limits of their competence have the possibility of exercising influence on specific spheres that have substantial effects on greenhouse gas emissions. The reduction of greenhouse gas emissions can contribute to the development of the local economy and the creation of new jobs. In Slovenia, local communities' active participation in the reduction of greenhouse gas emissions is at an embryonic stage. We expect the provision of suitable information and proper incentives will encourage local communities to formulate their own programmes of reduction of greenhouse gas emissions, which will be additionally facilitated by the preparation of Local Agenda 21.

The participation of public utility services is paramount to the successful reduction of emissions. To this end, within the framework of reducing greenhouse gas emissions, instruments will be used that will enable flexibility of implementation and initiative by public utility services. The identification of new market niches relating to emission reduction will open up new challenges for public utility services, not only on the Slovenian but also on foreign markets.

It is necessary to involve, to the greatest extent possible, various interest groups in raising public awareness and stressing the urgent need to mitigate and adapt to climate change, thus actively participating in achieving consensus on the possibilities, methods and opportunities for emission reduction and sustainable development. In accordance with the National Environmental Protection Programme, the government, and particularly the Ministry of the Environment and Spatial Planning, will encourage dialogue between different interest groups on the reduction of greenhouse gas emissions.

The direct involvement of individuals in reducing emissions is especially important. It has been estimated that efficient behaviour in the workplace, at home and while using a car can reduce energy consumption, and thus emissions of CO_2, by approximately 5 % in most cases. This means that individuals can have direct and indirect impacts on around half of all emissions of CO_2. The effects of individual decisions have also been evident in greenhouse gas emissions associated with waste management.

5.1.3 Preparation of the Programme of Reduction of Greenhouse Gas Emissions and its Integration into Sectoral Policies

For the purpose of fulfilling the commitment to reducing greenhouse gas emissions, a programme needs to be drafted, on the basis of the National Environmental Protection Programme, that will upgrade the Strategy and put it into operation. Within the framework of their developmental programmes already adopted or in course of preparation, the relevant sectors will formulate sectoral programmes of reduction of greenhouse gas emissions, in accordance with the points of departure and criteria specified in the Strategy. The coordinated sectoral programmes will at the same time form a constituent part of the National Programme of Reduction of Greenhouse Gas Emissions and central programmes. Coordination will be led by the Ministry of the Environment and Spatial Planning. The preparation of the programme was initiated in 2001.

Slovenia has not yet drawn up the Air Protection Strategy, as envisaged in the National Environmental Protection Programme. The transgression of limit immission values, the consequent harmful effects on people's health and the environment, and the emission reduction commitments pursuant to the Convention on Long-Range Transboundary Air Pollution additionally underscore the necessity for systemic arrangement of this area. Measures for air protection and climate change mitigation are closely related to each other, which is why it is possible, using a coordinated approach, to achieve the objectives in these areas incurring smaller costs both in the stage of formulation of strategies and programmes and, even more so, in the implementation of measures. The Air Protection Strategy will be drafted in a parallel yet integrated process with the Programme of Reduction of Greenhouse Gas Emissions.

5.1.4 Short-Term Action Plan of Reduction of Greenhouse Gas Emissions

The operational gap until the time of adoption of the comprehensive Programme of Reduction of Greenhouse Gas Emissions has been and will be bridged by the Short-Term Action Plan of Reduction of Greenhouse Gas Emissions, which is a constituent part of the Strategy. The Plan contains a summary of 30 measures and activities that the Slovenian government planed to launch into operation in 2001.

5.2 Measures for Reduction of Greenhouse Gas Emissions

5.2.1 Status of Measures for Reduction of Greenhouse Gas Emissions

Slovenia began to implement certain measures targeted at reducing greenhouse gas emissions even before the adoption of the Strategy of Reduction of Greenhouse Gas Emissions. The most significant measure involves CO_2 tax (1996); Slovenia was the first country in the central and southern European region to introduce this measure. Other measures that have contributed to managing greenhouse gas emissions have been aimed chiefly at enhancing economic efficiency by introducing new technologies and ensuring efficient energy use, as well as at reducing burdens on the air, water and soil.

The sections of this chapter will outline those measures contributing to a reduction of greenhouse gas emissions that have already been implemented, are planned or whose introduction is in the stage of investigation. The measures currently in the stage of planning are described on the basis of the Short-Term Action Plan of Reduction of Greenhouse Gas Emissions, which stipulates their launch as early as 2001. From the group of more than 120 measures included in the Strategy, we will describe only the most important measures under investigation.

5.2.2 Measures for Reduction of Co_2 Emissions

Inter-sectoral measures

Implemented measures

5.2.2.1 CO_2 Tax

CO_2 tax was introduced in 1996 pursuant to the Environmental Protection Act. The aim of the tax is to reduce emissions, while at the same time contributing additional budgetary funding, thus enabling the reduction of the contribution rates applying to labour taxation. The tax is charged for the exploitation of fossil fuels for energy purposes. It is differentiated with respect to the level of pollution caused by individual fuels. Upon introduction the tax amounted to SIT 1/kg CO_2; in 1998 this was increased to SIT 3/kg CO_2 (15 EUR/t CO_2). Following the tax increase, partial exemptions were introduced for electrical energy facilities (92 %), industry (66 %), and the local production of heat and distribution of natural gas (50 %). Special reliefs have been enjoyed by those producing their own electricity, whose tax payment base is reduced by 0.44 kg CO_2 per 1 kWh released into the distribution network. Companies may exercise exemptions with respect to their maximum annual consumption of fuels from the reference year onwards. The exemptions were introduced in order to avoid threats to the industry competitiveness. Since the introduction of value added tax, the CO_2 tax for engine fuels has no longer been charged separately but is contained in the excise duty applying to these fuels. The CO_2 tax contributes approximately 1 % to total budgetary income.

Since 1998 the CO_2 tax has been supplemented with mechanisms that directly promote the reduction of emissions. So, for example, it is possible to enjoy a reduction in the payment of this tax by constructing a facility with an above-average level of heat insulation or, in industry, by making an investment that reduces electricity consumption.

Plans have been made for the CO_2 tax to be introduced for the consumption of electricity, which for the time being has enjoyed a privileged status, as it has been subject to a substantially smaller tax. The tax will be differentiated with respect to type of user. Households will be charged progressively with respect to consumption for the purpose of alleviating social differences and exerting additional pressure on excessive consumption.

5.2.2.2 Loan Funds

The Environmental Development Fund of the Republic of Slovenia, founded in 1995, grants favourable loans for reducing environmental impacts. The Fund offers both legal and natural persons loans for a transition from fuels hazardous to the environment (solid fuels, fuel oils) to more environment-friendly fuels (natural gas, district heating and renewable resources of energy), which in addition to reducing toxic emissions also reduce greenhouse gas emissions. Part of these loans are also intended for the modernisation of public passenger transport. Since 1996 loans have been granted to a total value of SIT 3.2 billion. Though the criterion of reduction of greenhouse gas emissions has not been applied, the majority of loans have contributed to reducing these emissions.

The Efficient Use of Energy Investment Fund for legal persons was founded by the Agency for Efficient Use of Energy. The Fund is managed by a commercial bank selected on the basis of a public tender. The state's subsidy and an interest-free loan from the EU (Phare) ensure an interest rate that is one third lower than commercial rates. More than SIT 2 billion have so far been granted in the form of favourable loans.

The Short-Term Action Plan of Reduction of Greenhouse Gas Emissions provides for injections of equity capital for both Funds. Plans have been made for the funding received from both Funds to be targeted at reducing greenhouse gas emissions.

<u>Planned measures</u>

5.2.2.3 Energy Suppliers' Active Role in the Promotion of Efficient Use of Energy

Article 67 of the Energy Act imposes on energy suppliers the obligation to inform their consumers of the trends and characteristics of their energy consumption at least once a year. To this end they may draw up programmes which, in an appropriate manner, encourage and guide consumers to use energy supplied efficiently and to use potentials for saving energy. This will serve as the basis for drawing up the Rules on the Implementation of Activities for the Promotion of Efficient Use of Energy for Non-Commercial Suppliers, whose costs will be covered, pursuant to the Act, from the price of energy. Plans are also in place for designing incentive mechanisms for market-oriented projects relating to the efficient use of energy, which will be carried out by energy suppliers.

5.2.2.4 Spatial Planning and Balanced Regional Development

Spatial use is one of the fundamental determinants underlying the method of energy supply and the need for mobility. Spatial use changes are virtually irreversible; as a result, spatial planning in Slovenia will have substantial effects on capacities for reducing greenhouse gas emissions in the future. The Ministry of the Environment and Spatial Planning will draft guidelines for the development of settlements and towns with the aim of facilitating the advancement of district heating and spatial development, which will contribute to the management of car transport. In accordance with the concept of polycentric development, it will be necessary to create the conditions for demographically and economically balanced regional development, which will have an impact on the population's daily migrations.

5.2.2.5 Encouraging Local Communities to Assume Voluntary Commitments to Reduce Greenhouse Gas Emissions

Within their competences, local communities may contribute considerably to reducing greenhouse gas emissions, particularly in the spheres of traffic arrangement, local energy supply and spatial planning. To date, only two local communities in Slovenia (Ljubljana and Gornji Grad) have assumed the voluntary commitment of reducing greenhouse gas emissions, though local emission reduction programmes have not yet been drafted. The Ministry of the Environment and Spatial Planning will subsidise the formulation of local programmes for reducing greenhouse gas emissions, especially within the framework of the preparation of the local Agenda 21, while via the Republic of Slovenia Environmental Agency and the Agency for Efficient Use of Energy, it will also provide local communities with suitable technical aid. To this end the Agency for Efficient Use of Energy has already designed a methodology for drawing up municipal energy bases, and carried out the project of training local government staff in energy planning. As part of its programmes, the Agency for Efficient Use of Energy has already co-financed the design of a number of municipal energy bases. The obligation to prepare energy bases was also imposed on local communities by the Energy Act. The Ministry of the Environment and Spatial Planning is committed to encouraging the international linking of the local communities that have assumed the commitment to reduce greenhouse gas emissions.

5.2.2.6 Encouraging Non-Governmental Organisations and Professional Associations to Act in the Sphere of Climate Change Mitigation

Non-governmental organisations and professional associations can to a large extent contribute to raising awareness of the problem of climate change mitigation, thus enhancing the effectiveness of the implementation of measures aimed at reducing greenhouse gas emissions. Professional associations are also important for their promotion of the introduction and use of state-of-the-art technologies that reduce emissions. In the future the Ministry of the Environment and Spatial Planning will increase its support for activities aimed specifically at addressing climate change mitigation.

<u>Measures under investigation</u>

5.2.2.7 General Excise Duty on Energy Consumption

The economic instruments envisaged in the Short-Term Action Plan of Reduction of Greenhouse Gas Emissions will not be sufficient to activate adequate potentials that would largely enable the achievement of the planned reduction of greenhouse gas emissions using domestic measures. As a result, the introduction of an additional excise duty on energy is under consideration; this would promote the efficient use of energy in transport and contribute to selecting alternative means of transportation. The additional excise duty, in exchange for voluntary agreements, is expected to pose merely a small burden on industry, therefore not affecting its competitiveness. The exemption applying to renewable resources would further facilitate their use. From the aspect of the national economy, the introduction of an additional excise duty is certainly interesting as it would reduce expenditure related to the purchase of fuels, lessen the country's energy dependence , and increase the amount of investments within the national economy. One of the possibilities takes the form of the introduction of a flexible excise rate that would be adjusted to the price of fuels on the world market. The enabling of minor price fluctuations would improve the conditions for planning investments in the efficient use of energy.

5.2.2.8 Special-Purpose Use of a Part of Budgetary Income from CO_2 tax

For the purpose of ensuring the stable financing of measures targeted at reducing greenhouse gas emissions, the possibility is being considered of earmarking and allocating part of budgetary income generated by CO_2 tax for measures aimed at reducing greenhouse gas emissions, mainly measures for promoting efficient use of energy and for developing new technologies. Part of these funds would be allocated via the Efficient Use of Energy Investment Fund and the Environmental Development Fund.

Energy supply

Implemented measures

5.2.2.9 Gradual Closure of the Trbovlje-Hrastnik Brown Coal Mine Act

The National Assembly has adopted the Gradual Closure of the Trbovlje-Hrastnik Brown Coal Mine By the End of 2007 Act, which also addresses the developmental restructuring of the region. As a consequence, the only mine that will be in operation in Slovenia after the above year will be Velenje Lignite Mine. The mine's closure will contribute to reducing the share of coal in total consumption of primary energy, while also cutting down emissions of methane in mining activities.

Planned measures

5.2.2.10 Programme of Energy Use of Wood Biomass

The Programme of Energy Use of Wood Biomass is in the course of adoption. The Programme stipulates, by the end of 2010, the erection of 50 district heating systems, 5,000 individual combustion plants, and the construction or reconstruction of 100 boilers for wood biomass in industry. The Programme will be realised through budgetary subsidies amounting to 30 % of the investment value. The total reduction of emissions of CO_2 resulting from the Programme's implementation will reach 320,000 tonnes (1.5 % of total greenhouse gas emissions in Slovenia) by 2010.

5.2.2.11 Promotion of Combined Heat and Power Generation

After a standstill in the development of co-generation lasting several decades, the positive shifts occurring after 1995 have been halted by uncertainties relating to the opening-up of the electricity market, increases in the price of natural gas and oil, and the lack of systemic measures for promoting co-generation. The new Energy Act is favourable to co-generation, as are the executive regulations governing the purchase of electricity from qualified producers of electricity; however, the current purchase price of electricity does not sufficiently encourage it. For the purpose of reducing greenhouse gas emissions and from other national economic aspects, systemic measures are to be drawn up to promote co-generation and determine its minimum progressive share in the total production of electricity by 2010.

5.2.2.14 Promotion of the Use of Renewable Sources

In addition to wood biomass, Slovenia has substantial unused potentials of water energy, wind power, landfill gas and biogas, and geothermal and solar energy. In order to increase the share of energy generated from renewable sources in the total consumption of primary energy and the production of electricity, plans have been made for setting quantitative targets by 2020 and for laying down appropriate systemic measures. The framework for the systemic measures is provided for by the already-adopted Energy Act, which provides the government with the possibility of determining the minimum share of renewable sources in the supply of individual forms of energy.

5.2.2.13 Balanced Utilisation of Hydro-Potentials

In Slovenia less than half the technical potential of water energy has been used. The more efficient utilisation of water potentials has been prevented by local environmental aspects and economic criteria. A more integrated approach to energy utilisation, a reduction of flood risk and the provision of water for agriculture can contribute to reducing the costs of achieving the objectives, and thus to increasing the efficiency of utilisation of energy offered by hydro-potentials. Special attention must be devoted to shedding light on the problem of seasonal accumulations for retaining flood waves and enriching low flows, which is also important in the context of adaptation to climate change.

5.2.2.14 Removal of Barriers for Energy Utilisation of Waste (Waste Incineration)

The most important aspect of the indirect reduction of greenhouse gas emissions in waste management is the maximum exploitation of energy within the framework of the thermal processing of waste. To this end, combined heat and power generation must be ensured. The key issue here is the utilisation of heat, which does not allow long-distance transmission and is therefore dependent on location. As a result, the location of plants must enable the maximum possible consumption of heat. In accordance with the National Environmental Protection Programme, which stipulates the maximum possible substance and energy utilisation of waste, the Ministry of the Environment and Spatial Planning will draw up guidelines for the selection of a location and technologies, and for an environmental impact assessment that will lay down the compulsory consideration of avoidable emissions in heat and power generation by waste incineration plants. The Ministry will provide the public with appropriate information on the overall environmental aspects of waste incineration.

Industry

Implemented measures

5.2.2.15 Energy Advice and Energy Inspections

The Agency for Efficient Use of Energy has organised an energy advisory programme for major consumers of energy. Energy advice covers energy inspections, talks with management and the provision of information for employees. From 1997 to 1999, 44 companies were involved in the energy advisory programme; together they hold a 18 % share in the end use of energy in industry. The energy inspection programme covered 124 companies, which consume 9 % of the total energy used in industry. The recommended measures have enabled the reduction of energy-related costs by an average of 15 %.

5.2.2.16 Promotion of the Introduction of Environmental Management Systems in Accordance with ISO 14000 and EMAS

More than 100 Slovenian companies have so far received a certificate for environmental management systems according to the ISO 14000 standard. The Ministry of the Environment and Spatial Planning is committed to promoting the introduction of environmental management systems in production and service companies. In addition to reducing local environmental burdens, enhanced supervision of the energy and substance balance and greater environmental awareness on the part of management and employees contributes to cutting down greenhouse gas emissions. The Ministry of the Environment and Spatial Planning will also prepare framework bases for the implementation and promotion of EMAS, which is more effective than ISO 14000 with regard to the reduction of greenhouse gas emissions.

Planned measures

5.2.2.17 Voluntary Agreements

If they are to maintain their competitiveness, large industrial consumers cannot be substantially burdened with tax on energy consumption. Voluntary agreements on emission reduction provide companies with greater flexibility, and therefore with greater economic efficiency. This instrument has not been used in Slovenia to date. However, plans have been made for concluding voluntary agreements with the aluminium production industry and certain other energy-intensive industries with the aim of reducing energy consumption and direct CO_2 emissions per production unit. The formulation of the agreements will be taken over by the Agency for Efficient Use of Energy, on behalf of state administration.

Households, and the public and service sectors

Implemented measures

5.2.2.18 Energy Advice and Information Campaigns

The Agency for Efficient Use of Energy has organised a widespread network of advice offices responsible for households. A total of 33 offices (on average one per 60,000 inhabitants) are currently in operation; these are distributed equally across the country. Since 1991, when this activity was launched, offices have offered advice and drafted written reports for more than 15,000 households (2 % of the total number of households in Slovenia).

In addition to information published in the media, themed workshops and seminars, approximately 10,000 copies of 42 different information leaflets have been issued as part of information campaigns and promotional activities for efficient use of energy, as well as 5,000 copies of the Let Us Save Energy brochure aimed at promoting efficient use and renewable sources of energy.

For raising the awareness of schoolchildren in primary and secondary schools and facilitating their activities, contributions were encouraged from schoolchildren addressing efficient use and renewable sources of energy. In order to realise this promotion within the framework of optional natural science programmes in schools, the Agency for Efficient Use of Energy has used state subsidies to facilitate the implementation of 17 special programmes addressing efficient use and renewable sources of energy.

5.2.2.19 Promotion of the Implementation of Measures Facilitating Efficient Use of Energy in Households

Since 1996 the Agency for Efficient Use of Energy has promoted various measures targeted at enhancing the efficient use of energy in households. To this end, it has offered incentives for roof insulation, the proofing of windows and doors, the placing of oil burners near central heating boilers, the use of energy-saving lightbulbs, and the replacement of windows or glass elements. The state’s financial incentives have been compensated for with energy savings within periods ranging from six months to less than two years. In addition to energy savings, these incentives have achieved model awareness-raising effects, reverberating among and raising the interest of citizens, and always exceeding the objectives required from the public tenders. More than 12,000 households have participated in these campaigns or public tenders. In the initial years the purpose of the incentives was to carry out less demanding measures in terms of investment. From 1998 to 2000, 1,995 initiatives were put forward for the installation of energy-efficient glazing and windows, which for households are less demanding measures in terms of investment. However, the persistent interest of citizens supports the fact that the potential opportunities for receiving a state subsidy have significant effects on their decision and on the implementation of a given measure. Aside from this, certain indirect effects were ascertained, such as the gradual establishment of modern technical standards and trust on the part of an increasing number of consumers in the efficient use of products that meet the criteria of energy efficiency, which contributes to these products gradually becoming a natural choice on the market. The significance of these effects is normally greater than the mere lowering of financial or social obstacles to investment by citizens.

5.2.2.20 Income Tax Reliefs for the Use of Energy-Efficient Plants

The special decree entitled Regulations on the Criteria of Energy Efficiency, Low Consumption of Drinking Water and Low Environmental Pollution Applying to Certain Plants (1996) enabled the government to deduct the costs of purchase of certain plants from the income tax base. The amount observed is only 3 % of the exemption from the base rate, including other purchase reliefs. Income tax relief can be obtained for the purchase of highly efficient refrigerators, freezers, washing machines and dishwashers, dryers, vacuum cleaners, and windows with low heat conductivity.

Planned measures

5.2.2.21 New Decree on Stricter Standards Applying to Heat Losses and Gains in Buildings

The currently valid standard applying to heat conductivity in new buildings was adopted in 1987 and requires 5-cm-thick insulation of external walls. Plans are underway for setting a new standard that will render the requirements applying to heat conductivity in new buildings substantially stricter while laying down the maximum heat conductivity in buildings that may not be exceeded in the event of the renovation of facades of existing buildings.

5.2.2.22 Energy Profile Card of Buildings

As an instrument for promoting improvements in energy efficiency and reducing emissions of CO_2, plans are underway for designing energy profile cards for buildings. The introduction of energy profile cards for buildings are, in legal terms, based on the Energy Act. In the first stage of introduction, the profile cards will be launched in accordance with a voluntary scheme aimed at promoting energy-efficient and sustainable building construction. In addition, the possession of energy profile cards will be linked to national incentive programmes and favourable loan programmes for constructions with above-average energy efficiency standards. In the medium term, the energy profile card will become compulsory.

5.2.2.23 New Standards for Small Combustion Plants

The existing Decree on Emissions from Small Combustion Plants lays down the efficiency factors for both existing and new combustion plants. The new Decree, which is about to be adopted, will render more stringent the minimum efficiency factors and set forth the transitional periods for the modernisation or replacement of existing combustion plants. The implementation of the new Decree will be ensured particularly through the setting-up of a system for monitoring efficiency factors and emissions in operating plants.

5.2.2.24 Labelling of the Category of Energy Efficiency of Devices

The majority of household appliances, including refrigerators, washing machines and dishwashers, are approaching the end of their lifespan. In order to ensure support for decisions on the purchase of new devices, plans have been made for a new regulation to be drafted that will require producers to supply a label indicating the category of energy efficiency of household appliances contained in their product range. Additional regulations will be adopted to govern the minimum energy efficiency factors of refrigerators and freezers.

5.2.2.25 Energy Rehabilitation of State and Public Buildings

Plans are underway to draw up an energy rehabilitation programme for state-owned buildings (schools, hospitals, state administration buildings). The programme will involve an energy inspection, the introduction of energy management in state-owned buildings and gradual rehabilitation. The state will also prepare the legal and organisational bases required for contractual investment in measures aimed at achieving the efficient consumption of energy by third parties in the public sector. On the basis of the international project of the transfer of German experience to Slovenia, it will be necessary to design incentive mechanisms, especially in the form of the engagement of relevant experts to assist local communities and the rest of the public sector to compile concrete projects of contractual financing of measures towards efficient energy consumption.

Transport

Planned measures

5.2.2.26 Control of Engine Settings and of the Composition Of Exhaust Gases Released by Motor Vehicles

The control of emissions released by motor vehicles has already been addressed by existing legislation governing technical inspections of vehicles; however, existing control has not been properly defined and its implementation is insufficient. As a result, relevant EU directives are planned for transposition into national legislation, accompanied with the setting-up of an appropriate system for ensuring their implementation. The control of engine settings and of the composition of exhaust gases released by motor vehicles can entail a 2-3 % reduction of specific emissions of CO_2 in the case of older vehicles, while this percentage is somewhat smaller for newer ones.

5.2.2.27 Excise Duty Proportionate with the Normative Consumption of Fuels Upon the Purchase of New Vehicles

By employing economic instruments, the government may focus the renovation of the vehicle fleet on vehicles generating smaller emissions of CO_2. To this end, one of the criteria for excise duty upon purchase of a new car is envisaged to take the form of normative consumption of fuels, or specific emissions of CO_2. Additionally, particularly as a model measure, the government will define the consumption of fuels as one of the criteria applying to the purchase of cars on the basis of public procurement orders.

5.2.2.28 Preparation of Programmes of Reduction of Greenhouse Gas Emissions and Toxic Gases in Urban Traffic

The highest growth of greenhouse gas emissions generated by traffic has been registered in urban environments. Growing urban traffic also releases toxic substances, increases traffic congestions and generally diminishes quality of life. In light of this, programmes for the management of environmental impacts caused by urban traffic will be drawn up in conjunction with local communities.

5.2.2.29 Preparation of Systemic Measures for the Promotion of Public Transport

Public passenger transport generates approximately five times fewer greenhouse gas emissions per passenger per kilometre than indiviual one. In addition to increasing greenhouse gas emissions, the growth in private transport causes greater pollution with toxic emissions and transport infrastructure overloads. The trend of a decrease in public passenger transport will be reversed through the implementation of systemic measures targeted at providing bus transport with privileged status within traffic arrangements, consolidating links between bus and rail transport, pursuing an appropriate parking fee policy, and granting direct subsidies to public transport projects.

5.2.2.30 Preparation of Systemic Measures for Increasing the Share of Rail Transport in Freight Transport

Compared to road transport, rail freight transport releases considerably smaller quantities of toxic and greenhouse gases per tonne per kilometre. For the purpose of increasing the share of rail transport in overall freight transport, investments will be made in modernisation of the railway and the enhancement of its competitiveness. Due to the expected high increases in transit transport by road, it is exceptionally important to redirect as large a share of transit from road to rail as possible. To this end, economic measures must be accompanied with administrative measures, which must be coordinated with the EU and neighbouring countries.

5.2.2.31 Greater Consistency in the Implementation of Regulations Governing Speed Limits Outside Settlements

Speeding on motorways requires engine power to overcome the resistance that grows approximately by a power of three relative to speed, which in turn increases both the consumption of fuel and emissions of CO_2. The management of excessive speeds is at the same time important for improving road safety. Excessive speeds can be brought down by both exercising control and imposing sanctions pursuant to existing legislation, and by raising the awareness of road users.

5.2.2.32 Increasing Toll For Freight Vehicles

Tolls charged to freight vehicles using motorways are not proportionate with the attrition caused by these vehicles. Increasing tolls for freight vehicles and thus increasing the variable costs of freight transport by road contributes to enhancing the efficiency of freight vehicles and, at the same time, to redirecting transport from road to rail.

5.2.2.33 Inclusion of the Issue of Efficient Use of Vehicles in Driving School Programmes

The energy-efficient use of vehicles may reduce the consumption of fuels and greenhouse gas emissions by more than 10 %, while improving road safety. In addition to information campaigns in the media, information on energy-efficient driving techniques will be incorporated into driving school programmes.

5.2.3 Measures for Reducing Emissions of CH_4

Waste management

Planned measures

5.2.3.1 Fee for Environmental Burdens Caused by Waste Disposal

The draft Decree on the Environmental Burden Fee for Waste Disposal lays down a double-level charging of fees for environmental burdens caused by waste disposal, i.e. for physical space and air burdens. The first part is charged on the basis of the total mass of waste disposed; the second (greater) part is determined with respect to the composition and quantity of biodegradable waste. In accordance with the IPCC methodology for the preparation of national inventories of emissions, an assessment is made of methane emissions, for which, with respect to the greenhouse effect caused by methane, a fee is charged pursuant to the regulation governing the fee charged for releasing carbon dioxide emissions into the air. On the basis of this methodology the release of methane at waste disposal sites will be subjected to the payment of a fee amounting to SIT 630/kg (EUR 300 /tonne). Apart from reducing biodegradable waste, the Decree promotes the capture of methane from waste disposal sites, since the base for charging the fee is reduced by the quantity of methane captured and incinerated at waste disposal sites. An additional incentive encourages the production of electricity using landfill gas, as it offers relief equal to 0.44 kgCO_2 per kWh produced. The Decree will directly promote advanced waste management technologies, given that it stipulates a partial fee exemption amounting to the scope of measures targeted at reducing environmental impacts. The fees charged for air burdens are expected to generate, before exemption, approximately SIT 4 billion (EUR 10 per capita).

Waste management offers relatively the greatest possibility for reducing greenhouse gas emissions, given that it is possible to more than halve them in ten years. The fee for environmental burdens caused by waste disposal will be one of the central instruments for activating these potentials.

Agriculture

Implemented measures

5.2.3.2 Subsidies per Area of Arable Land

As part of Slovenia's approximation to the EU, Slovenian agricultural policy has already begun the transition from subsidies per unit of food produced to subsidies per area of arable land. This consolidates the role of agriculture in the preservation of the cultural landscape, while promoting sustainable agriculture policies (organic agriculture, greater share of grazing, production of higher-quality fodder, reduced use of mineral fertilisers, etc.), all of which reduces emissions of methane and N_2O .

Planned measures

5.2.3.3 Inclusion of the Reduction of Methane Emissions in Agricultural Policy

Agriculture is a sector on which the state exerts a considerable influence, reflected in subsidies. Given that agriculture generates a large share of greenhouse gas emissions, the aspect of reduction of methane emissions must necessarily be integrated in agricultural policy. Measures in the area of reduction of methane emissions will be focused particularly on ensuring the production of higher-quality voluminous fodder and on selectively improving the genetic potential of cattle for the purpose of reducing emissions resulting from enteric fermentation in the production of milk and beef. In addition, the state will promote the preservation of traditional systems of separate collection of solid and liquid manure, and increase the share of grazing, which in Slovenia is pursued to an insufficient extent given its potential. Due to local environmental impacts, the increasingly large pig farms will gradually become equipped with liquid manure treatment plants. In relation to this, the capture and energy use of biogas will be promoted. Given that membership of the EU poses a great challenge to Slovenian agriculture due to Slovenia's specific natural features and inherited discrepancies, measures targeted at reducing greenhouse gas emissions will be incorporated in this context to the greatest possible extent.

5.2.4 Measures for Reducing Emissions of N_2O

Agriculture

Implemented measures

5.2.4.1 Decree on the Input of Plant Nutrients and Protective Agents into the Soil

The Decree is aimed primarily at preventing the pollution of underground waters and, to this end, sets forth the method, periods and maximum input of nitrogen into the soil. The 2001 updated version of the Decree declared the entire territory of Slovenia a sensitive region, thus limiting the annual input of nitrogen via animal fertilisers to 170 kg/ha. The reduction of levels of nitrogen in the soil directly reduces emissions of N_2O.

Planned measures

5.2.4.2 Inclusion of the Reduction of Emissions of N_2O in Agricultural Policy

The largest quantities of N_2O are released by mineral fertilisers and fertilisers of animal origin. The quantities of fertilisers of animal origin are dependent on the magnitude of breeding of domestic animals and quality of fodder. Part of measures to reduce the input of nitrogen into the soil thus coincide with measures to reduce methane emissions in agriculture. In order to reduce emissions of N_2O, the consumption of mineral fertilisers needs to be controlled. The input of nitrogen into the soil can be reduced chiefly by enhancing the quality of fertilisation and taking into account the needs of plants and agro-meteorological conditions, as well as paying attention to the input of nitrogen via rainfall. The co-natural orientation of agriculture (greater share of organic land cultivation and animal husbandry) can contribute to reducing emissions of N_2O.

5.2.5 Measures for Reducing Emissions of PFC, HFC and SF_6

Planned measures

5.2.5.1 Voluntary Agreements for the Reduction of Emissions of PFC and SF_6

Aluminium production is practically the only source of emissions of PFC in Slovenia. In order to reduce these emissions, a voluntary agreement will be concluded with the industry on reducing the frequency and duration of anodic effects, which release these emissions during aluminium production, while increasing energy consumption. For the purpose of reducing emissions of SF_6, a voluntary agreement will be concluded binding the electricity transmission and electricity distribution company to capture SF_6 from worn-out switching devices and to renovate using devices with a low level of leakage.

5.2.6 Increasing of CO_2 Sinks

Planned measures

5.2.6.1 Inclusion of Increasing of Sinks in Forestry and Agricultural Policy

The National Forest Development Programme sets out a comprehensive approach to forest management, taking into account the environmental, production and social functions of forests. The co-natural orientation of forest management stipulates an increase in wood stock and thus the preservation of CO_2 sinks. With regard to the new aspects of climate change mitigation, the premises of agricultural and forestry policy will be reconsidered with regard to the scope of preservation of the cultural landscape and the increase in forest area. In addition to the function of forests as sinks, the protective function of forests will also be taken into account in the context of adaptation to climate change.

6. Projections of Emissions and Assessment of Impacts of Policies and Measures

6.1. Introduction

For the assessment of greenhouse gas emissions up to 2020, two basic scenarios have been defined. The first Scenario (A) describes the development of emissions in the event of already-implemented measures, without their intensification or the introduction of new emission-reduction measures. The second Scenario (B) is targeted specifically at emissions reduction. Thus, Scenario B takes into account planned measures and measures under investigation. Scenario B has not been made completely consistent between sectors, since certain sectors (agriculture, waste management and transport) have not yet been evaluated, meaning that the marginal costs of reduction have not been adjusted, nor have other criteria included in the Strategy of Reduction of Greenhouse Gas Emissions been taken into account. This means that Scenario B does not constitute a final decision on the method and scope of reduction of greenhouse gas emissions in Slovenia. This will be set forth in more detail in the Programme of Reduction of Greenhouse Gas Emissions, which is in the process of preparation.

The following sections outline the projections of emissions of specific direct greenhouse gases.

6.2. Emissions of CO_2

6.2.1. Emissions of CO_2 from the Energy Sector

Projections of energy-induced emissions have been made using the model of Slovenia's energy system implemented in the MESAP programming environment. The model was developed by Institut Jožef Stefan as part of the "Comprehensive Planning of Energy for Efficient Use of Energy in Slovenia" project between 1994 and 1997, functioning as support for preparation of the National Energy Programme. The model has since been supplemented. In addition to calculations of CO_2 emissions, it includes calculations of emissions of CH_4 and N_2O on the basis of the emission factors used for the inventories of greenhouse gas emissions. The model used for developing emission projections is scenario-based and contains no optimisation elements, except for the production of electricity.

Both scenarios are based on the same assumptions regarding GDP growth (an average 3.8 %) and other macroeconomic expectations. Scenario B does not take into account the reverse effect of measures on the structure of industrial production, which is the same in both scenarios. Finally, both scenarios take into consideration the gradual liberalisation of internal energy markets.

Table 16: Basic assumptions of both scenarios of developments of CO_2 emissions from the energy sector

	1997	2000	2005	2010	2015	2020
GDP [SIT97]	2,907	3,355	4,079	4,774	5,686	6,890
Exports [SIT97]	1,670	1,942	2,587	3,318	4,134	5,152
Index of physical volume of industrial production	1.00	1.05	1.09	1.08	1.09	1.13
Residential area per capita [m^2]	24.7	25.5	26.5	27.1	27.5	29.0
Discount rate [%]	10					
World market prices of energy			IEA World Energy Outlook 1998			

Source: Institut Jožef Stefan

Scenario A envisages the implementation of already-adopted measures, including the CO_2 tax (Chapter 5), in the same manner as to date. Scenario B on the other hand takes account of planned measures and measures under investigation. The set of additional measures can be summarised as follows:

- greater intensity of promotional and model programmes, and improved normative-institutional arrangements;
- use of economic instruments, including intensive promotional programmes financed at the level of the general 2 % charge for energy consumption, and the CO_2 tax introduced parallel with recycling; an additional tax on energy for households and the service sector amounting to 20 %;
- active participation of industry, formalised through voluntary agreements on the enhancement of efficient energy use;
- intensive measures for selecting alternative means of transportation and enhancing the energy efficiency of vehicles;
- activation of new entities and programmes in addition to the Agency for Efficient Use of Energy and the Environmental Development Fund, action by energy suppliers, and the formation of a number of national funds for the realisation of measures relating to efficient use of energy and renewable resources of energy.

Both scenarios share the assumption that, in accordance with the law, the mining of brown coal in Slovenia will cease in 2007. Scenario A stipulates that given the current level, the annual mining of lignite falls only slightly, though Scenario B envisages a somewhat greater reduction. In addition, both scenarios envisage the construction of hydroelectric power plants producing an annual total of 912 GWh by 2010, and the operation of Krško Nuclear Power Plant until the end of its lifespan.

As for industry, it has been estimated that by 2020 companies will exhaust all economically justified potentials relating to the reduction of energy consumption or emissions of CO_2, where Scenario B envisages more rapid exploitation. In the area of households and buildings, Scenario B takes into account the utilisation of potentials according to which the costs of emission reduction are up to SIT 5/kg CO_2, and the spontaneous introduction of more demanding measures on a smaller scale. In the sphere of traffic, Scenario A envisages that the average specific consumption of cars will fall by 19 % by 2010, while Scenario B stipulates a 25 % reduction with respect to the current situation. In addition, Scenario B envisages a more active policy regarding the selection of alternative means of transportation.

Table 17: Emissions of CO_2 from the energy sector according to Scenario A - already-implemented measures

Sector	1986	1996	1997	2000	2005	2010	2015	2020	Index 1986/ 2010 %
				Gg CO_2					
1 Energy	14,553	14,927	15,156	15,375	16,251	16,213	16,188	16,434	111
A Fuel Combustion	14,462	14,804	15,020	15,212	16,083	16,052	16,039	16,277	111
1 Energy Industries	6,308	5,362	5,641	5,682	5,617	5,234	4,832	4,916	83
2 Manufacturing Industries and Constr.	4,112	2,361	2,362	2,436	2,495	2,489	2,446	2,524	61
3 Transport	2,004	4,199	4,557	4,612	5,454	5,804	6,169	6,127	290
4 Other Sectors	2,037	2,883	2,460	2,482	2,517	2,525	2,592	2,711	124
B Fugitive Emissions from Fuels	90	123	136	163	168	160	149	156	179

Source: Institut Jožef Stefan

Table 18: Emissions of CO_2 from the energy sector according to Scenario B - already-implemented measures, planned measures and measures under investigation

Sector	1986	1996	1997	2000	2005	2010	2015	2020	Index 1986/ 2010 %
				Gg CO_2					
1 Energy	14.553	14.927	15.156	15.375	15.466	15.009	14.835	14.893	103
A Fuel Combustion	14,462	14,804	15,020	15,212	15,309	14,856	14,694	14,742	103
1 Energy Industries	6,308	5,362	5,641	5,682	5,199	4,659	4,474	4,790	74
2 Manufacturing Industries and Constr.	4,112	2,361	2,362	2,436	2,464	2,432	2,398	2,482	59
3 Transport	2,004	4,199	4,557	4,612	5,240	5,468	5,583	5,247	273
4 Other Sectors	2,037	2,883	2,460	2,482	2,405	2,298	2,239	2,223	113
B Fugitive Emissions from Fuels	90	123	136	163	157	153	140	150	170

Source: Institut Jožef Stefan

6.2.2. Emissions of CO_2 from Industrial Processes

As for projections of emissions of CO_2 from industrial processes, there are no significant differences between the two scenarios, as the scenarios do not envisage a different volume and structure of physical production. The difference between the two scenarios resulting from the planned modernisation of aluminium production, which will however remain at the same default volume, is insignificant. As a result, for CO_2 emissions we give only one projection, shared by both scenarios. For CO_2 emissions generated by the use of solvents, we have assumed they will be halved by 2010.

Table 19: Emissions of CO_2 from industrial processes and use of solvents

Sector	1986	1996	1997	2000	2005	2010	2015	2020	Index 1986/2010
				Gg CO_2					%
2 Industrial Processes	**954**	**777**	**828**	**911**	**1,034**	**1,128**	**1,273**	**1,462**	**118**
A Mineral Products	725	539	591	668	786	881	1,023	1,206	122
B Chemical Industry	120	87	87	93	95	94	96	100	79
C Metal Production	109	150	149	151	153	153	154	156	140
3 Solvent and Other Product Use	**46**	**33**	**32**	**28**	**22**	**16**	**16**	**16**	**35**

Source: Studio Okolje

6.3 Emissions of CH_4

With regard to emissions of methane from the energy sector, the two scenarios are the same as those applying to emissions of CO_2 from this sector. The model is based on the assumption of constant emission factors.

Regarding the agricultural sector, both scenarios share the assumption that the volume of agricultural production will remain constant. Scenario A, addressing already-implemented measures, envisages no changes in methane emissions. Scenario B, including planned measures and measures under investigation, additionally contains the following:

- construction of treatment plants, including the capture of methane at major pig farms;
- increase in the share of cattle grazing;
- reduction of the herd of young cattle and lactating ruminants at the expense of greater additions through breeding and milk yield;
- utilisation of 10 % of capacities for the production of biogas in large cattle and pig breeding farms.

According to the model's assessment, the additional measures reduce emissions of methane in agriculture by 6 % with respect to 1996.

In the area of solid waste management, we have estimated that emissions in the scenario that takes into account already-implemented measures will not change significantly. In contrast, Scenario B, covering planned measures and measures under investigation, stipulates a substantial reduction of emissions. The central instrument for reducing emissions is the fee charged for polluting the atmosphere with emissions of methane, supplemented with an active policy pursued by the state in this area. Projections of methane emissions generated by waste management have been based on the default IPCC methodology, which does not consider the progress through time of methane release. Both scenarios assume that methane emissions resulting from wastewater treatment, which are one oreder of magnitude smaller than those generated by solid waste management, will remain unchanged.

The only source identified as the generator of emissions of CH_4 from industrial processes is the production of methanol; both scenarios assume that it will remain unchanged both quantitatively and technologically.

Table 20: Emissions of CH_4 according to Scenario A - already-implemented measures

Sector	**1986**	**1996**	**1997**	**2000**	**2005**	**2010**	**2015**	**2020**	**Index 2010/ 1996**
					Gg CH_4				**%**
Total Emissions	120.3	112.8	115.0	116.9	115.7	114.1	113.2	113.7	101
1 Energy	24.3	17.6	18.6	17.7	16.5	14.9	14.0	14.5	85
2 Industrial Processes	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	100
4 Agriculture	50.6	42.7	42.7	42.7	42.7	42.7	42.7	42.7	100
6 Waste	45.2	52.3	53.5	56.3	56.3	56.3	56.3	56.3	108

Source: Institut Jožef Stefan, Institute of Agriculture of Slovenia, Studio Okolje

Table 21: Emissions of CH_4 according to Scenario B - already-implemented measures, planned measures and measures under investigation

Sector	**1986**	**1996**	**1997**	**2000**	**2005**	**2010**	**2015**	**2020**	**Index 2010/ 1996**
					Gg CH_4				**%**
Total Emissions	120.3	112.8	115.0	116.2	102.0	90.6	82.8	80.3	80
1 Energy	24.3	17.6	18.6	17.7	15.8	14.4	13.5	14.4	82
2 Industrial Processes	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	100
4 Agriculture	50.6	42.7	42.7	42.0	41.2	40.4	39.6	38.7	95
6 Waste	45.2	52.3	53.5	56.3	44.8	35.6	29.5	27.0	68

Source: Institut Jožef Stefan, Institute of Agriculture of Slovenia, Studio Okolje

6.4 Emissions of N_2O

The scenarios dealing with emissions of N_2O from the energy sector are the same as those applying to emissions of CO_2 from this sector. The model assumes constant emission factors, which particularly in terms of emissions from traffic downgrades the accuracy of projections. In both scenarios, emissions of N_2O from the energy sector are expected to increase due to the growth in the volume of traffic of vehicles using catalytic converters.

With respect to emissions of N_2O in agriculture, the scenarios are the same as those applying to emissions of CH_4. Scenario A stipulates that emissions will remain unchanged. Scenario B envisages the use in the future of the same quantities of mineral fertilisers, which given the area of arable land in Slovenia is relatively low. The reduction of emissions of N_2O predicted by Scenario B is therefore chiefly the result of reduced numbers of cattle.

Table 22: Emissions of N_2O according to Scenario A - already-implemented measures

Sector	**1986**	**1996**	**1997**	**2000**	**2005**	**2010**	**2015**	**2020**	**Index 2010/ 1996**
				Gg N_2O					**%**
Total Emissions	5.87	5.31	5.12	5.27	5.53	5.63	5.68	5.68	106
1 Energy	0.51	0.56	0.37	0.52	0.78	0.88	0.93	0.93	156
3 Solvent and Other Product Use	0.26	0.06	0.06	0.06	0.06	0.06	0.06	0.06	100
4 Agriculture	4.95	4.54	4.54	4.54	4.54	4.54	4.54	4.54	100
6 Waste	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	100

Source: Institut Jožef Stefan, Institute of Agriculture of Slovenia

Table 23: Emissions of N_2O according to Scenario B - already-implemented measures, planned measures and measures under investigation

Sector	**1986**	**1996**	**1997**	**2000**	**2005**	**2010**	**2015**	**2020**	**Index 2010/ 1996**
				Gg N_2O					**%**
Total Emissions	5.87	5.31	5.12	5.16	5.35	5.41	5.36	5.22	102
1 Energy	0.51	0.56	0.37	0.52	0.74	0.82	0.83	0.77	146
3 Solvent and Other Product Use	0.26	0.06	0.06	0.06	0.06	0.06	0.06	0.06	100
4 Agriculture	4.95	4.54	4.54	4.43	4.40	4.38	4.32	4.24	96
6 Waste	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	100

Source: Institut Jožef Stefan, Institute of Agriculture of Slovenia

6.5 Emissions of PFC, HFC and SF_6

Both scenarios are based on the assumption that the quantity of produced aluminium, which is the major source of emissions of PFC, will not change. As a result of the voluntary agreement between the producer and the state, Scenario B envisages the modernisation of technology, which would reduce these emissions by one order of magnitude.

Projections of emissions of HFC without any measures for their reduction point to a large growth of this source, chiefly due to emissions from air-conditioning devices installed in vehicles. By 2020 the share of HFC may reach 2 % of all greenhouse gas emissions. It has been estimated that the measures included in Scenario B, particularly the replacement of HFC with other substances, the enhanced maintenance of devices and the capture of HFC from worn-out devices, may reduce these emissions by one third in the long run.

It is envisaged that emissions of SF_6 according to Scenario B will be reduced by capturing this gas from high-voltage devices and installing devices with smaller leakage levels, which would be facilitated by voluntary agreements with electrical distribution companies.

Table 24: Emissions of PFC, HFC and SF_6 according to Scenario A - already-implemented measures

Sector	1995	1996	1997	2000	2005	2010	2015	2020	Index 2010/ 1996
				Gg					%
Aluminium - Emissions of CF_4	0.0385	0.0323	0.0322	0.0322	0.0322	0.0322	0.0322	0.0322	100
Aluminium - Emissions of C_2F_6	0.0039	0.0032	0.0032	0.0032	0.0032	0.0032	0.0032	0.0032	100
Semiconductors - Emissions of CF_4	-	-	-	0.0006	0.0007	0.0008	0.0009	0.001	-
HFC	0.024	0.023	0.029	0.055	0.117	0.220	0.273	0.317	960
SF_6	0.0011	0.0009	0.0009	0.0012	0.00155	0.0050	0.0012	0.0013	560

Source: Chamber of Commerce and Industry of Slovenia, Studio Okolje

Table 25: Emissions of PFC, HFC and SF_6 according to Scenario B - already-implemented measures, planned measures and measures under investigation

Sector	1995	1996	1997	2000	2005	2010	2015	2020	Index 2010/ 1996
				Gg					%
Aluminium - Emissions of CF_4	0.0385	0.0323	0.0322	0.03222	0.002274	0.002274	0.002274	0.002274	6
Aluminium - Emissions of C_2F_6	0.0039	0.0032	0.0032	0.0032	0.0002	0.0002	0.0002	0.0002	5
Semiconductors - Emissions of CF_4	-	-	-	0.0006	0.0007	0.0008	0.0009	0.001	-
HFC	0.024	0.023	0.029	0.055	0.058	0.091	0.103	0.114	379
SF_6	0.0011	0.0009	0.0009	0.0012	0.00095	0.0010	0.0009	0.0008	91

Source: Chamber of Commerce and Industry of Slovenia, Studio Okolje

6.6 Total Emissions of Direct Greenhouse Gases

Projections of total direct greenhouse gas emissions have been made using the global warming potentials of individual gases applying to the 100-year time horizon and specified in the Second Assessment Report of the IPCC. Scenario A, based on already-implemented measures, indicates a growth in emissions, though, due to the effects of the measures, at a lower growth ratethan between 1993 and 1997. According to this scenario, by 2010 emissions of CO_2 would increase by 12 % with respect to 1986, while the growth in total greenhouse gas emissions would be lower by two percentage points. Scenario A expects emissions to grow also after 2010. On the other hand, Scenario B, stipulating the additional intensive implementation of planned measures and measures under investigation, some of which are quite costly, estimates that by 2010 total greenhouse gas emissions would fall by 1 % relative to 1986. Scenario B expects a substantial change in the structure of shares of individual greenhouse gases, where emissions of CO_2 would increase by 4 %, while emissions of all other greenhouse gases would decrease.

Table 26: Total direct greenhouse gas emissions by sector according to Scenario A - already-implemented measures

Sector	**1986**	**1996**	**1997**	**2000**	**2005**	**2010**	**2015**	**2020**	**Index 1986/ 2010**
				Gg CO_2 equiv.					**%**
Total Emissions	20,181	20,042	20,318	20,746	21,884	22,147	22,244	22,750	110
1 Energy	15,220	15,37870	15,663	15,908	16,840	16,798	16,771	17,028	110
2 Industrial Processes	1,241	1,070	1,130	1,258	1,471	1,782	1,905	2,155	144
3 Solvent and Other Product Use	127	52	51	47	41	35	35	35	27
4 Agriculture	2,597	2,304	2,304	2,304	2,304	2,304	2,304	2,304	89
6 Waste	996	1,145	1,170	1,229	1,229	1,229	1,229	1,229	123

Source: MOP-ARSO

Table 27: Total direct greenhouse gas emissions, by gas, according to Scenario A - already-implemented measures

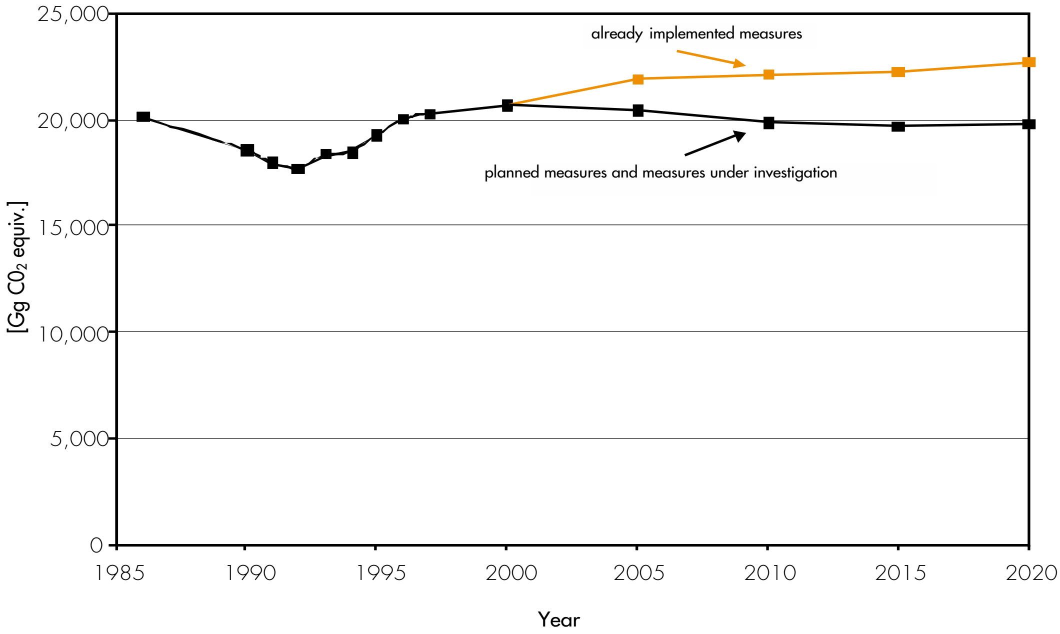
Gas	**1986**	**1996**	**1997**	**2000**	**2005**	**2010**	**2015**	**2020**	**Index 1986/ 2010**
					Gg CO_2 equiv.				**%**
Total Emissions	20,181	20,045	20,318	20,746	21,884	22,147	22,244	22,750	110
CO_2	15,552	15,740	16,016	16,314	17,307	17,357	17,477	17,912	112
CH_4	2,526	2,369	2,416	2,455	2,430	2,397	2,378	2,388	95
N_2O	1,820	1,646	1,588	1,634	1,715	1,744	1,761	1,761	96
PFC, HFC, SF_6	283	291	298	343	432	649	628	688	229

Source: MOP-ARSO

Table 28: Total greenhouse gas emissions, by sector, according to Scenario B - already-implemented measures, planned measures and measures under investigation

Gas	1986	1996	1997	2000	2005	2010	2015	2020	Index 1986/ 2010
					Gg CO_2 equiv.				%
Total Emissions	20,181	20,045	20,317	20,697	20,441	19,897	19,699	19,865	99
1 Energy	15,220	15,470	15,662	15,908	16,027	15,566	15,373	15,433	102
2 Industrial Processes	1,241	1,071	1,130	1,258	1,157	1,296	1,455	1,657	104
3 Solvent and Other Product Use	127	56	51	47	41	35	35	35	27
4 Agriculture	2,597	2,304	2,304	2,255	2,229	2,206	2,171	2,127	85
6 Waste	996	1,145	1,170	1,229	987	794	666	614	80

Source: MOP-ARSO



Source: MOP-ARSO

Figure 11: Projections of total direct greenhouse gas emissions according to the scenario of already-implemented measures and the scenario envisaging the intensive implementation of costlier planned measures and measures under investigation

6.7 Emissions of Indirect Greenhouse Gases

Indirect greenhouse gas emissions of SO_2, NO_x and VOC will be restricted with the Protocol on Reduction of Acidification, Eutrophication and Surface Ozone, which has already been signed by Slovenia but which has not yet entered into force. Similar limit values of emissions will be laid down in a EU directive (NEC Directive).

7. Vulnerability Assessment

7.1. Introduction

The Earth's climate is a changing system, influenced by the intensity of radiation from the Sun, the motion of the Earth, the properties of the Earth's surface and the composition of the atmosphere. In the last few centuries the natural effects on the climate system have been accompanied by anthropogenic effects. In the course of the 20th century, the global average surface temperature increased by between 0.3 and 0.6 °C. A physical explanation can be given for global warming. Anthropogenic emissions have changed the concentration of greenhouse gases in the Earth's atmosphere, thus affecting the Earth's heat balance. Changes in temperature, rainfall and other climatic parameters underline complex interactions resulting from modifications of the Earth's heat balance. In its Second Assessment Report, the Intergovernmental Panel on Climate Change (IPCC) states that "the balance of evidence suggests a discernible human influence on global climate".

Climate change will have an impact on ecosystems, the national economies, and human health and welfare. The purpose of the vulnerability assessment is to identify the negative impacts on individual segments of the natural environment and society, to estimate their adaptability, and to give an assessment of the impacts of expected climate change. In this Communication we are giving the first assessment of impacts and vulnerability for:

- agriculture;
- forestry;
- water cycle;
- biologic diversity;
- sea and coastal zones;
- Alpine world;
- tourism;
- energy;
- human health and wellbeing.

In Slovenia, systematic research into this area is at an embryonic stage. As a result, the vulnerability assessment is based on expert assessments in most cases.

7.2 Results of Long-Term Measurements of Meteorological Parameters

The first systematic measurements of temperature in the territory of Slovenia were carried out in 1851 in Ljubljana (Figure 12). The results of measurements show a noticeable increase in temperature. Particularly for this station the impacts of changes in micro-location must be taken into account, as they can be of the same magnitude as long-term climate change. Meteorological stations whose position has not been changed and in whose surroundings no changes have been indicated that would affect the microclimatic conditions have shorter operational period. As an example, Figure 13 shows the progress of temperatures measured at the Kredarica (2,514 m) and Rateče (864 m) Alpine observation stations. In the last 50 years, increasing temperature trends have also been observed in other meteorological stations across Slovenia, where external impacts have not been changed.

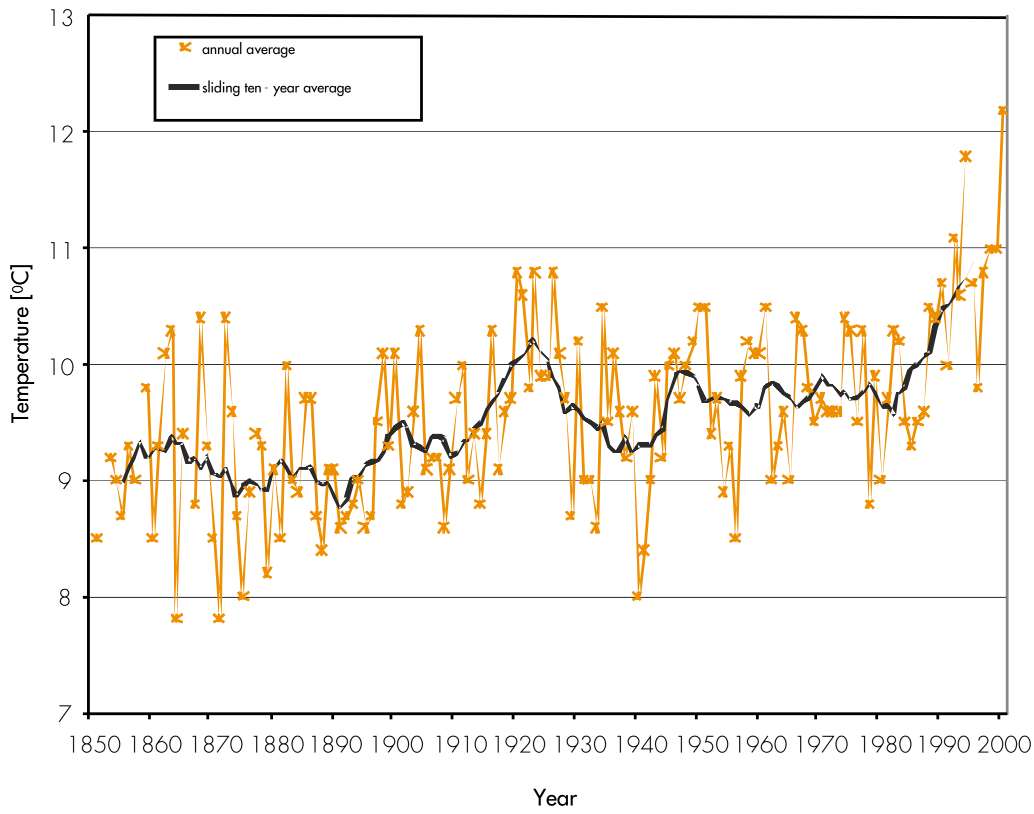


Figure 12: Average annual temperatures of the air measured in Ljubljana

Source: MOP-ARSO

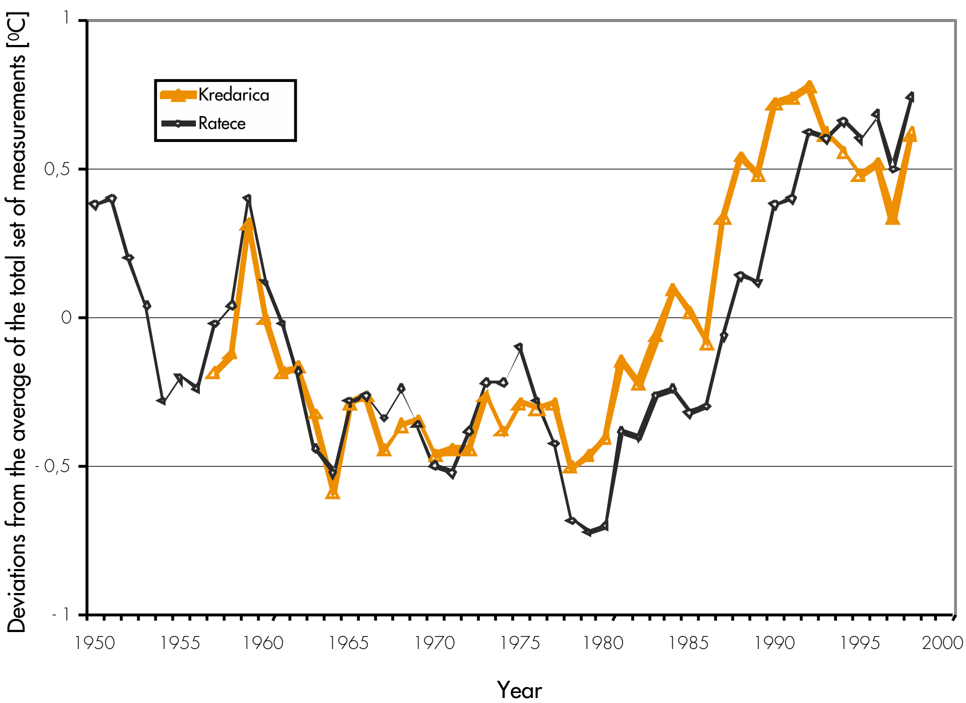
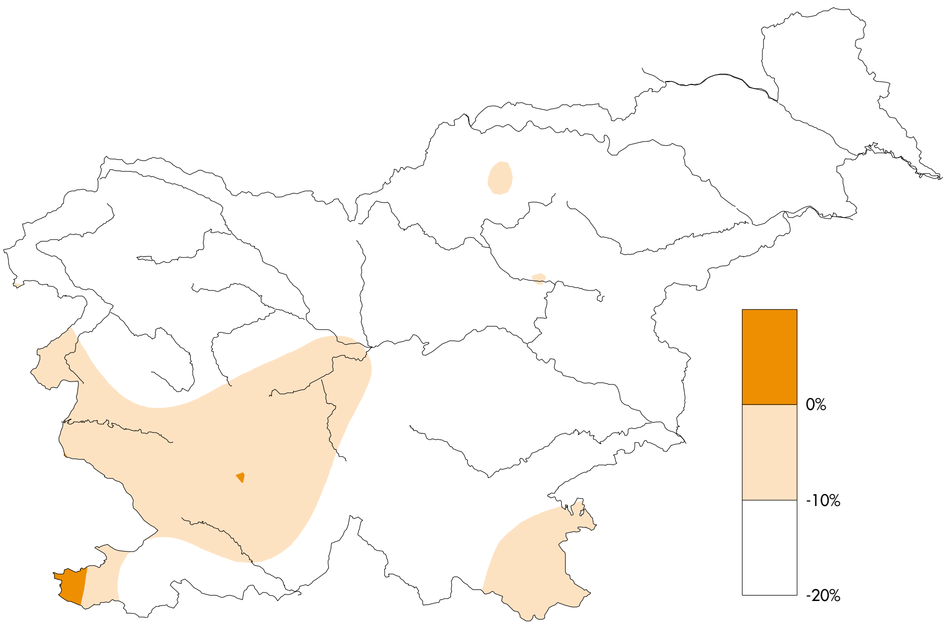


Figure13: Deviations from the average annual temperature of the air measured in Rateče (864 m) and Kredarica (2,514 m), five-year sliding average

Source: MOP-ARSO

Measurements of the annual quantity of rainfall show a slight fall. The coastal region of Slovenia stands out in the area of changes in rainfall, given that this region has even experienced a slight increase in the quantity of rainfall.



Source: *MOP-ARSO*

Figure 14: Trends in the average annual quantity of rainfall observed in Slovenia in 1951-1997

Observations in Slovenia point to the great spatial diversity of trends in air temperature and rainfall. Due to the relatively short period of measurements and extensive natural variability of the climate, the trends have only a low statistical significance.

7.3 Climate Change Scenarios in Slovenia

Today's general circulation models (GCM) give a relatively good picture of the global climate, while their results on a regional scale are less accurate. This applies particularly to mountainous regions or regions in their vicinity, the global circulation models for which describe the climate conditions less accurately due to their coarse spatial resolution, which is generally less than two radius degrees. As a result, the diverse climate conditions in Slovenia, whose small area is the intersection of three climate zones and on which weather processes have extremely different effects, are represented by a single general circulation model point.
Statistical and dynamic methods of local interpolation of the results of GCM have not yet been prepared for Slovenia, which is why the results of GCM have formed the basis for initial incremental scenarios of climate change. Slovenia has been subjected to a simplification to the effect that climate change will be spatially homogeneous.

Table 30: Incremental climate change scenarios used for Slovenia

Period	Temperature change	Change in annual quantity of rainfall	Notes
Medium term (approx. 2025)	+1 ^{0}C ±0.5 ^{0}C	0 % ± 10 %	More intensive warming of the cold half of the year, reduction of the daily temperature range, more intensive downpours
Long term (approx. 2075)	+2.5 ^{0}C ±1 ^{0}C	0 % ± 10 %	More frequent and more intensive extreme weather events

Source: Biotechnical Faculty

Due to regional uncertainties, the incremental scenarios have been designed only for temperatures and rainfall. Uncertainty is greater in the case of rainfall, where there is also the uncertainty of whether the change will be positive or negative. In terms of quality we have also assumed a greater probability of extreme weather events. It has been assumed that climate change in Slovenia will be uniform.

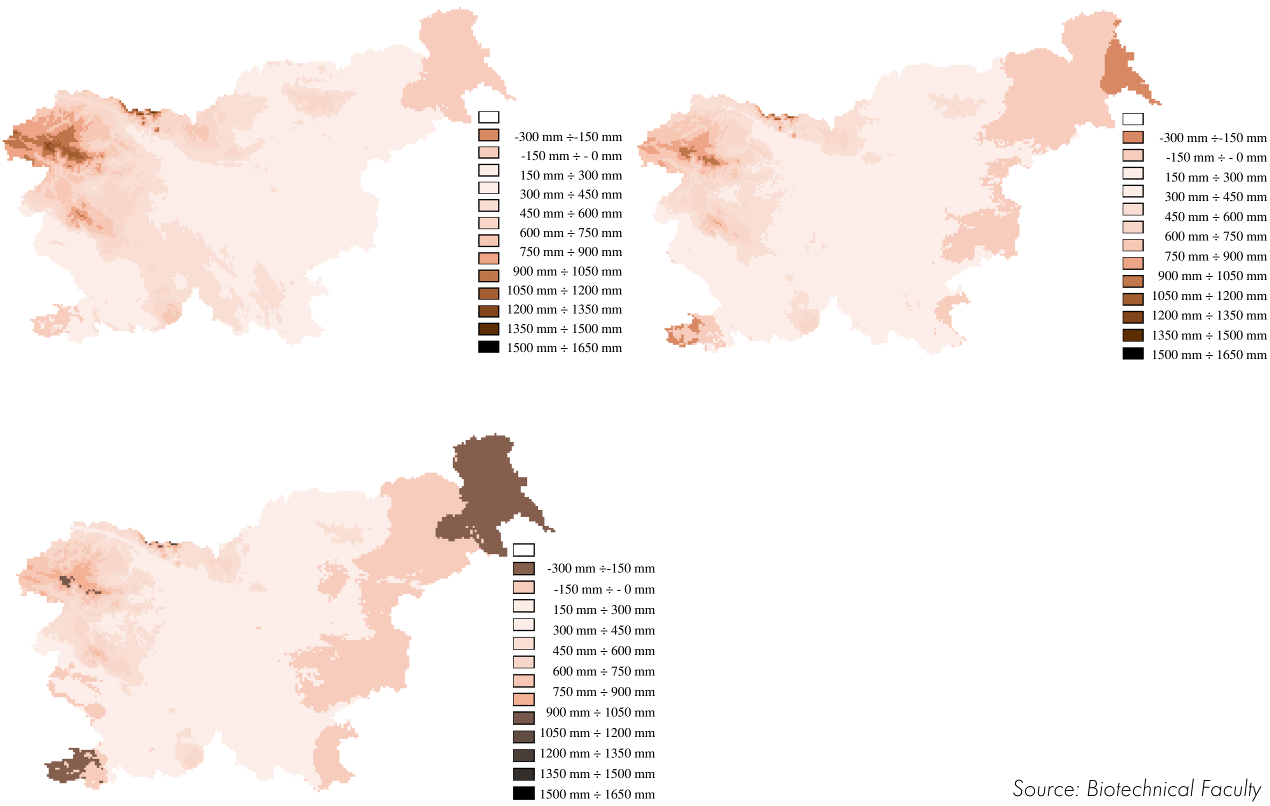
7.4 Agriculture

Agriculture is an activity directly depending on climate conditions. In addition to climate change, plant cultivation will also be affected by increased concentrations of CO_2 in the atmosphere. The analyses show that the effects of climate change in Slovenia will be both positive and negative.

In terms of samples, models have been made for an assessment of the effects of climate change on corn produce, which accounts for 40 % of sown field areas in Slovenia, and summer barley. The simulation took into account the conditions applying to central Slovenia.

The results show that the effects of climate change on corn cultivation in the region under examination will be positive. The average yield in the medium term, assuming a temperature increase of 1 ^{0}C and an unchanged quantity of rainfall, would be 20 % higher than in the comparative period, while in the event of warming by 2.5 ^{0}C, it would be 16 % higher. A higher temperature increase and a smaller quantity of rainfall (+3.5 ^{0}C, -10 % rainfall) in the long run nearly completely cancels out the positive effects of increased concentrations of CO_2, as yield would increase by a mere 3 %. In the case of summer barley, in the medium term and assuming a temperature increase of 1^{0}C and an unchanged quantity of rainfall, the average yield would be 10 % higher, while in the long term, assuming a temperature increase of 2.5 ^{0}C, it would be a mere 3 % higher. Despite the fertilising effect of increased concentrations of CO_2, in the long term, at a temperature increase of 3.5 ^{0}C and a decrease in rainfall of 10 %, the summer barley yield would be 24 % less.

The results of the models show that in central Slovenia, which with an annual quantity of rainfall of up to 1,500 mm is considerably wet during the year, the quantity of produce will be dictated to a great extent by the availability of water, assuming unchanged agricultural practice. This aspect will be even more significant in northeastern Slovenia, where the majority of field areas are located and where the annual quantity of rainfall is almost 50 % less. The restricting aspect of water availability is also clear from maps showing differences between the quantity of rainfall and potential evapotranspiration - the return of water to the atmosphere by evaporation from the wet soil. In the 1960-1997 period, 8 % of the entire territory of Slovenia had quantities of rainfall smaller than potential evapotranspiration in the vegetational period; a temperature increase of 1.5 ^{0}C and a rainfall decrease of 10 % would expand this area to 20 %, while a temperature increase of 3.5 ^{0}C and a rainfall decrease of 10 % would expand it to cover 29 % of the entire country. Interpretation of these results must take into account the fact that the most critical period will be the summer, during which 15 % of Slovenian territory currently receives rainfall levels at less than potential evapotranspiration. In addition, on the basis of the GCM results, the conclusion can be drawn that the seasonal redistribution of rainfall will result in even less rainfall in the summer period, when the effects of the shortage of water in the soil are most unfavourable for land cultivation.



Source: Biotechnical Faculty
MOP-HMZ

Figure 15: Map of differences between the quantity of rainfall and potential evapotranspiration in the vegetational period. A: average in the 1960-1997 period; B: conditions assuming a temperature increase of 1.5 ^{0}C and rainfall decrease of 10 %; C: conditions assuming a temperature increase of 3.5 ^{0}C and a rainfall decrease of 10 %

The effects of climate change on Slovenian agriculture can be roughly classified into positive and negative effects. Positive effects include:

- more produce due to the fertilising effect of greater concentrations of CO_2;
- longer vegetational period, which in some areas opens up the possibility of several sowings and enhances the possibility of stubble crops;
- more appropriate temperature conditions for the cultivation of temperature-sensitive plants;
- expansion of the range of culture plants in higher altitude regions.

The expected negative effects include:

- shortened growing periods;
- more intensive evapotranspiration, and thus greater probability of water shortage as a factor restraining growth;
- greater probability of extreme weather events - storms entailing wind, hail and heavy downpours, frosts, droughts and floods;
- reduced yield in some regions regarding plants which, at a specific phenological stage, are sensitive to extreme temperatures;
- change in the frequency and intensity of attacks by pests and diseases;
- problems with vernalisation - negative effects of increased temperatures in a period of inactivity.

It has been assessed that the expected negative effects will be more pronounced than the positive ones. As a result, we can expect that the price per unit produced will be higher. Damage can be particularly severe due to water shortages. This has been supported by the fact that in the last decade droughts have caused significant losses of agricultural produce. In Slovenia, agriculture does not constitute a significant direct share in the national economy, but it does have a substantial social significance, at the same time performing the function of preserving the cultural landscape. The expected negative effects of climate change on agriculture can therefore be considered important.

7.5 Forests

Slovenia has exceptionally extensive forests, with forests covering more than 55 % of its territory. Model assessments of potential climate change impacts on forest ecosystems have not yet been drawn up; estimates are therefore based chiefly on experts' assessments.

The potential negative effects of climate change on Slovenian forests are exacerbated by the fact that their composition has undergone anthropogenic modifications in recent centuries. Coniferous trees, particularly spruce, which inhabit boreal forests and higher vegetational zones in central Europe, have been disseminated, for economic reasons, to lower vegetational zones. Vulnerability has been further exacerbated by the reduced vitality of forests - mainly the result of air pollution. The reduced vitality of forests also for existing forest structures in some regions can be ascribed partly to unfavourable climate conditions in recent period, especially severe droughts. According to climate change scenarios assuming either less or an unchanged quantity of rainfall, the stress induced by water shortages will escalate. Adaptation capabilities will be positively influenced by co-natural forest management practices, which boasts a long tradition in Slovenia. A substantial segment of forests is being renewed in the natural manner, which increases the genetic diversity of forest structures. In addition, forestry practice is avoiding the creation of more vulnerable monoculture structures.

According to estimates, the most vulnerable species, spruce and fir, make up 33 and 9.9 %

respectively of the total wood stock in Slovenian forests. Disproportionately large shares of these species are present in sub-mountainous and lowland forests, where they account for more than half the total forest area in Slovenia. The adverse effects of climate change can first and foremost (and most seriously) be expected in these forests.

We can expect that, following warmer conditions, forest trees will be subjected to greater pressure from those pests already present, with the possibility of new pests emerging. The same applies to plant diseases. Due to the increased evapotranspiration and potential reduction in rainfall, the risk of fire in forests, especially in the sub-Mediterranean zone, may be higher.

In some regions a direct negative effect of the reduced vitality of forests will take the form of the undermining of forests' protective function. Particularly on inclined terrains, this may result in greater erosion and landsliding, as well as in the greater probability of flash floods because of a reduction in retention capabilities.

For the time being, an estimate of the economic effects of climate change cannot be given. The expected smaller growth rate of conifers, and their possible deterioration in more exposed locations, may be compensated for by a greater growth rate of other species, resulting from longer vegetational periods and the fertilising effect of CO_2. In any case, due to sanitary fells and additional investments in the care, protection and cultivation of forests, the costs of forest management will increase.

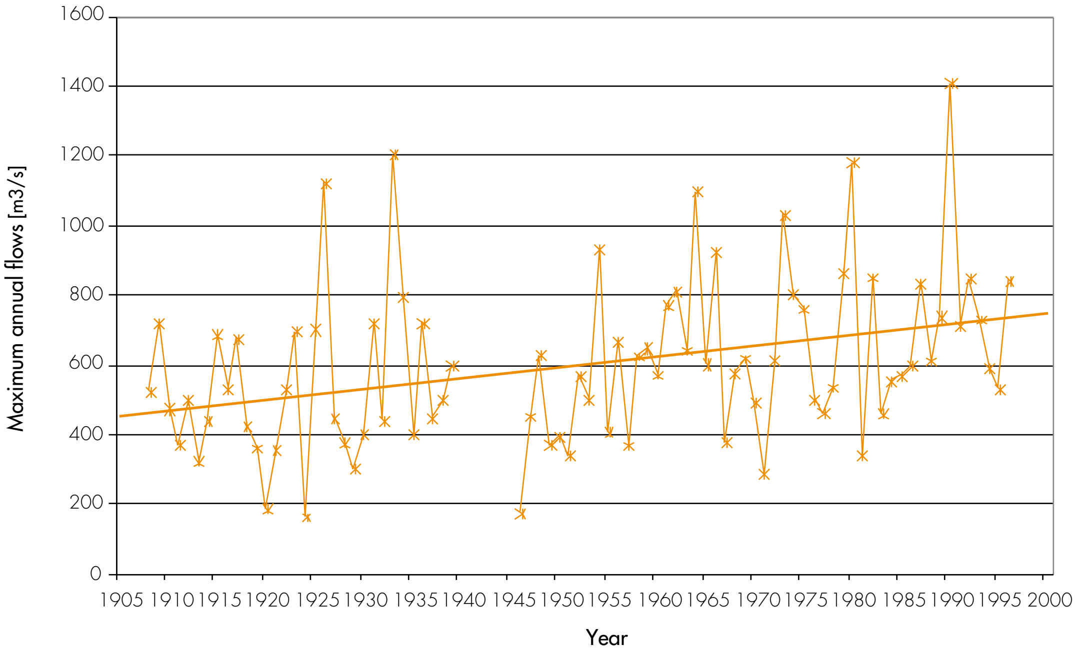
The adaptation of the composition of forests to changed climate features is slow because of the long lifespan of trees. In addition, specific forest structures gradually adjust the chemical properties of the soil and the mycorrhyzal population. The slow pace of adaptation of forest ecosystems exacerbates their vulnerability.

7.6 Water Cycle

Increased evapotranspiration and the possible change in rainfall quantity will have an impact on underground and surface waters. Generally we can expect that average annual outflows will decrease. Model calculations show a decrease in outflow even with a 10 % increase in rainfall and a temperature increase of 2.5 (C across the entire territory of Slovenia, except for the wet Soča river basin. If the warming is accompanied with decreased rainfall, we can expect the beds of smaller watercourses in the Pomurje region, where rainfall is lowest, to be mostly dry. The reduction in low flows will also affect the self-cleaning capability of waters due to the smaller dilution of emissions and, in the summer months, also due to lower oxygen levels, which results from higher watercourse temperatures. We can expect the pressure on watercourses from which water is captured for the needs of water supply activities to intensify.

High waters with a cyclic period of 50 years pose a risk to approximately 74,000 ha of land, of which 2,440 ha are urban areas. The last decade has seen a number of large-scale floods. It has been estimated that floods in the Savinja river basin have caused damage amounting to 20 % of Slovenia's national income. The values of the peaks of maximum flows of the majority of watercourses have grown. Due to the coarse spatial and time resolution, climatological general circulation models are not able to cover extreme weather events, which normally have small dimensions both in terms of physical space and time. Physically speaking, it is sensible to forecast that the higher temperatures and greater instability of the troposphere will increase the probability of intensive rainfall. The model assessment of the impact of an increase in intense rainfall by 20 % shows that in this case large watercourses in the Alpine and sub-Alpine worlds would rise by 30 %. The risk of floods in the Alpine and sub-Alpine regions is directly escalated by increasing temperature of the atmosphere, since some flood situations in the autumn and spring are mitigated by the transition from rain to snow in regions lying at higher altitudes.

Vulnerability to floods is also increasing owing to settling in border flood regions. We have estimated that vulnerability to floods will increase in the future due to the combined impact of direct anthropogenic factors (change in the outflow properties of watercourses, settlement of border flood regions) and climate change.



Source: MOP-ARSO

Figure 16: Annual values of maximum flows of the Savinja river in Laško

Due to the temperature increases and potential greater frequency of droughts, water consumption by end users is expected to increase, while the conditions for water supply are likely to deteriorate. In certain regions supplied with water from shallower watercourses, we can expect the exacerbation of difficulties resulting from decreases in the surface levels of watercourses, particularly during drought periods. Utilisation of the dynamic reserves of watercourses is low, given that it does not exceed 22 % in any region. The quality of water from watercourses has deteriorated, which together with the effects of climate change is worsening the capacities for the supply of quality drinking water.

7.7 Biological Diversity

Slovenia's above-average biological diversity will be strongly affected by climate change. Generally speaking, climate change will reflect itself in the shift of vegetational zones. A particular risk will be posed on extreme highland habitat types, since a temperature increase of 2.5 ^{0}C is expected to raise the upper boundary of the sub-Alpine zone to an approximate altitude of 2,500 m. The climate conditions will confine the existence of Alpine and sub-nival ecosystems to a very small area, which will be further restricted by pedological properties. Extreme habitats of species depending on low temperatures, which in some places have survived as remains of glacial periods, will also be at risk. A comparison of documents from the 19th century with the current situation points to a decrease in the number of specific cold-dependent species in the region of Snežnik (the highest non-Alpine peak in Slovenia). This might be a consequence of the already-changed climate in conjunction with other reasons for stress, which in this location is mainly the result of air polluted with ozone.

Vulnerability is also high in the case of water ecosystems, given that we can generally expect low flows of smaller volume, and more frequent and longer dry periods of smaller watercourses. The conditions may be further exacerbated by the increased pressure to capture water for irrigation and energy purposes.

Special importance must be ascribed to the vulnerability of endemic species, with regard to which currently available data is insufficient. In this regard, special attention must be paid to rich underground ecosystems, which host the largest number of endemic animal species. As the result of higher levels of CO_2 and higher temperatures, we can expect changes in karstification in caves.

The response of natural ecosystems to climate change is complex and, for the time being, has been insufficiently investigated. Ecosystems will have to adapt to the changed climate conditions, where the swiftness of climate change may result in the impoverishment of the range of plant and animal species in Slovenia. Smaller, fragmented and isolated ecosystems which do not have the genetic potential required for adaptation and the spatial capacities for relocating to a new location are particularly vulnerable.

7.8 Alpine World

Subject to climate change, the Alpine world and other mountainous regions in Slovenia can become high-risk regions; this will affect both natural ecosystems and a number of human activities. In addition to changed temperatures, climate change will have the greatest effects on the water balance. The number of days with snow cover will decrease. The Triglav glacier, which used to be the largest glacier, is becoming smaller; we can expect its remnants to disappear ultimately in the decades to come. Among other things, this will give rise to difficulties in the supply of water for the largest mountain post in Slovenia, the Kredarica mountain lodge. The thaw will begin earlier in the year, which will shift the maximum outflow to the period between March and June. The frequency of small flows in late summer and in autumn will grow. The increased probability of intensive rainfall and reduced protective function of forests due to climate change can exacerbate unfavourable geomorphological processes, such as landslides, muddy flows and torrential floods.

7.9 Sea and Coastal Zones

Slovenia has a relatively small coastal region; it is nevertheless important from the aspect of the national interest. This region boasts the most intensive tourist activities, while highly-developed port activities promote other economic activities. Climate change will have a direct impact on this region in the form of raised sea levels resulting from the thermal expansion of oceans due to increased water temperatures. The Third Assessment Report by the IPCC anticipates a global sea level rise by the end of the 21st century of between 9 and 88 cm. The high sea level is to a great extent also the result of low air pressure and, due to the position of the Slovenian coastal region in the corner of the Adriatic sea, of the *jugo* wind. A fall in air pressure of 1 mbar causes a rise in the sea level of 1 cm, while a very strong *jugo* by 50 cm. These phenomena are related to each other, given that the intensity of the *jugo* is, as a rule, highest in conditions of low air pressure. There is also the possibility of greater intensity of weather processes, which may increase the frequency and intensity of the rise in sea level due to meteorological factors. In the future we can therefore expect the intensification of present problems due to at times stongly increased sea level. The regions at greatest risk are parts of the cultural and historical town of

Piran and the saltpan regions, while difficulties may also occur in part of the port infrastructure and in the marinas.
Changes in temperature, and especially temperature differences between individual parts of the Mediterranean sea, and changes in the inflow of rivers into the northern Adriatic, may cause a change in sea currents. We can also expect higher sea temperatures. These factors can substantially affect biological processes in the sea. Economically speaking, great importance must be ascribed to the potential effects of climate change on sea sliming, which in the last decade has often affected the summer tourist season.

7.10 Energy

The changed climate will have an impact on the consumption of energy for tempering premises. In the colder part of the year, therefore, we can expect shortened heating seasons. In the event of the atmosphere warming by 0.5 ^{0}C, the heating season in Slovenia will be shortened on the average by 6 days and the temperature deficit will fall by 6 %. In the event of a temperature increase of 3.5 ^{0}C, the heating season will be shorter by 46 days, with a 39 % fall in the temperature deficit. As a result, in Ljubljana, the Slovenian capital, in the event of warming of 3.5 ^{0}C, we can expect only 163 instead of 207 heating days, and a fall in the temperature deficit from 3,230 to 1,900 degree-days. These are values which, according to the current climate, are characteristic of the Slovenian coastal region.
The fall in the consumption of energy for heating will at least partly be compensated for by the increased requirements for cooling, particularly if new constructions and building adaptations fail to observe the passive possibilities for diminished needs therefor. This will mean an increased consumption of energy in the summer months.
Climate change will also affect energy supply. The lower river flows will reduce the production of hydro-energy, which in Slovenia accounts for approximately 30 % of total electricity production. Due to the changed snow thawing regime, there will be less water in the spring and in early summer. The potential increase in flows in wintertime may increase production during this season of the year, when demand for electricity is at its peak. The changed water regime may also have effects on the production in thermo power plants, particularly at Krško nuclear power plant, which even now, in the event of low water levels in the Sava, encounters cooling problems during the summer months. Additionally, difficulties may be expected with specific thermo power plants using wet cooling towers for cooling in relation to the provision of adequate quantities of water.

7.11 Tourism

We have estimated that climate change will have the greatest adverse effect on winter sports tourism. Warming would shorten the winter season, and at the same time exacerbate uncertainty concerning the provision of appropriate snow conditions even in the peak season. In general, ski slopes lying at higher altitudes will be less affected. However, altitude is not the only criterion for risk assessment. In some cases we can even expect temperature inversions to threaten ski slopes at medium altitudes more than specific low-lying slopes. The greater availability of ski slopes can be ensured through the provision of artificial snow, which however is energy-intensive, can have negative effects on undergrowth, and increases costs. That winter sports tourism is at great risk has been supported by the experience of a number of green winters in the past decade, which in certain low-lying ski resorts have caused the loss of virtually the entire season and severely affected the local economies.
Heat burdens will be substantially larger than they are today in towns and lowlands. Even if we

take into account the possible acclimatisation of the population, an increasingly large number of people will search for relaxation in places where they can avoid frequent and extensive heat. An increasingly large number of tourists are likely to opt for tourist destinations at higher altitudes. This opens up opportunities for health resort tourism in places at higher altitudes. Our projections also show that farm tourism in mountain farms will also benefit from climate change. Specific (currently mostly winter sports) centres, if they undertake appropriate restructuring, can at least partly compensate for income reduction due to the shortened winter season.

Over recent years, urban tourism has been on the increase across the world. Climate change and thus increased heat burdens, especially in the case of outdoor tourist activities, are expected to worsen the conditions for urban summer tourism.

Coastal tourism is closely related to climate conditions. In the peak of summer, the Slovenian coast is already very hot, which is why this period of the year is already unsuitable for visits by highly-sensitive people and risk groups. Climate change will lengthen this period, though on the other hand the bathing season will extend towards spring and autumn. Water shortages can pose an additional problem to coastal areas.

7.12 Human Health and Wellbeing

Climate change can be expected to have both direct and indirect effects on human health and wellbeing. Direct effects can be considered to include increased heat burdens and the effects of the potentially higher frequency and intensity of extreme weather events.

The effects of heat are particularly strong in urban areas, where the natural heat burden is accompanied by the phenomenon of heat islands, which intensifies the harsh heat conditions and extends them into the evening and night. The heat island in the centre of Ljubljana already now exhibits such temperature differences with respect to its surroundings as are expected to be generated by climate change in the next 50 years. Heat waves worsen symptoms of disease, reduce productivity, and increase the probability of accidents at work and road accidents. Though in Slovenia we have not yet identified a strong link between an increased fatality rate and heatwaves, the warming of the atmosphere will undoubtedly change this situation. Vulnerability will increase, as we are expecting increased levels of urbanisation in Slovenia.

Extreme weather events, though the link between them and climate change has hitherto been uncertain, may in many respects worsen living conditions. In addition to the above-mentioned heat burdens, importance must be ascribed to natural disasters associated with intensive rainfall. So, for example, extreme weather events in 2000 triggered a mudslide, which took its toll of human lives. The intensity of landslides, which pose a threat to certain settlements, also increased. Particularly worrying in the context of climate change is the already considerable risk of floods. Apart from direct risk to human life and health, floods exert an increased risk and psychological pressure on the population living in the regions at risk.

In the warmer part of the year, climate change can be expected to increase burdens resulting from air pollution. The photo-chemical smog season will extend, while at the same time we can expect synergistic stress effects in the event of heatwaves. There is also the possibility of increased allergenic burdens, both due to the extended season of plant growth and the spread of specific non-autochthonous plants, for example ambrosia.

Certain diseases are linked to specific climate conditions. Climate change and potential climate variability could accelerate their spread and extend the periods in which these diseases occur. The possibility of the emergence in Slovenia of as-yet-unknown diseases has not yet been investigated, though, for example, the emergence of malaria in the event of pronounced climate change cannot be ruled out. Climate change may also cause a greater spatial diffusion of and an increase in the population of hosts and carriers of diseases, for example ticks, which transmit Lyme disease and tick-borne meningitis.

Our estimates point to an increase in migration flows, triggered by climate change. The flow of migrants will be directed towards regions in which climate change does not have such strong effects, i.e. towards economically developed countries, which will find it easier to cope with climate change. Slovenia might become one such destination, particularly because of its geographical position, located as it is at the heart of transit routes; this will render it additionally exposed to the import of infectious diseases.

8. Adaptation Measures

8.1 Introduction

It is inevitable that, in the future, humankind will be faced with climate change. Even the most optimistic scenarios of global anthropogenic emissions of greenhouse gases show that concentrations of greenhouse gases in the atmosphere will continue to increase for quite a while. As is clear from Chapter 7, climate change will have a great impact on ecosystems, economic activities and living conditions in Slovenia.

Measures targeted at climate change adaptation have not yet been carried out in Slovenia. Despite this, specific activities aimed especially at mitigating the effects of current climate variability can be considered to be the first steps in the direction of adaptation to climate change. In the future, the aspect of adaptation to climate change will have to be included, without any exceptions, in at least the most vulnerable segments. Until the adoption of an appropriate strategy of adaptation to climate change, this Communication represents the government's starting points for coordinating the measures addressing this area.

The planning of adaptation to climate change in Slovenia is considerably restricted by the uncertainty of regional scenarios of climate change. Particularly uncertain are changes in the rainfall regime and the emergence of extreme weather events, which may have major adverse effects. Despite this uncertainty, it is sensible to begin to plan and implement measures in areas:

- in which vulnerability to current climate variability is already serious;
- in which current developmental trends have increased vulnerability to climate change;
- in which the period of adaptation is longest and where subsequent corrections in development are associated with the highest costs - this applies particularly to spatial use, the construction of specific infrastructural facilities, and forestry.

8.2 Agriculture

A considerable share of plants in agricultural production are annual. This will facilitate adaptation to climate change via the adjustment of soil cultivation, sowing times, and the selection of cultivated plants and species. During their lifespan, perennial plants, including fruit trees and vines, may be faced with considerable climate change, though it will be possible to at least partly mitigate these effects by pursuing appropriate agricultural practices. It is possible to carry out a substantial number of adaptation measures at the level of farms themselves. The government will promote this by enhancing the level of farming expertise, providing education and information, promoting to the greatest possible extent the use of agro-meteorological data and forecasts and, of course, by conducting research targeted at ensuring additional identification and evaluation of adaptation opportunities. As a result of changes in the lifespans of plant pathogens, greater emphasis will be placed on the prognostic service. In addition, measures for preventing the import of new diseases and pests must be made stricter.

In the long run, the most important project in relation to agricultural production is the provision of irrigation capacities. To this end, spatial reservations must be preserved for the planned water reservoirs, and the possibilities must be investigated of including in spatial plans new areas suitable for reservoirs.

8.3 Forestry

Co-natural forest management, which has already been one of the basic policies of Slovenian forestry, represents a good basis for the adaptation of forests to climate change. The increase in wood stock in Slovenian forests, as envisaged in the Forest Development Programme, will improve the resistance of forest ecosystems, thus enhancing their tolerance to climate change. The key adaptation issue is the modification of the composition of forest structures. The basic policy is the increase in thermophilic species. Most forestry experts have endorsed an increase in the share of deciduous trees, especially beech. Coordination of the composition of forest structures calls for the intensification of the monitoring of conditions and for studies of the vulnerability of the potentially most threatened lowland and sub-mountainous forests with a disproportionately high share of coniferous trees. A potentially increased level of fire risk calls for measures of passive and active forest protection, especially in regions that have already been exposed to risk.

8.4 Water Cycle

Climate change will bring about a potentially increased risk of flooding. The risk of flooding in Slovenia is already high. Apart from systematic implementation of hydro-technical measures, it will be important to downgrade the penetration of settlements in regions at flood risk, as the costs of technical protection against floods may grow substantially, while exacerbating problems downstream. All this will require more robust planning of specific infrastructural facilities, particularly bridges and road and rail connections. Room must be preserved for inundation areas and high water catchment areas. The expected reduced low flows must be taken into account in the design of the dimensions of wastewater treatment plants and plans for capturing water for industrial needs and irrigation.

Torrential floods represent a particularly serious problem in Slovenia; these emerge in the upper parts of river basins. These situations are characterised by a lack of time for the preparation and implementation of measures, and for the possible evacuation of goods and people. As a consequence, the damage and risk to human life are substantially greater. In order to address this problem successfully, plans have been drawn up for the early warning system to be upgraded. This system is based on meteorological prognostic models with high spatial resolution linked with hydrological models, which makes it possible for the responsible services to engage promptly in a state of increased readiness. To this end, the real-time monitoring of rainfall enabled by meteorological stations and radars can serve as a basis for the implementation of measures.

Increased consumption of water, and the consequent reduction in dynamic water reserves, calls for strict protection of those watercourses that have already been used or are planned for use for water supply. Long-term objectives must tend towards a reduction in the quantity of end consumption and a reduction of losses from water supply systems.

8.5 Biological Diversity

Prevention of the reduction of the surface, fragmentation and the isolation of ecosystems is of primary importance for preserving biological diversity. This will enhance the genetic potential for adaptation and facilitate the migration of species. The objective of increasing protected areas to the planned 30 % of the entire territory of Slovenia is sensible also from the point of view of adaptation to climate change. The preservation of biological diversity will also call for the reduction of other stress factors, particularly air pollution.

8.6 Alpine World

The increased risk to the Alpine world accentuates the protective role of forests in preventing landslides, erosion and the extension of water retention. Particularly for sloped areas, the expediency of preserving the cultural landscape must be reconsidered and coordinated afforestation introduced. Reduction of the stress caused by increased concentrations of ozone is particularly important in the Alpine world.

8.7 Sea and Coastal Zones

In addition to global warming, the rise in sea level is the most certain effect of climate change. This aspect has already been taken into account in the construction of port infrastructure. It will also have to be taken into account in arrangements of the remaining part of the coastal zone and in the planning of drainage of precipitation and wastewater into the sea. More importance must be allocated to the prognostic service responsible for forecasting high sea levels.

8.8 Tourism

The greatest challenge of adaptation to climate change has to be tackled by winter sports tourism, which has already been greatly affected by variations within the current climate. Low- and medium-lying tourist ski resorts will have to expand their range of services during the winter in order to provide their guests with the possibility of pursuing other activities if conditions are less appropriate for skiing. Appropriate plans must be made to increase the share of slopes that can be furnished with snow artificially in order to take advantage of colder periods for preparing a snow base. Plans to expand ski slopes must observe the micro-climatic conditions to a greater extent, while slope management must take advantage of meteorological forecasts more actively. The expediency of additional investments in ski infrastructure in those resorts where climate change will shorten an already-short ski season must be reconsidered. Ski resorts will be able to compensate for the shortening of the winter season at least partly by attracting tourists to the mountainous regions during the summer, which will require the development of an appropriate range of services.

8.9 Energy

Due to reduced water flows, especially in periods of drought, in the sphere of energy supply we can expect a smaller contribution from conventional hydroelectric power plants to the daily regulation of production. This is one further reason for re-examining plans to construct pumped storage plants in order to balance daily fluctuations in the consumption of electric power. In addition, the construction must be reconsidered of seasonal accumulation basins for flow enrichment during drought periods for the more balanced production of electricity and for reducing the adverse effects of low flows on river populations. For enhancing the stability of the energy system it is also important to diversify sources, for example by exploiting wind energy. Additionally, the aspect of the improvement of flood protection is gaining significance in the construction of new hydroelectric power plants.

The problem of cooling thermal power plants in drought periods can be resolved by constructing cooling towers, which will call for additional investment.

In order to reduce the consumption of energy required for cooling, during new construction it will be necessary to employ passive measures, including the appropriate orientation of buildings, architectural solutions and the use of suitable construction elements. It would also be sensible to carry out additional measures aimed at reducing the need for cooling during the reconstruction of old buildings.

8.10 Human Health and Wellbeing

The most important long-term step towards the mitigation of stress caused by heat in urban areas will be the reduction of intensity of urban heat islands. This can be achieved mainly by pursuing appropriate spatial planning, allowing the exchange of air with colder urban surroundings, increasing green areas and planting trees, and using construction materials with lower absorption of solar irradiation and heat accumulation. The requirements for reduced heat burdens must also be taken into account in architectural concept designs of residential and business buildings. The effects of increased heat burdens can also be mitigated by providing the public with appropriate information and by drawing attention to the hazards of heat-induced stress.

9. Research and Systematic Observation

9.1. Research

In Slovenia, research into the problem of climate change has been conducted by the university and certain other institutions. Some of the research projects were carried out in previous years, while a number of them have been completed for the purposes of this Communication. While the university deals primarily with the problem of climate change itself, identification of climate change trends in Slovenia, the effects that climate change will have on ecosystems and different human activities, and adaptation to climate change and variability, other institutions address the issue of greenhouse gas emissions and the possibilities and measures for their reduction.

9.2. Systematic Observation

Meteorological observation and measurements have been carried out in Slovenia since 1850. The data obtained from these measurements is very valuable, given that Slovenia has very diverse climate conditions: a continental climate in the northeast, an Alpine climate in the Alps and a sub-Mediterranean in the Primorska region. All these climates are intertwined in Slovenia, which leads to great climatic differences between places at little distance from each other. The largest differences have been indicated in annual rainfall quantity - five times higher in the western part of the country than in its eastern part. Substantial differences have also been recorded in the annual distribution of air temperature, snowfall, wind characteristics, etc. Climatic diversity is also greatly influenced by the exceptionally variegated relief. This diversity poses a serious difficulty to the analysis of the spatial distribution of climatic parameters, as the measurement network would have to be at least twice as dense as it is currently.

The Environmental Agency (ARSO) is investigating the climate conditions on the basis of long-term measurements of air temperature, relative humidity, air pressure, the quantity and types of rainfall, the speed and direction of the wind, the duration of solar irradiation, solar energy, and on the basis of observation of different meteorological phenomena, including the quantity and types of clouds, fog, storms, hail, frost, sleet, etc. Climatic analyses of data contain basic descriptive statistics, frequencies of occurrence of individual events, variability in time and space, deviations from referential averages, etc. In addition to climate measurements, the ARSO performs a number of other tasks in the sphere of climatology, including: analyses of spatial and time distributions of climate conditions in Slovenia; estimates of the frequency and probability of hazardous and harmful weather events, such as strong downpours, hail, long droughts, quantity of UVB radiation; selection of climatically most favourable locations for different projects; estimates of the potential of wind energy and solar irradiation for the locations selected; collection of data on climate change in Slovenia and on expected annual and seasonal climate change with respect to the prognoses obtained from different climatic models; and estimates of the impact of potential climate change on the environment and living organisms.

Climate data is available to the public via various publications issued by the ARSO. For example, the ARSO bulletin outlines monthly data on most meteorological variables. The climate description also includes a description of the values in individual months, specifying a long-term average. The ARSO also publishes the Meteorological Yearbook, which includes daily meteorological data in individual years for the selected stations, values obtained monthly for all measuring stations, etc. The three Climatography volumes contain monthly data on air temperature, rainfall and solar irradiation for all places in Slovenia in which measurements were carried out between 1961 and 1990, i.e. the last referential climate period.

Slovenia currently operates 13 synoptic, 185 rainfall, 41 climatologic and 30 automatic meteorological stations, and 321 hydrological stations (for surface water, underground water and the sea), 19 of the latter of which are automatic stations, a radio sounding station, sodar, meteorological radar and satellite receiving station.

9.2.1. Climatological Stations

Climatological meteorological stations carry out measurements three times a day, at 7 am, 2 pm and 9 pm CET. Weather phenomena are monitored and recorded by observers throughout the day. In the event of rainfall or snowfall, in addition to the duration they monitor the form and type of precipitation. Certain climatological stations also record the duration of direct solar irradiation and intensity of rainfall.

Especially in the case of subjectively monitored quantities, the data often depends on the observer's conscientiousness (e.g. how diligently he records the phenomena that occur during observation schedules, how accurately he estimates the quantity of clouds). In addition to conscientiousness, the observer's psycho-physical characteristics are also important (e.g. an observer with impaired hearing will record fewer cases of thunder and storms), where conditions in the surroundings of the station also have an impact (a noisy urban environment requires less distance for thunder to be heard than a quiet environment).

There are not yet any "referential climatological stations" in Slovenia because no conditions have been created for ensuring the environmental invariability of the observation premises and for a continuous method of measurements and observation that would ensure the acquisition of homogeneous climatological data which would credibly reflect large-scale climate change.

10. Education, Training and Public Awareness

10.1. Introduction

Awareness of the causes and potential impacts of climate change is not yet widespread in Slovenia. The reasons for this include Slovenia's late inclusion in the negotiating process concerning the Framework Convention on Climate Change, the heavy administrative workload in tasks relating to Slovenia's independence, transition and membership of the European Union, and a lack of interest on the part of the media. While some of these reasons are still in place, the situation in other areas has greatly improved, and consequently the awareness of the broad and professional publics and decision-makers has been heightened. This process has been facilitated by individual public debates, growing media interest in the problem, intensified activities by non-governmental organisations in this area, and so on.

10.2. Media

The media are now seen as showing greater interest in the problem of climate change. This was particularly evident during sessions of the Conference of the Parties to the Convention on Climate Change - COP (special attention has been devoted to COP3 where the Kyoto Protocol was adopted, and COP6). A considerable share of the public have been informed by the media of the existence of the Kyoto Protocol and of what it is about, within the framework of the proposed erection of a new thermal power plant fired by low-quality domestic coal. The future obligations set forth in the Protocol were one of main arguments on the basis of which the people decided to reject construction at the relevant referendum.

Newspapers: In addition to the high level of publicity during COP3 and COP6, which was higher than during the other sessions carried out to date, newspapers have published a series of articles on the problem of climate change. A substantial number of articles have been written by government negotiators, and some by university professors and specialist journalists.

Radio: Different aspects of climate change do not enjoy high priority, though national and certain local radio stations have organised a number of phone-in programmes, featuring, in addition to a journalist, representatives of the government, the university and non-governmental organisations.

TV: A number of attempts have been made to design a climate change programme, but the two major TV broadcasting companies have not so far shown interest in this topic. Indeed, the national television network recently filmed a programme addressing climate change; it was, however, withdrawn from programming for unknown reasons.

Internet: The website of the Ministry of the Environment Spatial Planning and Energy has enabled access to the draft version and subsequently the final version of the Strategy of Reduction of Greenhouse Gas Emissions, while the Republic of Slovenia Environmental Agency offers information on climate change based primarily on IPCC documents.

Books: The year 1997 saw the publication of a book by Dr Matjaž Ravnik entitled *Topla greda - Podnebne spremembe, ki jih povzroča človek* (Greenhouse - Anthropogenic Climate Change). In the book the author summarises the entire problem in an accessible and layman-friendly manner. The book boasts rich pictorial material, which makes it interesting and attractive reading for a wide readership.

10.3 Education

Eighty-five Slovenian schools have been involved in the *EKO ŠOLA KOT NAČIN ŽIVLJENJA* (ECO SCHOOL AS A WAY OF LIFE) programme. This is an international project which introduces environmental education, in a systematic and comprehensive manner, into primary and secondary schools. Throughout Europe approximately 5,000 schools have been included in this programme, Slovenia having launched it five years ago. The fundamental objective of the project is not only to raise the awareness of young people but also to introduce into lessons knowledge of the environment, and education about and for the environment. A school which becomes a participant in the programme drafts an environmental protection plan for the school for the following academic year, which then becomes a constituent part of the plan of work of the school. The contents and activities are carried out during regular lessons within the framework of the valid curriculum, as well as in extra-curricular form via various project tasks. A school that successfully competes the seven prescribed steps and achieves notable results in enhancing its local environment is granted the ECO flag, which represents a distinguished national and international recognition for environmental action. Forty-three Slovenian schools have so far received this flag.

In the past five years in Slovenia, the ECO school has operated voluntarily, i.e. informally. Efforts are currently being made to incorporate it into compulsory curricula so that it can be embraced by all primary and secondary schools, where special emphasis will be placed on the problem of climate change.

Information on climate change, its effects and required measures, and the effects the Kyoto Protocol will have on the Slovenian economy is also delivered, though to a smaller extent, to company managers. The information is available through periodic seminars organised to ensure familiarity with environmental conventions and legislation.

10.4 Workshops

A number of workshops addressing the issue of climate change have been organised, partly as part of the compilation of this Communication and partly within the framework of different programmes, e.g. the programme addressing the exploitation of biomass for district heating, the programme addressing the efficient use of energy, etc. The highest number of participants was attracted by the workshop organised by the Ministry of the Environment and Spatial Planning in conjunction with UNEP, which included the participation of experts from different countries.

10.5 Non-Governmental Organisations (NGOs)

An important share of training and education in the area of climate change has been contributed by NGOs in the form of lectures, advisory services, campaigns, etc. This method of information provision is important because it reaches people who are not directly involved in certain forms of the educational process or professionally connected with environmental developments. NGOs also play an important role in popularising the use of renewable resources of energy, the efficient use of energy, environment-friendly traffic, co-generation, the use of biogas, the use of bicycles instead of motor vehicles in urban areas, etc.

10.6 Ministry of the Environment, Spatial Planning and Energy

First National Communication: The design of this Communication has been carried out by the Ministry of the Environment, Spatial Planning and Energy. A considerable number of copies in Slovene will be distributed to ministries and parliamentary deputies, local authorities, industrial units, schools, research institutes, NGOs, etc.

A very important element in raising the awareness of the professional public has been the involvement of numerous institutions and the university in the preparation of individual chapters of the Communication. This has enabled many to establish contact with this issue for the first time, or to get to know it in more detail, while some individuals were working on this issue before (e.g. in the sphere of vulnerability and adaptation to climate change).

Leaflet: In october 2001, a leaflet was printed, intended mainly for primary and secondary schools. The leaflet, in a succinct and reader-friendly manner, describes the problem of climate change, including all causes and effects, both globally and as it effects Slovenia in particular. In addition, the leaflet includes a description of measures, particularly no-regret measures which can be pursued in everyday life at home, in school, in the workplace, on our way to school or work, etc. The leaflet underscored and argued the fact that these measures, rather than lowering our standard of living, improve the environment and reduce expenditure as a result of the more efficient use of energy and material resources.

Bulletin: The Ministry of the Environment, Spatial Planning and Energy has for some time published the Environmental and Spatial Planning Bulletin (O&P); it contains environmental news and, by and large, consists of articles addressing the issue of climate change. For example, the bulletin publishes information on the occasion of every important event organised by the working bodies of the Convention and International Panel on Climate Change (IPCC), as well as on the occasion of relevant domestic events (workshops, sessions of the Climate Committee, adoption of the Strategy of Reduction of Greenhouse Gas Emissions).

Climate Committee: The founding of the Climate Committee (1997), which is a government body and is presided over by the Minister of the Environment, Spatial Planning and Energy, triggered the coming-together of ministries for the purpose of the coordination of national strategies, especially the energy, transport and agricultural strategies. Cooperation between representatives of the ministries and NGOs also contributes to raising awareness, particularly within the framework of these institutions. All resolutions adopted by the Climate Committee can be accessed via the web pages of the Ministry of the Environment and Spatial Planning.

Strategy of Reduction of Greenhouse Gas Emissions: During the first part of the COP6 session held in The Hague, the Slovenian government adopted the Strategy of Reduction of Greenhouse Gas Emissions, prepared under the auspices of the Ministry of the Environment, Spatial Planning and Energy, in conjunction with other relevant ministries and NGOs. The Strategy identifies the bulk of measures and policies by sector for the entire country, through which Slovenia is to fulfil its commitment arising from the Kyoto Protocol - to reduce its greenhouse gas emissions by 8 % with respect to the base year. Work on this project was initially very demanding, because of coordination between individual sectors among other things. However, the most difficult part still lies ahead, as we will have to design a concrete, financially evaluated programme of measures, together with social and other implications. The design of this Strategy and the future programme is an additional "means" for raising the awareness of all those who have participated and will participate in this work, and of those who will use both documents.

10.7 Conclusion

A substantial part of Slovenia is under considerable threat from expected climate change; this applies particularly to the country's mountainous and Karst regions, and to its exceptionally rich biological diversity. At the same time, Slovenia and its economy are facing great pressure from the commitments specified in the Kyoto Protocol. It is therefore important that people, and this includes decision-makers and the population as a whole, are acquainted with the problem of climate change and with the measures necessary for preventing or mitigating this change. As we have seen, a great deal has already been done in this area - but a great deal more needs to be done in the years to come.

Appendix 1: Summary of the Inventories of Greenhouse Gas Emissions for 1986 and for 1990-1996

Table 7A: Summary Report for National Greenhouse Gas Inventories for 1986 - Gg

Greenhouse Gas Source and Sink Categories	CO2 emissions	CO2 sinks	CH4	N2O	NOx	CO	NMVOC	SO2	HFCs		PFCs		SF6	
									P	A	P	A	P	A
Total National Emissions and Removals	15,553	-2,950	120.3	5.87	63.1	237.1	55.8	246.9	0.0000	0.0000		0.0410	0.0006	0.0003
1 Energy	**14,552**	**0**	**24.3**	**0.51**	**62.8**	**236.3**	**35.4**							
A Fuel Combustion (Sectoral Approach)	14,462		6.0	0.51	62.8	236.3	33.5							
1 Energy Industries	6,308		0.1	0.11	19.0	1.2	1.8							
2 Manufacturing Industries and Construction	4,112		0.5	0.13	12.4	13.1	1.7							
3 Transport	2,004		0.5	0.08	22.2	140.6	20.9							
4 Other Sectors	2,037		4.9	0.19	9.2	81.4	9.1							
B Fugitive Emissions from Fuels	90		18.3		0.0	0.0	1.9							
1 Solid Fuels	90		17.1											
2 Oil and Natural Gas			1.2		0.0	0.0	1.9							
2 Industrial Processes	**954**	**0**	**0.2**	**0.00**	**0.2**	**0.9**	**5.9**		**0.0000**	**0.0000**		**0.0410**	**0.0006**	**0.0003**
A Mineral Products	725					0.0	0.8							
B Chemical Industry	120		0.2	0.00	0.0	0.0	2.8							
C Metal Production	109		0.0	0.00	0.0	0.0	0.0					0.0410		
D Other Production	0				0.2	0.9	2.3							
F Consumption of HFCs and SF6									0.0000	0.0000			0.0006	0.0003
3 Solvent and Other Product Use	**46**			**0.26**			**14.5**							
4 Agriculture			**50.6**	**4.95**	**0.0**	**0.0**								
A Enteric Fermentation			37.7											
B Manure Management			12.9	1.45										
D Agricultural Soils				3.50										
5 Land-Use Change & Forestry	**0**	**-2,950**	**0.0**	**0.00**	**0.0**	**0.0**								
A Changes in Forest and Other Woody Biomass Stocks	0	-1,631												
B Forest and Grassland Conversion	0		0.0	0.00	0.0	0.0								
C Abandonment of Managed Lands		-224												
D CO2 Emissions and Removals from Soil	0	-1,095												
6 Waste			**45.2**	**0.15**	**0.0**	**0.0**	**0.0**							
A Solid Waste Disposal on Land			38.5											
B Wastewater Handling			6.8	0.15										
C Waste Incineration														
Memo Items:														
International Bunkers	**98**		**0.0**	**0.00**	**0.4**	**0.1**	**0.0**	**0.0**						
Aviation	0		0.0	0.00	0.0	0.0	0.0	0.0						
Marine	0		0.0	0.00	0.0	0.0	0.0	0.0						
CO2 Emissions from Biomass	**819**													

P - Potential emissions based on Tier 1 Approach
D - Actual emissions based on Tier 2 Approach

Table 7A: Summary Report for National Greenhouse Gas Inventories for 1990 - Gg

Greenhouse Gas Source and Sink Categories	CO2 emissions	CO2 sinks	CH4	N2O	NOx	CO	NMVOC	SO2	HFCs		PFCs		SF6	
									P	A	P	A	P	A
Total National Emissions and Removals	**14,293**	**-4,336**	**113.6**	**5.36**	**63.4**	**241.0**	**53.8**	**193.7**	**0.0000**	**0.0000**		**0.0382**	**0.0000**	**0.0000**
1 Energy	**13,300**	**0**	**19.9**	**0.44**	**63.2**	**240.1**	**36.2**							
A Fuel Combustion (Sectoral Approach)	13,192		4.9	0.44	63.2	237.8	36.2							
1 Energy Industries	5,911		0.1	0.10	16.7	1.1	1.7							
2 Manufacturing Industries and Construction	3,011		0.4	0.08	8.4	8.9	1.4							
3 Transport	2,660		0.7	0.10	30.7	155.3	25.7							
4 Other Sectors	1,610		3.7	0.15	7.4	72.4	7.3							
B Fugitive Emissions from Fuels	108		15.0		0.0	2.3	0.0							
1 Solid Fuels	108		14.4											
2 Oil and Natural Gas			0.6		0.0	2.3	0.0							
2 Industrial Processes	**956**	**0**	**0.1**	**0.00**	**0.2**	**0.9**	**5.9**		**0.0000**	**0.0000**		**0.0382**		
A Mineral Products	678					0.0	0.7							
B Chemical Industry	93		0.1	0.00	0.0	0.0	2.8							
C Metal Production	185		0.0	0.00	0.0	0.0	0.0					0.0382		
D Other Production	0				0.2	0.8	2.5							
F Consumption of HFCs and SF6									0.0000	0.0000				
3 Solvent and Other Product Use	**37**			**0.14**			**11.7**							
4 Agriculture			**49.6**	**4.63**	**0.0**	**0.0**								
A Enteric Fermentation			36.3											
B Manure Management			13.3	1.39										
D Agricultural Soils				3.25										
5 Land-Use Change & Forestry	**0**	**-4,336**	**0.0**	**0.00**	**0.0**	**0.0**								
A Changes in Forest and Other Woody Biomass Stocks	0	-3,038												
B Forest and Grassland Conversion	0		0.0	0.00	0.0	0.0								
C Abandonment of Managed Lands		-220												
D CO2 Emissions and Removals from Soil	0	-1,078												
6 Waste			**44.0**	**0.15**	**0.0**	**0.0**	**0.0**							
A Solid Waste Disposal on Land			38.0											
B Wastewater Handling			6.0	0.15										
C Waste Incineration														
Memo Items:														
International Bunkers	**79**		**0.0**	**0.00**	**0.3**	**0.1**	**0.0**	**0.0**						
Aviation	0		0.0	0.00	0.0	0.0	0.0	0.0						
Marine	**0**		**0.0**	**0.00**	**0.0**	**0.0**	**0.0**	**0.0**						
CO2 Emissions from Biomass	**819**													

P - Potential emissions based on Tier 1 Approach
D - Actual emissions based on Tier 2 Approach

Table 7A: Summary Report for National Greenhouse Gas Inventories for 1991 - Gg

Greenhouse Gas Source and Sink Categories	CO2 emissions	CO2 sinks	CH4	N2O	NOx	CO	NMVOC	SO2	HFCs		PFCs		SF6	
									P	A	P	A	P	A
Total National Emissions and Removals	13,591	-4,748	116.3	5.33	57.7	234.4	53.3	180.8	0.0000	0.0000		0.0449		
1 Energy	12,764	0	19.1	0.42	57.5	233.9	37.5							
A Fuel Combustion (Sectoral Approach)	12,671		5.1	0.42	57.5	233.9	35.4							
1 Energy Industries	5,330		0.1	0.10	14.0	1.1	1.6							
2 Manufacturing Industries and Construction	2,895		0.3	0.07	7.7	7.5	0.7							
3 Transport	2,514		0.7	0.10	28.0	150.7	25.3							
4 Other Sectors	1,932		4.1	0.16	7.9	74.6	7.8							
B Fugitive Emissions from Fuels	93		14.0		0.0	0.0	2.1							
1 Solid Fuels	93		13.5											
2 Oil and Natural Gas			0.6		0.0	0.0	2.1							
2 Industrial Processes	794	0	0.2	0.00	0.1	0.5	5.2		0.0000	0.0000		0.0449		
A Mineral Products	565					0.0	0.5							
B Chemical Industry	73		0.2	0.00	0.0	0.0	2.5							
C Metal Production	155		0.0	0.00	0.0	0.0	0.0					0.0449		
D Other Production	0				0.1	0.5	2.1							
F Consumption of HFCs and SF6									0.0000	0.0000				
3 Solvent and Other Product Use	34		48.4	4.64	0.0	0.0								
4 Agriculture			35.4											
A Enteric Fermentation			13.0	1.35										
B Manure Management			0.0											
D Agricultural Soils			0.0	0.00	0.0	0.0								
5 Land-Use Change & Forestry	0	-4,748												
A Changes in Forest and Other Woody Biomass Stocks	0	-3,452	0.0	0.00	0.0	0.0								
B Forest and Grassland Conversion	0													
C Abandonment of Managed Lands		-218												
D CO2 Emissions and Removals from Soil	0	-1,078	0.0	0.00	0.0	0.0								
6 Waste	0	0	48.6	0.15	0.0	0.0	0.0							
A Solid Waste Disposal on Land			43.3											
B Wastewater Handling			5.3	0.15										
C Waste Incineration														
Memo Items:														
International Bunkers	28		0.0	0.00	0.1	0.0	0.0	0.0						
Aviation	0		0.0	0.00	0.0	0.0	0.0	0.0						
Marine	0		0.0	0.00	0.0	0.0	0.0	0.0						
CO2 Emissions from Biomass	819													

P - Potential emissions based on Tier 1 Approach

D - Actual emissions based on Tier 2 Approach

Table 7A: Summary Report for National Greenhouse Gas Inventories for 1992 - Gg

Greenhouse Gas Source and Sink Categories	CO2 emissions	CO2 sinks	CH4	N2O	NOx	CO	NMVOC	SO2	HFCs		PFCs		SF6	
									P	A	P	A	P	A
Total National Emissions and Removals	13,513	-5,085	113.9	5.18	56.8	245.4	54.5	189.5	0.0000	0.0000		0.0360		
1 Energy	**12,775**	0	**20.0**	**0.37**	**56.7**	**245.0**	**39.6**							
A Fuel Combustion (Sectoral Approach)	12,697		4.8	0.37	56.7	245.0	37.2							
1 Energy Industries	5,869		0.1	0.08	14.5	1.1	1.7							
2 Manufacturing Industries and Construction	2,534		0.3	0.06	6.7	7.4	0.6							
3 Transport	2,589		0.8	0.09	28.4	164.1	27.6							
4 Other Sectors	1,705		3.7	0.14	7.1	72.4	7.3							
B Fugitive Emissions from Fuels	77		15.1		0.0	0.0	2.3							
1 Solid Fuels	77		14.6											
2 Oil and Natural Gas			0.6		0.0	0.0	2.3							
2 Industrial Processes	**706**	0	**0.0**	**0.00**	**0.1**	**0.4**	**4.6**		0.0000	0.0000		0.0360		
A Mineral Products	488					0.0	0.6							
B Chemical Industry	52		0.0	0.00	0.0	0.0	2.1							
C Metal Production	166		0.0	0.00	0.0	0.0	0.0					0.0360		
D Other Production	0				0.1	0.4	1.9							
F Consumption of HFCs and SF6									0.0000	0.0000				
3 Solvent and Other Product Use	**33**			**0.09**			**10.2**							
4 Agriculture			**46.6**	**4.57**	**0.0**	**0.0**								
A Enteric Fermentation			33.8											
B Manure Management			12.8	1.30										
D Agricultural Soils				3.27										
5 Land-Use Change & Forestry	**0**	**-5,085**	**0.0**	**0.00**	**0.0**	**0.0**								
A Changes in Forest and Other Woody Biomass Stocks	0	-3,789												
B Forest and Grassland Conversion	0		0.0	0.00	0.0	0.0								
C Abandonment of Managed Lands		-218												
D CO2 Emissions and Removals from Soil	0	-1,078												
6 Waste			**47.4**	**0.15**	**0.0**	**0.0**	**0.0**							
A Solid Waste Disposal on Land			42.8											
B Wastewater Handling			4.5	0.15										
C Waste Incineration														
Memo Items:														
International Bunkers	**34**		**0.0**	**0.00**	**0.1**	**0.1**	**0.0**							
Aviation	0		0.0	0.00	0.0	0.0	0.0							
Marine	0		0.0	0.00	0.0	0.0	0.0							
CO2 Emissions from Biomass	**819**													

P - Potential emissions based on Tier 1 Approach

D - Actual emissions based on Tier 2 Approach

Table 7A: Summary Report for National Greenhouse Gas Inventories for 1993 - Gg

Greenhouse Gas Source and Sink Categories	CO2 emissions	CO2 sinks	CH4	N2O	NOx	CO	NMVOC	SO2	HFCs		PFCs		SF6	
									P	A	P	A	P	A
Total National Emissions and Removals	**14,126**	**-5,174**	**113.6**	**5.19**	**61.7**	**268.2**	**58.2**	**182.8**				**0.0372**		
1 Energy	**13,464**	**0**	**18.7**	**0.37**	**61.6**	**268.0**	**44.3**							
A Fuel Combustion (Sectoral Approach)	13,386		4.8	0.37	61.6	268.0	41.6							
1 Energy Industries	5,850		0.1	0.08	15.4	1.0	1.8							
2 Manufacturing Industries and Construction	2,353		0.3	0.06	6.1	7.2	0.7							
3 Transport	2,990		0.9	0.10	33.0	189.2	32.3							
4 Other Sectors	2,193		3.6	0.13	7.1	70.5	6.9							
B Fugitive Emissions from Fuels	77		13.9		0.0	0.0	2.8							
1 Solid Fuels	77		13.4											
2 Oil and Natural Gas			0.5		0.0	0.0	2.8							
2 Industrial Processes	**632**	**0**	**0.0**	**0.00**	**0.1**	**0.3**	**4.3**					**0.0372**		
A Mineral Products	394					0.0	0.7							
B Chemical Industry	69		0.0	0.00	0.0	0.0	2.0							
C Metal Production	169		0.0	0.00	0.0	0.0	0.0					0.0372		
D Other Production	0				0.1	0.2	1.6							
F Consumption of HFCs and SF6														
3 Solvent and Other Product Use	**31**			**0.06**			**9.6**							
4 Agriculture			**45.6**	**4.61**	**0.0**	**0.0**								
A Enteric Fermentation			33.3											
B Manure Management			12.4	1.28										
D Agricultural Soils				3.33										
5 Land-Use Change & Forestry	**0**	**-5,174**	**0.0**	**0.00**	**0.0**	**0.0**								
A Changes in Forest and Other Woody Biomass Stocks	0	-3,880												
B Forest and Grassland Conversion	0		0.0	0.00	0.0	0.0								
C Abandonment of Managed Lands		-216												
D CO2 Emissions and Removals from Soil	0	-1,078												
6 Waste			**49.2**	**0.15**	**0.0**	**0.0**	**0.0**							
A Solid Waste Disposal on Land			45.3											
B Wastewater Handling			4.0	0.15										
C Waste Incineration														
Memo Items:														
International Bunkers	**48**		**0.0**	**0.00**	**0.2**	**0.1**	**0.0**	**0.0**						
Aviation	0		0.0	0.00	0.0	0.0	0.0	0.0						
Marine	0		0.0	0.00	0.0	0.0	0.0	0.0						
CO2 Emissions from Biomass	**819**													

P - Potential emissions based on Tier 1 Approach
D - Actual emissions based on Tier 2 Approach

Table 7A: Summary Report for National Greenhouse Gas Inventories for 1994 - Gg

Greenhouse Gas Source and Sink Categories	CO2 emissions	CO2 sinks	CH4	N2O	NOx	CO	NMVOC	SO2	HFCs		PFCs		SF6	
									P	A	P	A	P	A
Total National Emissions and Removals	14,259	-5,332	112.4	5.21	64.6	272.7	60.7	176.5				0.0417		
1 Energy	13,461	0	17.9	0.42	64.5	272.3	45.9							
A Fuel Combustion (Sectoral Approach)	13,374		4.6	0.42	64.5	272.3	42.8							
1 Energy Industries	5,472		0.1	0.07	15.4	1.1	1.6							
2 Manufacturing Industries and Construction	2,460		0.3	0.06	6.5	7.3	0.7							
3 Transport	3,361		1.0	0.15	35.2	195.0	33.8							
4 Other Sectors	2,081		3.3	0.14	7.5	68.8	6.8							
B Fugitive Emissions from Fuels	87		13.3		0.0	0.0	3.1							
1 Solid Fuels	87		12.8											
2 Oil and Natural Gas			0.5		0.0	0.0	3.1							
2 Industrial Processes	765	0	0.1	0.00	0.1	0.4	4.5					0.0417		
A Mineral Products	505					0.0	0.9							
B Chemical Industry	83		0.1	0.00	0.0	0.0	2.0							
C Metal Production	177		0.0	0.00	0.0	0.0	0.0					0.0417		
D Other Production	0				0.1	0.4	1.6							
F Consumption of HFCs and SF6														
3 Solvent and Other Product Use	33			0.06			10.3							
4 Agriculture			44.5	4.58	0.0	0.0								
A Enteric Fermentation			33.2											
B Manure Management			11.3	1.29										
D Agricultural Soils				3.29										
5 Land-Use Change & Forestry	0	-5,332	0.0	0.00	0.0	0.0								
A Changes in Forest and Other Woody Biomass Stocks	0	-4,037												
B Forest and Grassland Conversion	0		0.0	0.00	0.0	0.0								
C Abandonment of Managed Lands		-216												
D CO2 Emissions and Removals from Soil	0	-1,078												
6 Waste			49.9	0.15	0.0	0.0	0.0							
A Solid Waste Disposal on Land			46.2											
B Wastewater Handling			3.7	0.15										
C Waste Incineration														
Memo Items:														
International Bunkers	54		0.0	0.00	0.2	0.1	0.0	0.0						
Aviation	0		0.0	0.00	0.0	0.0	0.0	0.0						
Marine	0		0.0	0.00	0.0	0.0	0.0	0.0						
CO2 Emissions from Biomass	819													

P - Potential emissions based on Tier 1 Approach
D - Actual emissions based on Tier 2 Approach

Table 7A: Summary Report for National Greenhouse Gas Inventories for 1995 - Gg

Greenhouse Gas Source and Sink Categories	CO_2 emissions	CO_2 sinks	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	HFCs		PFCs		SF6	
									P	A	P	A	P	A
Total National Emissions and Removals	14,983	-5,674	112.3	5.24	62.8	277.2	60.9	124.0	0.0693	0.0236	0.0000	0.0424	0.0013	0.0011
1 Energy	14,189	0	18.1	0.48	62.7	276.7	45.7							
A Fuel Combustion (Sectoral Approach)	14,054		4.5	0.48	62.7	276.7	42.4							
1 Energy Industries	5,729		0.1	0.06	14.3	1.1	1.7							
2 Manufacturing Industries and Construction	2,456		0.3	0.07	6.8	7.1	0.7							
3 Transport	3,624		1.0	0.21	34.6	200.9	33.6							
4 Other Sectors	2,246		3.2	0.13	7.0	67.7	6.5							
B Fugitive Emissions from Fuels	135		13.6		0.0	0.0	3.3							
1 Solid Fuels	135		13.0											
2 Oil and Natural Gas			0.6		0.0	0.0	3.3							
2 Industrial Processes	764	0	0.2	0.00	0.1	0.5	5.7		0.0693	0.0236	0.0000	0.0424	0.0013	0.0011
A Mineral Products	520					0.0	0.8							
B Chemical Industry	83		0.2	0.00	0.0	0.0	3.0							
C Metal Production	160		0.0	0.00	0.0	0.0	0.0				0.0000	0.0424		
D Other Production	0				0.1	0.5	1.9							
F Consumption of HFCs and SF6									0.0693	0.0693	0.0693	0.0693	0.0013	0.0011
3 Solvent and Other Product Use	30			0.06			9.4							
4 Agriculture			43.6	4.56	0.0	0.0								
A Enteric Fermentation			33.4											
B Manure Management			10.2	1.30										
D Agricultural Soils				3.26										
5 Land-Use Change & Forestry	0	-5,674	0.0	0.00	0.0	0.0								
A Changes in Forest and Other Woody Biomass Stocks	0	-4,399												
B Forest and Grassland Conversion	0		0.0	0.00	0.0	0.0								
C Abandonment of Managed Lands		-215												
D CO_2 Emissions and Removals from Soil	0	-1,061												
6 Waste			50.4	0.15	0.0	0.0	0.0							
A Solid Waste Disposal on Land			48.2											
B Wastewater Handling			2.2	0.15										
C Waste Incineration														
Memo Items:														
International Bunkers	58		0.0	0.00	0.2	0.1	0.0	0.0						
Aviation	0		0.0	0.00	0.0	0.0	0.0	0.0						
Marine	0		0.0	0.00	0.0	0.0	0.0	0.0						
CO_2 Emissions from Biomass	819													

P - Potential emissions based on Tier 1 Approach
D - Actual emissions based on Tier 2 Approach

Table 7A: Summary Report for National Greenhouse Gas Inventories for 1996 - Gg

Greenhouse Gas Source and Sink Categories	CO2 emissions	CO2 sinks	CH4	N2O	NOx	CO	NMVOC	SO2	HFCs		PFCs		SF6	
									P	A	P	A	P	A
Total National Emissions and Removals	15,737	-5,560	112.8	5.31	67.0	287.7	64.2	111.6	0.0553	0.0233	0.0000	0.0355	0.0012	0.0009
1 Energy	14,927	0	17.6	0.56	66.8	287.3	47.7							
A Fuel Combustion (Sectoral Approach)	14,804		4.6	0.56	66.8	287.3	44.0							
1 Energy Industries	5,362		0.0	0.06	14.3	0.8	1.6							
2 Manufacturing Industries and Construction	2,361		0.3	0.07	6.7	8.2	0.7							
3 Transport	4,199		1.1	0.29	38.2	210.8	35.2							
4 Other Sectors	2,883		3.2	0.13	7.6	67.5	6.5							
B Fugitive Emissions from Fuels	123		13.0		0.0	0.0	3.7							
1 Solid Fuels	123		12.4											
2 Oil and Natural Gas			0.6		0.0	0.0	3.7							
2 Industrial Processes	777	0	0.2	0.00	0.1	0.4	6.1		0.0553	0.0233		0.0355	0.0012	0.0009
A Mineral Products	539					0.0	1.0							
B Chemical Industry	87		0.2	0.00	0.0	0.0	3.1							
C Metal Production	150		0.0	0.00	0.0	0.0	0.0					0.0355		
D Other Production	0				0.1	0.4	1.9							
F Consumption of HFCs and SF6									0.0553	0.0233			0.0012	0.0553
3 Solvent and Other Product Use	33			0.06			10.4							
4 Agriculture			42.7	4.54	0.0	0.0								
A Enteric Fermentation			33.5											
B Manure Management			9.2	1.30										
D Agricultural Soils				3.24										
5 Land-Use Change & Forestry	0	-5,560	0.0	0.00	0.0	0.0								
A Changes in Forest and Other Woody Biomass Stocks	0	-4,285												
B Forest and Grassland Conversion	0		0.0	0.00	0.0	0.0								
C Abandonment of Managed Lands		-215												
D CO2 Emissions and Removals from Soil	0	-1,061												
6 Waste			52.3	0.15	0.0	0.0	0.0							
A Solid Waste Disposal on Land			48.7											
B Wastewater Handling			3.6	0.15										
C Waste Incineration														
Memo Items:														
International Bunkers	53		0.0	0.00	0.2	0.1	0.0	0.0						
Aviation	0		0.0	0.00	0.0	0.0	0.0	0.0						
Marine	0		0.0	0.00	0.0	0.0	0.0	0.0						
CO2 Emissions from Biomass	819													

P - Potential emissions based on Tier 1 Approach
A - Actual emissions based on Tier 2 Approach