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**UN Framework Convention on Climate Change**

# ***Liechtenstein National Climate Report, 2005***

**December 2005**

**Government of the Principality of Liechtenstein**

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## Foreword

In 2001, the Intergovernmental Panel on Climate Change (IPCC) issued the results of its third study on the effects of global warming. The results of the study are clear: Anthropogenic emissions are influencing our climate and are likely to have a serious impact on it in the future. Liechtenstein is also affected by this process. Liechtenstein has therefore ratified both the United Nations Framework Convention on Climate Change (1995) and the Kyoto Protocol (2004), thereby taking its responsibility seriously.

Pursuant to these instruments, Liechtenstein is obligated to establish an annual inventory of climate emissions and to report periodically on the policies and measures adopted. The relevant guidelines have been established by resolutions of the Conference of Parties and the UN Climate Change Secretariat. A first national report was submitted in 1995 and a second report in 2001. Since then, several new foundations have been developed and implementation measures introduced.

With this report, Liechtenstein's Fourth National Communication in accordance with resolution 4/CP.8 of the Conference of Parties, Liechtenstein is fulfilling its responsibilities as an "Annex 1 country" in accordance with the UN Framework Convention, providing information on the current status of climate-related activities. In view of the small size of the country and its bilateral and multilateral cooperation treaties, cooperation with other countries (in particular pursuant to the Customs Treaty with Switzerland) plays an important role.

The structure and design of this report are based on the report submitted in 2001. The text has been significantly revised, however, and the content has been adapted to the changes and measures adopted in the meantime.

Forward-looking measures have been taken with the heat insulation requirements, the revised clean air legislation, and the Energy Concept 2013. The data on greenhouse gas emissions is still incomplete, but it already indicates that the measures adopted so far have been able to slow down the growth of greenhouse gas emissions. However, substantial efforts are still necessary to achieve a reduction of the emissions compared to base year 1990, as the Kyoto Protocol requires of Liechtenstein. Accordingly, Liechtenstein is also reviewing the possibility of emissions reductions abroad, in accordance with the flexible mechanisms of the Kyoto Protocol.

Hugo Quaderer

Minister of Environmental Affairs, Land Use Planning, Agriculture and Forestry

Vaduz, December 2005

# 1 Summary

## Introduction

This report summarizes the basic information and activities of the Principality of Liechtenstein with respect to climate. With a population of 34,600 as of 31 December 2004, Liechtenstein is a small central European State in the Alpine region. Its structure is comparable to that of its neighboring countries, Switzerland and Austria. Liechtenstein is a constitutional hereditary monarchy on a democratic and parliamentary basis. The relationship between Liechtenstein and Switzerland is very close and heavily influenced by the Customs and Currency Treaty between the two countries (customs and currency union). The Customs Treaty with Switzerland has a significant impact on environmental and fiscal strategies. Many Swiss environmental provisions (e.g., environmental standards) are also applicable in Liechtenstein or are implemented into Liechtenstein law on the basis of specific international treaty rules.

At the same time, Liechtenstein has implemented large portions of EU legislation and has participated in various EU programs since joining the European Economic Area (EEA) in 1995.

## Current and future emissions

In terms of the technical data, the elaboration of the 2003 climate inventory is being closely coordinated with the air pollution register. The work has not yet been concluded. By the spring of 2006, Liechtenstein will submit an expanded climate gas inventory to the Climate Change Secretariat, along with the National Inventory Report. At this point, only interim results can be presented. Overall, the data quality is "middling" and will be improved considerably in the coming years.

In 2003, Liechtenstein emitted 264 gigagrams (Gg<sup>1</sup>) of CO<sub>2</sub> equivalents. Almost 93% of all climate gas emissions were caused by energy-related processes. These are distributed as follows: 36% by traffic and transport, 26% by commercial activities and industry, and 31% by residential, institutional, and commercial combustion. Compared with 1990, the emissions are 5.3% higher; however, not all emissions have been estimated for the base year 1990, so that the increase may turn out to be slightly lower once the inventory has been completed. With respect to forests, the assumption has so far been made that the binding of CO<sub>2</sub> from the atmosphere (creation of biomass) and the emissions of CO<sub>2</sub> roughly compensate each other, so that forests neither represent a source or sink. Over the next few months, it will be investigated whether this assumption is valid.

Carbon dioxide emissions (CO<sub>2</sub>) alone in 2003 amount to nearly 240 Gg or 91% of the total emissions. Of the 240 Gg, 38% are due to traffic and transport, 28% to industry, and 34% to the residential, institutional, and commercial sector.

Methane emissions (CH<sub>4</sub>) in 2003 amount to 0.72 Gg and are largely due to agriculture (92%). Compared to 1990, agricultural methane emissions have decreased slightly, thanks to conversion to

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<sup>1</sup> 1 gigagram = 1 billion (thousand million) grams = 1000 tons.

production methods that are environmentally friendly. The share of methane (measured in CO<sub>2</sub> equivalent) in the overall emissions is 6%.

Nitrous oxide emissions (N<sub>2</sub>O) in 2003 amount to 0.028 Gg and arise primarily from both agriculture (57%) and transport (38%), due to the use of (older) catalytic converters in motor vehicles; the small remainder (5%) results from residential, institutional, and commercial combustion. Because of the increased use of catalytic converters to reduce specific air pollutants, the nitrous oxide emissions increased slightly between 1990 and 2003 by 5.5%. The share of nitrous oxide (measured in CO<sub>2</sub> equivalent) as part of total emissions is 3.3%.

Figure 1-1 shows the composition of the emissions by sector and by gas. Other climate gases such as HFC, PFC and SF<sub>6</sub>, which are of significant to the Kyoto Protocol, play a negligible role in Liechtenstein.

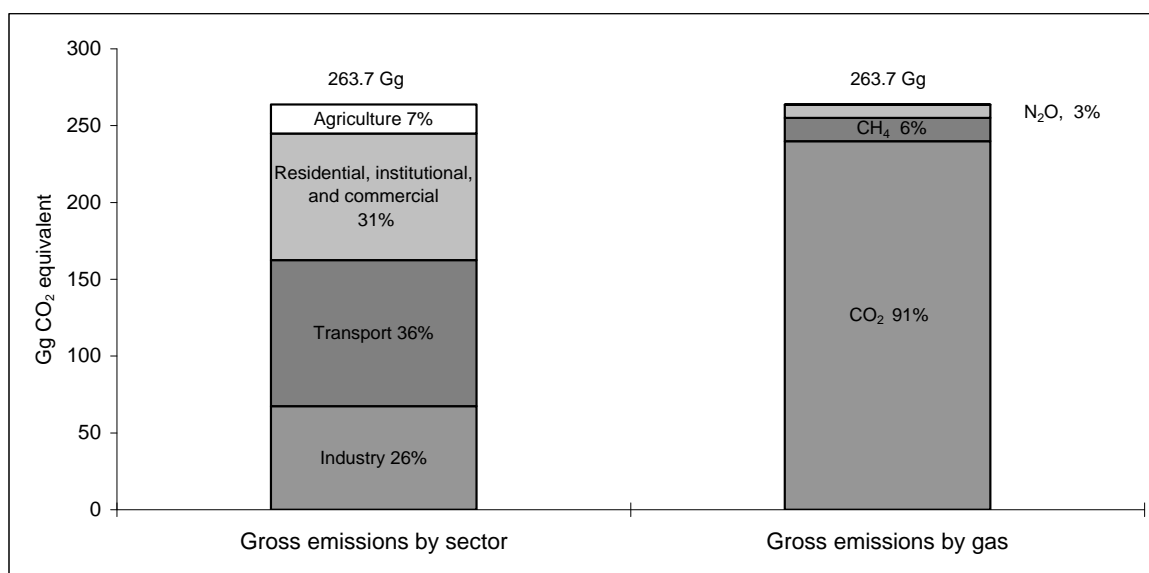


Figure 1-1: Emissions in CO<sub>2</sub> equivalent by sector and by gas, 2003

By 2010, the following changes in emissions of the most important climate gases relative to 1990 are expected:

- The CO<sub>2</sub> emissions will increase by nearly 5%, especially due to increases in transport and industry.
- The CH<sub>4</sub> emissions will decrease by 0.3%, thanks to further improvements in agriculture.
- The N<sub>2</sub>O emissions will sink by 15.6%, especially due to technical improvements in transport (catalytic converters).

It should be taken into account that the data is only provisional, and in particular that some of the 1990 emissions had to be calculated differently from the 2003 emissions. The data pool will be considerably improved by the next submission in 2006.

Figure 1-2 summarizes the developments in a graph. The total emissions will increase by nearly 4% between 1990 and 2010. In this projection, the effects of the measures adopted in Liechtenstein are roughly taken into account, but not the effects of the planned measures. The results are primarily recalculations of the Swiss projections.

So far, the precursor gases and SO<sub>2</sub> emissions have only been calculated in detail with respect to the energy sector. Thanks to exhaust regulations and clean air measures, the emissions of precursor gases will decrease significantly by 2010, while the emissions of SO<sub>2</sub> will slightly increase.

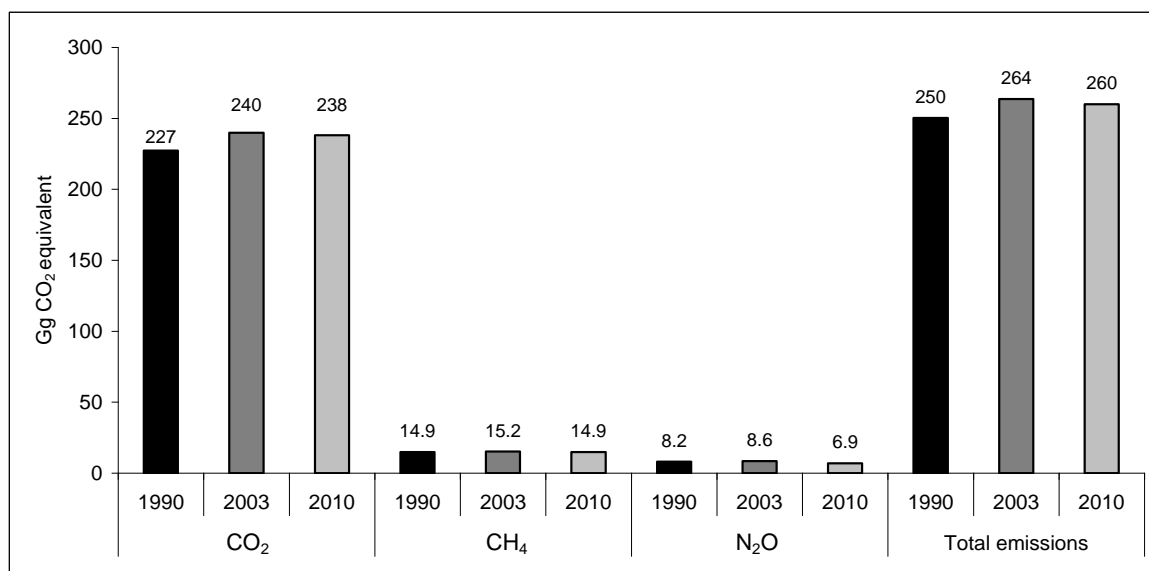


Figure 1-2: Trend and projection of climate gases 1990-2010

### Policies and measures

Liechtenstein has integrated its climate policy very strongly into the individual sectoral policies. The focus is on energy policy, environmental policy, transport policy, agricultural policy, and forestry policy. All of these areas contain measures that contribute to the reduction of climate gases. When determining the measures to reduce greenhouse gases, the highest priority is given to measures that also entail additional local benefits, especially with respect to air pollution control. Because of the small size of the country, cross-border cooperation plays an important role. Especially important is the relationship with Switzerland and cooperation among the countries in the Lake Constance area.

Liechtenstein endeavors to enshrine the principle of sustainability in its policies. This includes provident use of resources and maintenance of a high quality of life. To the extent possible, Liechtenstein also tries to make a contribution to the solution of global environmental problems. Climate protection enjoys a high political priority in this regard, constituting a primary field of action in Liechtenstein's environmental policy.

- Environmental policy:** The cornerstone is the Clean Air Act, which underwent a total revision in 2003 and which now also lays down climate policy objectives. With respect to the technical implementation, Liechtenstein is bound by the Customs Treaty with Switzerland in some areas (e.g., Substance Ordinance). Air pollution thresholds are also largely identical with those of Switzerland; in some areas, however, they have been adapted to the thresholds provided by relevant EU directives, pursuant to the EEA Agreement.
- Energy policy:** Liechtenstein has initiated a modern energy conservation policy prescribing target values and creating financial incentives for the promotion of renewable energies (wood, solar energy) and energy conservation measures. The Bureau of Energy Consumption and Conservation engages in public information work. A key component of the new "Energy Concept 2013" is incorporation of climate policy objectives. The Energy Ordinance on the Construction Act was comprehensively revised in 2003; its purpose is to



ensure that the expected growth in the construction sector does not automatically entail an increase in CO<sub>2</sub> emissions.

- **Transport policy:** Transport policy is based on the principles of sustainability and gives highest priority to public transport. With the introduction of a heavy vehicle fee, cost transparency is being implemented with respect to the truck transport of goods. Most of the bus fleet of the public transport system has been converted to natural gas. With the establishment of a natural gas fueling station, the necessary infrastructure is now also available to provide fuel to private motor vehicles running on natural gas.
- **Agriculture:** Liechtenstein agriculture primarily relies on animal husbandry (70% of agricultural revenue). A working group has already elaborated a new agricultural policy concept, which was considered by Parliament in November 2004. Future agricultural policy will be based on these guidelines. The guidelines promote the trend toward greater ecological agriculture in Liechtenstein. In addition to maintaining soil fertility, the environmental impact will also be minimized. Environmentally friendly forms of production, such as integrated production and organic farming, will be promoted in a targeted manner. Landscape conservation is also considered a responsibility of agriculture, and its importance will continue to increase. In the technical field, subsidies of open liquid manure containers have been abolished. As an alternative, the Government is considering subsidies of flexible tube systems to distribute liquid manure.
- **Forestry:** Forests are very important to Liechtenstein. 43% of the country's territory is covered by forests. For this reason, sustainability in forestry has been accorded great importance ever since the introduction of the Forestry Regulations in 1865. Important goals include sustainable forest management, the maintenance of the forest stock, and the promotion of nature-friendly forest management. The entire Liechtenstein forest stock is certified according to the criteria of the Forest Stewardship Council (FSC) (SGS-FM/COC-0764).
- **International cooperation:** International cooperation is an important pillar of Liechtenstein climate policy. Through international cooperation, important synergies are made possible, despite the small size of the country and its limited capacities. In addition to close cooperation with Switzerland, cooperation among countries in the Lake Constance region and various international agreements (Climate Convention and Kyoto Protocol, agreements relating to air pollution control, Convention for the Protection of the Alps, etc.) play an important role. Upon its ratification of the Kyoto Protocol, Liechtenstein supported a project in a developing country, by means of which the CO<sub>2</sub> emissions in rural mountain areas are to be reduced through prevention. Finally, Liechtenstein is participating in the European Interreg III-B program in several projects<sup>2</sup>, the mandate of which includes the promotion of sustainable forms of transport to solve the problem of high traffic volumes and the protection of the diversity of our natural and cultural heritage.

Table 1-1 summarizes the most important adopted and planned measures. For details and additional measures, see chapter 4.

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<sup>2</sup> Via Nova, LP: Forschungsgesellschaft Mobilität, Austrian Mobility Research, FGM-AMOR. NENA – Network Enterprise Alps, LP: Development Association for Natural and Cultural Heritage, Province of Vorarlberg. Walser Alps, LP: International Association for Walser Heritage, Switzerland. Dynalp, LP: Municipality of Mäder, Province of Vorarlberg

Policy / Measure	Goals / Approach	Type of instrument	Status
<b>a) Energy</b>			
Energy Conservation Act	Promotion of the renovation of old buildings, heating systems (wood, solar energy, heat pumps), of renewable energies and demonstration facilities.	Fiscal measure (subsidy)	In force since 1996
Heating regulations	Heated outdoor areas and ramps, outdoor heating and warm air curtains, electric room heating, and other stationary resistance heating of over 3kW are prohibited. Heating costs calculated according to consumption. Periodic monitoring of ventilation systems.	Regulation	Implemented since 1993 New Energy Ordinance since 2003
Heat insulation regulations	Buildings and installations must be planned as energy-efficient as possible (minimum insulation values), according to Ordinance / SIA Norm 380/1. If the building volume exceeds 2000 m <sup>3</sup> , the heating requirements may not exceed 80% of the SIA value.	Regulation	Implemented since 1993 New Energy Ordinance since 2003
Minergy standard for State buildings	Requirement that all new State buildings be constructed according to the Minergy standard.	Regulation	Implementation since 2003
Supply requirements	Determination of energy supply areas with requirement to join a district heating network.	Planning measure	Implemented since 1995 (Energy Ordinance)
Liechtenstein Energy Concept 2013	Reduction of CO <sub>2</sub> emissions through appropriate measures. The Minergy standard now includes a subsidy, supplementing the Energy Conservation Act. Stronger promotion of heat insulation in old buildings and of photovoltaics. An additional measure is the construction of a biogas facility for the fermentation of biomass. The biogas generated will be refined to natural gas quality and used as fuel.		Adopted by the Government in 2004
Green electricity (LiStrom Öko)	Auditing (SQS) and certification (VUE) of all domestic production sites according to "naturemade" product mixture of renewable energy sources (drinking water power plants) and new renewable energy sources (photovoltaic systems).	Market-oriented supply, demand for ecological products (voluntary basis)	Since the beginning of 2004 (open-ended)
Promotion of photovoltaic systems of private owners	Through the sale of green electricity, the Liechtenstein Power Authority (LPA) pays 80 cents / kWh for energy generated from photovoltaic systems certified as "naturemade star" from 2004-2009.	Promotion by the LPA	Since the beginning of 2004
Promotion of energy generated by systems for efficient energy production	The conveyance price for the energy volume for own use may be waived in the case of production systems based on renewable energies or systems for efficient energy use.	Electricity Market Act	In force since 2002
Intelligent Energy Europe	Sustainable development in the field of energy. The EU program makes a balanced contribution to the attainment of general goals: energy supply security, competitiveness, and environmental protection.	EU program	Since 2003
Energy Star (labeling program for energy-saving office)	The Energy Star label has already attained international significance. Appliances with the Energy Star label	Agreement between the US and the EU	In force

Policy / Measure	Goals / Approach	Type of instrument	Status
appliances)	have a competitive advantage compared with non-labeled appliances. In a simple way, the label provides information to the consumer on the energy efficiency of the appliances. Reduction of CO <sub>2</sub> emissions by preventing unnecessary stand-by of electric appliances.		
Participation of municipalities in the Energy City label <sup>3</sup>			Award of the label to the first municipality (Triesen)
Climate protection and energy platform, as part of the Environment Commission of the International Lake Constance Conference	Coordination, exchange of experiences, information	Data collection	2005: Status report on climate protection on Lake Constance, with recommendations for activities 2005: Guidelines with practical examples
Elaboration of a hydrogeological map as a basis for using near-surface geothermal heat	Use of near-surface geothermal energy for heating purposes	Foundations	2005: Completion of the map
<b>b) Transport</b>			
Heavy Vehicle Fee	Relocation of goods transport from the road to railways, and reduction of transalpine road transport	Fiscal measure (internalization of external costs)	Implemented since 1.1.2001
Promotion of solar, electric, natural gas, and/or hybrid vehicles	Vehicle tax waived for electric, natural gas, and/or hybrid vehicles	Fiscal measure	Implemented 1999
Conversion from diesel buses to natural gas buses in public transport	Purchase of new natural gas buses	Investment measure; Subsidy (using HFV funds)	Implemented 2001
Subsidies of electric scooters and electric bicycles	Promotion of light electric vehicles used for personal transport instead of private automobiles	Fiscal measure (subsidy)	Implemented 2002
Construction and operation of a public natural gas fueling station	Infrastructure for providing fuel to private vehicles	Investment measure; Infrastructure measure	Implemented since 2001
Supply of biogas into the natural gas fueling station	Supply of CO <sub>2</sub> -free fuel for the natural gas fueling station	Investment measure; Infrastructure measure	Planned beginning 2006/07
Design of motor vehicle tax according to specific CO <sub>2</sub> emission	Incentive system for purchase of private vehicles with lower CO <sub>2</sub> emissions	Regulation, Fiscal measure	Planned beginning 2007
Promotion of public transport	Establishment of the Liechtenstein Bus Authority and introduction of the "Liechtenstein Takt" regional train schedule	Institutional measure	Implemented since 2000
Exhaust regulations	Adoption of the European exhaust regulations (EURO norms), fuel regulations	Regulation	Ongoing (since 1993)
Promotion of slow transport	The bicycle and pedestrian network is being expanded continuously and made more attractive.	Institutional measure	Ongoing
Zoning requirements	Limitation of the number of parking spaces for construction projects, where justified by municipal or national	Regulation	Starting 2002

<sup>3</sup> Municipalities of any size are awarded the "Energy City" label (by the SwissEnergy program, [www.energiestadt.ch](http://www.energiestadt.ch)), if they have implemented or adopted selected energy policy measures. It is a certificate of achievement for a consistent and result-oriented energy policy.

Policy / Measure	Goals / Approach	Type of instrument	Status
	planning.		
<b>c) Stationary facilities and waste</b>			
Emissions regulations	Emissions regulations for stationary facilities (heating, industry)	Regulation	Implemented since 1987 Revised 1992 and 2005
Waste removal regulations in construction	Waste management: disposal concept and proof of recycling must be provided before construction begins.	Regulation	Implemented 1993 (Ordinance on the Construction Act)
<b>d) Agriculture</b>			
Ecological equalization payments in agriculture	Product-independent contributions for conversions to ecological cultivation methods	Fiscal measure (direct payments)	Implemented since 1996
Preservation of soil for agricultural use	Agriculture: permanent protection of soil for agricultural use from misuse	Regulation	Implemented since 1992
Water Protection Act	Cap on maximum number of cattle per land area	Regulation	Implemented since 2003
<b>e) Planning</b>			
Foundations for a register	Establishment of a national energy register	Planning measure	Planned starting 2002
National guidance plan	Coordinated and sustainable development of the living and economic area of Liechtenstein on a inter-municipal and cross-border scale	Planning measure, regulations, binding on State authorities	Planned (consultations beginning of 2006, adoption end of 2006)
<b>f) Forests</b>			
Cultivation regulations in the Forestry Act	Sustainable cultivation of forests	Regulation	Implemented 1991
Ordinance on the scope and benefits of compensation and financial aid in the framework of the Forestry Act	Performance target	Regulation	Implemented 1995
Ordinance on forest reserves and protected areas	Performance target	Regulation	Implemented 2000
Forest Inventory 1998 and National Forest Program (2002-2012)	Binding specifications for future use of forests; development of a Forest Inventory 2010	Planning measure, Regulations	Implemented 2001
FSC certification of the entire forest stock	Performance target	Operational planning	Implemented 2001

Table 1-1: Overview of the most important adopted and planned measures

Liechtenstein commissioned a report (Factor 2000) on the foundation of the country's future climate strategy (implementation of the Kyoto Protocol). At that time, the report concluded that a purely national strategy would be difficult to implement, and that the marginal costs of additional reductions would be relatively high, based on the already high existing level of climate-control measures. The report recommended an internationally oriented strategy based on the Kyoto Mechanisms (Joint Implementation, Clean Development Mechanism, Emission Trading). These mechanisms would allow a significant improvement of the cost-effectiveness of climate policy. Liechtenstein is currently examining its level of engagement and participation in these international instruments and taking the necessary preparatory steps. The focus is on the requisite implementation of the National Register under its obligations arising from the Kyoto Protocol; in accordance with the Marrakech Accords, Liechtenstein is striving for a hosting solution in collaboration with Switzerland. Administrative cooperation is also being considered with respect to the assessment and implementation of projects in the framework of Joint Implementation and the Clean Development Mechanism.

In principle, however, national measures are accorded the highest priority. In this regard, Liechtenstein also expects to implement appropriate measures of Swiss climate policy. This could primarily concern the introduction of a CO<sub>2</sub> tax (beginning in 2006), if the voluntary measures provided for in the Swiss CO<sub>2</sub> Act prove ineffective. Beginning in 2006, Switzerland will levy a tax of 35 francs per ton of CO<sub>2</sub>, which corresponds to approx. 9 cents per liter of heating oil. Initially, no tax will be levied on engine fuel; instead, what is known as a "climate cent" will be levied as a voluntary private sector measure. The measure is time-bound: If it does not have the required effect, the Federal Council intends to introduce a CO<sub>2</sub> tax on petrol as well. Pursuant to the joint economic area with Switzerland, the climate cent will also be levied in Liechtenstein. The Government has signed an agreement with the Swiss "Climate Cent Foundation" to this effect, governing the administrative and organizational measures. Questions concerning the use of the revenue for climate protection projects must still be developed in detail. In principle, the revenue will be earmarked for climate protection projects in Liechtenstein and abroad.

## **Other activities**

### ***Adaptation measures***

It is difficult to translate models of the effects of global warming to Liechtenstein. The available climate models are not yet sufficient to predict regional effects in detail. Generally speaking, however, the following overall effects may be expected should CO<sub>2</sub> concentrations continue to increase: Temperatures will rise by 3-5 degrees Celsius, precipitation will increase in the winter and decrease in the summer, and the number of days with snow cover will decrease by 10 to 20 days per degree Celsius at elevations above 2500 meters. In principle, the situation for Liechtenstein will be similar to the situation for the Swiss Alpine region. Possible consequences will affect human health through heat waves, the spread of tropical diseases, and damage arising from natural catastrophes. Negative consequences are to be expected with respect to water circulation, ecosystems, and therefore on the economic sectors of agriculture and tourism.

The strategies for dealing with these new risks are very sector-specific. With its laws relating to nature and landscape, agriculture, and tourism, Liechtenstein has established important foundations for sustainable cultivation.

### ***Financial resources and technology transfer***

Liechtenstein takes its international humanitarian responsibility seriously. Solidarity with poor countries and with countries affected by disasters and armed conflicts is a traditional focus of Liechtenstein foreign policy. Liechtenstein's engagement in International Humanitarian Cooperation (IHC) is founded on the three pillars of emergency assistance, reconstruction assistance, and development cooperation.

Development cooperation entails cooperation both with bilateral and with multilateral partners, as a rule international organizations and institutions. The focus areas of IHC and development cooperation in particular are health, social security, education, protection and sustainable use of natural resources, rural development, and good governance. A particular emphasis is placed on the promotion of women.

Of particular note from the perspective of environmental policy is Liechtenstein's engagement through financial and human resources, such as the provision of experts and the promotion of sustainable mountain region development in the Carpathians, the Caucasus, and Central Asia.

In 2004, Liechtenstein spent about 14 million Swiss francs or 400 francs per capita on International Humanitarian Cooperation. Liechtenstein is planning to steadily increase this amount in the coming years.

### ***Research and climate observation***

Liechtenstein does not have any research institutions of its own dedicated to basic research. For this reason, Liechtenstein supports research activities abroad (Switzerland, EU research programs,

Interreg programs, etc.). Liechtenstein public authorities are also indirectly involved in the technology area. The Liechtenstein University of Applied Sciences contributes a budget of 7.6 million CHF (2004) to the training of professionals.

Liechtenstein collects a wide range of data relating to climate, both through its own measuring stations and through interregional cooperation, especially with Switzerland. Liechtenstein does not have large measuring stations, however, that feed their data into a network such as the Global Climate Observing System (GCOS). Here again, cross-border cooperation is important, especially with Switzerland. Since 2003, Liechtenstein has also participated in the GLOBE program. This is a worldwide information network, in which over 100 countries participate. Its goal is to sensitize young people to the global character of environmental issues by compiling ecological data and feeding the data into the program. The Liechtenstein Gymnasium (academic high school) is currently involved in the project. The focus is on compilation of meteorological data.

### ***Education, information, and public outreach***

Liechtenstein promotes a sustainable way of thinking and behaving through a wide range of activities at schools, with the general public, in cooperation with NGOs, and as part of specific programs, such as: the use of environmental experts at individual schools and the organization of environment days; environmental protection calendar and various information events for the general public at the municipal and national level; cooperation with the Liechtenstein Environmental Protection Society and other NGOs and regional networks.

## 2 Country information

### 2.1 Geography and economy

#### Location

The Principality of Liechtenstein is located between 47°02' and 47°16' north and 9°28' to 9°38' east. It is situated in the heart of Europe, between Austria and Switzerland, and covers an area of 160 km<sup>2</sup>. The transport axes Munich-Milan and Zurich-Vienna intersect near the Principality of Liechtenstein. There are no freeways on Liechtenstein territory, however, so that Liechtenstein's road network is only of regional importance. A high mountain range in the east constitutes the natural border to Austria; the Rhine River marks the border to Switzerland. Two thirds of the country is mountainous, while the remaining third consists of the densely populated Rhine Valley, where nine of Liechtenstein's eleven municipalities are located.

#### Climate

Liechtenstein has a continental climate, i.e., the weather varies considerably over the course of the year. In the capital Vaduz, at 433 meters elevation, the average annual temperature is 9.6°C. The average precipitation has not changed appreciably in the last 20 years. In Vaduz, it is approximately 900 mm per year.

#### Population

At the end of 2004, Liechtenstein had a population of 34,600, a third of whom were foreign citizens (especially Swiss, Austrians, and Germans). The population density in 2004 was 216.3 inhabitants per km<sup>2</sup> or about 550 inhabitants per km<sup>2</sup> in the densely settled Rhine Valley. Figure 2-1 indicates the development of Liechtenstein's population between 1900 and 2004.

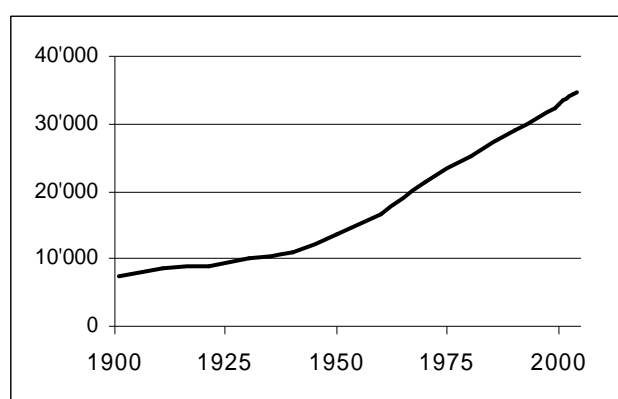


Figure 2-1: Population 1900-2004 (OEA 2005a and 2005d)



Figure 2-2: The Principality of Liechtenstein

### Land use

The country covers 160 km<sup>2</sup>, 41% of which is forested, 34% agricultural (cropland, pastures, plantations, alp meadows), 9.7% populated, and 15% unproductive (as of the end of 2002). Built-up areas more than doubled between 1950 and 1990 and increased again by 7.8% to 15.6 hectares between 1996 and 2002. Transport infrastructure covers nearly 2.5% of the country's area. Between 1955 and 1995, cropland decreased by 15%, but only by approx. 1.5% between 1996 and 2002.

### Economy

GDP was determined for the first time in 1998, as part of Liechtenstein's National Economic Accounting. Older GDP figures were calculated using a different method and can therefore not be compared directly. In 2001, nominal gross domestic product (GDP) stood at 4.2 billion (thousand million) Swiss francs, and economic growth was 0.3%. Figure 2-3 shows the development of nominal GDP between 1998 and 2001.

According to economic sector, industry and manufacturing generated 39% of added value in 2001, general services 25%, financial services 30%, and agriculture and households 6%.



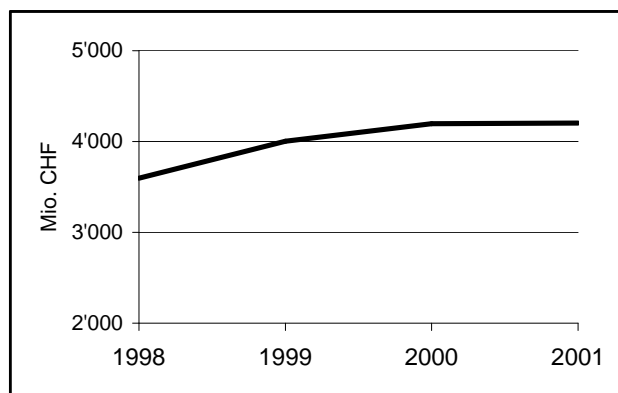


Figure 2-3: GDP at current prices (nominal) 1998-2001 (OEA 2002)

Figure 2-4 shows the development of nominal GDP per inhabitant and per employed person (in full-time equivalents). In 2001, GDP per capita was 160,000 CHF and GDP per employed person was 112,000 CHF.

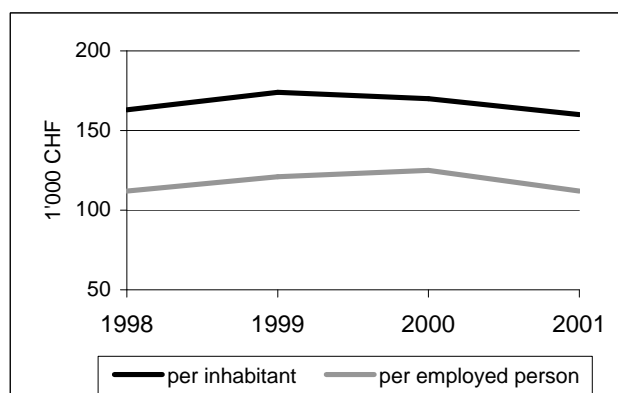


Figure 2-4: GDP at current prices (nominal) per inhabitant and per employed person (in full-time equivalents) 1998-2001 (OEA 2002)

The unemployment rate calculated according to the domestic principle (in percentage of total number of employed persons) was 2.4% in 2004. Almost half of the work force lives abroad, commuting from Switzerland, Austria, or Germany to Liechtenstein. Just over two thirds of the work force are foreign citizens.

### Energy supply

Liechtenstein has no fossil fuel resources of its own. Only 6.7% of the energy used comes from Liechtenstein. Liechtenstein's own supply of energy is limited to firewood, ambient heat, and electricity (hydroelectric power plants, photovoltaic systems, biogas and natural gas block-heating plants).

Total energy consumption in 2004 was 1,337 GWh (4,813 TJ). Natural gas (29%) and electricity (26%) constitute the greatest share of the total energy consumption. Figure 2-5 illustrates energy consumption and energy imports by energy source in 2004.

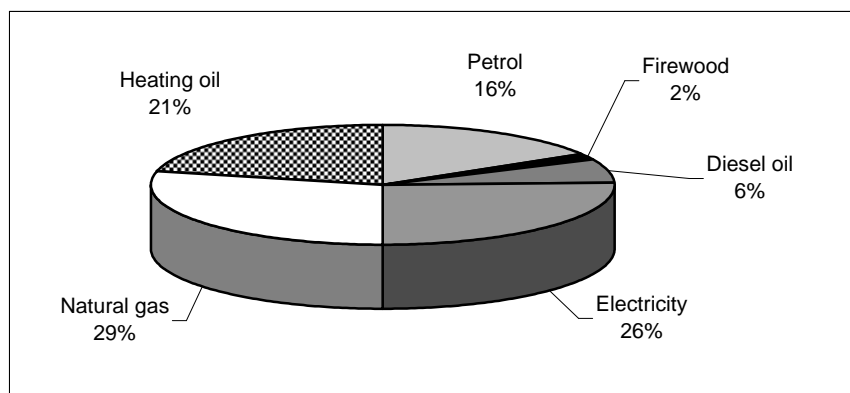


Figure 2-5: Energy consumption by energy source, 2004. 100% corresponds to 1337 GWh or 4813 TJ (OEA 2005b).

In 2004, total energy consumption per capita reached 38.6 MWh. Figure 2-6 illustrates energy consumption per inhabitant between 1965 and 2004. Energy productivity decreased between 2000 and 2002, but reached the level of 1998-1999 again in 2003 and 2004.

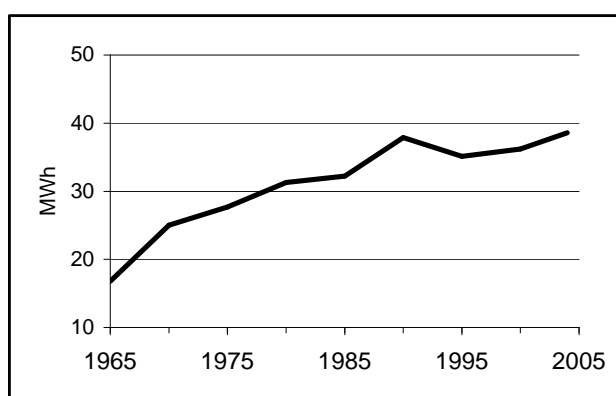


Figure 2-6: Energy consumption per inhabitant 1965-2004 (OEA 2005b)

### Energy prices

Liechtenstein does not compile its own statistics on the development of energy prices; however, energy prices are comparable to those in Switzerland. Figure 2-7 illustrates the development of real energy prices for the most important energy sources – electricity, natural gas, petroleum, and light heating oil – in Switzerland between 1960 and 2004. By the beginning of the 1990's, the prices of these energy sources had sunk in general and reached a historic low point. Since the end of the 1990's, they have slightly risen again and/or remained stable. (Note: The supply of natural gas to Liechtenstein began only in 1990.) The figure does not indicate the increase of petroleum prices in 2004, which lasted until September 2005.

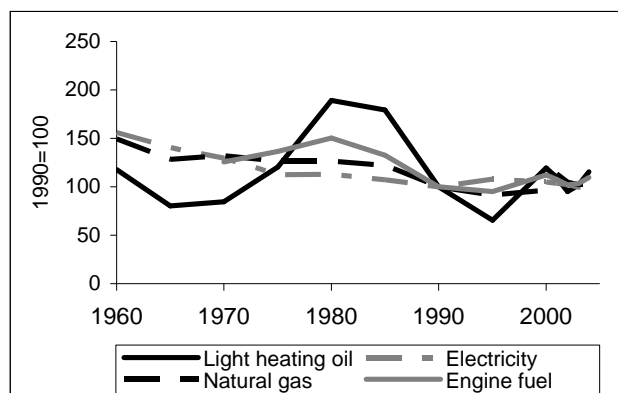


Figure 2-7: Real energy prices of the most important energy sources 1960-2004, Index 1990=100 (SFOE 2005)

### Electricity

In 2004, the electricity fed into the national network amounted to 344 GWh. About four fifths of the energy consumed in Liechtenstein comes from abroad. Liechtenstein's own production amounts to approximately 70 GWh (hydroelectric plants, block-heating plants, photovoltaic systems). The average electricity growth over the last 5-year period (2000-2004) was about 3%.

### Transport

The most important transport network in Liechtenstein is the road network. The only railway is a route crossing the country from Feldkirch to Buchs, operated by the Austria Federal Railway (ÖBB). Public transport is ensured by a dense network of buses. On the Swiss side of the Liechtenstein border, there is a freeway.

The bulk of commercial transport consists of internal or destination-source transport (96%); only a small amount is transit transport (4%). In 1999/2000, light motor vehicles traveled 187 million vehicle-kilometers per year on Liechtenstein roads; heavy motor vehicles traveled 11 million vehicle-kilometers (OEP 2002).

Over the last thirty years, the number of motor vehicles in Liechtenstein has quadrupled. In 2005, 24,393 automobiles were registered (degree of motorization: 688 automobiles per 1000 inhabitants). Figure 2-8 illustrates the development of the number of vehicles between 1970 and 2005, and figure 2-9 shows the number of automobiles by total weight in kg in 2005.

Pursuant to decision 1753/2000/EC, which has been adopted into the EEA Agreement, Liechtenstein is required to determine the average CO<sub>2</sub> emissions of automobiles newly introduced into circulation. The goal agreed upon between the EU and the automobile producers states that as of 2008/09, the average emission of new vehicles should be 140g CO<sub>2</sub>/km. The current Liechtenstein data is still far from achieving this goal.

The average CO<sub>2</sub> emissions of all vehicles newly introduced into circulation in 2004 is 207 g/km. The emissions of petrol vehicles are 216 g/km, slightly higher on average than the 188 g/km emitted by diesel vehicles. 51% of the newly registered automobiles achieve emissions of less than 200 g/km.

CO<sub>2</sub> emissions rise with increasing engine sizes, engine power, and vehicle weight. Most of the technically achieved reductions in CO<sub>2</sub> emissions have been cancelled out by the larger and more powerful engines and heavier vehicles that continue to be popular.

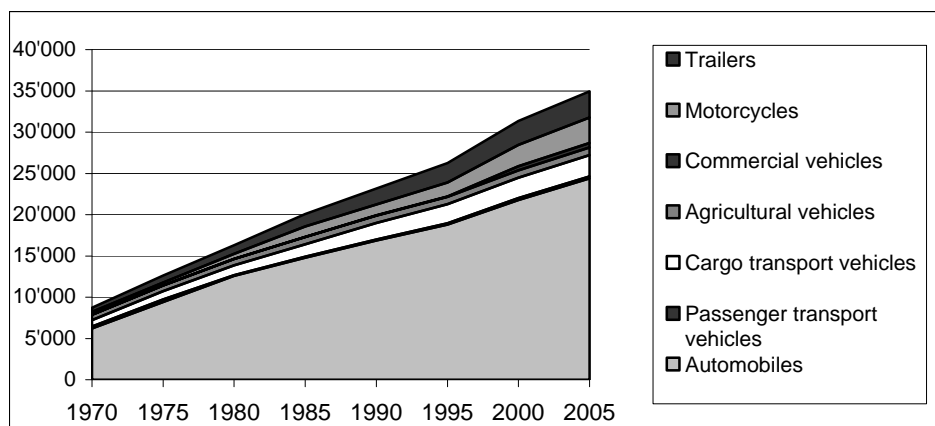


Figure 2-8: Number of vehicles 1970-2005 (OEA 2005c)

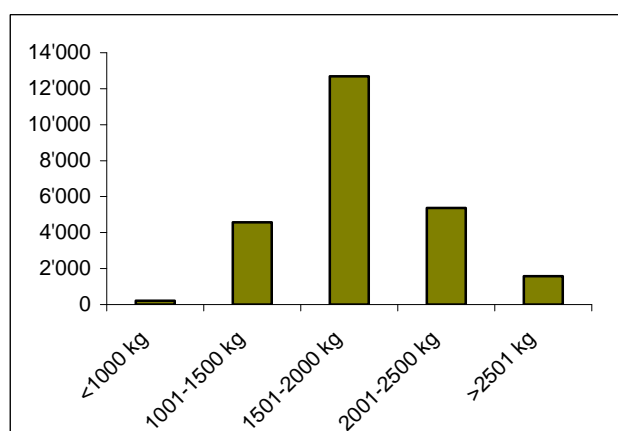


Figure 2-9: Number of vehicles by total weight 2005 (OEA 2005c)

## 2.2 Political structure of Liechtenstein

### System of State

The Principality of Liechtenstein is a constitutional hereditary monarchy on a democratic and parliamentary basis. The power of the State is embodied in the Reigning Prince and the People. The relatively strong position of the Reigning Prince is balanced by far-reaching direct-democratic rights of the people.

### Separation of powers

In the dualistic system of State of the Principality of Liechtenstein, the power of the State is embodied in both the Reigning Prince and the People. Separation of powers is further safeguarded by vesting separate rights in the executive branch (Government), the legislative branch (Parliament), and the judicial branch (courts).

### Reigning Prince (Head of State)

The Reigning Prince is the Head of State and represents the State in all its relations with foreign States, notwithstanding the requisite participation of the competent Government. On the proposal of Parliament, the Reigning Prince appoints the Members of the Government. He is also responsible for appointing judges, the election of which is undertaken by Parliament on the

proposal of a special selection body. On important grounds, the Reigning Prince may dissolve Parliament and dismiss the Government. The Reigning Prince may also exercise emergency powers. He also may exercise the powers of pardon, mitigation, and quashing with respect to criminal investigations. Every law requires the sanction of the Reigning Prince to enter into force. In exercising his powers, the Reigning Prince is bound by the provisions of the Constitution

### **Parliament**

The Liechtenstein Parliament is elected every four years. Parliament consists of 25 Members. They are elected in universal, equal, direct, and secret elections in accordance with proportional representation. In the current legislative term (2005-2009), three parties are represented in Parliament. The Progressive Citizens' Party is the strongest party with 12 seats. The Patriotic Union has 10 seats, and the Free List is represented with three seats.

The most important responsibilities of Parliament are participation in the legislative process, assent to international treaties, approval of State funds, election of judges on the proposal of the selection body, and supervision of the National Administration. Parliament elects the Government and proposes its appointment to the Reigning Prince. It can also trigger dismissal of the Government when the Government loses its confidence. Parliament constitutes a quorum if at least two thirds of its Members are present.

### **Government**

The Government consists of five Ministers: the Prime Minister, the Deputy Prime Minister, and three other Ministers. The Ministers are appointed by the Reigning Prince on the recommendation of Parliament. The Government is the supreme executive authority, to which over 40 offices and several diplomatic missions abroad are subordinate. About 50 commissions and advisory councils support the work of the Administration.

### **Jurisdiction**

Jurisdiction is divided into jurisdiction under public law (special jurisdiction) and ordinary jurisdiction. Jurisdiction under public law is exercised by the Administrative Court and the Constitutional Court. The Administrative Court is the instance for complaints against decisions and orders of the Government or commissions acting on the Government's behalf. The responsibilities of the Constitutional Court include in particular the protection of the rights guaranteed by the Constitution, the European Convention on Human Rights, and the human rights instruments of the United Nations. It also reviews the constitutionality of laws and international treaties and the legality of Government ordinances.

Ordinary jurisdiction encompasses the administration of justice in civil and criminal matters. The first instance is the Liechtenstein Court of Justice in Vaduz. Before a complaint can be lodged with the Liechtenstein Court of Justice in contentious civil matters, a mediation procedure must be undertaken in the municipality of residence of the defendant. Only if the mediation procedure fails can the Liechtenstein Court of Justice be invoked as the first instance. Ordinary jurisdiction in the first instance is exercised by individual judges. The second instance is exercised by the Court of Appeal, and the third instance by the Supreme Court. Both courts are collegial bodies.

### **Municipalities**

Municipal autonomy plays an important role in Liechtenstein. The autonomous scope of authority of the 11 municipalities is laid down in article 110 of the Constitution. The eligible voters of each municipality elect a Municipal Council headed by a Mayor who, depending on the size of the municipality, exercises his office full-time or part-time. The municipal authorities conduct their affairs autonomously and manage the municipal assets. Citizens may call a referendum against their decisions.

### **Relations with Switzerland**

The relations between Liechtenstein and Switzerland are very close and friendly. The two countries have concluded numerous bilateral agreements. The most important treaty is the Customs Treaty, which, together with other agreements, ensures an open border between Liechtenstein and Switzerland also for passenger traffic. Also of great importance to the Liechtenstein economy is the Currency Treaty, which governs the use of the Swiss franc as the official currency in Liechtenstein.

The Customs Treaty provides that all Swiss customs regulations and all other Swiss federal legislation shall apply to Liechtenstein to the extent their application is necessary for the customs union. All provisions of Swiss federal legislation are exempt from this rule that would give rise to a contribution requirement by the Swiss Confederation. In addition, all trade and customs treaties concluded between Switzerland and third countries apply to Liechtenstein pursuant to the Customs Treaty. Switzerland is also authorized to represent Liechtenstein at such negotiations and to conclude these treaties effective for Liechtenstein. In principle, the Customs Treaty is limited to the transport of goods. In the 1990's, the Customs Treaty was adapted as a consequence of European integration. Since then, Liechtenstein has been able to become a State party to international conventions and a member of international organizations concerning the scope of the Customs Treaty, as long as Switzerland also belongs to these conventions and organizations. On the other hand, Liechtenstein may also join such conventions and organizations even if Switzerland does not join. In this event, Liechtenstein and Switzerland conclude a special agreement, such as in 1994 pursuant to Liechtenstein's accession to the European Economic Area (EEA). In addition to its effect under international law, the Customs Treaty also has symbolic significance for the particularly close relations between Liechtenstein and Switzerland. It has created the basis for legal alignment and harmonization in the fields of economics and social law, extending far beyond the scope of the treaty. These close links manifest themselves today in a wide range of agreements and treaties, including in the areas of social security, vocational training, transport, indirect taxes, and cross-border police cooperation.

The Customs Treaty is also relevant to environmental law. The bulk of Swiss environmental standards also apply to Liechtenstein. Environmental taxes and tax incentives are not covered by the Customs Treaty, due to Liechtenstein's tax sovereignty. It is therefore planned to conclude a special bilateral treaty relating to environmental taxes, which includes a parallel levy of environmental taxes in Switzerland. Until this treaty enters into force, the existing Swiss environmental taxes will be declared applicable to Liechtenstein, as part of an interim solution on the basis of the Customs Treaty. A similar treaty framework already exists in the area of transport with respect to the Heavy Vehicle Fee (HVF).

### **Liechtenstein and the EU**

The relations between Liechtenstein and the EU are close, and cooperation is intensive. Since 1 May 1995, Liechtenstein has been linked with the European Union (EU) and its member States through an extensive association agreement – the Agreement on the European Economic Area (EEA). This agreement extends the Single Market of the EU by three of the four EFTA States, namely Liechtenstein, Iceland, and Norway. Including the new member States that joined on 1 May 2004, the EU now has 25 members and the EEA 28 members.

Through the EEA Agreement, the EU member States and the three EEA/EFTA States Liechtenstein, Iceland, and Norway are brought together into a Single Market, in which the same basic rules (*acquis communautaire*) apply to all participating States. The rules relate to the four basic freedoms (free movement of goods, free movement of persons, free movement of services, free movement of capital) and to joint competition rules.

In addition to the legal provisions concerning the Single Market, the EEA Agreement also contains horizontal and flanking policies aimed at strengthening the Single Market. These additional areas

of cooperation include environmental protection, consumer protection, research and development, education, statistics, company law, and social policy. A large share of EU environmental standards therefore also applies in Liechtenstein. Liechtenstein also takes part in EU programs in the aforementioned areas, such as in the 6th Framework Program for Research and Technological Development (2002-2006), and, through its participation in committees, has a voice in the development and execution of the programs.

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## 3 Inventory of climate emissions

The guidelines for preparing the national reports of Annex 1 States and the revised IPCC guidelines for national greenhouse gas inventories (UNEP / WMO / IPCC 1996 and UNFCCC 2002) establish the standard for technical inventory information. The inventory tables compiled pursuant to these guidelines are reproduced in the annex to this report. This chapter presents and discusses the inventory data in detail. The most important sources (chapter 3.1) and the emissions trends for 1990-2003 (chapter 3.2) of the six "Kyoto gases" are illustrated.

Carbon dioxide (CO<sub>2</sub>), the most significant and frequent climate gas, is primarily generated by the burning of petroleum products and natural gas.

Methane (CH<sub>4</sub>) largely arises from agricultural livestock breeding. Although its volume is significantly less than CO<sub>2</sub>, it has a Global Warming Potential (GWP) 21 times greater than CO<sub>2</sub>.

Nitrous oxide (N<sub>2</sub>O) is generated by petrol vehicles with (older) three-phase catalytic converters and by the fertilization of agricultural soil. Like methane, it is emitted in much smaller volumes than CO<sub>2</sub>, but its GWP is 310 times higher than CO<sub>2</sub>.

The synthetic gases sulfur hexafluoride (SF<sub>6</sub>), hydrofluorcarbons (HFC), and perfluorcarbons (PFC) are the trace gases with the greatest GWP. They are used in refrigeration technology and for insulation foams. However, they are only emitted in very, very small volumes.

### 3.1 Overview of sources and sinks

#### 3.1.1 Methodology

The climate inventory for the Principality of Liechtenstein is still under development. The work is primarily linked to the development of an emissions register for air pollution control. Detailed values are not yet available for all sectors. The following data (and the values for 1990 and 2010) are therefore based on estimates. The most important steps and assumptions are illustrated in table 3-1.



IPCC	Category	Procedure for calculating the emissions	Data quality
1	Energy	Fuel sales statistics by energy source (petrol, diesel, heating oil, natural gas, firewood, liquid gas) and emission factor	Natural gas: good Other fuels: medium
1A	Fuel combustion activities	Sales statistics fueling stations, heating oil dealers, Customs Authority (refund of mineral oil tax for agricultural vehicles)	See 1A1-1A4
1A1+1A2	Industries	1A1 Energy industries: no emissions 1A2 Other industries: Sales statistics heating oil dealers, estimates of shares of 1A2, 1A4 CO <sub>2</sub> emission factors from carbon content or Swiss emission factors	good medium good medium
1A3	Transport	Sales statistics fueling stations, carbon content of the fuels (CO <sub>2</sub> emissions factor), Swiss emission factors for CH <sub>4</sub> , N <sub>2</sub> O	good CO <sub>2</sub> good CH <sub>4</sub> , N <sub>2</sub> O medium
1A4	Residential, institutional, commercial	Petroleum statistics Sales statistics heating oil dealers, carbon content of the fuels (CO <sub>2</sub> emissions factor), Swiss emission factors for CH <sub>4</sub> , N <sub>2</sub> O	good medium CO <sub>2</sub> good CH <sub>4</sub> , N <sub>2</sub> O medium
1A5	Others (off-road)	Data included in Transport (1A3)	---
1B	Fugitive emissions	Estimate of losses via sales volume	poor
2	Industrial processes	No estimate Except for SF <sub>6</sub> from LPA transformer	--- good
3	Solvents	Figures are not estimated; the emissions volumes are certainly low	---
4	Agriculture	Activity data (number of livestock, surface data, land use) and Swiss emission factors.	good Soil emissions: poor
5	Land use and forestry (sinks)	Simplifying assumption of equilibrium (source capacity = sink capacity)	poor
6	Waste	No emissions: waste incineration in Switzerland; former waste disposal sites no longer generate gas.	good
Memo items	CO <sub>2</sub> emissions from biomass	Report and energy statistics of the Office of Forests	good

Table 3-1: Overview of the most important methodological assumptions for the calculation of the climate gas inventory (the structure corresponds to the IPCC categories, see coding in leftmost column).

### 3.1.2 Status of the Liechtenstein climate gas inventory

So far, Liechtenstein has compiled inventories in the Common Reporting Format (CRF) for 1990 and 2003. Both of them are not yet complete, but they cover the most important sources. Because of the state of the data, the 1990 emissions could not be calculated consistently with the 2003 emissions for some sources. The data will be supplemented and adjusted for the next submission in 2006. For some calculations, emission factors from the Swiss greenhouse gas inventory were used,

where it made sense to do so (FOEN 2005). The annex includes copies of the most important tables from the 2003 CRF and a table for the 1990 base year.

### 3.1.3 CO<sub>2</sub>

In 2003, 240 Gg (calculated value 239.86 Gg) of gross CO<sub>2</sub> emissions were produced, which corresponds to 6.9 tons per capita. Almost two fifths of these emissions were generated by transport (38%). Industry is responsible for 28%. Other sources such as residential, institutional, and commercial users (room heating and warm water) account for 34% of emissions. Other sources such as agriculture play an insignificant role by comparison.

As in previous climate reports, the simplifying assumption is made that the sink capacity of forests resulting from the build-up of biomass (binding of CO<sub>2</sub> in forests primarily in the form of wood) is approximately the same as the source capacity (emission by rotting and burning). The quality of the assumption could not yet be verified.

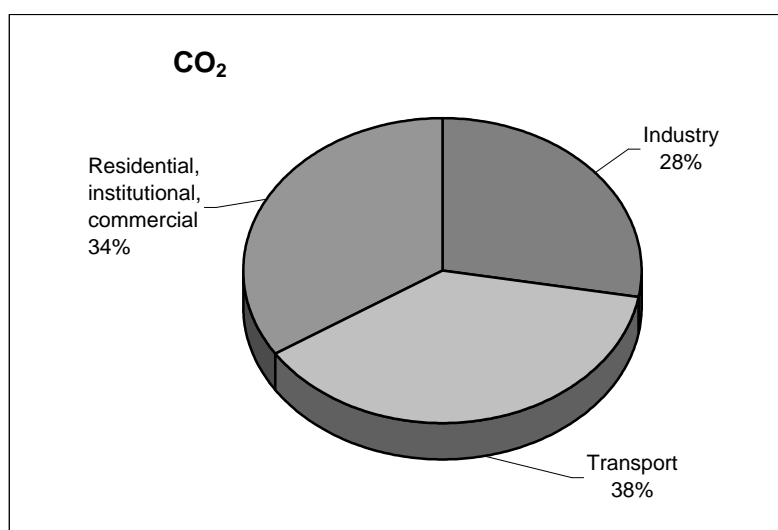


Figure 3-1: CO<sub>2</sub> emissions by sector in 2003 (assignment to IPCC categories: see Table 3-1). 100% corresponds to nearly 240 Gg (240,000 t).

### 3.1.4 CH<sub>4</sub>

In 2003 0.723 Gg of CH<sub>4</sub> were emitted. This corresponds to 15.18 Gg of CO<sub>2</sub> equivalent. 92% of this volume was generated by agriculture, two thirds of which were caused by ruminants. 4% are fugitive emissions, namely losses from the natural gas network. Other sources such as residential, institutional, and commercial users (room heating and warm water) account for 2%, and transport and industry 1% each. Waste processing no longer generates CH<sub>4</sub> emissions, since the former waste deposit sites no longer emit gases, and since Liechtenstein's waste is incinerated in Switzerland (Waste Incineration Facility in Buchs, SG) and its emissions are included in the Swiss inventory.

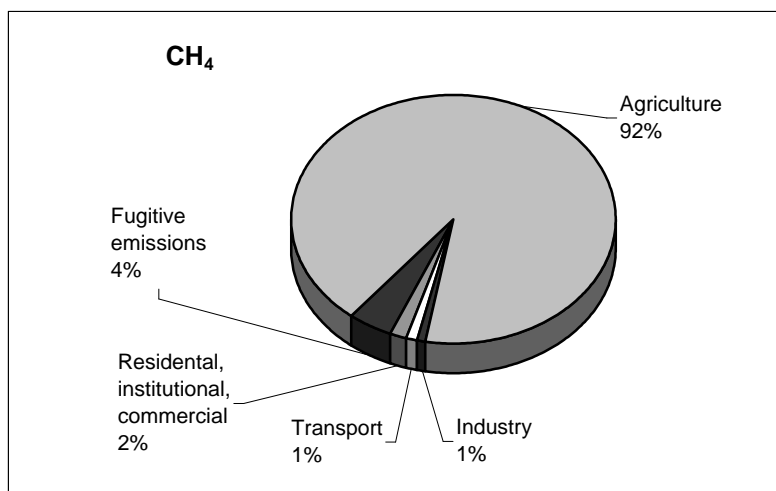


Figure 3-2:  $CH_4$  emissions by sector in 2003 (assignment to IPCC categories: see Table 3-1). 100% corresponds to 0.723 Gg (723 t) or 15 Gg  $CO_2$  equivalent (15,000 t  $CO_2$  eq).

### 3.1.5 $N_2O$

0.028 Gg  $N_2O$  were emitted in 2003. This corresponds to 8.6 Gg  $CO_2$  equivalent. Approximately two thirds are generated by agriculture (57%). Another important source is transport, with a share of 38%. Other sources such as residential, institutional, and commercial users as well as industry are very minor in comparison.

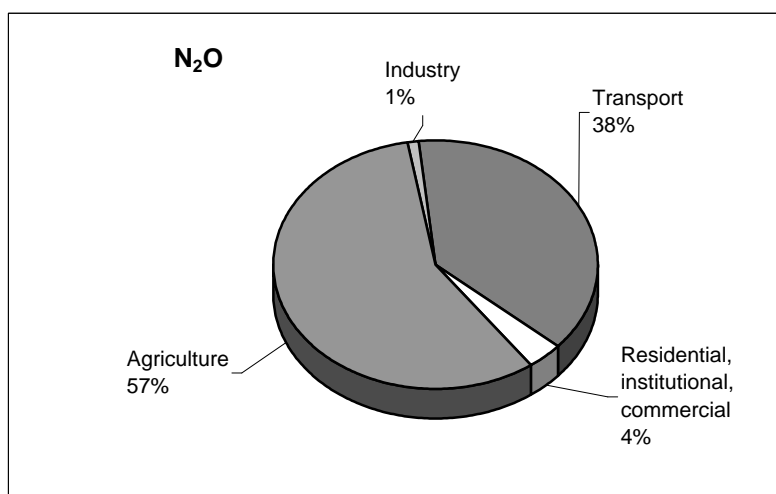


Figure 3-3:  $N_2O$  emissions by sector in 2003 (assignment to IPCC categories: See Table 3-1). 100% is 0.028 Gg (28 t) or 8.6 Gg  $CO_2$  equivalents (860 t  $CO_2$  eq).

### 3.1.6 Other greenhouse gases (HFC, PFC, $SF_6$ )

So far, only sulfur hexafluoride emissions ( $SF_6$ ) have been quantified, namely modest amounts (3 kg  $SF_6$  or 62 t  $CO_2$  eq) from the transformer stations of the Liechtenstein Power Authority. Other emissions of synthetic gases are not known so far. (In Switzerland, HFC, PFC and  $SF_6$  emissions have so far been of marginal importance, namely approximately 1% of the total gross greenhouse gas emissions. The situation is likely to be similar in Liechtenstein.)

### 3.1.7 Precursor substances and SO<sub>2</sub>

For the precursor substances NO<sub>x</sub>, CO and NMVOC as well as for the gas SO<sub>2</sub>, only emissions values for the energy sector (IPCC category 1A) are available. In 2003, 0.416 Gg NO<sub>x</sub>, 1.665 Gg CO, 0.148 Gg NMVOC and 0.085 Gg SO<sub>2</sub> were emitted.

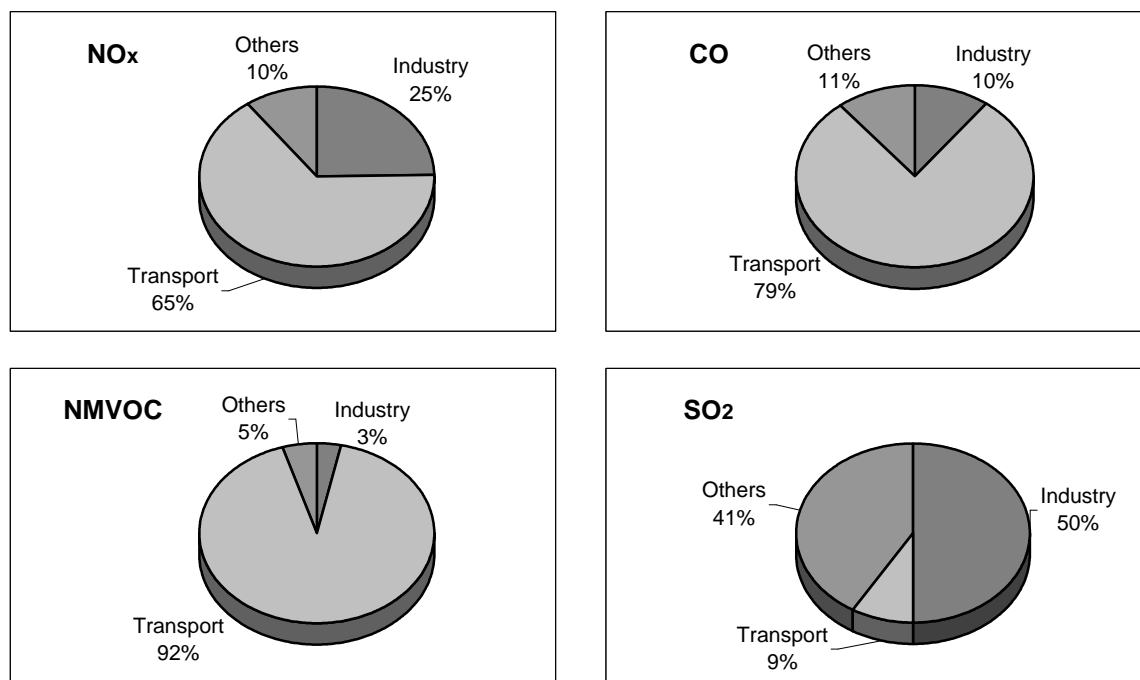


Figure 3-4: Emissions of NO<sub>x</sub>, CO, NMVOC and SO<sub>2</sub> in 2003 (according to IPCC categories)

### 3.1.8 2003 summary

Table 3-2 presents an overview of the greenhouse gas emissions of the Principality of Liechtenstein for the year 2003.

Please note: The IPCC categories 1-4 and 6 are added, generating the "Total without CO<sub>2</sub> emissions from land use/forestry". IPCC category 5, land use/forestry, can represent either a source or a sink. If its net contribution, positive or negative, is added to the other sources, this generates the "Total with net CO<sub>2</sub> emissions from land use/forestry".

IPCC	Category Source / Sink	CO <sub>2</sub> Gg	CH <sub>4</sub> Gg	N <sub>2</sub> O Gg	SF <sub>6</sub> Gg	NO <sub>x</sub> Gg	CO Gg	NM VOC Gg	SO <sub>2</sub> Gg
1 (1A) (1B)	Total energy Fuel combustion activities Fugitive emissions	239.86 (239.86) (0.00)	0.06 (0.03) (0.03)	0.012 (0.012) (0.000)	NO	0.42 (0.42) (0.00)	1.66 (1.66) (0.00)	0.15 (0.15) (0.00)	0.09 (0.09) (0.00)
2	Industrial processes	0	0	0	3·10 <sup>-6</sup>	0	0	0	0
3	Solvents	0	0	0	0	0	0	0	0
4	Agriculture	0	0.66	0.016	NO	0	0	0	0
6	Waste	0	0	0	NO	0	0	0	0
	Total without CO <sub>2</sub> emissions from land use/forestry	239.86	0.72	0.028	3·10 <sup>-6</sup>	0.42	1.66	0.15	0.09
5	Land use/forestry	0	0	0	NO	0	0	0	0
	Total with net CO <sub>2</sub> emissions from land use/forestry	239.86	0.72	0.028	3·10 <sup>-6</sup>	0.42	1.66	0.15	0.09
Me- mo	International bunkers	0	0	0	0	0	0	0	0

Table 3-2: Overview of emissions and sinks in 2003 (according to IPCC categories). NO = not occurring.

To compare the climate gases with each, they must be converted into CO<sub>2</sub> equivalent according to their Global Warming Potential. Table 3-3 presents the corresponding figures without precursor gases.

IPCC	Category Source / Sink	CO <sub>2</sub> Gg CO <sub>2</sub> eq	CH <sub>4</sub> Gg CO <sub>2</sub> eq	N <sub>2</sub> O Gg CO <sub>2</sub> eq	SF <sub>6</sub> Gg CO <sub>2</sub> eq	Total Gg CO <sub>2</sub> eq	Share %
1	Total energy	239.86	1.23	3.67	NO	244.77	92.8%
1A	Fuel combustion	(239.86)	(0.55)	(3.67)		(244.09)	(92.6%)
1B	activities Fugitive emissions	(0.00)	(0.68)	(0.00)		(0.68)	(0.2%)
2	Industrial processes	0	0	0	0.06	0.06	0.02%
3	Solvents	0	0	0	0	0	0
4	Agriculture	0	13.95	4.93	NO	18.87	7.2%
6	Waste	0	0	0	NO	0	0%
	Total without CO <sub>2</sub> emissions land use/forestry	239.86	15.18	8.60	0.06	263.71	100%
5	Land use/forestry	0	0	0	0	0	0
	Total with net CO <sub>2</sub> emissions land use/forestry	239.86	15.18	8.60	0.06	263.71	100%
	Share	91.0%	5.8%	3.3%	0.02%	100%	

Table 3-3: Emissions in 2003. eq: equivalent. NO = not occurring. Conversion into CO<sub>2</sub> equivalent: GWP(CH<sub>4</sub>) = 21, GWP(N<sub>2</sub>O) = 310.

Table 3-4 presents the emissions of CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O in the road traffic sector, including off-road vehicles, arising from the use of petrol, diesel, and natural gas. No emission values have been calculable so far for the precursor gases NO<sub>x</sub>, CO and NMVOC or for the gas SO<sub>2</sub>.

Fuel	Sales	Emissions in 2003 (in Gg)			Emissions in 2003 (in Gg CO <sub>2</sub> equivalent)			
		CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	Total
Petrol	880.48	65.07	0.0086	0.00963	65.07	0.18	2.99	68.24
Diesel	330.04	24.29	0.0005	0.00092	24.29	0.01	0.29	24.59
Natural gas	31.68	1.74	NE	NE	1.74	NE	NE	1.74
Kerosene	7.26	0.53	0.0001	0.00002	0.53	0.002	0.006	0.53
Total	1242.46	91.63	0.0092	0.01056	91.63	0.19	3.27	95.10

Table 3-4: Sales in TJ and emissions from traffic in 2003 (road traffic, off-road vehicles) in Gg and in Gg CO<sub>2</sub> equivalent.

## 3.2 Most recent emissions trends

Figure 3-5 presents emissions trends of the three most important climate gases CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O from 1990 to 2003 (years in between were not calculated). The interpretation of the graph should take into account that the emissions calculations for 1990 and 2003 are not consistent for all sources (i.e., the quality of the input data and methods is not always equivalent for the two years).

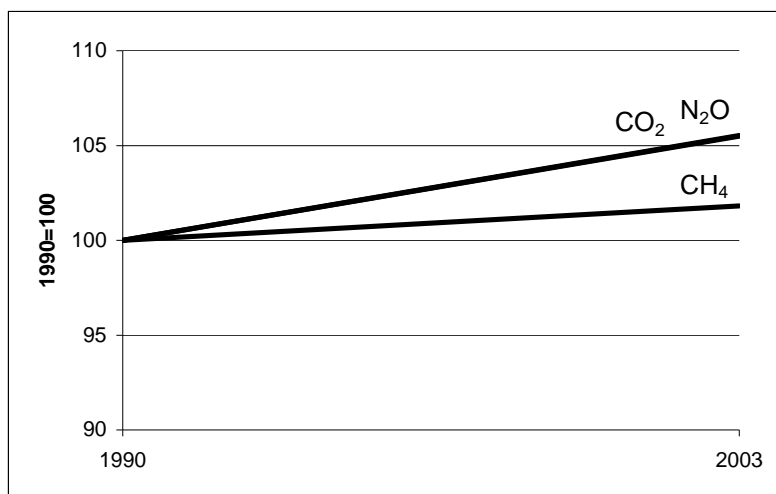


Figure 3-5: Development of the emissions from 1990-2003. Index: 1990 = 100. Numeric values for 2003 are CO<sub>2</sub>: 105.5; CH<sub>4</sub>: 101.8; and N<sub>2</sub>O: 105.5.

### 3.2.1 CO<sub>2</sub>

CO<sub>2</sub> emissions amounted to 227.29 Gg in 1990 and 239.86 Gg in 2003, which corresponds to an increase of 5.5%. Transport increased by 4.4%, industry and the residential, institutional, and commercial sector by 6.3%. In particular with respect to room heat production, which constitutes the largest share of the residential, institutional, and commercial sector, climate variation plays an important role. In colder winters, it is natural that more fuel will be used than in warmer winters. In 2003, heating degree-days in Switzerland were 4.8% higher than in 1990. This would explain the bulk of the increase by 6.3% with reference to climatic conditions. The remaining increase represents real growth (especially an increase of the heated building volume). The increase in transport also represents real growth and results from the combination of greater specific driving output and larger, heavier vehicles.

### 3.2.2 CH<sub>4</sub>

At 0.723 Gg, CH<sub>4</sub> emissions in 2003 are about 2% higher than in 1990 (0.710 Gg). The reason for this increase is not real growth, but rather methodological. Not all sources could be calculated for 1990. In particular, 1990 data is lacking for industry, transport, and the residential, institutional, and commercial sector. Presumably, these emissions have been effectively reduced (higher share of vehicles with catalytic converters<sup>4</sup>). Due to the reduction of the number of farm animals, agricultural methane emissions have decreased by 2%. If all emissions were known for 1990, the development from 1990 to 2003 would most probably be a reduction, not growth.

### 3.2.3 N<sub>2</sub>O

The figures indicate an increase in emissions from 0.0263 Gg in 1990 to 0.0277 Gg in 2003, which corresponds to 5.5%. In both sectors contributing significantly to emissions – petroleum vehicles and agricultural soils – there has been an increase by 5-6%.

<sup>4</sup> In Switzerland, methane emissions in the transport sector were reduced by a factor of 3 from 1990-2003.

### 3.2.4 Precursor substances and SO<sub>2</sub>

A comparison is only possible for the energy sector. Thanks to the reduction of the sulfur content in diesel and heating oil, the SO<sub>2</sub> emissions decreased from 1990 to 2003, but at the same time, the use of both energy sources has risen.

Year	Emissions (in Gg)			
	NO <sub>x</sub>	CO	NM VOC	SO <sub>2</sub>
1990	0.39	1.600	0.1500	0.08
2003	0.42	1.665	0.1479	0.09
2003/1990	107%	104%	99%	106%

Table 3-5: Development of the emissions of NO<sub>x</sub>, CO, NMVOC and SO<sub>2</sub> 1990-2003

## 3.3 Total emissions

### 3.3.1 CO<sub>2</sub> equivalent per gas

The Global Warming Potential (GWP) varies for each gas. 1 ton of methane has the same GWP as 21 tons of CO<sub>2</sub>, so that GWP(CH<sub>4</sub>) = 21. For nitrous oxide, the factor is even GWP(N<sub>2</sub>O) = 310 (UNEP / WMO / IPCC, 1996). To add the GWP of all gases, the emissions of methane and nitrous oxide must first be multiplied by their GWPs. This results in Gg CO<sub>2</sub> equivalent. Using this method, total emissions for Liechtenstein in 2003 were 263.7 Gg CO<sub>2</sub> equivalent. In comparison with the 1990 values, there are no differences between the shares of the various greenhouse gases as part of the total emissions. The increase from 1990-2003 was 5.3%.

Gg CO <sub>2</sub> equivalent	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	Total
Gross emissions 1990	227.29	14.91	8.15	250.4
Share in %	90.8%	5.9%	3.3%	100%
Gross emissions 2003	239.86	15.18	8.60	263.7
Share in %	91.0%	5.7%	3.3%	100%

Table 3-6: Emissions in CO<sub>2</sub> equivalent per gas in 1990 and 2003. (The share of sulfur hexafluoride is negligibly small.)

### 3.3.2 CO<sub>2</sub> equivalent per sector

The following sectors are significant with respect to total emissions in CO<sub>2</sub> equivalent: transport (36%); industry (26%); agriculture (7%). Waste and solvents are not relevant. The other sectors (residential, institutional, and commercial) are not broken down (total of 31%). 91% of emissions in CO<sub>2</sub> equivalent are energy-related (engine and heating fuel).



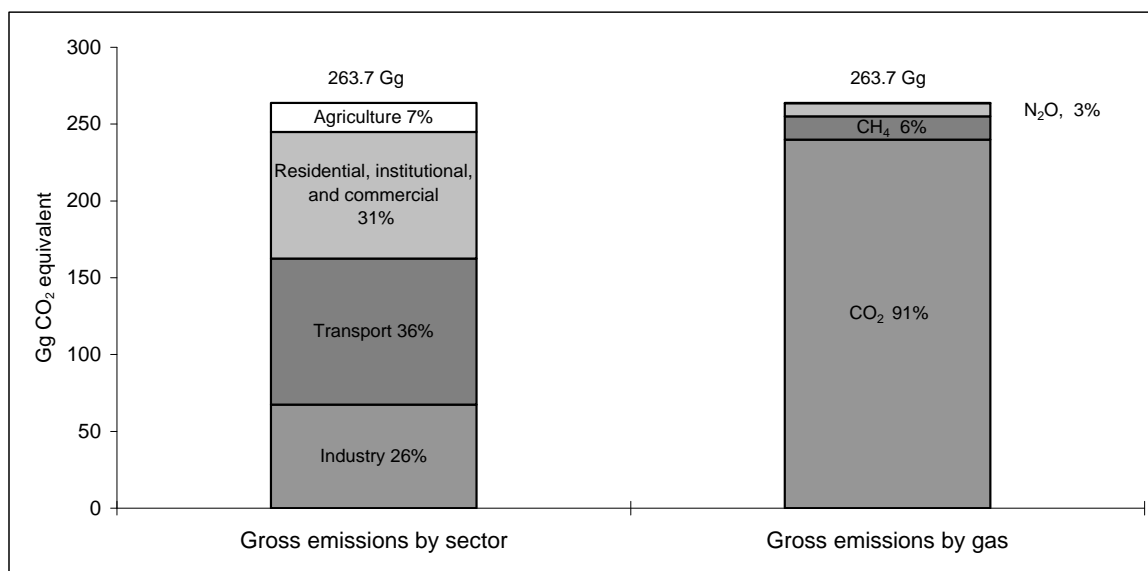


Figure 3-6: Emissions in CO<sub>2</sub> equivalent by sector and by gas in 2003.

## References

FOEN (Swiss Federal Office for the Environment) 2005: Greenhouse Gas Inventory for Switzerland 1990-2004: Common Reporting Format (CRF) and National Inventory Report (NIR), Berne

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## 4 Policies and measures

### 4.1 Climate policy areas in Liechtenstein

Liechtenstein has integrated its climate policy very strongly into the individual sectoral policies. The focus is on energy policy, environmental policy, transport policy, agricultural policy, and forestry policy. All of these areas encompass measures that contribute to the reduction of climate gases. When determining the measures to reduce greenhouse gases, the highest priority is given to measures that also entail additional local benefits, especially with respect to air pollution control.

Because of the small size of the country, cross-border cooperation plays an important role. Especially important is the relationship with Switzerland and cooperation among the countries in the Lake Constance area. Thanks to the Customs Treaty, cross-border measures and bilateral execution are simplified in many areas, since various Swiss enactments are directly applicable in Liechtenstein pursuant to the Treaty. In these cases, Liechtenstein executes the provisions similarly to a Swiss canton (e.g., mineral oil tax, regulations for environmental substances). Accordingly, most policy areas are very closely linked with Swiss policy, in terms of both content and execution.

Liechtenstein endeavors to enshrine the principle of sustainability in its policies. This includes provident use of resources and maintenance of a high quality of life. To the extent possible, Liechtenstein also tries to make a contribution to the solution of global environmental problems. Climate protection enjoys a high political priority in this regard, constituting a primary field of action in Liechtenstein's environmental policy.

A parliamentary motion called for the drafting of CO<sub>2</sub> legislation. This mandate was implemented with the revision of the Clean Air Act. The new Clean Air Act of 2003 encompasses climate protection and climate policy targets similar to the Swiss CO<sub>2</sub> Act. In particular, the possibility of introducing a CO<sub>2</sub> tax has been included in the Act. The concrete structure of a CO<sub>2</sub> tax will again, however, be undertaken in close collaboration with Switzerland.

Pursuant to the joint economic area with Switzerland, the climate cent levied on engine fuel in Switzerland since October 2005 is also being levied in Liechtenstein. The Government has signed an agreement with the Swiss "Climate Cent Foundation" to this effect, governing the administrative and organizational measures. Questions concerning the use of the revenue for climate protection projects must still be developed in detail. In principle, the revenue will be earmarked for climate protection projects in Liechtenstein and abroad.

#### 4.1.1 Environmental policy

The deliberate decision was made not to establish superordinate environmental protection legislation; the relevant provisions are to be found in the individual sectoral policies. With respect to technical implementation, Liechtenstein is bound by the Customs Treaty with Switzerland in some areas (e.g., Substance Ordinance, VOC tax, SO<sub>2</sub> tax, see chapter 4.3). Air pollution thresholds are also largely identical with those of Switzerland; in some areas, however, they have been adapted to the thresholds provided by relevant EU directives, pursuant to the EEA Agreement.

In Liechtenstein, two laws substantially influence environmental policy and climate policy:

- The comprehensively revised *Clean Air Act (2003)* now also specifies climate policy objectives. It lays down ongoing reduction of greenhouse gases and a reduction of CO<sub>2</sub> emissions from the energy-related use of fossil energy sources of at least 10% by the year 2010, relative to 1990. With regard to technical aspects, the Clean Air Act governs the limitation of emissions for stationary installations, the maximum air pollution level, measures to be taken in the event emissions thresholds are exceeded, and the requirements on engine and heating fuel. Important elements include the polluter-pays-principle and the obligation to provide information to the public. The ordinance on the Clean Air Act was amended in 1999. The amendments lay down new requirements on petrol and diesel oil, but also a new threshold for particulate matter in air. The annual average for sulfur dioxide (threshold) was reduced from 30 micrograms/m<sup>3</sup> to 20 micrograms/m<sup>3</sup>. Beginning on 1 January 2000, the ordinance prohibits the sale of leaded supreme petrol. The lead content in unleaded petrol has also been reduced from 0.013g/l to 0.005 g/l, and the share of carcinogenic benzene in petrol has been reduced from 5% to 1%. The sulfur content in diesel has been reduced from 0.5 to 0.35 g/kg.
- The *Waste Prevention and Disposal Act (1988)* requires the separate disposal of different types of waste. At the level of an ordinance, the Government may require that certain waste be recycled, if such recycling improves the ecological balance. This law is also based on the polluter-pays-principle. Almost no waste is disposed of in reactor dumps. All trash is incinerated in the waste incineration plan in Buchs, Switzerland, and the energy generated is reused.

#### 4.1.2 Energy policy

The commitment to saving energy was legally enshrined in the Energy Ordinance in 1993 and further consolidated in 1996. The focus is on the following elements:

- Target values for the insulation of buildings (heat insulation requirements), for devices such as heaters, air conditioners, and ventilation systems, and requirements for the maintenance of such devices. These measures are governed by the revised Construction Act and relevant ordinances.
- An Energy Commission advises the Government on energy policy and communicates its views on all fundamental questions of energy policy. The Energy Commission consists of experts from all relevant areas (architecture, energy industry, other industries, manufacturing and trades, administrative offices, environmental organizations).
- A Bureau of Energy Consumption and Conservation has been established within the Office of Economic Affairs. The Bureau advises municipalities and private parties on all areas of energy conservation, is responsible for the content and administration of subsidy applications, and elaborates and implements energy policy strategies. The Bureau provides information to the public through lectures, radio discussions, and personal talks.
- The promotion of energy conservation is a central concern of Liechtenstein's energy policy. Energy conservation in buildings is supported financially, especially with regard to renovation of old buildings, building services installations, block heating plants, and solar collectors.

The Energy Conservation Act of 18 September 1996 (Liechtenstein Law Gazette LGBI. 1996 No. 193) and the relevant Ordinance of 26 November 1996 (LGBI. 1996 No. 202) as well as the Energy Ordinance of 23 September 2003 on the Construction Act (LGBI. 2003 No. 193) constitute the legal framework for the implementation of measures relating to buildings. A gratifying development is also that municipalities now supplement national Energy Conservation Act subsidies with their own funds. The Government intends to promote the measures for implementing the objectives laid down in the energy strategy with financial resources and advice. The increase of energy efficiency and in particular the increased use of renewable energies are of central

importance for the reduction of greenhouse gas emissions and accordingly for a long-term climate policy.

In the beginning of 2004, the Government adopted an energy strategy that will provide future-oriented impulses for the national energy policy of the coming ten years. The focus areas of the concept are the promotion of efficient energy use, the use of renewable energies, and energy conservation. The goal is to increase the share of renewable energy in total energy use from 8% to 10% by 2013.

A further goal is to triple the use of solar energy through thermal solar panels, and to increase the production of electricity from solar energy through photovoltaic systems by a factor of 2.5. A significant portion of fuel consumption takes place in buildings. Measures are envisaged in this area as well. For instance, heat insulation in old buildings and the Minergy standard<sup>5</sup> in both old and new buildings will be supported. An energy controlling system will be established for public buildings.

Almost all Liechtenstein municipalities provide additional funds to projects subsidized at the national level pursuant to the Energy Conservation Act. In collaboration with the forestry sector, an increasing number of wood chip plants are used in public buildings to generate heat. The new Act and the Ordinance on the Liberalization of the Electricity Market provide mechanisms to support the conveyance of renewable energies. The Liechtenstein Power Authority also offers a "Green Electricity" label.

A first municipality (Triesen) has been awarded the Energy City label; others are in preparation.

#### 4.1.3 Transport policy

Transport policy in Liechtenstein takes into account the interests of society, the economy, and the environment. In this way, the Government has implemented or prepared a wide range of projects to promote public transportation and to reduce emissions arising from transport (expansion of the Liechtenstein Bus Authority, "Liechtenstein Takt" regional train schedule, preferential treatment of buses at traffic lights, subsidies of electric scooters and electric bicycles, tax exemptions for solar, hybrid, electronic, and natural gas vehicles, security measures along the way to school, mobility campaigns, studies on a new, high-performance public transport system, and medium-term expansion of the railway offerings).

Goods transport policy also plays an important role. As of 1 January 2001, Liechtenstein introduced a Heavy Vehicle Fee, analogous to Switzerland. This fee is based on the polluter-pays-principle and is differentiated according to distance driven and the total weight of the vehicle. It increases productivity in road traffic, contributes to a large-scale shift of heavy goods traffic from road to rail, and in this way also eases the burden on roads in Liechtenstein.

In the framework of the Customs Treaty, Liechtenstein also supports the efforts of importers to reduce specific fuel consumption in accordance with the Swiss rules, and Liechtenstein is also required to declare consumption in accordance with EU directives. Based on the data that has been collected so far in this way, it now appears possible to undertake taxation of automobiles also with respect to specific CO<sub>2</sub> emissions. The Government is currently examining this option.

The public bus fleet has largely been converted to natural gas. A natural gas fueling station has also been built. The Government is examining the establishment of a biogas facility to generate gas from organic waste, which again could significantly improve the climate balance.

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<sup>5</sup> Minergy is a quality label for new and renovated buildings. The brand is supported jointly by the Swiss Confederation, cantons, and businesses. The goal of Minergy is to achieve energy consumption that is lower by a factor of 3 than in conventional buildings. The Bureau of Energy Consumption and Conservation within the Office of Economic Affairs is the certification authority for Minergy buildings in Liechtenstein.

#### 4.1.4 Agriculture

A working group has elaborated a new agricultural policy concept, which was considered by Parliament in November 2004. Policy messages were formulated for the target areas of soil, ecology, economy, markets, society, education, and social welfare. Future agricultural policy will be based on these guidelines.

The guidelines promote the trend toward greater ecological agriculture in Liechtenstein. In addition to maintaining soil fertility, the environmental impact will also be minimized. Environmentally friendly forms of production, such as integrated production and organic farming, will be promoted in a targeted manner. Landscape conservation is also considered a responsibility of agriculture, and its importance will continue to increase.

By means of the Direct Payment Act, the Law on Compensation for Ecological and Animal-Friendly Practices in Agriculture (Compensation Act), and the Ordinance on the Compensation Act, Liechtenstein aims to promote environmentally friendly and animal-friendly agriculture as well as the cultivation of natural habitats and permanent pastures on swampy and mixed soils. In the case of wildflower meadows, the preservation of which is of particular interest to nature conservation, the demands on ecological cultivation are even higher. In parallel with Switzerland, the Ecological Performance Certificate was introduced for environmentally friendly and animal-friendly cultivation. 121 of 131 registered farms operated according to these principles. Direct payments are only made if the cultivation corresponds to the provisions of the animal protection legislation and the environmental protection provisions. The use of agricultural aids (fertilizers, pesticides) is strictly regulated; in forests and in the Alpine areas, the use of these aids (with the exception of manure) is prohibited.

In 2002, the promotion of farm animals consuming roughage was included in the Direct Payment Act. Livestock has increased over the past five years, which can be explained with reference to structural changes and the switch to mother cow husbandry. (Liechtenstein agriculture primarily relies on animal husbandry, which generates 70% of agricultural revenue.)

The new Water Protection Act, which entered into force in 2003 and is comparable to the Swiss law, specifies the thresholds for cattle and horses per area unit.

With respect to the storage and distribution of manure, subsidies of open liquid manure containers have been abolished. As an alternative, the Government is considering subsidies of flexible tube systems to distribute liquid manure.

#### 4.1.5 Forestry

Forests are very important to Liechtenstein. 43% of the country's territory is covered by forests, and this area is still growing. For this reason, sustainability in forestry has been accorded great importance ever since the introduction of the Forestry Regulations in 1865. Important goals of the current Forestry Act (1991) include the qualitative and quantitative (prohibition of clearing) preservation of the forest stocks and the promotion of nature-friendly forest management. In addition to the Forestry Act, international agreements (such as the 1993 Helsinki Ministerial Conference on the Protection of Forests in Europe) provide the basis for modern forest management. The natural rejuvenation of forests with local tree species appropriate to the location, the promotion of graded forest stock structures, and the ecological improvement of the edges of forests are examples of this. In general, the promotion of biological diversity in forests is becoming an increasingly important part of Liechtenstein forest management. For instance, Liechtenstein now maintains forest reserves on one fifth of the forest area, where all forms of forestry activities are prohibited.

In June 2001, Liechtenstein published a National Forest Program. With the program, Liechtenstein reacted to international obligations to promote sustainable forest management. With a view to meeting sustainable development goals, the National Forest Program encompasses the following principles in particular: respect for national sovereignty and self-responsibility in the use of resources, compatibility with the domestic legal provisions, compliance with obligations arising

from international conventions and agreements, establishment of partnerships and participation of all interested groups, use of a holistic approach to the preservation and cultivation of forests, and selection of a long-term and iterative planning, implementation, and monitoring process.

The entire Liechtenstein forest stock is certified according to the criteria of the Forest Stewardship Council (FSC) (SGS-FM/COC-0764).

#### 4.1.6 International cooperation

International cooperation is an important pillar of Liechtenstein climate policy, given the small size of the country and its limited capacities. Liechtenstein ratified the Climate Convention on 22 June 1994 and the Kyoto Protocol on 3 December 2004, thereby taking on the obligation of reducing its greenhouse gas emissions during the period of 2008-2012 by 8% relative to 1990.

Liechtenstein is also State party to several other environmental agreements. The following agreements more or less closely related to climate should be mentioned in this context:

- Vienna Convention for the Protection of the Ozone Layer.
- Montreal Protocol on Substances that Deplete the Ozone Layer.
- Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa.
- Convention on Long-Range Transboundary Air Pollution. Liechtenstein has also ratified seven of the eight protocols, namely those concerning Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 percent, Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP), Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes, Further Reduction of Sulphur Emissions, Persistent Organic Pollutants (POPs), Heavy Metals and Control of Nitrogen Oxides or their Transboundary Fluxes. In 1999, Liechtenstein also signed the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone.
- Convention on Environmental Impact Assessment in a Transboundary Context.
- Convention on the Protection of the Alps and its protocols on spatial planning and sustainable development, mountain farming, conservation of nature and landscape preservation, mountain forests, tourism, soil protection, energy, transport, and settlement of disputes.

## 4.2 Overview of the measures

Table 4-1 provides an overview of the most important implemented and planned measures in Liechtenstein. The key measures will be presented in detail in the following chapters.

Policy / Measure	Goals / Approach	Affected climate gas	Type of instrument	Status	Responsible institution	Implementation indicators
<b>a) Energy</b>						
Energy Conservation Act	Promotion of heat insulation (renovation of old buildings), residential technical installations (room heating and non-potable warm water), solar energy (thermal solar collectors and photovoltaics), and demonstration facilities.	CO <sub>2</sub>	Fiscal measure (subsidy)	In force since 1996	Office of Economic Affairs	Substitution of approx. 850,000 liters of heating oil per year
Heating regulations	Heated outdoor areas and ramps, outdoor heating and warm air curtains, electric room heating, and other stationary resistance heating of over 3kW are prohibited. Heating costs calculated according to consumption. Periodic monitoring of ventilation systems.	CO <sub>2</sub>	Regulation	Implemented since 1993 New Energy Ordinance since 2003	Building and Fire Authority	
Heat insulation regulations	Buildings and installations must be planned as energy-efficient as possible (minimum insulation values), according to Ordinance / SIA Norm 380/1. If the building volume exceeds 2000 m <sup>3</sup> , the heating requirements may not exceed 80% of the SIA value.	CO <sub>2</sub>	Regulation	Implemented since 1993 New Energy Ordinance since 2003	Building and Fire Authority	
Minergy standard for State buildings	Requirement that all new State buildings be constructed according to the Minergy standard.	CO <sub>2</sub>	Regulation	Implementation since 2003	Building and Fire Authority	Energy savings of 30% per building
Supply requirements	Determination of energy supply areas with requirement to join a district heating network.	CO <sub>2</sub>	Planning measure	Implemented since 1995 (Energy Ordinance)	Building and Fire Authority	
Liechtenstein Energy Concept 2013	Reduction of CO <sub>2</sub> emissions through appropriate measures. The Minergy standard now includes a subsidy, supplementing the Energy Conservation Act. Stronger promotion of heat insulation in old buildings and of photovoltaics. An additional measure is the construction of a biogas facility for the	CO <sub>2</sub>		Adopted by the Government in 2004	Office of Economic Affairs	

Policy / Measure	Goals / Approach	Affected climate gas	Type of instrument	Status	Responsible institution	Implementation indicators
	fermentation of biomass. The biogas generated will be refined to natural gas quality and used as fuel.					
Green electricity (LiStrom Öko)	Auditing (SQS) and certification (VUE) of all domestic production sites according to "naturemade" product mixture of renewable energy sources (drinking water power plants) and new renewable energy sources (photovoltaic systems).	CO <sub>2</sub>	Market-oriented supply, demand for ecological products (voluntary basis)	Since the beginning of 2004 (open-ended)	Liechtenstein Power Authority	
Promotion of photovoltaic systems of private owners	Through the sale of green electricity, the Liechtenstein Power Authority (LPA) pays 80 cents / kWh for energy generated from photovoltaic systems certified as "naturemade star" from 2004-2009.	CO <sub>2</sub>	Promotion by the LPA	Since the beginning of 2004		
Promotion of energy generated by systems for efficient energy production	The conveyance price for the energy volume for own use may be waived in the case of production systems based on renewable energies or systems for efficient energy use.	CO <sub>2</sub>	Electricity Market Act	In force since 2002		
Intelligent Energy Europe	Sustainable development in the field of energy, by making a balanced contribution to the attainment of the following general goals: energy supply security, competitiveness, and environmental protection.	CO <sub>2</sub>	EU program	Since 2003		
Energy Star (labeling program for energy-saving office appliances)	The Energy Star label has already attained international significance. Appliances with the Energy Star label have a competitive advantage compared with non-labeled appliances. In a simple way, the label provides information to the consumer on the energy efficiency of the appliances.  Reduction of CO <sub>2</sub> emissions by preventing unnecessary stand-by of electric appliances. Stand-by accounts for about 10% of energy use of appliances.	CO <sub>2</sub>	Agreement between the US and the EU	In force		



Policy / Measure	Goals / Approach	Affected climate gas	Type of instrument	Status	Responsible institution	Implementation indicators
Participation of municipalities in the Energy City label (see footnote 3)				Award of the label to the first municipality (Triesen)		
Climate protection and energy platform, as part of the Environment Commission of the International Lake Constance Conference	Coordination, exchange of experiences, information	all	Data collection	2005: Status report on climate protection on Lake Constance, with recommendations for activities 2005: Guidelines with practical examples	Office of Environmental Protection	
Elaboration of a hydrogeological map as a basis for using near-surface geothermal heat	Use of near-surface geothermal energy for heating purposes	CO <sub>2</sub> , precursor gases	Foundations	2005: Completion of the map	Office of Environmental Protection	
<b>b) Transport</b>						
Heavy Vehicle Fee	Relocation of goods transport from the road to railways, and reduction of transalpine road transport	CO <sub>2</sub> , precursor gases	Fiscal measure (internalization of external costs)	Implemented since 1.1.2001	Finance Administration	Expected reduction of 13.6-17.2% truck-kilometers 1/3 of revenue used for environment and transport
Promotion of solar, electric, natural gas, and/or hybrid vehicles	Vehicle tax waived for electric, natural gas, and/or hybrid vehicles	CO <sub>2</sub> , precursor gases	Fiscal measure	Implemented 1999	Driver and Vehicle Licensing Office	
Conversion from diesel buses to natural gas buses in public transport	Purchase of new natural gas buses	precursor gases (NO <sub>x</sub> , VOC, SO <sub>2</sub> )	Investment measure; Subsidy (using HFV funds)	Implemented 2001	Liechtenstein Bus Authority	Reduction of bus fleet emissions by approx. 40% (esp. NO <sub>x</sub> , VOC, SO <sub>2</sub> )
Subsidies of electric scooters and electric bicycles	Promotion of light electric vehicles used for personal transport instead of private automobiles.	CO <sub>2</sub> , precursor gases	Fiscal measure (subsidy)	Implemented 2002	Driver and Vehicle Licensing Office	
Construction and operation of a public natural gas fueling station	Infrastructure for providing fuel to private vehicles	CO <sub>2</sub>	Investment measure; Infrastructure measure	Implemented since 2001	Building and Fire Authority Bureau of Energy Consumption and Conservation	Approx. 20% fewer CO <sub>2</sub> emissions with a natural gas engine than with a petrol engine
Supply of biogas into the natural gas fueling station	Supply of CO <sub>2</sub> -free fuel for the natural gas fueling station	CO <sub>2</sub>	Investment measure; Infrastructure measure	Planned beginning 2006/07	Building and Fire Authority; Bureau of Energy Consumption and	

Policy / Measure	Goals / Approach	Affected climate gas	Type of instrument	Status	Responsible institution	Implementation indicators
					Conservation; Office of Environmental Protection	
Design of motor vehicle tax according to specific CO <sub>2</sub> emission	Incentive system for purchase of private vehicles with lower CO <sub>2</sub> emissions	CO <sub>2</sub>	Regulation, Fiscal measure	Planned beginning 2007	Driver and Vehicle Licensing Office Office of Environmental Protection	
Promotion of public transport	Establishment of the Liechtenstein Bus Authority and introduction of the "Liechtenstein Takt" regional train schedule	CO <sub>2</sub> , precursor gases	Institutional measure	Implemented since 2000	Finance Administration	
Exhaust regulations	Adoption of the European exhaust regulations (EURO norms) Fuel regulations	precursor gases	Regulation	Ongoing (since 1993)	Driver and Vehicle Licensing Office	Continuous reduction of all road traffic emissions
Promotion of slow transport	The bicycle and pedestrian network is being expanded continuously and made more attractive.	CO <sub>2</sub> , precursor gases	Institutional measure	Ongoing	Ministry of Transport and Telecommunications, Office of Civil Engineering	
Zoning requirements	Limitation of the number of parking spaces for construction projects, where justified by municipal or national planning.	CO <sub>2</sub> , precursor gases	Regulation	Implemented since 2003	Building and Fire Authority	
<b>c) Stationary facilities and waste</b>						
Emissions regulations	Emissions regulations for stationary facilities (heating, industry)	CO <sub>2</sub> , precursor gases	Regulation	Implemented since 1987 Revised 1992 and 2005	Office of Environmental Protection	
Waste removal regulations in construction	Waste management: disposal concept and proof of recycling must be provided before construction begins.	CH <sub>4</sub> , CO <sub>2</sub>	Regulation	Implemented 1993, (Ordinance on the Construction Act)	Building and Fire Authority	
<b>d) Agriculture</b>						
Ecological equalization payments in agriculture	Product-independent contributions for conversions to ecological cultivation methods	CH <sub>4</sub> , N <sub>2</sub> O	Fiscal measure (direct payments)	Implemented since 1996	Office of Agriculture	Ecological Performance Certificate
Preservation of soil for agricultural use	Agriculture: permanent protection of soil for agricultural use from misuse	CH <sub>4</sub> , N <sub>2</sub> O	Regulation	Implemented since 1992	Office of Agriculture	
Water Protection Act	Cap on maximum number of cattle per land area	CH <sub>4</sub> , N <sub>2</sub> O	Regulation	Implemented since 2003	Office of Environmental Protection	

Policy / Measure	Goals / Approach	Affected climate gas	Type of instrument	Status	Responsible institution	Implementation indicators
<b>e) Planning</b>						
Foundations for a register	Establishment of a national energy register	CO <sub>2</sub>	Planning measures	Planned starting 2002	Building and Fire Authority	
National guidance plan	Coordinated and sustainable development of the living and economic area of Liechtenstein on an inter-municipal and cross-border scale.	---	Planning measure, regulations, binding on State authorities	Planned (consultations beginning of 2006, adoption end of 2006)	Office of Land Use Planning	
<b>f) Forests</b>						
Cultivation regulations in the Forestry Act	Sustainable cultivation of forests	CO <sub>2</sub> (sinks)	Regulation	Implemented 1991	Office of Forests, Nature and Land Management	National Forest Inventory 1998
Ordinance on the scope and benefits of compensation and financial aid in the framework of the Forestry Act	Performance target	CO <sub>2</sub> (sinks)	Regulation	Implemented 1995	Office of Forests, Nature and Land Management	National Forest Inventory 1998
Ordinance on forest reserves and protected areas	Performance target	CO <sub>2</sub> (sinks)	Regulation	Implemented 2000	Office of Forests, Nature and Land Management	National Forest Inventory 1998
Forest Inventory 1998 and National Forest Program (2002-2012)	Binding specifications for future use of forests; development of a Forest Inventory 2010	CO <sub>2</sub> (sinks)	Planning measure, Regulations	Implemented 2001	Office of Forests, Nature and Land Management	
FSC certification of the entire forest stock	Performance target	CO <sub>2</sub> (sinks)	Operational planning	Implemented 2001	Office of Forests, Nature and Land Management; Forestry operations	Certification report

Table 4-1: *Implemented and planned measures*

## 4.3 Implemented measures

With its new Energy Concept 2013 (Energy Commission 2004), Liechtenstein has staked out ambitious goals, such as increasing the share of renewable energy as part of total energy consumption by 10% by 2013, reducing heat loss, investments in block heating plants, etc. The following sections will present the most important and interesting measures to attain these goals.

### 4.3.1 Energy

The following measures are the focus of the efforts to promote energy conservation:

- **Renovation of old buildings:**  
Many older buildings are insufficiently insulated against heat loss. Subsidies of up to 75,000 CHF may be granted for subsequent heat insulation.
- **Promotion of the Minergy standard:** The standard requires buildings to offer a high level of comfort, economic efficiency, and low energy consumption. Monitored ventilation systems also optimize air quality. In Liechtenstein, the standard is employed for all new administrative buildings.
- **Residential technical installations:**  
If the building shell already fulfills the requirements for modern insulation, then residential technical installations with low consumption or operating with renewable energy can further enhance conservation. State subsidies may be granted up to 20,000 CHF.
- **Solar collectors:**  
Thermal solar collectors can produce most of the warm water needed, thereby reducing heating oil and electricity consumption. The State subsidizes such collectors with a contribution of 350 CHF per square meter.
- **Photovoltaics:**  
Photovoltaic systems generating electricity are subsidized with a contribution of 8,500 CHF per installed output (kW). The maximum subsidy per system is CHF 7,500. The generated electricity must be fed into the public network.
- **Demonstration facilities:**  
Liechtenstein law also provides for the promotion of demonstration facilities, with which public understanding of energy conservation is enhanced and the use of new technology and new technical possibilities is demonstrated.
- **Finally, a hydrogeological map will be developed as a foundation for using near-surface geothermal energy for heating purposes.**
- **Offer of cooperation to "Energy City for Everyone" municipalities.** "Energy City" municipalities are municipalities committed to energy conservation and energy efficiency that submit themselves to annual evaluation. A first municipality (Triesen) has already received the label.

In 2004, CHF 48,000 were contributed to the renovation of old buildings, CHF 165,000 to residential technical installations, CHF 281,000 to solar collectors/photovoltaic systems, and CHF 543,000 to demonstration facilities. The municipalities individually supplement the national subsidies with additional funds.

In addition to these energy provisions, the Minergy standard is promoted and employed in public buildings. The reduction in heating energy consumption achieved by these measures entails that the

relative share of energy consumption for heating water is rising. Covering this consumption through the use of solar energy is therefore becoming increasingly important.

### **4.3.2 Transport**

#### **Heavy Vehicle Fee**

The Heavy Vehicle Fee was introduced on 1 January 2001 in parallel with Switzerland. It internalizes external costs. With the help of highly modern recording technology, the kilometers driven are measured. The fee applies to vehicles with a permissible total weight of 3.5 tons and above, and amounted to 1.6 cents per kilometer per ton of total weight in the first phase (2001 to 2005). In the second phase (since the beginning of 2005), the fee has been increased to 2.5 cents (at least 2.15 cents, at most 2.88 cents). It is graded according to emissions criteria (EURO norms). In this way, carriers are given an incentive to purchase the most modern vehicles and to use them efficiently and at full capacity. In addition, the measure increases the costs for goods transport by roads, which results in a movement of goods to the railways. One third of the revenue is earmarked for the environment and transport. This amounts to approximately 3 million CHF.

#### **Promotion of green vehicles**

Vehicles with environmentally friendly engines (solar, electric, and/or hybrid vehicles) are exempt from the motor vehicle tax. This relative discount creates greater incentives to purchase and use such vehicles.

As a member of the European Economic Area, Liechtenstein must also implement the EU regulations in this area. The focus is on the EURO norms (exhaust regulations) and on measures to promote energy-efficient vehicles, especially by introduction of a labeling system. The goal is to reduce CO<sub>2</sub> emissions, precursor substances, and N<sub>2</sub>O emissions.

#### **Promotion of electric scooters and electric bicycles**

The Liechtenstein State subsidizes private purchases of electric scooters and electric bicycles by up to 50%. This achieves an increased substitution of short automobile rides.

#### **Promotion of public transport**

Public transport enjoys a high priority in Liechtenstein. For this purpose, the public transport schedule has been significantly improved in recent years, especially in cross-border transport ("Liechtenstein Takt"). In 2006, a new public transport schedule will be implemented, which will again entail significant improvements in frequency and attractiveness. In 2004, a Liechtenstein Transport Report was drafted, which established the foundations for the long-term orientation of public transport. These demands on high-performance public transport in Liechtenstein are currently being defined. Liechtenstein is also participating in international planning studies to improve public transportation. Studies used as examples include "BodanRail 2020" (improvement of railway access in the greater Lake Constance region) and the feasibility of a cross-border regional suburban train.

In 2001, a natural gas fueling station was established, and the public transport bus fleet was subsequently converted to natural gas. More than 50% of bus-kilometers are now driven with natural gas buses.

### **4.3.3 Industry and waste**

Liechtenstein does not have any heavy industries. As a rule, Swiss measures have been adopted in this area. The focus is on the following measures:

**VOC tax:** This disincentive tax was introduced in 1999 in parallel with Switzerland. On 1 January 2000, a tax of 2 CHF per kilogram was introduced for products containing more than 3% NMVOC. In 2003, the tax was raised to 3 CHF per kilogram of VOC.

SO<sub>2</sub> policy: Liechtenstein has adopted Swiss regulations for reducing the sulfur content of engine and heating fuels (from 0.2% to 0.05% for diesel (since 1994), from 1.5% to 1% for heavy oil (since 1991)). In addition, Liechtenstein also levies a SO<sub>2</sub> tax on light oils (with a sulfur content of over 1%). This tax was adopted in 1998.

Regulations on dangerous substances: The Ordinance on Dangerous Substances (since 1995) regulates dangerous substances (from the perspective of the climate, especially HFC, PFC, SF). The Ordinance bans several substances (especially in fire extinguishers and spray cans). For spray cans, only HFC-125 is allowed as a substitute substance. These Swiss regulations were revised in 2005. Pursuant to the Customs Treaty, these new provisions are again applicable to Liechtenstein.

Between 2002 and 2004, all heating systems exceeding 1 MW were brought up to the most current level of technology, which entails a significantly lower consumption of natural gas and petroleum.

#### **4.3.4 Agriculture and forestry**

In cultivating forests and soil, Liechtenstein pays attention to nature-friendly implementation. The key measures of recent years have legally enshrined nature-friendly cultivation (Forestry Act, FSC certification) and have promoted them via direct payments (ecological compensation payments). In addition, a status quo of forest and agricultural areas is being required: If an area is used for a different purpose, an equivalent area of forest or arable land must be made available.

Recently, closer attention has been paid to the problem of ammonia emissions from agriculture. The subsidies for liquid manure containers have been amended to eliminate incentives to construct open liquid manure holes. Promotion of liquid manure distribution through flexible tube systems is being reviewed in 2005.

## **4.4 Planned measures**

The following approaches are especially relevant to future climate policy.

### **4.4.1 Climate policy**

Liechtenstein has commissioned a report (Factor 2000) on the foundation of the country's future climate strategy (implementation of the Kyoto Protocol). At that time, the report concluded that a purely national strategy would be difficult to implement, and that the marginal costs of additional reductions would be relatively high, based on the already high existing level of climate-control measures. The report recommended an internationally oriented strategy based on the Kyoto Mechanisms (Joint Implementation, Clean Development Mechanism, Emission Trading). These mechanisms would allow a significant improvement of the cost-effectiveness of climate policy. Liechtenstein is currently examining its level of engagement and participation in these international instruments and taking the necessary preparatory steps. The focus is on the requisite implementation of the National Register under Liechtenstein's obligations arising from the Kyoto Protocol; in accordance with the Marrakech Accords, Liechtenstein is striving for a hosting solution in collaboration with Switzerland. Administrative cooperation is also being considered with respect to the assessment and implementation of projects in the framework of Joint Implementation and the Clean Development Mechanism.

In principle, however, national measures are accorded the highest priority. In this regard, Liechtenstein also expects to implement appropriate measures of Swiss climate policy. This could primarily concern the introduction of a CO<sub>2</sub> tax (beginning in 2006), if the voluntary measures provided for in the Swiss CO<sub>2</sub> Act prove ineffective. Pursuant to the joint economic area with Switzerland, the climate cent levied by Switzerland on engine fuel since October 2005 is also being levied in Liechtenstein. The Government has signed an agreement with the Swiss "Climate Cent Foundation" to this effect, governing the administrative and organizational measures. Questions concerning the use of the revenue for climate protection projects must still be developed in detail.

In principle, the revenue will be earmarked for climate protection projects in Liechtenstein and abroad.

#### **4.4.2 Energy**

##### **Energy Market Act (EMA 2002)**

The Energy Market Act entered into force in 2002. In October 2004, the Liechtenstein electricity market was opened up and liberalized 100%. This means that every approved client may now freely choose which electricity supplier to buy electricity from.

##### **Energy Conservation Act**

Pursuant to the measures envisaged by the Energy Concept 2013, the Energy Conservation Act and its ordinance will be amended as of the middle of 2006. The Energy Concept 2013 lists a package of measures contributing to the achievement of the Kyoto goals. In particular, energy conservation for room heating will be reached through targeted thermal renovations of buildings. An important objective is also the increase in the share of renewable energies to over 10% of total energy consumption by 2013. A further point is the expanded use of domestic biomass, also in the form of biogas, as well as an increased use of solar energy.

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## 5 Projections and overall effect of the measures

### 5.1 Methodology

The United Nations Climate Convention requires that the climate reports of the States Parties not only list the emissions in recent years, but also include projections for the future (UNFCCC 1999). In view of its small size, however, Liechtenstein does not have such comprehensive projections at its disposal. The results presented for the year 2010 therefore rely primarily on comparisons and analogies with Switzerland (FOEN 2005).

#### **Swiss foundations for the energy sectors**

The Swiss Federal Office of Energy periodically determines energy scenarios (SFOE 2005). These are based on a detailed set framework and a "bottom up" approach, in which new structural prognoses are regularly incorporated. These energy scenarios are adjusted using macro-economic models.

The energy perspectives include a reference scenario ("with measures implemented") and a further-reaching scenario ("with measures adopted or planned") for the period 2000 to 2010. The reference scenario is based on the following assumptions concerning the development of important structural parameters:

- the population will grow by approx. 4%,
- GDP will grow by approx. 1.5% annually,
- industrial added value and production will increase by approx. 10%.

In the energy sector, a nearly constant price of crude oil is assumed. The increased implementation of energy policy measures will lead to greater energy efficiency in households and industry. In the transport sector, two opposing trends are assumed: on the one hand, the energy efficiency of vehicles will grow; on the other hand, automobiles will become increasingly larger and heavier. At the same time, the share of diesel vehicles and the share of natural gas and bio-fuel vehicles will increase, which will reduce "fuel tourism" in Switzerland and Liechtenstein (i.e., less petroleum "export" and less diesel "import").

Details on both energy scenarios and their effects can be found in the fourth national climate report of Switzerland (FOEN 2005).

#### **Swiss foundations for non-energy sectors**

The other projections are primarily compiled by the Swiss Federal Office for the Environment (FOEN). They are emissions projections on the basis of structural models and projections for emission factors, which are also continuously updated. In the current report (FOEN 2005), the emissions projections for all Kyoto gases are represented for all Kyoto gases between 1990 and 2010.

## 5.2 CO<sub>2</sub>

Table 5-1 provides an overview of the CO<sub>2</sub> emissions between 1990 and 2010. From 1990 to 2003, the emissions increased by 5.5%; a slight decrease is expected from 2003 to 2010. For the whole period from 1990 to 2010, however, an increase of 4.8% is assumed.

The results reflect the development under the assumption that the adopted measures will be effective (reference scenario). If the planned measures would also be taken into account, especially the introduction of a CO<sub>2</sub> tax, then the emissions could be reduced slightly relative to 1990. More detailed calculations for the aggregated effects of the individual measures are not possible, however.

Carbon dioxide CO <sub>2</sub>	1990 (Gg) (1990 = 100%)	2003 (Gg)	2010 (Gg)
Industry	62.5 (100%)	66.4 (106.3%)	66.8 (106.8%)
Transport	87.8 (100%)	91.6 (104.4%)	90.3 (102.9%)
Residential, institutional, commercial	77.0 (100%)	81.8 (106.2%)	81.1 (105.3%)
Agriculture	NO	NO	NO
Waste	NO	NO	NO
Gross total emissions	227.3 (100%)	239.9 (105.5%)	238.2 (104.8%)

Table 5-1: Trend and projection of CO<sub>2</sub> emissions, 1990–2010.

## 5.3 CH<sub>4</sub>

Table 5-2 shows the development of the CH<sub>4</sub> emissions between 1990 and 2010. Since so far, not all emissions for the base year 1990 have been able to be estimated, the trend of the total emissions can only be qualitatively estimated. To a high degree of certainty, however, it can be assumed that the emissions will decrease, since the emissions from the transport, residential, institutional, and commercial sectors in 1990 were higher than in 2003, so that all sectors exhibit a decrease, whether thanks to improved exhaust technologies or because of a decreasing number of agricultural animals.

<b>Methane CH<sub>4</sub></b>	<b>1990 (Gg) (1990 = 100%)</b>	<b>2003 (Gg)</b>	<b>2010 (Gg)</b>
Industry and network losses in gas supply	0.030 (100%)	0.038 (125%)	0.036 (120%)
Transport	NE	0.009	0.006
Residential, institutional, commercial	NE	0.012	0.013
Agriculture	0.680 (100%)	0.664 (98%)	0.653 (96%)
Waste	NO	NO	NO
Gross total emissions	0.710 (incomplete)	0.723	0.708

Table 5-2: Trend and projection of CH<sub>4</sub> emissions, 1990–2010.

## 5.4 N<sub>2</sub>O

Table 5-3 shows the development of N<sub>2</sub>O emissions between 1990 and 2010. The total emissions of N<sub>2</sub>O will decrease by about 15.6% in this time period. The greatest decrease (almost 40%) will be in the transport sector: While the first generations of three-phase catalytic converters still generated a relatively high amount of nitrous oxide, the new catalytic converters have been improved in this regard. In the coming years, agriculture will also generate less nitrous oxide, thanks to reductions in the use of fertilizers containing nitrogen and decreasing numbers of farm animals.

<b>Nitrous oxide N<sub>2</sub>O</b>	<b>1990 (Gg) (1990 = 100%)</b>	<b>2003 (Gg)</b>	<b>2010 (Gg)</b>
Industry	0.00030 (100%)	0.000286 (95.2%)	0.00029 (96.7%)
Transport	0.01000 (100%)	0.01056 (105.6%)	0.00612 (61.2%)
Residential, institutional, commercial	0.00100 (100%)	0.001006 (100.6%)	0.00101 (101.3%)
Agriculture	0.01500 (100%)	0.01589 (105.9%)	0.01478 (98.6%)
Waste	NO	NO	NO
Gross total emissions	0.02630 (100%)	0.02775 (105.5%)	0.02221 (84.4%)

Table 5-3: Trend and projection of N<sub>2</sub>O emissions, 1990–2010.

## 5.5 Aggregated projection

The following figures and tables show the aggregated greenhouse gas emissions for 1990, 2003, and 2010 in CO<sub>2</sub> equivalent. The sum of the climate gas emissions increased by almost 4% from 1990-2003. A decrease in N<sub>2</sub>O and CH<sub>4</sub> emissions is opposed by an increase in CO<sub>2</sub> emissions, which dominates the overall picture. In considering this result, however, it should be noted that the

1990 estimate is incomplete (see table entries with NE: not estimated). It can be assumed that the methane emissions that are not estimated amount to at least 4 Gg CO<sub>2</sub> equivalent, so that the 1990 sum is in effect higher by this amount. If this estimate is used as a basis, then the increase would roughly be cut in half (2% between 1990 and 2010).

Using these assumptions for the development from 2003 to 2010, there will still be an increase of climate gas emissions, despite all efforts and instead of the reduction required by the Climate Convention and especially by the Kyoto Protocol.

Sectors	CO <sub>2</sub> Gg CO <sub>2</sub> eq.			CH <sub>4</sub> Gg CO <sub>2</sub> eq.			N <sub>2</sub> O Gg CO <sub>2</sub> eq.			Total Gg CO <sub>2</sub> eq.		
	1990	2003	2010	1990	2003	2010	1990	2003	2010	1990	2003	2010
Industry (incl. fugitive emissions)	62.5	66.4	66.8	0.63	0.79	0.75	0.09	0.09	0.09	63.22 100%	67.28 106.4%	67.61 106.9%
Transport	87.8	91.6	90.3	NE	0.19	0.13	3.10	3.27	1.90	90.87 100%	95.10 104.7%	92.32 101.6%
Residential, institutional, commercial	77.0	81.8	81.1	NE	0.25	0.27	0.31	0.31	0.31	77.33 100%	82.39 106.5%	81.72 105.7%
Agriculture	NE	NE	NE	14.28	13.95	13.7 1	4.65	4.93	4.58	18.93 100%	18.87 99.7%	18.29 96.6%
Waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (rounded)	227.3	239.9	238.2	14.9	15.2	14.9	8.2	8.6	6.9	250.4 100%	263.7 105.3%	260.0 103.8%

Table 5-4: Trend and projection of climate gases in CO<sub>2</sub> equivalent, 1990–2010.

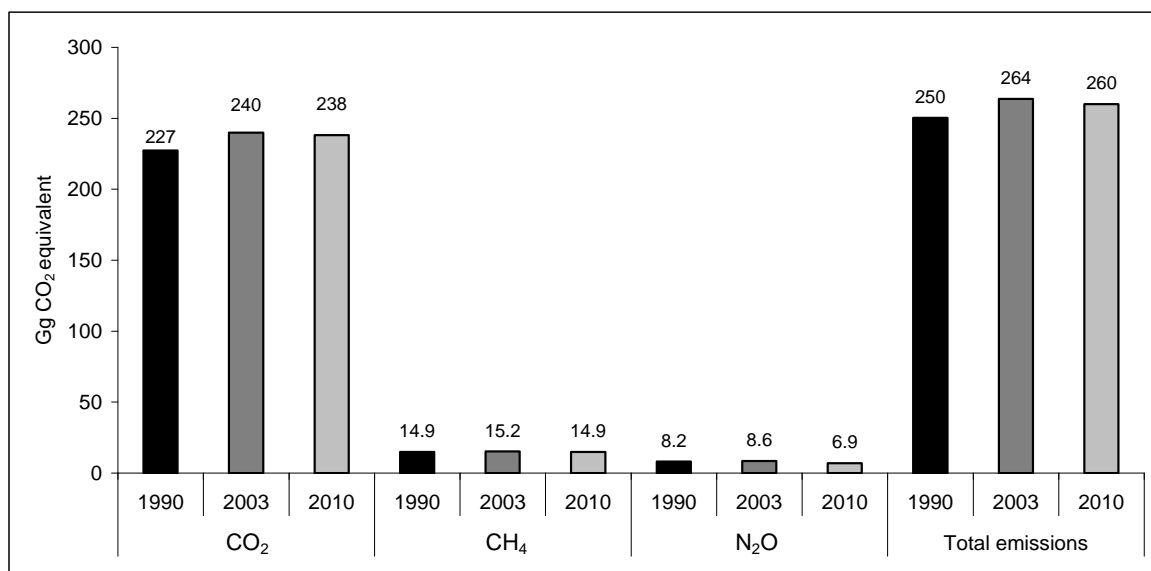


Figure 5-1: CO<sub>2</sub>, CH<sub>4</sub>, und N<sub>2</sub>O emission

s 1990, 2003 and 2010 in Gg CO<sub>2</sub> equivalent (corresponds to Table 5-4 above).

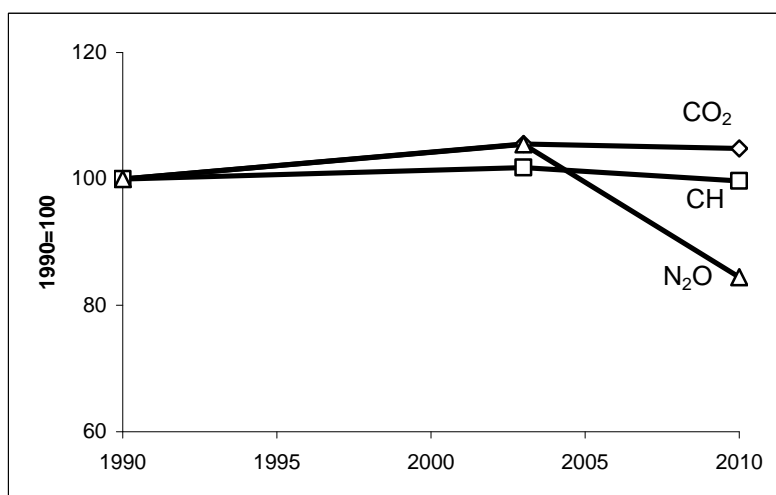


Figure 5-2: Relative development of the CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions, 1990-2010, Index 1990 = 100.

## 5.6 Precursor substances and SO<sub>2</sub>

Table 5-5 shows the trends and projections of the precursor gases NO<sub>x</sub>, CO, and NMVOC and of SO<sub>2</sub> between 1990 and 2010. The emissions of the precursor gases are decreasing thanks to the exhaust regulations for road traffic and other clean air measures. The SO<sub>2</sub> emissions, however, are increasing slightly due to the current trend toward more diesel vehicles instead of petrol vehicles.

Gas (Gg)	1990	2003	2010
NO <sub>x</sub>	0.390 (100%)	0.416 (107%)	0.330 (85%)
CO	1.600 (100%)	1.665 (104%)	1.237 (77%)
NM VOC	0.150 (100%)	0.148 (99%)	0.092 (61%)
SO <sub>2</sub>	0.080 (100%)	0.085 (106%)	0.081 (102%)

Table 5-5: Trend and projection of precursor gases and SO<sub>2</sub> for 1990–2010.

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## 6 Effects of global warming and adaptation measures

### 6.1 Expected effects of global warming

In recent years, various research programs on the effects of global climate warming in the Alpine region have been conducted. The development so far and projections indicate that noticeable effects are to be expected. Changes to the permafrost boundary and water drainages will play a central role in this regard. Liechtenstein is also affected by these developments. These effects have primarily been studied in Switzerland (as part of a national research projects). Several natural events in recent years (e.g., the storm Lothar) have had severe consequences for the Liechtenstein forests – approximately one year of wood use was lost due to Lothar.

#### 6.1.1 Observations, measurements and projections:

**Temperature:** The average temperature in Switzerland has risen by 0.4°–0.6°C per decade since 1970, in both the summer and the winter. This increase is three times as great as the worldwide increase. This trend of a greater increase has also been observed in the other Alpine countries (Begert 2005). Within the framework of the EU project PRUDENCE, temperature increases of 1°–5°C in the summer and 1°–3°C in the winter are being calculated for Switzerland by 2050.

**Precipitation:** A significant increase in precipitation of 0.7% – 1% per decade has been observed in recent years in Switzerland on the northern side of the Alps. In the Alps themselves, increases of even 1.6% – 3.7% per decade have been observed in the winter half-year (Schmidli 2002). The Advisory Body on Climate Change (OcCC), which advises the Swiss Federal Council on questions of climate change, predicts future precipitation increases of 5% – 25% for the winter half-year and reductions of between 5% and 40% in the summer half-year. This would represent a substantial shift in the seasonal distribution of precipitation (OcCC 2003).

**Glaciers and permafrost:** According to the most recent observations, glaciers in the Alps have lost 25% of their volume since 1970 (Paul 2004). In the record hot summer of 2003 alone, 5% – 10% of the volume melted. Accordingly, a particularly high number of rock slides was recorded in 2003, an indication of further reduction of permafrost.

**Ecosystems:** Phenological observations show that the biological beginning of spring has been advancing by 1.5–2.5 days per decade (Studer 2005). For instance, cherry blossoms at the bend of the Rhine in Basel now appear several days earlier than they did in 1980, and the highest elevation where mistletoe is found in Switzerland has risen by 250 meters.

#### 6.1.2 Possible consequences

It is difficult to transfer the consequences of global climate warming calculated on the basis of models to Liechtenstein. The available climate models are not yet able to predict detailed regional consequences. Overall, however, the following general effects can be expected as a consequence of a further increase of the CO<sub>2</sub> concentration and the associated rise in temperature and reduction of permafrost:

Health: Heat waves with increased mortality. In Switzerland, an increase by 7% was observed in 2003 (Grize 2005). Effects on health are also precipitated by changes of the environmental condition for pathogens. Tropical diseases will increasingly also surface in Central Europe (malaria, dengue fever), and existing diseases will spread to higher elevations and therefore also to new regions of the country (borreliosis, meningitis). Indirect consequences for health are to be expected from storm, floods, and landslides.

Ecosystems: Warming changes the composition of forest vegetation. Deciduous trees may become more important than today. Additional weather instabilities (e.g., storms, avalanches) may have a further negative effect on forest vegetation.

Water cycles and soil: The increasing weather instabilities may lead to floods in the winter and droughts in the summer. A great danger in this regard exists in the narrow Alpine valleys (mountain streams), where various protective measures (e.g., rock fall barriers and water course corrections) are necessary. A further danger is posed by the Rhine; although regulated, the Rhine may endanger the heavily used Rhine Valley floor in the event of a flood.

Individual economic sectors: Global climate warming will affect various economic sectors in Liechtenstein. Because of the processes described above, agriculture and forestry will be affected directly. A rise in temperature will have a negative effect on the productivity of grain cultivation in the long term (Führer 2003). The expected increase in elevation of the snow and permafrost boundaries and increasing weather instability also have an effect on the important recreation and tourism area of Malbun. The international engagement of the insurance sector will likely suffer the most severe consequences from an increase in the probability of losses.

As a pure mountain country, Liechtenstein is dependent on the stability of the ecosystem. This is an important reason why Liechtenstein has initiated an active climate policy and why it takes part in international networks (such as the Alpine Convention).

## 6.2 Adaptation policies

The strategies for dealing with this new risk are very sector-specific. Chapter 4 illustrated how agriculture and forestry is aiming to become more sustainable and less vulnerable to climate problems through a modern, ecologically oriented policy. Important legal foundations in this regard are:

- Law on the Protection of Nature and Landscape (1996),
- Forestry Act (1991),
- Law on the Preservation and Maintenance of Agricultural Soil (1992),
- Ordinance on the Integral Rehabilitation of Alpine and Mountain Regions (1968).

Liechtenstein has always given a high priority to the protection of infrastructures and flood protection. These constructions are particularly important for the protection of transport routes.

The potential threat to individual economic sectors has led to a wide range of activities. Various municipalities and institutions have introduced new offerings for winter and summer tourism, in order to counter potential revenue losses. The focus is on strategies to promote "gentle tourism".

The revised Tourism Act, which entered into force in May 2000, is based on the principles of sustainability and takes into account the interests of the natural and social environment. In recent years, a tourism mission statement has been developed for the country. It deals intensively with marketing and the framework conditions for tourism. With the exception of the mountain and Alpine region, the interfaces for the protection of the landscape are still insufficient with respect to all the demands that have been formulated. In the mountain and Alpine region, an integral approach



to all utilization interests is ensured by the Ordinance on the Integral Rehabilitation of Alpine and Mountain Regions (1968).

Conceptual work will be continued by approaching the problem of tourism through the development of separate guidelines for the mountain region. On the basis of an appropriateness assessment for tourism, these guidelines will show which forms of tourism are economically desirable as well as ecologically and socio-culturally sustainable in the Liechtenstein mountain region. On this basis, a concept will be developed with appropriate measures.

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## 7 Financial resources and technology transfer

### 7.1 Responsibilities and legal foundations

Liechtenstein takes its international humanitarian responsibility seriously. Solidarity with poor countries and with countries affected by disasters and armed conflicts is a traditional focus of Liechtenstein foreign policy. The Office for Foreign Affairs is responsible for the overall coordination of International Humanitarian Cooperation (IHC) in Liechtenstein.

The Law of 19 December 1984 on the Promotion of Development and Disaster Assistance and the Law of 2 April 1998 on the Acceptance of Asylum-Seekers and Persons in Need of Protection currently constitute the foundations for Liechtenstein IHC. A reorganization is underway, however, and is currently being circulated for consultations among interested circles. This reorganization is intended to orient humanitarian engagement according to current developments and to establish an overarching profile and an up-to-date legal foundation for Liechtenstein's humanitarian engagement. According to this new concept, the Liechtenstein engagement focuses on the three areas of emergency assistance, reconstruction assistance, and development cooperation.

**Emergency assistance** provides assistance and support after catastrophes and in the wake of armed conflicts. It is primarily granted in the form of contributions to programs of international aid organizations such as the ICRC and UNHCR, as well as bilaterally, especially through the Swiss Agency for Development and Cooperation (SDC) and the Austrian Development Agency (ADA). In addition, the Government employs the instrument of "doubling" the donation campaigns of the Liechtenstein aid organizations (especially the Liechtenstein Red Cross, Caritas Liechtenstein, and the Liechtenstein Aid Society) and of private persons.

**Reconstruction assistance** for refugees was established at the beginning of the 1990's as a consequence of the crisis in the former Yugoslavia, which precipitated a wave of refugees that brought several hundred refugees to Liechtenstein. As its name indicates, it focuses on the reconstruction of infrastructure and social institutions (schools, roads, housing, healthcare, etc.) in the home countries of refugees housed in Liechtenstein. The goal is to create conditions in the former conflict areas that allow refugees to return home and that provide new perspectives for the future of the refugees and those who remained behind. The largest share of reconstruction assistance so far has been allocated to Kosovo and Bosnia and Herzegovina. Reconstruction assistance will continue to be harmonized with the refugee situation in Liechtenstein and Liechtenstein refugee policy. However, due to the increasing diversification of refugees in Liechtenstein, it will no longer be possible in the near future to sustain such a clear geographic focus. For this reason, it is likely that general refugee and reconstruction projects will also be funded more frequently in the future.

**Development cooperation** constitutes the largest share of IHC. Through economic, social, and cultural development, it aims to sustainably eradicate poverty in developing countries and transitional economies, elevate the standard of living in the population, and improve the rule of law and democratic structures in these countries. The focus is on the principle of "helping countries help themselves". The public funds for bilateral development cooperation are administered by the independent "Liechtenstein Development Service Foundation" (LDS), whose mandate is annually

approved by the Government. Overall, LDS currently administers 60 development projects and programs in its traditional focus countries of Bolivia, Peru and Nicaragua, Niger, Mali, Burkina Faso, Senegal, Mozambique, Malawi, Zambia, and Zimbabwe. Recently, LDS has also taken on Liechtenstein's Eastern European assistance projects and will now also become active in Eastern European and CIS countries as well as Asia. Multilateral development cooperation consists in the support of general or topic-specific humanitarian and development policy programs of international organizations or institutions as well as non-governmental organizations. The focus areas of IHC and of development cooperation in particular are public health, social security, education, protection and sustainable use of natural resources, rural development, and good governance. A particular emphasis is placed on the promotion of women.

Of particular note from the perspective of environmental policy is Liechtenstein's engagement through financial and human resources, such as the provision of experts and the promotion of sustainable mountain region development in the Carpathians, the Caucasus, and Central Asia.

Within the framework of **international solidarity**, Liechtenstein also regularly makes general contributions to international organizations with humanitarian or development policy objectives. Liechtenstein especially supports UN programs, but also programs run by the Council of Europe and the OSCE. Liechtenstein also contributes to funds of the European Free Trade Association (EFTA) and the World Trade Organization (WTO) that support the development of poor countries through technical cooperation. Finally, Liechtenstein regularly makes contributions to the Cohesion Fund as part of its membership in the EEA.

## 7.2 Overview of financial contributions

In 2004, Liechtenstein contributed about 14 million Swiss francs or about 400 francs per capita to International Humanitarian Cooperation (IHC). Liechtenstein expects to steady increase contributions over the coming years.

On the occasion of Liechtenstein's ratification of the Kyoto Protocol, the Government decided to support a climate project as a sign of solidarity and climate policy engagement. In 2005, Liechtenstein therefore supported the project of the Central Asian Mountain Partnership (CAMP) in Central Asia on "Saving energy, protecting natural resources, improving quality of life" with 100,000 Swiss francs.

An overview of the financial contributions of Liechtenstein as part of International Humanitarian Cooperation in 2004 can be found in the 2004 Annual Report of the Government to Parliament, p. 75-78 and p. 93-96 (LDS)<sup>6</sup>.

Table 7-1 provides an overview of the most important contributions relating to the environment in 2004.

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<sup>6</sup> See <http://www.llv.li/amtstellen/llv-rk-amts-geschaefte-rechenschaftsbericht/llv-rk-amts-geschaefte-archiv2004.htm> (in German).

Contributions and projects	Partner	Amount (CHF)
Climate Convention: contribution to general budget	UNFCCC	1,300
Multilateral fund of the Montreal Protocol (Ozone Fund): annual contribution		17,300
World Conservation Union (IUCN): contribution to general budget	IUCN	13,700
Permanent Secretariat of the Alpine Convention: contribution to the annual budget		24,000
UNEP: contribution to the general budget / Environment Fund	UNEP (UN Environment Programme)	5,900
Basel Convention: contribution to the general budget		7,500
Sustainable development of mountain regions in the Caucasus – Pilot projects for the creation of a regional strategy (financial contribution and Liechtenstein advisor/expert)	Regional Environmental Centre for the Caucasus (REC)	32,000
Campaign for better insulation of homes in Central Asia	Central Asian Mountain Partnership (CAMP)/SDC	75,000
Establishment of an information-protection cabin in the Borjomi Kharagauli National Park	WWF (Borjomi Kharagauli National Park)	30,000
TOTAL		206,700

*Table 7-1: Overview of the most important contributions as part of Liechtenstein's international engagement in environmental protection, 2004*

With the strategy report already mentioned in chapter 4 (Factor 2000), an important foundation has been laid for Liechtenstein's international climate policy. Currently, a number of options are under detailed consideration for expanding Liechtenstein's engagement in the area of climate.

## 8 Research and climate monitoring

### 8.1 Research

#### Basic research

Liechtenstein maintains its own University of Applied Sciences, at which institutes (Institute for Architecture and Planning) also examine sustainable development. Currently, the Institute is working in concert with other organizations on a project entitled "Alpine Rhine Valley: Future Concepts for Settlement, Nature and Networking". One goal of this project is sustainable regional development for settlement, transport, and landscape. In the context of natural scientific research on the country, national authorities and private organizations are also collaborating with foreign university research facilities and institutes. The goal is to gain ecological insights on a scientific basis that constitute a basis for formulating a sustainable development policy, in conjunction with insights gained from economic and socio-cultural surveys and research.

Liechtenstein supports research activities abroad by making annual contributions in the total amount of 250,000 CHF each to Switzerland (Swiss National Science Foundation, SNSF) and Austria (Austrian Science Fund, FWF). As a member of the EEA, Liechtenstein also participates in the European research programs (5th and 6th Framework Programme on Research).

#### Technological research

Public institutions in Liechtenstein are also indirectly engaged in technology research. The Liechtenstein University of Applied Sciences contributes a budget of 7.6 million CHF (2004) to the training of experts. Liechtenstein also supports the Interstate University of Applied Sciences of Technology Buchs (NTB) with an annual contribution of 854,000 CHF.

#### Direct international engagement

Liechtenstein is interested in cooperation with its neighboring States and with international bodies and advocates cross-border coordination of land use planning. Liechtenstein is involved in the Interreg III B program "Alpine Space". Through the various Interreg projects, Liechtenstein supports the focus areas of water protection (including agricultural measures) and joint monitoring of air pollutant emissions in the Lake Constance region. Because of its small size, Liechtenstein's focus is on regional linkages. Liechtenstein is in contact with Switzerland, Austria, and Germany through various international agreements.

Various research projects on sustainable transport development have already been mentioned above in chapter 4.

### 8.2 Climate monitoring

Liechtenstein collects a wide range of data relating to climate, both through its own measuring stations and through interregional cooperation, especially with Switzerland. Liechtenstein does not have large measuring stations, however, that feed their data into a network such as the Global

Climate Observing System (GCOS). Since 1974, the largest measuring station in the country has been in operation in Vaduz, measuring the usual meteorological data (air pressure, air temperature, relative humidity, wind direction, wind strength, precipitation, sunshine duration, etc.). A private company has also measured similar data at several locations since 1997. Since 1970, the Office of Civil Engineering has measured snow depth at 10 locations. Since the 1960's, the Office of Environmental Protection has taken water samples at various locations to monitor quality and determine the groundwater table.

In 2000, Liechtenstein signed an agreement with the Eastern Swiss cantons on joint emissions monitoring of air pollutants. Pursuant to this agreement, air pollution in Liechtenstein and Eastern Switzerland has been jointly monitored since 1 January 2001.

Since 2003, Liechtenstein has also participated in the GLOBE program. This is a worldwide information network, in which over 100 countries participate. Its goal is to sensitize young people to the global character of environmental issues by compiling ecological data and feeding the data into the program. The Liechtenstein Gymnasium (academic high school) is currently involved in the project. The focus is on compilation of meteorological data.

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## 9 Education, information, and public outreach

### Education at schools

The Ministry of Education is responsible for the coordination of education. The relevant legislative provisions are the Education Act and the Vocational Training Act, along with the relevant ordinances. In addition, it is particularly significant that the various relevant special laws, especially the more recent ones such as the Forestry Act and the Nature Conservation Act, lay down the binding requirement for implementing authorities to promote regular basic and ongoing training for the affected bodies, to ensure information for the public, and in general to strengthen public awareness for sustainable development, in addition to comprehensive monitoring.

Also after the 1992 Earth Summit, various school projects on environmental education were conducted at Liechtenstein schools. These included:

The use of environmental focal points at various schools: Teachers are exempted from one teaching period in exchange for assuming responsibility for instruction on environmental issues. The environmental focal points initiate and support concrete environmental projects at their schools. This has resulted in forest days, school gardens, environmentally friendly recess areas, field trips, and much more.

Environment days: Environment days take place at all schools in the country. For instance, a secondary school class visited a hydroelectric power plant on "The Day of Water", and other classes built waterwheels and a small biotope.

Eco-friendly office and school supplies: A specific catalogue recommends eco-friendly office and school supplies to teachers (paper, notebooks, writing implements, etc.).

Various other support activities: With the publication of various teaching materials (e.g., "School on the Farm"), the organization of specific continuing education courses for teachers, etc., the Office of Education promotes environmental consciousness that fulfills the goals of the new curriculum.

During mandatory schooling, the "People and the Environment" cluster constitutes a fixed component of the curriculum along with other teaching areas.

### Public outreach

Public outreach is the responsibility of the administrative office assigned to the area in question. In addition, some tasks are delegated to external institutions, and individual outreach campaigns by NGOs are supported. In 2005, an NGO organized an exhibition entitled "Glaciers in the Greenhouse" and received financial support from the Government. Local authorities conduct public events. The population is also provided with information on individual environmental concerns through reports in the newspapers. Research and survey results concerning the condition of the mountain region and information on environmental developments and changes are regularly brought to the attention of the public by authorities and public authorities via publication series, thematic brochures, posters, and reports in newspapers. Specialized excursions with school classes, population groups, and professional organizations conducted by various authorities constitute an



important component of public outreach. An audit is currently under development with the goal of improving the compatibility of winter sports facilities with the landscape and the environment.

The Office of Environmental Protection annually distributes an environmental protection calendar to the public. Each year, the environmental protection calendar focuses on a different environmental topic. School children are included in the development of the calendar, by asking them to contribute a drawing to the calendar's theme. In this way, children are already sensitized to the environment. The 2006 environmental calendar is explicitly dedicated to the theme of climate protection.

Through the establishment of an emissions register and the network of measuring stations mentioned in chapter 8, the population can be provided with concrete information on the pollutant emissions of individual facilities and vehicles. The compiled data will be published each year in a report.

Finally, it should be mentioned that local authorities regularly conduct events for the public on tasks falling within their scope of responsibility.

### **Cooperation with private institutions and NGOs**

Various institutions are also engaged in public information and education. In particular, these include the Liechtenstein Environmental Protection Society ([www.lgu.li](http://www.lgu.li)), the Solar Society, and the Liechtenstein Transport Association (VCL).

CIPRA (International Commission for the Protection of the Alps), which is headquartered in Liechtenstein, has conducted the "Summer Academy on the Alps" each year since 1998. The Summer Academy is a valuable continuing education program for young people with a university or technical college degree who are interested in an interdisciplinary, transnational approach to Alpine issues. The Summer Academy consists of a three-week basic course on the Alps and an optional four-week practice-oriented project component. Experts from all the Alpine countries are hired as instructors. The State of Liechtenstein supports this project financially.

An important focus area of the "Lake Constance Agenda 21" of the International Lake Constance Conference (ILCC), of which Liechtenstein has been a member since 2000, is the atmosphere. In this context, the Office of Environmental Protection has established a special contact bureau for municipalities, business sectors, and NGOs for questions concerning sustainable development. In 2004, the bureau was assigned to the Office of Future Trends, which reports directly to the Government.

## **Annex**

### **Summary Tables for Liechtenstein Greenhouse Gas Inventory**

#### **Inventory of Tables for 2003**

## Summary 1.A: Summary Report for National Greenhouse Gas Inventories (2003)

(IPCC Table 7A)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO <sub>2</sub> emissions	CO <sub>2</sub> removals	CH <sub>4</sub>	N <sub>2</sub> O	HFCs <sup>(1)</sup>		PFCs <sup>(1)</sup>		SF <sub>6</sub>		NO <sub>x</sub>	CO	NM VOC	SO <sub>2</sub>		
	(Gg)				CO <sub>2</sub> equivalent (Gg)				(Gg)							
	P	A	P	A	P	A	P	A	P	A						
<b>Total National Emissions and Removals</b>	<b>239.86</b>	<b>0.00</b>	<b>0.72</b>	<b>0.03</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.000003</b>	<b>0.42</b>	<b>1.66</b>	<b>0.15</b>	<b>0.09</b>		
<b>1. Energy</b>	<b>239.86</b>		<b>0.06</b>	<b>0.0119</b>							<b>0.42</b>	<b>1.66</b>	<b>0.15</b>	<b>0.09</b>		
A. Fuel Combustion	Reference Approach <sup>(2)</sup>	0.00														
	Sectoral Approach <sup>(2)</sup>	239.86	0.03	0.0119							0.42	1.66	0.15	0.09		
1. Energy Industries		0.00	0.00	0.0000							0.00	0.00	0.00	0.00		
2. Manufacturing Industries and Construction		66.41	0.01	0.0003							0.10	0.17	0.01	0.04		
3. Transport		91.63	0.01	0.0106							0.27	1.32	0.14	0.01		
4. Other Sectors		81.82	0.01	0.0010							0.04	0.18	0.01	0.04		
5. Other		0.00	0.00	0.0000							0.00	0.00	0.00	0.00		
B. Fugitive Emissions from Fuels		0.00	0.03	0.0000							0.00	0.00	0.00	0.00		
1. Solid Fuels		0.00	0.00	0.0000							0.00	0.00	0.00	0.00		
2. Oil and Natural Gas		0.00	0.03	0.0000							0.00	0.00	0.00	0.00		
<b>2. Industrial Processes</b>	<b>0.00</b>		<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>		
A. Mineral Products		0.00	0.00	0.00							0.00	0.00	0.00	0.00		
B. Chemical Industry		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
C. Metal Production		0.00	0.00	0.00				0.00		0.00	0.00	0.00	0.00	0.00		
D. Other Production <sup>(3)</sup>	IE										0.00	0.00	0.00	0.00		
E. Production of Halocarbons and SF <sub>6</sub>						0.00	0.00		0.00	0.00						
F. Consumption of Halocarbons and SF <sub>6</sub>					0.00	0.00	0.00	0.00	0.00	0.00						
G. Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

P = Potential emissions based on Tier 1 approach of the IPCC Guidelines.

A = Actual emissions based on Tier 2 approach of the IPCC Guidelines.

<sup>(1)</sup> The emissions of HFCs and PFCs are to be expressed as CO<sub>2</sub> equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II) of this common reporting format.

<sup>(2)</sup> For verification purposes, countries are asked to report the results of their calculations using the Reference approach and to explain any differences with the Sectoral approach. Where possible, the calculations using the Sectoral approach should be used for estimating national totals. Do not include the results of both the Reference approach and the Sectoral approach in national totals.

<sup>(3)</sup> Other Production includes Pulp and Paper and Food and Drink Production.

**Note:** The numbering of footnotes to all tables containing more than one sheet continue to the next sheet. Common footnotes are given only once at the first point of reference.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO <sub>2</sub>	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	HFCs <sup>(1)</sup>		PFCs <sup>(1)</sup>		SF <sub>6</sub>		NO <sub>x</sub>	CO	NMVOC	SO <sub>2</sub>
	emissions	removals			P	A	P	A	P	A				
	(Gg)				CO <sub>2</sub> equivalent (Gg)				(Gg)					
<b>3. Solvent and Other Product Use</b>	<b>0.00</b>			<b>0.00</b>									<b>0.00</b>	
<b>4. Agriculture</b>	<b>0.00</b>	<b>0.00</b>	<b>0.66</b>	<b>0.02</b>							0.00	0.00	0.00	0.00
A. Enteric Fermentation			0.43											
B. Manure Management			0.20	0.00									0.00	
C. Rice Cultivation			0.00										0.00	
D. Agricultural Soils <sup>(4)</sup>	<sup>(4)</sup>	<sup>(4)</sup>	0.03	0.0159									0.00	
E. Prescribed Burning of Savannas			0.00	0.00							0.00	0.00	0.00	
F. Field Burning of Agricultural Residues			0.00	0.00							0.00	0.00	0.00	
G. Other			0.00	0.00							0.00	0.00	0.00	
<b>5. Land-Use Change and Forestry</b>	<sup>(5)</sup> <b>0.00</b>	<sup>(5)</sup> <b>0.00</b>	<b>0.00</b>	<b>0.00</b>							<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
A. Changes in Forest and Other Woody Biomass Stocks	<sup>(5)</sup> 0.00	<sup>(5)</sup> 0.00												
B. Forest and Grassland Conversion	0.00		0.00	0.00							0.00	0.00		
C. Abandonment of Managed Lands	<sup>(5)</sup> 0.00	<sup>(5)</sup> 0.00												
D. CO <sub>2</sub> Emissions and Removals from Soil	<sup>(5)</sup> 0.00	<sup>(5)</sup> 0.00												
E. Other	<sup>(5)</sup> 0.00	<sup>(5)</sup> 0.00	0.00	0.00							0.00	0.00		
<b>6. Waste</b>	<b>0.00</b>		<b>0.00</b>	<b>0.00</b>							<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
A. Solid Waste Disposal on Land	<sup>(6)</sup> 0.00		0.00									0.00	0.00	
B. Wastewater Handling			0.00	0.00							0.00	0.00	0.00	
C. Waste Incineration	<sup>(6)</sup> 0.00		0.00	0.00							NO	NO	NO	NO
D. Other	0.00		0.00	0.00							0.00	0.00	0.00	0.00
<b>7. Other (please specify)</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>

<sup>(4)</sup> According to the IPCC Guidelines (Volume 3. Reference Manual, pp. 4.2, 4.87), CO<sub>2</sub> emissions from agricultural soils are to be included under Land-Use Change and Forestry (LUCF). At the same time, the Summary Report 7A (Volume 1. Reporting Instructions, Tables.27) allows for reporting CO<sub>2</sub> emissions or removals from agricultural soils, either in the Agriculture sector, under D. Agricultural Soils or in the Land-Use Change and Forestry sector under D. Emissions and Removals from Soil. Parties may choose either way to report emissions or removals from this source in the common reporting format, but the way they have chosen to report should be clearly indicated, by inserting explanatory comments to the corresponding cells of Summary 1.A and Summary 1.B. Double-counting of these emissions or removals should be avoided. Parties should include these emissions or removals consistently in Table8(a) (Recalculation - Recalculated data) and Table10 (Emission trends).

<sup>(5)</sup> Please do not provide an estimate of both CO<sub>2</sub> emissions and CO<sub>2</sub> removals. "Net" emissions (emissions - removals) of CO<sub>2</sub> should be estimated and a single number placed in either the CO<sub>2</sub> emissions or CO<sub>2</sub> removals column, as appropriate. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

<sup>(6)</sup> Note that CO<sub>2</sub> from Waste Disposal and Incineration source categories should only be included if it stems from non-biogenic or inorganic waste streams.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO <sub>2</sub> emissions	CO <sub>2</sub> removals	CH <sub>4</sub>	N <sub>2</sub> O	HFCs		PFCs		SF <sub>6</sub>		NO <sub>x</sub>	CO	NMVOc	SO <sub>2</sub>
					P	A	P	A	P	A				
	(Gg)				CO <sub>2</sub> equivalent (Gg)						(Gg)			
<b>Memo Items:</b> <sup>(7)</sup>														
<b>International Bunkers</b>	0.00		0.00	0.00							0.00	0.00	0.00	0.00
Aviation	0.00		0.00	0.00							NO	NO	NO	NO
Marine	0.00		0.00	0.00							NO	NO	NO	NO
<b>Multilateral Operations</b>	NO		NO	NO							NO	NO	NO	NO
<b>CO<sub>2</sub> Emissions from Biomass</b>	8.83													

<sup>(7)</sup> Memo Items are not included in the national totals.

## Summary 1.B: Short Summary Report for National Greenhouse Gas Inventories (2003)

(IPCC TABLE 7B)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO <sub>2</sub>	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	HFCs <sup>(1)</sup>		PFCs <sup>(1)</sup>		SF <sub>6</sub>		NO <sub>x</sub>	CO	NMVOC	SO <sub>2</sub>
	emissions	removals			P	A	P	A	P	A				
	(Gg)				CO <sub>2</sub> equivalent (Gg)						(Gg)			
<b>Total National Emissions and Removals</b>	<b>239.86</b>	<b>0.00</b>	<b>0.72</b>	<b>0.03</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.0000026</b>	<b>0.42</b>	<b>1.66</b>	<b>0.15</b>	<b>0.09</b>
<b>1. Energy</b>	<b>239.86</b>		<b>0.06</b>	<b>0.01</b>							<b>0.42</b>	<b>1.66</b>	<b>0.15</b>	<b>0.09</b>
A. Fuel Combustion	Reference Approach <sup>(2)</sup>	0.00												
	Sectoral Approach <sup>(2)</sup>	239.86	0.03	0.01							0.42	1.66	0.15	0.09
B. Fugitive Emissions from Fuels		0.00	0.03	0.00							0.00	0.00	0.00	0.00
<b>2. Industrial Processes</b>	<b>0.00</b>		<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.000003</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
<b>3. Solvent and Other Product Use</b>	<b>0.00</b>			<b>0.00</b>							<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
<b>4. Agriculture<sup>(3)</sup></b>	<b>0.00</b>	<b>0.00</b>	<b>0.66</b>	<b>0.02</b>							<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
<b>5. Land-Use Change and Forestry</b>	<sup>(4)</sup> <b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>							<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
<b>6. Waste</b>	<b>0.00</b>		<b>0.00</b>	<b>0.00</b>							<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
<b>7. Other</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
<b>Memo Items:</b>														
<b>International Bunkers</b>	<b>0.00</b>		<b>0.00</b>	<b>0.00</b>							<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
Aviation	0.00		0.00	0.00							NO	NO	NO	NO
Marine	0.00		0.00	0.00							NO	NO	NO	NO
<b>Multilateral Operations</b>	<b>NO</b>		<b>NO</b>	<b>NO</b>							<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>
<b>CO<sub>2</sub> Emissions from Biomass</b>	<b>8.83</b>													

P = Potential emissions based on Tier 1 approach of the IPCC Guidelines.

A = Actual emissions based on Tier 2 approach of the IPCC Guidelines.

<sup>(1)</sup> The emissions of HFCs and PFCs are to be expressed as CO<sub>2</sub> equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II) of this common reporting format.

<sup>(2)</sup> For verification purposes, countries are asked to report the results of their calculations using the Reference approach and to explain any differences with the Sectoral approach in document box of Table 1.A(c). Where possible, the calculations using the Sectoral approach should be used for estimating national totals. Do not include the results of both the Reference approach and the Sectoral approach in national totals.

<sup>(3)</sup> See footnote 4 to Summary 1.A.

<sup>(4)</sup> Please do not provide an estimate of both CO<sub>2</sub> emissions and CO<sub>2</sub> removals. "Net" emissions (emissions - removals) of CO<sub>2</sub> should be estimated and a single number placed in either the CO<sub>2</sub> emissions or CO<sub>2</sub> removals column, as appropriate. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

## Summary 2: Summary Report for CO<sub>2</sub> Equivalent Emissions (1990)

GREENHOUSE GAS SOURCE AND SINK	CO <sub>2</sub> <sup>(1)</sup>	CH <sub>4</sub>	N <sub>2</sub> O	HFCs	PFCs	SF <sub>6</sub>	Total
CATEGORIES	CO <sub>2</sub> equivalent (Gg)						
<b>Total (Net Emissions)<sup>(1)</sup></b>	<b>227.29</b>	<b>14.91</b>	<b>8.15</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>250.35</b>
<b>1. Energy</b>	<b>227.29</b>	<b>0.63</b>	<b>3.50</b>				<b>231.42</b>
A. Fuel Combustion (Sectoral Approach)	227.29	0.00	3.50				230.79
1. Energy Industries	0.00	0.00	0.00				0.00
2. Manufacturing Industries and Construction	62.50	0.00	0.09				62.59
3. Transport	87.77	0.00	3.10				90.87
4. Other Sectors	77.02	0.00	0.31				77.33
5. Other	0.00	0.00	0.00				0.00
B. Fugitive Emissions from Fuels	0.00	0.63	0.00				0.63
1. Solid Fuels	0.00	0.00	0.00				0.00
2. Oil and Natural Gas	0.00	0.63	0.00				0.63
<b>2. Industrial Processes</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
A. Mineral Products	0.00	0.00	0.00				0.00
B. Chemical Industry	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Metal Production	0.00	0.00	0.00		0.00	0.00	0.00
D. Other Production	0.00						0.00
E. Production of Halocarbons and SF <sub>6</sub>				0.00	0.00	0.00	0.00
F. Consumption of Halocarbons and SF <sub>6</sub>				0.00	0.00	0.00	0.00
G. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>3. Solvent and Other Product Use</b>	<b>0.00</b>		<b>0.00</b>				<b>0.00</b>
<b>4. Agriculture</b>	<b>0.00</b>	<b>14.28</b>	<b>4.65</b>				<b>18.93</b>
A. Enteric Fermentation		9.45					9.45
B. Manure Management		4.20	0.00				4.20
C. Rice Cultivation		0.00					0.00
D. Agricultural Soils <sup>(2)</sup>		0.63	4.65				5.28
E. Prescribed Burning of Savannas		0.00	0.00				0.00
F. Field Burning of Agricultural Residues		0.00	0.00				0.00
G. Other		0.00	0.00				0.00
<b>5. Land-Use Change and Forestry<sup>(1)</sup></b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>				<b>0.00</b>
<b>6. Waste</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>				<b>0.00</b>
A. Solid Waste Disposal on Land	0.00	0.00					0.00
B. Wastewater Handling		0.00	0.00				0.00
C. Waste Incineration	0.00	0.00	0.00				0.00
D. Other	0.00	0.00	0.00				0.00
<b>7. Other (please specify)</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
<b>Memo Items:</b>							
<b>International Bunkers</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>				<b>0.00</b>
Aviation	0.00	0.00	0.00				0.00
Marine	0.00	0.00	0.00				0.00
<b>Multilateral Operations</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>				<b>0.00</b>
<b>CO<sub>2</sub> Emissions from Biomass</b>	<b>0.00</b>						<b>0.00</b>

<sup>(1)</sup> For CO<sub>2</sub> emissions from Land-Use Change and Forestry the net emissions are to be reported. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

<sup>(2)</sup> See footnote 4 to Summary 1.A of this common reporting format.

GREENHOUSE GAS SOURCE AND SINK	CO <sub>2</sub> emissions	CO <sub>2</sub> removals	Net CO <sub>2</sub> emissions / removals	CH <sub>4</sub>	N <sub>2</sub> O	Total emissions
CATEGORIES	CO <sub>2</sub> equivalent (Gg)					
<b>Land-Use Change and Forestry</b>	<b>CO<sub>2</sub> equivalent (Gg)</b>					
A. Changes in Forest and Other Woody Biomass Stocks	0.00	0.00	0.00			0.00
B. Forest and Grassland Conversion	0.00		0.00	0.00	0.00	0.00
C. Abandonment of Managed Lands	0.00	0.00	0.00			0.00
D. CO <sub>2</sub> Emissions and Removals from Soil	0.00	0.00	0.00			0.00
E. Other	0.00	0.00	0.00	0.00	0.00	0.00
<b>Total CO<sub>2</sub> Equivalent Emissions from Land-Use Change and Forestry</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>

Total CO <sub>2</sub> Equivalent Emissions without Land-Use Change and Forestry <sup>(a)</sup>	250.35
Total CO <sub>2</sub> Equivalent Emissions with Land-Use Change and Forestry <sup>(a)</sup>	250.35

<sup>(a)</sup> The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report emissions and removals from Land-Use Change and Forestry. Note that these totals will differ from the totals reported in Table 10s5 if Parties report non-CO<sub>2</sub> emissions from LUCF.

## Summary 2: Summary Report for CO<sub>2</sub> Equivalent Emissions (2003)

GREENHOUSE GAS SOURCE AND SINK	CO <sub>2</sub> <sup>(1)</sup>	CH <sub>4</sub>	N <sub>2</sub> O	HFCs	PFCs	SF <sub>6</sub>	Total
CATEGORIES	CO <sub>2</sub> equivalent (Gg)						
<b>Total (Net Emissions)<sup>(1)</sup></b>	<b>239.86</b>	<b>15.18</b>	<b>8.60</b>	<b>0.00</b>	<b>0.00</b>	<b>0.06</b>	<b>263.71</b>
<b>1. Energy</b>	<b>239.86</b>	<b>1.23</b>	<b>3.67</b>				<b>244.77</b>
A. Fuel Combustion (Sectoral Approach)	239.86	0.55	3.67				244.09
1. Energy Industries	0.00	0.00	0.00				0.00
2. Manufacturing Industries and Construction	66.41	0.11	0.09				66.60
3. Transport	91.63	0.19	3.27				95.10
4. Other Sectors	81.82	0.25	0.31				82.39
5. Other	0.00	0.00	0.00				0.00
B. Fugitive Emissions from Fuels	0.00	0.68	0.00				0.68
1. Solid Fuels	0.00	0.00	0.00				0.00
2. Oil and Natural Gas	0.00	0.68	0.00				0.68
<b>2. Industrial Processes</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.06</b>	<b>0.06</b>
A. Mineral Products	0.00	0.00	0.00				0.00
B. Chemical Industry	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Metal Production	0.00	0.00	0.00		0.00	0.00	0.00
D. Other Production	IE						0.00
E. Production of Halocarbons and SF <sub>6</sub>				0.00	0.00	0.00	0.00
F. Consumption of Halocarbons and SF <sub>6</sub>				0.00	0.00	0.06	0.06
G. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>3. Solvent and Other Product Use</b>	<b>0.00</b>		<b>0.00</b>				<b>0.00</b>
<b>4. Agriculture</b>	<b>0.00</b>	<b>13.95</b>	<b>4.93</b>				<b>18.87</b>
A. Enteric Fermentation		9.12					9.12
B. Manure Management		4.13	0.00				4.13
C. Rice Cultivation		0.00					0.00
D. Agricultural Soils <sup>(2)</sup>		0.70	4.93				5.63
E. Prescribed Burning of Savannas		0.00	0.00				0.00
F. Field Burning of Agricultural Residues		0.00	0.00				0.00
G. Other		0.00	0.00				0.00
<b>5. Land-Use Change and Forestry<sup>(1)</sup></b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>				<b>0.00</b>
<b>6. Waste</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>				<b>0.00</b>
A. Solid Waste Disposal on Land	0.00	0.00					0.00
B. Wastewater Handling		0.00	0.00				0.00
C. Waste Incineration	0.00	0.00	0.00				0.00
D. Other	0.00	0.00	0.00				0.00
<b>7. Other (please specify)</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
							0.00
<b>Memo Items:</b>							
<b>International Bunkers</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>				<b>0.00</b>
Aviation	0.00	0.00	0.00				0.00
Marine	0.00	0.00	0.00				0.00
<b>Multilateral Operations</b>	<b>NO</b>	<b>0.00</b>	<b>0.00</b>				<b>0.00</b>
<b>CO<sub>2</sub> Emissions from Biomass</b>	<b>8.83</b>						<b>8.83</b>

<sup>(1)</sup> For CO<sub>2</sub> emissions from Land-Use Change and Forestry the net emissions are to be reported. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

<sup>(2)</sup> See footnote 4 to Summary 1.A of this common reporting format.

GREENHOUSE GAS SOURCE AND SINK	CO <sub>2</sub> emissions	CO <sub>2</sub> removals	Net CO <sub>2</sub> emissions / removals	CH <sub>4</sub>	N <sub>2</sub> O	Total emissions
<b>CATEGORIES</b>						
<b>Land-Use Change and Forestry</b>	<b>CO<sub>2</sub> equivalent (Gg)</b>					
A. Changes in Forest and Other Woody Biomass Stocks	0.00	0.00	0.00			0.00
B. Forest and Grassland Conversion	0.00		0.00	0.00	0.00	0.00
C. Abandonment of Managed Lands	0.00	0.00	0.00			0.00
D. CO <sub>2</sub> Emissions and Removals from Soil	0.00	0.00	0.00			0.00
E. Other	0.00	0.00	0.00	0.00	0.00	0.00
<b>Total CO<sub>2</sub> Equivalent Emissions from Land-Use Change and Forestry</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>

Total CO <sub>2</sub> Equivalent Emissions without Land-Use Change and Forestry <sup>(a)</sup>	263.71
Total CO <sub>2</sub> Equivalent Emissions with Land-Use Change and Forestry <sup>(a)</sup>	263.71

<sup>(a)</sup> The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report emissions and removals from Land-Use Change and Forestry. Note that these totals will differ from the totals reported in Table 10s5 if Parties report non-CO<sub>2</sub> emissions from LUCF.



## Abbreviations

CH <sub>4</sub>	Methane
CHF	Swiss francs
CIPRA	International Commission for the Protection of the Alps
CO	Carbon monoxide
CO <sub>2</sub>	Carbon dioxide
COP	Conference of the Parties
ETH/ETHZ	Swiss Federal Institute of Technology, Zurich
FL	Fürstentum Liechtenstein (Principality of Liechtenstein)
FOEN	Swiss Federal Office for the Environment
GCOS	Global Climate Observing System
GDP	Gross domestic product
Gg	Gigagrams (1,000 tons)
GHG	Greenhouse gases
GWP	Global Warming Potential, factor for converting CH <sub>4</sub> , N <sub>2</sub> O, HFC, PFC, and SF <sub>6</sub> emissions into CO <sub>2</sub> equivalents
HFC	Hydrofluorcarbons
ILCC	International Lake Constance Conference
IPCC	Intergovernmental Panel on Climate Change
HVF	Heavy Vehicle Fee
NE	Not estimated (in Liechtenstein)
NGO	Non-governmental organization
NMVOC	Non-methane volatile organic compounds
NO	Not occurring (in Liechtenstein)
NO <sub>x</sub>	Nitrogen oxides
N <sub>2</sub> O	Nitrous oxide
OEA	Office of Economic Affairs
PFC	Perfluorcarbons
SDC	Swiss Agency for Development and Cooperation
SF <sub>6</sub>	Sulfur hexafluoride
SFOE	Swiss Federal Office of Energy
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change