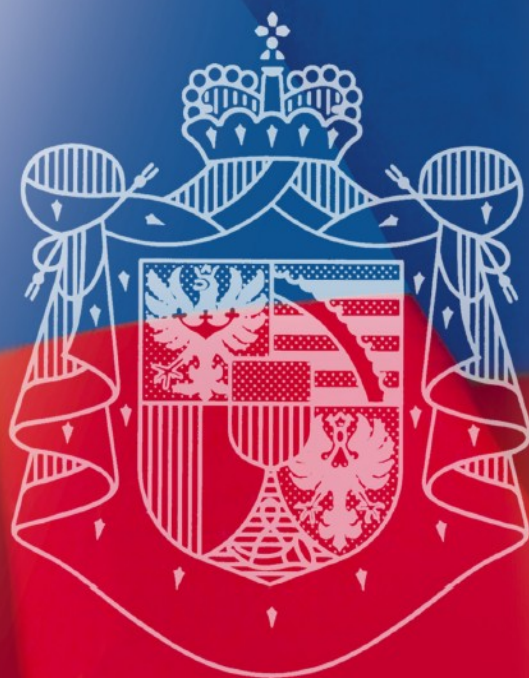




REGIERUNG
DES FÜRSTENTUMS LIECHTENSTEIN

Liechtenstein's Fifth National Communication under the UNFCCC and the Kyoto Protocol

January 2010



LIECHTENSTEIN

Imprint

Office of Environmental Protection (project management)

P.O. Box 684

9490 Vaduz

Liechtenstein

INFRAS Consulting Group

8045 Zurich

Switzerland

For further information

Mr. Sven Braden, Office of Environmental Protection

Sven.braden@aus.llv.li

Table of contents

Foreword.....	7
1. Executive Summary	8
1.1 Introduction	8
1.2 GHG Inventory information, including information on National Systems and National Registries	8
1.3 Policies and measures.....	11
Projections and the total effect of measures.....	13
1.4 Impacts, vulnerability assessment and adaptation.....	15
1.5 Financial resources and transfer of technology.....	17
1.6 Research and systematic observation	17
1.7 Education, training and public awareness	18
2. National circumstances relevant to greenhouse gas emissions and removals....	20
2.1 Governmental structure	20
2.2 Population.....	22
2.3 Climate	23
2.4 Geography.....	23
2.5 Economy	23
2.6 Energy	25
2.7 Transport.....	27
2.8 Industry.....	29
2.9 Waste	30
2.10 Building stock and urban structure.....	32
2.11 Agriculture and Forestry	32
3. Greenhouse Gas Inventory information, including information on National Systems and National Registries	34
3.1 Summary tables	34
3.2 Trends in greenhouse gas emissions and removals (1990-2007)	34
3.2.1 Aggregated greenhouse gas emissions 2007	34
3.2.2 Other greenhouse gases (HFC, PFC, SF ₆ , precursors).....	38
3.2.3 Emission trends by gas.....	38
3.2.4 Emission trends by sources and sinks	42
3.2.5 Emission trends for indirect greenhouse gases and SO ₂	46
3.3 Data for activities under Article 3, Paragraph 3 and 4 of the Kyoto Protocol (KP-LULUCF).....	47
3.4 Status of the National Inventory System	48
3.4.1 National entity	48
3.4.2 Institutional, legal and procedural arrangements	48
3.4.3 Methodology.....	51

3.4.4	Key source identification.....	52
3.4.5	Recalculations	56
3.4.6	QA / QC activities	56
3.5	National Registry.....	60
3.5.1	Registry administrator	60
3.5.2	Consolidated system	60
3.5.3	Database structure and capacity	60
3.5.4	Conformity with Data Exchange Standards (DES)	62
3.5.5	Prevention of discrepancies.....	62
3.5.6	Determent of unauthorized manipulations.....	71
3.5.7	Public Reports	74
3.5.8	Internet address.....	74
3.5.9	Safeguard and Recovery Plan.....	75
3.5.10	Test procedures	76
3.5.11	Commitment period reserve (CPR)	76
4.	Policies and measures	79
4.1	Policy making process – general policy context.....	79
4.2	Domestic and regional programmes and/or legislative arrangements and enforcement and administrative procedures	80
4.3	Policies and measures and their effects	80
4.3.1	Cross Sectoral Policies.....	80
4.3.2	Environmental policy	80
4.3.3	Climate policy.....	81
4.3.4	Energy policy.....	84
4.3.5	Transport policy	88
4.3.6	Agriculture	91
4.3.7	Forestry	92
4.3.8	Waste Management.....	93
4.3.9	International cooperation.....	94
4.4	Policies and measures no longer in place	95
5.	Projections and the total effect of policies and measures.....	98
5.1	Projections	98
5.1.1	Measures implemented	98
5.1.2	CO ₂	99
5.1.3	CH ₄	101
5.1.4	N ₂ O	103
5.1.5	Other GHG's (HFC's, PFCs, SF ₆).....	105
5.1.6	Precursors and SO ₂	105
5.2	Aggregated projection	106
5.3	Supplementarity relating to mechanisms under Article 6, 12 and 17, of the Kyoto Protocol .	108
5.4	Methodology for GHG emission projections	109
5.4.1	Emissions from energy-related sectors.....	109
5.4.2	Emissions from non-energy sectors.....	112
6.	Vulnerability assessment, climate change impacts and adaptation measures ..	115
6.1	Observed and expected impacts of climate change	115
6.1.1	Temperature:	115
6.1.2	Impacts of warming on the cryosphere	116

6.1.3	Precipitation.....	116
6.1.4	Impacts on the hydrological cycle and water resources.....	117
6.1.5	Impacts on extreme events and natural hazards.....	117
6.1.6	Impacts on natural ecosystems and biodiversity.....	119
6.2	Vulnerability Assessment.....	120
6.3	Adaptation measures.....	121
7.	Financial resources and transfer of technology.....	124
7.1	Assistance to developing country Parties that are particularly vulnerable to climate change	124
7.2	Provision of financial resources, including financial resources under Article 11 of the Kyoto Protocol.....	125
7.3	Activities related to transfer of technology.....	127
8.	Research and systematic observation.....	129
8.1	General policy on research and systematic observation.....	129
8.1.1	Basic research.....	129
8.1.2	Technological research.....	129
8.1.3	Direct international engagement.....	129
8.2	Research.....	129
8.3	Systematic observation.....	130
9.	Education, training and public awareness.....	131
9.1	Education at schools.....	131
9.2	Public outreach.....	132
9.3	Cooperation with private institutions and NGOs.....	132
Annex.....	134
	Summary 1.A: Summary Report for National Greenhouse Gas Inventories (2007).....	135
	Summary 1.B: Short Summary Report for National Greenhouse Gas Inventories (2007).....	138
	Summary 2: Summary Report for CO ₂ Equivalent Emissions (1990).....	139
	Summary 2: Summary Report for CO ₂ Equivalent Emissions (2007).....	140
Abbreviations.....	142

Foreword

In 2007, the Intergovernmental Panel on Climate Change (IPCC) issued the results of its Fourth Assessment Report on the effects of global warming. The report provides the largest and most detailed summary of the climate change situation ever undertaken, involving thousands of authors from dozens of countries. The results of the report are clear: Warming of the climate system is unequivocal. Anthropogenic emissions are influencing our climate and are very likely to have a serious impact on it in the future.

Liechtenstein's Fifth National Communication takes into account this updated and even stronger scientific evidence on climate change and reflects the fact that our national and international climate change related activities will be in support of the conclusion of a legally binding climate change agreement after 2012.

The Fifth National Communication therefore provides comprehensive information on the action taken by Liechtenstein on the commitments under the UN Framework Convention on Climate Change as well as under the Kyoto Protocol. During the past four years fundamental improvements have been achieved with respect to the quality of greenhouse gas emissions data as well as on information related to implemented policy measures and emission projections.

In 2007, Liechtenstein has – for example – adopted the National Climate Protection Strategy to ensure that the need for a low carbon economy will be reflected within the development of our future policies. Besides concrete measures as for example the accession to the European Emissions Trading Scheme, the adoption of a CO₂ levy and the introduction of feed-in tariffs for renewable energy production, the Government promoted several national initiatives that support a more environmental friendly and energy efficient lifestyle. By the establishment of the LIFE Climate Foundation Liechtenstein the Government has introduced a green growth think tank within the framework of a real Public Private Partnership. The participation of representatives from the country's economy as well as from the science and policy sectors provides important access to the relevant players and driving forces within the emerging environmental and carbon markets.

Although the Liechtenstein Government is prepared to taking further steps in order to protect our climate it is obvious that the global impact of climate change cannot be addressed by unilateral means alone. Deep cuts in global emissions are required. As stated in the Copenhagen Accord the global community should therefore cooperate in achieving the peaking of global emissions as soon as possible, recognizing that the time frame for peaking will be longer in developing countries and that a low-emission development strategy is indispensable to sustainable development.

Industrialized countries will, however, continue to have to lead the way. With this respect Liechtenstein is committed to taking its fair share in combating climate change.

Renate Müssner

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

Vaduz, January 2010

1. Executive Summary

1.1 Introduction

This report summarizes the basic information and activities of the Principality of Liechtenstein with respect to climate. With a population of 35,356 at the end of 2007, Liechtenstein is a small central European State in the Alpine region. Its structure is comparable to that of its neighbouring 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 are also applicable in Liechtenstein or are implemented into Liechtenstein law on the basis of specific international treaty rules (e.g. CO₂ Act).

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.

1.2 GHG Inventory information, including information on National Systems and National Registries

In 2007, Liechtenstein emitted 243.5 Gg CO₂ equivalent (excluding LULUCF) to the atmosphere corresponding to 6.89 tonnes CO₂ equivalent per capita. About 88% of all climate gas emissions were caused by energy-related processes. These are distributed as follows: 36% by Transport, 13% by Manufacturing Industries and Construction, and 36% "Other sectors" (Residential, Institutional, and Commercial combustion). Compared to 1990, the emissions have increased by 6.1%.

Carbon dioxide emissions (CO₂) alone amount to nearly 211 Gg or 86.8% of the total emissions in 2007. Of the 211 Gg, 42% are due to the Transport sector, 16% to Industry, and 42% to "Other sectors".

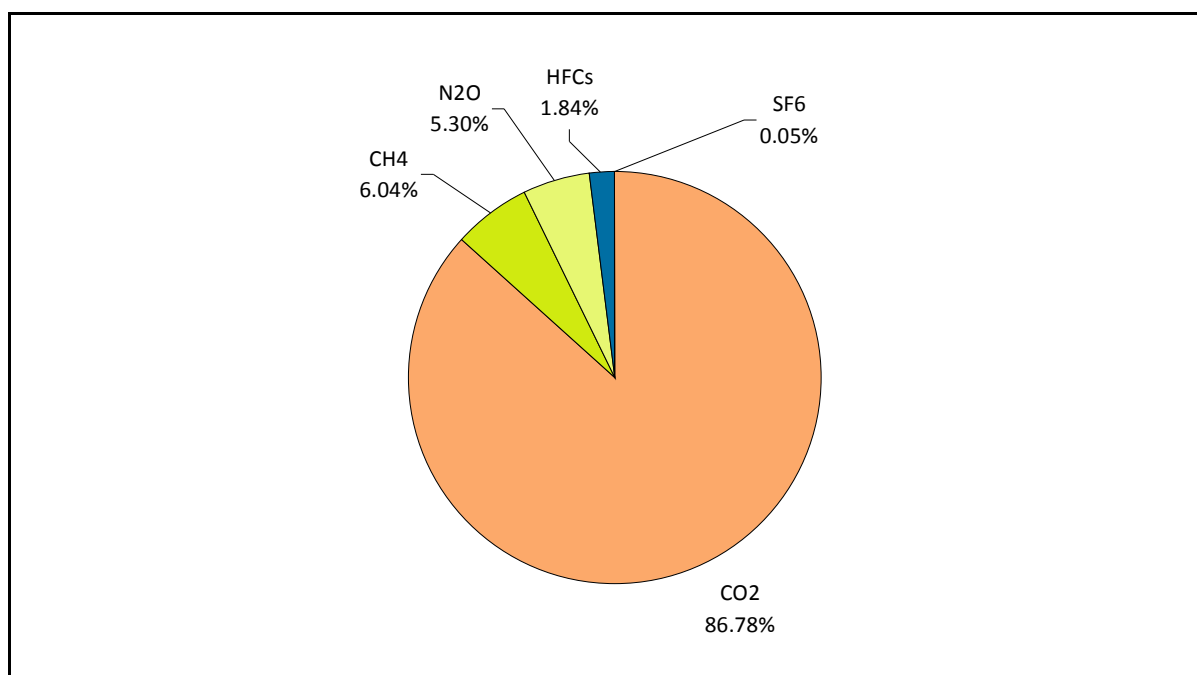
Methane emissions (CH₄) in 2007 amount to 0.7 Gg – corresponding 14.7 Gg CO₂ eq - and are largely due to Agriculture (82%). Compared to 1990, agricultural methane emissions have increased, which is the result of an increase in the sectors energy and waste. The share of methane on the overall Greenhouse gas emissions (in CO₂ equivalent) is 6%.

Nitrous oxide emissions (N₂O) in 2007 amount to 0.041 Gg – corresponding 12.9 Gg CO₂ eq - and arise primarily from Agriculture (81%) with minor contribution of Transport (5%) and Waste (9%). The share of N₂O on the overall GHG emissions (in CO₂ equivalent) is 5.3%.

Table 1-1 and Figure 1-1 show the composition of the emissions by sector and by gas. Other greenhouse gases such as HFC and SF₆ play a minor role in Liechtenstein (1.9% of the national total emissions). Figure 1-2 shows the relative development of the main climate gases and figure 1-3 shows the development of the total GHG emissions by sources.

Table 1-1 Emissions in CO₂ equivalent by sector and by gas in 2007.

IPPC	Category	CO ₂	CH ₄	N ₂ O	HFCs	SF ₆	Total	Share
	Source/ Sink	CO ₂ equivalent (Gg)						%
1	Total Energy	210.41	1.87	1.07			213.35	87.62%
(1A)	Fuel combustion activities	210.41	0.80	1.07			212.28	87.19%
(1B)	Fugitive emissions		1.07				1.07	0.44%
2	Industrial Processes				4.47	0.12	4.59	1.89%
3	Solvent and other Product Use	0.86		0.25			1.11	0.46%
4	Agriculture	0.00	12.12	10.46			22.58	9.27%
6	Waste	0.01	0.71	1.13			1.85	0.76%
	Total (excl. LULUCF)	211.28	14.70	12.91	4.47	0.12	243.48	100.00%
	Share (excl. LULUCF)	86.78%	6.04%	5.30%	1.84%	0.05%	100.00%	
5	LULUCF	-6.57					-6.57	-2.70%
	Total (incl. LULUCF)	204.71	14.70	12.91	4.47	0.12	236.91	97.30%
	Share (incl. LULUCF)	86.41%	6.21%	5.45%	1.89%	0.05%	100.00%	

Figure 1-1 Contribution of the individual gases to Liechtenstein's total GHG emissions 2007. 100% corresponds to 243.5 Gg CO₂ eq. (excl. LULUCF)

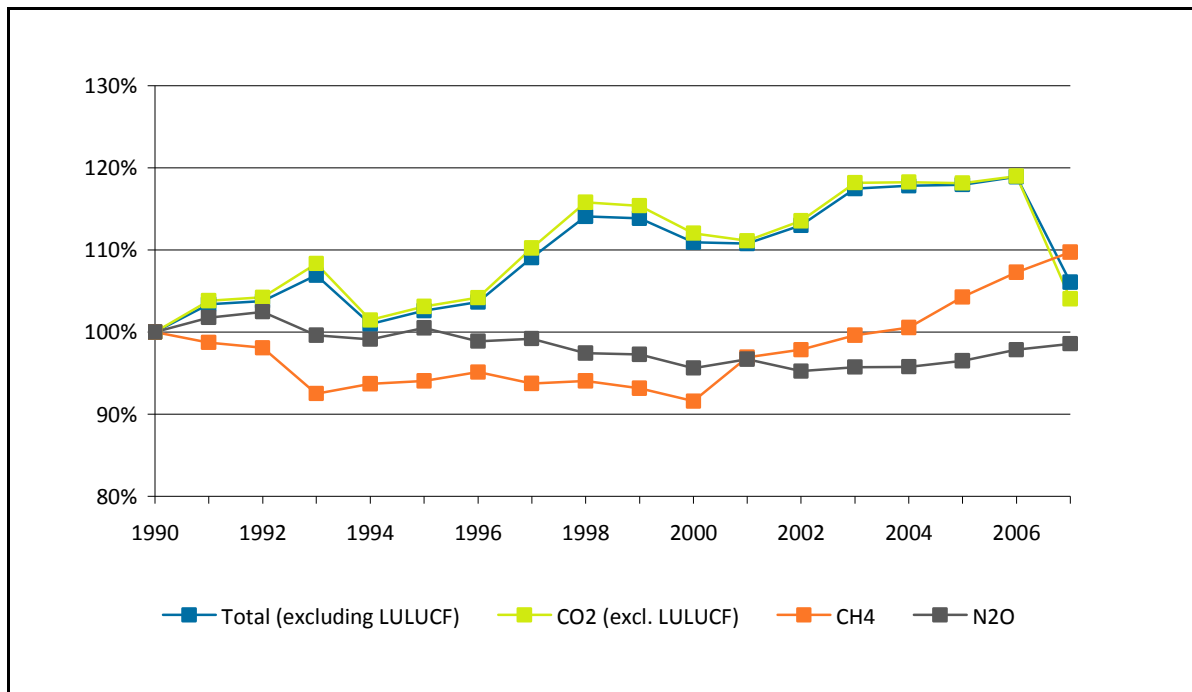


Figure 1-2 Relative trend of Liechtenstein's most important greenhouse gas emissions (CO₂, CH₄ and N₂O) and the national total (all excl. LULUCF) 1990-2007.

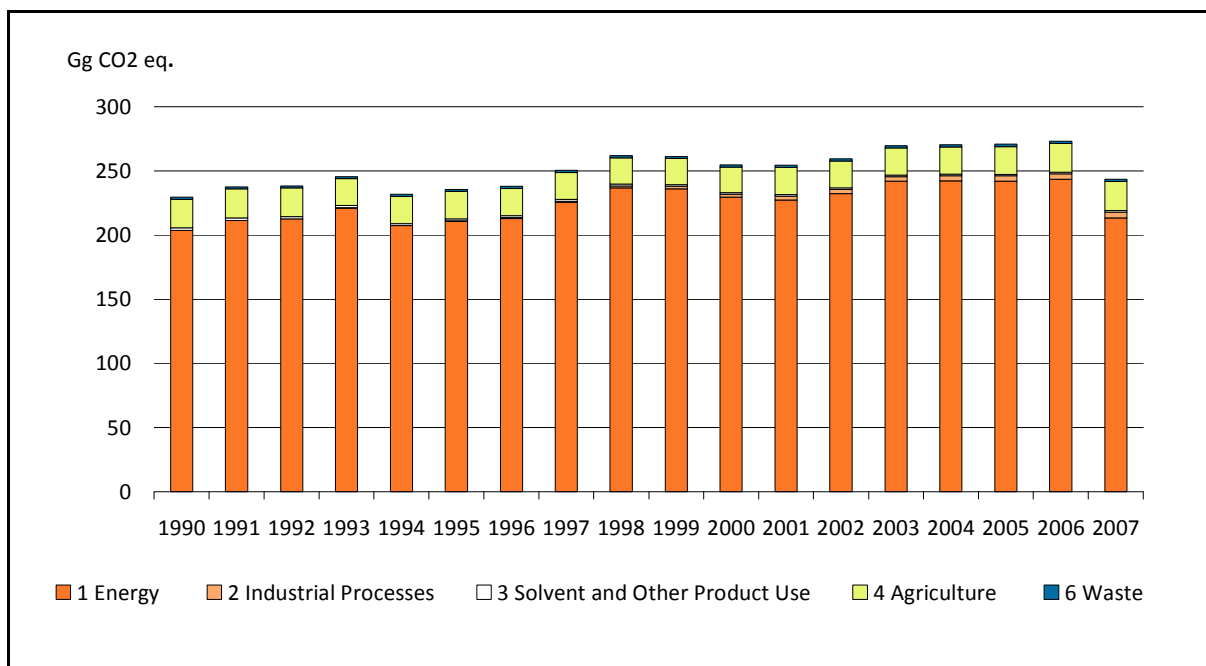


Figure 1-3 Emission trends of Liechtenstein's GHG emissions (excl. LULUCF) by main source categories, 1990-2007.

1 Energy: The sub-sectors (Tab. 3 7) show different trends between 1990 and 2007. Overall the emissions are slightly increasing in the Energy sector until 2006. From 2006 to 2007 there is a pronounced jump downward, which may be explained as follows: A very high price for gas oil in the corresponding period gave an incentive for people to reduce fuel consumption and also caused people to hold off the filling of their oil tanks. Simultaneously, warm winter months at the beginning and at the end of 2007 occurred, which is documented by a reduction of 5% to 10% in the heating degree days of Liechtenstein in 2007. The generally increasing trend is due to an increase in the two sub-sectors Transport (1A3 41%,) and "Other sectors" (1A4 42%) which contribute over 80% and therefore dominate the Energy sector.

2 Industrial Processes: Due to the lack of heavy industry in Liechtenstein, only synthetic gases contribute to sector 2. The increasing trend is determined by HFC emissions from 2F1 Refrigeration and Air Conditioning Equipment.

3 Solvent and Other Product Use: Emissions have strongly decreased due to reduction measures for NMVOCs resulting from legal restrictions and the introduction of the VOC levy (-44.4%).

4 Agriculture: The emissions show a minimum around 2000 due to decreasing and increasing animal numbers. In 2007 the emissions reached more or less the same amount as in 1990 (increase of 0.2%).

5 LULUCF: Increase and decrease of living biomass in forests are the dominant LULUCF categories. The conversion rates of Forest Land, which are derived from aerial photographs in three years (1984, 1996, 2002), differ significantly. They result in time series similar to a step-like function and result in a rather constant sink of 6.5 Gg CO₂ eq. since 2003.

6 Waste: Few emissions from the sector Waste are occurring, because all municipal solid waste is exported to a Swiss incineration plant. The increasing trend (19.2%) of the emissions remaining in Liechtenstein is determined by increasing composting activities and a slight increase in emissions from waste water handling.

National System

The Government of the Principality of Liechtenstein bears the overall responsibility for the National Inventory System (NIS). By Liechtenstein's Emission Trading Act (Emissionshandelsgesetz), the Office of Environmental Protection (OEP) is in charge of establishing emission inventories and is therefore also responsible for all aspects concerning the establishment of the NIS under the UN Framework Convention on Climate Change (UNFCCC) and under the Kyoto Protocol. The responsibility of the OEP for establishing the NIS is also described in the report of the Government to the parliament for ratifying the Kyoto Protocol. The Office of Economic Affairs (OEA), the Office of Agriculture (OA), the Office of Forests, Nature and Land Management (OFNLM) and the Office of Land Use Planning (SLP) participate directly in the compilation of the inventory. Several other administrative and private institutions are involved in inventory preparation.

1.3 Policies and measures

Liechtenstein endeavours to keep 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.

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. In order to ensure a coordinated implementation of climate policies within the various areas the Government passed a Climate Protection Strategy in 2007. This strategy requires an interdisciplinary coordination in the fields of environment, energy, building, transportation, agriculture and forestry with respect to the development of climate policy measures. Liechtenstein's Ministry of Environment and the Office of Environmental Protection are the coordinating authorities with respect to the executions of the Climate Protection Strategy.

In 2009, the Government together with Liechtenstein Bankers Association, Liechtenstein Association of Professional Trustees, Liechtenstein Investment Fund Association and the University of Liechtenstein founded "LIFE Climate Foundation Liechtenstein". The goal of LIFE Climate Foundation Liechtenstein is - as an initiator - to raise awareness regarding climate change issues and to constructively help shape the development and advancement of market-based instruments in the area of climate protection. The foundation organizes public events as well as workshops and provides input with respect to the development of the emerging markets for environmental commodities.

Because of the small size of the country, cross-border cooperation plays also an important role. Especially important is the relationship with Switzerland and cooperation among the countries in the Lake Constance area.

Liechtenstein's legislative and administrative main arrangements to meet its commitments under the Kyoto Protocol are to be found in the Emissions Trading Act and the CO₂ Act:

The **Emissions Trading Act** (EHG) sets up the general framework for the fulfilment of Liechtenstein's reduction obligations originating from the ratification of the Kyoto Protocol. The EHG states that emission reductions are first and foremost to be reduced by inland measures. If the reduction obligations cannot be fulfilled through inland measures the government may participate in project activities abroad or in international emissions trading. Besides this, the EHG implements Directive 2003/87/EC (Emissions Trading Directive) into national law and obliges two industrial installations to participate within the European Emissions Trading Scheme. The regulations of the EHG with respect to the participation of Liechtenstein in the Kyoto Protocol's flexible mechanisms as well as with respect to emissions trading are executed by the Office of Environmental Protection.

The **CO₂ Act** corresponds with the CO₂ Act of Switzerland and is in force since 2008. The Act introduces a levy on the consumption of fossil fuel. It is part of "The Bilateral Agreement between the Principality of Liechtenstein and the Swiss Confederation on Environmental Levies within the Principality of Liechtenstein".

Various other sectoral measures and policies have been implemented. Two of the most important are:

The **climate cent** which is 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. The revenue will be earmarked for climate protection projects in Liechtenstein and abroad.

The commitment to saving energy was legally enshrined in the **Energy Ordinance of the respective Building Act** in 2008.

Policies planned

National measures are accorded the highest priority. In this regard, Liechtenstein also expects to implement further appropriate measures of Swiss climate policy. This could primarily concern an adaptation of the Emissions Trading Act and the CO₂ Act in case Switzerland successfully accesses the European Emissions Trading Scheme, as officially announced in 2009.

Another national measure regarding a climate friendly energy acquisition is the use of geological heat from deep thermal aquifers for heating and electric power generation. A first pilot study in 2008 concluded that the geological preconditions in Liechtenstein are promising for the use of deep geothermic energy. Due to the results of the study further investigations are currently executed supervised by the Office of Environmental Protection.

With respect to fiscal measures the Government is currently (2009) exploring the introduction of an energy efficiency and/or emission based motor vehicle tax. In 2008 a first draft was realized combining a CO₂ emission based vehicle tax with an incentive system for the private purchase of vehicles with lower CO₂ emissions.

Projections and the total effect of measures

Given its small size, Liechtenstein does not have comprehensive projections at its disposal. The projections presented for the years 2010, 2015 and 2020 rely on the latest emission and energy use data available for Liechtenstein, projections of reductions through measures implemented from the Bureau of Energy Consumption and Conservation as well as on comparisons and analogies with the projections and assumptions developed for Switzerland.

Liechtenstein's financially most relevant and for projections most reliably quantifiable measures currently in place contribute to the renovation of old buildings, solar collector systems and substitution to heat pumps and wood heatings induced under the Energy ordinance (EEG). Their effects are visible in a reduction in the consumption of heating fuels and finally a reduction of emissions in the sectors Industry (1A2) and "Others" (1A4). The municipalities individually supplement the national subsidies with additional funds. Other measures such as savings through more efficient new private heatings and a steampipe for Industry companies are independent of the EEG but relevant for emission reduction.

Table 1-2 Estimated cumulative effect of implemented and adopted policies and measures

Estimated and expected yearly reduction compared to 2007 of implemented and adopted policies and measures					
in t CO ₂ Reduction/year					
	sector	measure	2010	2015	2020
Energy efficiency act measure	1A2/ 1A4	Renovation of old buildings	1'565	4'848	8'130
	1A2/ 1A4	Thermal solar collectors	845	2'199	3'553
	1A2/ 1A4	Substitution to heat pumps	3'378	9'944	16'510
	1A2/ 1A4	Substitution to wood heatings	1'776	5'059	8'342
other measures	Savings through more efficient				
	1A4	new private heatings	197	328	328
	1A2	Steampipe for Industry	17'423	17'635	17'635
Total reduction			25'184	40'013	54'498

Based on these measures emissions until 2020 are projected:

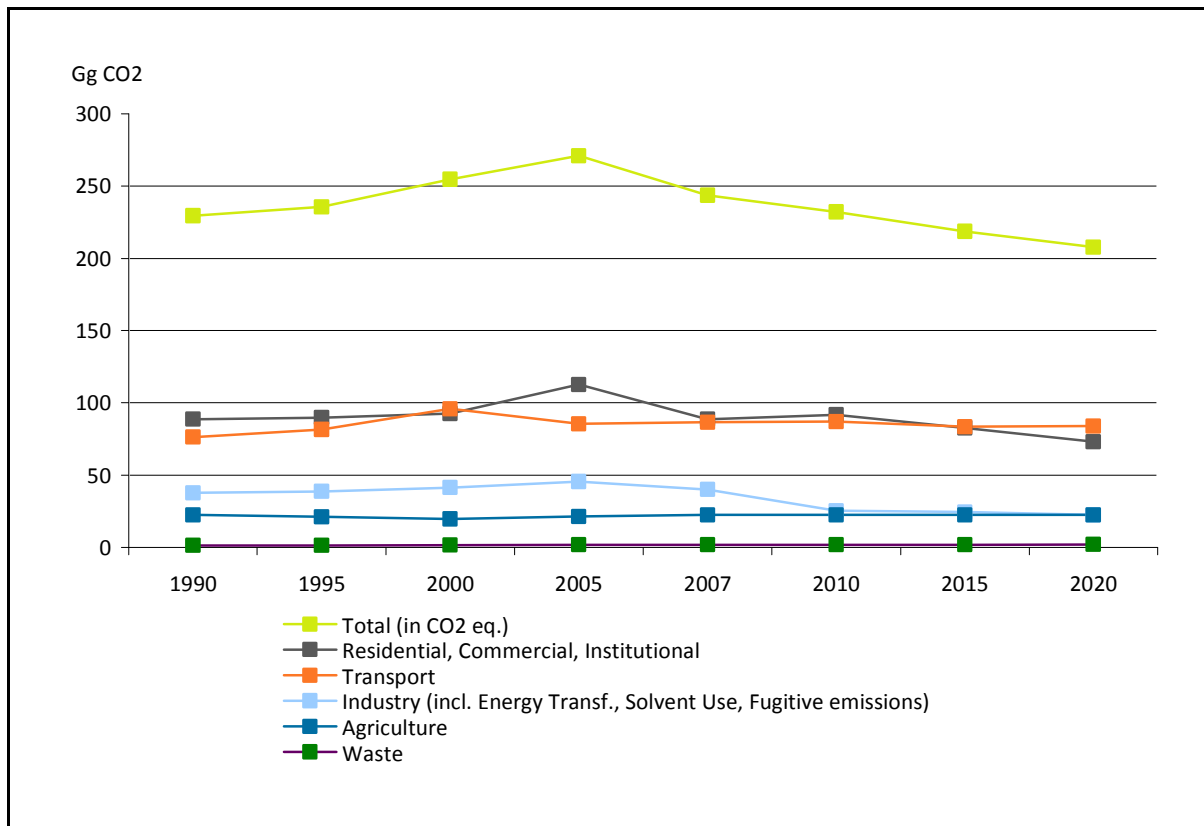


Figure 1-4 Total CO₂ (in CO₂ eq., excl. LULUCF) by sector 1990-2020 “with measures implemented”

Kyoto Protocol target

The assigned amount of Liechtenstein under the Kyoto Protocol in the first commitment period (2008-2012) is 211.99 Gg CO₂ equivalents per year which is a reduction of 8% below 1990 levels (229.49 Gg CO₂ eq.). Liechtenstein decided not to account for Art. 3.4. of the Kyoto Protocol. In 2007 the Government decided to make use of the flexible mechanisms and purchase about 230 Gg CO₂ eq within the period of 2008 – 2012. The respective investments shall help to realize climate protection projects that show ecological benefits and social-ethical acceptability for the population of the host country. In order to ensure these quality standards Liechtenstein’s National Climate Protection Strategy aims at the acquisition of such emission reductions that are certified by additional quality labels (e.g. Gold Standard, Social Carbon). The Strategy further excludes the purchase of Assigned Amount Units for the purpose of Liechtenstein’s Kyoto Compliance – unless a “Green Investment Scheme” has been defined by the respective host country. Emission reductions from HFC-23 and carbon capture storage projects will not be purchased.

The projections of the total greenhouse gases show a 1% increase by 2010 compared to 1990 which means the Kyoto target will not be reached by domestic action only. However, projections always involve uncertainties.

Table 1-3 Kyoto target 2008-2012

Gross and net GHG emissions during the commitment period 2008 - 2012	
Kyoto Protocol emissions (Gg CO ₂ eq.)	
Kyoto target (assigned amount units per year, average 2008–2012)	211.99
Total projected gross GHG emissions WM (projection for 2010)	232.05
Use of Kyoto mechanisms (CDM) (annually)	46
Net GHG emissions	186.05

1.4 Impacts, vulnerability assessment and adaptation

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.

Impacts

The mean annual temperature of Liechtenstein currently lies at 10.4°C (1996 – 2006). The mean annual temperature has increased from 1980 to 2007 by 1.3 °C. Mean temperature projections for the years 2030, 2050 and 2070 have been calculated. The results for winter and summer are graphically shown in Figure 1-5 together with observed temperature anomalies from 1864 to 2008. According to the mean estimate temperatures will increase in Liechtenstein and northern Switzerland by 1.8 °C in winter and 2.7 °C in summer.

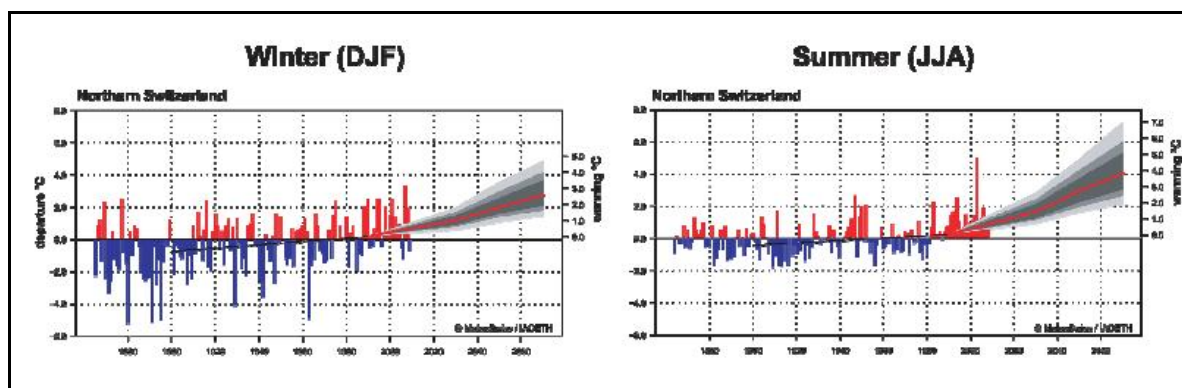


Figure 1-5 Observed temperature anomalies and projected changes in mean temperature (Data: MeteoSwiss/IACETH)

The trends in precipitation are less distinct than in temperature. For a number of stations a significant increase in precipitation is found in winter and spring (+2.7 to +3.1% per decade). For summer and autumn no significant trends are detectable. On the northern side of the Alps, until the middle of the 21st century, an increase of 8% is expected in winter and a decrease of 17% in summer.

The warming trend and changing precipitation patterns are also expected to have significant effects on ecosystems. The Biodiversity Monitoring Switzerland reports that impacts of climate change are being observed even within limited time frames. For instance, typical alpine vascular plants have shifted their distribution in the uphill direction during the past few years.

The expected increased intensity of storms and reduced snowfall and snow cover duration are particularly important for alpine areas, tourism and forestry due to more frequent floods, landslides and debris flows and an increase of the danger of avalanches.

Vulnerability assessments

It is difficult to transfer the consequences of global climate warming calculated on the basis of models to the spatial scale of 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 CO₂ concentration and the associated rise in temperature and reduction of permafrost:

Health: The increase in intensity of heat waves in combination with high tropospheric ozone concentrations represents the greatest risk that climate change poses to people's health. Another important risk of climate change for health is the occurrence of vector-borne diseases. There is still a great deal of uncertainty as to what future developments will be.

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.

Tourism: Within the next decades Liechtenstein's tourism sector will have to deal with great challenges caused by climate change related developments in Liechtenstein's ecosystems. Especially the winter tourism sector will be hit by higher temperature as the rise of the freezing level will lead to higher snow lines.

Other economic sectors: Global climate warming will affect further 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 (Fuhrer 2003). The expected increase in elevation of the snow and permafrost boundaries and increasing weather instability also have an effect on the important recreation area of Malbun and Steg. The international engagement of the insurance sector will likely suffer the most severe consequences from an increase in the probability of losses.

Adaptation

The projected consequences of an ongoing climate change require the immediate implementation of the so called Two-Pillar-Strategy – Mitigation (Pillar1) and Adaptation (Pillar2)

Mitigation: The necessary reduction of greenhouse gases can only be achieved if concrete measures are implemented in due time. Liechtenstein has recently launched a set of measures to address the problem of growing greenhouse gas emissions such as the Energyconcept 2013 / Energy-Vision 2020 (2010), Emissions Trading Act (2008), Energy Efficiency Act (2008), CO₂-Act (2008), Environmental Protection Act (2008), National Transport Policy (2008), National Climate Protection Strategy (2007) and Action Plan Air (2007). Liechtenstein's climate policy goal is – in the midterm – to fulfill the obligations originating from the Kyoto Protocol. The mitigation measures however will be further developed, especially with respect to sectors that have not yet been totally included into strict climate change regulation (e.g. traffic and transportation).

Adaptation: It is already obvious that certain climate change related consequences will become irreversible. Pillar 2 deals with the question of how these future threats could be addressed and how potential future damages can be limited or even avoided.

Natural hazard: Liechtenstein has established so called "Geological Risk Maps" with a special focus on residential areas. These maps provide regional information on the specific risks regarding avalanches, rock- and landslides and flooding.

Agriculture: Identified adaptation measures are an increased use of appropriate corn provenances, that have already anticipated future conditions of the changing environment. However, the use of genetically modified crops is not foreseen. The irrigation of agricultural fields will increasingly be used thereby causing conflicts with other public interests, especially during longer draught periods.

Forestry: The increase of draught periods with consequential damages caused by insects, pathogens (viruses, bacteria, fungus) fire or storms will lead to a decrease of the forests protection abilities in Liechtenstein. Adaptation measures that address the problems of these projected situations and that are already executed are the conversion of spruce and fir stocks into mixed deciduous and coniferous forests.

Tourism: Further examinations have to be concluded within the next years. The production of artificial snow, as currently practiced, is not considered to be a sustainable solution. Nevertheless, 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".

1.5 Financial resources and transfer of technology

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 operational tasks of International Humanitarian Cooperation and Development (IHCD) are carried out by the Office for Foreign Affairs, the Immigration and Passport Office, the Office of Forests, Nature and Land Management, and the Liechtenstein Development Service (LED). The overall coordination of the IHCD activities lies with the Office for Foreign Affairs.

IHCD encompasses all forms of the humanitarian and development policy of the State of Liechtenstein and of the LED (a foundation under private law). These activities are set out in the Law on International Humanitarian Cooperation and Development (IHCD Act) of 2007. Liechtenstein's engagement focuses on **emergency and reconstruction assistance, international refugee and migration assistance** as well as **bilateral and multilateral development cooperation**.

Liechtenstein works closely together with the affected population and local organizations, with aid and development organizations in Liechtenstein, Switzerland, Austria and Germany as well as with European and international organizations. In total, Liechtenstein, through its IHCD, maintains working relationships with more than 100 partners. The bulk of Liechtenstein's support is provided in the form of financial resources. In parallel, Liechtenstein engages in active knowledge transfer by providing specialists from Liechtenstein. These specialists work on projects on-site, as seconded personal at international organisations, or as ad-hoc experts and are funded by Liechtenstein.

In 2008, Liechtenstein IHCD had resources in the amount of about 25.5 million Swiss francs, i.e. about 700 Swiss francs per capita. The total Official Development Assistance (ODA) amount, was about 26 million Swiss francs. Since 2000, the Government has nearly doubled the resources for ODA.

In connection with the protection and preservation of the environment, Liechtenstein as an Alpine country is particularly engaged on behalf of the development of mountain regions. Under the umbrella of the Alpine Convention, Alpine countries cultivate a partnership with mountain regions in the Balkans, the Carpathians, the Caucasus, and Central Asia.

1.6 Research and systematic observation

Research

Liechtenstein maintains its own University of Applied Sciences, at which institutes (Institute for Architecture and Planning and Institute for Financial Services) also examine sustainable development. One of the main focus points of the Institute for Architecture is the establishment of concepts for a sustainable regional development with respect to settlement, transport, and landscape. The Institute for Financial Services examines the impacts, challenges and opportunities of the emerging environmental commodity markets, as for example carbon markets. 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 (2009) 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 (7th Framework Programme on Research, 11.7 million CHF from 2007 to 2013).

Public institutions in Liechtenstein are also indirectly engaged in technology research. The Liechtenstein University of Applied Sciences contributes a budget of 8.3 million CHF (2009) 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 (2009).

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.

Systematic observation

Liechtenstein collects a wide range of data relating to climate, both through its own measuring stations and through interregional cooperation, especially with Switzerland. Since 1974, the largest measuring station in the country has been in operation in Vaduz, measuring the common meteorological data (air pressure, air temperature, relative humidity, wind direction, wind speed, precipitation, radiation, 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.

Since 2001 the Eastern Swiss cantons and Liechtenstein execute a monitoring procedure on joint ambient concentration of air pollutants.

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.

1.7 Education, training and public awareness

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.

Environmental education forms part of Liechtenstein's all-encompassing educational program and is based on the official curriculum of the Principality of Liechtenstein (2005, 2nd Edition). As one out of several reasons for the faculty of "Human and Environment" (topics are, among others: Climate, Weather, Economy, Industrialization) the respective curriculum states: "Students deal with humans as part of society and environment. They recognize dependencies as well as the possibility to act for or to influence relevant procedures. Thanks to this approach environmental education influences the content of various school subjects – it is not only a part of subjects like "Biology" or "Nature" (ecology) but also of "Economy and Policy" (ecological and economical relations).

Moreover various school projects on environmental education were conducted at Liechtenstein schools. These include the use of environmental focal points at various schools, environment days, eco-friendly office and school supplies and other support activities.

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. The Government also provided financial support to several projects in order to raise public awareness with respect to climate change issues. Among others, projects like "LIFE Climate Foundation" Liechtenstein (2008) and the Implementation of a personal carbon footprint program within the framework of a social networking platform received such support.

The Office of Environmental Protection annually distributes an environmental protection calendar to the public. Various institutions are also engaged in public information and education. In particular, these include the Liechtenstein Environmental Protection Society, the Solar Society, and the Liechtenstein Transport Association (VCL). Also CIPRA (International Commission for the Protection of the Alps), 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 is financially supported by the Government.

2. National circumstances relevant to greenhouse gas emissions and removals

2.1 Governmental structure

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 as well as the powers of pardon, mitigation, and quashing with respect to criminal investigations. Furthermore, 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 (2009-2012), three parties are represented in Parliament. The Patriotic Union is the strongest party with 13 seats. The Progressive Citizens' Party has 11 seats, and the Free List is represented with one seat.

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 to which Liechtenstein is a State party. 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 the Liechtenstein Court of Justice will 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 ensures that all Swiss customs regulations and all other Swiss federal legislation shall apply to Liechtenstein to the extent to which 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 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. Liechtenstein has therefore concluded "The bilateral Agreement between the Principality of Liechtenstein and the Swiss Confederation on Environmental Levies within the Principality of Liechtenstein" to ensure a parallel levying of environmental taxes in Liechtenstein. 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 January 2007, the EU now has 27 members and the EEA 30 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 and, through its participation in committees, has a voice in the development and execution of the programs.

2.2 Population

At the end of 2007, Liechtenstein had a population of 35,356, a third (33.6%) of whom were foreign citizens (especially Swiss, Austrians, Italians and Germans). The population density in 2007 was 220.3 inhabitants per km². Figure 2-1 indicates the development of Liechtenstein's population between 1901 and 2007.

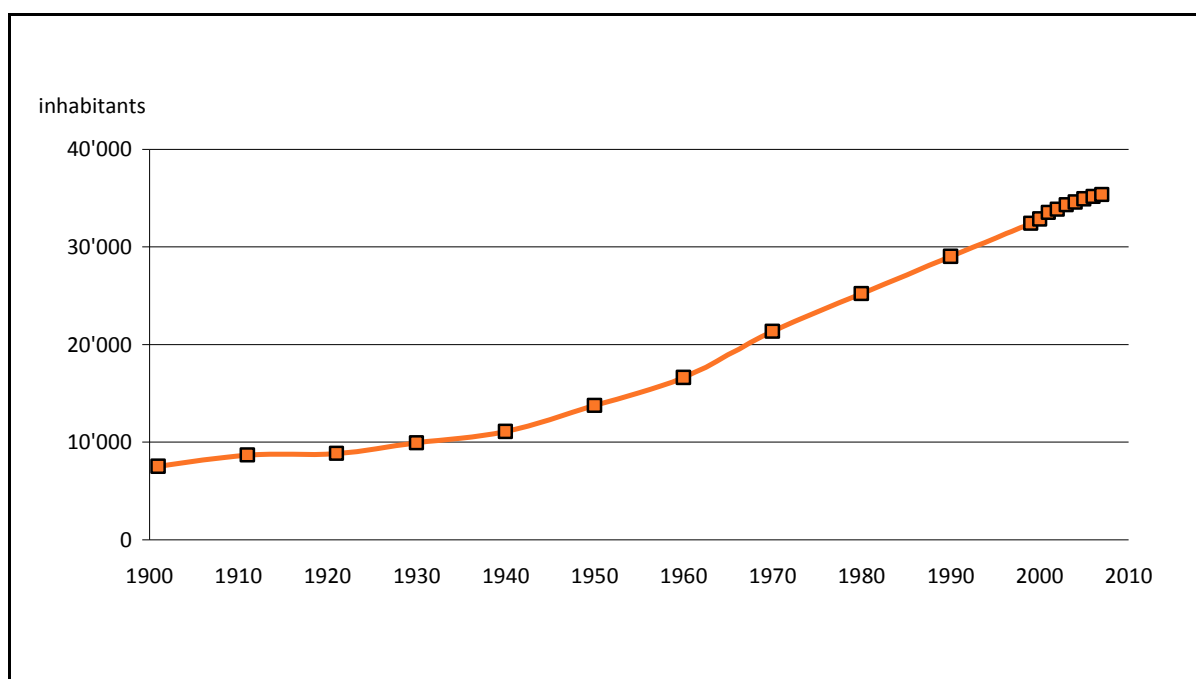


Figure 2-1 Population 1901-2007 (OS 2009a)

2.3 Climate

Liechtenstein has a continental climate, i.e., the weather varies considerably over the course of the year. In the capital Vaduz, at 456 meters elevation, the average annual temperature was 10.7°C in the year 2007. The average precipitation has not changed appreciably in the last 20 years. In Vaduz, it is approximately 970 mm per year (annual average precipitation 1974-2007).

2.4 Geography

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 km². The transport axes Munich-Milan and Zurich-Vienna intersect near the Principality of Liechtenstein. There are no freeways on Liechtenstein's territory, however, so that Liechtenstein's road network is only of regional importance. A high mountain range (the Alps) in the east constitutes the natural border to Austria; the River Rhine marks the border to Switzerland.



Figure 2-2 The Principality of Liechtenstein

2.5 Economy

At the end of 2007, Liechtenstein had 32,435 employed persons. More than half of the work force lives abroad commuting from Switzerland, Austria, or Germany to Liechtenstein. Over two thirds of the work force are foreign citizens. In 2007 55.4% of the employed persons worked in the sector services, 43.5% in the sector manufacturing and 1.1% in the sector agriculture and forestry.

The unemployment rate calculated according to the domestic principle (unemployed persons in percentage of total number of in Liechtenstein domiciled employed persons) was 2.3% in 2008.

The gross domestic product (GDP) and the gross national income (GNI) were determined for the first time in 1998, as part of Liechtenstein's National Economic Accounting. Older GDP and GNI figures were calculated using a different method and can therefore not be compared directly. In 2006, the GDP stood at 5.0 billion (thousand million) Swiss francs, and economic growth was 9.8%. The GNI was at 4.4 billion Swiss francs. A first estimation for the GDP in 2007 is 5.5 billion Swiss francs. Figure 2-3 shows the development of the GDP and GNI between 1998 and 2006.

According to economic sector, industry and manufacturing generated 40% of gross value added in 2006, general services 24%, financial services 29%, and agriculture and households 7%.

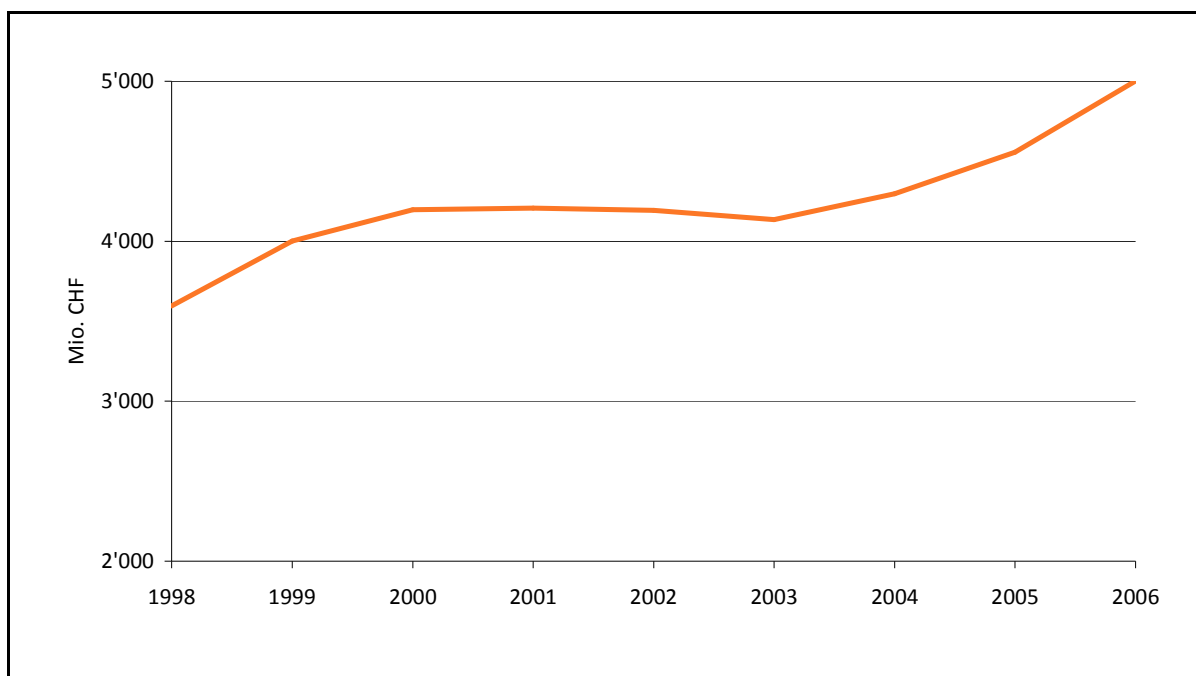


Figure 2-3 GDP at current prices 1998-2006 (OS 2009 c)

Figure 2-4 shows the development of GDP per employed person (in full-time equivalents) and GNI per inhabitant. In 2006, GDP per employed person was 181,000 CHF and GNI per inhabitant was 126,000 CHF. A distinctive feature of the Liechtenstein GDP is that it derives to a considerable extent from the work done by working personnel domiciled abroad. In 2006 48.7% of people at work in Liechtenstein were cross-border commuters from abroad. For this reason, it is not valid to calculate per capita GDP based on inhabitants. This would yield to misleading results in comparison with other countries.

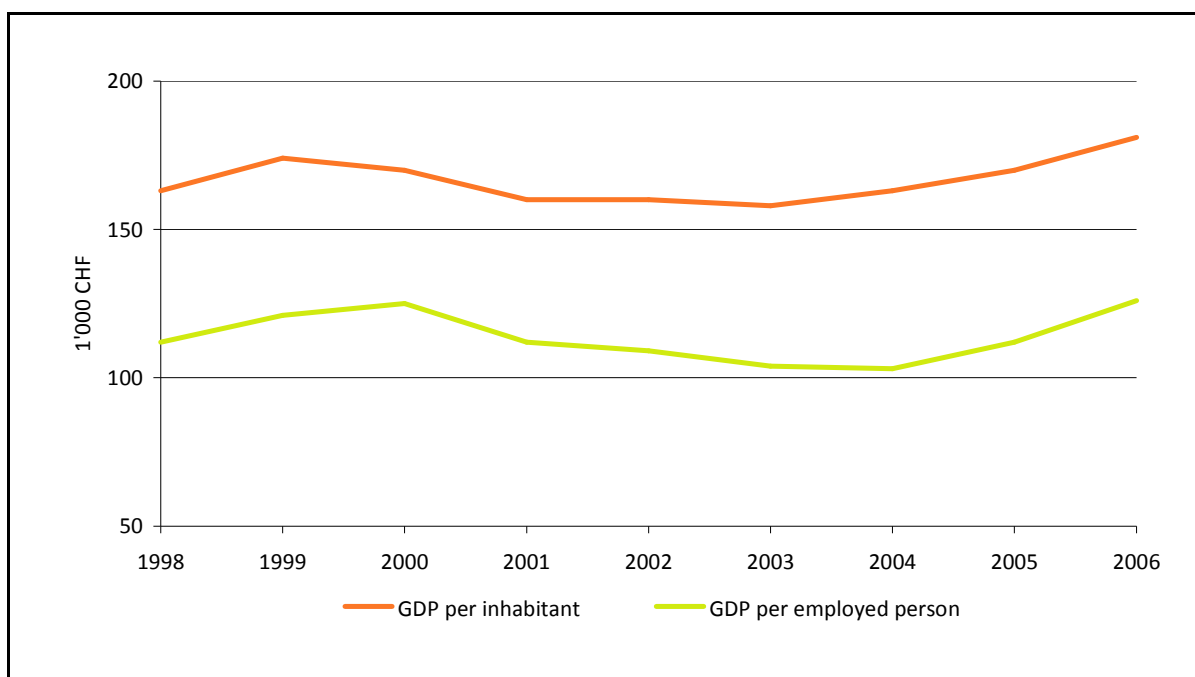


Figure 2-4 GDP at current prices per employed person (in full-time equivalents) and at current prices per inhabitant 1998-2006 (OEA 2008)

2.6 Energy

Energy supply

Liechtenstein has no fossil fuel resources of its own. In the year 2008, only 7.8% of the energy used comes from Liechtenstein. Regarding electricity, 17.7% was produced in 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 2008 was 1,384 GWh (4,982 TJ). Natural gas (29%) and electricity (28%) constitute the greatest share of the total energy consumption. Figure 2.5 illustrates energy consumption and energy imports by energy source in 2008.

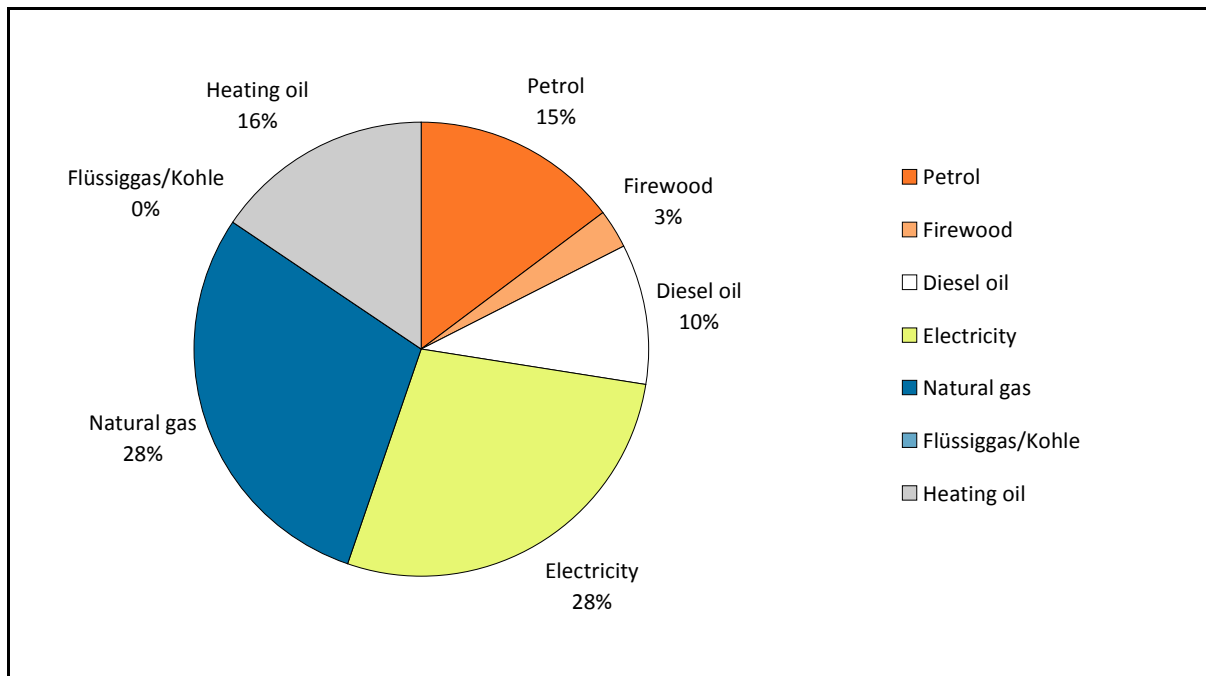


Figure 2-5 Energy consumption by fuels, 2008. 100% corresponds to 1384 GWh or 4982 TJ (OS 2009b).

In 2008, total energy consumption per capita reached 38.9 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.

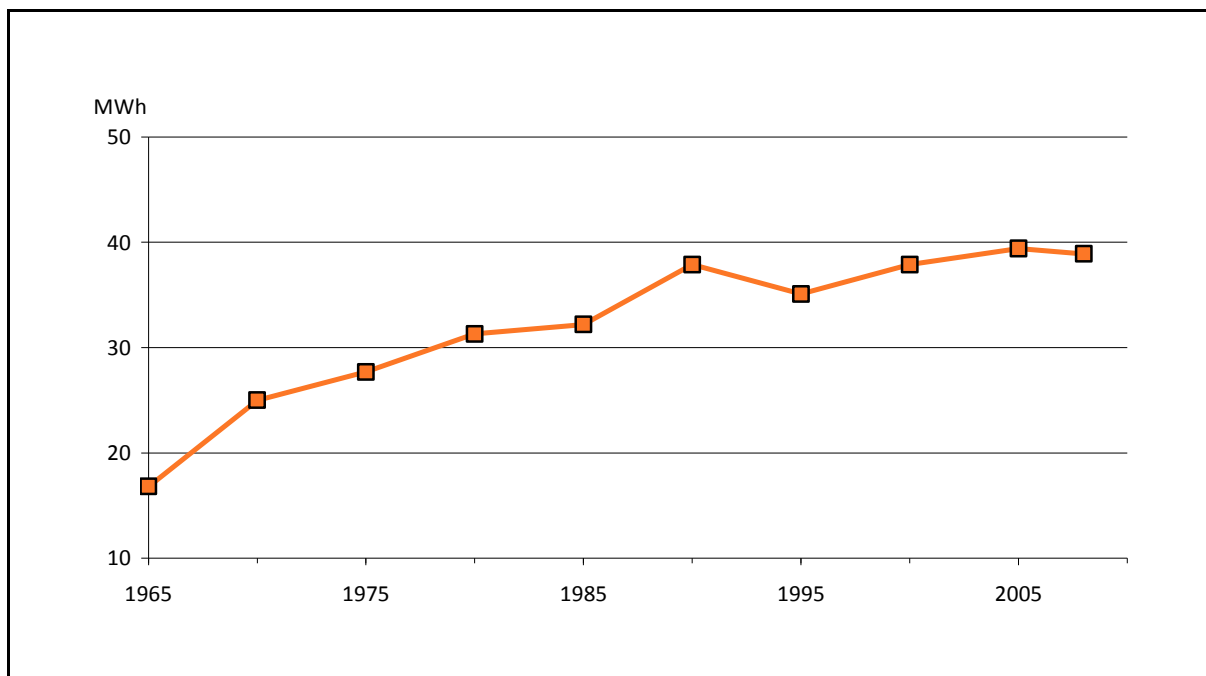


Figure 2-6 Energy consumption per capita 1965-2004 (OS 2009b)

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. After rather low energy prices in the early 70ies, real prices of energy sources increased between 1978 and 1985. Prices for heating fuel then reached a historic low in the mid 90ies. However, from the end of the 1990ies, real energy prices have risen again, with a stronger increase since 2004 and another very strong increase between 2007 and 2008 for heating fuel prices. Electricity is an exception, its real prices tended to decrease since the mid-1990ies.

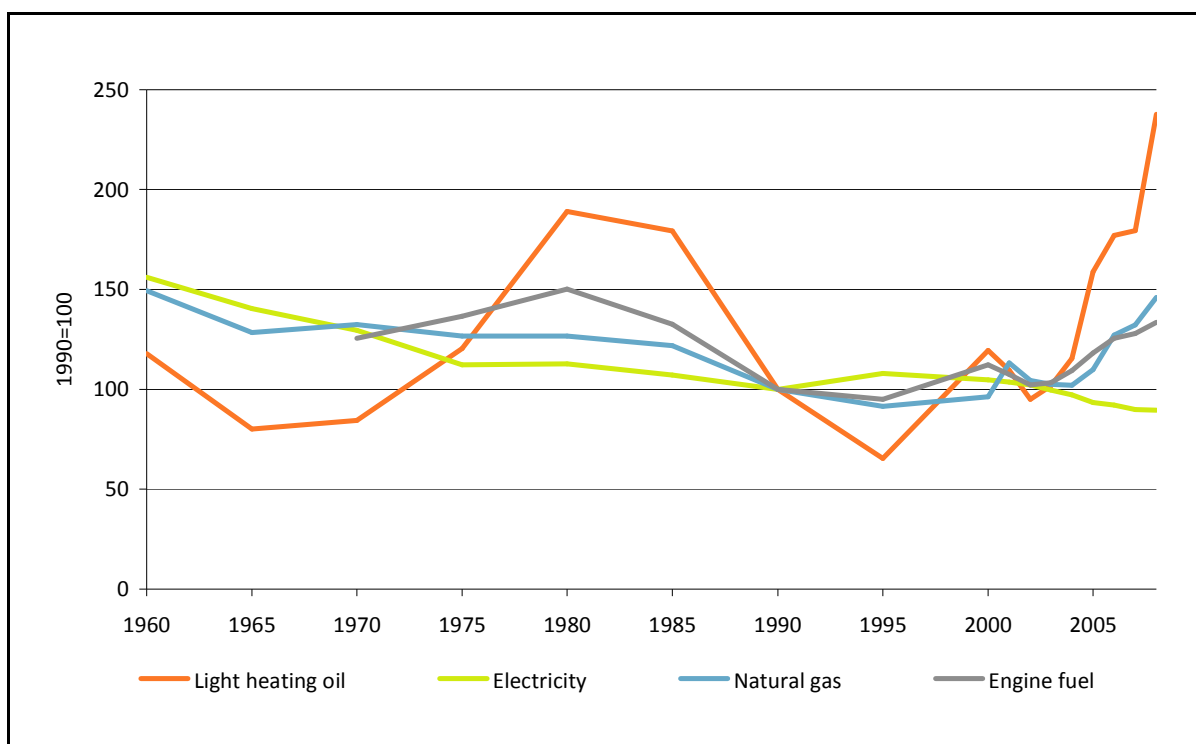


Figure 2-7 Real energy prices of the most important energy sources 1960-2008, Index 1990=100 (SFOE 2008)

Electricity

In 2008, the electricity fed into the national network amounted to 386 GWh. About four fifths (82.3%) of the energy consumed in Liechtenstein is being imported. Liechtenstein's own production amounts to approximately 71 GWh (hydroelectric plants, block-heating plants, photovoltaic systems). The average electricity growth over the last 4-year period (2004-2008) was about 2.9%.

2.7 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 2008, 25,462 automobiles were registered (degree of motorization: 718 automobiles per 1000 inhabitants). Figure 2-8

illustrates the development of the number of vehicles between 1970 and 2008, and Figure 2-9 shows the number of automobiles by total weight in kg in 2008.

Pursuant to decision 1753/2000/EC, which has been incorporated into the EEA Agreement, Liechtenstein is required to determine the average CO₂ 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 CO₂/km. The current Liechtenstein data is still far from achieving this goal.

The average CO₂ emissions of all vehicles newly introduced into circulation in 2008 was 190 g/km. The emissions of petrol vehicles were 191 g/km, slightly higher on average than the 188 g/km emitted by diesel vehicles. 69% of the newly registered automobiles achieve emissions of less than 200 g/km.

CO₂ emissions rise with increasing engine sizes, engine power, and vehicle weight. In the past years most of the technically achieved reductions in CO₂ emissions have been cancelled out by the larger and more powerful engines and heavier vehicles that continue to be popular. For the first time these figures now decreased. The proportion of economically, light vehicles rises and also vehicles with alternative fuels (natural gas, hybrid) are better accepted.

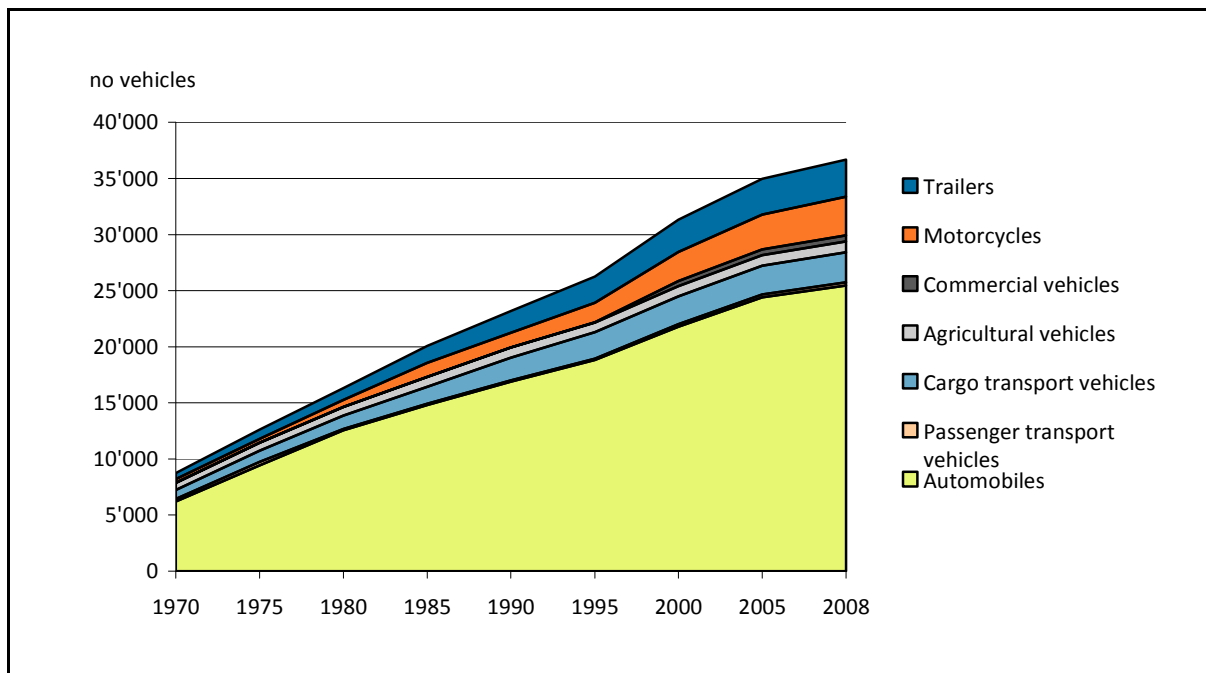


Figure 2-8 Number of vehicles 1970-2008 (OS 2008)

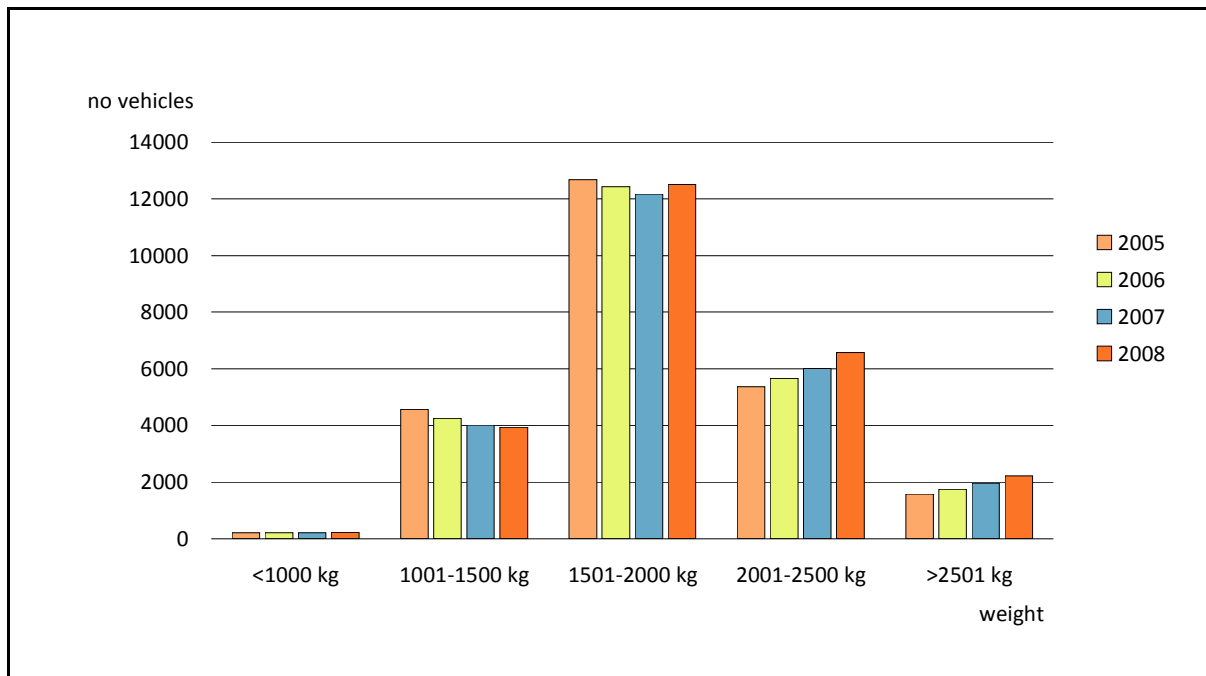


Figure 2-9 Number of vehicles by total weight 2008 (OS 2008)

2.8 Industry

Liechtenstein's economy has a significant emphasis on industrial production. In 2007, the production sector provided 43% of the jobs, which in comparison with other European countries is extraordinarily high. The most important industrial branches are mechanical engineering, electrical machinery, vehicle components, dental technology, food products as well as construction work.

Due to Liechtenstein's limited domestic market, especially the larger enterprises are heavily export-oriented. A vast majority of their goods production is sold abroad. The most important export countries of Liechtenstein's industry and goods production sector are Switzerland, Germany and the USA.

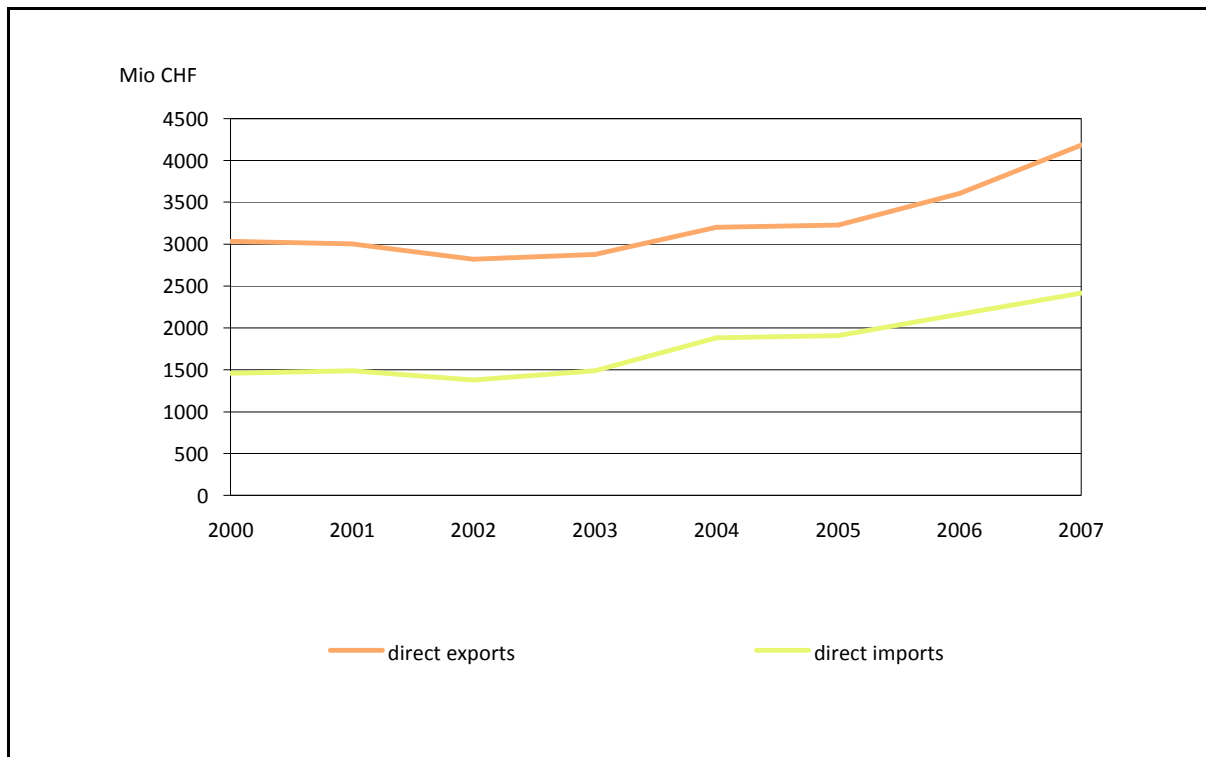


Figure 2-10 Direct goods imports and exports since 2000 in Mio CHF, Goods exchange with Switzerland is not included (OEA 2009).

2.9 Waste

After the implementation of fees on municipal waste considering the polluter-pays-principle in 1994 the amount of waste apparently declines. In the following years, the amount develops parallel to the population growth. Due to the open borders to Switzerland, the recycling quote cannot be evaluated for Liechtenstein. However, the quote is comparable with Switzerland.

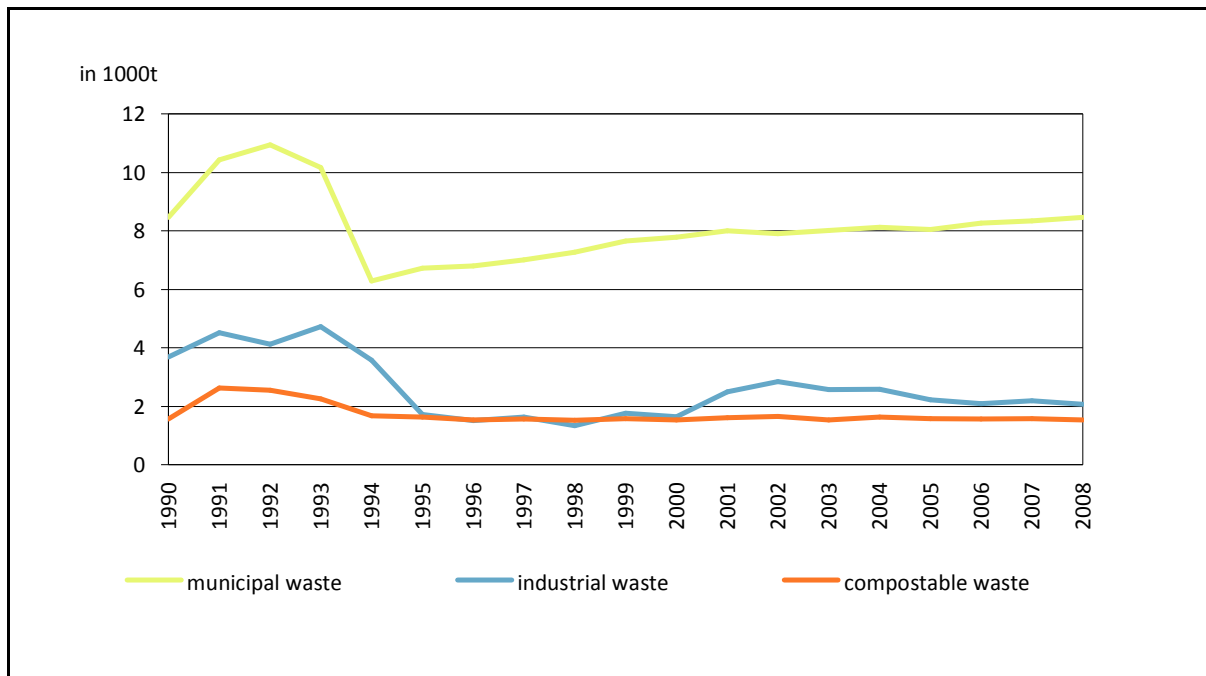


Figure 2-11 Development of waste production 1990-2008 (OEA 2009).

The amount of landfill volume fluctuates strongly depending on building activities and market conditions. There is no landfill for hazardous waste. In Liechtenstein only excavated material and construction waste are deposited.

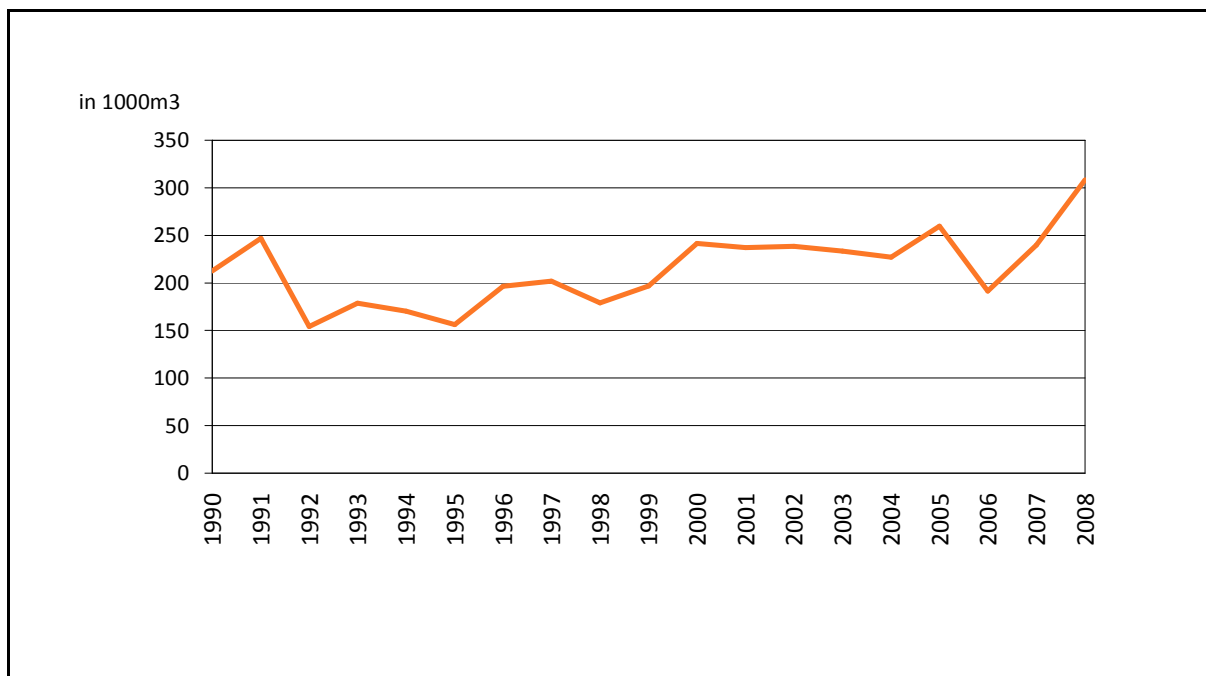


Figure 2-12 Development of landfill volumes since 1990 in 1000 cubic metres (OEA 2009)

2.10 Building stock and urban structure

Between 1984 and 2002 the settlement area increased by 322 hectares (25.6%) to 15.8 km² or 10% of the country's area. The transport infrastructure covered 2.6% of the country's area in 2002. 3.7% of the country's area were living area. In 2000 there existed 8,341 residential buildings in Liechtenstein. In 1970 the number of residential buildings in Liechtenstein was 4,632.

2.11 Agriculture and Forestry

The country covers 160 km², 41% of which is forested, 34% agricultural (cropland, pastures, plantations, alp meadows), 10% populated, and 15% unproductive (as of the end of 2002). Between 1984 and 2002 the agricultural area decreased from 58.3 km² to 54.4 km².

The abovementioned data (Chapter 2.10 and 2.11) originate from Liechtenstein's population census in 2002 and Liechtenstein's Areal Statistic from 2002. Both data sources will be updated in the course of 2010.

References

- LPA (Liechtenstein Power Authority), 2008: Annual Report 2008, Schaan.
- OEA (Office of Economic Affairs), 2000 Final Report on People Census
- OEA (Office of Economic Affairs), 2009 Liechtenstein in Figures.
- OEA (Office of Economic Affairs), 2008: Liechtenstein National Economic Accounting, 2006, Vaduz.
- Office of Land Use Planning, 2002: Areal Statistik 1984, 1996, 2002
- OS (Office of Statistics), 2009a: Statistical Yearbook 2009, Vaduz.
- OS (Office of Statistics), 2009b: Energiestatistik 2008.
- OS (Office of Statistics), 2009c: Liechtenstein National Economic Accounting. Estimation of Gross domestic product 2007, Vaduz.
- OS (Office of Statistics), 2009: Agriculture statistics 2007, Vaduz.
- OS (Office of Statistic), 2008: Motor Vehicle Statistics, 1 July 2008, Vaduz.
- Principality of Liechtenstein (official Internet portal): www.liechtenstein.li (2009-10-02).
- SFOE 2008: Schweizerische Gesamtenergiestatistik 2008, BFE 2008, Ittigen, Bern

3. Greenhouse Gas Inventory information, including information on National Systems and National Registries

3.1 Summary tables

Summary tables of the national greenhouse gas inventory in the common reporting format are provided in Annex 1.

3.2 Trends in greenhouse gas emissions and removals (1990-2007)

3.2.1 Aggregated greenhouse gas emissions 2007

In 2007, Liechtenstein emitted 243.5 Gg CO₂ equivalent (excluding LULUCF) to the atmosphere corresponding to 6.89 tonnes CO₂ equivalent per capita.

With a share of 87% the largest contributor gas was CO₂. With 211.3 Gg CO₂ emissions, the most important source was sector 1 Energy with 88% share (213 Gg CO₂ equivalent). Tab. 3-1 shows emissions by gas and sector in Liechtenstein for the year 2007. A breakdown of Liechtenstein's total emissions by gas is given in Tab. 3-4 and Tab. 3-5. Figure 3-1 shows the relative contributions of the individual gases to the total greenhouse gas emissions (excluding LULUCF).

Fuel combustion within the energy sector was by far the largest single source of emissions of CO₂ in 2007. Emissions of CH₄ and N₂O originated mainly from agriculture.

Tab. 3-1 Overview of GHG emissions in CO₂-equivalent (Gg) by gas and sector 2007 (according to IPCC categories). Abrev.: NO not occurring, NA not applicable.

Emissions 2007	CO ₂	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Total
	CO ₂ equivalent (Gg)						
1 All Energy	210.4	1.9	1.1				213.3
2 Industrial Processes	NO	NO	NO	4.5	NA,NO	0.1	4.6
3 Solvent and other Product Use	0.9		0.2				1.1
4 Agriculture	0.0	12.1	10.5				22.6
6 Waste	0.008	0.7	1.1				1.9
Total (excluding LULUCF)	211.3	14.7	12.9	4.5	0.0	0.1	243.5
5 LULUCF	-6.6	NO	NO				-6.6
Total (including LULUCF)	204.7	14.7	12.9	4.5	0.0	0.1	236.9
<i>International Bunkers</i>	<i>0.8</i>	<i>0.0001</i>	<i>0.0074</i>				0.8

Tab. 3-2 Overview of the greenhouse gas emissions of Liechtenstein for the year 2007 in Gg.

IPCC	Category	CO ₂	CH ₄	N ₂ O	SF ₆	NO _x	CO	NMVOG	SO ₂
	Source / Sink	Gg							
1	Total energy	210.41	0.09	0.00		NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
(1A)	Fuel combustion activities	210.41	0.04	0.00		NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
(1B)	Fugitive emissions from fuels	NA,NO	0.05	NA,NO		NA,NO	NA,NO	NA,NO	NA,NO
2	Industrial processes	NO	NO	NO	0.00	NA,NO	0.01	0.01	NA,NO
3	Solvents and Other Product Use	0.86		0.00		NO	NO	0.24	NO
4	Agriculture		0.58	0.03		NA,NO	NA,NO	NA,NE,NO	NO
6	Waste	0.01	0.03	0.00		NA,NE,NO	NA,NE,NO	NA,NE,NO	NE
	Total excl. LULUCF	211.28	0.70	0.04	0.00001	NA,NE,NO	0.01	0.25	NA,NE,NO
5	LULUCF	-6.57	NO	NO		NE,NO	NE,NO	NE	NO
	Total incl. LULUCF	204.71	0.70	0.04	0.00001	NA,NE,NO	0.01	0.25	NA,NE,NO
Memo	International bunkers	0.76	0.00	0.00		NE,NO	NE,NO	NE,NO	NE,NO

Please note: The IPCC categories 1-4 and 6 are added, generating the "Total excluding LULUCF". IPCC category 5, LULUCF may either be a source or a sink. The sum of all IPCC categories 1-6 are called "Total including LULUCF".

To compare the climate gases with each other, they must be converted into CO₂ equivalent according to their Global Warming Potential (GWP). The GWP varies for each gas. 1 ton of methane has the same GWP as 21 tons of CO₂ meaning that GWP (CH₄) = 21. For nitrous oxide, the factor is even much higher GWP (N₂O) = 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 CO₂ equivalent.

Tab. 3-3 GHG emissions of Liechtenstein in 2007 in CO₂ equivalent. The column to the right represents the share of the sectors.

IPCC	Category	CO ₂	CH ₄	N ₂ O	HFCs	SF ₆	Total	Share
	Source/ Sink	CO ₂ equivalent (Gg)						%
1	Total Energy	210.41	1.87	1.07			213.35	87.62%
(1A)	Fuel combustion activities	210.41	0.80	1.07			212.28	87.19%
(1B)	Fugitive emissions		1.07				1.07	0.44%
2	Industrial Processes				4.47	0.12	4.59	1.89%
3	Solvent and other Product Use	0.86		0.25			1.11	0.46%
4	Agriculture	0.00	12.12	10.46			22.58	9.27%
6	Waste	0.01	0.71	1.13			1.85	0.76%
	Total (excl. LULUCF)	211.28	14.70	12.91	4.47	0.12	243.48	100.00%
	Share (excl. LULUCF)	86.78%	6.04%	5.30%	1.84%	0.05%	100.00%	
5	LULUCF	-6.57					-6.57	-2.70%
	Total (incl. LULUCF)	204.71	14.70	12.91	4.47	0.12	236.91	97.30%
	Share (incl. LULUCF)	86.41%	6.21%	5.45%	1.89%	0.05%	100.00%	

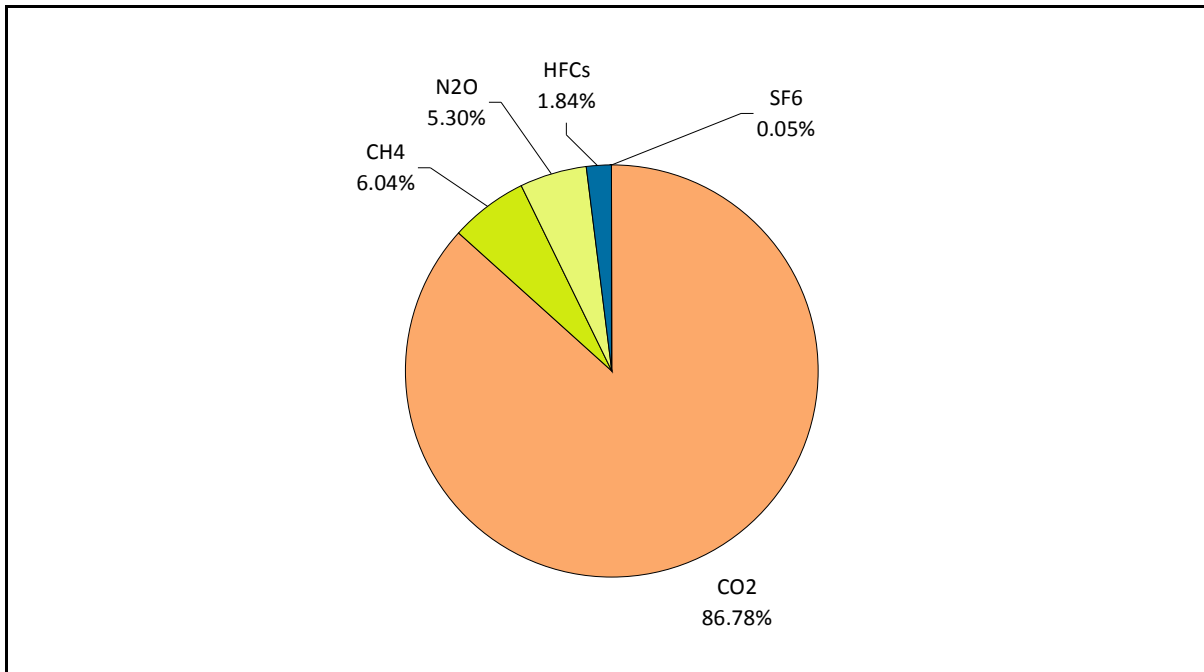


Figure 3-1 Contribution of the individual gases to Liechtenstein's total GHG emissions 2007. 100% corresponds to 243.5 Gg CO₂ eq. (excl. LULUCF)

CO₂ (excl. LULUCF)

In 2007, 211Gg of gross CO₂ emissions were produced, which corresponds to 6.03 tonnes per capita. Approximately two fifths (42%) of these emissions were generated by Transport (composed of Transport and Offroad Vehicles and Machinery). Commercial, Institutional and Residential users (room heating and warm water) account for another roughly two fifths (42%) of emissions. Industry (composed of Energy Industries and Manufacturing Industries and Combustion) is responsible for 16%. Other sources such as Waste and Solvent and Other Product Use play an insignificant role by comparison, while Agriculture is not a source of CO₂ at all.

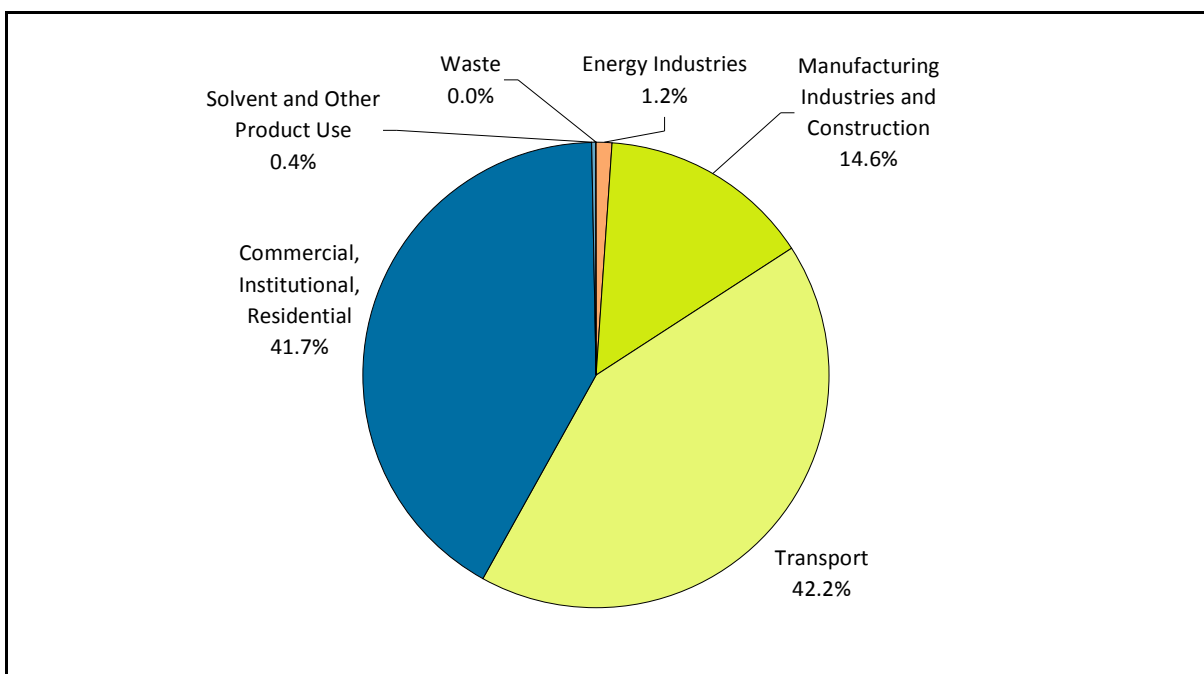


Figure 3-2 CO₂ emissions by sector in 2007 (assignment to IPCC categories: see Table 3-1). 100% corresponds to 211 Gg.

CH₄

In 2007 0.7 Gg of CH₄ were emitted corresponding to 14.7 Gg of CO₂ equivalents. 82% of this volume was generated by the agriculture sector, whereof 70% were caused by ruminants. 7% derive from 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 4%, whereas the source Waste accounts for 5%. Industrial processes account for only 0.5% of the CH₄ emissions, transport emissions for only 1% respectively.

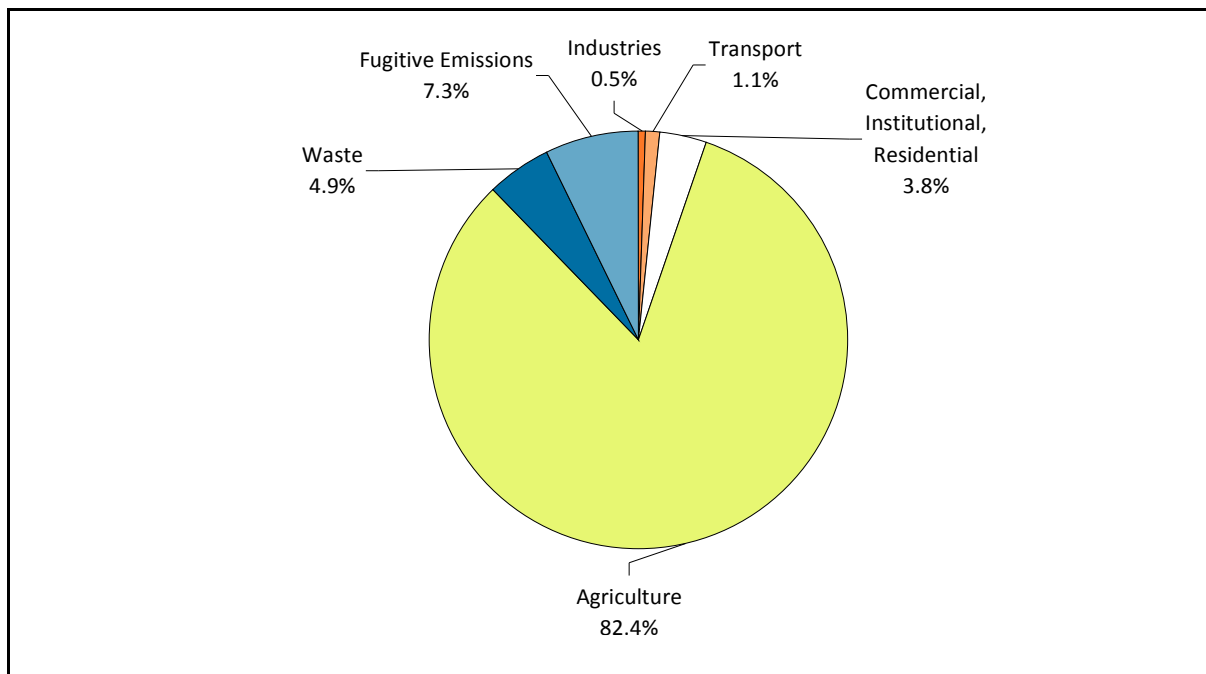


Figure 3-3 CH₄ emissions by sector in 2007 (assignment to IPCC categories: see Table 3-1). 100% corresponds to 0.7 Gg or 14.7 Gg CO₂ eq.

N₂O

In 2007, 0.041Gg N₂O were emitted corresponding to 12.9 Gg CO₂ equivalents. Approximately four fifths are generated by Agriculture (81%). Further important sources are Waste with a share of 9% and Transport with a share of 5%. Contribution of other sources such as Residential, Institutional, and Commercial users as well as Industry and Solvent and other Product Use are very minor in comparison.

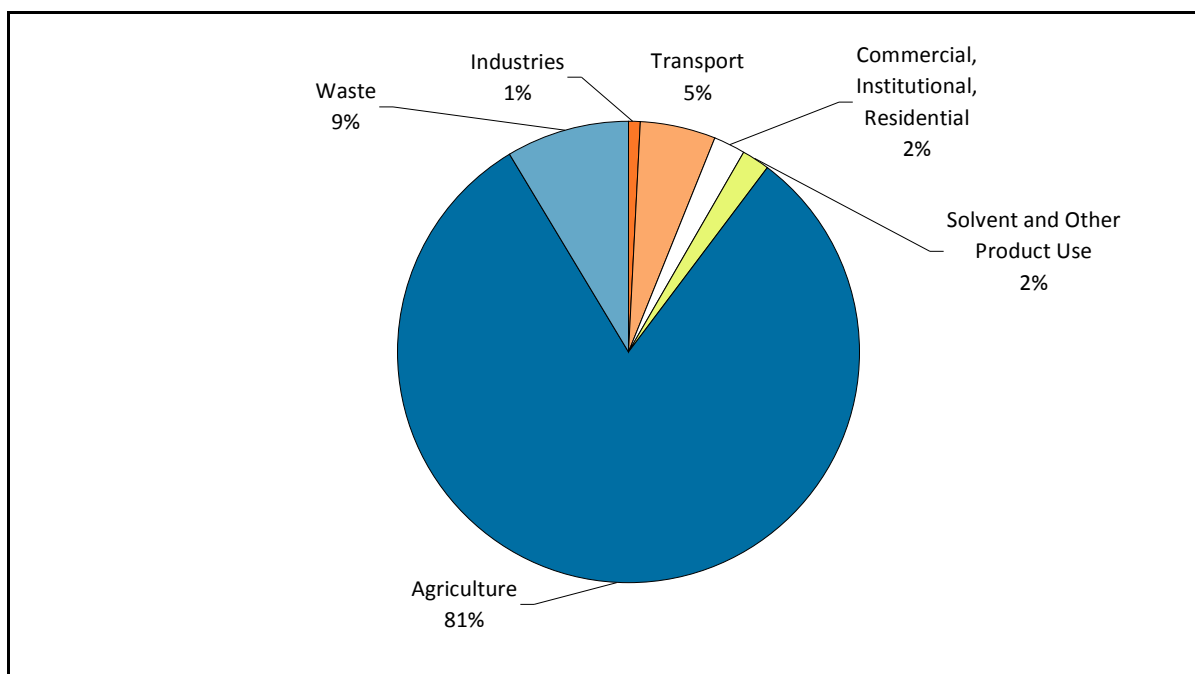


Figure 3-4 N₂O emissions by sector in 2007 (assignment to IPCC categories: see Table 3-1) 100% is 0.041 Gg or 12.9 Gg CO₂ eq.

3.2.2 Other greenhouse gases (HFC, PFC, SF₆, precursors)

Synthetic gases

Sulfur hexafluoride emissions (SF₆) account for 103 t CO₂ equivalents deriving from transformer stations of the Liechtenstein Power Authority. Furthermore, there are 4471 t CO₂ eq. deriving from HFC mainly from refrigeration and air conditioning appliances. Further emissions of synthetic gases (such as PFC) are not known for Liechtenstein so far (in Switzerland, the emissions of PFC contribute 0.2% to the national total).

Synthetic gases emissions have so far been of marginal importance with 1.9% of the gross greenhouse gas emissions in 2007.

Precursor substances and SO₂

For the precursor substances NO_x, CO and NMVOC as well as for the gas SO₂, data from the submission under the UNECE Convention on Long-range Transboundary Air Pollution (CLRTAP) are used. The system boundaries for the transportation sector are not the same as under the UNFCCC reporting since the CLRTAP uses the territorial principle. In 2007, 0.629 Gg NO_x, 0.614 Gg CO, 0.406 Gg NMVOC and 0.030 Gg SO₂ were emitted.

3.2.3 Emission trends by gas

Emission trends by gas for the period 1990–2007 are summarized in Tab. 3-4. The percentage shares of the individual gases excluding LULUCF are shown for selected years in Tab. 3-5.

Tab. 3-4 Summary of Liechtenstein's GHG emissions in CO₂ eq. (Gg) by gas 1990–2007. The column on the far right (digits in italics) shows the percent change in emissions in 2007 as compared to the base year 1990.

Greenhouse Gas Emissions	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO ₂ equivalent (Gg)									
CO ₂ emissions including net CO ₂ from LULUCF	194.7	202.4	203.3	211.6	197.6	200.9	203.0	218.9	230.2	229.4
CO ₂ emissions excluding net CO ₂ from LULUCF	203.1	210.8	211.7	220.0	206.1	209.4	211.6	223.8	235.1	234.3
CH ₄ emissions including CH ₄ from LULUCF	13.4	13.2	13.1	12.4	12.6	12.6	12.7	12.6	12.6	12.5
CH ₄ emissions excluding CH ₄ from LULUCF	13.4	13.2	13.1	12.4	12.6	12.6	12.7	12.6	12.6	12.5
N ₂ O emissions including N ₂ O from LULUCF	13.1	13.3	13.4	13.0	13.0	13.2	13.0	13.0	12.8	12.8
N ₂ O emissions excluding N ₂ O from LULUCF	13.1	13.3	13.4	13.0	13.0	13.2	12.9	13.0	12.8	12.7
HFCs	0.0	0.0	0.0	0.1	0.1	0.4	0.7	1.0	1.4	1.8
PFCs	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
SF ₆	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.0	0.0	0.0	0.0
Total (including LULUCF)	221.2	229.0	229.8	237.0	223.3	227.1	229.4	245.5	257.0	256.4
Total (excluding LULUCF)	229.6	237.3	238.2	245.5	231.7	235.5	237.9	250.4	261.9	261.3

Greenhouse Gas Emissions	2000	2001	2002	2003	2004	2005	2006	2007	1990-2007
	CO ₂ equivalent (Gg)								%
CO ₂ emissions including net CO ₂ from LULUCF	222.6	220.7	225.6	233.5	233.7	233.4	235.1	204.7	5.1
CO ₂ emissions excluding net CO ₂ from LULUCF	227.5	225.6	230.6	240.0	240.2	240.0	241.6	211.3	4.0
CH ₄ emissions including CH ₄ from LULUCF	12.3	13.0	13.1	13.3	13.5	14.0	14.4	14.7	9.7
CH ₄ emissions excluding CH ₄ from LULUCF	12.3	13.0	13.1	13.3	13.5	14.0	14.4	14.7	9.7
N ₂ O emissions including N ₂ O from LULUCF	12.5	12.7	12.5	12.5	12.6	12.7	12.8	12.9	-1.4
N ₂ O emissions excluding N ₂ O from LULUCF	12.5	12.7	12.5	12.5	12.5	12.6	12.8	12.9	-1.4
HFCs	2.3	3.0	3.2	3.7	4.2	4.2	4.2	4.5	---
PFCs	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	---
SF ₆	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	---
Total (including LULUCF)	249.8	249.4	254.5	263.1	263.9	264.3	266.5	236.9	7.1
Total (excluding LULUCF)	254.7	254.3	259.4	269.6	270.4	270.8	273.0	243.5	6.1

Tab. 3-5 Liechtenstein's total GHG emissions (excl. LULUCF) in CO₂ eq. in selected years and the percentage shares of the different GHG.

Greenhouse Gas Emissions excl. LULUCF	1990		1995		2000		2005		2007	
	CO ₂ eq (Gg)	%	CO ₂ eq (Gg)	%	CO ₂ eq (Gg)	%	CO ₂ eq (Gg)	%	CO ₂ eq (Gg)	%
CO ₂ emissions excl.net CO ₂ from LULUCF	203.1	88.5%	209.4	88.9%	227.5	89.3%	240.0	88.6%	211.3	86.8%
CH ₄ emissions excl. CH ₄ from LULUCF	13.4	5.8%	12.6	5.3%	12.3	4.8%	14.0	5.2%	14.7	6.0%
N ₂ O emissions excl. N ₂ O from LULUCF	13.1	5.7%	13.2	5.6%	12.5	4.9%	12.6	4.7%	12.9	5.3%
HFCs	0.00001	0.00%	0.38	0.16%	2.34	0.92%	4.16	1.54%	4.47	1.84%
PFCs	NA,NO		NA,NO		NA,NO		NA,NO		NA,NO	
SF ₆	NA,NO		NA,NO		0.02	0.007%	0.06	0.021%	0.12	0.049%
Total (excluding LULUCF)	229.6	100%	235.5	100%	254.7	100%	270.8	100%	243.5	100%

The emission trends for individual gases are as follows (see Tab. 3-4, Tab. 3-5 and Figure 3-5):

Total emissions excluding LULUCF Removals/Emissions increased from 1990 to 2007 by 6.1%.

Total emissions including LULUCF increased more strongly by 7.1%.

The CO₂ emissions excluding net CO₂ from LULUCF increased from 1990 to 2007 by 5.1%. As CO₂ persistently forms the major part of total GHG emissions (accounting for about 88.5% of the total emissions in 2007) its relative trend between 1990 and 2007 is largely in line with the total GHG emissions excluding LULUCF. This share fluctuated between 86.8% and 89.8% in the period 1990–2007.

The CO₂ emissions excluding net CO₂ from LULUCF show a very significant decrease from 2006 to 2007 (the explanation is provided in Chpt. 3.2.4 below by the analysis of the sources).

CH₄ emissions excluding CH₄ from LULUCF show an increase of 9.7%, which is the result of an increase in the sectors Energy and Waste. Its contribution to the total national emissions is 6.0 % in 2007, which is slightly higher than in 1990 (5.8%).

N₂O emissions excluding N₂O from LULUCF have decreased by 1.4% due to reduced input of mineral fertilizers and due to a reduction of organic soils. Its contribution to the total national emissions decreased from 5.7% in 1990 to 5.3% in 2007.

HFC emissions (mainly from 2F1 Refrigeration and Air Conditioning Equipment) increased due to their role as a substitute for CFCs. SF₆ emissions stem from electrical transformation stations and play a minor role for the total of synthetic gases. PFC emissions are not occurring. The share of synthetic gases to the national total emissions increased from 0.0% (1990) to 1.9% (2007).

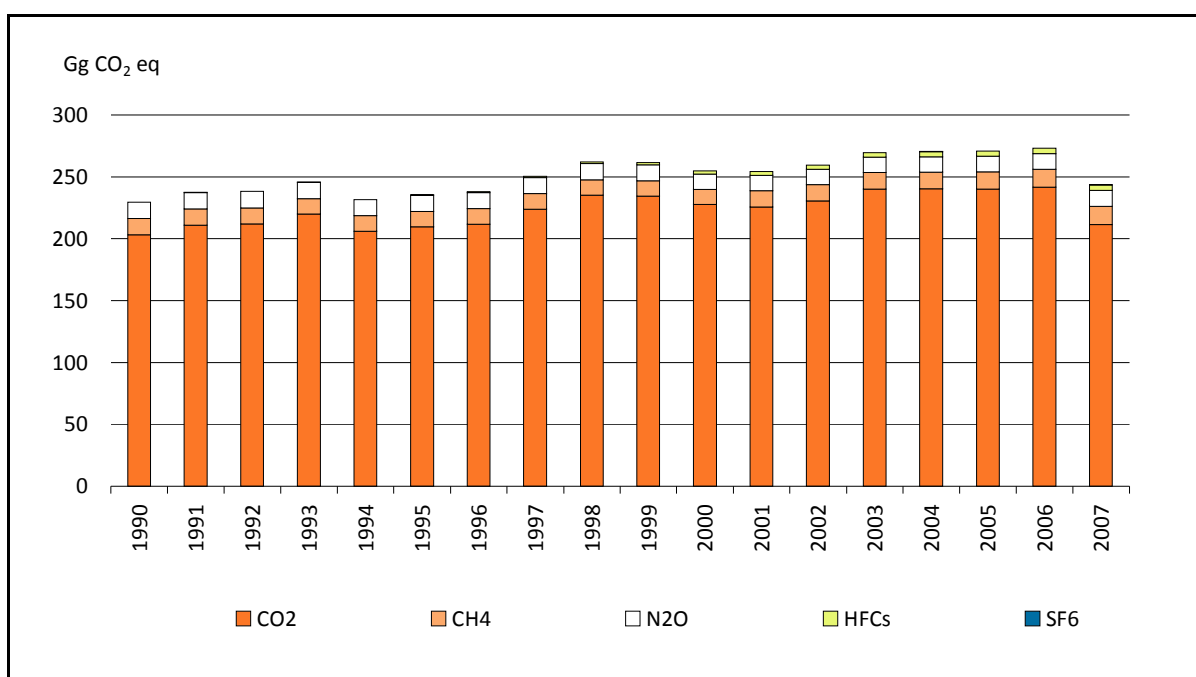


Figure 3-5 Trend of Liechtenstein's greenhouse gas emissions by gases 1990–2007. CO₂, CH₄ and N₂O correspond to the respective total emissions excl. LULUCF.

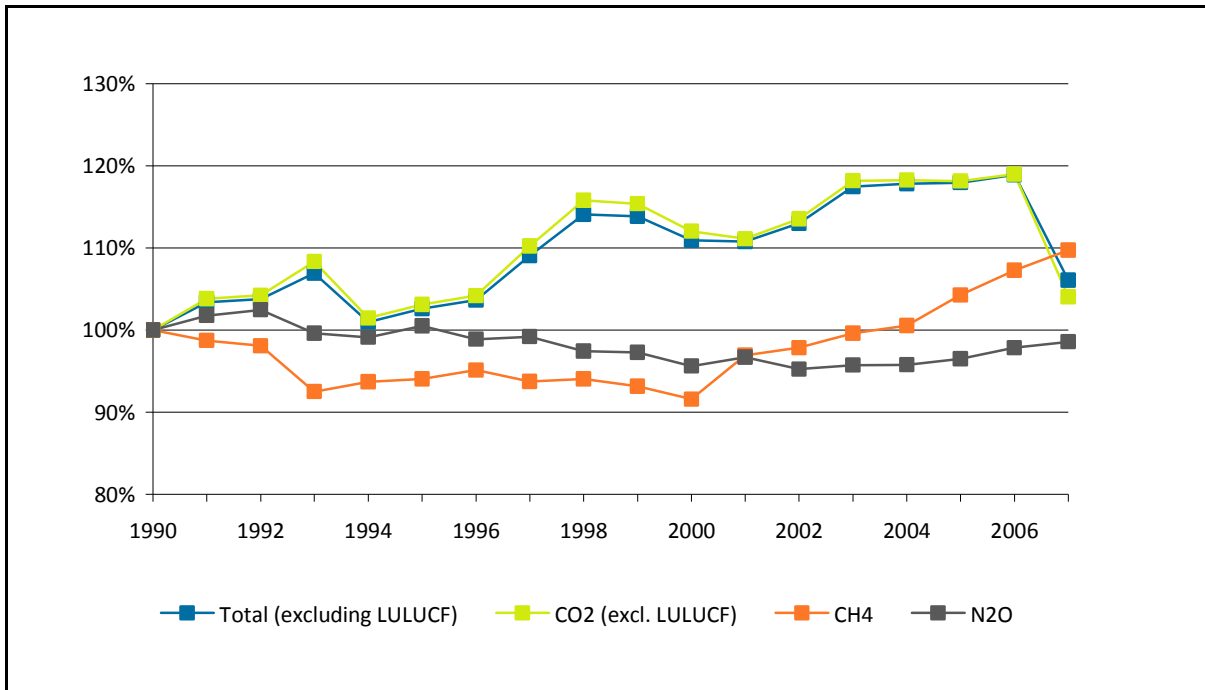


Figure 3-6 Relative trend of Liechtenstein's most important climate gases CO₂, CH₄ and N₂O and Total (all excl. LULUCF) 1990-2007.

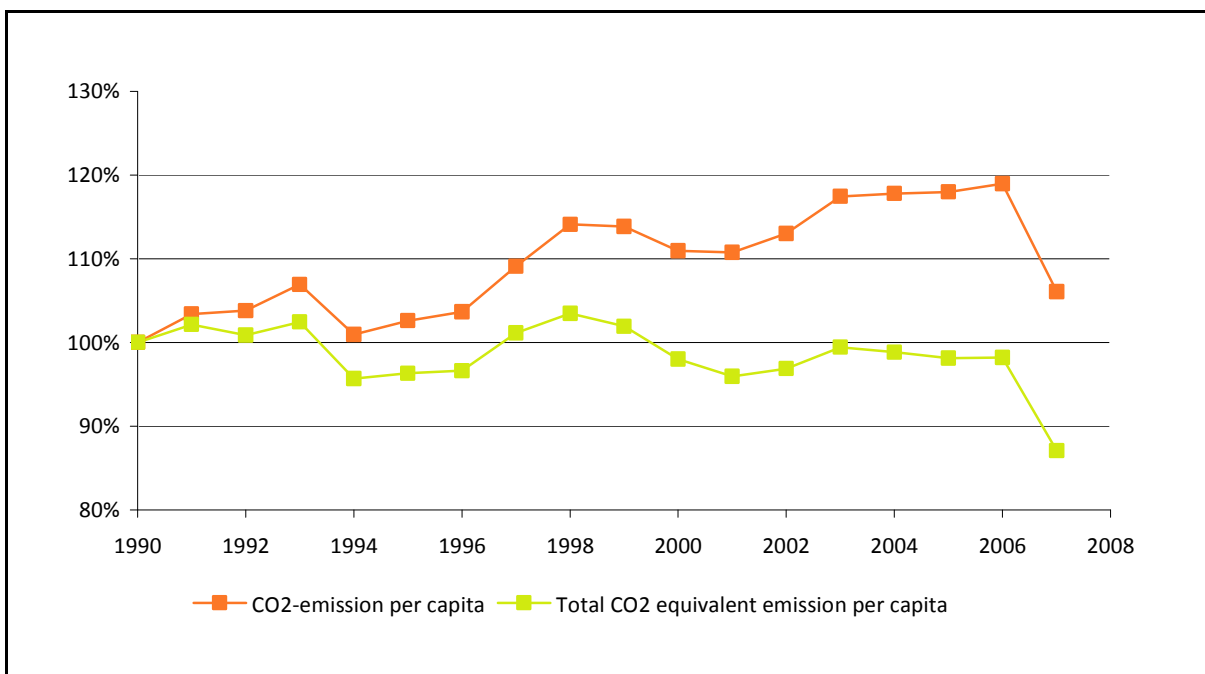


Figure 3-7 Relative CO₂ eq. emissions per capita (excl. LULUCF) and CO₂ emissions per capita (excl. LULUCF) between 1990 and 2007.

3.2.4 Emission trends by sources and sinks

Tab. 3-6 shows the emission trends for all major source and sink categories. As the largest share of emissions originated from the energy sector, Tab. 3-7 also includes the contributions of the energy sub-sectors.

Tab. 3-6 Liechtenstein's GHG emissions in CO₂ eq (Gg) by sources and sinks, 1990-2007. The column on the far right in the lower part of the table (digits in italic) indicates the percentage change in emissions in 2007 as compared to the base year 1990.

Source and Sink Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO ₂ equivalent (Gg)									
1 Energy	203.5	211.5	212.6	221.1	207.2	210.7	212.9	225.4	236.8	236.0
1A Fuel combustion	203.2	211.1	212.2	220.6	206.7	210.2	212.4	224.8	236.1	235.3
1B Fugitive emissions from oil and natural gas	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.7	0.7
2 Industrial Processes	0.0	0.0	0.0	0.1	0.1	0.4	0.7	1.0	1.4	1.8
3 Solvent and Other Product Use	2.0	1.9	1.8	1.7	1.7	1.6	1.5	1.4	1.4	1.3
4 Agriculture	22.5	22.5	22.3	21.1	21.1	21.3	21.1	21.0	20.8	20.5
6 Waste	1.6	1.5	1.5	1.5	1.6	1.5	1.6	1.6	1.6	1.6
Total (excluding LULUCF)	229.6	237.3	238.2	245.5	231.7	235.5	237.9	250.4	261.9	261.3
5 LULUCF	-8.3	-8.4	-8.4	-8.4	-8.5	-8.5	-8.5	-4.9	-4.9	-4.9
Total (including LULUCF)	221.2	229.0	229.8	237.0	223.3	227.1	229.4	245.5	257.0	256.4

Source and Sink Categories	2000	2001	2002	2003	2004	2005	2006	2007	1990-2007
	CO ₂ equivalent (Gg)								<i>trend %</i>
1 Energy	229.5	227.4	232.3	241.9	242.1	241.9	243.6	213.3	4.9
1A Fuel combustion	228.8	226.6	231.5	241.0	241.2	240.9	242.5	212.3	4.5
1B Fugitive emissions from oil and natural gas	0.7	0.8	0.8	0.9	0.9	1.0	1.1	1.1	233.5
2 Industrial Processes	2.4	3.0	3.3	3.7	4.2	4.2	4.2	4.6	---
3 Solvent and Other Product Use	1.3	1.2	1.2	1.2	1.1	1.1	1.1	1.1	-44.4
4 Agriculture	19.8	21.0	20.9	21.1	21.2	21.6	22.3	22.6	0.2
6 Waste	1.7	1.6	1.8	1.8	1.8	1.9	1.8	1.9	19.2
Total (excluding LULUCF)	254.7	254.3	259.4	269.6	270.4	270.8	273.0	243.5	6.1
5 LULUCF	-4.9	-4.9	-4.9	-6.5	-6.5	-6.5	-6.5	-6.6	-21.1
Total (including LULUCF)	249.8	249.4	254.5	263.1	263.9	264.3	266.5	236.9	7.1

Tab. 3-7 Emission trends for the sub-categories in the sector 1 Energy, 1990-2007.

Source and Sink Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO ₂ equivalent (Gg)									
1A1 Energy Industries	0.2	0.8	1.9	1.9	1.8	2.0	2.5	2.5	2.9	2.9
1A2 Manufacturing Industries and Construction	35.3	34.2	34.2	36.0	34.2	34.4	34.3	35.9	38.2	37.6
1A3 Transport	76.4	89.7	89.1	87.0	79.6	81.7	82.9	86.6	86.2	91.9
1A4 Other Sectors	88.9	83.4	84.2	93.3	88.8	89.9	90.3	97.3	105.9	99.8
1A5 Other (Offroad)	2.4	2.9	3.0	2.4	2.3	2.2	2.3	2.6	3.0	3.1
1B Fugitive emissions from oil and natural gas	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.7	0.7
1 Energy	203.5	211.5	212.6	221.1	207.2	210.7	212.9	225.4	236.8	236.0

Source and Sink Categories	2000	2001	2002	2003	2004	2005	2006	2007	1990-2007
	CO ₂ equivalent (Gg)								
1A1 Energy Industries	2.7	2.9	2.5	2.8	2.9	3.1	2.8	2.5	1354
1A2 Manufacturing Industries and Construction	34.3	34.6	35.7	38.3	37.4	36.2	37.4	30.9	-12.5
1A3 Transport	95.9	92.2	87.7	87.3	86.0	85.5	82.5	86.6	13.4
1A4 Other Sectors	92.8	94.4	102.9	109.2	111.9	112.6	116.2	88.8	0.0
1A5 Other (Offroad)	3.0	2.6	2.8	3.5	3.1	3.5	3.7	3.4	41.0
1B Fugitive emissions from oil and natural gas	0.7	0.8	0.8	0.9	0.9	1.0	1.1	1.1	233.5
1 Energy	229.5	227.4	232.3	241.9	242.1	241.9	243.6	213.3	4.9

Tab. 3-8 Liechtenstein's total gross GHG emissions in CO₂ eq. (excl. LULUCF) and the shares of individual source categories for selected years.

Source and Sink Categories	1990		1995		2000		2005		2007	
	CO ₂ eq (Gg)	%	CO ₂ eq (Gg)	%	CO ₂ eq (Gg)	%	CO ₂ eq (Gg)	%	CO ₂ eq (Gg)	%
1 Energy	203.5	88.6%	210.7	89.5%	229.5	90.1%	241.9	89.3%	213.3	87.6%
1A Fuel combustion	203.2	88.5%	210.2	89.2%	228.8	89.8%	240.9	89.0%	212.3	87.2%
1B Fugitive emissions oil and natural	0.3	0.1%	0.5	0.2%	0.7	0.3%	1.0	0.4%	1.1	0.4%
2 Industrial Processes	0.0	0.0%	0.4	0.2%	2.4	0.9%	4.2	1.6%	4.6	1.9%
3 Solvent and Other Product Use	2.0	0.9%	1.6	0.7%	1.3	0.5%	1.1	0.4%	1.1	0.5%
4 Agriculture	22.5	9.8%	21.3	9.1%	19.8	7.8%	21.6	8.0%	22.6	9.3%
6 Waste	1.6	0.7%	1.5	0.6%	1.7	0.7%	1.9	0.7%	1.9	0.8%
Total (excluding LULUCF)	229.6	100.0%	235.5	100.0%	254.7	100.0%	270.8	100.0%	243.5	100.0%

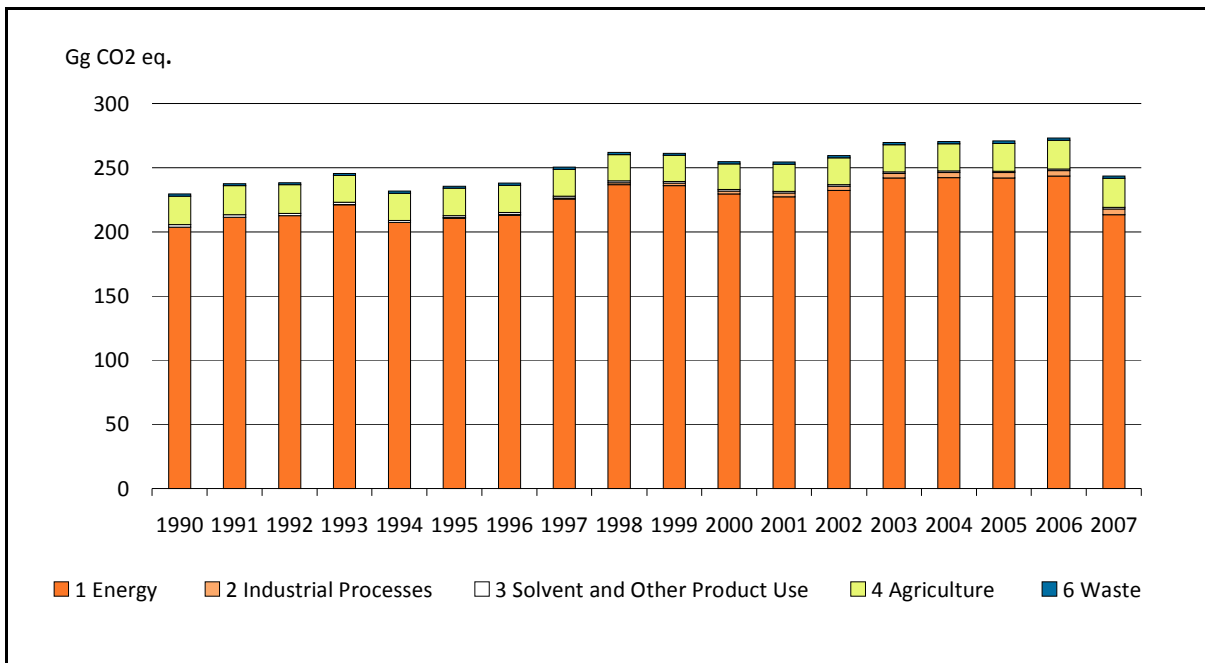


Figure 3-8 Emission trends of Liechtenstein's GHG emissions (excl. LULUCF) by main source categories, 1990-2007.

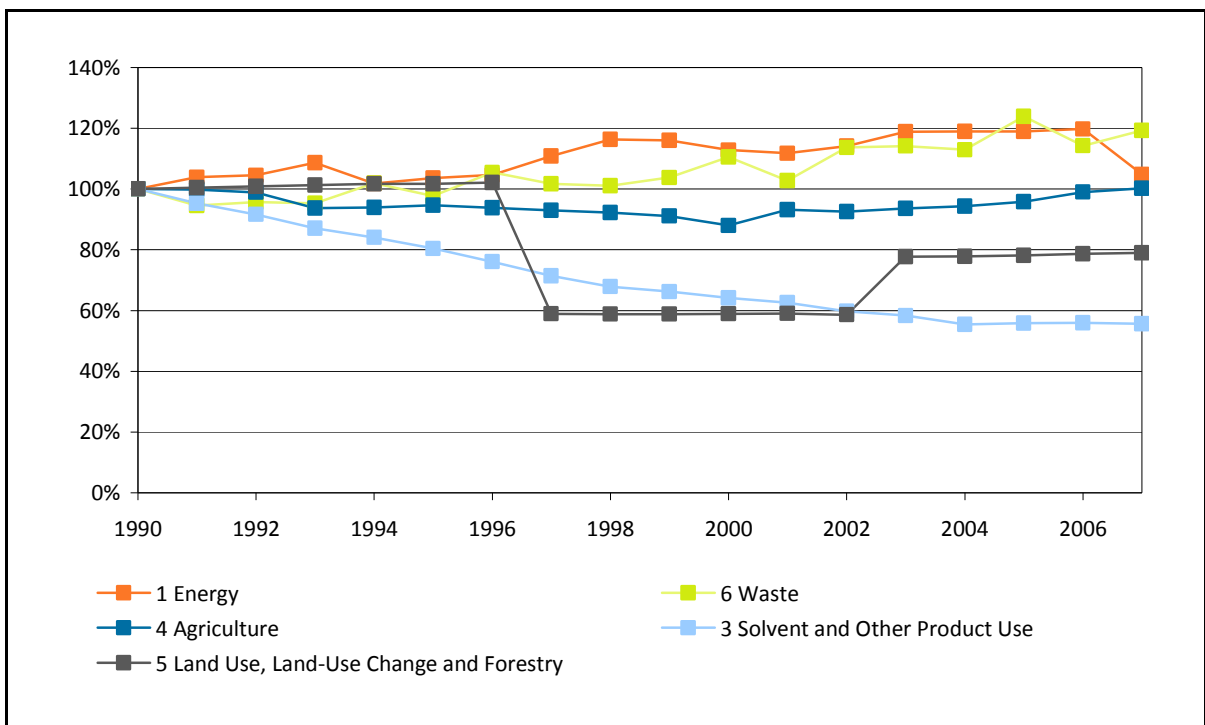


Figure 3-9 Relative emission trends of Liechtenstein's GHG emissions by main source categories, 1990-2007.

Emission trends for the various sectors can be summarized as follows:

1 Energy: 87.6% of Liechtenstein's GHG emissions stem from the energy sector. The sub-sectors (Tab. 3-7) show different trends between 1990 and 2007. Overall the emissions are slightly increasing in the Energy sector until 2006. From 2006 to 2007 there is a pronounced jump downward which is explained under the

subsector 1A4. The generally increasing trend is due to an increase in the two sub-sectors 1A3 and 1A4 which contribute over 80% (1A3 41%, 1A4 42%) and therefore dominate the Energy sector.

1A1: The consumption of natural gas in co-generation plants has enormously increased twenty fold. Accompanied by an extension of the gas-grid, natural gas has replaced gas oil as the main heating fuel in buildings.

1A2: The consumption of natural gas by industries has increased whereas gas oil has decreased. In total the trend is rather stable, showing a slight increase until 2006. There is a jump downward between 2006 and 2007 which is most likely due to the same phenomenon described under 1A4. Overall there is a decrease of 12.5% between 1990 and 2007

1A3: In line with a general increase of the road-vehicle kilometres of all vehicle categories, the fuel consumption and the emissions are increasing (13.4% between 1990 and 2007).

1A4: Inhabitants have increased by 22% whereas employment has increased by 40% in the period 1990-2007, which is reflected in a similar increase of energy consumption and GHG emissions by 30.7% until 2006 with several fluctuations caused by warm and cold winter periods. From 2006 to 2007 a pronounced jump downwards of almost one forth is observed. There are two hypotheses that may explain this decrease: First of all, a price for gas oil in the corresponding period, which provided an incentive for people to reduce fuel consumption and also caused people to hold off refilling their oil tanks. Secondly, warm winter months at the beginning and at the end of 2007, resulting in a reduction of 5% to 10% in the heating degree days of Liechtenstein in 2007. Holding off the filling of the residential fuel tanks would mean that to some extent instead of buying new fuel, stocks in private residential fuel tanks were depleted. A calculation based on consumption data without taking account of those residential stock changes, as it is currently the case for Liechtenstein, may therefore underestimate actual emissions in 2007. Similarly, actual emissions may be overestimated in the following years, when residential tanks might be refilled. Next year's fuel consumption data will probably show which of the reasons explain the decrease in fuel consumption from 2006 to 2007.

1A5: The emissions reported under this category are all kind of vehicles from construction sites. The general construction activities have increased in Liechtenstein with a subsequent, fluctuating increase of diesel consumption and emissions (41.0%).

1B: In parallel with the built-up of Liechtenstein's gas supply network since 1990, the fugitive emissions have strongly increased over the period 1990-2007 (233%).

2 Industrial Processes: Due to the lack of heavy industry in Liechtenstein, only synthetic gases contribute to sector 2. The increasing trend is determined by HFC emissions from 2F1 Refrigeration and Air Conditioning Equipment (substitutes for CFCs).

3 Solvent and Other Product Use: Emissions have strongly decreased due to reduction measures for NMVOCs resulting from legal restrictions and the introduction of the VOC levy (-44.4%).

4 Agriculture: The emissions show a minimum around 2000 due to decreasing and increasing animal numbers. In 2007 the emissions reached more or less the same amount as in 1990 (increase of 0.2%).

5 LULUCF: Figure 3-10 shows the net removals (negative emissions) by sources and sinks from LULUCF categories in Liechtenstein. Increase and decrease of living biomass in forests are the dominant categories. The conversion rates of Forest Land, which are derived from aerial photographs in three years (1984, 1996, 2002), differ significantly. They result in time series similar to a step-like function. Other categories of land-use changes and soils have a much smaller influence on the net removals.

6 Waste: In Liechtenstein only few emissions from the sector Waste are occurring, because all municipal solid waste is exported to a Swiss incineration plant. The increasing trend (19.2%) of the emissions remaining in Liechtenstein is determined by increasing composting activities and a slight increase in emissions from waste water handling.



Figure 3-10 Liechtenstein's CO₂ emissions/removals of source category 5 LULUCF 1990–2007 in Gg CO₂ eq. Negative values refer to removals.

Tab. 3-9 presents the emissions of CO₂, CH₄ and N₂O of road transportation, including off-road vehicles, arising from the use of liquid fuels, gaseous fuels and biomass.

Fuel	Sales	Emissions in 2007 (in Gg)			Emissions 2007 (in Gg CO ₂ equivalent)			
		TJ	CO ₂	CH ₄	N ₂ O	CO ₂	CH ₄	N ₂ O
liquid fuels	1171.43	86.44	0.0050	0.0022	86.44	0.11	0.68	87.23
gaseous fuels	49.32	2.71	0.0025	0.0000	2.71	0.05	0.00	2.77
biomass	1.12	0.10	0.0000	0.0000	0.10	0.00	0.00	0.10
Total	1221.87	89.26	0.0075	0.0022	89.26	0.16	0.68	90.10

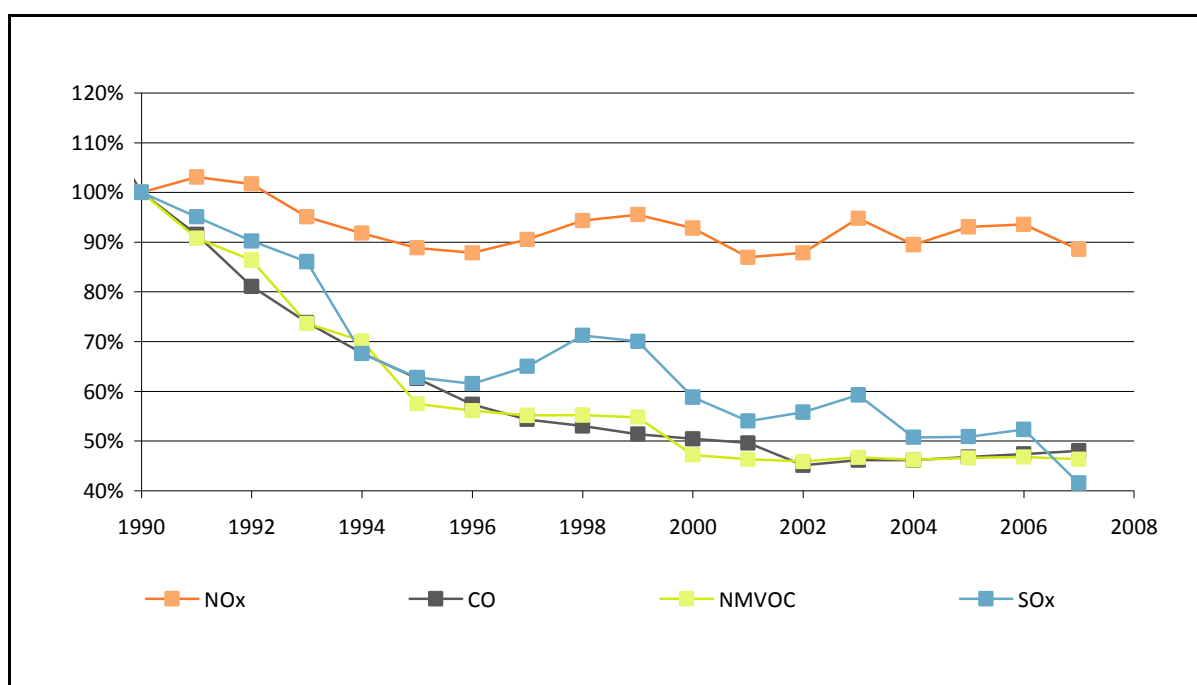
3.2.5 Emission trends for indirect greenhouse gases and SO₂

For the precursor substances NO_x, CO and NMVOC as well as for the gas SO₂, data from the submission for the UNECE Convention on Long-range Transboundary Air Pollution (CLRTAP) is used. The system boundaries for the transportation sector are not the same as under the UNFCCC Reporting since the CLRTAP uses the territorial principle. Thanks to the reduction of the sulfur content in diesel and heating oil, the SO₂ emissions decreased from 1990 to 2003, but at the same time, the fuel consumption has risen.

Tab. 3-10 Development of the emissions of NO_x, CO, NMVOC (in t) and SO₂ 1990-2007

Source and Sink Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	t (Mg)									
NO _x	841.1	829.2	806.6	783.8	762.0	711.0	733.2	723.5	676.0	652.8
CO	2'097.0	1'972.4	1'810.0	1'653.8	1'510.1	1'276.7	1'169.0	1'035.8	943.1	864.5
NMVOC	969.8	952.4	934.7	916.9	900.2	874.5	794.2	755.7	644.4	613.5
SO _x	87.1	91.4	86.8	82.6	78.2	71.6	68.1	64.7	61.7	48.4

Source and Sink Categories	2000	2001	2002	2003	2004	2005	2006	2007	1990-2007	share 2007
	t (Mg)								%	
NO _x	659.9	618.4	624.8	674.0	636.5	661.7	665.3	629.4	75%	37%
CO	644.3	633.7	576.5	589.9	589.4	597.5	605.3	613.9	29%	37%
NMVOC	413.2	405.7	401.7	408.8	404.2	407.9	409.6	405.7	42%	24%
SO _x	42.1	38.7	40.0	42.5	36.4	36.5	37.5	29.8	34%	2%

Figure 3-11 Trend of emissions of NO_x, CO, NMVOC and SO₂ 1990-2007

3.3 Data for activities under Article 3, Paragraph 3 and 4 of the Kyoto Protocol (KP-LULUCF)

Accounting periodicity for activities under Article 3, paragraph 3:

According to paragraph 25 of the annex to decision 13/CMP.1, Liechtenstein had to determine for each activity of the LULUCF sector whether removal units (RMUs) shall be issued annually or for the entire commitment period. Liechtenstein has chosen to account annually for emissions and removals from the LULUCF sector [see Chapter 7 of the Initial Report (OEP 2006a)]. The decision remains fixed for the entire first commitment period.

Liechtenstein has elected to not account for LULUCF activities under Article 3.4 during the first commitment period, as stated in its Initial Report (OEP 2006a, p.22).

The change in area between the Activities under Article 3, paragraph 3 is listed in Kyoto Table NIR 2. For Liechtenstein, only columns with „Articles 3.3 activities“ apply, Art. 3.4 activities are not elected by

Liechtenstein (notation key NA). Area changes from afforestation to deforestation did not occur within the period 2006-2007.

Tab. 3-11 KP(LULUCF), Table NIR 2

Table NIR 2. LAND TRANSITION MATRIX								Liechtenstein	
Area change between the previous and the current inventory year ^{(1), (2), (3)}								2007	2009
FROM...	TO...	Article 3.3 activities		Article 3.4 activities			Other	Total	
		Afforestation and reforestation	Deforestation	Forest Management (if elected)	Cropland Management (if elected)	Grazing Land Management (if elected)			Revegetation (if elected)
(kha)									
Article 3.3 activities	Afforestation and Reforestation	0.60	NO					0.60	
	Deforestation		0.02					0.02	
	Forest Management (if elected)		0.00	NA				0.00	
Article 3.4 activities	Cropland Management ⁽⁴⁾ (if elected)	NA	NA		NA	NA	NA	0.00	
	Grazing Land Management ⁽⁴⁾ (if elected)	NA	NA		NA	NA	NA	0.00	
	Revegetation ⁽⁴⁾ (if elected)	NA			NA	NA	NA	0.00	
Other		0.02	NA	NA	NA	NA	NA	0.02	
Total area		0.62	0.02	0.00	0.00	0.00	0.00	0.64	

⁽¹⁾ This table should be used to report land area and changes in land area subject to the various activities in the inventory year. For each activity it should be used to report area change between the previous year and the current inventory year. For example, the total area of land subject to Forest Management in the year preceding the inventory year, and which was deforested in the inventory year, should be reported in the cell in column B and in the row of Forest Management.

⁽²⁾ Some of the transitions in the matrix are not possible and the cells concerned have been shaded.

⁽³⁾ In accordance with section 4.2.3.2 of the IPCC good practice guidance for LULUCF, the value of the reported area subject to the various activities under Article 3.3 and 3.4 for the inventory year should be that on 31 December of that year.

⁽⁴⁾ Lands subject to Cropland Management, Grazing Land Management or Revegetation which, after 2008, are subject to activities other than those under Article 3.3 and 3.4, should still be tracked and reported under Cropland Management, Grazing Land Management or Revegetation, respectively.

The afforested area caused removals of 11.2 Gg CO₂ cumulated for the period 1990-2006. Due to deforestation, 16.3 Gg CO₂ were emitted simultaneously in the period 1990-2006. Afforestation and deforestation resulted in a net emission of 5.1 Gg CO₂ within 1990-2006.

Tab. 3-12 Afforestation is taken from Table KP(5-I)A.1.1. Deforestation from Table KP(5-I)A.2.

Activity	Area (cumulated 1990-2007) kha	Net CO ₂ emission/removal (cumulated 1990-2007) Gg CO ₂
Afforestation	0.60	-11.2
Deforestation	0.02	16.3
Total		5.1

3.4 Status of the National Inventory System

Each Annex I Party shall provide a description of how it is performing the general and specific functions of the national system under Article 5, paragraph 1, including

3.4.1 National entity

The Office of Environmental Protection (OEP) is in charge of establishing emission inventories and is therefore also responsible for all aspects concerning the establishing of the National Inventory System (NIS) under the Kyoto Protocol. Its project manager is:

Dr. Patrick Insinna

Dr. Grass-Str. 12, P.O. Box 684, 9490 Vaduz, Principality of Liechtenstein

patrick.insinna@aus.llv.li ; Tel.: +423 236 6196 Fax: +423 236 6199

3.4.2 Institutional, legal and procedural arrangements

The Office of Environmental Protection (OEP) is in charge of compiling the emission data and bears overall responsibility for Liechtenstein's national greenhouse gas inventory. In addition to the OEP, the Office of Economic Affairs (OEA), the Office of Agriculture (OA), the Office of Forests, Nature and Land Management

(OFNLM) and the Office of Land Use Planning (SLP) participate directly in the compilation of the inventory. Several other administrative and private institutions are involved in inventory preparation.

Liechtenstein is a small central European State in the Alpine region with a population of 35'365 inhabitants (as of 31 December 2007) and with an area of 160 km². Its neighbours are therefore important partners: Liechtenstein and Switzerland form a customs and monetary union governed by a customs treaty. On the basis of this union, Liechtenstein is linked to Swiss foreign trade strategies, with few exceptions, such as trade with the European Economic Community: Liechtenstein – contrary to Switzerland – is a member of the Agreement of the European Economic Area. The Customs Union Treaty with Switzerland impacts greatly on environmental and fiscal strategies. Many Swiss taxes and regulations for special goods (for example, environmental standards) are also adapted and applied in Liechtenstein. For the determination of the GHG emissions, Liechtenstein appreciates having been authorised to adopt a number of Swiss methods and Swiss emission factors.

As part of a comprehensive project, the Government mandated its Office of Environmental Protection in 2005 to design and establish the NIS in order to ensure full compliance with the reporting requirements of the UNFCCC and its Kyoto Protocol. With regard to the provisions of Art. 5.1 of the Kyoto Protocol, the project encompasses the following elements:

- Collaboration and cooperation of the different offices involved in data collection,
- Upgrading and updating of central GHG emissions data base,
- Setting up a simplified QA/QC system,
- Official consideration and approval of the data.

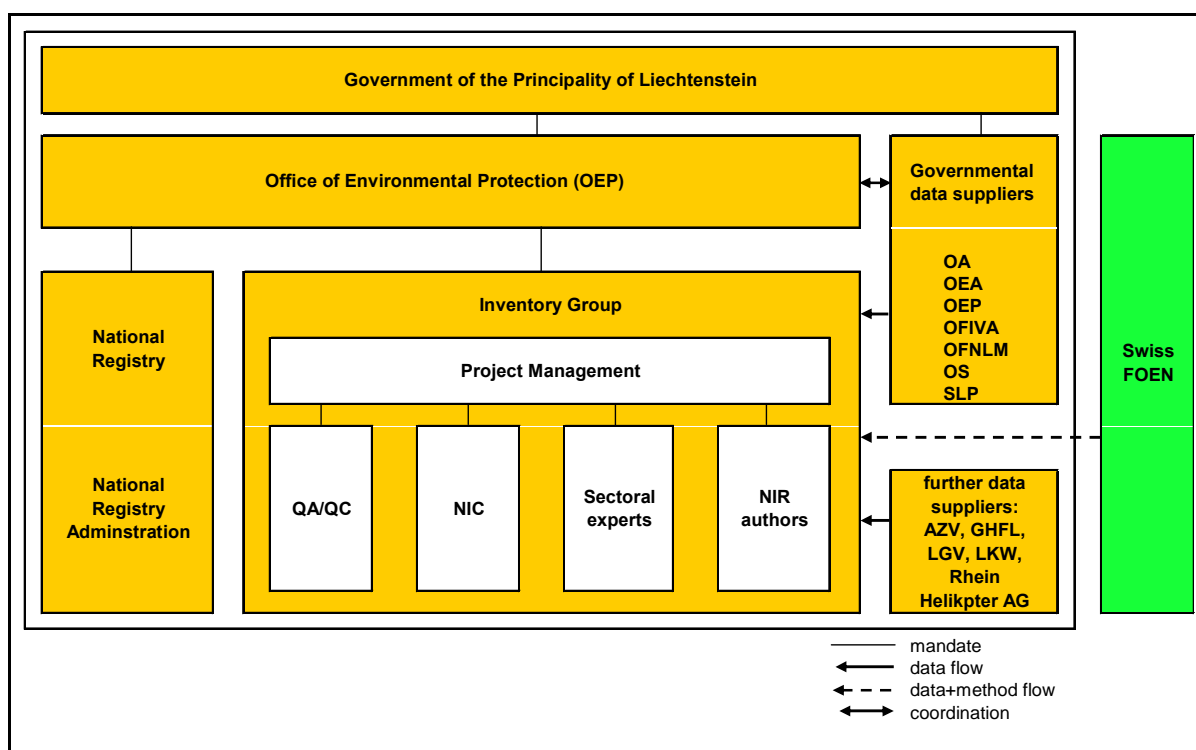


Figure 3-12 gives a schematic overview of the institutional setting of the process of inventory preparation within the NIS

The **Government of the Principality of Liechtenstein** bears the overall responsibility for the NIS. According to the Emissions Trading Act (Emissionshandelsgesetz), the Office of Environmental Protection (OEP) is in charge of establishing emission inventories and is therefore also responsible for all aspects concerning the establishing of the National Inventory System (NIS) under the Kyoto Protocol. The responsibility of the OEP for establishing the NIS is also described in the report of the Government to the parliament for ratifying the Kyoto Protocol.

The **Office of Environmental Protection (OEP)** plays a major role in the National Inventory System. The project manager of the inventory group is also the National Registry Administrator. In cooperation with the responsible head of the unit he coordinates the data flow from the governmental data suppliers to the Inventory Group.

The **Inventory group** consists of the project manager, the responsible person for the QA/QC activities, the National Inventory Compiler (NIC), represented by the head of the OEP and his replacement. Furthermore several external experts belong to the Inventory Group: Sectoral specialists for modelling the greenhouse gas emissions and removals and the NIR authors.

Among the **governmental data suppliers** there are

- Office of Economic Affairs (OEA)
- Office of Statistics (OS)
- Office of Forest, Nature and Land Management (OFNLM)
- Office of Agriculture (OA)
- Office of Land Use Planning (SLP)
- Office of Environmental Protection (OEP)

Further data suppliers are

- Co-operation for the storage of gas oil in the Principality of Liechtenstein / Genossenschaft für Heizöl-Lagerhaltung im Fürstentum Liechtenstein (GHFL)
- Liechtenstein's Gas Utility / Liechtensteinische Gasversorgung (LGV)
- Electric power company / Liechtensteinische Kraftwerke (LKW)
- Abwasserzweckverband (AZV)
- Heliport Balzers (Rhein Helikopter AG and ROTEX HELICOPTER AG)

Swiss Federal Office for the Environment (FOEN)

The Swiss Federal Office for the Environment (FOEN) is the agency that has the lead within the Swiss federal administration regarding climate policy and its implementation. The FOEN and Liechtenstein's OEP cooperate in the inventory preparation. Due to the customs treaty of the two states, the import statistics in the Swiss overall energy statistics also includes the fossil fuel consumption of the Principality of Liechtenstein. FOEN therefore corrects its fuel consumption data by subtracting Liechtenstein's fuel consumption from the data provided in the Swiss overall energy statistics. To that aim, OEP calculates its energy consumption and provides FOEN with the data. FOEN, on the other hand, makes a number of methods and emission factors available to OEP (mainly transportation, agriculture, LULUCF, synthetic gases, solvents). Liechtenstein has benefited to a large extent from the methodological support by the inventory core group within the FOEN and its readiness to share very openly data and spreadsheet-tools. Its kind support is herewith highly appreciated.

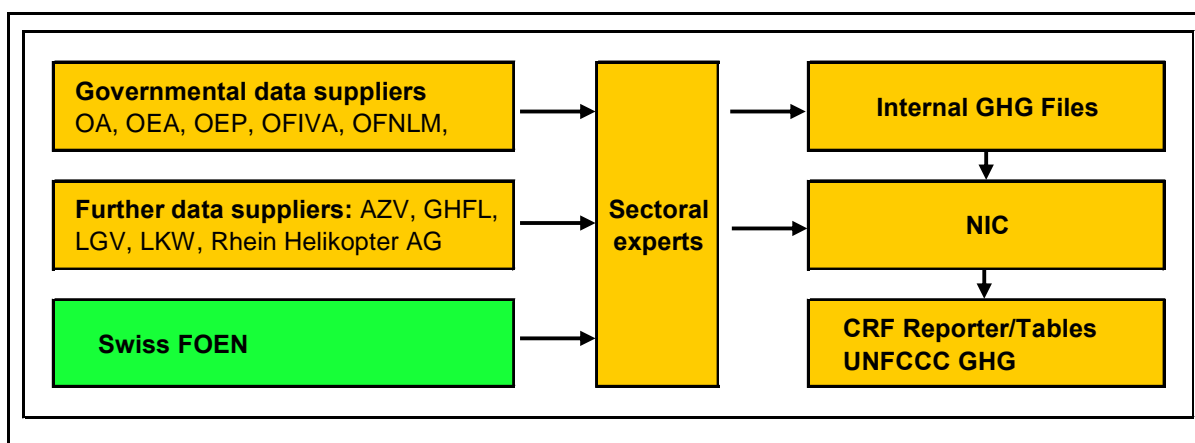


Figure 3-13 illustrates in a simplified manner the data flow leading to the CRF tables required for reporting under the UNFCCC and under the Kyoto Protocol

3.4.3 Methodology

The emissions are calculated based on the standard methods and procedures of the Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories (IPCC 1997a, 1997b, 1997c) and IPCC Good Practice Guidances (IPCC 2000, IPCC 2003) as adopted by the UNFCCC.

The emissions are modeled by using country specific activity data. Country specific emissions factors are applied if available. A number of default emission factors from IPCC are used. For a majority of emission sources, however, emission factors are adopted from the Swiss GHG inventory after checking their applicability. In those cases, the emission factors are reported as country specific. It is noteworthy that there is a very close relationship between Liechtenstein and Switzerland based on the Customs Union Treaty between the two countries. The Customs Union Treaty with Switzerland has a significant impact on environmental and fiscal strategies. Many Swiss environmental provisions and climate-protection regulations are also applicable in Liechtenstein or are implemented into Liechtenstein law on the basis of specific international treaty rules. In the following paragraph, a short summary of the methods used is given for every sector.

1 Energy

- Emissions from 1A Fuel Combustion Activities: Activity data is taken from the National Energy Statistics (including consistency modifications) and from census for the fuel sales of gasoline and diesel oil. The methods are country specific, the levels Tier 1 and Tier 2 are applied.
- Emissions from 1B Fugitive Emissions from Fuels: The Swiss method is applied corresponding country specific, Tier 3 level.

2 Industrial Processes

- HFC emissions from 2F1 Refrigeration and Air Conditioning Equipment are reported and are calculated with the rule of proportion applied on the Swiss emissions using country specific activity data as proxy for the conversion (e.g. no. of inhabitants).
- SF6 emissions from 2F8 Electrical Equipment are reported based on country specific data.
- CO and NMVOC emissions from 2A5 Asphalt Roofing and 2A6 Road Paving with Asphalt. The emissions are estimated from the Swiss emissions using the no. of inhabitants as a proxy for the rough estimate of Liechtenstein's emissions.
- Other emissions from industrial processes (CO₂, CH₄, N₂O, PFCs) are not occurring.

3 Solvent and Other Product Use

- Emissions 3A–3D are estimated by country specific methods and emission factors: Swiss emissions are transformed using the number of Liechtenstein's inhabitants as a proxy for the rough estimate of Liechtenstein's emissions.

4 Agriculture

- Emissions are reported for 4A Enteric Fermentation, 4B Manure Management and 4D Agricultural Soils by applying Swiss methods (country specific).

5 LULUCF

- Emissions and removals are reported for 5A to 5F. The methods are adopted from Switzerland (country specific).

6 Waste

- Emissions are modeled by applying the following methods: 6A T2, 6B CS (CH₄) and D (N₂O), 6C T2 and 6D CS.

3.4.4 Key source identification

The key category analysis (KCA) is performed according to the IPCC Good Practice Guidance (IPCC 2000, chapter 7): A Tier 1 level and trend assessment is applied with the proposed threshold of 95%. The analysis is performed four times, for the base year 1990 and the latest year 2007, both years with and without LULUCF categories.

KCA without LULUCF categories

For 2007, among a total of 121 categories, 15 have been identified as key categories with an aggregated contribution of 95.2% of the national total emissions. 14 among the 15 are key categories due to the level assessment, 13 due to the trend assessment.

Of the 15 key categories, 11 are out of the energy sector, contributing 85.8% to total CO₂ equivalent emissions in 2007. The other key categories are from sectors Industrial Processes (1.8%), Solvent and Other Product Use (0.3%) and Agriculture (7.6%). There are six major key sources:

- 1A3b Energy, Fuel Combustion, Road Transportation, gasoline: CO₂, level contribution 22.9%,
- 1A4a Energy, Fuel Combustion, Other Sectors, Commercial/Institutional, liquid fuels: CO₂, level contribution 11.4%.
- 1A4a Energy, Fuel Combustion, Other Sectors, Commercial/Institutional, gaseous fuels: CO₂, level contribution 11.3%.
- 1A3b Energy, Fuel Combustion, Road Transportation, diesel: CO₂, level contribution 11.1%,
- 1A4b Energy, Fuel Combustion, Other Sectors, Residential, gaseous fuels: CO₂, level contribution 9.3%.
- 1A2 Energy, Fuel Combustion, Manufacturing Industries and Construction, gaseous fuels: CO₂, level contribution 9.0%.

Further details are shown in Tab. 3-13

For the base year 1990 (see Tab. 3-14) there are 12 level key categories, which are also key categories in 2007. Gaseous fuels in 1A1 and 1A3b as well as consumption of halocarbons in 2F, which are all key categories with respect to level or trend 2007, are no level key categories in 1990.

Tab. 3-13 List of Liechtenstein's 15 key categories 2007. Upper part sorted by NFR code (by category code), lower part sorted by contribution in level.

Key Category Analysis 2007 (without LULUCF)				Direct	Base Year	Year t	Level	Trend	%	Result level	Result trend	
IPCC Source Categories (and fuels if applicable)				GHG	1990	Estimate	Assessment	Assessment	Contribution	assessment	assessment	
						Estimate			in Trend			
Sorted by NFR code						[Gg CO2e]	[Gg CO2e]					
1A1	1. Energy	A. Fuel Combustion	1. Energy Industries	Gaseous Fuels	CO ₂	0.12	2.44	1.00%	0.008942	1.7%	KC level	KC trend
1A2	1. Energy	A. Fuel Combustion	2. Manufacturing Industries and Construction	Gaseous Fuels	CO ₂	16.48	21.84	8.97%	0.016879	3.3%	KC level	KC trend
1A2	1. Energy	A. Fuel Combustion	2. Manufacturing Industries and Construction	Liquid Fuels	CO ₂	18.74	8.97	3.68%	0.042251	8.2%	KC level	KC trend
1A3b	1. Energy	A. Fuel Combustion	3. Transport, Road Transportation	Diesel	CO ₂	14.77	27.13	11.14%	0.044390	8.6%	KC level	KC trend
1A3b	1. Energy	A. Fuel Combustion	3. Transport, Road Transportation	Gaseous Fuels	CO ₂	0.00	2.71	1.11%	0.010504	2.0%	KC level	KC trend
1A3b	1. Energy	A. Fuel Combustion	3. Transport, Road Transportation	Gasoline	CO ₂	60.53	55.85	22.94%	0.032351	6.3%	KC level	KC trend
1A4a	1. Energy	A. Fuel Combustion	4. Other Sectors, Commercial/Institutional	Gaseous Fuels	CO ₂	8.70	27.40	11.25%	0.070348	13.7%	KC level	KC trend
1A4a	1. Energy	A. Fuel Combustion	4. Other Sectors, Commercial/Institutional	Liquid Fuels	CO ₂	57.10	27.62	11.35%	0.127542	24.8%	KC level	KC trend
1A4b	1. Energy	A. Fuel Combustion	4. Other Sectors, Residential	Gaseous Fuels	CO ₂	2.51	22.54	9.26%	0.078974	15.0%	KC level	KC trend
1A4b	1. Energy	A. Fuel Combustion	4. Other Sectors, Residential	Liquid Fuels	CO ₂	18.74	8.97	3.68%	0.042251	8.2%	KC level	KC trend
1A5	1. Energy	A. Fuel Combustion	5. Other	Liquid Fuels	CO ₂	2.36	3.33	1.37%	0.003196	0.6%	KC level	-
2F	2. Industrial Proc.	F. Consumption of Halocarbons and SF6			HFC	0.00	4.47	1.84%	0.017314	3.4%	KC level	KC trend
4A	4. Agriculture	A. Enteric Fermentation			CH ₄	9.80	10.38	4.26%	0.000066	0.0%	KC level	-
4D1	4. Agriculture	D. Agricultural Soils; Direct Soil Emissions			N ₂ O	5.75	5.66	2.33%	0.001704	0.3%	KC level	-
4D3	4. Agriculture	D. Agricultural Soils; Indirect Emissions			N ₂ O	2.73	2.51	1.03%	0.001487	0.3%	KC level	-

Sorted by contribution in level												
1A3b	1. Energy	A. Fuel Combustion	3. Transport, Road Transportation	Gasoline	CO ₂	60.53	55.85	22.94%	0.032351	6.3%	KC level	KC trend
1A4a	1. Energy	A. Fuel Combustion	4. Other Sectors, Commercial/Institutional	Liquid Fuels	CO ₂	57.10	27.62	11.35%	0.127542	24.8%	KC level	KC trend
1A4a	1. Energy	A. Fuel Combustion	4. Other Sectors, Commercial/Institutional	Gaseous Fuels	CO ₂	8.70	27.40	11.25%	0.070348	13.7%	KC level	KC trend
1A3b	1. Energy	A. Fuel Combustion	3. Transport, Road Transportation	Diesel	CO ₂	14.77	27.13	11.14%	0.044390	8.6%	KC level	KC trend
1A4b	1. Energy	A. Fuel Combustion	4. Other Sectors, Residential	Gaseous Fuels	CO ₂	2.51	22.54	9.26%	0.078974	15.0%	KC level	KC trend
1A2	1. Energy	A. Fuel Combustion	2. Manufacturing Industries and Construction	Gaseous Fuels	CO ₂	16.48	21.84	8.97%	0.016879	3.3%	KC level	KC trend
4A	4. Agriculture	A. Enteric Fermentation			CH ₄	9.80	10.38	4.26%	0.000066	0.0%	KC level	-
1A2	1. Energy	A. Fuel Combustion	2. Manufacturing Industries and Construction	Liquid Fuels	CO ₂	18.74	8.97	3.68%	0.042251	8.2%	KC level	KC trend
1A4b	1. Energy	A. Fuel Combustion	4. Other Sectors, Residential	Liquid Fuels	CO ₂	18.74	8.97	3.68%	0.042251	8.2%	KC level	KC trend
4D1	4. Agriculture	D. Agricultural Soils; Direct Soil Emissions			N ₂ O	5.75	5.66	2.33%	0.001704	0.3%	KC level	-
2F	2. Industrial Proc.	F. Consumption of Halocarbons and SF6			HFC	0.00	4.47	1.84%	0.017314	3.4%	KC level	KC trend
1A5	1. Energy	A. Fuel Combustion	5. Other	Liquid Fuels	CO ₂	2.36	3.33	1.37%	0.003196	0.6%	KC level	-
1A3b	1. Energy	A. Fuel Combustion	3. Transport, Road Transportation	Gaseous Fuels	CO ₂	0.00	2.71	1.11%	0.010504	2.0%	KC level	KC trend
4D3	4. Agriculture	D. Agricultural Soils; Indirect Emissions			N ₂ O	2.73	2.51	1.03%	0.001487	0.3%	KC level	-
1A1	1. Energy	A. Fuel Combustion	1. Energy Industries	Gaseous Fuels	CO ₂	0.12	2.44	1.00%	0.008942	1.7%	KC level	KC trend

Tab. 3-14 List of Liechtenstein's 12 key categories in 1990. Upper part sorted by NFR code (by category code), lower part sorted by contribution in level.

Key Category Analysis 1990 (without LULUCF)		Direct GHG	Base Year 1990 Estimate	Level Assessment	Cumulative Total Column E-L	Result level assessment			
IPCC Source Categories (and fuels if applicable)									
Sorted by NFR code									
1A2	1. Energy	A. Fuel Combustion	2. Manufacturing Industries and Construction	Gaseous Fuels	CO ₂	16.48	7.18%	74.75%	KC level
1A2	1. Energy	A. Fuel Combustion	2. Manufacturing Industries and Construction	Liquid Fuels	CO ₂	18.74	8.16%	59.41%	KC level
1A3b	1. Energy	A. Fuel Combustion	3. Transport; Road Transportation	Diesel	CO ₂	14.77	6.43%	81.19%	KC level
1A3b	1. Energy	A. Fuel Combustion	3. Transport; Road Transportation	Gasoline	CO ₂	60.53	26.37%	26.37%	KC level
1A4a	1. Energy	A. Fuel Combustion	4. Other Sectors; Commercial/Institutional	Gaseous Fuels	CO ₂	8.70	3.79%	89.25%	KC level
1A4a	1. Energy	A. Fuel Combustion	4. Other Sectors; Commercial/Institutional	Liquid Fuels	CO ₂	57.10	24.87%	51.24%	KC level
1A4b	1. Energy	A. Fuel Combustion	4. Other Sectors; Residential	Gaseous Fuels	CO ₂	2.51	1.09%	94.04%	KC level
1A4b	1. Energy	A. Fuel Combustion	4. Other Sectors; Residential	Liquid Fuels	CO ₂	18.74	8.16%	67.57%	KC level
1A5	1. Energy	A. Fuel Combustion	5. Other	Liquid Fuels	CO ₂	2.36	1.03%	95.07%	KC level
4A	4. Agriculture	A. Enteric Fermentation			CH ₄	9.80	4.27%	85.46%	KC level
4D1	4. Agriculture	D. Agricultural Soils; Direct Soil Emissions			N ₂ O	5.75	2.51%	91.75%	KC level
4D3	4. Agriculture	D. Agricultural Soils; Indirect Emissions			N ₂ O	2.73	1.19%	92.94%	KC level
Sorted by contribution in level									
1A3b	1. Energy	A. Fuel Combustion	3. Transport; Road Transportation	Gasoline	CO ₂	60.53	26.37%	26.37%	KC level
1A4a	1. Energy	A. Fuel Combustion	4. Other Sectors; Commercial/Institutional	Liquid Fuels	CO ₂	57.10	24.87%	51.24%	KC level
1A2	1. Energy	A. Fuel Combustion	2. Manufacturing Industries and Construction	Liquid Fuels	CO ₂	18.74	8.16%	59.41%	KC level
1A4b	1. Energy	A. Fuel Combustion	4. Other Sectors; Residential	Liquid Fuels	CO ₂	18.74	8.16%	67.57%	KC level
1A2	1. Energy	A. Fuel Combustion	2. Manufacturing Industries and Construction	Gaseous Fuels	CO ₂	16.48	7.18%	74.75%	KC level
1A3b	1. Energy	A. Fuel Combustion	3. Transport; Road Transportation	Diesel	CO ₂	14.77	6.43%	81.19%	KC level
4A	4. Agriculture	A. Enteric Fermentation			CH ₄	9.80	4.27%	85.46%	KC level
1A4a	1. Energy	A. Fuel Combustion	4. Other Sectors; Commercial/Institutional	Gaseous Fuels	CO ₂	8.70	3.79%	89.25%	KC level
4D1	4. Agriculture	D. Agricultural Soils; Direct Soil Emissions			N ₂ O	5.75	2.51%	91.75%	KC level
4D3	4. Agriculture	D. Agricultural Soils; Indirect Emissions			N ₂ O	2.73	1.19%	92.94%	KC level
1A4b	1. Energy	A. Fuel Combustion	4. Other Sectors; Residential	Gaseous Fuels	CO ₂	2.51	1.09%	94.04%	KC level
1A5	1. Energy	A. Fuel Combustion	5. Other	Liquid Fuels	CO ₂	2.36	1.03%	95.07%	KC level

Combined KCA without and with LULUCF categories

The key category analysis including LULUCF categories is also carried out for 1990 and 2007. The results are summarised in Table 135, Annex 1. According to IPCC Good Practice Guidance for LULUCF (IPCC 2003), Section 5.4.2, the set of key categories consists of all non-LULUCF key categories that result from the KCA without LULUCF combined with all LULUCF-key-categories that result from the KCA with LULUCF.

Tab. 3-15 Liechtenstein's key categories in 2007 and in 1990 combined without and with LULUCF categories.

Key Category Analysis 2007 (including LULUCF)				Direct	Base Year	Year t	Level	Trend	%	Result level	Result trend	
IPCC Source Categories (and fuels if applicable)				GHG	1990	Estimate	Assessment	Assessment	Contribution	assessment	assessment	
					Estimate				in Trend			
Sorted by NFR code					[Gg CO ₂ eq]	[Gg CO ₂ eq]						
1A1	1. Energy	A. Fuel Combustion	1. Energy Industries	Gaseous Fuels	CO ₂	0.12	2.44	1.00%	0.008942	1.7%	KC level	KC trend
1A2	1. Energy	A. Fuel Combustion	2. Manufacturing Industries and Construction	Gaseous Fuels	CO ₂	16.48	21.84	8.97%	0.016879	3.3%	KC level	KC trend
1A2	1. Energy	A. Fuel Combustion	2. Manufacturing Industries and Construction	Liquid Fuels	CO ₂	18.74	8.97	3.68%	0.042251	8.2%	KC level	KC trend
1A3b	1. Energy	A. Fuel Combustion	3. Transport; Road Transportation	Diesel	CO ₂	14.77	27.13	11.14%	0.044390	8.6%	KC level	KC trend
1A3b	1. Energy	A. Fuel Combustion	3. Transport; Road Transportation	Gaseous Fuels	CO ₂	0.00	2.71	1.11%	0.010504	2.0%	KC level	KC trend
1A3b	1. Energy	A. Fuel Combustion	3. Transport; Road Transportation	Gasoline	CO ₂	60.53	55.85	22.94%	0.032351	6.3%	KC level	KC trend
1A4a	1. Energy	A. Fuel Combustion	4. Other Sectors; Commercial/Institutional	Gaseous Fuels	CO ₂	8.70	27.40	11.25%	0.070348	13.7%	KC level	KC trend
1A4a	1. Energy	A. Fuel Combustion	4. Other Sectors; Commercial/Institutional	Liquid Fuels	CO ₂	57.10	27.62	11.35%	0.127542	24.8%	KC level	KC trend
1A4b	1. Energy	A. Fuel Combustion	4. Other Sectors; Residential	Gaseous Fuels	CO ₂	2.51	22.54	9.26%	0.076974	15.0%	KC level	KC trend
1A4b	1. Energy	A. Fuel Combustion	4. Other Sectors; Residential	Liquid Fuels	CO ₂	18.74	8.97	3.68%	0.042251	8.2%	KC level	KC trend
1A5	1. Energy	A. Fuel Combustion	5. Other	Liquid Fuels	CO ₂	2.36	3.33	1.37%	0.003196	0.6%	KC level	-
2F	2. Industrial Proc.	F. Consumption of Halocarbons and SF ₆		HFC		0.00	4.47	1.84%	0.017314	3.4%	KC level	KC trend
4A	4. Agriculture	A. Enteric Fermentation		CH ₄		9.80	10.38	4.26%	0.000066	0.0%	KC level	-
4D1	4. Agriculture	D. Agricultural Soils; Direct Soil Emissions		N ₂ O		5.75	5.66	2.33%	0.001704	0.3%	KC level	-
4D3	4. Agriculture	D. Agricultural Soils; Indirect Emissions		N ₂ O		2.73	2.51	1.03%	0.001487	0.3%	KC level	-
5A1	5. LULUCF	A. Forest Land	1. Forest Land remaining Forest Land		CO ₂	18.64	19.03	6.91%	0.002670	0.6%	KC level	KC trend
5B1	5. LULUCF	B. Cropland	1. Cropland remaining Cropland		CO ₂	4.33	4.45	1.62%	0.000508	0.1%	KC level	-
5C1	5. LULUCF	C. Grassland	1. Grassland remaining Grassland		CO ₂	2.13	1.80	0.85%	0.001595	0.3%	KC level	-
5C2	5. LULUCF	C. Grassland	2. Land converted to Grassland		CO ₂	0.08	0.87	0.32%	0.002692	0.6%	-	KC trend
5E2	5. LULUCF	E. Settlements	2. Land converted to Settlements		CO ₂	3.30	3.47	1.26%	0.000124	0.0%	KC level	-

Key Category Analysis 1990 (including LULUCF)				Direct	Base Year	Year t	Level	Cumulative				
IPCC Source Categories (and fuels if applicable)				GHG	1990	Estimate	Assessment	Total Column				
					Estimate			E-L				
Sorted by NFR code					[Gg CO ₂ eq]	[Gg CO ₂ eq]						
1A2	1. Energy	A. Fuel Combustion	2. Manufacturing Industries and Construction	Gaseous Fuels	CO ₂	16.48	16.48	7.18%	74.75%		KC level	
1A2	1. Energy	A. Fuel Combustion	2. Manufacturing Industries and Construction	Liquid Fuels	CO ₂	18.74	18.74	8.16%	59.41%		KC level	
1A3b	1. Energy	A. Fuel Combustion	3. Transport; Road Transportation	Diesel	CO ₂	14.77	14.77	6.43%	81.19%		KC level	
1A3b	1. Energy	A. Fuel Combustion	3. Transport; Road Transportation	Gasoline	CO ₂	60.53	60.53	26.37%	26.37%		KC level	
1A4a	1. Energy	A. Fuel Combustion	4. Other Sectors; Commercial/Institutional	Gaseous Fuels	CO ₂	8.70	8.70	3.79%	89.25%		KC level	
1A4a	1. Energy	A. Fuel Combustion	4. Other Sectors; Commercial/Institutional	Liquid Fuels	CO ₂	57.10	57.10	24.87%	51.24%		KC level	
1A4b	1. Energy	A. Fuel Combustion	4. Other Sectors; Residential	Gaseous Fuels	CO ₂	2.51	2.51	1.09%	94.04%		KC level	
1A4b	1. Energy	A. Fuel Combustion	4. Other Sectors; Residential	Liquid Fuels	CO ₂	18.74	18.74	8.16%	67.57%		KC level	
1A5	1. Energy	A. Fuel Combustion	5. Other	Liquid Fuels	CO ₂	2.36	2.36	1.03%	95.07%		KC level	
4A	4. Agriculture	A. Enteric Fermentation		CH ₄		9.80	9.80	4.27%	85.46%		KC level	
4D1	4. Agriculture	D. Agricultural Soils; Direct Soil Emissions		N ₂ O		5.75	5.75	2.51%	91.75%		KC level	
4D3	4. Agriculture	D. Agricultural Soils; Indirect Emissions		N ₂ O		2.73	2.73	1.19%	92.94%		KC level	
5A1	5. LULUCF	A. Forest Land	1. Forest Land remaining Forest Land		CO ₂	18.64	18.64	7.20%	67.12%		KC level	
5B1	5. LULUCF	B. Cropland	1. Cropland remaining Cropland		CO ₂	4.33	4.33	1.67%	90.23%		KC level	
5C1	5. LULUCF	C. Grassland	1. Grassland remaining Grassland		CO ₂	2.13	2.13	0.82%	95.27%		KC level	
5E2	5. LULUCF	E. Settlements	2. Land converted to Settlements		CO ₂	3.30	3.30	1.27%	91.51%		KC level	

In the KCA 2007 including LULUCF categories there are in total 135 categories. 22 of them are key categories. Five of the key categories are from the LULUCF sector. The largest category is 5A1 Forest Land remaining Forest Land; the other LULUCF key categories are of minor importance.

In the KCA 1990 including LULUCF categories, 16 categories appear as key categories. Four of the key categories are from the LULUCF sector. In contrast to the analysis for 2007 5C2 Land converted to Grassland drops from the list of key categories since its contribution is small.

3.4.5 Recalculations

The implied emission factors for 2006 have been updated due to the Swiss emission factors (FOEN 2008). The update affects CH₄ and N₂O emissions of the categories 1A3b Road Transportation, 1A4c Other Sectors, Agriculture/Forestry and 1A5b Other / off-road.

- 1A3b: CH₄ and N₂O emission factors are decreasing in the actual period due to technological improvements. The updated factors 2006 are therefore some percent lower than the factor used for 2006 in the previous submission. The emissions 2006 have thus been recalculated.
- The Swiss off-road database has been updated (INFRAS 2008). It is used for Switzerland's emission modelling of most off-road source (except aviation). Liechtenstein adopts implied emission factors for construction vehicles and machinery; Industrial off-road vehicles and machinery. Updated emissions of CH₄ and N₂O implied adaptations for Liechtenstein's emission factors used for the sectors 1A4c Agriculture/Forestry and 1A5b Other (off-road). A recalculation with the updated emission factors for the complete time series 1990-2006 has been carried out. CH₄ and N₂O emissions increase by ca. 60% and 40% respectively. The base year 1990 is affected too and shows an increase of source category 1A5b of 0.008 Gg CO₂ eq in the latest compared to the previous version. For source category 1A4c, the increase is 0.003 Gg CO₂ eq in 1990.

In 1A4a, CH₄ and N₂O implied emission factors for liquid fuels were corrected. In the last submission, an error had been made concerning the emission factor of LPG; as most of the liquid fuel is gas oil and not LPG, the correction has only a minor influence on the implied emission factors for liquid fuels. A recalculation was made for the time series; the base year 1990 was not affected.

3.4.6 QA / QC activities

QA /QC Procedures

Terms and objectives

According to the IPCC Good Practice Guidance (IPCC 2000) the major elements of a QA/QC system are:

- an inventory agency responsible for coordinating QA/QC activities;
- a QA/QC plan;
- QC procedures;
- QA review procedures;
- reporting, documentation, and archiving procedures.

The state of implementation of these quality elements is described in the following chapters. One has to note that Liechtenstein's QA/QC system accounts for the specific circumstances of the Principality of Liechtenstein: Due to the smallness of the State, not every process, data flow and arrangement does need to be established by a formal agreement due to short "distances" within the administration and due to a high degree of acquaintance between the persons involved. Therefore, the National System manages with little number of written documents.

Objectives of the quality system

The quality management shall enable the party to principally fulfil the requirements of the articles 3, 5 and 7 of the Kyoto Protocol. Specifically, it shall ensure and improve the quality of GHG inventory that means a

continuous improvement of transparency, consistency, comparability, completeness and confidence. In detail, it serves

- for providing checks to ensure data integrity, correctness and completeness;
- to identify errors and omissions,
- to reduce the uncertainties of the emission estimates,
- to document and archive inventory material.

Responsible agency for coordinating QA/QC activities

The QA/QC activities are coordinated by the quality manager of the GHG Inventory Group. The responsible person is Mr. Andreas Gstoehl, head of the unit Air Pollution Control, Noise and Climate (e-mail: Andreas.Gstoehl@aus.llv.li, phone: +423 236 61 86), Office of Environmental Protection (OEP). The QA/QC activities are organised within the Inventory Group.

Operational tasks are delegated to the lead NIR author. He distributes checklists to the NIC, to the sectoral experts, to the other NIR authors and to the quality manager. They fill in the procedures that they carried out. The lists are then sent back to the quality manager, who confirms the performance of the QA/QC activities. The activities are documented in the NIR (see Annex 8).

QA/QC plan

Table 3-16 illustrates the annual cycle of inventory planning and preparation including the time-lines for the performance of QC activities. The current inventory for the submission April 2009 proceeded due to the general schedule shown in the table below.

Issue	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Mai
Meeting of Inventory Group													
Meeting of Group Environment/Spatial Planning													
Consideration of UNFCCC Syn.&Ass. II													
Data Collection													
Quality check of sectoral data								energy	other sectors				
Calculation of emissions/removals													
Generation of CRF tables													
Quality checks CRF tables													
Key Category Analysis incl. QC checks													
Uncertainty Analysis incl. QC checks													
Generation of NIR tables													
Compilation/Editing of NIR													
QC: Proofread of NIR (correctness, transparency etc.)													
QC: Fill in checklist									energy	other issues			
QA activities									int. review				
Official consideration and approval													
Submission to the UNFCCC secretariat													
Publication of NIR/CRF													
Archiving, storage of GHG inventory documents													

QC procedures

Quality control (QC) is defined by: "System of routine technical activities to measure and control the quality of the inventory as it is being developed." (IPCC 2000).

Overall Activities

The following QC activities are carried out:

- The annual cycle for inventory preparation contains several meetings of the Inventory Group and several meetings of governmental and other data suppliers with the OEP. On these meetings the activities, responsibilities and schedule for the inventory preparation process are being organised and determined.

- Regular meetings of the group “Umwelt und Raum” (environment and spatial planning). The group is formed by the heads of the OEP, SLP, OFNLM and the minister for the environment. It prepares policy matters for the attention of the Government including climate affairs.
- The project manager, the sectoral experts, the national inventory compiler (NIC) and the NIR authors accomplish a number of QC activities:
- The NIR authors check the emission results produced by the sectoral experts, for consistency of cross-cutting parameters, correctness of emissions aggregation, completeness of the GHG inventory. They compare the methods used with IPCC Good Practice Guidance, check the correct compiling of the methods in the NIR, the correct transcription of CRF data into NIR data tables and figures, the consistency between data tables and text in the NIR, the completeness of references in the NIR, and are responsible for the correctness of the key source and the uncertainty analysis.
- The sectoral experts check the description of methods, numbers and figures in the NIR.
- The NIC checks the integrity of the database files, the consistency of time series, the correct and complete inputs into the CRF Reporter.
- Further staff members of the OEP carry out a proof reading of single sectors.
- The quality manager executes an overall checking function for the GHG inventory and the NIR: He monitors the GHG emission modelling and the key category analysis. He checks the NIR for correctness, completeness, transparency and quality, checks for the complete archiving of documents, and the completeness of the CRF submission document.

It may be mentioned that the OEP enlarged its staff in the unit Climate Protection in the beginning of 2007 by two more collaborators. They are responsible for emission modelling, GHG inventory, implementation of the emissions trading system, national registry, national allocation plan and the Kyoto mechanisms (JI, CDM).

Documentation of the QC Activities

For the previous submission 2008, the QC activities had been documented for the first time by means of checklist. The lists are updated for the current submission and are shown in the Annex 8. The classification of the QC activities follows the IPCC GPG table 8.1 (IPCC 2000). The following persons are involved in the QC activities:

- Sectoral experts for energy, industrial processes etc.
- NIC
- NIR authors
- Project manager

Special attention of the QC activities for emissions has been directed to the key categories.

QA Review Procedures

Quality assurance (QA): System of activities that include a “system of review procedures conducted by personnel not directly involved in the inventory compilation development process, to verify that data quality objectives were met, ensure that the inventory represents the best possible estimate of emissions and sinks given the current state of scientific knowledge and data available, and support the effectiveness of the QC programme” (IPCC 2000).

Liechtenstein’s NIS quality management system follows a Plan-Do-Check-Act-Cycle (PDCA-cycle), which is a generally accepted model for pursuing a systematic quality performance according to international standards. This approach is in accordance with procedures described in decision 19/CMP.1 and in the IPCC Good Practice Guidance.

Liechtenstein carries out the following QA activities:

- Internal review: The draft NIR is passing through an internal review. The project manager, the project manager assistant, two specialised staff members of the climate unit, another staff member of the OEP and the NIC are proofreading the NIR or parts of it. They document their findings in checklists, which are sent back to the NIR authors (see Annex 8)
- The Swiss inventory management charges external experts for sectoral QA activities to review the Swiss GHG inventory. Since a number of Swiss methods and Swiss emission factors are used for the preparation of the Liechtenstein inventory, the results of the Swiss QA activities have to be checked and analysed by Liechtenstein's experts. Positive reviews may be interpreted as positive for Liechtenstein too, and problematic findings must not only be taken account for in Switzerland but also in Liechtenstein. Which sectors have already been reviewed for the Swiss GHG inventory?
- In 2006, a consulting group (not involved in the GHG emission modelling) was mandated to review the two sectors Energy and Industrial Processes with respect to methods, activity data, emission factors, CRF tables, NIR chapter (Eicher and Pauli 2006). The results were documented in a review report and communicated to Liechtenstein's Inventory Group. The consequences for the main findings have been evaluated for Liechtenstein's GHG inventory and for the NIR for submission December 2006.
- For the Swiss NIR, an internal review takes places annually shortly before the submission. Every chapter of the NIR is being proofread by specialists not involved in the emission modelling or in the NIR editing. The internal review is organised by the quality officer and the results are compiled by the same person that is also compiling Liechtenstein's NIR (lead author J. Heldstab, INFRAS). The results of the Swiss review are therefore communicated to Liechtenstein's Inventory Group. Where methods and results are concerned that are relevant for Liechtenstein too, the consequences were taken into account. This procedure has been performed in the three last and the current submissions (May and December 2006, May 2007, February 2008). It will also be repeated for future submissions.
- The applicability of Swiss methodologies and emission factors to Liechtenstein's GHG inventory is reviewed as well: Before Swiss methods are applied, they are discussed with the experts of Liechtenstein's administration. This process has taken place before the submission in December 2006 for the sectors Energy, Agriculture and Waste, for the sector LULUCF before the submission in February 2008.

Archiving Procedures

The electronic files of Liechtenstein's GHG inventory are all saved by the backup system of Liechtenstein's administration.

Every computer belonging to the administration, including the computers of the Office of Environmental Protection, are connected to the central network. The data of the server systems, file-clusters and database servers, are being saved in a tape-library. Due to safety reasons, the tape-library is not in the computing centre but in a building of the National police: In case of a total lost of the computing centre, the data are still available.

There are several backups

- daily incremental saved up to one month (4 weeks)
- Weekly full backup saved up to two months
- Monthly full backup saved up to one year

The backup files are being initialised via scheduler of the master server. The data are written via network onto one of the LTO 2 Drives (tape). The master server manages the handling of the tapes. Backups are checked daily via Activity Monitor. If a backup is not carried out, it may be caught up manually. Since daily restores of user data is carried out, there is a guarantee for keeping the data readable.

For archiving reasons, the backup tapes are being doubled four times a year. The duplicates are not being overwritten during five years.

In addition to the administrative archiving system, the external experts of Acontec, who are mandated with the emission modelling and CRF generation, save all CRF and background tables yearly on CD ROM /DVD ROM. The disks are stored in a bank safe of the Liechtensteinische Landesbank (Liechtenstein's National Bank).

3.5 National Registry

3.5.1 Registry administrator

The name and contact information of the registry administrator designated by the Party to maintain the national registry:

Registry Administrator	Contacts
Office of Environmental Protection (OEP) P.O. Box 684 Dr. Grass-Strasse 12 9490 Vaduz Principality of Liechtenstein phone: +423 236 75 96 fax: +423 236 61 99 email: registry@aus.llv.li website: http://www.llv.li/amtstellen/llv-aus-emissionshandel_en.htm	Main Contact Dr. Patrick Insinna Email: patrick.insinna@aus.llv.li Alternative Contact Andreas Gstöhl Email: andreas.gstoehl@aus.llv.li Alternative Contact Dr. Helmut Kindle Email: helmut.kindle@aus.llv.li

3.5.2 Consolidated system

Liechtenstein cooperates with Switzerland and Monaco for the setting-up and operation of the IT-Platform (hardware and software) for the National Registry. Switzerland is responsible for the hosting of the registries of these Parties on servers physically located in Switzerland. The three National Registries are maintained as independent systems with independent registry administrators. The National Registry is based on the Seringas™ registry software, which was developed by the French Caisse des Dépôts et Consignations, CDC. Further developments, updates and releases of the software are undertaken in cooperation with all Seringas™ licensees

3.5.3 Database structure and capacity

According to Decision 13/CMP.1, paragraph 18 „any two or more Parties may voluntarily maintain their respective national registries in a consolidated system, provided that each national registry remains distinct“. This consolidated solution was implemented by Liechtenstein together with Monaco and Switzerland. The latter acting as the technical host with servers physically located in the Swiss Federal Office of Information Technology, Systems and Telecommunication (FOIT). The three Parties' registries are running in parallel but maintained as independent systems with independent registry administrators. The Information and Communication Technology (ICT) architecture is illustrated below.

French software application SERINGAS from the developer „Caisse des Dépôts et Consignations (CDC) has been implemented using a Microsoft SQL Server relational data base management system with a dedicated conceptual data model developed by CDC .

The total capacity of the registry is only limited by the maximum size of the Microsoft SQL Server. By November 2009, 25 accounts have been installed and activated.

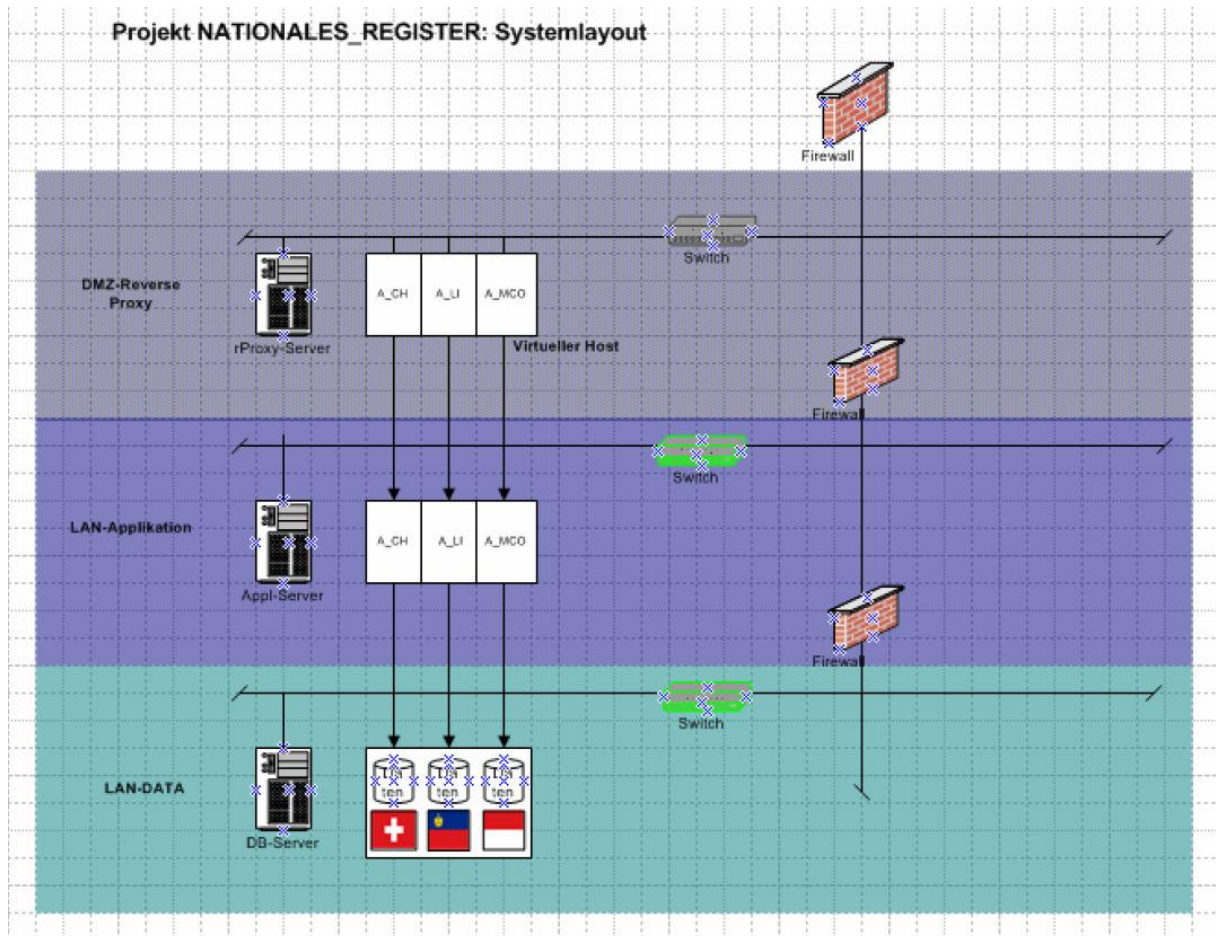


Figure 3-14 Information and communication technology (ICT) architecture for the consolidated registry system of Switzerland, Liechtenstein and Monaco. Figure kindly provided by the Federal Office of Information Technology, Systems and Telecommunication (FOITT).

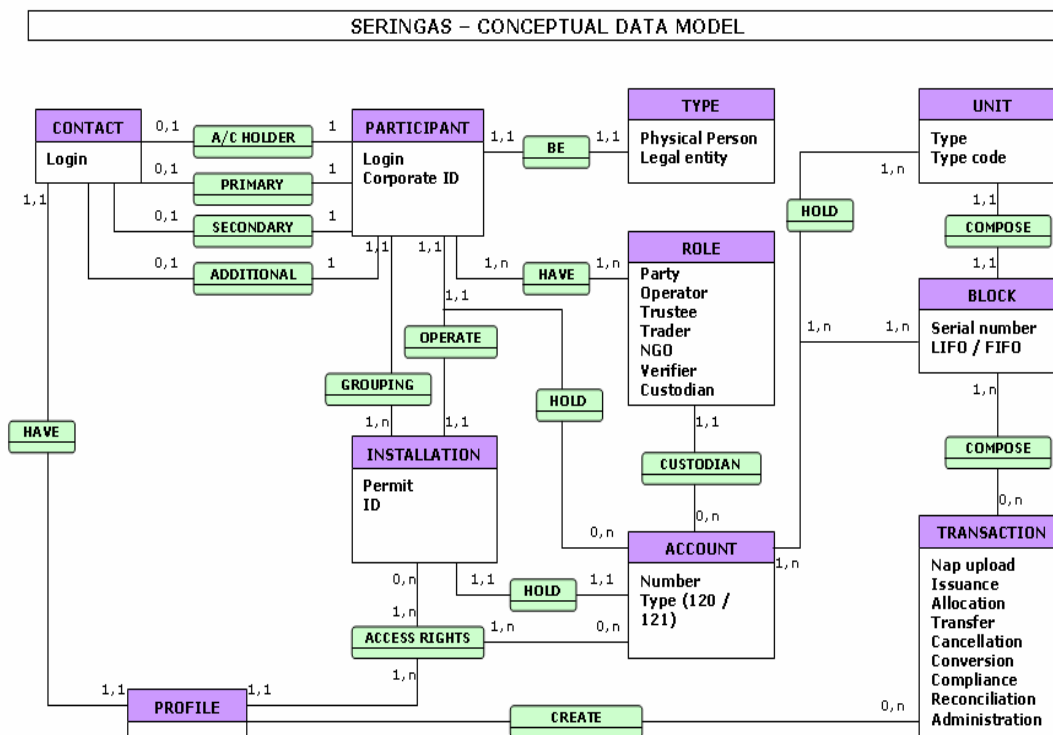


Figure 3-15 Conceptual Data Model developed by CDC. Figure taken from the „Registry Administrator User Guide Version 4“, page 19.)

3.5.4 Conformity with Data Exchange Standards (DES)

Liechtenstein's National Registry is in conformity with the DES in the relevant version to ensure the correct treatment and reception of information by the ITL. Software version 4.06. and 4.2 (including all relevant patches of version 4.0.6) respectively were used for interoperability tests according to Annex H of the DES, version 1.1.002, between the national registry of Liechtenstein and the International Transaction Log (ITL) on 5. September 2007. With the final Independent Assessment Report (IAR) dating from 7. December, the ITL Administrator confirmed the successfully completed initialization process.

Further, the requirements mentioned in IR 2006 concerning account numbers, serial numbers of units including project identifier and transaction numbers (Annex F) as well as concerning the list and electronic format of information transmitted electronically when transferring, acquiring, issuing, cancelling or retiring AAUs, CERs, ERUs or RMUs to other national registries or to the CDM registry and/or the ITL (Annex I) are still fulfilled.

3.5.5 Prevention of discrepancies

To prevent discrepancies between national registries and the ITL, the SERINGAS Software applies a number of internal checks before submitting transactions to the ITL.

Table 3-16 List of internal checks; taken from the document “Seringas internal checks before submitting transactions to ITL”, 15. December 2008.

General checks	Equivalent check in ITL/CITL
Transaction identifier check: Transactions identifier proposed by the registry must be unique. Transaction identifier received by the registry must be unique.	3001 and more*
Transaction status check: Completed, terminated, accepted, rejected or cancelled status are final status, thus, once a transaction has completed, terminated, accepted, rejected or cancelled status, it can not change its status anymore	3003, 3004, 3007, 3008, 3009, 3013, 3014, 3015, 3016
Transaction status evolution check: The registry propose a transaction with status = "proposed" If the transaction status comes back with "checked with discrepancies", then the registry terminate the transaction If the transaction status comes back with "checked with no discrepancies", then the registry complete the transaction	3005, 3006, 3011
Unit check: a unit is compulsory to create a transaction, and only one unit per transaction (except for cancellation and replacement transaction)	5004, 5057
The source account check: all transactions must have an active source account (except for Issuance transaction). The source account for a transaction can only be from type 100, 120 and 121. More restrictions can be added, depending on the transaction type. Only one account can be selected	4011, 4012, 4014, 7406 and more
The destination account check: all transactions must have an active destination account; only one account destination can be selected.	5154, 7208, 5204, 5253 and more
Quantity check: The quantity of a transaction must not be greater than the quantity of the source account (except for issuance transaction as it has no source account). The quantity of a transaction must be greater than 0	4016 and more
Period check: the applicable period of the unit is compulsory to create a transaction, and only one can be selected (except for issuance, the period is calculated by the system)	No equivalent
Unit blocks check: the unit block of a transaction is flagged as "reserved" until the transaction has a final status (Completed, terminated, accepted, rejected or cancelled). A block flagged as "reserved" can not be used for another transaction.	4010
The destination registry check: for all transactions, the destination registry is the same as the source registry, except for external transfers and excess issuance cancellation transactions.	4006
Project checks: project is compulsory for transactions involving ERU, CER, tCER and ICER.	No equivalent

* "<ITL/CITL code> and more" means that the registry makes the same checks as the ITL/CITL which provide for that reason with a particular <ITL/CITL code>, but this code does not cover all checks made by the registry, thus, there's no right equivalent in the CITL/ITL codes for the appropriate registry checks.

Specific transaction checks Issuance Transaction (01-00)	Equivalent check in ITL/CITL
Issuance unit check: only AAU and RMU can be issued by the registry	5001, 5002, 5003
Issuance period check: The applicable and the commitment period are calculated from the system date: if the system date is in 2008 to 2012, then the applicable and the commitment period is 1. if the system date in 2013 to 2017, the then the applicable and the commitment period is 2	5005, 5006, and more
Issuance of serial number check: The serial number must be unique, can not have the same serial number for AAU and RMU	5007, and more
Issuance acquiring account check: the issuance acquiring account must be 100-2-0	5017, and more
Issuance LULUCF activity check: the LULUCF activity is compulsory when the registry issue RMU	No equivalent

Specific transaction checks Issuance of allowances (10-52)	Equivalent check in ITL/CITL
Issuance of allowances unit check: only AAU can be choose for this transaction, as the issuance of allowances is treated as a conversion of AAU into EUA	7205, 7219 and more
Issuance of allowances period check: the period of the allowances is the same period as the AAU used for the issuance	7205
Issuance of allowances serial number check: The serial number must be the same as the AAU used for the issuance	No equivalent
Issuance of allowance source account checks: the source account must be 100-2-0	No equivalent
Issuance of allowance destination account checks: the destination account must be 100-4-0	7202 and more

Specific transaction checks Allocation transaction (10-53)	Equivalent check in ITL/CITL
Allocation units check: only allowances (EUA) can be used for allocation	No equivalent
Allocation source account check: the source account is 100-4-0	7360, and more
Allocation destination account check: the destination account must be account type 120	7206
Allocation year check: the allocation year is compulsory	No equivalent

Specific transaction checks Correction to allowances (10-55)	Equivalent check in ITL/CITL
Correction to allowances unit check: only allowances (EUA) can be used a correction to allowances transaction	No equivalent
Correction to allowances source account check: the source account is 100-4-0	No equivalent
Correction to allowances destination account check: the source account is 100-2-0	No equivalent

Specific transaction checks Voluntary cancellation (04-00)	Equivalent check in ITL/CITL
Voluntary cancellation unit check: all Kyoto units and EUA are useable for voluntary cancellation.	No equivalent
Voluntary cancellation source account check: only holding accounts can be used as source account for cancellation, with the exception of 100-3-0	No equivalent
Voluntary cancellation destination account check: only account type 230 is allowed as destination account for voluntary cancellation transactions.	5153 and more

Specific transaction checks Domestic transfers (10-00)	Equivalent check in ITL/CITL
Domestic transfer unit check: all Kyoto units and EUA are useable for domestic transfers	No equivalent
Domestic transfer destination account check: the destination account can only be holding accounts (type 100, 120 or 121) except 100-4-0; only one destination account can be entered.	7407

Specific transaction checks External transfers, outgoing (03-00)	Equivalent check in ITL/CITL
External transfers, outgoing unit check: all Kyoto units and EUA are useable for outgoing external transfers	No equivalent
External transfer, outgoing destination account check: the destination account can only be holding accounts (type 100, 120 or 121); only one destination account can be entered.	No equivalent
Domestic transfer, outgoing destination registry check: the destination registry can not be source registry.	4007

Specific transaction checks External transfers, incoming (03-00)	Equivalent check in ITL/CITL
External transfers, incoming unit check: all Kyoto units and EUA are useable for incoming external transfers	No equivalent
External transfer, incoming destination account check: the destination account can only be holding accounts (type 100, 120 or 121), and the account number must exist in the acquiring registry.	No equivalent

Specific transaction checks Conversion of AAU and RMU into ERU (02-00)	Equivalent check in ITL/CITL
Conversion units check: only AAU and RMU can be used for a conversion transaction	5056
Conversion source account check: the source account can only be national holding accounts (type 100).	5052
Conversion destination account check: the destination account is the same as the source account	No equivalent
Conversion project check: a project is compulsory for a conversion transaction. The project has to be created before the conversion transaction.	No equivalent

Specific transaction checks Surrendering (10-02)	Equivalent check in ITL/CITL
Surrendering units check: only EUA, CER and ERU converted from AAU can be used for a surrendering transaction	7356
Surrendering source account check: the source account can only be operator holding accounts (type 120).	7354
Surrendering destination account check: the destination account has to be 100-3-0	7202
Surrendering year check: the surrendering year is compulsory	No equivalent

Specific transaction checks Cancellation and replacement (10-41)	Equivalent check in ITL/CITL
Cancellation and replacement destination account check: the destination account can only be a national holding account (type 100)	7202, 7407
Cancellation and replacement transaction date check: Cancellation and replacement transaction can only be made on the 1 st of May	No equivalent
Cancellation and replacement quantity check: the quantity replaced is calculated with the percentage entered in the settings of the transaction. The quantity "cancelled" is all EUA of holding accounts except 100-3-0	No equivalent
Cancellation and replacement transaction procedure: move all EUA of the previous period from holding accounts, by transferring them into a national holding account and converting them into AAU ("cancellation" process), then convert AAU (from the account 100-8-0) of the current period into EUA and transfers the EUA from the current period to the holding accounts ("replacement"). The quantity is of the replacement is calculated from the percentage set for the transaction.	7205, 7219, 7360, 7402, 7406

Specific transaction checks Retirement(05-00)	Equivalent check in ITL/CITL
Retirement unit check: All Kyoto units can be used. Allowances (EUA) are not useable.	7365 and more
Retirement transaction date check: retirement transactions can be made only on the 30 th of June	
Retirement source account check: the retirement source account can only be national holding account (type 100)	7360 and more
Retirement destination account check: the destination account can only be a retirement account (type 300)	5252

Notification Checks Net source cancellation (04-00)	Equivalent check in ITL/CITL
Net source cancellation notification Identifier check: the notification identifier is compulsory, and fixed by the notification	5158
Net source cancellation unit check: only AAU, RMU, CER, ERU and EUA can be used for a net source cancellation transaction.	5156
Voluntary cancellation destination account check: only account type 210 is allowed as destination account for voluntary cancellation transactions.	5153

Notification Checks Non compliance cancellation (04-00)	Equivalent check in ITL/CITL
Non compliance cancellation notification Identifier check: the notification identifier is compulsory, and fixed by the notification	5159
Net source cancellation unit check: only AAU, RMU, CER, ERU and EUA can be used for a net source cancellation transaction.	5156
Voluntary cancellation destination account check: only account type 220 is allowed as destination account for voluntary cancellation transactions.	5153

Notification Checks Expiry date replacement (06-00)	Equivalent check in ITL/CITL
Expiry date replacement notification Identifier check: the notification identifier is compulsory, and fixed by the notification	5216, 5217
Expiry date replacement unit check: only AAU, RMU, CER, tCER and EUA can be used for a replacement of tCER. Only AAU, RMU, CER can be used for a replacement of ICER. The unit to be replaced is given by the notification and is compulsory for this transaction. Once the unit is replaced, it is flagged as replaced.	5206, 5207, and more
Expiry date replacement destination account check: only account type 411 is allowed as destination account for replacement of tCER. Only account type 421 is allowed as destination account for replacement of ICER.	5202, 5203, 5213, 5214
Expiry date replacement quantity check: the quantity fixed by the notification and can not be changed.	5209

Notification Checks Reversal of storage cancellation (04-00)	Equivalent check in ITL/CITL
Reversal of storage cancellation notification Identifier check: the notification identifier is compulsory, and fixed by the notification	5160
Reversal of storage cancellation unit check: only ICER of the project described in the notification can be used for a reversal of storage cancellation transaction.	No equivalent
Reversal of storage cancellation destination account check: only account type 250 is allowed as destination account for this transaction.	5153

Notification Checks Reversal of storage cancellation (06-00)	Equivalent check in ITL/CITL
Reversal of storage replacement notification Identifier check: the notification identifier is compulsory, and fixed by the notification	5218, 5220
Reversal of storage replacement unit check: only AAU, RMU, ERU, CER, EUA and ICER of the project described in the notification can be used for a reversal of storage cancellation transaction. The unit to be replaced is ICER and is compulsory for this transaction. Once the unit is replaced, it is flagged as replaced.	5206, 5207, 5215
Reversal of storage replacement destination account check: only account type 422 is allowed as destination account for this transaction.	5203
Reversal of storage replacement quantity check: the quantity fixed by the notification and it can be changed. The quantity is the same for replacing units and replaced units.	5209

Notification Checks Non submission of certification report cancellation (04-00)	Equivalent check in ITL/CITL
Non submission of certification cancellation notification Identifier check: the notification identifier is compulsory, and fixed by the notification	5161
Non submission of certification cancellation unit check: only ICER of the project described in the notification can be used for a non submission of certification cancellation transaction.	No equivalent
Non submission of certification cancellation destination account check: only account type 250 is allowed as destination account for this transaction.	5153

Notification Checks Non submission of certification report cancellation (06-00)	Equivalent check in ITL/CITL
Non submission of certification replacement notification Identifier check: the notification identifier is compulsory, and fixed by the notification	5219, 5220
Non submission of certification replacement unit check: only AAU, RMU, ERU, CER, EUA and ICER of the project described in the notification can be used for a reversal of storage cancellation transaction. The unit to be replaced is ICER and is compulsory for this transaction. Once the unit is replaced, it is flagged as replaced.	5206, 5207
Non submission of certification replacement destination account check: only account type 423 is allowed as destination account for this transaction.	5203
Non submission of certification replacement quantity check: the quantity fixed by the notification and it can be changed. The quantity is the same for replacing units and replaced units.	5209

Notification Checks Excess issuance for CDM project cancellation (03-00)	Equivalent check in ITL/CITL
Excess issuance for CDM cancellation notification Identifier check: the notification identifier is compulsory, and fixed by the notification or received by mail	No equivalent
Excess issuance for CDM cancellation destination account check: only account type 240 is allowed as destination account for this transaction.	No equivalent
Excess issuance for CDM cancellation destination registry check: only CDM registry is allowed for this transaction	5152

Notification Checks Carry-over (07-00)	Equivalent check in ITL/CITL
Carry-over notification Identifier check: the notification identifier is compulsory, and fixed by the notification.	5310
Carry-over unit check: only AAU, ERU converted from AAU and CER can be carried over. The commitment period is increased by one period.	5303, 5305, 5306, 5307
Carry-over source account check: only holding account type can be used for the carry-over transaction.	5302
Carry-over destination account check: the destination account must be the same as the source account.	No equivalent

Notification Checks Expiry date change (08-00)	Equivalent check in ITL/CITL
Expiry date change notification Identifier check: the notification identifier is compulsory, and fixed by the notification.	5453
Expiry date change unit check: only unit fixed by the notification is used for the transaction.	5454

List of internal checks; taken from the document "Seringas internal checks before submitting transactions to ITL", 15. December 2008.

3.5.6 Determent of unauthorized manipulations

User identification and authentication

Every user of the registry system is identified by a distinctive Login name and authenticated by a personal password composed of a minimum of 10 characters including at least one number. The validity of the password is limited on 60 days and have to be renewd accordingly. The new password must be different from the last 10 password and must not contain neither the surname or name nor the login of the user. Plain text of the password can not be viewed by third persons or even the registry administrator as it is tored by 1-way coding.

Profile Management

Every user is designed to a determined profile depending on his/her role defined in the application form and implemented by the system administrator. Currently there are seven profiles available:

- P1 = System administrator (Registry administrator)
- P2 = Registry administrator
- P3 = Account consultant
- P4 = Primary authorized contact
- P5 = Secondary authorized contact
- P6 = Guest
- P7 = Verified allowances management (Verifier)
- P8 = Verified allowances validation (Competent authority)

Access Protection

Apart from the measures within the software for the identification and authentication of authorised users, the following technical and organisational measures are in place, to prevent third parties access to the data:

- SSL-based encoding of the data transmission in the WEB and user authentication to gain entry to the system,
- Employment of continuously updated virus-scanner software on the servers and the clients of the registry administration,

- Continuous security updates of the system software
- Network infrastructure with hardware firewalls
- Continuous check of the firewall logs for attack attempts,

Table 3-17: Authorized functionalities for profiles

Authorised functionalities	System administrator	Registry Administrator	Account consult	Primary authorized contact	Secondary authorized contact	Guest	Verified allowances management (Verifier)	Verified allowances validation (Competent authority)
Add account	x	x						
Add contact	x	x		x				
Add installation	x	x						
Add operation	x	x		x	x			
Add participant	x	x		x				
Add processing unit	x	x						
Add profile	x							
Add unit	x	x						
Advanced search	x	x	x	x	x	x	x	x
Advanced search to document text	x	x	x	x	x	x	x	x
Categories of activities management	x							
Change main participant	x	x						
Compliance status	x	x						
Consult account	x	x		x	x			
Consult contact	x	x	x	x	x			x
Consult installation	x	x	x	x	x			x
Consult NAP detail	x	x						
Consult NAP Table	x	x						
Consult transaction	x	x	x	x	x			
Consult participant	x	x	x	x	x		x	x
Consult processing unit	x	x		x	x			
Consult profile	x	x	x	x	x			
Consult unit	x	x		x				
Consult reports	x	x	x	x	x		x	x
Consult verified allowances	x	x	x	x			x	x

Authorised functionalities	System administrator	Registry Administrator	Account consult	Primary authorized contact	Secondary authorized contact	Guest	Verified allowances management (Verifier)	Verified allowances validation (Competent authority)
Create contact	x	x						
Create participant	x	x		x	x			
Create processing units	x	x		x	X			
Create installation	x	x						
Create account	x	X						
Create transaction	x	x		x	x			
Create unit	x	x						
Create profile	x	x						
Create verified allowances	x						x	
Disconnections	x	x	x	x	x			x
Delete account	x	x		x				
Delete contact	x	x		x				
Delete installation	x	x						
Delete participant	x	x		x				
Delete processing unit	x	x		x	x			
Delete profile	x	x						
Delete Transaction	x	x						
Delete unit	x	x						
Enter verified emissions	x	x					x	x
Installation load from xml file	x							
Modify account	x	x		x	x			
Modify contact	x	x		x	x			
Modify installation	x	x		x	x			
Modify participant	x	x		x	x			
Modify password	x	x	x	x	x		x	
Modify processing unit	x	x		x	x			
Modify profile	x							
Modify unit	x	x						
NAP load from xml file	x							
Operator load from xml file	x							
Password management	x	x		x	x			

Authorised functionalities	System administrator	Registry Administrator	Account consult	Primary authorized contact	Secondary authorized contact	Guest	Verified allowances management (Verifier)	Verified allowances validation (Competent authority)
Validate verified emissions	x	x						x

3.5.7 Public Reports

For each account the following reports are available on the public area of the national registry:

- 1) List of legal entities holding an account in the national registry
- 2) List of installations in line with the European emissions trading directive
- 3) List of accounts opened in the national registry
- 4) Annual summary of quantity of units per type of operation performed in the national registry
- 5) Compliance status of installations concerning the declaration of verified emissions, grouped by operators
- 6) Summary statement on the quantity of allowances surrendered by an operator for compliance
- 7) Report on consolidated position of all installations verified emissions compared with total allowances surrendered
- 8) Report on the assessment of operator's compliance, grouped by operators
- 9) List of non-compliant installations
- 10) Verified emissions table

Additionally, FAQs, international texts (Kyoto Protocol, Marrakesh Accords etc.), and details of the national allocation plan are publicly available by means of the user interface.

3.5.8 Internet adress

The URL of the interface for the national registry of Liechtenstein is:

www.emissionshandelsregister.li and alias

www.emissionstradingregistry.li

3.5.9 Safeguard and Recovery Plan

The following measures taken to safeguard, maintain and recover data in the event of a disaster are implemented:

Table 3-18: Backup strategy of National Registry (Source: Initial Report of Switzerland).

	Description	Frequency	Retention Period	Storage
System data	Full Backup	Weekly	3 months	Tape, offsite
	Incremental backup	Daily	1 week	Tape, offsite
Application DB	Online backup of the data base on a daily basis	Daily	3 months	Tape, offsite
	Creating transaction logfiles	Hourly	1 week	Local system disk on the data base server. This device is separate from the device holding the DB.
Transaction Logfiles	Transaction logfiles will be subject to the system data backup			

3.5.10 Test procedures

Interoperability tests based on Annex H of the DES version 1.1.002 were performed on 5. September 2007 and passed successfully. Additionally, the Remote Tests between the national registry of Liechtenstein and the Community Independent Transaction Log (CITL) focusing on issues relevant for EU-ETS (Allocation Plan Details; Issuance of EUAs, etc) were carried out in line with the ETS Testing Plan Version 4 out and completed successfully.

3.5.11 Commitment period reserve (CPR)

According to the Annex of decision 11/CMP.1, each Party included in Annex I shall maintain, in its national registry, a commitment period reserve which should not drop below 90 per cent of the Party's assigned amount calculated pursuant to Article 3, paragraphs 7 and 8, of the Kyoto Protocol, or 100 per cent of five times its most recently reviewed inventory, whichever is lowest. In line with these specifications, Liechtenstein reported its commitment period reserve to be 950,061 CO₂ eq based on the assigned amount, which is consistent with the initial review report 2006 (FCCC/IRR/2007/LIE).

Liechtenstein considers that the „most recently reviewed inventory“ refers to the inventory 2007 presented in the current NIR. The inventory is understood to be calculated without LULUCF emissions/removals.

In order to determine which of the two methods to calculate the commitment period reserve results in the lower value, the results of both methods are indicated below.

Method 1		Method 2	
Assigned amount calculated pursuant to Art. 3, para. 7 and 8 of the Kyoto protocol (five times 92% of 1990 emissions), [Gg CO ₂ equivalent]	1'055.623	2007 emissions without LULUCF, [Gg CO ₂ equivalent]	243.478
90% of the assigned amount [Gg CO ₂ equivalent]	950.061	100% of five times the 2007 emissions without LULUCF [Gg CO ₂ equivalent]	1217.389

Table 3-19 Calculation of Liechtenstein's commitment period reserve 2007.

The CPR remains unchanged since method 1 still results in the lower value and is therefore used to calculate the minimum amount of the CPR. **The commitment period reserve of Liechtenstein should therefore not drop below 950.061 Gg CO₂ equivalent (0.950061 million tonnes CO₂ equivalent).**

References

FOEN (Swiss Federal Office for the Environment) 2008: Greenhouse Gas Inventory for Switzerland 1990-2006 Common Reporting Format (CRF) and National Inventory Report (NIR), Berne

IPCC 1997a: Greenhouse Gas Inventory Reference Manual. Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 1, Reporting Instructions, Intergovernmental Panel on Climate Change a.o., IPCC WG I Technical Support Unit, Bracknell, U.K.

<http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm> [19.02.2009]

IPCC 1997b: Greenhouse Gas Inventory Reference Manual, Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2, Workbook, Intergovernmental Panel on Climate Change a.o., IPCC WG I Technical Support Unit, Bracknell, U.K.

<http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm> [19.02.2009]

IPCC 1997c: Greenhouse Gas Inventory Reference Manual, Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 3, Reference Manual, Intergovernmental Panel on Climate Change a.o., IPCC WG I Technical Support Unit, Bracknell, U.K.

<http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm> [19.02.2009]

IPCC 2000: Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC GPG) <http://www.ipcc-nggip.iges.or.jp/public/gp/gpgaum.htm> [19.02.2009]

IPCC 2003: Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC GPG LULUCF).

<http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.htm> [19.02.2009]

OEP (Office of Environmental Protection, Liechtenstein) 2009: Liechtenstein's Greenhouse Gas Inventory 1990 – 2007, National Inventory Report 2009

OEP 2006a: Liechtenstein's Initial Report under Article 7, paragraph 4 of the Kyoto Protocol. Office of Environmental Protection (OEP), Vaduz, 22 December 2006.

4. Policies and measures

4.1 Policy making process – general policy context

Liechtenstein endeavors to enshrine the principle of sustainability in its policies. This includes prudent 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.

Liechtenstein has integrated its climate policy very strongly into the individual sectoral policies. The focus is on energy policy, environmental policy, transport policy, agricultural and forestry policy. All of these areas encompass measures that contribute to the reduction of climate gases. In order to ensure a coordinated implementation of climate policies within the various areas the Government passed a Climate Protection Strategy in 2007. The Strategy requires an interdisciplinary coordination in the fields of environment, energy, building, transportation, agriculture and forestry with respect to the development of climate policy measures. Liechtenstein's Ministry of Environment and the Office of Environmental Protection are the coordinating authorities with respect to the executions of the Climate Protection Strategy.

Because of the small size of the country, however, 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). Accordingly, most policy areas are very closely linked with Swiss policy, in terms of both content and execution.

Pursuant to the cross border cooperation with Switzerland Liechtenstein and Switzerland concluded "The bilateral Agreement between the Principality of Liechtenstein and the Swiss Confederation on Environmental Levies within the Principality of Liechtenstein" (2009). The agreement enables Liechtenstein to implement several environmental levies of Switzerland into national law while using the existing infrastructure of the Swiss authorities for the execution of the respective national laws. The Ministry of Environment and the Office of Environmental Protection Foreign Affairs and the Office for Foreign Affairs are the competent authorities with respect to the execution of the bilateral agreement.

4.2 Domestic and regional programmes and/or legislative arrangements and enforcement and administrative procedures

Liechtenstein's legislative and administrative main arrangements to meet its commitments under the Kyoto Protocol are to be found in the Emissions Trading Act and the CO₂ Act.

The Emissions Trading Act (EHG) sets up the general framework for the fulfilment of Liechtenstein's reduction obligations originating from the respective ratification of the Kyoto Protocol. The EHG states that emission reductions are first and foremost to be reduced by inland measures. If the reduction obligations cannot be fulfilled through inland measures the government may participate in project activities abroad or in international emissions trading. Besides this the EHG implements Directive 2003/87/EC (Emissions Trading Directive) into national law and obliges two industrial installations (2009) to participate within the European Emissions Trading Scheme. The regulations of the EHG with respect to the participation of Liechtenstein in the Kyoto Protocols flexible mechanisms as well as with respect to domestic emissions trading are executed by the Office of Environmental Protection.

The CO₂ Act corresponds with the CO₂ Act of Switzerland (in force since 2008) and introduces a levy on the consumption of fossil fuel (oil and natural gas). The CO₂ Act is part of "The bilateral Agreement between the Principality of Liechtenstein and the Swiss Confederation on Environmental Levies within the Principality of Liechtenstein", mentioned above.

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. The revenue will be earmarked for climate protection projects in Liechtenstein and abroad.

In 2007 the Government notified its Designated National Authority as well as its Designated Focal Point to the UNFCCC secretariat and in 2008 the "National Guidelines for Approving Projects in Accordance with Article 6 and Article 12 of the Kyoto Protocol" were established.

Legislative arrangements, guidelines and further information on Liechtenstein's climate policy are available on the Office of Environmental Protection's homepage, www.aus.llv.li.

4.3 Policies and measures and their effects

4.3.1 Cross Sectoral Policies

The deliberate decision was made not to establish superordinate environmental protection legislation; the relevant provisions are to be found in the individual sectoral policies. However, the 2007 adopted Climate Protection Strategy requires a coordinated approach by the competent Ministries when drafting sectoral legislation.

4.3.2 Environmental policy

Environmental Protection Act

In 2008 the Government passed the Environmental Protection Act. The Act summarized a set of individual legislative measures in order to streamline procedures within environmental law. The Act is a legislative framework which now governs the main aspects of environmental protection, eg. air pollution and waste treatment and is comparable to the Swiss Federal Act on Protection of the Environment. The Act is the legal basis for further ordinances and regulations. It contains the following fundamental principles:

- precautionary principle: Environmental damages are to be limited at an early stage,
- polluter-pays-principle: Polluters of detrimental effects have to bear the costs for measures for the protection of the environment,

- principle of holistic approach: Environmental problems must be understood and tackled integrally and coherently,
- cooperation principle: Authorities and the economy collaborate as far as possible to achieve the goals of environmental protection.

With regard to air pollution, the Environmental Protection 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. An Important element is and the obligation to provide information to the public. Requirements on petrol and diesel oil, but also thresholds for particulate matters in air are regulated by Ordinance on Air Pollution. With this regard the annual average for sulfur dioxide (threshold) is 20 micrograms/m³. The sale of leaded supreme petrol is prohibited since 2000. The lead content in unleaded petrol is 0.005 g/l, and the share of carcinogenic benzene may not exceed 1%. The sulfur content in diesel and petrol may not exceed 0.01 g/kg.

With regard to waste treatment the Environmental Protection Act 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. The requirements are also based on the polluter-pays-principle. All trash is incinerated in the waste incineration plant in Buchs, Switzerland and the energy generated is reused.

The Environmental Protection Act also provides the legal basis for the so called "Action Plan Air" a measure plan effective since 2007 in order to reduce all kind of emissions. The Action Plan Air itself is, however, not legally binding but provides proposals that have to be considered for future decisions by the Government.

Environmental Levies

The bilateral Agreement between the Principality of Liechtenstein and the Swiss Confederation on Environmental Levies within the Principality of Liechtenstein enables Liechtenstein to implement several environmental levies of Switzerland into national law while using the existing infrastructure of the Swiss authorities for the execution of the respective national laws. The environmental levies are:

- Act on the tax for the rehabilitation of contaminated sites (ASAG)
- Act on the incentive tax on petrol and diesel oil with a sulphur content of more than 0.001 per cent (BDSG)
- Act on the incentive tax on "extra light" heating oil with a sulphur content of more than 0.1 per cent (HELG)
- Act on the incentive tax on volatile organic compounds (VOCG)
- CO₂ Act

Environmental levies on pollutants serve to "internalize" externalized costs, and to reduce the costs of pollution to society by increasing the proportion paid by polluters themselves.

4.3.3 Climate policy

In Liechtenstein, two laws substantially influence climate policy:

Emissions Trading Act

The Emissions Trading Act implements Directive 2003/87/EC (Emissions Trading Directive) and Directive 2004/101/EC. The Act obliges two industrial combustion installations (2009) to participate within the European Emissions Trading Scheme. In conjunction with Liechtenstein's accession to the European Emissions Trading Scheme the Government had to work out a National Allocation Plan in 2007.

The Plan was approved by the EFTA Surveillance Authority in December 2007. The amount of European Union Allowances (EUA) which will be allocated to the respective operators during the period 2008 - 2012 by the Office of Environmental Protection corresponded to 82 % of the installations average emissions from

2002 to 2005. By end of March of each period year the operators of these two installations are obliged to submit an amount of EUA's that corresponds with the amount of CO₂ emitted the previous year. Therefore the emissions have to be monitored and verified according to Commission Decision 2007/589/EC. With respect to the countries Kyoto-obligation the Emissions Trading Act establishes a priority on national reduction measures before considering the Protocol's flexible Mechanisms (CDM/JI/IET). The concrete procedure has to be defined in a National Climate Protection Strategy.

The Act served as an incentive for the construction of a steam pipeline, a privately financed energy project. Since 2009 both industrial plants covered by the EHG started to substitute the use of fossil fuels by the acquisition of steam which is produced in a waste incineration plant in Buchs, Switzerland.

CO₂ Act

The CO₂ Act is an important legislative arrangement which specifies climate policy objectives. It lays down ongoing reduction of greenhouse gases and a reduction of CO₂ emissions from the energy-related use of fossil energy sources of at least 10% by the year 2010, relative to 1990. The economical use of fossil fuel is promoted by the establishment of a levy on fossil fuel consumption covering the sectors of economy as well as private households. The levy therefore is intended to promote the economical use of fossil fuels throughout Liechtenstein.

The levy revenues originating from the economy are returned to the sector by granting subsidies to employers obligations within the "Old Age and Survivors Insurance". However, contrary to the CO₂ levy in Switzerland, the revenues originating from private households are not returned. This is due to the fact that an efficient reimbursement procedure is only possible by using subsidy grants within the compulsory health insurance (as it is the case in Switzerland). Since the health insurance system of Liechtenstein is already heavily subsidized the steering effect is too little to justify the respective bureaucratic efforts.

The actual levy rate depends on the development of the CO₂-emissions in Switzerland. Liechtenstein will adapt the rates defined in Switzerland accordingly. The levy rates on fossil fuels in 2008 and 2009 have been 12 CHF per tonne CO₂. The rate will triple in 2010 up to 36 CHF per tonne CO₂.

Policies planned

National measures are accorded the highest priority. In this regard, Liechtenstein also expects to implement further appropriate measures of Swiss climate policy. This could primarily concern an adaptation of the Emissions Trading Act and the CO₂ Act in case Switzerland successfully accesses the European Emissions Trading Scheme, as officially announced in 2009.

Another national measure regarding a climate friendly energy acquisition is the use of geological heat from deep thermal aquifers for heating and electric power generation. A first pilot study in 2008 concluded that the geological preconditions in Liechtenstein are promising for the use of deep geothermic energy. Due to the results of the study further investigations are currently executed supervised by the Office of Environmental Protection. With respect to fiscal measures the Government is currently (2009) exploring the introduction of a CO₂-based motor vehicle tax. In 2008 a first draft was realized combining a CO₂ emission based vehicle tax with an incentive system for the private purchase of vehicles with lower CO₂ emissions.

Summary of policies and measures

Name of policy or measure ^b	Objective and/or activity affected	GHG affected	Type of instrument	Status ^c	Implementing entity or entities	Estimate of mitigation impact, by gas (for a particular year, not cumulative, in CO ₂ eq.) ^d		
						2010	2015	2020
Climate Protection Strategy	Definition of a clear and transparent strategy for climate policy in Liechtenstein with 10 precise action fields and measures to fulfil the requirements of the Kyoto Protocol	all	Planning Measure	Implemented 2007	Government of Liechtenstein			
Environmental Protection Act	Legal basis for all regulations and ordinance, especially with respect to air pollution and waste treatment	all	Law	Implemented 2008	Office of Environmental Protection			
Action Plan Air	Measure Plan according to air pollution control regulations within the Environmental Protection Act	All	Planning measure	In force since 2007	Office of Environmental Protection			
Emissions regulations	Emissions regulations for stationary facilities (heating industry)	CO ₂ , precursors or gases	Law	Implemented 1987, Revised 1992 and 2005				
Water Protection Act	Cap on maximum number of cattle per land area	CH ₄ , N ₂ O	Law	Implemented 2003	Office of Environmental Protection			
Emissions Trading Act	Implementation of Directive 2003/87/EC and Directive 2004/101/EC	all	Law	Implemented 2008	Office of Environmental Protection			
CO ₂ Act	Implementation of ecological steering levy modelled by Switzerland, reduction of CO ₂ emissions from fossil fuels and inducement for a economical use of energy and renewable energies	CO ₂	Steering Levy, Law	Implemented 2008, transferred into national Law in 2010	Office of Environmental Protection, Swiss Federal Office of the Environment	IE	IE	IE
Steam Pipeline	Acquisition of Steam from waste incineration plant in neighbouring city of Buchs (Switzerland) in order to replace fossil fuels for manufacturing industry	CO ₂	Infrastructure measure	In operation since 2009	Private	17.5* Gg CO ₂	2.2* Gg CO ₂	2.2* Gg CO ₂
Deep Geothermal Energy	Use of geological heat from deep thermal aquifers for electric power and heating	CO ₂	Planning measure	Pilot Study finalized 2008, further investigations in process (2009/2010)	Office of Environmental Protection	-		
Climate protection platform as part of the Environment Commission of the International Lake	Coordination, exchange of information	All	Data Collection	2005: Status Report on climate protection on Lake Constance with recommendations for	Office of Environmental Protection			

Constance Conference				activities 2005: Guidelines with practical examples 2007: Status Report on impact of climate change and potential adaptation strategies 2009: Status Report on renewable energies				
Elaboration of a hydro geological map as a basis for using near surface geothermal heat	Use of near surface geothermal energy for heating purposes	CO ₂ , precursors or gases	Data Collection	2005 Completion of Map, in force since March 2006, Revision 2007/2008				
Design of motor vehicle tax based on vehicle specific emissions	Establishing Incentives for the purchase of vehicles with low CO ₂ emissions	CO ₂	Law, Fiscal measure	Planned, first draft in 2008, Consultations in process	Drivers and Vehicle Licensing Office, Office of Environmental Protection			

4.3.4 Energy policy

The commitment to saving energy was legally enshrined in the Energy Ordinance in 2008 and further consolidated in 2008. 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 Efficiency Act of 30. Mai 2008 and the relevant Ordinance of 30. Mai 2009 as well as the Energy Ordinance of 24. August 2007 on the Construction Act 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 2004 the Government adopted "The Energy Concept 2013". The strategy provides future-oriented impulses for the national energy policy. 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 standard¹ 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 Efficiency 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.

Four municipalities (Triesen, Planken, Mauren, Schaan) have been awarded the Energy City label; others are in preparation.

Policies implemented

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.

¹ 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.

- **Photovoltaics:**
Photovoltaic systems generating electricity are subsidized with a contribution of 2,500 CHF per installed output (kW). The maximum subsidy per system is CHF 200'000.-- The generated electricity must be fed into the public network. The price guarantee for the first 10 years is 0.55CHF/kWh.
- **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. Four municipalities (Triesen, Planken, Mauren, Schaan) have already received the label.

In 2008, CHF 1'681'873 were contributed to the renovation of old buildings, CHF 784'172 to residential technical installations, CHF 1'067'272 to solar collector systems, CHF 838'325 to solar photovoltaic systems and CHF 176'622 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.

Policies planned

From 2009 – 2010 the Energy Conservation Act will be reviewed. Besides further support of renewable energy production and energy efficiency the new "Energy Vision 2020" will put an additional focus on the field of traffic and transportation, a sector that contributes to almost 1/3 of Liechtenstein's greenhouse gas emissions. The envisaged measures shall contribute to the achievement of further reduction commitments under a new convention treaty on climate change after 2012.

Summary of policies and measures in energy sector

Name of policy or measure ^b	Objective and/or activity affected	GHG affected	Type of instrument	Status ^c	Implementing entity or entities	Estimate of mitigation impact, by gas (for a particular year, not cumulative, in CO ₂ eq.) ^d		
						2010	2015	2020
Energy Efficiency Act	Aims for the reduction of energy, the intelligent and economic use of energy as well as the promotion of renewable energies. Promotion of heat insulation (renovation of old buildings), residential technical installations (room heating and nonpotable water), solar energy (thermal solar collectors and photovoltaics) and demonstration facilities.	CO ₂	Fiscal Measure (Subsidy)	Implemented 2008	Office of Economic Affairs	2.9* Gg CO ₂	2.9* Gg CO ₂	2.9* Gg CO ₂
Heated 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	CO ₂	Law	Implemented 1993, Energy Ordinance, 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 ³ , the heating requirements may not exceed 80% of the SIA value.	CO ₂	Regulation	Implemented 1993 New Energy Ordinance 2003	Building and Fire Authority			
Minergy standard for State Buildings	Requirement that all new State buildings have to comply with the Minergy Standard; Energy savings of 30% per building	CO ₂	Law	Implemented 2003	Building and Fire Authority			
Supply requirements	Determination of energy supply areas with the aim to join a district heating network	CO ₂	Planning measure					
Liechtenstein Energy Concept / Energy Vision 2020	Governmental Strategy that ensures a sustainable energy supply	CO ₂	Planning measure	2010 (planned)	Government of Liechtenstein / Office of Economic Affairs			
Green electricity (LiStrom Öko)	Auditing (SQS) and certification of all domestic production sites according to "naturemade" product mixture of renewable energy sources (hydropower plant) and new renewable energy sources (photovoltaic systems)	CO ₂	Promotion by Liechtenstein Power Authority (LPA)	Implemented 2004	LPA			
Promotion of photovoltaic systems of private owner	Through the sale of green electricity, the LPA pays 80 cents / kWh for energy generated from photovoltaic systems certified as "naturemade star" from 2004-2009.	CO ₂	Promotion by the LPA	Implemented 2004				
Promotion of energy generated by systems for efficient	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	CO ₂	Electricity Market Act	Implemented 2002				

energy production	energy use.							
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 ₂	EU Program	Implemented 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 ₂ emissions by preventing unnecessary stand-by of electric appliances. Stand-by accounts for about 10% of energy use of appliances.	CO ₂	Agreement between the US and the EU					
Participation of municipalities in the Energy City label	Reduction of CO ₂ emissions on the level of municipalities by increased use of renewable energies and high energy-efficient technologies for all premises. Award of the label to the first municipality (Triesen) 2007: two additional municipalities reached the requirements of the label (Schaan, Planken, Mauren) 2008: Municipality of Balzers, Eschen, Ruggell, Triesenberg and Vaduz in evaluation process	CO ₂ , precursors or gases	Labeling					
Hydro Power	Extension of hydropower	CO ₂	Planning measure	Planning phase for power plant Samina, planned implementation 2013	LPA			

4.3.5 Transport policy

Transport policy in Liechtenstein takes into account the interests of society, the economy, and the environment. In 2008, a national transport policy ("Mobiles Liechtenstein 2015") was approved by the Government, which includes a strategy for developing the transport sector in mid-term and long-term. 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 and medium-term expansion of the railway offerings).

Goods transport policy also plays an important role. 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.

Liechtenstein also supports the efforts of importers to reduce specific fuel consumption in accordance with 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, it now appears possible to undertake taxation of automobiles also with respect to specific CO₂ emissions. The Government is currently examining this option.

The public bus fleet has largely been converted to natural gas. Three natural gas fueling stations have 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.

Policies implemented

- 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 in multiple steps to 2.66 cents (at least 2.26 cents, at most 3.07 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 on roads, which results in a movement of goods to the railways. One third of the revenue is earmarked for environment and transport issues. 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 CO₂ emissions, precursor substances and N₂O emissions.

Furthermore the Government considers a system of motor vehicle taxation which implements a bonus-malus-system based on the energy efficiency and/or emissions of vehicles

- 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 was implemented, which entailed again significant improvements in frequency and attractiveness. In 2009 Liechtenstein, Austria and Austrian Railway signed a treaty to improve the railway infrastructure across Liechtenstein to establish a cross-border regional suburban train.

Until 2009, three natural gas fueling stations have been built and the public transport bus fleet was subsequently converted to natural gas. Meantime there are three natural gas fueling stations in Liechtenstein. More than 50% of bus-kilometers are now driven with natural gas buses.

Summary of policies and measures in transport sector

Name of policy or measure ^b	Objective and/or activity affected	GHG affected	Type of instrument	Status ^c	Implementing entity or entities	Estimate of mitigation impact, by gas (for a particular year, not cumulative, in CO ₂ eq.) ^d		
						2010	2015	2020
Heavy Vehicle Fee	Relocation of goods transport from road to railways and reduction of transalpine road transport	CO ₂ , Precursors or gases	Fiscal measure	Implemented 2001	Finance Administration			
Promotion of solar, electric, natural gas and/or hybrid vehicles	Vehicle tax waived for electric, natural gas and hybrid vehicles	CO ₂ , Precursors or 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	Precursors or gases (NO _x , VOC, SO ₂)	Investment measure; subsidy (using HFV funds)	Implemented 2001	Liechtenstein Bus Authority			
Subsidies for electric scooters and electric bicycles	Promotion of light electric vehicles used for personal transport instead of private automobiles	CO ₂ , Precursors or gases	Fiscal Measure (subsidy)	Implemented 2002	Driver and Vehicle Licensing Office			
Construction and operation of three public natural gas station	Infrastructure for providing fuel to private vehicles	CO ₂	Investment measure, Infrastructure measure	Implemented 2007, further evaluation in progress (2009)	Building and Fire Authority			
Supply of Biogas into natural gas fueling station	Supply of CO ₂ -free fuel for the natural gas filling station	CO ₂ , precursors or gases	Investment measures, Infrastructure measure	Implemented 2007, Evaluation in 2008	Building and Fire Authority, Bureau of Energy Consumption and Conservation; Office of Environmental Protection			
Design of motor vehicle tax according to energy efficiency and/or emissions	Incentive system for purchase of private vehicles with high efficiency and/or low emissions	CO ₂	Law, fiscal measure	Consultation in process (2009)	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 ₂ , precursors or gases	Institutional measures	Implemented 2000	Finance Administration			
Exhaust regulations	Adoption of the European exhaust regulations (EURO norms) and fuel regulations, Continuous reduction of road traffic emissions	Precursors or gases	Law	Implemented 1993	Driver and Vehicle Licensing Office			
Promotion of slow transport	The bicycle and pedestrian network is being expanded continuously and made more attractive	CO ₂ , precursors or gases	Institutional measures	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 ₂ , precursors or gases	Law	Implemented 2003	Building and Fire Authority			
Internal Mobility Management for State Authority	Efficient and environmentally suitable improvement of traffic volume by increased usage of public transport and bicycle	CO ₂ , precursors or gases	Institutional measure	Implemented 2008	Ministry of Transport and Telecommunications, Finance Administration			
Promotion of public transport	Introduction of an extended regional train schedule by 2015	CO ₂ , precursors or gases	Institutional measure, fiscal measure	Planning of the necessary railway infrastructure	Office of Civil Engineering			

4.3.6 Agriculture

International challenges as well as the changing environment within agricultural policies require strong flexibility from Liechtenstein's farmers. The general demand for more efficient and sustainable farming procedures is constantly growing. International liberalization of world markets have also led to certain deregulation measures in Liechtenstein. Besides that the agricultural sector has to provide an increasing amount of services that are not remunerated by markets but required by public interests. The new Agricultural Law, adopted in 2008, addresses the abovementioned issues and promotes the trend toward greater ecological agriculture in Liechtenstein. In order to maintain soil fertility, the environmental impact is minimized by environmentally friendly forms of production, such as integrated production and organic farming. Landscape conservation is also considered as a task of agriculture and its importance will continue to increase.

By means of the Agriculture Law Liechtenstein aims to promote environmentally friendly and animal-friendly agriculture as well as 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. 119 of 128 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.

Since 2002, the promotion of farm animals consuming roughage is included in the Direct Payment System. 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 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 a temporal restricted measure (2006-2009) the Government subsidizes flexible tube systems to distribute liquid manure.

Summary of policies and measures in Agriculture sector

Name of policy or measure ^b	Objective and/or activity affected	GHG affected	Type of instrument	Status ^c	Implementing entity or entities	Estimate of mitigation impact, by gas (for a particular year, not cumulative, in CO ₂ eq.) ^d		
						2010	2015	2020
Ecological equalization payments in agriculture	Product-independent contributions for conversions to ecological cultivation methods	CH ₄ , N ₂ O	Fiscal measure (direct payments)	Implemented 1996	Office of Agriculture			
Preservation of soil for agricultural use	Agriculture: permanent protection of soil for agricultural use from misuse	CH ₄ , N ₂ O	Law	Implemented 1992	Office of Agriculture			
Water Protection Act	Cap on maximum number of cattle per land area	CH ₄ , N ₂ O	Law	Implemented 2003	Office of Environmental Protection			

4.3.7 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. 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).

Summary of policies and measures in forestry sector

Name of policy or measure ^b	Objective and/or activity affected	GHG affected	Type of instrument	Status ^c	Implementing entity or entities	Estimate of mitigation impact, by gas (for a particular year, not cumulative, in CO ₂ eq.) ^d		
						2010	2015	2020
Cultivation regulations in the Forestry Act	Sustainable cultivation of forests	CO ₂ (sinks)	Law	Implemented 1991	Office of Forests, Nature and Land Management			
Ordinance on the Scope and benefits of compensation and financial aid in the framework of the Forestry Act	Performance target	CO ₂ (sinks)	Law	Implemented 1995	Office of Forests, Nature and Land Management			
Ordinance on forest reserves and protected areas	Performance target	CO ₂ (sinks)	Law	Implemented 2000	Office of Forests, Nature and Land Management			
Forest Inventory 1998 and National Forest Program (2002 – 2012)	Binding specifications for future use of forests; development of a Forest Inventory 2010	CO ₂ (sinks)	Planning measures, Law	Implemented 2001	Office of Forests, Nature and Land Management			
FSC certification of the entire forest stock	Performance target	CO ₂ (sinks)	Operational planning	Implemented 2001	Office of Forests, Nature and Land Management			

4.3.8 Waste Management

Policies implemented

In Liechtenstein the Ministry of Environment together with the Office of Environmental Protection is responsible for developing legislation and policies to ensure the recovery and environmentally sound disposal of waste, coordinating the planning of waste disposal facilities and for the implementation of the policy framework in close collaboration with the eleven communes. The basis for waste legislation in Liechtenstein is the Environmental Protection Act (2008), see also chapter 4.2.3.

Because of the customs union treaty with Switzerland the Swiss waste law is also applied in Liechtenstein and there is no custom control between Liechtenstein and Switzerland. The borders are controlled by Swiss authorities. The Swiss Federal Office for the Environment (FOEN) checks the import, export and transit of wastes and hazardous wastes for Liechtenstein. Switzerland is a member of the OECD and the Basel Convention and therefore carries out these controls according to the OECD and the Basel Convention-Decisions. The authorities of Liechtenstein will be informed in every case and have the possibility to refuse unwanted exports, imports and transits of wastes under control.

Moreover the Ordinance on Dangerous Substances (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.

Registration, Evaluation, Authorization and restriction of Chemicals (REACH) is a European Union Regulation (2006). REACH addresses the production and use of chemical substances, and their potential impacts on both human health and the environment. It is the strictest law to date regulating chemical substances. REACH entered into force in 2008, with a phased implementation over the next decade. It is also applicable in Liechtenstein.

Summary of policies and measures in waste management sector

Name of policy or measure ^b	Objective and/or activity affected	GHG affected	Type of instrument	Status ^c	Implementing entity or entities	Estimate of mitigation impact, by gas (for a particular year, not cumulative, in CO ₂ eq.) ^d		
						2010	2015	2020
Environmental Protection Act	Legal basis for all regulations and ordinance, especially with respect to air pollution and waste treatment	all	Law	Implemented 2008	Office of Environmental Protection			
REACH	Manufacturers and importers are required to gather information on the properties of their chemical substances, which will allow their safe handling, and to register the information in a central database run by the European Chemicals Agency (ECHA)	all	Law	2007	Office of Environmental Protection			

4.3.9 International cooperation

International cooperation is an important pillar of Liechtenstein's 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 2008-2010 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.

4.4 Policies and measures no longer in place

The Energy Conservation Act from 1996 was displaced by the regulations of the Act on Energy Efficiency in 2008.

References

- Emissions Trading Act (EHG), 2007: Liechtenstein Law Gazette (814.05)
- Energy Commission 2004: Liechtenstein Energy Concept 2013 of the Government of the Principality of Liechtenstein, January 2004, Vaduz.
- Energy Efficiency Act, 2008; Liechtenstein Law Gazette (730.2)
- Environmental Protection Act, 2008: Liechtenstein Law Gazette (814.01)
- Forestry Act, 1991: Liechtenstein Law Gazette (921.0).
- Government of the Principality of Liechtenstein, 2007: National Allocation Plan of the Principality of Liechtenstein, 2008-20012, <http://www.llv.li/pdf-llv-aus-nap.pdf>
- Government of the Principality of Liechtenstein, 2007: National Climate Protection Strategy, 2007, http://www.llv.li/pdf-llv-aus-nationale_klimaschutzstrategie_07.pdf
- Government of the Principality of Liechtenstein, 2008: National Guidelines for Approving Projects in Accordance with Article 6 and Article 12 of the Kyoto Protocol, available under: http://www.llv.li/pdf-llv-aus-national_ji_cdm_guidelines_of_liechtenstein.pdf
- Government of the Principality of Liechtenstein, 2008: Opinion by the Government to the Parliament of the Principality of Liechtenstein on the Questions Arising during the First Reading of the Accomplishing a Law on Agriculture and Modifying other Laws.
- Government of the Principality of Liechtenstein, 2008: Report of the Government to the Parliament of the Principality of Liechtenstein on the Accomplishment of a Law on Agriculture
- Government of the Principality of Liechtenstein, 2009: The bilateral Agreement between the Principality of Liechtenstein and the Swiss Confederation on Environmental Levies within the Principality of Liechtenstein
- Law on Agriculture, 2009: Liechtenstein Law Gazette (910.1)
- Law on Compensation for Ecological and Animal-Friendly Practices in Agriculture (Compensation Act), 1996: Liechtenstein Law Gazette (910.2).
- Law on Hardship Allowances for the Cultivation of the Mountain Regions and Alpine Slopes (Mountain Region and Alpine Slope Act), 1997: Liechtenstein Law Gazette (912.1).
- Law on Income-supporting Direct Payments in Agriculture (Direct Payment Act), 1995: Liechtenstein Law Gazette (910.1).
- Law on the Heavy Vehicle Fee (Heavy Vehicle Fee Act, HVFA), 2000: Liechtenstein Law Gazette (641.81).
- Näscher, F., 2001: National Forest Program for the Liechtenstein Forests.
- Office of Transport Coordination, 2001: Interim Report on the Overall Transport Strategy.
- Ordinance on Air Pollution, 2008: Liechtenstein Law Gazette (813.301.1)
- Ordinance on Energy, 2007: Liechtenstein Law Gazette (701.013)
- Ordinance on forests reserves and protected areas, 2000, Liechtenstein Law Gazette (921.013)
- Ordinance on Income-supporting Direct Payments (Direct Payment Ordinance), 1996: Liechtenstein Law Gazette (910.11).
- Ordinance on the Mountain Region and Alpine Slope Act (Mountain Region and Alpine Slope Ordinance), 1998: Liechtenstein Law Gazette (912.11).
- Ordinance on the Promotion of Energy Efficiency and Renewable Energy, 2008: Liechtenstein Law Gazette (730.21)
- Ordinance on the Scope and Payment of Compensation and Financial Assistance in the Framework of the Forestry Act, 1995: Liechtenstein Law Gazette (921.012).

Parliament, Government, and Courts, 2008: Report of Parliament, Annual Report of the Government to Parliament, Report of the Courts, National Budget.

Peter, S., Hartmann, M., Weber, M., Lehmann, B. und Hediger, W. 2009: „THG 2020“ – Möglichkeiten und Grenzen zur Vermeidung landwirtschaftlicher Treibhausgase in der Schweiz. Schriftenreihe 2009/1 der Gruppe Agrar-, Lebensmittel und Umweltökonomie, ETH Zürich, Zürich.

5. Projections and the total effect of policies and measures

5.1 Projections

Given its small size, Liechtenstein does not have comprehensive projections at its disposal. The projections presented for the years 2010, 2015 and 2020 rely on the latest emission and energy use data available for Liechtenstein, projections of reductions from the Bureau of Energy Consumption and Conservation (OEA 2009) through measures implemented and on comparisons and analogies with the projections and assumptions developed for Switzerland (FOEN 2009).

5.1.1 Measures implemented

Liechtenstein's financially and for the projections most relevant measures currently in place contribute to the renovation of old buildings, solar collector systems and substitution to heat pumps and wood heatings. These measures are induced under the Energy Efficiency Act (EEG 2008) (see Chapter 4.3.4). The municipalities individually supplement the national subsidies with additional funds. Other measures such as savings through more efficient new private heatings are independent of the EEG but also relevant for emission reduction. Savings through a newly installed steampipeline for two industrial plants was induced through the Emissions trading act (see Chapter 4.3.3).

Table 5-1 shows an overview of the measures implemented until 2020. These measures, quantified by the Bureau of Energy Consumption and Conservation (OEA 2009), were subtracted from the baseline scenario to get a projection "with measures implemented". Note that due to methodological reasons the figures indicated in Table 5-1 are different to the ones in the table "summary of policies and measures in the energy sector" in Chapter 4.3.4. Whereas the figures of Table 5-1 are cumulative and thus considerably higher to obtain a scenario "with measures" the ones in Chapter 4 are not cumulative.

It was not possible to quantify the effect of all further measures adopted, but they certainly do have a reductive effect on further development of Liechtenstein's energy use and thus emissions:

- CO₂ levy on heating fuel (CHF 12 per t CO₂ in 2008 and 2009; 36 CHF per t CO₂ 2010).
- Agreements with car importers to enhance energy efficiency and reduce CO₂ emissions (no CO₂ tax on transport fuels) in accordance with Switzerland (The transport sector development was projected analogue to Switzerland with this measure incorporated)
- Heavy vehicle fee (HVF) analogous to Switzerland. (The transport sector development was projected analogue to Switzerland with this measure incorporated)
- Promotion of Minergy standard

For detailed information on the implemented measures compare Chapter 4.3.4. to 4.3.8.

Table 5-1 Estimated cumulative effect of implemented and adopted policies and measures

Estimated and expected yearly reduction compared to 2007 of implemented and adopted policies and measures					
in t CO ₂ Reduction/year					
	sector	measure	2010	2015	2020
Energy efficiency act measure	1A2/ 1A4	Renovation of old buildings	1'565	4'848	8'130
	1A2/ 1A4	Thermal solar collectors	845	2'199	3'553
	1A2/ 1A4	Substitution to heat pumps	3'378	9'944	16'510
	1A2/ 1A4	Substitution to wood heatings	1'776	5'059	8'342
other measures	Savings through more efficient				
	1A4	new private heatings	197	328	328
	1A2	Steampipe for Industry	17'423	17'635	17'635
Total reduction			25'184	40'013	54'498

5.1.2 CO₂

Liechtenstein's development of energy-related sectors

Projections of the different energy-related sectors 1A1 to 1A5 are mainly based on the energy statistics of Liechtenstein (AS 2009a) and on the projections on the impact of currently implemented and adopted policies and measures of the Bureau of Energy Consumption and Conservation Liechtenstein (OEA 2009) "with measures implemented". For 1A3 "Transport" projections are developed analogue to the ones of Switzerland.

CO₂ emissions from energy-related sectors will decrease from 2007 to 2020 by 15% (23% compared to 2005, 10% compared to 1990), mainly due to a reduction in heating fuel consumption (oil and natural gas) induced by building renovation and energy efficiency programs in the sectors 1A2 "Industry" and 1A4 "Other Sectors" (Residential, commercial, and institutional buildings). A significant reduction in 1A2 "Industry" is accomplished by the substitution of fossil fuel heating by the acquisition of steam through two big industry companies.

Heating fuels used in 1A4 "Other Sectors" is the most important source of CO₂ emissions in the energy sector. Accompanied by an extension of the gas-grid, natural gas has replaced gas oil as the main heating fuel in buildings. Between 1990 and 2007 consumption of gas has doubled whereas oil consumption has halved. The total consumption of heating fuels increased slightly but continuously since 1995 until 2006. As outlined in Tab 5-2 the consumption of heating fuels shows a remarkable decrease in 2007 due to various reasons discussed in chapter 0. In the future 1A4 is assumed to decrease due to the measures implemented through the Energy efficiency law outlined in chapter 4.3.4 ("Energy Efficiency Act", EEG 2008).

Consumption of transport fuels which is the second largest emission source is more or less stable since 1996 and is assumed to be slightly decreasing in the future.

Energy consumption of international air traffic increased from 5.84 TJ in 1990 to 10.36 TJ in 2007 exclusively consisting of the consumption of only two helicopter companies. Future energy use and thus Greenhouse gas emissions of international air traffic are expected to remain more or less constant until 2020. Also the split between international bunkers and domestic aviation is expected to be constant.

Non-energy related sectors

Industrial Processes

As Liechtenstein has only few IPCC source categories in the sector "Industrial Processes" no CO₂ emissions occurred in this sector until 2007. Consequently, as no structural changes are expected in the industrial sector, no CO₂ emissions are projected until 2020. Sources in the categories 2B, 2C, 2D, 2E and 2G are not occurring at all, from categories 2A "Mineral Products" and 2F "Consumption emissions of halocarbons and SF₆" only HFC's and SF₆ are reported (see also Chapter 5.1.5)

Solvent and other Product Use

Emissions from solvents are based on per capita emission factors. Therefore CO₂ emissions are expected to increase slightly, analogous to the population development of Liechtenstein (AS 2009b).

LULUCF Forests and harvested wood products

Projections until 2020 are based on an extrapolation of the data of the period 1984-2002. Therefore the LULUCF sector remains a sink of 6.5 Gg CO₂ / year.

Waste

There are no waste incineration plants in Liechtenstein. All municipal solid waste is exported to Switzerland for incineration. Therefore the main sources of emissions from the waste sector are emissions from composting and wastewater treatment. Both sources are calculated based on per capita emission factors. As a consequence, future CO₂ emissions are projected proportional to the population development of Liechtenstein (AS 2009b).

Overview CO₂

Tab 5-2 and Figure 5-1 provide an overview of the CO₂ emissions between 1990 and 2020. From 1990 to 2005 emissions increased by 18%. The energy sector is by far the most important sector for total CO₂ emissions. It consists of two main consumers: Heating fuels (main component of 1A2 and 1A4) and transport fuels (main component of 1A3). Total energy consumption showed a strong decrease between 2006 and 2007 which is assumed to have various reasons which lead to a significant decrease in heating fuel consumption of 16% whereas transport fuel consumption showed no such effect but increased by 3%. Based on the latest energy statistics with the latest consumption data of 2008 (AS 2009a) (showing another increase of 9% in consumption of heating fuel compared to 2007) projections consider the outlier year 2007 (see also Chapter 0).

By 2020 a decrease of 13% of CO₂ emissions (excl. LULUCF) compared to 1990 is projected. The results reflect the development under the assumption that adopted measures will be effective (see also Chapter 5.2 and 5.4).

Tab 5-2 CO₂ emissions (excl. LULUCF) by sector from 1990 to 2020 "with measures implemented"

CO ₂ in Gg		Inventories					Projections		
IPCC	Source/Sink Categories	1990	1995	2000	2005	2007	2010	2015	2020
Total	Emissions without LULUCF	203.06	209.39	227.53	239.96	211.28	199.59	186.17	176.40
1	All Energy	201.53	208.15	226.51	239.08	210.41	198.67	185.21	175.40
1A	Fuel Combustion	201.53	208.15	226.51	239.08	210.41	198.67	185.21	175.40
	1 Energy/Transformation	0.12	1.96	2.61	2.97	2.44	2.44	2.44	2.44
	2 Industry	35.23	34.26	34.24	36.09	30.81	15.78	14.85	14.12
	3 Transport	75.37	80.32	94.54	84.60	85.82	86.26	82.68	83.11
	4 Other Sectors	88.44	89.43	92.15	111.92	88.00	90.86	81.92	72.40
	5 Other (Off road)	2.36	2.19	2.96	3.50	3.33	3.33	3.33	3.33
1B	Fugitive Emissions	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	solid fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	2 Oil/Natural Gas	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2	Industrial Processes	NO	NO	NO	NO	NO	NO	NO	NO
3	Solvent Use	1.53	1.23	1.01	0.87	0.86	0.90	0.95	0.99
4	Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	LULUCF	-8.32	-8.50	-4.92	-6.53	-6.57	-6.57	-6.57	-6.57
6	Waste	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1A3 ai	International Bunkers	0.43	0.43	0.49	0.48	0.76	0.76	0.76	0.76

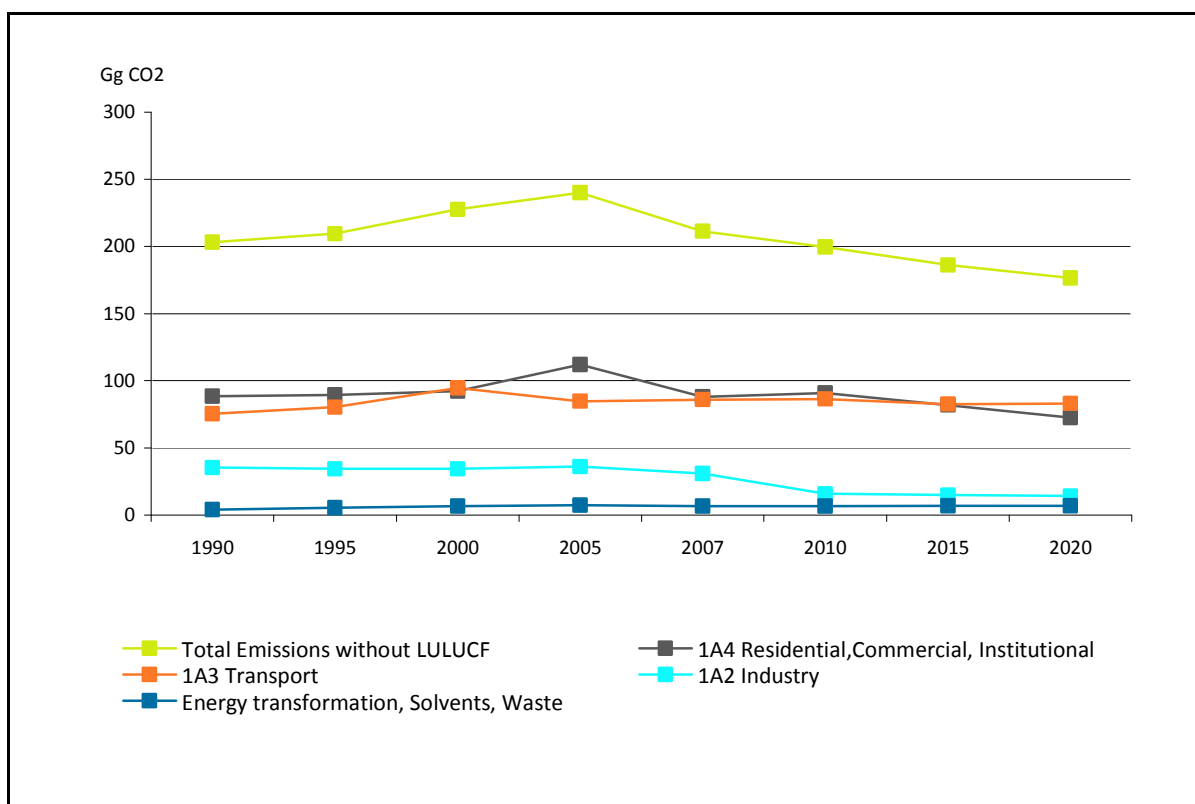


Figure 5-1 CO₂ emissions (excl. LULUCF) by sector from 1990 to 2020 “with measures implemented”, main sectors

5.1.3 CH₄

Energy-related sectors

CH₄ emissions from energy related sectors are of minor significance. The most important energy-related CH₄ source stems from fugitive emissions, i.e. methane losses from natural gas network. These losses increased significantly between 1990 and 2007 as the network of Liechtenstein expanded and consumption of natural gas notably increased. According to the “Liechtensteinische Gasversorgung” (Liechtenstein’s gas utility) no further expansion of the natural gas network is planned (2009), therefore CH₄ emissions are assumed to remain constant.

All other projections of energy-related CH₄ emissions are assumed to be proportional to the CO₂ emissions as they are all emitted from fuel combustion and are based on the same activity data.

Agriculture

Agriculture is the main source of CH₄ emissions in Liechtenstein. The most important factor for CH₄ emissions is enteric fermentation, mainly derived from cattle stock. Therefore Liechtenstein’s CH₄ emissions between 1990 and 2007 vary in parallel to the development of cattle stock, which has decreased until 2000 and since then shows a relevant increase in number. There are no official projections from the Office for Agriculture as the development of cattle stock numbers is very much unpredictable. No measures are planned, so the conservative assumption of a stable situation until 2020 seems to be justifiable: CH₄ are expected to remain constant until 2020.

Waste

There are no waste incineration plants in Liechtenstein. All municipal solid waste from Liechtenstein is exported to Switzerland for incineration. Therefore the main sources of CH₄ emissions from the waste sector are emissions from composting and wastewater treatment. Both sources are estimated based on per

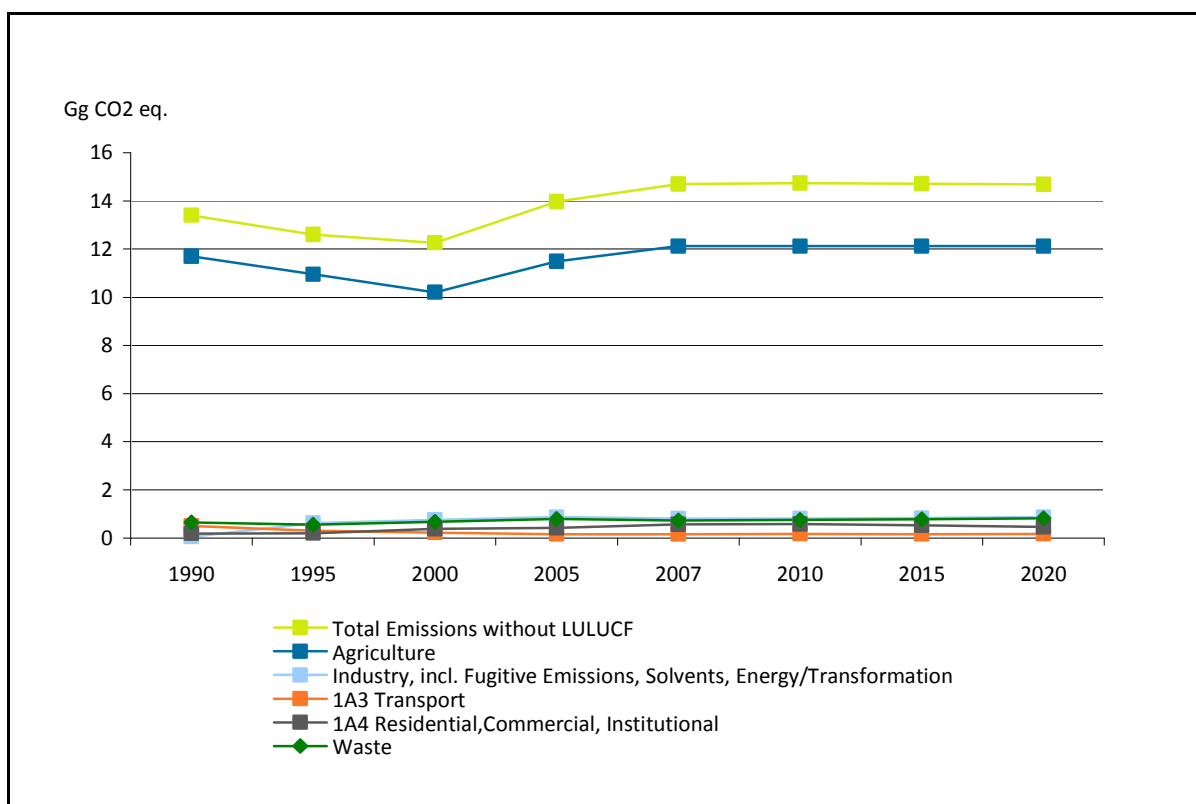


Figure 5-2 CH₄ emissions (excl. LULUCF) by sector from 1990 to 2020 “with measures implemented”

5.1.4 N₂O

Energy-related sector

Emissions from energy-related sectors have minor significance for N₂O emissions. Most energy-related N₂O emissions are proportional to CO₂ emissions as they are all emitted from fuel combustion, they base on the same activity data. In the transport sector, N₂O is a by-product of catalytic conversion of exhaust gases. These emissions increased from 1990 to 2000 but decreased from 2000 to 2007 as a result of more efficient catalytic converters. In future, it is assumed conservatively that the emission factor will remain constant.

Agriculture

Agriculture is the main source of N₂O emissions in Liechtenstein. In analogy to the projections of the CH₄ emissions, N₂O emissions from agriculture are projected to remain constant.

Other sources

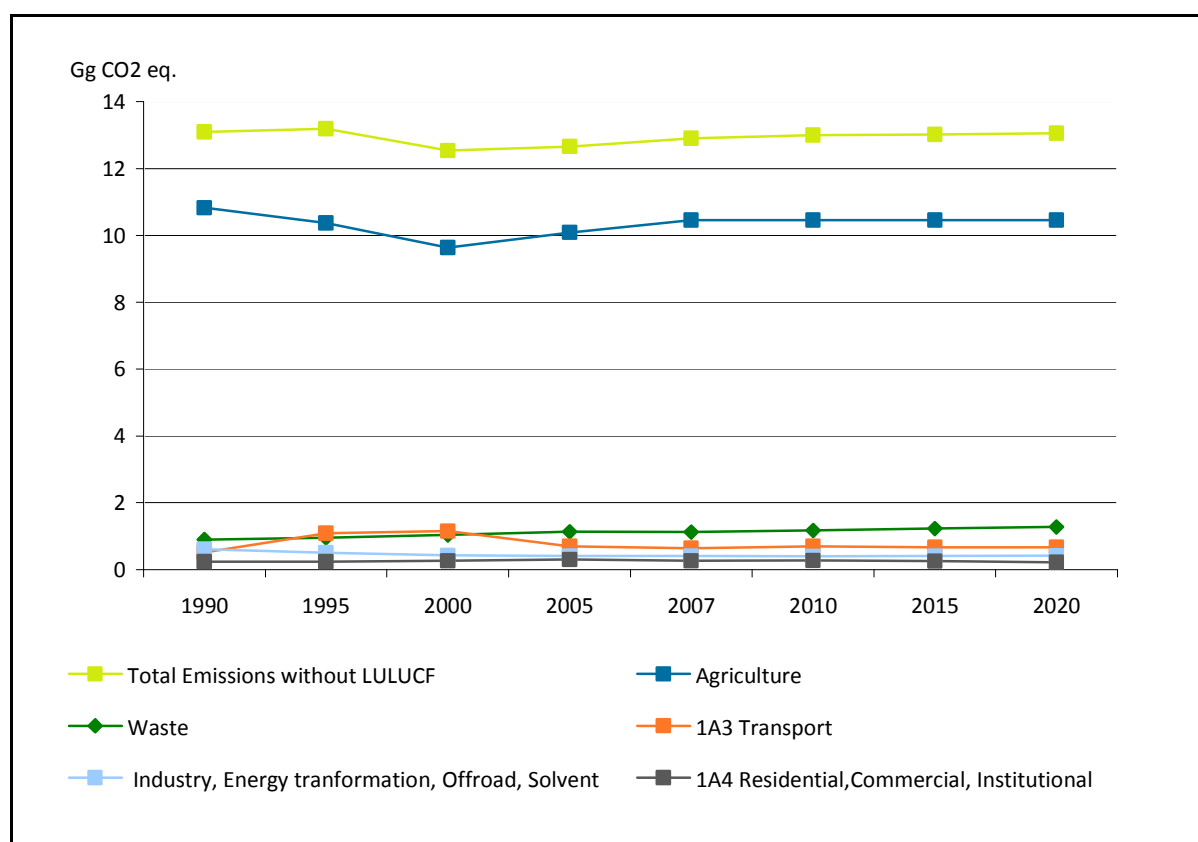
Small amounts of N₂O are emitted by many other sources such as wastewater handling, industrial processes, fuel combustion and medical treatment. Emissions of these sources will follow the general trend of the underlying activity data, which are proportional to Liechtenstein’s population.

Overview

Figure 5-3 and Tab 5-4 show that total emissions of N₂O have slightly decreased by 1% between 1990 and 2007 and are expected to increase again slightly by 1% from 2007 to 2020. Similar to CH₄ agriculture is the dominant source, thus projections are highly dependent on the developments in the agricultural sector.

Tab 5-4 N₂O emissions (excl. LULUCF) by sector from 1990 to 2020 “with measures implemented”

N ₂ O Gg CO ₂ eq		Inventories					Projections		
IPCC	Source/Sink Categories	1990	1995	2000	2005	2007	2010	2015	2020
Total	Emissions without LULUCF	13.09	13.19	12.54	12.66	12.91	13.00	13.01	13.05
1	All Energy	0.90	1.46	1.58	1.17	1.07	1.12	1.06	1.04
1A	Fuel Combustion	0.90	1.46	1.58	1.17	1.07	1.12	1.06	1.04
	1 Energy/Transformation	0.05	0.06	0.08	0.07	0.08	0.08	0.08	0.08
	2 Industry	0.06	0.05	0.05	0.05	0.03	0.02	0.02	0.02
	3 Transport	0.52	1.09	1.15	0.70	0.64	0.70	0.67	0.67
	4 Other Sectors	0.24	0.23	0.26	0.30	0.27	0.28	0.25	0.22
	5 Other (Off road)	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04
1D	Fugitive Emissions	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	solid fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	2 Oil/Natural Gas	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2	Industrial Processes	NO	NO	NO	NO	NO	NO	NO	NO
3	Solvent Use	0.47	0.38	0.27	0.24	0.25	0.25	0.26	0.27
4	Agriculture	10.83	10.37	9.63	10.09	10.46	10.46	10.46	10.46
5	LULUCF	NO	0.03	0.02	0.03	NO	NO	NO	NO
6	Waste	0.90	0.95	1.04	1.13	1.13	1.17	1.23	1.28
1A3 ai	International Bunkers	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01


 Figure 5-3 N₂O emissions (excl. LULUCF) by sector from 1990 to 2020 “with measures implemented”, main sectors

5.1.5 Other GHG's (HFC's, PFCs, SF₆)

Figure 5-4 and Tab 5-5 present inventory data and projections for emissions of synthetic gases between 1990 and 2020.

The projections are based on a bottom-up model used in Switzerland (Carbotech 2009) as Liechtenstein does not have an own import statistics or industry data which would allow developing specific data models to estimate the emissions. Therefore emissions and projections for Liechtenstein are estimated by applying the rule of proportion on basis of the emissions reported by Switzerland and specific indicators such as number of households, number of employees, number of cars, etc. It is assumed that consumption patterns for industry, service sector and household sector of Liechtenstein are similar to Switzerland which results in plausible figures for Liechtenstein.

In the most important sectors (refrigeration and air conditioning) technological developments (e.g. use of CO₂ instead of HFC 134 as a refrigerant) may reduce HFC emissions. For SF₆, as no major changes are expected, emissions are assumed to remain stable beyond 2010. In Liechtenstein no PFC emissions are reported.

Based on these assumptions, emissions remain almost constant until 2015 and show a decrease of 26% between 2015 and 2020.

Tab 5-5 Emissions of synthetic gases from 1990 to 2020 (in CO₂ eq.)

	Inventories					Projections		
	1990	1995	2000	2005	2007	2010	2015	2020
HFC, SF ₆ in Gg CO ₂ eq.								
HFC	0.000	0.384	2.336	4.161	4.471	4.604	4.623	3.393
SF ₆	NO	NO	0.019	0.057	0.120	0.115	0.112	0.108
Total	0.000	0.384	2.355	4.218	4.591	4.719	4.734	3.501

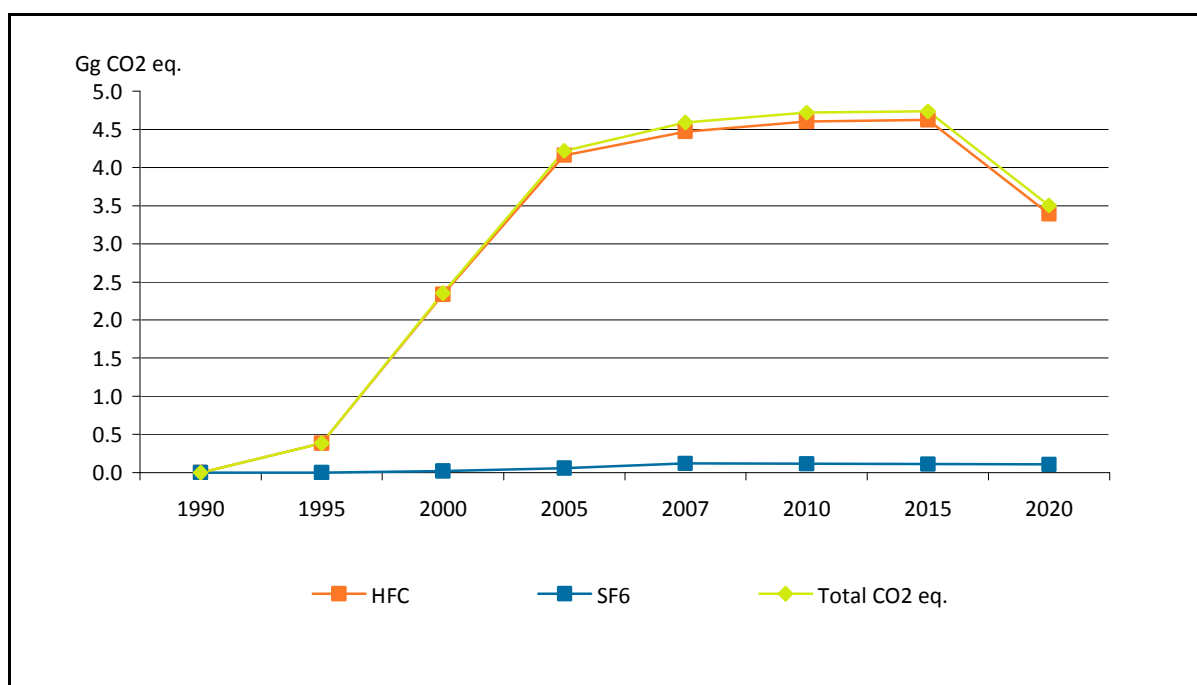


Figure 5-4 Emissions of synthetic Gases from 1990 to 2020 in CO₂ equivalent

5.1.6 Precursors and SO₂

There are no projections for precursor gases and SO₂ for Liechtenstein available.

5.2 Aggregated projection

Table 5-6 and Figure 5-5 show the aggregated greenhouse gas emissions 1990-2020 in CO₂ equivalent with measures implemented.

The sum of GHG emissions (excl. LULUCF) increased by almost 6% from 1990 to 2007. From 2006 to 2007 a pronounced jump downwards is observed. Chapter 0 discusses the reasons for this significant decrease. Projections for 2020 show a decrease of 10% respectively 22.2 Gg CO₂ equivalents compared to 1990 and a total decrease of 15% compared to 2007 with measures implemented. For the period 1990-2020 CO₂, CH₄ and N₂O change by -13%, +10% and 0% respectively. Synthetic gases are expected to decrease by 20% between 2007 and 2020.

Table 5-6 Total GHG emissions (in Gg CO₂ eq.) by sector 1990-2020 “with measures implemented”

CO ₂ in Gg CO ₂ equivalent		Inventories					Projections		
IPCC	Source/Sink Categories	1990	1995	2000	2005	2007	2010	2015	2020
Total	Emissions without LULUCF	229.55	235.56	254.69	270.81	243.48	232.05	218.63	207.64
1	All Energy	203.48	210.70	229.49	241.95	213.35	201.68	188.09	178.19
1A	Fuel Combustion	203.16	210.17	228.76	240.92	212.28	200.60	187.01	177.11
	1 Energy/Transformation	0.18	2.04	2.72	3.07	2.55	2.55	2.55	2.55
	2 Industry	35.33	34.35	34.34	36.20	30.90	15.83	14.89	14.16
	3 Transport	76.39	81.71	95.91	85.46	86.62	87.13	83.51	83.95
	4 Other Sectors	88.87	89.86	92.79	112.65	88.83	91.72	82.69	73.08
	5 Other (Off road)	2.39	2.22	3.00	3.54	3.38	3.38	3.38	3.38
1B	Fugitive Emissions	0.32	0.53	0.73	1.03	1.07	1.08	1.08	1.08
	solid fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA, NO	NA, NO	NA, NO
	2 Oil/Natural Gas	0.32	0.53	0.73	1.03	1.07	1.08	1.08	1.08
2	Industrial Processes	0.00	0.38	2.36	4.22	4.59	4.72	4.73	3.50
3	Solvent Use	2.00	1.61	1.28	1.11	1.11	1.16	1.21	1.26
4	Agriculture	22.52	21.32	19.83	21.58	22.58	22.58	22.58	22.58
5	LULUCF	-8.32	-8.46	-4.90	-6.50	-6.57	-6.57	-6.57	-6.57
6	Waste	1.55	1.52	1.72	1.93	1.85	1.92	2.02	2.10
1A3 ai	International Bunkers	0.43	0.43	0.49	0.48	0.77	0.77	0.77	0.77

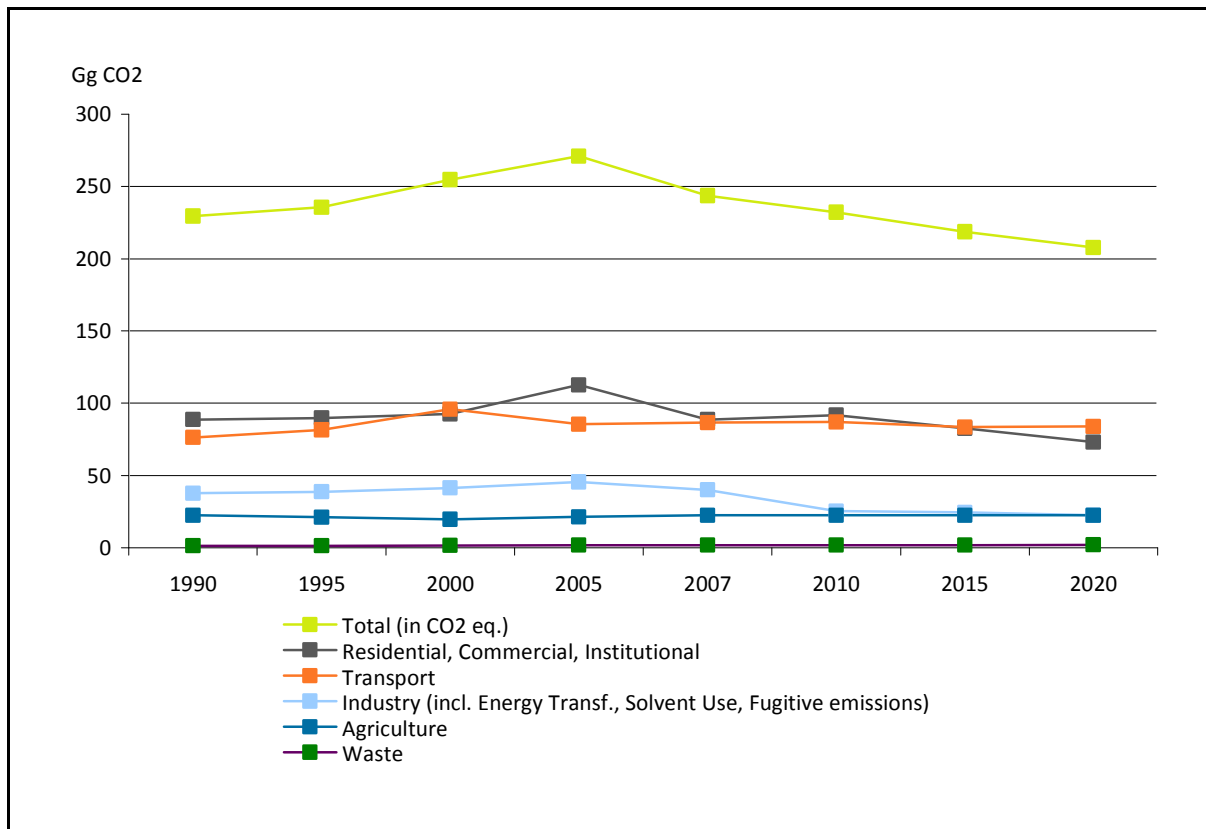


Figure 5-5 Total CO₂ (in CO₂ eq., excl. LULUCF) by sector 1990-2020 “with measures implemented”

Scenario “with measures implemented” and “without measures”

The following graph shows the comparison of the two scenarios “with measures implemented” and “without measures” implemented. Only for measures that have been quantified by the Bureau of Energy Consumption and Conservation a differentiation between two scenarios “with measures implemented” and “without measures” can be done. Where analogies with Switzerland have been used for projections (e.g. 1A3 Transport) the effect of measures is already in the standard projection for Liechtenstein (if measures are the same in Switzerland). In these cases, there is only one scenario “with measures” implemented.

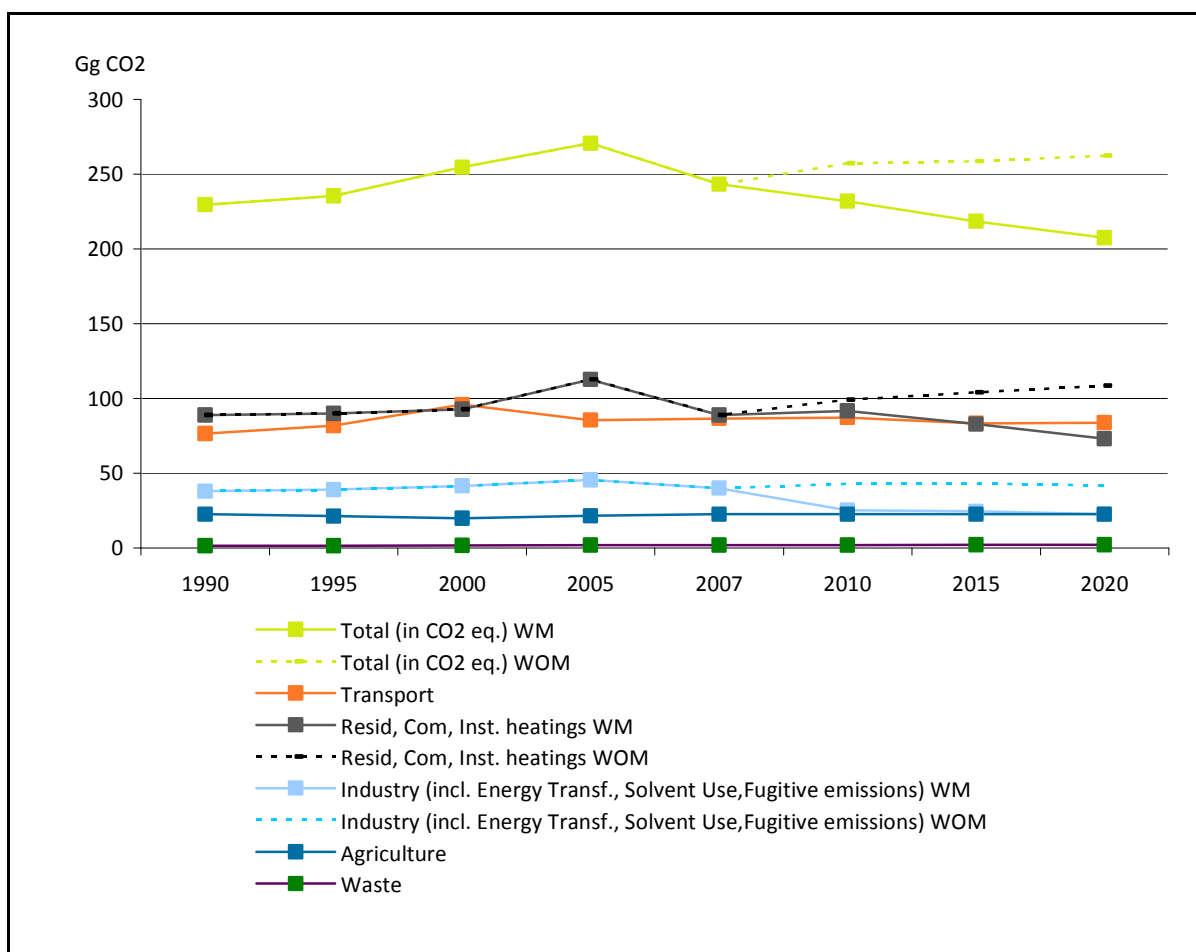


Figure 5-6 Comparison of development of total CO₂ eq. (excl. LULUCF) development by sector 1990-2020 under the scenario WM (with measures implemented) and WOM (without measures implemented).

5.3 Supplementary relating to mechanisms under Article 6, 12 and 17, of the Kyoto Protocol

The Government will use the flexible mechanism in order to fulfill a part of the country's obligation to lower GHG emissions 8 % under the emissions from 1990. To ensure that the use of the flexible mechanisms is supplemental to domestic action, the Parliament has incorporated a respective regulation within the Emissions Trading Act from 2007.

Article 4 Section 2 states:

"Where the obligation to reduce GHG emissions cannot be fulfilled by domestic action alone, the Government may take advantage of the flexible Mechanisms of the Kyoto Protocol."

The Article ensures that the main focus of reduction measures shall be kept on domestic action. Only if calculations show that the reduction potential of all possible domestic actions is not sufficient with respect to the reduction obligation the purchase of project-based reduction credits will be allowed.

Domestic action constitutes a significant element of the efforts made to meet the quantified limitation and reduction commitments of Liechtenstein. These commitments have an important impact within several policy fields, such as energy, finance, transport, environment and forestry. For example, subsidies and taxes are or will soon be linked to CO₂ figures, promotion of renewable energy or sustainable forestry management are further examples of existing domestic actions.

In this context and with respect to the administrative complexity and the financial means that are involved within domestic actions the use of the flexible mechanism do only state a supplemental aspect of Liechtenstein's climate policy.

The assigned amount of Liechtenstein is published in the Initial Report (OEP 2006a) and the Corrigendum to the Initial Report of 19 Sep 2007 (OEP 2007b). Under the Kyoto Protocol Liechtenstein's target for CO₂ eq. GHG emissions in the first commitment period (2008-2012) is 211.99-Gg CO₂ equivalent per year which is a reduction of 8% below 1990 levels (229.48 Gg CO₂ eq.). Liechtenstein decided not to account for Art. 3.4. of the Kyoto Protocol. In 2007 the Government decided to make use of the flexible mechanisms and will purchase about 230 Gg. CO₂ eq within the period of 2008 – 2012. The respective investments shall help to realize climate protection projects that show ecological benefits and social-ethical acceptability for the population of the host country. In order to ensure these quality standards Liechtenstein's National Climate Protection Strategy aims at the acquisition of such emission reductions that are certified by additional quality labels (e.g. Gold Standard, Social Carbon, etc.). The Strategy further excludes the purchase of Assigned Amount Units for the propose of Liechtenstein's Kyoto Compliance – unless a "Green Investment Scheme" has been defined by the respective host country. Emission reductions from HFC-23 and carbon capture storage projects will not be purchased.

The projections presented in this chapter show a 1% increase by 2010 compared to 1990 which means the Kyoto target will not be reached by domestic action only. However, projections always involve uncertainties, so policy options are required to make allowances for alternative future developments.

Table 5-7 Kyoto target 2008-2012

Gross and net GHG emissions during the commitment period 2008 - 2012	
Kyoto Protocol emissions (Gg CO ₂ eq.)	
Kyoto target (assigned amount units per year, average 2008–2012)	211.99
Total projected gross GHG emissions WM (projection for 2010)	232.05
Use of Kyoto mechanisms (CDM) (annually)	46
Net GHG emissions	186.05

5.4 Methodology for GHG emission projections

5.4.1 Emissions from energy-related sectors

1A1 Energy/ Transformation

Sector 1A1 solely consists of the consumption of natural gas in co-generation which has increased twenty fold until 2007 but is not expected to increase further as Liechtenstein has no plans for further expansion of the natural gas network. Therefore emissions from 1A1 Energy/ Transformation are expected to remain constant until 2020.

1A2 Industry

The source category 1A2 Manufacturing Industries and Construction comprises all emissions from the combustion of fuels in stationary boilers, gas turbines and engines within manufacturing industries and construction. This includes industrial auto-production of heat and electricity. Not included are combustion installations in the commercial/institutional and the residential sector as well as in agriculture/forestry. These are included in category 1A4 Other Sectors.

In the energy statistics (AS 2009a) the use of heating fuels is not referenced to either 1A2 or 1A4. The share of 1A2 is thus a constant proportion of the total. Therefore the correction for the outlier year 2007 is also valid for 1A2 and described in detail in Chapter 0. According to an analysis in Switzerland (BFS 2009) decoupling between GDP growth and greenhouse gas emissions in the Industry sector has taken place in Switzerland between 1990 and 2005. As Liechtenstein has a very similar structural composition and

technological level in sector 1A2, energy efficiency is assumed to balance out the economic growth and to remain constant until 2020 on the adjusted level of 2008.

The final emissions in the industry sector under the scenario “with measures implemented” are derived from the baseline trend less the reductions in CO₂ emissions from various measures implemented for sector 1A2 (see also 1A4 Other sectors):

- The most important measure for the Industry sector is the substitution of gas by the acquisition of steam from a Swiss combustions plant (waste incineration) starting in 2009. This measure was induced by the Emissions trading act (see Chapter 4.3.3).
- All other measures are also influencing emissions from heating fuels according to the Bureau of Energy Consumption (OEA 2009) and Conservation Liechtenstein. Consequently a constant proportion of 5% of CO₂ emission reductions induced by these measures are accounted for (subtracted) in the industry sector.
- As CH₄ and N₂O emissions also stem from the combustion of the same heating fuels, they are subject to the same trends and are projected proportionally to the CO₂ emissions.

1A3 Transport

In Liechtenstein, 1A3 Transport mainly consists of sub-category 1A3b Road Transportation with a minor contribution (0.15% of CO₂ emissions in 2007) of 1A3a Civil Aviation.

Because there are no projections available for Liechtenstein’s transport sector, the projections of the Swiss model have been fully adapted (FOEN 2009, Ecoplan 2009a, 2009b). Projections until 2020 of Liechtenstein’s greenhouse gas emissions from transport are proportional to the ones of Switzerland.

This approach is justifiable because of the similarities between Switzerland and Liechtenstein. Liechtenstein forms a customs union with Switzerland and has therefore similar fuel prices. Vehicle fleet, level of motorisation, infrastructure and the economic structure are very similar. Concerning measures implemented both countries have a “heavy traffic fee”, are embedded to the European traffic policies and are trying to promote energy efficient vehicles (see 4.3.5).

The Swiss traffic model is part of the projection within the Energy sector. It consists of a short term model until 2012 and a long term model projection until 2020. The transport sector is segmented into on-road traffic, off-road traffic and off-road non-traffic. Tonne-kilometres, passenger-kilometres, vehicle-kilometres, specific energy use and substitution effects (e.g. mode of driving, modal shifts between private and public transport) were determined on the basis of model estimations. The model is focusing on on-road traffic as it is by far the greatest consumer of energy. Off-road emissions are assumed to remain constant.

In the Swiss short-term model (Ecoplan 2009b) population and GDP development are not explanatory variables for transport fuel development whereas fuel price, relative fuel price compared to Germany (tank tourism indicator), merchandise exports are. Thus eventual significant differences between Liechtenstein and Switzerland in projections of population growth and GDP development can be neglected (projected increase in population is roughly twice as high as in Switzerland, GDP development is projected relatively similar until 2012, from there on no projections for Liechtenstein exist).

1A4 Other Sectors

The source category 1A4 “Other sectors” comprises emissions from fuels combusted in commercial and institutional buildings as well as in the residential sector. Emissions from fuel combustion of agricultural machineries are of minor importance (1.6.% of CO₂ emissions of 1A4 in 2007) and therefore not projected separately.

Basis for the projection of greenhouse gas emissions from heating fuels (gas and oil) are the energy statistics of Liechtenstein (AS 2009a). As there is no allocation of heating fuels to 1A2 or 1A4 in the statistics, the share of 1A4 remains constant with respect to the total.

From 2006 to 2007 a pronounced jump downwards of 16% of heating fuel consumption is observed. Consequently also greenhouse gas emissions of 1A2 and 1A4 in 2007 are significantly reduced (about -25% in 1A4). There are two hypotheses that may explain the decrease in heating fuel consumption of 2007. First of all, a very high price for gas oil in the corresponding period provided an incentive for consumers to reduce fuel consumption and also prevented population from refilling their oil tanks. Secondly, warm winter months at the beginning and at the end of 2007 which is documented by a reduction of 5% to 10% in the heating degree days of Liechtenstein in 2007. A similar - albeit less significant - phenomenon is observed in Switzerland where prices for gas oil are similar to Liechtenstein. Hold off on filling up the residential fuel tanks would mean that to some extent instead of buying new fuel stocks in private residential fuel tanks were depleted (NIR LIE 2009). Data from the latest energy statistics (AS 2009a) confirm this hypothesis with an increase in heating fuel consumption of 9% in 2008.

As a consequence, projections have to take this fact into account and correct for the special outlier year 2007. Projections for 1A2 and 1A4 are thus, instead of 2007 GHG data, based on 2008 energy consumption data which is not yet published under the UNFCCC but is already available. Consumption of heating fuels increased again by 9% compared to 2007. Accordingly CO₂ emissions are projected to increase by 9% in 2008. Furthermore, emissions of 1A4 are also assumed to develop proportionally to the population (projection, scenario trend, of Liechtenstein (AS 2009b)).

The final emissions in this sector under the scenario "with measures implemented" is this baseline projection less the reductions in CO₂ emissions from various measures implemented for sector 1A4 "Others" (see also Chpt. 5.2.):

Measures induced and subsidized through the Energy Efficiency Act (EEG) (see also Chapter 5.1.1)

- Renovation of old buildings: 95% of the savings in CO₂ emissions are accounted for in 1A4.
- Thermal solar collectors: 95% of the savings in CO₂ emissions are accounted for in 1A4.
- Substitution of conventional heatings with heat pumps and wood heatings: 95% of the savings in CO₂ emissions are accounted for in 1A4.
- Savings through more efficient new private heatings: 100% accounted for in 1A4. This measure is not an EEG measure.

The quantification of the impact of the implemented measures has been carried out by the Bureau of Energy Consumption and Conservation Liechtenstein. Calculated reductions in CO₂ emissions are based on an implied emission factor of the substituted heating fuel mix 2008 multiplied with the estimation of implemented reductions per year (OEA 2009).

As CH₄ and N₂O emissions also stem from the combustion of the same heating fuels, they are subject to the same trends and are projected proportionally to the CO₂ emissions.

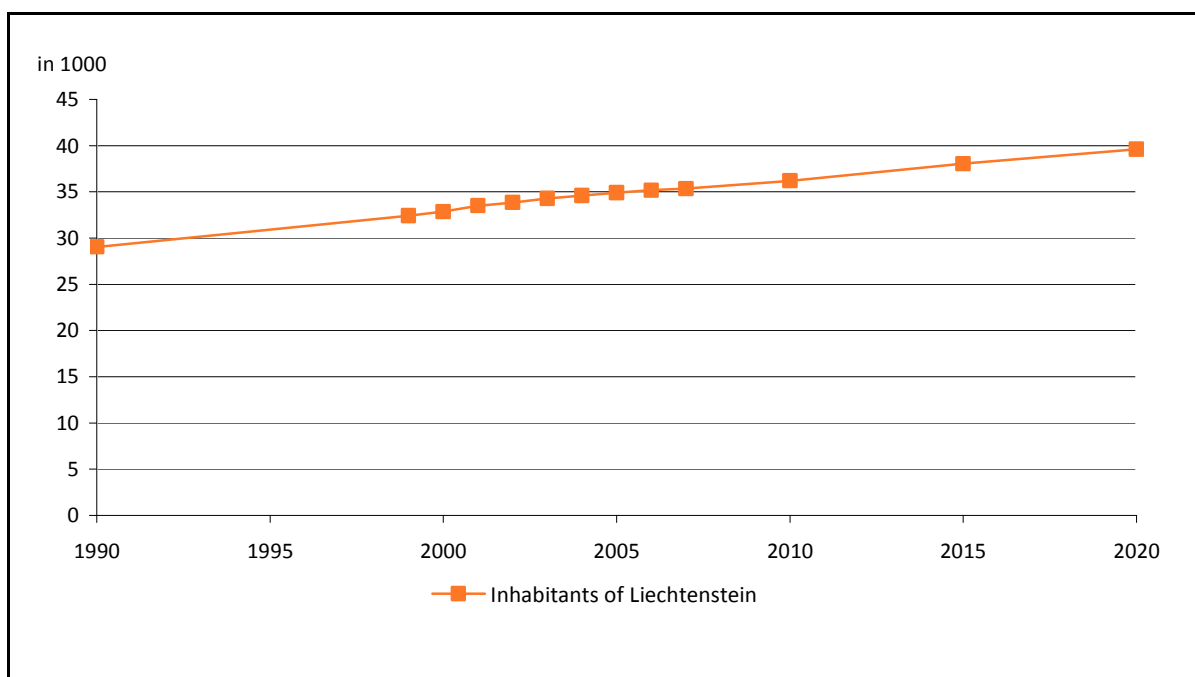


Figure 5-7 Observed and expected population development in Liechtenstein 1990 – 2020.

1A5 Other (Offroad)

The emissions reported under this category stem from construction vehicles and machinery as well as industrial vehicles and machinery. The general construction activities have increased in Liechtenstein with a subsequent, fluctuating increase of diesel consumption and emissions.

Projections for this sector assume emissions to remain constant as a slight further increase in activities is likely to be compensated by efficiency gains and a modernization of the vehicle fleet.

5.4.2 Emissions from non-energy sectors

Solvent and other Product Use

Emissions from solvents are based on per capita emission factors. Therefore CO₂ emissions are expected to develop analogous to the population development of Liechtenstein (AS 2009b).

Agriculture

Emissions of the agricultural sector are assumed to remain constant.

Comparison with the Swiss economic optimization model for projections of agricultural GHG emissions (Peter et. al 2009) shows that reductions options are relatively small, and a current free trade conditions with the EU Scenario assumed, lead to only around 3% reduction of greenhouse gas emissions in Switzerland compared to 2006. The recursively dynamic linear optimization model represents agricultural production structures based on economically rational behavior.

As the development of the key parameter for total agricultural greenhouse gas emissions - cattle stock - is quite unpredictable, Liechtenstein disclaimed to carry out specific projections. Therefore, Liechtenstein decided to conservatively assume constant emissions in the agriculture sector until 2020 on the level of 2007.

LULUCF

The land areas from 1990 to 2007 are represented by geographically explicit land-use data with a resolution of one hectare, following a Tier 3 approach. Land-use statistics for Liechtenstein are available for the years 1984, 1996 and 2002. They are based on the same methodology as the Swiss land-use statistics. The land-use status for the years between two data collections are calculated by linear interpolation. Dates of aerial

References

- AS (Office for Statistics Liechtenstein) 2009a: Energiestatistik 2008
- AS (Office for Statistics Liechtenstein) 2009b: Bevölkerungsszenarien
- BFS (Bundesamt für Statistik) Effizienzgewinne in der Wirtschaft, BFS Aktuell 2009, Neuchâtel
- CARBOTECH 2009: Swiss Greenhouse Gas Inventory 2007: PFCs, HFCs and SF₆ Emissions. Confidential report no. 251.10 for internal use on behalf of the Federal Office for the Environment, Bern. Basel
- Ecoplan 2009a: Volkswirtschaftliche Auswirkungen der Schweizer Post-Kyoto-Politik. Analyse mit einem dynamischen Gleichgewichtsmodell für die Schweiz, Bern.
<http://www.bafu.admin.ch/klima/00509/00511/index.html?lang=de&download=NHZlpZig7t,lnp6l0NTU042l2Z6ln1acy4Zn4Z2qZpnO2YUq2Z76gpJCFfX58hGym162dpYbUzd,Gpd6emK2Oz9aGodetmqaN19XI2ldvoaCVZ,s-.pdf>
- Ecoplan 2009b: CO₂-Emissionen 2008 – 2012. Kurzfristperspektiven der energiebedingten CO₂-Emissionen der Schweiz, Update 2009
- EEG 2008: Gesetz vom 24. April 2008 über die Förderung der Energieeffizienz und der erneuerbaren Energien (energy efficiency law)
- FOEN (Federal Office for the Environment) 2005: Federal options for implementation of the CO₂ Act, Berne. This report and others on energy perspectives can be downloaded from the Internet at: www.energieperspektiven.ch
- FOEN (Federal Office for the Environment), 2009: Switzerland's Fifth National Communication under the UNFCCC and simultaneously serving as Switzerland's First National Communication under the Kyoto Protocol to the UNFCCC, Berne.
- OEA (Office of Economic Affairs), Bureau of Energy Consumption and Conservation, 2009: Estimated CO₂ Reductions in Liechtenstein 2008 - 2020
- OEP 2006a: Liechtenstein's Initial Report under Article 7, paragraph 4 of the Kyoto Protocol. Office of Environmental Protection (OEP), Vaduz, 22 December 2006.
- OEP 2007b: Liechtenstein's Initial Report under Article 7, paragraph 4 of the Kyoto Protocol. Corrigendum, 19 September 2007. Office of Environmental Protection (OEP), Vaduz.
- Peter, S., Hartmann, M., Weber, M., Lehmann, B. und Hediger, W. 2009: „THG 2020“ – Möglichkeiten und Grenzen zur Vermeidung landwirtschaftlicher Treibhausgase in der Schweiz. Schriftenreihe 2009/1 der Gruppe Agrar-, Lebensmittel und Umweltökonomie, ETH Zürich, Zürich.
- Peter, S. 2008: Modellierung agrarökologischer Fragestellungen unter Berücksichtigung des landwirtschaftlichen Strukturwandels. Dissertation. ETH Zürich, Zürich.
- SFOE (Swiss Federal Office for Energy), 2007, Energy perspectives Link
- UNFCCC (United Nations Framework Convention on Climate Change) 1999: UNFCCC Reporting Guidelines of National Communications by Parties included in Annex I to the Convention, FCCC/CP/1999/7

6. Vulnerability assessment, climate change impacts and adaptation measures

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.

The expected impacts of climate change have primarily been studied in Switzerland and draw to a large extent on the findings of a report prepared by the Swiss Advisory Body on Climate Change (OCCC 2007) which documents the present state of knowledge.

Regarding observed trends in climate variability, climate extremes and climate change, the Federal Office of Meteorology and Climatology of Switzerland (MeteoSwiss) operates a high resolution atmospheric observation network and provides homogenized temperature and precipitation data meeting international monitoring and quality standards. This network also includes a measurement centre in Vaduz. The collected network data form the basis for assessing extent and impacts of changes in climatic parameters to date.

6.1 Observed and expected impacts of climate change

6.1.1 Temperature:

Observed changes

Liechtenstein's climate is directly connected to the topography of the Upper Rhine Valley and characterized by warm down slope winds. The mean annual temperature currently lies at 10.4°C (1996 – 2006).

These climate relevant values have experienced significant changes in the past 30 years. The mean annual temperature has increased from 1980 to 2007 by 1.3 °C . This development is consistent with general observations experienced during the past 100 years on the northern side of the alps.

Expected changes

Mean temperature projections for the years 2030, 2050 and 2070 have been calculated for the northern side of the Alps (Frei 2004). The results for winter and summer are graphically shown below: together with observed temperature anomalies from 1864 to 2008. Winter data refer to the months December to February, summer data refer to the months June to August. Positive anomalies (warmer than average) are shown in red, negative ones (cooler) in blue. The red line presents the projected trend in mean temperature, the grey areas indicate the uncertainty in the projection (5-95% confidence intervals). The black line denotes the linear trend from 1901-1990.

According to mean estimates (median value) temperatures will increase in Liechtenstein and northern Switzerland by 1.8 °C in winter and 2.7 °C in summer. For the transitional seasons, warming is expected to be similar to the trend projection for winter (spring: +1.8 °C; autumn: +2.1 °C.)

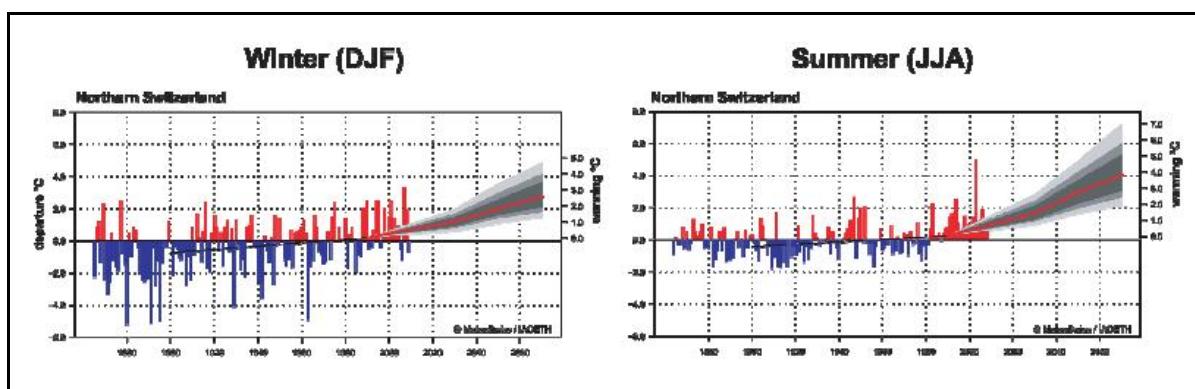


Figure 6-1 Observed temperature anomalies and projected changes in mean temperature (Data: MeteoSwiss/IACETH)

6.1.2 Impacts of warming on the cryosphere

Freezing level

In wintertime, the seasonal freezing level (altitude, where surface air temperature is 0°C) has risen by about 200 m per degree of warming from approximately 600 m in the 1960s to approximately 900 m in the 1990s (Scherrer and Appenzeller 2006). If warming in winter continues as expected, the freezing level will further rise by about 180 m until 2050 in case of moderate warming (+0.9 °C), by about 360 m in case of medium warming (+1.8 °C), and by about 680 m in case of strong warming (+3.4 °C) (Occc 2007). The freezing level roughly corresponds to the height of the snow line (the lower limit of the snow cap).

Permafrost

The warming of permanently frozen ground (permafrost) in the high mountains is a slow process with long-term implications. The warming described in the Occc climate scenario will cause thawing of ice-rich rock faces in shady slopes at 2000 to 3000 m a.s.l., causing complete unfreezing in some places. Warming of the outer 50 meters of frozen rock faces, which has already been caused by the temperature rise in the 20th century, will penetrate into greater depths, thereby increasing thermal imbalance. In the surroundings of summits and ridges such effects will be particularly pronounced as the heat may penetrate from different sides. Continued warming of ground surface and propagation of existing thermal anomalies to greater depths increases the probability of large-scale mass movements from slopes at high altitudes.

6.1.3 Precipitation

Observed changes

In Switzerland, systematic recording of precipitation began in the middle of the 19th century. Compared to long-term changes of mean temperatures, trends in mean precipitation are less distinct. For a number of stations a significant increase in precipitation is found in winter and spring (+2.7 to +3.1% per decade, see Occc 2008). In Liechtenstein the mean precipitation amount shows 900mm (valley areas) and 1900mm (alpine areas) respectively. From the beginning of systematic recording the annual precipitation amounts have increased by 4%. Intensive rainfall periods lasting 1 – 5 days during autumn and winter periods were also higher than 25 years ago.

Expected changes

Projections of mean precipitation for the years 2030, 2050 and 2070 have been calculated for the northern side of the Alps (Frei 2004). The results for winter and summer are graphically shown in Figure 6-2 together with the observed precipitation anomalies from 1864 to 2008. Winter data refer to December to February, summer data refer to June to August. Positive anomalies (wetter than average) are shown in green, negative ones (drier) in orange. The red line presents the projected trend in mean precipitation, the grey areas indicate the uncertainty in the projection (5-95% confidence intervals). The black line shows the linear trend from 1901-1990.

Until the middle of the 21st century, an increase of 8% is expected on the northern side of the Alps in winter, and a decrease of 17% in summer with respect to 1990 values. In spring and in autumn trends for precipitation are small. The magnitude of uncertainty is largest for trends in summer.

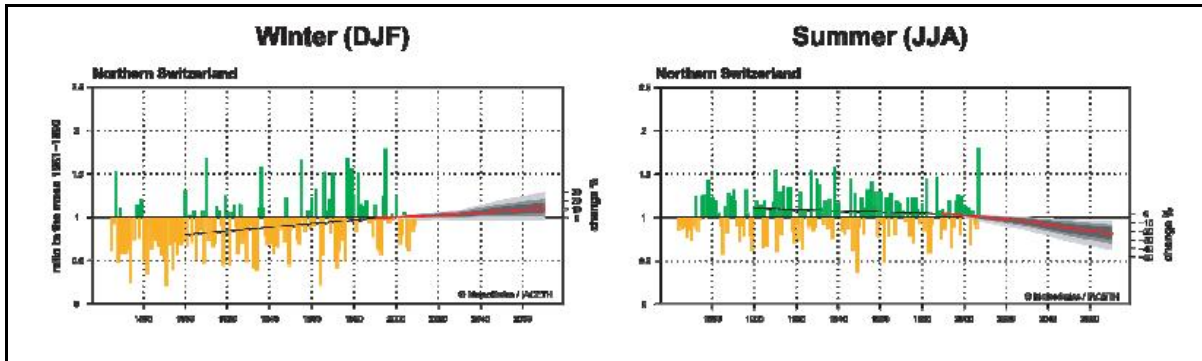


Figure 6-2 Observed precipitation anomalies and projected changes in mean precipitation (Data: MeteoSwiss/IACETH)

6.1.4 Impacts on the hydrological cycle and water resources

The changes in the hydrological cycle and water resources can be summarized as follows: Due to rising temperatures, less precipitation is expected to fall as snow at lower to medium altitudes. As a consequence, the extent of the snow cover will decrease, the snow line will rise resulting in a shift in discharge regime at a given altitude towards regimes traditionally encountered at lower levels. This implies smaller differences between maximum and minimum values of mean monthly run-off and earlier peaks in mean monthly run-off by about one month.

Evaporation will generally increase as a result of warming. In combination with a decrease in total annual rainfall, the annual run-off will decrease as a consequence. This will happen in spite of the temporary contribution of additional melt water by retreating glaciers.

6.1.5 Impacts on extreme events and natural hazards

Scenarios of the trends of frequency and intensity of extreme events are still very uncertain. Due to their limited number, statistical trends of extreme events are difficult to establish (Frei and Schär 2001). So far, they have been detected for a few categories of extreme events only. The following compilation documents trends where these are statistically significant based on past observations or where confidence in the understanding of the climate system is sufficiently good to make meaningful predictions of future trends.

Temperature extremes

Temperature extremes show the most distinct trend. With a rise in mean summer temperatures, higher temperatures will also occur during hot spells (Fig. 91) (Schär et al. 2004). Climate models show a more significant increase in absolute maximum temperatures than in mean daily maxima. According to the OccC climate scenario, conditions as during the summer 2003 heat wave will still be rare events in case of moderate warming but will occur every few decades in case of medium warming and every few years in case of strong warming. Extremely hot summers will occur more frequently if, additionally, year-to-year variability of summer temperatures increases, as various climate simulations suggest.

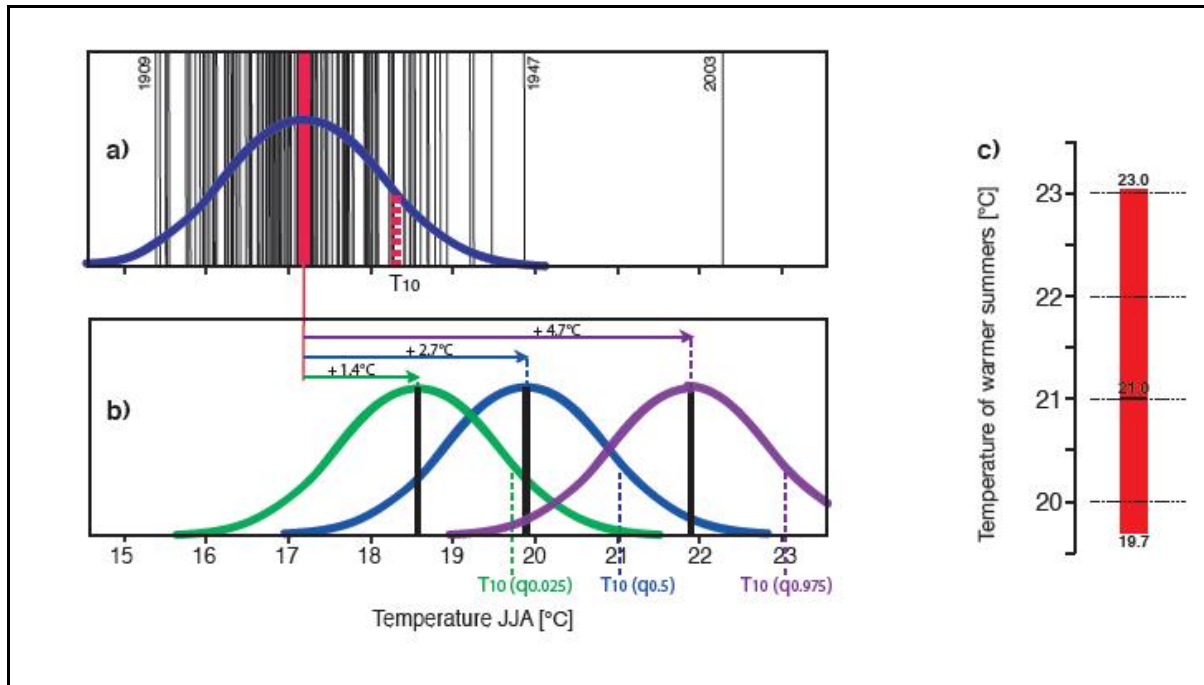


Figure 6-3 Distribution of mean summer temperatures.

Explanations for Figure 6-3:

a) Probability distribution of summer temperatures 1864-2003 (each summer is represented by a vertical bar). b) Expected shift in the distribution of summer temperatures in 2050 for the three OcCC scenarios (corresponding to increases in mean summer temperature of 1.4 °C (green), 2.7 °C (blue), and 4.7 °C (purple), respectively, relative to average temperatures observed to date). c) Temperature range of the three scenarios for a hot summer occurring once every 10 years (represented as T10 in graphs a and b, dashed lines). For comparison: the mean summer temperature in Switzerland within period 1864-2003 was about 17.2 °C (thick red line in panel a). (OcCC (2007), adapted from Schär et al. (2004))

By contrast, the frequency of cold spells and the number of frost days have already declined and will continue to decline. In winter, the daily temperature variability is likely to become smaller because minimum temperatures are projected to rise more strongly than mean temperatures. This effect is expected to be particularly pronounced in areas where the snow cover diminishes as a result of warming. The change in risk of late frosts (i.e., frosts that occur after the beginning of the vegetation period) is uncertain since the vegetation period will start earlier in the year too, along with changing temperatures.

Precipitation extremes

Analyses of global and regional climate models show that the mean precipitation intensity and the frequency of heavy and extreme precipitation events may increase in central and northern Europe in winter. At altitudes above 2000 m, more frequent heavy precipitation events in winter would lead to higher amounts of snowfall in short periods of time. This may increase the danger of avalanches. An increase in heavy precipitation in central Europe may also occur in spring and autumn. For summer, the situation is less clear. Although the models show a distinct decrease in average summer rainfall, the extreme value with a return period of 5 years increases slightly.

Floods, landslides and debris flows

An increase in precipitation intensity and the rise in snow line bring about the potential for more frequent floods, landslides and debris flows. However, the actual incidence of these natural hazards is determined by other processes, some of which are also affected by climate change. Factors influencing the formation and magnitude of floods, landslides and debris flows are soil moisture, soil cover, snowmelt, discharge regime, topography and size of catchment areas.

The temperature increase will cause more frequent changes between snowfall and snowmelt, leading to more frequent run-off of accumulated precipitation on the alpine border. Since evaporation is small in winter, no noteworthy compensation effects are expected. In small catchment areas of the Swiss central plateau and in the Alps, the biggest floods usually occur in summer after short but heavy thunderstorms. It is inconclusive whether a change in frequency will occur and in what direction.

A recent expert assessment (KOHS 2007) concludes that at altitudes up to 1'500 m a.s.l. the size and frequency of winter and spring floods is likely to increase. Due to rising precipitation intensities, landslides are expected to become more frequent in winter and spring.

Drought

In agreement with the decrease in average summer rainfall and the number of rainy days, extremely dry periods might last longer and occur more frequently. The combination of decreasing rainfall and higher evaporation may result in a decrease of the soil water content at the regional level. The availability of river water to compensate for lacking precipitation is reduced in summer and autumn due to reduced river run-off in areas where glaciers have disappeared.

Wind storms

The scenarios for storms are very uncertain. Some models indicate that the frequency of storms is likely to decrease in central Europe. At the same time, the intensity of storms will probably increase (Swiss Re 2006). Generally the tracks of cyclones and storms are expected to shift polewards, which would reduce the probability of Liechtenstein being hit.

6.1.6 Impacts on natural ecosystems and biodiversity

Biological diversity - the natural wealth of the Earth – encompasses ecosystems, species, and genes that build the basis for life and prosperity of mankind, providing e.g. food, medicine, fuel, fertile soil and drinking water. However, biodiversity has been under pressure for many years. In the future, current factors affecting biodiversity will be increasingly superimposed by the effects of climate change. Not only the number but also the composition of species will change in the mid- to long-term, since individual species react differently to changing climatic conditions. Many of these changes are irreversible. On one hand, hitherto existing species will disappear, on the other hand, foreign plant and animal species will immigrate from warmer regions. The former may outcompete local species which play a key role in the overall food chain. The latter may act as vectors affecting human health or introduce new pests against which local species have no defense mechanisms. New species may also interbreed, thus affecting the genetic diversity. The flora and fauna is expected to gradually shift towards the characteristics of flora and fauna in lower-lying and more southern areas. Species bound to cooler living conditions with little opportunity for migration to appropriate areas will be particularly affected by rising temperatures.

In its latest publication, Biodiversity Monitoring Switzerland reports that impacts of climate change are being observed even within short time frames (BDM 2009). The findings are based on eight years of intensive monitoring of vascular plants, butterflies, birds, mosses and snails. Formerly absent species such as Mediterranean butterflies, dragonflies and bird species are now extending their habitat into Switzerland. Typical alpine vascular plants have shifted their distribution in the uphill direction during the past few years. The number of plant species on alpine sample plots has increased. The upward moving species may compete with, and crowd out, species, which traditionally have occupied territories at higher altitudes.

According to recent research, about 100 invasive alien insect species are established in European forests (Mattson et al. 2007). Mostly, these were introduced via global trade but their subsequent establishment in forests is often the result of higher temperatures.

Vast evidence of the impact of changing climatic conditions on plants stems from phenological observations. There are numerous indications for shifts in the phenological phases of plant development like the start of blossoming, flushing of leaves, length of the vegetation period and start of leaf fall in autumn (Defila and Clot 2001).

Higher temperatures have led to an extended vegetation period, in particular in spring. For the observed change in vegetation, mild winter temperatures and less frequent late frosts are most relevant (Menzel et al. 2003). There are indications that the physiological reaction of plants to the extended vegetation period is different in the Swiss lowlands and in the Alps (Swiss lowlands: 21 days earlier onset of the spring in 2002

compared to 1951; Alps: 17 days). In comparison with plants living at lower altitudes, alpine plants, which are adapted to a rougher climate, are more sensitive to a relative increase in temperature and show stronger reactions (Defila 2006).

Another indication for more favorable growth conditions at higher elevations is the upward shift of the tree line which has been found in Switzerland (Gehrig-Fasel et al. 2007). Correspondingly, in the hot and dry year of 2003, increased growth was found at altitudes above 1'200 m a.s.l. whereas tree growth in the lowlands was reduced due to limited water availability (Dobbertin 2005).

Even though overall trends in the future development of climate are well established, it is very difficult to predict the resulting evolution of natural forest composition. Uphill and south-north migration velocity is different for individual plant species as are the reactions of plants to enhanced temperatures and reduced water availability. The effects of climate change on pests and diseases are another important factor increasing the uncertainty of any predictions on the development of the forests.

Even under the most modest climate change scenario, impacts on biodiversity are expected to increase. Changes in ecosystem structure and functioning including unexpected outcomes are likely to become apparent. An illustrative example is the regular larch budmoth peaks which recurred every eight to ten years until 1981. Since then no peak events have been recorded (Esper et al. 2007). It is yet unclear whether the absence of peak events is an indication for a new balance under changed climatic conditions or whether it signals a state which is detrimental to the development of larch forests.

6.2 Vulnerability Assessment

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 CO₂ 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 winter and droughts in 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 river Rhine; although regulated, the Rhine may endanger the heavily used Rhine Valley floor in the event of a flood.

Tourism: Within the next decades Liechtenstein's tourism sector will have to deal with great challenges caused by climate change related developments in Liechtenstein's ecosystems. Especially the winter tourism sector will be hit by higher temperature as the rise of the freezing level will lead to higher snow lines. As a consequence the skiing periods will be shorter, especially for skiing areas situated between 1500m and 2000m, like Malbun. Consequences will be fewer accommodations in the hotel sector as well as fewer guests in the sectors of winter sports and gastronomy.

Other economic sectors: Global climate warming will affect further 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 (Fuhrer 2003). The expected increase in elevation of the snow and permafrost boundaries and increasing weather instability also have an effect on the important recreation area of Malbun and Steg. 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).

6.3 Adaptation measures

The projected consequences of an ongoing climate change require the immediate implementation of the so called Two-Pillar-Strategy – Mitigation (Pillar1) and Adaptation (Pillar2)

Mitigation (Pillar1): The necessary reduction of greenhouse gases can only be achieved if concrete measures are implemented in due time. Liechtenstein has recently launched a set of measures to address the problem of growing greenhouse gas emissions:

- Energy-Concept 2013 / Energy-Vision 2020 (2010)
- Emissions Trading Act (2008)
- Energy Efficiency Act (2008)
- CO2-Act (2008)
- National Climate Protection Strategy (2007)
- Action Plan Air (2007)

Liechtenstein's climate policy goal is – in the midterm - to exceed the obligations originating from the Kyoto Protocol. The mitigation measures however will be further developed, especially with respect to sectors that have not yet been totally included into strict climate change regulation (eg. traffic and transportation).

Adaptation (Pillar2): It is already obvious that certain climate change related consequences will become irreversible. Pillar 2 deals with the question of how this negative developments could be addressed and how potential future damages can be limited or even avoided.

Natural Hazards: The avoidance of an increasing number of natural hazards as flooding, avalanches, landslides will not be possible. It is, however, necessary to calculate the potential risks by observing and marking the regions that are highly vulnerable to natural hazards – with a special focus on residential areas. Liechtenstein has established so called “Geological Risk Maps”. These maps provide regional information on the specific risks regarding avalanches, rock- and landslides and flooding. These maps are continuously updated by the Office of Forests, Nature and Land Management.

Agriculture and Forestry: Up to now the agricultural sector has benefited from longer vegetation periods. The projected increase of precipitation intensity as well as longer drought periods will, however, lead to long-term negative effects as crop failure, soil erosion or intensified insect attacks. Identified adaptation measures are an increased use of appropriate corn provenances, that have already anticipated future conditions of the changing environment. However, the use of genetically modified crops is not foreseen. The irrigation of agricultural fields will increasingly be used thereby causing conflicts with other public interests, especially during longer draught periods. Considering the given topography Liechtenstein's alpine forests play an important role with respect to natural preservation and protection of residential areas. The increase of draught periods with consequential damages caused by insects, pathogens (viruses, bacteria, fungus) fire or storms will lead to a decrease of the forests protection abilities in Liechtenstein. Adaptation measures that address the problems of these projected situations and that are already executed are the conversion of spruce and fir stocks into mixed deciduous and coniferous forests.

Tourism: Summer tourism will benefit from climate change related developments. Increased heat waves will not become a major problem for the alpine tourism but the city tourism of Vaduz. With respect to adaptation measures Liechtenstein will have to focus on the projected situation for winter tourism. With this respect further examinations have to be concluded within the next years. The production of artificial snow, as currently practiced, is not considered to be a sustainable solution. Nevertheless, 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".

References

- BDM 2009: The state of biodiversity in Switzerland. Overview of the findings of Biodiversity Monitoring Switzerland (BDM) as of May 2009
<http://www.bafu.admin.ch/publikationen/publikation/01035/index.html?lang=en>.
- Defila C. und Clot B. 2001: Phytophenological trends in Switzerland. *Int. J. Biometeorol.* 45: 203–207, 2001.
- Defila, C. 2006: Phänologische Beobachtungen in der Schweiz im Jahre 2005. *Schweizer. Zeitschrift für Forstwesen* 157: 171-173.
- Dobbertin, M. 2005: Tree growth as indicator of tree vitality and of tree reaction to environmental stress: a review. *European Journal of Forest Research* 124: 319-334.
- Frei C. and Schär, C. 2001: Detection probability of trends in rare events: Theory and application to heavy precipitation in the Alpine region. *J. Climate*, 14, 1568-1584.
- Frei C. 2004: Die Klimazukunft der Schweiz – Eine probabilistische Projektion. OcCC, Bern (www.occc.ch/Products/CH2050/CH2050-Scenarien.pdf).
- Fuhrer, J. 2003: Agroecosystem responses to combinations of elevated CO₂, ozone, and global climate change. *Agric. Ecosyst. Environment* 97, 1-20.
- Geological Risk Maps, 2009: <http://geodaten.llv.li/geoshop/naturgefahren/naturgefahren.html>
- Gehrig-Fasel J., Guisan, A, Zimmermann, N.E. 2007: Tree line shifts in the Swiss Alps: Climate change or land abandonment? *J Veg Sci* 18: 571–582.
- Grize, L., Huss, A., Thommen, O., Schindler, C., Braun-Fahrländer, C., 2005: Heat wave 2003 and mortality in Switzerland. *Swiss Med Wkly* 135, 200-205.
- Internationale Bodenseekonferenz, 2007: Auswirkungen des Klimawandels und mögliche Anpassungsstrategien, AWEL Zürich und Kommission Umwelt der Internationalen Bodenseekonferenz
- KHOS 2007: Auswirkungen der Klimaänderung auf den Hochwasserschutz in der Schweiz. Ein Standortpapier der Kommission Hochwasserschutz im Schweizerischen Wasserwirtschaftsverband (KOHS). Was-ser Energie Luft – 99. Jahrgang, Heft 1
- Mattson W., Vanhanen H, Veteli T, Sivonen S, Niemelä P. 2007: Few immigrant phytophagous insects on woody plants in Europe: legacy of the European crucible? *Biol Invasions* 9: 957–974.
- Menzel A., Jacobi, G., Ahas, R., Scheifinger, H., Estrella N. 2003: Variation of the climatological growing season (1951-2000) in Germany compared with other countries. *Int. J. of Climatology* 23: 793-812.
- Meteo Switzerland; Measurement Station Vaduz 1971 - 2005
- OcCC (Swiss Advisory Body on Climate Change), 2003: Extreme Events and Climate Change. OcCC, Berne.
- OcCC 2007: Climate Change and Switzerland 2050. Expected Impacts on Environment, Society and Economy. The Advisory Body on Climate Change, Bern. (<http://www.proclim.ch/products/ch2050/ch2050-report.html>)
- OcCC 2008: Das Klima ändert – was nun? Der neue UN-Klimabericht (IPCC 2007) und die wichtigsten Ergebnisse aus Sicht der Schweiz. The Advisory Body on Climate Change, Bern. (<http://proclimweb.scnat.ch/Products/OcCC-IPCC/OcCC-IPCC-lowres.pdf>)
- OS (Office of Statistics), 2009a: Statistical Yearbook 2008, Vaduz.

Scherrer, S.C. and Appenzeller, C. 2006: Swiss Alpine snow pack variability: major patterns and links to local climate and large-scale flow. *Climate Research*, 32, 187-199.

Swiss Re 2006: The effects of climate change: Storm damage in Europe on the rise. (www.swissre.com -> Research & Publications -> Risk & Expertise -> Alphabetical overview)

7. Financial resources and transfer of technology

The following chapter also serves to provide information as required by Art. 10 lit f) of the Kyoto Protocol.

7.1 Assistance to developing country Parties that are particularly vulnerable to climate change

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 operational tasks of International Humanitarian Cooperation and Development (IHCD) are carried out by the Office for Foreign Affairs, the Immigration and Passport Office, the Office of Forests, Nature and Land Management, and the Liechtenstein Development Service (LED). The overall coordination of the IHCD activities lies with the Office for Foreign Affairs.

IHCD encompasses all forms of the humanitarian and development policy of the State of Liechtenstein and of the LED (a foundation under private law). These activities are set out in the Law on International Humanitarian Cooperation and Development (IHCD Act) of 2007. Liechtenstein's engagement focuses on emergency and reconstruction assistance, international refugee and migration assistance as well as bilateral and multilateral development cooperation.

Liechtenstein works closely together with the affected population and local organizations, with aid and development organizations in Liechtenstein, Switzerland, Austria and Germany as well as with European and international organizations. In total, Liechtenstein, through its IHCD, maintains working relationships with more than 100 partners. The bulk of Liechtenstein's support is provided in the form of financial resources. In parallel, Liechtenstein engages in active knowledge transfer by providing specialists from Liechtenstein. These specialists work on projects on-site, as seconded personal at international organizations, or as ad-hoc experts and are funded by Liechtenstein.

Emergency and reconstruction assistance encompasses measures aimed at immediately saving human lives during and after political crises, armed conflicts, and natural disasters and at alleviating the suffering of the people affected. In addition, the establishment of infrastructures creates the preconditions for further social and economic development in these regions. Urgent measures include the provision of food, tents, blankets, and ovens. The repair of houses, schools, hospitals, water supply lines, and similar elementary infrastructure already serves the purpose of reconstruction. Emergency and reconstruction assistance aid also seeks to prevent acute emergency situations by way of targeted preventive measures and pays special attention to so-called forgotten conflicts and emergency situations. The IHCD Act promotes solidarity of the Liechtenstein population, allowing donations by Liechtenstein aid organizations and of private persons to be supplemented by public IHCD funds.

The central concern of **international refugee and migration assistance** is to support affected persons in improving their living conditions and promoting the self-responsible conduct of their life and the optimal utilization of their potentials. It includes measures for integration of returnees including education, health, municipal and community development, protection of minorities and reconciliation. Worldwide, international refugee and migration assistance advocates on behalf of an improvement of refugee and migration regimes. It supports countries of origin and destination in their search for permanent solutions and the development of appropriate structures to improve the long-term situation of refugees and migrants. Immigration and migration assistance also promotes compliance with international legal, human

rights, and humanitarian standards in connection with migration and combats inhuman practices such as people smuggling and trafficking.

Development cooperation aims at a sustainable and comprehensive development of disadvantaged and marginalized regions of the world. **Bilateral development cooperation** is the oldest and most significant pillar of Liechtenstein IHCD and concentrates on the development of rural regions in 12 priority countries and attaches particular importance in all its activities to the empowerment of women, social justice and the environment. Bilateral development is carried out by the Liechtenstein Development Service (LED), a foundation under private law, on the basis of a service agreement with the Liechtenstein Government. **Multilateral development cooperation** tackles problems, which – due to their complexity, political sensitivity, or global or cross-boarder relevance – necessitate a common engagement of countries, peoples and organizations.

An intact environment and the sustainable development and use of natural resources are necessary preconditions for the social and economic development of a region. Not only the shortage of certain natural resources, but also lack of access to these resources constitutes a growing problem for many poor regions. IHCD seeks to protect the environment and natural resources as a basis of life also for coming generations. 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.

7.2 Provision of financial resources, including financial resources under Article 11 of the Kyoto Protocol

In 2008, Liechtenstein IHCD had resources in the amount of about 25.5 million Swiss francs, i.e. about 700 Swiss francs per capita. The total Official Development Assistance (ODA) amount, was about 26 million Swiss francs. Since 2000, the Government has nearly doubled the resources for ODA.

An overview of Liechtenstein's financial contributions as part of its International Humanitarian Cooperation and Development in 2008 can be found in the 2008 Annual Report of the Government to Parliament (pp. 104-107 and pp. 129-130)². The following table provides an overview of contributions related to the environment in 2008.

Type of contribution	Partner	Amount (CHF)
Basel Convention: annual contribution	UNEP	289
Climate Convention: annual contribution	UNFCCC	2'622
Contribution to a project related to the producing of carbon neutral coffee in Costa Rica	LED	399'874
Contribution to a waste management project in Kutaisi (Georgia)	Regional Environmental Center for the (REC) Caucasus	12'000
Contribution to an energy efficiency project in Kyrgyzstan	Central Asia Mountain Partnership (CAMP)	55'000

² See http://www.llv.li/pdf-llv-rk_rb2008_rechenschaftsbericht_gesamt_.pdf (in German).

Contribution to the EMEP Trust Fund	UNECE	610
Contribution to the Alliance of Central Asian Mountain Communities	Secretariat of the Alpine Convention	8'000
Contribution to the Basel Convention Technical Co-operation Trust Fund	UNEP	5'300
Contribution to the campaign "Walking on a Clean Beach in Poti" (Georgia)	REC Caucasus	6'500
Contribution to the reconstruction of the Lake Paliastomi system in Poti (Georgia)	REC Caucasus	22'000
Contribution to the Sustainable Development of Mountain Regions of the Caucasus / Local Agenda 21	REC Caucasus	110'000
Convention on Biological Diversity: annual contribution	UNEP	622
Convention on Long-range Transboundary Air Pollution: annual contribution	UNECE	551
Convention on the Conservation of Migratory Species of Wild Animals (CMS): annual contribution	UNEP	457
ICP Forests: annual contribution	UNECE	34
International Council for Game and Wildlife Conservation (CIC): annual contribution	CIC	2'988
Kyoto Protocol: annual contribution	UNFCCC	1'990
Multilateral fund of the Montreal Protocol (Ozone Fund): annual contribution	UNEP	9'441
Permanent Secretariat of the Alpine Convention: annual contribution	Secretariat of the Alpine Convention	28'191
Ramsar Convention: annual contribution	IUCN	1'000
Rotterdam Convention: annual contribution	UNEP	231
Stockholm Convention: annual contribution	UNEP	645
UNCCD Supplementary Fund: annual contribution	UNCCD	5'000
UNCCD: annual contribution	UNCCD	1'209
UNEP: annual contribution / Environment Fund	UNEP	8'664
UNFCCC International Transaction Log: annual contribution	UNFCCC	9'407
World Conservation Union (IUCN): annual contribution	IUCN	14'536
TOTAL		707'161
Source: 2008 Annual Report of the Government to Parliament		

Table 7-1: Overview of the most important contributions as part of Liechtenstein's international engagement in environmental protection, 2008

multilateral contributions

	Multilateral contributions (CHF) (SDC only)			
	2005	2006	2007	2008
Multilateral institutions:				
1. European Bank for Reconstruction and Development (EBRD)	86'625	41'580	33'412	23'000
2. United Nations Development Programme (UNDP)	213'000	170'000	180'000	340'000
3. UNEP	25'350	24'770	22'934	25'649
4. UNFCCC (Kyoto Adaptation Fund)	1'350	1'653	1'934	14'019
5. UNCCD	541	5'540	5'214	6'209
6. International Union for the Conservation of Nature (IUCN)	15'072	15'241	15'363	15'536
Total	341'938	258'784	258'857	424'413

Summary of information on financial resources and technology transfer

Official development assistance (ODA in 2008)	25'984'138 CHF
Climate-related aid in bilateral ODA	
Climate-related support programmes	
Contributions to GEF (USD million)	
Pledge for third GEF replenishment	
Activities implemented jointly	
JI and CDM under the Kyoto Protocol (2008 – 2012)	7'920'000 CHF
Other (bilateral/multilateral)	

Abbreviations: CDM = clean development mechanism, GEF = Global Environment Facility, JI = joint implementation.

7.3 Activities related to transfer of technology

In connection with the protection and preservation of the environment, Liechtenstein as an Alpine country is particularly engaged on behalf of the development of mountain regions. Under the umbrella of the Alpine Convention, Alpine countries cultivate a partnership with mountain regions in the Balkans, the Carpathians, the Caucasus, and Central Asia.

Project / programme title: CO₂ neutral Coffee Production in Los Santos, Costa Rica

Goal: Use of organic waste to generate renewable energie and to reduce greenhouse gas emissions

Recipient country	Sector	Total funding	Years in operation
Costa Rica	Coffee Production	CHF 439'632	1

Description:

- Production of 180'000 litres of ethanol per harvest
- Implementation of a bio digester in order to generate 90 MW electricity per annum

Expected added value of the programme:

- Improved cost effectiveness through lowering production costs, strengthening of fuel independence
- Avoidance of methane emissions and less waste water production
- new jobs, further development of the digester technology in cooperation with neighbouring cooperatives Coopetarrazu and CoepeLlanoBonito

Technology transferred:

Improved processes of fermentation

Biogas digester technology

Impact on greenhouse gas emissions/sinks: Reduction of 4'100 t of CO₂ eq /a

Liechtenstein Development Service, LED (2008)

8. Research and systematic observation

8.1 General policy on research and systematic observation

8.1.1 Basic research

Liechtenstein maintains its own University of Applied Sciences at which institutes (Institute for Architecture and Planning and Institute for Financial Services) also examine sustainable development. One of the main focus points of the Institute for Architecture is the establishment of concepts for a sustainable regional development with respect to settlement, transport and landscape. The Institute for Financial Services examines the impacts, challenges and opportunities of the emerging environmental commodity markets, as for example carbon markets. 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 (2009) 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 (7th Framework Programme on Research, 11.7 million CHF from 2007 to 2013).

8.1.2 Technological research

Public institutions in Liechtenstein are also indirectly engaged in technology research. The Liechtenstein University of Applied Sciences contributes a budget of 8.3 million CHF (2009) to the training of experts. Liechtenstein supports the Interstate University of Applied Sciences of Technology Buchs (NTB) with an annual contribution of 854,000 CHF (2009).

8.1.3 Direct international engagement

Liechtenstein is interested in cooperations 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, the country's focus is on regional linkages. Liechtenstein is in contact with Switzerland, Austria and Germany through various international agreements.

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

8.2 Research

The Institute for Architecture and Planning (University of Applied Science) offers concrete climate, energy and environmentally relevant research possibilities with the Urban Sustainability, Climate and Planning Education (short UrbanSCAPE) program. It provides an in-depth, English language Master's level program, anchored with the goal of climate protection and energy autonomy in space planning. In 2009 the Institute

of Architecture and Space Planning started an annual symposium initiative (www.responsibleproperty.org). The initiative engages itself with the development of sustainable real estate, whereby a special focus is on climate and energy concerns. A respective seminar will be offered Summer Semester 2010 in cooperation with the Institute for Financial Services.

The Institute for Financial Services also offers research possibilities covering linkages of financial and carbon markets in collaboration with LIFE Climate Foundation Liechtenstein (Chpt. 9.3).

8.3 Systematic observation

Liechtenstein collects a wide range of data relating to climate, both through its own measuring stations and through interregional cooperation, especially with Switzerland. The data is fed into 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.

Since 2001 the Eastern Swiss cantons and Liechtenstein execute a monitoring procedure on joint emissions of air pollutants.

Since 2003, Liechtenstein (Liechtenstein Gymnasium, academic high school) 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.

Due to the growing complexity of environmental procedures and the limited human resources of the respective authorities (only 15 employees cater for around 350 legal procedures) the Office of Environmental Protection currently works on the establishment of a unified data structure system for environmental data, LUIS (Liechtenstein Umweltinformationssystem). The system aims at centralizing data collections (eg. GHG emissions, air pollution etc.) in order to provide the competent authorities with necessary information required for the various legal procedures.

References

Gantner-Stokar, R., 1997: Erhebung von Klima- und Wetterdaten in Liechtenstein.

Huber, M and Schöpfer, S. Geographic Data Warehouse to Consolidate Dispersed Environmental Information (2008)

Liechtenstein University of Applied Sciences: <http://www.hochschule.li>.

LIFE Climate Foundation Liechtenstein (2009), www.climatefoundation.li

9. Education, training and public awareness

9.1 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.

Environmental education forms part of Liechtenstein's all-encompassing educational program and is based on the official curriculum of the Principality of Liechtenstein (2005, 2nd Edition). As one out of several reasons for the faculty of "Human and Environment" (topics are, among others: Climate, Weather, Economy, Industrialization) the respective curriculum states: "Students deal with humans as part of society and environment. They recognize dependencies as well as the possibility to act for or to influence relevant procedures. Thanks to this approach environmental education influences the content of various school subjects – it is not only a part of subjects like "Biology" or "Nature" (ecology) but also of "Economy and Policy" (ecological and economical relations).

Moreover 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 (e.g. on the World Environment Day in June) take place at all schools in the country.

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.

The Institute for Architecture and Planning (University of Applied Science) offers a concrete climate, energy and environmentally relevant education with the Urban Sustainability, Climate and Planning Education (short UrbanSCAPE) programme. It provides an in-depth, English language Master's level programme, anchored with the goal of climate protection and energy autonomy in space planning.

The Institute for Financial Services has introduced a Focus on environmental commodities within its Department of Banking and Financial Management. The Institute's intention is to strengthen academic education in the field of social and responsible investments in the future.

9.2 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. The Government also provided financial support to several projects in order to raise public awareness with respect to climate change issues. Among others, projects like LIFE Climate Foundation Liechtenstein (2008) and the Implementation of a personal carbon footprint program within the framework of a social networking platform received such support. 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 was 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.

9.3 Cooperation with private institutions and NGOs

In 2008 the Government together with Liechtenstein Bankers Association, Liechtenstein Association of Professional Trustees, Liechtenstein Investment Fund Association and the University of Liechtenstein launched the "Liechtenstein Initiative of the Financial Centre in Emissions Trading (LIFE). In 2009 the Initiative was incorporated into a non-profit foundation under the name "LIFE Climate Foundation". The foundation acts within the framework of a real Public-Private Partnership. The participation of representatives from the country's economy as well as from the science and policy sectors provides important access to the relevant players and driving forces within environmental and carbon markets. The close cooperation with the University of Liechtenstein's Institute for Financial Services offers the possibility to examine environmental questions related to financial issues on an academic basis.

The foundation organizes public events and workshops. In 2009 two public events "Climate Change and Energy – a future for international financial markets?" and "CO₂-Emissions Trading – Perspectives and experiences from market participants" were organized by the foundation. All services provided by the foundation are free of charge and publicly accessible.

Further Information available under www.climatefoundation.li.

Various institutions are also engaged in public information and education. In particular, these include the Liechtenstein Environmental Protection Society (www.lgu.li), the Solar Society (www.solargenossenschaft.li) and the Liechtenstein Transport Association (www.vcl.li).

Another important institution in this field is CIPRA (International Commission for the Protection of the Alps), which is headquartered in Liechtenstein and publishes 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.

Annex

Annex 1: Summary and trend tables for Liechtenstein's Greenhouse Gas Inventory

Summary 1.A: Summary Report for National Greenhouse Gas Inventories (2007)

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)

(Sheet 1 of 3)

Inventory 2007

Submission 2009 v1.1

LIECHTENSTEIN

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO ₂ emissions/removals	CH ₄	N ₂ O	HFCs ⁽¹⁾		PFCs ⁽¹⁾		SF ₆		NO _x	CO	NMVOC	SO ₂
				P	A	P	A	P	A				
	(Gg)				CO ₂ equivalent (Gg)						(Gg)		
Total National Emissions and Removals	204.71	0.70	0.04	81.36	4.47	NA,NO	NA,NO	0.00	0.00	NA,NE,NO	0.01	0.25	NA,NE,NO
1. Energy	210.41	0.09	0.00							NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
A. Fuel Combustion	210.46												
Reference Approach ⁽²⁾	210.46												
Sectoral Approach ⁽²⁾	210.41	0.04	0.00							NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
1. Energy Industries	2.44	0.00	0.00							NE	NE	NE	NE
2. Manufacturing Industries and Construction	30.81	0.00	0.00							NE,NO	NE,NO	NE,NO	NE,NO
3. Transport	85.82	0.01	0.00							NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
4. Other Sectors	88.00	0.03	0.00							NE	NE	NE	NE
5. Other	3.33	0.00	0.00							NA,NE	NA,NE	NA,NE	NA,NE
B. Fugitive Emissions from Fuels	NA,NO	0.05	NA,NO							NA,NO	NA,NO	NA,NO	NA,NO
1. Solid Fuels	NA,NO	NA,NO	NA,NO							NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	NA,NO	0.05	NA,NO							NA,NO	NA,NO	NA,NO	NA,NO
2. Industrial Processes	NO	NO	NO	81.36	4.47	NA,NO	NA,NO	0.00	0.00	NA,NO	0.01	0.01	NA,NO
A. Mineral Products	NO	NO	NO							NO	0.01	0.01	NO
B. Chemical Industry	NO	NO	NO	NA	NA	NA	NA	NA	NA	NA,NO	NA,NO	NA,NO	NA,NO
C. Metal Production	NO	NO	NO				NO		NO	NO	NO	NO	NO
D. Other Production ⁽³⁾	NO									NO	NO	NO	NO
E. Production of Halocarbons and SF ₆					NA,NO		NO		NO				
F. Consumption of Halocarbons and SF ₆				81.36	4.47	NO	NA,NO	0.00	0.00				
G. Other	NO	NO	NO	NO	NA,NO	NO	NO	NO	NO	NO	NO	NO	NO

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

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

Note: All footnotes for this table are given at the end of the table on sheet 3.

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)
(Sheet 2 of 3)

Inventory 2007
Submission 2009 v1.1
LIECHTENSTEIN

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO ₂ emissions/removals	CH ₄	N ₂ O	HFCs ⁽¹⁾		PFCs ⁽¹⁾		SF ₆		NO _x	CO	NMVOC	SO ₂
				P	A	P	A	P	A				
	(Gg)	CO ₂ equivalent (Gg)						(Gg)					
3. Solvent and Other Product Use	0.86		0.00							NO	NO	0.24	NO
4. Agriculture		0.58	0.03							NA,NO	NA,NO	NA,NE,NO	NO
A. Enteric Fermentation		0.49											
B. Manure Management		0.08	0.01									NE,NO	
C. Rice Cultivation		NA,NO										NA,NO	
D. Agricultural Soils ⁽⁴⁾		NA,NO	0.03									NA,NE,NO	
E. Prescribed Burning of Savannas		NA	NA							NO	NO	NO	
F. Field Burning of Agricultural Residues		NA,NO	NA,NO							NA,NO	NA,NO	NA,NO	
G. Other		NA	NA							NA	NA	NA	NO
5. Land Use, Land-Use Change and Forestry	⁽⁵⁾ -6.57	NO	NO							NE,NO	NE,NO	NE	NO
A. Forest Land	⁽⁵⁾ -19.13	NO	NO							NE,NO	NE,NO	NE	
B. Cropland	⁽⁵⁾ 4.56	NO	NO							NO	NO	NE	
C. Grassland	⁽⁵⁾ 2.67	NO	NO							NO	NO	NE	
D. Wetlands	⁽⁵⁾ 0.76	NO	NO							NO	NO	NE	
E. Settlements	⁽⁵⁾ 3.53	NO	NO							NO	NO	NE	
F. Other Land	⁽⁵⁾ 1.04	NO	NO							NO	NO	NE	
G. Other	⁽⁵⁾ NO	NO	NO							NO	NO	NE	NO
6. Waste	0.01	0.03	0.00							NA,NE,NO	NA,NE,NO	NA,NE,NO	NE
A. Solid Waste Disposal on Land	⁽⁶⁾ NO	0.00								NO	NO	NO	
B. Waste-water Handling		0.00	0.00							NA,NE,NO	NA,NE,NO	NA,NE,NO	
C. Waste Incineration	⁽⁶⁾ 0.01	0.00	0.00							NE	NE	NE	NE
D. Other		NO	0.03	0.00						NE	NE	NE	NE
7. Other (please specify)⁽⁷⁾	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other non-specified	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Note: All footnotes for this table are given at the end of the table on sheet 3.

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)
(Sheet 3 of 3)

Inventory 2007
 Submission 2009 v1.1
 LIECHTENSTEIN

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO ₂	CH ₄	N ₂ O	HFCs		PFCs		SF ₆		NO _x	CO	NM VOC	SO ₂
	emissions/removals			P	A	P	A	P	A				
	(Gg)			CO ₂ equivalent (Gg)				(Gg)					
Memo Items: ⁽⁸⁾													
International Bunkers	0.76	0.00	0.00							NE,NO	NE,NO	NE,NO	NE,NO
Aviation	0.76	0.00	0.00							NE	NE	NE	NE
Marine	NA,NO	NA,NO	NA,NO							NO	NO	NO	NO
Multilateral Operations	NO	NO	NO							NO	NO	NO	NO
CO₂ Emissions from Biomass	15.66												

⁽¹⁾ The emissions of HFCs and PFCs are to be expressed as CO₂ equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II) of this common reporting format.

⁽²⁾ 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 the documentation box to Table 1.A.(c). For estimating national total emissions, the results from the Sectoral approach should be used, where possible.

⁽³⁾ Other Production includes Pulp and Paper and Food and Drink Production.

⁽⁴⁾ Parties which previously reported CO₂ from soils in the Agriculture sector should note this in the NIR.

⁽⁵⁾ For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

⁽⁶⁾ CO₂ from source categories Solid Waste Disposal on Land and Waste Incineration should only be included if it stems from non-biogenic or inorganic waste streams. Only emissions from Waste Incineration Without Energy Recovery are to be reported in the Waste sector, whereas emissions from Incineration With Energy Recovery are to be reported in the Energy sector.

⁽⁷⁾ If reporting any country-specific source category under sector "7. Other", detailed explanations should be provided in Chapter 9: Other (CRF sector 7) of the NIR.

⁽⁸⁾ Countries are asked to report emissions from international aviation and marine bunkers and multilateral operations, as well as CO₂ emissions from biomass, under Memo Items. These emissions should not be included in the national total emissions from the energy sector. Amounts of biomass used as fuel are included in the national energy consumption but the corresponding CO₂ emissions are not included in the national total as it is assumed that the biomass is produced in a sustainable manner. If the biomass is harvested at an unsustainable rate, net CO₂ emissions are accounted for as a loss of biomass stocks in the Land Use, Land-use Change and Forestry sector.

Summary 1.B: Short Summary Report for National Greenhouse Gas Inventories (2007)

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B)

(Sheet 1 of 1)

Inventory 2007

Submission 2009 v1.1

LIECHTENSTEIN

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO ₂ emissions/removals	CH ₄	N ₂ O	HFCs ⁽¹⁾		PFCs ⁽¹⁾		SF ₆		NO _x	CO	NMVOC	SO ₂
				P	A	P	A	P	A				
	(Gg)	CO ₂ equivalent (Gg)						(Gg)					
Total National Emissions and Removals	204.71	0.70	0.04	81.36	4.47	NA,NO	NA,NO	0.00	0.00	NA,NE,NO	0.01	0.25	NA,NE,NO
1. Energy	210.41	0.09	0.00							NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
A. Fuel Combustion	210.46												
Reference Approach ⁽²⁾	210.46												
Sectoral Approach ⁽²⁾	210.41	0.04	0.00							NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
B. Fugitive Emissions from Fuels	NA,NO	0.05	NA,NO							NA,NO	NA,NO	NA,NO	NA,NO
2. Industrial Processes	NO	NO	NO	81.36	4.47	NA,NO	NA,NO	0.00	0.00	NA,NO	0.01	0.01	NA,NO
3. Solvent and Other Product Use	0.86		0.00							NO	NO	0.24	NO
4. Agriculture⁽³⁾		0.58	0.03							NA,NO	NA,NO	NA,NE,NO	NO
5. Land Use, Land-Use Change and Forestry	⁽⁴⁾ -6.57	NO	NO							NE,NO	NE,NO	NE	NO
6. Waste	0.01	0.03	0.00							NA,NE,NO	NA,NE,NO	NA,NE,NO	NE
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items:⁽⁵⁾													
International Bunkers	0.76	0.00	0.00							NE,NO	NE,NO	NE,NO	NE,NO
Aviation	0.76	0.00	0.00							NE	NE	NE	NE
Marine	NA,NO	NA,NO	NA,NO							NO	NO	NO	NO
Multilateral Operations	NO	NO	NO							NO	NO	NO	NO
CO₂ Emissions from Biomass	15.66												

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

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

⁽¹⁾ The emissions of HFCs and PFCs are to be expressed as CO₂ equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II) of this common reporting format.

⁽²⁾ 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 the documentation box to Table 1.A.(c).

For estimating national total emissions, the result from the Sectoral approach should be used, where possible.

⁽³⁾ Parties which previously reported CO₂ from soils in the Agriculture sector should note this in the NIR.

⁽⁴⁾ For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

⁽⁵⁾ Countries are asked to report emissions from international aviation and marine bunkers and multilateral operations, as well as CO₂ emissions from biomass, under Memo Items. These emissions should not be included in the national total emissions from the energy sector. Amounts of biomass used as fuel are included in the national energy consumption but the corresponding CO₂ emissions are not included in the national total as it is assumed that the biomass is produced in a sustainable manner. If the biomass is harvested at an unsustainable rate, net CO₂ emissions are accounted for as a loss of biomass stocks in the Land Use, Land-use Change and Forestry sector.

Summary 2: Summary Report for CO₂ Equivalent Emissions (1990)

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS (Sheet 1 of 1)

Inventory 1990
Submission 2009 v1.1
LIECHTENSTEIN

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs ⁽²⁾	PFCs ⁽²⁾	SF ₆ ⁽²⁾	Total
	CO ₂ equivalent (Gg)						
Total (Net Emissions)⁽¹⁾	194.74	13.40	13.09	0.00	NA,NO	NA,NO	221.23
1. Energy	201.53	1.05	0.90				203.48
A. Fuel Combustion (Sectoral Approach)	201.53	0.73	0.90				203.16
1. Energy Industries	0.12	0.00	0.05				0.18
2. Manufacturing Industries and Construction	35.23	0.04	0.06				35.33
3. Transport	75.37	0.50	0.52				76.39
4. Other Sectors	88.44	0.19	0.24				88.87
5. Other	2.36	0.00	0.03				2.39
B. Fugitive Emissions from Fuels	NA,NO	0.32	NA,NO				0.32
1. Solid Fuels	NA,NO	NA,NO	NA,NO				NA,NO
2. Oil and Natural Gas	NA,NO	0.32	NA,NO				0.32
2. Industrial Processes	NO	NO	NO	0.00	NA,NO	NA,NO	0.00
A. Mineral Products	NO	NO	NO				NO
B. Chemical Industry	NO	NO	NO	NA	NA	NA	NA,NO
C. Metal Production	NO	NO	NO	NO	NO	NO	NO
D. Other Production	NO						NO
E. Production of Halocarbons and SF ₆				NO	NO	NO	NO
F. Consumption of Halocarbons and SF ₆ ⁽²⁾				0.00	NO	NO	0.00
G. Other	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	1.53		0.47				2.00
4. Agriculture		11.70	10.83				22.52
A. Enteric Fermentation		9.80					9.80
B. Manure Management		1.90	1.52				3.42
C. Rice Cultivation		NA,NO					NA,NO
D. Agricultural Soils ⁽³⁾		NA,NO	9.31				9.31
E. Prescribed Burning of Savannas		NA	NA				NA
F. Field Burning of Agricultural Residues		NA,NO	NA,NO				NA,NO
G. Other		NA	NA				NA
5. Land Use, Land-Use Change and Forestry⁽¹⁾	-8.32	NO	NO				-8.32
A. Forest Land	-18.74	NO	NO				-18.74
B. Cropland	4.44	NO	NO				4.44
C. Grassland	2.05	NO	NO				2.05
D. Wetlands	0.11	NO	NO				0.11
E. Settlements	3.35	NO	NO				3.35
F. Other Land	0.47	NO	NO				0.47
G. Other	NO	NO	NO				NO
6. Waste	0.01	0.65	0.90				1.55
A. Solid Waste Disposal on Land	NO	0.22					0.22
B. Waste-water Handling		0.02	0.81				0.83
C. Waste Incineration	0.01	0.01	0.00				0.01
D. Other	NO	0.40	0.08				0.49
7. Other (as specified in Summary I.A)	NO	NO	NO	NO	NO	NO	NO
Memo Items:⁽⁴⁾							
International Bunkers	0.43	0.00	0.00				0.43
Aviation	0.43	0.00	0.00				0.43
Marine	NA,NO	NA,NO	NA,NO				NA,NO
Multilateral Operations	NO	NO	NO				NO
CO₂ Emissions from Biomass	5.67						5.67
Total CO ₂ Equivalent Emissions without Land Use, Land-Use Change and Forestry							229.55
Total CO ₂ Equivalent Emissions with Land Use, Land-Use Change and Forestry							221.23

⁽¹⁾ For CO₂ from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

⁽²⁾ Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

⁽³⁾ Parties which previously reported CO₂ from soils in the Agriculture sector should note this in the NIR.

⁽⁴⁾ See footnote 8 to table Summary I.A.

Summary 2: Summary Report for CO₂ Equivalent Emissions (2007)

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS (Sheet 1 of 1)

Inventory 2007
Submission 2009 v1.1
LIECHTENSTEIN

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs ⁽²⁾	PFCs ⁽²⁾	SF ₆ ⁽²⁾	Total
	CO ₂ equivalent (Gg)						
Total (Net Emissions)⁽¹⁾	204.71	14.70	12.91	4.47	NA,NO	0.12	236.91
1. Energy	210.41	1.87	1.07				213.35
A. Fuel Combustion (Sectoral Approach)	210.41	0.80	1.07				212.28
1. Energy Industries	2.44	0.03	0.08				2.55
2. Manufacturing Industries and Construction	30.81	0.05	0.03				30.90
3. Transport	85.82	0.16	0.64				86.62
4. Other Sectors	88.00	0.56	0.27				88.83
5. Other	3.33	0.00	0.04				3.38
B. Fugitive Emissions from Fuels	NA,NO	1.07	NA,NO				1.07
1. Solid Fuels	NA,NO	NA,NO	NA,NO				NA,NO
2. Oil and Natural Gas	NA,NO	1.07	NA,NO				1.07
2. Industrial Processes	NO	NO	NO	4.47	NA,NO	0.12	4.59
A. Mineral Products	NO	NO	NO				NO
B. Chemical Industry	NO	NO	NO	NA	NA	NA	NA,NO
C. Metal Production	NO	NO	NO	NO	NO	NO	NO
D. Other Production	NO						NO
E. Production of Halocarbons and SF ₆				NA,NO	NO	NO	NA,NO
F. Consumption of Halocarbons and SF ₆ ⁽²⁾				4.47	NA,NO	0.12	4.59
G. Other	NO	NO	NO	NA,NO	NO	NO	NA,NO
3. Solvent and Other Product Use	0.86		0.25				1.11
4. Agriculture		12.12	10.46				22.58
A. Enteric Fermentation		10.38					10.38
B. Manure Management		1.74	1.63				3.37
C. Rice Cultivation		NA,NO					NA,NO
D. Agricultural Soils ⁽³⁾		NA,NO	8.83				8.83
E. Prescribed Burning of Savannas		NA	NA				NA
F. Field Burning of Agricultural Residues		NA,NO	NA,NO				NA,NO
G. Other		NA	NA				NA
5. Land Use, Land-Use Change and Forestry⁽¹⁾	-6.57	NO	NO				-6.57
A. Forest Land	-19.13	NO	NO				-19.13
B. Cropland	4.56	NO	NO				4.56
C. Grassland	2.67	NO	NO				2.67
D. Wetlands	0.76	NO	NO				0.76
E. Settlements	3.53	NO	NO				3.53
F. Other Land	1.04	NO	NO				1.04
G. Other	NO	NO	NO				NO
6. Waste	0.01	0.71	1.13				1.85
A. Solid Waste Disposal on Land	NO	0.02					0.02
B. Waste-water Handling		0.03	0.99				1.02
C. Waste Incineration	0.01	0.01	0.00				0.01
D. Other	NO	0.66	0.14				0.80
7. Other (as specified in Summary I.A)	NO	NO	NO	NO	NO	NO	NO
Memo Items:⁽⁴⁾							
International Bunkers	0.76	0.00	0.01				0.77
Aviation	0.76	0.00	0.01				0.77
Marine	NA,NO	NA,NO	NA,NO				NA,NO
Multilateral Operations	NO	NO	NO				NO
CO ₂ Emissions from Biomass	15.66						15.66
Total CO ₂ Equivalent Emissions without Land Use, Land-Use Change and Forestry							243.48
Total CO ₂ Equivalent Emissions with Land Use, Land-Use Change and Forestry							236.91

⁽¹⁾ For CO₂ from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

⁽²⁾ Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

⁽³⁾ Parties which previously reported CO₂ from soils in the Agriculture sector should note this in the NIR.

⁽⁴⁾ See footnote 8 to table Summary I.A.

Annex 2: Summary of reporting of the Supplementary information under Article 7, paragraph 2, of the Kyoto Protocol

Table 7. Summary of reporting of the Supplementary information under Article 7, paragraph 2, of the Kyoto Protocol in the NC5 (example of summary table)

Information reported under Article 7, paragraph 2	NC5 section
National systems in accordance with Article 5, paragraph 1	III.C
National registries	III.D
Supplementarity relating to the mechanisms pursuant to Articles 6, 12 and 17	V.C
Policies and measures in accordance with Article 2	IV.C
Domestic and regional programmes and/or legislative arrangements and enforcement and administrative procedures	IV.B
Information under Article 10	III.C IV.B and VI.C; VII.D VIII IX
Financial resources (Annex II only)	VII.A-C

Abbreviations

AZV	Abwasserzweckverband
CH ₄	Methane
CHF	Swiss francs
CIPRA	International Commission for the Protection of the Alps
CLRTAP	UNECE Convention on Long-range Transboundary Air Pollution
CO	Carbon monoxide
CO ₂	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 ₄ , N ₂ O, HFC, PFC, and SF ₆ emissions into CO ₂ equivalents
HFC	Hydrofluorcarbons
ILCC	International Lake Constance Conference
IPCC	Intergovernmental Panel on Climate Change
ha	hectare
HVF	Heavy Vehicle Fee
KCA	Key Category Analysis
kha	kilohectare, 1000 hectares
KP	Kyoto Protocol
LGV	Liechtensteinische Gasversorgung (Liechtenstein's gas utility)
LKW	Liechtensteinische Kraftwerke (Liechtenstein's electric power company)
LULUCF	Land Use, Land-Use Change and Forestry
NA	Not applicable (notation key)
NE	Not estimated in Liechtenstein (notation key)
NFR	Nomenclature for reporting (category codes)

NGO	Non-governmental organization
NIC	National Inventory Compiler
NIR	National Inventory Report
NIS	National Inventory System
NMVOC	Non-methane volatile organic compounds
NO	Not occurring (in Liechtenstein)
NO _x	Nitrogen oxides
N ₂ O	Nitrous oxide
OA	Office of Agriculture
OEA	Office of Economic Affairs
OEP	Office of Environmental Protection
OFNLM	Office of Forests, Nature and Land Management
OS	Office of Statistics
PFC	Perfluorocarbons
QA/QC	Quality assurance, quality control
SDC	Swiss Agency for Development and Cooperation
SF ₆	Sulfur hexafluoride
SFOE	Swiss Federal Office of Energy
SLP	Office of Land Use Planning
T1, T2, T3	Tier 1, Tier 2, Tier 3 (methodological levels)
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change