



Republic of Croatia

**Ministry of Environmental Protection,
Physical Planning and Construction**

NATIONAL INVENTORY REPORT 2008

**Submission to the United Nations
Framework Convention on Climate Change**



Ordered by: Croatian Environment Agency

Contract No.: 10-08-326/01

Title:

NATIONAL INVENTORY REPORT 2008

**Croatian greenhouse gas inventory
for the period 1990-2006**

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Zagreb, May 2008

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LIST OF ABBREVIATIONS

<i>CBS</i>	- <i>Central Bureau of Statistics</i>
<i>CFC</i>	- <i>Chlorofluorocarbons</i>
<i>COPERT</i>	- <i>Computer Programme to Calculate Emissions from Road Transport</i>
<i>CORINAIR</i>	- <i>Core Inventory of Air Emissions in Europe</i>
<i>CPS Molve</i>	- <i>Central Gas Station Molve</i>
<i>CRF</i>	- <i>Common Reporting Format</i>
<i>EKONERG</i>	- <i>Energy Research and Environmental Protection Institute</i>
<i>EIHP</i>	- <i>Energy Institute "Hrvoje Požar"</i>
<i>EMEP</i>	- <i>Co-operative Programme for Monitoring and Evaluation of the Long Rang Transmission of Air Pollutants in Europe</i>
<i>ERT</i>	- <i>Expert Review Team</i>
<i>FAO</i>	- <i>Food and Agriculture Organization of the United Nations</i>
<i>GHG</i>	- <i>Greenhouse gas</i>
<i>GWP</i>	- <i>Global Warming Potential</i>
<i>HEP</i>	- <i>Croatian Electricity Utility Company</i>
<i>IEA</i>	- <i>International Energy Agency</i>
<i>INA</i>	- <i>Croatian Oil and Gas Company</i>
<i>IPCC</i>	- <i>Intergovernmental Panel on Climate Change</i>
<i>ISWA</i>	- <i>International Solid Waste Association</i>
<i>LULUCF</i>	- <i>Land-use, Land Use Change and Forestry</i>
<i>MEPPPC</i>	- <i>Ministry of Environmental Protection, Physical Planning and Construction</i>
<i>NGGIP</i>	- <i>National Greenhouse Gas Inventories Programme</i>
<i>NM VOC</i>	- <i>Non-methane Volatile organic Compounds</i>
<i>UNECE</i>	- <i>United Nations Economic Commission for Europe</i>
<i>UNFCCC</i>	- <i>United Nations Framework Convention on Climate Change</i>
<i>ZGOS</i>	- <i>Zagreb's Environmental Protection and Waste Management Company</i>

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EXECUTIVE SUMMARY

ES.1. BACKGROUND INFORMATION ON GHG INVENTORIES AND CLIMATE CHANGE

The Republic of Croatia became a party to the United Nations Framework Convention on Climate Change (UNFCCC) on 17 January 1996 when the Croatian Parliament passed the law on its ratification (Official Gazette, International Treaties No. 2/96). For the Republic of Croatia the Convention came into force on 7 July 1996. As a country undergoing the process of transition to market economy, Croatia has, pursuant to Article 22, paragraph 3 of the Convention, assumed the commitments of countries included in Annex I. By the amendment that came into force on 13 August 1998 Croatia was listed among Parties included in Annex I to the Convention.

The Republic of Croatia signed the Kyoto Protocol on 11 March 1999. At the session of the Conference of Parties (COP 7) held in Marrakesh in 2001 the Republic of Croatia submitted a request for recognition of specific circumstances under Article 4, paragraph 6 of the Convention. The request was related to the increase of emissions level by 4.46 Mt CO₂-eq in the base year, i.e. 1990, based on the specific circumstance that Croatia has been integrated into the common economic, energy and infrastructural system of the former Yugoslavia in that year.

At the session of the COP 11 held in Montreal in 2005 the Decision 10/CP.11 was adopted allowing Croatia a certain degree of flexibility in determining the reference value of greenhouse gas emission levels compared to the historical level. At the session of the COP 12 held in Nairobi in 2006 the Decision 7/CP.12 was adopted allowing Croatia to add 3.5 Mt CO₂-eq to its 1990 level of greenhouse gas emissions for the purpose of establishing the level of emissions for the base year for implementation of its commitments under Article 4, paragraph 2, of the Convention.

The adoption of the Decision 7/CP.12 by the Conference of Parties was acknowledged by the Croatian Parliament which ratified the Kyoto Protocol on 27 April 2007 (Official Gazette, International Treaties No. 5/07). The Kyoto Protocol has entered into force in Croatia on 28 August 2007.

One of the commitments outlined in Article 4, paragraph 1 of the UNFCCC is that Parties are required to develop, periodically update, publish and make available to the Conference of the Parties, in accordance with Article 12, national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, using comparable methodologies to be agreed upon by the Conference of the Parties.

Furthermore, Article 5, paragraph 1 of the Kyoto Protocol requires that each Party included in Annex I shall have in place, no later than one year prior to the start of the first commitment period, a national system for the estimation of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol. A national system includes all institutional, legal and procedural arrangements made within a Party

included in Annex I for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and for reporting and archiving inventory information.

The Republic of Croatia is also a country which is currently in the process of accession to the EU. Accession is conditioned by the harmonization, adoption and implementation of the entire *acquis communautaire*, i.e. the body of legislation and rules already implemented in the EU. This process is very complex and requires changes that are systemic in its nature particularly in institutional and legislative sphere. As a future EU member state, Croatia will have to implement legislation concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol, which also stipulates establishment of mechanism for monitoring emissions by sources and removals by sinks of greenhouse gases, evaluating progress towards meeting commitments in respect of these emissions and for implementing the UNFCCC and the Kyoto Protocol, as regards national programmes, inventories, national system and registries.

Taking into consideration abovementioned comprehensive reporting requirements and previous experience in preparation of annual inventory submissions, Ministry of Environmental Protection, Physical Planning and Construction as a national focal point has decided to enforce regulation which shall stipulate institutional and procedural arrangements for greenhouse gas monitoring and reporting in Croatia. In this regard the Regulation on Greenhouse Gas Emissions Monitoring in the Republic of Croatia came into force on 2 January 2007 (Official Gazette, No. 2/07) stipulated by Article 46. of the Air Protection Act (Official Gazette No. 178/04). It is important to emphasize that this inventory submission is the first which was prepared under the provisions of new Regulation.

In this NIR, the inventory of the emissions and removals of the greenhouse gases is reported for the period from 1990 to 2006. The NIR is prepared in accordance with the UNFCCC reporting guidelines on annual Inventories as adopted by the COP by its Decision 18/CP.8. The methodologies used in the calculation of emissions are based on the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC Guidelines)* and the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC Good Practice Guidance)* prepared by the Intergovernmental Panel on Climate Change (IPCC). As recommended by the IPCC Guidelines country specific methods have been used where appropriate and where they provide more accurate emission data. The important part of the inventory preparation is uncertainty assessment of the calculation and verification of the input data and results, all this with the aim to increase the quality and reliability of the calculation.

Furthermore, since the introduction of annual technical reviews of the national inventories by experts review teams (ERT), Croatia has undergone three reviews so far, in-country review in 2004 and centralized reviews in 2005 and 2006. Issues recommended by the ERT have been included in this report as far as possible.

The calculation includes the emissions which are the result of anthropogenic activities and these include the following greenhouse gases: carbon dioxide (CO₂), methane (CH₄), nitrous

oxide (N₂O), halogenated carbons (HFCs, PFCs) and sulphur hexafluoride (SF₆) and indirect greenhouse gases: carbon monoxide (CO), oxides of nitrogen (NO_x), non-methane volatile organic compounds (NMVOCs) and sulphur dioxide (SO₂). The greenhouse gases covered by Montreal Protocol on the pollutants related to ozone depletion (freons) are reported in the framework of this protocol and therefore are excluded from this Report.

Greenhouse gas emission sources and sinks are divided into six main sectors: Energy, Industrial Processes, Solvent and Other Product Use, Agriculture, Land Use, Land-Use Change and Forestry and Waste. Generally, the methodology for emission calculation could be described as a product of the particular economic activity (e.g. fuel consumption, cement production, number of animals, increase of wood stock etc.) with corresponding emission factors. The use of specific national emission factors is recommended wherever possible and justified, whereas on the contrary, the methodology gives typical values of emission factors for all relevant activities of the particular sectors.

ES.1.1. INSTITUTIONAL AND ORGANIZATIONAL STRUCTURE OF GREENHOUSE GAS EMISSIONS INVENTORY PREPARATION

Institutional arrangement for inventory preparation in Croatia is regulated in Part II of the Regulation on greenhouse gas emissions monitoring in the Republic of Croatia, entitled National system for the estimation and reporting of anthropogenic greenhouse gas emissions by sources and removals by sinks. Institutional arrangements for inventory management and preparation in Croatia could be characterized as decentralized and out-sourced with clear tasks breakdown between participating institutions including Ministry of Environmental Protection, Physical Planning and Construction, Croatian Environment Agency and competent governmental bodies responsible for providing of activity data. The preparation of inventory itself is entrusted to Authorised Institution which is elected for three year period by public tendering.

Ministry of Environmental Protection, Physical Planning and Construction (MEPPPC) is a national focal point for the UNFCCC, with overall responsibility for functioning of the National system in a sustainable manner, including:

- mediation and exchange of data on greenhouse gas emissions and removals with international organisations and Parties to the Convention;
- mediation and exchange of data with competent bodies and organisations of the European Union in a manner and within the time limits laid down by legal acts of the European Union;
- control of methodology for emission calculation and greenhouse gas removal in line with good practices and national circumstances;
- consideration and approval of the Greenhouse Gas Inventory Report prior to its formal submission to the Convention Secretariat.

Croatian Environment Agency (CEA) is responsible for the following tasks:

- organisation of greenhouse gas inventory preparation with the aim of meeting the due deadlines referred to in Article 12 of this Regulation;
- collection of activity data referred to in Article 11 the Regulation;
- development of quality assurance and quality control plan (QA/QC plan) related to the greenhouse gas inventory in line with the guidelines on good practices of the Intergovernmental Panel on Climate Change;
- implementation of the quality assurance procedure with regard to the greenhouse gas inventory in line with the quality assurance and quality control plan;
- archiving of activity data on calculation of emissions, emission factors, and of documents used for inventory planning, preparation, quality control and quality assurance;
- maintaining of records and reporting on authorised legal persons participating in the Kyoto Protocol flexible mechanisms;
- reporting on modifications in the National System;
- selection of Authorised Institution (in Croatian: *Ovlaštenik*) for preparation of the greenhouse gas inventory.
- provide insight into data and documents for the purpose of technical reviews.

Authorised Institution is responsible for preparation of inventory, which include:

- emission calculation of all anthropogenic emissions from sources and removals by greenhouse gas sinks, and calculation of indirect greenhouse gas emissions, in line with the methodology stipulated by the effective guidelines of the Convention, guidelines of the Intergovernmental Panel on Climate Change, Instructions for reporting on greenhouse gas emissions as published on the Ministry's website, and on the basis of the activities data referred to in Article 11 of this Regulation;
- quantitative estimate of the calculation uncertainty referred to in indent 1 of this Article for each category of source and removal of greenhouse gas emissions, as well as for the inventory as a whole, in line with the guidelines of the Intergovernmental Panel on Climate Change;
- identification of key categories of greenhouse gas emission sources and removals;
- recalculation of greenhouse gas emissions and removals in cases of improvement of methodology, emission factors or activity data, inclusion of new categories of sources and sinks, or application of coordination/adjustment methods;
- calculation of greenhouse gas emissions or removal from mandatory and selected activities in the sector of land use, land-use change and forestry;
- reporting on issuance, holding, transfer, acquisition, cancellation and retirement of emission reduction units, certified emission reduction units, assigned amount units and removal units, and carry-over, into the next commitment period, of emission reduction units, certified emission reduction units and assigned amount units, from the Registry in line with the effective decisions and guidelines of the Convention and supporting international treaties;
- implementation of and reporting on quality control procedures in line with the quality control and quality assessment plan;

- preparation of the greenhouse gas inventory report, including also all additional requirements in line with the Convention and supporting international treaties and decisions;
- cooperation with the Secretariat's ERTs for the purpose of technical review and assessment/evaluation of the inventory submissions.

EKONERG – Energy Research and Environmental Protection Institute was selected as Authorised Institution for preparation of 2008 inventory submission.

ES.2. SUMMARY OF NATIONAL EMISSION AND REMOVAL RELATED TRENDS

In this chapter the results of the greenhouse gas emission calculation in the Republic of Croatia are presented for the period from 1990 to 2006. The results are presented as total emissions of all greenhouse gases in CO₂ equivalents over sectors and then as emissions for the individual greenhouse gas by sectors. Since the certain greenhouse gases have different irradiation properties, and consequently different contribution to the greenhouse effect, it is necessary to multiply the emission of every gas with proper Global Warming Potential (GWP). The Global Warming Potential is a measure of the impact on greenhouse effect of the certain gas compared to CO₂ impact which is accordingly defined as a referent value. In that case the emission of greenhouse gases is presented as the equivalent emission of carbon dioxide (CO₂-eq). If the removal of greenhouse gases occurs (e.g. the absorption of CO₂ at increase of wood stock in forests) than it refers to sinks of greenhouse gases and the amount is presented as a negative value. Table ES.2-1 shows the global warming potentials for particular gases.

Table ES.2-1: Global warming potentials for certain gases (100- year time horizon)

Gas	Global Warming Potential
Carbon dioxide (CO ₂)	1
Methane (CH ₄)	21
Nitrous oxide (N ₂ O)	310
HFC-32	650
HFC-125	2800
HFC-134a	1300
HFC-143a	3800
CF ₄	6500
C ₂ F ₆	9200
SF ₆	23900

ES.3. OVERVIEW OF SOURCES AND SINK CATEGORY EMISSION ESTIMATES AND TRENDS

Total emission/removal of greenhouse gases for the period 1990-2006 and their trend in Sectors is given in table ES.3-1, while the contribution of the individual gases is given in table ES.3-2.

Table ES.3-1: Emissions/removals of GHG by sectors for the period 1990-2006 (Gg CO₂-eq)

Source	Emissions and removals of GHG (Gg CO ₂ -eq)									
	Base year ¹	1990	1995	2000	2001	2002	2003	2004	2005	2006
Energy		22882	16400	18907	19953	21074	22580	22048	22411	22548
Industrial Processes		4609	2785	3400	3271	3148	3346	3659	3833	4004
Solvent and Other Product Use		80	80	69	75	99	108	135	155	182
Agriculture		4558	3191	3285	3485	3400	3348	3549	3560	3507
Waste		399	475	567	599	633	663	697	601	591
Total emission (excluding net CO₂ from LULUCF)	36027	32527	22930	26228	27383	28353	30045	30088	30561	30834
Removals (LULUCF)		-4185	-9154	-5281	-8214	-8206	-6276	-7900	-7726	-7490
Total emission (including LULUCF)		28342	13776	20947	19169	20148	23768	22189	22835	23344

Table ES.3-2: Emissions/removals of GHG by gases for the period 1990-2006 (Gg CO₂-eq)

Source	Emissions and removals of GHG (Gg CO ₂ -eq)									
	Base year ¹	1990	1995	2000	2001	2002	2003	2004	2005	2006
Carbon dioxide (CO ₂)		24069	17007	20102	21018	21994	23577	23180	23595	23699
Methane (CH ₄)		3390	2684	2638	2785	2847	2953	3070	2962	3110
Nitrous oxide (N ₂ O)		4079	3197	3465	3531	3463	3352	3649	3654	3594
HFCs, PFCs and SF ₆		989	43	23	49	49	164	189	349	431
Total emission (excluding net CO₂ from LULUCF)	36027	32527	22930	26228	27383	28353	30045	30088	30561	30834
Removals (LULUCF)		-4185	-9154	-5281	-8214	-8206	-6276	-7900	-7726	-7490
Total emission (including LULUCF)		28342	13776	20947	19169	20148	23768	22189	22835	23344

¹ See Annex 8: Decision 7/CP.12 Level of emissions for the base year of Croatia

Table ES.3-1 represents the contribution of the individual sectors to total emissions and removals of the greenhouse gases. The largest contribution to the greenhouse gas emission in 2006 has the Energy Sector with 73.1 percent, followed by Industrial Processes with 13.0 percent, Agriculture with 11.4 percent, Waste with 1.9 percent and Solvent and Other product Use with 0.6 percent. This structure is with minor changes consistent through all the observed period from 1990 to 2006. In the year 2006 the amount of removed emissions of the greenhouse gases by CO₂ from the forestry sector was 24.3 percent.

Energy sector is the largest contributor to greenhouse gas emissions. In this sector, in the year 2006 the total energy consumption was 0.8 percent lower than in the former year 2005, whereat the total largest increase was in consumption of liquid fuels (0.4 percent) from the Manufacturing Industries and Consumption sector (9.3 percent). The CO₂ emission from electric and heat power production in thermal power plants, public heating plants and public cogeneration plants was 62.6 TJ in 2006, representing 20.3 percents in total greenhouse emission in the Republic of Croatia.

Emission of CH₄ and N₂O in the Agricultural sector is conditioned by different agricultural activities. For the emission of CH₄ the most important source is livestock farming (Enteric Fermentation). The number of cattle showed continuous decrease in the period from 1990 to 2000. As a consequence, this led to CH₄ emission reduction. In the year 2000, the number of cattle has started increasing and this trend was retained until 2006. The emission of N₂O is considered as a direct emission from cultivation of agricultural soils, emission from the animal manure (Manure Management) and indirect emission and since 2000 has been more or less stable.

In Industrial Processes sector the key emission sources are Cement Production, Lime Production, Ammonia Production, Nitric Acid Production and Consumption of HFCs in Refrigeration and Air Conditioning Equipment, which all together contribute with 98.8 percent in total sectoral emission in 2006. The iron production in blast furnaces and aluminium production were ended in 1992, and ferroalloys production ended in 2002. The cement production in the period from 1997-2005 was constantly increasing. The aim of the producer is maximum use of the existing capacities which amounts about 3.2 millions of tons of clinker in total per year, whereas in the year 2006, 3.1 millions of tons of clinker was produced. The ammonia production in 2006 was 1.8 percent lower in comparison to the previous year. Also, the nitric acid production in 2006 was 1.1 percent lower in comparison to 2005. The level of emissions from these sub-sectors strongly depends on consumer's demand for particular type of mineral fertilizer at the market.

CO₂ emission from Solvent and Other Product Use is the key source, which contribution to the total greenhouse gas emission in 2006 amounts 0.6 percent.

Waste sector includes waste disposal, waste water management and waste incineration, whereas the waste disposal represents dominant CH₄ emission source from that sector in the Republic of Croatia. The emission depends on the amount and composition of municipal solid waste, management practices on-site including implementation of measures for collection and utilization of landfill gas. The First Order Decay (FOD) model was used for CH₄ emission

calculation. Although increasing of municipal solid waste amounts as a result of the growth in the living standard, this rise has been declined due to effects of measures undertaken to avoid/reduce and recycle waste. Priority is given according avoiding and reducing waste generation and reducing its hazardous properties. These objectives, defined by the *Waste Management Strategy* and *Waste Management Plan in the Republic of Croatia* include the assumed time-lags with respect to relevant EU legislation (Landfill Directive). CH₄ that is recovered and burned in a flare or energy recovery device in 2005 and 2006 have been included in emission estimation. It should be emphasized that Solid Waste Disposal on Land contributes with 70.5 percent in total sectoral emission in 2006. Waste sector contributes to total greenhouse gas emissions with 1.9 percent in 2006.

ES.3.1. CARBON DIOXIDE EMISSION (CO₂)

Carbon dioxide is the most significant anthropogenic greenhouse gas. As in the majority of countries, the most significant anthropogenic sources of CO₂ emissions in Croatia are the processes of fossil fuel combustion for electricity or/and heat production, transport and industrial processes (cement and ammonia production). The results of the CO₂ emission calculation in Croatia are presented in table ES.3-3.

Table ES.3-3: CO₂ emission/removal by sectors from 1990-2006 (Gg CO₂)

Sector	1990	1995	2000	2001	2002	2003	2004	2005	2006
Energy	21314	15029	17518	18447	19500	20952	20383	20746	20726
Industrial processes	2675	1897	2515	2496	2395	2518	2662	2695	2791
Solvent and Other Product Use	80	80	69	75	99	108	135	155	182
LULUCF	-4185	-9154	-5281	-8214	-8206	-6276	-7900	-7726	-7490
Total CO₂ emission	24069	17007	14821	12804	13789	17300	15280	15869	16209
Net CO₂ emission	19884	7852	20102	21018	21994	23577	23180	23595	23699

ES.3.1.1. Energy sector

This sector covers all the activities which include fossil fuel consumption and fugitive emission from fuels. Fugitive emission arises from production, transport, processing, storage and distribution of fossil fuels. The Energy sector is the main source of the anthropogenic greenhouse gas emission with share of 73 percent in total greenhouse gas emission. CO₂ emission from fuel combustion makes the largest part of it (88 percent of emission in the Energy sector). Emission by sub-sectors is presented in table ES.3-4.

Table ES.3-4: CO₂ emission by sub-sectors from 1990-2006 (Gg CO₂)

Source	1990	1995	2000	2001	2002	2003	2004	2005	2006
Energy Industries	7286	5198	5907	6327	7228	7895	6853	6884	6657
Manufacturing Industries & Constr.	5833	2943	3091	3231	3023	3184	3573	3671	3768
Transport (Road & Off-Road)	4266	3469	4644	4752	5062	5453	5612	5839	6226
Comm./Inst., Resid., Agr /For./Fish.)	3832	2922	3521	3713	3802	4061	3968	3997	3763
Natural gas scrubbing (CGS Molve)	416	697	633	688	665	684	710	691	663
Total CO₂ emission	21633	15229	17796	18711	19780	21277	20716	21082	21077

Emission calculation is based on fuel consumption data recorded in annual national energy balance, where the fuel consumption and supply is presented at the sufficient level of detail which enables more detailed calculation by sub-sectors in the framework of the formal IPCC methodology (i.e. Sectoral approach). Furthermore, the simplest method of the calculation was carried out (i.e. Reference approach) which takes into account only the total balance of fuel, without sub-sector analysis. The relative deviation of CO₂ emissions between sectoral and reference approach for Croatia is around 5 percent which is within the acceptable values (table ES.3-5).

Table ES.3-5: CO₂ emission comparison due to fuel combustion (Gg)

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Reference appr.	21068	15230	17935	18744	20336	21330	20798	21167	20924
Sectoral appr.	20898	14332	16885	17759	18835	20268	19673	20055	20063
Relative Differ (%)	0.82	6.26	6.22	5.55	7.97	5.24	5.72	5.55	4.30

Two energy most intensive sub-sectors are energy transformation (thermal power plants, heating plants, refineries and oil and gas field combustion) and manufacturing industry and construction. In the framework of the sub-sector Manufacturing Industry and Construction, the largest CO₂ emissions are the result of fuel combustion in construction material industry and than in iron and steel industry, non-metal industry, chemical industry, industry of pulp, paper and print, food and drink production, tobacco production etc. Furthermore, this sub-sector includes electricity and heat production in manufacturing industry for manufacturing processes.

Transport is also one of more important CO₂ emission sources. The largest part of the emission arises from Road transportation (86 – 95 percent depending on the year) followed by railways and domestic civil aviation and navigation. Emission from fuel sold for the international aviation and marine transportation is reported separately and it's not included in total national emission balance. In the year 2006, emission from Transport sector contributed with 20.2 percent to total greenhouse gas emission.

Biomass combustion (fuel wood and waste wood, biodiesel, biogas) also results in greenhouse gas emissions. CO₂ emission from biomass is not included in balance according the guidelines, due to assumption that life-cycle CO₂ emitted is formerly absorbed for the growth of biomass. Sinks or CO₂ emissions resulted in change of forest biomass is calculated in sector Land Use, Land-Use Change and Forestry.

Fugitive greenhouse gas emission from coal, liquid fuels and natural gas, resulted from exploration of minerals, production, processing, transport, distribution and activities during mineral use is also included in this sector. Although this emission is not characteristic for CO₂, yet for CH₄, there is a CO₂ emission present during the process of scrubbing of natural gas in Central Gas Station Molve. The natural gas exploited on Croatian fields is rich in carbon dioxide (more than 15 percent) and before the natural gas is distributed in commercial gas pipeline it is necessary to remove the CO₂ (scrubbing) so that the maximum volume share of CO₂ in natural gas is 3 percent. Emission assessment during the removal is based on material balance method and amounts up to 2,1 percent of the total CO₂ emission in Energy sector.

ES.3.1.2. Industrial processes

The greenhouse gas emission is a by-product in various industrial processes where the raw material is chemically transformed in final product. Industrial processes where the contribution to CO₂ emission is identified as relevant are production of cement, lime, ammonia, as well as use of limestone and soda ash in various industrial activities.

General methodology used for emission calculation from industrial processes, recommended by the Convention, includes the product of annual produced or consumed amount of a product or material with appropriate emission factor per unit of this production or consumption. Annual production or consumption data for particular industrial processes are extracted, in most cases, from monthly industrial reports published by Central Bureau of Statistics. Certain activity data was collected from survey of manufacturers. The results of the CO₂ emission in industrial processes are shown in table ES.3-6.

Table ES.3-6: CO₂ emission from Industrial Processes for the period from 1990-2006 (Gg CO₂)

Source	1990	1995	2000	2001	2002	2003	2004	2005	2006
Cement production	1069.1	622.6	1232.6	1393.8	1360.5	1369.6	1456.4	1487.1	1572.0
Lime production	160.6	83.4	137.8	162.8	180.6	177.8	186.1	198.4	244.5
Limestone and dolomite use	43.2	11.2	8.0	8.9	9.6	11.4	11.5	12.1	10.7
Soda ash production and use	25.7	14.4	11.0	12.1	12.1	14.2	16.5	17.2	15.1
Ammonia production	861.6	1051.4	1037.9	848.2	769.0	876.6	919.9	907.4	878.5
Ferroalloys production	194.5	33.9	20.5	0.5	0.0	0.0	0.0	0.0	0.0
Aluminum production	111.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total CO₂ emission	2466.1	1816.9	2447.8	2426.3	2331.8	2449.6	2590.4	2622.2	2720.8

The most significant CO₂ industrial processes emission sources are production of cement, ammonia and lime. In 2006, cement production contributes in total sectoral CO₂ emission with 40.0 percent, lime production with 6.2 percent and ammonia production with 22.3 percent. Generally, CO₂ emissions from industrial processes declined from 1990 to 1995, due to the decline in industrial activities. However in the next period from 1996-2006 the emission was increasing to the level reported in 1990.

The quantity of the CO₂ emitted during cement production is directly proportional to the lime content of the clinker. Therefore, the CO₂ emissions are calculated using an emission factor, in tones of CO₂ released per tone of clinker produced, to the annual clinker output corrected with the fraction of clinker that is lost from the kiln in the form of Cement Kiln Dust (CKD). The emission factor and correction factor for CKD is determined according to *Revised 1996 IPCC Guidelines* and *Good Practice Guidance*. Country specific emission factors and CKD was estimated using data from individual plants. The activity data for clinker production were collected from survey of cement manufacturers and cross-checked with cement production data from monthly industrial reports published by Central Bureau of Statistics.

In ammonia production natural gas provides both feedstock and fuel. Emission of CO₂ from natural gas used as feedstock is stoichiometrically determined based on carbon content in natural gas. Emissions from natural gas used as are calculated by means of multiplying energy consumption of natural gas by default emission factors. One part of the CO₂ produced in ammonia production is further used as feedstock in urea production, i.e. mineral fertilizer. Emission of intermediately bound CO₂ occurs during the use of urea as a fertilizer in agriculture. However, according to IPCC methodology this approach is not distinguished.

ES.3.1.3. CO₂ removals

According to Forest Management Area Plan of the Republic of Croatia (2006-2015), the forests and the forest land cover 42 percent of the total surface area. By its origin, approximately 95 percent of the forests in Croatia were formed by natural regeneration and the 5 percent of the forests are grown artificially.

The Republic of Croatia only reports data for Forest land category. Data needed for calculations of emissions/removals for other land categories are partly available but not enough adequate, consistent and complete.

The total growing stock in the Croatian forests is around 398 million m³. The most frequent species are Beech (*Fagus sylvatica*), Common Oak (*Quercus robur*), Sessile Oak (*Quercus petraea*), European Hornbeam (*Carpinus betulus*), Common Fir (*Abies alba*) and other types of deciduous and evergreen trees. The average growing stock in the state-owned forests is 190 m³/ha and in the privately owned forests 80 m³/ha. The annual increment in Croatian forests is around 10.5 million m³ of wood. The quality and quantity of increment can be improved by different methods of forest cultivation. Annual cut is a part of the forest timber stock planned for commercial harvesting for a certain period (1 year, 10 years, 20 years) expressed in timber stock (m³, m³/ha) or by the surface area. To satisfy the basic principles of the sustainable forest management, the annual cut must not be larger than the increment value. The problem of deforestation in Croatia does not exist. According to present data the total forest area has not been reduced in the last 100 years.

The methodology used for CO₂ removal calculation is taken from the IPCC and it is based on data on annual increment, commercial roundwood fellings, fuelwood gathering and wildfires. GHG emissions are estimated only for aboveground and belowground biomass. Other carbon pools, dead wood, litter and soil, are not included due to lack of activity data. The figure ES.3-1 shows the CO₂ emission removal trend in the forestry sector.

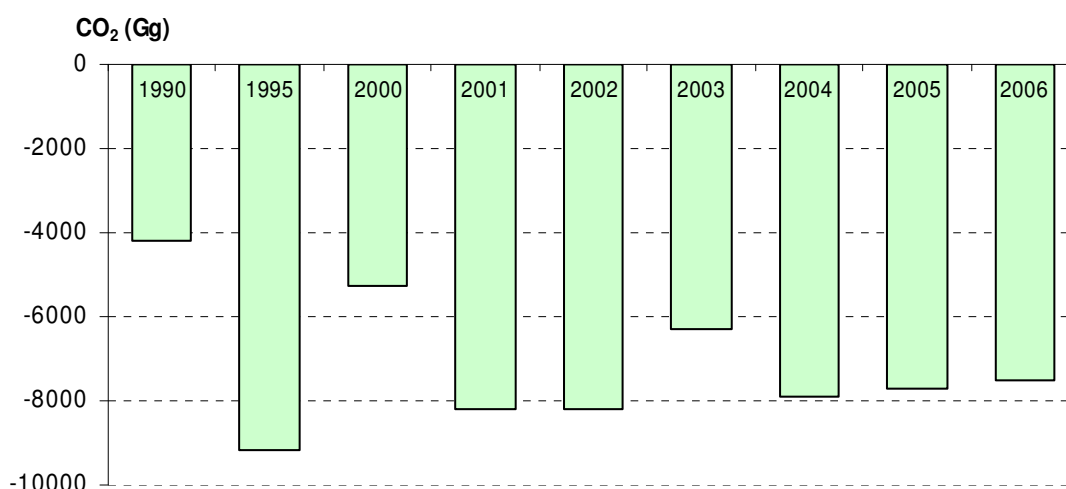


Figure ES.3-1: CO₂ emission removal in forestry sector from 1990-2006 (Gg CO₂)

ES.3.2. METHANE EMISSION (CH₄)

The major sources of methane (CH₄) emission are fugitive emission from production, processing, transportation and activities related with fuel use in Energy sector, Agriculture and Waste Disposal on Land. In table ES.3-7, sectoral and total CH₄ emissions are reported.

Table ES.3-7: CH₄ emission in Croatia in the period from 1990-2006 (Gg CH₄)

Source	1990	1995	2000	2001	2002	2003	2004	2005	2006
Energy	69.1	61.1	59.3	64.4	66.9	68.4	69.6	69.7	76.3
Industrial Processes	0.8	0.5	0.3	0.3	0.3	0.3	0.3	0.3	0.4
Agriculture	76.2	48.0	43.0	43.6	42.7	44.7	47.4	46.7	47.4
Waste	15.2	18.3	23.0	24.2	25.6	27.1	28.8	24.4	24.0
Total CH₄ emission	161.4	127.8	125.6	132.6	135.6	140.6	146.2	141.1	148.1

Fugitive methane emission is mainly the result of exploration, production, processing, transportation and distribution of natural gas (about 97 percent). The fugitive emission from oil accounts with about 0.6 percent; venting and flaring of gas/oil production accounts with approximately 2.4 percent. In 1999 by closing of the coal mines in Istra, large amount of fugitive emissions arising from the exploration, processing and transportation of coal, were avoided.

In the Agricultural sector there are two significant methane emission sources present: enteric fermentation in the process of digestion of ruminants (dairy cows represent the major source) and different activities related with storage and use of organic fertilizers (manure management). The total methane emission for domestic animals is being calculated as a sum of emission from enteric fermentation and emission related to manure management.

Methane emission from solid waste disposal sites (SWDSs) is a result of anaerobic decomposition of organic waste by methanogenic bacteria. The amount of methane emitted during the process of decomposition is directly proportional to the fraction of degradable organic carbon (DOC) which is defined as carbon content in different types of organic biodegradable wastes. In Croatia, more than million tons of municipal solid waste is produced annually and the

average composition of its biodegradable part is: paper and textile (21-22 percent), garden and park waste (18-19 percent), food waste (23-24 percent), wood waste and straw (3 percent). As for the wastewater handling in Croatia, aerobic biological process is used mostly in wastewater treatment. Anaerobic process is applied in some industrial wastewater treatment. Total amount of gas is flared in these treatments, and therefore all methane from gas is oxidized to carbon dioxide and water vapour. Disposal of domestic and commercial wastewater, particularly in rural areas where systems such as septic tanks are used, are partly anaerobic without flaring, which results with CH₄ emissions.

ES.3.3. NITROUS OXIDE EMISSION (N₂O)

The most important sources of N₂O emissions in Croatia are agricultural activities, nitric acid production, but as well, the N₂O emissions occur in energy sector and waste management. In table ES.3-8 the N₂O emission is reported according to sectors.

Table ES.3-8: N₂O emission in Croatia for the period from 1990-2006 (Gg N₂O)

Source	1990	1995	2000	2001	2002	2003	2004	2005	2006
Energy	0.4	0.3	0.5	0.5	0.5	0.6	0.7	0.7	0.7
Industrial Processes	3.0	2.7	2.8	2.3	2.3	2.1	2.6	2.5	2.5
Agriculture	9.5	7.0	7.7	8.3	8.1	7.8	8.2	8.3	8.1
Waste	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Total N₂O emission	13.2	10.3	11.2	11.4	11.2	10.8	11.8	11.8	11.6

In the Agricultural sector, three N₂O emission sources are determined: direct N₂O emission from agricultural soils, direct N₂O emission from livestock farming and indirect N₂O emission induced by agricultural activities. The largest emission is a result of direct emission from agricultural soils. According to IPCC methodology, the mineral nitrogen, nitrogen from organic fertilizers, amount of nitrogen in fixing crops, amount of nitrogen which is released from crop residue mineralization and soil nitrogen mineralization due to cultivation of histosols, are separately analyzed.

In the sector Industrial Processes the N₂O emission occurs in nitric acid production, which is used as a raw material in nitrogen mineral fertilizers. In the framework of the N₂O reduction measure analysis, the possibility for application of non-selective catalytic reduction device was considered, whereby the nitric acid production influence on N₂O emissions would be practically eliminated.

In Energy sector the emission was calculated on the basis of fuel consumption and adequate emission factors (IPCC). The N₂O emission increase in Energy sector is the consequence of greater use of three-way catalytic converters in road transport motor vehicles, which have about 30 times greater N₂O emission comparing to vehicles without a catalytic converter.

N₂O emission from the Waste sector indirectly occurs from the human sewage. It is calculated on the basis of the total number of inhabitants and annual protein consumption per inhabitant. Data on the annual per capita Protein intake value were obtained by the FAOSTAT Statistical Database. Extrapolation method has been used for calculation of insufficient data.

ES.3.4. HALOGENATED CARBONS (HFCs, PFCs) AND SF₆ EMISSIONS

Synthetic greenhouse gases include halogenated carbons (HFCs and PFCs) and sulphur hexafluoride (SF₆). Although on an absolute scale their emissions are not great, due to their high global warming potential (GWP) their contribution to global warming is considerable. According to survey carried out among major agents, users and consumers of these gases, information related to import and export of HFCs (provided by the Ministry of Environmental Protection, Physical Planning and Construction) was used for emission calculation which is presented in Gg of CO₂ eq and showed on the figure ES.3-2.

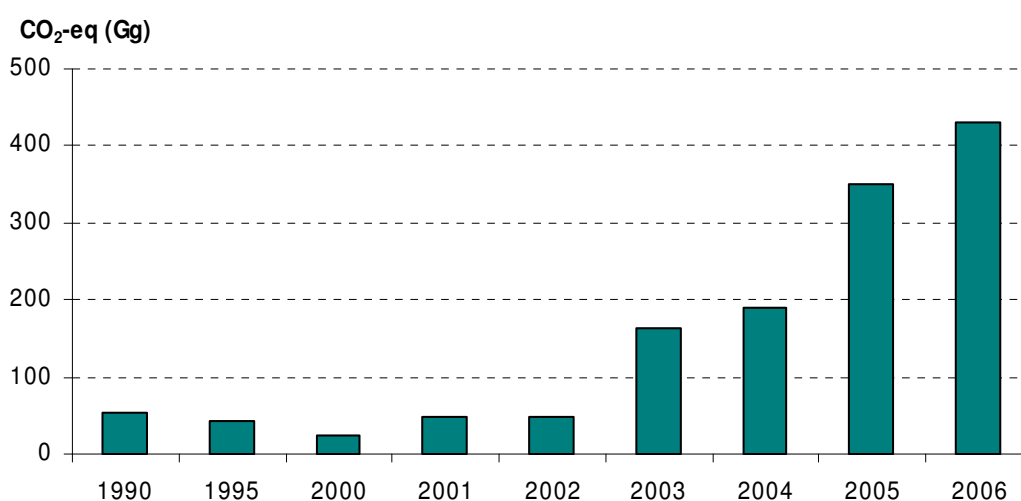


Figure ES.3-2: Halogenated carbons emission in the period from 1990-2006 (Gg CO₂-eq)

ES.4. EMISSION OF INDIRECT GREENHOUSE GASES

The photochemically active gases, carbon monoxide (CO), oxides of nitrogen (NO_x) and non-methane volatile organic compounds (NMVOCs) indirectly contribute to the greenhouse gas effect. These are generally called indirect greenhouse gases or ozone precursors, because they are involved in creation and degradation of ozone which is also one of the greenhouse gases. Sulphur dioxide (SO₂), as a precursor of sulphate and aerosols, is believed to contribute negatively to the greenhouse effect. The calculations of aggregated results for the emissions of indirect gases in the period 1990-2006 are given in table ES.4-1.

Table ES.4-1: Emissions of ozone precursors and SO₂ by different sectors (Gg)

Gas	Emissions (Gg)								
	1990	1995	2000	2001	2002	2003	2004	2005	2006
NO_x Emission	83.90	57.79	68.46	69.35	68.13	68.74	67.39	73.71	69.44
Energy Industries	13.61	10.30	11.99	11.58	13.19	13.77	11.20	12.04	11.14
Manufacturing Ind. & Construction	17.49	8.92	9.73	10.59	10.22	9.72	11.82	16.60	12.26
Transport	37.00	29.83	33.28	32.99	31.03	31.14	30.61	31.33	32.22
Other Energy (fuel combustion)	15.03	8.13	12.85	13.62	13.13	13.57	13.16	13.15	13.23
Fugitive Emission from Fuels	0.40	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Industrial Processes	0.37	0.31	0.31	0.27	0.26	0.24	0.30	0.29	0.29
CO Emission	499.40	336.37	374.94	320.46	303.48	318.93	305.36	326.48	332.10
Energy Industries	1.54	0.99	1.21	1.04	0.97	1.38	1.23	0.93	1.35
Manufacturing Ind. & Construction.	40.44	41.26	37.82	38.62	37.89	38.02	41.61	32.60	36.69
Transport	252.45	176.61	188.74	164.97	151.04	137.46	125.38	159.24	159.93
Other Energy (fuel combustion)	203.98	116.74	146.47	115.22	112.99	141.45	136.44	133.02	133.47
Fugitive Emission from Fuels	0.60	0.50	0.50	0.40	0.40	0.40	0.50	0.50	0.40
Industrial Processes	0.39	0.27	0.20	0.21	0.19	0.22	0.20	0.19	0.26
NM VOC Emission	108.19	78.78	86.33	88.22	90.31	97.85	101.92	110.45	73.03
Energy Industries	0.32	0.23	0.28	0.26	0.30	0.34	0.29	0.29	0.29
Manufacturing Ind. & Construction	1.70	1.37	1.44	1.47	1.44	1.73	1.93	1.76	3.33
Transport	40.93	29.99	32.89	27.38	25.56	22.06	19.44	18.46	18.49
Other Energy (fuel combustion)	12.15	6.91	9.01	7.48	7.29	8.82	8.50	8.30	8.38
Fugitive Emission from Fuels	8.20	7.80	9.70	10.40	10.80	10.50	9.70	9.10	8.90
Industrial Processes	17.51	9.04	7.53	7.39	8.23	8.34	9.14	10.29	10.20
Solvent Use	27.38	23.44	25.48	33.84	36.69	46.06	52.92	62.25	23.44
SO₂ Emission	175.34	81.49	69.93	69.90	75.62	74.20	61.66	67.92	67.22
Energy Industries	78.51	38.98	25.39	26.04	23.29	35.70	25.66	32.76	30.44
Manufacturing Ind. & Construction	55.84	24.66	22.59	24.88	29.93	15.62	11.82	10.29	11.59
Transport	5.33	3.46	6.01	4.91	6.30	7.44	7.93	8.48	9.02
Other Energy (fuel combustion)	23.87	4.65	6.50	6.09	7.97	7.48	6.92	6.63	5.85
Fugitive Emission from Fuels	6.40	5.00	4.80	4.50	4.50	4.50	4.70	4.60	4.40
Industrial Processes	5.39	4.74	4.64	3.48	3.63	3.46	4.63	5.16	5.92

1. INTRODUCTION

1.1. BACKGROUND INFORMATION ON GHG INVENTORIES AND CLIMATE CHANGE

The Republic of Croatia became a party to the United Nations Framework Convention on Climate Change (UNFCCC) on 17 January 1996 when the Croatian Parliament passed the law on its ratification (Official Gazette, International Treaties No. 2/96). For the Republic of Croatia the Convention came into force on 7 July 1996. As a country undergoing the process of transition to market economy, Croatia has, pursuant to Article 22, paragraph 3 of the Convention, assumed the commitments of countries included in Annex I. By the amendment that came into force on 13 August 1998 Croatia was listed among Parties included in Annex I to the Convention.

The Republic of Croatia signed the Kyoto Protocol on 11 March 1999. At the session of the Conference of Parties (COP 7) held in Marrakesh in 2001 the Republic of Croatia submitted a request for recognition of specific circumstances under Article 4, paragraph 6 of the Convention. The request was related to the increase of emissions level by 4.46 Mt CO₂-eq in the base year, i.e. 1990, based on the specific circumstance that Croatia has been integrated into the common economic, energy and infrastructural system of the former Yugoslavia in that year.

At the session of the COP 11 held in Montreal in 2005 the Decision 10/CP.11 was adopted allowing Croatia a certain degree of flexibility in determining the reference value of greenhouse gas emission levels compared to the historical level. At the session of the COP 12 held in Nairobi in 2006 the Decision 7/CP.12 was adopted allowing Croatia to add 3.5 Mt CO₂-eq to its 1990 level of greenhouse gas emissions for the purpose of establishing the level of emissions for the base year for implementation of its commitments under Article 4, paragraph 2, of the Convention.

The adoption of the Decision 7/CP.12 by the Conference of Parties was acknowledged by the Croatian Parliament which ratified the Kyoto Protocol on 27 April 2007 (Official Gazette, International Treaties No. 5/07). The Kyoto Protocol has entered into force in Croatia on 28 August 2007.

One of the commitments outlined in Article 4, paragraph 1 of the UNFCCC is that Parties are required to develop, periodically update, publish and make available to the Conference of the Parties, in accordance with Article 12, national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, using comparable methodologies to be agreed upon by the Conference of the Parties.

Furthermore, Article 5, paragraph 1 of the Kyoto Protocol requires that each Party included in Annex I shall have in place, no later than one year prior to the start of the first commitment period, a national system for the estimation of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol. A national system includes all institutional, legal and procedural arrangements made within a Party included in Annex I for estimating anthropogenic emissions by sources and removals by sinks of

all greenhouse gases not controlled by the Montreal Protocol, and for reporting and archiving inventory information.

The Republic of Croatia is also a country which is currently in the process of accession to the EU. Accession is conditioned by the harmonization, adoption and implementation of the entire *acquis communautaire*, i.e. the body of legislation and rules already implemented in the EU. This process is very complex and requires changes that are systemic in its nature particularly in institutional and legislative sphere. As a future EU member state, Croatia will have to implement legislation concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol, which also stipulates establishment of mechanism for monitoring emissions by sources and removals by sinks of greenhouse gases, evaluating progress towards meeting commitments in respect of these emissions and for implementing the UNFCCC and the Kyoto Protocol, as regards national programmes, inventories, national system and registries.

Taking into consideration abovementioned comprehensive reporting requirements and previous experience in preparation of annual inventory submissions, Ministry of Environmental Protection, Physical Planning and Construction as a national focal point has decided to enforce regulation which shall stipulate institutional and procedural arrangements for greenhouse gas monitoring and reporting in Croatia. In this regard the Regulation on Greenhouse Gas Emissions Monitoring in the Republic of Croatia came into force on 2 January 2007 (Official Gazette, No. 2/07) stipulated by Article 46. of the Air Protection Act (Official Gazette No. 178/04). It is important to emphasize that this inventory submission is the first which was prepared under the provisions of new Regulation.

In this NIR, the inventory of the emissions and removals of the greenhouse gases is reported for the period from 1990 to 2006. The NIR is prepared in accordance with the UNFCCC reporting guidelines on annual Inventories as adopted by the COP by its Decision 18/CP.8. The methodologies used in the calculation of emissions are based on the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC Guidelines)* and the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC Good Practice Guidance)* prepared by the Intergovernmental Panel on Climate Change (IPCC). As recommended by the IPCC Guidelines country specific methods have been used where appropriate and where they provide more accurate emission data. The important part of the inventory preparation is uncertainty assessment of the calculation and verification of the input data and results, all this with the aim to increase the quality and reliability of the calculation.

Furthermore, since the introduction of annual technical reviews of the national inventories by experts review teams (ERT), Croatia has undergone three reviews so far, in-country review in 2004 and centralized reviews in 2005 and 2006. Issues recommended by the ERT have been included in this report as far as possible.

The calculation includes the emissions which are the result of anthropogenic activities and these include the following greenhouse gases: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), halogenated carbons (HFCs, PFCs) and sulphur hexafluoride (SF₆) and indirect

greenhouse gases: carbon monoxide (CO), oxides of nitrogen (NO_x), non-methane volatile organic compounds (NMVOCs) and sulphur dioxide (SO₂). The greenhouse gases covered by Montreal Protocol on the pollutants related to ozone depletion (freons) are reported in the framework of this protocol and therefore are excluded from this Report.

Greenhouse gas emission sources and sinks are divided into six main sectors: Energy, Industrial Processes, Solvent and Other Product Use, Agriculture, Land Use, Land-Use Change and Forestry and Waste. Generally, the methodology for emission calculation could be described as a product of the particular economic activity (e.g. fuel consumption, cement production, number of animals, increase of wood stock etc.) with corresponding emission factors. The use of specific national emission factors is recommended wherever possible and justified, whereas on the contrary, the methodology gives typical values of emission factors for all relevant activities of the particular sectors.

1.2 BRIEF DESCRIPTION OF THE INSTITUTIONAL ARRANGEMENT FOR INVENTORY PREPARATION

Institutional arrangement for inventory preparation in Croatia is regulated in Part II. of the Regulation on greenhouse gas emissions monitoring in the Republic of Croatia, entitled National system for the estimation and reporting of anthropogenic greenhouse gas emissions by sources and removals by sinks. Institutional arrangements for inventory management and preparation in Croatia could be characterized as decentralized and out-sourced with clear tasks breakdown between participating institutions including Ministry of Environmental Protection, Physical Planning and Construction, Croatian Environment Agency and competent governmental bodies responsible for providing of activity data. The preparation of inventory itself is entrusted to Authorised Institution which is elected for three year period by public tendering.

Ministry of Environmental Protection, Physical Planning and Construction (MEPPPC) is a national focal point for the UNFCCC, with overall responsibility for functioning of the National system in a sustainable manner, including:

- mediation and exchange of data on greenhouse gas emissions and removals with international organisations and Parties to the Convention;
- mediation and exchange of data with competent bodies and organisations of the European Union in a manner and within the time limits laid down by legal acts of the European Union;
- control of methodology for emission calculation and greenhouse gas removal in line with good practices and national circumstances;
- consideration and approval of the Greenhouse Gas Inventory Report prior to its formal submission to the Convention Secretariat.

Croatian Environment Agency (CEA) is responsible for the following tasks:

- organisation of greenhouse gas inventory preparation with the aim of meeting the due deadlines referred to in Article 12 of this Regulation;

- collection of activity data referred to in Article 11 the Regulation;
- development of quality assurance and quality control plan (QA/QC plan) related to the greenhouse gas inventory in line with the guidelines on good practices of the Intergovernmental Panel on Climate Change;
- implementation of the quality assurance procedure with regard to the greenhouse gas inventory in line with the quality assurance and quality control plan;
- archiving of activity data on calculation of emissions, emission factors, and of documents used for inventory planning, preparation, quality control and quality assurance;
- maintaining of records and reporting on authorised legal persons participating in the Kyoto Protocol flexible mechanisms;
- reporting on modifications in the National System;
- selection of Authorised Institution (in Croatian: *Ovlaštenik*) for preparation of the greenhouse gas inventory.
- provide insight into data and documents for the purpose of technical reviews

Authorised Institution is responsible for preparation of inventory, which include:

- emission calculation of all anthropogenic emissions from sources and removals by greenhouse gas sinks, and calculation of indirect greenhouse gas emissions, in line with the methodology stipulated by the effective guidelines of the Convention, guidelines of the Intergovernmental Panel on Climate Change, Instructions for reporting on greenhouse gas emissions as published on the Ministry's website, and on the basis of the activities data referred to in Article 11 of this Regulation;
- quantitative estimate of the calculation uncertainty referred to in indent 1 of this Article for each category of source and removal of greenhouse gas emissions, as well as for the inventory as a whole, in line with the guidelines of the Intergovernmental Panel on Climate Change;
- identification of main categories of greenhouse gas emission sources and removals;
- recalculation of greenhouse gas emissions and removals in cases of improvement of methodology, emission factors or activity data, inclusion of new categories of sources and sinks, or application of coordination/adjustment methods;
- calculation of greenhouse gas emissions or removal from mandatory and selected activities in the sector of land use, land-use change and forestry;
- reporting on issuance, holding, transfer, acquisition, cancellation and retirement of emission reduction units, certified emission reduction units, assigned amount units and removal units, and carry-over, into the next commitment period, of emission reduction units, certified emission reduction units and assigned amount units, from the Registry in line with the effective decisions and guidelines of the Convention and supporting international treaties;
- implementation of and reporting on quality control procedures in line with the quality control and quality assessment plan;
- preparation of the greenhouse gas inventory report, including also all additional requirements in line with the Convention and supporting international treaties and decisions;

- cooperation with the Secretariat's ERTs for the purpose of technical review and assessment/evaluation of the inventory submissions.

EKONERG – Energy Research and Environmental Protection Institute was selected as Authorised Institution for preparation of 2008 inventory submission.

1.3. BRIEF DESCRIPTION OF THE PROCESS OF INVENTORY PREPARATION

Process of inventory preparation encompasses several steps starting with activity data collection and followed by emissions estimation and recalculations in accordance with the IPCC methodology and recommendations for improvements from the ERT review reports, compilation of inventory including the NIR and the CRF and in parallel implementation of general and source-category specific quality control procedures.

Activity data collection is under responsibility of Croatian Environment Agency which represents a hub between governmental and public institutions responsible for providing activity data and Authorised Institution responsible for inventory preparation. The scope and due dates for delivering activity data to CEA are prescribed by the Regulation. In addition several operators from energy and industrial sector were directly approached by the CEA and EKONERG for more detailed activity data since higher tier methods have been applied (see table 1.4-1 for details).

After activity data are collected and processed, inventory team performed emission estimations and recalculation in accordance with the IPCC methodology and taking into consideration recommendations for inventory improvements. Results are checked against quality control procedures in order to ensure data integrity, correctness and completeness.

It is important to emphasize that process of inventory preparation has been improved in recent submissions mainly as a result of activities carried out under the framework of two capacity building projects, i.e.:

- UNDP/GEF regional project "Capacity building for improving the quality of GHG inventories" in which following inventory related documents were prepared:
 - National GHG Inventory Improvement Strategy
 - National QA/QC plan
 - National QA/QC guidance
 - Manuals of procedures for compiling, archiving, updating and managing GHG Inventory
 - Description of inventory archives
 - Description of awareness-raising campaign
 - Improvement of GHG emission calculation from road transport
 - Improvement of methane emission calculations from waste disposal
- EC LIFE Third Countries project "Capacity building for implementation of the UNFCCC and the Kyoto Protocol in the Republic of Croatia" in which following inventory related documents were prepared:
 - Draft of National implementation strategy and action plan
 - Regulation on Greenhouse Gas Emissions Monitoring in the Republic of Croatia

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 - Draft of National implementation strategy and action plan
 - Regulation on greenhouse gas emissions monitoring in the Republic of Croatia

Since the introduction of annual technical reviews of the national inventories by experts review teams (ERT), Croatia has undergone three reviews so far, in-country review in 2004 and centralized reviews in 2005 and 2006. Issues recommended by the ERT have been included in this report as far as possible. In the latest review “Report of the individual review of the greenhouse gas inventory of Croatia submitted in 2006” the main findings of the ERT are that the inventory is well documented and that NIR and CRF are in conformity with the *Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories* and the *IPCC good practice guidance*. The ERT recognized the improvements made since the previous submissions.

1.4. BRIEF DESCRIPTION OF METHODOLOGIES AND DATA SOURCES USED

The methodologies from *Revised 1996 IPCC Guidelines for National GHG Inventories* and *Good Practice Guidance and Uncertainty Management in National GHG Inventories*, recommended by the UNFCCC were used for emission estimations of greenhouse gases which are result of anthropogenic activities, i.e. CO₂, CH₄, N₂O, HFCs, PFCs, SF₆, CO, NO_x, NMVOCs, and SO₂.

Carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) are principal greenhouse gases and though they occur naturally in the atmosphere, their recent atmospheric build-up appears to be largely the result of human activities. Synthetic gases such as halogenated hydrocarbons (PFCs, HFCs) and sulphur hexafluoride (SF₆) are also considered as greenhouse gases and they are solely the result of human activities. The methodology does not include the CFCs which are the subject of the Montreal Protocol. In addition, there are other photochemically active gases such as carbon monoxide (CO), oxides of nitrogen (NO_x) and non-methane volatile organic compounds (NMVOCs) that, although not considered as greenhouse gases, contribute indirectly to the greenhouse effect in the atmosphere. These are generally referred to as ozone precursors, because they participate in the creation and destruction of tropospheric and

stratospheric ozone (which is also GHG). Sulphur dioxide (SO₂), as a precursor of sulfate and aerosols, is believed to exacerbate the greenhouse effect because the creation of aerosols removes heat from the environment.

Generally, methodology applied to estimate emissions includes the product of activity data (e.g. fuel consumption, cement production, wood stock increment and so forth) and associated emission factor. The use of country-specific emission factors, if available, is recommended but these cases should be based on well-documented research. Otherwise, the *Revised 1996 IPCC Guidelines* provides methodology with default emission factors for different tiers. The emission estimates are divided into following sectors: Energy, Industrial Processes, Solvent and Other Product Use, Agriculture, Land Use, Land-Use Change and Forestry and Waste. Detailed description of the applied methodologies is described in sector specific chapters of the NIR from 3 to 9 and overview is given in the CRF tables 3s1-3s2.

The 2008 reporting cycle represents a transition from voluntary to in principal mandatory activity data collection system stipulated by the Regulation on Greenhouse Gas Emissions Monitoring in the Republic of Croatia. Activity data sources for inventory preparation are presented in the Table 1.4-1, but more detailed information is given in sectoral chapters.

Table 1.4-1: Data sources for GHG inventory preparation

CRF Sector/Sub-sector	Type of data	Source of data
Energy	<p>Energy balance</p> <p>Registered motor vehicles database</p> <p>Fuel consumption and fuel characteristic data for thermal power plants</p> <p>Fuel characteristic data</p> <p>Natural gas processed (scrubbed), CO₂ content before scrubbing and CO₂ emission</p>	<p>Ministry of Economy, Labour and Entrepreneurship with assistance of Energy Institute Hrvoje Požar</p> <p>Ministry of Interior</p> <p>Voluntary survey of HEP - Croatian Power Utility Company</p> <p>Voluntary survey of INA - Oil and Gas Company</p> <p>Voluntary survey of INA - Central Gas Station MOLVE</p>
Industrial Processes	<p>Activity data on production/consumption of material for particular industrial process</p> <p>Activity data on production/consumption of halogenated hydrocarbons (PFCs, HFCs) and sulphur hexafluoride (SF₆)</p> <p>Data on consumption and composition of natural gas in ammonia production</p>	<p>Central Bureau of Statistics, Department of Manufacturing and Mining</p> <p>Ministry of Environmental Protection, Physical Planning and Construction</p> <p>Voluntary survey of ammonia manufacturer (Petrokemija Fertilizer Company Kutina)</p>
Solvent and Other Product Use	Activity data on production for particular source category and number of inhabitants	Central Bureau of Statistics, Department of Manufacturing and Mining
Agriculture	<p>Livestock number</p> <p>Production of N-fixing crops and non N-fixing crops</p> <p>Area of histosols</p> <p>Activity data on mineral fertilisers applied in Croatia</p>	<p>Central Bureau of Statistics</p> <p>Central Bureau of Statistics</p> <p>Faculty of Agriculture</p> <p>Voluntary survey of Petrokemija Fertilizer Company Kutina</p>
LULUCF	Activity data on areas of different land use categories, annual increment and annual cut, fuel wood and wildfires	Ministry of Regional Development, Forestry and Water Management with assistance of public company "Hrvatske šume"
Waste	<p>Activity data on municipal solid waste disposed to different types of SWDSs</p> <p>Activity data on wastewater handling</p> <p>Activity data on waste incineration</p>	<p>Ministry of Environmental Protection, Physical Planning and Construction;</p> <p>Croatian Environment Agency</p> <p>State company Croatian Water Resources Management (Hrvatske vode)</p> <p>Croatian Environment Agency</p>

1.5. BRIEF DESCRIPTION OF KEY CATEGORIES

According to the *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* key categories are those which represent 95% of the total annual emissions in the last reported year or belonging to the total trend, when ranked from contributing the largest to smallest share in annual total and in the trend.

The analysis is based on the contribution of CO₂ equivalents from different sources and sinks on the sectoral level. The recommended IPCC categories as well as the categories recommended in *Good Practice Guidance for Land Use, Land-Use Change and Forestry* to be assessed in the key category analysis are presented in Table A1-1 of the Annex 1. Furthermore, Croatian experts determined certain sub-categories which are particularly significant, such as CO₂ Emission from Natural Gas Scrubbing (also shown in Table A1-1 of the Annex 1).

The results of the Level Assessment including/excluding LULUCF are shown in Table A1-2 and Table A1-3 respectively, with the key categories shaded. The key categories are sorted in descending order of magnitude and the cumulative total is included in the final column of the table.

The results of the Trend Assessment including/excluding LULUCF are shown in Table A1-4 and Table A1-5 respectively, with the key categories shaded. The key categories are sorted in descending order of magnitude, and the cumulative total is shown in the final column of the table.

Finally, the results of the Key Category analysis including/excluding LULUCF are summarized by sector and gas in Table A1-6 and A1-7 respectively. The tables indicate whether the key category arises from the level assessment or the trend assessment or both level and trend assessment.

Some changes in the Key Categories occurred in NIR 2008 in relation to NIR 2007, e.g. Mobile combustion: Agriculture/Forestry/Fishing, Ferroalloys Production and Aluminium Production are excluded from Trend Assessment. Furthermore, Lime production is included in Key Category (Level and Trend Assessment). These changes are shown in Table A1-8.

1.6. INFORMATION ON THE QA/QC PLAN INCLUDING VERIFICATION AND TREATMENT OF CONFIDENTIALITY ISSUES

1.6.1. QA/QC PLAN

According to Good Practice Guidance and Uncertainty Management in National GHG Inventories, QA/QC plan is an internal document to organize, plan, and implement QA/QC activities. Croatia has prepared QA/QC plan for 2008 reporting cycle following the recommendations from document Quality Assurance and Quality Control Plan, Samples and Manual for Development which was prepared under regional UNDP/GEF project Capacity building for improving the quality of GHG inventories (RER/01/G31).

QA/QC plan follows the proposed cycle of activities including:

- Development and approval of QA/QC plan (QA/QC manager and Inventory team leader);
- Data checking and inventory reviewing activities (QA/QC manager and sectorial experts);
- Compilation of findings (QA/QC manager);
- Recommendations for corrective actions (QA/QC manager);
- Implementing and reporting corrective actions (sectorial experts);
- Reporting (QA/QC manager).

Quality control activities are focused on following elements of inventory preparation process:

- Activity data gathering and handling activities;
- Activity data documentation and archiving;
- Choice of emission factors and emissions estimation.

General (Tier 1) and source-specific (Tier 2) QC procedures for each QC activity outlined in *Good Practice Guidance and Uncertainty Management in National GHG Inventories* were followed. In that regard Manuals of procedures for Compiling, Archiving, Updating and Managing of GHG Inventory were prepared for all IPCC sectors² in order to support inventory team with comprehensive guidelines for choice of methodology, emission factors and activity data, uncertainty estimates, QA/QC activities, reporting and documentation and inventory improvement plan. These guidelines are in accordance with *IPCC Guidelines and Good Practice Guidance* but also contain detail information on national circumstances particularly related to status of activity data, data gaps and short- and medium-term actions for improvement of the inventory.

For the purposes of transparency of the emission calculation, inventory team has continued with preparation of Inventory Data Record Sheets which were introduced in 2001 submission and which contain details of the person and/or organization responsible for an emission estimate, the primary or secondary sources of activity data and emission factors used, the methodology

² UNDP/GEF regional project "Capacity building for improving the quality of GHG inventories"

applied, data gaps, ways to cross-check, suggestion for future improvement in the estimates and relevant bibliographic references. The information provided in Inventory Data Record Sheets is available for each source category and for the entire time-series. An example of Inventory Data Record Sheet for 2006 in Waste sector is presented in Annex 6, Table A6-1.

During the preparation of the NIR a number of checks were carried out by sector experts related to completeness, consistency, comparability, recalculation and uncertainty of activity data, emission factors and emission estimates. The details on these issues are elaborated in the NIR and the CRF.

Finally, before submitting this NIR an audit has been carried out by designated QA/QC manager. The audit covered all IPCC sectors in the NIR with purpose to check which quality control elements, both general and specific, as defined in the *IPCC Good Practice Guidance*, are already implemented by sector experts and which improvements and corrective actions should be carried out in the future submissions. It is also important to mention that EKONERG - Energy Research and Environmental Protection Institute is certified against ISO 9001:2000 and that all activities should be conducted in line with internal quality management system procedures.

1.6.2. VERIFICATION AND CONFIDENTIALITY ISSUES

The verification process of calculation is aimed at the improvement of the input quality and identification of the calculation reliability. The *IPCC Guidelines* recommend that inventories should be verified through the use of a set of simple checks for completeness and accuracy, such as checks for arithmetic errors, checks of country estimates against independently published estimates, checks of national activity data against international statistics and checks of CO₂ emissions from fuel combustion calculated using sectoral methods with the IPCC Reference Approach. Further verification checks may be done through comparison with other national inventory calculation data.

In the development of the Croatian inventory, certain steps and some of these checks were performed:

- Comparison with the national inventory data of other countries was conducted by comparing CRF tables or through a direct communication;
- Activity data were compared using different sources such as Croatian Bureau of Statistics and individual emission sources;
- The CO₂ emissions from fossil fuel combustion, within the framework of IPCC methodology, are estimated using two approaches: (1) Reference Approach and (2) Sectoral Approach (Tier 1).

1.7. GENERAL UNCERTAINTY EVALUATION

The uncertainties associated with both annual estimates of emissions, and emission trends over time are reported according to the *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. The Croatian inventory team estimates uncertainties

using Tier 1 method described by the IPCC, which provides estimates of uncertainties by pollutant. The uncertainties are estimated for both excluding LULUCF and including LULUCF due to the *Good Practice Guidance for Land Use, Land-Use Change and Forestry*.

According to the uncertainty analysis the total uncertainty excluding LULUCF is 15.0 percent, while the total uncertainty including LULUCF is 16.0 percent. The uncertainty introduced into the trend in total national emissions excluding LULUCF is estimated to be 4.5 percent and including LULUCF 10.1 percent. The combined uncertainty as a share of total emissions is dominated by CH₄ emissions from fugitive emissions from oil and gas operations (uncertainty of the 14.3 percent excluding LULUCF and 11.5 percent including LULUCF). Furthermore, LULUCF sources/sink shows quite large uncertainty of 10.6 percent.

The results of the Tier 1 approach are shown in Table A5-1 and A5-2 (Annex 5), where the shaded rows represent key categories.

1.8. GENERAL ASSESSMENT OF THE COMPLETENESS

Croatian inventory consists of the emission estimates for the period from 1990-2006.

The completeness is evaluated following the IPCC methodology and appropriate use of the following notation keys: *NO* (not occurred); *NE* (not estimated); *NA* (not applicable); *IE* (included elsewhere); *C* (confidential). Detailed description by activities and gases of the status of the emission calculation is given in corresponding CRF tables.

Generally, the objective of the completeness is achieved in compliance with the capabilities of the Republic of Croatia in collecting adequate and acceptable activity data. The issues related with lack of activity data are described in sectoral chapters where necessary. The aim of the Croatian inventory is to include all antropogenic sources of GHGs in the future.

The summary of the “not estimated” sources/sinks is given in Annex 4 – Assessment of completeness and (potential) sources and sinks of greenhouse gas emissions and removals excluded, Table A4-1.

2. TRENDS IN GREENHOUSE GAS EMISSIONS

2.1. BRIEF DESCRIPTION AND INTERPRETATION OF EMISSION TRENDS FOR AGGREGATED GREENHOUSE GAS EMISSIONS

The total GHG emissions in 2006, excluding removals by sinks, amounted to 30.834 mill. t CO₂-eq (equivalent CO₂ emissions), which represents 5.2 percent emissions reduction compared to GHG emission in the year 1990.

Overall decline of economic activities and energy consumption in the period 1991-1994, which was mainly the consequence of the war in Croatia, had directly caused the decline in total emissions of greenhouse gases in that period. With the entire national economy in transition process, some energy intensive industries reduced their activities or phased out certain productions (e.g. blast furnaces in Sisak, primary aluminium production in Šibenik, coke plant in Bakar), which was considerably reflected in GHG emissions reduction. Emissions have started to increase in the 1995 at an average rate of 2.8 percent per year. The main reason of GHG emission increase was Energy sector (Public electricity and Heat production and Transport) and Industrial processes (production of cement, lime and ammonia; consumption of HFCs)

2.2. BRIEF DESCRIPTION AND INTERPRETATION OF EMISSION TRENDS BY GAS

The shares of GHG emission have not significantly changed during the entire period. The CO₂ is the largest anthropogenic contributor to total national GHG emissions. In 2006 the shares of GHG emissions were as follows: 76.9 percent CO₂, 10.1 percent CH₄, 11.7 percent N₂O and 1.4 percent HFCs. The trend of aggregated emissions/removals, divided by gasses, is shown in the Table 2.2-1 and the Figure 2.2-1.

Table 2.2-1: Aggregated emissions and removals of GHG by gases (1990-2006)

Gas	Emissions and removals of GHG (Gg CO ₂ -eq)								
	1990	1995	2000	2001	2002	2003	2004	2005	2006
CO ₂	24069	17007	20102	21018	21994	23577	23180	23595	23699
CH ₄ as CO ₂ -eq	3390	2684	2638	2785	2847	2953	3070	2962	3110
N ₂ O as CO ₂ -eq	4079	3197	3465	3531	3463	3352	3649	3654	3594
HFCs as CO ₂ -eq	53	43	23	49	49	164	189	349	431
PFCs as CO ₂ -eq	937	0	0	0	0	0	0	0	0
SF ₆ as CO ₂ -eq	NE	NE	NE	NE	NE	NE	NE	NE	NE
Total GHG emission	32527	22930	26228	27383	28353	30045	30088	30561	30834
Removals (CO ₂)	-4185	-9154	-5281	-8214	-8206	-6276	-7900	-7726	-7490
Total emission (including LULUCF)	28342	13776	20947	19169	20148	23768	22189	22835	23344

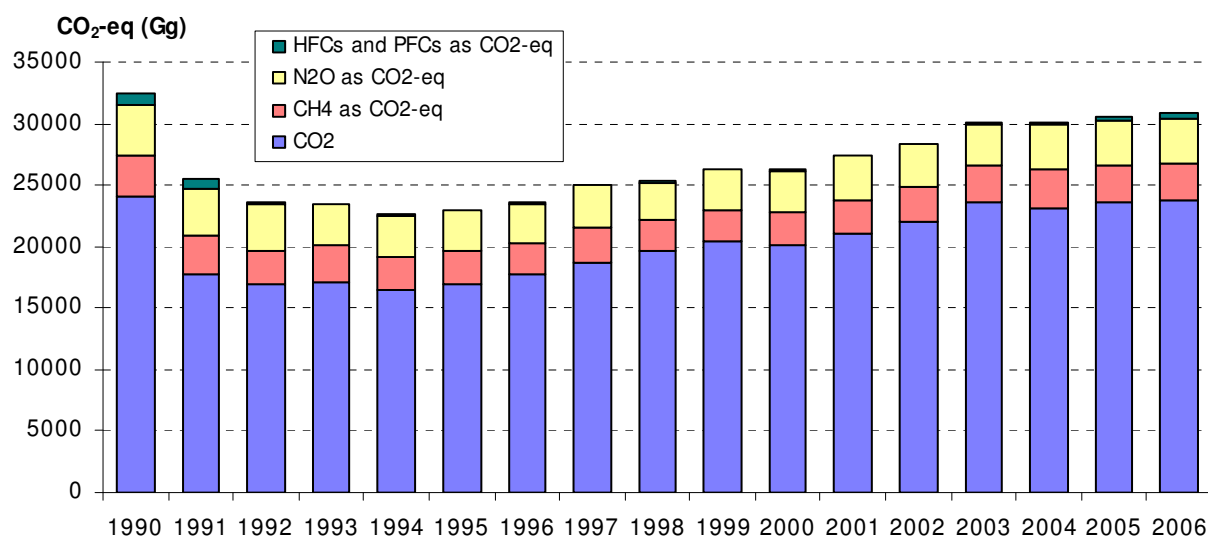


Figure 2.2-1: Trend of GHG emissions, by gases

2.2.1. CARBON DIOXIDE – CO₂

The most significant anthropogenic greenhouse gas is carbon dioxide (CO₂). In 2006, CO₂ emission was 2 percent smaller than in 1990. CO₂ removals by sinks were almost 79 percent larger than removals in 1990. The largest CO₂ emission growth was in Energy sector (Road Transport and Public Electricity & Heat Production) and Industrial processes. There was a permanent increase in mobility (number of road vehicles) and therefore increase in motor fuel

consumption in last ten years. There was also a significant increase in electricity demand and supply. Consequently, two new thermal power plants were installed in last few years (coal burned thermal power plant - 210 MW and combined cycled gas turbine – 200 MW). The largest CO₂ emission growth in Industrial Processes is in Mineral production (Cement and Lime) and Chemical industry (Ammonia production).

2.2.2. METHANE – CH₄

The CH₄ emission in 2006 was 8 percent below the emission in 1990, largely due to decrease in emission in Agriculture sector (Enteric Fermentation and Manure Management), as a consequence of lower number of domestic animals.

2.2.3. NITROUS OXIDE – N₂O

The N₂O emission in 2006 was 12 percent lower than emission in 1990. Decrease of emission was in Energy Sector (Manufacturing Industries and Construction and Other Sectors), Industrial Processes (Nitric Acid Production) and Agriculture (N₂O emission from manure management, Direct emission from agriculture soils, Direct N₂O emissions from animals, Indirect N₂O emission from nitrogen used in agriculture).

2.2.4. FLUOROCARBONS – HFCS AND PFCs

PFCs emissions were generated in the production of primary aluminium. The Croatian aluminium industry was still operational in 1990/1991, but production was stopped in 1992. HFCs were used as substitutes for cooling gases in refrigerating and air-conditioning systems that deplete the ozone layer. According to provided calculations, the contribution of F-gases in total national GHG emission in 2006 was 1 percent.

2.2.5. SULPHUR HEXAFLUORIDE SF₆

The SF₆ emission estimation is still not included in the inventory, because the input data is not reliable.

2.3. BRIEF DESCRIPTION AND INTERPRETATION OF EMISSION TRENDS BY CATEGORY

According to the UNFCCC reporting guidelines and IPCC methodological guidelines, total national emission are divided into six sectors: Energy, Industrial Processes, Solvent and Other Product Use, Agriculture, Land Use, Land-Use Change and Forestry and Waste. The total national GHG emissions and removals, divided by sectors, are presented in the Table 2.3-1 and the Figure 2.3-1.

Table 2.3-1: Aggregated emissions and removals of GHG by sectors (1990-2006)

Source	Emissions and removals of GHG (Gg CO ₂ -eq)								
	1990	1995	2000	2001	2002	2003	2004	2005	2006
Energy	22882	16400	18907	19953	21074	22580	22048	22411	22548
Industrial Processes	4609	2785	3400	3271	3148	3346	3659	3833	4004
Solvent and Oth.Prod.Use	80	80	69	75	99	108	135	155	182
Agriculture	4558	3191	3285	3485	3400	3348	3549	3560	3507
Waste	399	475	567	599	633	663	697	601	591
Total GHG emission	32527	22930	26228	27383	28353	30045	30088	30561	30834
Removals (LULUCF)	-4185	-9154	-5281	-8214	-8206	-6276	-7900	-7726	-7490
Total emission (including LULUCF)	28342	13776	20947	19169	20148	23768	22189	22835	23344

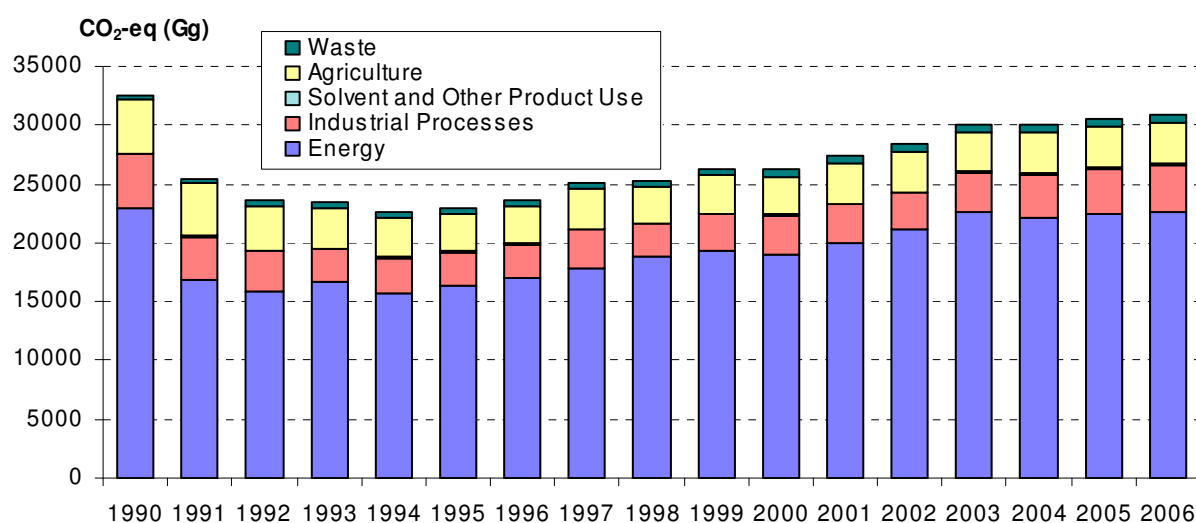


Figure 2.3-1: Trend of GHG emissions, by sectors

2.3.1. ENERGY

The most important IPCC sector in Croatia is Energy sector. The Energy sector accounted for some 73 percent of the total national GHG emissions (presented as equivalent emission of CO₂). In 2006 the GHG emission from Energy was 1 percent smaller than emission in 1990.

2.3.2. INDUSTRIAL PROCESSES

Industrial Processes contributes to total GHG emission with approximately 13 percent, depending on the year. There was a significant decrease of GHG emission from Industrial Processes. The GHG emission in 2006 was 13 percent lower than emission in 1990.

2.3.3. SOLVENT AND OTHER PRODUCT USE

Solvent and Other Product Use contributes to total GHG emission with some 0.3 - 0.6 percent of the total national GHG emissions (presented as equivalent emission of CO₂). The GHG emission in 2006 was still 56 percent larger than emission in 1990.

2.3.4. AGRICULTURE

The GHG emissions from Agriculture have also a decreasing trend. The GHG emission in 2006 was 22 percent lower in comparison with 1990 emission. According to estimation of Croatian experts for agriculture, approximately 11 percent of total GHG emissions belong to Agriculture.

2.3.5. WASTE

Emissions from Waste sector have been constantly increasing in the period 1990-2006. Increasing emissions are a consequence of greater quantities of waste, activities in wastewater handling and waste incineration. The GHG emission in 2006 was 33 percent larger in comparison with 1990 emission. Contribution of waste sector to total GHG emission is approximately 2 percent.

2.4. BRIEF DESCRIPTION AND INTERPRETATION OF EMISSION TRENDS FOR INDIRECT GREENHOUSE GASSES AND SO₂

Although they are not considered as greenhouse gases, photochemical active gases such as carbon monoxide (CO), oxides of nitrogen (NO_x) and non-methane volatile organic compounds (NMVOCs) indirectly contribute to the greenhouse effect. These are generally referred to as indirect greenhouse gases or ozone precursors, because they take effect in the creation and degradation of O₃ as one of the GHGs. Sulphur dioxide (SO₂), as a precursor of sulphate and aerosols, is believed to contribute negatively to the greenhouse effect. The emissions of ozone precursors and SO₂ are shown in the Table 2.4-1.

Table 2.4-1: Emissions of ozone precursors and SO₂ by different sectors (Gg)

Gas	Emissions (Gg)								
	1990	1995	2000	2001	2002	2003	2004	2005	2006
NO_x Emission	83.90	57.79	68.46	69.35	68.13	68.74	67.39	73.71	69.44
Energy Industries	13.61	10.30	11.99	11.58	13.19	13.77	11.20	12.04	11.14
Manufacturing Ind. & Construction	17.49	8.92	9.73	10.59	10.22	9.72	11.82	16.60	12.26
Transport	37.00	29.83	33.28	32.99	31.03	31.14	30.61	31.33	32.22
Other Energy (fuel combustion)	15.03	8.13	12.85	13.62	13.13	13.57	13.16	13.15	13.23
Fugitive Emission from Fuels	0.40	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Industrial Processes	0.37	0.31	0.31	0.27	0.26	0.24	0.30	0.29	0.29
CO Emission	499.40	336.37	374.94	320.46	303.48	318.93	305.36	326.48	332.10
Energy Industries	1.54	0.99	1.21	1.04	0.97	1.38	1.23	0.93	1.35
Manufacturing Ind. & Construction.	40.44	41.26	37.82	38.62	37.89	38.02	41.61	32.60	36.69
Transport	252.45	176.61	188.74	164.97	151.04	137.46	125.38	159.24	159.93
Other Energy (fuel combustion)	203.98	116.74	146.47	115.22	112.99	141.45	136.44	133.02	133.47
Fugitive Emission from Fuels	0.60	0.50	0.50	0.40	0.40	0.40	0.50	0.50	0.40
Industrial Processes	0.39	0.27	0.20	0.21	0.19	0.22	0.20	0.19	0.26
NMVOC Emission	108.19	78.78	86.33	88.22	90.31	97.85	101.92	110.45	73.03
Energy Industries	0.32	0.23	0.28	0.26	0.30	0.34	0.29	0.29	0.29
Manufacturing Ind. & Construction	1.70	1.37	1.44	1.47	1.44	1.73	1.93	1.76	3.33
Transport	40.93	29.99	32.89	27.38	25.56	22.06	19.44	18.46	18.49
Other Energy (fuel combustion)	12.15	6.91	9.01	7.48	7.29	8.82	8.50	8.30	8.38
Fugitive Emission from Fuels	8.20	7.80	9.70	10.40	10.80	10.50	9.70	9.10	8.90
Industrial Processes	17.51	9.04	7.53	7.39	8.23	8.34	9.14	10.29	10.20
Solvent Use	27.38	23.44	25.48	33.84	36.69	46.06	52.92	62.25	23.44
SO₂ Emission	175.34	81.49	69.93	69.90	75.62	74.20	61.66	67.92	67.22
Energy Industries	78.51	38.98	25.39	26.04	23.29	35.70	25.66	32.76	30.44
Manufacturing Ind. & Construction	55.84	24.66	22.59	24.88	29.93	15.62	11.82	10.29	11.59
Transport	5.33	3.46	6.01	4.91	6.30	7.44	7.93	8.48	9.02
Other Energy (fuel combustion)	23.87	4.65	6.50	6.09	7.97	7.48	6.92	6.63	5.85
Fugitive Emission from Fuels	6.40	5.00	4.80	4.50	4.50	4.50	4.70	4.60	4.40
Industrial Processes	5.39	4.74	4.64	3.48	3.63	3.46	4.63	5.16	5.92

3. ENERGY (CRF sector 1)

3.1. OVERVIEW OF SECTOR

3.1.1. INTRODUCTION

This sector covers all activities that involve fuel combustion from stationary and mobile sources, and fugitive emission from fuels.

The Energy sector is the main cause for anthropogenic emission of greenhouse gases. It accounts for approximately 75 percent of the total emission of all greenhouse gases presented as equivalent emission of CO₂. Looking at its contribution to total emission of carbon dioxide (CO₂), the energy sector accounts for about 90 percent. The contribution of energy in methane (CH₄) emission is substantially smaller (49 percent) while the contribution of nitrous oxide (N₂O) is quite small (about 6 percent).

During complete combustion, the carbon contained in fuel oxidizes and transforms into CO₂, while through the incomplete combustion the small amounts of CH₄, CO and NMVOC emissions also appear. The CO₂ is the most important greenhouse gas from fuel combustion. The emission of CO₂ depends on the quantity and type of the fuel used. The specific emission is the highest during combustion of coal, then oil and natural gas. A rough ratio of specific emission during combustion of the stated fossil fuels is 1 : 0.75 : 0.55 (coal : oil : gas).

There are some other gases generated from fuel combustion such as methane (CH₄) and nitrous oxide (N₂O), and indirect greenhouse gases such as nitrogen oxides (NO_x), carbon monoxide (CO) and non-methane volatile organic compounds (NMVOC). The indirect greenhouse gases participate in the process of creation and destruction of ozone, which is one of the GHGs. In the framework of the IPCC methodology, the calculation of sulphur dioxide (SO₂) emission is also recommended. The sulphur dioxide as a precursor of sulphate and aerosols, is believed to have a negative impact on the greenhouse effect because the creation of aerosols removes heat from the environment.

The fuel fugitive emission is also estimated, which is generated during production, transport, processing, storing, and distribution of fossil fuels. These activities produce mainly the emission of CH₄, and smaller quantities of NMVOC, CO and NO_x.

Emissions from fossil fuel combustion comprise the majority (more than 90 percent) of energy-related emissions. Contribution of individual subsectors to emission of greenhouse gases, for the last estimated year (2006), is presented in the Figure 3.1-1.

Greenhouse gases are also generated during combustion of biomass and biomass-based fuels. The CO₂ emission from biomass, in line with IPCC guidelines, is not included into the national emission totals because emitted CO₂ had been previously absorbed from the atmosphere for growth and development of biomass. Removal or emission of CO₂ due to the changes in the forest biomass is estimated in the sector of Land Use, Land-use Change and Forestry.

The emission from fuel combustion in international air and waterborne transport is reported separately and it has not been included in the national emission totals.

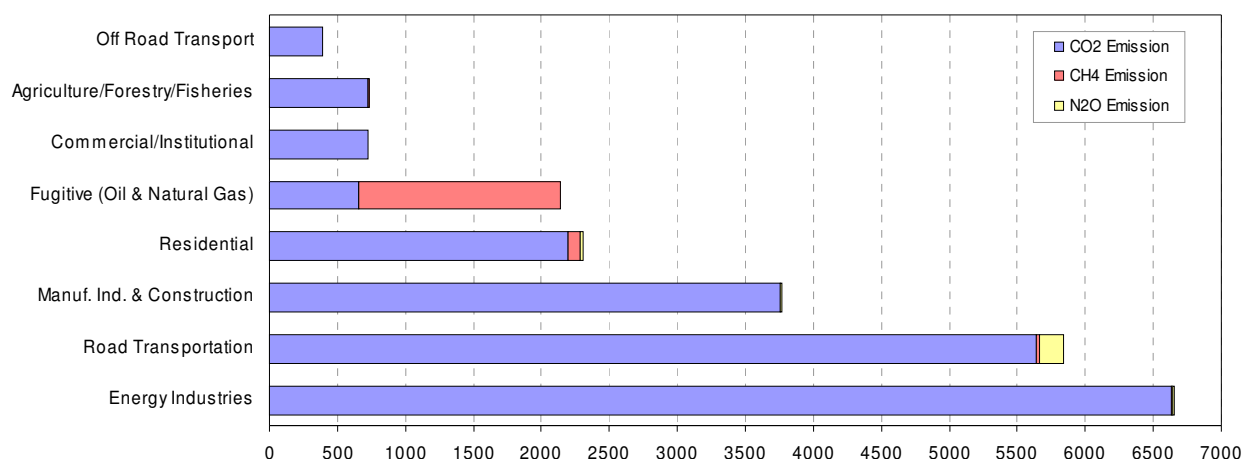


Figure 3.1-1: The contribution of different subsectors to GHG emission, year 2006

3.1.2. ENERGY STRUCTURE

The basis for estimates of the GHG emissions from Energy sector is the national energy balance. Data on production, imports, exports, stock change and consumption of fuels are reported both in natural units (kg or m³) and energy units (J). National energy balance for 2006 is presented in Annex 3.

For easier comparison of data from energy balance the natural units are transformed to energy units by using appropriate national net calorific values for different fuels. The structure of energy consumption of fossil fuels from 1990 to 2006 is shown in Figure 3.1-2.

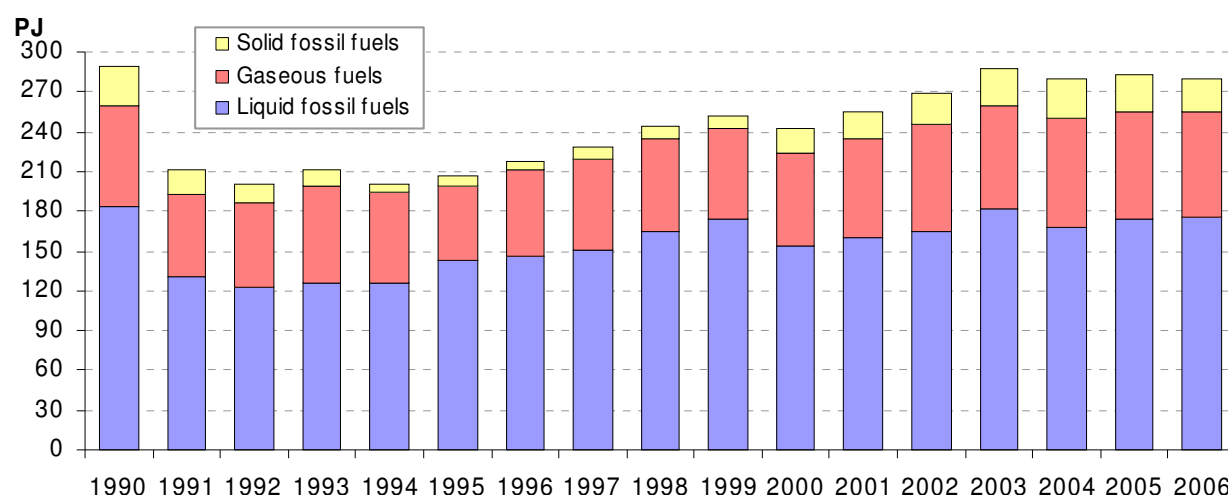


Figure 3.1-2: Structure of energy consumption

Liquid fossil fuels are mainly used with share between 60 to 70 percent, and natural gas with approximately 30 percent, while share of solid fossil fuels is 3-11 percent. Fuel woods and biomass-based fuels are neutral with regard to CO₂ emission. Therefore, they are not shown in the Figure 3.1-2.

3.1.3. COMPARISON OF THE SECTORAL APPROACH WITH THE REFERENCE APPROACH

The methodology used for estimating CO₂ emissions follows the *Revised 1996 IPCC Guidelines*. The emission of CO₂ is calculated using two different approaches: Reference approach and Sectoral approach. Sectoral emission estimates are based on fuel consumption data given in National Energy Balance, where energy demand and supply is given at sufficiently detailed level, what allows emissions estimation by sectors and subsectors. In Reference approach the input data are production, import, export, international bunkers and stock change for primary and secondary fuel. Comparison between these approaches was made and presented in Annex 3. The total differences in fuel consumption and CO₂ emissions for chosen years are given in Table 3.1-1.

Table 3.1-1: The fuel consumption and CO₂ emissions from fuel combustion (Reference & Sectoral approach)

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Fuel consumpt. (PJ)									
Reference appr.	292.93	206.04	241.32	256.54	278.89	289.38	281.59	285.25	284.04
Sectoral appr.	288.59	206.44	241.74	254.54	268.94	287.09	279.58	282.91	280.53
Relative Differ. (%)	1.50	-0.20	-0.17	0.79	3.70	0.80	0.72	0.83	1.25
CO ₂ Emission (Gg)									
Reference appr.	21068	15230	17935	18744	20336	21330	20798	21167	20924
Sectoral appr.	20898	14332	16885	17759	18835	20268	19673	20055	20063
Relative Differ (%)	0.82	6.26	6.22	5.55	7.97	5.24	5.72	5.55	4.30

The CO₂ emission calculated by Reference approach is higher in comparison to Sectoral approach. The reason is that CO₂ emission from non-energy fuel consumption is calculated

under Reference approach while it is not accounted for under Sectoral approach, since it is reported in Industrial processes.

3.1.4. INTERNATIONAL BUNKER FUELS

The CO₂ emissions from the consumption of fossil fuels for aviation and marine international transport activities, as required by the IPCC methodology, are reported separately and not included in national emission totals. The fuel consumption (PJ) for International Aviation and Marine Bunkers and GHG emissions for observed period are shown in the Table 3.1-2.

International marine bunkers are included in national energy balance for the period from 1994 to 2006, as separate data. Until the year 1994, international marine bunkers are based on expert estimation. According to suggestion of review team the disaggregation of fuel between international and domestic aviation was recalculated based on International Energy Agency (IEA) data. International aviation bunker was included in national energy balance data first time for the year 2004.

Table 3.1-2: Fuel consumption and GHG emissions for International aviation and marine bunkers, from 1990 to 2006

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Fuel combustion (PJ)									
Aviation bunkers	2.11	NO	NO	1.41	2.81	2.51	2.37	2.51	2.68
Marine bunkers	1.44	0.95	1.07	1.52	1.83	1.36	1.52	0.97	1.08
Total bunkers	3.55	0.95	1.07	2.92	4.64	3.86	3.90	3.48	3.76
CO₂-eq emission (Gg)									
Aviation bunkers	149.38	NO	NO	99.59	199.18	177.39	168.06	177.39	189.84
Marine bunkers	108.69	71.43	80.74	114.70	138.52	102.15	115.07	73.73	81.11
Total bunkers	258.08	71.43	80.74	214.29	337.70	279.54	283.13	251.00	270.81

Table 3.1-2: Fuel consumption and GHG emissions for International aviation and marine bunkers, from 1990 to 2006 (cont.)

	1999	2000	2001	2002	2003	2004	2005	2006
Fuel combustion (PJ)								
Aviation bunkers	1.58	1.41	0.88	0.84	1.01	1.23	1.70	1.70
Marine bunkers	0.88	0.76	1.19	0.98	0.91	0.97	1.05	0.81
Total bunkers	2.46	2.16	2.07	1.81	1.92	2.20	2.74	2.51
CO₂-eq emission (Gg)								
Aviation bunkers	112.04	99.59	62.24	59.13	71.58	87.14	120.13	120.44
Marine bunkers	65.77	57.10	89.49	73.34	68.76	73.17	79.09	61.07
Total bunkers	177.70	156.59	151.60	132.36	140.24	160.19	199.09	181.51

3.1.5. FEEDSTOCKS AND NON-ENERGY USE OF FUELS

Non-energy fuel consumptions (fuels used as feedstock) and appropriate emissions, where one part or even the whole carbon is stored in product for a longer time and the other part oxidizes and goes to atmosphere, are described here. The feedstock use of energy carriers occurs in chemical industry (natural gas consumption for ammonia production, production of naphtha, ethane, paraffin, and wax), construction industry (bitumen production), and other products such

as motor oil, industrial oil, grease etc. As a result of non-energy use of bitumen in construction industry there is no CO₂ emission because all carbon is bound to the product. In order to avoid double counting, CO₂ emission in non-energy consumption of natural gas in ammonia production, as well as non-energy consumption of naphta, lubricants, ethane and other, was estimated in sector Industrial Processes.

3.1.6. CO₂ CAPTURE FROM FLUE GASES AND SUBSEQUENT CO₂ STORAGE

There are no plants in operation for recovery and storage of CO₂ in Croatia, although there are plans for storage of CO₂ in two oil fields in central part of Croatia as part of EOR project conducted by INA - Oil company. Natural gas produced in Croatian gas fields contains a large amount of CO₂, more than 15 percent, and before coming to commercial pipeline has to be cleaned (scrubbed), but CO₂ is emitted without capture and storage. The CO₂ emission from gas scrubbing in Central Gas Station Molve, estimated by material balance method, is described in the Chapter 3.3.1.2.

3.1.7. COUNTRY-SPECIFIC ISSUES

There are also a few technical country-specific issues, which are connected to GHG emission calculation in Energy sector:

- The methodology for estimating CO₂ emission from natural gas scrubbing is not given in the IPCC Guidelines. The CO₂ emission is determined on the base of differences in CO₂ content before and after scrubbing units and quantity of scrubbed natural gas (material balance method). The data for estimating CO₂ emission is given from gas field Molve.
- Country-specific net calorific values obtained from national energy balance are used in GHG emission calculation (Annex 2).

3.2. FUEL COMBUSTION ACTIVITIES (CRF 1.A.)

3.2.1. SOURCE CATEGORY DESCRIPTION

3.2.1.1. Energy Industries (CRF 1.A.1.)

This subsector comprises emission from fuel combustion in public electricity and heat production plants, petroleum refining plants, solid transformation plants, oil and gas extraction and coal mining. The total GHG emission from Energy Industries is given in the Table 3.2-1 and Figure 3.2-1. The GHG emissions from thermal power plants and public cogeneration plants in the period from 1990-2006, were calculated using more detailed Tier 2 approach while emissions from Petroleum Refining and Other Energy Industries were calculated using Tier 1 approach.

Table 3.2-1: The CO₂-eq emissions (Gg) from Energy Industries

CO ₂ -eq emission (Gg)	1990	1995	2000	2001	2002	2003	2004	2005	2006
Public El. and Heat Prod.	3719	2911	3822	4489	5160	5750	4658	4722	4694
Petroleum Refining	2575	1892	1792	1603	1800	1882	1916	1811	1654
Other Energy Industries	992	395	293	235	269	264	279	351	309
Total Energy Industries	7286	5198	5907	6327	7228	7895	6853	6884	6657

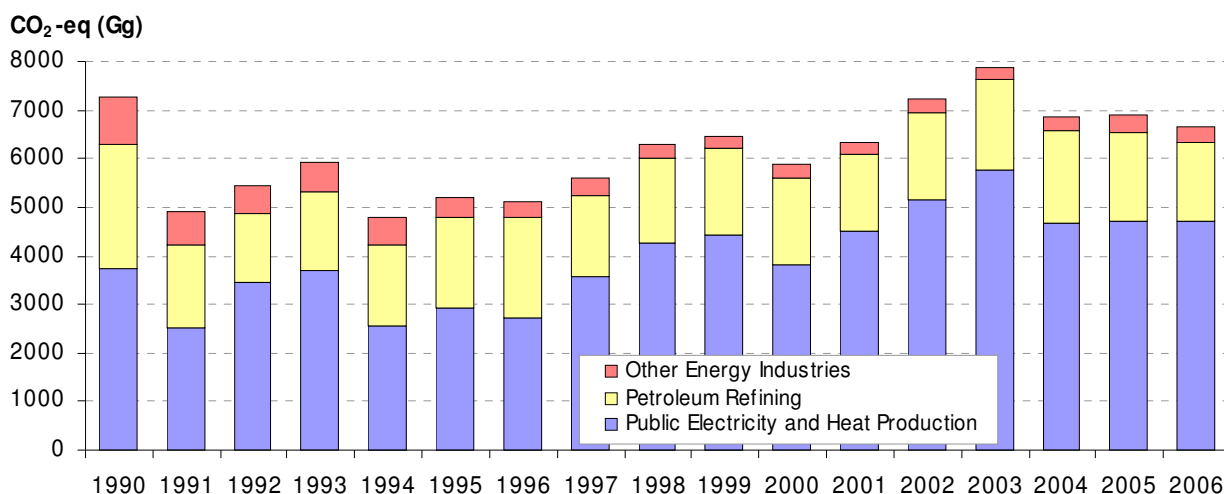


Figure 3.2-1: The CO₂-eq emissions from Energy Industries

It should be stressed out that approximately 53 percent of the electricity is generated in Hydro power plants; therefore the emission from this sector is relatively small, 28-35 percent of emission from total Energy sector. The largest part (53-73 percent) of the emission is a consequence of fuel combustion in thermal power plants, then the combustion in oil refineries 24-40 percent. The remaining combustion in oil and gas fields, coal mines and the coke plant accounts for some 3-9 percent.

Public Electricity and Heat Production (CRF 1.A.1.a)

The installed electricity generating capacities in the Republic of Croatia include power plants owned by the HEP Group (Croatian Power Company), a certain number of industrial power plants and a few privately owned power plants (wind power plants, small hydro power plants).

Total capacities serving the needs of the Croatian electric power system amount to 3993 MW (including 50% of nuclear unit Krško in Slovenia). Out of this amount, 1397 MW is placed in thermal power plant, 2056 MW in hydro power plant and 348 MW in the nuclear unit Krško (50% of total available capacity). Generating capacities of HPPs, TPPs and NPP Krško are presented in the Table 3.2-2.

Table 3.2-2: Generating capacities of HPPs, TPPs and NPP Krško

	Available Power (MW)		Fuel
	Generator	Net Output	
HPPs		2056	water
NPP Krško*	353.5	348	UO2
TPP Plomin 1	105	98	coal
TPP Plomin 2**	210	192	coal
TPP Rijeka	320	303	fuel oil
TPP Sisak	2x210	396	fuel oil / n. gas
CHP Zagreb (east)	25 + 120 + 210	337	f.oil / n.gas / ELO
CHP Zagreb (west)	12.5 + 32 + 52	90	f.oil / n.gas / ELO
CPP Osijek	45 + 2x25	90	f.oil / n.gas / ELO
CCGT Jertovec	2x42.5	83	n.gas / ELO
Emergency diesel (4)	29	29	D2
Emergency diesel (1)	13	13	2GT
Total (HPPs+NPP+TPPs)		4049	

UO2 - uranium oxide

ELO - extra light oil

D2/2GT - special fuel oil for operation of emergency TPPs

* - 50% of NPP Krško is owned by HEP

** - TPP Plomin 2 Ltd. (HEP and RWE Power Co-ownership – share 50% : 50%)

During the observed period between 1990 and 2006 in Croatia only 18 to 38 percent of Croatian electricity demands were covered by thermal power plants. The largest contribution to electricity production in Croatia had hydro power plants 48 to 74 percent Nuclear power plant Krško delivered 50 percent of its electricity to Croatian power system until 1998 after which was a four year period of non-delivery. The delivery of electricity from NPP Krško started again in 2003. The past few years the electricity demand was compensated with import. Therefore, in 2000 the electricity import was larger than production in all Croatian thermal power plants (TPPs). In 2006, the import of electricity was about 46 percent of total electricity consumption in Croatia.

In this subsector there are few types of plants:

- Thermal Power Plants (TPPs), which produce only electricity
- Public Cogeneration Plants (PCPs), which produce combined heat and electricity
- Public Heating Plants (PHPs), which produce only heat

Electricity and heat production, fuel consumption and GHG emissions for the years 1990, 1995, and 2000-2006 are presented in tables A2-1 to A2-2 of the Annex 2.

Petroleum Refining (CRF 1.A.1.B)

Croatia has two oil refineries in Rijeka and Sisak, while lubricants are produced in Rijeka and Zagreb. Processing capacities of the Croatian refineries, which belong to INA – oil and gas company, are shown in the Table 3.2-3.

Table 3.2-3: Processing Capacities of Oil & Lube Refineries

PROCESSING CAPACITIES	INSTALLED (1000 t/year)
Oil Refinery Rijeka (Urinj)	
atmospheric distillation	5000
reforming	730
fluidized-bed catalytic cracking (FCC)	1000
visbreaking	600
isomerisation	250
hydrodesulphurisation (HDS)	1040
mild hydrocracking (MHC)	560
Lube Refinery Rijeka (Mlaka)	
vacuum distillation	630
deasphalting	110
furfural extraction	220
deparaffination	140
ferofining	230
deoiling	30
bitumen	350
Oil Refinery Sisak	
atmospheric distillation	4000
reforming	720
fluidized-bed catalytic cracking (FCC)	500
coking	240
vacuum distillation	800
bitumen	350
Lube Refinery Zagreb	
atmospheric distillation	-
lubricants	60

In the refineries, there are two types of fuel combustion – for heating and/or cogeneration and for own use of energy for production processes. National energy balance gives separate values for own use of energy in refineries, while fuel combustion for heating/cogeneration plants is presented together with similar industrial plants. Because of that, cogeneration and heating plants in refineries were calculated (previous submission) in the sub-sector Manufacturing Industries and Construction instead of Energy Industries (Petroleum Refining), which has been done in this submission.

Fuel consumption and GHG emissions from petroleum refining are presented in Table A2-5 and Table A2-6 of the Annex 2.

Manufacturing of Solid Fuels and Other Energy Industries (CRF 1.A.1.C)

In Croatia the coal production in the period 1990-1998 was rather low. Last coal mines in Istria were closed in 1999. Coke-oven plant in Bakar, nearby Rijeka, was also closed in 1994. Crude oil is produced from 34 oil fields and gas condensation products from 10 gas-condensations fields, which covers about 35 percent of the total domestic demand.

Natural gas is produced from 20 gas fields from on-shore and 5 off-shore gas fields, which covers about 94.3 percent of the total demand in 2006. The largest quantities come from the Molve, Kalinovac and Stari Gradec, where the Central Gas Stations (CGS Molve) for gas processing and transport preparation were built – Molve I, II and III. Their capacities are:

- 1 mill. m³/day for Molve I
- 3 mill. m³/day for Molve II
- 5 mill. m³/day for Molve III

The underground gas storage Okoli was designed with the nominal capacity of 550 mill. m³. Maximal injection capacity is 3.8 mill. m³/day and maximal drawdown capacity is 5 mill. m³/day.

Fuel consumption and GHG emissions from manufacturing of solid fuels and other energy industries are presented in the Table A2-7 of the Annex 2.

Fuel consumption and GHG emissions from Manufacturing Industries and Construction are presented in Table A2-8 and Table A2-9 of the Annex 2.

3.2.1.2. Manufacturing Industries and Construction (CRF 1.A.2.)

Manufacturing Industries and Construction include the emissions from fuel combustion in different industries, such as iron and steel industries, industries of non-ferrous metals, chemicals, pulp and paper, food processing, beverages and tobacco, construction and building material industries. This sector also includes the emissions from fuel used for the generation of electricity and heat in industry (industrial cogeneration plants and industrial heating plants). The total GHG emission from Manufacturing Industries and Construction is given in the Table 3.2-4 and Figure 3.2-2.

Table 3.2-4: The CO₂-eq emissions (Gg) from Manufacturing Industries and Construction

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Iron & Steel Industry				93	67	81	65	89	102
Non-Ferrous Metals				16	20	16	27	21	18
Chemical				540	420	481	860	473	582
Pulp, Paper & Print				123	109	114	125	130	136
Food Proc. Bev. & Tab.				450	514	471	488	542	543
Other (Constr. Material...)				2009	1893	2021	2008	2417	2387
Total Manufact. Ind. & Cons.	5833	2943	3091	3231	3023	3184	3573	3671	3768

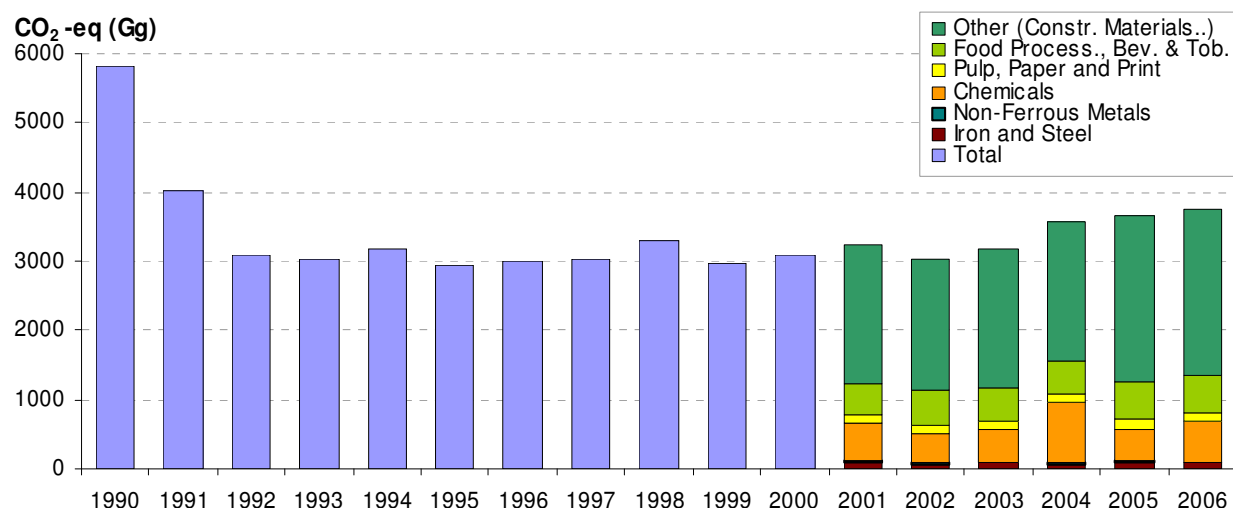


Figure 3.2-2: The CO₂-eq emissions from Manufacturing Industries and Construction

The emission from this sector contributes 14-25 percent of the total emission from Energy sector. In national energy balance the fuel combustion in industrial cogeneration and heating plants is not divided on appropriate industrial branches, for which electricity and/or thermal energy is produced. The fuel consumed in industrial cogeneration and heating plants is divided by industrial subsectors for the period 2001-2006. The largest contributor to emissions is fuel combustion in industry of construction materials (subsector: Other in Figure 3.2-2), followed by chemical industry, food processing industry, iron and steel industry, industry of glass and non-metal, non-ferrous metal and paper industry.

The GHG emissions from Manufacturing Industries and Construction by fuels are shown in Table A2-9 and Table A2-10 of the Annex 2.

3.2.1.3. Transport (CRF 1.A.3.)

The emission from combustion and evaporation of fuel for all transport activities is included in this sector. In addition to road transport, this sector includes the emission from air, rail and marine transport as well. The total GHG emission from Transport sector is given in the Table 3.2-5 and Figure 3.2-3.

Table 3.2-5: The CO₂-eq emissions (Gg) from Transport

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Road Transport	3642	3174	4346	4408	4706	5111	5268	5469	5836
Domestic Aviation	352	89	126	164	157	142	160	174	184
Railways	139	107	86	88	87	88	92	96	102
National Navigation	134	99	86	92	111	112	91	100	104
Total Transport	4266	3469	4644	4752	5062	5453	5612	5839	6226

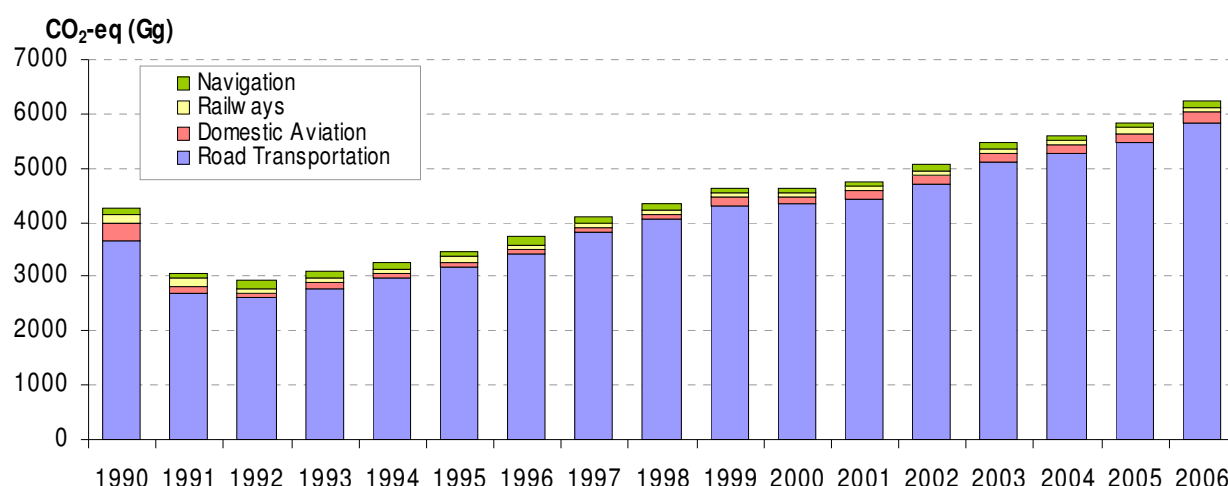


Figure 3.2-3: The CO₂-eq emissions from Transport

The emissions from fuel consumption in aircraft or marine vessel engaged in international transport are excluded from the national total. These emissions are reported separately.

The contribution from Transport to total emissions from Energy sector was 18-25 percent. The most of the emission comes from road transport (86-94 percent), than from domestic air, rail and marine transport (Figure 3.2-3). The increase of emissions from this sector is a consequence of growth of number of road vehicles and fuel consumption.

Road Transport

The COPERT III package (Tier 2/3 method) was used for CO₂, CH₄ and N₂O emissions (and other pollutants) calculation from road transport in the period from 1990 to 2006. For calculating emissions, COPERT III emission factors per fuel types were used.

The aggregate number of road motor vehicles is presented in the Table A2-11 of the Annex 2. Fuel consumption and GHG emissions from Road Transport are presented in the Table A2-12 of the Annex 2.

Key assumption – motor fuel tanked (filled in vehicle reservoir) abroad and consumed in Croatia is equal with fuel tanked in Croatia and consumed abroad. Fuel consumption calculated by COPERT multiplying number of vehicles and annual average vehicle mileage should be equal with appropriate data from national energy balance (difference is less than 1%). It is necessary to avoid inconsistency in trend emissions.

Off-road Transport

The GHG emission calculation from off-road transport was calculated using Tier 1 approach, based on fuel consumption data (national energy balance) and default IPCC emission factors. The fuel consumption and appropriate GHG emissions for domestic air transport, national navigation and railway transport are shown in Table A2-13, Table A2-14 and Table A2-15 of the Annex 2. According to suggestion of review team the disaggregation of fuel between

international and domestic aviation was recalculated based on International Energy Agency (IEA) data.

3.2.1.4. Small Stationary Energy Sources (CRF 1.A.4.)

This sector includes emission from fuel combustion in commercial and institutional buildings, emission from fuel combustion in residential sector and the emission from fuel combustion in agriculture, forestry and fishing. The total GHG emissions from abovementioned small stationary energy sources are shown in the Table 3.2-6 and Figure 3.2-4.

Table 3.2-6: The CO₂-eq emissions (Gg) from small stationary energy sources

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Commercial/Institutional	790	640	641	745	792	824	811	791	729
Residential	2200	1699	2019	2167	2269	2482	2456	2494	2302
Agricult./Forestry/Fishing	843	583	861	801	741	755	702	712	732
Total	3832	2922	3521	3713	3802	4061	3968	3997	3763

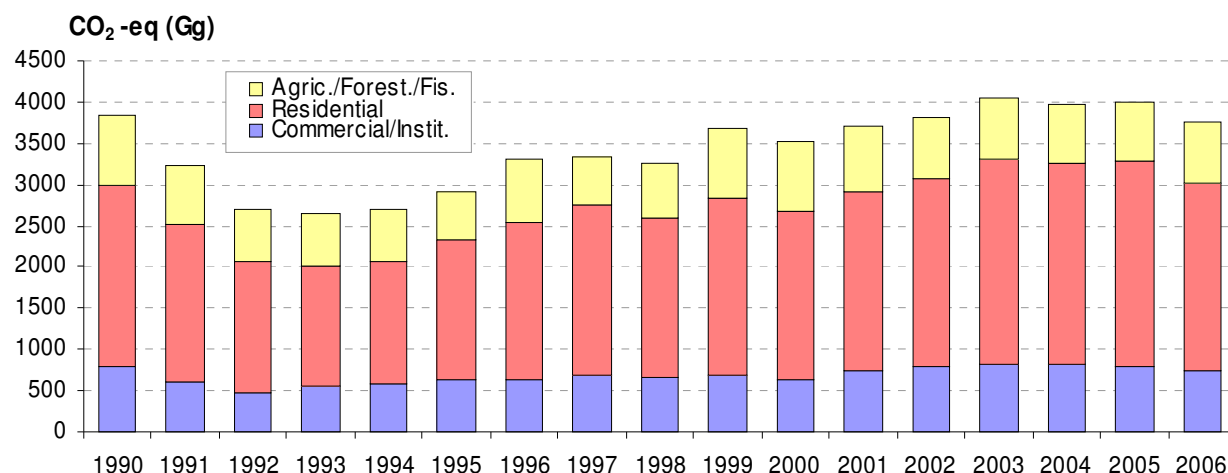


Figure 3.2-4: The CO₂-eq emissions from Small Stationary Sources

The CO₂-eq emissions from these subsectors were about 17-20 percent of the total emissions from energy sector. The most of the emission comes from small household furnaces and boiler rooms (55-62 percent), then from service sector (15-21 percent), while the combustion of fuel in agriculture, forestry and fishing accounts for 18 to 25 percent (Figure 2.3-4).

The GHG emissions calculation from these subsectors were calculated using Tier 1 approach, based on fuel consumption data (national energy balance) and default IPCC emission factors. The fuel consumption and GHG emissions for Commercial/Institutional, Residential and Agriculture/Forestry/Fishing are presented in Table A2-16, Table A2-17 and Table A2-18, Annex 2.

3.2.1.5. Ozone Precursors and SO₂ Emissions

The emission of indirect greenhouse gases (NO_x, CO and NMVOC) and SO₂ is described in this chapter. Ozone precursors are cause of greenhouse gas - tropospheric ozone, whereas SO₂

was added to a list of pollutants first time in Revised 1996 IPCC Guidelines for National GHG Inventories due to the importance of this gas from the position of acidification and eutrophication.

The emission of NO_x is the largest from road transport (about 50 percent), then from energy industries and manufacturing industries and construction. Emissions of CO and NMVOC are mainly from road transport and small household furnaces using firewood or coal. The emission of SO₂ mainly originates from stationary energy sources, such as thermal power plants and refineries, and depends on the quantity of fuel used and the sulphur content of fuel.

The emissions of ozone precursors and SO₂ are shown in the Table 3.2-7.

Table 3.2-7: Emissions of ozone precursors and SO₂ from fuel combustion (Gg)

Emission (Gg)	1990	1995	2000	2001	2002	2003	2004	2005	2006
NO_x Emission	83.13	57.18	67.85	68.78	67.57	68.20	66.79	73.12	68.85
Energy Industries	13.61	10.30	11.99	11.58	13.19	13.77	11.20	12.04	11.14
Manuf. Ind. & Construction	17.49	8.92	9.73	10.59	10.22	9.72	11.82	16.60	12.26
Transport	37.00	29.83	33.28	32.99	31.03	31.14	30.61	31.33	32.22
Other Energy	15.03	8.13	12.85	13.62	13.13	13.57	13.16	13.15	13.23
CO Emission	498.41	335.60	374.24	319.85	302.89	318.30	304.66	325.78	331.44
Energy Industries	1.54	0.99	1.21	1.04	0.97	1.38	1.23	0.93	1.35
Manuf. Ind. & Construction	40.44	41.26	37.82	38.62	37.89	38.02	41.61	32.60	36.69
Transport	252.45	176.61	188.74	164.97	151.04	137.46	125.38	159.24	159.93
Other Energy	203.98	116.74	146.47	115.22	112.99	141.45	136.44	133.02	133.47
NMVOC Emission	55.10	38.50	43.63	36.59	34.59	32.94	30.17	28.80	30.49
Energy Industries	0.32	0.23	0.28	0.26	0.30	0.34	0.29	0.29	0.29
Manuf. Ind. & Construction	1.70	1.37	1.44	1.47	1.44	1.73	1.93	1.76	3.33
Transport	40.93	29.99	32.89	27.38	25.56	22.06	19.44	18.46	18.49
Other Energy	12.15	6.91	9.01	7.48	7.29	8.82	8.50	8.30	8.38
SO₂ Emission	163.56	71.76	60.49	61.92	67.49	66.25	52.32	58.16	56.89
Energy Industries	78.51	38.98	25.39	26.04	23.29	35.70	25.66	32.76	30.44
Manuf. Ind. & Construction	55.84	24.66	22.59	24.88	29.93	15.62	11.82	10.29	11.59
Transport	5.33	3.46	6.01	4.91	6.30	7.44	7.93	8.48	9.02
Other Energy	23.87	4.65	6.50	6.09	7.97	7.48	6.92	6.63	5.85

3.2.2. METHODOLOGICAL ISSUES

The GHG emission calculation is mainly provided using Tier 1 approach. There are two exceptions, as follows:

- Thermal power plants and public cogeneration plants (Energy Industries, CRF 1.A.1.a)
- Road transport (Transport, CRF 1.A.3.b)

3.2.2.1. Tier 1 Approach

CO₂ emissions

The CO₂ emission is estimated by two approaches: (1) Reference approach and (2) Sectoral approach. Inputs in the Reference approach are production, import, export, international bunkers and stock change for primary and secondary fuels. The Sectoral approach is used to identify the emission by means of fuel consumption for each group of sources (sectors). Data from the national energy balance were recalculated from natural units into energy units by

means of its net calorific values for each fuel. Calorific values are also taken from the energy balance. The emission factors used for calculation are taken from *IPCC Guidelines (Revised 1996 IPCC Guidelines for National GHG Inventories, Workbook, Page 1.6)*.

Since the combustion processes are not 100 percent efficient, the part of carbon stored is not emitted to the atmosphere so it occurs as soot, ash and other by-products of inefficient combustion. Therefore, it is necessary to know the fraction of carbon which oxidizes. This value was taken from *Revised 1996 IPCC Guidelines* as recommended (Workbook, Page 1.8).

Non-energy uses of fossil fuels can result in storage (in products) of some or all of the carbon contained in the fuel for a certain period of time, depending on the end-use. The fraction of carbon stored in products is suggested in *Revised 1996 IPCC Guidelines* (Workbook, auxiliary worksheet 1-1. page 1.37).

According to guidelines the emissions from international transport activities were not included in national totals.

Emissions of CH₄, N₂O and indirect greenhouse gases

Emissions of CH₄, N₂O and indirect greenhouse gases (NO_x, CO and NMVOC) have been identified by Tier 1 method in such a way that the fuel used in each sector is multiplied by the emission factor suggested in *Revised 1996 IPCC Guidelines for National GHG Inventories* (Reference Manual, page 1.33-1.42). The basis for the estimate is the fuel used in different energy sectors. The used fuel is grouped into basic fossil fuels categories according to its aggregate condition: coal, natural gas and oil, and biomass-based fuel. Data about quantities of the fuel used are taken from the national energy balance.

In order to identify the SO₂ emission, besides the data on the type and the quantity of fuel consumed it is necessary to know the sulphur content in fuel. The available data on the sulphur content were collected from INA - Oil and Gas Company (for petroleum derivatives: gasoline, residual oil, diesel oil, jet fuel) and from HEP – Croatian Electric Utility Company (for fossil fuels consumed in thermal power plants).

3.2.2.2. Tier 2/3 Approach

Thermal power plants and public cogeneration plants (CRF 1.A.1.a)

The GHG emissions from thermal power plants and public cogeneration plants in the period from 1990-2006, were calculated using more detailed Tier 2 approach. Tier 2 approach is based on bottom-up fuel consumption data from every boiler or gas turbine in plant. There were available data about monthly fuel consumption and detailed fuel characteristics data (net calorific value, sulphur and ash content...). For estimation of CO₂ emissions, default IPCC emission factors were used, while implied emission factors for CH₄ and N₂O are based on technology type and configuration (Tier 2).

Road transport (CRF 1.A.3.b)

The COPERT III package (Tier 2/3 method) was used for air emission calculation from road transport emission in the period from 1990 to 2006 for CO₂, CH₄ and N₂O emissions.

Very detailed set of input data is necessary for COPERT implementation. In Croatian case, main data provider is Ministry of Interior, which is responsible for compilation of detailed motor vehicle database. The database assures the following information about:

- type of vehicles (passenger cars, light duty vehicles, heavy duty vehicles, buses, mopeds, motorcycles)
- type of motor (gasoline four-stroke, gasoline two-stroke, diesel, rotation motor and electromotor)
- cylinder capacity (<1.4 lit, 1.4-2.0 lit, >2.0 lit)
- weight class (<3.5 t, 3.5-7.5 t, 7.5-16 t, 16-32 t, >32 t)
- age of vehicles (distribution of vehicles per ECE categories according to EC directives)

Fuel consumption data (from Energy Institute "Hrvoje Požar") and fuel characteristics data (from INA - Oil and Gas Company) are also necessary for calculation of emissions from road transport using COPERT software.

Additional data, like highway, rural and urban transport mileage, average speed of different kind of vehicles and different road types, average daily trip distance, beta value (the fraction of the monthly mileage driven before the engine and any exhaust components have reached their nominal operation temperature) and temperature per month are estimated (based on data from statistics) or COPERT default data are used.

COPERT calculates emission factors according to driving conditions data (the average speed per vehicle type and per road), fuel variables and climate conditions (average monthly temperatures data).

3.2.3. UNCERTAINTIES AND TIME-SERIES CONSISTENCY

3.2.3.1. Uncertainty of CO₂ emissions

The CO₂ emission, from the fossil fuel combustion, depends of the amount of fuel consumed (from energy balance), net calorific values (from energy balance), carbon emission factors (IPCC), the fraction of carbon stored (IPCC) and the fraction of carbon oxidised (IPCC) .

The national energy balance is based on data from different available sources. The data from Central Bureau of Statistics about production, usage of raw material and consumption of fuels in all industrial facilities in Croatia are used. The data from questionnaires about monthly use of natural gas in certain sectors from all distributive companies in Croatia, about annual consumption of coal in certain sectors and the data from Customs Administration about export and import of fossil fuels are also used. The data from these sources and other necessary data are organised in related database. The estimated uncertainty of data from energy balance is below 5 percent.

The accuracy of data on net calorific values, which are also taken from national energy balance, is high.

There are more uncertainties in data on international marine and aviation bunkers. Nevertheless, possible errors in estimated values do not significantly affect the accuracy of data of national emission, as marine and aviation transport have relatively small influence. The estimated CO₂ emissions for International Marine and Aviation Transport are not included in national totals.

The other data needed for calculation, such as, carbon emission factors, the fraction of carbon stored for non-energy uses of fuel and the fraction of carbon oxidized, are taken from *Revised 1996 IPCC Guidelines for National GHG Inventories*. Experts believe that CO₂ emission factors for fuels are generally well determined within 5 percent, as they are primarily dependent on the carbon content of the fuel.

For example, for the same primary fuel type (e.g. coal), the amount of carbon contained in the fuel per unit of useful energy can vary. Non-energy uses of the fuel can also create situations where the carbon is not emitted to the atmosphere (e.g. plastics, asphalt, etc.) or is emitted at a much-delayed rate. Additionally, inefficiencies in the combustion process, which can result in ash or soot remaining unoxidized for long periods, were also assumed. These factors all contribute to the uncertainty in the CO₂ estimates. However, these uncertainties are believed to be relatively small. Overall uncertainty for CO₂ emission estimates from the fossil fuel combustion are considered accurate within 7 percent.

3.2.3.2. Uncertainty of CH₄, N₂O and indirect greenhouse gases emissions

Estimates of CH₄, N₂O and ozone precursor emissions are based on fuel (coal, natural gas, oil and bio-fuels) and aggregate emission factors for different sectors. Uncertainties in estimates are due to the fact that emissions are estimated on the base of emission factors representing only a limited subset of combustion conditions.

Using the aggregate emission factors for each sector, the differences between various types of coal and especially liquid fuel are not included, nor are the differences in the technology and the contribution of equipment for emission reduction. Therefore, the uncertainties associated with emission estimates of these gases are greater than estimates of CO₂ emissions from the fossil fuel combustion.

The uncertainty of CH₄ emission is estimated to ± 40 percent; while the uncertainty of N₂O emission is estimated to factor 2 (the emission could be twice larger or smaller than the estimated one). The largest part of uncertainty refers to the emission factor applied while the fuel consumption data (national energy balance) are rather good. Implementation of Tier 2/3 approach for estimation of CH₄ and N₂O emissions from thermal power plants and public cogeneration plants (CRF 1.A.1.a) and road transport (CRF 1.A.3.b) lead to certain uncertainty reduction (Annex 4).

3.2.3.3. Time-series consistency

Activity data, emission factors and methodology implied for GHG emission calculation from fuel combustion activities is very consistent for entire period. Negligible inconsistency is a consequence of implementation more detailed approach (Tier 2/3) for last four years in Energy Industries.

3.2.4. SOURCE-SPECIFIC QA/QC

Quality control activities were divided in two phases according to the QA/QC plan, first phase included activities during the inventory preparation performed by sector expert, and the second phase included audit conducted by the designated QA/QC manager after the preparation of final draft of the NIR.

During the preparation of the inventory submission activities related to quality control were mainly focused on completeness and consistency of activity data and emission estimates and on proper use of notation keys in the CRF tables. Also, several checks have been carried out in order to ensure correct aggregation from lower to higher reporting level and correct use of conversion factors.

The basis for emission estimates in Energy sector is Energy balance prepared by Energy Institute "Hrvoje Požar" and usage of mainly default emission factors provided by the IPCC guidelines. Background information and assumptions for entire time-series are transparently recorded in *Inventory Data Record Sheets* which allow third party to evaluate quality of estimates in this sector.

After preparation of final draft of this chapter an audit was carried out to check selected activities from Tier 1 General inventory level QC procedures and Tier 2 source-specific QC procedures according to QA/QC plan.

Regarding to QC Tier 2 activities, activity data were checked for key source categories. In Energy industries, Public Electricity and Heat Production a more detailed Tier 2 methodology was applied for the whole period 1990-2006, due to availability of detail information on fuel consumption in the facilities. Activity data from energy balance were compared with data provided by individual facilities. Results of this comparison showed that there is no significant difference between these two sets of data. These bottom up data are still not available for other sub-categories therefore Tier 1 methodology was applied.

Also, inventory team used country-specific fuel net calorific values for emission estimates. Calorific values from energy balance were compared with data from the IPCC Guidelines. Results of this comparison showed that there is no significant difference between these two sets of data.

In Mobile combustion – Road, a COPERT III model was used for the whole period (1990-2006). This model requires a very detailed set of input data and could be considered as a Tier 3 methodology. Activity data for vehicle fleet were obtained from three different sources: Ministry of Interior, Central Bureau of Statistics and Centre for Vehicles. It was decided that database

from Ministry of Interior is relevant because it contains the complete data set on each registered vehicle in Croatia. In Mobile combustion – Domestic and International Aviation, a data from International Energy Agency statistics was used in order to reduce trend inconsistency, but it was pointed out that uncertainty of international bunkers is relatively higher comparing to other data.

3.2.5. SOURCE-SPECIFIC RECALCULATIONS

Public Electricity and Heat Production (1.A.1.a.)

Since emissions from Stationary Combustion are identified as a key source category more detailed plant-level data on fuel consumption and emissions are included for the period 1990-2006. Consequently, CO₂, CH₄ and N₂O emissions from Public Electricity and Heat Production were recalculated as follows:

Years:	1990-2005
Gases:	CO ₂ , CH ₄ and N ₂ O
Method:	The GHG emissions were calculated using more detailed Tier 2 approach. Tier 2 approach is based on bottom-up fuel consumption data from boilers or gas turbines in a plant.
EF:	For estimation of CO ₂ emissions, default IPCC emission factors were used, while implied emission factors for CH ₄ and N ₂ O are based on technology type and configuration (Tier 2).

Manufacture of Solid Fuels and Other Energy Industries (1.A.1.c.)

Inconsistency in calculation of total fuel consumption for the period from 1990 to 2005 was detected, during the activity data checking. For period from 1990-2001 consumption of fuel from NGL plant for own use was not included in total fuel consumption, while for the period from 2002 to 2005 it was included. Consequently, GHG emissions from Manufacture of Solid Fuels and Energy Industries were recalculated as follows:

Year:	1990 - 2001
Gases:	CO ₂ , CH ₄ and N ₂ O
Activity data:	Consumption of fuel from NGL plant for own use is added to total fuel consumption.
EF:	For estimation of CO ₂ , CH ₄ and N ₂ O emissions, default IPCC emission factors were used.

Consumption of coke oven gas in previous reports was calculated as solid fuel for the period from 1990 to 1994. In this report coke oven gas is subtracted from solid fuels consumption and added to gaseous fuel consumption. Associated default emission factors for CO₂, CH₄ and N₂O were used.

Manufacturing Industries and Construction (1.A.2.)

Consumption of coke oven gas in previous reports was calculated as solid fuel for the period from 1990 to 2005. In this report coke oven gas is subtracted from solid fuels consumption and added to gaseous fuel consumption. Associated default emission factors for CO₂, CH₄ and N₂O were used. Consequently, CO₂, CH₄ and N₂O emissions from Manufacturing Industries and Construction are recalculated as follows:

Years: 1990-2005
Gases: CO₂, CH₄ and N₂O
Method: The GHG emissions are calculated using Tier 1 approach.
EF: For estimation of CO₂, CH₄ and N₂O emissions, default IPCC emission factors for Coke oven gas were used.

Energy consumption of natural gas in petrochemical industry (1.A.2.f Manufacturing industries and construction – Other – Petrochemical Industry) was subtracted and calculated under the Industry sector, subsector 2.B.1. Ammonia Production, to avoid double counting.

Domestic Air Transport (1.A.3.a.)

The disaggregating of jet kerosene for 1990 between international and domestic aviation was recalculated based on International Energy Agency (IEA) data.

During the activity data checking, inconsistency in Gasoline consumption calculation for the period from 1990 to 2005 was detected. For the period from 1991-1995 consumption of gasoline was not included in total fuel consumption while for the period from 1996 to 2005 it was calculated. Consequently, GHG emissions from Domestic Air transport were recalculated as follows:

Year: 1990-1995
Gases: CO₂, CH₄ and N₂O
Activity data: Gasoline consumption is added to total fuel consumption of Domestic Air transport.
EF: For estimation of CO₂, CH₄ and N₂O emissions, default IPCC emission factors for Gasoline were used.

Road Transportation (1.A.3.b.)

Up till now activity data source for the number of road vehicles was Croatian Centre for Vehicles. From now activity data source for Vehicle database is Ministry of Interior as it is defined by Regulation on the Greenhouse Gases Emissions Monitoring in the Republic of Croatia (Official Gazette No. 1/07), which came into force in January 2007 and first Inventory Submission stipulated by this Regulation is 2008. Consequently, CO₂, CH₄ and N₂O emissions from Road transport (1990-2005) were recalculated as follows:

Years: 1990-2005
Gases: CO₂, CH₄ and N₂O
Method: Tier 3 methodology for calculation of CO₂, CH₄ and N₂O emission from Road transport was implied.
EF: Emission factors based on COPERT III software for CO₂, CH₄ and N₂O was implied.

Railways (1.A.3.c.)

During the activity data checking, inconsistency in fuel consumption calculation for the period from 1990 to 2005 was detected. For the period from 1990-1997 consumption of Gas/Diesel Oil was not included in Liquid fuel consumption while for the period from 1998 to 2005 it was calculated. Consequently, GHG emissions from Railways were recalculated as follows:

Year: 1990-1997
Gases: CO₂, CH₄ and N₂O
Activity data: Consumption of Gas/Diesel Oil is added to Liquid fuel consumption.
EF: For estimation of CO₂, CH₄ and N₂O emissions, default IPCC emission factors for Gas/Diesel Oil were used.

Commercial/Institutional (1.A.4.a.)

In previous reports consumption of Gas Works Gas was calculated as solid fuel for the period from 1990 to 2005. In this report Gas Works Gas is subtracted from solid fuels consumption and added to gaseous fuel consumption for the whole period (1990-2006). Associated default emission factors for CO₂, CH₄ and N₂O were used.

Consumption of Liquefied Petroleum Gases in previous report was not included in Liquid fuel consumption for the period from 1990-2005. Consequently, CO₂, CH₄ and N₂O emissions from Commercial/Institutional are recalculated as follows:

Years: 1990-2005
Gases: CO₂, CH₄ and N₂O
Method: The GHG emissions are calculated using Tier 1 approach.
EF: For estimation of CO₂, CH₄ and N₂O emissions, default IPCC emission factors for Gas Works Gas and Liquefied Petroleum Gases were used.

Residential (1.A.4.b.)

In previous reports consumption of Gas Works Gas was calculated as solid fuel for the period from 1990 to 2005. In this report Gas Works Gas is subtracted from solid fuels consumption and added to gaseous fuel consumption for the whole period (1990-2006). Associated default emission factors for CO₂, CH₄ and N₂O were used.

Years:	1990-2005
Gases:	CO ₂ , CH ₄ and N ₂ O
Method:	The GHG emissions are calculated using Tier 1 approach.
EF:	For estimation of CO ₂ , CH ₄ and N ₂ O emissions, default IPCC emission factors for Gas Works Gas were used.

3.2.6. SOURCE-SPECIFIC PLANNED IMPROVEMENTS

For the purpose of GHG inventory improvement, missing data should be collected and also quality of existing data, emission factors and methods should be improved. Implementation of well-documented country specific emission factors and appropriate detailed methods are recommended. Consequently, the main objectives of the GHG inventory improvement plan are:

- data gaps reduction,
- data collection improvement,
- activity data and emission factors uncertainties reduction,
- activities on improvement methodologies and emission factors, documentation and description of inventory system.

As a result of comprehensive analysis of GHG inventory quality, based on information prepared in the framework of Centralized Review Report, short-term and long-term goals for GHG inventory improvement are obtained.

Short-term goals (< 1 years)

Generally, the changes from Tier 1 to Tier 2/3 estimation methodologies for Energy key sources, as much as possible, are recommended. The priority should be the key sources with high uncertainties of emission estimation. But, significant constraints are availability of activity data, especially for the beginning years of concerned period. Consequently, implementation of more detailed methodology approach (Tier 2/3) for key sources, for entire period, will be very difficult.

Long-term goals (> 1 years)

The extensive use of plant-specific data which will be collected in the newly established Register of Environmental Pollution is highly recommended ("bottom up" approach). In addition, usage of more source-specific QA/QC procedures will improve the quality of GHG inventory in Energy sector.

3.3. FUGITIVE EMISSIONS FROM FUELS (CRF 1.B.)

3.3.1. SOURCE CATEGORY DESCRIPTION

This section describes fugitive emission of greenhouse gases from coal, oil and natural gas activities. This category includes all emissions from mining, production, processing, transportation and use of fossil fuels. During all stages from the extraction of fossil fuels to their final use, the escape or release of gaseous fuels or volatile components may occur.

3.3.1.1. Solid fuels (CRF 1.B.1.)

All underground and opencast coal mines release methane during their regular operation. The amount of methane generated during mining is primarily a function of the coal rank and mining depth, as well as other factors such as moisture. After coal has been mined, small amounts of methane retained in coal are released during post-mining activities, such as coal processing, transportation and utilization.

In Croatia the coal production was steadily decreasing in the period 1990-1999. Until 1999 only underground coal mines in Istria were in operation (Tupljak, Ripenda and Koromačno) and they produced some 0.015 to 0.174 mill. tonnes of coal. Global Average Method (Tier 1) was used for the methane emission estimation and the estimated emission was 0.2 to 2.3 Gg. The emissions of methane from mining and post-mining activities are showed in the Figure 3.3-1 and Table A2-19, Annex 2.

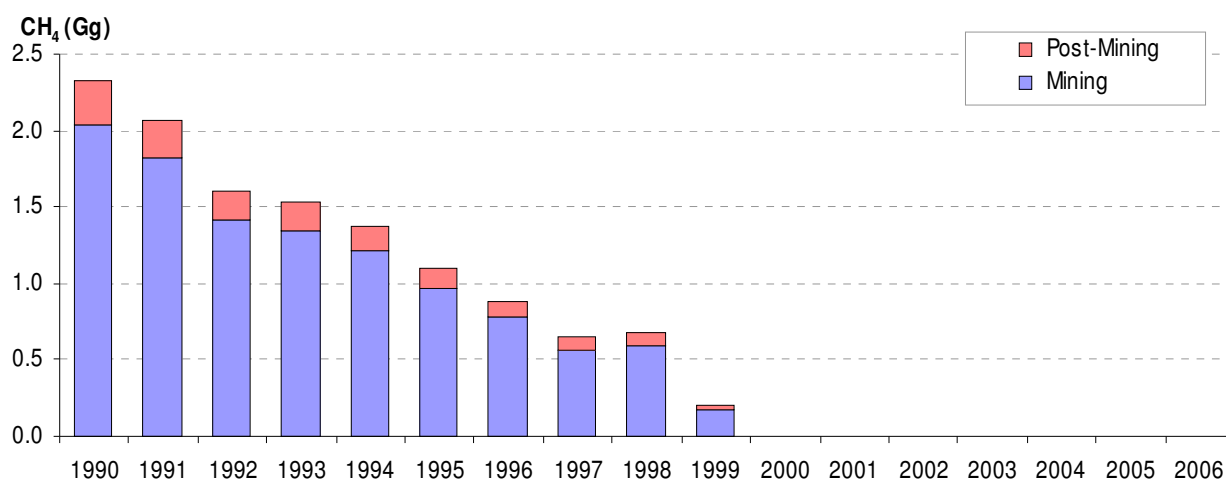


Figure 3.3-1: The fugitive emissions of methane from coal mines

3.3.1.2. Oil and natural gas (CRF 1.B.2.)

The fugitive emission of methane is inevitable during all the activities involving oil and natural gas. This category includes the fugitive emission from production, refining, transportation, processing and distribution of crude oil or oil products and gas. The fugitive emission also includes the emission of methane, which is the result of incomplete combustion of gas during flaring, and the emission from venting during oil and gas production.

The most significant fugitive emissions after methane among the activities relating to oil and gas are the emissions of non-methane volatile organic compounds (NMVOCs). They are produced by evaporation when fuel oil gets in contact with air during refining, transportation, and distribution of oil products. In addition to NMVOCs there are fugitive emissions of NO_x , CO and SO_2 during various processes in oil refineries.

Fugitive emission of methane

For estimating the fugitive emission of methane the simplest procedure has been used (Tier 1), which is based on production, unloading, processing and consumption of oil and gas.

According to the IPCC, all countries are divided into regions with relatively homogenous characteristics of oil and gas systems. Croatia is included in the region that covers the countries of Central & East Europe and former Soviet Union. For this region higher emission factors are provided, especially for the gas system. In the absence of better data, average emission factors provided for the region are used for estimating the fugitive emission of methane. Estimated results are given in Figure 3.3-2 and Table A2-20, Annex 2.

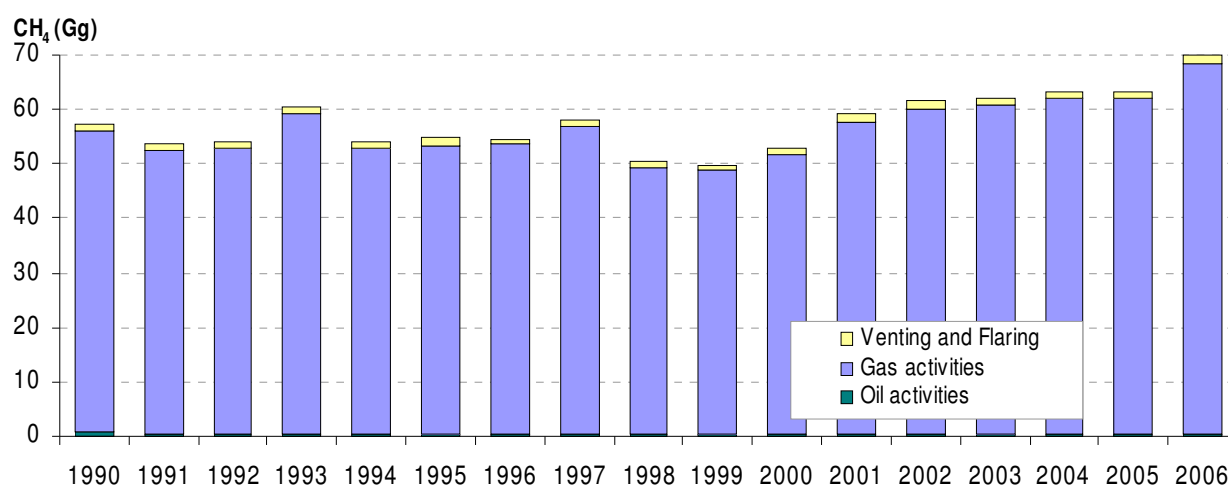


Figure 3.3-2: The fugitive emissions of methane from oil and gas activities

The fugitive emission of methane is mainly (about 97 percent) consequence of production, transmission and distribution of natural gas. The fugitive emission from oil accounts for about 1 percent and venting and flaring of gas/oil production accounts for approximately 2 percent.

Fugitive emission of ozone precursors and SO_2

A simplified Tier 1 procedure was used for fugitive emission estimates of ozone precursors and SO_2 from oil refineries, for the entire period from 1990 to 2006. The simplified procedure is based on the quantity of crude oil processed in oil refineries. Default emission factors were used for the estimation. A summary of estimated results of the fugitive emissions of CO, NO_x and NMVOC and SO_2 are illustrated in the Table 3.3-1.

Table 3.3-1: The fugitive emissions of ozone precursors and SO₂ from oil refining

Emissions (Gg)	1990	1995	2000	2001	2002	2003	2004	2005	2006
CO emission	0.62	0.48	0.46	0.43	0.43	0.44	0.46	0.45	0.40
NO _x emission	0.41	0.32	0.31	0.29	0.29	0.29	0.30	0.30	0.30
NM VOC emission	8.23	7.77	9.73	10.41	10.81	10.51	9.70	9.05	8.90
SO ₂ emission	6.38	4.96	4.80	4.49	4.49	4.52	4.72	4.60	4.40

CO₂ emission from natural gas scrubbing

Fugitive emission of greenhouse gases from coal, oil and natural gas, due to mining, production, processing, transportation and use of fossil fuels is also part of Energy sector. Although these emission sources are not characteristic in respect of CO₂ emission, specifically in Croatia emission of CO₂ from natural gas scrubbing in Central Gas Station Molve, which is assigned here. IPCC doesn't offer methodology for estimating CO₂ emission scrubbed from natural gas and subsequently emitted into atmosphere.

Natural gas produced in Croatian gas fields (Molve, Kalinovac and Stari Gradac) contains a large amount of CO₂, more than 15 percent, and before coming to commercial pipeline has to be cleaned (scrubbed). Since the maximum volume content of CO₂ in commercial natural gas is 3 percent, it is necessary to clean the natural gas before transporting through pipeline to end-users. Because of that, the Scrubbing Units exist at largest Croatian gas field. The estimated CO₂ emissions, by the material balance method, are presented in Table 3.3-2.

Table 3.3-2: The CO₂ emissions (Gg) from natural gas scrubbing in CGS Molve

CO ₂ emission (Gg)	1990	1995	2000	2001	2002	2003	2004	2005	2006
Central Gas Station MOLVE	416	697	633	688	665	684	710	691	663

3.3.2. METHODOLOGICAL ISSUES

The fugitive emission of methane from coal, oil, and gas has been identified by Tier 1 method with average emission factors given in *Revised 1996 IPCC Guidelines for National GHG Inventories* (Workbook, page 1.26 and 1.30). Data about quantities of the mined coal and production, unloading, transportation, processing, storing and consumption of oil and gas are taken from the national balance, energy supply and demand.

Inputs on processed crude oil in refineries are taken from national energy balance while emission factors are taken from *IPCC Guidelines* (Reference Manual, page 1.133 and 1.134).

The methodology for estimating CO₂ emission from natural gas scrubbing is not given in IPCC Guidelines. The CO₂ emission is determined on the base of differences in CO₂ content before and after scrubbing units and quantity of scrubbed natural gas.

3.3.3. UNCERTAINTIES AND TIME SERIES CONSISTENCY

3.3.3.3. Uncertainty

The fugitive emission of methane from coal mining and handling is determined by use of Global Average Method (Tier 1), which is based on multiplication of coal produced and emission factor. The amount of coal produced is taken from energy balance and that value is very accurate. The main uncertainty of calculation depends on accuracy of used emission factor. The arithmetic average value of emission factor has been chosen from *IPCC Guidelines* for the region to which Croatia belongs. The estimated uncertainty of methane emissions, for underground mining may be as high as a factor of 2 and for post-mining activities a factor of 3.

The Production-Based Average Emission Factors Approach is used to determine fugitive emission from oil and natural gas activities. This approach is based on activity data (production, transport, refining and storage of fossil fuels) and average emission factors. Due to the complexity of the oil and gas industry, it is difficult to quantify the uncertainties. The uncertainty of calculation is linked mostly to the emission factor, just like the determination of fugitive emission of methane from coal mining and handling. The expert estimated that accuracy of calculation of fugitive emission from oil is better than from fugitive emission from gas, but the uncertainty of both estimations is pretty high. Similarly, the uncertainty of calculation of emission of ozone precursors and SO₂ is also very high.

The CO₂ emission from scrubbing of natural gas is also shown here. The calculation is based on material balance which gives much better accuracy (± 10 percent).

3.3.3.4. Time-series consistency

Activity data, emission factors and methodology implied for fugitive emission from fuels is consistent for entire period.

3.3.4. SOURCE-SPECIFIC QA/QC

Quality control activities were divided in two phases, first phase included activities during the For Fugitive emissions from oil and gas operations a Tier 1 method was applied and emission factor is a mean value of the range proposed in the IPCC Manual. The CO₂ emission from natural gas scrubbing in CPS Molve was estimated using country specific methodology since IPCC Guidelines does not provide methodology for this source category.

In this subsector QA/QC plan for 2008 does not prescribe source-specific quality control procedures since it is county specific issue and comparison with other similar cases in other countries is not possible. Only general (Tier 1) quality control procedures were applied.

3.3.5. SOURCE-SPECIFIC RECALCULATIONS

Natural gas – Other Leakage at industrial plants and power stations (1.B.2.b.)

During the activity data checking, inconsistency in total fuel consumption calculation for the period from 1990 to 2005 was detected. For the period from 1990-1995 error in inserting the

activity data from Energy balance occurred. Consequently, GHG emissions from Other Leakage at industrial plants and power stations were recalculated as follows:

Year: 1990 - 1995

Gases: CH₄

Activity data: Consumption of Natural gas at industrial plants and power stations.

EF: For estimation of CH₄ emission default IPCC emission factors were used.

3.3.6. SOURCE-SPECIFIC PLANNED IMPROVEMENTS

For estimation of fugitive emissions from oil and natural gas operations a Tier 1 method was applied. Used emission factors are an average value of the range proposed in the *IPCC Manual*. However, fugitive emission from natural gas is key source and implementation of rigorous source-specific evaluations approach (Tier 3) is necessary. The Tier 3 approach will generally involve compiling the following types of information:

- detailed inventories of the amount and types of process infrastructure (e.g. wells, field installations and production/processing facilities),
- production disposition analyses of oil and gas production, vented, flared and reinjected volumes of gas and fuel gas consumption,
- accidental releases (i.e. well blow-outs and pipeline ruptures),
- typical design and operating practices and their impact on the overall level of emission control.

Additional technical and financial resources is necessary for implementation of rigorous source-specific evaluations approach (Tier 3).

3.4. OVERVIEW OF GHG EMISSIONS FROM ENERGY SECTOR

This chapter gives overview of the GHG emissions. The contribution of individual energy subsectors to the total emissions of greenhouse gases for the observed period is given in the Table 3.3-3 and Figure 3.3-3.

Table 3.3-3: The CO₂-eq emissions (Gg) from Energy sector

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Energy Industries	7286	5198	5907	6327	7228	7895	6853	6884	6657
Manuf. Ind. and Constr.	5833	2943	3091	3231	3023	3184	3573	3671	3768
Transport	4266	3469	4644	4752	5062	5453	5612	5839	6226
Other Sectors	3832	2922	3521	3713	3802	4061	3968	3997	3763
Fugitive Emissions	1666	1869	1744	1929	1958	1987	2041	2021	2135
Total emission (Gg CO₂-eq)	22883	16400	18907	19953	21074	22580	22048	22411	22548

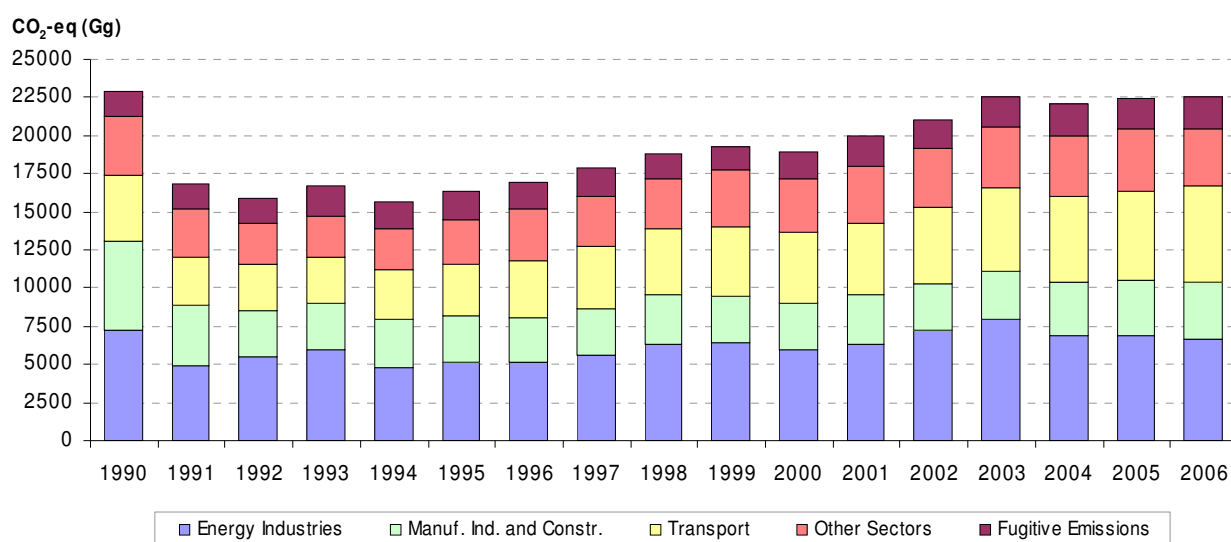


Figure 3.3-3: The CO₂-eq emissions from Energy sector

The Energy sector was the main cause for anthropogenic emission of greenhouse gases. It accounted for approximately 75 percent of the total emission of all greenhouse gases presented as equivalent emission of CO₂. Looking at its contribution to total emission of carbon dioxide (CO₂), the energy sector accounts for approximately 90 percent. The contribution of energy in methane (CH₄) emission is substantially smaller (48 percent) while the contribution of nitrous oxide (N₂O) is quite small (6 percent).

The largest part (28 to 35 percent) of the emissions are a consequence of fuel combustion in Energy Industries, then the combustion in Transport with increasing trend (18 percent in 1990; 27 percent in 2006) and the combustion in Manufacturing Industries and Construction with decreasing trend (26 percent in 1990; 17 percent in 2006). Small stationary energy sources, such as Commercial/Institutional, Residential and Agriculture/Forestry/Fishing, contribute to total emission from Energy sector with 17 to 20 percent, while Fugitive Emissions from Fuels contribute with about 10 percent. The majority of energy-related GHG emissions belong to CO₂ (91 to 93 percent), then follows CH₄ (6 to 8 percent) and N₂O (less than 1 percent).

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4. INDUSTRIAL PROCESSES (CRF sector 2)

4.1. OVERVIEW OF SECTOR

Greenhouse gas emissions are produced as by-products of non-energy industrial processes in which raw materials are chemically transformed to final products. During these processes different greenhouse gases (GHGs) such as carbon dioxide (CO₂), methane (CH₄) or nitrous oxide (N₂O) are released in the atmosphere.

Industrial processes whose contribution to CO₂ emissions was identified as significant are production of cement, lime, ammonia, as well as use of limestone and soda ash in different industrial activities. Nitric acid production is source of N₂O emissions. Emissions of CH₄ are appeared in production of other chemicals, as well as carbon black and ethylene.

Consumption of halocarbons (HFCs), which are used as substitution gases in refrigeration and air conditioning systems, foam blowing and fire extinguishers, is source of emissions of fluorinated compounds.

Some industrial process, particularly petrochemical, generate emissions of short-lived ozone and aerosol precursor gases such as carbon monoxide (CO), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC) and sulphur dioxide (SO₂). These gases indirect contribute to greenhouse effect.

The general methodology applied to estimate emissions associated with each industrial process, as recommended by *Revised 1996 IPCC Guidelines* and *Good Practice Guidance and Uncertainty Management in National GHG Inventories* involves the product of amount of material produced or consumed, and an associated emission factor per unit of production/consumption.

The activity data on production/consumption for particular industrial process are, in most cases, extracted from Monthly Industrial Reports, published by Central Bureau of Statistics, Department of Manufacturing and Mining. These reports cover industrial activities according to prescribed national classification of activities and comprise data on production and consumption of raw materials on monthly basis. In cases when such data were insufficient or some production-specific data were required to calculate emissions, individual manufacturers were contacted and surveys were carried out.

Regulation on the Greenhouse Gases Emissions Monitoring in the Republic of Croatia (Official Gazette No. 1/07) prescribes obligation and procedure for emissions monitoring, which comprise estimation and/or reporting of all anthropogenic emissions and removals. According to requirement, sources of abovementioned greenhouse gases are responsible to report required activity data for more accurate emissions estimation.

Emission factors used for calculation of emissions are, in most cases, default emission factors according to *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, and *Good Practice Guidance and Uncertainty Management in National GHG Inventories*, mainly due

to a lack of plant-specific emission factors. Country-specific emission factors for cement and lime production as well as ammonia production were estimated by collecting the actual data from individual plants.

Uncertainty estimates associated with emission factors for some industrial processes are well reported in *Good Practice Guidance*, while those associated with activity data are based on expert judgements since statistics and manufacturers have not particularly assessed the uncertainties.

Generally, CO₂ emissions from industrial processes declined from 1990 to 1995, due to the decline in industrial activities caused by the war in Croatia, while in the period 1996-2006 emissions slightly increased. Production of iron and aluminium were stopped in 1992.

The total annual emissions of GHGs, expressed in Gg CO₂-eq, from Industrial Processes in the period 1990-2006 are presented in the Figure 4.1-1.

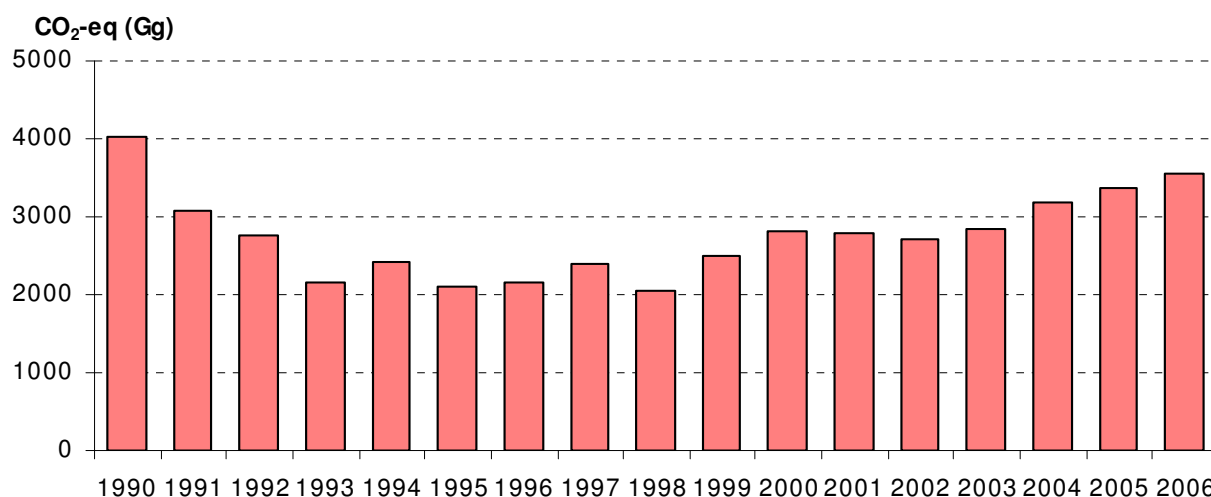


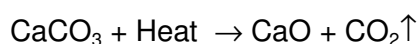
Figure 4.1-1: Emissions of GHGs from Industrial Processes (1990-2006)

4.2. MINERAL PRODUCTS (CRF 2.A.)

4.2.1. CEMENT PRODUCTION

4.2.1.1. Source category description

During cement production, calcium carbonate (CaCO₃) is heated in a cement kiln at high temperatures to form lime (i.e. calcium oxide, CaO) and CO₂ in a process known as calcination or calcining:



Lime is combined with silica-containing materials (clays or shales) to form dicalcium and tricalcium silicates which are the main constituents of cement clinker, with the earlier CO₂ being released in the atmosphere as a by-product. The clinker is then removed from the cement kiln, cooled, pulverized and mixed with small amount of gypsum to form final product called Portland cement.

There are four manufacturers of cement in Croatia, producing mostly Portland cement. There is production of Aluminate cement in the minor quantities. CO₂ emitted during the cement production process represents the most important source of non-energy industrial process of total CO₂ emissions. Different raw materials are used for Portland cement and Aluminate cement production. The quantity of the CO₂ emitted during Portland cement production is directly proportional to the lime content of the clinker. Emissions of SO₂ (non-combustion emissions) in the cement production originate from sulphur in the clay raw material.

4.2.1.2. Methodological issues

Estimation of CO₂ emissions is accomplished by applying an emission factor, in tonnes of CO₂ released per tonne of clinker produced, to the annual clinker output corrected with the fraction of clinker that is lost from the kiln in the form of Cement Kiln Dust (CKD), (Tier 2 method, *Good Practice Guidance*).

Country-specific emission factor for Portland and Aluminate cement was estimated by using data on CaO and MgO content of clinker produced from individual plants. Corrections for imports of CaO and MgO via raw materials were made. CO₂ from Cement Kiln Dust (CKD) leaving the kiln system was calculated based on the volumes of dust and an emission factor. Because CKD is not fully calcined, the correction factor for CKD (CF_{ckd}) was determined based on the emission factor for clinker and the calcinations rate of the CKD, which is based on plant-specific data. In the absence of data, the default CF_{ckd} was used in same cases.

The activity data for clinker production, data on the CaO and MgO content of the clinker, information on the CKD collection and recycling practices and likewise on the calcination fraction of the CKD were collected by survey of cement manufacturers. The data were cross-checked with cement production data from Monthly Industrial Reports published by Central Bureau of Statistics, Department of Manufacturing and Mining. The data on clinker production and emission factors are presented in Table 4.2-1. The quantity of clinker imported has not been considered in the emission estimations.

Table 4.2.1: Clinker production and emission factors (1990 - 2006)

Year	Clinker production Portland cement (tonnes) ¹	Clinker production Aluminate cement (tonnes) ¹	Actual clinker production (tonnes) ²	Emission factor Portland cement (t CO ₂ /t clinker)	Emission factor Aluminate cement (t CO ₂ /t clinker)
1990	2017840	44585	2087566	0.516	0.332
1991	1296146	40974	1353518	0.510	0.319
1992	1538923	27378	1585341	0.512	0.295
1993	1264565	40511	1321083	0.516	0.267
1994	1548980	34702	1602991	0.522	0.294
1995	1148756	48854	1211973	0.523	0.306
1996	1245692	60570	1322204	0.513	0.281
1997	1470234	63541	1552350	0.506	0.289
1998	1571767	77344	1664424	0.515	0.277
1999	2063838	87175	2171550	0.507	0.244

Table 4.2.1: Clinker production and emission factors (1990 - 2006), cont.

Year	Clinker production Portland cement (tonnes) ¹	Clinker production Aluminate cement (tonnes) ¹	Actual clinker production (tonnes) ²	Emission factor Portland cement (t CO ₂ /t clinker)	Emission factor Aluminate cement (t CO ₂ /t clinker)
2000	2308148	73999	2405355	0.519	0.301
2001	2645180	94065	2765583	0.511	0.296
2002	2627934	70667	2725194	0.504	0.314
2003	2609349	82741	2731521	0.508	0.294
2004	2764331	87911	2891372	0.510	0.295
2005	2827258	99320	2969013	0.510	0.232
2006	3007818	96549	3150994	0.507	0.259

¹ Clinker production according to survey of cement manufacturers

² Actual clinker productions calculated as a product of clinker production and CF_{ckd}, which is, for Portland cement; in the range 1.009 – 1.015; for Aluminate cement CF_{ckd} equals 1.02

Import/export quantities of clinker are presented in Table 4.2-2.

Table 4.2.2: Import/export quantities of clinker (1990 - 2006)

Year	Clinker import / tonnes		Clinker export / tonnes	
	Portland	Aluminate	Portland	Aluminate
1990	0	0	0	0
1991	0	0	0	0
1992	0	0	4376	0
1993	0	0	0	0
1994	0	0	0	2200
1995	52500	0	0	5504
1996	0	0	32715	5500
1997	57973	0	63529	5000
1998	116397	0	82451	14
1999	0	0	114868	287
2000	0	0	111226	576
2001	0	100	131565	519
2002	0	0	5029	2987
2003	112467	0	0	285
2004	51791	0	53387	157
2005	0	0	195888	238
2006		0	243708	438

The resulting emissions of CO₂ from Cement Production in the period 1990-2006 are presented in the Figure 4.2-1.

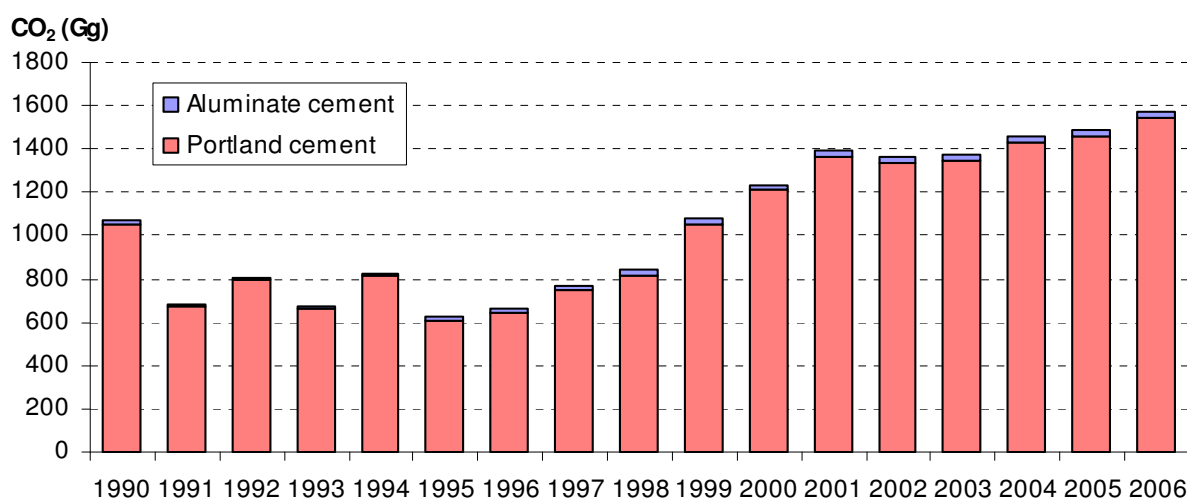


Figure 4.2-1: Emissions of CO₂ from Cement Production (1990-2006)

The activity data for cement production (see Table 4.2-3) were collected by survey of cement manufacturers and cross-checked with cement production data from Monthly Industrial Reports published by Central Bureau of Statistics, Department of Manufacturing and Mining.

Table 4.2-3: Cement production (1990-2006)

Year	Cement production / tonnes	
	Portland	Aluminate
1990	2598066	44698
1991	1702589	33184
1992	1810780	30532
1993	1596244	36895
1994	2049140	31499
1995	1571415	39731
1996	1643049	51654
1997	1906133	59365
1998	2161827	68503
1999	2549726	79743
2000	2909466	83388
2001	3152805	84655
2002	3415011	76737
2003	3607840	81860
2004	3553985	89563
2005	3528544	100509
2006	3657889	98041

SO₂ emissions originate from sulphur in the fuel and in the clay raw material. The fuel emissions are counted as energy emissions (these emissions are presented in the chapter on emissions from energy sources). SO₂ emissions from the clay are counted as process emissions and calculated on the basis of produced quantities of cement. About 70-95 percent of the SO₂ generated in the process is absorbed in the produced alkaline clinker. SO₂ emissions have been calculated by applying emission factor of 0.3 kg SO₂/tonne cement according to *Revised 1996 IPCC Guidelines*.

The resulting emissions of SO₂ from Cement Production in the period 1990-2006 are presented in the review on indirect GHG emissions from non-energy industrial processes.

4.2.1.3. Uncertainties and time-series consistency

Uncertainty estimate associated with emission factors amounts 3 percent, accordingly to values (1 to 5 percent) reported in *Good Practice Guidance*. Uncertainty estimate associated with activity data amounts 3 percent (1 to 5 percent), based on expert judgements since statistics and manufacturers have not been particularly assessed the uncertainties.

Emissions from Cement Production have been calculated using the same method and data sets for every year in the time series.

4.2.1.4. Source-specific QA/QC and verification

During the preparation of the inventory submission activities related to source specific quality control were mainly focused on completeness and consistency of emission estimates and on proper use of notation keys in the CRF tables according to QA/QC plan.

After preparation of final draft of this chapter an audit was carried out to check selected activities from Tier 1 General inventory level QC procedures and Tier 2 source-specific QC procedures. Cement Production is one of the key source categories in Industrial Processes. Regarding to Tier 2 activities, emission factors and activity data were checked for key source categories. CO₂ emissions from cement production were estimated using Tier 2 method which is a *good practice*. Basic activity data from Monthly Industrial Reports were compared with data provided by individual plants. Results of this comparison showed that there is no significant difference between these two sets of data. Country-specific emission factors for Portland cement were compared with IPCC default emission factor. Difference between these two data sets is caused by difference in CaO/MgO content in raw materials and clinker.

4.2.1.5. Source-specific recalculations

In the previous report, data for the clinker production from one cement manufacturer were not included for the period 1990-1997 (in which manufacturer produced Portland cement clinker) and for the period 1990-1999 (in which manufacturer produced Aluminate cement clinker). Data for the specific EF and its CKD correction factor for Portland and Aluminate cement clinker were not included for defined periods. Also, errors were done during calculation of the specific EF and CKD for the period 1998-2005 for all cement manufacturers.

In this report, Portland cement clinker production data for the period 1990-1997 and Aluminate cement clinker production data for the period 1990-1999 have been collected from survey of cement manufacturer due to improving comparability and time series consistency. Data for the specific EF and its CKD correction factor for Portland and Aluminate cement clinker have been collected for defined periods. Also, incorrect data for the specific EF and CKD for the period 1998-2005 have been corrected.

Thereupon, CO₂ emissions have been recalculated for the period 1990-2005.

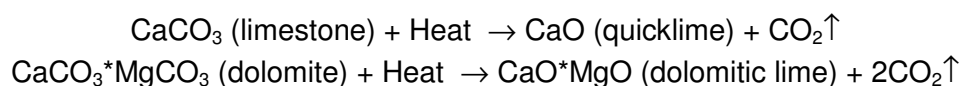
4.2.1.6. Source-specific planned improvements

Detailed activity data have been collected from individual plants and there is no necessity for further improvements.

4.2.2. LIME PRODUCTION

4.2.2.1. Source category description

The production of lime involves a series of steps which include quarrying the raw material, crushing and sizing, calcination and hydration. CO₂ is generated during the calcination stage, when limestone (CaCO₃) or dolomite (CaCO₃*MgCO₃) are burned at high temperature (900-1200 °C) in a kiln to produce quicklime (CaO) or dolomitic lime (CaO*MgO) and CO₂ which is released in the atmosphere:



There are four manufacturers of lime in Croatia, among one manufacturer produce both quicklime and dolomitic lime and the others produce only quicklime. Total seven kilns are used, among four are parallel-flow regenerative shaft kilns, two are annular shaft kilns and one is long rotary kiln.

4.2.2.2. Methodological issues

Calculation of CO₂ emissions from lime production is accomplished by applying an emission factor in tonnes of CO₂ released per tonne of quicklime or dolomitic lime produced, to the annual lime output. The emission factors were derived on the basis of calcination reaction depending on the type of raw material used in the process.

Country-specific emission factor for quicklime was estimated by using data on CaO content of the lime and stoichiometric ratio between CO₂ and CaO from individual plants. Country-specific emission factor for dolomitic lime was estimated by using data on CaO*MgO content of the lime and stoichiometric ratio between CO₂ and CaO*MgO from one plant.

Vertical shaft kilns, which are mostly used, generate relatively small amounts of Lime Kiln Dust (LKD). It is judged that a correction factor for LKD from vertical shaft kilns would be negligible and do not need to be estimated.

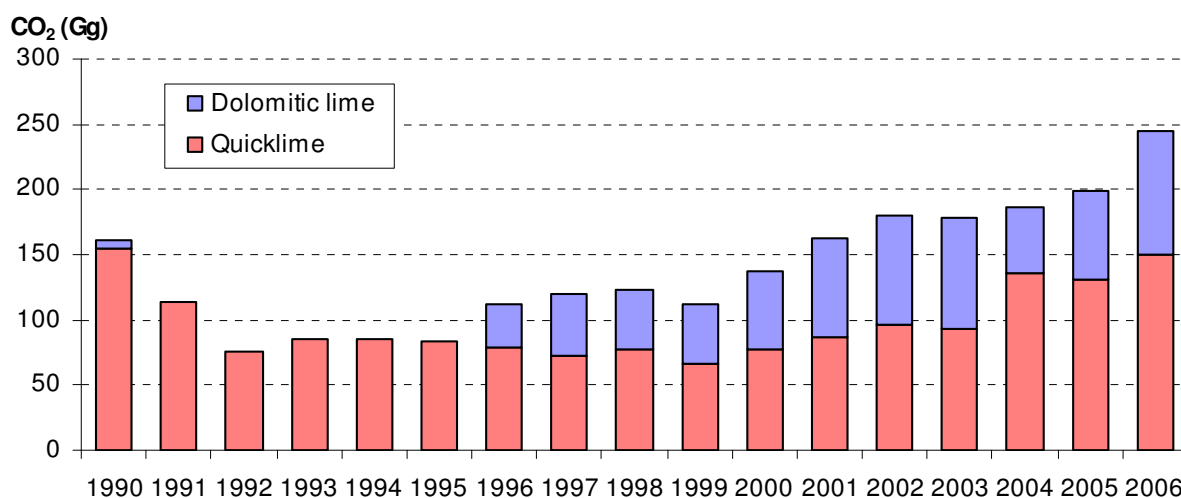
The data for quicklime and dolomitic lime production, data on the CaO and CaO*MgO content of the lime and stoichiometric ratio between CO₂ and CaO and CaO*MgO were collected by survey of lime manufacturers. The data for quicklime and dolomitic lime production were cross-checked with lime production data from Monthly Industrial Reports published by Central Bureau of Statistics, Department of Manufacturing and Mining. Also, certain amounts of quicklime were produced in the blast furnace processes, during 1990 and 1991.

The data on lime production and emission factors are presented in Table 4.2-4.

Table 4.2-4: Lime production and emission factors (1990-2006)

Year	Quicklime		Dolomitic lime	
	Production (tonnes)	EF (t CO ₂ /t lime)	Production (tonnes)	EF (t CO ₂ /t lime)
1990	211801	0.728	7474	0.869
1991	155258	0.732	0	-
1992	106393	0.720	0	-
1993	116893	0.723	0	-
1994	117178	0.725	0	-
1995	113452	0.735	0	-
1996	109185	0.722	38070	0.862
1997	100863	0.720	55171	0.850
1998	105261	0.733	53367	0.874
1999	90794	0.738	52704	0.870
2000	105374	0.731	68572	0.887
2001	118161	0.741	84838	0.887
2002	129134	0.746	94378	0.892
2003	124617	0.749	96191	0.879
2004	181306	0.747	56689	0.895
2005	173710	0.757	76351	0.875
2006	199784	0.750	105653	0.895

The resulting emissions of CO₂ from Lime Production in the period 1990-2006 are presented in the Figure 4.2-2.

Figure 4.2-2: Emissions of CO₂ from Lime Production (1990-2006)

The methodology for calculating SO₂ emissions from Lime Production is not available in *Revised 1996 IPCC Guidelines*. Process (non-combustion) SO₂ emissions depend on the sulphur content and mineralogical form of the stone feed, the quality of the lime produced and the type of kiln.

4.2.2.3. Uncertainties and time-series consistency

Uncertainty estimate associated with emission factors amounts 3 percent, accordingly to values (1 to 5 percent) reported in *Good Practice Guidance*. Uncertainty estimate associated with

activity data amounts 3 percent (1 to 5 percent), based on expert judgements since statistics and manufacturers have not been particularly assessed the uncertainties.

Emissions from Lime Production have been calculated using the same method and data sets for every year in the time series.

4.2.2.4. Source specific QA/QC and verification

During the preparation of the inventory submission activities related to source specific quality control were mainly focused on completeness and consistency of emission estimates and on proper use of notation keys in the CRF tables according to QA/QC plan.

After preparation of final draft of this chapter an audit was carried out to check selected activities from Tier 1 General inventory level QC procedures and Tier 2 source-specific QC procedures. Lime Production is one of the key source categories in Industrial Processes. Regarding to Tier 2 activities, emission factors and activity data were checked for key source categories. CO₂ emissions from lime production were estimated using Tier 2 method which is a *good practice*. Basic activity data from Monthly Industrial Reports were compared with data provided by individual plants. Results of this comparison showed that there is no significant difference between these two sets of data. Country-specific emission factors for quicklime and dolomitic lime were compared with IPCC default emission factors. Difference between these two data sets is caused by difference in CaO/CaO*MgO content in lime.

4.2.2.5. Source specific recalculations

In the previous report, the activity data for total lime production were extracted from Monthly Industrial Reports published by Central Bureau of Statistics, Department of Manufacturing and Mining, and also were partly collected by survey of lime manufacturer since national classification of activities does not distinguish quicklime and dolomitic lime production.

In this report, quicklime and dolomitic lime production data for the period 1990-2006 were collected from survey of lime manufacturers due to improving comparability and time series consistency. Also, country specific EFs were developed.

Thereupon, CO₂ emissions are recalculated for the period 1990-2005.

4.2.2.6. Source-specific planned improvements

Detailed activity data have been collected from individual plants and there is no necessarily for further improvements.

4.2.3. LIMESTONE AND DOLOMITE USE

4.2.3.1. Source category description

Limestone (CaCO₃) and dolomite (CaCO₃*MgCO₃) are basic raw materials having commercial applications in a number of industries including metal production, glass and ceramic manufacture, refractory materials manufacture, chemical, agriculture, construction and environmental pollution control. For some of these applications carbonates are sufficiently

heated to high temperature as part of the process to generate CO₂ as a by-product. The major utilization of dolomite in Croatia is in glass, ceramic and refractory materials manufacture as well as the limestone use in the pig iron production (during 1990 and 1991).

4.2.3.2. Methodological issues

Emissions of CO₂ from use of limestone and dolomite have been calculated by multiplying annual consumption of raw material in processes (limestone/dolomite) by emission factors, which are based on a ratio between CO₂ and limestone/dolomite used in a particular process. Emissions of CO₂ from the use of limestone have been estimated by using emission factor which equals 440 kg CO₂/tonne limestone. Emissions of CO₂ from the use of dolomite have been estimated by using emission factor which equals 477 kg CO₂/tonne dolomite, assuming 100 percent purity of raw material (*Revised 1996 IPCC Guidelines*).

The activity data for limestone use in the pig iron production for the 1990 and 1991 were collected by survey of iron manufacturer.

The activity data for dolomite use in glass, ceramic and refractory materials manufacture in the period 1990-1995 were extracted from Monthly Industrial Reports published by Central Bureau of Statistics, Department of Manufacturing and Mining. National classification of activities distinguished dolomite use in glass, ceramic and refractory materials manufacture in that period. After this period national classification of activities did not distinguish dolomite use in abovementioned activities and because of that, AD was collected by survey of manufacturer. The activity data for dolomite use in glass manufacture in the period 1996-2006 were collected by survey of glass manufacturer. Some of these activities (from the period 1990-1995) were halted in the meantime. According to statistical data and data from survey there was no limestone use in abovementioned processes (see Table 4.2-5).

Table 4.2-5: Limestone and dolomite use (1990-2006)

Year	Limestone use (tonnes)	Dolomite use (tonnes)
1990	41816	52031
1991	12037	40452
1992	0	22091
1993	0	20134
1994	0	32504
1995	0	23461
1996	0	15906
1997	0	14762
1998	0	17565
1999	0	16205
2000	0	16695
2001	0	18596
2002	0	20022
2003	0	23975
2004	0	24088
2005	0	25269
2006	0	22350

The resulting emissions of CO₂ from Limestone and Dolomite Use in the period 1990-2006 are presented in the Figure 4.2-3.

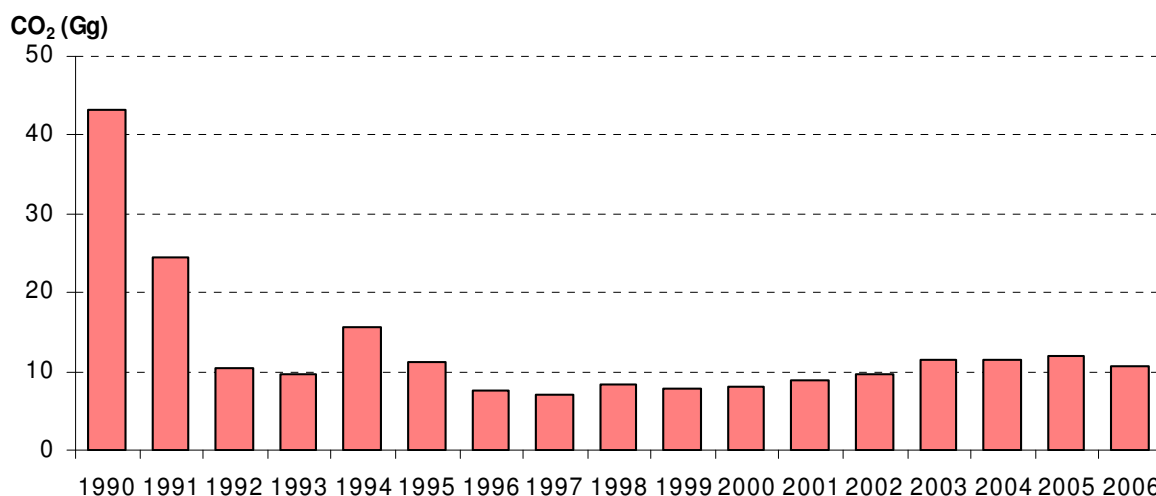


Figure 4.2-3: Emissions of CO₂ from Limestone and Dolomite Use (1990-2006)

4.2.3.3. Uncertainties and time-series consistency

Uncertainties in CO₂ estimates are related to possible variations in the chemical composition of limestone and dolomite (carbonates may contain smaller amounts of impurities i.e. magnesia, silica, and sulphur). Uncertainties contained in these estimates are due to provided default emission factor which assume 100 percent purity of raw material.

Uncertainty estimate associated with default emission factors amounts 30 percent, based on expert judgements. Uncertainty estimate associated with activity data amounts 7.5 percent (5 to 10 percent), based on expert judgements since statistics and manufacturers have not been particularly assessed the uncertainties.

Emissions from Limestone and Dolomite Use have been calculated using the same method for every year in the time series. Data sets are different for the period 1990-1995 in relation to the period 1996-2006. As abovementioned, in the period 1990-1995 national classification of activities distinguished dolomite use in glass, ceramic and refractory materials manufacture. After this period national classification of activities did not distinguish dolomite use in abovementioned activities and because of that, AD was collected by survey of manufacturer. Some of these activities (from the period 1990-1995) were halted in the meantime, and there is no possibility to collect AD by the same data sets, for entire period.

4.2.3.4. Source specific QA/QC and verification

During the preparation of the inventory submission activities related to quality control were mainly focused on completeness and consistency of emission estimates and on proper use of notation keys in the CRF tables according to QA/QC plan.

After preparation of final draft of this chapter an audit was carried out to check selected activities from Tier 1 General inventory level QC procedures. Since this source category is not a key source, QA/QC plan does not prescribes source specific quality control procedures.

4.2.3.5. Source specific recalculations

Activity data obtained from one glass manufacturer have been corrected for the period 1996-2004. Thereupon, CO₂ emissions are recalculated for the period 1990-2004.

4.2.3.6. Source-specific planned improvements

For the purpose of accurate calculation of national emission factors for dolomite use, knowledge of chemical composition of dolomite which is used as raw materials in abovementioned commercial applications (glass, ceramic and refractory materials manufacture) is favourably and plans to investigate. For now, detailed data have been collected from only one glass manufacturer.

4.2.4. SODA ASH PRODUCTION AND USE

4.2.4.1. Source category description

Soda ash (sodium carbonate, Na₂CO₃) is a white crystalline solid that is commercially used as a raw material in a large number of industrial processes including glass and ceramic manufacture, soap and detergents, pulp and paper production and water treatment.

According to Department of Manufacturing and Mining (Central Bureau of Statistics) there was not any significant production, both natural and synthetic, of soda ash in Croatia in the period 1990-2006. Therefore, only CO₂ emissions arising in soda ash consumption in glass and ceramic manufacture, and in the production of soap and detergents, have been estimated.

4.2.4.2. Methodological issues

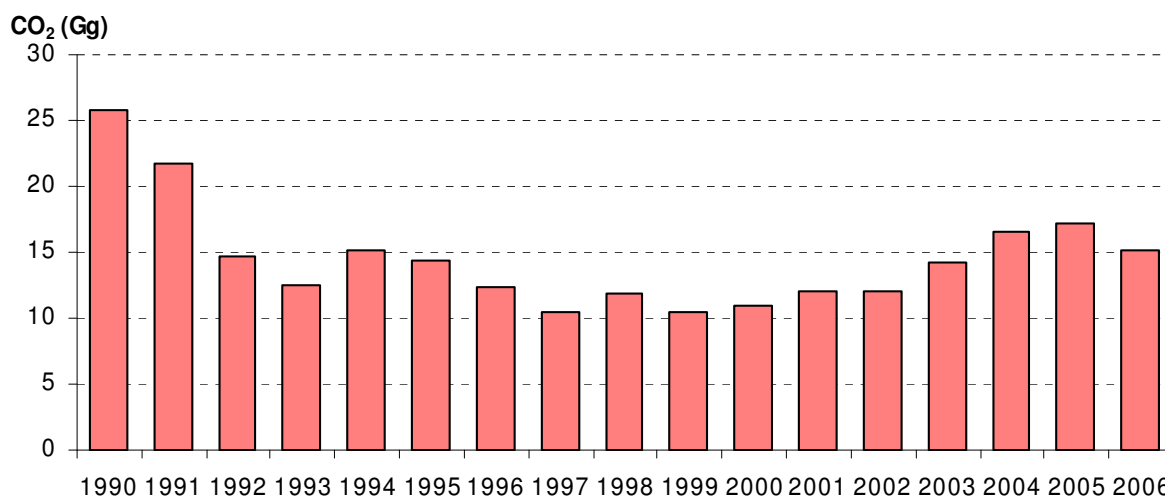
Emissions of CO₂ from the soda ash use have been calculated by multiplying annual consumption of soda ash by emission factor, which is based on a ratio between CO₂ and soda ash used. Default emission factor equals 415 kg CO₂/tonne soda ash has been used (*Revised 1996 IPCC Guidelines*).

The activity data for soda ash use in glass and ceramic manufacture, and in the production of soap and detergents in the period 1990-1995, were extracted from Monthly Industrial Reports published by Central Bureau of Statistics, Department of Manufacturing and Mining. National classification of activities distinguished soda ash use in glass and ceramic manufacture and in the production of soap and detergents in that period. After this period national classification of activities did not distinguish soda ash use in abovementioned activities and because of that, AD was collected by survey of manufacturer. The activity data for soda ash use in glass manufacture in the period 1996-2006 were collected by survey of glass manufacturers (see Table 4.2-6).

Table 4.2-6: Soda ash use (1990-2006)

Year	Soda ash use (tonnes)
1990	62024
1991	52415
1992	35376
1993	30202
1994	36659
1995	34668
1996	29706
1997	25125
1998	28499
1999	25121
2000	26536
2001	29134
2002	29179
2003	34178
2004	39730
2005	41498
2006	36487

The resulting emissions of CO₂ from Soda Ash Use in the period 1990-2006 are presented in the Figure 4.2-4.

Figure 4.2-4: Emissions of CO₂ from Soda Ash Use (1990-2006)

4.2.4.3. Uncertainties and time-series consistency

Emissions of CO₂ from soda ash use are dependent upon a type of end-use processes involved. Specific information characterizing the emissions from particular end-use process is not available. Therefore, uncertainties are related primarily to the accuracy of the emission factor.

Uncertainty estimate associated with default emission factors amounts 30 percent, based on expert judgements. Uncertainty estimate associated with activity data amounts 7.5 percent (5 to

10 percent), based on expert judgements since statistics and manufacturers have not been particularly assessed the uncertainties.

Emissions from Soda Ash Use have been calculated using the same method for every year in the time series. Data sets are different for the period 1990-1995 in relation to the period 1996-2006. As abovementioned, in the period 1990-1995 national classification of activities distinguished soda ash use in glass and ceramic manufacture and in the production of soap and detergents. After this period national classification of activities did not distinguish soda ash use in abovementioned activities and because of that, AD was collected by survey of manufacturers. Some of these activities (from the period 1990-1995) were halted in the meantime, and there is no possibility to collect AD by the same data sets, for entire period.

4.2.4.4. Source-specific QA/QC and verification

During the preparation of the inventory submission activities related to quality control were mainly focused on completeness and consistency of emission estimates and on proper use of notation keys in the CRF tables according to QA/QC plan.

After preparation of final draft of this chapter an audit was carried out to check selected activities from Tier 1 General inventory level QC procedures. Since this source category is not a key source, QA/QC plan does not prescribes source specific quality control procedures.

4.2.4.5. Source specific recalculations

Activity data obtained from one glass manufacturer have been corrected for the periods 1996-1999 and 2001-2004. Thereupon, CO₂ emissions are recalculated for these periods.

4.2.4.6. Source-specific planned improvements

For the purpose of accurate calculation of national emission factors, investigation of specific information characterizing the emissions from particular end-use processes is favourably and plans to investigate.

4.2.5. PRODUCTION AND USE OF MISCELLANEOUS MINERAL PRODUCTS

4.2.5.1. Source category description

There are several mineral production processes which caused emissions of indirect GHGs: Asphalt Roofing Production, Road Paving with Asphalt and Glass Manufacturing.

4.2.5.2. Methodological issues

Asphalt Roofing Production

Asphalt roofing production includes production of asphalt roofing and process of asphalt blowing. Emissions of indirect GHGs have been calculated by multiplying annual produced quantities with related emission factor provided by *Revised 1996 IPCC Guidelines*.

For indirect GHGs emissions estimation in the Asphalt Roofing Production the emission factors of 0.049 kg NMVOC/tonne asphalt roofing and 0.0095 kg CO/tonne asphalt roofing have been applied. In the Asphalt Blowing process the emission factor of 2.4 kg NMVOC/tonne asphalt blown has been applied.

The annual produced quantities were extracted from Monthly Industrial Reports published by Central Bureau of Statistics, Department of Manufacturing and Mining. The resulting emissions of indirect GHGs from Asphalt Roofing Production Processes in the period 1990-2006 are presented in the review on indirect GHG emissions from non-energy industrial processes.

Road Paving with Asphalt

Emissions of indirect GHGs from Road Paving with Asphalt include emissions from asphalt plant, from road surfacing operations and from subsequent road surface. Emissions of indirect GHGs have been calculated by multiplying annual produced quantities of asphalt with related emission factor provided by *Revised 1996 IPCC Guidelines*.

For NMVOC emissions estimation from Asphalt Plant the emission factor of 0.023 kg NMVOC/tonne asphalt has been applied. In the previous report errors were done during emission factor appliance for Road Paving, because *Revised 1996 IPCC Guidelines* offer different value (320 kg NMVOC/tonne asphalt) then *EMEP-CORINAIR Emission Inventory Guidebook* (0.023 kg NMVOC/tonne asphalt). In this report the emission factor of 0.023 kg NMVOC/tonne asphalt has been applied for NMVOC emissions estimation from Road Surface.

The annual produced quantities of asphalt were extracted from Monthly Industrial Reports published by Central Bureau of Statistics, Department of Manufacturing and Mining. The resulting emissions of indirect GHGs from Road Paving with Asphalt in the period 1990-2006 are presented in the review on indirect GHG emissions from non-energy industrial processes.

Glass Manufacturing

Emissions from Container Glass Production and Flat Glass Production have been calculated by multiplying annual produced quantities of container and flat glass with emission factor provided by *Revised 1996 IPCC Guidelines*. The emission factor of 4.5 kg NMVOC/tonne glass has been applied.

The annual produced quantities of glass were extracted from Monthly Industrial Reports published by Central Bureau of Statistics, Department of Manufacturing and Mining. The resulting emissions of NMVOC from Glass Manufacturing in the period 1990-2006 are presented in the review on indirect GHG emissions from non-energy industrial processes.

4.2.5.3. Uncertainties and time-series consistency

Uncertainties related to emissions of indirect GHGs are related primarily to the accuracy of the emission factor. *Good Practice Guidance* didn't recommend uncertainty estimate associated with default emission factors for Production and Use of Miscellaneous Mineral Products.

Uncertainties associated with default emission factors and activity data were not estimated for Production and Use of Miscellaneous Mineral Products.

Emissions from Production and Use of Miscellaneous Mineral Products have been calculated using the same method and data sets for every year in the time series.

4.2.5.4. Source-specific QA/QC and verification

During the preparation of the inventory submission activities related to quality control were mainly focused on completeness and consistency of emission estimates and on proper use of notation keys in the CRF tables according to QA/QC plan.

After preparation of final draft of this chapter an audit was carried out to check selected activities from Tier 1 General inventory level QC procedures. Since this source category is not a key source, QA/QC plan does not prescribes source specific quality control procedures.

4.2.5.5. Source specific recalculations

There are no source-specific recalculations because only NMVOC emissions are calculated in abovementioned sub-sectors. The *IPCC Guidelines* do not provide methodologies for calculation of CO₂ emission from these sources.

4.2.5.6. Source-specific planned improvements

For the purpose of accurate calculation of national emission factors, analyze and investigation of specific information related to type of asphalt roofing production processes and type of asphalt as well as amounts of diluent which are used in asphalt production plans to achieve.

4.3. CHEMICAL INDUSTRY (CRF 2.B.)

4.3.1. AMMONIA PRODUCTION

4.3.1.1. Source category description

Ammonia is produced by catalytic steam reforming of natural gas in which hydrogen is chemically separated from the natural gas and combined with nitrogen to produce ammonia (NH₃). Carbon dioxide which is formed from carbon monoxide in CO shift converter is removed by using two methods: monoethanolamine scrubbing and hot potassium scrubbing. After absorbing the CO₂, the amine solution is preheated and regenerated which results in removing the CO₂ by steam stripping and then by heating. The CO₂ is either vented to the atmosphere or used as a feedstock in other parts of the plant complex (for production of UREA or dry ice).

4.3.1.2. Methodological issues

In ammonia production natural gas provides both feedstock and fuel. Emissions of CO₂ from natural gas used as feedstock have been calculated by means of multiplying annual consumption of natural gas in process by carbon content of natural gas and molecular weight ratio between CO₂ and carbon (Tier 1a, *Revised 1996 IPCC Guidelines*).

Emissions of CO₂, CH₄ and N₂O from natural gas used as fuel have been calculated by means of multiplying annual energy consumption of natural gas by default emission factors (Tier 1, *Revised 1996 IPCC Guidelines*).

Data on consumption and composition of natural gas (see Table 4.3-1) used as a feedstock and fuel were collected by survey of ammonia manufacturer (Petrokemija Fertilizer Company Kutina) and cross-checked with ammonia production data from Monthly Industrial Reports published by Central Bureau of Statistics, Department of Manufacturing and Mining. Carbon content of gas (kg C/m³) has been estimated from volume fraction of CH₄, C₂H₆, C₃H₈, C₄H₁₀, C₅H₁₂, CO₂ and N₂ in natural gas.

Table 4.3-1: Consumption and composition of natural gas in Ammonia Production (1990-2006)

Year	Natural gas consumption (m ³)		Carbon content of gas (kg C/m ³)
	Feedstock	Fuel	
1990	242905233	211094767	0.5519
1991	230492226	248307774	0.5579
1992	299567927	316032073	0.5524
1993	238269046	265730954	0.5395
1994	239717137	273782863	0.5401
1995	232773362	321226638	0.5423
1996	254116356	279183644	0.5395
1997	277311935	308688065	0.5372
1998	207973360	251626640	0.5373
1999	262772017	286027983	0.5388
2000	266433375	280466625	0.5377
2001	214441408	232458592	0.5416
2002	193045364	212154636	0.5421
2003	216859822	245040178	0.5431

Table 4.3-1: Consumption and composition of natural gas in Ammonia Production (1990-2006), cont.

Year	Natural gas consumption (m ³)		Carbon content of gas (kg C/m ³)
	Feedstock	Fuel	
2004	264367950	220332050	0.5391
2005	259004302	219095698	0.5383
2006	253861433	209038567	0.5409

The resulting emissions of CO₂ from Ammonia Production in the period 1990-2006 are presented in the Figure 4.3-1. Emissions of CH₄ and N₂O from natural gas used as fuel in Ammonia production in the period 1990-2006 are presented in the Table 4.3-2.

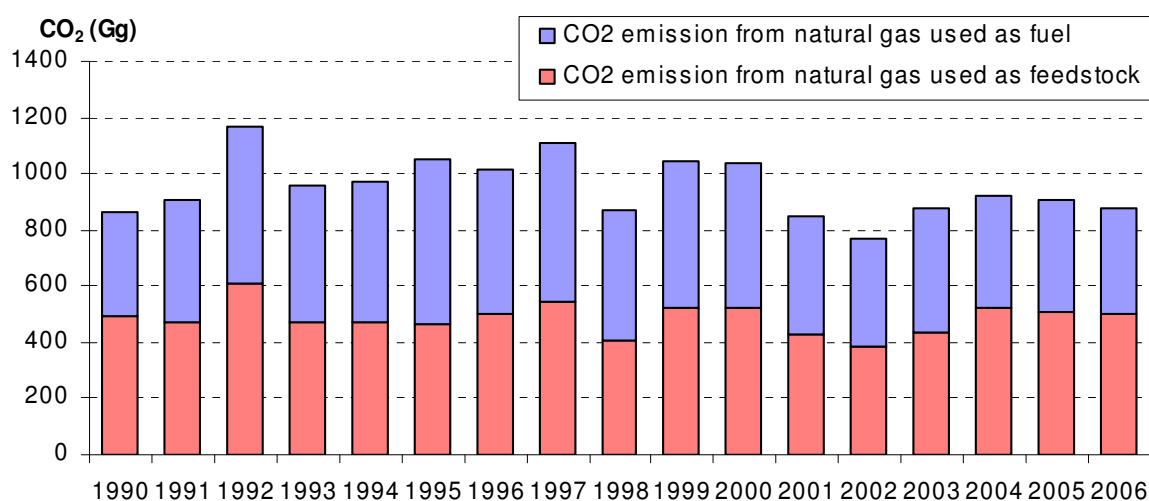


Figure 4.3-1: Emissions of CO₂ from Ammonia Production (1990-2006)

Table 4.3-2: Emission of CH₄ and N₂O in Ammonia Production from consumption of natural gas as fuel (1990-2006)

Year	CH ₄ (Gg)	N ₂ O (Gg)
1990	0.0359	0.0007
1991	0.0422	0.0008
1992	0.0537	0.0011
1993	0.0452	0.0009
1994	0.0465	0.0009
1995	0.0546	0.0011
1996	0.0475	0.0009
1997	0.0525	0.0010
1998	0.0428	0.0009
1999	0.0486	0.0010
2000	0.0477	0.0010
2001	0.0395	0.0008
2002	0.0361	0.0007
2003	0.0417	0.0008
2004	0.0375	0.0007
2005	0.0372	0.0007
2006	0.0355	0.0007

4.3.1.3. Uncertainties and time-series consistency

According to *Revised 1996 IPCC Guidelines* the most accurate method of emissions estimation from natural gas as feedstock is based on the consumption and composition of natural gas in the process. There are some uncertainties concerning to use of CO₂ as a feedstock in downstream manufacturing processes, in the production of urea, dry ice and fertilizer. According to *Revised 1996 IPCC Guidelines* no account should consequently be taken for intermediate binding of CO₂ in production of urea, dry ice and fertilizer. Also, emissions estimation from natural gas as fuel is based on the consumption of natural gas and default emission factors.

Uncertainty estimate associated with emission factors amounts 5 percent, accordingly to value recommended in *Good Practice Guidance*. Uncertainty estimate associated with activity data amounts 3 percent (1 to 5 percent), based on expert judgements since statistics and manufacturers have not been particularly assessed the uncertainties.

Emissions from Ammonia Production have been calculated using the same data sets for every year in the time series. Emissions estimation from natural gas as feedstock has been calculated using the Tier 1a method for entire period. Emissions estimation from natural gas as fuel has been calculated using the Tier 1 method for entire period.

4.3.1.4. Source-specific QA/QC and verification

During the preparation of the inventory submission activities related to quality control were mainly focused on completeness and consistency of emission estimates and on proper use of notation keys in the CRF tables according to QA/QC plan.

After preparation of final draft of this chapter an audit was carried out to check selected activities from Tier 1 General inventory level QC procedures and Tier 2 source-specific QC procedures. Ammonia Production is one of the key source categories in Industrial Processes. Regarding to Tier 2 activities, emission factors and activity data were checked for key source categories. Emissions of CO₂ from consumption of natural gas as feedstock were estimated using Tier 1a method which could be considered as a *good practice*. Emissions of CO₂, CH₄ and N₂O from consumption of natural gas as fuel were estimated using Tier 1 method. Basic activity data from Monthly Industrial Reports were compared with data provided by plant. Results of this comparison showed that there is no significant difference between these two sets of data.

4.3.1.5. Source-specific recalculations

In the previous report, emissions from consumption of natural gas as fuel were calculated in Energy sector (presented in the CRF table 1.A.2.f Manufacturing Industries and Construction – Other – Petrochemical Industry).

In this report, emissions from consumption of natural gas as fuel have been added to emissions from consumption of natural gas as feedstock in Industrial processes (presented in the CRF table 2.B.1 Chemical Industry – Ammonia production). Thereupon, CO₂, CH₄ and N₂O emissions are recalculated for the period 1990-2005.

4.3.1.6. Source-specific planned improvements

Since Ammonia Production is a key source category, more detailed information about use of CO₂ as a feedstock in downstream manufacturing processes, are planned to investigate.

4.3.2. NITRIC ACID PRODUCTION

4.3.2.1. Source category description

There is one manufacturer of nitric acid in Croatia, with dual pressure type of production process, according to the pressure used in the oxidation and absorption stages. Ammonia, which is used as a feedstock, is vaporized, mixed with air and burned over a platinum/rhodium alloy catalyst. Nitrogen monoxide is formed and oxidized to nitrogen dioxide at medium pressures and absorbed in water at high pressure to give nitric acid. During oxidation stage, nitrogen and nitrous oxide are formed as a by-product and released from reactor vents into the atmosphere. There is no abatement technology installed at the plant. Nitric acid is used in the manufacture of fertilizers.

4.3.2.2. Methodological issues

Emissions of N₂O from nitric acid production have been calculated by multiplying annual nitric acid production by emission factor which reflects the process type, i.e. dual pressure type. According to *Good Practice Guidance* emission factor given for European designed dual pressure plants is in the range from 8 to 10 kg N₂O/tonne nitric acid. Emission factor was determined as mean value of estimated range, i.e. 9 kg N₂O/tonne nitric acid. Data on nitric acid production (see Table 4.3-3) were collected by survey of nitric acid manufacturer and cross-checked with nitric acid production data from Monthly Industrial Reports published by Central Bureau of Statistics, Department of Manufacturing and Mining.

Table 4.3-3: Nitric acid production (1990-2006)

Year	Nitric acid production (tonnes)
1990	332459
1991	291997
1992	381797
1993	287805
1994	311236
1995	299297
1996	278683
1997	292892
1998	220509
1999	260198
2000	306201
2001	257534
2002	249992
2003	235645
2004	287567
2005	280746
2006	277590

The resulting emissions of N₂O from Nitric Acid Production in the period 1990-2006 are presented in the Figure 4.3-2.

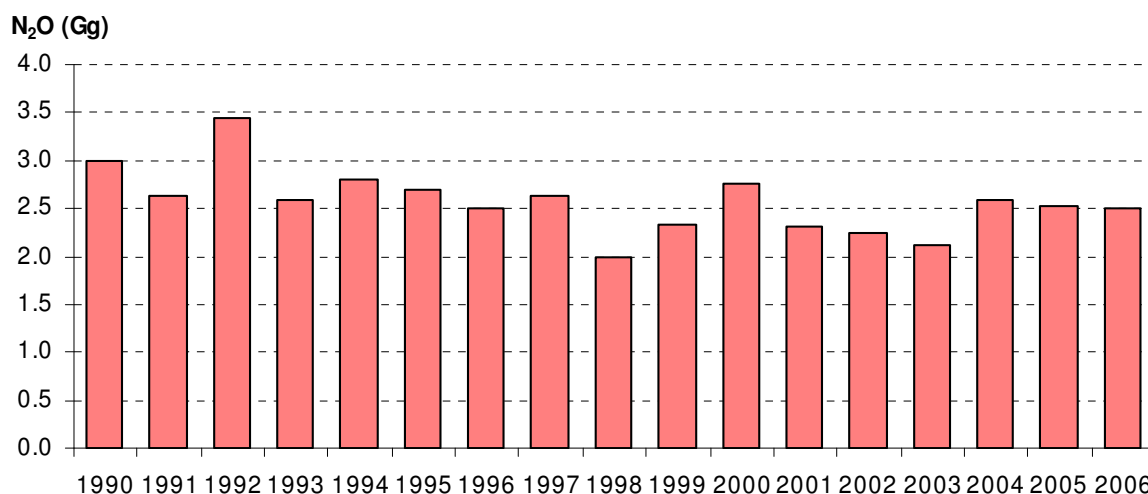


Figure 4.3-2: Emissions of N₂O from Nitric Acid Production (1990-2006)

4.3.2.3. Uncertainties and time-series consistency

The main uncertainties concerning the emissions of N₂O from nitric acid production are due to applied emission factor. As mentioned before the process of nitric acid production in Croatia is European designed dual pressure type and because none of the emission factors proposed by *Revised 1996 IPCC Guidelines* correspond to plant type default emission factor was taken from *Good Practice Guidance*³.

Uncertainty estimate associated with default emission factors amounts 30 percent, based on expert judgements. Uncertainty estimate associated with activity data amounts 3 percent (1 to 5 percent), based on expert judgements since statistics and manufacturers have not been particularly assessed the uncertainties.

Emissions from Nitric Acid Production have been calculated using the same method and data sets for every year in the time series.

4.3.2.4. Source-specific QA/QC and verification

During the preparation of the inventory submission activities related to quality control were mainly focused on completeness and consistency of emission estimates and on proper use of notation keys in the CRF tables according to QA/QC plan.

After preparation of final draft of this chapter an audit was carried out to check selected activities from Tier 1 General inventory level QC procedures and Tier 2 source-specific QC procedures. Regarding to Tier 2 activities, emission factors and activity data were checked for key source categories. Nitric Acid Production is one of the key source categories in Industrial

³ *IPCC Guidelines* provide emission factor for medium pressure plants in the range of 6 to 7.5 kg N₂O/t nitric acid which could be considered as nearest which correspond to plant type. *Good Practice Guidance* provide emission factor for European designed, dual pressure, double absorption plant, in the range of 8 to 10 kg N₂O/t nitric acid.

Processes. Emissions of N₂O from nitric acid production were based on default emission factor from *IPCC Good Practice Guidance* and annual amount of nitric acid production. It is a *good practice* to use direct emission measurement for national emission factor calculation. Basic activity data from Monthly Industrial Reports were compared with data provided by individual plant. Results of this comparison showed that there is no significant difference between these two sets of data

4.3.2.5. Source-specific recalculations

There are no source-specific recalculations in sub-sector Nitric Acid Production.

4.3.2.6. Source-specific planned improvements

Since Nitric Acid Production is a key source category, more detailed information about using of direct emission measurement for calculation of national emission factor are planned to investigate. Furthermore, this data are not available since CEM system is not installed and manufacturer is not obliged yet to conduct spot measurement according to relevant regulation.

4.3.3. PRODUCTION OF OTHER CHEMICALS

4.3.3.1. Source category description

The production of other chemicals such as carbon black, coke, and some petrochemicals (ethylene, dichloroethylene, styrene) can be sources of CH₄ emissions. Although most CH₄ sources from industrial processes individually are small, collectively they may be significant.

4.3.3.2. Methodological issues

Emissions of CH₄ from the production of other chemicals have been calculated by multiplying an annual production of each chemical with related emission factor provided by *Revised 1996 IPCC Guidelines*. The annual production of chemicals (see Table 4.3-4) was extracted from Monthly Industrial Reports published by Central Bureau of Statistics, Department of Manufacturing and Mining.

Table 4.3-4: Production of other chemicals (1990-2006)

Year	Carbon black (tonnes)	Ethylene (tonnes)	Dichloro- ethylene (tonnes)	Styrene (tonnes)	Coke (tonnes)
1990	30624	72631	72653	8923	556084
1991	18783	66871	68325	6376	441584
1992	13479	68318	92089	1381	409371
1993	17123	68634	79608	0	420676
1994	21468	65285	97528	0	276854
1995	27185	67547	84374	0	0
1996	26735	64782	48630	0	0
1997	24214	63554	26264	0	0
1998	22165	60148	31308	0	0
1999	17589	60295	47686	0	0

Table 4.3-4: Production of other chemicals (1990-2006), cont.

Year	Carbon black (tonnes)	Ethylene (tonnes)	Dichloro-ethylene (tonnes)	Styrene (tonnes)	Coke (tonnes)
2000	20029	38918	71364	0	0
2001	21180	46632	64442	0	0
2002	19385	43554	0	0	0
2003	21497	41252	0	0	0
2004	20271	49886	0	0	0
2005	18498	50263	0	0	0
2006	26264	48824	0	0	0

The resulting emissions of CH₄ from Production of Other Chemicals in the period 1990-2006 are reported in Table 4.3-5.

Table 4.3-5: Emissions of CH₄ from Production of Other Chemicals (1990-2006)

Year	Emissions of CH ₄ from production of other chemicals (Gg)				
	Carbon black	Ethylene	Dichloro-ethylene	Styrene	Coke
1990	0.34	0.07	0.03	0.04	0.28
1991	0.21	0.07	0.03	0.03	0.22
1992	0.15	0.07	0.04	0.01	0.20
1993	0.19	0.07	0.03	-	0.21
1994	0.24	0.07	0.04	-	0.14
1995	0.30	0.07	0.03	-	-
1996	0.29	0.06	0.02	-	-
1997	0.27	0.06	0.01	-	-
1998	0.24	0.06	0.01	-	-
1999	0.19	0.06	0.02	-	-
2000	0.22	0.04	0.03	-	-
2001	0.23	0.05	0.03	-	-
2002	0.21	0.04	-	-	-
2003	0.24	0.04	-	-	-
2004	0.22	0.05	-	-	-
2005	0.20	0.05	-	-	-
2006	0.29	0.05	-	-	-

Emissions of indirect GHGs from Production of Other Chemicals have been calculated by multiplying an annual production of each chemical with related emission factor provided by *Revised 1996 IPCC Guidelines*. The resulting emissions of indirect GHGs from Production from Other Chemicals in the period 1990-2006 are presented in the review on indirect GHG emissions from non-energy industrial processes.

4.3.3.3. Uncertainties and time-series consistency

Uncertainty estimate associated with default emission factor for CH₄ emissions amounts 30 percent, based on expert judgements. Uncertainty estimate associated with activity data for CH₄

emissions amounts 7.5 percent (5 to 10 percent), based on expert judgements since statistics and manufacturers have not been particularly assessed the uncertainties.

Emissions from Production from Other Chemicals have been calculated using the same method and data sets for every year in the time series.

4.3.3.4. Source-specific QA/QC and verification

During the preparation of the inventory submission activities related to quality control were mainly focused on completeness and consistency of emission estimates and on proper use of notation keys in the CRF tables according to QA/QC plan.

After preparation of final draft of this chapter an audit was carried out to check selected activities from Tier 1 General inventory level QC procedures. Since this source category is not a key source, QA/QC plan does not prescribes source specific quality control procedures.

4.3.3.5. Source-specific recalculations

There are no source specific recalculations in sub-sector Production of Other Chemicals.

4.3.3.6. Source-specific planned improvements

For the purpose of accurate emission calculations, Croatia planned to analyze specific chemical production processes.

4.4. METAL PRODUCTION (CRF 2.C.)

4.4.1. IRON AND STEEL PRODUCTION

4.4.1.1. Source category description

Primary production of pig iron in blast furnace was halted in 1992.

Steel production in electric arc furnaces (EAF) are used to produce carbon and alloy steel. The input material to EAFs is 100 percent scrap. Cylindrical lined EAFs are equipped with carbon electrodes. Alloying agents and fluxing materials (limestone) are added. Electric current of opposite polarity electrodes generates heat between the electrodes and through the scrap. The operations which generate emissions during the EAF steelmaking process are melting, refining, charging scrap, tapping steel and dumping slag. During the melting phase carbon electrodes are kept above the steel melt and the electrical arc oxidises the carbon to CO or CO₂.

4.4.1.2. Methodological issues

Pig Iron Production

Emissions of CO₂ have been calculated by multiplying annual production of pig iron by the emission factor proposed by *Revised 1996 IPCC Guidelines* (1.6 tonnes CO₂/tonne pig iron produced). The emission factor applied was assumed to be applicable to both pig iron production and integrated pig iron and steel production.

The activity data for pig iron were extracted from Monthly Industrial Reports published by Central Bureau of Statistics, Department of Manufacturing and Mining and cross-checked with iron and steel manufacturer⁴.

The resulting emission of CO₂ from Pig Iron Production in 1990 was amounted 335000 tonnes. In 1991 about 111000 tonnes of CO₂ was emitted. CO₂ emissions are not included in Metal Production to avoid double-counting. These emissions are included in Energy sector because Coke Oven Coke used in blast furnace is given in energy balance.

Steel Production

Emissions of CO₂ have been calculated by multiplying annual steel production with related emission factor provided by *Revised 1996 IPCC Guidelines*. The carbon emission factor is based on carbon loss from the electrode. Accordingly to value recommended in *Good Practice Guidance* for carbon released from consumed electrodes (roughly 1-1.5 kg carbon/tonne steel), the arithmetic mean has been taken (1.25 kg carbon/tonne steel) and emission factor of 4.58 kg CO₂/tonne steel has been applied.

⁴ It should be noticed that blast furnaces were closed at the end of 1991 mainly due to war activities near the location of iron and steel plant.

The activity data for steel production (see Table 4.4-1) were extracted from Monthly Industrial Reports published by Central Bureau of Statistics, Department of Manufacturing and Mining.

Table 4.4-1: Steel production (1990-2006)

Year	Steel production (tonnes)
1990	189368
1991	171147
1992	119733
1993	101942
1994	32674
1995	17021
1996	46424
1997	70660
1998	104854
1999	77213
2000	70998
2001	57963
2002	33839
2003	42235
2004	85947
2005	73640
2006	80516

The resulting emissions of CO₂ from Steel Production in the period 1990-2006 are presented in the Figure 4.4-1.

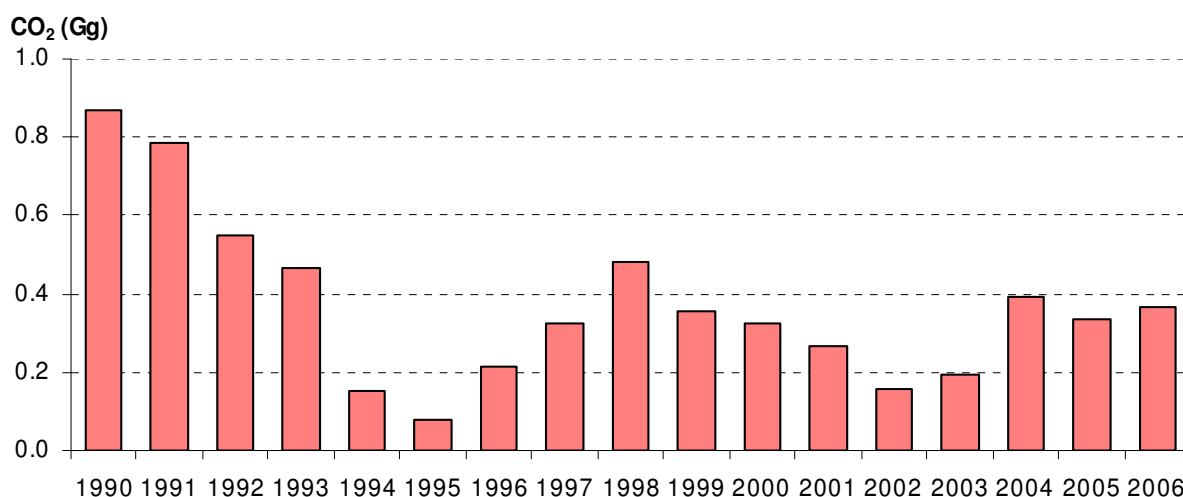


Figure 4.4-1: Emissions of CO₂ from Steel Production (1990-2006)

4.4.1.3. Uncertainties and time-series consistency

The main uncertainties concerning the emission of CO₂ from steel production are due to applied emission factor. The use of plant-specific emission factors would minimize uncertainty, but these factors were not available in adequate form.

Uncertainty estimate associated with default emission factors amounts 30 percent, based on expert judgements. Uncertainty estimate associated with activity data amounts 7.5 percent (5 to 10 percent), based on expert judgements since statistics and manufacturers have not been particularly assessed the uncertainties.

Emissions from Steel Production have been calculated using the same method and data sets for every year in the time series.

4.4.1.4. Source specific QA/QC and verification

During the preparation of the inventory submission activities related to quality control were mainly focused on completeness and consistency of emission estimates and on proper use of notation keys in the CRF tables according to QA/QC plan.

After preparation of final draft of this chapter an audit was carried out to check selected activities from Tier 1 General inventory level QC procedures. Since this source category is not a key source, QA/QC plan does not prescribes source specific quality control procedures.

4.4.1.5. Source-specific recalculations

There are no source-specific recalculations in sub-sector Steel Production.

4.4.1.6. Source-specific planned improvements

For the purpose of accurate calculation of national emission factors, Croatia planned to investigate the plant-specific emission factor to minimize emission calculation uncertainty.

4.4.2. FERROALLOYS PRODUCTION

4.4.2.1. Source category description

Ferroalloys are alloys of iron and metals such as silicon, manganese and chromium. Similar to emissions from the production of iron and steel, CO₂ is emitted when metallurgical coke is oxidized during a high-temperature reaction with iron and the selected alloying element. Ferroalloys production was halted in 2002.

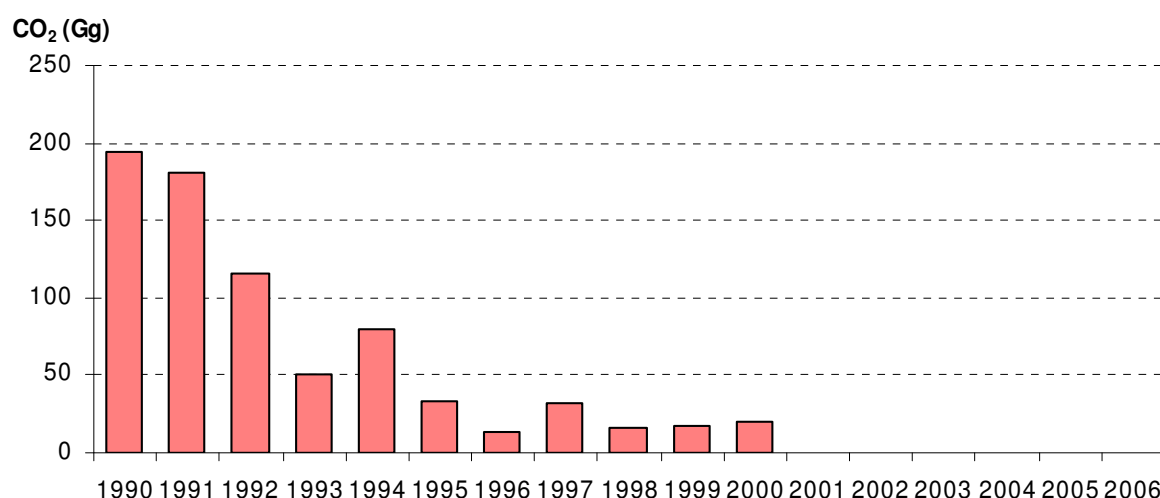
4.4.2.2. Methodological issues

Emissions of CO₂ have been calculated by multiplying annual ferroalloys production by material-specific emission factor (1.7 tonnes CO₂/tonne silicon manganese, 1.6 tonnes CO₂/tonne ferromanganese and 1.3 tonnes CO₂/tonne ferrochromium). The activity data for ferroalloys production (see Table 4.4-2) were extracted from Monthly Industrial Reports published by Central Bureau of Statistics, Department of Manufacturing and Mining. Interpolation method has been used for calculation of insufficient data for 1999 year. Taking into account the ferroalloys production trend, values for 1998 and 2000 have been used as the pattern for ferroalloys production calculation in 1999. Ferroalloys production was halted in 2002.

Table 4.4-2: Production of ferroalloys (1990-2006)

Year	Ferromanganese (tonnes)	Silicon manganese (tonnes)	Ferrochromium (tonnes)
1990	20535	48561	60859
1991	13053	38365	72845
1992	0	25572	56058
1993	0	8577	28028
1994	562	22071	31704
1995	0	0	26081
1996	0	0	10559
1997	0	0	24231
1998	0	0	11861
1999	0	0	13807
2000	0	0	15753
2001	0	0	361
2002	0	0	0
2003	0	0	0
2004	0	0	0
2005	0	0	0
2006	0	0	0

The resulting emissions of CO₂ from Ferroalloys Production in the period 1990-2006 are presented in the Figure 4.4-2.

Figure 4.4-2: Emissions of CO₂ from Ferroalloys Production (1990-2006)

4.4.2.3. Uncertainties and time-series consistency

Uncertainty estimate associated with default emission factors amounts 30 percent, based on expert judgements. Uncertainty estimate associated with activity data amounts 7.5 percent (5 to 10 percent), based on expert judgements since statistics and manufacturers have not been particularly assessed the uncertainties.

Emissions from Ferroalloys Production have been calculated using the same method and data sets for every year in the time series, except insufficient data for 1999, which was obtained by interpolation method.

4.4.2.4. Source specific QA/QC and verification

During the preparation of the inventory submission activities related to quality control were mainly focused on completeness and consistency of emission estimates and on proper use of notation keys in the CRF tables according to QA/QC plan.

After preparation of final draft of this chapter an audit was carried out to check selected activities from Tier 1 General inventory level QC procedures. Since this source category is not a key source, QA/QC plan does not prescribes source specific quality control procedures.

4.4.2.5. Source-specific recalculations

There are no source specific recalculations in sub-sector Ferroalloys Production.

4.4.3. ALUMINIUM PRODUCTION

4.4.3.1. Source category description

Primary aluminium is produced in two steps. First bauxite ore is ground, purified and calcined to produce alumina (Al_2O_3). Following this, the alumina is electrically reduced to aluminium by smelting in large pots. This process results in emission of several greenhouse gases including CO_2 , and two PFCs: CF_4 and C_2F_6 . Primary aluminium production was halted in 1991.

4.4.3.2. Methodological issues

The quantity of CO_2 released was estimated from the production of primary aluminium and the specific consumption of carbon which is oxidized to CO_2 in the process. During alumina reduction using prebaked anodes approximately 1.5 tonnes of CO_2 is emitted for each tonne of primary aluminium produced.

Data on primary aluminium production were collected by survey of aluminium manufacturer⁵.

The resulting emission of CO_2 from Aluminium Production in 1990 was amounted about 111 Gg CO_2 . In 1991 about 76 Gg CO_2 was emitted.

PFCs emissions from Aluminium Production could represent a significant source of emissions due to high GWP values. Since only aluminium production statistics were available, emissions of CF_4 and C_2F_6 were estimated by multiplying annual primary aluminium production with default emission factors provided by *Good Practice Guidance*. Default emission factors equal 1.7 kg/tonne Al for CF_4 and 0.17 kg/tonne Al for C_2F_6 (Side Worked Prebaked Anodes).

⁵ It should be noticed that primary aluminium production (electrolysis) were closed at the end of 1991 mainly due to war activities near the location of aluminium plant.

820 Gg CO₂-eq of CF₄ and 116 Gg CO₂-eq of C₂F₆ were emitted in 1990. 563 Gg CO₂-eq of CF₄ and 80 Gg CO₂-eq of C₂F₆ were emitted in 1991.

Occasionally, sulphur hexafluoride (SF₆) is also used by the aluminium industry as a cover gas for special foundry products. There are no available data on SF₆ consumption in aluminium industry.

The resulting emissions of indirect GHGs from Aluminium Production in the period 1990-1991 are presented in the review on indirect GHG emissions from non-energy industrial processes.

4.4.3.3. Uncertainties and time-series consistency

Uncertainties related to calculation of CO₂ emissions are primarily due to applied emission factor. Emissions vary depending on the specific technology used by each plant, however evidence suggests that there is little variation in CO₂ emissions from plants utilising similar technology.

A less uncertain method to calculate CO₂ emissions would be based upon the amount of reducing agent, i.e. amount of prebaked anodes used in a process but this information was not available. Nevertheless, it is very likely that use of the technology-specific emission factor, provided by *Revised 1996 IPCC Guidelines*, along with the correct production data produce accurate estimates.

Uncertainty estimate associated with default emission factor for CO₂ emissions amounts 30 percent, based on expert judgements. Uncertainty estimate associated with activity data for CO₂ emissions amounts 3 percent (1 to 5 percent), based on expert judgements since statistics and manufacturer have not been particularly assessed the uncertainties.

More uncertainties are related to calculation of PFCs emissions because continuous emission monitoring was not carried out, and smelter-specific operating parameters were not available. Default emission factors were therefore applied to calculate PFCs emissions. Uncertainty estimate associated with default emission factor for PFCs emissions amounts 50 percent, based on expert judgements. Uncertainty estimate associated with activity data for PFCs emissions amounts 30 percent, based on expert judgements.

Emissions from Aluminium Production have been calculated using the same method and data sets for every year in the time series.

4.4.3.4. Source specific QA/QC and verification

During the preparation of the inventory submission activities related to quality control were mainly focused on completeness and consistency of emission estimates and on proper use of notation keys in the CRF tables according to QA/QC plan.

After preparation of final draft of this chapter an audit was carried out to check selected activities from Tier 1 General inventory level QC procedures. Since this source category is not a key source, QA/QC plan does not prescribes source specific quality control procedures.

4.5. OTHER PRODUCTION (CRF 2.D.)

4.5.1. PULP AND PAPER

4.5.1.1. Source category description

Kraft (sulphate) pulping, acid sulphite pulping and neutral sulphite semi-chemical process are three types of paper production processes. Kraft pulping was used in 1990 and acid sulphite pulping was used until 1994 for paper production. After that, only neutral sulphite semi-chemical process has been used for paper production.

4.5.1.2. Methodological issues

Emissions of indirect GHGs have been calculated by multiplying annual production quantities with related emission factor provided by *Revised 1996 IPCC Guidelines*. For Kraft Pulping following default emission factors have been used: 7 kg SO₂/tonne dried pulp, 1.5 kg NO_x/tonne dried pulp, 3.7 kg NMVOC/tonne dried pulp and 5.6 kg CO/tonne dried pulp. For Acid Sulphite Pulping emission factor of 30 kg SO₂/tonne dried pulp has been used.

According to *Revised 1996 IPCC Guidelines*, only data for emissions estimation from Kraft and Acid Sulphite Process are available. The methods for emission estimation from Neutral Sulphite Semi-Chemical Process are not available and emissions from that process have therefore not been taken into account.

The activity data for pulp and paper production were extracted from Monthly Industrial Reports published by Central Bureau of Statistics, Department of Manufacturing and Mining.

The resulting emissions of indirect GHGs from Pulp and Paper in the period 1990-1994 are presented in the review on indirect GHG emissions from non-energy industrial processes.

4.5.1.3. Uncertainties and time-series consistency

Uncertainties associated with default emission factors and activity data were not estimated for Pulp and Paper Production.

Emissions from Pulp and Paper have been calculated using the same method and data sets for every year in the time series.

4.5.2. FOOD AND DRINK

4.5.2.1. Source category description

Emissions of NMVOC from following types of Food and Drink production processes have been calculated: meat, fish and poultry, sugar, margarine and solid cooking fats, cakes, biscuits and cereals, bread, animal feed, coffee roasting, wine, white wine, beer, spirits and brandy.

4.5.2.2. Methodological issues

Emissions of indirect GHGs from the production of food and drink have been calculated by multiplying annual production quantities with related emission factors provided by *Revised 1996 IPCC Guidelines*.

The activity data for food and drink production were extracted from Monthly Industrial Reports published by Central Bureau of Statistics, Department of Manufacturing and Mining. The resulting emissions of indirect GHGs from Food and Drink in the period 1990-2006 are presented in the review on indirect GHG emissions from non-energy industrial processes.

4.5.2.3. Uncertainties and time-series consistency

Uncertainties associated with default emission factors and activity data were not estimated for Food and Drink. Emissions from Food and Drink have been calculated using the same method and data sets for every year in the time series.

4.6. CONSUMPTION OF HALOCARBONS AND SF₆ (CRF 2.F.)

4.6.1. REFRIGERATION AND AIR CONDITIONING EQUIPMENT

4.6.1.1. Source category description

Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) are synthetic greenhouse gases whose present contribution to greenhouse effect is relatively small comparing to major greenhouse gases but due to their extremely long lifetime and Global Warming Potentials (GWP) they will continue to accumulate in the atmosphere as long as emissions continue.

Emissions are released by the handling and consumption of synthetic greenhouse gases. HFCs (HFC-32, HFC-125, HFC-134a and HFC-143a) are used as substitutes for cooling gases in refrigerating and air-conditioning systems that deplete the ozone layer. There is no production of HFCs in Croatia, therefore all quantities of HFCs are imported. Minor quantities of some substances are exported.

4.6.1.2. Methodological issues

In order to estimate consumption of HFCs in the period 1990-2006 a questionnaires have been sent to trading, service and manufacturing companies previously identified as possible sources of handling or consumption of these compounds. Several institutions such as Ministry of Environmental Protection, Physical Planning and Construction, Customs Department and Central Bureau of Statistics were contacted and asked to provide information on import and export of HFCs as well as information on consumption of each individual gas at the rather detailed level in order to use Tier 2 method (*Revised 1996 IPCC Guidelines*).

Results of a survey were unable to provide certain data in required extent. Also, National Classification of Activities used by Central Bureau of Statistics, in the same manner, does not particularly mark HFCs, PFCs and SF₆. Customs Departments Tariff Number does not precisely distinguish these compounds from other fluorinated chemicals which are controlled with Montreal Protocol.

The only useful information is those related to import and export of HFCs provided by Ministry of Environmental Protection, Physical Planning and Construction, which is responsible for monitoring of consumption of substitutes and mixture of substitutes for gases that deplete the ozone layer. According to this information potential HFCs emissions from Refrigeration and Air Conditioning Equipment were calculated (Tier 1a method, *Revised 1996 IPCC Guidelines*) for the period 1990-2006. Insufficient data were estimated by interpolation/extrapolation method. Extrapolation method has been used for calculation of insufficient emission estimations for HFC 32 (1990-1999), HFC 125 (1990-1995), HFC 134a (1990-1994) and HFC 143a (1990-1995). Taking into account the emissions trend, the pattern over three years from 2000 to 2002 has been used for calculation of HFC 32 emissions for the period 1990-1999. The pattern over period from 1996 to 2002 has been used for HFC 125 and HFC 143a emissions calculation for the period 1990-1995. The pattern over period from 1995 to 2002 has been used for HFC 134a

emissions calculation for the period 1990-1994. Data for 2003 and 2004 have been calculated by interpolation method using the pattern over entire time series and data for 2005 and 2006, which were obtained by Ministry of Environmental Protection, Physical Planning and Construction.

Annual emissions of HFCs, expressed in Gg CO₂-eq, in the period 1990-2006, are presented in the Table 4.6-1.

Table 4.6-1: Emissions of HFCs (Gg CO₂-eq) (1990 – 2006)

Gas	1990	1991	1992	1993	1994	1995	1996	1997	1998
HFC 32	0.14	0.13	0.13	0.12	0.12	0.11	0.11	0.10	0.10
HFC 125	24.46	22.99	21.53	20.06	18.59	17.13	22.20	22.18	1.12
HFC 134a	10.20	10.47	10.74	11.02	11.29	7.80	2.34	33.44	14.60
HFC 143a	18.11	18.12	18.13	18.14	18.15	18.15	35.61	35.57	1.82
Total emission (Gg CO₂-eq)	52.90	51.71	50.52	49.34	48.15	43.20	60.26	91.29	17.64

Table 4.6-1: Emissions of HFCs (Gg CO₂-eq) (1990 – 2006), cont.

Gas	1999	2000	2001	2002	2003	2004	2005	2006
HFC 32	0.09	0.07	0.12	0.06	1.29	1.58	3.25	7.29
HFC 125	1.76	5.35	12.91	13.29	45.09	52.12	98.76	125.65
HFC 134a	4.63	8.92	14.53	14.32	41.80	47.81	82.71	86.16
HFC 143a	2.70	8.82	21.43	21.64	75.52	87.36	164.46	195.93
Total emission (Gg CO₂-eq)	9.18	23.16	48.99	49.31	163.71	188.87	349.18	415.03

4.6.1.3. Uncertainties and time-series consistency

The main uncertainties of HFCs emissions estimation concerning to activity data. Quantities of HFCs contained in various products imported into or exported from a country were difficult to estimate. Also, the application of abovementioned methodology may lead to underestimation or overestimation of potential emissions, depending on whether the majority of HFC containing products is being imported or exported.

Uncertainty estimate associated with estimation of potential emissions of HFC-32, HFC-125, HFC-134a and HFC-143a amounts 70 percent for emission factor and 70 percent for activity data, based on expert judgements.

Emissions from Consumption of HFCs in Refrigeration and Air Conditioning Equipment have been calculated using the same method for every year in the time series. Two sources of information were used for data sets: data were provided by Ministry of Environmental Protection, Physical Planning and Construction and insufficient data were assessed by interpolation/extrapolation methods.

4.6.1.4. Source-specific QA/QC and verification

During the preparation of the inventory submission activities related to quality control were mainly focused on completeness and consistency of emission estimates and on proper use of notation keys in the CRF tables according to QA/QC plan.

After preparation of final draft of this chapter an audit was carried out to check selected activities from Tier 1 General inventory level QC procedures and Tier 2 source-specific QC procedures. Consumption of HFCs in Refrigeration and Air Conditioning Equipment is one of the key source categories in Industrial Processes. Regarding to Tier 2 activities, emission factors and activity data were checked for key source categories. Due to incompleteness of data set, QA/QC plan does not prescribes source specific quality control procedures at this moment, but it recommends improvements which should be implemented in short-term period (see Chapter 4.6.1.6).

4.6.1.5. Source-specific recalculations

In this report, the total consumption of HFCs has been corrected for 1990 and 2005. Extrapolation method has been used for calculation of insufficient emission estimates for 1990.

4.6.1.6. Source-specific planned improvements

For the purpose of accurate emission calculations it is essential to adjust National Classification of Activities used by Central Bureau of Statistics in order to particularly mark HFCs, PFCs and SF₆ and Customs Departments Tariff Number to distinguish these compounds from other fluorinated chemicals which are controlled with Montreal Protocol.

According to requirement of Regulation on the Greenhouse Gases Emissions Monitoring in the Republic of Croatia (Official Gazette No. 1/07) each sources of HFCs emissions should report required activity data for more accurate emissions estimation (Tier 2 method). Regulation on controls of ozone-depleting substances (Official Gazette No. 120/05) prescribes control of import and export of these gases and providing of register to the Ministry of Environmental Protection, Physical Planning and Construction. Customs Departments Tariff Number of substitutes and mixture of substitutes has been introduced since 2007. Therefore, it is expected that information on consumption of each individual gas will be available at the rather detailed level in the future period in order to use Tier 2 method.

4.6.2. OTHER CONSUMPTION OF HFCs, PFCs AND SF₆

4.6.2.1. Source category description

Potential emissions from Foam Blowing and Fire Extinguishers have been calculated only for 2006, because the data for the period 1990-2005 are not available. The data on consumption of HFC-152-a (which is used for Foam Blowing), and HFC-125, HFC-227ea and HFC-236fa (which are used in Fire Extinguishers) have been provided by Ministry of Environmental Protection, Physical Planning and Construction.

Emissions from Consumption of HFCs for Aerosols/Metered Dose Inhalers and Solvents have not been calculated because activity data are not available.

A certain amount of SF₆ is contained in electrical equipment used in Croatian National Electricity (HEP) and KONCAR Electrical Industries Inc. Equipment manufacturers guarantee annual leakage of less than 1 percent, so this information could be used to determine the SF₆ emissions. However, it is still not included in the inventory because the input data for emission calculation are not available.

4.6.2.2. Methodological issues

The information related to consumption of HFCs provided by Ministry of Environmental Protection, Physical Planning and Construction have been used for potential HFCs emissions calculations from Foam Blowing and Fire Extinguishers (Tier 1a method, *Revised 1996 IPCC Guidelines*) for 2006.

The emission from Foam Blowing in 2006 has been amounted to 0.00006 Gg CO₂-eq of HFC-152a. The resulting emissions from Fire Extinguishers in 2006 have been amounted to 3.55 Gg CO₂-eq of HFC-125, 5.80 Gg CO₂-eq of HFC-227ea and 6.30 Gg CO₂-eq of HFC-236fa.

4.6.2.3. Uncertainties and time-series consistency

The main uncertainties of HFCs emissions estimation concerning to activity data. Uncertainty estimate associated with estimation of potential emissions of HFC-152a, HFC-125, HFC-227ea and HFC-236fa amounts 70 percent for emission factor and 70 percent for activity data, based on expert judgements.

Emissions from Consumption of HFCs in Foam Blowing and Fire Extinguishers have been calculated only for 2006 because the data for the period 1990-2005 are not available. Data for 2006 were provided by Ministry of Environmental Protection, Physical Planning and Construction.

4.6.2.4. Source-specific QA/QC and verification

During the preparation of the inventory submission activities related to quality control were mainly focused on completeness and consistency of emission estimates and on proper use of notation keys in the CRF tables according to QA/QC plan.

After preparation of final draft of this chapter an audit was carried out to check selected activities from Tier 1 General inventory level QC procedures. Since this source category is not a key source, QA/QC plan does not prescribes source specific quality control procedures.

4.6.2.5. Source-specific recalculations

There are no source specific recalculations in sub-sector Other Consumption of HFCs, PFCs and SF₆.

4.6.2.6. Source-specific planned improvements

For the purpose of accurate emission calculations it is essential to adjust National Classification of Activities used by Central Bureau of Statistics in order to particularly mark HFCs, PFCs and SF₆ and Customs Departments Tariff Number to distinguish these compounds from other fluorinated chemicals which are controlled with Montreal Protocol.

According to requirement of Regulation on the Greenhouse Gases Emissions Monitoring in the Republic of Croatia (Official Gazette No. 1/07) each sources of HFCs emissions should report required activity data for more accurate emissions estimation (Tier 2 method). Regulation on controls of ozone-depleting substances (Official Gazette No. 120/05) prescribes control of import and export of these gases and providing of register to the Ministry of Environmental Protection, Physical Planning and Construction. Customs Departments Tariff Number of substitutes and mixture of substitutes has been introduced since 2007. Therefore, it is expected that information on consumption of each individual gas will be available at the rather detailed level in the future period in order to use Tier 2 method.

4.7. NON - ENERGY USE (CRF 2.G.)

4.7.1. SOURCE CATEGORY DESCRIPTION

Non-energy fuel consumptions (fuels used as feedstock) and appropriate emissions, where one part or even the whole carbon is stored in product for a longer time and the other part oxidizes and goes to atmosphere, are included here. The feedstock use of energy carriers occurs in chemical industry (naphta, lubricants, ethane and other), construction industry (bitumen production), and other products such as motor oil, industrial oil, grease etc.

4.7.2. METHODOLOGICAL ISSUES

CO₂ emissions from non-energy fuel consumptions (fuels used as feedstock) have been calculated by multiplying annual fuels consumption with default emission factors provided by *Good Practice Guidance* (Tier 1 method, *Revised 1996 IPCC Guidelines*) for the period 1990-2006. The activity data were extracted from national nnergy balance.

4.7.3. UNCERTAINTIES AND TIME-SERIES CONSISTENCY

Uncertainty estimate associated with default emission factor for CO₂ emissions amounts 50 percent, based on expert judgements. Uncertainty estimate associated with activity data for CO₂ emissions amounts 5 percent, based on expert judgements.

Emissions from Non-energy Use have been calculated using the same method and data sets for every year in the time series.

4.7.3.1. Source-specific QA/QC and verification

During the preparation of the inventory submission activities related to quality control were mainly focused on completeness and consistency of emission estimates and on proper use of notation keys in the CRF tables according to QA/QC plan.

After preparation of final draft of this chapter an audit was carried out to check selected activities from Tier 1 General inventory level QC procedures. Since this source category is not a key source, QA/QC plan does not prescribes source specific quality control procedures.

4.7.3.2. Source-specific recalculations

There are no source specific recalculations in Non-energy Use.

4.7.3.3. Source-specific planned improvements

For the purpose of accurate emission calculations, the use of naphta, lubricants, ethane and other products in various industry should be investigated.

4.8. EMISSION OVERVIEW

4.8.1. GHG EMISSIONS

Emissions of GHGs from Industrial Processes in the period 1990-2006 are presented in Table 4.8-1.

Table 4.8-1: Emissions of GHGs from Industrial Processes (1990-2006)

Source	Year	GHG	Emission (Gg)	GWP ¹	Emission (Gg CO ₂ -eq)	Percent in Industrial Processes	Percent in Total Country Emission
Cement production	1990	CO ₂	1069.06	1	1069.06	24.30	3.29
	1991		681.81		681.81	19.32	2.68
	1992		805.61		805.61	24.28	3.42
	1993		671.67		671.67	25.35	2.87
	1994		827.95		827.95	28.31	3.67
	1995		622.64		622.64	23.03	2.72
	1996		664.47		664.47	24.91	2.82
	1997		771.43		771.43	25.99	3.08
	1998		838.53		838.53	33.40	3.32
	1999		1077.61		1077.61	35.81	4.10
	2000		1232.59		1232.59	37.00	4.70
	2001		1393.77		1393.77	43.55	5.09
	2002		1360.46		1360.46	44.11	4.80
	2003		1369.64		1369.64	41.80	4.56
	2004		1456.35		1456.35	40.59	4.84
	2005		1487.12		1487.12	39.55	4.87
	2006		1571.98		1571.98	39.97	5.10
Lime production	1990	CO ₂	160.63	1	160.63	3.65	0.49
	1991		113.60		113.60	3.22	0.45
	1992		76.58		76.58	2.31	0.33
	1993		84.48		84.48	3.19	0.36
	1994		84.92		84.92	2.90	0.38
	1995		83.42		83.42	3.09	0.36
	1996		111.65		111.65	4.18	0.47
	1997		119.51		119.51	4.03	0.48
	1998		123.79		123.79	4.93	0.49
	1999		112.82		112.82	3.75	0.43
	2000		137.85		137.85	4.14	0.53
	2001		162.84		162.84	5.09	0.59
	2002		180.56		180.56	5.85	0.64
	2003		177.83		177.83	5.43	0.59
	2004		186.09		186.09	5.19	0.62
	2005		198.36		198.36	5.28	0.65
	2006		244.47		244.47	6.22	0.79

Table 4.8-1: Emissions of GHGs from Industrial Processes (1990-2006), cont.

Source	Year	GHG	Emission (Gg)	GWP ¹	Emission (Gg CO ₂ -eq)	Percent in Industrial Processes	Percent in Total Country Emission
Limestone and dolomite use	1990	CO ₂	43.22	1	43.22	0.98	0.13
	1991		24.59		24.59	0.70	0.10
	1992		10.54		10.54	0.32	0.04
	1993		9.60		9.60	0.36	0.04
	1994		15.50		15.50	0.53	0.07
	1995		11.19		11.19	0.41	0.05
	1996		7.59		7.59	0.28	0.03
	1997		7.04		7.04	0.24	0.03
	1998		8.38		8.38	0.33	0.03
	1999		7.73		7.73	0.26	0.03
	2000		7.96		7.96	0.24	0.03
	2001		8.87		8.87	0.28	0.03
	2002		9.55		9.55	0.31	0.03
	2003		11.44		11.44	0.35	0.04
	2004		11.49		11.49	0.32	0.04
	2005		12.05		12.05	0.32	0.04
	2006		10.66		10.66	0.27	0.03
Soda ash production and use	1990	CO ₂	25.74	1	25.74	0.59	0.08
	1991		21.75		21.75	0.62	0.09
	1992		14.68		14.68	0.44	0.06
	1993		12.53		12.53	0.47	0.05
	1994		15.21		15.21	0.52	0.07
	1995		14.39		14.39	0.53	0.06
	1996		12.33		12.33	0.46	0.05
	1997		10.43		10.43	0.35	0.04
	1998		11.83		11.83	0.47	0.05
	1999		10.43		10.43	0.35	0.04
	2000		11.01		11.01	0.33	0.04
	2001		12.09		12.09	0.38	0.04
	2002		12.11		12.11	0.39	0.04
	2003		14.18		14.18	0.43	0.05
	2004		16.49		16.49	0.46	0.05
	2005		17.22		17.22	0.46	0.06
	2006		15.14		15.14	0.38	0.05
Ammonia production	1990	CO ₂	861.630	1	861.630	19.58	2.65
	1991		908.697		908.697	25.75	3.57
	1992		1168.324		1168.324	35.21	4.97
	1993		956.523		956.523	36.11	4.09
	1994		974.553		974.553	33.32	4.32
	1995		1051.416		1051.416	38.89	4.59
	1996		1012.130		1012.130	37.94	4.30
	1997		1112.148		1112.148	37.47	4.44
	1998		872.258		872.258	34.75	3.45
	1999		1041.547		1041.547	34.61	3.96
	2000		1037.941		1037.941	31.15	3.96
	2001		848.155		848.155	26.50	3.10
	2002		769.014		769.014	24.94	2.71
	2003		876.623		876.623	26.75	2.92
	2004		919.894		919.894	25.64	3.06
	2005		907.368		907.368	24.13	2.97
	2006		878.521		878.521	22.33	2.85

Table 4.8-1: Emissions of GHGs from Industrial Processes (1990-2006), cont.

Source	Year	GHG	Emission (Gg)	GWP ¹	Emission (Gg CO ₂ -eq)	Percent in Industrial Processes	Percent in Total Country Emission
Nitric acid production	1990	N ₂ O	2.99	310	927.56	21.08	2.85
	1991		2.63		814.67	23.09	3.20
	1992		3.44		1065.21	32.10	4.53
	1993		2.59		802.98	30.31	3.43
	1994		2.80		868.35	29.69	3.85
	1995		2.69		835.04	30.89	3.64
	1996		2.51		777.53	29.14	3.30
	1997		2.64		817.17	27.53	3.26
	1998		1.98		615.22	24.51	2.44
	1999		2.34		725.95	24.12	2.76
	2000		2.76		854.30	25.64	3.26
	2001		2.32		718.52	22.45	2.62
	2002		2.25		697.48	22.62	2.46
	2003		2.12		657.45	20.06	2.19
	2004		2.59		802.31	22.36	2.67
	2005		2.53		783.28	20.83	2.56
	2006		2.50		774.48	19.69	2.51
Production of other chemicals	1990	CH ₄	0.75	21	15.80	0.36	0.05
	1991		0.55		11.49	0.33	0.05
	1992		0.46		9.74	0.29	0.04
	1993		0.50		10.48	0.40	0.04
	1994		0.48		10.06	0.34	0.04
	1995		0.40		8.41	0.31	0.04
	1996		0.38		7.94	0.30	0.03
	1997		0.34		7.15	0.24	0.03
	1998		0.32		6.65	0.26	0.03
	1999		0.27		5.73	0.19	0.02
	2000		0.29		6.04	0.18	0.02
	2001		0.31		6.41	0.20	0.02
	2002		0.26		5.39	0.17	0.02
	2003		0.28		5.83	0.18	0.02
	2004		0.27		5.73	0.16	0.02
	2005		0.25		5.33	0.14	0.02
	2006		0.34		7.09	0.18	0.02
Steel production	1990	CO ₂	0.87	1	0.87	0.020	0.003
	1991		0.78		0.78	0.022	0.003
	1992		0.55		0.55	0.017	0.002
	1993		0.47		0.47	0.018	0.002
	1994		0.15		0.15	0.005	0.001
	1995		0.08		0.08	0.003	0.000
	1996		0.21		0.21	0.008	0.001
	1997		0.32		0.32	0.011	0.001
	1998		0.48		0.48	0.019	0.002
	1999		0.35		0.35	0.012	0.001
	2000		0.33		0.33	0.010	0.001
	2001		0.27		0.27	0.008	0.001
	2002		0.15		0.15	0.005	0.001
	2003		0.19		0.19	0.006	0.001
	2004		0.39		0.39	0.011	0.001
	2005		0.34		0.34	0.009	0.001
	2006		0.37		0.37	0.009	0.001

Table 4.8-1: Emissions of GHGs from Industrial Processes (1990-2006), cont.

Source	Year	GHG	Emission (Gg)	GWP ¹	Emission (Gg CO ₂ -eq)	Percent in Industrial Processes	Percent in Total Country Emission
Ferroalloys production	1990	CO ₂	194.53	1	194.53	4.42	0.60
	1991		180.80		180.80	5.12	0.71
	1992		116.35		116.35	3.51	0.49
	1993		51.02		51.02	1.93	0.22
	1994		79.64		79.64	2.72	0.35
	1995		33.91		33.91	1.25	0.15
	1996		13.73		13.73	0.51	0.06
	1997		31.50		31.50	1.06	0.13
	1998		15.42		15.42	0.61	0.06
	1999		17.95		17.95	0.60	0.07
	2000		20.48		20.48	0.61	0.08
	2001		0.47		0.47	0.01	0.00
	2002 - 2006		-		-	-	-
Aluminium production	1990	CO ₂	111.37	1	111.37	2.53	0.34
	1991		76.40		76.40	2.16	0.30
	1992 - 2006		-		-	-	-
	1990	CF ₄	0.13	6500	820.44	18.65	2.52
	1991		0.09		562.79	15.95	2.21
	1992 - 2006		-		-	-	-
	1990	C ₂ F ₆	0.013	9200	116.12	2.64	0.36
	1991		0.009		79.66	2.26	0.31
	1992 - 2006		-		-	-	-
Consumption of HFCs, PFCs and SF₆²	1990	HFC	3	3	52.90	1.20	0.16
	1991				51.71	1.47	0.20
	1992				50.52	1.52	0.21
	1993				49.34	1.86	0.21
	1994				48.15	1.65	0.21
	1995				43.20	1.60	0.19
	1996				60.26	2.26	0.26
	1997				91.29	3.08	0.36
	1998				17.64	0.70	0.07
	1999				9.18	0.31	0.03
	2000				23.16	0.70	0.09
	2001				48.99	1.53	0.18
	2002				49.31	1.60	0.17
	2003				163.71	5.00	0.54
	2004				188.87	5.26	0.63
	2005				349.18	9.29	1.14
	2006				430.68	10.95	1.40

¹ Time horizon chosen for GWP values is 100 years² Consumption of SF₆ is not included because data are not available³ HFC-32 (GWP=650); HFC-125 (GWP=2800); HFC-134a (GWP=1300); HFC-143a (GWP=3800); HFC-152a (GWP=130); HFC-227ea (GWP=2900); HFC-236fa (GWP=6300) - total emissions of HFCs are presented

4.8.2. INDIRECT GHG EMISSIONS

Many non-energy industrial processes generate emissions of ozone and aerosol precursor gases including carbon monoxide (CO), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC) and sulphur dioxide (SO₂) (see Table 4.8-2).

Table 4.8-2: Gases generated from different non-energy industrial process

Gas	Industrial Process
SO ₂	Cement Production
	Production of other chemicals
	Pulp and paper production
NO _x	Nitric acid production
	Production of other chemicals
	Pulp and paper production
CO	Asphalt Roofing Production
	Ammonia production
	Production of other chemicals
	Pulp and paper production
NMVOC	Asphalt Roofing Production
	Road paving with asphalt
	Glass production
	Production of other chemicals
	Pulp and paper production
	Alcoholic beverage production
	Bread and other food production

Total annual emissions of indirect GHGs in the period 1990-2006 are reported in table 4.8-3.

Table 4.8-3: Emissions of indirect GHGs from Industrial Processes (1990-2006)

Year	SO ₂ (Gg)	NO _x (Gg)	CO (Gg)	NMVOC (Gg)
1990	5.39	0.37	0.39	17.51
1991	3.97	0.30	0.19	14.22
1992	5.57	0.39	0.13	11.19
1993	3.77	0.29	0.17	10.36
1994	4.37	0.32	0.21	8.21
1995	4.74	0.31	0.27	9.04
1996	4.62	0.29	0.27	9.81
1997	4.34	0.30	0.24	8.76
1998	3.76	0.23	0.22	8.51
1999	4.39	0.27	0.18	7.97
2000	4.64	0.31	0.20	7.53
2001	3.48	0.27	0.21	7.39
2002	3.63	0.26	0.19	8.23
2003	3.46	0.24	0.22	8.34
2004	4.63	0.30	0.20	9.14
2005	5.16	0.29	0.19	10.29
2006	5.92	0.29	0.26	10.20

4.9. REFERENCES

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5. SOLVENT AND OTHER PRODUCT USE (CRF sector 3)

5.1. SOLVENT AND OTHER PRODUCT USE

5.1.1. SOURCE CATEGORY DESCRIPTION

The most significant emissions in this category are the emissions of non-methane volatile organic compounds (NMVOCs). The use of solvents is the cause of less than 15 percent of anthropogenic national emissions of NMVOC. The emissions of NMVOC is caused by use of solvent based paint and varnish, degreasing of metal and dry cleaning, in production of chemicals, in printing industry, by use of glue, by use of solvents in households and by all other activities where solvents are used. NMVOC emissions oxidize in the atmosphere and CO₂ emissions are generated as a consequence of this oxidation.

NMVOC and CO₂ emissions are included in emissions estimates in this sector. N₂O emissions from medical uses and other possible sources are not estimated because activity data are not available.

5.1.2. METHODOLOGICAL ISSUES

Estimation of NMVOC emissions from Solvent and Other Product Use (provided by *EMEP-CORINAIR Emission Inventory Guidebook*) has been carried out by estimating the amount of solvent containing products consumed. The NMVOC emissions from Solvent and Other Product Use have been calculated by using simpler methodology. Default emission factor (*EMEP-CORINAIR Emission Inventory Guidebook*) has been applied for each source category. For several source categories (degreasing and dry cleaning, pharmaceutical products manufacturing and domestic solvent use) the NMVOC emissions calculation is based on population data. The activity data for the other sources were extracted from Monthly Industrial Reports published by Central Bureau of Statistics, Department of Manufacturing and Mining.

The contribution of group of activities to NMVOC emissions is given in the Figure 5.1-1.

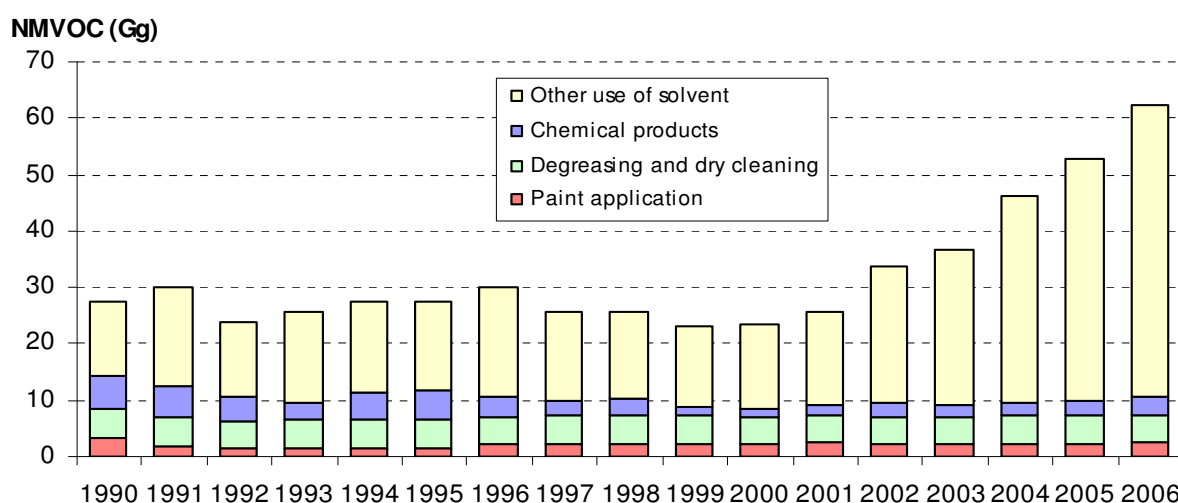


Figure 5.1-1: Emissions of NMVOC from Solvent and Other Product Use (1990-2006)

Activity data, NMVOC emissions and average emission factors are shown in the Table 5.1-1.

Table 5.1-1: NMVOC emissions from Solvent and Other Product Use (Gg) (1990-2006)

Source and Sink Categories		Activity Data									NMVOC Emission									EF
		1990	1991	1992	1993	1994	1995	1996	1997	1998	1990	1991	1992	1993	1994	1995	1996	1997	1998	1990-2006
		Gg (1000 capita*)									Gg									t/Gg (cap)
3	Total – Solvent Use										27.376	29.984	23.960	25.621	27.516	27.358	29.900	25.577	25.581	
3A	Paint Application										3.184	2.011	1.376	1.314	1.566	1.562	2.020	2.175	2.244	
	Use of Solvent Base Paint	6.367	4.023	2.753	2.629	3.131	3.124	4.041	4.351	4.487	3.184	2.011	1.376	1.314	1.566	1.562	2.020	2.175	2.244	500
3B	Degreasing and Dry Cleaning										5.256	4.965	4.917	5.105	5.114	5.136	4.943	5.029	4.951	
	Metal Degreasing *	4778	4514	4470	4641	4649	4669	4494	4572	4501	4.061	3.837	3.800	3.945	3.952	3.969	3.820	3.886	3.826	0.85
	Dry Cleaning *	4778	4514	4470	4641	4649	4669	4494	4572	4501	1.195	1.129	1.118	1.160	1.162	1.167	1.124	1.143	1.125	0.25
3C	Chemical Products										5.830	5.546	4.302	3.275	4.697	5.140	3.488	2.561	3.050	
	Polyurethane – rigid foam	0.147	0.081	0.016	0.021	0.035	0.029	0.022	0.044	0.039	0.002	0.001	0	0	0.001	0	0	0.001	0.001	15
	Polyurethane – soft foam	3.616	2.717	1.660	2.025	2.427	2.880	1.800	1.710	1.790	0.090	0.068	0.042	0.051	0.061	0.072	0.045	0.043	0.045	25
	Polyester Resins	6.047	4.159	3.523	2.570	2.546	2.225	3.367	7.022	8.258	0.242	0.166	0.141	0.103	0.102	0.089	0.135	0.281	0.330	40
	Polystyrene Foam	39.069	26.383	57.045	57.666	58.215	49.356	56.513	50.894	54.240	0.586	0.396	0.856	0.865	0.873	0.740	0.848	0.763	0.814	15
	Polyvinylchloride	104.60	69.357	70.969	44.259	78.331	93.352	44.565	23.094	33.134	4.184	4.184	2.839	1.770	3.133	3.734	1.783	0.924	1.325	40
	Rubber Processing	5.739	5.442	2.439	2.477	2.338	2.285	1.279	0.026	0.017	0.086	0.082	0.037	0.037	0.035	0.034	0.019	0.0004	0.0003	15
	Pharmaceutical Products Manufacturing*	4778	4514	4470	4641	4649	4669	4494	4572	4501	0.067	0.063	0.063	0.065	0.065	0.065	0.063	0.064	0.063	0.014
	Paint and Varnish Manufacturing	21.956	13.872	9.493	9.064	10.797	10.773	13.933	15.002	15.473	0.329	0.208	0.142	0.136	0.162	0.162	0.209	0.225	0.232	15
	Ink Manufacturing	4.672	3.626	1.343	0.985	1.416	1.367	1.420	1.430	1.071	0.140	0.109	0.040	0.030	0.042	0.041	0.043	0.043	0.032	30
	Glue Manufacturing	5.139	13.451	7.151	10.910	11.166	10.076	17.197	10.874	10.379	0.103	0.269	0.143	0.218	0.223	0.202	0.344	0.217	0.208	20
3D	Other Use of Solvent										13.107	17.461	13.365	15.927	16.139	15.520	19.448	15.811	15.337	
	Printing Industry	4.672	3.626	1.343	0.985	1.416	1.367	1.420	1.430	1.071	0.467	0.363	0.134	0.099	0.142	0.137	0.142	0.143	0.107	100
	Application of Glue	5.139	13.451	7.151	10.910	11.166	10.076	17.197	10.874	10.379	3.083	8.071	4.291	6.546	6.700	6.046	10.318	6.524	6.227	600
	Domestic Solvent Use*	4778	4514	4470	4641	4649	4669	4494	4572	4501	9.556	9.028	8.940	9.282	9.298	9.338	8.988	9.144	9.002	2

* - Activity Data is Number of Inhabitants in Croatia (1000 capita)

Table 5.1-1: NMVOC emissions from Solvent and Other Product Use (Gg) (1990-2005), cont.

Source and Sink Categories		Activity Data								NMVOC Emission								EF
		1999	2000	2001	2002	2003	2004	2005	2006	1999	2000	2001	2002	2003	2004	2005	2006	1990-2006
		Gg (1000 capita*)								Gg								t/Gg (cap)
3	Total – Solvent Use									22.992	23.439	25.477	33.836	36.694	46.058	52.918	62.249	
3A	Paint Application									2.203	2.191	2.435	2.200	2.223	2.299	2.377	2.511	
	Use of Solvent Base Paint	4.406	4.381	4.870	4.400	4.446	4.599	4.754	5.022	2.203	2.191	2.435	2.200	2.223	2.299	2.377	2.511	500
3B	Degreasing and Dry Cleaning									5.009	4.819	4.881	4.887	4.886	4.883	4.886	4.884	
	Metal Degreasing *	4554	4381	4437	4443	4442	4439	4442	4440	3.871	3.724	3.771	3.777	3.776	3.773	3.776	3.774	0.85
	Dry Cleaning *	4554	4381	4437	4443	4442	4439	4442	4440	1.139	1.095	1.109	1.111	1.111	1.110	1.111	1.110	0.25
3C	Chemical Products									1.669	1.363	1.774	2.265	2.098	2.259	2.761	3.108	
	Polyurethane – rigid foam	0.060	0.060	0.095	0.180	0.070	0.060	0.120	0.120	0.001	0.001	0.001	0.003	0.001	0.001	0.002	0.002	15
	Polyurethane – soft foam	1.770	1.800	2.655	5.431	2.855	2.424	2.799	2.240	0.044	0.045	0.066	0.136	0.071	0.061	0.070	0.056	25
	Polyester Resins	5.609	12.848	9.661	14.693	9.704	10.948	10.886	14.112	0.224	0.514	0.386	0.588	0.388	0.438	0.435	0.564	40
	Polystyrene Foam	53.047	16.518	47.146	45.439	46.361	34.311	52.933	47.755	0.796	0.248	0.707	0.682	0.695	0.515	0.794	0.716	15
	Polyvinylchloride	3.085	0.811	0.640	0.617	0.206	0.055	0	0	0.123	0.032	0.026	0.025	0.008	0.002	0	0	40
	Rubber Processing	0.020	0.021	0.021	0.015	0.006	0.011	0.004	0.004	0.0003	0.003	0.0003	0.0002	0.0001	0.0002	0.0001	0.0001	15
	Pharmaceutical Products Manufacturing*	4554	4381	4437	4443	4442	4439	4442	4440	0.064	0.061	0.062	0.062	0.062	0.062	0.062	0.062	0.014
	Paint and Varnish Manufacturing	15.194	15.107	16.794	15.174	15.332	15.857	16.393	17.318	0.228	0.227	0.252	0.228	0.230	0.238	0.246	0.260	15
	Ink Manufacturing	0.797	0.916	0.822	0.863	0.789	0.673	0.665	0.684	0.024	0.027	0.025	0.026	0.024	0.020	0.020	0.021	30
	Glue Manufacturing	8.206	10.355	12.385	25.851	30.873	46.119	56.577	71.330	0.164	0.207	0.248	0.517	0.617	0.922	1.131	1.427	20
3D	Other Use of Solvent									14.111	15.067	16.387	24.483	27.487	36.617	42.894	51.746	
	Printing Industry	0.797	0.916	0.822	0.863	0.789	0.673	0.665	0.684	0.080	0.092	0.082	0.086	0.079	0.067	0.067	0.068	100
	Application of Glue	8.206	10.355	12.385	25.851	30.873	46.119	56.573	71.330	4.924	6.213	7.431	15.511	18.524	27.671	33.944	42.798	600
	Domestic Solvent Use*	4554	4381	4437	4443	4442	4439	4442	4440	9.108	8.762	8.874	8.886	8.884	8.878	8.884	8.880	2

* - Activity Data is Number of Inhabitants in Croatia (1000 capita)

IPCC Guidelines do not provide methodology for calculation of CO₂ emissions from Solvent and Other Product Use. CO₂ emissions are calculated using conversion factor which contains ratio C/NMVOC = 0.8 and recalculation ratio of C to CO₂ equal to 44/12. The overall conversion factor has value of 2.93.

The resulting emissions of CO₂ from Solvent and Other Product Use in the period 1990-2006 are presented in the Figure 5.1-2.

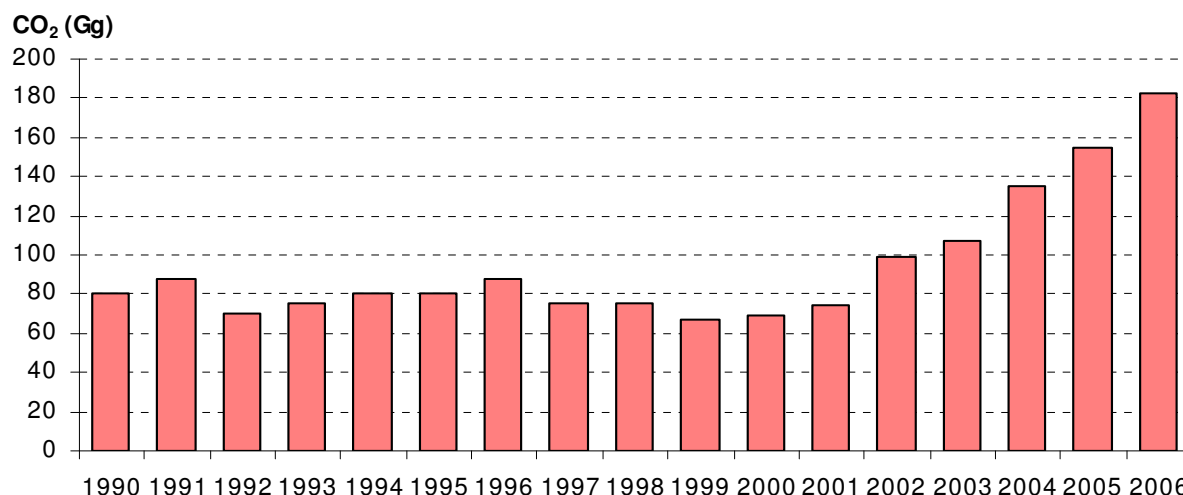


Figure 5.1-2: Emissions of CO₂ from Solvent and Other Product Use (1990-2006)

5.1.3. UNCERTAINTIES AND TIME-SERIES CONSISTENCY

Uncertainties in CO₂ emissions estimates are mainly due to the accuracy of used conversion factor (C/NMVOC) and reliability of calculation is very low.

Uncertainty estimates are based on expert judgement. Uncertainty estimate associated with emission factors amounts 50 percent. Uncertainty estimate associated with activity data amounts 50 percent.

Emissions from Solvent and Other Product Use have been calculated using the same method and data sets for every year in the time series.

5.1.4. SOURCE-SPECIFIC QA/QC AND VERIFICATION

During the preparation of the inventory submission activities related to quality control were mainly focused on completeness and consistency of emission estimates and on proper use of notation keys in the CRF tables according to QA/QC plan.

After preparation of final draft of this chapter an audit was carried out to check selected activities from Tier 1 General inventory level QC and Tier 2 source-specific QC procedures. Solvent and Other Product Use is key source category. Regarding to Tier 2 activities, emission factors and activity data were checked for key source categories. Due to incompleteness of data set, QA/QC plan does not prescribes source specific quality control procedures at this moment,

but it recommends improvements which should be implemented in short-term period (see Chapter 5.1.6).

5.1.5. SOURCE-SPECIFIC RECALCULATIONS

There are no source specific recalculations in Solvent and Other Product Use.

5.1.6. SOURCE-SPECIFIC PLANNED IMPROVEMENTS

For the purpose of accurate emission calculations, Croatia plan to investigate source category degreasing and dry cleaning, pharmaceutical products manufacturing and domestic solvent use. The NMVOC emissions calculation in these categories is based on population data.

N₂O emissions from medical uses and other possible sources are not estimated because input data are not available. According to requirement of Regulation on the Greenhouse Gases Emissions Monitoring in the Republic of Croatia (Official Gazette No. 1/07) each sources of CO₂ and N₂O emissions from Solvent and Other Product Use should report required activity data for more accurate emissions estimation.

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6. AGRICULTURE (CRF sector 4)

6.1. OVERVIEW OF SECTOR

The agricultural activities contribute directly to the emission of greenhouse gases through various processes. The following sources have been identified to make a more complete break down in the emission calculation:

- Livestock: enteric fermentation (CH_4) and manure management (CH_4 , N_2O)
- Agricultural soils (N_2O)

The total emissions in 2006 produced by the agricultural activities were 3507.50 Gg CO_2 -eq, which represents 11.38 percent of the emission of the total emission inventory. The methane (CH_4) and nitrous oxide (N_2O) are primary greenhouse gases discharged as a consequence of agricultural activities (Figure 6.1-1). Of all the ruminants, the dairy cattle are the largest source of methane (CH_4) emission. The results of the agricultural soil management, manure management, and the agricultural engineering in cultivation of some crops are relatively high emissions of nitrous oxide (N_2O). The emission generated by burning the agricultural residues was not included in calculation because this activity is prohibited by Croatian regulations. There are no ecosystems in the Republic of Croatia that could be considered natural savannas or rice fields; consequently, no greenhouse gas emissions therefore exist for this sub-category.

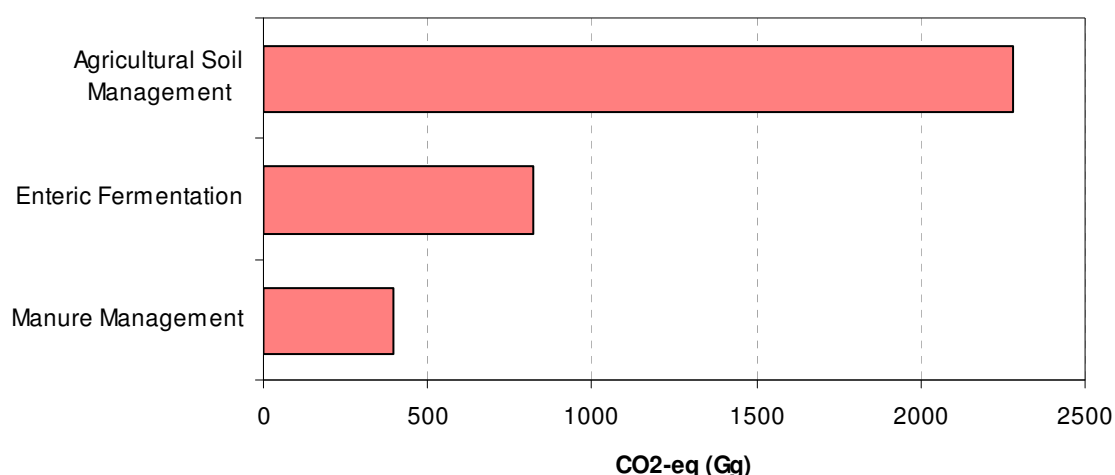


Figure 6.1-1: Agriculture GHG Sources (year 2006)

Table 6.1-1 and Table 6.1-2 show the total emission from agriculture by gases and emission sources for the period 1990-2006. The emission in Table 6.1-2 is given in the equivalents of CO_2 .

Table 6.1-1: Emission of greenhouse gases from agriculture (Gg)

Gas/Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
CH₄	76.25	71.84	55.77	55.55	50.69	48.00	45.33	44.50	43.58	44.40
Enteric Fermentation	65.34	61.05	47.66	47.16	42.29	40.43	37.87	37.17	36.36	36.40
Manure management	10.91	10.79	8.11	8.39	8.39	7.57	7.47	7.32	7.23	8.00
N₂O	9.54	9.48	8.34	7.41	7.36	7.04	7.06	7.97	7.12	7.62
Manure management	1.23	1.17	0.91	0.91	0.84	0.79	0.75	0.73	0.72	0.73
Agricultural soil	8.31	8.31	7.43	6.51	6.53	6.25	6.31	7.24	6.40	6.89

Table 6.1-1: Emission of greenhouse gases from agriculture (Gg), cont.

Gas/Source	2000	2001	2001	2002	2003	2004	2005	2006
CH₄	43.02	43.61	43.61	42.74	44.72	47.44	46.72	47.40
Enteric Fermentation	35.59	36.14	36.14	35.16	36.78	38.84	39.23	39.77
Manure management	7.42	7.47	7.47	7.59	7.95	8.60	7.48	7.63
N₂O	7.68	8.29	8.29	8.07	7.77	8.24	8.32	8.10
Manure management	0.71	0.71	0.71	0.70	0.73	0.76	0.74	0.75
Agricultural soil	6.98	7.57	7.57	7.37	7.04	7.48	7.58	7.35

Table 6.1-2: Emission of greenhouse gases from agriculture CO₂-eq (Gg)

Gas/Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
CH₄	1601.21	1508.62	1171.26	1166.63	1064.39	1008.10	951.96	934.43	915.27	932.31
Enteric Fermentation	1372.14	1281.97	1000.86	990.40	888.17	849.07	795.19	780.65	763.50	764.38
Manure management	229.07	226.66	170.40	176.22	176.22	159.03	156.77	153.78	151.77	167.93
N₂O	2956.38	2937.94	2585.36	2298.51	2282.38	2182.56	2187.46	2471.02	2206.59	2361.96
Manure management	380.88	361.98	282.80	281.23	259.10	245.37	230.97	226.59	221.96	226.32
Agricultural soil	2575.50	2575.95	2302.57	2017.27	2023.28	1937.19	1956.49	2244.43	1984.62	2135.65

Table 6.1-2: Emission of greenhouse gases from agriculture CO₂-eq (Gg), cont.

Gas/Source	2000	2001	2001	2002	2003	2004	2005	2006
CH₄	903.38	915.78	915.78	897.64	939.20	996.19	981.02	995.38
Enteric Fermentation	747.45	758.98	758.98	738.30	772.34	815.64	823.89	835.21
Manure management	155.92	156.79	156.79	159.34	166.86	180.55	157.13	160.16
N₂O	2381.71	2569.50	2569.50	2502.04	2409.17	2553.15	2578.99	2512.12
Manure management	219.27	221.57	221.57	217.22	226.46	235.19	229.71	233.14
Agricultural soil	2162.44	2347.93	2347.93	2284.82	2182.71	2317.96	2349.28	2278.98

Below there is a review of the greenhouse gas emission calculation according to previously stated sources.

6.2. CH₄ EMISSIONS FROM ENTERIC FERMENTATION IN DOMESTIC LIVESTOCK (CRF 4.A.)

6.2.1. SOURCE CATEGORY DESCRIPTION

Methane is a direct product of animal metabolism generated during the digestion process. The greatest producers of methane are ruminants (cows, cattle, and sheep). The amount of methane produced and excreted depends on the animal digestive system and the amount and type of the animal feed. Figure 6.2-1 shows the emission of methane from enteric fermentation for the period from 1990-2006. Estimates in the inventory include only emissions in farm animals. Buffalo, camels, and lamas do not occur in the Republic of Croatia. Emissions from wild animals and semi domesticated game are not quantified and neither are emissions from humans or pet animals. CH₄ emission from enteric fermentation is a key source. Dairy cattle is the single major source of emissions representing 56 % of total CH₄ emission from enteric fermentation, followed by non dairy cattle representing 30 % of total CH₄ emission from enteric fermentation. Jointly, cattle are responsible for 86 % of total CH₄ emission from enteric fermentation. No methodology for calculating CH₄ emission from poultry is available in *Revised 1996 IPCC Guidelines*.

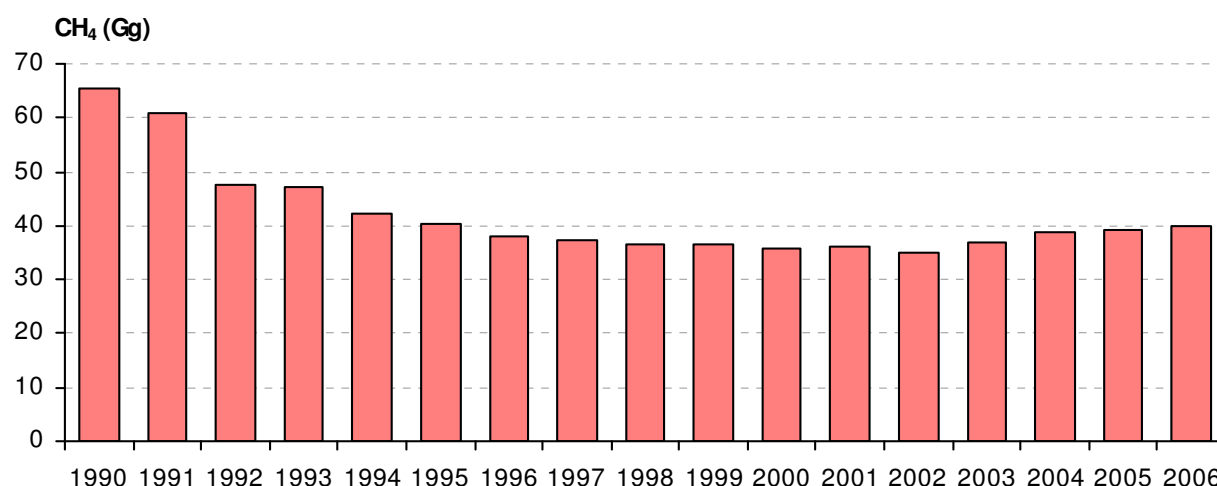


Figure 6.2-1: CH₄ emission from Enteric Fermentation (Gg)

6.2.2. METHODOLOGICAL ISSUES

The IPCC methodology has been used to calculate the methane emission from enteric fermentation. IPCC methodology provides two different methods for estimating the quantity of methane from enteric fermentation. Tier 1 (simplified method) has been used as well as default EF specific for the animal type, the climate zone (cool), geographic region (eastern Europe) and the degree of the region development (developing countries), (*Revised 1996 IPCC Guidelines*). Data for Dairy Cattle, Non-Dairy Cattle, Sheep, Horses, Swine and Poultry for the period 1990-2006 were obtained from Croatian Statistical Yearbooks, published by Central Bureau of Statistics. Data for Goats and Mules and Asses for the period 1990-2006 were obtained directly from Central Bureau of Statistics. The numbers of livestock are reported in Figure 6.2-2 and Figure 6.2-3. Tier 2 method was not applied to dairy cattle because accurate activity data were not available.

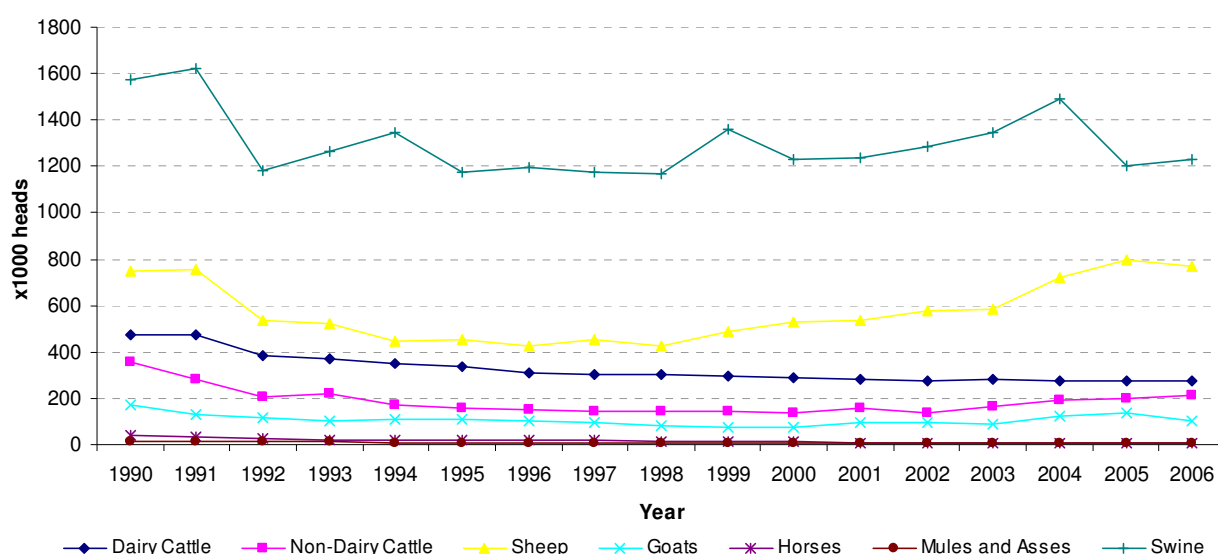


Figure 6.2-2: Number of dairy cattle, cattle, swine sheep, goats and horses

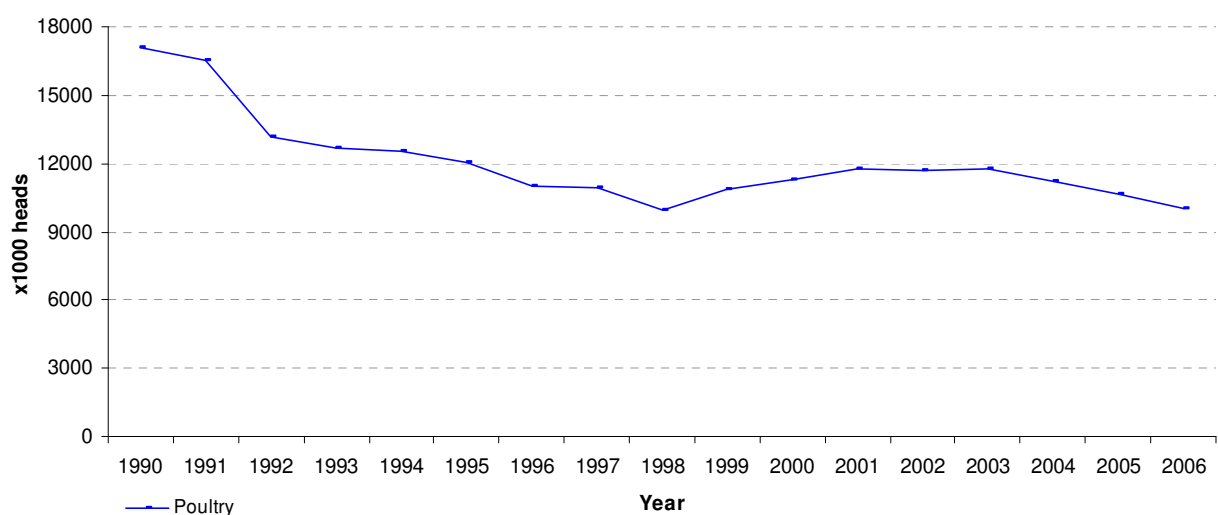


Figure 6.2-3: Number of poultry

6.2.3. UNCERTAINTIES AND TIME-SERIES CONSISTENCY

Uncertainty estimates are based on expert judgement. Uncertainty of activity data amounts 30%. Uncertainty of emission factors amounts 40%.

CH₄ emissions from Enteric Fermentation have been calculated using the same method and data sets for every year in the time series.

6.2.4. SOURCE SPECIFIC RECALCULATIONS

New activity data for different animal categories were included for following years:

- Dairy Cattle – 1990, 1992
- Non-Dairy Cattle - 1990, 1992, 2003

- Sheep - 1990, 1993, 1996, 1997
- Horses - 1990 and 1991
- Swine - 1995, 1996 and 1997
- Goats - 1990, 1991, period 1998-2002, 2005

In the previous report, data were obtained from different sources and some insufficient data were assessed by expert judgement. In this report, more accurate data have been obtained from Central Bureau of Statistics. CH₄ emissions have been recalculated for defined years.

6.3. MANURE MANAGEMENT – CH₄ EMISSIONS (CRF 4.B.)

6.3.1. SOURCE CATEGORY DESCRIPTION

Management of livestock manure produces both methane (CH₄) and nitrous oxide (N₂O) emissions. Methane is generated under the conditions of anaerobic decomposition of manure. Storing methods of the manure in which anaerobic conditions prevail (liquid animal manure in septic pits) are favourable for anaerobic decomposition of organic substance and release of methane. The storing of solid animal manure results in aerobic decomposition and very low production of methane. The methane emission from manure management for the period from 1990 to 2006 is given in the Figure 6.3-1.

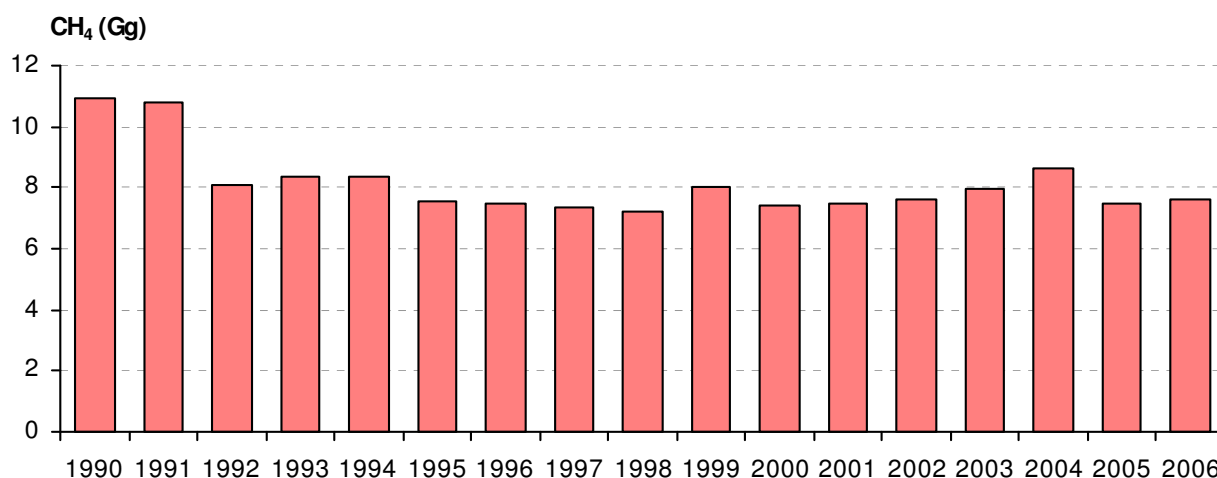


Figure 6.3-1: CH₄ emission from Manure Management (Gg)

6.3.2. METHODOLOGICAL ISSUES

The IPCC methodology (Tier 1) has been used to calculate the methane emission from manure management. The basic input is the head of cattle (dairy cattle, cattle, sheep, horses, pigs, poultry, goats, mules and asses). Emission factors specific for the animal type, climate zone (cool), geographic region (Eastern Europe), and the degree of the region development (developing countries) were used for the calculation of the emission. Data for Dairy Cattle, Non-Dairy Cattle, Sheep, Horses, Swine and Poultry for period 1990-2006 were obtained from Croatian Statistical Yearbooks, published by Central Bureau of Statistics. Data for Goats and Mules and Asses for period 1990-2006 were obtained directly from Central Bureau of Statistics. The emission factors have been taken from the *Revised 1996 IPCC Reference Manual*.

6.3.3. UNCERTAINTIES AND TIME-SERIES CONSISTENCY

Uncertainty estimates are based on expert judgement. Uncertainty of activity data amounts 30%. Uncertainty of emission factors amounts 40%.

CH₄ emissions from Manure Management have been calculated using the same method and data sets for every year in the time series.

6.3.4. SOURCE SPECIFIC RECALCULATIONS

New activity data for different animal categories were included for following years:

- Dairy Cattle – 1990, 1992
- Non-Dairy Cattle - 1990, 1992, 2003
- Sheep - 1990, 1993, 1996, 1997
- Horses - 1990 and 1991
- Swine - 1995, 1996 and 1997
- Goats - 1990, 1991, period 1998-2002, 2005

In the previous report, data were obtained from different sources and some insufficient data were assessed by expert judgement. In this report, more accurate data have been obtained from Central Bureau of Statistics. CH₄ emissions have been recalculated for defined years.

6.4. N₂O EMISSIONS FROM MANURE MANAGEMENT (CRF 4.B.)

6.4.1. SOURCE CATEGORY DESCRIPTION

The emissions of nitrous oxide (N₂O) from all Animal Waste Management Systems are estimated. A considerable amount of nitrous oxide evolves during storage of animal waste and is attributed to livestock breeding. This includes emissions from anaerobic lagoons, liquid systems, solid storage, dry lot, and other systems. The N₂O emissions from pasture range and paddock are reported under Agricultural soils. Farm animals emit very little nitrous oxide directly and this has not been considered in estimation of GHG emissions. In the Republic of Croatia manure is not used as fuel. Some projects are in pre-feasibility and feasibility studies and it is presumed that these projects will be implemented in the near future.

6.4.2. METHODOLOGICAL ISSUES

The IPCC methodology (Tier 1) has been used. The emission factors are taken from the *Revised 1996 IPCC Reference Manual*. The nitrous oxide (N₂O) emission is calculated according to the following equations:

$$Nex_{(AWMS)} = \sum_{(T)} [N_{(T)} \times Nex_{(T)} \times AMWS_{(T)}]$$

Nex_(AWMS) - N excretion per Animal Waste Management System

N_(T) - numbers of animals of type

Nex_(T) - N excretion of animals of type

AMWS_(T) - fraction of Nex_(T) that is managed in one of the different distinguished animal waste management systems

T - type of animal category

$$N_2O_{(AWMS)} = \sum [Nex_{(AWMS)} \times EF_3]$$

$N_2O_{(AWMS)}$ - N_2O emissions from all Animal Waste Management Systems (kg N/yr)

$Nex_{(AWMS)}$ - N excretion per Animal Waste Management System (kg/yr)

EF_3 - emission factor

Nitrous oxide (N_2O) emissions from manure management for the period from 1990 to 2006 are shown in Figure 6.4-1.

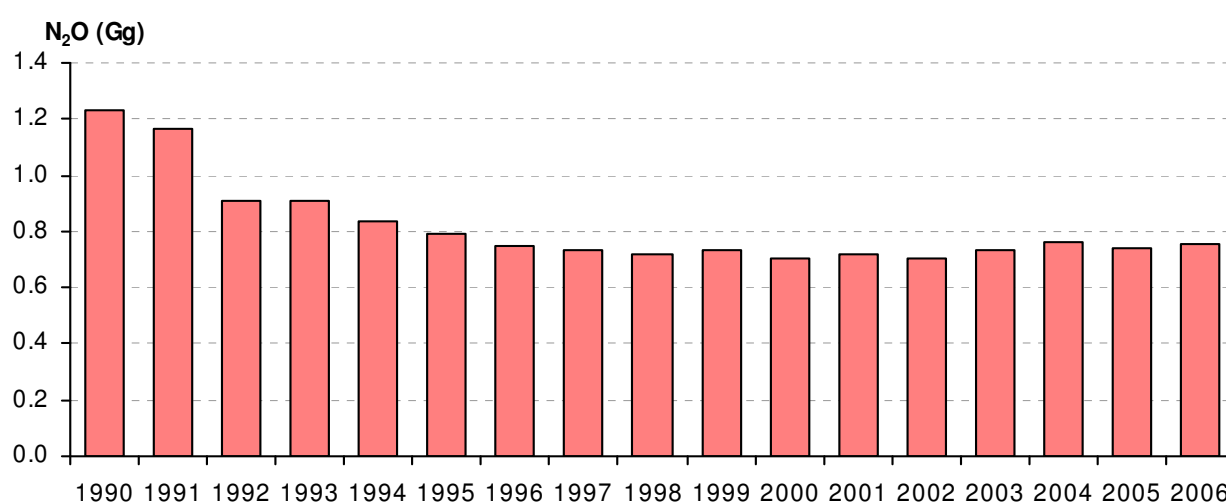


Figure 6.4-1: N_2O Emissions from Manure Management (Gg)

Data for Dairy Cattle, Non-Dairy Cattle, Sheep, Horses, Swine and Poultry for the period 1990-2006 were obtained from Croatian Statistical Yearbooks, published by Central Bureau of Statistics. Data for Goats and Mules and Asses for the period 1990-2006 were obtained directly from Central Bureau of Statistics. Nitrogen excretion for each manure management system and emission factors were taken from the *Revised 1996 IPCC Reference Manual* (Table 5.1.7).

6.4.3. UNCERTAINTIES AND TIME-SERIES CONSISTENCY

Uncertainty estimates are based on expert judgement. Uncertainty of activity data amounts 30%. Uncertainty of emission factors amounts 60%.

N_2O emissions from Manure Management have been calculated using the same method and data sets for every year in the time series.

6.4.4. SOURCE SPECIFIC RECALCULATIONS

New activity data for different animal categories were included for following years:

- Dairy Cattle – 1990, 1992
- Non-Dairy Cattle - 1990, 1992, 2003
- Sheep - 1990, 1993, 1996, 1997
- Horses - 1990 and 1991

- Swine - 1995, 1996 and 1997
- Goats - 1990, 1991, period 1998-2002, 2005

In the previous report, data were obtained from different sources and some insufficient data were assessed by expert judgement. In this report, more accurate data have been obtained from Central Bureau of Statistics. N₂O emissions have been recalculated for defined years.

6.5. AGRICULTURAL SOILS (CRF 4.D.)

A number of agricultural activities add nitrogen to soils, thereby increasing the amount of nitrogen available for nitrification and denitrification, and ultimately the amount of N₂O emitted.

Three sources of nitrous oxide emissions are distinguished:

- Direct emissions of N₂O from agricultural soils
- Direct soil emissions of N₂O from animal production
- Indirect emissions of N₂O conditioned by agricultural activities

Major part of emission comes directly from agricultural soils by cultivation of soil and crops. The activities stated include the use of synthetic and organic fertilizers, growing of leguminous plants and soybean (nitrogen fixation), nitrogen from the agricultural residues, and the treatment of histosols. Emissions of nitrous oxide (N₂O) from Agricultural Soils for the period from 1990 to 2006 are shown in the Figure 6.5-1.

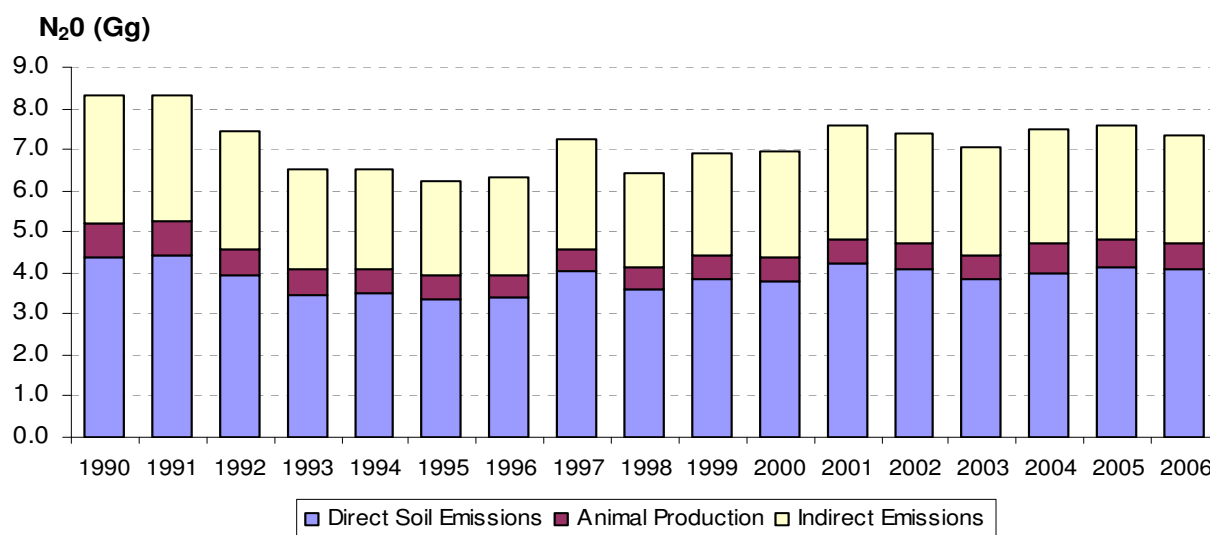


Figure 6.5-1: Total N₂O Emissions from Agricultural Soils (Gg)

6.5.1. DIRECT EMISSION FROM AGRICULTURAL SOILS

6.5.1.1. Source category description

Direct N₂O emissions from agricultural soils include total amount of nitrogen applied to soils through cropping practices. These practices include application of synthetic fertilizer, nitrogen from animal waste, production of nitrogen – fixing crops, nitrogen from crop residue mineralization and soil nitrogen mineralization due to cultivation of histosols. The input data

required for this part of the calculation are: annual quantity of the synthetic fertilizer used, the quantity of organic fertilizer used, the head of animals by its category, the biomass of leguminous plants and soybean, and the surface of histosols. The direct emission from agricultural soils is calculated by the following equation:

$$N_2O_{\text{DIRECT}} \text{ (kg N/yr)} = (F_{\text{SN}} + F_{\text{AW}} + F_{\text{CR}} + F_{\text{BN}}) \times EF_1 + F_{\text{OS}} \times EF_2$$

N_2O_{DIRECT} - direct N_2O emission from agricultural soils (kg N/yr)

F_{SN} - nitrogen from synthetic fertilizer excluding emissions of NH_3 and NO_x (kg N/yr)

F_{AW} - nitrogen from animal waste (kg N/yr)

F_{CR} - nitrogen from crop residues (kg N/yr)

F_{BN} - nitrogen from N-fixing crops (kg N/yr)

EF_1, EF_2 - emission factors

F_{OS} - nitrogen from histosols, (kg N/yr)

Direct Emissions of N_2O from Agricultural Soils for the period from 1990 to 2006 are shown in the Figure 6.5-2.

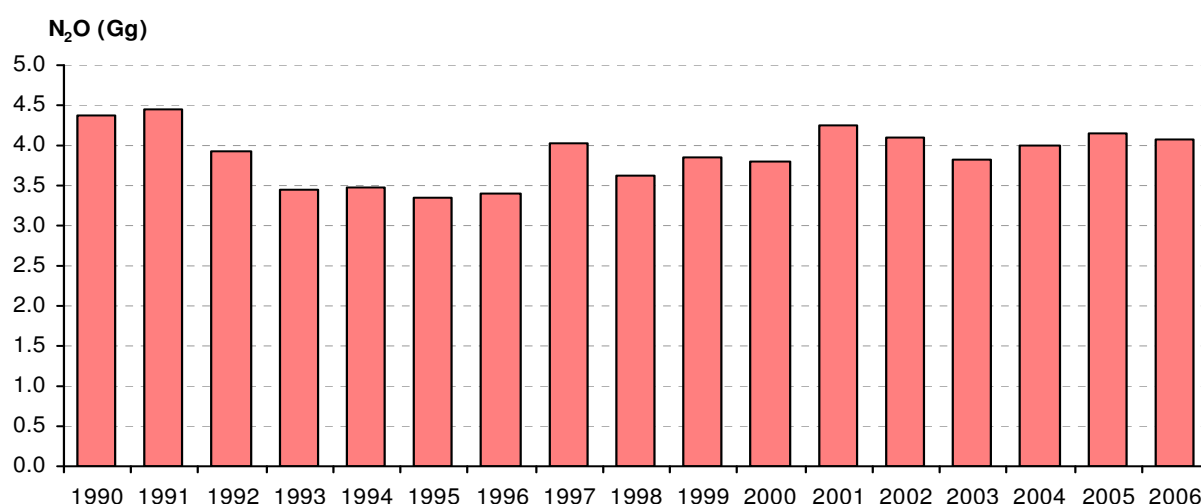


Figure 6.5-2: Direct N_2O Emissions from Agricultural Soils (Gg)

6.5.1.2. Methodological issues

For the emission from Agricultural Soils the IPCC methodology (Tier 1) has been used. The emission factors have been taken from the *Revised 1996 IPCC Reference Manual*.

Nitrous oxide from mineral fertilisers

This estimate is based on the amount of N in mineral fertiliser that is annually consumed in the Republic of Croatia. Data on the consumption of mineral fertilisers that are produced and applied in Croatia were obtained from Petrokemija Fertilizer Company Kutina, for the period 1992-2006. Data for mineral fertilizers produced and applied in Croatia in 1990 and 1991 have been estimated by extrapolation method using pattern from 1992 to 2006. Data on import of mineral fertilizers were obtained from Petrokemija, for the period 2000-2006. Data on import before year 2000 are negligible due to tariffs which were eliminated in 2000. Nitrogen dispersed

into atmosphere in the form of ammonia and NO_x (10%; *Revised 1996 IPCC Guidelines*) was subtracted from the total estimated quantity of emitted nitrogen N. The emission of nitrous oxide was then calculated by multiplying the quantity of the remaining N with emission factor 0.0125 kg $\text{N}_2\text{O-N/kg N}$ (*Revised 1996 IPCC Guidelines*).

Nitrous oxide from animal manure and liquid/slurry

The estimate is based on the amount of N in solid manure and liquid manure/slurry, which is annually used for fertilizing crops. Of the total estimated quantity of emitted N, the N that is emitted on the pasture (24%, country specific), and N that is dispersed into the atmosphere in the form of ammonia and NO_x (20%, *Revised 1996 IPCC Guidelines*.) was subtracted. The emission of nitrous oxide was then calculated by multiplying the quantity of the remaining N with emission factor 0.0125 kg $\text{N}_2\text{O-N/kg N}$ (*Revised 1996 IPCC Guidelines*).

Nitrous oxide from biological fixation of N

The estimate is based on the amount of pulses and soybeans (Croatian Statistical Yearbooks, published by Central Bureau of Statistics) produced in country as a dry biomass. According to *Revised 1996 IPCC Guidelines*, dry biomass of N-fixing crops was multiplied by factor 2 and by fraction of nitrogen in N-fixing crops (3%, *Revised 1996 IPCC Guidelines*). The emission of nitrous oxide was then calculated by multiplying the quantity of the remaining N with emission factor 0.0125 kg $\text{N}_2\text{O-N/kg N}$ (*Revised 1996 IPCC Guidelines*).

Emissions of nitrous oxide from crop residue

The estimate is based on methodology recommended by *Revised 1996 IPCC Guidelines*, which is based on the assumption that the total biomass produced is approximately twice the amount of the produced edible parts of crops, which means that 45% of the produced total biomass is removed from agricultural soils. Dry biomass production of pulses and soybeans and dry biomass production of other crops are the basic data for the calculation (Croatian Statistical Yearbooks, published by Central Bureau of Statistics and expert judgment). Dry biomass is calculated by applying factor to account for crop water content. Fraction of N-fixing crops (3%), fraction of nitrogen in non N-fixing crops (1.5%), fraction of crop residue that is removed from the field as crop (45%) and fraction of crop residue that is burned rather than left on field (10%) were obtained from *Revised 1996 IPCC Guidelines*. The emission of nitrous oxide was then calculated by multiplying the quantity of the remaining N with emission factor 0.0125 kg $\text{N}_2\text{O-N/kg N}$ (*Revised 1996 IPCC Guidelines*).

Emissions of nitrous oxide due to cultivation of organic soils

Cultivation of soils with the high content of organic material causes the release of a long term bound N. The area of organic soil in Republic of Croatia has been obtained from expert judgment. The emission of nitrous oxide due to cultivation of histosols was then calculated by multiplying the area of histosols with emission factor 5 kg N/ha/yr (*Revised 1996 IPCC Guidelines*).

6.5.1.3. Uncertainties and time-series consistency

Uncertainty estimates based on expert judgement. Uncertainty of activity data amounts 30%. Uncertainty of emission factors amounts 40%.

Direct N₂O emissions from agricultural soils have been calculated using the same method and data sets for every year in the time series.

6.5.1.4. Source specific recalculations

New activity data for application of mineral fertilizers were included for the period 1992-2005. Data for mineral fertilizers applied in Croatia in 1990 and 1991 have been estimated by extrapolation method using pattern from 1992 to 2006. Moreover, data on import of mineral fertilizers were included for period 2000-2005. New data on pulses and soyabeans and non-N fixing crop production for years 2004 and 2005 were included instead of data estimated by extrapolation method in the previous report. Thus, direct N₂O emissions from Agricultural Soils have been recalculated for the period 1990-2005.

6.5.2. DIRECT N₂O EMISSION FROM PASTURE, RANGE AND PADDOCK MANURE (CRF 4.D.2.)

6.5.2.1. Methodological issues

Estimates of N₂O emissions from animals were based on animal waste deposited directly on soils by animals on pasture, range and paddock. N₂O emissions from animals can be calculated as follows:

$$N_2O_{ANIMALS} = N_2O_{(AWMS)} = \sum_{(T)} [N_{(T)} \times Nex_{(T)} \times AWMS_{(T)} \times EF_{3(AWMS)}]$$

$N_2O_{ANIMALS}$ - N₂O emissions from animal production (kg N/yr)

$N_2O_{(AWMS)}$ - N₂O emissions from Animal Waste Management Systems (kg N/yr)

$N_{(T)}$ - number of animals of type T

$Nex_{(T)}$ - N excretion of animals of type T (kg N/animal/yr)

$AWMS_{(T)}$ - fraction of $Nex_{(T)}$ that is managed in one of the different distinguished animal waste management systems for animals of type T

$EF_{3(AWMS)}$ - emission factor

The same emission factor (0.02 kg N₂O-N/kg of emitted N), recommended by *Revised 1996 IPCC Guidelines*, was used for all grazing animals regardless of their species and climatic conditions. Direct N₂O Emissions from Pasture, Range and Paddock Manure for the period from 1990 to 2006 are shown in the Figure 6.5-3.

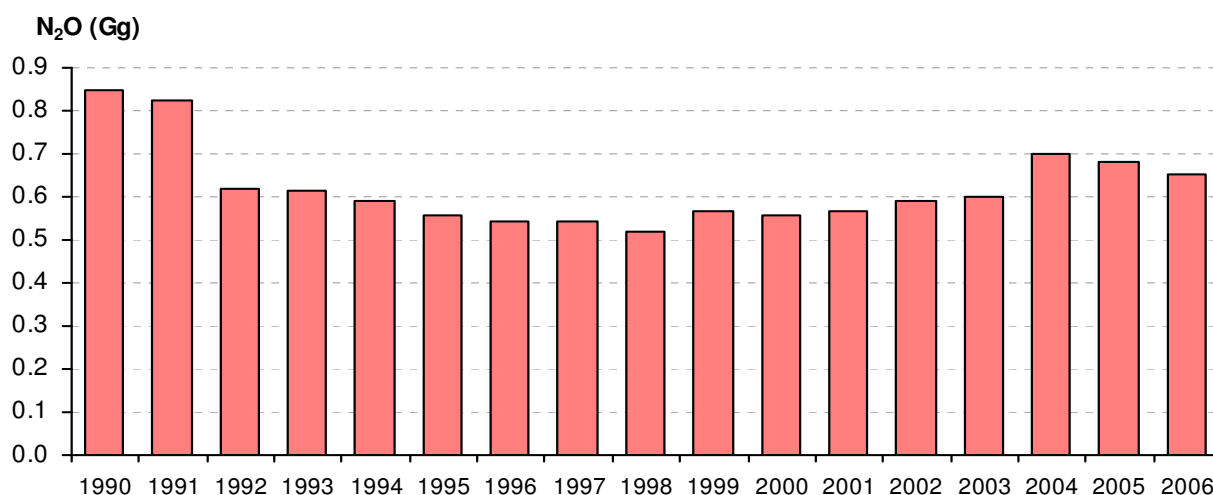


Figure 6.5-3: Direct N₂O Emissions from Animals (Gg)

6.5.2.2. Uncertainties and time-series consistency

Uncertainty estimates are based on expert judgement. Uncertainty of activity data amounts 30%. Uncertainty of emission factors amounts 40%.

Direct N₂O emissions from Pasture, Range and Paddock Manure have been calculated using the same method and data sets for every year in the time series.

6.5.2.3. Source specific recalculations

New activity data for different animal categories were included for following years:

- Dairy Cattle – 1990, 1992
- Sheep - 1990, 1993, 1996, 1997
- Horses - 1990 and 1991
- Swine - 1995, 1996 and 1997
- Goats - 1990, 1991, period 1998-2002, 2005

In the previous report, data were obtained from different sources and some insufficient data were assessed by expert judgement. In this report, more accurate data have been obtained from Central Bureau of Statistics. N₂O emissions have been recalculated for defined years.

6.5.3. INDIRECT N₂O EMISSIONS FROM NITROGEN USED IN AGRICULTURE

6.5.3.1. Source category description

Calculations of indirect N₂O emission from the nitrogen used in agriculture are based on two pathways. These are: volatilization and subsequent atmospheric deposition of NH₃ and NO_x (originating from the application of fertilizers and animal manure), and leaching and runoff of the N that is applied to or deposited on soils. These two indirect emission pathways are treated separately, although activity data used are identical. The indirect emission of N₂O from the agriculture is calculated by the following equation:

$$N_2O_{\text{INDIRECT}} = N_2O_{(G)} + N_2O_{(L)}$$

N_2O_{INDIRECT} - indirect N_2O emissions (kg N/yr)

$N_2O_{(G)}$ - N_2O emissions due to atmospheric deposition of NH_3 and NO_x (kg N/yr)

$N_2O_{(L)}$ - N_2O emissions due to nitrogen leaching and runoff (kg N/yr)

The emissions of N_2O produced from the discharge of human sewage N into rivers are reported under the sector Waste.

Indirect Emission of N_2O from Agriculture for the period from 1990 to 2006 is shown in the Figure 6.5-4.

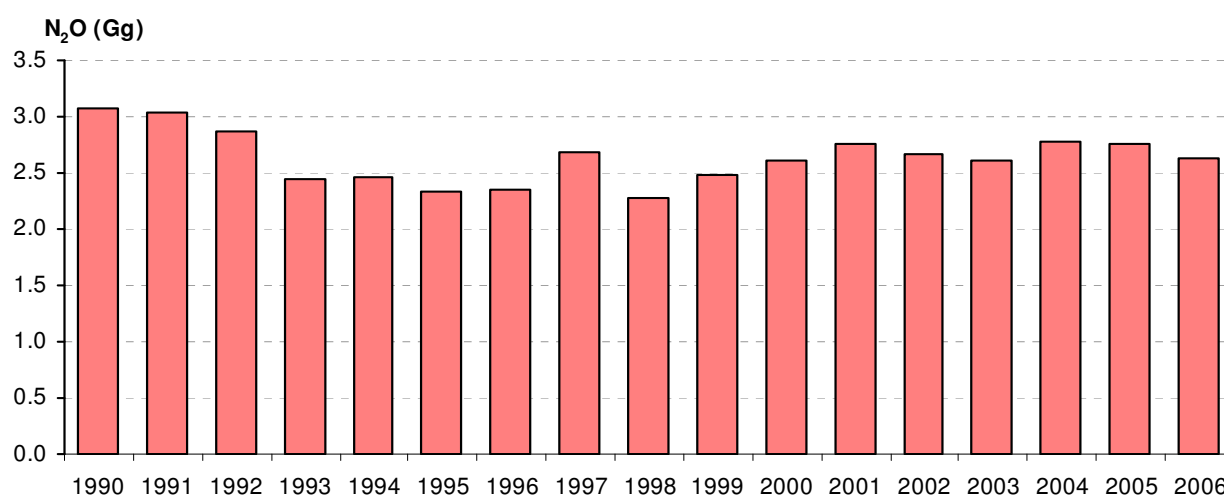


Figure 6.5-4: Indirect N_2O Emissions from Agricultural (Gg)

6.5.3.2. Methodological issues

Nitrous oxide arising due to volatilization of ammonia (NH_3) and nitrogen oxides (NO_x)

In fertilizing agricultural soils with nitrogen fertilizers, some N volatilises in form of ammonia and nitrogen oxides (NO_x). This nitrogen is deposited by precipitation and particulate matter on agricultural soil, in forests and waters and thus indirectly contributes to emissions of N_2O . Emissions are attributed to the place of origin of ammonia and NO_x , not to the place where N is re-deposited, causing N_2O emissions.

Emissions from mineral fertilizers

Indirect emissions of nitrous oxide from mineral fertilizers depend to a large extent on the fraction of N that volatilises during fertilizing. The amount of volatilised N depends very strongly on the type of fertilizer as well as on weather conditions and the manner of application. It has been considered that 10% of N from mineral fertilizers volatilises (*Revised 1996 IPCC Guidelines*). For calculating indirect emissions of nitrous oxide, the emission factor 0.01 kg N_2O -N/kg NH_3 and NO_x -N has been used (*Revised 1996 IPCC Guidelines*).

Emissions from animal manure

Numerous factors influence the fraction of volatilised N in form of ammonia and nitrogen oxides, such as: the ratio between N excreted in dung and N excreted in urine, the manner of slurry storage, the manner of slurry application etc. Generic IPCC emission factor (20%, *Revised 1996 IPCC Guidelines*) of the excreted N is supposed to volatilise in form of ammonia and nitrogen oxides. Emissions of nitrous oxide have been calculated by multiplying the estimated quantities of volatilised N with emission factor 0.01 kg N₂O-N/kg NH₃-N and NO_x-N (*Revised 1996 IPCC Guidelines*).

Nitrous oxide from leaching and runoff of nitrogen compounds into surface waters, groundwater and watercourses

Surface runoff and leaching of N into groundwater, surface waters, and watercourses due to mineral fertilisers:

It has been considered that 30% of N from mineral fertilizers is lost through surface runoff and leaching into the groundwater and watercourses. In calculating emissions of nitrous oxide, it has been considered that for every kg of leached/run-off nitrogen, 0.025 kg of N₂O-N is emitted (*Revised 1996 IPCC Guidelines*).

Nitrogen leaching and runoff into groundwater, surface waters, and watercourses due to animal manure:

It has been considered that for every kg of N, which is excreted by farm animals, 0.3 kg of N is lost through surface runoff to watercourses and groundwater (*Revised 1996 IPCC Guidelines*). In calculating emissions of nitrous oxide, the same emission factors has been considered as in the case of nitrogen leaching/runoff due to mineral fertilizer (0.025 kg N₂O-N/kg of leached/run-off N)

6.5.3.3. Uncertainty and time-series consistency

The uncertainty of the calculation is conditioned by the use of the emission factors recommended by the methodology and the unreliability of the input data. According to the bibliography, the uncertainty of the recommended emission factors is high. Uncertainty of activity data is 30%. Uncertainty of emission factors is 60%.

Indirect N₂O emissions have been calculated using the same method and data sets for every year in the time series.

6.5.3.4. Source specific recalculations

New activity data for animal livestock and application of mineral fertilisers were included. Thus, indirect N₂O emissions were recalculated for period from 1990 to 2005.

6.6. SOURCE SPECIFIC QA/QC AND VERIFICATION

During the preparation of the inventory submission activities related to quality control were mainly focused on completeness and consistency of emission estimates and on the proper use of notation keys in the CRF tables. After preparation of final draft of this chapter an audit was carried out to check selected activities from Tier 1 General inventory level QC procedures which

revealed that most of the activities were correctly carried out during preparation of the inventory despite the fact that formal QC procedures were not prepared.

Regarding to Tier 2 activities, emission factors and activity data were checked for key source categories. Activity data for livestock were compared with the FAO database. Results of this comparison showed that there is no significant difference between these two sets of data. In Agriculture five source categories represent key source category (Table 6.6-1): CH₄ Emissions from Enteric Fermentation in Domestic Livestock, N₂O Emissions from Manure Management, Direct N₂O Emission form Agricultural Soils, N₂O Emissions from Pasture Range and Paddock Manure and Indirect N₂O Emissions from Nitrogen Use in Agriculture.

Table 6.6-1: Key categories in Agriculture sector based on the level and trend assessment¹

IPCC Source Categories	Direct GHG	Criteria for Identification			
		Level		Trend	
		2005	2006	2005	2006
AGRICULTURE SECTOR					
CH ₄ Emissions from Enteric Fermentation in Domestic Livestock	CH ₄	Yes	Yes	Yes	Yes/No*
N ₂ O Emissions from Manure Management	N ₂ O	Yes	Yes	No	No
Direct N ₂ O Emissions from Agricultural Soils	N ₂ O	Yes	Yes	No	No
N ₂ O Emissions from Pasture, Range and Paddock Manure	N ₂ O	Yes	Yes/No*	No	No
Indirect N ₂ O Emissions from Nitrogen Used in Agriculture	N ₂ O	Yes	Yes/No*	No	No

¹Data on key categories are taken from Annex 1 Key Categories

*Key category only for excluding LULUCF

6.7. SOURCE SPECIFIC PLANNED IMPROVEMENT

CH₄ Emissions from Enteric Fermentation in Domestic Livestock were estimated using Tier 1 method since detailed data on livestock population is not available at the moment and a comprehensive research is required in the future to provide these data. The availability of activity data is still a major problem in other key source categories within this sector and application of higher tier methodologies will be possible in the future after detailed research and adjustments of statistical methods for data collection. Moreover, national emission factors should be developed to increase the calculation quality.

6.8. REFERENCES

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7. LAND-USE, LAND USE CHANGE AND FORESTRY (CRF sector 5)

7.1. OVERVIEW OF SECTOR

Forests and woodland in the Republic of Croatia are goods of a general interest and are under special protection of the state. Forest is an area of land of minimum 0.1 ha covered with trees (*Forestry Act, Official Gazette 140/05, 82/06*). The terms and the way of their use have been prescribed in Forestry Act. Ministry of Regional Development, Forestry and Water Management is authorized institution for collecting data about state of forest land. Moreover, Regulation on the Greenhouse Gases Emissions Monitoring in the Republic of Croatia (Official gazette No. 1/07), which came into force in January 2007 and first Inventory Submission stipulated by the Regulation is 2008, prescribes obligation and procedure for emissions monitoring. Among others, the regulation prescribes monitoring of areas within different land use categories, such as forest area, agricultural area, grasslands, wetlands, settlements and other land. Based on the Forest Management Area Plan of the Republic of Croatia (2006-2015), the forests and the forest land cover 42 percent of the total surface area. By its origin, approximately 95 percent of the forests in Croatia were formed by natural regeneration and the 5 percent of the forests are grown artificially. In the Republic of Croatia 78% of the forest are state owned and 22% are private. The basic principles of the Croatian forestry are sustainable forest management along with the preservation of the natural structure and diversity of the forests, as well as the permanent enhancement of the stability and quality of the forests commercial and welfare functions.

The total growing stock in the Croatian forests is around 398 million m³. The most frequent species are Beech (*Fagus sylvatica*), Common Oak (*Quercus robur*), Sessile Oak (*Quercus petraea*), European Hornbeam (*Carpinus betulus*), Common Fir (*Abies alba*) and other types of deciduous and evergreen trees. The average growing stock in the state-owned forests is 190 m³/ha and in the privately owned forests 80 m³/ha. The annual increment in Croatia forests is around 10.5 million m³ of wood. The increment is an increase in the forest timber stock over a specific period and it is calculated as an annual, periodical and average increment. The check method or the method of bore-spills is most often used in Croatia to identify the increment. The quality and quantity of increment can be improved by different methods of forest cultivation. The annual cut is a part of the forest timber stock planned for commercial harvesting for a certain period (1 year, 10 years, 20 years) expressed in timber stock (m³, m³/ha) or by the surface area. To satisfy the basic principles of the sustainable forest management, the annual cut must not be larger than the increment value.

According to the methodology proposed by IPCC Good Practice Guidance for LULUCF (GPG 2003) the top-level categories for greenhouse gas (GHG) reporting are:

- Forest land
- Cropland
- Grassland
- Wetlands
- Settlements
- Other land

The Republic of Croatia only reports data for Forest land category. Data needed for calculations of emissions/removals for other land categories are partly available but not enough adequate, consistent and complete.

7.2. SOURCE CATEGORY

7.2.1. SOURCE CATEGORY DESCRIPTION

Carbon in forests is bound in trees, underbrush, soil and dead wood. As a result of biological processes in forests and anthropogenic activities carbon is in a constant cycling process. Deforestation, among all anthropogenic activities, has the greatest impact on the change of carbon stock in the existing forests. The problem of deforestation in Croatia does not exist. According to the current data total forest area in Croatia has not decreased over the last 100 years.

7.2.2. METHODOLOGICAL ISSUES

The IPCC methodology (GPG 2003) has been used for calculation of CO₂ emissions and removals from LULUCF sector. GHG inventory for the land-use category Forest Land Remaining Forest Land (FF) is reported using Tier 1 method. All emission factors were used according to GPG 2003. The Forest Management Area Plan of the Republic of Croatia for the period 1986-1996, 1996-2005 and 2006-2015 are main sources of data on the forest land and the annual increment. Data on commercial harvesting and wood fuel for period 1991-1996 are obtained from Statistical Yearbooks. Data on commercial harvest including wood for fuel for the year 1990 and period 1997-2006 are obtained from experts preparing data for UNECE. Data on forest fires are obtained from Ministry of Regional Development, Forestry and Water Management for the period 1992-2006 which as a source of data used official statistics of Croatian Forest Ltd., national establishment for management of state-owned forests. Data for 1990 and 1991 were estimated as average value of period 1992-2006. The criteria in choosing data were the following: continuity, quality, comparability as well as accessibility of sources. Contemporarily National Forestry Inventory Project (CRONFI) is ongoing and should be completed in 2008. The Forestry Act (Official gazette No. 140/05, 82/06) prohibits the renewal of forests by clear cutting, and the natural rejuvenation is the principal method for renewal of all natural forests.

7.2.2.1. Forest Land Remaining Forest Land

According to GPG 2003, Tier 1 method, GHG emissions for the Forest land remaining forest land (FF) are estimated only for aboveground and belowground biomass. Other carbon pools are not included since Tier 1 method is applied due to lack of activity data.

Change in carbon stocks in living biomass is calculated by multiplying difference in oven dry weight of biomass increments and losses with appropriate carbon fraction. Tier 1 method (default method) is applied for estimating carbon stock changes in biomass. Tier 1 method required the biomass carbon loss (ΔC_{FFL}) to be subtracted from the biomass carbon increment (ΔC_{FFG}) for the reporting year (GPG 2003, Equation 3.2.2.)

Annual Increase in Carbon Stock due to biomass increment (ΔC_{FFG}) in FF is estimated according to Equation 3.2.4, GPG 2003. Estimation of annual increase in carbon stock due to biomass increment requires estimation of area and annual increment of total biomass for each forest type (coniferous, deciduous) (G_{TOTAL}) and climatic zone (temperate) in Croatia. The annual increase in carbon stock is calculated only for areas under forest vegetation. Areas with degraded forest vegetation are not included because annual increment for these vegetation types could not be obtained. Areas of mixed forest are divided in half and split between coniferous and deciduous category. The carbon fraction of biomass (CF) used is default value of 0.5.

G_{TOTAL} is the expansion of annual increment rate of aboveground biomass (Gw) to include belowground part involving multiplication by the ratio of belowground biomass to aboveground biomass (root to shoot ratio) that applies to increments. Since Gw data are not available directly the increment in volume (lv) was used with biomass expansion factor for conversion of annual net increment to aboveground increment.

Average annual increment in biomass (Gw) is calculated according to Equation 3.2.5, GPG 2003, using data on:

- lv = average annual net increment in volume suitable for industrial processing, $m^3 \text{ ha}^{-1} \text{ yr}^{-1}$ (Forestry Management Plans 1986-2006)
- D = basic wood density, tonnes d.m. m^{-3} , (GPG 2003)
- BEF1 = biomass expansion factor for conversion of annual net increment (including bark) to aboveground tree biomass, dimensionless (GPG 2003)
- R = root to shoot ratio, dimensionless; GPG 2003, Table 3A.1.8
- CF = carbon fraction of dry matter (default = 0.5), tonnes C (tonne d. m.) $^{-1}$

Average Increment in Biomass (G_{TOTAL}) is calculated multiplying average increment in biomass (Gw) per root to shoot ratio (R) appropriate to increment, dimensionless (GPG 2003, Table 3A.1.8.)

Annual Decrease in Carbon Stock Due to Biomass Loss in FF (ΔC_{FFL}) is calculated as a sum of losses from commercial roundwood feelings ($L_{fellings}$), fuelwood gathering ($L_{fuelwood}$) and other losses ($L_{other \text{ losses}}$)(GPG 2003, Equation 3.2.6.).

Annual Carbon Loss due to Commercial fellings ($L_{fellings}$) is calculated according to Equation 3.2.7, GPG 2003, using input data on:

- H = annual extracted volume, roundwood, $m^3 \text{ yr}^{-1}$ (Statistical Yearbooks 1991-1996, UNECE 1990 and 1997-2006)
- D = basic wood density, tonnes d.m. m^{-3} , (GPG 2003)
- BEF2 = biomass expansion factor for conversion volumes of extracted roundwood to total aboveground (including bark) biomass, dimensionless (GPG 2003)
- f_{BL} = fraction of biomass left to decay in forest
- CF = carbon fraction of dry matter (default = 0.5), tonnes C (tonne d. m.) $^{-1}$

In applying above mentioned equation, f_{bl} is set to 0 according to assumption that total biomass associated with volume of the extracted roundwood is considered as an immediate emission.

Annual Carbon Loss due to Fuelwood gathering is estimated according to Equation 3.2.8, GPG 2003, using input data on:

- FG = annual volume of fuelwood gathering, tonnes C yr^{-1} . (Statistical Yearbooks 1991-1996, UNECE 1990 and 1997-2006)
- D = basic wood density, tonnes d.m. m^{-3} , (GPG 2003)
- BEF2 = biomass expansion factor for conversion volumes of extracted roundwood to total aboveground (including bark) biomass, dimensionless (GPG 2003)
- CF = carbon fraction of dry matter (default = 0.5), tonnes C (tonne d. m.) $^{-1}$

Annual Carbon Loss due to Other losses includes only data on forest fires and is estimated according to Equation 3.2.9, GPG 2003, using input data on:

- $A_{\text{disturbance}}$ = forest areas affected by fires, ha yr^{-1} . Data for period 1992-2006 were obtained from Ministry of Regional Development, Forestry and Water Management. Data for 1990 and 1991 were estimated as average value of period 1992-2006.
- Bw = average biomass stock of forest areas, tonnes d.m. ha^{-1} , (GPG 2003, Table 3A.1.4)
- CF = carbon fraction of dry matter (default = 0.5), tonnes C (tonne d. m.) $^{-1}$

In applying above mentioned equation, f_{bl} is set to 0 according to assumption that all aboveground biomass carbon is lost upon disturbance.

Table 7.2-1 provides information on factors used.

Table 7.2-1: Emission factors used in estimations

Forest type	D	BEF1	R	BEF2	CF	Bw
Coniferous	0.4	1.15	0.23	1.3	0.5	107
Deciduous	0.588	1.2	0.24	1.4	0.5	107

- D = basic wood density, calculated from table 3A.1.9 (GPG 2003) according to major tree species in growing stock in Croatia
- BEF1 = biomass expansion factor for conversion of annual net increment (including bark) to aboveground tree biomass, dimensionless (GPG 2003)
- R = root to shoot ratio, dimensionless; (GPG 2003, Table 3A.1.8)
- BEF2 = biomass expansion factor for conversion volumes of extracted roundwood to total aboveground (including bark) biomass, dimensionless (GPG 2003)
- CF = carbon fraction of dry matter (default = 0.5), tonnes C (tonne d. m.) $^{-1}$
- Bw = average biomass stock of forest area, tonnes d.m. ha^{-1} , (GPG 2003, Table 3A.1.4)

Moreover, non- CO_2 greenhouse gas emissions released in wildfires for CH_4 , CO , N_2O and NO_x are estimated according to Equation 3.2.19, GPG 2003 using input data on:

- A = area burned, ha
- B = mass of available fuel, kg d.m. ha^{-1}
- C = combustion efficiency, dimensionless
- D = emission factor, g (kg d.m.) $^{-1}$

Product of B and C is estimated using GPG 2003, Table 3.A.1.13.

Table 7.2-2 provides information on Annual change in Carbon Stock in living biomass in Forest Land Remaining Forest Land.

Table 7.2-2: Annual change in Carbon Stock in living biomass in Forest Land Remaining Forest Land (Gg CO₂)

Year	Annual increase in carbon stocks (Gg CO ₂)	Annual decrease in carbon due to carbon loss (Gg CO ₂)	Annual change in carbon stock in living biomass (Gg CO ₂)
1990	13505.18	9320.26	4184.92
1991	13505.18	4805.54	8699.63
1992	13505.18	4210.85	9294.32
1993	13505.18	5468.55	8036.63
1994	13505.18	4846.85	8658.32
1995	13505.18	4350.94	9154.24
1996	14876.47	5386.52	9489.95
1997	14876.47	6673.55	8202.93
1998	14876.47	8035.35	6841.12
1999	14876.47	6723.39	8153.08
2000	14876.47	9595.78	5280.69
2001	14876.47	6662.69	8213.78
2002	14876.47	6670.87	8205.61
2003	14876.47	8600.00	6276.47
2004	14876.47	6976.63	7899.85
2005	14876.47	7150.10	7726.37
2006	16333.04	8842.74	7490.29

7.2.3. UNCERTAINTIES AND TIME-SERIES CONSISTENCY

The uncertainty of the input data for CO₂ emissions was estimated at 40 to 50 percent, while uncertainty of using wood density and BEFs was estimated at 30 percent.

The uncertainty of activity data for non-CO₂ emissions from fires was estimated at 25 percent, while for emission factors at 70 percent.

Emissions from sub-sector Forest Land Remaining Forest Land have been calculated using the same data source for every year in the time series except for data on commercial harvesting and wood fuel. Data on commercial harvesting and wood fuel for period 1991-1996 are obtained from Statistical Yearbooks. Data on commercial harvest including wood for fuel for the year 1990 and period 1997-2006 are obtained from experts preparing data for UNECE.

7.2.4. SOURCE-SPECIFIC QA/QC AND VERIFICATION

During the preparation of the inventory submission activities related to quality control were mainly focused on completeness and consistency of emission estimates and on proper use of notation keys in the CRF tables. After preparation of final draft of this chapter an audit was carried out to check selected activities from Tier 1 General inventory level QC procedures which revealed that most of the activities were correctly carried out during preparation of the inventory despite the fact that formal QC procedures were not prepared.

Due to the discrepancy in data on annual increment between Croatian Forestry Plans and Forest Resources Assessment 2005, data were checked with experts from Ministry of Regional Development, Forestry and Water Management and Croatian Forest Ltd. Moreover, data were compared with the data on annual increment from Slovenian National Inventory Report.

Afterwards, it was decided that data from Croatian Forestry Plans are relevant and were included in estimation of emissions. There are three possible sources of data on wildfires in Croatia, Croatian Forests Ltd., Ministry of Interior and Croatian Protection and Rescue Directorate, all of which have the obligation to deliver the data on forest fires to different international institutions. Data obtained from Croatian Forest Ltd. are considered relevant and were included in estimation of emissions.

7.2.5. SOURCE-SPECIFIC RECALCULATIONS

Revised activity data for forest area and annual net increment are included for whole period 1990-2005. The annual increase in carbon stock is calculated only for the areas under forest vegetation. Areas under degraded forest vegetation are not included because annual net increment for these vegetation types could not be estimated. Areas under mixed forest are divided in half and split between coniferous and deciduous category. Emissions resulting from wildfires are included in estimation of Annual Decrease in Carbon Stock. Data for wildfires exist for period 1992-2006 thus data for 1990 and 1991 are estimated as average value for period 1992-2006. Recalculation for the period 1990-2005 was conducted.

7.2.6. SOURCE-SPECIFIC PLANNED IMPROVEMENTS

Major areas for improvement:

- Development of land use database needed for greenhouse gas inventories with aim to collect more quality data and to use complete land inventories. Regulation on the Greenhouse Gases Emissions Monitoring in the Republic of Croatia (Official gazette No. 1/07) prescribes obligation and procedure for emissions monitoring. Among others, the regulation prescribes monitoring of areas within different land use categories, such as forest area, agricultural area, grasslands, wetlands, settlements and other land.
- Development of country specific factors (BEFs).

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8. WASTE (CRF sector 6)

8.1. OVERVIEW OF SECTOR

Waste management activities, such as disposal and treatment of municipal solid waste and wastewaters as well as waste incineration, can produce emissions of greenhouse gases (GHGs) including methane (CH_4), carbon dioxide (CO_2) and nitrous oxide (N_2O).

CH_4 emissions as a result of disposal and treatment of municipal solid waste, CH_4 emissions from disposal of domestic and commercial wastewater in septic tanks, indirect N_2O emissions from human sewage and CO_2 emissions resulting from incineration of hazardous and clinical waste (without energy recovery) are included in emissions estimates in this sector.

The methodology used to estimate emissions from waste management activities requires country-specific knowledge on waste generation, composition and management practice. The fact that waste management activities in Croatia are generally inadequately organized and implemented results in the lack and inconsistency of data. Therefore, effort was done in order to evaluate and compile data coming from different sources and adjust them to recommended Intergovernmental Panel on Climate Change (IPCC) methodology which is used for GHGs emissions estimation.

Regulation on the Greenhouse Gases Emissions Monitoring in the Republic of Croatia (Official Gazette No. 1/07) prescribes obligation and procedure for emissions monitoring, which comprise estimation and/or reporting of all anthropogenic emissions and removals. According to requirement, sources of abovementioned greenhouse gases should report required activity data for more accurate emissions estimation.

The total annual emissions of GHGs, expressed in Gg $\text{CO}_2\text{-eq}$, from waste management in the period 1990-2006 are presented in the Figure 8.1-1.

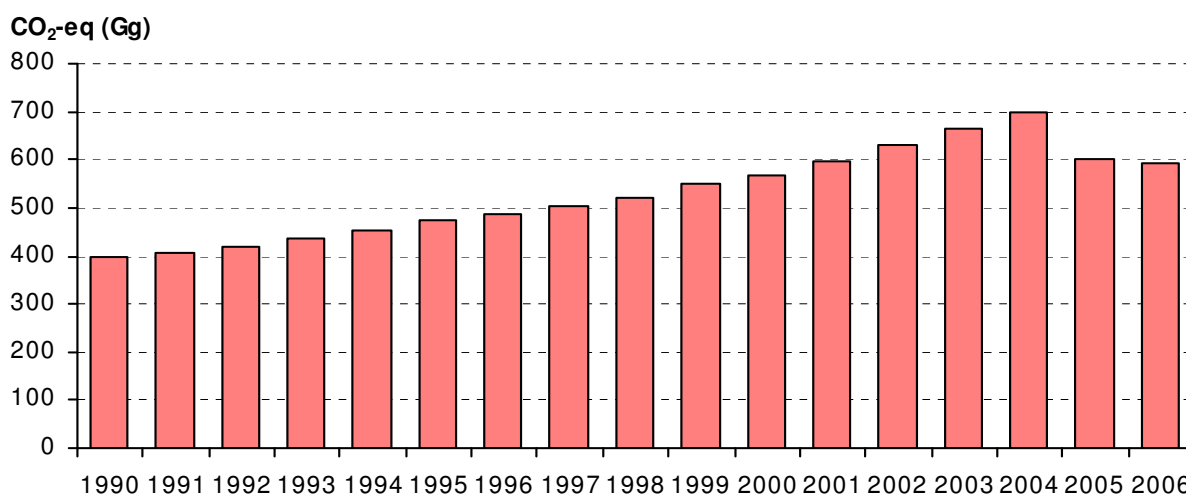


Figure 8.1-1: Emissions of GHGs from Waste (1990-2006)

8.2. SOLID WASTE DISPOSAL ON LAND (CRF 6.A.)

8.2.1. SOURCE CATEGORY DESCRIPTION

Landfill gas consists of approximately 50 percent CO₂ and 50 percent CH₄ by volume. Anaerobic decomposition of organic matter in Solid Waste Disposal Sites (SWDSs) results in the release of CH₄ to the atmosphere. The composition of waste is one of the main factors influencing the amount and the extent of CH₄ production within SWDSs. Temperature, moisture content and pH are important physical factors influencing fermentation of degradable organic substances and gas production.

8.2.2. METHODOLOGICAL ISSUES

A method used to calculate CH₄ emissions according to *Revised 1996 IPCC Guidelines* is First Order Decay (FOD) method. The quantity of CH₄ emitted during decomposition process is directly proportional to the fraction of degradable organic carbon (DOC), which is defined as the carbon content of different types of organic biodegradable wastes such as paper and textiles, garden and park waste, food waste, wood and straw waste. DOC was estimated by using country-specific data on waste composition and quantities based on compiled data from Potočnik, V. (2000), *Report: The basis for methane emissions estimation in Croatia 1990-1998*, B. *Data on Municipal Solid Waste in Croatia 1990-1998*. Country-specific composition of waste is presented in the Table 8.2-1.

Table 8.2-1: Country-specific composition of waste

Waste stream	Percent in the MSW	Percent DOC
Paper and textiles	21 - 22	40
Garden and park waste	18 - 19	17
Food waste	23 - 24	15
Wood and straw waste	3	30

The country-specific fraction of DOC in municipal solid waste (MSW), according to data from Table 8.2-1, was estimated to be 0.17 in the period 1990-2004 and 0.16 in 2005 and 2006. The decomposition of DOC does not occur completely and some of the potentially degradable materials always remain in the site over a long period of time. According to *Good Practice Guidance* approximately 50-60 percent of total DOC actually degrades⁶ and converts to landfill gas. A mean value, i.e. 55 percent, was taken into account for the purpose of CH₄ emissions estimation from SWDSs.

The methodology provides a classification of SWDSs into “managed” and “unmanaged” sites through knowledge of site activities carried out. Unmanaged sites are further divided as deep (≥ 5 m depth) or shallow (< 5 m depth). The classification is used to apply a methane correction factor (MCF) to account for the methane generation potential of the site.

Quality and composition of disposed MSW and the main characteristic of SWDSs in Croatia have been evaluated for the entire time series. Historical data for the total amount of generated

⁶ The *Revised 1996 IPCC Guidelines* provide a default value of 77 percent for DOC that is converted to landfill gas, but this value, according to review of recent literature, is too high.

waste and disposed MSW for the period 1970-1990 have been estimated based on national rate for waste generation and fraction of MSW disposed at different types of SWDSs. Extrapolation/interpolation methods has been used to obtain insufficient data. Total annual MSW disposed to SWDSs for the period 1990-1998 has been evaluated from available relevant data compiled into Report; Fundurulja, D., Mužinić, M. (2000) *Estimation of the Quantities of Municipal Solid Waste in the Republic of Croatia in the period 1990 – 1998 and 1998 – 2010*, Zagreb. Data for the quantity of disposed MSW in 1999 were evaluated by interpolation method. Data for the quantity of disposed MSW in 2000 were obtained from *Report of Environment Condition*, Ministry of Environmental Protection, Physical Planning and Construction. Data for the quantity of disposed MSW in 2005 were obtained from *Waste Management Plan in the Republic of Croatia (2007-2015)*. Taking into account the pattern over 2000 and 2005 (total quantity of disposed MSW), quantity of MSW disposed to different types of SWDSs and the main characteristic of SWDSs for the period 2001 to 2004 were assessed by interpolation method. Data for the quantity of disposed MSW in 2006 were obtained from *Cadastre of Waste - Municipal Solid Waste, Report 2006*, Croatian Environment Agency.

Recovered CH₄ in 2005 and 2006 have been obtained. Information on CH₄ that is recovered and burned in a flare or energy recovery device in 2005 and 2006 has been estimated by official document provided by ZGOS Ltd. and document *Guidelines Development for starting implementation of Waste Management Plan in the Republic of Croatia*, provided by EKONERG Ltd. 4.96 Gg CH₄ has been recovered in 2005 and 4.19 Gg CH₄ in 2006.

The most of managed SWDSs are not covered with aerated material and because of that default value for oxidation factor (OX), which equals zero, has been used.

The total annual MSW disposed to different types of SWDSs in the period 1990-2006 and related MCF are reported in the Table 8.2-2.

Table 8.2-2: Total annual MSW disposed to SWDSs and related MCF (1990-2006)

Year	Managed SWDS (Gg)	Unmanaged SWDS (≥5m) (Gg)	Unmanaged SWDS (<5m) (Gg)	MCF (fraction)
1990	18	277	295	0.606
1991	19	280	300	0.606
1992	20	284	309	0.605
1993	22	297	324	0.606
1994	26	322	329	0.613
1995	31	364	342	0.623
1996	35	392	361	0.625
1997	40	433	375	0.632
1998	45	470	398	0.636
1999*	54	538	383	0.654
2000	60	618	260	0.702
2001*	135	627	245	0.729
2002*	211	636	230	0.754
2003*	286	645	216	0.775
2004*	362	653	201	0.793
2005	437	663	186	0.810
2006	681	501	153	0.856

* data on the annual MSW disposed to different types of SWDSs were obtained by interpolation method.

Although increasing of municipal solid waste amounts as a result of the growth in the living standard, this rise has been declined due to effects of measures undertaken to avoid/reduce and recycle waste. Priority is given according avoiding and reducing waste generation and reducing its hazardous properties. If waste generation can neither be avoided nor reduced, waste must be re-used-recycled and/or recovered; reasonably unusable waste must be permanently deposited in an environmentally friendly way. These objectives, defined by the *Waste Management Strategy* and *Waste Management Plan* include the assumed time-lags with respect to relevant EU legislation (Landfill Directive). CH₄ that is recovered and burned in a flare or energy recovery device in 2005 and 2006 have been included in emission estimation.

The resulting annual emissions of CH₄ from land disposal of MSW in the period 1990-2006 are presented in the Figure 8.2-1.

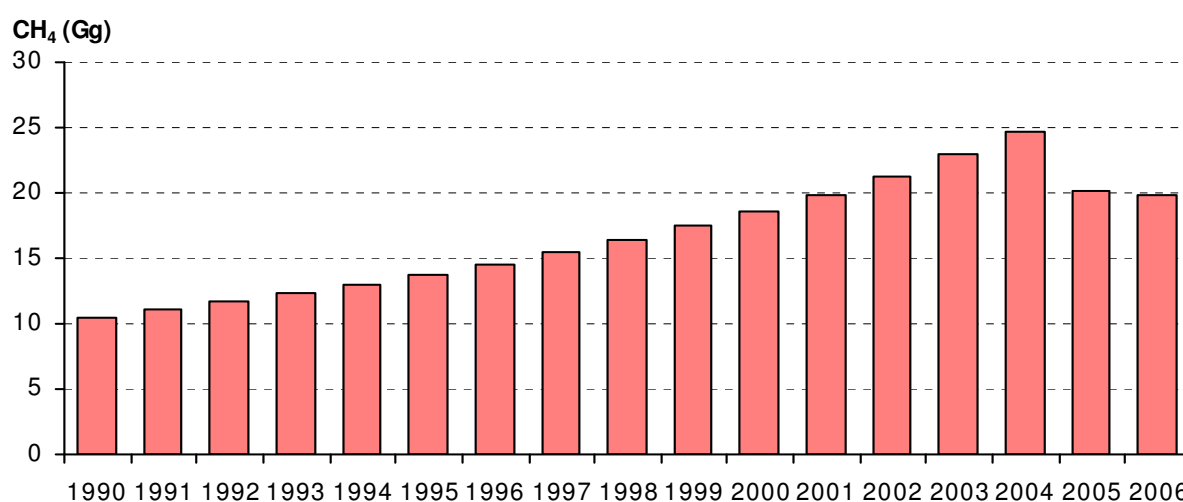


Figure 8.2-1: Emissions of CH₄ from Solid Waste Disposal on Land (1990-2006)

8.2.3. UNCERTAINTIES AND TIME-SERIES CONSISTENCY

The uncertainties contained in CH₄ emissions estimates are related primarily to assessment of historical data for quantity of MSW disposed to different types of SWDSs and the main characteristic of SWDSs as well as the usage of default IPCC methane generation rate constant ($k=0.05$).

In addition, SWDSs in Croatia are classified into several categories, according to applied waste management activities, legality, volume (capacity and quantity of disposed MSW) as well as status. Municipal solid waste which is disposed to "Official" SWDSs is in most cases collected in an organized manner by registered companies. "Official" SWDSs do not necessarily fall under managed SWDSs category as defined by IPCC (site management activities carried out in "Official" SWDSs in most cases do not meet requirements to be characterized as managed). "Unofficial" SWDSs can be described as locations where all sorts of waste are dumped uncontrollably without any site management activities carried out. In order to adjust country-specific to IPCC SWDSs classification it was proposed that "Unofficial" SWDSs fall under unmanaged shallow and deep IPCC categories, whereas "Official" SWDSs fall under all three IPCC categories depending on management activities and dimensions of waste disposal sites.

It is obvious that this distribution represents additional uncertainty in the estimation of country-specific MCF.

Another uncertainty is related to estimation of degradable organic carbon (DOC) in MSW. There were only few sorting of waste in Croatia, and in consequence of that these results were compared and adjusted to relevant data in similar countries.

Uncertainty estimate associated with emission factor amounts 50 percent, accordingly to provided uncertainty assessment in *Good Practice Guidance*. Uncertainty estimate associated with activity data amounts 50 percent, based on expert judgements.

Emissions from Solid waste Disposal on Land have been calculated using the same method for every year in the time series. Different source of information were used for data sets.

8.2.4. SOURCE-SPECIFIC QA/QC AND VERIFICATION

During the preparation of the inventory submission activities related to quality control were mainly focused on completeness and consistency of emission estimates and on proper use of notation keys in the CRF tables according to QA/QC plan.

After preparation of final draft of this chapter an audit was carried out to check selected activities from Tier 1 General inventory level QC procedures and Tier 2 source-specific QC procedures. Regarding to Tier 2 activities, emission factors and activity data were checked for key source categories. Solid waste disposal on land represent key source category in Waste sector. CH₄ emissions from solid waste disposal on land were estimated using Tier 2 method which is a *good practice*. The uncertainty of activity data is very high due to high discrepancy between various data sources. Basic country-specific activity data for CH₄ emission calculation were compared with data set from similar countries. Results of this comparison showed that there is no significant difference between these two sets of data.

8.2.5. SOURCE SPECIFIC RECALCULATIONS

In this report, the quantity of MSW disposed to different types of SWDSs and the main characteristic of SWDSs in the period 2001-2004 have been assessed by interpolation method, taking into account the pattern over 2000 and 2005. Fraction of MSW disposed at solid waste disposal sites in 2005 has been assessed according to information provided by official document *Waste Management Plan in the Republic of Croatia (2007-2015)*. Recovered CH₄ in 2005 has been included. Information on CH₄ that is recovered and burned in a flare or energy recovery device has been obtained by official document provided by ZGOS Ltd. Thereupon, CH₄ emissions have been recalculated for the period 2001-2004.

8.2.6. SOURCE-SPECIFIC PLANNED IMPROVEMENTS

According to National Environmental Action Plan (NEAP) (Official Gazette No. 46/02), Croatian Waste Management Strategy (Official Gazette No. 130/05) and *Waste Management Plan in the Republic of Croatia (2007-2015)* (Official Gazette No. 85/07), infrastructure development for integral system of waste management has been emphasized, respectively, conditions for

effectively waste management activities are created. Consequently, more accurate data for CH₄ emission calculations should be available.

8.2.6.1. Activity data improvement

By-law on Cadastre of Emission to Environment (Official Gazette No. 36/96) and The Waste Law (Official Gazette No. 178/04, 111/06) define administration commitments of manufacturers and all entities which contributed in waste management. The base for systematic gathering and saving activity data was created by establishment of the Revision of Cadastre of Waste Disposal Sites (KEO). This will present part of new KEO software which is developed as a electronic managed data base with georeferent application (*Geographical Information System, GIS*) and access to the data base through web site of Croatian Environmental Agency. By means of data base in GIS-tools, assessment and quantitative categorization of waste disposal sites are provided.

For the purposes of improvement activity data gathering from solid waste disposal activities it is necessary to improve quality of existing data:

- equipping the major landfills with automatic weigh-bridges in order to accurately estimate the quantities of delivered MSW;
- providing methodology to determine country-specific MSW composition;
- periodic analysis of waste composition at major landfills according to provided methodology;
- modification of Cadastre of Emission to Environment (KEO) Reporting Forms regarding to MSW with additional information on waste quantities and composition.

8.2.6.2. Emission factor and methodology improvement

For the purposes of emission inventory improvement it is necessary to adjust country-specific to IPCC SWDSs classification, in order to accurately estimate the MCF. Due to lack of adequate information, extrapolation method has been applied for estimation of waste and landfills characteristics over a long period of time. For the purposes of emission inventory improvement it is necessary to improve the quality of existing data and to reconstruct historical data. It is also necessary to apply a unique methodology to determinate waste quantity and composition.

By-law on Conditions for Waste Treatment (Official Gazette No. 123/97, 112/01) as well as By-law on Waste Management (Official Gazette No. 23/07) defines priority for improvement and organization of disposal sites and waste disposal on managed disposal sites.

8.3. WASTEWATER HANDLING (CRF 6.B.)

8.3.1. SOURCE CATEGORY DESCRIPTION

Aerobic biological process is used mostly in wastewater treatment. Anaerobic process is applied in some industrial wastewater treatment. Total amount of gas is flared in these treatments, and therefore all methane from gas is oxidized to carbon dioxide and water vapour.

Disposal of domestic and commercial wastewater, particularly in rural areas where systems such as septic tanks are used, are partly anaerobic without flaring, which results with CH₄ emissions. CH₄ emissions from these systems and indirect N₂O emissions from human sewage are included in emission estimates for the period 1990-2006.

8.3.2. METHODOLOGICAL ISSUES

8.3.2.1. Domestic and commercial wastewater

Methane emissions from domestic and commercial wastewater (disposal particularly in rural areas where systems such as septic tanks are used) have been calculated using the methodology proposed by *Revised 1996 IPCC Guidelines*, by multiplying the total domestic organic wastewater in kg BOD/yr and emission factor which was obtained using default value for maximum methane producing capacity (0.25 kg CH₄/kg BOD).

Data for population with individual system of drainage and data for calculation of degradable organic component in kg BOD/1000 person/yr have been obtained by state company Croatian Water Resources Management (Hrvatske vode) for 1990, 1995, 2000 and for the period 2003-2006. Insufficient data have been assessed by interpolation method. Data for CH₄ emission calculation for the period 1990-2006 are presented in the Table 8.3.1.

Table 8.3-1: Data for CH₄ emission calculation from Domestic and Commercial Wastewater (1990-2006)

Year	DOC (kg BOD/1000persons/yr)	Population*
1990	21899.86	2866000
1991	21899.55	2842800
1992	21899.58	2819600
1993	21899.60	2796400
1994	21899.63	2773200
1995	21900.00	2750000
1996	21900.00	2732000
1997	21900.00	2714000
1998	21900.00	2696000
1999	21900.00	2678000
2000	21900.00	2660000
2001	21899.65	2630333
2002	21899.70	2601666
2003	21900.16	2574000
2004	21900.00	2560000
2005	21900.01	2541460
2006	21900.17	2525460

* data for population with individual system of drainage

The resulting annual emissions of CH₄ from Domestic and commercial wastewater in the period 1990-2006 are presented in the Figure 8.3-1.

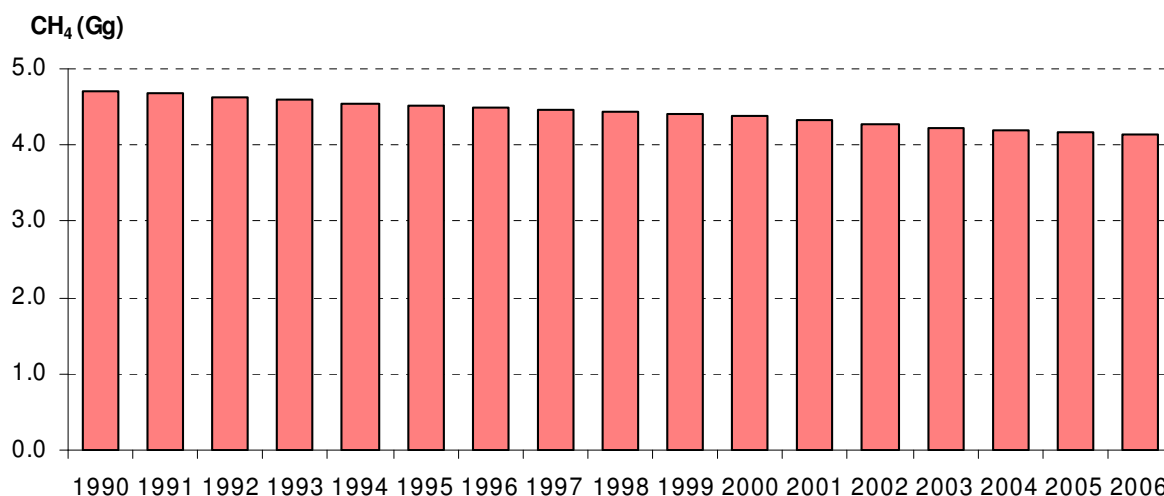


Figure 8.3-1: Emissions of CH₄ from Domestic and Commercial Wastewater (1990-2006)

8.3.2.2. Human sewage

Indirect nitrous oxide (N₂O) emissions from human sewage have been calculated using the methodology proposed by *Revised 1996 IPCC Guidelines*, by multiplying annual per capita protein intake, fraction of nitrogen in protein, number of people in country and default emission factor which equals 0.01 kg N₂O-N/kg sewage N produced.

The population estimate of the Republic of Croatia for the period 1990-2006 were taken from Statistical Yearbooks. Croatian data on the annual per capita Protein intake value (PIV), for the period 1992-2003, were obtained by the FAOSTAT Statistical Database. Extrapolation method has been used for calculation of insufficient data. Taking into account the PIV trend, the pattern over three years from 1992 to 1994 has been used for calculation of data in 1990 and 1991. Data for 2002 and 2003 have been used as the pattern for data calculation in the period 2004-2006.

Data for N₂O emission calculation from Human Sewage for the period 1990-2006 are presented in the Table 8.3.2.

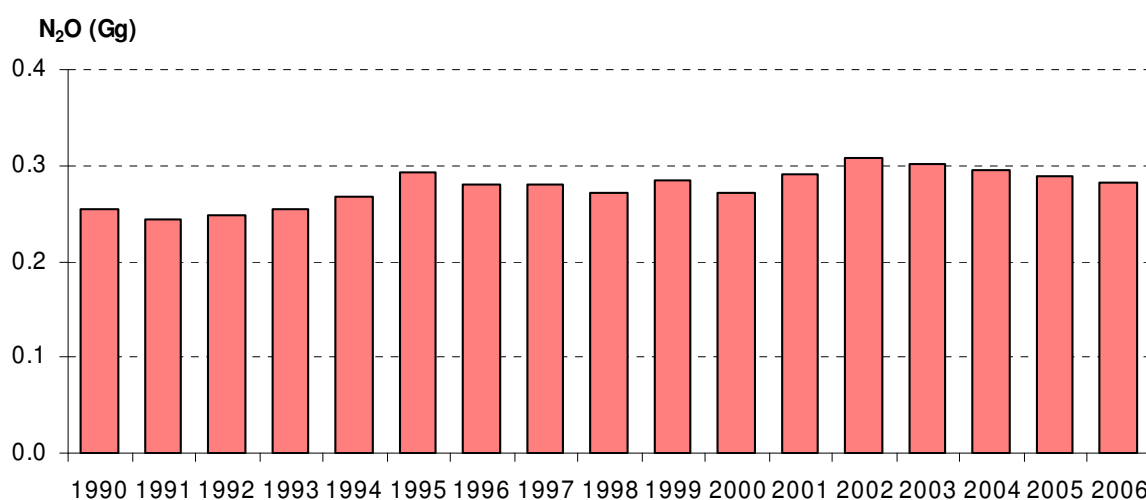
Table 8.3-2: Data for N₂O emission calculation from Human Sewage (1990-2006)

Year	Protein intake (kg/person/yr)	Population
1990	21.13	4778000
1991	21.53	4513000
1992	22.16	4470000
1993	21.86	4641000
1994	22.96	4649000
1995	25.00	4669000
1996	24.78	4494000
1997	24.38	4572000
1998	23.98	4501000

Table 8.3-2: Data for N₂O emission calculation from Human Sewage (1990-2006), cont.

Year	Protein intake (kg/person/yr)	Population
1999	24.86	4554000
2000	24.67	4381000
2001	26.10	4437000
2002	27.52	4443000
2003	26.94	4442000
2004	26.38	4439000
2005	25.80	4442000
2006	25.22	4440000

The resulting annual emissions of N₂O from Human Sewage in the period 1990-2006 are presented in the Figure 8.3-2.

Figure 8.3-2: Emissions of N₂O from Human Sewage (1990-2006)

8.3.3. UNCERTAINTIES AND TIME-SERIES CONSISTENCY

The uncertainties contained in CH₄ emissions estimates are related primarily to applied default emission factor and assessed values for degradable organic component for the period 1990-2000. Data for 1990, 1995, and 2000 have been assessed based on information from different sources and consequently have high uncertainty. Also, insufficient data in this period have been assessed by interpolation, which represents additional uncertainty in the estimations.

The uncertainties contained in N₂O emissions estimates are related primarily to applied default emission factor and extrapolated values for protein intake.

Uncertainty estimate associated with emission factor amounts 30 percent, accordingly to provided uncertainty assessment in *Good Practice Guidance*. Uncertainty estimate associated with activity data amounts 50 percent, based on expert judgements.

Emissions from Domestic and Commercial Wastewater and Human Sewage have been calculated using the same method for every year in the time series. Different source of information were used for data sets.

8.3.4. SOURCE-SPECIFIC QA/QC AND VERIFICATION

During the preparation of the inventory submission activities related to quality control were mainly focused on completeness and consistency of emission estimates and on proper use of notation keys in the CRF tables according to QA/QC plan.

After preparation of final draft of this chapter an audit was carried out to check selected activities from Tier 1 General inventory level QC procedures. Since this source category is not a key source, QA/QC plan does not prescribes source specific quality control procedures.

8.3.5. SOURCE SPECIFIC RECALCULATIONS

Data for CH₄ emission calculation from Domestic and Commercial Wastewater for the period 1990-2003 were not included in the previous report. In this report, data for 1990, 1995, 2000 and for the period 2003-2006 have been obtained by state company Croatian Water Resources Management (Hrvatske vode). Insufficient data have been assessed by interpolation method. Also, data for 2004 and 2005 have been corrected according to new assessment provided by state company Croatian Water Resources Management (Hrvatske vode). Thereupon, CH₄ emissions have been recalculated for the period 1990-2005.

Data for N₂O emission calculation from Human Sewage (Protein intake value) has been corrected for 1990. Extrapolation method has been used for calculation of insufficient data. Thereupon, N₂O emission has been recalculated for 1990.

8.3.6. SOURCE-SPECIFIC PLANNED IMPROVEMENTS

Improvements in the sub-sector Disposal of Domestic and Commercial Wastewater are related primarily to establishment of effectively *Water Information System* with base for systematic gathering and saving data needed for monitoring and planning of development of all wastewater handling systems.

In order to accurate calculation of N₂O emissions from Human Sewage, Croatia planned to analyze the influence of tourism on the population influx due to summer months, as well as fact that nearly 25 percent of the Croatian population lives close to the sea, which has influence on the emission factor.

8.4. WASTE INCINERATION (CRF 6.C.)

8.4.1. SOURCE CATEGORY DESCRIPTION

Incineration of waste produces emissions of CO₂, CH₄ and N₂O. According to *Revised 1996 IPCC Guidelines* only CO₂ emissions resulting from incineration of carbon in waste of fossil origin (e.g. plastics, textiles, rubber, liquid solvents and waste oil) without energy recovery, should be included in emissions estimates from Waste sector. Emissions from incineration with energy recovery should be reported in the Energy sector.

An incinerator of hazardous waste was functioning in Croatia between 1998 and 2002. CO₂ emissions from incineration of hazardous waste have not been estimated because data for categorisation of waste types is lacking. There is incineration of clinical waste. CO₂ emissions from incineration of clinical waste are included in emission estimates for the period 1990-2006.

8.4.2. METHODOLOGICAL ISSUES

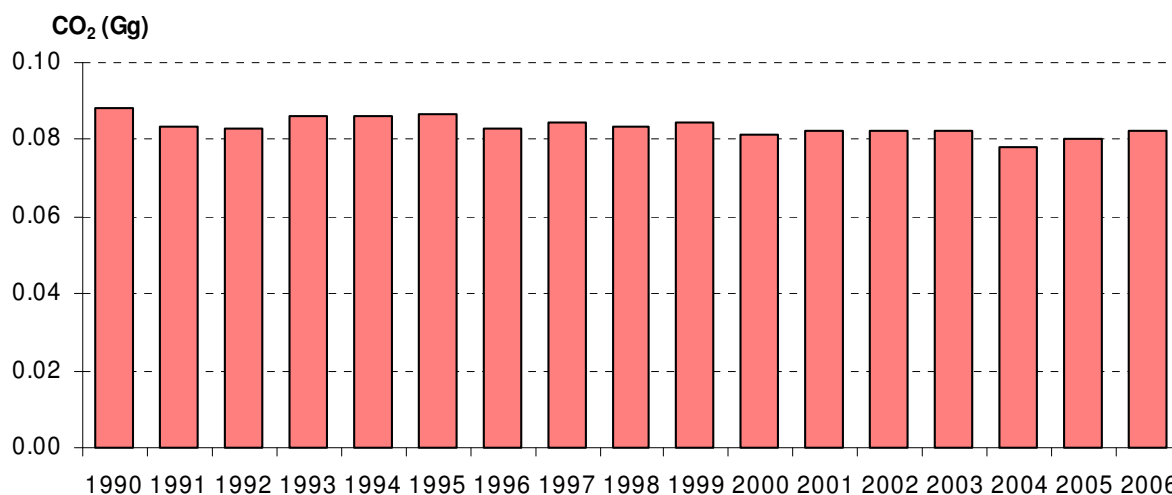
CO₂ emissions from incineration of clinical waste have been calculated using the methodology proposed by *Revised 1996 IPCC Guidelines*, by multiplying the total incinerated clinical waste with default values for fraction of carbon content, fraction of fossil carbon and burn out efficiency of combustion.

Data for quantity of incinerated waste for the period 2004-2006 were obtained by Croatian Environment Agency. Data are accepted from Cadastre of Emission to Environment (KEO) Reporting Forms regarding to hazardous waste. Data for 2005 has been corrected according to assessment carried out by interpolation method, because the data in Reporting Forms has been incomplete. Data for 2004 and 2006 have been used as the pattern for interpolation. Insufficient data for the period 1990-2003 have been assessed using population data as reference. Data for CO₂ emission calculation for the period 1990-2006 are presented in the Table 8.3.3.

Table 8.3-3: Incinerated clinical waste (1990-2006)

Year	Incinerated waste (tonnes)
1990	105.73
1991	99.87
1992	98.92
1993	102.70
1994	102.88
1995	103.32
1996	99.45
1997	101.18
1998	99.60
1999	100.78
2000	96.95
2001	98.19
2002	98.32
2003	98.30
2004	93.41
2005	95.83
2006	98.26

The resulting annual emissions of CO₂ from Waste Incineration in the period 1990-2006 are presented in the Figure 8.3-3.

Figure 8.3-3: Emissions of CO₂ from Waste Incineration (1990-2006)

8.4.3. UNCERTAINTIES AND TIME-SERIES CONSISTENCY

The uncertainties contained in CO₂ emissions estimates from incineration of clinical waste are related primarily to applied default emission factor and assessed activity data for the period 1990-2003.

Uncertainty estimate associated with emission factor amounts 30 percent, accordingly to provided uncertainty assessment in *Good Practice Guidance*. Uncertainty estimate associated with activity data amounts 50 percent, based on expert judgements.

8.4.4. SOURCE-SPECIFIC QA/QC AND VERIFICATION

During the preparation of the inventory submission activities related to quality control were mainly focused on completeness and consistency of emission estimates and on proper use of notation keys in the CRF tables according to QA/QC plan.

After preparation of final draft of this chapter an audit was carried out to check selected activities from Tier 1 General inventory level QC procedures. Since this source category is not a key source, QA/QC plan does not prescribes source specific quality control procedures.

8.4.5. SOURCE SPECIFIC RECALCULATIONS

Data for CO₂ emission calculation from Waste Incineration for the period 1990-2003 were not included in the previous report. In this report, data for CO₂ emission calculation from incineration of hospital waste have been assessed using population data as reference, for the period 1990-2003. Also, data for 2005 have been corrected according to assessment carried out by interpolation method, because the data in the previous report has been incomplete. Data for 2004 and 2006 have been used as the pattern for interpolation. Thereupon, CO₂ emissions have been recalculated for the period 1990-2003 and 2005.

8.4.6. SOURCE-SPECIFIC PLANNED IMPROVEMENTS

Improvements in the sub-sector Waste Incineration are related primarily to aggregation of accurate data for CO₂ emission calculations from incineration of hazardous and clinical waste.

8.5. EMISSION OVERVIEW

Emissions of GHGs from Waste in the period 1990-2006 are presented in Table 8.5-1.

Table 8.5-1: Emissions from Waste (1990-2006)

Source	Year	GHG	Emission (Gg)	GWP ¹	Emission (Gg CO ₂ -eq)	Percent in Waste	Percentage in Total Country Emission
Solid Waste Disposal on Land	1990	CH ₄	10.53	21	221.21	55.46	0.68
	1991		11.12		233.57	57.33	0.92
	1992		11.71		245.84	58.48	1.04
	1993		12.32		258.72	59.57	1.11
	1994		12.98		272.60	60.37	1.21
	1995		13.74		288.59	60.82	1.26
	1996		14.57		305.92	62.81	1.30
	1997		15.48		325.17	64.30	1.30
	1998		16.45		345.38	66.09	1.37
	1999		17.53		368.16	67.08	1.40
	2000		18.62		391.10	68.96	1.49
	2001		19.89		417.59	69.75	1.53
	2002		21.32		447.63	70.74	1.58
	2003		22.90		480.98	72.53	1.60
	2004		24.64		517.38	74.23	1.72
	2005		20.21		424.31	70.56	1.39
	2006		19.85		416.86	70.50	1.35
Domestic and Commercial Wastewater	1990	CH ₄	4.71	21	98.85	24.79	0.30
	1991		4.67		98.05	24.07	0.39
	1992		4.63		97.25	23.13	0.41
	1993		4.59		96.45	22.21	0.41
	1994		4.55		95.65	21.18	0.42
	1995		4.52		94.85	19.99	0.41
	1996		4.49		94.23	19.35	0.40
	1997		4.46		93.61	18.51	0.37
	1998		4.43		92.99	17.79	0.37
	1999		4.40		92.37	16.83	0.35
	2000		4.37		91.75	16.18	0.35
	2001		4.32		90.73	15.15	0.33
	2002		4.27		89.74	14.18	0.32
	2003		4.23		88.78	13.39	0.30
	2004		4.20		88.30	12.67	0.29
	2005		4.17		87.66	14.58	0.29
	2006		4.15		87.11	14.73	0.28

Table 8.5-1: Emissions from Waste (1990-2006), cont.

Source	Year	GHG	Emission (Gg)	GWP ¹	Emission (Gg CO ₂ -eq)	Percent in Waste	Percentage in Total Country Emission
Domestic and Commercial Wastewater - Human Sewage	1990	N ₂ O	0.25	310	78.69	19.73	0.24
	1991		0.24		75.73	18.59	0.30
	1992		0.25		77.21	18.37	0.33
	1993		0.26		79.07	18.21	0.34
	1994		0.27		83.20	18.43	0.37
	1995		0.29		90.98	19.17	0.40
	1996		0.28		86.80	17.82	0.37
	1997		0.28		86.88	17.18	0.35
	1998		0.27		84.13	16.10	0.33
	1999		0.28		88.24	16.08	0.34
	2000		0.27		84.24	14.85	0.32
	2001		0.29		90.26	15.08	0.33
	2002		0.31		95.30	15.06	0.34
	2003		0.30		93.27	14.07	0.31
	2004		0.29		91.27	13.09	0.30
	2005		0.29		89.33	14.85	0.29
	2006		0.28		87.28	14.76	0.28
Waste Incineration	1990	CO ₂	0.088	1	0.088	0.02	0.0003
	1991		0.083		0.083	0.02	0.0003
	1992		0.083		0.083	0.02	0.0004
	1993		0.086		0.086	0.02	0.0004
	1994		0.086		0.086	0.02	0.0004
	1995		0.086		0.086	0.02	0.0004
	1996		0.083		0.083	0.02	0.0004
	1997		0.085		0.085	0.02	0.0003
	1998		0.083		0.083	0.02	0.0003
	1999		0.084		0.084	0.02	0.0003
	2000		0.081		0.081	0.01	0.0003
	2001		0.082		0.082	0.01	0.0003
	2002		0.082		0.082	0.01	0.0003
	2003		0.082		0.082	0.01	0.0003
	2004		0.078		0.078	0.01	0.0003
	2005		0.080		0.080	0.01	0.0003
	2006		0.082		0.082	0.01	0.0003

¹ Time horizon chosen for GWP values is 100 years

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9. RECALCULATIONS AND IMPROVEMENTS

The key differences between the previous and latest submission of CRF tables for the time series 1990-2006 are outlined in this chapter. Detailed description and explanations for recalculations are shown in recalculation sections in the sector chapters, Chapters 3 to 8.

9.1. EXPLANATIONS AND JUSTIFICATIONS FOR RECALCULATIONS, INCLUDING IN RESPONSE TO THE REVIEW PROCESS

The recalculations are performed in accordance with:

- 1) decisions of sectoral experts
- 2) suggestions of expert review team⁷

Recalculations are performed in the following sectors:

- Energy (Public Electricity and Heat Production, Manufacturing Industry and Construction, Road Transportation and Residential)
- Industrial Processes (Cement Production, Lime production, Limestone and Dolomite Use, Soda Ash Production and Use, Ammonia Production, Consumption of Halocarbons and SF₆)
- Agriculture (CH₄ Emissions from Enteric Fermentation in Domestic Livestock, CH₄ Emissions from Manure Management, N₂O Emissions from Manure Management, Direct N₂O Emission from Agricultural Soils, Direct N₂O Emission from Pasture, Range and Paddock Manure, Indirect N₂O Emissions from Nitrogen Used in Agriculture)
- Land Use, Land-Use Change and Forestry

In this section, the summary of the recalculations performed and justification is given using the following categories of distinction:

- Changes or refinements in methods (Chapter 9.1.1.)
- Correction of errors (Chapter 9.1.2.)

9.1.1. CHANGES OR REFINEMENTS IN METHODS

The following methodological changes were made for the calculation of greenhouse gases according to:

- Changes in available data;
- Consistency with good practice guidance;
- New methods.

Energy

Public Electricity and Heat Production (1.A.1.a.)

Since emissions from Stationary Combustion are identified as a key source category more detailed plant-level data on fuel consumption and emissions are included for the period 1990-2006. The GHG emissions are calculated using more detailed Tier 2 approach. Tier 2 approach

⁷ Suggestions reported in "Report of the individual review of the greenhouse gas inventory of Croatia submitted in 2006"

is based on bottom-up fuel consumption data from boilers or gas turbines in a plant. For estimation of CO₂ emissions, default IPCC emission factors were used, while implied emission factors for CH₄ and N₂O are based on technology type and configuration (Tier 2).

Manufacturing Industries and Construction (1.A.2.)

Consumption of coke oven gas in previous reports was calculated as solid fuel for the period from 1990 to 2005. In this report coke oven gas is subtracted from solid fuels consumption and added to gaseous fuel consumption. Associated default emission factors for CO₂, CH₄ and N₂O were used.

Road Transportation (1.A.3.b.)

Up till now activity data source for the number of road vehicles was Croatian Centre for Vehicles. From now activity data source for Vehicle database is Ministry of Interior as it is defined by Regulation on the Greenhouse Gases Emissions Monitoring in the Republic of Croatia (Official Gazette No. 1/07) which came into force in 2008. For emissions calculation Tier 3 methodology was implied. Emission factors based on COPERT III software for CO₂, CH₄ and N₂O was implied.

Commercial/Institutional (1.A.4.a.)

In the previous report consumption of Gas Works Gas was calculated as solid fuel for the period from 1990 to 2005. In this report Gas Works Gas is subtracted from solid fuels consumption and added to gaseous fuel consumption for the whole period (1990-2006). Associated default emission factors for CO₂, CH₄ and N₂O were used.

Residential (1.A.4.b.)

In the previous report consumption of Gas Works Gas was calculated as solid fuel for the period from 1990 to 2005. In this report Gas Works Gas is subtracted from solid fuels consumption and added to gaseous fuel consumption for the whole period (1990-2006). Associated default emission factors for CO₂, CH₄ and N₂O were used.

Industrial processes

Mineral products (2.A.); Cement Production (2.A.1.)

In the previous report, data for the clinker production from one cement manufacturer were not included for the period 1990-1997 (in which manufacturer produced Portland cement clinker) and for the period 1990-1999 (in which manufacturer produced Aluminate cement clinker). Data for the specific EF and its CKD correction factor for Portland and Aluminate cement clinker were not included for defined periods. Also, errors were done during calculation of the specific EF and CKD for the period 1998-2005 for all cement manufacturers.

In this report, Portland cement clinker production data for the period 1990-1997 and Aluminate cement clinker production data for the period 1990-1999 have been collected from survey of cement manufacturer due to improving comparability and time series consistency. Data for the specific EF and its CKD correction factor for Portland and Aluminate cement clinker have been collected for defined periods. Also, incorrect data for the specific EF and CKD for the period 1998-2005 have been corrected.

Mineral products (2.A.); Lime Production (2.A.2.)

In the previous report, the activity data for total lime production were extracted from Monthly Industrial Reports published by Central Bureau of Statistics, Department of Manufacturing and Mining, and also were partly collected by survey of lime manufacturer since national classification of activities does not distinguish quicklime and dolomitic lime production.

In this report, quicklime and dolomitic lime production data for the period 1990-2006 were collected from survey of lime manufacturers due to improving comparability and time series consistency. Also, country specific EFs were developed.

Mineral products (2.A.); Limestone and Dolomite Use(2.A.3.)

Activity data obtained from one glass manufacturer have been corrected for the period 1996-2004.

Mineral products (2.A.); Soda Ash Production and Use (2.A.4.)

Activity data obtained from one glass manufacturer have been corrected for the periods 1996-1999 and 2001-2004.

Chemical Industry (2.B.); Ammonia Production (2.B.1.)

In the previous report, emissions from consumption of natural gas as fuel were calculated in Energy sector (presented in the CRF table 1.A.2.f Manufacturing Industries and Construction - Other - Petrochemical Industry). In this report, emissions from consumption of natural gas as fuel have been added to emissions from consumption of natural gas as feedstock in Industrial processes (presented in the CRF table 2.B.1 Chemical Industry - Ammonia production).

Consumption of Halocarbons and SF₆ (2.F.); Refrigeration and Air Conditioning Equipment (2.F.1.)

In this report, the total consumption of HFCs has been corrected for 1990 and 2005.

Agriculture**CH₄ Emissions from Enteric Fermentation in Domestic Livestock (4.A.); CH₄ Emissions from Manure Management (4.B.); N₂O Emissions from Manure Management (4.B.); Direct Emission of N₂O from Pasture, Range and Paddock Manure (4.D.2.); Indirect N₂O Emissions from Nitrogen Used in Agriculture (4.D.3.)**

New activity data for different animal categories were included for following years:

- Dairy Cattle – 1990, 1992
- Non-Dairy Cattle - 1990, 1992, 2003
- Sheep - 1990, 1993, 1996, 1997
- Horses - 1990 and 1991
- Swine - 1995, 1996 and 1997
- Goats - 1990, 1991, period 1998-2002, 2005

In the previous report, data were obtained from different sources and some insufficient data were assessed by expert judgement. In this report, more accurate data have been obtained from Central Bureau of Statistics.

Direct Emission from Agricultural Soils (4.D.1.); Indirect N₂O Emissions from Nitrogen Used in Agriculture (4.D.3.)

New activity data for application of mineral fertilizers were included for the period 1992-2005. Data for mineral fertilizers applied in Croatia in 1990 and 1991 have been estimated by extrapolation method using pattern from 1992 to 2006. Moreover, data on import of mineral fertilizers were included for period 2000-2005. New data on pulses and soyabeans and non-N fixing crop production for years 2004 and 2005 were included instead of data estimated by extrapolation method in the previous report.

Land-use, Land Use Change and Forestry

Revised activity data for forest area and annual net increment are included for whole period 1990-2005. The annual increase in carbon stock is calculated only for the areas under forest vegetation. Areas under degraded forest vegetation are not included because annual net increment for these vegetation types could not be estimated. Areas under mixed forest are divided in half and split between coniferous and deciduous category. Emissions resulting from wildfires are included in estimation of Annual Decrease in Carbon Stock. Data for wildfires exist for period 1992-2006 thus data for 1990 and 1991 are estimated as average value for period 1992-2006.

Waste**Solid Waste Disposal on Land (6.A)**

In this report, the quantity of MSW disposed to different types of SWDSs and the main characteristic of SWDSs in the period 2001-2004 have been assessed by interpolation method, taking into account the pattern over 2000 and 2005. Fraction of MSW disposed at solid waste disposal sites in 2005 has been assessed according to information provided by official document *Waste Management Plan in the Republic of Croatia (2007-2015)*. Recovered CH₄ in 2005 has been included. Information on CH₄ that is recovered and burned in a flare or energy recovery device has been obtained by official document provided by ZGOS Ltd.

Domestic and Commercial Wastewater (6.B.2)

Data for CH₄ emission calculation from Domestic and Commercial Wastewater for the period 1990-2003 were not included in the previous report. In this report, data for 1990, 1995, 2000 and for the period 2003-2006 have been obtained by state company Croatian Water Resources Management (Hrvatske vode). Insufficient data have been assessed by interpolation method. Also, data for 2004 and 2005 have been corrected according to new assessment provided by state company Croatian Water Resources Management (Hrvatske vode).

Data for N₂O emission calculation from Human Sewage (Protein intake value) has been corrected for 1990. Extrapolation method has been used for calculation of insufficient data.

Waste Incineration (6.C)

Data for CO₂ emission calculation from Waste Incineration for the period 1990-2003 were not included in the previous report. In this report, data for CO₂ emission calculation from incineration of hospital waste have been assessed using population data as reference, for the period 1990-2003. Also, data for 2005 have been corrected according to assessment carried out by

interpolation method, because the data in the previous report has been incomplete. Data for 2004 and 2006 have been used as the pattern for data interpolation.

Consistency with good practice guidance:

Energy

Manufacture of Solid Fuels and Other Energy Industries (1.A.1.c.)

Inconsistency in calculation of total fuel consumption for the period from 1990 to 2005 was detected, during the activity data checking. For the period from 1990-2001 consumption of fuel from NGL plant for own use was not included in total fuel consumption, while for the period from 2002 to 2005 it was included. Consequently, GHG emissions from Manufacture of Solid Fuels and Energy Industries were recalculated as follows: Consumption of fuel from NGL plant for own use is added to total fuel consumption and for estimation of CO₂, CH₄ and N₂O emissions, default IPCC emission factors were used.

Domestic Air Transport (1.A.3.a.)

The disaggregating of jet kerosene for 1990 between international and domestic aviation was recalculated based on International Energy Agency (IEA) data. During the activity data checking, inconsistency in Gasoline consumption calculation for the period from 1990 to 2005 was detected. For the period from 1991-1995 consumption of gasoline was not included in total fuel consumption while for the period from 1996 to 2005 it was calculated. Consequently, GHG emissions from Domestic Air transport were recalculated as follows: Gasoline consumption is added to total fuel consumption of Domestic Air transport and for estimation of CO₂, CH₄ and N₂O emissions, default IPCC emission factors for Gasoline were used.

Railways (1.A.3.c.)

During the activity data checking, inconsistency in fuel consumption calculation for the period from 1990 to 2005 was detected. For the period from 1990-1997 consumption of Gas/Diesel Oil was not included in Liquid fuel consumption while for the period from 1998 to 2005 it was calculated. Consequently, GHG emissions from Railways were recalculated as follows: Consumption of Gas/Diesel Oil is added to Liquid fuel consumption and for estimation of CO₂, CH₄ and N₂O emissions, default IPCC emission factors for Gas/Diesel Oil were used.

Natural gas – Other Leakage at industrial plants and power stations (1.B.2.b.)

During the activity data checking, inconsistency in total fuel consumption calculation for the period from 1990 to 2005 was detected. For the period from 1990-1995 error in inserting the activity data from Energy balance occurred. Consequently, GHG emissions from Other Leakage at industrial plants and power stations were recalculated as follows: Consumption of Natural gas at industrial plants and power stations and for estimation of CH₄ emission default IPCC emission factors were used.

9.2. THE IMPLICATION OF THE RECALCULATIONS ON THE LEVEL AND TREND, INCLUDING TIME SERIES CONSISTENCY

This section outlines the implications over time for the emission levels as well as the implications for emission trends, including time-series consistency.

Table 9.2-1 shows the differences between the last submission (NIR 2007) and current submission (NIR 2008), on the level of the different greenhouse gases.

Table 9.2-1: Differences between NIR 2007 and NIR 2008 for 1990-2005 due to recalculations

Gas	Source	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO ₂ (Tg) Incl. LULUCF	NIR 2007	17.03	6.42	5.60	5.96	5.52	6.25	7.64	9.69	11.24
	NIR 2008	19.88	8.99	7.58	9.12	7.84	7.85	8.18	10.55	12.82
	Difference %	17	40	35	53	42	26	7	9	14
CO ₂ (Tg) Excl. LULUCF	NIR 2007	23.31	17.22	16.44	16.96	16.26	16.88	17.61	18.66	19.57
	NIR 2008	24.07	17.69	16.87	17.16	16.50	17.01	17.67	18.75	19.66
	Difference %	3.3	2.7	2.7	1.2	1.5	0.8	0.4	0.5	0.5
CH ₄ (CO ₂ -eq Gg)	NIR 2007	3247	3018	2835	2779	2573	2540	2565	2631	2466
	NIR 2008	3390	3156	2802	2941	2717	2684	2658	2724	2557
	Difference %	4.4	4.5	-1.2	5.8	5.6	5.7	3.6	3.5	3.7
N ₂ O (CO ₂ -eq Gg)	NIR 2007	4017	3908	3498	3221	3224	3116	3058	3398	2955
	NIR 2008	4079	3910	3804	3263	3315	3197	3149	3486	3026
	Difference %	1.5	0.1	8.8	1.3	2.8	2.6	3.0	2.6	2.4
HFCs (CO ₂ -eq Gg)	NIR 2007	43	52	51	49	48	43	60	91	18
	NIR 2008	53	52	51	49	48	43	60	91	18
	Difference %	22.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PFCs (CO ₂ -eq Gg)	NIR 2007	936.56	642.44	NO	NO	NO	NO	NO	NO	NO
	NIR 2008	936.5	642.4	NO	NO	NO	NO	NO	NO	NO
	Difference %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SF ₆ (CO ₂ -eq Gg)	NIR 2007	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NIR 2008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Difference %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total (Tg CO ₂ -eq) Incl. LULUCF	NIR 2007	25.27	14.04	11.99	12.01	11.36	11.95	13.33	15.81	16.68
	NIR 2008	28.34	16.75	14.24	15.38	13.92	13.78	14.05	16.85	18.42
	Difference %	12.2	19.3	18.8	28.0	22.5	15.3	5.5	6.6	10.4
Total (Tg CO ₂ -eq) Excl. LULUCF	NIR 2007	31.55	24.84	22.82	23.01	22.10	22.58	23.29	24.78	25.00
	NIR 2008	32.53	25.45	23.53	23.41	22.58	22.93	23.54	25.05	25.26
	Difference %	3.1	2.5	3.1	1.8	2.2	1.6	1.1	1.1	1.0

Table 9.2-1: Differences between NIR 2007 and NIR 2008 for 1990-2005 due to recalculations (cont.)

Gas	Source	1999	2000	2001	2002	2003	2004	2005
CO ₂ (Tg) Incl. LULUCF	NIR 2007	12.13	11.93	12.07	13.49	15.62	15.20	15.79
	NIR 2008	12.26	14.82	12.80	13.79	17.30	15.28	15.87
	Difference %	1	24	6	2	11	1	1
CO ₂ (Tg) Excl. LULUCF	NIR 2007	20.36	19.95	20.94	22.03	23.50	23.15	23.57
	NIR 2008	20.41	20.10	21.02	21.99	23.58	23.18	23.60
	Difference %	0.2	0.8	0.3	-0.2	0.3	0.1	0.1
CH ₄ (CO ₂ -eq Gg)	NIR 2007	2501	2548	2691	2746	2925	3015	2956
	NIR 2008	2576	2638	2785	2847	2953	3070	2962
	Difference %	3.0	3.5	3.5	3.7	0.9	1.8	0.2
N ₂ O (CO ₂ -eq Gg)	NIR 2007	3148	3317	3289	3358	3263	3680	3608
	NIR 2008	3307	3465	3531	3463	3352	3649	3654
	Difference %	5.0	4.4	7.4	3.1	2.7	-0.8	1.3
HFCs (CO ₂ -eq Gg)	NIR 2007	9	23	49	49	164	189	349
	NIR 2008	9	23	49	49	164	189	349
	Difference %	0.0	0.1	0.0	0.0	0.0	0.0	0.0
PFCs (CO ₂ -eq Gg)	NIR 2007	NO	NO	NO	NO	NO	NO	NO
	NIR 2008	NO	NO	NO	NO	NO	NO	NA,NO
	Difference %	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SF ₆ (CO ₂ -eq Gg)	NIR 2007	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NIR 2008	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Difference %	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total (Tg CO ₂ -eq) Incl. LULUCF	NIR 2007	17.79	17.82	18.09	19.65	21.98	22.08	22.70
	NIR 2008	18.15	20.95	19.17	20.15	23.77	22.19	22.83
	Difference %	2.0	17.5	5.9	2.5	8.2	0.5	0.6
Total (Tg CO ₂ -eq) Excl. LULUCF	NIR 2007	26.02	25.84	26.97	28.19	29.85	30.03	30.48
	NIR 2008	26.30	26.23	27.38	28.35	30.04	30.09	30.56
	Difference %	1.1	1.5	1.5	0.6	0.6	0.2	0.3

The change in the 1990-2006 trend for the greenhouse gas emissions compared to the previous submission is presented in Table 9.2-2. It can be concluded that the trend in the total national emissions decreased by 2.44 percent including LULUCF and 1.42 percent excluding LULUCF compared to NIR 2007. The largest absolute changes in emission trends are recorded for CO₂, HFCs and total CO₂-eq, described in Table 9.2-2.

Table 9.2-2: Differences between NIR 2007 and NIR 2008 for the emission trends 1990-2005

Gas CO ₂ -eq (Gg)	Trend (absolute)			Trend (percent)		
	NIR 2006*	NIR 2007**	Difference	NIR 2006*	NIR 2007**	Difference
CO ₂ emissions including net CO ₂ from LULUCF	-1826.97	-4014.97	2188.00	-10.73	-7.27	-3.46
CO ₂ emissions excluding net CO ₂ from LULUCF	-159.86	-473.53	313.67	-0.69	1.11	-1.80
CH ₄	-231.74	-427.69	195.95	-7.14	-8.96	1.82
N ₂ O	-337.86	-424.61	86.75	-8.41	-10.18	1.77
HFCs	145.49	296.28	-150.79	335.42	704.76	-369.34
PFCs	-936.56	-936.56	0.00	-100.00	-100.00	0.00
Total (including LULUCF)	-3187.64	-5507.57	2319.93	-12.61	-10.17	-2.44
Total (excluding LULUCF)	-1520.53	-1966.11	445.58	-4.82	-3.40	-1.42

* Difference, in previous submission, between emissions in 2005 and 1990 (absolute and percent)

** Difference, in latest submission, between emissions in 2005 and 1990 (absolute and percent)

9.3. PLANNED IMPROVEMENTS TO THE INVENTORY

The framework for development of Croatian greenhouse gas emissions inventory was established during preparation of the First National Communication to the UNFCCC in 2001. The framework was built upon experiences and lessons learned from the previously established scheme for national reporting and international data exchange through the EEA/ETC-ACC system and reporting under Convention on Long-range Transboundary Air Pollution (CLRTAP). Since then Croatia has submitted National Inventory Reports in 2003 for period 1995-2001, in 2004 for period 1990-2002, in 2005 for period 1990-2003, in 2006 for period 1990-2004, in 2007 for period 1990-2005 and this latest submission in May 2008.

Generally, Croatia has developed a sound and well-documented greenhouse gas inventory system but it still requires continuous improvements in almost all key elements related to compilation and submission of the inventory. In order to fulfill these requirements Croatia has taken strategic approach and as a result a draft of National GHG Inventory Improvement Strategy has been prepared⁸. The purpose of this strategic document is to recognize strengths and weaknesses of the existing national GHG inventory system and to determine a realistic short- and long- term objectives in order to establish cost-effective GHG inventory preparation system that will enable timely, accurate, transparent and consistent international reporting, taking into account national circumstances, resources and available information.

There are several priority tasks for improvements of the inventory system which are outlined in the strategy:

- preparation of Regulation on the Greenhouse Gas Emissions Monitoring in the Republic of Croatia (Official Gazette No. 1/2007), which came into force in January 2007 and first Inventory Submission stipulated by this Regulation is 2008. It should improve existing system of greenhouse gas emission monitoring and reporting in accordance with the requirements of the Kyoto protocol and relevant legislation of the EU (Decision 280/2004/EC) and defines institutional responsibilities and mandates for national inventory compilation;
- authorization of appropriate national institution to be in charge of approving the inventory;
- establish national reference centre for air and climate change;
- ensuring sustainable inventory preparation process including establishment of QA/QC system;
- carrying out awareness-raising campaign targeting policy-makers and other stakeholders on importance and benefits of sustainable inventory process;
- improving collection of activity data, emission factors and overall emission calculation for key sources, based on long-term inventory preparation program;
- increasing the financial, technical and human resources for inventory preparation, based on long-term inventory program.

⁸ National GHG Inventory Improvement Strategy was prepared under UNDP/GEF regional project Capacity Building for Improving the Quality of GHG Inventories (Europe and CIS Region).

Sector specific goals are outlined below:

ENERGY

Short-term goals (< 1 years)

Generally, the changes from Tier 1 to Tier 2/3 estimation methodologies for Energy key sources, as much as possible, are recommended. The priority should be the key sources with high uncertainties of emission estimation. But, significant constraints are availability of activity data, especially for the beginning years of concerned period. Consequently, implementation of more detailed methodology approach (Tier 2/3) for key sources, for entire period, will be very difficult.

Long-term goals (> 1 years)

The extensive use of plant-specific data which will be collected in the newly established Register of Environmental Pollution is highly recommended ("bottom up" approach). In addition, usage of more source-specific QA/QC procedures will improve the quality of GHG inventory in Energy sector.

For estimation of fugitive emissions from oil and natural gas operations a Tier 1 method was applied. Used emission factors are an average value of the range proposed in the IPCC Manual. However, fugitive emission from natural gas is key source and implementation of rigorous source-specific evaluations approach (Tier 3) is necessary. The Tier 3 approach will generally involve compiling the following types of information:

- detailed inventories of the amount and types of process infrastructure (e.g. wells, field installations and production/processing facilities),
- production disposition analyses oil and gas production, vented, flared and reinjected volumes of gas and fuel gas consumption,
- accidental releases (i.e. well blow-outs and pipeline ruptures),
- typical design and operating practices and their impact on the overall level of emission control.

For implementation of rigorous source-specific evaluations approach (Tier 3) is necessary additional technical and financial resources.

INDUSTRIAL PROCESSES AND SOLVENT AND OTHER PRODUCT USE

Short-term goals (< 1 years)

Uncertainty of emission estimation is mainly caused by implementation of default IPCC emission factors. Consequently, wider use of well documented country-specific (technology-specific and plant-specific) emission factors, in sectors Industrial Processes and Solvent and Other Product Use, is an important short-term goal. The use of country-specific EFs, where available, as a way to minimize uncertainty, is recommended.

Short-term goals are also improvements of halocarbons and SF₆ emission estimations. According to requirement of Regulation on the Greenhouse Gases Emissions Monitoring in the

Republic of Croatia (Official Gazette No. 1/07) each sources of HFCs and SF₆ emissions should report required activity data for more accurate emissions estimation (Tier 2 method).

There are gaps in the time series of some productions, provided by statistical institutions. Filling these gaps by using direct surveys and comparison with time series of other related data is recommended.

Long-term goals (> 1 years)

As a small country with a small number of plants and good-quality production statistics, Croatia has often adopted higher-tier methodologies for Industrial Processes, based on plant-level information. Croatia considers wider use of source-specific verification procedures, through systematic cross-checking of plant-specific information with production statistics, and also the use other sources of information, such as CEE and the national energy balance.

AGRICULTURE

Emission of CH₄ from enteric fermentation in domestic livestock were estimated using Tier 1 method since detailed data on livestock population is not available at the moment and a comprehensive research is required in the future to provide these data. The availability of activity data is still a major problem in other key source categories within this sector and application of higher tier methodologies will be possible in the future after detailed research and adjustments of statistical methods for data collection. Moreover, national emission factors should be developed to increase the calculation quality.

LAND-USE CHANGE AND FORESTRY

Major areas for improvement:

- Development of land use database needed for greenhouse gas inventories with aim to collect more quality data and to use complete land inventories. Regulation on the Greenhouse Gases Emissions Monitoring in the Republic of Croatia (Official Gazette No. 1/07), prescribes obligation and procedure for emissions monitoring. Among others, the Regulation prescribes monitoring of areas within different land use categories, such as forest area, agricultural area, grasslands, wetlands, settlements and other land.
- Development of country specific factors (BEFs).

WASTE

Short-term goals (< 1 years)

Croatia plans to improve its waste statistics and to carry out sector-specific studies related to Solid Waste Disposal in order to improve usage of the Tier 2 method.

By-law on Cadastre of Emission to Environment (Official Gazette No. 36/96) and The Waste Law (Official Gazette 151/03) define administration commitments of manufacturers and all entities which contributed in waste management. The base for systematic gathering and saving activity data was created by establishment of the Revision of Cadastre of Waste Disposal Sites (CEE). This will present part of new CEE software which is developed as an electronic managed data base with georeferent application (*Geographical Information System, GIS*) and

access to the data base through web site of Croatian Environment Agency. By means of data base in GIS-tools, assessment and quantitative categorization of waste disposal sites will be provided.

By-law on Conditions for Waste Treatment (Official Gazette No. 123/97, 112/01) as well as By-law on Waste Management (Official Gazette No. 23/07) defines priority for improvement and organization of disposal sites and waste disposal on managed disposal sites.

For the purposes of emission inventory improvement it is necessary to adjust country-specific to IPCC SWDSs classification, in order to accurately estimate the MCF.

Also, it is necessary to apply a unique methodology to determine waste quantity and composition. For the purposes of improvement activity data gathering from solid waste disposal activities it is necessary to improve quality of existing data:

- equipping the major landfills with automatic weigh-bridges in order to accurately estimate the quantities of delivered MSW;
- providing methodology to determine country-specific MSW composition;
- periodic analysis of waste composition at major landfills according to provided methodology;
- modification of Cadastre of Emission to Environment (CEE) Reporting Forms regarding to MSW with additional information on waste quantities and composition.

In order to accurate calculation of N₂O emissions from Human Sewage, Croatia planned to analyze the influence of tourism on the population influx due to summer months, as well as fact that nearly 25 percent of the Croatian population lives close to the sea, which has influence on the emission factor.

Long-term goals (> 1 years)

New waste statistics and sector-specific studies should be used to reconstruct historical activity data in applying the Tier 2 method for key source Solid Waste Disposal on Land.

Improvements in the sub-sector Wastewater Handling are related primarily to establishment of effectively *Water Information System* with base for systematic gathering and saving data needed for monitoring and planning of development of all wastewater handling systems.

Improvements in the sub-sector Waste Incineration are related primarily to aggregation of accurate data for CO₂ emission calculations from incineration of hazardous and clinical waste.

ANNEX 1

KEY CATEGORIES

A1.1. DESCRIPTION OF METHODOLOGY USED FOR IDENTIFYING KEY CATEGORIES

Key categories according to the IPCC Good Practice Guidance (IPCC, 2000) are those found in the accumulative 95% of the total annual emissions in the last reported year or belonging to the total trend, when ranked from contributing the largest to smallest share in annual total and in the trend. As originally designed it applied only to source categories. In addition, *Good Practice Guidance for Land Use, Land-Use Change and Forestry* expands the original approach to enable the identification of key categories that are either sources or sinks, which provides on how to identify key categories for the LULUCF. Therefore, the key category analysis was determined using both approaches:

- excluding LULUCF
- including LULUCF

Following the *Good Practice Guidelines*, Croatia undertook a key category analysis using Tier 1 Level and Trend methods.

The IPCC and *Good Practice Guidance for Land Use, Land-Use Change and Forestry* also recommended which sources should be checked for their key category status, Table A1-1. Additionally, other sources of direct greenhouse gas emissions not listed in above mentioned guidances were added to the list, e.g. CO₂ Emissions from Natural Gas Scrubbing, CO₂ Emissions from Solvent and Other Product Use, CO₂ Emissions from Non energy-use in Industrial Processes reported under 2.G Other non-specified NEU in CRF Reporter.

Table A1-1: Categories Assessed in Key Category Analysis

Source Categories Assessed in Key Source Category Analysis	Direct GHG	Special Considerations
ENERGY SECTOR		
CO ₂ Emissions from Stationary Combustion - Coal	CO ₂	
CO ₂ Emissions from Stationary Combustion - Oil	CO ₂	
CO ₂ Emissions from Stationary Combustion - Gas	CO ₂	
Non-CO ₂ Emissions from Stationary Combustion	CH ₄	
Non-CO ₂ Emissions from Stationary Combustion	N ₂ O	
Mobile Combustion - Road Vehicles	CO ₂	
Mobile Combustion - Road Vehicles	CH ₄	
Mobile Combustion - Road Vehicles	N ₂ O	
Mobile Combustion: Water-borne Navigation	CO ₂	
Mobile Combustion: Water-borne Navigation	CH ₄	
Mobile Combustion: Water-borne Navigation	N ₂ O	
Mobile Combustion: Aircraft	CO ₂	
Mobile Combustion: Aircraft	CH ₄	
Mobile Combustion: Aircraft	N ₂ O	
Mobile Combustion - Agriculture/Forestry/Fishing	CO ₂	
Mobile Combustion - Agriculture/Forestry/Fishing	CH ₄	
Mobile Combustion - Agriculture/Forestry/Fishing	N ₂ O	
Fugitive Emissions from Coal Mining and Handling	CH ₄	
Fugitive Emissions from Oil and Gas Operations	CH ₄	
CO ₂ Emissions from Natural Gas Scrubbing	CO ₂	IPCC doesn't offer methodology for estimating emission of CO ₂ scrubbed from natural gas and subsequently emitted into atmosphere. Natural gas produced in Croatian gas fields has a large amount of CO ₂ , more than 15 percent. The maximum volume content of CO ₂ in commercial natural gas is 3 percent and gas must be cleaned before coming to pipeline and transport to users. Because of that, the Scrubbing Units exist at largest Croatian gas field. The CO ₂ , scrubbed from natural gas, is emitted into atmosphere. The emission is estimated by material balance method.
INDUSTRIAL SECTOR		
CO ₂ Emissions from Cement Production	CO ₂	
CO ₂ Emissions from Lime Production	CO ₂	
CO ₂ Emissions from Iron and Steel Production	CO ₂	

Table A1-1: Categories Assessed in Key Category Analysis (cont.)

N ₂ O Emissions from Nitric Acid Production	N ₂ O	
N ₂ O Emissions from Adipic Acid Production	N ₂ O	
PFC Emissions from Aluminium production	PFC	
CO ₂ Emissions from Ammonia Production	CO ₂	
CO ₂ Emissions from Ferroalloys Production	CO ₂	
CO ₂ Emissions from Aluminium production	CO ₂	
Sulfur hexafluoride (SF ₆) from Magnesium Production	SF ₆	
SF ₆ Emissions from Electrical Equipment	SF ₆	
SF ₆ Emissions from Other Sources of SF ₆	SF ₆	
SF ₆ Emissions from Production of SF ₆	SF ₆	
PFC, HFC, SF ₆ Emissions from Semiconductor manufacturing		
Emissions from Substitutes for Ozone Depleting Substances (ODS Substitutes)		
HFC-23 Emissions from HCFC-22 Manufacture	HFC-23	
HFC Emissions from Consumption of HFCs, PFCs and SF ₆	HFC	
CO ₂ Emissions from Non energy-use in Industrial Processes	CO ₂	
SOLVENT AND OTHER PRODUCT USE	CO ₂	
AGRICULTURE SECTOR		
CH ₄ Emissions from Enteric Fermentation in Domestic Livestock	CH ₄	
CH ₄ Emissions from Manure Management	CH ₄	
N ₂ O Emissions from Manure Management	N ₂ O	
CH ₄ and N ₂ O Emissions from Savanna Burning		
CH ₄ and N ₂ O Emissions from Agricultural Residue Burning		
Direct N ₂ O Emissions from Agricultural Soils	N ₂ O	
N ₂ O Emissions from Pasture, Range and Paddock Manure	N ₂ O	
Indirect N ₂ O Emissions from Nitrogen Used in Agriculture	N ₂ O	
CH ₄ Emissions from Rice Cultivation	CH ₄	
LULUCF		
Forest land remaining forest land	CO ₂	
Forest land remaining forest land	CH ₄	
Forest land remaining forest land	N ₂ O	
WASTE SECTOR		
CH ₄ Emissions from Solid Waste Disposal Sites	CH ₄	
Emissions from Waste Water Handling	CH ₄	
Emissions from Waste Water Handling	N ₂ O	
Emissions from Waste Incineration	CO ₂	
Emissions from Waste Incineration	N ₂ O	

The reference to the summary overview for Key Categories 2005 in CRF tables is the Excel file HRV-2007-2005-v1.1, Table 7.

The level of disaggregation is in accordance with the suggested source categories split of the *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and additionally, with the LULUCF category following the *Good Practice Guidance for Land Use, Land-Use Change and Forestry*.

A1.2. TABLES 7.A1-7.A3 OF THE IPCC GOOD PRACTICE GUIDANCE

Table A1-2: Key categories analysis – Level Assessment - Tier 1 (Excluding LULUCF)

Tier 1 Analysis - Level Assessment – Excluding LULUCF					
IPCC Source Categories	Direct GHG	Base Year (1990) Estimate (Gg eq-CO ₂)	Current Year (2006) Estimate (Gg eq-CO ₂)	Level Assessment	Cumulative Total (%)
CO ₂ Emissions from Stationary Combustion - Oil	CO ₂	8468.29	6433.60	0.209	21%
Mobile Combustion - Road Vehicles	CO ₂	3561.40	5635.18	0.183	39%
CO ₂ Emissions from Stationary Combustion - Gas	CO ₂	4582.56	4419.64	0.143	53%
CO ₂ Emissions from Stationary Combustion - Coal	CO ₂	2826.19	2457.31	0.080	61%
CO ₂ Emissions from Cement Production	CO ₂	1069.06	1571.98	0.051	67%
Fugitive Emissions from Oil and Gas Operations	CH ₄	1201.18	1471.65	0.048	71%
Direct N ₂ O Emissions from Agricultural Soils	N ₂ O	1357.84	1262.68	0.041	75%
CO ₂ Emissions from Ammonia Production	CO ₂	861.63	878.52	0.028	78%
CH ₄ Em. from Enteric Fermentation in Domestic Livestock	CH ₄	1372.14	835.21	0.027	81%
Indirect N ₂ O Emissions from Nitrogen Used in Agriculture	N ₂ O	955.51	813.41	0.026	84%
Nitric Acid Production	N ₂ O	927.78	774.70	0.025	86%
Mobile Combustion - Agriculture/Forestry/Fishing	CO ₂	839.19	729.49	0.024	88%
CO ₂ Emissions from Natural Gas Scrubbing*	CO ₂	415.95	663.00	0.022	91%
HFC Emissions from Consumption of HFCs, PFCs and SF6	HFC	52.90	430.68	0.014	92%
Solid Waste Disposal Sites	CH ₄	221.21	416.86	0.014	93%
CO ₂ Emissions from Lime Production	CO ₂	160.63	244.47	0.008	94%
N ₂ O Emissions from Manure Management	N ₂ O	380.88	233.14	0.008	95%
N ₂ O Emissions from Pasture, Range and Paddock Manure	N ₂ O	262.16	202.89	0.007	96%
Mobile Combustion: Aircraft	CO ₂	348.83	182.60	0.006	96%
Total Solvent and Other Product Use	CO ₂	80.21	182.39	0.006	97%
Mobile Combustion - Road Vehicles	N ₂ O	48.08	168.71	0.005	97%
CH ₄ Emissions from Manure Management	CH ₄	229.07	160.16	0.005	98%
Mobile Combustion: Water-borne Navigation	CO ₂	132.98	103.66	0.003	98%
Mobile Combustion: Railways	CO ₂	138.14	101.16	0.003	99%
Fuel Combustion - Stationary Sources	CH ₄	168.23	97.76	0.003	99%
Emissions from Waste Water Handling	N ₂ O	78.69	87.28	0.003	99%
Emissions from Waste Water Handling	CH ₄	98.85	87.11	0.003	99%
Other non-specified NEU	CO ₂	208.05	70.04	0.002	100%
Fuel Combustion - Stationary Sources	N ₂ O	62.32	47.10	0.002	100%
Mobile Combustion - Road Vehicles	CH ₄	32.13	32.18	0.001	100%
CO ₂ Emissions from Soda Ash Production and Use	CO ₂	25.74	15.14	0.000	100%
CO ₂ Emissions from Limestone and Dolomite Use	CO ₂	43.22	10.66	0.000	100%
Production of Other Chemicals	CH ₄	16.55	7.84	0.000	100%
Mobile Combustion - Agriculture/Forestry/Fishing	N ₂ O	2.04	1.79	0.000	100%
Mobile Combustion: Aircraft	N ₂ O	3.06	1.60	0.000	100%
Mobile Combustion - Agriculture/Forestry/Fishing	CH ₄	1.30	1.10	0.000	100%
CO ₂ Emissions from Iron and Steel Production	CO ₂	0.87	0.37	0.000	100%
Mobile Combustion: Water-borne Navigation	N ₂ O	0.34	0.26	0.000	100%
Mobile Combustion: Railways	N ₂ O	0.39	0.26	0.000	100%
Mobile Combustion: Water-borne Navigation	CH ₄	0.19	0.15	0.000	100%
Mobile Combustion: Railways	CH ₄	0.21	0.14	0.000	100%
Emissions from Waste Incineration	CO ₂	0.09	0.08	0.000	100%
Mobile Combustion: Aircraft	CH ₄	0.05	0.03	0.000	100%
CO ₂ Emissions from Ferroalloys Production	CO ₂	194.53	-	0.000	100%
Aluminium Production	CO ₂	111.37	-	0.000	100%
Fugitive Emissions from Coal Mining and Handling	CH ₄	48.76	-	0.000	100%
PFC Emissions from Aluminium production	PFC	936.56	-	0.000	100%
TOTAL		32527.325	30833.982		

Table A1-3: Key categories analysis – Level Assessment - Tier 1 (Including LULUCF)

Tier 1 Analysis - Level Assessment - Including LULUCF					
IPCC Source Categories	Direct GHG	Base Year (1990) Estimate (Gg eq-CO ₂)	Current Year (2005) Estimate (Gg eq-CO ₂)	Level Assessment	Cumulative Total (%)
Forest land remaining forest land	CO ₂	4184.932	7490.295	0.195	20%
CO ₂ Emissions from Stationary Combustion - Oil	CO ₂	8468.291	6433.601	0.168	36%
Mobile Combustion - Road Vehicles	CO ₂	3561.401	5635.178	0.147	51%
CO ₂ Emissions from Stationary Combustion - Gas	CO ₂	4582.556	4419.637	0.115	63%
CO ₂ Emissions from Stationary Combustion - Coal	CO ₂	2826.191	2457.315	0.064	69%
CO ₂ Emissions from Cement Production	CO ₂	1069.055	1571.984	0.041	73%
Fugitive Emissions from Oil and Gas Operations	CH ₄	1201.180	1471.653	0.038	77%
Direct N ₂ O Emissions from Agricultural Soils	N ₂ O	1357.837	1262.677	0.033	80%
CO ₂ Emissions from Ammonia Production	CO ₂	861.630	878.521	0.023	83%
CH ₄ Em. from Enteric Fermentation in Domestic Livestock	CH ₄	1372.140	835.212	0.022	85%
Indirect N ₂ O Emissions from Nitrogen Used in Agriculture	N ₂ O	955.505	813.414	0.021	87%
Nitric Acid Production	N ₂ O	927.783	774.696	0.020	89%
Mobile Combustion - Agriculture/Forestry/Fishing	CO ₂	839.186	729.494	0.019	91%
CO ₂ Emissions from Natural Gas Scrubbing*	CO ₂	415.949	663.000	0.017	92%
HFC Emissions from Consumption of HFCs, PFCs and SF6	HFC	52.899	430.679	0.011	94%
Solid Waste Disposal Sites	CH ₄	221.208	416.856	0.011	95%
CO ₂ Emissions from Lime Production	CO ₂	160.629	244.469	0.006	95%
N ₂ O Emissions from Manure Management	N ₂ O	380.878	233.138	0.006	96%
N ₂ O Emissions from Pasture, Range and Paddock Manure	N ₂ O	262.158	202.893	0.005	96%
Mobile Combustion: Aircraft	CO ₂	348.828	182.600	0.005	97%
Total Solvent and Other Product Use	CO ₂	80.211	182.390	0.005	97%
Mobile Combustion - Road Vehicles	N ₂ O	48.084	168.712	0.004	98%
CH ₄ Emissions from Manure Management	CH ₄	229.067	160.164	0.004	98%
Mobile Combustion: Water-borne Navigation	CO ₂	132.980	103.661	0.003	99%
Mobile Combustion: Railways	CO ₂	138.142	101.156	0.003	99%
Fuel Combustion - Stationary Sources	CH ₄	168.233	97.757	0.003	99%
Emissions from Waste Water Handling	N ₂ O	78.690	87.278	0.002	99%
Emissions from Waste Water Handling	CH ₄	98.855	87.110	0.002	100%
Other non-specified NEU	CO ₂	208.051	70.037	0.002	100%
Fuel Combustion - Stationary Sources	N ₂ O	62.316	47.097	0.001	100%
Mobile Combustion - Road Vehicles	CH ₄	32.130	32.185	0.001	100%
CO ₂ Emissions from Soda Ash Production and Use	CO ₂	25.740	15.142	0.000	100%
CO ₂ Emissions from Limestone and Dolomite Use	CO ₂	43.218	10.661	0.000	100%
Production of Other Chemicals	CH ₄	16.552	7.839	0.000	100%
Mobile Combustion - Agriculture/Forestry/Fishing	N ₂ O	2.038	1.787	0.000	100%
Mobile Combustion: Aircraft	N ₂ O	3.055	1.600	0.000	100%
Mobile Combustion - Agriculture/Forestry/Fishing	CH ₄	1.299	1.098	0.000	100%
CO ₂ Emissions from Iron and Steel Production	CO ₂	0.867	0.369	0.000	100%
Mobile Combustion: Water-borne Navigation	N ₂ O	0.337	0.263	0.000	100%
Mobile Combustion: Railways	N ₂ O	0.392	0.257	0.000	100%
Mobile Combustion: Water-borne Navigation	CH ₄	0.190	0.148	0.000	100%
Mobile Combustion: Railways	CH ₄	0.214	0.145	0.000	100%
Emissions from Waste Incineration	CO ₂	0.088	0.082	0.000	100%
Mobile Combustion: Aircraft	CH ₄	0.052	0.027	0.000	100%
Forest land remaining forest land	CH ₄	0.011	0.001	0.000	100%
Forest land remaining forest land	N ₂ O	0.003	0.000	0.000	100%
CO ₂ Emissions from Ferroalloys Production	CO ₂	194.526	-	-	100%
Aluminium Production	CO ₂	111.372	-	-	100%
Fugitive Emissions from Coal Mining and Handling	CH ₄	48.757	-	-	100%
PFC Emissions from Aluminium production	PFC	936.564	-	-	100%
TOTAL		36712.271	38324.279		

Table A1-4: Key categories analysis – Trend Assessment - Tier 1 (Excluding LULUCF)

Tier 1 Analysis - Trend Assessment – Excluding LULUCF						
IPCC Source Categories	Direct GHG	Base Year (1990) Estimate (Gg eq-CO ₂)	Last Year (2006) Estimate (Gg eq-CO ₂)	Trend Assessm.	% Contrib. on to trend	Cumulative Total of Column F
Mobile Combustion - Road Vehicles	CO ₂	3561.40	5635.18	0.116	0.299	30%
HFC Emissions from Consumption of HFCs, PFCs and SF ₆	HFC	52.90	430.68	0.101	0.258	56%
CO ₂ Emissions from Stationary Combustion - Oil	CO ₂	8468.29	6433.60	0.039	0.099	66%
CO ₂ Emissions from Cement Production	CO ₂	1069.06	1571.98	0.027	0.069	73%
Mobile Combustion - Road Vehicles	N ₂ O	48.08	168.71	0.014	0.036	76%
CO ₂ Emissions from Natural Gas Scrubbing*	CO ₂	415.95	663.00	0.014	0.036	80%
Fugitive Emissions from Oil and Gas Operations	CH ₄	1201.18	1471.65	0.013	0.034	83%
Solid Waste Disposal Sites	CH ₄	221.21	416.86	0.013	0.033	86%
CH ₄ Emissions from Enteric Fermentation in Domestic Livestock	CH ₄	1372.14	835.21	0.009	0.023	89%
Total Solvent and Other Product Use	CO ₂	80.21	182.39	0.008	0.020	91%
CO ₂ Emissions from Stationary Combustion - Coal	CO ₂	2826.19	2457.31	0.006	0.015	92%
CO ₂ Emissions from Lime Production	CO ₂	160.63	244.47	0.005	0.012	93%
CO ₂ Emissions from Stationary Combustion - Gas	CO ₂	4582.56	4419.64	0.003	0.007	94%
Nitric Acid Production	N ₂ O	927.78	774.70	0.003	0.007	95%
N ₂ O Emissions from Manure Management	N ₂ O	380.88	233.14	0.003	0.006	96%
Mobile Combustion: Aircraft	CO ₂	348.83	182.60	0.002	0.006	96%
Indirect N ₂ O Emissions from Nitrogen Used in Agriculture	N ₂ O	955.51	813.41	0.002	0.006	97%
CO ₂ Emissions from Ammonia Production	CO ₂	861.63	878.52	0.002	0.005	97%
Mobile Combustion - Agriculture/Forestry/Fishing	CO ₂	839.19	729.49	0.002	0.005	98%
Other non-specified NEU	CO ₂	208.05	70.04	0.001	0.004	98%
CH ₄ Emissions from Manure Management	CH ₄	229.07	160.16	0.001	0.003	99%
Fuel Combustion - Stationary Sources	CH ₄	168.23	97.76	0.001	0.003	99%
N ₂ O Emissions from Pasture, Range and Paddock Manure	N ₂ O	262.16	202.89	0.001	0.003	99%
Mobile Combustion: Railways	CO ₂	138.14	101.16	0.001	0.002	99%
Direct N ₂ O Emissions from Agricultural Soils	N ₂ O	1357.84	1262.68	0.001	0.002	99%
Mobile Combustion: Water-borne Navigation	CO ₂	132.98	103.66	0.001	0.001	100%
Emissions from Waste Water Handling	N ₂ O	78.69	87.28	0.0005	0.0012	100%
Fuel Combustion - Stationary Sources	N ₂ O	62.32	47.10	0.0003	0.0007	100%
CO ₂ Emissions from Limestone and Dolomite Use	CO ₂	43.22	10.66	0.0002	0.0006	100%
Emissions from Waste Water Handling	CH ₄	98.85	87.11	0.0002	0.0005	100%
CO ₂ Emissions from Soda Ash Prod. and Use	CO ₂	25.74	15.14	0.0002	0.0005	100%
Production of Other Chemicals	CH ₄	16.55	7.84	0.0001	0.0003	100%
Mobile Combustion - Road Vehicles	CH ₄	32.13	32.18	0.0001	0.0002	100%
Mobile Combustion: Aircraft	N ₂ O	3.06	1.60	0.0000	0.0001	100%
CO ₂ Emissions from Iron and Steel Production	CO ₂	0.87	0.37	0.00001	0.00002	100%
Mobile Combustion - Agriculture/Forestry/Fishing	N ₂ O	2.04	1.79	0.00000	0.00001	100%
Mobile Combustion - Agriculture/Forestry/Fishing	CH ₄	1.30	1.10	0.00000	0.00001	100%
Mobile Combustion: Railways	N ₂ O	0.39	0.26	0.00000	0.00001	100%
Mobile Combustion: Water-borne Navigation	N ₂ O	0.34	0.26	0.000001	0.000004	100%
Mobile Combustion: Railways	CH ₄	0.21	0.14	0.000001	0.000003	100%
Mobile Combustion: Water-borne Navigation	CH ₄	0.19	0.15	0.000001	0.000002	100%
Mobile Combustion: Aircraft	CH ₄	0.05	0.03	0.000000	0.000001	100%
Emissions from Waste Incineration	CO ₂	0.09	0.08	0.0000000	0.0000001	100%
CO ₂ Emissions from Ferroalloys Production	CO ₂	194.53	-	0.0000000	0.0000000	100%
Aluminium Production	CO ₂	111.37	-	0.0000000	0.0000000	100%
Fugitive Emiss. from Coal Mining and Handling	CH ₄	48.76	-	0.0000000	0.0000000	100%
PFC Emissions from Aluminium production	PFC	936.56	-	0.0000000	0.0000000	100%
TOTAL (Excluding LULUCF)		32527.325	30833.982			

Table A1-5: Key categories analysis – Trend Assessment - Tier 1 (Including LULUCF)

Tier 1 Analysis - Trend Assessment – Including LULUCF						
IPCC Source Categories	Direct GHG	Base Year (1990) Estimate (Gg eq-CO ₂)	Last Year (2006) Estimate (Gg eq-CO ₂)	Trend Assessm.	% Contrib. on to trend	Cumul. Total of Column F
Forest land remaining forest land	CO ₂	-4184.932	-7490.295	0.322	0.360	36%
Mobile Combustion - Road Vehicles	CO ₂	3561.401	5635.178	0.192	0.215	58%
HFC Emissions from Consumption of HFCs, PFCs and SF ₆	HFC	52.899	430.679	0.136	0.152	73%
CO ₂ Emissions from Cement Production	CO ₂	1069.055	1571.984	0.046	0.052	78%
CO ₂ Emissions from Stationary Combustion - Gas	CO ₂	4582.556	4419.637	0.034	0.038	82%
Fugitive Emissions from Oil and Gas Operations	CH ₄	1201.180	1471.653	0.028	0.031	85%
CO ₂ Emissions from Natural Gas Scrubbing*	CO ₂	415.949	663.000	0.023	0.026	87%
Mobile Combustion - Road Vehicles	N ₂ O	48.084	168.712	0.020	0.022	90%
Solid Waste Disposal Sites	CH ₄	221.208	416.856	0.020	0.022	92%
Total Solvent and Other Product Use	CO ₂	80.211	182.390	0.012	0.013	93%
CO ₂ Emissions from Stationary Combustion - Coal	CO ₂	2826.191	2457.315	0.009	0.010	94%
CO ₂ Emissions from Ammonia Production	CO ₂	861.630	878.521	0.009	0.010	95%
Direct N ₂ O Emissions from Agricultural Soils	N ₂ O	1357.837	1262.677	0.008	0.009	96%
CO ₂ Emissions from Lime Production	CO ₂	160.629	244.469	0.008	0.009	97%
CO ₂ Emissions from Stationary Combustion - Oil	CO ₂	8468.291	6433.601	0.007	0.008	98%
CH ₄ Emissions from Enteric Fermentation in Domestic Livestock	CH ₄	1372.140	835.212	0.006	0.007	98%
Mobile Combustion - Agriculture/Forestry/Fishing	CO ₂	839.186	729.494	0.003	0.003	99%
Indirect N ₂ O Emissions from Nitrogen Used in Agriculture	N ₂ O	955.505	813.414	0.002	0.003	99%
Mobile Combustion: Aircraft	CO ₂	348.828	182.600	0.002	0.002	99%
N ₂ O Emissions from Manure Management	N ₂ O	380.878	233.138	0.002	0.002	99%
Nitric Acid Production	N ₂ O	927.783	774.696	0.002	0.002	99%
Other non-specified NEU	CO ₂	208.051	70.037	0.001	0.002	100%
Emissions from Waste Water Handling	N ₂ O	78.690	87.278	0.001	0.001	100%
Fuel Combustion - Stationary Sources	CH ₄	168.233	97.757	0.001	0.001	100%
CH ₄ Emissions from Manure Management	CH ₄	229.067	160.164	0.001	0.001	100%
Emissions from Waste Water Handling	CH ₄	98.855	87.110	0.0004	0.0004	100%
Mobile Combustion - Road Vehicles	CH ₄	32.130	32.185	0.0003	0.0003	100%
CO ₂ Emissions from Limestone and Dolomite Use	CO ₂	43.218	10.661	0.0002	0.0003	100%
Mobile Combustion: Railways	CO ₂	138.142	101.156	0.0002	0.0003	100%
CO ₂ Emissions from Soda Ash Production and Use	CO ₂	25.740	15.142	0.0001	0.0001	100%
Production of Other Chemicals	CH ₄	16.552	7.839	0.0001	0.0001	100%
N ₂ O Emissions from Pasture, Range and Paddock Manure	N ₂ O	262.158	202.893	0.0001	0.0001	100%
Fuel Combustion - Stationary Sources	N ₂ O	62.316	47.097	0.0001	0.0001	100%
Mobile Combustion: Water-borne Navigation	CO ₂	132.980	103.661	0.00003	0.00003	100%
Mobile Combustion: Aircraft	N ₂ O	3.055	1.600	0.00002	0.00002	100%
Mobile Combustion - Agriculture/Forestry/Fishing	N ₂ O	2.038	1.787	0.00001	0.00001	100%
CO ₂ Emissions from Iron and Steel Production	CO ₂	0.867	0.369	0.00001	0.00001	100%
Mobile Combustion - Agriculture/Forestry/Fishing	CH ₄	1.299	1.098	0.000003	0.000003	100%
Mobile Combustion: Railways	N ₂ O	0.392	0.257	0.000001	0.000002	100%
Mobile Combustion: Railways	CH ₄	0.214	0.145	0.000001	0.000001	100%
Emissions from Waste Incineration	CO ₂	0.088	0.082	0.0000005	0.0000006	100%
Mobile Combustion: Aircraft	CH ₄	0.052	0.027	0.0000003	0.0000003	100%
Mobile Combustion: Water-borne Navigation	N ₂ O	0.337	0.263	0.0000001	0.0000001	100%
Forest land remaining forest land	CH ₄	0.011	0.001	0.0000000	0.0000000	100%
Mobile Combustion: Water-borne Navigation	CH ₄	0.190	0.148	0.0000000	0.0000000	100%
Forest land remaining forest land	N ₂ O	0.003	0.000	0.0000000	0.0000000	100%
CO ₂ Emissions from Ferroalloys Production	CO ₂	194.526	-	0.0000000	0.0000000	100%
Aluminium Production	CO ₂	111.372	-	0.0000000	0.0000000	100%
Fugitive Emissions from Coal Mining and Handling	CH ₄	48.76	-	0.0000000	0.0000000	100%
PFC Emissions from Aluminium production	PFC	936.56	-	0.0000000	0.0000000	100%
TOTAL (Including LULCF)		28342.406	23343.688			

Table A1-6: Key categories for Croatia – summary (Excluding LULUCF)

Tier 1 Analysis – Source Analysis Summary (Croatian Inventory)			
IPCC Source Categories	Direct GHG	Key Source Category Flag	Criteria for Identification
ENERGY SECTOR			
CO ₂ Emissions from Stationary Combustion: Coal	CO ₂	Yes	Level, Trend
CO ₂ Emissions from Stationary Combustion: Oil	CO ₂	Yes	Level, Trend
CO ₂ Emissions from Stationary Combustion: Gas	CO ₂	Yes	Level, Trend
Non-CO ₂ Emissions from Stationary Combustion	CH ₄	No	
Non-CO ₂ Emissions from Stationary Combustion	N ₂ O	No	
Mobile Combustion: Road Vehicles	CO ₂	Yes	Level, Trend
Mobile Combustion: Railways	CO ₂	No	
Mobile Combustion: Domestic Aviation	CO ₂	No	
Mobile Combustion: National Navigation	CO ₂	No	
Mobile Combustion: Agriculture/Forestry/Fishing	CO ₂	Yes	Level
Mobile Combustion: Road Vehicles	CH ₄	No	
Mobile Combustion: Railways	CH ₄	No	
Mobile Combustion: Domestic Aviation	CH ₄	No	
Mobile Combustion: National Navigation	CH ₄	No	
Mobile Combustion: Agriculture/Forestry/Fishing	CH ₄	No	
Mobile Combustion: Road Vehicles	N ₂ O	Yes	Trend
Mobile Combustion: Railways	N ₂ O	No	
Mobile Combustion: Domestic Aviation	N ₂ O	No	
Mobile Combustion: National Navigation	N ₂ O	No	
Mobile Combustion: Agriculture/Forestry/Fishing	N ₂ O	No	
Fugitive Emissions from Coal Mining and Handling	CH ₄	No	
Fugitive Emissions from Oil and Gas Operations	CH ₄	Yes	Level, Trend
CO ₂ Emissions from Natural Gas Scrubbing	CO ₂	Yes	Level, Trend
INDUSTRIAL SECTOR			
CO ₂ Emissions from Cement Production	CO ₂	Yes	Level, Trend
CO ₂ Emissions from Lime Production	CO ₂	Yes	Level, Trend
CO ₂ Emissions from Limestone and Dolomite Use	CO ₂	No	
CO ₂ Emissions from Soda Ash Production and Use	CO ₂	No	
CO ₂ Emissions from Ammonia Production	CO ₂	Yes	Level
CO ₂ Emissions from Iron and Steel Production	CO ₂	No	
CO ₂ Emissions from Ferroalloys Production	CO ₂	No	
CO ₂ Emissions from Aluminium Production	CO ₂	No	
CH ₄ Emissions from Production of Other Chemicals	CH ₄	No	
N ₂ O Emissions from Nitric Acid Production	N ₂ O	Yes	Level, Trend
HFC Emissions from Consumption of HFCs	HFC	Yes	Level, Trend
PFC Emissions from Aluminium production	PFC	No	
CO ₂ Emissions from Other non-specified NEU	CO ₂	No	
SOLVENT AND OTHER PRODUCT USE			
CO ₂ Emissions from solvent and other product use	CO ₂	Yes	Trend
AGRICULTURE SECTOR			
CH ₄ Emissions from Enteric Fermentation in Domestic Livestock	CH ₄	Yes	Level, Trend
CH ₄ Emissions from Manure Management	CH ₄	No	
CH ₄ and N ₂ O Emissions from Agricultural Residue Burning	CH ₄	No	
N ₂ O Emissions from Manure Management	N ₂ O	Yes	Level
Direct N ₂ O Emissions from Agricultural Soils	N ₂ O	Yes	Level
N ₂ O Emissions from Pasture Range and Paddock Manure	N ₂ O	No	
Indirect N ₂ O Emissions from Nitrogen Used in Agriculture	N ₂ O	Yes	Level
CH ₄ and N ₂ O Emissions from Agricultural Residue Burning	N ₂ O	No	
WASTE SECTOR			
CH ₄ Emissions from Solid Waste Disposal Sites	CH ₄	Yes	Level, Trend
N ₂ O Emissions from Human Sewage	N ₂ O	No	

Table A1-7: Key categories for Croatia – summary (Including LULUCF)

Tier 1 Analysis – Source Analysis Summary (Croatian Inventory)			
IPCC Source Categories	Direct GHG	Key Source Category Flag	Criteria for Identification
ENERGY SECTOR			
CO ₂ Emissions from Stationary Combustion - Coal	CO ₂	Yes	Level, Trend
CO ₂ Emissions from Stationary Combustion - Oil	CO ₂	Yes	Level
CO ₂ Emissions from Stationary Combustion - Gas	CO ₂	Yes	Level, Trend
Non-CO ₂ Emissions from Stationary Combustion	CH ₄	No	
Non-CO ₂ Emissions from Stationary Combustion	N ₂ O	No	
Mobile Combustion – Road Vehicles	CO ₂	Yes	Level, Trend
Mobile Combustion - Railways	CO ₂	No	
Mobile Combustion - Domestic Aviation	CO ₂	No	
Mobile Combustion - National Navigation	CO ₂	No	
Mobile Combustion - Agriculture/Forestry/Fishing	CO ₂	No	
Mobile Combustion – Road Vehicles	CH ₄	No	
Mobile Combustion - Railways	CH ₄	No	
Mobile Combustion - Domestic Aviation	CH ₄	No	
Mobile Combustion - National Navigation	CH ₄	No	
Mobile Combustion - Agriculture/Forestry/Fishing	CH ₄	No	
Mobile Combustion – Road Vehicles	N ₂ O	Yes	Trend
Mobile Combustion - Railways	N ₂ O	No	
Mobile Combustion - Domestic Aviation	N ₂ O	No	
Mobile Combustion - National Navigation	N ₂ O	No	
Mobile Combustion - Agriculture/Forestry/Fishing	N ₂ O	No	
Fugitive Emissions from Coal Mining and Handling	CH ₄	No	
Fugitive Emissions from Oil and Gas Operations	CH ₄	Yes	Level, Trend
CO ₂ Emissions from Natural Gas Scrubbing	CO ₂	Yes	Level, Trend
SOLVENT AND OTHER PRODUCT USE			
CO ₂ Emissions from solvent and other product use	CO ₂	Yes	Trend
INDUSTRIAL SECTOR			
CO ₂ Emissions from Cement Production	CO ₂	Yes	Level, Trend
CO ₂ Emissions from Lime Production	CO ₂	Yes	Level
CO ₂ Emissions from Limestone and Dolomite Use	CO ₂	No	
CO ₂ Emissions from Soda Ash Production and Use	CO ₂	No	
CO ₂ Emissions from Ammonia Production	CO ₂	Yes	Level, Trend
CO ₂ Emissions from Iron and Steel Production	CO ₂	No	
CO ₂ Emissions from Ferroalloys Production	CO ₂	No	
CO ₂ Emissions from Aluminium Production	CO ₂	No	
CH ₄ Emissions from Production of Other Chemicals	CH ₄	No	
N ₂ O Emissions from Nitric Acid Production	N ₂ O	Yes	Level
HFC Emissions from Consumption of HFCs	HFC	Yes	Level, Trend
PFC Emissions from Aluminium production	PFC	No	
CO ₂ Emissions from Other non-specified NEU	CO ₂	No	
AGRICULTURE SECTOR			
CH ₄ Emissions from Enteric Fermentation in Domestic Livestock	CH ₄	Yes	Level
CH ₄ Emissions from Manure Management	CH ₄	No	
CH ₄ and N ₂ O Emissions from Agricultural Residue Burning	CH ₄	No	
N ₂ O Emissions from Manure Management	N ₂ O	No	
Direct N ₂ O Emissions from Agricultural Soils	N ₂ O	Yes	Level
N ₂ O Emissions from Pasture Range and Paddock Manure	N ₂ O	No	
Indirect N ₂ O Emissions from Nitrogen Used in Agriculture	N ₂ O	No	
CH ₄ and N ₂ O Emissions from Agricultural Residue Burning	N ₂ O	No	
LULUCF			
CO ₂ Emissions from Forest land remaining forest land	CO ₂	Yes	Level, Trend
CH ₄ Emissions from Forest land remaining forest land	CH ₄	No	
N ₂ O Emissions from Forest land remaining forest land	N ₂ O	No	
WASTE SECTOR			
CH ₄ Emissions from Solid Waste Disposal Sites	CH ₄	Yes	Level, Trend
N ₂ O Emissions from Human Sewage	N ₂ O	No	

Table A1-8: Changes in Key categories for Croatia based on the Level and Trend of Emissions

Tier 1 Analysis – Source Analysis Summary (Croatian Inventory)					
IPCC Source Categories	Direct GHG	Criteria for Identification			
		Level		Trend	
		2005	2006	2005	2006
ENERGY SECTOR					
CO ₂ Emissions from Stationary Combustion: Coal	CO ₂	Yes	Yes	Yes	Yes
CO ₂ Emissions from Stationary Combustion: Oil	CO ₂	Yes	Yes	Yes	Yes/No*
CO ₂ Emissions from Stationary Combustion: Gas	CO ₂	Yes	Yes	Yes	Yes
Mobile Combustion: Road Vehicles	CO ₂	Yes	Yes	Yes	Yes
Mobile Combustion: Agriculture/Forestry/Fishing	CO ₂	Yes	Yes	Yes	No
Mobile Combustion: Road Vehicles	N ₂ O	No	No	Yes	Yes
Fugitive Emissions from Oil and Gas Operations	CH ₄	Yes	Yes	Yes	Yes
CO ₂ Emissions from Natural Gas Scrubbing	CO ₂	Yes	Yes	Yes	Yes
INDUSTRIAL SECTOR					
CO ₂ Emissions from Cement Production	CO ₂	Yes	Yes	Yes	Yes
CO ₂ Emissions from Lime Production	CO ₂	No	Yes	No	Yes/No*
CO ₂ Emissions from Ammonia Production	CO ₂	Yes	Yes	No	No
CO ₂ Emissions from Ferroalloys Production	CO ₂	No	No	Yes	No
N ₂ O Emissions from Nitric Acid Production	N ₂ O	Yes	Yes	Yes	Yes/No*
PFC Emissions from Aluminium Production	PFC	No	No	Yes	No
CO ₂ Emissions from Aluminium Production	CO ₂	No	No	Yes	No
HFC Emissions from Consumption of HFCs	HFC	Yes	Yes	Yes	Yes
SOLVENT AND OTHER PRODUCT USE					
CO ₂ Emissions from solvent and other product use	CO ₂	No	No	Yes	Yes
AGRICULTURE SECTOR					
CH ₄ Emissions from Enteric Fermentation in Domestic Livestock	CH ₄	Yes	Yes	Yes	Yes/No*
N ₂ O Emissions from Manure Management	N ₂ O	Yes	Yes	No	No
Direct N ₂ O Emissions from Agricultural Soils	N ₂ O	Yes	Yes	No	No
N2O Emissions from Pasture, Range and Paddock Manure	N ₂ O	Yes	Yes/No*	No	No
Indirect N ₂ O Emissions from Nitrogen Used in Agriculture	N ₂ O	Yes	Yes/No*	No	No
LULUCF					
CO ₂ Emissions from Forest land remaining forest land	CO ₂	Yes	Yes	Yes	Yes
WASTE SECTOR					
CH ₄ Emissions from Solid Waste Disposal Sites	CH ₄	Yes	Yes	Yes	Yes

*Key category only for excluding LULUCF

ANNEX 2

DETAILED DISCUSSION OF ACTIVITY DATA AND EMISSION FACTORS FOR ESTIMATING CO₂ EMISSIONS FROM FOSSIL FUEL COMBUSTION

Table A2-1: The GHG emissions from Thermal Power Plants

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Production									
Electricity product. (GWh)	3580	1919	3400	2414	3388	3787	2891	2842	3823
Fuel consumption									
Hard coal (1000 t)	253.7	96.2	569.9	627.3	800.5	905.1	849.0	915.0	835.9
NCV for hard coal (MJ/kg)	25.1	25.7	26.2	25.6	25.4	24.3	24.1	24.2	24.6
Fuel oil (1000 t)	570.4	325.4	283.4	397.6	406.4	559.0	251.4	284.0	311.4
NCV for fuel oil (MJ/kg)	40.4	40.8	40.5	61.4	61.6	40.4	40.3	40.3	40.4
Extra light oil (1000 t)	0.7	2.6	7.5	5.7	2.1	7.2	2.3	3.0	1.0
NCV for ex. light oil (MJ/kg)	42.3	42.0	42.0	28.0	28.0	42.3	42.3	42.3	42.3
Natural gas (1000000 m ³)	194.6	114.5	155.7	165.0	319.1	100.0	140.5	48.2	128.4
NCV for nat. gas (MJ/m ³)	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
Gas coke (1000000 m ³)	24.5								
NCV for gas coke (MJ/m ³)	17.6								
Total fuel consumpt. (TJ)	36347	19641	31930	37897	47603	48224	35386	35336	37478
Emissions									
EF CO ₂ – hard coal (t/TJ)	92.7	92.7	92.7	92.7	92.7	92.7	92.7	92.7	92.7
EF CO ₂ – fuel oil (t/TJ)	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6
EF CO ₂ – extra light oil (t/TJ)	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3
EF CO ₂ – natural gas (t/TJ)	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8
EF CO ₂ – coke gas (t/TJ)	106.0								
CO₂ emission (Gg)	2764	1464	2577	3046	3752	3977	2942	3030	3113
EF CH ₄ – hard coal (kg/TJ)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
EF CH ₄ – fuel oil (kg/TJ)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
EF CH ₄ – extra light oil (kg/TJ)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
EF CH ₄ – natural gas (kg/TJ)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
EF CH ₄ – coke gas (kg/TJ)	1.0								
CH₄ emission (Mg)	37.4	19.4	22.9	27.4	38.6	38.6	24.8	26.1	27.5
EF N ₂ O – hard coal (kg/TJ)	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
EF N ₂ O – fuel oil (kg/TJ)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
EF N ₂ O – extra light oil (kg/TJ)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
EF N ₂ O – natural gas (kg/TJ)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
EF N ₂ O – coke gas (kg/TJ)	1.4								
N₂O emission (Mg)	18.3	8.4	28.0	31.2	38.6	42.4	36.3	39.1	37.2

Table A2-2: The GHG emissions from Public Cogeneration Plants

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Production									
Electricity production (GWh)	514	804	924	1184.0	1273.7	1952.7	2079	1847	1835
Heat production (TJ)	8953	7986	6868	8672	8668.0	8116	7724	8137	7418
Total (TJ)	10803	10882	10194	12934	13253	15146	15209	14786	14023
Fuel consumption									
Fuel oil (1000 t)	117.7	336.2	108.6	115.0	92.6	166.2	113.4	162.0	156.1
NCV for fuel oil (MJ/kg)	40.5	40.5	40.7	40.6	40.6	40.6	40.8	40.7	38.4
Extra light oil (1000 t)	0.0	1.0	0.9	0.5	0.0	3.2	0.0	0.0	0.0
NCV for extra light oil (MJ/kg)	0.0	21.3	21.4	21.6	20.6	21.6	21.4	21.4	0.0
Natural gas (1000000 m ³)	312.7	103.3	357.7	431.1	454.7	518.9	579.6	479.0	458.8
NCV for natural gas (MJ/m ³)	33.3	33.4	33.4	33.6	33.6	33.8	33.6	33.4	33.6
Total fuel consumption (TJ)	15196	17170	16399	19135	19002	24295	23986	22567	21411

Table A2-2: The GHG emissions from Public Cogeneration Plants (cont.)

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Emissions									
EF CO ₂ – fuel oil (t/TJ)	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6
EF CO ₂ – ex.light oil (t/TJ)	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3
EF CO ₂ – natural gas (t/TJ)	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8
CO₂ emission (Gg)	947	1240	1005	1164	1139	1489	1435	1397	1322
EF CH ₄ – fuel oil (kg/TJ)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
EF CH ₄ – ex.light oil (kg/TJ)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
EF CH ₄ – nat. gas (kg/TJ)	4.6	3.6	4.4	3.6	3.9	4.7	4.6	5.2	5.2
CH₄ emission (Mg)	11.6	24.9	34.4	56.1	62.2	87.1	93.0	88.6	85.2
EF N ₂ O – fuel oil (kg/TJ)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
EF N ₂ O – ex.light oil (kg/TJ)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
EF N ₂ O – nat. gas (kg/TJ)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
N₂O emission (Mg)	2.5	4.5	2.5	2.9	2.7	3.8	3.3	3.6	3.4

Table A2-3: The GHG emissions from Public Heating Plants

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Production									
Heat production (TJ)	0	2493	2708	3338	3171	3470	3304	3478	2984
Fuel consumption									
Fuel oil (1000 t)		35.6	37.0	38.6	36.4	38.1	38.6	39	33.5
NCV for fuel oil (MJ/kg)	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2
Extra light oil (1000 t)	0.0	6.0	4.4	3.6	3.7	4.3	6.8	6.7	5.3
NCV for extra light oil (MJ/kg)	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7
Natural gas (1000000 m ³)	0.0	36.2	53.0	70.1	67.2	69.6	64.3	71.3	62.1
NCV for natural gas (MJ/m ³)	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
LPG (1000 t)		1.5							
NCV for LPG (MJ/kg)	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9
Gas works gas (1000000 m ³)				1.4	1.3	1.3	1.3	1.5	1.8
NCV for GWG (MJ/m ³)	18.6			19.5	19.5	22.6	21.5	21.5	30.4
Total fuel consumption (TJ)	0.0	2988.2	3477.0	4115.8	3931.1	4110.7	4056.6	4309.1	3737.5
Emissions									
EF CO ₂ – fuel oil (t/TJ)	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6
EF CO ₂ – extra light oil (t/TJ)	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3
EF CO ₂ – natural gas (t/TJ)	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8
CO₂ emission (Gg)	0.0	201.5	228.3	266.1	253.9	266.0	265.2	279.7	243.3
EF CH ₄ – fuel oil (kg/TJ)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
EF CH ₄ – extra light oil (kg/TJ)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
EF CH ₄ – natural gas (kg/TJ)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
CH₄ emission (Mg)	0.0	7.0	6.8	7.5	7.2	7.5	7.7	8.0	6.9
EF N ₂ O – fuel oil (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O – extra light oil (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O – natural gas (kg/TJ)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
N₂O emission (Mg)	0.0	1.2	1.2	1.3	1.2	1.3	1.3	1.4	1.2

The GHG emissions from thermal power plants and public cogeneration plants. for the whole period (1990-2006). were calculated using more detailed Tier 2 approach. Tier 2 approach is based on bottom-up fuel consumption data from every boiler or gas turbine in plant. There were available data about monthly fuel consumption and detailed fuel characteristics data (net

calorific value. sulphur and ash content...). Every plant also has the equipment for continual measurements of SO₂. NO_x. CO and particulates emission.

For estimation of CO₂ emissions. default IPCC emission factors were used. while emission factors for CH₄ and N₂O are based on technology type and configuration (Tier 2). The results of GHG emission calculation. using more detailed approach are presented in tables A2-2 and A2-3 for the 1990. 1995 and last six years. on aggregated level. The GHG emissions on plant level. for the year 2006. are given in the Table A2-5.

Table A2-4: The GHG emissions from TPPs and PCPs (Tier 2). year 2006

	TPP Plomin	TPP Rijeka	TPP Sisak	CHP Zagreb – east	CHP Zagreb – west	CHP Osijek	CCGT Jertovec
Production							
Electricity production (GWh)	2237.3	825.2	741.2	1373.8	346.9	113.9	19.6
Heat production (TJ)				4146.0	2121.1	1151.2	
Total (TJ)	8054.2	2970.7	2668.1	9091.8	3369.9	1561.1	70.4
Fuel consumption							
Hard coal (1000 t)	835.9						
NCV for hard coal (MJ/kg)	24.6						
Fuel oil (1000 t)		199.8	111.6	80.4	39.0	36.7	
NCV for fuel oil (MJ/kg)		40.2	40.5	40.7	40.6	34.0	
Extra light oil (1000 t)	0.8	0.2					0.0
NCV for extra light oil (MJ/kg)	41.9	42.2					42.7
Natural gas (1000000 m ³)			121.5	308.7	125.9	24.2	6.9
NCV for natural gas (MJ/m ³)			33.4	33.3	33.3	34.0	33.3
Total fuel consumption (TJ)	20628.6	8043.0	8574.3	13560.9	5779.5	2070.4	232.1
Emissions							
EF CO ₂ – hard coal (t/TJ)	92.7						
EF CO ₂ – fuel oil (t/TJ)		76.6	76.6	76.6	76.6	76.6	
EF CO ₂ – extra light oil (t/TJ)	73.3	73.3					73.3
EF CO ₂ – natural gas (t/TJ)			55.8	55.8	55.8	55.8	55.8
CO₂ emission (Gg)	1911.8	616.0	572.5	824.9	355.5	141.5	13.0
EF CH ₄ – hard coal (kg/TJ)	0.7	0.7	0.7	0.7	0.7	0.7	0.7
EF CH ₄ – fuel oil (kg/TJ)	0.9	0.9	0.9	0.9	0.9	0.9	0.9
EF CH ₄ – extra light oil (kg/TJ)	0.9	0.9	0.9	0.9	0.9	0.9	0.9
EF CH ₄ – natural gas (kg/TJ)	0.1	0.1	0.1	5.5	5.1	1.8	6.0
CH₄ emission (Mg)	14.4	7.2	4.5	59.8	22.8	2.6	1.4
EF N ₂ O – hard coal (kg/TJ)	1.6	1.6	1.6	1.6	1.6	1.6	1.6
EF N ₂ O – fuel oil (kg/TJ)	0.3	0.3	0.3	0.3	0.3	0.3	0.3
EF N ₂ O – extra light oil (kg/TJ)	0.4	0.4	0.4	0.4	0.4	0.4	0.4
EF N ₂ O – natural gas (kg/TJ)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
N₂O emission (Mg)	33.0	2.4	1.8	2.0	0.9	0.5	0.0

Table A2-5: The GHG emissions from Petroleum refining – own use of energy

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Fuel consumption									
Fuel oil (1000 t)	127.7	101.2	47.8	36.8	57.4	51.7	66.2	70.8	58.1
NCV for fuel oil (MJ/kg)	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2
LPG (1000 t)		35.0	2.2	4.3	7.7	8.8	5.7	6.6	5.5
NCV for LPG (MJ/kg)		46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9
Petroleum coke (1000 t)	53.7	42.6	63.0	51.5	57.8	59.1	63.4	64.2	195.2
NCV for petroleum coke (MJ/kg)	29.31	29.31	31.00	31.00	31.00	31.00	31.00	31.00	31.00
Refinery gas (1000 t)	347.5	196.5	221.7	195.3	214.5	229.9	241.7	222.0	55.0
NCV for refinery gas (MJ/kg)	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6
Natural gas (1000000 m ³)				3.3	0.3	0.3	0.3	1.2	0.4
NCV for natural gas (MJ/m ³)				34.0	34.0	34.0	34.0	34.0	34.0
Total fuel consumption (TJ)	23584	16501	14745	12875	14888	15499	16643	15969	11329
Emissions									
EF CO ₂ – fuel oil (t/TJ)	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6
EF CO ₂ – LPG (t/TJ)	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4
EF CO ₂ – petroleum coke (t/TJ)	99.8	99.8	99.8	99.8	99.8	99.8	99.8	99.8	99.8
EF CO ₂ – refinery gas (t/TJ)	66.1	66.1	66.1	66.1	66.1	66.1	66.1	66.1	66.1
EF CO ₂ – natural gas (t/TJ)	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8
CO₂ emission (Gg)	1665.3	1169.2	1059.9	918.2	1067.0	1106.1	1192.8	1150.6	976.3
EF CH ₄ – fuel oil (kg/TJ)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
EF CH ₄ – LPG (kg/TJ)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
EF CH ₄ – petroleum coke (kg/TJ)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
EF CH ₄ – refinery gas (kg/TJ)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
EF CH ₄ – natural gas (kg/TJ)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
CH₄ emission (Mg)	70.8	49.5	44.2	38.4	44.6	46.5	49.9	47.8	34.0
EF N ₂ O – fuel oil (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O – LPG (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O – petroleum coke (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O – refinery gas (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O – natural gas (kg/TJ)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
N₂O emission (Mg)	14.2	9.9	8.8	7.7	8.9	9.3	10.0	9.6	6.8

Table A2-6: The GHG emissions from Petroleum refining – heating/cogeneration plants*

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Fuel consumption									
Fuel oil (1000 t)	227.2	199.5	193.4	183.8	205.9	212.9	192.6	183.2	191.8
NCV for fuel oil (MJ/kg)	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2
LPG (1000 t)	0.0	0.0	0.0	6.5	0.0	0.0	11.6	2.9	4.2
NCV for LPG (MJ/kg)	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9
Petroleum coke (1000 t)	0.0	0.0	0.0	4.1	6.3	6.9	6.2	6.5	6.9
NCV for petroleum coke (MJ/kg)	33.6	29.3	31.0	31.0	31.0	31.0	31.0	31.0	31.0
Refinery gas (1000 t)	58.4	27.7	40.7	25.3	22.7	28.6	22.1	19.1	15.2
NCV for refinery gas (MJ/kg)	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6
Natural gas (1000000 m ³)	7.3	7.1	0.2	0.6	0.3	0.3	0.0	0.0	0.0
NCV for natural gas (MJ/m ³)	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
Total fuel consumption (TJ)	12216	9605	9756	9068	9583	10170	9550	8628	8858

Table A2-6: The GHG emissions from Petroleum refining – heating/cogeneration plants* (cont.)

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Emissions									
EF CO ₂ – fuel oil (t/TJ)	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6
EF CO ₂ – LPG (t/TJ)	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4
EF CO ₂ – petroleum coke (t/TJ)	99.8	99.8	99.8	99.8	99.8	99.8	99.8	99.8	99.8
EF CO ₂ – refinery gas (t/TJ)	66.1	66.1	66.1	66.1	66.1	66.1	66.1	66.1	66.1
EF CO ₂ – natural gas (t/TJ)	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8
CO₂ emission (Gg)	900.6	716.5	726.3	679.8	726.7	769.1	716.9	653.8	672.8
EF CH ₄ – fuel oil (kg/TJ)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
EF CH ₄ – LPG (kg/TJ)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
EF CH ₄ – petroleum coke (kg/TJ)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
EF CH ₄ – refinery gas (kg/TJ)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
EF CH ₄ – natural gas (kg/TJ)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
CH₄ emission (Mg)	36.2	28.3	29.3	27.2	28.7	30.5	28.7	25.9	26.6
EF N ₂ O – fuel oil (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O – LPG (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O – petroleum coke (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O – refinery gas (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O – natural gas (kg/TJ)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
N₂O emission (Mg)	7.2	5.6	5.9	5.4	5.7	6.1	5.7	5.2	5.3

Table A2-7: The GHG emissions from manufacturing of solid fuels and other energy industries

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Fuel consumption									
LPG (1000 t)	11.9		1						
NCV for LPG (MJ/kg)	46.9		46.9						
Coke gas (1000000 m ³)	107.4								
NCV for coke gas (MJ/m ³)	17.9								
Extra light oil (1000 t)	1.4	1.2	7.5	6.7	6.4	9.5	6.3	5.5	2.5
NCV for ex.light oil (MJ/kg)	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7
Natural gas (1000000 m ³)	392.0	205.8	140.5	112.8	130.9	123.2	136.5	175.5	158.3
NCV for nat. gas (MJ/m ³)	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34	34
Total fuel consumpt. (TJ)	15869	7048	5144	4121	4724	4594	4910	6202	5489
Emissions									
EF CO ₂ – LPG (t/TJ)	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4
EF CO ₂ – coke gas (t/TJ)	107.6	107.6	107.6	107.6	107.6	107.6	107.6	107.6	107.6
EF CO ₂ – ex.light oil (t/TJ)	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3
EF CO ₂ – natural gas (t/TJ)	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8
CO₂ emission (Gg)	990.2	394.3	293.1	235.1	268.5	263.6	278.8	350.3	308.3
EF CH ₄ – hard coal (kg/TJ)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
EF CH ₄ – coke gas (kg/TJ)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
EF CH ₄ – ex.ligh oil (kg/TJ)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
EF CH ₄ – nat. gas (kg/TJ)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
CH₄ emission (Mg)	16.0	7.2	5.8	4.7	5.3	5.4	5.4	6.7	5.7
EF N ₂ O – hard coal (kg/TJ)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
EF N ₂ O – coke gas (kg/TJ)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
EF N ₂ O – ex.ligh oil (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O – nat. gas (kg/TJ)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
N₂O emission (Mg)	2.3	0.7	0.7	0.6	0.6	0.7	0.6	0.7	0.6

Table A2-8: The GHG emissions from Manufacturing Industries and Construction – liquid fuels

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Fuel consumption									
Gasoline (1000 t)	0.2	8.5	7.6	7.8	7.6	9.1	10.2	6.9	7.3
NCV for gasoline (MJ/kg)	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	
Petroleum (1000 t)	0.1	0.1							
NCV for petroleum (MJ/kg)	44.0	44.0	44.0						
Gas/diesel oil (1000 t)	246.5	101.5	130.8	129.9	119.3	145.0	135.9	110.6	124.2
NCV for gas/diesel o.(MJ/kg)	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7
Fuel oil (1000 t)	419.2	269.7	302.2	325.5	324.4	284.7	230.5	198.6	195.7
NCV for fuel oil (MJ/kg)	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2
LPG (1000 t)	17.5	17.6	21.0	19.8	19.3	20.9	17.3	22.8	29.4
NCV for LPG (MJ/kg)	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9
Lubricants (1000 t)	8.6								
NCV for lubricants (MJ/kg)	33.6								
Petroleum coke (1000 t)	0.0			16.3	11.9	6.3	68.4	172.3	215.0
NCV for petroleum coke (MJ/kg)	29.3	29.3	31.0	31.0	31.0	31.0	31.0	31.0	31.0
Total fuel consumpt. (TJ)	28498	16383	19056	20411	18564	19216	18454	21513	23273

Table A2-8: The GHG emissions from Manufacturing Industries and Construction – liquid fuels (cont.)

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Emissions									
EF CO ₂ – gasoline (t/TJ)	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6
EF CO ₂ – petroleum (t/TJ)	71.1	71.1	71.1	71.1	71.1	71.1	71.1	71.1	71.1
EF CO ₂ – gas/diesel oil (t/TJ)	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3
EF CO ₂ – fuel oil (t/TJ)	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6
EF CO ₂ – LPG (t/TJ)	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4
EF CO ₂ – lubricants (t/TJ)	72.6	72.6	72.6	72.6	72.6	72.6	72.6	72.6	72.6
EF CO ₂ – petroleum coke (t/TJ)	99.8	99.8	99.8	99.8	99.8	99.8	99.8	99.8	99.8
CO₂ emission (Gg)	2135.5	1225.9	1424.6	1541.1	1398.3	1439.0	1428.7	1732.4	1892.3
EF CH ₄ – gasoline (kg/TJ)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
EF CH ₄ – petroleum (kg/TJ)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
EF CH ₄ – gas/diesel oil (kg/TJ)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
EF CH ₄ – fuel oil (kg/TJ)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
EF CH ₄ – LPG (kg/TJ)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
EF CH ₄ – lubricants (kg/TJ)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
EF CH ₄ – petroleum coke (kg/TJ)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
CH₄ emission (Mg)	0.057	0.033	0.038	0.041	0.037	0.038	0.037	0.043	0.047
EF N ₂ O – gasoline (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O – petroleum (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O – gas/diesel oil (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O – fuel oil (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O – LPG (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O – lubricants (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O – petroleum coke (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
N₂O emission (Mg)	0.017	0.010	0.011	0.012	0.011	0.012	0.011	0.013	0.014

Table A2-9: The GHG emissions from Manufacturing Industries and Construction – solid fuels

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Fuel consumption									
Anthracite (1000 t)	107.2	5.0			7.2		0.4		0.1
NCV for anthracite (MJ/kg)	29.3	29.3	29.3		29.3		29.3		29.3
Hard coal (1000 t)	42.0	41.9	53.2	68.8	70.3	125.7	253.7	68.8	151.0
NCV for hard coal (MJ/kg)	25.1	28.1	26.2	25.8	25.8	24.5	24.3	25.8	24.9
Brown Coal (1000 t)	261.2	95.8	28.2	42.3	35.5	34.4	59.2	42.3	61.3
NCV for brown coal (MJ/kg)	16.7	17.8	17.8	18.2	18.2	18.5	18.3	18.2	17.7
Lignite (1000 t)	73.2	56.3	14.4	20.2	25.6	18.4	0.7	20.2	0.2
NCV for lignite (MJ/kg)	10.9	12.0	12.0	12.2	12.2	12.3	12.2	12.2	12.3
Briquettes (1000 t)	3.3								
NCV for briquettes (MJ/kg)	16.7								
Coke oven coke (1000 t)	251.2	31.4	37.7	18.3	17.1	17.3	19.3	18.3	20.6
NCV for coke oven coke (MJ/kg)	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3
Total fuel consumpt. (TJ)	16784	4626	3171	3327	3272	4449	8209	5957	5448

Table A2-9: The GHG emissions from Manufacturing Industries and Construction – solid fuels (cont.)

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Emissions									
EF CO ₂ – anthracite (t/TJ)	96.3	96.3	96.3	96.3	96.3	96.3	96.3	96.3	96.3
EF CO ₂ – hard coal (t/TJ)	92.7	92.7	92.7	92.7	92.7	92.7	92.7	92.7	92.7
EF CO ₂ – brown coal (t/TJ)	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1
EF CO ₂ – lignite (t/TJ)	99.2	99.2	99.2	99.2	99.2	99.2	99.2	99.2	99.2
EF CO ₂ – briquettes (t/TJ)	95.6	95.6	95.6	95.6	95.6	95.6	95.6	95.6	95.6
EF CO ₂ – coke oven coke (t/TJ)	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0
CO₂ emission (Gg)	1676.8	448.4	310.5	318.2	313.0	421.5	770.2	562.6	514.7
EF CH ₄ – anthracite (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ – hard coal (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ – brown coal (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ – lignite (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ – briquettes (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ – coke oven coke (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
CH₄ emission (Mg)	0.168	0.046	0.032	0.033	0.033	0.044	0.082	0.060	0.054
EF N ₂ O – anthracite (kg/TJ)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
EF N ₂ O – hard coal (kg/TJ)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
EF N ₂ O – brown coal (kg/TJ)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
EF N ₂ O – lignite (kg/TJ)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
EF N ₂ O – briquettes (kg/TJ)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
EF N ₂ O – coke oven coke (kg/TJ)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
N₂O emission (Mg)	0.003	0.002	0.002	0.005	0.005	0.006	0.011	0.008	0.008

Table A2-10: The GHG emissions from Manufacturing Industries and Construction –gaseous fuels

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Fuel consumption									
Natural gas (1000000 m3)	845.7	656.8	703.8	715.4	673.8	683.6	711.5	712.2	703.4
NCV for natural gas (MJ/m3)	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
Gas Works Gas (1000 t)	6.1	9.8	7.9	0	9.6	4.4	3.0	3.6	3.0
NCV for gas work gas (MJ/kg)	15.8	15.8	15.8	15.8	19.5	22.6	19.5	21.5	30.4
Coke Oven Gas (1000 t)	29.9								
NCV for COG (MJ/kg)	17.9								
Blast Furance Gas (1000 t)	418.1								
NCV for blast fur. gas (MJ/kg)	3.6								
Total fuel consumption (TJ)	30895	22487	24054	24324	23096	23342	24249	24291	24008
Emissions									
EF CO ₂ - natural gas (t/TJ)	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8
EF CO ₂ - gas work gas (t/TJ)	46.7	46.7	46.7	46.7	46.7	46.7	46.7	46.7	46.7
EF CO ₂ - coke oven gas (t/TJ)	46.7	46.7	46.7	46.7	46.7	46.7	46.7	46.7	46.7
EF CO ₂ - blast fur. gas (t/TJ)	237.2	237.2	237.2	237.2	237.2	237.2	237.2	237.2	237.2
CO₂ Emission (Gg)	1992.5	1253.8	1341.6	1357.7	1298.9	1308.0	1356.6	1359.9	1344.9
EF CH ₄ - natural gas (kg/TJ)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
EF CH ₄ - gas work gas (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ - coke ov. gas (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ - blast fur. gas (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
CH₄ Emission (Mg)	0.1652	0.1132	0.1209	0.122	0.115	0.116	0.121	0.121	0.120

Table A2-10: The GHG emissions from Manufacturing Industries and Construction –gaseous fuels (cont.)

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Emissions									
EF N ₂ O - natural gas (kg/TJ)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
EF N ₂ O- gas work gas (kg/TJ)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
EF N ₂ O-coke ov. gas (kg/TJ)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
EF N ₂ O-blast fur.. gas (kg/TJ)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
N₂O Emission (Mg)	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002

Table A2-11: The number of road motor vehicles in Croatia

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Mopeds	18025	21561	46345	51950	58921	66815	74034	82185	89583
Motorcycles	12455	15317	24717	26764	29973	35940	41293	46313	51758
Passenger Cars	1120974	820071	1140964	1201474	1246100	1294763	1341228	1379737	1422784
Buses	6482	4497	4650	4708	4715	4727	4774	4798	4728
Light and Heavy Duty Vehicles	80017	90204	128848	135542	145331	156407	163740	168771	171106
Total	1237953	951650	1345524	1420438	1485040	1558652	1625069	1681804	1739959

Table A2-12: GHG emissions from Road Transport

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Fuel consumption									
Gasoline (1000 t)	759.5	557.9	764.2	734.9	742.8	739.6	705.2	693.5	694.5
NCV for gasoline (MJ/kg)	44.59	44.59	44.59	44.59	44.59	44.59	44.59	44.59	44.59
Diesel (1000 t)	364.5	406.2	557.8	601.0	683.6	810.9	888.1	955.6	1048.3
NCV for diesel (MJ/kg)	42.71	42.71	42.71	42.71	42.71	42.71	42.71	42.71	42.71
LPG (1000 t)	0.0	13.7	9.8	12.6	13.2	13.2	16.7	22.1	36.9
NCV for LPG (MJ/kg)	46.89	46.89	46.89	46.89	46.89	46.89	46.89	46.89	46.89
Total fuel consumption (TJ)	49434	42868	58359	59029	62937	68231	70159	72773	77471
Emissions									
CO₂ emission (Gg)	3561.4	3100.7	4218.8	4271.3	4557.8	4947.0	5092.6	5286.9	5635.2
CH₄ emission (Mg)	1.530	1.164	1.478	1.377	1.345	1.304	1.274	1.530	1.533
N₂O emission (Mg)	0.155	0.158	0.311	0.349	0.387	0.442	0.479	0.483	0.544

Table A2-13: The GHG emissions from Domestic Air Transport

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Fuel consumption									
Gasoline (1000 t)	0.0	0.3	0.1	0.2	0.1	0.2	1.1	1.1	1.1
NCV for gasoline (MJ/kg)	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6
Jet kerosene (1000 t)	112.0	28.0	40.0	52.0	50.0	45.0	50.0	54.4	57.6
NCV for jet kerosene (MJ/kg)	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0
Total fuel consumption (TJ)	4928	1244	1763	2295	2202	1987	2247	2440	2581
Emissions									
EF CO ₂ – gasoline (t/TJ)	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6
EF CO ₂ – jet kerosene (t/TJ)	70.8	70.8	70.8	70.8	70.8	70.8	70.8	70.8	70.8
CO₂ emission (Gg)	348.8	88.0	124.8	162.4	155.9	140.6	159.0	172.6	182.6
EF CH ₄ – gasoline (kg/TJ)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
EF CH ₄ – jet kerosene (kg/TJ)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
CH₄ emission (Mg)	2.5	0.6	0.9	1.1	1.1	1.0	1.1	1.2	1.3
EF N ₂ O – gasoline (kg/TJ)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
EF N ₂ O – jet kerosene (kg/TJ)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
N₂O emission (Mg)	9.9	2.5	3.5	4.6	4.4	4.0	4.5	4.9	5.2

Table A2-14: The GHG emissions from National Navigation

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Fuel consumption									
Gasoline (1000 t)	0.1	0.6	0.3	0.4	0.3	0.3			
NCV for gasoline (MJ/kg)	44.6	44.6	44.6	44.6	44.6	44.6			
Diesel (1000 t)	38.7	23.2	25.7	25.6	27.9	28.6	29.1	31.8	33.1
NCV for diesel (MJ/kg)	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7
Fuel oil (1000 t)	2.1	6.2	1.4	3.4	7.3	6.7			
NCV for fuel oil (MJ/kg)	40.2	40.2	40.2	40.2	40.2	40.2			
Light heating oil (1000 t)	1.6	1.5							
NCV for light heating oil (MJ/kg)	42.7	42.7							
Total fuel consumption (TJ)	1810.1	1330.9	1167.3	1247.9	1498.4	1504.2	1242.9	1358.2	1413.7
Emissions									
EF CO ₂ - gasoline (t/TJ)	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6
EF CO ₂ - diesel (t/TJ)	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3
EF CO ₂ - fuel oil (t/TJ)	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6
EF CO ₂ - light heating oil (t/TJ)	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3
CO₂ Emission (Gg)	133.0	98.3	85.7	91.9	110.8	111.1	91.1	99.6	103.7
EF CH ₄ - gasoline (kg/TJ)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
EF CH ₄ - diesel (kg/TJ)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
EF CH ₄ - fuel oil (kg/TJ)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
EF CH ₄ - light heating oil (kg/TJ)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
CH₄ Emission (Mg)	9.1	6.7	5.8	6.2	7.5	7.5	6.2	6.8	7.1
EF N ₂ O - gasoline (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O - diesel (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O - fuel oil (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O - light heating oil (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
N₂O Emission (Mg)	1.0	0.8	0.7	0.7	0.9	0.9	0.7	0.8	0.8

Table A2-15: The GHG emissions from Railways

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Fuel consumption									
Gasoline (1000 t)	0.1		0.1						
NCV for gasoline (MJ/kg)	44.6		44.6						
Diesel (1000 t)	36.1	30.7	27.2	28.0	27.8	28.1	29.4	30.5	32.3
NCV for diesel (MJ/kg)	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7
Fuel oil (1000 t)	0.2	1.5							
NCV for fuel oil (MJ/kg)	40.2	40.2							
Light heating oil (1000 t)	1.1	1.7							
NCV for light heating oil (MJ/kg)	42.7	42.7							
Brown coal (1000 t)	10.0								
NCV for brown coal (MJ/kg)	16.7								
Lignite (1000 t)	4.3								
NCV for lignite (MJ/kg)	10.9								
Jet Kerosene (1000 t)	0.1								
NCV for jet kerosene (MJ/m3)	43.9								
Petroleum (1000 t)		0.1							
NCV for petroleum (MJ/m3)		44.0							
Total fuel consumption (TJ)	1819.9	1448.5	1166.2	1195.9	1187.3	1200.1	1255.7	1302.7	1379.5
Emissions									
EF CO ₂ - gasoline (t/TJ)	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6
EF CO ₂ - diesel (t/TJ)	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3
EF CO ₂ - fuel oil (t/TJ)	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6
EF CO ₂ - light heating oil (t/TJ)	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3
EF CO ₂ - brown coal (t/TJ)	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1
EF CO ₂ - lignite (t/TJ)	99.2	99.2	99.2	99.2	99.2	99.2	99.2	99.2	99.2
EF CO ₂ - jet kerosene (t/TJ)	70.8	70.8	70.8	70.8	70.8	70.8	70.8	70.8	70.8
EF CO ₂ - petroleum (t/TJ)	71.1	71.1	71.1	71.1	71.1	71.1	71.1	71.1	71.1
CO₂ Emission (Gg)	138.1	106.4	85.5	87.7	87.1	88.0	92.1	95.5	101.2
EF CH ₄ - gasoline (kg/TJ)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
EF CH ₄ - diesel (kg/TJ)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
EF CH ₄ - fuel oil (kg/TJ)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
EF CH ₄ - light heating oil (kg/TJ)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
EF CH ₄ - brown coal (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ - lignite (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ - jet kerosene (t/TJ)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
EF CH ₄ - petroleum (t/TJ)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
CH₄ Emission (Mg)	10.2	7.2	5.8	6.0	5.9	6.0	6.3	6.5	6.9
EF N ₂ O - gasoline (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O - diesel (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O - fuel oil (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O - light heating oil (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O - brown coal (kg/TJ)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
EF N ₂ O - lignite (kg/TJ)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
EF N ₂ O - jet kerosene (t/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O - petroleum (t/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
N₂O Emission (Mg)	1.3	0.9	0.7	0.7	0.7	0.7	0.8	0.8	0.8

Table A2-16: The GHG emissions from Commercial/Institutional

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Fuel consumption									
Petroleum (1000 t)	0.1								
NCV for jet kerosene (MJ/kg)	43.9								
Light heating oil (1000 t)	89.5	101.4	120.6	130.7	141.5	145.0	143.8	131.6	112.5
NCV for light heating oil (MJ/kg)	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7
Fuel oil (1000 t)	66.1		3.9	5.0	10.6	8.8	6.6	6.6	4.5
NCV for fuel oil (MJ/kg)	40.2		40.2	40.2	40.2	40.2	40.2	40.2	40.2
LPG (1000 t)	4.3	13.8	13.9	16.6	19.2	20.2	19.2	20.1	21.1
NCV for LPG (MJ/kg)	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9
Anthracite (1000 t)									
NCV for anthracite (MJ/kg)									
Brown coal (1000 t)	24.5	12.7	9.5	5.6	8.4	10.9	4.8	0.2	4.5
NCV for brown coal (MJ/kg)	16.74	17.30	17.80	18.20	18.20	18.50	18.20	18.50	17.73
Lignite (1000 t)	40.0	1.6	1.2	2.4	2.6	2.2	0.6	0.6	0.2
NCV for lignite (MJ/kg)	10.9	10.1	12.0	12.2	12.2	12.3	12.2	12.1	12.3
Briquettes (1000 t)	2.9								
NCV for briquettes (MJ/kg)	16.7								
Gas work gas (1000000 m3)	4.9	1.4	1.5	1.6	1.7	5.0	3.8	3.4	3.3
NCV for gas work gas (MJ/m3)	15.8	15.9	19.5	19.5	19.5	22.6	21.5	21.5	30.4
Natural gas (1000000 m3)	102.5	133.7	98.7	133.0	124.1	129.9	138.4	151.2	147.0
NCV for natural gas (MJ/m3)	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
Gasoline (1000 t)		0.3							
NCV for gasoline (MJ/kg)		44.6							
Sub bituminous coal(1000 t)	123.1	11.1							
NCV for sub bitum. coal (MJ/kg)	16.74	17.3	17.8	18.2	18.2	18.5	18.2	18.5	17.73
Total fuel consumption (TJ)	13203	9797	9528	11246	11807	12252	12190	12054	11157
Emissions									
EF CO ₂ - petroleum (t/TJ)	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3
EF CO ₂ - diesel (t/TJ)	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3
EF CO ₂ - fuel oil (t/TJ)	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6
EF CO ₂ - LPG (t/TJ)	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4
EF CO ₂ - anthracite (t/TJ)	96.3	96.3	96.3	96.3	96.3	96.3	96.3	96.3	96.3
EF CO ₂ - brown coal (t/TJ)	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1
EF CO ₂ - lignite (t/TJ)	99.2	99.2	99.2	99.2	99.2	99.2	99.2	99.2	99.2
EF CO ₂ - briquettes (t/TJ)	95.6	95.6	95.6	95.6	95.6	95.6	95.6	95.6	95.6
EF CO ₂ - gas work gas (t/TJ)	107.6	107.6	107.6	107.6	107.6	107.6	107.6	107.6	107.6
EF CO ₂ - natural gas (t/TJ)	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8
EF CO ₂ - gasoline (t/TJ)	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6
EF CO ₂ - sub bit coal (t/TJ)	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1
CO₂ Emission (Gg)	980.0	655.5	638.2	741.6	788.6	820.7	807.3	787.3	725.6

Table A2-16: The GHG emissions from Commercial/Institutional (cont.)

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Emissions									
EF CH ₄ - petroleum (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ - diesel (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ - fuel oil (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ - LPG (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ - anthracite (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ - brown coal (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ - lignite (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ - briquettes (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ - gas work gas (kg/TJ)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
EF CH ₄ - natural gas (kg/TJ)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
EF CH ₄ - gasoline (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ - sub bit coal(kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
CH₄ Emission (Mg)	113.9	77.0	78.2	89.6	96.7	99.4	97.6	94.2	85.7
EF N ₂ O - petroleum (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O - diesel (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O - fuel oil (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O - LPG (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O - anthracite (kg/TJ)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
EF N ₂ O - brown coal (kg/TJ)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
EF N ₂ O - lignite (kg/TJ)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
EF N ₂ O - briquettes (kg/TJ)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
EF N ₂ O - gas work gas (kg/TJ)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
EF N ₂ O - natural gas (kg/TJ)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
EF N ₂ O - gasoline (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O - sub bit coal(kg/TJ)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
N₂O Emission (Mg)	8.5	4.1	4.2	4.6	5.1	5.3	5.0	4.6	4.2

Table A2-17: The GHG emissions from Residential sector

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Fuel consumption									
Petroleum (1000 t)		7.9	1.6	0.8	0.8	1.2	0.8	1	0.9
NCV for petroleum (MJ/kg)		44.0	44.0	44.0	44.0	44.0	44.0	44.0	44.0
Light heating oil (1000 t)	215.9	198.6	231.5	249.4	270.8	276.9	279.2	252.8	218.5
NCV for light heating oil (MJ/kg)	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7
Fuel oil (1000 t)	48.7	6.5	8.1	11.6	24.5	21.5	15.3	15.4	10.6
NCV for fuel oil (MJ/kg)	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2
LPG (1000 t)	97.9	57.3	51.9	53.3	55.9	57.4	61.3	60.9	63.5
NCV for LPG (MJ/kg)	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9
Brown coal (1000 t)	123.1	11.1	12.0	1.8	2.7	7.0	5.2	14	7.5
NCV for brown coal (MJ/kg)	16.7	17.3	17.8	18.2	18.2	18.5	18.2	18.5	17.7
Lignite (1000 t)	207.3	10.8	15.0	12.3	18.0	19.6	12.0	11.7	10.6
NCV for lignite (MJ/kg)	10.9	10.1	12.0	12.2	12.2	12.3	12.2	12.1	12.3
Briquettes (1000 t)	6.1								
NCV for briquettes (MJ/kg)	16.7								
Gas work gas (1000000 m3)	24.4	11.8	9.9	9.9	10.8	10.8	10.6	10.24	8.979
NCV for gas work gas (MJ/m3)	15.8	15.9	19.5	19.5	19.5	22.6	21.5	21.5	30.4
Natural gas (1000000 m3)	230.0	381.3	496.6	561.5	548.7	633.1	629.5	687.8	651.7
NCV for natural gas (MJ/m3)	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0

Table A2-17: The GHG emissions from Residential sector (cont.)

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Fuel consumption									
Biomass (TJ)	19080	11070	13410	10260	10368	13455	13140	12510	12600
Total fuel consumption (TJ)	47477	36301	43598	43379	44709	51028	50460	50831	48069
Emissions									
EF CO ₂ - petroleum (t/TJ)	71.1	71.1	71.1	71.1	71.1	71.1	71.1	71.1	71.1
EF CO ₂ - diesel (t/TJ)	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3
EF CO ₂ - fuel oil (t/TJ)	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6
EF CO ₂ - LPG (t/TJ)	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4
EF CO ₂ - brown coal (t/TJ)	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1
EF CO ₂ - lignite (t/TJ)	99.2	99.2	99.2	99.2	99.2	99.2	99.2	99.2	99.2
EF CO ₂ - briquettes (t/TJ)	95.6	95.6	95.6	95.6	95.6	95.6	95.6	95.6	95.6
EF CO ₂ - gas work gas (t/TJ)	107.6	107.6	107.6	107.6	107.6	107.6	107.6	107.6	107.6
EF CO ₂ - natural gas (t/TJ)	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8
EF CO ₂ - biomass (t/TJ)	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4
CO₂ Emission (Gg)	4068.6	2796.6	3348.9	3182.0	3293.9	3814.5	3757.8	3732.1	3551.1
EF CH ₄ - petroleum (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ - diesel (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ - fuel oil (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ - LPG (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ - brown coal (kg/TJ)	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0
EF CH ₄ - lignite (kg/TJ)	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0
EF CH ₄ - briquettes (kg/TJ)	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0
EF CH ₄ - gas work gas (kg/TJ)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
EF CH ₄ - natural gas (kg/TJ)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
EF CH ₄ - biomass (kg/TJ)	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0
CH₄ Emission (Mg)	7247.9	3594.1	4352.9	3364.8	3436.3	4409.6	4275.9	4133.5	4097.9
EF N ₂ O - petroleum (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O - diesel (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O - fuel oil (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O - LPG (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O - brown coal (kg/TJ)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
EF N ₂ O - lignite (kg/TJ)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
EF N ₂ O - briquettes (kg/TJ)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
EF N ₂ O - gas work gas (kg/TJ)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
EF N ₂ O - natural gas (kg/TJ)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
EF N ₂ O - biomass (kg/TJ)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
N₂O Emission (Mg)	92.8	53.1	63.5	51.4	52.9	65.8	64.3	61.6	60.7

Table A2-18: The GHG emissions from Agriculture/Forestry/Fishing

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Fuel consumption									
Gasoline (1000 t)	4.0	7.8	12.1	10.5	8.2	8.1	7.2	8.1	11.2
NCV for gasoline (MJ/kg)	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6
Other kerosene (1000 t)	0.1	0.1							
NCV for other kerosene (MJ/kg)	44.4	44.4							
Extra light oil (1000 t)	232.6	159.1	237.6	223.1	206.0	212.8	197.3	197.4	203.5
NCV for extra light oil (MJ/kg)	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7
Fuel consumption - mobile (TJ)	10117	7147	10687	9997	9164	9450	8748	8792	9191

Table A2-18: The GHG emissions from Agriculture/Forestry/Fishing (cont.)

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Fuel consumption									
Fuel oil (1000 t)	12.3	6.2	13.4	4.8	4.7	4.7	4.6	4.7	4.5
NCV for fuel oil (MJ/kg)	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2
LPG (1000 t)	4.4	3.2	2.6	2.7	2.6	2.8	2.7	2.7	2.8
NCV for LPG (MJ/kg)	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9
Gas work gas (1000000 m3)					0.1				
NCV for gas work gas (MJ/m3)					19.5				
Natural gas (1000000 m3)	25.0	15.5	14.5	23.6	24.3	19.9	19.4	23.2	18.9
NCV for natural gas (MJ/m3)	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
Fuel consum. - stationary (TJ)	1551	926	1154	1122	1139	997	971	1104	955
Total fuel consumption (TJ)	11668	8074	11841	11119	10303	10447	9719	9896	10146
Emissions									
EF CO ₂ - gasoline (t/TJ)	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6
EF CO ₂ - other kerosene (t/TJ)	71.1	71.1	71.1	71.1	71.1	71.1	71.1	71.1	71.1
EF CO ₂ - diesel (t/TJ)	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3
CO₂ emission (Gg) - mobile	741.0	522.4	781.1	730.8	670.2	691.2	639.9	643.0	671.6
EF CO ₂ - fuel oil (t/TJ)	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6	76.6
EF CO ₂ - LPG (t/TJ)	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4
EF CO ₂ - gas work gas (t/TJ)	107.6	107.6	107.6	107.6	107.6	107.6	107.6	107.6	107.6
EF CO ₂ - natural gas (t/TJ)	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8
CO₂ emission (Gg) - stationary	98.2	57.9	76.4	67.5	68.4	60.4	58.9	66.4	57.9
Total CO₂ emission (Gg)	839.2	580.3	857.5	798.3	738.6	751.6	698.8	709.4	729.5
EF CH ₄ - gasoline (kg/TJ)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
EF CH ₄ - other kerosene (kg/TJ)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
EF CH ₄ - diesel (kg/TJ)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
CH₄ emission (Mg) - mobile	50.6	35.7	53.4	50.0	45.8	47.2	43.7	44.0	46.0
EF CH ₄ - fuel oil (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ - LPG (kg/TJ)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
EF CH ₄ - gas work gas (kg/TJ)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
EF CH ₄ - natural gas (kg/TJ)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
CH₄ emission (Mg) - stationary	11.3	6.6	9.1	7.2	7.2	6.6	6.4	7.1	6.3
Total CH₄ emission (Mg)	61.8	42.4	62.5	57.2	53.1	53.8	50.2	51.1	52.3
EF N ₂ O - gasoline (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O - other kerosene (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O - diesel (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
N₂O emission (Mg) - mobile	6.1	4.3	6.4	6.0	5.5	5.7	5.2	5.3	5.5
EF N ₂ O - fuel oil (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O - LPG (kg/TJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
EF N ₂ O - gas work gas (kg/TJ)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
EF N ₂ O - natural gas (kg/TJ)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
N₂O emission (Mg) - stationary	0.5	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.3
Total N₂O emission (Mg)	6.6	4.6	6.9	6.3	5.8	5.9	5.5	5.5	5.8

Table A2-19: Methane emissions from Coal Mining and Handling from 1990 to 1999

Source and Sink Categories		Activity Data Production (PJ)	Emission Estimates CH ₄ /(Gg)	Emission Factor kgCH ₄ /t	Emission Factor m ³ CH ₄ /t
Year 1990					
1B 1a Underground mines			2.32		
	Mining	0.174	2.04	5.86	17.50
	Post-Mining	0.174	0.29	0.82	2.45
Year 1991					
1B 1a Underground mines			2.07		
	Mining	0.155	1.82	5.86	17.50
	Post-Mining	0.155	0.25	0.82	2.45
Year 1992					
1B 1a Underground mines			1.61		
	Mining	0.120	1.41	5.86	17.50
	Post-Mining	0.120	0.20	0.82	2.45
Year 1993					
1B 1a Underground mines			1.54		
	Mining	0.115	1.35	5.86	17.50
	Post-Mining	0.115	0.19	0.82	2.45
Year 1994					
1B 1a Underground mines			1.38		
	Mining	0.103	1.21	5.86	17.50
	Post-Mining	0.103	0.17	0.82	2.45
Year 1995					
1B 1a Underground mines			1.10		
	Mining	0.082	0.96	5.86	17.50
	Post-Mining	0.082	0.13	0.82	2.45
Year 1996					
1B 1a Underground Mines			0.89		
	Mining	0.066	0.78	5.86	17.50
	Post-Mining	0.066	0.11	0.82	2.45
Year 1997					
1B 1a Underground Mines			0.65		
	Mining	0.049	0.57	5.86	17.50
	Post-Mining	0.049	0.08	0.82	2.45
Year 1998					
1B 1a Underground Mines			0.68		
	Mining	0.051	0.60	5.86	17.50
	Post-Mining	0.051	0.08	0.82	2.45
Year 1999					
1B 1a Underground Mines			0.20		
	Mining	0.015	0.18	5.86	17.50
	Post-Mining	0.015	0.03	0.82	2.45

* - 0.67 kg/m³ – Methane density at 20 °C and pressure 1 atm.

Table A2-20: Methane emissions from Oil and Gas Activities. years 1990. 1995. 2000. 2006

Source and Sink Categories		Activity data Fuel Quantity PJ	Emission Estimates CH ₄ /(Gg)	Emission Factor kgCH ₄ /PJ
Year 1990				
1B 2a Oil			0.68	
	Production	112.9	0.30	2650
	Transport	174.1	0.13	745
	Refining	287.3	0.21	135
	Storage	287.3	0.04	135
1B 2b Natural gas				54.59
	Prod./Process./Trans./Distrib.	67.40	30.87 ¹⁾	458000
	Other Leakage (non-residential)	83.52	23.34 ²⁾	279500
	Other Leakage (residential)	7.82	1.09 ³⁾	139500
1B 2c Venting and flaring				
	Gas	67.4	1.21	18000
Year 1995				
1B 2a Oil			0.49	
	Production	62.8	0.17	2650
	Transport	159.3	0.12	745
	Refining	227.6	0.17	135
	Storage	227.6	0.03	135
1B 2b Natural gas				50.60
	Prod./Process./Trans./Distrib.	69.12	31.66 ¹⁾	458000
	Other Leakage (non-residential)	69.81	19.51 ²⁾	279500
	Other Leakage (residential)	12.96	1.81 ³⁾	139500
1B 2c Venting and flaring				1.20
	Gas	66.9	1.20	18000
Year 2000				
1B 2a Oil				0.45
	Production	51.4	0.14	2650
	Transport	165.6	0.12	745
	Refining	218.4	0.16	135
	Storage	218.4	0.03	135
1B 2b Natural Gas				51.39
	Prod./Process./Trans./Distrib.	59.40	27.21 ¹⁾	458000
	Other Leakage(non-residential)	78.09	21.83 ²⁾	279500
	Other Leakage (residential)	16.88	2.36 ³⁾	139500
1B 2c Venting and Flaring				1.07
	Gas	59.4	1.07	18000
Year 2006				
1B 2a Oil				0.414
	Production	40.110	0.106	2650
	Transport	169.540	0.126	745
	Refining	206.700	0.154	135
	Storage	206.7	0.028	135
1B 2b Natural Gas				61.670
	Prod./Process./Trans./Distrib.	94.27	43.18 ¹⁾	458000
	Other Leakage(non-residential)	77.7	21.72 ²⁾	279500
	Other Leakage (residential)	22.16	3.09 ³⁾	139500
1B 2c Venting and Flaring				1.4
	Gas	79.761	1.4	18000

¹⁾ – Methane emissions from Processing, Transmission and Distribution²⁾ – Other Leakage at Industrial Plants and Power Stations³⁾ – Other Leakage in Residential and Commercial Sectors

ANNEX 3

CO₂ REFERENCE APPROACH AND COMPARISON WITH SECTORAL APPROACH, AND RELEVANT INFORMATION ON THE NATIONAL ENERGY BALANCE

Table A3-1: Fuel combustion CO₂ emissions (Reference and Sectoral Approach)

YEAR	FUEL TYPES	Reference approach		Sectoral approach		Difference	
		Energy Consump. excluding non-energy (PJ)	CO ₂ emissions (Gg)	Energy Consump. (PJ)	CO ₂ emission (Gg)	Energy Consump. (%)	CO ₂ emission (%)
1990	Liquid Fuels	182.19	12845.26	183.56	13420.97	-0.75	-4.29
	Solid Fuels	34.27	3102.88	29.10	2846.60	17.77	9.00
	Gaseous Fuels	76.47	5119.89	75.93	4630.00	0.71	10.58
	Total	292.93	21068.03	288.59	20897.58	1.50	0.82
1991	Liquid Fuels	125.85	9007.48	130.07	9524.10	-3.24	-5.42
	Solid Fuels	21.07	1850.52	17.74	1728.49	18.76	7.06
	Gaseous Fuels	69.29	4761.08	63.41	3758.39	9.27	26.68
	Total	216.21	15619.09	211.23	15010.97	2.36	4.05
1992	Liquid Fuels	119.35	8509.32	123.14	9061.37	-3.08	-6.09
	Solid Fuels	17.25	1476.32	13.77	1316.11	25.34	12.17
	Gaseous Fuels	67.53	4925.12	63.40	3652.41	6.52	34.85
	Total	204.14	14910.77	200.31	14029.90	1.91	6.28
1993	Liquid Fuels	117.56	8510.98	126.16	9267.95	-6.81	-8.17
	Solid Fuels	14.71	1225.37	11.14	1060.24	32.09	15.57
	Gaseous Fuels	83.90	5629.63	73.52	4202.97	14.13	33.94
	Total	216.18	15365.98	210.81	14531.16	2.54	5.75
1994	Liquid Fuels	121.93	9050.93	125.78	9209.85	-3.06	-1.73
	Solid Fuels	9.20	771.63	6.84	661.74	34.49	16.61
	Gaseous Fuels	70.00	4874.18	68.17	3862.72	2.68	26.18
	Total	201.12	14696.73	200.79	13734.31	0.16	7.01
1995	Liquid Fuels	136.27	9987.52	142.32	10440.86	-4.25	-4.34
	Solid Fuels	7.71	735.29	7.63	728.68	1.04	0.91
	Gaseous Fuels	62.06	4507.30	56.49	3162.75	9.85	42.51
	Total	206.04	15230.10	206.44	14332.29	-0.20	6.26
1996	Liquid Fuels	147.34	10607.65	145.51	10674.10	1.26	-0.62
	Solid Fuels	6.21	581.76	6.18	589.91	0.42	-1.38
	Gaseous Fuels	72.48	5049.65	65.50	3667.91	10.66	37.67
	Total	226.03	16239.06	217.19	14931.91	4.07	8.75
1997	Liquid Fuels	147.43	10576.41	150.53	11027.81	-2.06	-4.09
	Solid Fuels	10.17	948.59	10.19	962.07	-0.17	-1.40
	Gaseous Fuels	74.01	5235.05	68.40	3827.87	8.21	36.76
	Total	231.62	16760.06	229.13	15817.75	1.09	5.96
1998	Liquid Fuels	163.14	11749.54	164.66	12099.18	-0.92	-2.89
	Solid Fuels	9.87	920.05	9.86	928.38	0.11	-0.90
	Gaseous Fuels	74.70	5033.22	69.69	3904.29	7.18	28.92
	Total	247.71	17702.81	244.21	16931.85	1.43	4.55
1999	Liquid Fuels	171.92	12720.47	174.79	12870.31	-1.64	-1.16
	Solid Fuels	8.63	803.39	8.52	800.49	1.23	0.36
	Gaseous Fuels	72.95	5104.55	67.99	3809.02	7.30	34.01
	Total	253.49	18628.41	251.29	17479.83	0.88	6.57
2000	Liquid Fuels	148.90	11055.21	154.33	11287.50	-3.51	-2.06
	Solid Fuels	18.65	1732.78	18.68	1750.18	-0.16	-0.99
	Gaseous Fuels	73.77	5147.35	68.74	3847.18	7.32	33.80
	Total	241.32	17935.33	241.74	16884.86	-0.17	6.22
2001	Liquid Fuels	155.14	11508.51	159.56	11707.27	-2.77	-1.70
	Solid Fuels	19.83	1842.48	19.69	1836.26	0.73	0.34
	Gaseous Fuels	81.58	5393.45	75.29	4215.80	8.35	27.93
	Total	256.54	18744.44	254.54	17759.34	0.79	5.55

Table A3-1: Fuel combustion CO₂ emissions (Reference and Sectoral Approach) - cont.

YEAR	FUEL TYPES	Reference approach		Sectoral approach		Difference	
		Energy Consump. excluding non-energy (PJ)	CO ₂ emissions (Gg)	Energy Consump. (PJ)	CO ₂ emission (Gg)	Energy Consump. (%)	CO ₂ emission (%)
2002	Liquid Fuels	169.08	12533.70	165.19	12122.35	2.36	3.39
	Solid Fuels	24.43	2277.22	24.03	2239.42	1.66	1.69
	Gaseous Fuels	85.37	5525.01	79.72	4473.28	7.09	23.51
	Total	278.89	20335.93	268.94	18835.05	3.70	7.97
2003	Liquid Fuels	179.28	13302.49	182.41	13390.56	-1.72	-0.66
	Solid Fuels	27.20	2532.94	27.03	2516.83	0.64	0.64
	Gaseous Fuels	82.90	5494.30	77.66	4360.20	6.75	26.01
	Total	289.38	21329.73	287.09	20267.59	0.80	5.24
2004	Liquid Fuels	166.44	12383.85	168.31	12361.46	-1.11	0.18
	Solid Fuels	28.88	2687.52	29.01	2699.99	-0.46	-0.46
	Gaseous Fuels	86.27	5726.60	82.25	4611.82	4.88	24.17
	Total	281.59	20797.97	279.58	19673.27	0.72	5.72
2005	Liquid Fuels	173.51	12962.09	174.44	12915.13	-0.54	0.36
	Solid Fuels	28.64	2667.30	28.53	2656.56	0.41	0.40
	Gaseous Fuels	83.10	5537.49	79.94	4482.91	3.95	23.52
	Total	285.25	21166.87	282.91	20054.60	0.83	5.55
2006	Liquid Fuels	174.83	13053.17	175.16	13149.82	-0.19	-0.74
	Solid Fuels	26.56	2389.29	26.38	2457.32	0.68	-2.77
	Gaseous Fuels	82.65	5482.00	78.99	4455.51	4.63	23.04
	Total	284.04	20924.46	280.53	20062.64	1.25	4.30

* - Excluding international bunkers

Table A3-2: Net calorific values for different fossil fuels from 1990 to 2006

			Net calorific values 1990- 2006 MJ/kg(m ³)
Liquid Fossil	Primary Fuel	Crude Oil	41.87-42.4
	Secondary Fuel	Motor Gasoline	44.59
		Jet Kerosene	43.96
		Gas/Diesel Oil	42.71
		Residual Fuel Oil	40.19
		LPG	46.89
		Naphtha	44.59
		Bitumen	33.5
		Lubricants	33.5
		Refinery Gas	48.57
		Petroleum Coke	29.31-31
		Ethane	47.31
Solid Fossil	Primary Fuel	Anthracite	29.29-29.31
		Other Bituminous Coal	24.3-26.9
		Sub Bituminous Coal	16.74-18.73
		Lignite	10.52-12.15
	Secondary Fuel	Gas Work Gas	15.82-22.63
		Coke Oven Coke	29.31
			TJ/Mm ³
Natural Gas		Natural Gas	34
Biomass		Solid Biomass Fuel Wood	9

Table A3-3: National energy balance for 2006

	Anthracite		Hard coal		Brown coal		Lignite	
	10 ³ t	PJ	10 ³ t	PJ	10 ³ t	PJ	10 ³ t	PJ
Production	-	-	-	-	-	-	-	-
Import	0.1	0.003	1082.5	26.90	73.3	1.30	11.0	0.14
Export	-	-	-	-	-	-	-	-
Stock change	-	-	-95.9	2.38	-	-	-	-
International marine bunkers	-	-	-	-	-	-	-	-
Energy supplied	0.1	0.003	986.6	24.52	73.3	1.30	11.0	0.14
Energy sector own use	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-oil and gas extraction	-	-	-	-	-	-	-	-
-electric energy supply industry	-	-	-	-	-	-	-	-
-oil refineries	-	-	-	-	-	-	-	-
-NGL plant	-	-	-	-	-	-	-	-
Total transformation sector	0.0	0.0	835.6	20.76	54.5	0.97	0.0	0.0
-hydro power plants	-	-	-	-	-	-	-	-
-thermal power plants	-	-	835.6	20.76	-	-	-	-
-public cogeneration plants	-	-	-	-	-	-	-	-
-public heating plants	-	-	-	-	-	-	-	-
-indust. cogeneration plants	-	-	-	-	54.5	0.97	-	-
-industrial heating plants	-	-	-	-	-	-	-	-
-petroleum refineries	-	-	-	-	-	-	-	-
-NGL-plant	-	-	-	-	-	-	-	-
-gas works	-	-	-	-	-	-	-	-
Non energy use	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Losses	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final energy demand	0.1	0.003	151.0	3.75	18.1	0.33	11.0	0.14
Industry	0.1	0.003	151.0	3.75	6.8	0.12	0.2	0.00
-iron and steel	-	-	-	-	-	-	-	-
-non-ferrous metals	-	-	-	-	-	-	-	-
-non-metallic minerals	-	-	3.1	0.08	-	-	-	-
-chemical	-	-	-	-	-	-	-	-
-construction materials	-	-	145.1	3.61	4.0	0.07	-	-
-pulp and paper	-	-	-	-	-	-	-	-
-food production	-	-	-	-	-	-	-	-
-not elsewhere specified	0.1	0.03	2.8	0.07	2.8	0.05	0.2	0.00
Other sectors	-	-	-	-	12.0	0.21	10.8	0.13
-households	-	-	-	-	7.5	0.13	10.6	0.13
-services	-	-	-	-	4.5	0.08	0.2	0.00
-agriculture	-	-	-	-	-	-	-	-
-construction	-	-	-	-	-	-	-	-
Transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-rail	-	-	-	-	-	-	-	-
-road	-	-	-	-	-	-	-	-
-air	-	-	-	-	-	-	-	-
-sea and river	-	-	-	-	-	-	-	-
-public city	-	-	-	-	-	-	-	-

Table A3-3: National energy balance for 2006 (continue)

	Crude oil		Natural gas		Fuel wood		Industrial waste
	10 ³ t	PJ	10 ⁶ m ³	PJ	10 ³ m ³	PJ	TJ
Production	917.4	38.90	2413.5	94.274	1668.0	15.01	2220.3
Import	3799.0	161.08	1126.5	38.301	3.4	0.03	-
Export	-	-	895.6	30.450	213.6	1.92	-
Stock change	23.9	1.01	-66.6	-	-	-	-
International marine bunkers	-	-	-	-	-	-	-
Energy supplied	4740.3	200.99	2877.8	2.264	1457.8	0.18	2220.3
Energy sector own use	-	-	91.5	3.11	-	-	-
-oil and gas extraction	-	-	85.7	2.91	-	-	-
-electric energy supply industry	-	-	-	-	-	-	-
-oil refineries	-	-	0.4	0.01	-	-	-
-NGL plant	-	-	5.4	0.18	-	-	-
Total transformation sector	4710.3	200.99	1032.5	37.12	-	-	2220.3
-hydro power plants	-	-	-	-	-	-	-
-thermal power plants	-	-	118.1	15.60	-	-	57.0
-public cogeneration plants	-	-	458.7	2.11	-	-	-
-public heating plants	-	-	62.1	9.23	-	-	-
-industrial cogeneration plants	-	-	271.4	2.28	-	-	132.3
-industrial heating plants	-	-	92.1	3.10	-	-	2031.0
-petroleum refineries	4629.8	196.3	-	-	-	-	-
-NGL-plant	110.5	4.69	31.0	3.07	-	-	-
-gas works	-	-	-	-	-	-	-
Non energy use	-	-	462.9	15.74	-	-	-
Losses	-	-	65.3	2.22	-	-	-
Final energy demand	-	-	1225.6	41.67	1457.8	13.12	-
Industry	-	-	408.0	13.87	57.8	0.52	-
-iron and steel	-	-	27.2	0.92	0.1	0.00	-
-non-ferrous metals	-	-	0.3	0.01	0.8	0.01	-
-non-metallic minerals	-	-	61.0	2.07	-	-	-
-chemical	-	-	69.1	2.35	0.2	0.00	-
-construction materials	-	-	118.3	4.02	0.4	0.00	-
-pulp and paper	-	-	6.3	0.21	-	-	-
-food production	-	-	71.9	2.44	0.2	0.00	-
-not elsewhere specified	-	-	53.9	1.83	56.1	0.50	-
Other sectors	-	-	817.6	27.80	1400	12.60	-
-households	-	-	651.7	22.16	1400	12.60	-
-services	-	-	147.0	5.00	-	-	-
-agriculture	-	-	18.9	0.64	-	-	-
-construction	-	-	-	-	-	-	-
Transport	-	-	-	-	-	-	-
-rail	-	-	-	-	-	-	-
-road	-	-	-	-	-	-	-
-air	-	-	-	-	-	-	-
-sea and river	-	-	-	-	-	-	-
-public city	-	-	-	-	-	-	-

Table A3-3: National energy balance for 2006 (continue)

	Coke oven coke		Liquefied petroleum gases		Unleaded motor gasoline		Standard motor gasoline	
	10 ³ t	PJ	10 ³ t	PJ	10 ³ t	PJ	10 ³ t	PJ
Production	-	-	335.1	15.71	964.3	43.0	118.7	5.29
Import	20.6	0.6	2.2	0.1	305.9	13.64	1.1	0.05
Export	-	-	171.6	8.05	559.5	24.95	120.5	5.37
Stock change	-	-	-2.3	-0.11	1.8	0.02	1.8	0.08
International marine bunkers	-	-	-	-	-	-	-	-
Energy supplied	20.6	0.6	163.4	7.66	710.2	31.67	1.1	0.05
Energy sector own use	-	-	-	-	-	-	-	-
-oil and gas extraction	-	-	-	-	-	-	-	-
-electric energy supply ind.	-	-	-	-	-	-	-	-
-oil refineries	-	-	5.5	0.26	-	-	-	-
-NGL plant	-	-	-	-	-	-	-	-
Total transformation sector	-	-	-	-	-	-	-	-
-hydro power plants	-	-	-	-	-	-	-	-
-thermal power plants	-	-	-	-	-	-	-	-
-public cogeneration plants	-	-	-	-	-	-	-	-
-public heating plants	-	-	-	-	-	-	-	-
-industrial cogeneration plants	-	-	4.2	0.2	-	-	-	-
-industrial heating plants	-	-	0.4	0.02	-	-	-	-
-petroleum refineries	-	-	-	-	-	-	-	-
-NGL-plant	-	-	-	-	-	-	-	-
-gas works	-	-	12.1	0.57	-	-	-	-
Non energy use	-	-	-	-	-	-	-	-
Losses	-	-	-	-	-	-	-	-
Final energy demand	20.6	0.6	141.2	6.62	-	-	-	-
Industry	20.6	0.6	23.9	1.12	-	-	-	-
-iron and steel	7.6	0.22	4.9	0.23	-	-	-	-
-non-ferrous metals	-	-	2.6	0.12	-	-	-	-
-non-metallic minerals	0.4	0.01	2.2	0.10	-	-	-	-
-chemical	-	-	-	-	-	-	-	-
-construction materials	4.9	0.14	7.1	0.33	-	-	-	-
-pulp and paper	-	-	0.1	0.00	-	-	-	-
-food production	7.3	0.21	3.0	0.14	-	-	-	-
-not elsewhere specified	0.4	0.01	4.0	0.19	-	-	-	-
Other sectors	-	-	80.4	3.77	15.7	0.7	-	-
-households	-	-	63.5	2.98	-	-	-	-
-services	-	-	9.0	0.42	-	-	-	-
-agriculture	-	-	2.8	0.13	8.4	0.37	-	-
-construction	-	-	5.1	0.24	7.3	0.33	-	-
Transport	-	-	36.9	1.73	694.5	30.97	1.1	0.05
-rail	-	-	-	-	-	-	-	-
-road	-	-	36.9	1.73	694.5	30.97	-	-
-air	-	-	-	-	-	-	1.1	0.05
-sea and river	-	-	-	-	-	-	-	-
-public city	-	-	-	-	-	-	-	-

Table A3-3: National energy balance for 2006 (continue)

	Petroleum		Jet fuel		Diesel oil		Light heating oil	
	10 ³ t	PJ	10 ³ t	PJ	10 ³ t	PJ	10 ³ t	PJ
Production	2.3	0.10	67.4	2.96	1124.6	48.03	440.1	18.8
Import	0.8	0.04	27.7	1.22	615.5	26.29	69.9	2.99
Export	1.2	0.05	2.2	0.10	282.0	12.04	112.0	4.78
Stock change	-1.0	-0.04	-1.0	0.15	-24.8	-1.06	-3.0	-0.13
International marine bunkers	-	-	-	-	6.4	0.27	-	-
Energy supplied	0.9	0.06	96.3	1.27	1426.9	12.91	114.4	1.93
Energy sector own use	-	-	-	-	-	-	2.5	0.11
-oil and gas extraction	-	-	-	-	-	-	2.5	0.11
-electric energy supply industry	-	-	-	-	-	-	-	-
-oil refineries	-	-	-	-	-	-	-	-
-NGL plant	-	-	-	-	-	-	-	-
Total transformation sector	-	-	-	-	-	-	11.3	0.48
-hydro power plants	-	-	-	-	-	-	-	-
-thermal power plants	-	-	-	-	-	-	1.1	0.05
-public cogeneration plants	-	-	-	-	-	-	-	-
-public heating plants	-	-	-	-	-	-	5.3	0.23
-industrial cogeneration plants	-	-	-	-	-	-	4.9	0.21
-industrial heating plants	-	-	-	-	-	-	-	-
-petroleum refineries	-	-	-	-	-	-	-	-
-NGL-plant	-	-	-	-	-	-	-	-
-gas works	-	-	-	-	-	-	-	-
Non energy use	-	-	-	-	-	-	-	-
Losses	-	-	-	-	-	-	-	-
Final energy demand	-	-	-	-	-	-	381.2	16.28
Industry	-	-	-	-	-	-	22.7	0.97
-iron and steel	-	-	-	-	-	-	1.3	0.06
-non-ferrous metals	-	-	-	-	-	-	0.5	0.02
-non-metallic minerals	-	-	-	-	-	-	1.8	0.08
-chemical	-	-	-	-	-	-	0.6	0.03
-construction materials	-	-	-	-	-	-	6.3	0.27
-pulp and paper	-	-	-	-	-	-	-	-
-food production	-	-	-	-	-	-	5.4	0.23
-not elsewhere specified	-	-	-	-	-	-	6.8	0.29
Other sectors	0.9	0.06	-	-	313.2	13.38	358.5	15.31
-households	0.9	0.06	-	-	-	-	218.5	9.33
-services	-	-	-	-	-	-	112.5	4.80
-agriculture	-	-	-	-	189.0	8.07	14.5	0.62
-construction	-	-	-	-	124.2	5.30	13.0	0.56
Transport	-	-	96.3	1.27	1113.7	47.57	-	-
-rail	-	-	-	-	32.3	1.38	-	-
-road	-	-	-	-	1022.5	43.67	-	-
-air	-	-	96.3	1.27	-	-	-	-
-sea and river	-	-	-	-	33.1	1.41	-	-
-public city	-	-	-	-	25.8	1.10	-	-

Table A3-3: National energy balance for 2006 (continue)

	Low sulphur fuel oil		Standard fuel oil		Naphta		White spirit	
	10 ³ t	PJ	10 ³ t	PJ	10 ³ t	PJ	10 ³ t	PJ
Production	-	-	1097.0	44.09	203.3	9.07	-	-
Import	118.0	4.74	-	-	-	-	5.3	0.18
Export	-	-	225.8	9.7	184.0	8.20	-	-
Stock change	-3.6	-0.14	4.9	0.2	22.4	1.00	-	-
International marine bunkers	-	-	13.3	0.53	-	-	-	-
Energy supplied	114.4	4.60	862.8	9.41	41.7	7.21	5.3	0.18
Energy sector own use	-	-	58.1	2.34	-	-	-	-
-oil and gas extraction	-	-	-	-	-	-	-	-
-electric energy supply industry	-	-	-	-	-	-	-	-
-oil refineries	-	-	58.1	2.34	-	-	-	-
-NGL plant	-	-	-	-	-	-	-	-
Total transformation sector	103.3	4.15	703.1	28.26	41.7	1.86	-	-
-hydro power plants	-	-	-	-	-	-	-	-
-thermal power plants	78.2	3.14	233.1	9.37	-	-	-	-
-public cogeneration plants	25.1	1.01	131.0	5.26	-	-	-	-
-public heating plants	-	-	33.5	1.35	-	-	-	-
-industrial cogeneration plants	-	-	262.1	10.53	-	-	-	-
-industrial heating plants	-	-	43.4	1.74	-	-	-	-
-petroleum refineries	-	-	-	-	41.7	1.86	-	-
-NGL-plant	-	-	-	-	-	-	-	-
-gas works	-	-	-	-	-	-	-	-
Non energy use	-	-	-	-	-	-	5.3	0.18
Losses	-	-	-	-	-	-	-	-
Final energy demand	11.1	0.45	101.6	4.08	-	-	-	-
Industry	11.1	0.45	82.0	3.30	-	-	-	-
-iron and steel	-	-	0.3	0.01	-	-	-	-
-non-ferrous metals	-	-	2.7	0.11	-	-	-	-
-non-metallic minerals	-	-	2.8	0.11	-	-	-	-
-chemical	10.1	0.41	33.5	1.35	-	-	-	-
-construction materials	-	-	27.3	1.10	-	-	-	-
-pulp and paper	-	-	1.8	0.07	-	-	-	-
-food production	-	-	7.0	0.28	-	-	-	-
-not elsewhere specified	1.0	0.04	6.6	0.27	-	-	-	-
Other sectors	-	-	19.6	0.79	-	-	-	-
-households	-	-	10.6	0.43	-	-	-	-
-services	-	-	4.5	0.18	-	-	-	-
-agriculture	-	-	4.5	0.18	-	-	-	-
-construction	-	-	-	-	-	-	-	-
Transport	-	-	-	-	-	-	-	-
-rail	-	-	-	-	-	-	-	-
-road	-	-	-	-	-	-	-	-
-air	-	-	-	-	-	-	-	-
-sea and river	-	-	-	-	-	-	-	-
-public city	-	-	-	-	-	-	-	-

Table A3-3: National energy balance for 2006 (continue)

	Bitumen		Lubricants		Paraffin and wax		Petroleum coke	
	10 ³ t	PJ	10 ³ t	PJ	10 ³ t	PJ	10 ³ t	PJ
Production	215.9	7.23	52.5	1.76	7.3	0.24	114.0	3.53
Import	77.9	2.61	27.9	0.93	6.0	0.20	213.6	6.62
Export	94.7	3.17	45.4	1.52	1.5	0.05	36.8	1.14
Stock change	0.7	0.02	3.1	0.10	-0.7	0.02	-13.9	0.43
International marine bunkers	-	-	-	-	-	-	-	-
Energy supplied	199.8	6.69	38.1	1.28	11.1	0.37	276.9	8.58
Energy sector own use	-	-	-	-	-	-	55.0	1.71
-oil and gas extraction	-	-	-	-	-	-	-	-
-electric energy supply industry	-	-	-	-	-	-	-	-
-oil refineries	-	-	-	-	-	-	55.0	1.71
-NGL plant	-	-	-	-	-	-	-	-
Total transformation sector	-	-	-	-	-	-	6.9	0.21
-hydro power plants	-	-	-	-	-	-	-	-
-thermal power plants	-	-	-	-	-	-	-	-
-public cogeneration plants	-	-	-	-	-	-	-	-
-public heating plants	-	-	-	-	-	-	-	-
-industrial cogeneration plants	-	-	-	-	-	-	6.9	0.21
-industrial heating plants	-	-	-	-	-	-	-	-
-petroleum refineries	-	-	-	-	-	-	-	-
-NGL-plant	-	-	-	-	-	-	-	-
-gas works	-	-	-	-	-	-	-	-
Non energy use	199.8	6.69	38.1	1.28	11.1	0.37	-	-
Losses	-	-	-	-	-	-	-	-
Final energy demand	-	-	-	-	-	-	-	-
Industry	-	-	-	-	-	-	215.0	6.67
-iron and steel	-	-	-	-	-	-	-	-
-non-ferrous metals	-	-	-	-	-	-	-	-
-non-metallic minerals	-	-	-	-	-	-	4.4	0.14
-chemical	-	-	-	-	-	-	1.1	0.03
-construction materials	-	-	-	-	-	-	205.6	6.37
-pulp and paper	-	-	-	-	-	-	-	-
-food production	-	-	-	-	-	-	-	-
-not elsewhere specified	-	-	-	-	-	-	3.9	0.12
Other sectors	-	-	-	-	-	-	-	-
-households	-	-	-	-	-	-	-	-
-services	-	-	-	-	-	-	-	-
-agriculture	-	-	-	-	-	-	-	-
-construction	-	-	-	-	-	-	-	-
Transport	-	-	-	-	-	-	-	-
-rail	-	-	-	-	-	-	-	-
-road	-	-	-	-	-	-	-	-
-air	-	-	-	-	-	-	-	-
-sea and river	-	-	-	-	-	-	-	-
-public city	-	-	-	-	-	-	-	-

Table A3-3: National energy balance for 2006 (continue)

	Ethane		Refinery gas		Refinery semiproducts		Additives	
	10 ³ t	PJ	10 ³ t	PJ	10 ³ t	PJ	10 ³ t	PJ
Production	63.6	3.01	210.4	10.22	-	-	-	-
Import	-	-	-	-	137.6	5.83	24.8	1.05
Export	-	-	-	-	-	-	-	-
Stock change	-	-	-	-	69.2	2.93	-0.5	-0.02
International marine bunkers	-	-	-	-	-	-	-	-
Energy supplied	-	-	210.4	10.22	206.8	8.77	24.3	1.03
Energy sector own use	-	-	195.2	9.48	-	-	-	-
-oil and gas extraction	-	-	-	-	-	-	-	-
-electric energy supply industry	-	-	-	-	-	-	-	-
-oil refineries	-	-	195.2	9.48	206.8	8.77	-	-
-NGL plant	-	-	-	-	-	-	-	-
Total transformation sector	-	-	15.2	0.74	-	-	24.3	1.03
-hydro power plants	-	-	-	-	-	-	-	-
-thermal power plants	-	-	-	-	-	-	-	-
-public cogeneration plants	-	-	-	-	-	-	-	-
-public heating plants	-	-	-	-	-	-	-	-
-industrial cogeneration plants	-	-	15.2	0.74	-	-	24.3	1.03
-industrial heating plants	-	-	-	-	-	-	-	-
-petroleum refineries	-	-	-	-	-	-	-	-
-NGL-plant	-	-	-	-	-	-	-	-
-gas works	-	-	-	-	-	-	-	-
Non energy use	63.6	3.01	-	-	-	-	-	-
Losses	-	-	-	-	-	-	-	-
Final energy demand	-	-	-	-	-	-	-	-
Industry	-	-	-	-	-	-	-	-
-iron and steel	-	-	-	-	-	-	-	-
-non-ferrous metals	-	-	-	-	-	-	-	-
-non-metallic minerals	-	-	-	-	-	-	-	-
-chemical	-	-	-	-	-	-	-	-
-construction materials	-	-	-	-	-	-	-	-
-pulp and paper	-	-	-	-	-	-	-	-
-food production	-	-	-	-	-	-	-	-
-not elsewhere specified	-	-	-	-	-	-	-	-
Other sectors	-	-	-	-	-	-	-	-
-households	-	-	-	-	-	-	-	-
-services	-	-	-	-	-	-	-	-
-agriculture	-	-	-	-	-	-	-	-
-construction	-	-	-	-	-	-	-	-
Transport	-	-	-	-	-	-	-	-
-rail	-	-	-	-	-	-	-	-
-road	-	-	-	-	-	-	-	-
-air	-	-	-	-	-	-	-	-
-sea and river	-	-	-	-	-	-	-	-
-public city	-	-	-	-	-	-	-	-

Table A3-3: National energy balance for 2006 (continue)

	Gas works gas		Other products		Electricity		Steam and hot water
	10 ³ m ³	PJ	10 ³ t	PJ	GWh	PJ	TJ
Production	17873.1	0.54	14.6	0.59	12429.6	44.75	33223.6
Import	-	-	2.9	0.12	8313.1	29.93	-
Export	-	-	14.5	0.58	2690.9	9.69	-
Stock change	-	-	-	-	-	-	-
International marine bunkers	-	-	-	-	-	-	-
Energy supplied	17873.1	0.54	3.0	0.12	18051.8	64.98	33223.6
Energy sector own use	-	-	-	-	1080.7	3.89	9160.1
-oil and gas extraction	-	-	-	-	113.4	0.41	668.7
-electric energy supply industry	-	-	-	-	33.4	0.12	-
-hydro power plants	-	-	-	-	216.5	0.78	-
-thermal power plants	-	-	-	-	317.5	1.14	-
-public cogeneration plants	-	-	-	-	96.1	0.35	770.1
-oil refineries	-	-	-	-	290.6	1.05	7209.3
-NGL plant	-	-	-	-	13.2	0.05	512.0
Total transformation sector	1756.0	0.05	-	-	-	-	-
-hydro power plants	-	-	-	-	-	-	-
-thermal power plants	-	-	-	-	-	-	-
-public cogeneration plants	1756.0	0.05	-	-	-	-	-
-public heating plants	-	-	-	-	-	-	-
-industrial cogeneration plants	-	-	-	-	-	-	-
-industrial heating plants	-	-	-	-	-	-	-
-gas works	-	-	-	-	-	-	-
-public heating plants	-	-	-	-	-	-	-
Total transformation sector	-	-	-	-	-	-	-
Non energy use	-	-	3.0	0.12	-	-	-
Losses	771.4	0.02	-	-	1908.8	6.87	1504.2
Final energy demand	15345.7	0.47	-	-	15062.3	54.22	22559.3
Industry	3035.7	0.09	-	-	3455.3	12.44	14956.0
-iron and steel	-	-	-	-	293.6	1.06	114.2
-non-ferrous metals	-	-	-	-	90.6	0.33	-
-non-metallic minerals	899.0	0.03	-	-	133.1	0.48	197.1
-chemical	-	-	-	-	483.9	1.74	4787.5
-construction materials	-	-	-	-	648.8	2.34	33.1
-pulp and paper	19.0	0.00	-	-	263.3	0.95	2207.1
-food production	170.7	0.01	-	-	555.6	2.00	4744.8
-not elsewhere specified	1947.0	0.06	-	-	986.4	3.55	2872.2
Other sectors	12310.0	0.37	-	-	11304.8	40.70	7603.3
-households	8979.0	0.27	-	-	6520.3	23.47	6118.7
-services	3331.0	0.10	-	-	4455.3	16.04	1484.6
-agriculture	-	-	-	-	68.3	0.25	-
-construction	-	-	-	-	260.9	0.94	-
Transport	-	-	-	-	302.2	1.09	-
-rail	-	-	-	-	180.4	0.65	-
-road	-	-	-	-	-	-	-
-air	-	-	-	-	10.9	0.04	-
-sea and river	-	-	-	-	25.6	0.09	-
-public city	-	-	-	-	62.5	0.23	-
-other	-	-	-	-	22.8	0.08	-

ANNEX 4

ASSESSMENT OF COMPLETENESS AND (POTENTIAL) SOURCES AND SINKS OF GREENHOUSE GAS EMISSIONS AND REMOVALS EXCLUDED

Table A4-1 shows source/sink categories of GHGs that are not estimated in the Croatian GHG inventory, and the explanations for those categories being omitted. This table is taken from the CRF Table9s1.

Table A4-1 GHGs and source/sink categories not considered in the Croatian GHG inventory

GHG	Sector	Source/sink category	Explanation
Carbon	5 LULUCF	5.A.2.2 Grassland converted to Forest Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.A.2.5 Other Land converted to Forest Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.1 5.B.1 Cropland remaining Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.2.1 Forest Land converted to Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.2.2 Grassland converted to Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.2.3 Wetlands converted to Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.2.5 Other Land converted to Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.1 5.C.1 Grassland remaining Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.2.1 Forest Land converted to Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.2.2 Cropland converted to Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.2.3 Wetlands converted to Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.2.5 Other Land converted to Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.D.1 5.D.1 Wetlands remaining Wetlands	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.1 5.E.1 Settlements remaining Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.2.1 Forest Land converted to Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.2.2 Cropland converted to Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.2.3 Grassland converted to Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.2.4 Wetlands converted to Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.2.5 Other Land converted to Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.F.2.1 Forest Land converted to Other Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.F.2.2 Cropland converted to Other Land	Difficulties in collecting adequate activity data.

Table A4-1 GHGs and source/sink categories not considered in the Croatian GHG inventory (cont.)

GHG	Sector	Source/sink category	Explanation
Carbon	5 LULUCF	5.F.2.3 Grassland converted to Other Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.F.2.4 Wetlands converted to Other Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.F.2.5 Settlements converted to Other Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.A.2.2 Grassland converted to Forest Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.A.2.5 Other Land converted to Forest Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.1 5.B.1 Cropland remaining Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.2.1 Forest Land converted to Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.2.2 Grassland converted to Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.2.3 Wetlands converted to Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.2.5 Other Land converted to Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.1 5.C.1 Grassland remaining Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.2.1 Forest Land converted to Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.2.2 Cropland converted to Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.2.3 Wetlands converted to Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.2.5 Other Land converted to Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.D.1 5.D.1 Wetlands remaining Wetlands	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.1 5.E.1 Settlements remaining Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.2.1 Forest Land converted to Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.2.2 Cropland converted to Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.2.3 Grassland converted to Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.2.4 Wetlands converted to Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.2.5 Other Land converted to Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.F.2.1 Forest Land converted to Other Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.F.2.2 Cropland converted to Other Land	Difficulties in collecting adequate activity data.

Table A4-1 GHGs and source/sink categories not considered in the Croatian GHG inventory (cont.)

GHG	Sector	Source/sink category	Explanation
Carbon	5 LULUCF	5.F.2.3 Grassland converted to Other Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.F.2.4 Wetlands converted to Other Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.F.2.5 Settlements converted to Other Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.A.1 5.A.1 Forest Land remaining Forest Land	no data available
Carbon	5 LULUCF	5.A.2.2 Grassland converted to Forest Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.A.2.5 Other Land converted to Forest Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.1 5.B.1 Cropland remaining Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.2.1 Forest Land converted to Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.2.2 Grassland converted to Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.2.3 Wetlands converted to Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.2.5 Other Land converted to Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.1 5.C.1 Grassland remaining Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.2.1 Forest Land converted to Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.2.2 Cropland converted to Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.2.3 Wetlands converted to Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.2.5 Other Land converted to Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.D.1 5.D.1 Wetlands remaining Wetlands	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.1 5.E.1 Settlements remaining Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.2.1 Forest Land converted to Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.2.2 Cropland converted to Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.2.3 Grassland converted to Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.2.4 Wetlands converted to Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.2.5 Other Land converted to Settlements	Difficulties in collecting adequate activity data.

Table A4-1 GHGs and source/sink categories not considered in the Croatian GHG inventory (cont.)

GHG	Sector	Source/sink category	Explanation
Carbon	5 LULUCF	5.F.2.1 Forest Land converted to Other Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.F.2.2 Cropland converted to Other Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.F.2.3 Grassland converted to Other Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.F.2.4 Wetlands converted to Other Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.F.2.5 Settlements converted to Other Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.D.1 5.D.1 Wetlands remaining Wetlands	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.1 5.E.1 Settlements remaining Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.2.1 Forest Land converted to Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.2.2 Cropland converted to Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.2.3 Grassland converted to Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.2.4 Wetlands converted to Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.E.2.5 Other Land converted to Settlements	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.F.2.1 Forest Land converted to Other Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.F.2.2 Cropland converted to Other Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.F.2.3 Grassland converted to Other Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.F.2.4 Wetlands converted to Other Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.F.2.5 Settlements converted to Other Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.A.1 5.A.1 Forest Land remaining Forest Land	no data available
Carbon	5 LULUCF	5.A.2.2 Grassland converted to Forest Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.A.2.5 Other Land converted to Forest Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.1 5.B.1 Cropland remaining Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.2.1 Forest Land converted to Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.2.2 Grassland converted to Cropland	Difficulties in collecting adequate activity data.

Table A4-1 GHGs and source/sink categories not considered in the Croatian GHG inventory (cont.)

GHG	Sector	Source/sink category	Explanation
Carbon	5 LULUCF	5.B.2.3 Wetlands converted to Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.2.5 Other Land converted to Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.1 5.C.1 Grassland remaining Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.2.1 Forest Land converted to Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.2.2 Cropland converted to Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.2.3 Wetlands converted to Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.2.5 Other Land converted to Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.A.1 5.A.1 Forest Land remaining Forest Land	no data available
Carbon	5 LULUCF	5.A.2.2 Grassland converted to Forest Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.A.2.5 Other Land converted to Forest Land	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.1 5.B.1 Cropland remaining Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.2.1 Forest Land converted to Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.2.2 Grassland converted to Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.2.3 Wetlands converted to Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.B.2.5 Other Land converted to Cropland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.1 5.C.1 Grassland remaining Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.2.1 Forest Land converted to Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.2.2 Cropland converted to Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.2.3 Wetlands converted to Grassland	Difficulties in collecting adequate activity data.
Carbon	5 LULUCF	5.C.2.5 Other Land converted to Grassland	Difficulties in collecting adequate activity data.
CH ₄	1 Energy	1.B.2.A.1 Exploration	Activity data and emission factors were not available
CH ₄	1 Energy	1.B.2.B.1 Exploration	Activity data and emission factors were not available
CH ₄	2 Industrial Processes	2.A.7.1 Glass Production	The IPCC Guidelines do not provide methodologies for calculation of CH ₄ emission

Table A4-1 GHGs and source/sink categories not considered in the Croatian GHG inventory (cont.)

GHG	Sector	Source/sink category	Explanation
CH ₄	2 Industrial Processes	2.C.1.1 Steel	The IPCC Guidelines do not provide methodologies for calculation of CH ₄ emission
CH ₄	2 Industrial Processes	2.B.5 Propylene	The IPCC Guidelines do not provide methodologies for calculation of CH ₄ emission
CH ₄	2 Industrial Processes	2.B.5 Polyvinylchloride	The IPCC Guidelines do not provide methodologies for calculation of CH ₄ emission
CH ₄	2 Industrial Processes	2.B.5 Polystyrene	The IPCC Guidelines do not provide methodologies for calculation of CH ₄ emission
CH ₄	2 Industrial Processes	2.B.5 Sulphuric acid production	The IPCC Guidelines do not provide methodologies for calculation of CH ₄ emission
CH ₄	2 Industrial Processes	2.B.5 Polyethylene low density	The IPCC Guidelines do not provide methodologies for calculation of CH ₄ emission
CH ₄	4 Agriculture	4.A 4.A Enteric Fermentation	No data available
CH ₄	5 LULUCF	5.A.1 5.A.1 Forest Land remaining Forest Land	Difficulties in collecting adequate activity data.
CH ₄	5 LULUCF	5.A.1 5.A.1 Forest Land remaining Forest Land	Difficulties in collecting adequate activity data.
CH ₄	5 LULUCF	5.B.1 5.B.1 Cropland remaining Cropland	Difficulties in collecting adequate activity data.
CH ₄	5 LULUCF	5.C.1 5.C.1 Grassland remaining Grassland	Difficulties in collecting adequate activity data.
CH ₄	5 LULUCF	5.D.1 5.D.1 Wetlands remaining Wetlands	Difficulties in collecting adequate activity data.
CH ₄	5 LULUCF	5.E.1 Settlements remaining Settlements	Difficulties in collecting adequate activity data.
CH ₄	5 LULUCF	5.E.2 Land converted to Settlements	Difficulties in collecting adequate activity data.
CH ₄	5 LULUCF	5.F.2 Land converted to Other Land	Difficulties in collecting adequate activity data.
CH ₄	5 LULUCF	5.G Harvested Wood Products	Difficulties in collecting adequate activity data.
CH ₄	6 Waste	6.B.2.1 6.B.2.1 Domestic and Commercial (w/o human sewage)	CH ₄ emissions from Wastewater Handling (Domestic and Commercial Wastewater) are not estimated because activity data are not available.
CH ₄	6 Waste	6.C.2 Incineration of hospital wastes	IPCC Guidelines do not provide default emission factor for CH ₄ emission calculation from Incineration of clinical waste. There is no national information on these data. Information about type of incineration/technology is lacking.
CO ₂	2 Industrial Processes	2.A.5 Asphalt Roofing	The IPCC Guidelines do not provide methodologies for calculation of CO ₂ emission
CO ₂	2 Industrial Processes	2.A.6 Road Paving with Asphalt	The IPCC Guidelines do not provide methodologies for calculation of CO ₂ emission
CO ₂	2 Industrial Processes	2.A.7.1 Glass Production	The IPCC Guidelines do not provide methodologies for calculation of CO ₂ emission
CO ₂	2 Industrial Processes	2.B.5.2 Ethylene	The IPCC Guidelines do not provide methodologies for calculation of CO ₂ emission
CO ₂	2 Industrial Processes	2.D.2 Food and Drink	CO ₂ from Food and Drink Production (e.g. gasification of water) can be of biogenic or non-biogenic origin. Only information on CO ₂ emissions of non-biogenic origin should be reported.

Table A4-1 GHGs and source/sink categories not considered in the Croatian GHG inventory (cont.)

GHG	Sector	Source/sink category	Explanation
CO ₂	2 Industrial Processes	2.B.5 Propylene	The IPCC Guidelines do not provide methodologies for calculation of CO ₂ emission
CO ₂	2 Industrial Processes	2.B.5 Polyvinylchloride	The IPCC Guidelines do not provide methodologies for calculation of CO ₂ emission
CO ₂	2 Industrial Processes	2.B.5 Polystyrene	The IPCC Guidelines do not provide methodologies for calculation of CO ₂ emission
CO ₂	2 Industrial Processes	2.B.5 Sulphuric acid production	The IPCC Guidelines do not provide methodologies for calculation of CO ₂ emission
CO ₂	2 Industrial Processes	2.B.5 Polyethylene low density	The IPCC Guidelines do not provide methodologies for calculation of CO ₂ emission
CO ₂	5 LULUCF	5.B.1 5.B.1 Cropland remaining Cropland	Difficulties in collecting adequate activity data.
CO ₂	5 LULUCF	5.B.1 5.B.1 Cropland remaining Cropland	Difficulties in collecting adequate activity data.
CO ₂	5 LULUCF	5.B.1 5.B.1 Cropland remaining Cropland	Difficulties in collecting adequate activity data.
CO ₂	5 LULUCF	5.C.1 5.C.1 Grassland remaining Grassland	Difficulties in collecting adequate activity data.
CO ₂	5 LULUCF	5.C.1 5.C.1 Grassland remaining Grassland	Difficulties in collecting adequate activity data.
CO ₂	5 LULUCF	5.C.1 5.C.1 Grassland remaining Grassland	Difficulties in collecting adequate activity data.
CO ₂	5 LULUCF	5.D.1 5.D.1 Wetlands remaining Wetlands	Difficulties in collecting adequate activity data.
CO ₂	5 LULUCF	5.G Harvested Wood Products	Difficulties in collecting adequate activity data.
CO ₂	6 Waste	6.A.1 Managed Waste Disposal on Land	IPCC Guidelines do not provide methodology for the calculation of CO ₂ emissions from Solid Waste Disposal on Land.
HFCs	2 Industrial Processes	2.F.4 Aerosols/ Metered Dose Inhalers	The total potential emission from consumption of HFCs has not been estimated because the input data for emission calculation are not available.
HFCs	2 Industrial Processes	2.F.5 Solvents	The total potential emission from consumption of HFCs has not been estimated because the input data for emission calculation are not available.
N ₂ O	2 Industrial Processes	2.A.7.1 Glass Production	The IPCC Guidelines do not provide methodologies for calculation of N ₂ O emission
N ₂ O	2 Industrial Processes	2.B.5.2 Ethylene	The IPCC Guidelines do not provide methodologies for calculation of N ₂ O emission
N ₂ O	2 Industrial Processes	2.B.5 Propylene	The IPCC Guidelines do not provide methodologies for calculation of N ₂ O emission
N ₂ O	2 Industrial Processes	2.B.5 Polyvinylchloride	The IPCC Guidelines do not provide methodologies for calculation of N ₂ O emission
N ₂ O	2 Industrial Processes	2.B.5 Polystyrene	The IPCC Guidelines do not provide methodologies for calculation of N ₂ O emission
N ₂ O	2 Industrial Processes	2.B.5 Sulphuric acid production	The IPCC Guidelines do not provide methodologies for calculation of N ₂ O emission
N ₂ O	2 Industrial Processes	2.B.5 Polyethylene low density	The IPCC Guidelines do not provide methodologies for calculation of N ₂ O emission

Table A4-1 GHGs and source/sink categories not considered in the Croatian GHG inventory (cont.)

GHG	Sector	Source/sink category	Explanation
N ₂ O	2 Industrial Processes	2.B.5 Polyethylene low density	The IPCC Guidelines do not provide methodologies for calculation of N ₂ O emission
N ₂ O	3 Solvent and Other Product Use	3.B Degreasing and Dry Cleaning	Activity data for emission calculation are presented by means of population. The IPCC guidelines do not provide methodologies for the calculation of emissions of N ₂ O from Solvent and Other Product Use.
N ₂ O	3 Solvent and Other Product Use	3.D.1 Use of N ₂ O for Anaesthesia	N ₂ O emissions from medical uses and other possible sources are not estimated because activity data are not available. IPCC Guidelines do not provide methodology for the calculation of N ₂ O emission.
N ₂ O	3 Solvent and Other Product Use	3.D.2 Fire Extinguishers	N ₂ O emissions are not estimated because activity data are not available. IPCC Guidelines do not provide methodology for the calculation of N ₂ O emission.
N ₂ O	3 Solvent and Other Product Use	3.D.3 N ₂ O from Aerosol Cans	N ₂ O emissions are not estimated because activity data are not available. IPCC Guidelines do not provide methodology for the calculation of N ₂ O emission.
N ₂ O	3 Solvent and Other Product Use	3.D.4 Other Use of N ₂ O	N ₂ O emissions are not estimated because activity data are not available. IPCC Guidelines do not provide methodology for the calculation of N ₂ O emission.
N ₂ O	3 Solvent and Other Product Use	3.D.5 Other Solvent Use (SNAP 0604)	IPCC Guidelines do not provide methodology for the calculation of N ₂ O emission.
N ₂ O	5 LULUCF	5.A.1 5.A.1 Forest Land remaining Forest Land	Difficulties in collecting adequate activity data.
N ₂ O	5 LULUCF	5.A.1 5.A.1 Forest Land remaining Forest Land	Difficulties in collecting adequate activity data.
N ₂ O	5 LULUCF	5.B.1 5.B.1 Cropland remaining Cropland	Difficulties in collecting adequate activity data.
N ₂ O	5 LULUCF	5.B.2.1 Forest Land converted to Cropland	Difficulties in collecting adequate activity data.
N ₂ O	5 LULUCF	5.B.2.1 Forest Land converted to Cropland	Difficulties in collecting adequate activity data.
N ₂ O	5 LULUCF	5.B.2.2 Grassland converted to Cropland	Difficulties in collecting adequate activity data.
N ₂ O	5 LULUCF	5.B.2.2 Grassland converted to Cropland	Difficulties in collecting adequate activity data.
N ₂ O	5 LULUCF	5.B.2.3 Wetlands converted to Cropland	Difficulties in collecting adequate activity data.
N ₂ O	5 LULUCF	5.B.2.3 Wetlands converted to Cropland	Difficulties in collecting adequate activity data.
N ₂ O	5 LULUCF	5.B.2.5 Other Land converted to Cropland	Difficulties in collecting adequate activity data.
N ₂ O	5 LULUCF	5.B.2.5 Other Land converted to Cropland	Difficulties in collecting adequate activity data.
N ₂ O	5 LULUCF	5.C.1 5.C.1 Grassland remaining Grassland	Difficulties in collecting adequate activity data.
N ₂ O	5 LULUCF	5.D.1 5.D.1 Wetlands remaining Wetlands	Difficulties in collecting adequate activity data.
N ₂ O	5 LULUCF	5.E.1 Settlements remaining Settlements	Difficulties in collecting adequate activity data.

Table A4-1 GHGs and source/sink categories not considered in the Croatian GHG inventory (cont.)

GHG	Sector	Source/sink category	Explanation
N ₂ O	5 LULUCF	5.E.2 Land converted to Settlements	Dificulies in collecting adequate activity data.
N ₂ O	5 LULUCF	5.F.2 Land converted to Other Land	Dificulties in collecting adequate activity data.
N ₂ O	5 LULUCF	5.G Harvested Wood Products	Dificulies in collecting adequate activity data.
N ₂ O	6 Waste	6.B.2.1 6.B.2.1 Domestic and Commercial (w/o human sewage)	IPCC Guidelines do not provide methodology for the calculation of N ₂ O emission from Domestic Wastewater
N ₂ O	6 Waste	6.B.2.1 6.B.2.1 Domestic and Commercial (w/o human sewage)	IPCC Guidelines do not provide methodology for the calculation of N ₂ O emission from Domestic Sludge.
N ₂ O	6 Waste	6.C.2 Incineration of hospital wastes	IPCC Guidelines do not provide default emission factor for N ₂ O emission calculation from Incineration of clinical waste. There is no national information on these data. Information about type of incineration/technology is lacking.
SF ₆	2 Industrial Processes	2.F.8 Electrical Equipment	The total potential emission from consumption of SF ₆ has not been estimated because the input data for emission calculation are not available.
SF ₆	2 Industrial Processes	2.F.8 Electrical Equipment	The total actual emission from consumption of SF ₆ has not been estimated because the input data for emission calculation are not available.
SF ₆	2 Industrial Processes	2.F.P2.1 In bulk	Data are not available.
SF ₆	2 Industrial Processes	2.F.P3.1 In bulk	Data are not available.

ANNEX 5

TABLE 6.1 OF THE IPCC GOOD PRACTICE GUIDANCE

Table A5-1: Tier 1 Uncertainty Calculation and Reporting – excluding LULUCF (Table 6.1 – IPCC Good Practice Guidance)

	A	B	C	D	E	F	G	H	I	J	K	L	M
	IPCC Source Category	GHG	Base year emissions 1990	Year t emissions 2006	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
			Gg CO ₂ equivalent	Gg CO ₂ equivalent	%	%	%	%	%	%	%	%	%
1A	CO ₂ Emissions from Stationary Combustion - Coal	CO ₂	2826.2	2457.3	5	5	7.07	0.56	-0.01	0.08	-0.03	0.38	0.38
1A	CO ₂ Emissions from Stationary Combustion - Oil	CO ₂	8468.3	6433.6	5	5	7.07	1.48	-0.05	0.20	-0.24	0.99	1.02
1A	CO ₂ Emissions from Stationary Combustion - Gas	CO ₂	4582.6	4419.6	5	5	7.07	1.01	0.00	0.14	0.01	0.68	0.68
1A	Mobile Combustion - Road Vehicles	CO ₂	3561.4	5635.2	5	5	7.07	1.29	0.07	0.17	0.35	0.87	0.93
1A	Mobile Combustion: Water-borne Navigation	CO ₂	133.0	103.7	5	5	7.07	0.02	0.00	0.00	0.00	0.02	0.02
1A	Mobile Combustion: Aircraft	CO ₂	348.8	182.6	5	5	7.07	0.04	-0.00455	0.01	-0.02	0.03	0.04
1A	Mobile Combustion: Railways	CO ₂	138.1	101.2	5	5	7.07	0.02	-0.00092	0.003	0.00	0.02	0.02
1A	Mobile Combustion - Agriculture/Forestry/Fishing	CO ₂	839.2	729.5	5	5	7.07	0.17	-0.00203	0.02	-0.01	0.11	0.11
1B	CO ₂ Emissions from Natural Gas Scrubbing*	CO ₂	415.9	663.0	10	3	10.44	0.22	0.00826	0.02	0.02	0.20	0.21
2A	CO ₂ Emissions from Cement Production	CO ₂	1069.1	1572.0	3	3	4.24	0.22	0.02	0.05	0.05	0.14	0.15
2A	CO ₂ Emissions from Lime Production	CO ₂	160.6	244.5	7.5	15	16.77	0.13	0.00	0.01	0.04	0.06	0.07
2A	CO ₂ Emissions from Limestone and Dolomite Use	CO ₂	43.2	10.7	7.5	30	30.92	0.01	0.00	0.00	-0.03	0.00	0.03
2A	CO ₂ Emissions from Soda Ash Production and Use	CO ₂	25.7	15.1	7.5	30	30.92	0.0152	-0.0003	0.0005	-0.0085	0.0035	0.0092
2B	CO ₂ Emissions from Ammonia Production	CO ₂	861.6	878.5	3	5	5.83	0.1661	0.0019	0.0270	0.0095	0.0810	0.0816
2C	CO ₂ Emissions from Iron and Steel Production	CO ₂	0.9	0.4	7.5	30	30.92	0.0004	0.0000	0.0000	-0.0004	0.0001	0.0004
2C	CO ₂ Emissions from Ferroalloys Production	CO ₂	194.5		7.5	30	30.92	0.0000	-0.0057	0.0000	-0.1701	0.0000	0.1701
2C	CO ₂ Emissions from Aluminium Production	CO ₂	111.4		3	30	30.15	0.0000	-0.0032	0.0000	-0.0974	0.0000	0.0974
2G	Other non-specified NEU	CO ₂	208.1	70.0	5	50	50.25	0.114137	-0.003910	0.002153	-0.195489	0.010766	0.195786
3	Total Solvent and Other Product Use	CO ₂	80.2	182.4			0.00	0.000000	0.003270	0.005607	0.000000	0.000000	0.000000
6C	Emissions from Waste Incineration	CO ₂	0.1	0.1	50	30	58.31	0.000155	0.000000	0.000003	-0.000002	0.000126	0.000126
	CO₂ Total		24068,9	23699.3									

Table A5-1: Tier 1 Uncertainty Calculation and Reporting – excluding LULUCF (Table 6.1 – IPCC Good Practice Guidance) (cont.)

A	B	C	D	E	F	G	H	I	J	K	L	M
	IPCC Source Category	GHG	Base year emissions 1990 Gg CO ₂ equivalent	Year t emissions 2006 Gg CO ₂ equivalent	Activity data uncertainty %	Emission factor uncertainty %	Combined uncertainty %	Combined uncertainty as % of total emissions in year t	Type A sensitivity %	Type B sensitivity %	Uncertainty in trend in national emissions introduced by activity data uncertainty %	Uncertainty in trend in national emissions introduced into the trend in total national emissions %
1A	Fuel Combustion - Stationary Sources	CH ₄	168.2	97.8	5	20	20.62	0.0654	-0.0019	0.0030	-0.0379	0.0408
1A	Mobile Combustion - Road Vehicles	CH ₄	32.1	32.2	5	40	40.31	0.0421	0.0001	0.0010	0.0021	0.0054
1A	Mobile Combustion: Water-borne Navigation	CH ₄	0.2	0.1	5	40	40.31	0.0002	0.0000	0.0000	0.0000	0.0000
1A	Mobile Combustion: Aircraft	CH ₄	0.1	0.0	5	40	40.31	0.0000	0.0000	0.0000	0.0000	0.0000
1A	Mobile Combustion: Railways	CH ₄	0.2	0.1	5	40	40.31	0.0002	0.0000	0.0000	-0.0001	0.0001
1A	Mobile Combustion - Agriculture/Forestry/Fishing	CH ₄	1.3	1.1	5	40	40.31	0.0014	0.0000	0.0000	-0.0002	0.0002
1B	Fugitive Emissions from Coal Mining and Handling	CH ₄	48.8		5	250	250.05	0.0000	-0.0014	0.0000	-0.3552	0.3552
1B	Fugitive Emissions from Oil and Gas Operations	CH ₄	1201.2	1471.7	5	300	300.04	14.3205	0.0102	0.0452	3.0702	3.0785
2B	Production of Other Chemicals	CH ₄	16.6	7.8	7.5	30	30.92	0.0079	-0.0002	0.0002	-0.0072	0.0075
4A	CH ₄ Emissions from Enteric Fermentation in Domestic Livestock	CH ₄	1372.1	835.2	30	40	50.00	1.3544	-0.0143	0.0257	-0.5722	0.9596
4B	CH ₄ Emissions from Manure Management	CH ₄	229.1	160.2	30	40	50.00	0.2597	-0.0018	0.0049	-0.0701	0.1635
6A	Solid Waste Disposal Sites	CH ₄	221.2	416.9	50	50	70.71	0.9560	0.0064	0.0128	0.3184	0.7155
6B	Emissions from Waste Water Handling	CH ₄	98.9	87.1	50	30	58.31	0.1647	-0.0002	0.0027	-0.0061	0.1340
	CH₄ Total		3389.9	3110.2								

Table A5-1: Tier 1 Uncertainty Calculation and Reporting – excluding LULUCF (Table 6.1 – IPCC Good Practice Guidance) (cont.)

	A	B	C	D	E	F	G	H	I	J	K	L	M
	IPCC Source Category	GHG	Base year emissions 1990	Year t emissions 2006	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
			Gg CO ₂ equivalent	Gg CO ₂ equivalent	%	%	%	%	%	%	%	%	%
1A	Fuel Combustion - Stationary Sources	N ₂ O	62.3	47.1	5	200	200.06	0.3056	-0.0004	0.0014	-0.0736	0.0072	0.0740
1A	Mobile Combustion - Road Vehicles	N ₂ O	48.1	168.7	5	200	200.06	1.0947	0.0038	0.0052	0.7571	0.0259	0.7575
1A	Mobile Combustion: Water-borne Navigation	N ₂ O	0.3	0.3	5	200	200.06	0.0017	0.0000	0.0000	-0.0003	0.0000	0.0003
1A	Mobile Combustion: Aircraft	N ₂ O	3.1	1.6	5	200	200.06	0.0104	0.0000	0.0000	-0.0080	0.0002	0.0080
1A	Mobile Combustion: Railways	N ₂ O	0.4	0.3	5	200	200.06	0.0017	0.0000	0.0000	-0.0007	0.0000	0.0007
1A	Mobile Combustion - Agriculture/Forestry/Fishing	N ₂ O	2.0	1.8	5	200	200.06	0.0116	0.0000	0.0001	-0.0009	0.0003	0.0009
2B	N ₂ O Emissions from Nitric Acid Production	N ₂ O	927.8	774.7	3	30	30.15	0.7575	-0.0032	0.0238	-0.0966	0.0715	0.1202
4B	N ₂ O Emissions from Manure Management	N ₂ O	380.9	233.1	30	60	67.08	0.5072	-0.0039	0.0072	-0.2359	0.2150	0.3192
4B	Direct N ₂ O Emissions from Agricultural Soils	N ₂ O	1357.8	1262.7	30	40	50.00	2.0475	-0.0008	0.0388	-0.0301	1.1646	1.1650
4D	N ₂ O Emissions from Pasture, Range and Paddock Manure	N ₂ O	262.2	202.9	30	40	50.00	0.3290	-0.0014	0.0062	-0.0561	0.1871	0.1954
4F	Indirect N ₂ O Emissions from Nitrogen Used in Agriculture	N ₂ O	955.5	813.4	30	60	67.08	1.7697	-0.0028	0.0250	-0.1703	0.7502	0.7693
6B	Emissions from Waste Water Handling	N ₂ O	78.7	87.3	10	30	31.62	0.0895	0.0004	0.0027	0.0117	0.0268	0.0293
	N₂O Total			4079.1	3593.8								
2F	HFC Emiss. from Consumption of HFCs, PFCs and SF ₆	HFC	52.9	430.7	70	70	98.99	1.1125	0.0102	0.0117	0.7159	0.8212	1.0894
2C	PFC Emissions from Aluminium production	PFC	936.6		30	50	58.31	0.0000	-0.0266	0.0000	-1.3312	0.0000	1.3312
	HFC/PFC/SF₆ Total		989.5	430.7									
	Total GHG Emissions	CO₂-eq	32527.3	30834.0									
	Total Uncertainties (Level/Trend)							14.99					4.45

Table A5-2: Tier 1 Uncertainty Calculation and Reporting – including LULUCF (Table 6.1 – IPCC Good Practice Guidance)

	A	B	C	D	E	F	G	H	I	J	K	L	M
	IPCC Source Category	GHG	Base year emissions 1990	Year t emissions 2006	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
			Gg CO ₂ equivalent	Gg CO ₂ equivalent	%	%	%	%	%	%	%	%	%
1A	CO ₂ Emissions from Stationary Combustion - Coal	CO ₂	2826.2	2457.3	5	5	7.07	0.45	-0.01	0.07	-0.07	0.33	0.34
1A	CO ₂ Emissions from Stationary Combustion - Oil	CO ₂	8468.3	6433.6	5	5	7.07	1.19	-0.07	0.18	-0.33	0.88	0.94
1A	CO ₂ Emissions from Stationary Combustion - Gas	CO ₂	4582.6	4419.6	5	5	7.07	0.82	-0.01	0.12	-0.05	0.60	0.60
1A	Mobile Combustion - Road Vehicles	CO ₂	3561.4	5635.2	5	5	7.07	1.04	0.05	0.15	0.26	0.77	0.81
1A	Mobile Combustion: Water-borne Navigation	CO ₂	133.0	103.7	5	5	7.07	0.02	0.00	0.00	0.00	0.01	0.01
1A	Mobile Combustion: Aircraft	CO ₂	348.8	182.6	5	5	7.07	0.03	0.00	0.00	-0.02	0.02	0.04
1A	Mobile Combustion: Railways	CO ₂	138.1	101.2	5	5	7.07	0.02	0.00	0.00	-0.01	0.01	0.01
1A	Mobile Combustion - Agriculture/Forestry/Fishing	CO ₂	839.2	729.5	5	5	7.07	0.13	0.00	0.02	-0.02	0.10	0.10
1B	CO ₂ Emissions from Natural Gas Scrubbing*	CO ₂	415.9	663.0	10	3	10.44	0.18	0.01	0.02	0.02	0.18	0.18
2A	CO ₂ Emissions from Cement Production	CO ₂	1069.1	1572.0	3	3	4.24	0.17	0.01	0.04	0.04	0.13	0.13
2A	CO ₂ Emissions from Lime Production	CO ₂	160.6	244.5	7.5	15	16.77	0.11	0.00	0.01	0.03	0.05	0.06
2A	CO ₂ Emissions from Limestone and Dolomite Use	CO ₂	43.2	10.7	7.5	30	30.92	0.01	0.00	0.00	-0.03	0.00	0.03
2A	CO ₂ Emissions from Soda Ash Production and Use	CO ₂	25.7	15.1	7.5	30	30.92	0.0122	-0.0003	0.0004	-0.0096	0.0031	0.0101
2B	CO ₂ Emissions from Ammonia Production	CO ₂	861.6	878.5	3	5	5.83	0.1337	-0.0006	0.0239	-0.0029	0.0718	0.0718
2C	CO ₂ Emissions from Iron and Steel Production	CO ₂	0.9	0.4	7.5	30	30.92	0.0003	0.0000	0.0000	-0.0004	0.0001	0.0004
2C	CO ₂ Emissions from Ferroalloys Production	CO ₂	194.5		7.5	30	30.92	0.0000	-0.0055	0.0000	-0.1659	0.0000	0.1659
2C	CO ₂ Emissions from Aluminium Production	CO ₂	111.4		3	30	30.15	0.0000	-0.0032	0.0000	-0.0950	0.0000	0.0950
2G	Other non-specified NEU	CO ₂	208.1	70.0	5	50	50.25	0.091830	-0.004008	0.001908	-0.200398	0.009539	0.200624
3	Total Solvent and Other Product Use	CO ₂	80.2	182.4	50	50	70.71	0.336521	0.002687	0.004968	0.134362	0.248405	0.282415
5	Forest land remaining forest land	CO ₂	4184.9	7490.3	45	30	54.08	10.5703	0.0849	0.2040	2.5480	9.1812	9.5282
6C	Emissions from Waste Incineration	CO ₂	0.1	0.1	50	30	58.31	0.000125	0.000000	0.000002	-0.000008	0.000112	0.000112
	CO₂ Total		28253.8	31189.6									

Table A5-2: Tier 1 Uncertainty Calculation and Reporting – including LULUCF (Table 6.1 – IPCC Good Practice Guidance) (cont.)

	A	B	C	D	E	F	G	H	I	J	K	L	M
	IPCC Source Category	GHG	Base year emissions 1990	Year t emissions 2006	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
			Gg CO ₂ equivalent	Gg CO ₂ equivalent	%	%	%	%	%	%	%	%	%
1A	Fuel Combustion - Stationary Sources	CH ₄	168.2	97.8	5	20	20.62	0.0526	-0.0021	0.0027	-0.0424	0.0133	0.0445
1A	Mobile Combustion - Road Vehicles	CH ₄	32.1	32.2	5	40	40.31	0.0339	0.0000	0.0009	-0.0015	0.0044	0.0046
1A	Mobile Combustion: Water-borne Navigation	CH ₄	0.2	0.1	5	40	40.31	0.0002	0.0000	0.0000	-0.0001	0.0000	0.0001
1A	Mobile Combustion: Aircraft	CH ₄	0.1	0.0	5	40	40.31	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1A	Mobile Combustion: Railways	CH ₄	0.2	0.1	5	40	40.31	0.0002	0.0000	0.0000	-0.0001	0.0000	0.0001
1A	Mobile Combustion - Agriculture/Forestry/Fishing	CH ₄	1.3	1.1	5	40	40.31	0.0012	0.0000	0.0000	-0.0003	0.0001	0.0003
1B	Fugitive Emissions from Coal Mining and Handling	CH ₄	48.8	0.0	5	250	250.05	0.0000	-0.0014	0.0000	-0.3466	0.0000	0.3466
1B	Fugitive Emissions from Oil and Gas Operations	CH ₄	1201.2	1471.7	5	300	300.04	11.5216	0.0059	0.0401	1.7786	0.2004	1.7899
2B	Production of Other Chemicals	CH ₄	16.6	7.8	7.5	30	30.92	0.0063	-0.0003	0.0002	-0.0077	0.0016	0.0079
4A	CH ₄ Emissions from Enteric Fermentation in Domestic Livestock	CH ₄	1372.1	835.2	30	40	50.00	1.0897	-0.0163	0.0228	-0.6504	0.6825	0.9428
4B	CH ₄ Emissions from Manure Management	CH ₄	229.1	160.2	30	40	50.00	0.2090	-0.0022	0.0044	-0.0860	0.1309	0.1566
5A	Forest land remaining forest land	CH ₄	0.0	0.0	45	30	54.08	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6A	Solid Waste Disposal Sites	CH ₄	221.2	416.9	50	50	70.71	0.7691	0.0051	0.0114	0.2532	0.5677	0.6216
6B	Emissions from Waste Water Handling	CH ₄	98.9	87.1	50	30	58.31	0.1325	-0.0004	0.0024	-0.0131	0.1186	0.1194
	CH₄ Total		3389.9	3110.2									

Table A5-2: Tier 1 Uncertainty Calculation and Reporting – including LULUCF (Table 6.1 – IPCC Good Practice Guidance) (cont.)

	A	B	C	D	E	F	G	H	I	J	K	L	M
	IPCC Source Category	GHG	Base year emissions 1990	Year t emissions 2006	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
			Gg CO ₂ equivalent	Gg CO ₂ equivalent	%	%	%	%	%	%	%	%	%
1A	Fuel Combustion - Stationary Sources	N ₂ O	62.3	47.1	5	200	200.06	0.2459	-0.0005	0.0013	-0.0978	0.0064	0.0980
1A	Mobile Combustion - Road Vehicles	N ₂ O	48.1	168.7	5	200	200.06	0.8807	0.0032	0.0046	0.6456	0.0230	0.6461
1A	Mobile Combustion: Water-borne Navigation	N ₂ O	0.3	0.3	5	200	200.06	0.0014	0.0000	0.0000	-0.0005	0.0000	0.0005
1A	Mobile Combustion: Aircraft	N ₂ O	3.1	1.6	5	200	200.06	0.0084	0.0000	0.0000	-0.0087	0.0002	0.0087
1A	Mobile Combustion: Railways	N ₂ O	0.4	0.3	5	200	200.06	0.0013	0.0000	0.0000	-0.0008	0.0000	0.0008
1A	Mobile Combustion - Agriculture/Forestry/Fishing	N ₂ O	2.0	1.8	5	200	200.06	0.0093	0.0000	0.0000	-0.0019	0.0002	0.0019
2B	N ₂ O Emissions from Nitric Acid Production	N ₂ O	927.8	774.7	3	30	30.15	0.6095	-0.0053	0.0211	-0.1583	0.0633	0.1705
4B	N ₂ O Emissions from Manure Management	N ₂ O	380.9	233.1	30	60	67.08	0.4081	-0.0045	0.0064	-0.2688	0.1905	0.3294
4B	Direct N ₂ O Emissions from Agricultural Soils	N ₂ O	1357.8	1262.7	30	40	50.00	1.6474	-0.0042	0.0344	-0.1686	1.0318	1.0455
4D	N ₂ O Emissions from Pasture, Range and Paddock Manure	N ₂ O	262.2	202.9	30	40	50.00	0.2647	-0.0019	0.0055	-0.0771	0.1658	0.1829
4F	Indirect N ₂ O Emissions from Nitrogen Used in Agriculture	N ₂ O	955.5	813.4	30	60	67.08	1.4238	-0.0050	0.0222	-0.3007	0.6647	0.7296
5A	Forest land remaining forest land	N ₂ O	0.0	0.0	45	30	54.08	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6B	Emissions from Waste Water Handling	N ₂ O	78.7	87.3	10	30	31.62	0.0720	0.0001	0.0024	0.0042	0.0238	0.0241
	N₂O Total		4079.1	3593.8									
2C	HFC Emissions from Consumption of HFCs, PFCs and SF ₆	HFC	52.9	430.7	70	70	98.99	1.1125	0.0102	0.0117	0.7159	0.8212	1.0894
2F	PFC Emissions from Aluminium production	PFC	936.6		30	50	58.31	0.0000	-0.0266	0.0000	-1.3312	0.0000	1.3312
	HFC/PFC/SF₆ Total		989.5	430.7									
	Total GHG Emissions	CO₂-eq	36712.3	38324.3									
	Total Uncertainties (Level/Trend)							16.01					10.13

ANNEX 6

INVENTORY DATA RECORD SHEET

Table A6-1: An example of Inventory Data Record Sheet for 2006 in Waste

INVENTORY DATA RECORD SHEET**Year: 2006**

MODULE: WASTE	
SUBMODULE: METHANE EMISSIONS FROM SOLID WASTE DISPOSAL SITES	
WORKSHEET: 6-1	SHEET: 1 OF 1 CH ₄ EMISSIONS
STEP: 1 TO 4	PAGE: 1 of 2
DIRECT DATA SOURCE: A. ACTIVITY DATA: <i>Cadastre of Waste - Municipal Solid Waste, Report 2006, Croatian Environmental Agency.</i> Assessment of inappropriate activity data on quantities of MSW disposed to different types of SWDs - <i>Guidelines Development for starting implementation of Waste Management Plan in the Republic of Croatia</i> , EKONERG Ltd. <u>Quantities of MSW disposed to SWDSs:</u> Managed: 680.55 Gg Unmanaged – deep: 501.37 Gg Unmanaged – shallow: 153.08 Gg Country-specific methane correction factor (MCF): 0.856 Country-specific fraction of degradable organic carbon (DOC): 0.16 Recovered methane: 4.19 Gg B. METHODOLOGY/EMISSION FACTOR: Publications: IPCC/UNEP/OECD/IEA (1997), <i>Greenhouse Gas Inventory Workbook</i> , Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2. IPCC/UNEP/OECD/IEA (1997), <i>Greenhouse Gas Inventory Reference Manual</i> , Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3. IPCC (2000), <i>Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories</i> Methodology: First Order Decay method (Tier 2) Methane generation rate constant k=0.05 Fraction of DOC which really degrades: 0.55 (0.5-0.6) Fraction of carbon released as methane: 0.5	
ORIGINAL DATA SOURCE: A. ACTIVITY DATA: Ministry of Environmental Protection, Physical Planning and Construction (2006) <i>Guidelines Development for starting implementation of Waste Management Plan in the Republic of Croatia</i> , EKONERG Ltd., Zagreb Ministry of Environmental Protection, Physical Planning and Construction (2007) <i>Waste Management Plan in the Republic of Croatia (2007-2015)</i> , Zagreb	
METHOD: bottom-up (see publications in original data source)	
ADDITIONAL INTERCALCULATION: Evaluation and compiling of data coming from original data source and adjusting to recommended Intergovernmental Panel on Climate Change (IPCC) methodology.	
DATA ARCHIVATION: Publications: Fundurulja, D., Mužinić, M. (2000) <i>Estimation of the Quantities of Municipal Solid Waste in the Republic of Croatia in the period 1990 – 1998 and 1998 – 2010</i> . Potočnik, V. (2000), Report: The basis for methane emission estimation in Croatia 1990-1998, B. Data on Municipal Solid Waste in Croatia 1990-1998 Schaller, A. (2000), Republic of Croatia: First National Communication, Waste Management Review – Waste Disposal Sites.	
DATA GAPS: Quantities on MSW were in most cases gained by test weighing in order to estimate average volumes of waste delivered by vehicles and density of MSW.	

MODULE: WASTE	
SUBMODULE: METHANE EMISSIONS FROM SOLID WASTE DISPOSAL SITES	
WORKSHEET: 6-1	SHEET: 1 OF 1 CH ₄ EMISSIONS
STEP: 1 TO 4	PAGE: 2 of 2
SUGGESTION FOR THE FUTURE: <ul style="list-style-type: none"> ▪ Equipping the major landfills with automatic weigh-bridges in order to accurately estimate the quantities of delivered MSW ▪ Providing methodology to determine country-specific MSW composition ▪ Periodic analysis of waste composition at major landfills according to provided methodology ▪ Modification of Environmental Emissions Inventory (KEO) Reporting Forms regarding to MSW with additional information on waste quantities and composition ▪ Adjustment of country-specific to IPCC SWDSs classification, in order to accurately MCF estimation. 	
NOTES: -	
RESPONSIBILITY: Andrea Hublin, M.Sc. EKONERG address: Koranska 5, 10000 Zagreb tel.: +385 1 6000 134 fax.: +385 1 6171 560 e-mail: andrea.hublin@ekonerg.hr	

ANNEX 7

GHG EMISSION TREND

Table A7-1: GHG emission in Croatia, 1990

Croatia Year 1990	CO ₂	CH ₄		N ₂ O		HFC, PFC & SF ₆		Total (Gg CO ₂ eq)	Share %
	(Gg)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)		
1. Energy	21313.53	69.15	1452.05	0.37	116.22	NO	NO	22881.8	70.35
A. Fuel Comb (Sectoral Appr.)	20897.58	9.62	202.12	0.55	116.22	NO	NO	21215.9	65.22
1. Energy Industries	7267.61	0.17	3.61	0.07	13.80	NO	NO	7285.0	22.40
2. Man. Ind. and Constr.	5804.80	0.50	10.46	0.09	18.01	NO	NO	5833.3	17.93
3. Transport	4181.35	1.55	32.59	0.25	51.87	NO	NO	4265.8	13.11
4. Comm./Inst, Resid., Agric.	3643.81	7.40	155.46	0.15	32.55	NO	NO	3831.8	11.78
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	415.95	1249.94	1249.94	NO	NO	NO	NO	1665.9	5.12
1. Solid Fuels	NO	2.32	48.76	NO	NO	NO	NO	48.8	0.15
2. Oil and Natural Gas	415.95	57.20	1201.18	NO	NO	NO	NO	1617.1	4.97
2. Industrial Processes	2675.09	0.79	16.55	2.99	927.78	0.16	989.46	4608.9	14.17
A. Mineral Products	1298.64	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	1298.6	3.99
B. Chemical Industry	861.63	16.55	16.55	2.99	927.78	NO	NO	1806.0	5.55
C. Metal Production	306.77	NE,NO	NE,NO	NO	NO	0.14	936.56	1243.3	3.82
D. Other Production	NE	NO	NO	NO	NO	NO	NO	NE	NE
E. Prod. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	NO	NO	NO	NO
F. Cons. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	0.02	52.90	52.9	0.16
G. Other	208.05	NO	NO	NO	NO	NO	NO	208.1	0.64
3. Solvent and Other Product Use	80.21	NO	NO	NE	NE	NO	NO	80.2	0.25
4. Agriculture	NO	76.25	1601.21	9.54	2956.38	NO	NO	4557.6	14.01
A. Enteric Fermentation	NO	65.34	1372.14	0.00	0.00	NO	NO	1372.1	4.22
B. Manure Management	NO	10.91	229.07	1.23	380.88	NO	NO	609.9	1.88
C. Rice Cultivation	NO	NO	NO	0.00	0.00	NO	NO	NO	NO
D. Agricultural Soils	NO	NO	NO	8.31	2575.50	NO	NO	2575.5	7.92
E. Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agr. Residues	NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	-4184.93	0.00	0.01	0.00	0.00	NO	NO	-4184.9	-12.87
A. Forest Land	-4184.93	0.00	0.01	0.00	0.00	NO	NO	-4184.9	-12.87
B. Cropland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
C. Grassland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
D. Wetlands	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
G. Other	NE	NE	NE	NE	NE	NO	NO	NE	NE
6. Waste	0.09	15.24	320.06	0.25	78.69	NO	NO	398.8	1.23
A. Solid Waste Disp. on Land	NE,NO	10.53	221.21	0.00	0.00	NO	NO	221.2	0.68
B. Waste-water Handling	0.00	4.71	98.85	0.25	78.69	NO	NO	177.5	0.55
C. Waste Incineration	0.09	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	0.1	0.00
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Em./Rem. with LUCF	19883.98	161.42	3389.89	13.16	4079.08	0.16	989.46	28342.4	87.13
Total Emissions without LUCF	24068.91	161.42	3389.89	13.16	4079.08	0.16	989.46	32527.3	100.0
Share of Gases in Total Em./Rem.	70.16		11.96		14.39		3.49	100.0	
Share of Gases in Total Emissions	74.00		10.42		12.54		3.04	100.0	
Memo Items:									
International Bunkers	257.90	0.01	0.17	0.01	1.58	NO	NO	259.7	
Aviation	149.36	0.00	0.02	0.00	1.31	NO	NO	150.7	
Marine	108.54	0.01	0.15	0.00	0.27	NO	NO	109.0	
Multilateral Operations	C	C	C	C	C	NO	NO	C	
CO₂ Emissions from Biomass	2,436.76	NO	NO	NO	NO	NO	NO	2436.8	

Table A7-1: GHG emission in Croatia, 1991

Croatia Year 1991	CO ₂	CH ₄		N ₂ O		HFC, PFC & SF ₆		Total (Gg CO ₂ eq)	Share %
	(Gg)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)		
1. Energy	15466.80	62.05	1302.95	0.26	81.72	NO	NO	16851.5	66.22
A. Fuel Comb (Sectoral Appr.)	15010.97	6.32	132.76	0.39	81.72	NO	NO	15225.5	59.83
1. Energy Industries	4881.44	0.11	2.27	0.04	9.16	NO	NO	4892.9	19.23
2. Man. Ind. and Constr.	4001.92	0.37	7.86	0.06	13.12	NO	NO	4022.9	15.81
3. Transport	3005.05	1.18	24.79	0.18	37.67	NO	NO	3067.5	12.05
4. Comm./Inst, Resid., Agric.	3122.57	4.66	97.85	0.10	21.77	NO	NO	3242.2	12.74
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	455.83	1170.19	1170.19	NO	NO	NO	NO	1626.0	6.39
1. Solid Fuels	NO	2.07	43.45	NO	NO	NO	NO	43.5	0.17
2. Oil and Natural Gas	455.83	53.65	1126.74	NO	NO	NO	NO	1582.6	6.22
2. Industrial Processes	2134.18	0.59	12.38	2.63	814.93	0.12	694.16	3655.6	14.36
A. Mineral Products	841.75	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	841.7	3.31
B. Chemical Industry	908.70	12.38	12.38	2.63	814.93	NO	NO	1736.0	6.82
C. Metal Production	257.98	NE,NO	NE,NO	NO	NO	0.10	642.44	900.4	3.54
D. Other Production	NE	NO	NO	NO	NO	NO	NO	NE	NE
E. Prod. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	NO	NO	NO	NO
F. Cons. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	0.02	51.71	51.7	0.20
G. Other	125.75	NO	NO	NO	NO	NO	NO	125.7	0.49
3. Solvent and Other Product Use	87.85	NO	NO	NE	NE	NO	NO	87.9	0.35
4. Agriculture	NO	71.84	1508.62	9.48	2937.94	NO	NO	4446.6	17.47
A. Enteric Fermentation	NO	61.05	1281.97	0.00	0.00	NO	NO	1282.0	5.04
B. Manure Management	NO	10.79	226.66	1.17	361.98	NO	NO	588.6	2.31
C. Rice Cultivation	NO	NO	NO	0.00	0.00	NO	NO	NO	NO
D. Agricultural Soils	NO	NO	NO	8.31	2575.95	NO	NO	2576.0	10.12
E. Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agr. Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	-8699.64	0.00	0.01	0.00	0.00	NO	NO	-8699.6	-34.18
A. Forest Land	-8699.64	0.00	0.01	0.00	0.00	NO	NO	-8699.6	-34.18
B. Cropland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
C. Grassland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
D. Wetlands	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
G. Other	NE	NE	NE	NE	NE	NO	NO	NE	NE
6. Waste	0.08	15.79	331.62	0.24	75.73	NO	NO	407.4	1.60
A. Solid Waste Disp. on Land	NE,NO	11.12	233.57	0.00	0.00	NO	NO	233.6	0.92
B. Waste-water Handling	0.00	4.67	98.05	0.24	75.73	NO	NO	173.8	0.68
C. Waste Incineration	0.08	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	0.1	0.00
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Em./Rem. with LUCF	8989.27	150.27	3155.58	12.61	3910.32	0.12	694.16	16749.3	65.82
Total Emissions without LUCF	17688.92	150.27	3155.58	12.61	3910.32	0.12	694.16	25449.0	100.0
Share of Gases in Total Em./Rem.	53.67		18.84		23.35		4.14	100.0	
Share of Gases in Total Emissions	69.51		12.40		15.37		2.73	100.0	
Memo Items:									
International Bunkers	71.34	0.00	0.10	0.00	0.18	NO	NO	71.6	
Aviation	NO	NO	NO	NO	NO	NO	NO	NO	
Marine	71.34	0.00	0.10	0.00	0.18	NO	NO	71.6	
Multilateral Operations	C	C	C	C	C	NO	NO	C	
CO₂ Emissions from Biomass	1,680.37	NO	NO	NO	NO	NO	NO	1680.4	

Table A7-1: GHG emission in Croatia, 1992

Croatia Year 1992	CO ₂	CH ₄		N ₂ O		HFC, PFC & SF ₆		Total (Gg CO ₂ eq)	Share %
	(Gg)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)		
1. Energy	14507.23	60.81	1276.99	0.25	76.06	NO	NO	15860.3	67.40
A. Fuel Comb (Sectoral Appr.)	14029.90	5.15	108.05	0.36	76.06	NO	NO	14214.0	60.41
1. Energy Industries	5446.88	0.11	2.35	0.05	9.91	NO	NO	5459.1	23.20
2. Man. Ind. and Constr.	3087.06	0.30	6.32	0.05	9.97	NO	NO	3103.3	13.19
3. Transport	2884.87	1.04	21.93	0.18	37.77	NO	NO	2944.6	12.51
4. Comm./Inst, Resid., Agric.	2611.10	3.69	77.45	0.09	18.41	NO	NO	2707.0	11.50
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	477.33	1168.94	1168.94	NO	NO	NO	NO	1646.3	7.00
1. Solid Fuels	NO	1.61	33.77	NO	NO	NO	NO	33.8	0.14
2. Oil and Natural Gas	477.33	54.06	1135.18	NO	NO	NO	NO	1612.5	6.85
2. Industrial Processes	2296.57	0.52	10.86	3.44	1065.55	0.02	50.52	3423.5	14.55
A. Mineral Products	907.41	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	907.4	3.86
B. Chemical Industry	1168.32	10.86	10.86	3.44	1065.55	NO	NO	2244.7	9.54
C. Metal Production	116.90	NE,NO	NE,NO	NO	NO	NO	NO	116.9	0.50
D. Other Production	NE	NO	NO	NO	NO	NO	NO	NE	NE
E. Prod. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	NO	NO	NO	NO
F. Cons. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	0.02	50.52	50.5	0.21
G. Other	103.94	NO	NO	NO	NO	NO	NO	103.9	0.44
3. Solvent and Other Product Use	70.20	NO	NO	NE	NE	NO	NO	70.2	0.30
4. Agriculture	NO	55.77	1171.26	8.34	2585.36	NO	NO	3756.6	15.96
A. Enteric Fermentation	NO	47.66	1000.86	0.00	0.00	NO	NO	1000.9	4.25
B. Manure Management	NO	8.11	170.40	0.91	282.80	NO	NO	453.2	1.93
C. Rice Cultivation	NO	NO	NO	0.00	0.00	NO	NO	NO	NO
D. Agricultural Soils	NO	NO	NO	7.43	2302.57	NO	NO	2302.6	9.79
E. Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agr. Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	-9294.33	0.00	0.00	0.00	0.00	NO	NO	-9294.3	-39.50
A. Forest Land	-9294.33	0.00	0.00	0.00	0.00	NO	NO	-9294.3	-39.50
B. Cropland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
C. Grassland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
D. Wetlands	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
G. Other	NE	NE	NE	NE	NE	NO	NO	NE	NE
6. Waste	0.08	16.34	343.10	0.25	77.21	NO	NO	420.4	1.79
A. Solid Waste Disp. on Land	NE,NO	11.71	245.84	0.00	0.00	NO	NO	245.8	1.04
B. Waste-water Handling	0.00	4.63	97.25	0.25	77.21	NO	NO	174.5	0.74
C. Waste Incineration	0.08	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	0.1	0.00
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Em./Rem. with LUCF	7579.76	133.44	2802.22	12.27	3804.18	0.02	50.52	14236.7	60.50
Total Emissions without LUCF	16874.08	133.44	2802.22	12.27	3804.18	0.02	50.52	23531.0	100.0
Share of Gases in Total Em./Rem.	53.24		19.68		26.72		0.35	100.0	
Share of Gases in Total Emissions	71.71		11.91		16.17		0.21	100.0	
Memo Items:									
International Bunkers	80.62	0.01	0.11	0.00	0.20	NO	NO	80.9	
Aviation	NO	NO	NO	NO	NO	NO	NO	NO	
Marine	80.62	0.01	0.11	0.00	0.20	NO	NO	80.9	
Multilateral Operations	C	C	C	C	C	NO	NO	C	
CO₂ Emissions from Biomass	1,459.04	NO	NO	NO	NO	NO	NO	1459.0	

Table A7-1: GHG emission in Croatia, 1993

Croatia Year 1993	CO ₂	CH ₄		N ₂ O		HFC, PFC & SF ₆		Total (Gg CO ₂ eq)	Share %
	(Gg)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)		
1. Energy	15207.28	67.03	1407.68	0.27	82.29	NO	NO	16697.3	71.32
A. Fuel Comb (Sectoral Appr.)	14531.16	4.88	102.47	0.39	82.29	NO	NO	14715.9	62.86
1. Energy Industries	5928.45	0.14	2.85	0.05	9.90	NO	NO	5941.2	25.38
2. Man. Ind. and Constr.	3005.40	0.29	6.16	0.05	9.54	NO	NO	3021.1	12.90
3. Transport	3039.63	1.02	21.44	0.22	45.47	NO	NO	3106.5	13.27
4. Comm./Inst, Resid., Agric.	2557.68	3.43	72.02	0.08	17.38	NO	NO	2647.1	11.31
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	676.12	1305.21	1305.21	NO	NO	NO	NO	1981.3	8.46
1. Solid Fuels	NO	1.54	32.31	NO	NO	NO	NO	32.3	0.14
2. Oil and Natural Gas	676.12	60.61	1272.91	NO	NO	NO	NO	1949.0	8.33
2. Industrial Processes	1875.88	0.54	11.43	2.59	803.26	0.02	49.34	2739.9	11.70
A. Mineral Products	778.29	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	778.3	3.32
B. Chemical Industry	956.52	11.43	11.43	2.59	803.26	NO	NO	1771.2	7.57
C. Metal Production	51.48	NE,NO	NE,NO	NO	NO	NO	NO	51.5	0.22
D. Other Production	NE	NO	NO	NO	NO	NO	NO	NE	NE
E. Prod. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	NO	NO	NO	NO
F. Cons. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	0.02	49.34	49.3	0.21
G. Other	89.58	NO	NO	NO	NO	NO	NO	89.6	0.38
3. Solvent and Other Product Use	75.07	NO	NO	NE	NE	NO	NO	75.1	0.32
4. Agriculture	NO	55.55	1166.63	7.41	2298.51	NO	NO	3465.1	14.80
A. Enteric Fermentation	NO	47.16	990.40	0.00	0.00	NO	NO	990.4	4.23
B. Manure Management	NO	8.39	176.22	0.91	281.23	NO	NO	457.5	1.95
C. Rice Cultivation	NO	NO	NO	0.00	0.00	NO	NO	NO	NO
D. Agricultural Soils	NO	NO	NO	6.51	2017.27	NO	NO	2017.3	8.62
E. Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agr. Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	-8036.66	0.00	0.02	0.00	0.01	NO	NO	-8036.6	-34.33
A. Forest Land	-8036.66	0.00	0.02	0.00	0.01	NO	NO	-8036.6	-34.33
B. Cropland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
C. Grassland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
D. Wetlands	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
G. Other	NE	NE	NE	NE	NE	NO	NO	NE	NE
6. Waste	0.09	16.91	355.18	0.26	79.07	NO	NO	434.3	1.86
A. Solid Waste Disp. on Land	NE,NO	12.32	258.72	0.00	0.00	NO	NO	258.7	1.11
B. Waste-water Handling	0.00	4.59	96.45	0.26	79.07	NO	NO	175.5	0.75
C. Waste Incineration	0.09	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	0.1	0.00
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Em./Rem. with LUCF	9121.66	140.04	2940.94	10.53	3263.13	0.02	49.34	15375.1	65.67
Total Emissions without LUCF	17158.32	140.04	2940.94	10.53	3263.13	0.02	49.34	23411.7	100.0
Share of Gases in Total Em./Rem.	59.33		19.13		21.22		0.32	100.0	
Share of Gases in Total Emissions	73.29		12.56		13.94		0.21	100.0	
Memo Items:									
International Bunkers	214.11	0.01	0.17	0.00	1.15	NO	NO	215.4	
Aviation	99.57	0.00	0.01	0.00	0.87	NO	NO	100.5	
Marine	114.54	0.01	0.16	0.00	0.28	NO	NO	115.0	
Multilateral Operations	C	C	C	C	C	NO	NO	C	
CO₂ Emissions from Biomass	1,388.13	NO	NO	NO	NO	NO	NO	1388.1	

Table A7-1: GHG emission in Croatia, 1994

Croatia Year 1994	CO ₂	CH ₄		N ₂ O		HFC, PFC & SF ₆		Total (Gg CO ₂ eq)	Share %
	(Gg)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)		
1. Energy									
A. Fuel Comb (Sectoral Appr.)	14339.18	60.63	1273.14	0.26	80.35	NO	NO	15692.7	69.50
1. Energy Industries	13734.31	5.13	107.64	0.38	80.35	NO	NO	13922.3	61.66
2. Man. Ind. and Constr.	4775.76	0.12	2.49	0.04	7.46	NO	NO	4785.7	21.19
3. Transport	3175.15	0.28	5.97	0.04	8.96	NO	NO	3190.1	14.13
4. Comm./Inst, Resid., Agric.	3175.35	1.10	23.14	0.22	45.40	NO	NO	3243.9	14.37
5. Other	2608.04	3.62	76.04	0.09	18.53	NO	NO	2702.6	11.97
B. Fugitive Emissions from Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO
1. Solid Fuels	604.87	1165.50	1165.50	NO	NO	NO	NO	1770.4	7.84
2. Oil and Natural Gas	NO	1.38	28.97	NO	NO	NO	NO	29.0	0.13
2. Industrial Processes	604.87	54.12	1136.53	NO	NO	NO	NO	1741.4	7.71
A. Mineral Products	2080.38	0.53	11.03	2.80	868.64	0.02	48.15	3008.2	13.32
B. Chemical Industry	943.59	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	943.6	4.18
C. Metal Production	974.55	11.03	11.03	2.80	868.64	NO	NO	1854.2	8.21
D. Other Production	79.78	NE,NO	NE,NO	NO	NO	NO	NO	79.8	0.35
E. Prod. of Halocarbons & SF ₆	NE	NO	NO	NO	NO	NO	NO	NE	NE
F. Cons. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	0.00	NO	NO	NO	NO	0.02	48.15	48.2	0.21
3. Solvent and Other Product Use	82.46	NO	NO	NO	NO	NO	NO	82.5	0.37
4. Agriculture	80.62	NO	NO	NE	NE	NO	NO	80.6	0.36
A. Enteric Fermentation	NO	50.69	1064.39	7.36	2282.38	NO	NO	3346.8	14.82
B. Manure Management	NO	42.29	888.17	0.00	0.00	NO	NO	888.2	3.93
C. Rice Cultivation	NO	8.39	176.22	0.84	259.10	NO	NO	435.3	1.93
D. Agricultural Soils	NO	NO	NO	0.00	0.00	NO	NO	NO	NO
E. Burning of Savannas	NO	NO	NO	6.53	2023.28	NO	NO	2023.3	8.96
F. Field Burning of Agr. Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	NO	NO	NO	NO	NO	NO	NO	NO	NO
A. Forest Land	-8658.34	0.00	0.01	0.00	0.00	NO	NO	-8658.3	-38.35
B. Cropland	-8658.34	0.00	0.01	0.00	0.00	NO	NO	-8658.3	-38.35
C. Grassland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
D. Wetlands	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
G. Other	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
6. Waste	NE	NE	NE	NE	NE	NO	NO	NE	NE
A. Solid Waste Disp. on Land	0.09	17.54	368.25	0.27	83.20	NO	NO	451.5	2.00
B. Waste-water Handling	NE,NO	12.98	272.60	0.00	0.00	NO	NO	272.6	1.21
C. Waste Incineration	0.00	4.55	95.65	0.27	83.20	NO	NO	178.9	0.79
D. Other	0.09	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	0.1	0.00
Total Em./Rem. with LUCF	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Emissions without LUCF	7841.93	129.37	2716.83	10.69	3314.57	0.02	48.15	13921.5	61.65
Share of Gases in Total Em./Rem.	16500.27	129.37	2716.83	10.69	3314.57	0.02	48.15	22579.8	100.0
Share of Gases in Total Emissions	56.33		19.52		23.81		0.35	100.0	
Memo Items:	73.08		12.03		14.68		0.21	100.0	
International Bunkers									
Aviation	337.48	0.01	0.22	0.01	2.08	NO	NO	339.8	
Marine	199.15	0.00	0.03	0.01	1.74	NO	NO	200.9	
Multilateral Operations	138.33	0.01	0.19	0.00	0.34	NO	NO	138.9	
CO₂ Emissions from Biomass	C	C	C	C	C	NO	NO	C	

Table A7-1: GHG emission in Croatia, 1995

Croatia Year 1995	CO ₂	CH ₄		N ₂ O		HFC, PFC & SF ₆		Total (Gg CO ₂ eq)	Share %
	(Gg)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)		
1. Energy	15029.21	61.10	1283.05	0.28	87.60	NO	NO	16399.9	71.52
A. Fuel Comb (Sectoral Appr.)	14332.29	5.29	111.14	0.42	87.60	NO	NO	14531.0	63.37
1. Energy Industries	5185.76	0.14	2.86	0.04	9.38	NO	NO	5198.0	22.67
2. Man. Ind. and Constr.	2928.16	0.27	5.58	0.04	8.79	NO	NO	2942.5	12.83
3. Transport	3393.40	1.18	24.75	0.24	50.38	NO	NO	3468.5	15.13
4. Comm./Inst, Resid., Agric.	2824.97	3.71	77.94	0.09	19.05	NO	NO	2922.0	12.74
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	696.92	1171.92	1171.92	NO	NO	NO	NO	1868.8	8.15
1. Solid Fuels	NO	1.10	23.07	NO	NO	NO	NO	23.1	0.10
2. Oil and Natural Gas	696.92	54.71	1148.84	NO	NO	NO	NO	1845.8	8.05
2. Industrial Processes	1897.16	0.45	9.55	2.69	835.38	0.02	43.20	2785.3	12.15
A. Mineral Products	731.63	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	731.6	3.19
B. Chemical Industry	1051.42	9.55	9.55	2.69	835.38	NO	NO	1896.3	8.27
C. Metal Production	33.98	NE,NO	NE,NO	NO	NO	NO	NO	34.0	0.15
D. Other Production	NE	NO	NO	NO	NO	NO	NO	NE	NE
E. Prod. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	NO	NO	NO	NO
F. Cons. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	0.02	43.20	43.2	0.19
G. Other	80.13	NO	NO	NO	NO	NO	NO	80.1	0.35
3. Solvent and Other Product Use	80.16	NO	NO	NE	NE	NO	NO	80.2	0.35
4. Agriculture	NO	48.00	1008.10	7.04	2182.56	NO	NO	3190.7	13.91
A. Enteric Fermentation	NO	40.43	849.07	0.00	0.00	NO	NO	849.1	3.70
B. Manure Management	NO	7.57	159.03	0.79	245.37	NO	NO	404.4	1.76
C. Rice Cultivation	NO	NO	NO	0.00	0.00	NO	NO	NO	NO
D. Agricultural Soils	NO	NO	NO	6.25	1937.19	NO	NO	1937.2	8.45
E. Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agr. Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	-9154.24	0.00	0.00	0.00	0.00	NO	NO	-9154.2	-39.92
A. Forest Land	-9154.24	0.00	0.00	0.00	0.00	NO	NO	-9154.2	-39.92
B. Cropland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
C. Grassland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
D. Wetlands	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
G. Other	NE	NE	NE	NE	NE	NO	NO	NE	NE
6. Waste	0.09	18.26	383.44	0.29	90.98	NO	NO	474.5	2.07
A. Solid Waste Disp. on Land	NE,NO	13.74	288.59	0.00	0.00	NO	NO	288.6	1.26
B. Waste-water Handling	0.00	4.52	94.85	0.29	90.98	NO	NO	185.8	0.81
C. Waste Incineration	0.09	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	0.1	0.00
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Em./Rem. with LUCF	7852.38	127.82	2684.15	10.31	3196.51	0.02	43.20	13776.2	60.08
Total Emissions without LUCF	17006.62	127.82	2684.15	10.31	3196.51	0.02	43.20	22930.5	100.0
Share of Gases in Total Em./Rem.	57.00		19.48		23.20		0.31	100.0	
Share of Gases in Total Emissions	74.17		11.71		13.94		0.19	100.0	
Memo Items:									
International Bunkers	279.38	0.01	0.17	0.01	1.81	NO	NO	281.3	
Aviation	177.37	0.00	0.03	0.01	1.55	NO	NO	178.9	
Marine	102.01	0.01	0.14	0.00	0.25	NO	NO	102.4	
Multilateral Operations	C	C	C	C	C	NO	NO	C	
CO₂ Emissions from Biomass	1,452.60	NO	NO	NO	NO	NO	NO	1452.6	

Table A7-1: GHG emission in Croatia, 1996

Croatia Year 1996	CO ₂	CH ₄		N ₂ O		HFC, PFC & SF ₆		Total (Gg CO ₂ eq)	Share %
	(Gg)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)		
1. Energy	15575.95	61.77	1297.14	0.31	97.07	NO	NO	16970.2	72.08
A. Fuel Comb (Sectoral Appr.)	14931.91	6.23	130.88	0.46	97.07	NO	NO	15159.9	64.39
1. Energy Industries	5113.34	0.13	2.81	0.04	8.84	NO	NO	5125.0	21.77
2. Man. Ind. and Constr.	2972.35	0.27	5.60	0.04	8.76	NO	NO	2986.7	12.69
3. Transport	3661.73	1.30	27.25	0.27	56.59	NO	NO	3745.6	15.91
4. Comm./Inst, Resid., Agric.	3184.49	4.53	95.22	0.11	22.88	NO	NO	3302.6	14.03
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	644.04	1166.25	1166.25	NO	NO	NO	NO	1810.3	7.69
1. Solid Fuels	NO	0.89	18.61	NO	NO	NO	NO	18.6	0.08
2. Oil and Natural Gas	644.04	54.65	1147.64	NO	NO	NO	NO	1791.7	7.61
2. Industrial Processes	2011.24	0.43	8.94	2.51	777.82	0.02	60.26	2858.3	12.14
A. Mineral Products	796.03	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	796.0	3.38
B. Chemical Industry	1012.13	8.94	8.94	2.51	777.82	NO	NO	1798.9	7.64
C. Metal Production	13.94	NE,NO	NE,NO	NO	NO	NO	NO	13.9	0.06
D. Other Production	NE	NO	NO	NO	NO	NO	NO	NE	NE
E. Prod. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	NO	NO	NO	NO
F. Cons. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	0.02	60.26	60.3	0.26
G. Other	189.13	NO	NO	NO	NO	NO	NO	189.1	0.80
3. Solvent and Other Product Use	87.61	NO	NO	NE	NE	NO	NO	87.6	0.37
4. Agriculture	NO	45.33	951.96	7.06	2187.46	NO	NO	3139.4	13.34
A. Enteric Fermentation	NO	37.87	795.19	0.00	0.00	NO	NO	795.2	3.38
B. Manure Management	NO	7.47	156.77	0.75	230.97	NO	NO	387.7	1.65
C. Rice Cultivation	NO	NO	NO	0.00	0.00	NO	NO	NO	NO
D. Agricultural Soils	NO	NO	NO	6.31	1956.49	NO	NO	1956.5	8.31
E. Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agr. Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	-9489.96	0.00	0.01	0.00	0.00	NO	NO	-9490.0	-40.31
A. Forest Land	-9489.96	0.00	0.01	0.00	0.00	NO	NO	-9490.0	-40.31
B. Cropland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
C. Grassland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
D. Wetlands	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
G. Other	NE	NE	NE	NE	NE	NO	NO	NE	NE
6. Waste	0.08	19.05	400.15	0.28	86.80	NO	NO	487.0	2.07
A. Solid Waste Disp. on Land	NE,NO	14.57	305.92	0.00	0.00	NO	NO	305.9	1.30
B. Waste-water Handling	0.00	4.49	94.23	0.28	86.80	NO	NO	181.0	0.77
C. Waste Incineration	0.08	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	0.1	0.00
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Em./Rem. with LUCF	8184.92	126.58	2658.20	10.16	3149.15	0.02	60.26	14052.5	59.69
Total Emissions without LUCF	17674.88	126.58	2658.20	10.16	3149.15	0.02	60.26	23542.5	100.0
Share of Gases in Total Em./Rem.	58.25		18.92		22.41		0.43	100.0	
Share of Gases in Total Emissions	75.08		11.29		13.38		0.26	100.0	
Memo Items:									
International Bunkers	282.94	0.01	0.18	0.01	1.76	NO	NO	284.9	
Aviation	168.03	0.00	0.02	0.00	1.47	NO	NO	169.5	
Marine	114.91	0.01	0.16	0.00	0.28	NO	NO	115.4	
Multilateral Operations	C	C	C	C	C	NO	NO	C	
CO₂ Emissions from Biomass	1,734.09	NO	NO	NO	NO	NO	NO	1734.1	

Table A7-1: GHG emission in Croatia, 1997

Croatia Year 1997	CO ₂	CH ₄		N ₂ O		HFC, PFC & SF ₆		Total (Gg CO ₂ eq)	Share %
	(Gg)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)		
1. Energy									
A. Fuel Comb (Sectoral Appr.)	16417.53	64.87	1362.22	0.36	110.61	NO	NO	17890.4	71.41
1. Energy Industries	15817.75	6.31	132.50	0.53	110.61	NO	NO	16060.9	64.11
2. Man. Ind. and Constr.	5578.19	0.12	2.61	0.05	10.62	NO	NO	5591.4	22.32
3. Transport	3000.36	0.29	6.15	0.04	9.41	NO	NO	3015.9	12.04
4. Comm./Inst, Resid., Agric.	4009.53	1.39	29.25	0.32	67.79	NO	NO	4106.6	16.39
5. Other	3229.68	4.50	94.50	0.11	22.79	NO	NO	3347.0	13.36
B. Fugitive Emissions from Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO
1. Solid Fuels	599.78	1229.72	1229.72	NO	NO	NO	NO	1829.5	7.30
2. Oil and Natural Gas	NO	0.65	13.61	NO	NO	NO	NO	13.6	0.05
2. Industrial Processes	599.78	57.91	1216.10	NO	NO	NO	NO	1815.9	7.25
A. Mineral Products	2259.40	0.39	8.25	2.64	817.49	0.04	91.29	3176.4	12.68
B. Chemical Industry	908.41	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	908.4	3.63
C. Metal Production	1112.15	8.25	8.25	2.64	817.49	NO	NO	1937.9	7.74
D. Other Production	31.82	NE,NO	NE,NO	NO	NO	NO	NO	31.8	0.13
E. Prod. of Halocarbons & SF ₆	NE	NO	NO	NO	NO	NO	NO	NE	NE
F. Cons. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	0.00	NO	NO	NO	NO	0.04	91.29	91.3	0.36
3. Solvent and Other Product Use	207.01	NO	NO	NO	NO	NO	NO	207.0	0.83
4. Agriculture	74.94	NO	NO	NE	NE	NO	NO	74.9	0.30
A. Enteric Fermentation	NO	44.50	934.43	7.97	2471.02	NO	NO	3405.5	13.59
B. Manure Management	NO	37.17	780.65	0.00	0.00	NO	NO	780.7	3.12
C. Rice Cultivation	NO	7.32	153.78	0.73	226.59	NO	NO	380.4	1.52
D. Agricultural Soils	NO	NO	NO	0.00	0.00	NO	NO	NO	NO
E. Burning of Savannas	NO	NO	NO	7.24	2244.43	NO	NO	2244.4	8.96
F. Field Burning of Agr. Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	NO	NO	NO	NO	NO	NO	NO	NO	NO
A. Forest Land	-8202.94	0.00	0.01	0.00	0.00	NO	NO	-8202.9	-32.74
B. Cropland	-8202.94	0.00	0.01	0.00	0.00	NO	NO	-8202.9	-32.74
C. Grassland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
D. Wetlands	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
G. Other	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
6. Waste	NE	NE	NE	NE	NE	NO	NO	NE	NE
A. Solid Waste Disp. on Land	0.08	19.94	418.79	0.28	86.88	NO	NO	505.8	2.02
B. Waste-water Handling	NE,NO	15.48	325.17	0.00	0.00	NO	NO	325.2	1.30
C. Waste Incineration	0.00	4.46	93.61	0.28	86.88	NO	NO	180.5	0.72
D. Other	0.08	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	0.1	0.00
Total Em./Rem. with LUCF	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Emissions without LUCF	10549.01	129.70	2723.70	11.25	3486.01	0.04	91.29	16850.0	67.26
Share of Gases in Total Em./Rem.	18751.95	129.70	2723.70	11.25	3486.01	0.04	91.29	25052.9	100.0
Share of Gases in Total Emissions	62.61		16.16		20.69		0.54	100.0	
Memo Items:	74.85		10.87		13.91		0.36	100.0	
International Bunkers									
Aviation	251.00	0.01	0.13	0.01	1.73	NO	NO	252.9	
Marine	177.37	0.00	0.03	0.01	1.55	NO	NO	178.9	
Multilateral Operations	73.63	0.00	0.10	0.00	0.18	NO	NO	73.9	
CO₂ Emissions from Biomass	C	C	C	C	C	NO	NO	C	

Table A7-1: GHG emission in Croatia, 1998

Croatia Year 1998	CO ₂	CH ₄		N ₂ O		HFC, PFC & SF ₆		Total (Gg CO ₂ eq)	Share %
	(Gg)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)		
1. Energy	17521.01	56.93	1195.50	0.39	119.83	NO	NO	18836.4	74.56
A. Fuel Comb (Sectoral Appr.)	16931.85	5.84	122.64	0.57	119.83	NO	NO	17174.3	67.98
1. Energy Industries	6270.57	0.14	2.88	0.06	11.65	NO	NO	6285.1	24.88
2. Man. Ind. and Constr.	3286.80	0.30	6.22	0.05	9.59	NO	NO	3302.6	13.07
3. Transport	4219.19	1.46	30.62	0.37	78.34	NO	NO	4328.1	17.13
4. Comm./Inst, Resid., Agric.	3155.29	3.95	82.93	0.10	20.26	NO	NO	3258.5	12.90
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	589.17	1072.86	1072.86	NO	NO	NO	NO	1662.0	6.58
1. Solid Fuels	NO	0.68	14.26	NO	NO	NO	NO	14.3	0.06
2. Oil and Natural Gas	589.17	50.41	1058.60	NO	NO	NO	NO	1647.8	6.52
2. Industrial Processes	2068.16	0.36	7.54	1.99	615.49	0.01	17.64	2708.8	10.72
A. Mineral Products	982.52	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	982.5	3.89
B. Chemical Industry	872.26	7.54	7.54	1.99	615.49	NO	NO	1495.3	5.92
C. Metal Production	15.90	NE,NO	NE,NO	NO	NO	NO	NO	15.9	0.06
D. Other Production	NE	NO	NO	NO	NO	NO	NO	NE	NE
E. Prod. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	NO	NO	NO	NO
F. Cons. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	0.01	17.64	17.6	0.07
G. Other	197.48	NO	NO	NO	NO	NO	NO	197.5	0.78
3. Solvent and Other Product Use	74.95	NO	NO	NE	NE	NO	NO	75.0	0.30
4. Agriculture	NO	43.58	915.27	7.12	2206.59	NO	NO	3121.9	12.36
A. Enteric Fermentation	NO	36.36	763.50	0.00	0.00	NO	NO	763.5	3.02
B. Manure Management	NO	7.23	151.77	0.72	221.96	NO	NO	373.7	1.48
C. Rice Cultivation	NO	NO	NO	0.00	0.00	NO	NO	NO	NO
D. Agricultural Soils	NO	NO	NO	6.40	1984.62	NO	NO	1984.6	7.86
E. Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agr. Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	-6841.15	0.00	0.02	0.00	0.01	NO	NO	-6841.1	-27.08
A. Forest Land	-6841.15	0.00	0.02	0.00	0.01	NO	NO	-6841.1	-27.08
B. Cropland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
C. Grassland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
D. Wetlands	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
G. Other	NE	NE	NE	NE	NE	NO	NO	NE	NE
6. Waste	0.08	20.87	438.37	0.27	84.13	NO	NO	522.6	2.07
A. Solid Waste Disp. on Land	NE,NO	16.45	345.37	0.00	0.00	NO	NO	345.4	1.37
B. Waste-water Handling	0.00	4.43	92.99	0.27	84.13	NO	NO	177.1	0.70
C. Waste Incineration	0.08	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	0.1	0.00
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Em./Rem. with LUCF	12823.06	121.75	2556.71	9.76	3026.04	0.01	17.64	18423.4	72.92
Total Emissions without LUCF	19664.21	121.75	2556.71	9.76	3026.04	0.01	17.64	25264.6	100.0
Share of Gases in Total Em./Rem.	69.60		13.88		16.42		0.10	100.0	
Share of Gases in Total Emissions	77.83		10.12		11.98		0.07	100.0	
Memo Items:									
International Bunkers	270.81	0.01	0.14	0.01	1.86	NO	NO	272.8	
Aviation	189.81	0.00	0.03	0.01	1.66	NO	NO	191.5	
Marine	81.00	0.01	0.11	0.00	0.20	NO	NO	81.3	
Multilateral Operations	C	C	C	C	C	NO	NO	C	
CO₂ Emissions from Biomass	1,575.08	NO	NO	NO	NO	NO	NO	1575.1	

Table A7-1: GHG emission in Croatia, 1999

Croatia Year 1999	CO ₂	CH ₄		N ₂ O		HFC, PFC & SF ₆		Total (Gg CO ₂ eq)	Share %
	(Gg)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)		
1. Energy	18005.08	56.01	1176.25	0.42	130.13	NO	NO	19311.5	73.42
A. Fuel Comb (Sectoral Appr.)	17479.83	5.91	124.04	0.62	130.13	NO	NO	17734.0	67.42
1. Energy Industries	6436.58	0.14	2.91	0.06	11.73	NO	NO	6451.2	24.53
2. Man. Ind. and Constr.	2956.81	0.25	5.25	0.04	8.07	NO	NO	2970.1	11.29
3. Transport	4519.94	1.51	31.67	0.43	89.33	NO	NO	4640.9	17.64
4. Comm./Inst, Resid., Agric.	3566.50	4.01	84.20	0.10	21.00	NO	NO	3671.7	13.96
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	525.25	1052.21	1052.21	NO	NO	NO	NO	1577.5	6.00
1. Solid Fuels	NO	0.20	4.29	NO	NO	NO	NO	4.3	0.02
2. Oil and Natural Gas	525.25	49.90	1047.92	NO	NO	NO	NO	1573.2	5.98
2. Industrial Processes	2338.20	0.32	6.75	2.34	726.25	0.01	9.18	3080.4	11.71
A. Mineral Products	1208.58	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	1208.6	4.59
B. Chemical Industry	1041.55	6.75	6.75	2.34	726.25	NO	NO	1774.6	6.75
C. Metal Production	18.30	NE,NO	NE,NO	NO	NO	NO	NO	18.3	0.07
D. Other Production	NE	NO	NO	NO	NO	NO	NO	NE	NE
E. Prod. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	NO	NO	NO	NO
F. Cons. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	0.01	9.18	9.2	0.03
G. Other	69.77	NO	NO	NO	NO	NO	NO	69.8	0.27
3. Solvent and Other Product Use	67.37	NO	NO	NE	NE	NO	NO	67.4	0.26
4. Agriculture	NO	44.40	932.31	7.62	2361.96	NO	NO	3294.3	12.52
A. Enteric Fermentation	NO	36.40	764.38	0.00	0.00	NO	NO	764.4	2.91
B. Manure Management	NO	8.00	167.93	0.73	226.32	NO	NO	394.2	1.50
C. Rice Cultivation	NO	NO	NO	0.00	0.00	NO	NO	NO	NO
D. Agricultural Soils	NO	NO	NO	6.89	2135.65	NO	NO	2135.6	8.12
E. Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agr. Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	-8153.08	0.00	0.00	0.00	0.00	NO	NO	-8153.1	-31.00
A. Forest Land	-8153.08	0.00	0.00	0.00	0.00	NO	NO	-8153.1	-31.00
B. Cropland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
C. Grassland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
D. Wetlands	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
G. Other	NE	NE	NE	NE	NE	NO	NO	NE	NE
6. Waste	0.08	21.93	460.53	0.28	88.24	NO	NO	548.9	2.09
A. Solid Waste Disp. on Land	NE,NO	17.53	368.16	0.00	0.00	NO	NO	368.2	1.40
B. Waste-water Handling	0.00	4.40	92.37	0.28	88.24	NO	NO	180.6	0.69
C. Waste Incineration	0.08	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	0.1	0.00
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Em./Rem. with LUCF	12257.65	122.66	2575.84	10.67	3306.59	0.01	9.18	18149.3	69.00
Total Emissions without LUCF	20410.73	122.66	2575.84	10.67	3306.59	0.01	9.18	26302.4	100.0
Share of Gases in Total Em./Rem.	67.54		14.19		18.22		0.05	100.0	
Share of Gases in Total Emissions	77.60		9.79		12.57		0.03	100.0	
Memo Items:									
International Bunkers	177.70	0.01	0.11	0.00	1.15	NO	NO	179.0	
Aviation	112.02	0.00	0.02	0.00	0.98	NO	NO	113.0	
Marine	65.68	0.00	0.09	0.00	0.16	NO	NO	65.9	
Multilateral Operations	C	C	C	C	C	NO	NO	C	
CO₂ Emissions from Biomass	1,496.33	NO	NO	NO	NO	NO	NO	1496.3	

Table A7-1: GHG emission in Croatia, 2000

Croatia Year 2000	CO ₂	CH ₄		N ₂ O		HFC, PFC & SF ₆		Total (Gg CO ₂ eq)	Share %
	(Gg)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)		
1. Energy	17517.88	59.29	1245.16	0.46	143.97	NO	NO	18907.0	72.09
A. Fuel Comb (Sectoral Appr.)	16884.86	6.38	134.08	0.69	143.97	NO	NO	17162.9	65.44
1. Energy Industries	5889.65	0.14	3.01	0.07	14.61	NO	NO	5907.3	22.52
2. Man. Ind. and Constr.	3076.67	0.26	5.41	0.04	8.43	NO	NO	3090.5	11.78
3. Transport	4514.75	1.49	31.29	0.47	97.82	NO	NO	4643.9	17.71
4. Comm./Inst, Resid., Agric.	3403.79	4.49	94.37	0.11	23.11	NO	NO	3521.3	13.43
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	633.02	1111.08	1111.08	NO	NO	NO	NO	1744.1	6.65
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	633.02	52.91	1111.08	NO	NO	NO	NO	1744.1	6.65
2. Industrial Processes	2515.19	0.34	7.04	2.76	854.60	0.01	23.16	3400.0	12.96
A. Mineral Products	1389.41	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	1389.4	5.30
B. Chemical Industry	1037.94	7.04	7.04	2.76	854.60	NO	NO	1899.6	7.24
C. Metal Production	20.81	NE,NO	NE,NO	NO	NO	NO	NO	20.8	0.08
D. Other Production	NE	NO	NO	NO	NO	NO	NO	NE	NE
E. Prod. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	NO	NO	NO	NO
F. Cons. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	0.01	23.16	23.2	0.09
G. Other	67.03	NO	NO	NO	NO	NO	NO	67.0	0.26
3. Solvent and Other Product Use	68.68	NO	NO	NE	NE	NO	NO	68.7	0.26
4. Agriculture	NO	43.02	903.38	7.68	2381.71	NO	NO	3285.1	12.53
A. Enteric Fermentation	NO	35.59	747.45	0.00	0.00	NO	NO	747.5	2.85
B. Manure Management	NO	7.42	155.92	0.71	219.27	NO	NO	375.2	1.43
C. Rice Cultivation	NO	NO	NO	0.00	0.00	NO	NO	NO	NO
D. Agricultural Soils	NO	NO	NO	6.98	2162.44	NO	NO	2162.4	8.24
E. Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agr. Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	-5280.74	0.00	0.04	0.00	0.01	NO	NO	-5280.7	-20.13
A. Forest Land	-5280.74	0.00	0.04	0.00	0.01	NO	NO	-5280.7	-20.13
B. Cropland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
C. Grassland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
D. Wetlands	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
G. Other	NE	NE	NE	NE	NE	NO	NO	NE	NE
6. Waste	0.08	22.99	482.85	0.27	84.24	NO	NO	567.2	2.16
A. Solid Waste Disp. on Land	NE,NO	18.62	391.10	0.00	0.00	NO	NO	391.1	1.49
B. Waste-water Handling	0.00	4.37	91.75	0.27	84.24	NO	NO	176.0	0.67
C. Waste Incineration	0.08	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	0.1	0.00
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Em./Rem. with LUCF	14821.08	125.64	2638.47	11.18	3464.53	0.01	23.16	20947.2	79.87
Total Emissions without LUCF	20101.82	125.64	2638.47	11.18	3464.53	0.01	23.16	26227.9	100.0
Share of Gases in Total Em./Rem.	70.75		12.60		16.54		0.11	100.0	
Share of Gases in Total Emissions	76.64		10.06		13.21		0.09	100.0	
Memo Items:									
International Bunkers	156.59	0.00	0.09	0.00	1.01	NO	NO	157.7	
Aviation	99.57	0.00	0.01	0.00	0.87	NO	NO	100.5	
Marine	57.02	0.00	0.08	0.00	0.14	NO	NO	57.2	
Multilateral Operations	C	C	C	C	C	NO	NO	C	
CO₂ Emissions from Biomass	1,680.11	NO	NO	NO	NO	NO	NO	1680.1	

Table A7-1: GHG emission in Croatia, 2001

Croatia Year 2001	CO ₂	CH ₄		N ₂ O		HFC, PFC & SF ₆		Total (Gg CO ₂ eq)	Share %
	(Gg)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)		
1. Energy	18446.97	64.44	1353.28	0.49	152.84	NO	NO	19953.1	72.87
A. Fuel Comb (Sectoral Appr.)	17759.34	5.32	111.69	0.73	152.84	NO	NO	18023.9	65.82
1. Energy Industries	6308.87	0.16	3.39	0.07	15.17	NO	NO	6327.4	23.11
2. Man. Ind. and Constr.	3217.12	0.26	5.36	0.04	8.44	NO	NO	3230.9	11.80
3. Transport	4613.27	1.39	29.20	0.52	109.92	NO	NO	4752.4	17.36
4. Comm./Inst, Resid., Agric.	3620.07	3.51	73.75	0.09	19.30	NO	NO	3713.1	13.56
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	687.64	1241.59	1241.59	NO	NO	NO	NO	1929.2	7.05
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	687.64	59.12	1241.59	NO	NO	NO	NO	1929.2	7.05
2. Industrial Processes	2495.92	0.34	7.24	2.32	718.76	0.02	48.99	3270.9	11.95
A. Mineral Products	1577.57	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	1577.6	5.76
B. Chemical Industry	848.15	7.24	7.24	2.32	718.76	NO	NO	1574.2	5.75
C. Metal Production	0.74	NE,NO	NE,NO	NO	NO	NO	NO	0.7	0.00
D. Other Production	NE	NO	NO	NO	NO	NO	NO	NE	NE
E. Prod. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	NO	NO	NO	NO
F. Cons. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	0.02	48.99	49.0	0.18
G. Other	69.45	NO	NO	NO	NO	NO	NO	69.5	0.25
3. Solvent and Other Product Use	74.65	NO	NO	NE	NE	NO	NO	74.6	0.27
4. Agriculture	NO	43.61	915.78	8.29	2569.50	NO	NO	3485.3	12.73
A. Enteric Fermentation	NO	36.14	758.98	0.00	0.00	NO	NO	759.0	2.77
B. Manure Management	NO	7.47	156.79	0.71	221.57	NO	NO	378.4	1.38
C. Rice Cultivation	NO	NO	NO	0.00	0.00	NO	NO	NO	NO
D. Agricultural Soils	NO	NO	NO	7.57	2347.93	NO	NO	2347.9	8.57
E. Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agr. Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	-8213.80	0.00	0.01	0.00	0.00	NO	NO	-8213.8	-30.00
A. Forest Land	-8213.80	0.00	0.01	0.00	0.00	NO	NO	-8213.8	-30.00
B. Cropland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
C. Grassland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
D. Wetlands	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
G. Other	NE	NE	NE	NE	NE	NO	NO	NE	NE
6. Waste	0.08	24.21	508.32	0.29	90.26	NO	NO	598.7	2.19
A. Solid Waste Disp. on Land	NE,NO	19.89	417.59	0.00	0.00	NO	NO	417.6	1.53
B. Waste-water Handling	0.00	4.32	90.73	0.29	90.26	NO	NO	181.0	0.66
C. Waste Incineration	0.08	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	0.1	0.00
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Em./Rem. with LUCF	12803.82	132.60	2784.63	11.39	3531.36	0.02	48.99	19168.8	70.00
Total Emissions without LUCF	21017.62	132.60	2784.63	11.39	3531.36	0.02	48.99	27382.6	100.0
Share of Gases in Total Em./Rem.	66.80		14.53		18.42		0.26	100.0	
Share of Gases in Total Emissions	76.76		10.17		12.90		0.18	100.0	
Memo Items:									
International Bunkers	151.60	0.01	0.13	0.00	0.77	NO	NO	152.5	
Aviation	62.23	0.00	0.01	0.00	0.55	NO	NO	62.8	
Marine	89.37	0.01	0.13	0.00	0.22	NO	NO	89.7	
Multilateral Operations	C	C	C	C	C	NO	NO	C	
CO₂ Emissions from Biomass	1,315.01	NO	NO	NO	NO	NO	NO	1315.0	

Table A7-1: GHG emission in Croatia, 2002

Croatia Year 2002	CO ₂	CH ₄		N ₂ O		HFC, PFC & SF ₆		Total (Gg CO ₂ eq)	Share %
	(Gg)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)		
1. Energy	19500.37	66.93	1405.56	0.54	167.69	NO	NO	21073.6	74.33
A. Fuel Comb (Sectoral Appr.)	18835.05	5.38	112.94	0.80	167.69	NO	NO	19115.7	67.42
1. Energy Industries	7206.36	0.19	3.92	0.09	17.89	NO	NO	7228.2	25.49
2. Man. Ind. and Constr.	3010.16	0.25	5.15	0.04	8.10	NO	NO	3023.4	10.66
3. Transport	4911.53	1.36	28.55	0.58	121.95	NO	NO	5062.0	17.85
4. Comm./Inst, Resid., Agric.	3707.00	3.59	75.32	0.09	19.76	NO	NO	3802.1	13.41
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	665.32	1292.62	1292.62	NO	NO	NO	NO	1957.9	6.91
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	665.32	61.55	1292.62	NO	NO	NO	NO	1957.9	6.91
2. Industrial Processes	2394.86	0.29	6.15	2.25	697.70	0.02	49.31	3148.0	11.10
A. Mineral Products	1562.68	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	1562.7	5.51
B. Chemical Industry	769.01	6.15	6.15	2.25	697.70	NO	NO	1472.9	5.19
C. Metal Production	0.15	NE,NO	NE,NO	NO	NO	NO	NO	0.2	0.00
D. Other Production	NE	NO	NO	NO	NO	NO	NO	NE	NE
E. Prod. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	NO	NO	NO	NO
F. Cons. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	0.02	49.31	49.3	0.17
G. Other	63.02	NO	NO	NO	NO	NO	NO	63.0	0.22
3. Solvent and Other Product Use	99.14	NO	NO	NE	NE	NO	NO	99.1	0.35
4. Agriculture	NO	42.74	897.64	8.07	2502.04	NO	NO	3399.7	11.99
A. Enteric Fermentation	NO	35.16	738.30	0.00	0.00	NO	NO	738.3	2.60
B. Manure Management	NO	7.59	159.34	0.70	217.22	NO	NO	376.6	1.33
C. Rice Cultivation	NO	NO	NO	0.00	0.00	NO	NO	NO	NO
D. Agricultural Soils	NO	NO	NO	7.37	2284.82	NO	NO	2284.8	8.06
E. Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agr. Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	-8205.61	0.00	0.01	0.00	0.00	NO	NO	-8205.6	-28.94
A. Forest Land	-8205.61	0.00	0.01	0.00	0.00	NO	NO	-8205.6	-28.94
B. Cropland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
C. Grassland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
D. Wetlands	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
G. Other	NE	NE	NE	NE	NE	NO	NO	NE	NE
6. Waste	0.08	25.59	537.37	0.31	95.30	NO	NO	632.8	2.23
A. Solid Waste Disp. on Land	NE,NO	21.32	447.63	0.00	0.00	NO	NO	447.6	1.58
B. Waste-water Handling	0.00	4.27	89.74	0.31	95.30	NO	NO	185.0	0.65
C. Waste Incineration	0.08	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	0.1	0.00
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Em./Rem. with LUCF	13788.84	135.56	2846.73	11.17	3462.74	0.02	49.31	20147.6	71.06
Total Emissions without LUCF	21994.46	135.56	2846.73	11.17	3462.74	0.02	49.31	28353.2	100.0
Share of Gases in Total Em./Rem.	68.44		14.13		17.19		0.24	100.0	
Share of Gases in Total Emissions	77.57		10.04		12.21		0.17	100.0	
Memo Items:									
International Bunkers	132.36	0.01	0.11	0.00	0.70	NO	NO	133.2	
Aviation	59.12	0.00	0.01	0.00	0.52	NO	NO	59.6	
Marine	73.24	0.00	0.10	0.00	0.18	NO	NO	73.5	
Multilateral Operations	C	C	C	C	C	NO	NO	C	
CO₂ Emissions from Biomass	1,331.58	NO	NO	NO	NO	NO	NO	1331.6	

Table A7-1: GHG emission in Croatia, 2003

Croatia Year 2003	CO ₂	CH ₄		N ₂ O		HFC, PFC & SF ₆		Total (Gg CO ₂ eq)	Share %
	(Gg)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)		
1. Energy	20951.63	68.42	1436.89	0.62	191.50	NO	NO	22580.0	75.15
A. Fuel Comb (Sectoral Appr.)	20267.59	6.37	133.81	0.91	191.50	NO	NO	20592.9	68.54
1. Energy Industries	7870.97	0.22	4.53	0.09	19.70	NO	NO	7895.2	26.28
2. Man. Ind. and Constr.	3168.58	0.27	5.76	0.04	9.33	NO	NO	3183.7	10.60
3. Transport	5286.79	1.32	27.70	0.66	138.61	NO	NO	5453.1	18.15
4. Comm./Inst, Resid., Agric.	3941.24	4.56	95.82	0.11	23.86	NO	NO	4060.9	13.52
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	684.04	1303.08	1303.08	NO	NO	NO	NO	1987.1	6.61
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	684.04	62.05	1303.08	NO	NO	NO	NO	1987.1	6.61
2. Industrial Processes	2517.58	0.32	6.71	2.12	657.71	0.07	163.71	3345.7	11.14
A. Mineral Products	1573.09	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	1573.1	5.24
B. Chemical Industry	876.62	6.71	6.71	2.12	657.71	NO	NO	1541.0	5.13
C. Metal Production	0.19	NE,NO	NE,NO	NO	NO	NO	NO	0.2	0.00
D. Other Production	NE	NO	NO	NO	NO	NO	NO	NE	NE
E. Prod. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	NO	NO	NO	NO
F. Cons. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	0.07	163.71	163.7	0.54
G. Other	67.67	NO	NO	NO	NO	NO	NO	67.7	0.23
3. Solvent and Other Product Use	107.51	NO	NO	NE	NE	NO	NO	107.5	0.36
4. Agriculture	NO	44.72	939.20	7.77	2409.17	NO	NO	3348.4	11.14
A. Enteric Fermentation	NO	36.78	772.34	0.00	0.00	NO	NO	772.3	2.57
B. Manure Management	NO	7.95	166.86	0.73	226.46	NO	NO	393.3	1.31
C. Rice Cultivation	NO	NO	NO	0.00	0.00	NO	NO	NO	NO
D. Agricultural Soils	NO	NO	NO	7.04	2182.71	NO	NO	2182.7	7.26
E. Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agr. Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	-6276.50	0.00	0.02	0.00	0.01	NO	NO	-6276.5	-20.89
A. Forest Land	-6276.50	0.00	0.02	0.00	0.01	NO	NO	-6276.5	-20.89
B. Cropland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
C. Grassland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
D. Wetlands	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
G. Other	NE	NE	NE	NE	NE	NO	NO	NE	NE
6. Waste	0.08	27.13	569.77	0.30	93.27	NO	NO	663.1	2.21
A. Solid Waste Disp. on Land	NE,NO	22.90	480.98	0.00	0.00	NO	NO	481.0	1.60
B. Waste-water Handling	0.00	4.23	88.78	0.30	93.27	NO	NO	182.1	0.61
C. Waste Incineration	0.08	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	0.1	0.00
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Em./Rem. with LUCF	17300.29	140.60	2952.59	10.81	3351.66	0.07	163.71	23768.2	79.11
Total Emissions without LUCF	23576.80	140.60	2952.59	10.81	3351.66	0.07	163.71	30044.7	100.0
Share of Gases in Total Em./Rem.	72.79		12.42		14.10		0.69	100.0	
Share of Gases in Total Emissions	78.47		9.83		11.16		0.54	100.0	
Memo Items:									
International Bunkers	140.24	0.01	0.11	0.00	0.80	NO	NO	141.1	
Aviation	71.57	0.00	0.01	0.00	0.63	NO	NO	72.2	
Marine	68.67	0.00	0.10	0.00	0.17	NO	NO	68.9	
Multilateral Operations	C	C	C	C	C	NO	NO	C	
CO₂ Emissions from Biomass	1,714.51	NO	NO	NO	NO	NO	NO	1714.5	

Table A7-1: GHG emission in Croatia, 2004

Croatia Year 2004	CO ₂	CH ₄		N ₂ O		HFC, PFC & SF ₆		Total (Gg CO ₂ eq)	Share %
	(Gg)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)		
1. Energy	20383.27	69.62	1462.09	0.65	202.27	NO	NO	22047.6	73.28
A. Fuel Comb (Sectoral Appr.)	19673.27	6.24	131.09	0.96	202.27	NO	NO	20006.6	66.49
1. Energy Industries	6830.94	0.21	4.40	0.08	17.76	NO	NO	6853.1	22.78
2. Man. Ind. and Constr.	3555.41	0.32	6.76	0.05	11.12	NO	NO	3573.3	11.88
3. Transport	5434.73	1.29	27.03	0.72	150.19	NO	NO	5612.0	18.65
4. Comm./Inst, Resid., Agric.	3852.18	4.42	92.90	0.11	23.20	NO	NO	3968.3	13.19
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	710.00	1331.00	1331.00	NO	NO	NO	NO	2041.0	6.78
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	710.00	63.38	1331.00	NO	NO	NO	NO	2041.0	6.78
2. Industrial Processes	2661.50	0.31	6.52	2.59	802.54	0.08	188.87	3659.4	12.16
A. Mineral Products	1670.42	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	1670.4	5.55
B. Chemical Industry	919.89	6.52	6.52	2.59	802.54	NO	NO	1729.0	5.75
C. Metal Production	0.39	NE,NO	NE,NO	NO	NO	NO	NO	0.4	0.00
D. Other Production	NE	NO	NO	NO	NO	NO	NO	NE	NE
E. Prod. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	NO	NO	NO	NO
F. Cons. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	0.08	188.87	188.9	0.63
G. Other	70.79	NO	NO	NO	NO	NO	NO	70.8	0.24
3. Solvent and Other Product Use	134.95	NO	NO	NE	NE	NO	NO	134.9	0.45
4. Agriculture	NO	47.44	996.19	8.24	2553.15	NO	NO	3549.3	11.80
A. Enteric Fermentation	NO	38.84	815.64	0.00	0.00	NO	NO	815.6	2.71
B. Manure Management	NO	8.60	180.55	0.76	235.19	NO	NO	415.7	1.38
C. Rice Cultivation	NO	NO	NO	0.00	0.00	NO	NO	NO	NO
D. Agricultural Soils	NO	NO	NO	7.48	2317.96	NO	NO	2318.0	7.70
E. Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agr. Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	-7899.85	0.00	0.00	0.00	0.00	NO	NO	-7899.8	-26.26
A. Forest Land	-7899.85	0.00	0.00	0.00	0.00	NO	NO	-7899.8	-26.26
B. Cropland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
C. Grassland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
D. Wetlands	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
G. Other	NE	NE	NE	NE	NE	NO	NO	NE	NE
6. Waste	0.08	28.84	605.69	0.29	91.27	NO	NO	697.0	2.32
A. Solid Waste Disp. on Land	NE,NO	24.64	517.38	0.00	0.00	NO	NO	517.4	1.72
B. Waste-water Handling	0.00	4.20	88.30	0.29	91.27	NO	NO	179.6	0.60
C. Waste Incineration	0.08	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	0.1	0.00
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Em./Rem. with LUCF	15279.95	146.21	3070.48	11.77	3649.23	0.08	188.87	22188.5	73.74
Total Emissions without LUCF	23179.80	146.21	3070.48	11.77	3649.23	0.08	188.87	30088.4	100.0
Share of Gases in Total Em./Rem.	68.86		13.84		16.45		0.85	100.0	
Share of Gases in Total Emissions	77.04		10.20		12.13		0.63	100.0	
Memo Items:									
International Bunkers	160.19	0.01	0.11	0.00	0.94	NO	NO	161.3	
Aviation	87.13	0.00	0.01	0.00	0.76	NO	NO	87.9	
Marine	73.06	0.00	0.10	0.00	0.18	NO	NO	73.3	
Multilateral Operations	C	C	C	C	C	NO	NO	C	
CO₂ Emissions from Biomass	1,704.34	NO	NO	NO	NO	NO	NO	1704.3	

Table A7-1: GHG emission in Croatia, 2005

Croatia Year 2005	CO ₂	CH ₄		N ₂ O		HFC, PFC & SF ₆		Total (Gg CO ₂ eq)	Share %
	(Gg)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)		
1. Energy	20745.60	69.67	1463.08	0.65	202.65	NO	NO	22411.3	73.33
A. Fuel Comb (Sectoral Appr.)	20054.60	6.32	132.68	0.96	202.65	NO	NO	20389.9	66.72
1. Energy Industries	6860.86	0.20	4.26	0.09	18.45	NO	NO	6883.6	22.52
2. Man. Ind. and Constr.	3654.46	0.29	6.12	0.05	10.14	NO	NO	3670.7	12.01
3. Transport	5654.66	1.54	32.44	0.72	151.82	NO	NO	5838.9	19.11
4. Comm./Inst, Resid., Agric.	3884.62	4.28	89.85	0.11	22.24	NO	NO	3996.7	13.08
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	691.00	1330.40	1330.40	NO	NO	NO	NO	2021.4	6.61
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	691.00	63.35	1330.40	NO	NO	NO	NO	2021.4	6.61
2. Industrial Processes	2694.65	0.29	6.11	2.53	783.51	0.15	349.18	3833.5	12.54
A. Mineral Products	1714.75	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	1714.8	5.61
B. Chemical Industry	907.37	6.11	6.11	2.53	783.51	NO	NO	1697.0	5.55
C. Metal Production	0.34	NE,NO	NE,NO	NO	NO	NO	NO	0.3	0.00
D. Other Production	NE	NO	NO	NO	NO	NO	NO	NE	NE
E. Prod. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	NO	NO	NA,NO	NA,N O
F. Cons. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	0.15	349.18	349.2	1.14
G. Other	72.19	NO	NO	NO	NO	NO	NO	72.2	0.24
3. Solvent and Other Product Use	155.05	NO	NO	NE	NE	NO	NO	155.1	0.51
4. Agriculture	NO	46.72	981.02	8.32	2578.99	NO	NO	3560.0	11.65
A. Enteric Fermentation	NO	39.23	823.89	0.00	0.00	NO	NO	823.9	2.70
B. Manure Management	NO	7.48	157.13	0.74	229.71	NO	NO	386.8	1.27
C. Rice Cultivation	NO	NO	NO	0.00	0.00	NO	NO	NO	NO
D. Agricultural Soils	NO	NO	NO	7.58	2349.28	NO	NO	2349.3	7.69
E. Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agr. Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	-7726.37	0.00	0.00	0.00	0.00	NO	NO	-7726.4	-25.28
A. Forest Land	-7726.37	0.00	0.00	0.00	0.00	NO	NO	-7726.4	-25.28
B. Cropland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
C. Grassland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
D. Wetlands	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
G. Other	NE	NE	NE	NE	NE	NO	NO	NE	NE
6. Waste	0.08	24.38	511.97	0.29	89.33	NO	NO	601.4	1.97
A. Solid Waste Disp. on Land	NE,NO	20.21	424.31	0.00	0.00	NO	NO	424.3	1.39
B. Waste-water Handling	0.00	4.17	87.66	0.29	89.33	NO	NO	177.0	0.58
C. Waste Incineration	0.08	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	0.1	0.00
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Em./Rem. with LUCF	15869.01	141.06	2962.18	11.79	3654.47	0.15	349.18	22834.8	74.72
Total Emissions without LUCF	23595.38	141.06	2962.18	11.79	3654.47	0.15	349.18	30561.2	100.0
Share of Gases in Total Em./Rem.	69.49		12.97		16.00		1.53	100.0	
Share of Gases in Total Emissions	77.21		9.69		11.96		1.14	100.0	
Memo Items:									
International Bunkers	199.09	0.01	0.13	0.00	1.25	NO	NO	200.5	
Aviation	120.11	0.00	0.02	0.00	1.05	NO	NO	121.2	
Marine	78.98	0.01	0.11	0.00	0.19	NO	NO	79.3	
Multilateral Operations	C	C	C	C	C	NO	NO	C	
CO₂ Emissions from Biomass	1,586.57	NO	NO	NO	NO	NO	NO	1586.6	

Table A7-1: GHG emission in Croatia, 2006

Croatia Year 2006	CO ₂	CH ₄		N ₂ O		HFC, PFC & SF ₆		Total (Gg CO ₂ eq)	Share %
	(Gg)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)	(Gg)	(Gg CO ₂ eq)		
1. Energy	20725.64	76.33	1603.01	0.71	219.72	NO	NO	22548.4	73.13
A. Fuel Comb (Sectoral Appr.)	20062.64	6.26	131.36	1.05	219.72	NO	NO	20413.7	66.21
1. Energy Industries	6635.78	0.19	3.90	0.08	16.86	NO	NO	6656.5	21.59
2. Man. Ind. and Constr.	3751.87	0.29	6.00	0.05	10.12	NO	NO	3768.0	12.22
3. Transport	6022.59	1.55	32.50	0.81	170.83	NO	NO	6225.9	20.19
4. Comm./Inst, Resid., Agric.	3652.39	4.24	88.95	0.10	21.90	NO	NO	3763.2	12.20
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	663.00	1471.65	1471.65	NO	NO	NO	NO	2134.7	6.92
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	663.00	70.08	1471.65	NO	NO	NO	NO	2134.7	6.92
2. Industrial Processes	2791.18	0.37	7.84	2.50	774.70	0.18	430.68	4004.4	12.99
A. Mineral Products	1842.26	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	1842.3	5.97
B. Chemical Industry	878.52	7.84	7.84	2.50	774.70	NO	NO	1661.1	5.39
C. Metal Production	0.37	NE,NO	NE,NO	NO	NO	NO	NO	0.4	0.00
D. Other Production	NE	NO	NO	NO	NO	NO	NO	NE	NE
E. Prod. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	NO	NO	NA,NO	NO
F. Cons. of Halocarbons & SF ₆	0.00	NO	NO	NO	NO	0.18	430.68	430.7	1.40
G. Other	70.04	NO	NO	NO	NO	NO	NO	70.0	0.23
3. Solvent and Other Product Use	182.39	NO	NO	NE	NE	NO	NO	182.4	0.59
4. Agriculture	NO	47.40	995.38	8.10	2512.12	NO	NO	3507.5	11.38
A. Enteric Fermentation	NO	39.77	835.21	0.00	0.00	NO	NO	835.2	2.71
B. Manure Management	NO	7.63	160.16	0.75	233.14	NO	NO	393.3	1.28
C. Rice Cultivation	NO	NO	NO	0.00	0.00	NO	NO	NO	NO
D. Agricultural Soils	NO	NO	NO	7.35	2278.98	NO	NO	2279.0	7.39
E. Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agr. Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	-7490.30	0.00	0.00	0.00	0.00	NO	NO	-7490.3	-24.29
A. Forest Land	-7490.30	0.00	0.00	0.00	0.00	NO	NO	-7490.3	-24.29
B. Cropland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
C. Grassland	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
D. Wetlands	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
F. Other Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	NE,NO	NO
G. Other	NE	NE	NE	NE	NE	NO	NO	NE	NE
6. Waste	0.08	24.00	503.97	0.28	87.28	NO	NO	591.3	1.92
A. Solid Waste Disp. on Land	NE,NO	19.85	416.86	0.00	0.00	NO	NO	416.9	1.35
B. Waste-water Handling	0.00	4.15	87.11	0.28	87.28	NO	NO	174.4	0.57
C. Waste Incineration	0.08	NE,NO	NE,NO	NE,NO	NE,NO	NO	NO	0.1	0.00
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Em./Rem. with LUCF	16209.00	148.10	3110.20	11.59	3593.81	0.18	430.68	23343.7	75.71
Total Emissions without LUCF	23699.30	148.10	3110.20	11.59	3593.81	0.18	430.68	30834.0	100.0
Share of Gases in Total Em./Rem.	69.44		13.32		15.40		1.84	100.0	
Share of Gases in Total Emissions	76.86		10.09		11.66		1.40	100.0	
Memo Items:									
International Bunkers	181.41	0.00	0.10	0.00	1.21	NO	NO	182.7	
Aviation	120.42	0.00	0.02	0.00	1.05	NO	NO	121.5	
Marine	60.98	0.00	0.08	0.00	0.15	NO	NO	61.2	
Multilateral Operations	C	C	C	C	C	NO	NO	C	
CO₂ Emissions from Biomass	1,586.18	NO	NO	NO	NO	NO	NO	1586.2	

ANNEX 8

DECISION 7/CP.12

Decision 7/CP.12**Level of emissions for the base year of Croatia**

The Conference of the Parties,

Recalling Article 4, paragraph 6, of the Convention,

Responding to the request of the Government of Croatia that its base year greenhouse gas emissions be considered in accordance with Article 4, paragraph 6, of the Convention,

Recalling decisions 9/CP.2, 11/CP.4 and 10/CP.11,

Taking into account the submission from Croatia contained in FCCC/SBI/2006/MISC.1,

Noting the report of the individual review of the greenhouse gas inventory of Croatia submitted in 2004 and contained in FCCC/WEB/IRI/2004/HRV, which, inter alia, recognized that the greenhouse gas inventory of Croatia does not contain emissions from power plants outside the boundaries of Croatia for 1990 or subsequent years,

Noting that this decision has no implications for historical emission levels of any other Party, in particular for Bosnia and Herzegovina, Serbia, and Montenegro,¹

Considering that the flexibility under Article 4, paragraph 6, of the Convention to choose a base year different from 1990, in order to take into account the economic circumstances of countries undergoing the process of transition to a market economy, has previously been invoked by five Parties,

Considering the specific circumstances of Croatia with regard to greenhouse gas emissions before and after 1990, and the structure of the electricity generation sector of the former Yugoslavia,

Noting the intention that the approach taken should be conservative, and that unduly high flexibility should not be provided,

1. *Notes* that the inventory reported in 2004 showed the total greenhouse gas emissions in 1990 to be 31.7 Mt CO₂ equivalent;

2. *Decides* that Croatia, having invoked Article 4, paragraph 6, of the Convention, shall be allowed to add 3.5 Mt CO₂ equivalent to its 1990 level of greenhouse gas emissions not controlled by the Montreal Protocol for the purpose of establishing the level of emissions for the base year for implementation of its commitments under Article 4, paragraph 2, of the Convention.

*7th plenary meeting
17 November 2006*

¹ Montenegro is currently an observer State to the UNFCCC.