UNITED
NATIONS

UNFCCC Framework Convention on Climate Change

Distr.
RESTRICTED

FCCC/IDR.1/HRV
23 May 2002

ENGLISH ONLY

CROATIA

Report on the in-depth review of the first national communication of Croatia

Review team:

Eduardo Calvo (Peru)
Mikhail Gytarsky (Russian Federation)
Stefan Lechtenboehmer (Germany)
Astrid Olsson (UNFCCC secretariat)
Katia Simeonova (UNFCCC secretariat, coordinator)

I. INTRODUCTION AND NATIONAL CIRCUMSTANCES RELEVANT TO GREENHOUSE GAS EMISSIONS AND REMOVALS

1. The secretariat received the *First National Communication of the Republic of Croatia to the United Nations Framework Convention on Climate Change*, further referred to as the NC1, on 7 February 2002. An in-depth review of the NC1 was carried out between February 2002 and May 2002, including a visit to Zagreb from 4 to 8 March 2002. The review team consisted of Mr. Eduardo Calvo (Peru), Dr. Mikhail Gytarsky (Russian Federation), Mr. Stefan Lechtenboehmer (Germany), Ms. Astrid Olsson (UNFCCC secretariat) and Dr. Katia Simeonova (UNFCCC secretariat, coordinator).

2. The territory of Croatia covers 56,610 sq km, of which 56 per cent is agricultural land (arable land and pasture) and the remainder is forest land, including forests. Forests cover 20,615 sq km (36 per cent of the land area). State-owned forest land makes up 81 per cent of total forest land; it is subject to a forestry management plan and all forests are managed. The climate is Mediterranean on the Adriatic coast and continental inland. According to the preliminary unofficial results of the 2001 census, the population of Croatia amounted to 4.381 million.

3. Croatia became an independent state in 1991, when it separated from the former Yugoslavia, and in 1992 it joined the United Nations. In terms of administrative structure, the country is divided into 20 counties plus the City of Zagreb, which is the capital. The country is a parliamentary republic, legislative power lying with the parliament and executive power being exercised by both the Government and the president. Climate change falls under the responsibility of the Ministry of Environmental Protection and Physical Planning, referred to below as the Ministry of Environment, which coordinates the activities of other ministries and agencies dealing with climate-related issues.

4. The Croatian economy suffered from the wars resulting from the disintegration of the former Yugoslavia. Consequently, the gross domestic product (GDP) plummeted by 32 per cent from 1990 to 1994 but increased thereafter by 26 per cent to reach $19.03 billion by 2000. The main drivers of growth were consumer spending and investment. In terms of contribution to GDP in 2000, services were the most important sector, accounting for 35.4 per cent, followed by manufacturing and mining, 27 per cent, transport and trade, 22.2 per cent, agriculture, forestry and fishing, 9.5 per cent and construction, 5.9 per cent. The economic structure of the country reflects structural changes initiated in 1990 and associated with a shift away from manufacturing and mining towards services, especially tourism. Macroeconomic and financial policy is geared to ensuring financial stability, controlling inflation, reducing unemployment from the relatively high level of 23 per cent in 2002, privatization, market liberalization and integration with international markets.

5. The level of foreign direct investment was relatively high, $5 billion as of 2002, which on a per capita basis ranks Croatia among the top five countries in the region. A further boost to the economy as well as reducing barriers to foreign direct investment and overseas trade, was expected as a result of the implementation of the stabilization and association agreement with the European Community (EC) signed in 2001 and the prospect of Croatia becoming a member of the Central European Free Trade Agreement in 2002.

6. The country's energy resource endowment of crude oil, natural gas and hydro resources made it possible to cover around half of the energy demand from domestic sources. Exploitation of the limited coal reserves became uneconomical and 2000 saw the closure of the last coal mine. The total primary energy supply (TPES) rose from 348.2 PJ in 1996 to 359.6 PJ in 2000 to meet the growth of energy demand. In the same year, liquid fuels accounted for 44.6 per cent of TPES, natural gas 26.4 per cent, hydropower 15.8 per cent, coal 4.8 per cent, fuelwood 4.3 per cent, and imported electricity 4 per cent. Non-traditional renewables accounted for a very small share of TPES, less than 0.05 per cent.

7. In the same period, the total final energy consumption (TFEC) increased from 201.6 PJ to 221.2 PJ. This growth was attributed to the growth in demand from all sectors, the shares of which remained relatively constant. In 2000, the residential, commercial and public sectors accounted for 47.7 per cent of TFEC, transport 29.3 per cent, and industry 23 per cent. Because of the relatively small share of industry in TFEC and the low contribution of coal to TPES, the energy and carbon intensity of the economy was low.

8. Croatia became a Party to the United Nations Framework Convention on Climate Change, referred to below as the Convention, in 1996, after ratification by the parliament (Official Gazette # 55/196). As an Annex I country with an economy in transition, Croatia committed itself to stabilizing greenhouse gas (GHG) emissions by the year 2000 at their 1990 level. Judging from the information provided in the NC1, together with the initial results available from the inventory for 1999, the team concluded that Croatia was likely to meet this commitment. In the longer term, the country's objective is to continue to address climate change in a way that is consistent with the principles of sustainable development.

9. Croatia signed the Kyoto Protocol in 1999. At the time of the review visit, ratification was still under consideration. Under the Protocol, Croatia has a commitment to reduce its GHG emissions in the first commitment period by 5 per cent compared to base year emission levels.

10. In its first national communication (NC1), Croatia used the flexibility accorded by Article 4.6 of the Convention to Annex I Parties with economies in transition. It designated 1990 as the base year for implementing its commitments under the Convention and reported a base year emission level of 39,391 Gg CO_2 equivalent.[1]

11. The NC1 was prepared over a three-year period with support from the Global Environment Facility (GEF) and the United Nations Development Programme (UNDP). It addressed all aspects of climate change policy, in line with the 1996 UNFCCC Revised Guidelines for the Preparation of National Communications by Parties included in Annex I to the Convention (decision 9/CP.2), referred to below as the 1996 UNFCCC guidelines. In addition, it contained elements for a mitigation action plan. The NC1 was prepared with the participation of relevant stakeholders, including academia as well as business and environmental non-governmental organizations, and is based on policy documents adopted or in preparation at the time it was drafted. Plans existed to use the information from the NC1 for the purpose of raising the awareness of climate change on the part of the public at large and specific segments of society.

12. The Ministry of Environment assumed the responsibility of coordinating the preparation of the NC1. A National Committee for Climate Change was set up with representatives from the relevant ministries, national energy companies, the Chamber of Commerce, academia and non-governmental organizations to oversee the preparation of the document. In terms of operational arrangements, the work on the four main issues - inventory, mitigation, impacts and adaptation, and general policy issues - was done by four task forces coordinated by a project manager.

13. The work on the NC1 helped to streamline the efforts of the national institutions involved in climate change policy-making and facilitated the first steps towards establishing an institutional framework to address climate change, e.g. setting up the National Committee for Climate Change. It also helped to lay the foundation for future work in the framework of the National Climate Change Mitigation Programme (NCCMP). This approach ensured continuity, as it built on the work done on the NC1 and in particular on the action plan for mitigation. It also ensured continuity in terms of the institutional framework already built and capacity created.

---

[1] The base year emissions were calculated by adjusting on a per capita basis the estimates of the CO_2 emissions from fuel combustion in 1990, obtained following the IPCC approach.

14. The task forces were expected to continue their work in the framework of the NCCMP as a capacity-building part of it. In parallel, an NCCMP implementation programme had to be established with the task of implementing specific projects and preparing the necessary regulations, manuals and services. This reflected a shift in focus from the analysis of alternative options to the implementation of options and projects which could be economically and environmentally feasible, e.g. energy efficiency projects and renewables. It also reflected the intention to transfer knowledge and experience from the state and public institutions to the private sector and business, with a view to involving them more actively in the implementation of climate policies.

15. The review team concluded that the NC1 is a comprehensive document which outlines the initial steps taken by Croatia in formulating and implementing its climate change policy. In terms of integration of climate change into sectoral policies, the team acknowledged that climate change had gained prominence and was addressed both directly (increase of natural gas share, promotion of renewables, keeping the nuclear power option open, integration of climate change and other environmental considerations in regional planning) and indirectly (energy efficiency improvements, fiscal measures) in the *1999 Draft Energy Sector Development Strategy of Croatia*. The strategy was adopted at the beginning of 2002 and will underpin energy sector development in the near and mid-term.

II. GREENHOUSE GAS INVENTORY INFORMATION

16. The NC1 included the GHG inventory for the period 1990-1995 and covered emissions by sources and removals by sinks of direct GHGs such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), and emissions of indirect GHGs, or precursors, such as nitrogen oxides (NO_X), carbon monoxide (CO) and non-methane volatile organic compounds (NMVOCs). It also covered emissions of sulphur dioxide (SO_2), and emissions of the new gases, such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). Emission estimates for the period after 1995 were not provided. To report inventory results, Croatia used the 1996 UNFCCC guidelines, which are based on Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories (referred to below as the 1996 IPCC Guidelines). The team noted that the NC1 did not strictly follow these guidelines. In particular, the IPCC standard tables and emissions from international aviation and marine bunkers were not included in the NC1. Also no information was given on how feedstocks were considered, and no activity data or emission factors were included. During the visit, however, the team was provided with a GHG inventory report, which contained emission estimates for the period 1990-1995 with IPCC sectoral reporting tables and the necessary information on activity data, emission factors, and the assumptions made, as well as energy balances as background information.

17. The Ministry of Environment was responsible for coordinating work on the GHG inventory, while the compilation was done by the Energy and Environment Protection Institute (EKONERG) under a contract with the ministry. EKONERG subcontracted specific activities within inventory preparation to other institutions. Linkages between the various institutions involved in the inventory were established, so as to ensure consistency in inventory preparation. The team noted some insufficient coordination by the Ministry of Agriculture and Forestry in compiling the GHG inventory for agriculture and land-use change and forestry (LUCF) and it encouraged the Ministry to become more involved in inventory preparation in the future.

18. The GHG inventory was calculated according to the tier 1 or default approaches of the 1996 IPCC Guidelines except for the calculation of ozone precursors and SO_2 emissions from oil refining, where the tier 2 approach was used. The energy-related CO_2 emissions were calculated using the IPCC reference approach for the entire 1990-1995 period, thus offering a comparison with results from the sectoral approach and serving as a cross-check on inventory results. The difference in the results was in the range of 1.7 to 5.2 per cent.

19. Due to the high initial CO_2 content of the natural gas extracted, Croatia introduced an additional emission source that is not included in the 1996 IPCC Guidelines. The review team noted that CO_2 emissions from this source were estimated by means of a material balance approach that is broadly consistent with the IPCC methodology and is well documented.

20. Activity data were collected on an annual basis. The review team noted that the Central Bureau of Statistics (CBS) collected data on the import and export of fuels and fuel use in the industrial sector. This was done in accordance with EUROSTAT requirements. The energy balance was prepared by the National Energy Institute Hrvoje Pozar, referred to below as the Energy Institute, together with the CBS. The main source of activity data for industrial processes was the National Statistics Report by CBS, and these data were cross-checked with industry. The 1990 activity data for agriculture were taken from the National Statistics Report, while for the years 1991-1995 data compiled by the Food and Agriculture Organization of the United Nations (FAO) were used. The data for land-use change and forestry were obtained from the forest inventory conducted every 10 years, the latest one dating from 1986. The CBS was responsible for collecting activity data on municipal and industrial waste and recycling. Due to problems in collecting data for the inventory in the NC1, a project was implemented for the years 1990-1998 to obtain the missing activity data. The team was informed that since 2000 the data on waste collected by the CBS have followed the classification in the EC *European Waste Catalogue*. This is expected to help improve the inventory in the future.

21. To reflect Croatia's national circumstances as provided under Article 4, paragraph 6, of the Convention, the CO_2 emissions from fuel combustion for 1990 and 1991 were calculated using the IPCC approach and then adjusted to reflect the CO_2 per capita emissions from fuel combustion in the former Yugoslavia. This approach, and the underlying reasons for its use, are described in the addendum to the present report (FCCC/IDR.1/HRV/Add.1). The team noted that adjusting emissions using the per capita approach was not in line with the 1996 IPCC Guidelines. It also noted that the adjustment of emissions for two years contributed to inconsistency in the time-series of emission estimates.

22. The emission factors used in the GHG inventory were mainly IPCC default ones. The review team noted that Croatia used country-specific net calorific values for converting fuel quantities into energy units, which were within the range of net calorific values provided by the IPCC. The team also noted that Croatia used the emission factors of the *IPCC Report on Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* for estimating N_2O emissions from nitric acid and PFCs from aluminium production and a correction factor for the loss of clinker in cement kilns (cement kiln dust) when estimating CO_2 emissions from the cement industry. For solvent and other product use, the emission factors of the EMEP/CORINAIR Guidebook[2] were used. Croatia estimated the CH_4 emissions from solid waste disposal sites using the default IPCC methodology based on the fraction of degradable organic carbon (DOC). A special case study was launched to obtain a DOC factor based on country-specific data on waste composition. The team encouraged Croatia to make the results of this study publicly available in peer-reviewed literature.

23. Emissions from international aviation and marine bunkers were estimated annually using the IPCC methodology and were not included in the national totals, in line with the 1996 IPCC Guidelines. They were included in the GHG inventory report but not in the NC1. Activity data were taken from the energy balance. Fuel use for international aviation was estimated on the basis of expert judgement for each individual year. International marine bunkers were included in the energy balance from 1994 onwards. For the years 1990-1993 they were estimated on the basis of expert judgement.

---

[2] EMEP/CORINAIR stands for co-operative programme for monitoring and evaluation of the long range transmission of air pollutants in Europe (CORe INventory of AIR emissions). It is linked to the Convention on Long-range Transboundary Air Pollution.

24. The review team noted that CO_2 emissions from ammonia production were estimated from the amount and quality of natural gas used in the process as feedstock. However, this was not clear from the IPCC worksheets for the energy sector provided to the team during the visit for the year 1990. The team encouraged Croatia to provide this information in a transparent manner in its next GHG inventory.

25. Croatia closed its primary iron and steel plant in 1992. As of that year, only secondary steel was produced. It reported emissions from the iron and steel industry in the energy sector for the entire 1990-1995 period. The review team noted that for the years 1990 and 1991 there might be a potential double counting of CO_2 emissions within the iron and steel industry in the energy sector. The review team encouraged Croatia to study this further and to provide information on the calculations in the next inventory submission.

26. Croatia did not produce fluorocarbons. Emissions, therefore, stem from the use of HFCs, PFCs and SF_6 as well as processes associated with these gases. Croatia included estimates of potential emissions of HFCs for the year 1995. There were no estimates of potential emissions of PFCs. According to the GHG inventory report, the consumption of HFCs and PFCs during the period 1990-1995 was insignificant. The NC1 did not provide any data on the use of SF_6 and associated emissions. Such data were reported in the GHG inventory report, but due to the unreliability of the input data used, they were not included in the NC1.

27. Actual emissions of PFCs from aluminium production were estimated for the years 1990 and 1991 only, as thereafter no aluminium was produced in Croatia. There were no data available on the possible use of SF_6 in aluminium foundries. The review team encouraged Croatia to estimate potential and actual emissions from the use of PFCs and SF_6 as well as the actual emissions from use of HFCs.

28. The IPCC default approach was applied to estimate GHG emissions from the agricultural sector. The NC1 included non-CO_2 GHG emissions from agricultural residue burning for 1990. However, this information was missing for the period 1991-1995. The review team noted that emissions of non-CO_2 gases from residue burning were low. It also noted the problems with activity data for agricultural residue burning associated with the war in Croatia in the period 1991-1995. For the sake of completeness and consistency in reporting, it encouraged Croatia to make efforts to estimate these emissions for the years other than 1990.

29. Croatia used the default IPCC approach for estimating GHG removals by the forest sink. Only CO_2 removals resulting from changes in forest and other woody biomass stocks were reported in the NC1 due to the lack of activity data for the other subcategories in the LUCF sector. Because of the long-term nature of changes in forestry, the same annual removal estimate was given throughout the 1990-1995 period, based on estimates of removals by sinks for 1990 only. The review team noted that the values of GHG removals given in the NC1 differ from those in the GHG inventory report. The difference stemmed from the use of different expansion factors. The review team encouraged Croatia to provide in its GHG inventory report the estimates for 1991-1995. It also encouraged Croatia to ensure consistency in GHG reporting by cross-checking the values of GHG removals in the NC1 and the GHG inventory report.

30. Given the importance of forest for Croatia (43 per cent of its territory is forest land and 36 per cent is covered by forests), Croatia estimated the capacity for forest management under Article 3, paragraph 4, of the Kyoto Protocol. Although this is related to the Kyoto Protocol, the review team included a description of the approach for this estimate due to its links to inventory preparation. The estimate was based on the available national data on ongoing forest management activities and complied with the methodological guidance adopted by the Conference of the Parties at its seventh session (decision 11/CP.7).

31. The basis for calculations was a combination of the data on annual removals taken as a total annual increment (4,120 Gg C/yearly), provided by the public company Croatian Forests, and annual emissions obtained by subtracting the natural losses (160 Gg C/yearly) form the yearly cutting figures (1,440 Gg C/yearly) provided by the Ministry of Agriculture and Forestry to the FAO database. The difference between annual removals and emissions resulted in a net annual sink of 2,840 Gg.

32. To obtain the value of the cap for forest management activities under Article 3, paragraph 4, of the Kyoto Protocol, Croatia applied an 85 per cent discount factor to obtain a value of 426 Gg C/yearly. Taking into account national circumstances, and in accordance with footnote 5 of the annex to decision 11/CP.7, the value of 426 Gg C/yearly was increased to obtain 620 Gg C/yearly. The review team noted that the value of 620 Gg C/yearly can also be derived by applying the 85 per cent discount factor to the annual increment without cutting. Croatia made a special submission to the Conference of the Parties to incorporate the value of 620 Gg C/yearly in the decision on land use, land-use change and forestry (decision 11/CP.7).

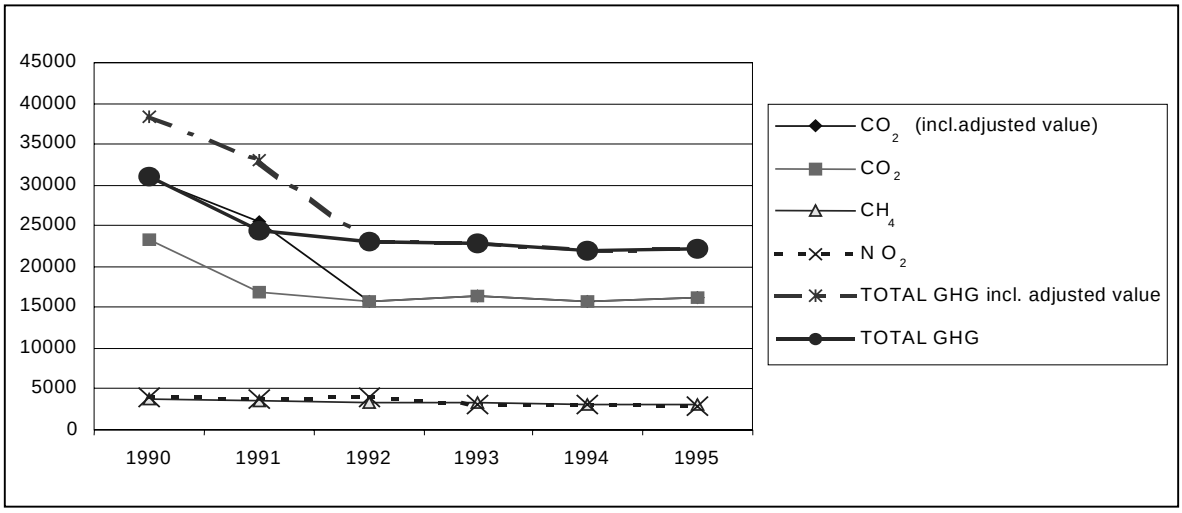
33. Uncertainties were mainly estimated by expert judgement and qualitative estimates were made in line with the IPCC. The uncertainty estimates were based on dividing emission estimates and activity data into three groups, highly reliable (±10 per cent uncertainty); medium reliable (±30 per cent uncertainty); and low reliable (more than 50 per cent uncertainty). The data from Croatia's national energy balance, except for 1990 and 1991 data, and emissions from industrial processes were considered highly reliable, while data for non-CO_2 emissions from fuel combustion, fugitive emissions, NMVOC emissions from solvent use, field burning of agricultural residues and land-use and management were considered low reliable.

34. The activity data and GHG emission estimates were verified by comparing them with Hungarian and Slovenian inventories. The CO_2 emissions from fuel combustion were compared with the calculations by the International Energy Agency (IEA). The average difference between the calculations was no higher than 4 per cent. The CO_2 emissions from road transport were compared with estimates made by the COPERT II method, resulting in a difference of about 2 per cent.

35. The team noted that in 1996, under the Law on Environmental Protection, the Croatian Environmental Emissions Inventory (EEI) was set up to collect information on emissions and emission trends. It also noted that, although not used for GHG inventory preparation for the NC1, the EEI was an important step towards improving the quality of the inventory. It encouraged Croatia to develop the EEI further, in parallel with the work on annual inventory reporting under the Convention. The team noted Croatia's intention to provide future GHG inventories annually using the common reporting format and develop "country-specific" emission factors. It acknowledged the difficulties Croatia faced in submitting a GHG inventory annually due to capacity constraints and noted the plans for revision and improvement of the inventory, including strengthening the legal and institutional framework, in particular for the preparation of energy balances, and enhancing the quality of national statistics and uncertainty analysis in line with IPCC Good Practice Guidance.

36. The trend in greenhouse gas emissions for the period 1990-1995 expressed in CO_2 equivalent is illustrated in figure 1. Emissions of HFCs, PFCs and SF_6 were not included, as the estimates covered a mix of actual and potential emissions. The total emissions in Croatia decreased by 47 per cent (adjusted value) or 30 per cent (unadjusted) between 1990 and 1995. In 1990, the share of CO_2 was 80 per cent (adjusted value) or 75 per cent (unadjusted), CH_4 10 per cent (adjusted value) or 12 per cent (unadjusted), and N_2O 10 per cent (adjusted value) or 13 per cent (unadjusted). The emission pattern did not change much over the period; in 1995 the share of CO_2 was 73 per cent, CH_4 14 per cent and N_2O 13 per cent.

Figure 1. Total GHG emissions and emissions by gas, 1990-1995 (Gg CO_2 equivalent)



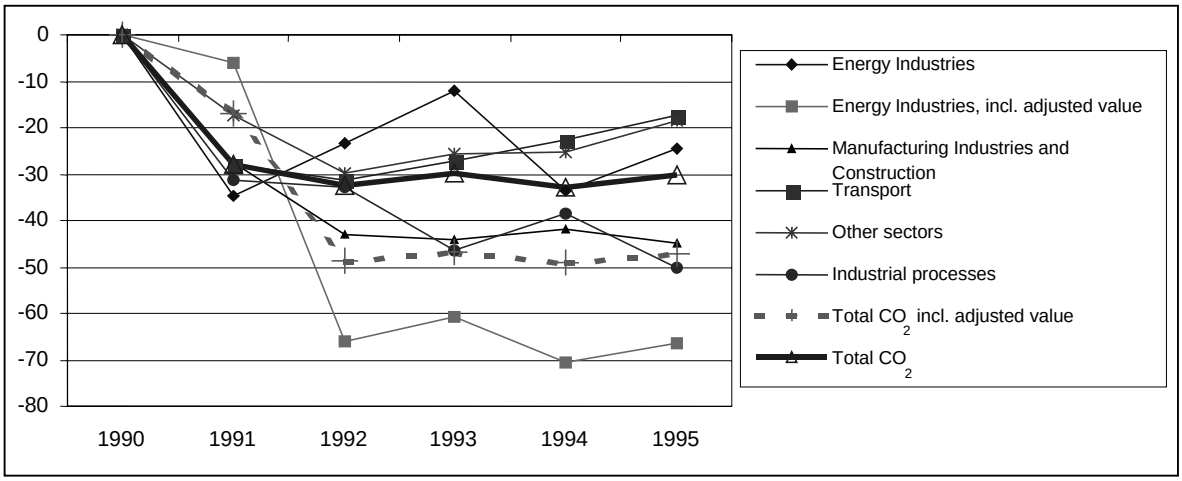
37. Total CO_2 emissions in Croatia plummeted by 47.1 per cent (adjusted value) or 30.4 per cent (unadjusted) between 1990 and 1995, from the 1990 level of 30,713 Gg (adjusted value) or 23,337 Gg (unadjusted). Emissions in all source categories were lower in 1995 than in 1990, because of the decline in business activity and energy demand brought about by the war and separation from the former Yugoslavia. For transport and other sectors the trend was upward after 1992, due to changes in behaviour, in particular the greater number of cars. After the war it was decided that the energy-intensive industries, i.e. primary iron, steel and aluminium production industries, which had been closed down during the war, would remain closed. In 1995, the emissions rose slightly due to increased activities in energy industries, transport and other sectors. Manufacturing industries and construction were the single most important source in 1990 and 1991 (without adjustments). As of 1992, energy industries became the most important sector with a share of 27 per cent in 1995, followed by other sectors and manufacturing industries and construction with almost equal shares of 22.6 and 22.3 per cent, transport 20.5 per cent and industry 7.2 per cent (table 1 and figure 2).

Table 1. Carbon dioxide emissions by source, 1990-1995 (Gg)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**
Energy						
Energy industries	5,897	3,847	4,514	5,185	3,925	4,460
Adjusted value	7,376	8,617				
Manufacturing industries and construction	6,546	4,732	3,730	3,658	3,815	3,617
Transport	4,046	2,917	2,781	2,949	3,124	3,337
Other sectors	4,503	3,726	3,161	3,355	3,372	3,668
Industrial processes	2,345	1,612	1,578	1,253	1,439	1,169
Total CO_2 incl. adjusted value	30,713	25,450	15,764	16,399	15,674	16,251
Total CO_2	**23,337**	**16,833**	**15,764**	**16,399**	**15,674**	**16,251**
LUCF removals	-6,505	-6,505	-6,505	-6,505	-6,505	-6,505

Note: Other sectors include small combustion, fugitive emissions and non-energy use.

Figure 2. Carbon dioxide emissions, percentage change from 1990, by source

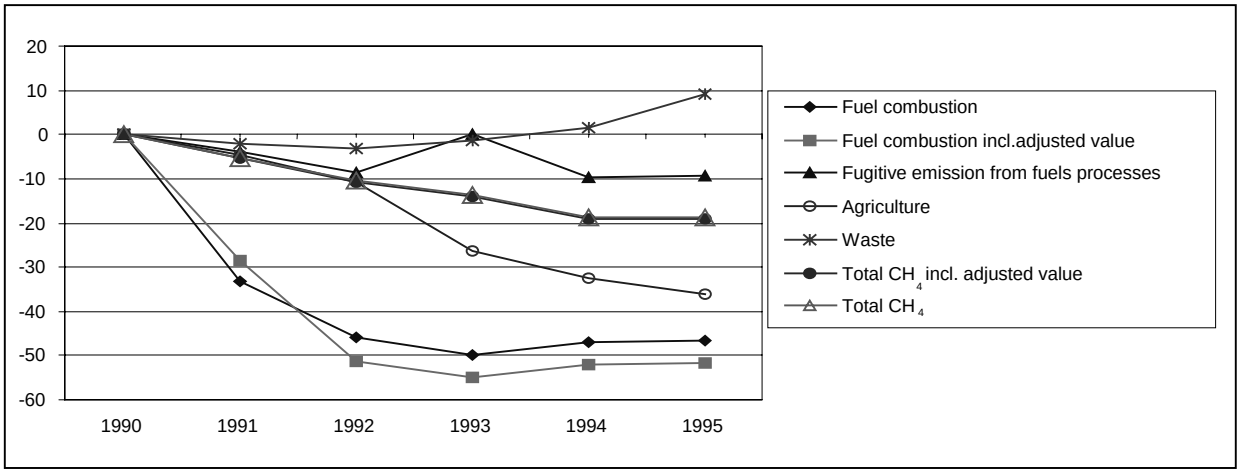


38. Total CH_4 emissions in Croatia were 183 Gg (adjusted value) or 182 Gg (unadjusted) in 1990. They declined by 19 per cent (adjusted value) or 18.6 per cent (unadjusted) between 1990 and1995. Fugitive emissions were the main source of CH_4 emissions in 1995, accounting for 36 per cent, followed by agriculture with 32.5 per cent, waste with 28 per cent and other sectors with 3.5 per cent. In 1990, agriculture was a major source of CH_4 emissions, accounting for 41 per cent. Emissions from agriculture fell by 36 per cent between 1990 and 1995, driven by decreases in livestock numbers. Emissions from waste increased by 9 per cent, due to changes in behaviour (table 2 and figure 3).

Table 2. Methane emissions by source, 1990-1995 (Gg)

	1990	1991	1992	1993	1994	1995
Fuel combustion	9.0	6.0	4.9	4.5	4.8	4.8
Fuel combustion, adjusted value	1.0	1.1				
Fugitive emissions	58.8	56.5	53.8	58.9	53.1	53.4
Agriculture	75.3	71.9	67.1	55.6	50.8	48.1
Waste	37.8	37.0	36.6	37.2	38.4	41.2
Total CH_4 incl. adjusted value	**182.6**	**173.1**	**162.8**	**156.7**	**147.6**	**147.8**
Total CH_4	**181.7**	**172.0**	**162.8**	**156.7**	**147.6**	**147.8**

Figure 3. Methane emissions, percentage change from 1990, by source

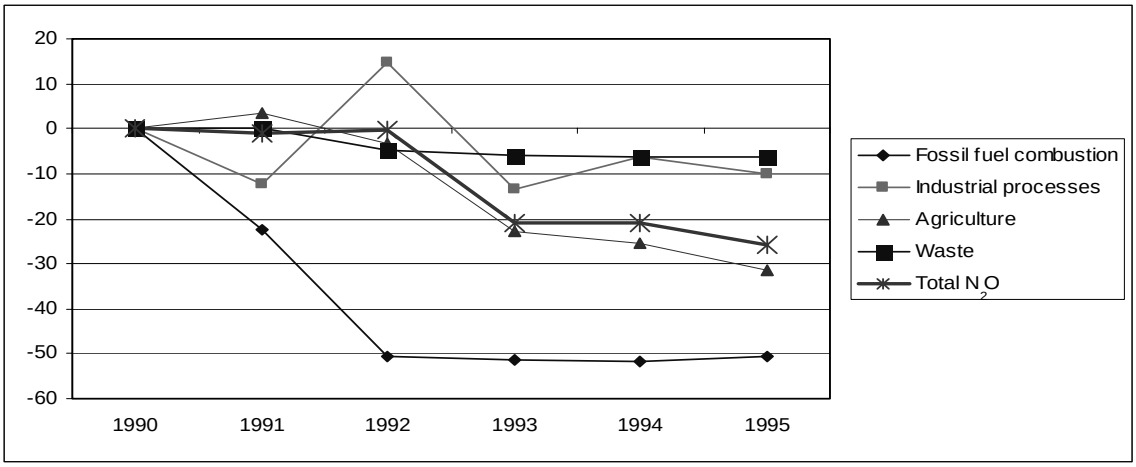


39. Total N_2O emissions in Croatia were 13 Gg in 1990 and they declined by 25.8 per cent between 1990 and 1995. Agriculture remained the major emission source with a share of emissions of 65 per cent in 1995, followed by industrial processes 28.8 per cent, waste 4.5 per cent and fuel combustion 1.7 per cent (table 3 and figure 4).

Table 3. Nitrous oxide emissions by source, 1990-1995 (Gg)

	1990	1991	1992	1993	1994	1995
Fossil fuel combustion	0.32	0.25	0.16	0.16	0.15	0.16
Industrial processes	3.0	2.6	3.4	2.6	2.8	2.7
Agriculture	8.8	9.1	8.6	6.8	6.6	6.1
Waste	0.45	0.45	0.43	0.42	0.42	0.42
Total N_2O	**12.6**	**12.5**	**12.6**	**10.0**	**10.0**	**9.3**

Figure 4. Nitrous oxide emissions, percentage change from 1990, by source



40. Inventory data for the LUCF sector came from the forest census undertaken every 10 years. The latest census was conducted in 1996 but data from the previous census (1986) were used for the inventory. The net annual removal was estimated as 6,505 Gg CO_2 and was assumed to remain the same for the entire 1990-1995 period due to the long-term nature of changes in forestry.

III. POLICIES AND MEASURES

41. The presentation of policies and measures in the NC1 followed to some extent the reporting requirements of the 1996 UNFCCC guidelines. It commenced with an overview of existing policies and measures by policy area, placing emphasis on the energy sector given its importance in terms of contribution to the total emissions. It then provided a broad overview of planned mitigation measures by sector. The team noted that the information on the status of implementation was not always clear, as it was difficult to determine which of the planned measures were covered by government decisions and ensured of support. Moreover, the summary table with information on policies and measures was not used. During the visit, however, the review team was provided with all the relevant information, including information in the format of the summary table.

42. The team noted that, with some exceptions, mitigation policies were at the planning stage. The policies already in place or adopted by legislation had been launched with objectives other than those related to climate change, such as energy market liberalization, privatization of energy industries,

strengthening of the building codes and enhancing of waste management. The central instruments used to achieve climate change goals were programmes providing frameworks for development of different sectors and identifying within these frameworks the energy demand and mitigation potentials. Economic and fiscal instruments were not used and regulatory instruments were employed in few cases. Voluntary agreements targeting some branches of industry and the service sector were mentioned as potential instruments in the NC1, but had not yet been implemented.

43. The NC1 contained a list of criteria used in policy design and implementation. Although cost-effectiveness was considered as the most important of them, the NC1 clearly stated that other policy objectives, such as addressing unemployment and economic growth, could be equally important. The team acknowledged as a particularly important and promising instrument the mandatory environmental impact analysis (EIA) of large industrial facilities and associated plans to reduce GHG emissions described in paragraphs 65-66 below.

44. In terms of monitoring and reviewing the implementation of policies, some steps had been taken to review some sectoral policies. For example, the Energy Law contains provisions for reporting every three years on the results obtained under the Strategy Implementation Programme. However, it remained unclear whether this reporting covered emission reductions. This was why the team concluded that a systematic approach for reviewing the implementation of policies and measures was yet to be established. This aspect could be covered in the framework of the planned implementation programme of the NCCMP. Also, the NC1 stressed that the development of the private sector was essential so that the bulk of the planned mitigation measures could be financed privately. The team noted that the participation of this sector, although not a focus of the review, was crucial for the success of the climate change policy.

A. Energy

Cross-cutting issues

45. In 1997 the Croatian Government adopted the National Energy Action Plan (NEAP), which included eleven programmes: a gas introduction programme (PLINCRO); two energy efficiency programmes for the building sector (KUENZ) and for the industrial, service and public sectors (MIEE); two programmes for cogeneration (COGEN) and for improvement of district heating systems (KUENC); a programme addressing efficiency and environmental protection in the transport sector (TRANSCRO); and, finally, five renewable energy resource programmes to promote energy from biomass and waste (BIOEN), solar energy (SUNEN), wind energy (ENWIND), geothermal energy (GEOEN), and small hydro projects (MANE). These programmes centred mostly on strategic research and development in the relevant fields. The NEAP was coordinated by the Energy Institute for the Ministry of Economy and by the Ministry of Communication and Transport for the transport part. Descriptions of the energy programmes are contained in the *1999 Draft Energy Sector Development Strategy of Croatia*.

46. During the visit, the team was provided with information on the legislative framework for establishing energy markets, and for restructuring and privatizing the two national energy companies, the Croatian Power Company (HEP) and the Croatian Oil and Gas Company (INA). This framework was designed to translate the EC directives on liberalization of energy markets into national law and also to comply with the relevant provisions of the European Energy Charter signed by Croatia in 1992.

47. The framework, described in detail in the *1999 Draft Energy Sector Development Strategy of Croatia*, envisaged a two-stage approach. Firstly, a package of five laws, including the Energy Law, the Energy Activities Regulation Law, the Electricity Market Law, the Gas Market Law and the Oil and Oil Derivatives Law, was adopted by the parliament in 2001.[3] Privatization of the HEP and INA was then

[3] Unofficial English translations of these laws are available at www.mingo.hr

envisaged and, as of 2002, the two respective laws were before the parliament for adoption. A set of implementing acts and legislation (by-laws) was under preparation in 2002 to enact this legislation, including energy efficiency standards, energy efficiency labelling, connecting independent power producers to the grid, renewable energy and targets for a minimum share of renewables, tariff systems and combined heat and power generation (CHP).

48. More specifically, the Energy Law set out the main objectives of energy policy and introduced policy instruments placing emphasis on planning to achieve these, such as the Strategic Implementation Programme for the near term (minimum of three years), the Energy Strategy for mid-term development (10 years) and National Energy Programmes for the long term (the 11 programmes introduced by the 1997 NEAP). At local level, the 21 counties had to produce their first energy master plans for their territories until 2003 on a mandatory basis. To facilitate this, since 1996 about half of them have participated in training and capacity-building activities undertaken by the Energy Institute and have already allocated the responsibilities for energy planning within the administration.

49. Liberalization of energy markets was initiated in 2002 by implementing the set of energy and privatization laws mentioned above. In the first stage of this process, 16 large industrial customers having an annual consumption of more than 40 GWh each, representing 10 per cent of the market, became eligible buyers. The mid-term perspective for Croatia was to become a part of the regional market under the Central European Free Trade Agreement and to further open the market by around 20 per cent by 2005. By 2010, when Croatia considered it possible to join the EC, the Croatian energy market was expected to be fully liberalized and to become an integral part of the EC-wide market.

50. According to the Electricity Market Law, the HEP was to be split in two stages. In the first stage, generation, transmission and distribution were to be unbundled by separate accounting. The establishment of independent system and market operators was also planned. In the second stage, three independent companies dealing with these activities were to be set up under the HEP holding. These companies could be privatized thereafter, but further splitting was not envisaged given their size relative to the size of the EC market.

51. The INA, which by 2002 held an almost complete monopoly over oil products, was to be split into a gas company for production, import and wholesale of gas and an oil company for pipeline, refinery, wholesale and retail activities. These companies could be privatized thereafter. Gas transport was considered a public service to be provided by the gas transportation company set up in 2001 and owned by the INA; distribution companies will form the basis of county concessions. Customers having a consumption of more than 100 million cubic metres of gas, as well as CHP producers and electricity producers regardless of their consumption, were eligible buyers. As of 2002, four companies accounting for 40 per cent of gas consumption were eligible buyers.

52. Oil product prices were controlled by the Ministry of Economy, which as of 2001 set a price cap based on Mediterranean spot oil prices. In the electricity, natural gas and heat sectors, the prices were still controlled by the Government and these prices broadly followed the cost pricing principle. For example, before taxation, electricity on the high-voltage part of the network supplying electricity to industry was 32 per cent less expensive than that on the low-voltage network supplying electricity mainly to households. A uniform 22 per cent value added tax was introduced in 1998 for all consumers. Nonetheless, some cross-subsidizing of electricity, natural gas and heat for households still existed in 2002, mainly at the expense of industry. The energy prices for households were expected to rise gradually with a view to removing the cross-subsidies.

53. Energy pricing in Croatia reflected the understanding that energy prices are also a tool to enhance energy efficiency both under current conditions and in the future liberalized energy market. Overall control of prices was to be entrusted to the electricity and gas regulator, especially for the prices

associated with transmission and distribution, considered as public services, while the prices for production were expected to be defined by the market. The prices for non-eligible customers were to be regulated by certain price cap formulas. A gas price tariff system, based on the on-border price of Russian gas and negotiated prices for consumers, was under preparation in 2002 with technical and financial support from the World Bank and the United States Agency for International Development.

54. The Energy Law pinpointed energy efficiency as one of the main goals of energy policy. It also defined the main instruments to enhance energy efficiency, including support for relevant programmes containing information and promotional activities at national and local levels as well as at enterprise level. It required the Government to prepare rules of efficient energy use for specific customer groups and efficiency labels for appliances. The relevant secondary legislation was under preparation in 2002 and Croatian experts expected it to come into effect in 2003 at the latest.

55. The Energy Law also envisaged a fund to support energy efficiency projects by means of grants and loans, including soft loans. The plan was to establish a joint fund for environmental protection and energy efficiency, controlled respectively by the Ministry of Environment and the Ministry of Economy. The main source for the fund was to be the revenue collected from air pollution charges and a CO_2 tax. The team noted that this scheme was just at the conceptual stage, as no CO_2 tax was planned**.** A revolving fund for energy efficiency was planned to be established as part of a $15 million project for energy efficiency in the public sector funded by the GEF and the World Bank.

56. The *1999 Draft Energy Sector Development Strategy of Croatia* included a plan for a national energy efficiency agency to be set up in Zagreb with branches in large regional cities such as Split, Rijeka and Osijek. The Energy Institute was to play a key role in setting up this agency. The team noted that the decision to set up the agency was still pending and financial resources were yet to be allocated.

57. The team stressed that energy efficiency was planned to deliver more than 40 per cent of the CO_2 reductions in the energy sector by 2010. The practical steps taken so far, however, did not go beyond some activities aimed at removing barriers to energy efficiency in the residential and service sectors. It also stressed that rigorous implementation was needed to achieve the targets set for energy efficiency and associated emission mitigation, including swift adoption of the relevant draft laws and the Strategy Implementation Programme, and setting up of the energy efficiency fund and agency.

Energy industries

58. The energy industries accounted for 27 per cent of total CO_2 emissions in 1995. Nevertheless, the contribution of this sector and, in particular, of the electricity sector to the overall emissions was relatively low, 18 per cent only, due to the relatively high share of hydro energy (47 per cent of the installed generation capacity) and natural gas in electricity generation, and also the relatively high share of cogeneration. In order to attain climate change goals in the sector, the main policy was to increase natural gas use, as outlined in the PLINCRO programme. The programme set out the goals to enhance the capacity of the infrastructure to import more gas and to increase gas use in the residential sector in the north of Croatia. The development of a gas network in the south, primarily based on liquefied petroleum gas (LPG), was also planned and in 2002 the first pilot project was launched.

59. The KOGEN programme was used as a tool to promote CHP, especially low-capacity CHP. The main instrument applied was the introduction of a guaranteed buy-back rate for CHP electricity by the HEP set at a level of 70 per cent of the average system prices for electricity. Use of this instrument was to continue in the future liberalized market. In 1999 and 2002, two new gas-fired combined cycle CHP plants with capacities of 50 MW and 210 MW were commissioned in Zagreb. Improvement of the existing four major district heating systems was planned under the KUENC energy programme.

60. In 2000, renewable energy accounted for more than 50 per cent of electricity produced and about 20 per cent of the TPES. As of 1994, the HEP purchased electricity from small producers (less than 5 MW) at the level of 70 per cent of the average system price for electricity from hydropower and 90 per cent from wind power.

61. According to the *1999 Draft Energy Sector Development Strategy of Croatia*, the use of renewables had to grow at the same pace as total energy consumption, maintaining a steady share thereof. Moreover, renewables were planned to deliver more than 30 per cent of CO_2 reductions from the energy sector in 2010. The Energy Law introduced specific instruments to promote renewables, such as regulations on minimum shares of renewable energy, purchasing regulations for green electricity based on the avoided costs principle plus a certain premium, and conditions for connecting the new sources to the grid. To implement these instruments, the secondary legislation has yet to be adopted.

62. The five renewable energy programmes, BIOEN, SUNEN, ENWIND, GEOEN and MANE, were used to promote the use of renewables, with the largest potential estimated for geothermal energy. Some pilot projects on biomass use in industry with technical support from the Netherlands and on the production of biofuels were under implementation in 2002. A few other projects were planned by the HEP to promote renewable energy in cooperation with the World Bank and the GEF. The first offshore wind park of 5.6 MW on a Croatian island was to be implemented by a foreign investor.

63. The implementation of policy to promote renewables was limited to the guaranteed buy-back rates and several ongoing pilot actions and projects to remove implementation barriers already mentioned, which resulted in the commissioning of very few additions of new capacity. The war and the subsequent deterioration in economic conditions also contributed to this. The team noted that a target-oriented approach and the setting up of a funding scheme could help foster the planned development of renewable energy.

Energy use in industry

64. The improvement of energy efficiency and, hence, the reduction of operating costs and enhancement of competitiveness were addressed by the MIEE programme. It envisaged setting up networks for energy efficiency improvement among industries and other sectors. Industry was also targeted by planned energy service company (ESCO) activities described below under the services sector. Several projects to use small CHP and bioenergy described in the energy industry section had yet to be implemented in the sector industry.

65. A mandatory EIA for different projects was introduced in 1986 in Croatia following the approaches adopted by the United States, and was subsequently updated in 1999. It applied to both construction and upgrading of all industrial facilities, including most power plants, manufacturing industries, landfills and other waste management facilities. The EIA procedure included public consultations and a decision on project acceptability to be made by the Government based on the conclusions of an independent expert committee appointed by the Government. The assessment had to include a cost-benefit analysis and estimates of environmental impact relevant to the implementation of Croatian commitments under international treaties such as the UNFCCC and its Kyoto Protocol.

66. As result of implementation of the EIA, the first two out of four cement plants that applied for permits to change over to a more carbon-intensive fuel, such as coal and petroleum coke, were required to develop action plans for CO_2 emissions reduction to offset the potential emissions increase. Also, several cement companies were planning to reduce energy consumption by setting a target to reach the upper level of specific energy consumption of the current best available technology by 2020.

Energy use in residential, commercial and public sectors

67. Efficiency gains and associated emissions reductions from heating systems were expected as a result of stricter implementation of the 1996 standards on air pollution and heat losses from small boilers. These standards were in line with the EC directives on small boilers and were designed for the entire building segment of the residential, commercial and institutional sectors.

68. The building code for new buildings introduced in 1992 and revised in 1995 regulated the average annual heat consumption to 100 kWh per square metre, which is in line with the building standards in the region. Further strengthening of the code to 70 kWh was envisaged, which was in line with recent German standards. Problems remained, however, with the enforcement of the building code in the household sector, especially for small family houses. Also, the team noted that the impact could be slight, given the existing large building stock and its slow turnover. The impact could be more visible in the commercial and institutional sectors, where enforcement could also be easier. The efficiency improvements in existing buildings were addressed in the KUENZ energy programme.

69. The secondary legislation to the Energy Law on energy efficiency standards and efficiency labelling of appliances was in preparation at the time of the visit. Pilot action was being taken to promote the use of compact fluorescent lamps, as an element of the $13 million project funded by the GEF and UNDP aimed at removing barriers to energy efficiency in the service sector.

70. For the service and public sectors, energy efficiency improvement was sought mainly through the establishment of a market for ESCO. ESCO services for hotels and other service sectors were envisaged under the GEF and World Bank project mentioned above. Also, the HEP was planning to set up ESCO for energy services in the public sector in the framework of a $15 million project funded by the GEF and UNDP. The first pilot project of such ESCO targeted the improvement of the street lighting in Zagreb.

71. A significant potential for the use of renewables was identified in the service sector, especially for geothermal energy using the existing wells from oil and gas drilling. Also, a pilot project promoting solar thermal energy in small guest houses was launched in 2002. These activities to some extent responded to the rising awareness in the tourism sector of the need for enhanced environmental management, which stems from the requirements of the major international tour operators. The team noted a need for a more rigorous incentive-based approach and also for information and education to improve the efficiency of energy use in the residential, commercial and institutional sectors.

Fugitive emissions from energy

72. Fugitive emissions of CH_4 and of CO_2 from natural gas scrubbing accounted for around 4 per cent of the total GHG emissions of Croatia in 1990 and 8 per cent in 1993. The emissions from refineries were addressed in a project for environmental reconstruction financed through a loan from the European Bank for Reconstruction and Development. This project involved a furnace replacement in the vacuum distillation unit of the refinery in Rijeka amounting to 2.5 million euro and storage tank repair for 11 million euro.

73. The indigenous natural gas has a very high CO_2 content and therefore has to be scrubbed before use. This practice was responsible for around 700 Gg CO_2 emissions annually. Several ongoing studies explored the option of injecting the scrubbed CO_2 into oilfields, which would also facilitate oil production. The reduction of losses from the gas grid was also studied, mainly with a view to improving the economic performance of the gas system.

B. Transport

74. The constantly increasing number of private cars and freight vehicles contributed to the transport sector becoming the fastest growing sector as of 1992 in terms of emissions. The TRANCRO programme managed jointly by the Ministry of Economy and the Ministry of Communication and Transport contained a list of possible measures to increase the energy efficiency in the transport sector and analyse their effectiveness. In addition, the INA was considering launching a pilot project for biodiesel. The transportation mitigation measures actually implemented were limited to the recent introduction of parking fees in most of the large Croatian cities. No measures were in place to prevent or moderate the modal shift from relatively well developed public transport to private cars.

75. The team was informed of the road construction under way, which was expected to boost emissions from the transport sector. Also, due to its geographic location, Croatia expected a significant growth of transit transport in both east-west and north-south directions.

C. Industry

76. The NC1 contained some potential technical measures for emission mitigation in industry. The most promising of those relating to CO_2 emissions from cement production included decreasing the clinker share (a 1 per cent reduction of clinker could reduce CO_2 emissions by 5.2 kg per ton of cement) and fuel switching in cement kilns (reduction potential of 265 Gg CO_2). The implementation of these measures was considered to depend on the fuel and cement market and support for them was not envisaged. What is more, the team noted that the cement industry might even change over to more carbon-intensive fuels such as petroleum coke and coal, which were relatively cheaper.

77. For N_2O mitigation, the construction of two non-selective catalytic reduction (NSCR) systems in the nitric acid unit of the fertilizer factory was considered an effective measure. The team noted that no steps had so far been taken to implement it. The NC1 mentioned the installation of two NSCR facilities, at $300,000 each, as a potential project for flexible mechanisms with a very low marginal cost of around $1 per ton CO_2 equivalent. The team stressed that no measures were yet under consideration to mitigate the still negligible but potentially rising emissions of fluorinated gases.

D. Agriculture

78. In 1995, agriculture accounted for almost 13 per cent of national GHG emissions. Around two thirds of these emissions were N_2O emissions from soil and manure management, while CH_4 emissions released by enteric fermentation and from manure management made up the rest. The agricultural sector suffered a great deal from the war between 1991 and 1995. As of 2002, around 20 per cent of the land area of the country was still covered by minefields, according to national experts. The economic efficiency of the sector was relatively low because of the significant disaggregation of land ownership and the lack of a clear development strategy for this sector. The measures in the sector centred on agricultural biomass use for energy, improved application of organic and mineral fertilizers, methane emission reduction by decreased fermentation, introduction of anaerobic waste management and biogas generation systems, and enhanced carbon storage in agricultural lands.

79. In the NC1, agricultural biomass use for energy and carbon storage in agricultural soils were considered among the measures to reduce CO_2 emissions. Promotion of organic farming and the Code of Good Agricultural Practice in mineral and organic fertilization were considered not only for N_2O emission reduction, but also for enhancing agricultural output. Reduction of methane emissions was considered feasible as a consequence of decreased fermentation resulting from feed improvement and biogas generation. In terms of implementation, as of 2002, biomass was used for energy to a limited extent and planning for the production of biogas under the BIOEN programme and a biodiesel pilot

project by the national oil company (INA) were at an advanced stage. No other measures were firmly committed to or assured of support.

E. Forestry

80. In 2002, around 44 per cent of Croatian territory was forest land and of that more than 80 per cent was State-owned. According to Croatian officials, the state of private forests was unsatisfactory. While maintaining traditional principles of sustainable forestry, the main measures described in the NC1 to reduce emissions and increase carbon removals in the forest sector targeted reforestation of bare productive land, extension of the thinning activities to new forest areas, expansion of thinning by inclusion of complete second age class forests, planting pioneer wood species, improvement of wood utilization efficiency and increase in harvesting.

81. In the context of these measures, a large reforestation project has been initiated by the public company, Croatian Forests, under a World Bank loan. Two of the above measures, namely, reforestation of bare productive land and planting of pioneer wood species, were considered to have a real potential for implementation in the forest sector by 2020. The other measures were still at the conceptual stage of development. The review team noted the potential for biofuel production from forests that is the focus of a pilot project between Croatia and the Netherlands, referred to in paragraph 106 below.

F. Waste management

82. Waste management was among the major environmental problems in Croatia and, hence, policies in this sector primarily addressed its environmental impact along with climate change. The waste management strategy adopted in 1992 introduced specific policy targets, including phasing out irregular dumping practices and introducing waste management practices in line with the EC directives on waste. In 1995, the Law on Waste was adopted together with associated secondary legislation, such as the regulations on waste classification and management. As of 2002, strategies for waste avoidance, separate collection and recycling were yet to be introduced. A specialized unit in the Ministry of Environment was entrusted with the administrative responsibility for waste management, while the municipalities were responsible for implementation of municipal waste management.

83. Around 1,000 dump sites and 220 official landfills existed in Croatia in 2002. Only seven relatively new or still uncompleted landfills, accounting for 25 per cent of the total waste, complied with the EC standards for proper waste management. According to the Law on Waste, all unmanaged landfills had to be closed by 2002. The team pointed to some inconsistency with the information contained in the NC1, which stated that around 80 per cent of all waste would be disposed of in managed landfills by 2020. Many municipalities were unable to meet the 2002 target, which was extended to mid-2003. The insufficient capacity-building effort for local authorities and funding could further affect this timetable.

84. A first waste incineration project, with a capacity of around 25 per cent of the total municipal waste in Croatia, was under preparation at the time of the review visit by a private consortium and the county of Zagreb. The team was informed of plans for wider use of co-firing of waste in cement kilns and power stations, as well as for separate collection of packaging waste, which made up 50 per cent of municipal waste. The team noted that measures to mitigate N_2O emissions from sewage treatment had not yet been considered.

IV. PROJECTIONS AND THE TOTAL EFFECT OF POLICIES AND MEASURES

85. The Energy Institute took the lead in preparing projections of emissions from the energy sector. EKONERG prepared the projections for the industrial processes and waste sectors in coordination with industry and other institutions. The University of Zagreb, and in particular the Faculty of Agriculture and Faculty of Forestry assessed the potential for policies and measures and prepared the projections for

agricultural emissions and for emissions and sinks in the LUCF sector. As no significant changes and effects was expected from policies in the LUCF sector by the year 2010, it was assumed that this sector would remain a net sink until that time, at the level of 6,500 Gg CO_2 annually as in 1995, but this was not included in the projections.

86. The NC1 provided projections of CO_2, CH_4 and N_2O emissions for "baseline" and "mitigation" scenarios in the key sectors and subsectors addressed in the inventory, except for the LUCF sector. The "new gases" (HFCs, PFCs and SF_6), indirect GHGs (CO, NO_X and NMVOCs) and SO_2 were not included in the scenarios. Fugitive emissions from fuels and emissions from some industrial subsectors and waste-water handling were assumed constant and were not accounted for in projections. The emissions included in projections accounted for around 90 per cent of emissions in 1995, the base year used for these projections.

87. Information on projections was reported by sector and by gas, and the expected effect of the main policies and measures was estimated. The results were presented by sector on a CO_2 equivalent basis only, but not on a gas-by-gas basis and disaggregated by sector as required by the 1996 UNFCCC guidelines. Results were presented in a chart format only and the tables required by the Guidelines with numerical information were not used. Also, projections of emissions associated with international bunker fuels were not provided. The team noted that, although the NC1 did not contain projections of all emissions and that the information on the methodology used for projections was limited, Croatia in general respected the Guidelines. It acknowledged the efforts that had gone into producing robust estimates of future emission trends.

88. The NC1 contained two sets of projections of the main GHGs: a "baseline" or "without additional measures" scenario and a "mitigation" scenario, with data on emissions by 2020, using 1995 as the base year. The approach to scenario definition was to establish a baseline scenario, assuming implementation of policies and measures to a very limited extent, and then a mitigation scenario assuming a higher degree of implementation of policies and measures driven by an enhanced level of State support, priority being given to energy management and energy efficiency, accelerated penetration of new technologies and better use of renewable energy. Thus the "baseline" scenario was not a frozen efficiency scenario but included some technological improvements and some progress in the use of renewable energy. The "mitigation" scenario was considered to provide a view of the possible future level and composition of energy demand and supply and associated emissions. It excluded some of the potential measures such as the proposed new nuclear plant, due to the high uncertainty associated with it.

89. Underlying the analysis in the NC1, four scenarios were initially considered based on different assumptions of GDP growth rate, namely, super high, higher, reference and low growth scenarios. These scenarios were prepared for the *1999 Draft Energy Sector Development Strategy of Croatia*. Only one of them, the reference scenario, which assumed a uniform 5 per cent GDP growth rate from 1994 to 2025 was taken as a basis for the "baseline" scenario, reported in the NC1. Hence, scenarios reported in the NC1 were closely linked to scenarios prepared by the Government in establishing short- and long-term strategic priorities of energy sector development.

90. The energy projections were prepared using four sets of models. To simulate the future trends of energy systems development, the simulation model ENPEP was used. Two separate models describing the electricity and gas sectors in greater detail provided the necessary input for the ENPEP model. These were an optimization model, WASP, for the electricity sector and a simulation model, PLINSCO, for the gas sector.

91. To project the future energy demand growth, detailed studies were conducted in 1996 and 1997 examining development options, strategies, and associated energy demand growth in five key sectors: agriculture and construction, industry, households, services and transportation. The final energy

demand projections were then obtained using the MEDEE model based on the results of these studies and on macroeconomic projections. The models applied were directly or indirectly sensitive to relative changes in energy prices. The team noted that it would be difficult to reflect the effect of the projected energy market liberalization on the energy and emission trends using the current modelling approach.

92. Among the key assumptions for projections in the baseline scenario were long-term political and economic stability of the country and membership of the EC by 2010, reflecting Croatia's main strategic political goal. As mentioned above, at macroeconomic level, the forecasts were for 5 per cent annual GDP growth over a 35-year period. The team noted it might be difficult to attain that goal over such a lengthy period. The actual economic performance of the country at the beginning of the forecast period, i.e. from 1995 to 2001, has proven the assumption to be optimistic. As to the energy prices, the assumption was that the natural gas price would remain below the average international price for the next decade due to the relatively high share of domestic production (around 60 per cent) and would converge with international prices thereafter. Oil prices were assumed to increase gradually and to reach a level of $25/bbl in 2020.

93. According to projections for the baseline scenario contained in the NC1, the growth in TFEC compared to 1995 was expected to be 30 per cent by 2000, 87 per cent by 2010 and 138 per cent by 2020, mainly because of increased demand in the transport, residential and industrial sectors (a respective increment of 75 PJ, 67 PJ and 66 PJ for the entire 1995-2020 period). Compared to 1995, electricity demand was expected to increase by 32 per cent by 2000, by 105 per cent by 2010 and by 128 per cent by 2020; demand for gaseous fuels was expected to grow by 45 per cent by 2000, by 146 per cent by 2010 and by 208 per cent by 2020; demand for liquid fuels was expected to grow by 23 per cent by 2000, by 60 per cent by 2010 and by 100 per cent by 2020; and the demand for coal was expected to stabilize by 2010.

94. The faster increase in the share of natural gas in energy demand projections reflected a shift towards less carbon-intensive fuels. This tendency was expected to be reinforced also by the projected growth in renewable energy, which was expected to maintain a share of about 7 per cent of TFEC. Electricity demand was to be met by new capacity coming into operation by 2020, of which 1,700 MW would be based on natural gas, 1,000 MW on imported coal and 378 MW on hydro resources to allow the use of around 25 per cent of the available hydro energy potential.

95. In terms of projected emission levels, the trend of energy-related CO_2 emissions, which account for the bulk of total emissions, was expected to be upwards as from 1995, the year when they reached their historical minimum of 15,082 Gg CO_2. Still, in 2000, these emissions were expected to be 16,690 Gg CO_2, without CO_2 from natural gas scrubbing, or 17,300 Gg CO_2 with it, which was lower than the adjusted 1990 value of 28,367 Gg CO_2 or unadjusted value of 20,991 Gg CO_2. By 2020, this growth would be boosted by the energy demand growth in all sectors and resulting commissioning of new capacity based on coal and natural gas. In addition, transport activities were expected to expand very fast in conjunction with the growth in mobility and vehicle numbers. The increase in living standards was considered to be the main driver for residential energy consumption and transport.

96. Croatia estimated the effects of individual policies and measures targeting energy-related emissions and their impact on the current and future emission trends in the context of the projection exercise. The team was informed that the effect of these policies and measures was difficult to assess in terms of emissions saved and costs involved. Hence, the estimates of mitigation effects should be taken as theoretical maximums. The results of these estimates, except for several measures regarded as highly uncertain, including biomass used for energy in the residential sector, are shown in table 4. The team noted that around half of the emission reductions (4,215 Gg CO_2 equivalent in 2010) could be delivered at negative cost, thanks mainly to the increased use of natural gas.

Table 4. Estimated potential of energy mitigation measures by 2010 and their marginal cost

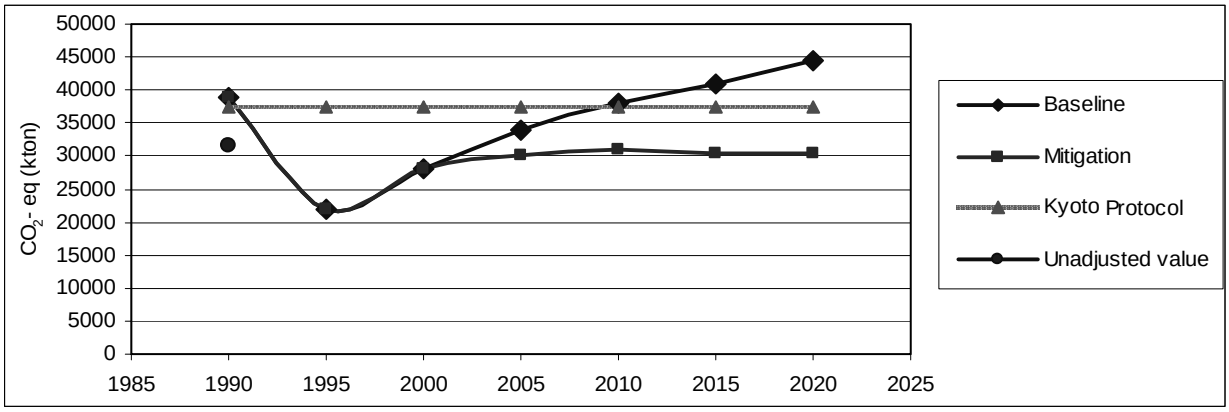
Measure	Mitigation potential Gg CO_2	Marginal cost $1000/Gg$CO_2$-eq
Industry		
Motor drive regulation	186.3	3.9
Cogeneration contribution	163.4	7.2
Improved efficiency of low temperature heat generation	97.7	30
Improved efficiency of high temperature heat generation	87.3	42.7
Transport		
Intercity passenger transport related measures	39.4	
City passenger transport related measures	0	
Freight transport related measures	0	
Increased use of biodiesel and hydrogen	99.2	
Services		
Electricity savings in non heat use (DSM)	25.1	-40.4
Fuel switching	2.3	-11.5
Increased solar energy use	79.1	-2.2
Increased geothermal energy use	17.1	5.8
Increased district heating and cogeneration use	70.3	8.3
Improved thermal insulation	441.6	31.5
Residential Sector		
Increased solar energy use	196.4	-2.5
Electricity savings in non heat use (DSM)	482.2	-2
Increased district heating application	146.6	3.8
Improved thermal insulation	401.9	30.5
Energy Industries		
Increased use of natural gas	1135.5	-24.8
Reducing transmission and distribution losses	47.4	
Wind power	126.6	
Small hydro plants	117.4	
Biomass use in cogeneration	251.8	
Total	**4214.6**	

97. As to the projections of emissions from non-energy sources, these were produced using expert estimates. The results obtained suggested that CO_2 emissions from industrial processes, in particular from cement production, would recover their 1990 levels of 1,023 Gg CO_2 by 2000 and remain stable thereafter. Emissions of CO_2 from ammonia production were expected to return to their historical peak levels of around 540–580 Gg CO_2 by 2010, depending on export options and domestic demand. The industrial process baseline emissions for nitric acid production were projected to remain stable from 2005 onwards at a level of 1 Gg CO_2 equivalent. The baseline scenario for waste assumed a steady growth in emissions by around 1,400 Gg CO_2 equivalent in 2010, starting from a relatively low level of 864 Gg CO_2 equivalent in 1995.

98. The potential for reducing emissions from industrial processes was considered negligible by 2010. However, it could become appreciable (around 800 Gg CO_2 equivalent) after 2010 if an NSCR system for nitric acid production was installed. The team noted that this reduction attributed to a single and currently available measure could be implemented at the very low cost of around $1 per ton CO_2 equivalent saved, as reported in the NC1. The potential for mitigating methane emissions from waste was around 400 Gg CO_2 equivalent by 2005 and around 1,000 Gg CO_2 equivalent by 2020. The utilization of this potential would be subject to the success of waste use for energy production, as the effects of waste avoidance, separation and recycling were already accounted for in the baseline scenario.

99. The projections presented in the NC1 reflected the effect of key policies and measures. The total effect of these measures was estimated at about 6,000 Gg CO_2 equivalent saved in 2010 and 12,000 Gg CO_2 equivalent saved in 2020. This effect could bring future emissions into line with the mitigation scenario, which implied a stabilization of emissions at the level of around 30,000 Gg CO_2 equivalent from 2005 onwards. By way of comparison, the baseline scenario specifies 42,000 Gg CO_2 equivalent in 2020 and emissions were expected to increase constantly throughout the 1995-2020 period. In terms of the contribution of policies and measures by sector to emission stabilization, by 2010 efficiency improvements in energy end-use sectors and in power generation could bring the most significant reductions, while in the period from 2010 to 2020 significant emission reductions could be made in the industrial processes.

Figure 5. Projections of GHG emissions, Gg CO_2 equivalent



V. VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

100. Croatia has done a remarkable job in assessing climate change impacts and adaptation and reporting on them in its NC1. It has been continuously developing activities in this field since 1992. To prepare this assessment, a team coordinated by the Hydrometeorological Service consisting of 22 experts and scientists from different sectors, working in 8 groups and coming from 10 institutions was set up. The objective of the team's work was to coordinate research on climate change impacts in the country, to help organizations to assess the vulnerability to climate change of different sectors and to plan appropriate adaptation measures.

101. The climate change scenarios used by the team were based on Hadley Centre modelling studies and were consistent with scenarios from the IPCC Second Assessment Report and a regional circulation model for the Mediterranean region. The two options considered were based on IPCC alternative scenarios (1992a and 1992e), that provided input for regional temperature rise scenarios to estimate plausible temperature rise and precipitation amount change in the next century.

102. The team also analysed the climate change observed in Croatia over the last 150 years, which suggested a significant overall decrease in the daily temperature range and a marked diminution of mean annual cloudiness. Together with various other Croatian institutions, the team further developed detailed climate impact studies. These studies covered impacts on water resources, agriculture, forestry, biodiversity and natural ecosystems, marine ecosystems and fishery, coastal areas and health.

103. Adaptation options were assessed for the sectors mentioned in paragraph 103, the most important of them being water resource management, forestry, agriculture and coastal zone management. The analysis and the results obtained were to be used for the preparation of a national climate change adaptation action plan.

VI. INTERNATIONAL COOPERATION

104. As a country with an economy in transition, Croatia participated in a range of international activities aimed at strengthening its capacity to address climate change and at implementing specific climate-related projects. The preparation of the NC1 with a grant from the GEF was among the most important of these activities. Other activities included projects aimed at (a) removing barriers to energy efficiency improvement in households and the service sector; (b) improving energy efficiency in the public sector and establishing energy-saving companies; (c) reducing emissions from oil refining; and (d) developing renewable energy. The capacity-building component of these projects was planned to be supported by the GEF and the remaining part by bank loans.

105. On the subject of bilateral cooperation, that with the Netherlands is worth mentioning, more specifically the two projects on removing barriers to biomass utilization. Since 1996, Croatia has also had an activity implemented jointly with a Belgian company for efficiency improvement in a brewery.

106. Regarding technology transfer, Croatia applied for GEF support for a technology needs assessment. It also prepared a web page on technology and climate change to be linked to the UNFCCC secretariat web page on technology. In addition, Croatia was active in a bioenergy programme supported by the IEA and also in the study of the role of nuclear power to meet the commitments under the Kyoto Protocol, supported by the International Atomic Energy Agency.

VII. RESEARCH AND SYSTEMATIC OBSERVATION

107. Systematic meteorological observations in Croatia started in 1851 and have since been performed by the Meteorological and Hydrological Service (MHSC) under the National Climate Change Mitigation Programme and the Ministry of Science and Technology. The MHSC also deals with continuous meteorological, marine, terrestrial, and environmental observations and data collection. Together with MHSC, the responsibility and institutional authority for systematic observation lies with the Ministry of Environment, Institute of Oceanography and Fisheries, Hydrographic Institute, Department of Geophysics of the University of Zagreb, and Centre for Marine Research of the Rudjer Boskovic Institute. Croatia has also developed expertise in climate modelling and forecasting. The team noted some problems with the coordination of climate-related observations at the national level.

108. In the international context, Croatia has been an active participant in the EUMETSAT space observation programme. It also participated in international programmes of the United Nations Environment Programme, IPCC and the World Meteorological Organization, and in several atmospheric monitoring and observing activities, such as the Global Climate Observing System and the Global Ocean Observing System.

109. The main part of climate research focused on improving the understanding of climate change impacts on hydrology, terrestrial and marine ecosystems, biodiversity, coastal areas, agriculture, forestry, and public health. Data and model results of climate change multidisciplinary studies were made available to the international scientific community through scientific proceedings and bulletins and the MHSC web site. Croatia's plans for systematic observation centred on enhanced coordination between observation networks at the national level; capacity-building for collection, exchange, and utilization of data to meet local, regional and international needs; modernization of existing climate databanks and networks for better data access and exchange; the recovery, entry and electronic processing of past climate data records; and improvement of space-based observation programmes.

VIII. EDUCATION, TRAINING AND PUBLIC AWARENESS

110. Responsibility for education, training and public awareness on climate change lay with the Ministry of Environment together with the Ministry of Education with regard to schools, and the Chamber of Commerce with regard to industry and commerce. The Government also funded public awareness actions by non-governmental organizations. The team noted that the Ministry of Science and Technology, responsible for university education, could be more actively involved in climate change activities.

111. The process of preparing and reviewing the NC1 involved more than 100 experts and the major stakeholder groups. It was the first significant step to raising awareness and building capacity among government experts and important stakeholder groups on climate change.

112. The NC1 contained a programme to raise public awareness and improve education on climate change issues. It included among other things the preparation of educational materials, films, booklets etc., the presentation of the NC1 to journalists, seminars for teachers and administration officials, and an educational campaign in primary and secondary schools. A possible extension of the programme was envisaged, centring on the training of professionals in businesses associated with the major GHG sources. The team noted that the funding for this important programme was not ensured.

113. In the field of university education, environmental courses especially in technical disciplines were yet to be introduced in Croatia. An education programme of two semesters was carried out in 2001 on the initiative of a non-governmental organization. The team noted the plans of the Ministry of Environment to include climate change in school curriculae and books.

114. Some successful actions related to climate change were carried out by non-governmental organizations, including street and poster actions, providing information to environmentally conscious journalists, and preparing campaigns and booklets to promote the use of renewables, energy efficiency etc.

IX. CONCLUSIONS

115. After reviewing the information provided in the NC1 and the wealth of additional information provided during the visit, the team concluded that Croatia had met its reporting commitments under Article 12 of the UNFCCC and broadly complied with the 1996 UNFCCC guidelines. Moreover, the NC1 addressed all climate change related aspects and adequately reflected the level of analysis, design and implementation of climate policies. It also covered in its inventory, policies and measures and projection sections all relevant GHGs and major emission sources and sinks. In some parts of the NC1, the presentation of information followed the 1999 UNFCCC guidelines, e.g. the information on policies and measures by sector, but not by gas.

116. The team did not identify major information gaps or deviations from the reporting guidelines. The additional information provided during the visit was broadly consistent with the analysis and the data presented in the NC1. None the less, the team noted that, to ensure transparency and consistency in reporting, more attention should be given in preparing the next national communication to the presentation of the current and future emission trends following strictly the formats required by the guidelines. Also, the team noted the requirement to prepare and submit GHG inventory annually, including for the years after 1995. It acknowledged the importance of estimating and reporting on the achieved and expected effect of policies and measures, which could help to strengthen the implementation of the existing measures and, if necessary, to identify and implement new ones.

117. In estimating its historical GHG emission levels, Croatia broadly followed the 1996 IPCC Guidelines. The major exception was the estimation of emissions for 1990, Croatia's base year for implementation of the Convention, and 1991. The difference sprang from the estimation of the CO_2 emissions from fuel combustion for 1990 and 1991, where Croatia used the 1996 IPCC Guidelines and adjusted the result using a per capita approach. The need for emission adjustment according to Croatian officials stemmed from the IPCC methodology being inappropriate to provide adequate estimates for the emissions of the country in 1990 and 1991 given its national circumstances.[4] It also stemmed from the high uncertainty associated with the energy data before 1992, the year of Croatia's independence. In estimating its future GHG emission levels, Croatia used a set of internationally recognized models and internally consistent assumptions, which made it possible to obtain robust estimates of how the future emission trends could evolve, and the overall effects of policies and measures.

118. The analysis of the historical emission trends and projections of emissions suggested that, after the initial drop in emissions between 1990 and 1995 driven by the war and a deterioration in economic conditions, the emissions were expected to rise again. Still, according to the preliminary inventory estimates, in 2000 the national GHG emissions were likely to be slightly below the 1990 unadjusted values and around 20 per cent below the adjusted value of base year emissions. Therefore, Croatia is likely to meet the stabilization aim of the UNFCCC.

119. In the period beyond 2000, however, it appeared very difficult to moderate the emission growth. According to the baseline scenario, which already included some level of implementation of policies and measures, the level of unadjusted base year emissions will be reached before 2003 and the level of adjusted base year emissions before 2010. According to the mitigation scenario, a theoretical potential existed to stabilize the emission level below the unadjusted base year emissions. This, however, was indeed a theoretical potential, as it could be achieved only by a rigorous implementation of policies and measures with the necessary financial support, which would put a heavy burden on the restructuring Croatian economy.

120. On policies and measures, the team acknowledged that, with some exceptions, these were at the planning stage. Major exceptions were the energy programmes included in the NEAP, dealing mostly with strategic research and development, and the legislation on energy market liberalization adopted in 2001. Also, the original objectives of virtually all policies were not guided by considerations of climate change: for example, they aimed at enhancing economic effectiveness through energy market liberalization and addressing environmental impacts from waste management.

121. Given that the bulk of emissions in Croatia came from energy, it was well understood that climate change mitigation in this sector was of particular significance for the response strategy. The team noted that the legislation on energy market liberalization and privatization was taking shape. Moreover, the work on secondary legislation was also under way, to ensure among other things that the environmental objectives are met in the process of energy market liberalization, including provisions for renewable energy, CHP and energy efficiency.

122. So far, however, the only progress made in moving towards less carbon-intensive fuels took the form of a very slight increase in the share of natural gas and prospects of a further increase in the near future, together with maintaining the share of renewables in meeting the energy demand growth. Notwithstanding some ongoing pilot actions and the relevant aspects of the legislation on energy market liberalization, the policy to promote energy efficiency and CHP and to increase further the share of

[4] The review team recalled that the Subsidiary Body for Scientific and Technological Advice concluded at its fourth session that Annex I Parties should report inventory information in mass units without adjustments according to paragraph 12 of the annex to decision 9/CP.2. In the context of this conclusion, adjustments referred to adjustments for weather variations and electricity trade, but not to any adjustments under Article 4, paragraph 6 of the Convention.

renewables was still at an early stage of implementation. The team stressed the urgent need to strengthen the institutional framework, introduce efficiency standards, and provide financial support and financial incentives for energy efficiency and renewables in order to attain the objectives set. In particular, standards for household appliances such as washing and cooling devices were noted as a very promising action which could be introduced quickly at low cost. The team also stressed the need to devote more attention to the transport sector, which as of 1992 was the fastest growing sector in terms of emissions. Finally, more attention to the mitigation options outside the energy sector could strengthen further the evolving mitigation strategy.

- - - - -