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Report on the in-depth review of the second national communication of Romania

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I. INTRODUCTION AND NATIONAL CIRCUMSTANCES

1.   Romania ratified the United Nations Framework Convention on Climate Change (UNFCCC) on 8 June 1994 and submitted its first national communication (NC1) in March 1995. In February 1999, the country submitted its second national communication (NC2), which was in turn reviewed between August 1999 and July 2000 and included a country visit by a review team from 27 September to 1 October 1999. The review team comprised Mr. Stanford Mwakasonda (United Republic of Tanzania), Mr. Tiit Kallaste (Estonia), Mr. Paul Ruyssenaars (Netherlands) and Ms Amrita Narayan Achanta (UNFCCC secretariat, coordinator).

2.   Romania is situated in the south-eastern part of Central Europe. It has an area of 238,390 km^2, of which 62 per cent is under agriculture, 27 per cent is forest (all managed), and 4 per cent is water. Due to its geographical position and relief, the country has a temperate continental climate. Of the total population, which amounted to 22.731 million in 1994, around 55 per cent inhabit urban areas. Between 1989, the country's base year, and 1994 the population decreased by around half a million inhabitants, and projections indicate a continuation of this trend.

3.   Since the overthrow of the Ceaucescu regime in 1989, the country has had a number of governments which have implemented reforms at varying speeds. In terms of the economy, the gross domestic product (GDP) declined sharply by more than 25 per cent between 1989 and 1992. Although 1994 brought an economic recovery with GDP representing 79 per cent of that in 1989, economic stabilization was yet to be achieved. In more recent years, the GDP growth has continued to be negative: -6.6 per cent in 1997, -7.3 per cent in 1998, and -5 per cent in 1999. Inflation has increased since 1990 due to price liberalization and the removal of direct and indirect subsidies. In 1995 and 1996 inflation declined, but in 1997 increased again. In the overall context of economic development, privatization is expected to receive greater priority, including in the energy sector, a fact which has been reflected in the projection exercise. The team gathered that the move towards privatization in various sectors is occurring at varying rates, the efforts within the industrial sector being the most apparent.

4.   With regard to domestic primary energy production, in 1998, natural gas had the highest share (39 per cent), followed by crude oil (21 per cent), lignite and hard coal (18 per cent), hydroelectricity and nuclear power (11 per cent), and wood and other fuels (11 per cent). Since 1989 the production of natural gas has fallen due to resource depletion, while coal output has been affected by low productivity and high production costs. Imports of crude oil, oil products, natural gas, coal, coke and electricity also dropped by half between 1989 and1994. In 1994, imported energy constituted around 26 per cent of primary energy consumption. Uranium reserves are expected to last another 20 years or so, based on current consumption trends and crude oil reserves another 20 to 30 years.

5.   The team learned that the Romanian Government had adopted a national target of stabilizing carbon dioxide (CO_2) emissions by 2000 at the 1989 level. With regard to institutional arrangements, the team learned of the constitution in 1996 of an inter-ministerial

committee called the National Commission on Climate Change, based on Governmental Decision No. 2175. The Commission is chaired by the Minister for the Environment and includes officials from the ministries of the environment (the Ministry of Waters, Forests and Environmental Protection), foreign affairs, transport, defence, food and agriculture, and industry and trade, the Institute of Agricultural and Silvicultural Sciences, members of academia and some non-governmental organizations. The membership of the Commission was reviewed in 2000, in response to a request to the participating ministries from the Ministry of Waters, Forests and Environmental Protection. The team learned that, while the mandate of the Commission extended to climate change, energy and sustainable development issues, there appeared to be a need for it to exert greater influence on policy formulation and implementation. The team also learned of the formulation of a "Sectoral Approximation Strategy for Air and Climate Change in Romania" (discussed later and targeted at monitoring greenhouse gas (GHG) emissions under European Community (EC) rules), which had identified the need to strengthen the governmental decision underlying the functioning of the above Commission. This strengthening relates to the constitution of a technical secretariat and more effective working groups to address key aspects such as inventories, GHG mitigation and the Kyoto Protocol mechanisms. The team also noted the establishment of the Sustainable Development Commission in 1999, with representation from ministries, state authorities, research societies and non-governmental organizations. This Commission was expected to prepare a sustainable development strategy in the future, which was also expected to address climate change.

II. INVENTORY OF ANTHROPOGENIC EMISSIONS AND REMOVALS

6.   The review team was informed that the Ministry of Waters, Forests and Environmental Protection was legally responsible for the estimation and reporting of the national GHG inventory, although the National Research and Development Institute for Environmental Protection was entrusted with the collection, processing (including verification) and updating of the inventory. Currently activity data are contributed by lead institutions such as the National Statistics Commission, the national power company and various key ministries.

7.   The team noted that in accordance with the UNFCCC reporting guidelines, information was provided on carbon dioxide, methane (CH_4) and nitrous oxide (N_2O), but was lacking on perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF_6). In accordance with the reporting guidelines, Romania also reported on the indirect greenhouse gases, carbon monoxide (CO), non-methane volatile organic compounds (NMVOCs) and nitrogen oxides (NO_X); and provided optional information on sulphur dioxide emissions from fuel combustion. While the NC2 included an appendix giving summary data tables for the period 1989-1991, the standard data tables and worksheets for the energy, agriculture and land-use change and forestry (LUCF) categories were not included in the NC2 nor made available during the visit.

8.   The team noted that to date the only official submission of inventory data to the secretariat had been that contained within the communications**.** Consequently, the team primarily relied on the inventory data contained in the NC2 for its analysis, which consisted of data for the period 1989-1994 for CO_2, CH_4, N_2O, NO_x, CO, NMVOCs and SO_2 from various

source categories (table 1). In addition to the information contained in the NC2, the hosts provided preliminary estimates of aggregate emissions for CO_2, CH_4, N_2O, NO_x, CO, NMVOCs and SO_2 for the period 1995-1997 during the review. These preliminary estimates for 1995-1997 were revised subsequent to the visit. In the NC2, the data disaggregated by the Intergovernmental Panel on Climate Change (IPCC) source categories, were provided as a summary table for the period 1989-1991 only; no additional information on this aspect was provided to the secretariat subsequent to the visit. For the entire period 1989-1997, the country made a distinction between the pre- and post-1991 data, the difference between the two data sets being in the range of 1-5 per cent. The pre-1991 data were stated to originate from the National Statistics Commission and were described as provisional, even during the visit.

9.   With regard to reporting on the inventory in the two communications, the NC2 reported more information. Reporting in the NC1 had been based on the reporting requirements of the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol and its amendments on ozone-depleting substances, using the CORINAIR methodology and emission factors, and had included only aggregated data estimates for CO_2, N_2O, CH_4 and other gases whereas the NC2, for its part, used the 1995 IPCC Guidelines for National Greenhouse Gas Inventories, a fact which made comparisons difficult. For example, the NC1 reported emission data as aggregate values in kg/capita year, while the NC2 used gigagrams (Gg) as recommended by the IPCC. Based on the limited information provided during the review, the team understood that at the methodological level, the NC2 used both the CORINAIR and the IPCC methodologies, including CORINAIR and IPCC default emission factors. For example, in the case of fugitive and other emissions IPCC default emission factors were used, whereas for emissions from transport the CORINAIR methodology, COPERT module, was used.

Table 1. Greenhouse gas emissions and removals, 1989-1997 (Gigagrams)

	1989	1990	1991	1992	1993	1994	1995*	1996*	1997*
CO_2	194 826	172 509	135 660	130 160	127 086	125 597	125 978	110 768	104 536
CH_4	2 357	1 976	1 734	1 603	1 523	14 60.9	1 536	1 524	1 549
N2O	66	49	25	27	26	25	25	24	24
NO_x	554	528	458	482	485	483	489	492	472
CO	2 421	2 441	1 981	1 705	1 767	1 800	1 812	1 826	1 789
NMVOC	529	492	401	372	406	413	491	513	439
SO_2	1 516	1 311	1 041	1 181	1 181	1 204	932	751	898
CO_2 removals	-2 925	-5 645	-6 590	-6 590	-6 590	-6 590	–6 590	-6 590	-6 590

* The data for these years were considered preliminary during the review but subsequent to the visit revised numbers were provided which are included here.

10.   The team also learned that, in a continuation of the situation prevailing at the time of the first in-depth review, the lack of reliable data on industrial solid and liquid wastes led to their exclusion in the NC2 also. Another deviation from the IPCC Guidelines was the continued inclusion of international bunker fuels in the transport category, due to the lack of distinct data on such fuels. Table 1 provides data for the period 1989-1997 for CO_2, CH_4, N_2O, NO_x, CO, NMVOC and SO_2 emissions, and CO_2 removals in the land-use change and forestry sector.

11.   On a CO_2 equivalent basis, in 1994, CO_2 accounted for about 74 per cent of the total aggregate emissions, CH_4 for about 21 per cent and N_2O for 5 per cent.

A. Carbon dioxide

12.   The team was provided with some details of the sectoral trends of CO_2 emissions (table 2), for 1989-1997. The team noted that CO_2 emissions were reported from the sectors of fuel combustion, and industrial processes and waste, and CO_2 removals were reported for the land-use change and forestry sector. In 1997, CO_2 emissions from fuel combustion made up 97 per cent of the total (compared with 95 per cent in 1989), emissions from industrial processes 2.4 per cent (4.7 per cent in 1989) and emissions from waste the remainder. For the period 1989-1991, the heading fuel combustion included disaggregated data for energy and transformation, industry, transport, small fuel sources, other categories and traditional combustion for energy production (this category was excluded from the national total). The team also gathered that the current data format used for collecting fuel consumption data was incompatible with that of the IPCC source categories.

13.   With regard to the estimation of CO_2 emissions from the energy sector, the review team was provided very limited additional information to that contained in the NC2. The team was informed that the calculations in the NC2 had been done using the IPCC methodology with IPCC default emission factors (unless otherwise indicated). For the period 1989-1994, the NC2 included two categories under fuel combustion, stationary sources and transportation, instead of the standard IPCC subcategories for fuel combustion. As a result, the team was able to estimate the contribution of the energy and transformation sector as being 40 per cent of the national CO_2 emissions on the basis of the 1989-1991 data, as no data were available for a more recent period, such as 1992-1997. The team learned, however, that CONEL (National Authority for Electricity) had been reporting fuel consumption by power plant since 1991.

Table 2. Carbon dioxide emissions and removals, by source and sink, 1989-1997
(Gigagrams)

Source category	1989	1990	1991	1992	1993	1994	1995	1996	1997
Fuel combustion[a]	185 575	165 382	130 465	125 498	122 644	121 327	122 955	108 127	102 037
Industrial processes	9 244	7 120	5 188	4 655	4 435	4 263	3 016	2 634	2 493
Waste	7	7	7	7	7	7	7	7	6
Total CO_2	**194 826**	**172 509**	**135 660**	**130 160**	**127 086**	**125 597**	**125 978**	**110 768**	**104 536**
LUCF removals	-2 925	-5 645	-6 590	-6 590	-6 590	-6 590	-6 590	-6 590	-6 590

a: The NC2 includes fuel combustion data by IPCC subcategories for 1989-1991 only, hence they are not included for the entire data period. International bunker fuels have not been estimated separately but are included under the transport sector.

14.   In 1998, 54 per cent of heat generation was based on gas, 25 per cent on liquid fuels and 12 per cent on coal. The review team was informed that a lack of reliable activity data, and difficulty in differentiating between the shares of emissions from electricity generation and district heating due to the use of the same capacity, were responsible for the absence of an estimate of CO_2 emissions from heat generation.

15.   In a deviation from the IPCC Guidelines, the CO_2 transport estimate did not consider rail transport but included international bunker fuels, as in the NC1 (due to the inability to separate domestic fuel consumption from international bunkers). The host officials informed the team that CO_2 emissions from the road transport sector had been computed using the CORINAIR-COPERT method and country-specific emission factors; the choice of the method being influenced by its correspondence to the data obtained by the National Statistics Commission. The review team learned that the parameters used to estimate emissions from road traffic included fuel consumption, driving conditions, number of vehicles by category and fuel properties, information which was made available during the visit. The team was further informed that emissions from road transport had been relatively constant over the 1989-1994 period.

Figure I. CO_2 emissions and removals, percentage change from 1989, by source and sink (Gigagrams)
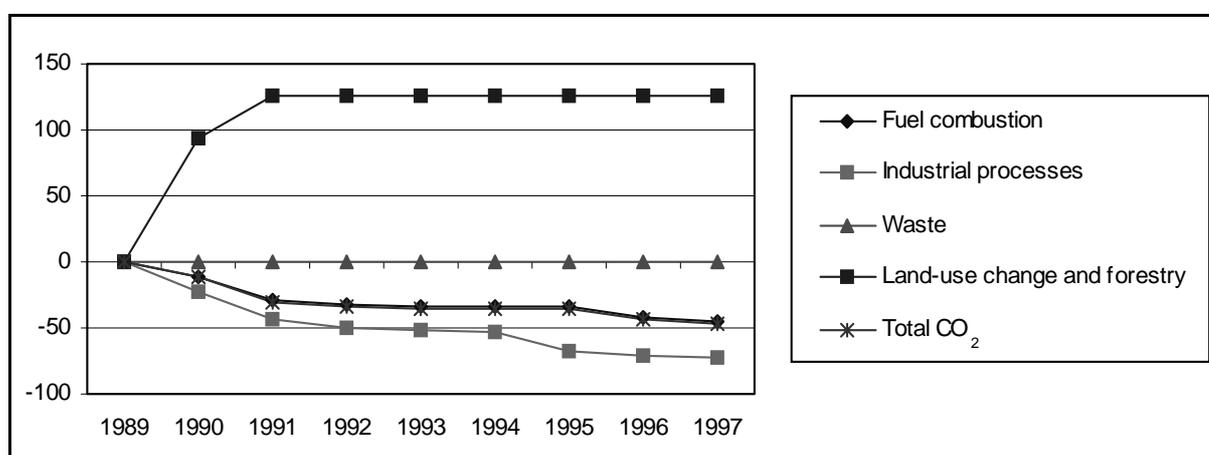
16.   The team learned that the CO_2 emission data for the subcategory of small combustion sources for 1989-1991, did not take the residential sector into account nor the agriculture, forestry and fishing subcategories. Additionally, the review team noted that, though the NC2 reported the operation of six incineration plants leading in turn to CO_2 emissions, the country waste expert indicated that incineration was not being used for domestic waste due to the associated costs in addition to the high water content and low calorific value of the waste. The inclusion of an estimate of 7 Gg for the period 1989-1997 for this source was explained as being due to assumed unchanged circumstances leading to these emissions.

17.   The NC2 also included an estimate of CO_2 emissions from the cement, lime, metallurgical, fertilizer, inorganic chemicals, acids, organic chemicals, wood and pulp and paper industries. The review team noted that the IPCC requirement that Parties provide information on how feedstocks were considered in the industrial processes (to prevent possible double counting or non-accounting of emissions) did not find inclusion in the NC2.

18.   The estimate of removals in the land-use change and forestry sector took into account the carbon stored in forest ecosystems (carbon balance in trees). Furthermore the country team had assumed that during the period 1992-1997, the storage of carbon in the forest ecosystems would remain at the 1991 level, an assumption which was not further elaborated upon. In terms of specific trends, CO_2 removals increased steeply from a value of -2,925 Gg in 1989 to -5,645 Gg in 1990, stabilizing at -6,590 Gg during 1991-1997. The team did not receive any further information on the underlying causes of this trend, except that it was broadly attributed to reduced logging due to a discontinuation of exports of wood products and the ongoing process of privatization of forests.

B. Methane

19. CH_4 emissions showed a decreasing trend from 1989 to 1994, a fact which was partially attributed to the falls in industrial output, population, number of livestock, and consumption of natural gas. The major CH_4 sources were fugitive emissions, agriculture, the waste sector, fossil fuel combustion, and industrial processes (table 3). In 1997, fugitive emissions constituted 55 per cent of the total (compared with 60 per cent in 1989), agriculture 28 per cent (27 per cent in 1989), waste15 per cent (10 per cent in 1989), fossil fuel combustion 1.5 per cent (2.1 per cent in 1989) and industry 0.3 per cent (0.7 per cent in 1989). No estimates were made of CH_4 emissions from the land-use change and forestry sector. Fugitive emissions were estimated using the IPCC Guidelines and default emission factors, and included emissions arising from natural gas production, transmission and distribution, extraction of solid fuels, and crude oil production.

Table 3. Emissions of methane, by source, 1989-1997 (Gigagrams)

Source category	1989	1990	1991	1992	1993	1994	1995	1996	1997
Fossil fuel combustion	50	45	34	24	24	24	24	24	24
Fugitive emissions	1 416	1 130	975	917	897	847	851	844	859
Industry	16	11	8	5	5	5	5	5	5
Agriculture	635	560	489	431	370	357	426	422	430
Waste	241	230	229	227	227	228	230	229	231
Total CH_4[a]	2 358	1 976	1 735	1 604	1 523	1 461	1 536	1 524	1 549

a: This total may not be identical to that contained in the NC2 due to rounding.

20.   The estimate of CH_4 emissions from waste management encompassed landfilled solid waste and waste water but excluded industrial waste water because of data uncertainties, as in the NC1. The team was informed that as much as 95 per cent of the municipal waste was landfilled. The host team referred to the calculation using a country-specific value of biological oxygen demand (BOD) of 54 grams BOD per inhabitant per day, multiplied by the population connected to the sewerage system.

Figure II. Methane emissions, percentage change from 1989, by source
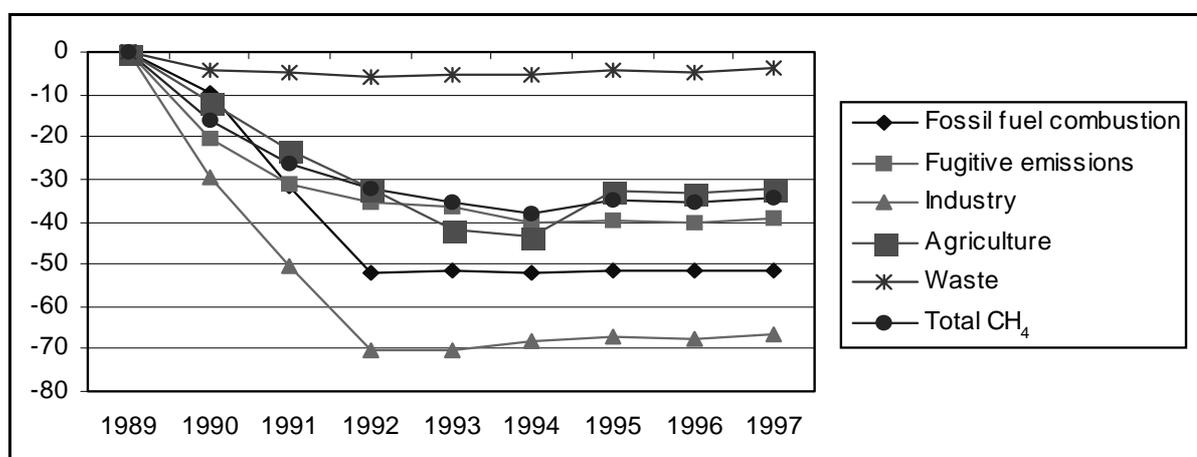
21.   The CH_4 emissions from agriculture were said to come from enteric fermentation in livestock, rice cultivation and burning of agricultural waste. No further details were provided to the team. The decrease in natural gas consumption was expected to result in a lower amount of leakage, as leakage is directly related to the amount of gas transported, among other factors.

C. Nitrous oxide

22. N_2O emissions fell by 63 per cent from 1989 to1997. In the NC2, Romania reported N_2O emissions from fuel combustion, which is the dominant source, followed by agriculture and industrial processes (table 4). In 1997, N_2O emissions from fossil fuel combustion accounted for 52 per cent of the total (compared with 26 per cent in 1989), industrial processes 24 per cent (36 per cent in 1989) and agriculture 24 per cent (38 per cent in 1989).

Table 4. Emissions of nitrous oxide, by source, 1989-1997 (Gigagrams)

Source category	1989	1990	1991	1992	1993	1994	1995	1996	1997
Fossil fuel combustion	17	15	12	13	13	13	13	12	13
Industrial processes	24	13	6	7	7	6	6	5	6
Agriculture	25	21	7	7	7	7	7	6	6
Total N_2O	**66**	**49**	**25**	**27**	**27**	**26**	**26**	**23**	**25**

Figure III. Nitrous oxide emissions, percentage change from 1989, by source
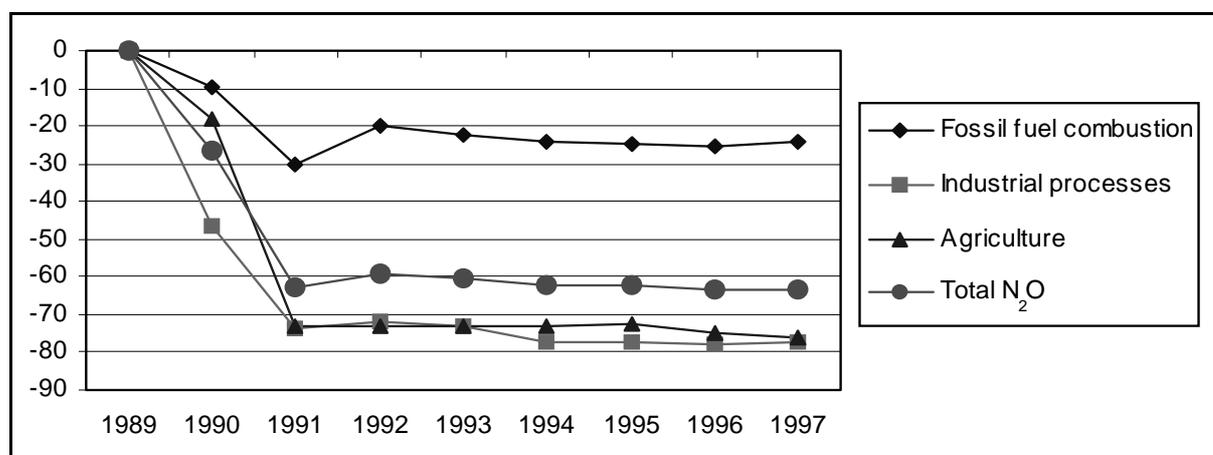
23.   The team noted the absence of estimates of N_2O emissions from the land-use change and forestry sector, and information on activities leading to industrial process emissions. The team gathered that the agricultural N_2O emissions were primarily due to the application of nitrogenous fertilizers and the burning of agricultural residues. A host expert informed the review team that the decline in nitrous oxide emissions was due to the drop in consumption of nitrogenous fertilizers following price increases.

24.   The host officials indicated that the Ministry of Waters, Forests and Environmental Protection was expecting to request funding from the National Agency for Science, Technology and Research for improvement of the national inventory, and was also examining other potential bilateral sources of funding as well as the Global Environment Facility. Among the major targeted improvements identified was the need for the preparation of a homogeneous data set for the period 1989-1997, using the 1996 Revised IPCC Guidelines. However, at present there were no concrete plans to either estimate emissions of new gases or identify uncertainty levels associated with different estimates. Furthermore, the team learned of the initiation of inventory estimates at the county level, leading to the creation of databases by two local environmental protection agencies and also a related manual, a process which was to be extended to other counties.

III. POLICIES AND MEASURES

25.   The NC2 represented a considerable improvement over the NC1 in terms of the extent of information on policies and measures. However, although the NC2 covered measures (planned and implemented) by gas and sector in accordance with the UNFCCC guidelines, there was a need for further adherence. For instance, while information was provided on the potential reduction of CO_2 emissions in 2010, by activity sectors for individual and aggregated measures (depending on the projection scenario), costs per unit CO_2 avoided, and annual average investments, information was lacking on the status of implementation (possibly due to the lack of a monitoring mechanism), estimate of mitigation impact by individual measure, and monitoring of the measure in progress. The tabulation in the NC2 was limited to the energy sector and

measures relating to CO_2 emission reduction, and primarily reflected the reference and two alternative mitigation scenarios of the projection exercise. The team also observed that most of the measures identified in the table lacked description, necessitating the provision of additional information both during and after the visit.

A. Cross-sectoral measures

26.   The team learned that, in the absence of a national strategy on climate change, different related aspects were included in the recent Medium-Term Environment Strategy, in the priorities identified within the National Environmental (Protection) Action Plan (NEAP) and in the recent Sectoral Approximation Strategy for Air and Climate Change in Romania. The Medium-Term Environment Strategy presented in 2000, having targets up to 2004, is based on objectives related to the ongoing process of approximation to EC legislation, compliance with international conventions which Romania has ratified, and regional environmental action programmes. This strategy is being implemented via the NEAP, which was approved by the Government in 1995 and is coordinated by the inter-ministerial committee for NEAP promotion and monitoring. A technical secretariat has been constituted to update the Plan and create structures at the local level for management and monitoring of approximately 300 projects identified in various economic sectors in the NEAP; these projects are estimated to cost around 227.6 million euros. The team was informed that a majority of the policies and measures identified in the NC2 were covered in the development programmes prepared by economic sector and the local environmental action plans relating to the NEAP. The host team referred to the mobilization of implementation funds by various ministries, the EC PHARE programme and some EC pre-accession funds.

27.   The team gained some insights into the progress made since 1996 towards Romania's proposed integration into the European Community, and the process of transposing legislation stipulated in various EC directives into the national legal framework. The process of approximation is being undertaken via a range of technical assistance projects funded by the European Commission and the Danish Environmental Protection Agency. The team noted that areas in which some progress had been made in this regard were waste management and air pollution. The team was specifically given the "Sectoral Approximation Strategy for Air and Climate Change in Romania" prepared jointly by the inter-ministerial working group on air pollution and climate change and the Danish Environmental Protection Agency, which the team felt had the potential to control vehicle emissions and monitor emissions of CO_2 and other GHGs. Furthermore, the team learned that among the climate-related EC directives not included in the Sectoral Approximation Strategy were those relating to integrated pollution prevention and control, and large combustion plants, which were instead placed in the industry section of the "acquis communautaire" (which refers to the entire body of EU regulations, of which around 300 relate to the environment). While the review team clearly observed the lack of a national strategy targeting climate change, it noted that the Government's future plans included the preparation of a draft air law in 2001, which was expected to include provisions for stabilizing and reducing GHG emissions.

28.   The team also learned of the government approval in 1998 of an energy strategy, which stipulates the framework principles for Romanian energy policy based on three possible scenarios for the development of energy demand. Among the broad elements included in the strategy and of relevance to climate change are the improvement of energy efficiency in all parts of the energy system, the reduction of environmental pollution and adherence to EC norms and regulations, development of an institutional and legal framework leading to further promotion of competition in the energy sector, support for research and development, and enhanced foreign investment.

29.   As regards energy efficiency, the team gathered that related policy-making and programme implementation came under the Romanian Agency for Energy Conservation (ARCE), which is part of the Ministry of Industry and Trade. The team was informed that, while the state budget provided a limited amount of support for research and development of energy efficient technologies, at present energy efficiency programmes were not being funded. While the team observed that an institutional base had been built up since the NC1, there was limited evidence of practical implementation of such measures, as well as a very modest reflection of this area in the identified policies and measures. The team also learned of the existence of a draft energy efficiency law, which was pending approval by the Government and which contained elements such as energy efficiency standards, fiscal incentives to enhance energy efficiency, obligations of energy consumers, an energy efficiency fund and sanctions and penalties. The team was also presented with some information on both completed and ongoing energy efficiency projects funded by the EC PHARE programme.

B. Energy supply and transformation

30.   Since the 1996 election, energy sector reform has included efforts to establish a legal and institutional framework for the sector, the restructuring and privatization of large parts of the energy industry and the phase-out of remaining subsidies. In 1998, the Government issued an emergency ordinance establishing the National Regulatory Authority for Energy (ANRE), which has competence for licensing and authorizing economic operators in the electricity and heat markets, tariff setting, concluding contracts for sale, purchase and supply of electricity and heat to final consumers and the development of efficiency standards for electricity and heat use. This authority has been provided with start-up funding from the EC PHARE programme and technical assistance from both the EU and the United States Agency for International Development (USAID) on issues relating to licensing, pricing, tariff methodology and surveillance of market reform. To date, the electricity market has been opened by 10 per cent of the electricity consumption for the year 1998 (about 4.5 TWh). Within this category those consumers with an annual electricity consumption higher than100 GWh are able to choose their suppliers and arrange purchase contracts. The above ordinance was followed shortly by another ordinance for the Electricity and Heat Law. The team was informed that the Electricity and Heat Law provides the framework for the regulation, production, transport, distribution and sale of electricity and heat in a market-based economy; and is to be further supplemented by secondary legislation. It also defines the content of an energy policy and identifies the related responsibilities regarding its preparation by the Ministry of Industry and Trade (such as development of programmes on energy efficiency, tariff setting and development of renewable energy).

31.   With regard to restructuring in the energy sector, in 1998, the state electricity monopoly RENEL was unbundled and transformed into a state-owned joint stock company, CONEL (National Electricity Company); three subsidiaries were established, one each for thermal and hydroelectric power generation and one for distribution. Nuclear operations were separated from CONEL, with the National Nuclear Power Company operating the Cernavoda nuclear power plant. In the oil sector, a vertically integrated oil company, SNP Petrom, has been created which incorporates two refineries and anticipates privatization or closure of the remaining seven refineries. Petrom is expected to be sold in 2000. In the mining sector, restructuring commenced in 1997, leading to the closure of loss-making pits and a reduction of the workforce, an aspect having significant socio-economic implications, which in turn is likely to influence and possibly soften the Government's restructuring plans.

32.   Approximately 99 per cent of the country's electricity needs are met through domestic production, with limited imports from neighbouring countries. Of the domestic electricity production, CONEL supplies about 80 per cent and 19 per cent is supplied equally by the Cernavoda nuclear power station, and industrial cogeneration plants and autonomous companies of municipalities. The dominance enjoyed by CONEL places it in a strong position with regard to the adoption of any mitigation measures in the sector, as will be evident from the further discussion. As of October 1998, Romania had an installed electric power capacity of 19,421 MW. Thermoelectric generation (of which around 55 per cent was based on lignite and black coal, and around 45 per cent on oil and gas), accounted for 66 per cent of the total, hydropower 30 per cent and nuclear power 4 per cent. While generating capacity serves as a broad indicator of potential emissions associated with electric power, Romania usually optimizes the use of those power stations having the lowest operational costs. So for instance between 1997 and 1998, exceptional hydrological conditions led to power production from hydropower stations increasing by about 8 per cent, whereas coal-fired power production declined by about 15 per cent. The team also noted the background to the existence of significant spare capacity (peak demand in 1998 for instance falling to 50 per cent of installed capacity) and the continuing decline in electricity demand. The prevailing situation described above and the availability of low-cost electricity from hydropower and nuclear power stations has led to a reduction in GHG emissions from electricity generation.

33.   The lack of inventory data by subcategories of fuel combustion for the period 1992-1997 prevented the review team from arriving at a precise estimate of the sector's recent contribution to total CO_2 emissions. However, over the 1991-1994 period, the structure of thermal energy generated by fuel type showed a rising trend for lignite and hard coal and a decline for natural gas and fuel oil. Regarding the introduction of mitigation measures in this sector, the review team learned that, as of the year 2000, many of the CONEL thermal plants will have exceeded their expected operating life, necessitating either their retrofit or replacement. The team also learned that, as most of the thermal power units have a capacity of more than 250 MW, there are few options in terms of the introduction of clean coal technologies. The team noted that, though the NC2 briefly mentioned mitigation measures such as the retirement of 1,267 MW of obsolete low-performance units, the use of gas turbines running on imported gas and the use of gas turbines along with heat recovery type boilers, no specific information was provided on the associated CO_2 reductions. Based on the information presented, the team was not in a position to

assess the actual progress in implementation beyond noting that this could have serious social implications and lead to rises in energy prices. The team gathered that the implementation of plans for rehabilitation and replacement were based on projections made by CONEL on the assumption that the electricity market would be of sufficient interest to outside investors to encourage investment in generation, as envisaged in the mitigation measures planned for the sector. According to information received during the visit from the Romanian Energy Policy Association (APER), investments either planned in the near term or in progress at the time of the visit included the use of a World Bank loan for upgrading some coal-fired plants running on medium- and low-grade lignite, the commissioning of gas turbines and recovery type boilers at the Grozavesti thermal power plant and the rehabilitation of the Progresul thermal power station.

34.   Since 1996, Romania has been operating one nuclear power station, which is located in Cernavoda. In 1997, this plant accounted for around 10 per cent of the country's electricity generation. At the time of the review, the hosts mentioned that the completion of unit 2 of the nuclear power station depended on the availability of financial resources, which at the time did not appear to be forthcoming in the short term. The team also learned in the course of the review that there were 33 unfinished large-scale hydroelectric power stations with a capacity of 1,400 MW, of which 14 were to be completed. Additionally, the current installed capacity for small hydro is around 332 MW, with 125 MW under construction (the identified potential being 1,060 MW). In 1998, the contribution of wind, geothermal and solar energy was 0.421 PJ, or approximately 0.02 per cent of the country's primary energy supply.

35.   Heat supply from centralized systems accounts for around 30 per cent of final energy consumption. The Romanian heating system appears to be well developed, about 60 per cent of the urban population being supplied with heat from district heating and cogeneration systems. In 1994, CONEL through its thermal generation subsidiary supplied around 44 per cent of the heat generated (94 per cent from cogeneration plants), the remainder originating from cogeneration and heat plants owned by industrial enterprises or autonomous companies owned by municipalities. Some of the industrial cogeneration plants were stated to be either operating on part-load or decommissioned. During the visit, the team learned of the presence of certain constraints within the sector, such as the use of technology dating from the 1960s and 1970s which has led to frequent breakdowns, lower boiler efficiencies and heat and water losses. This situation has in turn led to consumers either disconnecting from the grid, or supplementing their heat supply with other means and in some instances not paying their bills. On the other hand, a positive aspect of the heat production system leading to lower GHG emissions from the sector, has been the predominant use of natural gas (the share of which was 50 per cent in 1994), followed by oil products. The more recent status of the sector in terms of GHG implications remains unclear, as the import of natural gas has been declining due to both the lack of financial resources and the limited gas storage capacity.

36.   Among the mitigation measures listed in the NC2 for this sector were: the modernization and rehabilitation of hot water transport networks, the modernization of the thermal point (an installation responsible for hot water preparation and dispatch depending on consumer demand for space heating or sanitary purposes), rehabilitation and modernization of the secondary thermal networks, and control of heat supply, metering and dispatch. In terms of

implementation, the team learned that the cities of Buzau and Pascani had started the rehabilitation of their heat supply systems. Furthermore, while the NC2 identified a 5 per cent reduction in energy losses by 2005 associated with the adoption of identified sectoral measures, the review team felt that this would depend entirely on the availability of financial resources. In this connection, the hosts referred to the 1998/1999 law whereby the responsibility for financing heat generation plants shifted to the utilities and their shareholders (municipalities) and in the case of heat distribution facilities also to the municipalities. Municipalities were also to be responsible for covering the subsidies, recent (including in August 2000) increases in residential tariffs being intended to eliminate cross subsidies.

C. Residential and commercial sector

37.   The residential sector comes second to industry in final energy consumption, accounting for 10 per cent of the total in 1989 and 21 per cent in 1994. In contrast to the declining share of industry in final energy consumption, the share of the residential sector thus doubled between 1989 and1994. While the NC2 did not contain an estimate of CO_2 emissions from the residential sector; it identified the improvement of apartment insulation as a key energy-saving measure in the sector, although the specific policy under which this would happen was not identified. This included the improvement of thermal insulation in all new flats, use of triple glazing in existing buildings, and increase in the thermal insulation of existing buildings using a 4.8 cm thick polystyrene layer, options which would lead to savings of 11 GJ, 3.35 GJ and 8.36 GJ per year per dwelling, respectively. The actual progress made in the implementation of these measures was not indicated, nor was an estimate provided for the entire sector based on the building stock. However, the team was aware that lack of financial resources could be a handicap here as well. Among other initiatives the team was informed about were performance studies on various domestic appliances, the development of energy efficiency standards for washing machines, radios, television sets, vacuum cleaners, and small hot water boilers, and the adoption of a government decision relating to energy labelling for refrigerators, freezers and refrigerating combines (a combination of refrigerator and the freezer). The team did not receive any further details on how recent increases in residential energy prices (targeted at removal of cross subsidies), such as in 1999 (17.4 per cent) and even in August 2000, had altered the existing situation.

38.   No information was supplied by the NC2 or during the visit on mitigation measures targeting commercial buildings.

D. Industry

39.   Based on the data available for the period 1989-1991, the team noted that industrial CO_2 emissions appear to arise primarily from energy use rather than industrial processes, the main energy consumers being the chemical and metallurgical industries, and extraction and processing of iron ore. Industry remains the largest energy-consuming sector, in spite of a steep decline in its share of final energy consumption over the period 1989-1997 (77 to 45 per cent) due to the economic recession. Heat (mainly steam) consumption fell from 517 PJ to 223 PJ, and electricity consumption from 56 TWh to 28 TWh during the period 1989-1994, resulting in

lower emissions. The team noted that, though industrial usage constituted as much as two thirds of the total electricity consumption in 1998, there did not appear to be any specific policies targeted at enhancing the efficiency of sectoral electricity use or reducing emissions from the sector. On the other hand, the team noted the presence of projects like that initiated by the Ministry of Industry and Trade, the Romanian Agency for Energy Conservation and the Research Institute for Thermal Energy, aimed at analysing the current barriers to industrial energy efficiency and identifying ways to overcome them, and that assessing the energy-saving potential in key industries by the Romanian Association for Energy Conservation and APER. The energy-saving potential in cast iron production was estimated at 20 per cent, steel production using electrical furnaces at 20 per cent, ammonia production at 30 per cent, the petrochemical sector at 12 to 50 per cent and cellulose and paper production at 25 to 45 per cent. In addition to the emissions resulting from energy use, process emissions also arise from the cement, lime, paper and pulp and petrochemical industries.

40.   The focus of the mitigation section for industry identified in the NC2 was based on those measures identified within the projections section and consequently reflected that exercise. For instance, the identified options included structural changes leading to a reduced share of energy-intensive industries, improvement of existing energy management, and modernization and rehabilitation of existing technologies. While a clear picture of the actual implementation of identified measures did not emerge, the team gathered that improvements in industrial energy efficiency had been hindered by delays in restructuring and rationalizing industry to match capacity with reduced demand, weak energy management and difficulties in raising medium- and long-term finance. In addition, the review team learned that measures such as the creation of energy consulting companies, training in energy efficiency and review of the industrial 'power performance' standards (improved efficiency of energy-consuming equipment to achieve performances comparable to other countries) were being considered within the National Energy Strategy.

41.   The team was also informed of initiatives such as the draft law on the environmental fund (initiated in 1992 and still on the agenda for parliamentary adoption), meant to create a non-budgetary fund directed at industrial pollution control. Other initiatives included the use of life cycle analysis in the metallurgical industry as part of the development of a sectoral strategy, the ongoing consideration of environmental permits and voluntary agreements. The team also learned that the industry section of the "acquis communautaire" included the EC directives on integrated pollution prevention and control and on large combustion plants, although no further details were provided.

E. Transport

42.   Between 1989 and 1994, there was an overall decline in passenger and goods transport, in terms of both passenger-kilometres and tonne-kilometres. The limited inventory data available for the sector suggest that its contribution in 1991 to CO_2 emissions from fuel combustion was around 6 per cent. For this sector, the mitigation measures identified in the NC2 included the development of public urban and inter-city transport, subsidizing of public transport and improvement of road vehicle performance. The NC2 did not provide any details on the

associated GHG reductions. In light of a largely declining trend in public urban and inter-city transport, the Government had developed a local transportation strategy in 1990 for a 15-year period. Among other features, the strategy placed emphasis on electric traction, which was currently under implementation in the cities of Baia Mare, Targu Jiu, Vaslui Ploiesti and Botosani. As regards subsidies being provided to public transport, they were stated to range between 60 and 80 per cent, and for Bucharest to be around 68 per cent.

43.   The Romanian Government is targeting the improvement of road vehicle performance by introducing new motors based on EURO1 and EURO2 environmental standards and improving fuel composition through the incorporation of additives. The team noted that from 2000 onwards all imported buses were expected to adhere to EURO2 standards. Mention was also made of the existence of three experimental vehicles using liquefied petroleum gas. Other initiatives the Romanian Government has taken are the inclusion of the EC directive on vehicular emissions in domestic regulations for the sector. The current sales price of diesel was around 30 per cent lower than that of gasoline (gasoline costing US$ 0.53 per litre and diesel US$ 0.37). The revenues from taxes paid on gasoline and diesel by fuel producers and importers are paid into a fund for road improvement. Details of the taxes on transport fuels were not available.

F. Waste

44.   The NC2 identified the "development of hygienized depositing stations"or landfills and the extension of town water treatment as the sectoral mitigation measures. In 1997, of the total amount of waste generated of 218 million tonnes, 95 per cent was industrial waste, 2.7 per cent municipal waste, and 1.4 per cent agricultural waste. The team was informed that household waste was being collected by state-owned and private sanitation companies, at rates approved by local authorities. In terms of waste management, at present the landfill option appears to dominate, with landfills for industrial waste numbering 712 and those for urban waste numbering 258, both numbers being targeted for reduction. The team felt that this was understandable, given that at present only 10 per cent of the urban landfills had environmental permits under the Law on Environmental Protection (137/1995). Another ongoing concern of the Government was the rehabilitation of the open dumping sites, which would have implications for the controlled release of CH_4 emissions.

45.   With regard to the mitigation measures either in place or planned in the near term, the team learned that the Romanian parliament had been examining a draft waste management law at the time of the visit, which would directly influence the current system of waste management. This draft law lays down the principles of waste management and defines the competent authorities, the permit procedure, the financial aspects of waste management and penalties for defaulters, among other aspects. Additionally, since 1998, the design plans of all new projects relating to waste management have been expected to incorporate landfill gas recovery; three of the six projects initiated in 1998 were operational at the time of the visit. Incineration was not currently being applied to urban waste and was confined to specialized uses. Of the seven incinerators in place, only one was operational at the time of the visit.

G. Agriculture

46.   The NC2 improved upon the NC1 by including a limited amount of information on the agricultural sector. While the NC2 foresaw the privatization and modernization of the sector, leading to a decrease in per hectare fuel use by agricultural machinery and a decrease in energy demand through the modernization of livestock farms, the team was not provided with any concrete information on the degree of implementation. In 1998, the Romanian pig population was 7.1 million (as against 11.7 million in 1990), the cattle population 3.2 million (as against 6.3 million) and the sheep population 8.9 million (as against 15.4 million). This decline in livestock populations due to the economic situation has led to a decline in methane emissions.

H. Forestry and land-use change

47.   The country's forests cover around 6 million ha, or 27 per cent of the total area of the country. Seventy per cent of these forests are deciduous and 30 per cent coniferous. The team was informed that the ongoing process of land restitution whereby agricultural and forest land was being returned to its original private owners, was expected to affect 30-35 per cent of the forests, with major implications for forest management. This is in contrast to the pre-1990 period which was characterized by complete state ownership. The afforestation of heavily degraded agricultural lands was referred to as one of the mitigation measures within the sector. While the team did not learn any details of the programmes implemented so far, new plantations and direct sowing accounted for around 10, 000 ha/year over the 1992-1997 period, although the trend over the same period was on the decline. The Government assisted such afforestation efforts by providing free seedlings. Reforestation, on the other hand, was being promoted by the implementation of a silvicultural code which required forests to be replanted within two years of harvest.

IV. PROJECTIONS AND EFFECTS OF MEASURES

48.   The review team was provided with information on the NC2 projections, which were based on the 1996-1997 "Country Study on Climate Change, Element 3: Mitigation Options" financed by the Ministry of Research and Technology and the United States Country Studies Programme. The Institute for Power Studies and Design, the Economic Forecast Institute, the Industry Economic Institute, the Ministry of Waters, Forests and Environmental Protection, the Forest Research Institute and the Romanian Vehicles Register took part in this study. The team recognized that in contrast to the NC1, which had lacked this section, considerable progress had been made in the NC2 with regard to the development of various scenarios and the assessment of the effect of various policies and measures. The NC2 included three scenarios, namely, a reference or without measures scenario, and low and high mitigation (with measures) scenarios for CO_2, CH_4 and N_2O, based on projections for the period up to 2020. However, the NC2 provided data for 1995, 2000 and 2010 only, due to the higher uncertainties associated with the period between 2010 and 2020.

49.   Based on the content of the NC2 and the additional information provided during the visit, the review team made suggestions relating to the need for adherence to the UNFCCC guidelines and the improved presentation of results. Given the amount of additional information available, the team felt that the content of the NC2 could have been made more transparent. Furthermore, the team noted the lack of PFC, HFC and SF_6 projections and international bunker fuel projections. Additionally, the team observed that though the projections were presented by gas, the disaggregation at the sectoral level as presented in the NC2 made comparison with the source categories in the greenhouse gas inventory difficult. With regard to the treatment of measures in the reference and two mitigation scenarios (as also the extent of implementation), the team felt that the lack of transparency and information in the NC2 did not allow for a clear distinction to be made between the treatment of measures in the reference and the two mitigation scenarios.

50.   In spite of the provision of additional information in the country case study (mentioned earlier), and the presence of tables providing potential sectoral CO_2 reduction by Gg CO_2 per year in 2005 and 2010, for the reference and two mitigation scenarios, the team felt that it was difficult to discern the effect of individual policies and measures within the sectors. The team noted that information on how the effects of various policies and measures were assessed could be included. This is the reason why no specific GHG reduction estimates for individual measures have been included in this section. The team also suggested that the country conduct a sensitivity analysis of the key assumptions, even though it gathered that the hosts associated a 20 per cent level of uncertainty with the results. In terms of the land-use change and forestry sector, the review team recommended that the prevailing differences between the inventory and projection figures (discussed later) be carefully reviewed.

51.   The review team learned that the energy sector projections used four of the nine modules of the Energy and Power Evaluation Programs (ENPEP) model developed at the Argonne National Laboratory. The MAED (Model for Analysis of Energy Demand) module was used to analyse the energy demand for various economic sectors; the Wien Automatic System Planning (WASP) module was used to analyse the supply side and assess least-cost electricity supply plans to comply with electricity demand under a fuel supply constraint; the BALANCE module was used to balance energy supply and demand while considering the efficiency of supply, and financial aspects like subsidies and taxes; and the IMPACTS module was used to assess emissions related to the various fuel types using the IPCC default emission factors.

52.   In the case of the non-energy related emission projections, the country team relied on the use of spreadsheets, multiplying the projected activity data based on assumptions and expert judgement regarding the expected economic development of various sectors, by the IPCC default emission factors, to arrive at such estimates. Estimates of future carbon sequestration were developed using assumptions on the afforestation rate of degraded agricultural area and the age classes of standing forests, which were then multiplied by the sequestration rate per hectare as determined by the Romanian statistical office.

53.   The key assumptions used in both the reference and mitigation scenarios, relating to energy prices, GDP growth rate, population growth rate and GDP structure, were included in the NC2. Furthermore, the team learned that the mean GDP growth rate for the period up to 2010

ranged from 5 to 5.5 per cent, whereas population was projected to be about 3.5 per cent lower in 2010 than in1995. In the case of energy prices, the prices of domestic fuels were projected to increase, while those of imported fuels such as natural gas and fuel oil, which were based on the 1995 World Bank forecasts, were predicted to decrease. As regards the contribution of various sectors to GDP, this remains the same during the projected period, with industry contributing around 32 per cent, followed by services at 30 per cent and the agriculture and forestry sectors at 21 per cent.

Figure IV. Projected CO$_2$ emissions under reference, low and high mitigation scenarios (Gg)
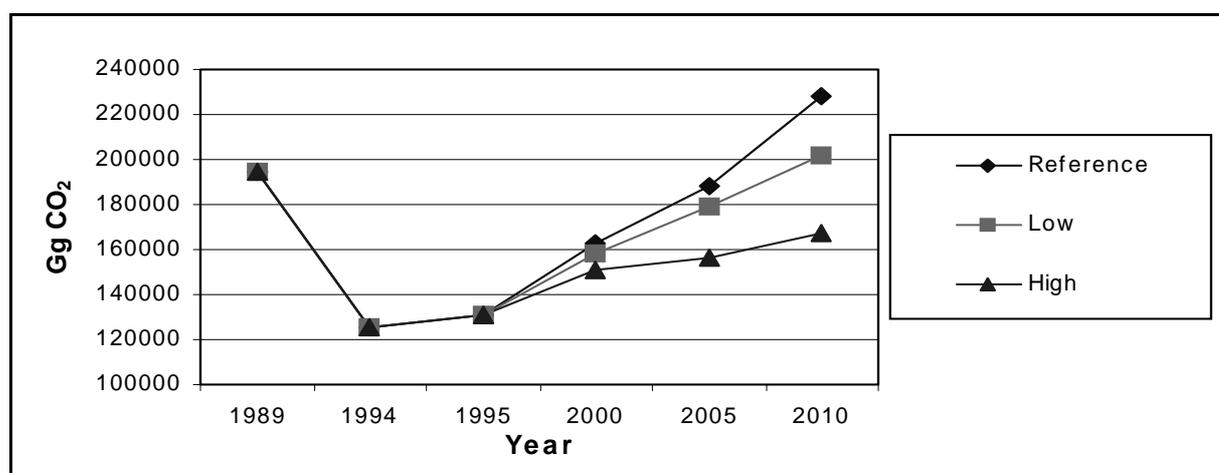
54.   The team was also informed of the key underlying assumptions used in the construction of the reference or without measures scenario. Among these were an increase in efficiency due to modernization of the economy associated with the transition to a market economy and improved management; an increase in energy demand by an average of 4.3 per cent per year between
1993 and 2020, and a reduction in energy intensity by about 0.6 per cent per year. In terms of the fuel shift under this scenario, it is expected that natural gas will be used as much as possible to meet the energy demand. The amount of natural gas used by the population is expected to increase by 40 per cent between 2000 and 2010, and by 100 per cent in 2020, in comparison to the current situation. Hard coal will be used for electricity and heat generation, and the Cernavoda nuclear plant is expected to be still operational after 2000. Furthermore, restructuring and rehabilitation of coal-, gas- and oil-fired power plants has been assumed, apart from modernization of about 1,300 MW of cogeneration capacity. Renewables are also anticipated to grow by over 60 per cent between 2000 and 2010.

55.   The host officials stated that of the 26 mitigation scenarios developed, only the "low" and "high" scenarios, which represented the upper and lower range of the developed scenarios, were included in the NC2. Both the scenarios use the same basic assumptions as the reference scenario but differ from each other with regard to the handling of the industrial sector. In the low mitigation scenario, the underlying assumption is that the share of the industrial sub-sectors

would change with respect to the reference scenario, with the share of heavy industries (chemistry, metallurgy) expected to decrease while that of light industries (such as food processing) increases. Under this scenario, total final energy demand is expected to decrease against the reference scenario by 13 per cent in 2010 and over17 per cent in 2020, and energy intensity would record a reduction of 1.9 per cent per year over the 1993-2010 period. The high mitigation scenario, in addition to the low scenario assumptions, includes the assumption that GHG reduction measures will be implemented in all sectors. Due to the assumed adoption of the measures, total final energy demand is expected to decrease against the reference scenario by 19 per cent in 2010 and 29 per cent in 2020 and overall energy intensity is expected to show a reduction of 2.7 per cent per year during the 1993-2020 period. In the industrial sector, higher levels of rehabilitation and implementation of advanced technologies were assumed than in the low scenario, leading to a decline in average energy intensity of 1.7 per cent per year over the 1993-2020 period, compared to 0.6 per cent in the reference scenario.

56.   The team learned that, of the 26 alternative mitigation scenarios, nine evaluated the effect of single GHG reduction measures, and the remaining 17 evaluated two or more reduction measures in combination (including the high scenario). The selection of measures considered in the national study was primarily based on expert judgement, an important criterion being whether the identified measure could be implemented on a short or medium term and the use of cost-benefit analysis to evaluate the potential of the measure being implemented. The data for the energy, industry, industrial processes, agriculture, transport, services and waste management sectors were obtained from the participating institutes.

57.   The team learned that the projection exercise for the energy sector considered both the structure of primary energy supply and the technologies used in electricity and heat generation, and the potential for GHG reduction therein. Alternative options for meeting the electricity and heat demand included the use of combined cycle gas-turbine technology using imported natural gas, use of nuclear power, use of imported hard coal, development of hydroelectric power, development of industrial cogeneration plants based on classical cycles running on natural gas, and urban cogeneration plants based on combined cycle technology. For instance, in the energy sector the development of industrial and cogeneration plants in 2010 rises by 455 MW in the high scenario, reaching 3,493 MW, as against 3,038 MW in the reference scenario, apart from an assumed 20 per cent reduction in heat losses within the distribution system and a reduction of approximately 3 per cent of heat delivered to consumers due to metering, controlling and dispatch monitoring, with respect to the reference scenario.

58.   The mitigation alternatives related to the reduction of energy demand in the main consumption sectors as given below primarily represent processes of modernization and restructuring. In the industrial sectors, the GHG reduction is primarily due to improvements in energy efficiency and material adopted due to improvements sought in product quality and decreased production costs. Among the options considered were major modifications of existing production facilities over the short and medium term and the setting up of new production capacities involving technologies under commercial development, while the implementation of highly advanced technologies was considered in the long term after 2010-2015. In the residential sector, the mitigation options considered included a decrease in energy demand for residential

heating through improved thermal insulation of old and new buildings and the increase of existing equipment efficiency.

59.   In the transport sector, both improved car performance and a shift in the modal split is projected. As a result of the restructuring of the economy, a reduction in transport of goods (tonne-kilometers) of about 3-5 per cent is projected between 1996 and 2010. Furthermore, it is assumed that the use of private cars will increase, in pace with the projected economic development and improved living standard of the population (while public transport will decrease). The performance of cars is projected to increase in line with the EU standards (EURO 2) for 2010. In the non-energy sector, the GHG reduction options in the agricultural sector include the modification and retrofitting of greenhouses, the optimization of agricultural practices, the use of agricultural machines and the development of poultry and animal breeding farms. Greenhouse energy demand is expected to fall by 3 per cent in 2010 due to modification and retrofitting activities, whereas optimization of agricultural practices and the use of agricultural machines are expected to lead to a 11 per cent reduction in motor fuel demand in the sector in 2005, rising to 15 per cent in 2010. The projections also assume that modernization of livestock farming will lead to an 8 per cent reduction in heat and electricity demand in 2010 and a 5 per cent reduction in fuel demand in the sector.

60.   The reference scenario assumed that forest area would be maintained at 6.5 million ha until 2020 and the quantity of wood cut would increase from 14.5 million m^3 in 1994 to 18 million m^3 in 2020, apart from routine maintenance and regeneration within the forests. The mitigation scenarios considered potential increases in forest areas due to afforestation of degraded non-forest lands, the evolution of timber demand, the increased use of forest management, and the use of new species. In the case of the low scenario, the study assumed that the extent of forest area would increase by 4,500-8,000 ha/year, reaching 103,000 ha in 2010 and in the high scenario it was assumed to be 9,000-16,000 ha/year, increasing to 190,000 ha in 2010. The team gathered that some difficulties in the process of transferring the degraded land to new owners as well as lack of funds have led to a decline in afforestation in the last five years. The team was told that extensive felling in the past had led to the current dominance of the younger age classes in forests, leading to a relatively higher carbon uptake.

61.   The review team also noted that there was a marked difference between the carbon sequestration data for the period 1991-1994 (-6,590 Gg CO_2) given in the national inventory and the data for 1995 indicated in the projection exercise (-18,488 Gg CO_2). The host experts attributed the difference partially to the inventory estimate being calculated using the IPCC Guidelines and the projection estimate using the National Research Institute for Environmental Engineering data, which assumed higher carbon sequestration rates. The difference was also attributed to ongoing research on carbon sequestration in Romanian forests, as well as improvement in the statistical record of quantities of wood and wood waste burnt. The team also felt that discussions during the review on vulnerability on the health of the Romanian forests, could further affect the current carbon sequestration estimate. The review team was informed that the forestry inventory was still under review. Taking all these aspects into consideration the team suggested that the existing estimates be carefully reviewed.

62.   Although an increasing trend in CO_2 emissions is visible in the reference and two mitigation scenarios, the level in 2000 will remain below that of 1989. The team noted that in the period after 2005, the CO_2 emissions in both the reference and the low mitigation scenarios would rise above emission levels in 1989. In the high mitigation scenario, the CO_2 emission levels reach 167,655 Gg in 2010, and therefore remain below the 1989 level.

63.   While assessing the overall results, the team gathered that in contrast to the assumed mean GDP growth rate of 5 per cent till 2010, the actual situation was that of an economic recession which continued till 1999, implying a lower growth in emissions. However, studies conducted by the EC, the International Institute for Applied Systems Analysis (IIASA) and in Romania showed that economic growth was expected in 2000, and was likely to range from 5 to 8 per cent in 2010. With regard to the assessment of the impact of the policies and measures included in the projections, the team gathered that the measures currently considered in the low and high scenarios had not all been implemented at the level envisaged at the time of the scenario construction. For instance, there has been a delay in the restructuring and rehabilitation within the energy sector, and the completion of the second unit of the Cernavoda nuclear power station has also been delayed. The main reason for these developments has been the continuing economic recession, due to which the energy demand is less than that assumed earlier and hence additional electricity generating capacity is not required.

64.   In the agriculture and forestry sectors, the implementation of the policies and measures has gone as planned. In the household sector, it had been anticipated that all new flats supplied from centralized heat sources would be fitted with thermal insulation (involving a shift from the base year value of 1.78 kcal/m^{2}h $^{\circ}$C to a value of 1.5 kcal/m^{2}h $^{\circ}$C in 2020). The team learned that by 2000, only 50 per cent of this target would be realized, whereas the targets for 2010 were expected to be met. While the hosts had assumed that the introduction of improved technologies would lead to an improvement in energy efficiency, as had happened in some sectors such as the cement and ammonia industries, the closure of many energy-intensive industries may have had a greater impact. The team concluded that, due to the fact that the identified policies and measures were being implemented at a lower than assumed level and also due to the recession, the effect of measures on emissions may have been overestimated.

65.   The NC2 also included projections of CH_4 emissions from fossil fuel combustion, fugitive emissions from natural gas drilling, transport and distribution, crude oil drilling and processing and underground coal mining, under both a reference and two mitigation scenarios. In the case of the projected fugitive CH_4 emissions the distinction between the scenarios lay primarily in the different assumptions made about transport and distribution of natural gas, emissions being determined by the volume of natural gas consumption. Projections of non-energy related CH_4 emissions were also made from the industrial sector, the agricultural sector and the waste management sector, for the above three scenarios. In the industrial sector, the emission projections were based on the same assumptions as those used for CO_2 projections from industrial processes. The reference scenario for the industrial sector assumed the emission factors as in the inventory and in the low and high mitigation scenarios, the emission factors were altered to reflect modernization of industrial technologies and increased efficiency in the use of raw materials. In the case of CH_4 emissions from waste management, the projections

considered measures such as the reduction in organic waste deposited and the aerobic treatment in waste water in oxidation tanks. The team observed that the projected total CH_4 emissions in all three scenarios for the period up to 2010 were below the level in 1989 (2,358 Gg CH_4). The emission projections for N_2O covered emissions from fossil fuel combustion, industrial processes and agriculture, for the reference scenario and two mitigation scenarios, for the same time period. According to all three scenarios, emissions increase but till 2010 remain below the 1989 level of 66 Gg N_2O. The review team suggested that there was a need for greater transparency in the assumptions underlying the emission projections for CH_4 and N_2O.

66.   Based on the information made available, the team noted that Romania will achieve the UNFCCC aim of not exceeding the 1989 emission levels. The team also observed that since there was a lower than anticipated level of implementation of policies and measures, and an economic recession instead of the anticipated economic growth, it was likely that the current projections were likely to be overestimates.

V. EDUCATION AND PUBLIC AWARENESS

67.   The team gathered that the school curricula included a broad treatment of environmental issues rather than a specific coverage of climate change. However, mention was made of the involvement of the Romanian Energy Policy Association in a pilot project involving the adaptation of the United States Green Schools Program to Romania. A lack of finance on the part of the environment ministry for such activities was specifically mentioned. At the postgraduate level, there is a UNESCO Chair of Engineering Sciences at Bucharest University, under whose auspices masters courses are offered on energy efficiency, energy conservation, management of natural resources, energy systems management and cleaner technologies for sustainable development. The existence of awareness campaigns on energy conservation targeted at various consumer groups, and the preparation of a training manual on district heat management for local authorities, both activities funded by the EC PHARE programme, were also mentioned.

VI. RESEARCH AND SYSTEMATIC OBSERVATION

68.   Climate research activities in Romania are mainly concentrated in the National Institute of Meteorology and Hydrology, the Faculty of Geophysics and Geography and the Department of Atmospheric Physics of the University of Bucharest, the Institute of Geography in the Romanian Academy, and the Academy of Agricultural and Forestry Sciences. The team learned of the participation of the National Institute of Meteorology and Hydrology in the WMO Climate Variability and Predictability Programme. At the national level, the main objectives of the climate research programme are the study of physical processes responsible for climate variability and predictability at regional level, improvement of the methodology for predicting monthly, seasonal and inter-annual climatic fluctuations, and the assessment of the impact of anthropogenic activities on the Romanian climate. The hosts also referred to the network of around 200 observing stations measuring various weather variables, and the existence of time-series data for the past 100 years.

VII. VULNERABILITY AND ADAPTATION

69.   The team gained some insight into the vulnerability and adaptation research being conducted by the National Institute of Meteorology, Hydrology and Water Management, the department of social sciences and the Institute of Forestry Research, focussing primarily on agriculture and water resources. This research has been funded by the United States, the Ministry of Waters, Forests and Environmental Protection and the National Agency of Science, Technology and Innovation. The research approach has involved assessing the impact of equilibrium and transient climate scenarios from general circulation models, on water management, agriculture and forestry. Experts studying the vulnerability of the water resources in the hydrographic basins of the Siret, Arges and Tarnava rivers, identified the Arges river basin as being the most vulnerable to climate change impact, which is a matter of particular concern due to the anticipated water demand of the Bucharest population in 2020. The team's attention was drawn to ongoing projects of the Government and the EC targeted at the informational system for the monitoring of water resources and demand. In the agriculture sector, the team was informed of work done at the Research Institute for Soil Science and Agrochemistry on crop simulation for winter wheat, maize and soyabeans. The country experts shared some of the findings of the Agroclimatic Change and European Soil Suitability programme and the Integrated Model to Predict European Land Use under Climate Change project.

70.   Impact research in the forestry sector, in particular on the effect of air pollution on Romanian forests, had shown that the share of trees with advanced defoliation had decreased from 13 per cent in 1990 to 9 per cent in 1991 but then increased to 16.7 per cent, 20.5 per cent and 21.3 per cent in 1992, 1993 and 1994 respectively. Broad-leaved species were more affected than resinous species. The hosts informed the team that the present condition of the forests could be attributed to a combination of droughts, local and transboundary air pollution and illegal tree felling. The team was also informed of the research findings using the Holdridge model wherein, under two general circulation model scenarios, the area of *Fagus sylvatica* was expected to fall by 10 per cent due to reduced rainfall and the oak species (*Quercus cerris and Quercus frainetto*) to extend their spread to the southern side of the country. The team was also provided with the results of the JABOWA II model used to evaluate changes in species composition and productivity at three specific sites under transient climate change, in addition to what was contained in the NC2.

VIII. CONCLUSIONS

71.   The Romanian Government has taken a few steps towards establishing an institutional framework to address climate change. The constitution of the National Commission on Climate Change in 1996 and subsequent attempts to strengthen its functioning are examples of such positive steps. While the team noted the development of the Sectoral Approximation Strategy for Air and Climate Change in Romania, targeted at monitoring GHG emissions under EC rules, it was too early to judge its implementation. Likewise the actual implementation of the sectoral level projects identified within the National Environmental Action Plan would depend on mobilization of the necessary funds. On the other hand, the absence of required annual inventory

submissions to the secretariat to date, reflects the need to further strengthen the existing reporting arrangements at the national level relating in particular to the GHG inventory.

72.   The extent of reporting on the national GHG inventory in the NC2 showed a vast improvement over the reporting in the NC1. To compile the inventory, the country used a combination of the1995 IPCC and CORINAIR methodologies. In terms of compliance with the UNFCCC reporting guidelines, the inventory included data on CO_2, CH_4 and N_2O and lacked data on PFCs, HFCs and SF_6. In accordance with the requirements of the reporting guidelines, the NC2 included summary data for 1989-1991 but standard data tables and worksheets for the energy, agriculture and land-use change and forestry categories were not provided. Subsequent to the visit, the team received aggregated data on CO_2, N_2O and CH_4 emissions for the period 1995-1997. Data disaggregated by the IPCC source categories were limited to the period 1989-1991 and were lacking for 1992-1997, a fact which impacted the team's analysis of the inventory, particularly of the energy sector. Two other deviations from the IPCC Guidelines were the continued inclusion of international bunker fuels in the transport category and the continued exclusion, due to uncertainties, of the industrial solid and liquid waste data in waste sector calculations.

73.   The NC2 also represented an improvement over the NC1with respect to the amount of information reported in the section on policies and measures. However, while the NC2 covered planned and implemented measures by sector and gas, this was not organized in accordance with the UNFCCC guidelines. The section on policies and measures appeared to reflect primarily the reference and mitigation scenarios in the projections section, rather than describing the policy context. The section did include information on the greenhouse gas reduction potential of various measures till 2010 (primarily at an aggregate level), costs per unit CO_2 avoided, and annual average investments; there was no coverage of the status of implementation, estimate of mitigation by individual measure or monitoring of the measure in progress. These gaps required the provision of additional information both during and after the visit.

74.   As the country is still in the process of economic transition and in view of the uncertainties of future economic development, future emissions will depend on the country's probable accession to the European Community, the pace of economic reform, the upgrading of the legal and institutional framework in the energy sector, the restructuring of the energy sector and the phase-out of the remaining subsidies. The planned and ongoing restructuring in turn is expected to have societal implications for levels of unemployment, as well as potentially higher energy costs, facts which have to be balanced against improved efficiencies of production and lowered emissions. In the electricity sector, the pace of adoption of planned mitigation measures will be influenced by the extent of investor interest in the electricity market, with CONEL enjoying a strong position to change the emission profile of the sector. In the case of the industrial sector, which is the largest energy-consuming sector, there was a decline in energy consumption over the 1989-1997 period due to the economic recession. The actual improvements in energy efficiency, however, have been limited due to reasons such as delays in restructuring, weak energy management and difficulties in raising the necessary finance. Among the positive developments within the sector are the completed assessments of the energy-saving potential in the key industries, the ongoing consideration of environmental permits and voluntary

agreements, the planned creation of energy consulting companies, training in energy efficiency, the review of power performance standards in industry and the formulation of a draft law on the environmental fund. A need to strengthen the monitoring of implemented policies and measures across sectors is also felt.

75.   In contrast to the NC1, which had lacked a projection section, the NC2 marked considerable progress with regard to scenario development and the assessment of the effect of various policies and measures. Although substantial additional information was provided both during and after the visit, the team felt that the section in the NC2 required further strengthening in terms of transparency, the inclusion of emission projections for PFCs, HFCs, SF_6 and international bunker fuels, subject to the availability of inventory estimates, and assessment of the effects of individual policies and measures. In terms of the emission trends, an increasing trend was evident in the reference and two mitigation scenarios, with emissions in 2000 however, remaining below the emission levels in 1989. With regard to the effects of various policies and measures, the measures currently considered within the projections were not all implemented at the level envisaged at the time of construction of the projection exercise, one major reason being the ongoing economic recession in the country. Based on this information, the country's GHG emissions in 2000 are not expected to exceed the 1989 level.

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