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

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I. INTRODUCTION AND NATIONAL CIRCUMSTANCES

1. The secretariat received the second national communication (NC2) of Greece under the UNFCCC on 12 December 1997. An in-depth review of the NC2 was carried out between May 1999 and February 2000, including a visit to the country from 17 to 21 May 1999. The review team consisted of Dr. Jiri Balajka (Slovakia), Dr. Domenico Gaudioso (Italy), Mr. Gene McGlynn (Organisation for Economic Co-operation and Development) (OECD) and Dr. Katia Simeonova (UNFCCC secretariat, coordinator).
2. The total area of Greece is 131,957 km² and the population was 10,467,000 in 1995. Forests and forest lands cover 65,131 km², comprising 14,266 km² of coniferous and 19,296 km² of deciduous high forests, as well as 31,539 km² of forest lands. Forests make up around 49 per cent of the territory of the country, and all are managed. Greece has a very long coastline of about 14,000 km and islands occupy a fifth of its territory. The climate is Mediterranean, with mild winters and hot summers, and precipitation occurring mainly in fall and winter.
3. Greece has an open economy, which has enjoyed a relatively steady development in the recent decade with gross domestic product (GDP) growing by 60 per cent between 1973 and 1995. Services, and especially tourism, is the fastest growing sector of the economy, accounting for a constantly increasing share of GDP as the shares of industry and agriculture shrink. In 1995, services accounted for 43 per cent of GDP, followed by industry 36 per cent and agriculture 21 per cent. Within industry, a slight increase in the share of energy-intensive industry was observed in the recent decade. Economic policy in recent years has been strongly influenced by efforts to meet the Maastricht criteria in order to join the European Monetary Union at the beginning of 2001, by reducing the high budget deficit and inflation.
4. With a share of 60.6 per cent in total primary energy supply (TPES) in 1997, oil remained by far the first energy choice for Greece, followed by coal (33.8 per cent), renewables (4.8 per cent) and natural gas (0.8 per cent). However, the structure of TPES is likely to change as a result of the policy launched in the early 1990s to promote natural gas in primary energy supply. At the beginning of 1997, the first part of the high- and medium-pressure gas systems was inaugurated and the first quantities of natural gas were delivered. Although the share of natural gas in TPES was still modest in 1997, the Government is committed to increasing this share steadily to 3 per cent in 2005 and 7 per cent in 2010. Lignite (brown coal), which is the most important indigenous energy resource in Greece, made up 80.3 per cent of these resources in 1997, followed by biomass, hydro and other renewables (14.2 per cent), oil (5.0 per cent) and gas (0.4 per cent). Lignite is predominantly used for electricity production. In 1997, out of the 39,236 GWh electricity produced, 70.6 per cent came from lignite, 18.4 per cent from oil, 10.4 per cent from hydro, 0.5 per cent from natural gas and the remaining 0.1 per cent from other renewables. As far as energy demand in 1997 is concerned, the bulk of energy was consumed in transport, and services together with households (38.4 and 34.9 per cent), followed by industry (24.1 per cent) and use of fuel for non-energy purposes (2.6 per cent).

5. Greece is a parliamentary democracy with two levels of government: central and municipal, and four levels of administration: central government, regions (13), prefectures (57) and finally local governments (900 municipalities and 133 communities). Climate change policy in Greece was developed by the central government through the concerted efforts of all ministries with competence in matters of climate change. The Ministry of the Environment, Physical Planning and Public Works, referred to below as the Ministry of the Environment, has a major role in developing and implementing the environmental policy of Greece, including climate policy. The responsibility for implementation of climate policy lies with several other ministries, including the Ministry of Development, dealing with industry, energy, technology, commerce and tourism, the Ministry of National Economy, the Ministry of Finance, the Ministry of Foreign Affairs, the Ministry of Transport, the Ministry of Agriculture, the Ministry of the Interior and the Ministry of the Merchant Marine. In 1996, a national inter-ministerial committee was set up to improve the coordination of climate change policy. All the ministries listed above, the Public Power Corporation (PPC) and some academic bodies (the National Observatory and the University of Athens) became members of this committee. Green non-governmental organizations did not participate directly in this committee, but they provided their views on the climate policy directly to the ministries. In addition to policy coordination, the committee oversaw the preparation of the NC2. Recently, the tasks of the committee have been extended to monitoring the implementation of climate policies.

6. The decisions on climate change and climate-related policies are taken in Greece after extensive consultations geared to balancing the interests of different stakeholders, which has helped implementation. The team found that the inter-ministerial committee facilitates the consultation process at the expert level and also contributes to implementation. In this context, the team noted that, as the climate process and climate policy evolves, more active participation of major stakeholders, such as businesses, non-governmental organizations, trade unions and the general public, was expected to become of vital importance for the successful implementation of the UNFCCC commitments and the binding commitments under the Kyoto Protocol, when ratified. The team felt that such participation could be ensured through consultations, workshops and information campaigns.

7. As the key governmental agency responsible for climate change policy coordination, the Ministry of the Environment took the lead in the preparation of the NC2, in close cooperation with the other agencies involved in the work of the inter-ministerial committee. The team noted the good cooperation among the ministries involved in preparing the NC2, the Public Power Corporation, the Public Gas Corporation (PGC) and the Centre for Renewable Energy Sources (CRES), which also provided valuable input for the NC2. The team acknowledged the commendable work of the National Observatory of Athens (NOA) in providing analytical support for climate policy formulation and the input for the NC2, and especially the efforts to constantly improve the quality of the greenhouse gas (GHG) inventory.

8. Virtually all policies in Greece, including climate policies, are directed by the central government. Still, some competence for environmental policies is delegated to the regional and local governments. This includes competence for policy formulation and strategic planning, and

legislative initiatives on the environment, management of waste and wastewater, land use, and spatial and urban planning. Moreover, as a result of the 1997 administrative reform, the participation of the regional and local governments in policy implementation has grown and become more effective, especially in the field of waste management.

9. In 1995 Greece published its climate action plan (CAP), in which it set the national aim, called “a realistic objective”, under the UNFCCC to restrict its carbon dioxide (CO₂) emissions growth to 15±3 per cent between 1990 and 2000, and this aim was reiterated in the NC2. In line with the European Community (EC) burden-sharing agreement, Greece made a commitment to restrict the growth of emissions of all six GHGs covered by the Kyoto Protocol to 25 per cent for the first commitment period (2008-2012) compared to 1990 level.

10. The team found the information presented in the NC2 more complete and transparent than that in the CAP, and felt that it reflected adequately the Greek climate change policy. However, while most of the information required by the UNFCCC guidelines is given in the NC2, the presentation of this information did not strictly follow the guidelines. The chapter on financial assistance and technology transfer was missing, for example, and the information on projections was incomplete.

II. INVENTORIES OF ANTHROPOGENIC EMISSIONS AND REMOVALS

11. The GHG inventory presented in the NC2 contains information on the gases having a direct effect, such as CO₂, methane (CH₄) and nitrous oxide (N₂O) and the gases having an indirect effect, or precursors, nitrogen oxides (NO_x), carbon monoxide (CO) and non-methane volatile organic compounds (NMVOCs). Emission estimates covered the period from 1990 to 1995. The NC2 was not accompanied by any document providing the detail required to fully assess the inventory. However, such information was contained in the 1998 annual inventory submission to the UNFCCC secretariat, with emissions for the 1990-1996 period, and in the 1999 draft inventory, with emissions for 1990-1997, provided to the team during the visit and subsequently submitted to the UNFCCC secretariat. The 1998 and 1999 annual inventory submissions, apart from giving new emission estimates for 1996 and 1997, respectively, and updated time-series for the gases included in the NC2, extended the inventory coverage to sulphur dioxide (SO₂), and the new gases, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆). The analysis provided in the current report is based on the 1999 inventory, which contains emission estimates for the years 1990-1997.

12. Since 1995, the NOA has been in charge of compiling the GHG inventory. The responsibility of the Ministry of the Environment has been to coordinate the inventory with other institutions participating in the inter-ministerial committee, which approves the inventory results, and to submit it to the UNFCCC secretariat. All the members of the inter-ministerial committee clearly recognized the essential role of the NOA in compiling the inventory, including collecting data and selecting emission factors, and providing emission estimates. This ensured good cooperation among institutions and resulted in an improved quality of the inventory.

13. To compile the inventory, the NOA employed mainly the “bottom-up” approach of the CORINAIR methodology. To report inventory data, the CORINAIR results were transformed into the formats of the Intergovernmental Panel on Climate Change (IPCC) Revised 1996 Guidelines for National Greenhouse Gas Inventories (the IPCC Guidelines). The inventory information contained in the report is clear and comprehensive. The team noted that, like many other countries, Greece only submitted the IPCC standard reporting tables and worksheet 1.1 on energy, but did not include the IPCC worksheets on agriculture, land-use change and forestry.

14. The main information on energy production and consumption has been provided by the Ministry of Development in its energy balance sheets, published annually, which include data for the previous year. The quality of these data is good, but they do not have the detail required by the CORINAIR “bottom-up” approach. Therefore, these data had to be supplemented by additional information provided by the Ministry of Development (and also forwarded to the International Energy Agency). Further information on activity data is furnished by the Public Power Corporation and the refineries, and a project commissioned by the Ministry of the Environment for the compilation of fuel consumption data for industrial sectors aimed at obtaining higher quality data on the final consumption was launched in 1999. Some problems exist with activity data for industry and agriculture. The 1999 inventory, for example, acknowledges that in 1999 official data for the majority of industrial products for the years 1996 and 1997 were not available, and hence activity data for these products were assumed to be at the same level as in 1995. For agriculture, activity data on livestock populations have been available with a delay of several years and the reorganization of the statistical services during the last three years was mentioned as one of the reasons for such delay.

15. The IPCC Guidelines and the Atmospheric Emission Inventory Guidebook of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) and CORINAIR were the main sources of emission factors and the choice of these factors was dictated by the applicability to the specific practices and climate conditions of Greece. For energy-related activities, CO₂ emissions were estimated using the IPCC emission factors, whereas emission factors from CORINAIR were mainly used for the emission estimates of other gases. The selection of an appropriate CO₂ emission factor for lignite has a strong impact on the national totals and shows significant variations on a yearly basis depending on the heat value of the lignite mined. The team stressed that the figures related to emissions from lignite should be reported in more detail. In very limited instances, country-specific factors came from on-site measurements of specific processes, for example emission factors for SO₂ and NO_x from the PPC and refineries. The team found the quality of both activity data and emission measurements to be good, in particular for the information provided by the PPC, which is a centralized publicly owned company. In the future, with energy market liberalization, more attention will be needed to maintain and improve the quality of these figures.

16. In line with the IPCC guidelines, Greece has used the reference approach to compare the CO₂ emissions from fossil fuel combustion estimated according to the sectoral approach, and the relevant tables were included in the annual inventory. The emission estimates obtained using

each approach have been compared, not only for the whole energy sector, as required by the IPCC, but also for each fuel category, i.e. liquid, solid and gaseous. The differences did not exceed 1.4 per cent, and could be even further reduced if CO₂ emissions are adjusted for transformation losses and statistical difference. Estimates of CO₂ emissions from non-energy uses of fossil fuels have been included in the inventory as a separate item. The team noted that this approach is not in line with the IPCC Guidelines, and could increase the risk of double-counting.

17. As to road transport, the 1999 inventory used new information on the distribution of vehicles by category, together with the detailed version of the COPERT software, as part of the EC CORINAIR project to estimate emissions from this subsector. Since this exercise resulted in a significant improvement in the accuracy of the inventory, the team felt that further efforts should be geared to incorporating in the inventory more detailed annual variations in the composition of the fleet, using, for instance, data from the existing schemes for vehicle inspection if available.

18. The Greek inventory provides estimates of CO₂ emissions associated with international maritime and aviation bunker fuel which, in line with the IPCC Guidelines, were not included in the national totals. The team noted that these estimates seem relatively high, more than 10 per cent higher than the total emissions. Nonetheless, they seem reliable as they draw upon reliable information on activity data, as unlike many other countries fuel consumption for national and international traffic is collected separately in Greece for both maritime and aviation activities.

19. The 1999 inventory contained detailed estimates of emissions from industrial processes. The estimates of emissions from aluminium production were improved as new information became available to allow a split of the total aluminium produced into primary and secondary, with subsequent use of emission factors for PFCs estimate for the primary production provided by the producer. These estimates, however, are only available on a CO₂-equivalent basis, due to their confidential nature. Estimates of the emissions of HFC-23 as a by-product of HCFC-22 production were included in the 1999 inventory. An evaluation of HFC emissions from refrigerators and air-conditioners for 1995 was also provided, but not included in the national totals, as this evaluation was a preliminary one and could have been partial, since it did not consider other important end-uses, such as fire extinguishers, foam blowing and metered propeller inhalers. Since 1999, the NOA has been gathering information on imports of HFCs to estimate the potential emissions of these substances. The preliminary estimates of SF₆ emissions from electrical transmission and distribution equipment included in the 1999 inventory were based on an estimate of the quantity of SF₆ contained in this equipment and corresponding leakages. Emissions were estimated at no more than 10 kg of SF₆ in the last 20 years and hence this figure has not been included in the national totals.

20. The estimates of NMVOC (and CO₂) emissions from solvents were preliminary, as official activity data for the whole sector were only available for the years 1983-1985. A programme to collect and process statistical data on solvent use in Greece was completed on

behalf of the Ministry of the Environment in 1999. Efforts were made, despite the limited amount of data available, to provide estimates for the years 1990-1996, with a detailed split by source activity. The team noted that in refining these figures, new activities such as metal degreasing, chemicals manufacturing and processing, textile and leather production, application of glues and adhesives had been included.

21. Greece did not provide estimates of emissions and removals from the land-use change and forestry sector in the IPCC format. The relevant information provided in the CAP and NC2 was limited to (a) a preliminary evaluation of annual growth in forest biomass stocks over the last five years; (b) annual data from 1980 to 1994 on reforested areas; (c) annual data on biomass harvest for the years 1990-1994; (d) annual data from 1980 to 1994 on areas hit by fires with the associated emissions from 1990 to 1994.

22. Most of the reasons for the difficulties Greece faces in providing annual estimates for the land-use change and forestry sector originate from the availability and quality of the information on land use and land cover, and some of these reasons are common to other countries. For instance, the agricultural statistics, available on a yearly basis, tend to focus on land use, whereas forestry statistics mainly address land cover. Greece has completed only one forest inventory. Even so, the team advocated the assessment of current trends in forested areas. This could be done in a number of ways, including satellite observations, field surveys, and the recording of information on forest fires and reforestation. The new figures on financial support from the EC for reforestation and rational use of farmland made available to the team by the Ministry of Agriculture could also be useful for this purpose. The team also noted that most Annex I Parties combine several options in preparing their forest inventories, only a small number of them relying on a single approach.

23. Estimates of emissions from waste were obtained by the NOA using the IPCC methodology and a set of assumptions, since no system for the monitoring of waste quantity and disposal was in place. Among others, these included an assumption concerning waste composition to select the emission factors for CO₂ from uncontrolled waste burning. Available figures for industrial waste production and disposal and for waste-water treatment were not used as they do not have the necessary detail or quality. To redress the situation, the Ministry of the Environment has launched a study to improve the quality of the information on this sector. As to the coverage of the estimates, the team noted that the emissions of CH₄ from landfilled industrial waste, especially from industries processing agricultural products, should be significant and could be considered along with the CH₄ emissions from industrial waste-water.

24. Assessment of the uncertainties of the emission estimates was not included in the NC2 or in the 1999 inventory. During the team's visit, Greek experts shared their view that estimates of CO₂ were highly reliable, whereas the uncertainty for CH₄ and N₂O could be as high as 50 per cent. The review team learned that studies of inventory uncertainty have already been undertaken and results will be included in the next inventory submission. The issue of confidentiality, and its importance for small countries with a small number of point sources, was often mentioned during the team visit, in order to explain the reason why some emission figures

were included in the national totals only on a CO₂ equivalent basis, and the relevant activity data were not included in the inventory reports.

25. Inventory estimates were always recalculated when a new inventory was prepared. The objective was to apply the IPCC 1996 Guidelines and to incorporate in the inventory new, more detailed and accurate information on activity data and emission factors. For instance, CO₂ emissions for 1990 were estimated at 82,100 Gg in the CAP, 84,575 Gg in the NC2, 85,349 Gg in the 1998 inventory and 84,254 Gg in the 1999 inventory. Also for 1990, CH₄ emissions were estimated at 342.8 Gg in the CAP, 443 Gg in the NC2, 437.1 Gg in the 1998 inventory and 438.5 Gg in the 1999 inventory, and finally N₂O emissions were estimated at 13.67 Gg in the CAP, 17.3 Gg in the NC2, 29.9 Gg in the 1998 inventory and 30.5 Gg in the 1999 inventory.

26. In each inventory, Greece provided a consistent time-series by recalculating the emissions estimates for all the years of the period covered. The main changes in methodology, emission factors and activity data were well documented. For example, the differences between the emission estimates in the 1999 inventory and the 1998 inventory resulted mainly from the use of new road vehicle data, new detailed fuel-use data for the years 1995-1996, updated activity data for industrial processes for 1994 and 1995 and new provisional industrial production data for 1996-1997.

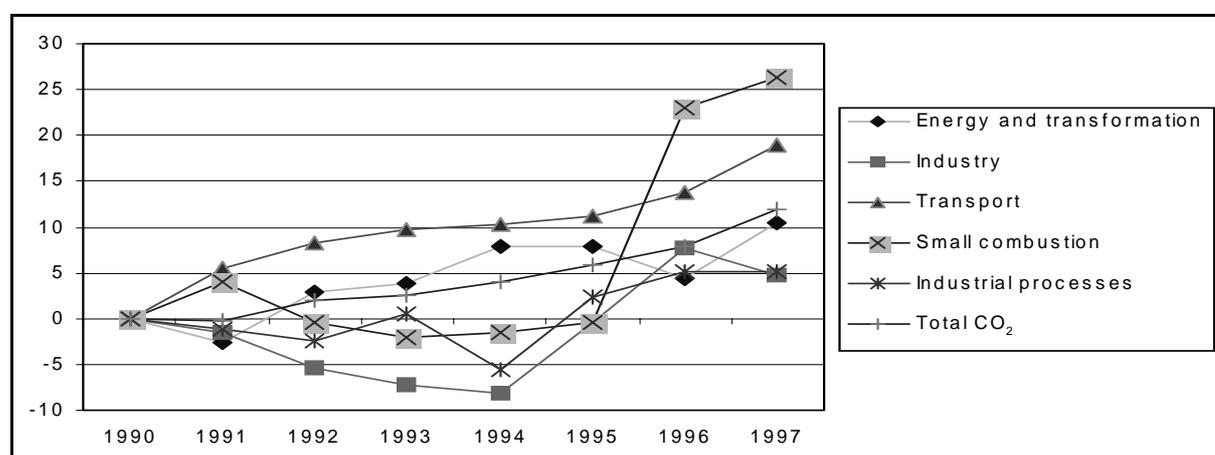
27. Analysis of GHG emissions for the period 1990-1997 indicates that while the total emissions, expressed on a CO₂ equivalent basis using their global warming potential values, increased by 12 per cent from 105,208 Gg to 118,729 Gg, the GHG emission pattern changed only slightly. Hence, CO₂ remained the most important gas with a share of total emissions of 81.0 per cent in 1990 and 80.4 per cent in 1997. N₂O and CH₄ had almost equal shares of the total emissions: N₂O accounted for 9.0 per cent in 1990 and 8.1 per cent in 1997, and CH₄ accounted for 8.8 per cent in 1990 and 8.2 per cent in 1997. Finally, the new gases (HFCs, PFCs, SF₆) made up the remaining 1.2 per cent in 1990 and 3.4 per cent in 1997.

28. The energy transformation industry, including electricity generation, was the major source of CO₂ emissions, accounting for around 51 per cent of total CO₂ emissions in 1997. Other significant contributions to the CO₂ emission level came from manufacturing industries and construction, transport, small combustion processes and industrial processes (cement and lime production). In 1997, oil products accounted for about 48 per cent of the total Greek energy-related CO₂ emissions, coal, including lignite, for 51 per cent and natural gas for only 1 per cent. Between 1990 and 1997, CO₂ emissions increased by 12.9 per cent, mainly as a result of the increase from small combustion processes, transport and energy industries, especially from the use of lignite for electricity generation.

Table 1. Carbon dioxide emissions, by source, 1990-1997 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997
Energy and transformation	43 658	42 526	44 902	45 320	47 111	47 107	45 533	48 252
Industry	9 820	9 679	9 294	9 101	9 027	9 781	10 583	10 295
Transport	15 188	16 024	16 450	16 651	16 756	16 879	17 279	18 051
Small combustion	8 168	8 499	8 139	8 002	8 046	8 132	10 039	10 316
Industrial processes	7 691	7 598	7 507	7 732	7 260	7 868	8 086	8 078
Other	729	695	661	577	477	482	382	418
Total	85 254	85 021	86 953	87 384	88 677	90 250	91 902	95 410

Note: Other includes emissions from fuel used for non-energy purposes, fugitive emissions and solvents.

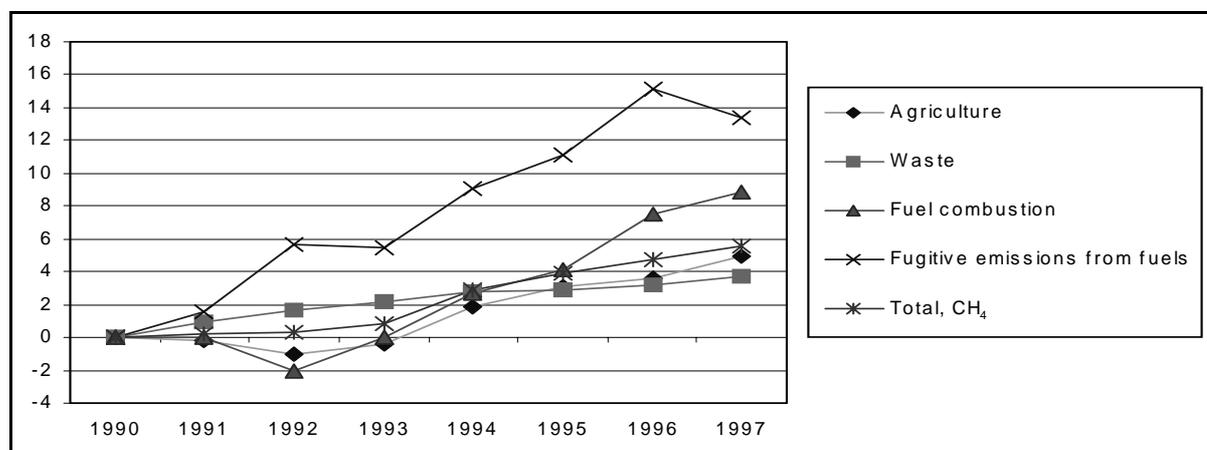
Figure I. Carbon dioxide emissions, percentage change from 1990, by source

29. The agricultural sector with two main sources, enteric fermentation in livestock and manure management, has been the largest anthropogenic source of CH₄ emissions in Greece, accounting for approximately 61 per cent of total CH₄ emissions in 1997. Landfills and waste-water treatment are the second largest anthropogenic sources of methane emissions, accounting for approximately 25 per cent of total Greek emissions. Fuel combustion, coal mining and the production and processing of natural gas and oil made up the remaining 14 per cent. CH₄ emissions in 1997 were 5.6 per cent higher than in 1990, coal mining being the fastest growing source of emissions.

Table 2. Methane emissions, by source, 1990-1997 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997
Agriculture	270.6	269.9	267.8	269.5	275.7	279.0	280.3	283.9
Waste	109.0	110.0	110.8	111.4	112.0	112.2	112.5	113.0
Fuel combustion	14.7	14.7	14.4	14.7	15.1	15.3	15.8	16
Fugitive emissions from fuels	44.2	44.9	46.97	46.6	48.2	49.1	50.9	50.1
Total	438.5	439.5	439.8	442.2	451.0	455.6	459.5	462.9

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

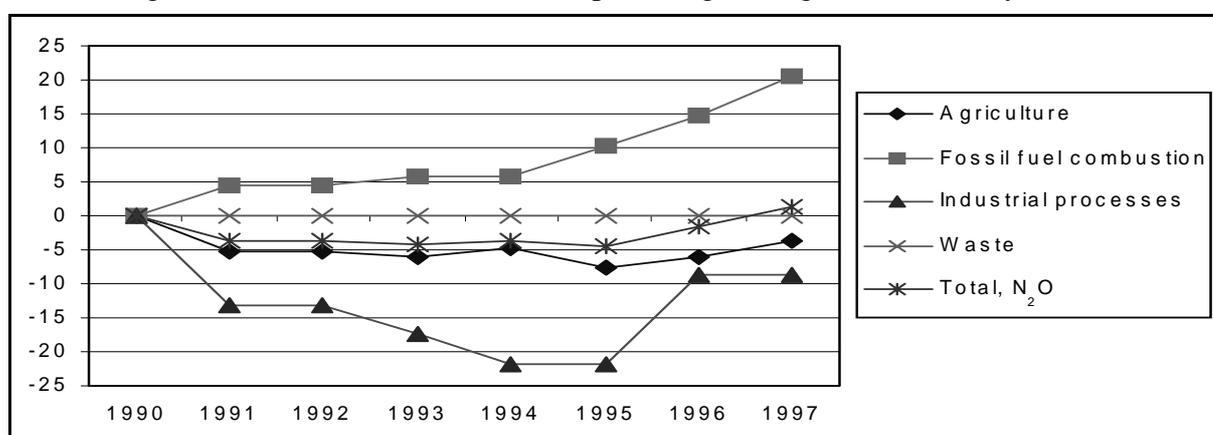


30. The major sources of N₂O emissions in Greece are fertilizer use, agricultural soils, fossil fuel combustion and industrial processes. Among these sources agricultural soils and fertilizer use accounted for 69 per cent of total emissions in 1990 and 66 per cent in 1997. The slight increase in N₂O emissions from 1990 to 1997 was driven by two opposite trends, namely, an increase in emissions from the energy sector and some decrease in emissions from nitric acid production and agricultural soils.

Table 3. Nitrous oxide emissions, by source, 1990-1997 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997
Agriculture	21.2	21.1	20.1	19.9	20.2	19.6	19.9	20.4
Fossil fuel combustion	6.8	7.2	7.1	7.2	7.2	7.5	7.8	8.2
Industrial processes	2.3	1.9	2.0	1.9	1.8	1.8	2.1	2.1
Waste	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Total	30.6	30.5	29.4	29.2	29.6	29.2	30.0	31.0

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



III. POLICIES AND MEASURES

31. The Greek NC2 contains an overview of policies and measures concerning CO₂ emissions and sinks in the energy, transport, agriculture and forestry sectors, including estimates of expected emission reductions and progress in implementation. Limited detail on these measures was provided in the NC2, although considerable further information was provided to the review team. Information in the NC2 on measures relating to non-CO₂ gases was also very limited and no measures were reported in the industrial process and waste sectors.

32. The focus of Greek climate change policy is the energy sector, including transport, as this sector accounts for almost 90 per cent of the national emissions. As a bit more than 60 per cent of energy supply comes from imports, energy security and diversity are important elements of Greek energy policy, influencing fuel mix choices and the level of emissions. In terms of policy instruments used, there is a heavy reliance on subsidy programmes, many funded through the EC Community Support Framework (CSF). Government officials expressed the view that subsidies were needed to achieve the high level of investment required to obtain emission savings. The review team found the CSF-supported subsidy programmes a key response measure. It noted that continuing reliance on EC subsidy programmes as the centrepiece of climate change response policies may inhibit development of an effective long-term response strategy.

33. Though there is a policy in place of differentiated taxation on mineral oils and exemptions on renewable energy sources, like biofuels, and natural gas from excise duty when it is not used as a propellant, in pursuit of environmental objectives, the Government does not in general consider the use of taxes on fuels and energy as a viable tool to control GHG emissions in Greece. This is due to concerns about loss of competitiveness and increases in inflation, which would prevent Greece from meeting the convergence criteria for the European Monetary Union. Greek officials also pointed out that price increases in the transport sector had failed to achieve behavioural change in the past, although the limits of available public transport infrastructure suggest that there were few attractive alternatives to cars.

34. As of 1999, many measures were at early stages of implementation and very limited evaluation of their effectiveness was available. Information on the evaluation of the current status of implementation of measures and an assessment of anticipated CO₂ savings in 2000 was provided to the team during the visit. Nonetheless, there is no set process for systematic review of policies and measures, except in the context of preparation of the CAP and NC2, and the plans laid down in the CAP to set up an expert action team for systematic monitoring of implementation have not materialized. The team noted that more regular and systematic evaluation and coordination of policies could assist future response strategies.

A. Carbon dioxide

35. The CAP, and consequently the NC2, focused almost entirely on the energy sector. Action in this sector is outlined in the following framework documents: Operational Plan for Energy (OPE), Law 2601/98, Energy 2001 package and Law 2244/94.

36. The OPE for the period from 1994 to 1999 included grants for power station construction, energy efficiency, fuel switching, combined heat and power (CHP) and renewables. As it expired in 1999, a new OPE was expected as part of the third CSF for the period 2000-2006. In 1999, the Ministry of Development prepared a development plan for submission to the EU. In this plan, environmental protection ranks third among the six OPE objectives and it includes a self-monitoring programme. While arrangements exist to assess the effect of action taken under the OPE, this information was not available to the review team.

37. Law 2601/98, which replaced the previous Law 1892/90, provides for subsidies for investment in equipment by industry, with components for energy efficiency and renewable energy. Some tax exemptions (up to 100 per cent) and long-term loans are available, with specific assessment criteria including environment, atmospheric protection and energy savings. Provisions for third party financing are also included. The change from Law 1892/90 to 2601/98 decreased the maximum levels of funding granted to private investors. Total funding also fell from Dr 160 billion (492 million euros) per year to Dr 100 billion (308 million euros) per year.¹ Under law 1892/90, approximately 35 per cent of the planned investments were realized.

38. Law 2244/94 covers the conditions under which renewable energy generators can have access to the electricity grid. It covers issues such as buyback rates, use of the grid for transmission, length of contracts, and administrative costs and procedures. The provisions of this law are more generous to renewable energy providers than previous arrangements.

39. Energy 2001 is a package of measures to reduce energy use in buildings, including public buildings, and is discussed further below. A range of other operational plans, including those for industry, environment, regional development, research and technological development, have programmes related to climate change. State-owned electricity and gas utilities also play important roles in implementing mitigation measures.

1. Energy supply and transformation

40. The Public Power Corporation, a state-owned company, controls electricity production, transmission and distribution in Greece. Electricity use grew at an average rate of 3.7 per cent per year from 1992 to 1997 and this strong growth is projected to continue over the next decade. This is largely due to growing demand in the services sector and households. Increased use of air conditioning recently became an important driver; in the last two years, peak demand has switched from winter to summer. At the time of the review team visit, the Greek electricity system worked in parallel with the systems of neighbouring Balkan countries and was expected to rejoin the European electricity network once the lines through former Yugoslavia are rebuilt.

41. The PPC provides an effective subsidy to electricity prices through the very low rate of return on capital investment (about 2 per cent in 1997). There are also cross-subsidies from the

¹ In 1999, the exchange rate was around Dr 325 to the euro and around Dr 305 to US\$.

mainland to the islands due to requirements for equal tariffs despite the higher cost of electricity supply to the islands. However, Greek electricity prices are at about the EC average, on a purchasing power parity basis, for both residential and industrial consumers. The PPC does not use integrated resource planning as a framework for investment decisions, despite its position as an integrated company.

42. Law 2773/99, on liberalization of the electricity market, entered into force at the end of 1999. It called for third party access to the mainland grid and tendering for production on the non-interconnected Greek islands. The law also called for creation of a market regulator and transmission network operator, who in turn will develop a grid code covering third party access, and a power exchange code determining dispatch and settlement rules. The PPC was expected to remain owner of generation, transmission and distribution assets, but these operations will have separate accounting. Competition was envisaged to be set at the minimum levels required by the EC directive on the electricity market. The new legislation would allow for public service obligations for operators, including environmental protection.

43. In September 1996, a new pipeline carrying natural gas from the Russian Federation through Bulgaria to Greece was commissioned. This was the first significant supply of natural gas in Greece. Sales rose to 800 million Nm³ in 1998, 62 per cent of which was sold to the PPC for power production. It is likely that in the future electricity generation will remain the largest single user of natural gas. Two former oil-fired power plants have been converted to natural gas, two new combined cycle stations were completed in 1998 and 1999, and another under construction was expected to be commissioned in 2001. In 1999, the combined capacity of the natural gas power stations completed or under construction amounted to around 15 per cent of total installed capacity. The state-owned Public Gas Corporation has been in charge of developing the natural gas system. As of 1999, around 30 companies distributed natural gas and 15 more had signed contracts. The high-pressure transmission system and medium-pressure systems in major cities and industrial zones are almost complete. In major cities, 1,500 km of low-pressure distribution pipes are in place and bids are being prepared to expand this network, which is planned to eventually reach 6,500 km. Sales to the domestic and commercial sectors have been minimal to date, and penetration in this sector will present commercial challenges. Work is also nearing completion on a liquefied natural gas terminal to allow imports from Algeria.

44. The OPE provided funding of 273 million euros to support construction of the largest of the operating natural gas power stations. However, it also provided funding of 280 million euros for construction of a lignite powered station, so the overall GHG impact of the electricity production part of the programme is hard to determine. Greater penetration of gas is clearly central to Greece's GHG policy and the review team was informed that plans for a future lignite power station were cancelled due to climate change concerns.

45. Other activities of the PPC have also contributed to GHG mitigation. For example, it has completed a programme to replace distribution transformers, entailing savings of 70 GWh per year, and efficiency improvements in lignite power stations have been initiated. District heating

plants have been installed at Agios Demetrios and Ptolemais and construction is under way in Amintaio. These plants, however, have relatively low heat output compared to electricity output, as total heat demand is low. Still, it remained unclear whether the potential for CHP in larger urban areas has been fully explored. All of these improvements are expected to yield savings of 226 Gg CO₂ by 2000, about 60 per cent of the savings anticipated in the NC2, and less than 0.5 per cent of total emissions from electricity and heat production.

46. Despite considerable support for renewable energy, its share in TPES has remained relatively stable over the last decade, fluctuating around 5 per cent. The bulk of renewable energy comes from biomass, 66.5 per cent, and large hydro, 23.5 per cent. In 1999, the Government no longer expected to reach the target set in the CAP of 10 per cent of energy from renewables by 2000. Instead, it anticipated reaching a figure of 6 per cent from renewables by 2000 and around 8 per cent by 2010. Moreover, Law 2601/98 in conjunction with the OPE was expected to give added impetus to the development of new renewable capacity by providing a subsidy of up to 60 per cent of the necessary investments.

47. In July 1998, buyback rates for independent generation from renewable energy sources and CHP were raised, due to an increase in PPC tariffs. For renewables, they were raised to Dr 18-24 per kWh, which corresponds to 70-90 per cent of the relevant PPC tariff, established by Law 2244/94. For CHP, it rose to Dr 16 per kWh, which corresponds to 60 per cent of the relevant PPC tariff. The PPC is directly involved in the development of a number of renewable energy sources, especially small hydro projects, of which seven with a total capacity of 318 MW were under construction, and wind energy projects.

48. Under the OPE, 124 renewable energy projects received grant funding of up to 55 per cent of project cost. These are spread across wind (19 projects, 131 MW), small hydro (32 projects, 72 MW), solar (55 projects), geothermal (1 project), biomass and district heating. Total OPE funding for these projects amounts to 151 million euros. The review team was informed that the original funding for renewable energy projects had to be increased, due to the high number and good quality of applications received for these grants. Another 55 renewable energy projects were funded through Law 1892/90 and other programmes. These included wind (28 projects, 142 MW), small hydro (15 projects, 10.7 MW), and biomass (11 projects).

49. Many of the projects will need to seek licences under the procedures set up by Law 2244/94. To date, only 10 of 68 projects approved under different schemes have been granted operating licences, which reflects slow approval procedures. The team noted that, given the strong interest in renewable energy, attempts to improve these procedures could be a cost-effective approach to promoting renewables and hence to reducing CO₂ emissions.

50. With regard to geothermal energy, studies have been completed on the most promising high enthalpy fields and a project on the island of Lesbos is being considered. This follows a previous trial where failure to control odours from the geothermal site led to local community opposition. Electricity produced from low enthalpy geothermal energy amounts to 97 Mwh

annually, which represents only about 4 per cent of the estimated economically recoverable potential.

2. Industry

51. The main component of GHG mitigation measures in the industrial sector is some pilot studies under way in selected industries, co-funded by the EC through the programme called Specific Actions for Vigorous Energy Efficiency (SAVE). Additionally, Dr 900 million (2.7 million euros) are being spent under the Operational Plan for Industry on 100 projects to promote the uptake of new standards (ISO 14001 and Eco Management and Audit Scheme) and Dr 50 million (0.15 million euros) on eco-labelling. There are also programmes to promote a general improvement in industrial infrastructure and quality management which are likely to have benefits for energy efficiency. There is no system of voluntary agreements in Greece between Government and industry to control energy use and GHG emissions, nor does there appear to be any comprehensive programme on emissions associated with energy use in industry.

52. Under the OPE, grants are available to help finance investments by industry in energy efficiency, CHP or fuel switching to natural gas or liquefied petroleum gas (LPG). Grants can cover up to 50 per cent of cost for energy conservation, 35 per cent for CHP or 40 per cent for fuel substitution. Dr 68 billion (209 million euros) of grants were approved under this programme, with Dr 44 billion (136 million euros, about 65 per cent of the total) going to energy efficiency, Dr 20 billion (62 million euros, 30 per cent) to CHP, and Dr 4 billion (12 million euros, 5 per cent) to fuel switching projects. The effects of these grants have not yet been assessed, but the objective of the programme is a 4.3 per cent improvement in industrial energy efficiency. An amount of 49 million euros has also been allocated under the OPE for projects of small and medium-sized enterprises. No evaluation is available, but an objective of 2.2 per cent energy savings in the tertiary sector has been set.

53. Under Law 1892/90, the expansion of CHP in one of Greece's four petroleum refineries has been completed. Furthermore, 10 projects on fuel switching, exhaust gas use and energy efficiency have been completed and five more are in progress.

54. Government data on energy consumption in specific industries are generally lacking or confidential, so the emission savings from measures addressing industrial energy use could not be estimated. A one-year study commenced in April 1999 will include detailed on-site surveys of industrial and commercial energy use. However, the review team felt that more coordinated attention to this sector, especially in terms of energy efficiency, was warranted.

3. Residential, commercial and public sectors

55. On energy labelling of household appliances, the EU directives on electric refrigerators and freezers, washing machines and driers were integrated into Greek legislation (Presidential Decree (PD) 180/94 and Joint Ministerial Decisions (JMD) 26810/94 and 3971/96). On energy efficiency standards, the EU directive on non-industrial boilers was also integrated into Greek

legislation (PD 335/93). In 1998, JMD 21475/4707/98, brought Greece into compliance with the EU directive on limiting carbon dioxide emissions by improving energy efficiency, which launched the SAVE programme. The same decision announced the Energy 2001 programme, an ambitious package of policies aimed at energy use in buildings. A number of energy conservation projects approved under the OPE are expected to result in a 2.2 per cent annual energy saving in this sector when finalized.

56. The Energy 2001 programme envisages energy efficiency standards for new buildings, which will be consistent with those for northern European countries. As of 2000, new buildings and, as of 2004, all buildings, including existing buildings, will be required to have an energy identity card, stating the energy performance of the building based on an energy audit. Tax incentives and third party finance will be available to support the introduction of the new standards by encouraging investments in energy efficiency, renewable energy and natural gas, with the maximum amount available determined by which of three climate zones the building is located in. There will also be demonstration projects, awards, competitions and penalties for construction companies which fail to meet the approved standards. There is also a component of the programme dealing with public buildings, many of which are among the most energy-intensive, especially hospitals. It envisages that all public buildings will have an energy officer to deal with energy management and most of these managers have already been identified. The review team felt that the Energy 2001 programme offered a more integrated approach in the building sector than in some others, but also a challenge for effective implementation.

4. Transport

57. In the transport sector, measures reported in the NC2 centred on vehicle efficiency, improvements in transportation infrastructure and its management, and modernization of public transport. During the visit the team was provided with information on fiscal measures, including a range of differential taxes on motor fuels, designed to support air quality objectives, including reductions in lead content.

58. A revised set of sales taxes on vehicles which passed into law in 1999 (Law 2682/1999) sets increasing sales taxes in proportion to engine capacity, as well as higher rates for vehicles lacking pollution control equipment. Rates for passenger cars range from 0 for hybrid electric vehicles to 560 per cent of the wholesale price for large vehicles without catalytic converters. The ranges for cars with pollution control technology are much smaller. Motorcycles, which are a rapidly increasing portion of the Greek vehicle fleet, are also included under this measure.

59. Tax incentives to replace old vehicles with new were introduced in 1990 but suspended shortly thereafter for budgetary reasons. About 380,000 old cars were removed during the two years of operation of this scheme, with benefits of up to Dr 1 million (3,000 euros) for a buyer of a new car replacing an old one, depending on the engine capacity. The measure was financed by the state budget. Consideration is being given to restarting this scheme.

60. As to motor fuels, natural gas for vehicles does not receive preferential tax treatment but is taxed at the LPG rate, in accordance with EC directives. Around Dr 30 billion (92 million euros) per year, equal to 5-7 per cent of the total revenue collected from motor fuel taxation (Dr 0.05 (0.015 euros) per litre), is channelled to the Ministry of the Environment for environmental purposes.

61. In terms of transport infrastructure, the second line of the Athens metro has been completed and another line is under construction with a forecast completion date in 2001. The railway network has been modernized, with the doubling of the existing single-track line and electrification of the Patra-Athens-Thessaloniki-Yugoslav border line. There have also been upgrades of inter-urban roads. Government officials noted that the overall GHG impact of these road projects was uncertain and could well be to increase emissions. Therefore, estimates of the impact of transport projects were not available. A decision has been made to provide the Athens public transport network with 130 natural gas fuelled buses and to construct a refuelling facility for compressed natural gas, but no details of implementation were available.

62. A number of traffic restrictions remain in place, which limit access to inner areas of some cities, especially Athens. However, there appears to be little evidence that the range of measures to control traffic growth are having a major impact, similar to the situation in many other countries. It also does not appear that climate change is a major policy concern in transport policy. Given the importance of transport to national emissions, and its expected rapid growth, this sector may require further policy attention.

5. Land-use change and forestry

63. In the forest sector, the CAP set a target to increase the rate of reforestation from 4,000 ha per year to 8,000 ha per year by 2000, which was reiterated in the NC2. However, little progress has been made on this goal as reforestation levels have remained at 4,000 ha per year, almost ten times less than the area destroyed by forest fires annually. The main reason for this appears to be budgetary, as only around 8 million euros is spent yearly on reforestation.

64. Little progress was made to control forest fires, which remained a significant problem for Greece, with an average of 47,000 ha per year being destroyed by fire from 1991 to 1997. The rate of construction of low dams to control soil erosion in mountainous areas remained constant and there was a large increase in construction of "log-dams", the efficacy of which has not yet been fully tested. Erosion on steeply sloping agricultural lands has not been extensively addressed. Organic farming on 20,000 ha takes place in Greece, supported by 5 million euros over the period 1996-1998. Another 20,000 ha have been set aside under EC regulation 2078/92, at a cost of 15 million euros.

65. Government officials indicated that the original CAP estimates of emission savings in this sector are unlikely to be achieved. Some measures had not progressed, including support for utilization of agricultural by-products (mostly straw), which accounted for 75 per cent of the original estimates of total savings from the sector. This measure is to be included in the next

regional development plan for the years 2000-2006. Lack of regular forest inventories precludes adequate assessment of land cover issues. A study on the role of forests and agriculture in the CO₂ balance is to be commenced following completion of the IPCC special report on land-use change and forestry. Overall, the review team felt that there was limited assessment of the full potential for emission reductions in this sector, and not enough priority given to implementation.

B. Methane

66. For waste management, Joint Ministerial Decision 69728/824/96 sets out relevant policies. To implement this decision, two subsequent decisions were taken: JMD 113944/1016/97, which sets out policy priorities related to waste reduction, recycling, reuse and improved technology for waste management (National Plan for Waste Management) and JMD 114218/97, which sets out the relevant guidelines and programmes for solid waste management. In 1998, a Law for Alternative Management of Solid Waste was adopted, which also incorporated the EU directive on the management of packaging material into the national legislation. This law sets targets for the utilization and recycling of solid waste for 2001 and 2004, but was not implemented as of 2000. A plan to implement these targets is being developed, which will include information campaigns, creation of a national organization for the alternative management of packaging material, guidelines for operation of waste management systems, subsidies for recyclers and participants in recycling schemes and penalties for non-compliance with legislation. Reduction of GHG emissions is not recognized as an objective in waste management policy, although the recovery of energy and materials is mentioned. Recycling rates for paper, glass and aluminium cans increased somewhat from 1989 to 1997, with the rate for paper rising from 24 per cent to 28 per cent, for glass from 19 per cent to 28 per cent and for aluminium cans from 22 per cent to 35 per cent. Recovery rates for paper and glass both fell from 1994 to 1997, while the rate for aluminium cans remained steady.

67. In implementing the policy for alternative management of solid waste, a composting unit in Kalamata has been completed and another composting unit is under construction in Attika (Athens region) which will treat the organic portion of municipal solid waste as well as 45,000 tons of sewage sludge per year. Four biogas projects have been granted an operating licence under Law 2244/94. The recent changes to the sub-national administrative structure should assist improvements in waste management. In particular, amalgamations would lead to a greater number of regions being able to support more advanced waste treatment technology. The review team noted that more attention to the potential for reducing methane emissions, especially in relation to waste management, could help to reduce emissions. It also noted that neither reduction of the organic material landfilled nor methane recovery from landfill were elements of the national plan on solid waste management.

C. Nitrous oxide

68. Programmes have been initiated to reduce the use of nitrate fertilizers in four major agricultural areas of Greece in implementing the EC directive on the protection of waters against pollution caused by nitrates from agricultural sources, which will have an impact on N₂O

emissions. In addition, compensation was already provided to farmers for loss of income from 11,500 ha of cotton farms in Thessaly resulting from reduced nitrate fertilizer use, at a total cost of 12 million euros over the 1996-1998 period. There are no measures in Greece to reduce the level of N₂O emissions from industrial processes.

D. New gases

69. New gases make up a small portion of Greece's emissions. Greece produced 131,000 tonnes of aluminium in 1997, accounting for 6 per cent of European production. Associated PFC emissions fell from around 355 Gg of CO₂ equivalent in 1990 to around 60 Gg in 1997. This was due to improvement in the efficiency of aluminium production processes by reducing anode effects and some reductions in output.

70. Emissions of SF₆ are not recorded in Greece. Over the last 20 years, of the 14 tonnes of SF₆ used in electrical equipment, only 10 kg have had to be replaced due to leakages. Between 2010 and 2020 the first-generation switches containing SF₆ will be removed. No measures have been considered for capture and recycling of these gases.

71. The release of HFC-23 into the atmosphere from HCFC-22 production will be cut by 65 per cent by 2010, as the production of these substances will be steadily reduced according to the objectives defined under the Montreal Protocol and relevant EC regulations. Further reductions could be obtained through the installation of ad hoc abatement systems. As concerns other end-uses of the new gases, CO₂ is already replacing HCFC-22 as a foam-blowing agent, and therefore this use of HFCs is not expected to increase. The replacement of HFCs in metered propellant inhalers, mainly used by asthma patients, could be considered, but since pharmaceuticals are not manufactured in Greece, the possible action would need to be coordinated internationally.

72. Government officials acknowledged that addressing the growth in new gases, especially HFCs for air conditioning, would be a key element of a plan to reach Greece's Kyoto Protocol target. Initial negotiations have taken place between industry and the Greek Government to establish voluntary agreements for the control of HFCs, PFCs and SF₆. Further development of measures will be required to achieve such control.

IV. PROJECTIONS AND ESTIMATES OF THE EFFECTS OF MEASURES

73. The projection section of the NC2 contains two sets of projections of energy-related CO₂ emissions: short-term projections for each year by 2000, which represent a subset of projections reported in the CAP, and long-term projections for 2000, 2005 and 2010. No estimates were given for the future trends of CH₄, N₂O, precursors, new gases, emissions associated with bunker fuel and sinks. The team noted that different baseline emission values, different emission factors, especially for lignite, and different energy statistics were used for the GHG inventory and projections. Furthermore, the presentation of information on projections did not conform with the guidelines, which requested data associated with projections to be

presented by gas and by sector, and information on methodology used and key assumptions was limited. In this sense, the information on projections was not fully transparent.

74. During the meetings, however, the team was provided with additional information, which threw light on the approach underlying projections and the results obtained. The team was also provided with two sets of new projections, prepared to estimate the policy implications of commitments under the Kyoto Protocol. The first set of projections was prepared by the NOA in cooperation with the PPC and PGC at the beginning of 1998 and included all direct GHGs and the new gases. The second set was prepared by the Technical University of Athens at the end of 1998 and covered projections of energy-related CO₂ emissions.

75. Five scenarios were reported in the NC2 as long-term projections of CO₂ emissions, all of them using 1990 as the base year. The first three scenarios, prepared by the Technical University of Athens were the *conventional wisdom* (CW) scenario, which included all mitigation measures in both energy demand and supply envisaged in the CAP, the *forum scenario* (FO), which assumes success in pursuing sustainable development policies, i.e. a portfolio of policies designed to achieve high economic growth without jeopardizing environmental quality, and the *business-as-usual scenario* (BAU), which was obtained from the CW scenario by removing the effect of measures evaluated outside the model. The fourth scenario, *current trends* (CT), was based on the energy projections of the Ministry of Development and financial data from the Ministry of National Economy for assessment of the impact of the sectoral policies and was submitted also to the International Energy Agency. Finally, the *effects of the community support framework* (ECSF) scenario was designed by the NOA in cooperation with the Athens University of Economics and Business, with the goal of estimating the implications for the economy and emissions of the OPE implemented in the framework of the second CSF for Greece.

76. The methodological approach to projecting the future emission trend in the NC2 chiefly showed continuity with the approach adopted in the CAP. For the first three scenarios (CW, FO and BAU) an improved version of the same MIDAS model applied in the CAP, combining demand side econometric modelling and supply side technology oriented modelling, was used. The model was developed in Greece under an EC project and its credibility was proven through its wide use for policy-making purposes in Greece and in the EC from 1980 onwards. Some difficulties in simulating the effects of energy market liberalization constitute a specific limitation to the model. The CT scenario was produced by extrapolation in the future of the current trends of economic development, energy demand and CO₂ emission level, while the main assumption behind the ECSF scenario was that the CSF will bring higher economic growth compared to the BAU, with associated energy and emission growth. The team noted that the use of different methodological approaches for projections is a useful exercise, which ensures that the results obtained fall within a certain range, and can be considered reliable. On the other hand, the use of a different set of assumptions for different scenarios produced by using different methods does not allow for direct comparison of results, and in particular for estimation of the effects of individual measures, or groups of measures.

77. The same assumption regarding population growth was used consistently for all five scenarios, while oil prices were assumed to be in the range of US\$ 16-23 per bbl in 2000 and in the range of US\$ 16-35 per bbl in 2010. Interestingly, oil prices were assumed to be higher in the baseline scenario than in the other four scenarios, although energy prices do not seem to have much impact on demand and consumer behaviour and, consequently, on emissions, as the team was told that the energy price elasticity of demand is very low. The baseline assumption on economic and GDP growth was revised slightly downwards between the CAP (2.1-2.6 per cent) and the NC2 (1-1.7 per cent), with a few exceptions (CT 3.3 per cent), with a view to reflecting the actual development trend in the years preceding preparation of the NC2. It is worth mentioning that the underlying assumption in the ECSF scenario was that the EC support will strengthen the economy and will bring about a higher GDP growth rate with associated higher energy demand and CO₂ emission level compared to the BAU.

78. The BAU projected the CO₂ emissions in 2000 to be 22 per cent higher than in 1990, while according to the CW scenario the increase will be only 12 per cent, which is in line with the national target of 15 per cent (± 3 per cent). The emission level projected in the CT scenario is situated in between the levels given by the former two scenarios. In the longer term, in 2010 compared to 1990, emissions are expected to be 43 per cent higher in the BAU scenario, 23 per cent higher in the CW scenario and a few per cent higher in the CT scenario, than in 1990. The emission trend of the ECSF scenario is consistently higher than in the other scenarios, due to the estimated positive impact of the CSF on the economy.

79. Broadly, some of the CAP projections, reiterated in the NC2 as short-term projections, were prepared by using in addition to the MIDAS model an engineering project-oriented bottom-up approach to estimate the effect of policies and measures, which the Greek experts felt helped to avoid some uncertainties compared to the other approaches and enables monitoring of implementation. According to these projections, emissions of CO₂ were anticipated to increase by 27 per cent in 2000 compared to 1990 for the business-as-usual scenario, which corresponded to an increase of 22,000 Gg CO₂. The CO₂ saving potential of the measures envisaged in the CAP was estimated at 13,400 Gg CO₂ and, under an expert assumption that around 70 per cent of the measures were likely to be successfully implemented, a saving of 9,600 Gg was estimated to be a realistic figure. This in turn implied that the emissions would increase by 15 per cent, or by 12,400 Gg CO₂ in the "with measures" scenario, which is in line with the national aim.

80. A comparison of the emission levels projected for 2000 in the short-term and long-term projections of the BAU scenario shows a level around two times lower in the case of the long-term projections due to the assumption of a lower rate of GDP growth. For the same year 2000, the "with measures" scenario of the short-term projections envisaged a 15 per cent growth in emissions, which lies between the FO and ECSF figures.

81. The effect of individual policies and measures of the CAP for 2000 was re-evaluated in 1998 in view of the actual implementation registered. These results need to be interpreted cautiously, as in some cases there was no clear link between the level of implementation of the project and the emission savings. This was especially true for the estimates in the transport,

residential and commercial sectors, which were considered highly uncertain. The new figure for the total CO₂ saved in 2000 was 7,253 Gg, which is 25 per cent less than the original CAP estimates. Overall, CO₂ savings from natural gas penetration were revised downward by 12 per cent, and savings from measures in the PPC were downscaled by 39 per cent, which was partly offset by a 15 per cent increase in the CO₂ saved from renewable energy.

82. No sensitivity analysis as such was performed to assess the effect on the emission trend of changes in the key assumptions. However, some ideas of the order of magnitude of the impact of these assumptions could be gained from the number of scenarios presented in the NC2 and from the analysis of historical trends of economic growth, energy prices and energy consumption.

83. The first set of three post-Kyoto (i.e. subsequent to the Kyoto session of the Conference of the Parties to the UNFCCC) scenarios projecting future emission trends of the three GHGs and the new gases was designed to facilitate the decision-making process and assess the maximal effect on emissions of different policy options. The modelling approach combined expert estimates and detailed energy supply modelling done by the PPC and PGC (maximum gas scenario). The reference scenario assumed the growth rate of electricity demand to be at the level of 3.5 per cent annually in line with historical figures and the degree of penetration of natural gas within the limits of the current contracts. In contrast, the low demand scenario assumed increased penetration of natural gas in the end-use sectors to the economically feasible level, increased share of renewables and a proactive policy to improve energy efficiency in the energy end-use sectors, which in turn was reflected in a lower value of the assumed electricity demand growth of 2.5 per cent annually. In the scenario with an increased penetration of natural gas, only one coal-fired power plant and one gas-fired power plant were assumed to be built to meet the demand growth, instead of two coal-fired power plants as was the case in the former two scenarios. Results obtained in the reference scenario indicate a possible growth of the total emissions of all six gases of 47.5 per cent between 1990 and 2010, compared to the low demand scenario, 35 per cent and the increased penetration of natural gas scenario 29 per cent. This last figure is about 4 per cent higher than the 25 per cent growth target, indicating the necessity of new measures to meet the commitments under the Kyoto Protocol.

84. Finally, the second set of post-Kyoto projections, which are the most recent ones, was developed using a new methodological approach, resulting from an endeavour to improve the MIDAS model. The new approach consists of consecutive use of three different models: (1) GEM3, an equilibrium macroeconomic model, (2) PRIME, a core model consisting of an elaborated energy demand and supply model, which is linked to an extensive database with technical, economic and environmental parameters of the currently available and future energy technology alternatives, and (3) BOLPS, a market-oriented model providing estimates of world energy prices. An advanced feature of the new approach is the detailed modelling of energy end-use technologies and the ability to simulate the impact of energy market liberalization.

85. Only one scenario was prepared using the new modelling approach, which encompasses the effect of all the climate-related political decisions taken by 1999. As this scenario was devised to facilitate decision-making on the Kyoto Protocol, it was considered as a reference

scenario. However, to the extent that it included the effect of all the implemented policies, in terms of the UNFCCC guidelines this scenario could be considered as the most recent “with measures” scenario. The underlying assumptions used in the model were broadly the same as those used in the previous projections.

86. According to the most recent projections, CO₂ emissions in 2000 are expected to be about 25 per cent higher than in 1990, i.e. close to the CAP BAU scenario, and in 2010 to be already 54 per cent higher. The main driver of this growth is the expected increase in fuel and electricity consumption, mainly in the transportation and service sectors, while in the energy supply sector implementation of new technologies and use of fuel having a lower carbon content, such as natural gas in combined cycle plants, was expected to partly offset the expected emission growth in the other sectors.

V. VULNERABILITY ASSESSMENT AND ADAPTATION MEASURES

87. Greece has a number of research projects related to climate change impacts and adaptation that are completed or under way. Still, in 1999, a mechanism for coordination, prioritization or systematic collection of information on impacts and adaptation was yet to be established. In this context, Greece put forward a proposal under the third CSF to develop an integrated programme for climate change research, with the aim of facilitating the preparation of appropriate adaptation strategies.

88. In the areas of water, forests and the coastal zone, a number of initiatives have been taken on the integrated management of natural resources. These could be used to better monitor impacts, including climate impacts in these areas, which appeared to be the most important for Greece, and to design adaptation strategies. In forestry, 100 sites on a systematic grid throughout the country are annually monitored for health condition and four sites representative of key ecosystems are monitored more intensively. A master plan for water management has been developed and the third CSF was expected to include programmes to support the rational use of water, including monitoring and development of integrated water management planning.

89. Greece has also made progress in developing and implementing integrated coastal zone management, including updating and modernizing data systems, and undertaking detailed case studies of likely future pressures and impacts in six regions (six case studies), as part of a Europe-wide project. The Greek islands present special ecological challenges, as they tend to be small and easily stressed. One of the six case studies was on the Cyclades, the only island site in the European project. In addition, a detailed study of potential future impacts on the island of Rhodes, including climate change impacts, was completed in 1991. The review team was informed that one conclusion of all these studies was that the impact of development pressures, especially tourism, on these islands was likely to outweigh the impacts of climate change. Hence, measures to adapt to these development pressures were expected to address also climate change impacts.

90. In 1998, an International Conference on the Impacts of Climate Change on the Mediterranean Countries organized by the Ministry of the Environment was held in Metsovo, Greece. At this conference, presentations were made by experts from the region on the impacts of climate change in areas such as agriculture, urban heating and cooling, desertification and biodiversity.

VI. FINANCIAL ASSISTANCE AND TECHNOLOGY TRANSFER

91. The NC2 did not contain information on financial assistance and technology transfer. During the team visit, however, these issues were discussed in detail and relevant information was presented to the team by the Ministry of National Economy. Even so, the team emphasized that it was important to provide such information in the NC2 in view of the significant role of cooperation between the Parties in implementing the Convention. Since 1999, the Ministry of National Economy has been coordinating financial assistance and technology transfer activities. Greece has also launched a process to set up an institutional and legislative framework with respect to financial assistance and technology transfer to facilitate these activities. To that end, a new law (2731/99) was adopted and the Ministry of the Environment is expected to become directly involved in cooperation projects with an environmental profile, and possibly climate change projects.

92. Greece took part in the first and second replenishments of the Global Environment Facility (GEF) and has already disbursed its pledged amount of the first and second instalments, Dr 766 million, under the second replenishment, Dr 1,532 million (about 4.7 million euros).

93. In 1997, a five-year plan for international cooperation was launched and a decision was taken to increase the amount of official development assistance (ODA) to 0.2 per cent of gross national product. In fact, the amount of ODA, for bilateral and multilateral assistance, has increased since 1993 in both relative and absolute terms (1993 - US\$ 90.5 million, or 0.1 per cent; 1994 - US\$ 122 million, or 0.12 per cent; 1995 - US\$ 152.3 million, or 0.13 per cent; 1996 - US\$168.2 million, or 0.14 per cent; and 1997 - US\$ 181.6 million, or 0.15 per cent).

94. Greek development assistance focused chiefly on the neighbouring Balkan countries and on the least developed countries. In 1997, five projects were implemented in the framework of the five-year programme for international cooperation, with total financing of US\$ 2.19 million. Two of these five projects were related to climate change: a project with Ecuador to preserve the tropical rainforest and a project with the former Yugoslav Republic of Macedonia aimed at strengthening the institutional, regulatory and legislative framework on the environment, and modernizing water treatment.

95. Greece does not participate in any joint implementation projects, but in general there is an interest in industry in the new Kyoto Protocol mechanisms. To respond to this interest and to inform all the interested entities of the challenges and opportunities of the Kyoto Protocol, the Ministry of the Environment scheduled a meeting with the business community at the end of

2000. This meeting is expected also to address the issue of technology transfer, since in Greece, as in most other countries, no clear picture emerged of the scale and priorities of technology transfer. It could also help the Government to formulate its policy on technology transfer and the incentives needed to facilitate transfer of climate technologies.

VII. RESEARCH AND SYSTEMATIC OBSERVATION

96. Various research activities related to climate change have taken place in Greece at universities and research institutes, without central coordination. The General Secretariat for Research and Technology of the Ministry of Development, which is responsible for planning and carrying out research, established within the framework of the third CSF an Operating Programme for Research and Technology for the period from 1995 to 2000. This ongoing programme centres on air pollution, innovation in industry, applied research, technology transfer innovation, and other issues relevant to climate change. The share of the climate change component in the overall budget is around 2 per cent, which corresponds to 10 million euros. Moreover, efforts have been made by the same secretariat to put into operation a large computer facility, considering, *inter alia*, the needs for climate change research. Financial support of approximately 3 million euros was made available for this purpose by the third CSF. Other climate research activities have been supported by the fourth CSF and by bilateral cooperation agreements between the EC member States and neighbouring countries.

97. The Ministry of the Environment has launched a comprehensive research study entitled, *Assessment of the impact of CO₂ emissions and other GHG gases on climate change*. Different observation networks for climate parameters have been supported by the National Meteorological Office, the NOA, the Ministry of Agriculture and the Ministry of the Environment. The network of the National Meteorological Office is best fitted to carry out climate observations and has already provided data to the World Meteorological Organization. A small number of stations of this network that have been operating for a sufficiently long time and provide high quality data, including that of the NOA, can also be used for climate change observations. In order to overcome some of the existing problems associated with data measurement, a proposal was put forward to establish a national climate change observation network, based on the existing networks of the National Meteorological Office and the NOA.

98. Under the Convention on Long-Range Transboundary Air Pollution, a network for the monitoring of forest conditions related to air pollution and other effects has been established. After 10 years of monitoring, an important conclusion made was that insects, grazing and drought have been the main factors influencing the state of health of the Greek forests. This network has already provided time-series of phenological data which, coupled with climatic data, could be used to study the sensitivity of different tree species to droughts and desertification.

VIII. EDUCATION, TRAINING AND PUBLIC AWARENESS

99. The Ministry of the Environment and the Ministry of Education worked in close cooperation with academic and green non-governmental organizations on issues related to

education, training and public awareness. For more than 20 years, Greece has introduced environmental components into its education system. In 1993, the Ministry of the Environment requested the University of Ioannina to draw up a programme for teaching environmental subjects in high schools with the focus on waste recycling, efficient use of energy and clean energy technologies. Recently, the Ministry of the Environment allocated Dr 5 billion (15.4 million euros) for recycling projects in 100 cities. While the content of environmental programmes in schools was rather broad, recently students expressed increased interest in climate change. In this context, the understanding of the Greek officials was that scientific support is needed to launch such programmes on climate change and the team learned that such support was expected to become available soon. At university level, an additional master's degree course on meteorology and climatology has been introduced in the University of Thessaloniki. CRES has also been training technicians in boiler efficiency and preparing education packages for schools.

100. The team found that the participation of students in "solar schools" was an interesting and potentially replicable initiative. Moreover, the team noted the innovative approach taken in the 1996 GLOBE/ALEXANDROS programme, implemented under the auspices of the two ministries mentioned above and with technical support from the University of Athens. Under this programme, 24 schools participated in studying the atmosphere, biology, hydrology and geology and the results were communicated through the World Wide Web.

101. The team noted that the public awareness of climate change had been raised in Greece, especially after the Kyoto Conference, mainly due to the role of the mass media. It also acknowledged the wide spectrum of activities being conducted by CRES aimed at raising public awareness of renewables and energy efficiency, and especially the information package for high schools and the general public. The PPC has also been active in launching media campaigns for energy saving, mainly through television, PPC customer service offices and advertising leaflets.

IX. CONCLUSIONS

102. The GHG inventory is clearly an area where substantial progress was made in the period between the CAP and the NC2, and especially in the latest submission of the annual inventory to the UNFCCC secretariat. The team was impressed by the efforts made to improve the transparency, consistency, comparability, accuracy and completeness of the inventory, compared with previous submissions, and by the substantial amount of work currently under way to improve the availability and quality of the basic information, including activity data and emission factors.

103. The team felt that many initiatives relating to energy supply and transformation sector reported in the CAP and elaborated thereafter will have a noticeable impact on mitigating CO₂ emissions and constitute the core of the national strategy to mitigate GHG emissions. In particular, greater penetration of natural gas in the future was seen as the main component of this strategy. In the other sectors, such as industry, transport, residential, commercial and public sectors, agriculture, land-use change and forestry, and industrial processes, some policies exist.

However a strategic approach to GHG abatement has yet to be developed as part of a comprehensive strategy to control GHG emissions. This is especially important for transport, for promotion of renewables, for the residential and commercial sector, and industry, where a significant energy efficiency potential remained untapped. More attention to abatement options outside the energy sector, including full implementation of already planned measures, would also benefit a comprehensive and cost-effective response.

104. Such a comprehensive strategy could assist in achieving Greece's GHG objectives and may go well beyond the current reliance on generous subsidies, which in turn would create a more conducive environment for private sector attention to GHG mitigation. This could include, for example, a system of cooperative agreements supported by appropriate regulatory frameworks, consideration of other types of economic incentives, programmes of consumer information such as energy labelling, and regular strategic reviews of national action plans to evaluate effectiveness and "re-tune" strategies as needed. The current policy framework does not support long-term investment planning in relation to GHG emissions, does not guarantee cost-effectiveness across or within sectors, does not support the incorporation of GHG issues in all areas of policy-making, and runs the risk of "free-rider" behaviour. Major data gaps exist regarding forestry, land use and the new gases and some data gaps exist regarding energy consumption, which could make a comprehensive approach difficult, and it is promising that studies are under way or planned to fill these gaps. It also became apparent during the team visit that in some areas, including uptake of renewable energy, imperfect administrative systems cause delays which hinder achievement of environmental goals; further streamlining of these systems would be advantageous.

105. With respect to projections, the team noted with appreciation the improvements in the models used, which have broadly led to more robust results. It was also evident that projections, and especially some of the projections prepared in the post-Kyoto period, give a clear picture of the mitigation potential of the measures and have helped to facilitate the decision-making process. At the same time, however, the presentation of the results did not follow the reporting guidelines. Projections continue to focus mainly on energy-related CO₂ emissions and the historical value of CO₂ emissions used for the base year 1990 did not match the relevant value from the GHG inventory. The team emphasized the importance of using consistent activity data and emission factors for projections and inventories, so that the results of projections can be used directly for policy-making purposes. The projection results given in the NC2 indicate that CO₂ emissions in 2000 were expected to be 2 to 27 per cent above the 1990 levels, according to the different scenarios. The most recent projections and the strong upward trend of historical emissions suggest that emissions in 2000 might be closer to the upper value. The stronger-than-expected economic growth, considerable delay in implementation of the CAP measures and smaller-than-anticipated effect of some of the implemented measures underline this tendency.

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