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

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I. INTRODUCTION AND NATIONAL CIRCUMSTANCES

1. Spain ratified the United Nations Framework Convention on Climate Change on 21 December 1993. Its first national communication (NC1) was submitted to the secretariat on 28 September 1994 and the second national communication (NC2) on 12 November 1997. The in-depth review of the NC2 was conducted between October 1998 and November 1999 and included a visit to Madrid from 5 to 9 October 1998. The team comprised Mr. Sergio Gonzalez (Chile), Mr. Carlos Grezzi (Uruguay), Ms. Fatima Espiritu Santo (Portugal) and Ms. June Budhooram (UNFCCC secretariat, coordinator). The in-depth review was coordinated by the National Climate Council (Consejo Nacional del Clima) under the Ministry of the Environment and involved discussions with officials in government, members of the scientific community and key stakeholders in the business community and non-governmental organizations.

2. With a population of 39.21 million in 1995 and a land area of 505,990 sq km, Spain is the second largest country in Western Europe. As a member of the European Community (EC), Spain has an open economy which experienced a period of sustained economic growth between 1983 and 1990, with gross domestic product (GDP) growing at an average annual rate of 3.6 per cent compared to 2.8 per cent in the EC as a whole. Between 1991 and 1993 there was a slowdown, with GDP growing at only 0.6 per cent annually, similar to the EC average. The period between 1994 and 1996 was one of somewhat restrained economic expansion, with a GDP growth rate of 2.3 per cent annually and is expected to grow at 3.5 - 4.0 per cent annually in the short-medium term. Per capita GDP was US\$ 13,400 in 1997, about 38 per cent lower than the EC average of US\$ 21,600. Since 1985, the Spanish economy has opened up progressively in an effort to attain economic convergence with the EC. Spain is the largest of the four EC cohesion countries, which have a per capita GDP lower than the EC average, and it is therefore eligible to receive special project financing to strengthen economic and social cohesion within the EC.

3. In Spain, the central Government is responsible for the coordination and promotion of environmental policies and for issuing, through its respective ministries, basic environmental policy guidelines and strategies relating to such matters as the management of public water resources, transport and energy. The next level of government comprises the 17 autonomous communities and 2 autonomous cities, which are responsible for the implementation and monitoring of environmental policies. These autonomous entities can independently issue additional and more restrictive laws on the exploitation of natural resources within their provinces. They also have direct responsibility for managing and implementing policies having local impacts, such as waste management.

4. Spain launched its climate change abatement strategy in 1992, with the creation of the National Climate Commission, chaired by the former Minister of Public Works, Transport and Environment, with the Vice-chairmanship at the former State Secretariat of the Environment and Housing, and its secretariat located at the National Institute of Meteorology, both of which came under the former Ministry of Public Works, Transport and Environment. The strategy provided the mechanism for coordination of climate-related policies and set the general framework for the

implementation of Spain's National Climate Programme of 1995. The Commission ceased to exist in May 1996 when the Ministry of the Environment (MIMAM) was created to coordinate environmental policies and propose environmental legislation. In February 1998 the Government created the National Climate Council under the Ministry of the Environment. The Council's main function is to facilitate better coordination among public agencies under different ministries, as a means of addressing some previously existing deficiencies. To achieve this aim, special working groups on industry and energy, transport, agriculture and environment, and inter-institutional cooperation have been formed. The Council is also entrusted with the preparation of Spain's Climate Change Strategy, of which a first draft was completed in March 1999.

5. The initial target of Spain as a member of the EC was to limit the increase of energy-related carbon dioxide (CO₂) emissions to 25 per cent between 1990 and 2000. This represented a reduction of 20 per cent from Spain's business-as-usual trend, which would have led to an estimated increase of 45 per cent in 2000, if no measures were taken. This target was set within the context of the EC policy to stabilize CO₂ emissions. In 1995, the Government announced that the 1992-1994 economic slowdown, during which energy output and CO₂ emissions increased less than expected, would allow Spain to lower its energy-related CO₂ emissions target for 2000 to an increase of 16-20 per cent over 1990 rather than 25 per cent (an increase of 13-15 per cent rather than the previous estimate of 20 per cent for total CO₂ emissions). The aim of the Convention of reducing greenhouse gas emissions to 1990 levels by 2000 will be met by the EC as a whole, as stated by the EC in its ratification. It should be noted, however, that in 1990 Spain's per capita CO₂ emissions were approximately 6 tonnes compared to the EC average of 12 tonnes. By 1995, per capita emissions had risen to 6.5 tonnes, still almost 50 per cent below the EC average.

6. For the purposes of the EC burden-sharing agreement under Article 4 of the Kyoto Protocol to the UNFCCC, Spain agreed in June 1998 to limit the net growth of the six GHGs covered by the Protocol to 15 per cent above the 1990 level by the period 2008 to 2012. More than two-thirds of Spain's GHG emissions come from energy-related activities. In light of the growing energy demand, Spain has been attempting to diversify fuel supply since 1993. Oil constituted 55 per cent of total supply in 1995. Coal supply has stabilized since 1985, but its share declined to 16 per cent in 1995 from 25 per cent in 1990. The share of natural gas reached 8 per cent of total energy supply while nuclear and hydropower accounted for 14 and 4 per cent, respectively, in 1995. Non-hydro renewables have been increasing slowly at less than 1 per cent annually, but accounted for almost 4 per cent of the energy supply balance in 1995.

7. It was noted by the members of the review team that the establishment of the National Climate Council as a coordinating agency in February 1998 placed climate change issues at a very high level in the central government. This new framework is expected to deal with environmental matters and especially to manage in a more comprehensive way all the national commitments assumed by Spain as a signatory of the Convention and the Kyoto Protocol (which it has yet to ratify however).

II. INVENTORIES OF ANTHROPOGENIC EMISSIONS AND REMOVALS

8. The NC2 contains inventory data for emissions of the direct greenhouse gases, carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O), and the indirect greenhouse gases, carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOCs) for 1990 to 1994. Additional data were provided during the review, including the 1995 inventory, which are presented below. Data for perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF₆) were not presented in the NC2 as these were considered to be too preliminary. However, the national team provided data on these gases for 1990 and 1995 during the review. Data on international marine and aviation bunkers were reported separately, as recommended by the Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories. Inventory data for 1996 and 1997 were still in preparation at the time of the review.

9. In preparing the inventory, Spain used the CORINAIR methodology for all categories, except for land-use change and forestry. These inventories were converted to the IPCC format as required under the Guidelines using a CORINAIR/IPCC interface. For the land-use change and forestry sector, Spain has developed its own methodology while adhering to IPCC definitions of all subcategories. The review team formed a favourable impression of the quality of work being done by the national inventory experts in relation to activity data and methodologies employed for the energy-related emission estimates. The experts informed the team that considerable efforts are being devoted to improving the national methodology for the land-use change emissions and sequestration and reducing its associated uncertainties.

10. It was noted by the review team that the GHG inventory included in the NC2 filled all the gaps detected in NC1 and amended during its in-depth review. Additionally, adequate explanations were provided on the technical issues related to inventory preparation. The review team noted that coordination among experts involved in inventory preparation had improved since the NC1, knowledge of the IPCC methodology had been enhanced, considerably more activity data were available, and methodological consistency with the IPCC Guidelines was closer.

11. The inventories were reported on the basis of the 1995 IPCC Guidelines and using the standard format tables. They were prepared by experts from the Directorate-General for Environmental Quality and Assessment, using official energy, transport, industrial, agricultural, forestry, and economic data from the National Institute of Statistics and other national institutions responsible for collecting information on these sectors annually. These data are also used for preparing energy balances and macroeconomic aspects of sectoral projections. The GHG inventory was produced by applying mainly default emission factors, although local values were applied where they were available. Default values were taken from both the CORINAIR and the IPCC Guidelines. A copy of the comprehensive CORINAIR report on Spain's inventories was provided to the team.

12. The 1990 GHG emissions inventory (revised and updated during the NC1 in-depth review) were estimated at 226,423 Gg for CO₂, 2,181 Gg for CH₄ and 86,3 Gg for N₂O. The inventories included CH₄ and NMVOC emissions from agricultural soils and CO₂, N₂O, NO_x, CO and NMVOC emissions from solid waste disposal sites and sewage water treatment plants. The review team pointed out that these emissions are not considered by the IPCC Guidelines. The national inventory team explained that these inaccuracies are due to the harmonization between the CORINAIR and IPCC GHG inventory calculation methods and would be addressed as the inventories are revised.

13. The work that Spain has done in the land-use change and forestry category was commended by the review team. In calculating the CO₂ sink capacity, two consecutive forest inventories were used so as to reduce the level of uncertainty associated with the results for carbon capture from the atmosphere and its accumulation as forest biomass; the comparison of the forest biomass at two different periods is known to give a comprehensive result for forestry management (biomass expansion and harvest) and land-use conversion (agricultural land rehabilitation, native forest substitution). In order to fulfil the requirements of the IPCC Guidelines, data on carbon sinks should be disaggregated as defined therein. This would add more transparency to the data presented on the land-use change and forestry category.

14. Emission estimates were not adjusted for temperature. The level of uncertainty of emission estimates was evaluated using the CORINAIR method and was well documented in the NC2. However, in accordance with the IPCC Guidelines, the inventory team was advised to report on the uncertainty of estimates in terms of high, medium and low in future. Officials noted that CO₂ estimates for energy-related emissions are regarded as being of high quality. All CH₄ estimates were considered medium and N₂O estimates low. NO_x and CO estimates were considered as high to medium and NMVOC estimates were generally low.

15. The review team recommend that for the NC3, in an effort to enhance the transparency of the communication, a brief description of the method used to convert the CORINAIR inventory to the IPCC format, as well as a table containing emission factors and another including activity data such as fuel consumption per year, surface area devoted to rice crops or surface afforested per year, and livestock numbers, would be helpful in obtaining a better understanding of GHG emission trends on all sectors and activities. The required information is available and is already used for preparing the national inventory. The in-depth review team would like to encourage the national team to continue its work on the forest inventory, as this inventory is generating some very basic and highly valuable data on carbon content in forest soils and biomass expansion rates by forest types, among others, that may be replicable in other countries and also facilitate the methodological work currently being done in this area.

16. In 1990, and using the CO₂ equivalent based on 100-year global warming potentials (GWP), CO₂ accounted for 75.1 per cent, CH₄ for 15.2 per cent and N₂O for 9.7 per cent of total GHG emissions respectively, with CO₂ emissions increasing at 1.8 per cent annually between 1990 and 1995, CH₄ increasing at 1.7 per cent annually and N₂O decreasing at 1.1 per cent annually in the same period.

A. Carbon dioxide

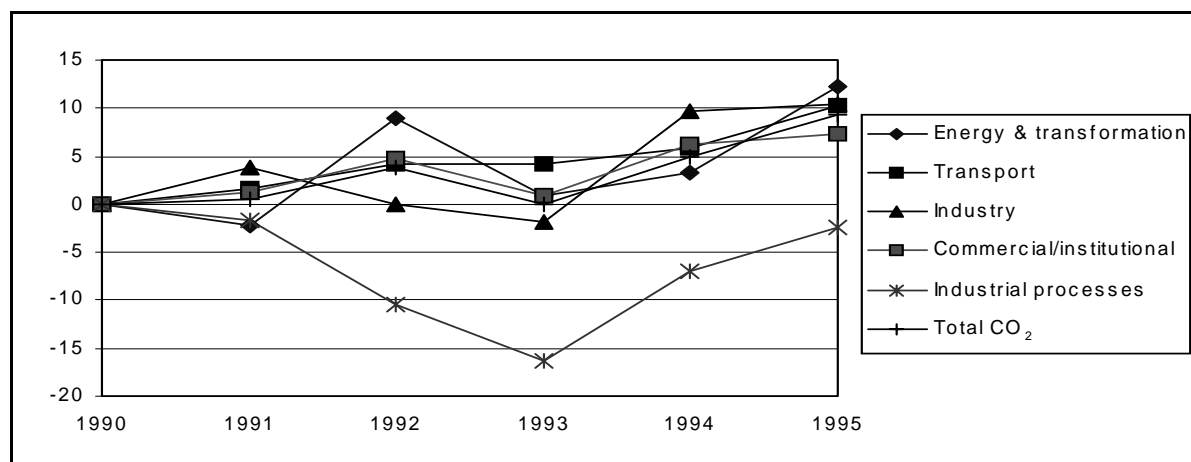
17. In 1995, CO₂ emissions accounted for about 75 per cent of Spain's direct GHG emissions, on a CO₂ equivalent basis. Table 1 and figure I indicate that CO₂ emissions increased by 9.4 per cent between 1990 and 1995, the largest increases coming from the energy and transformation sector (12.2 per cent), transport (10.3 per cent) and industry (10.4 per cent). CO₂ emissions from bunkers, which were estimated at 18,024 Gg in 1990, rose to 19,306 Gg in 1995, an increase of 7 per cent. Of total CO₂ emissions from bunkers, 13,085 Gg were marine and 6,221 Gg from aviation. Between the NC1 and the NC2, the estimate of total CO₂ emissions in 1990 was revised downward from 256,477 Gg to 226,423 Gg. Most of the reduction was due to methodological adjustment.

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

	1990	1991	1992	1993	1994	1995
Energy & transformation	75 184	73 470	81 882	75 907	77 645	84 330
Transport	58 260	59 154	60 687	60 681	61 625	64 268
Industry	47 971	49 803	47 938	47 091	52 657	52 968
Commercial/institutional	26 177	26 499	27 397	26 400	27 803	28 110
Industrial processes	17 690	17 408	15 830	14 789	16 469	17 278
Other	1 141	1 181	1 211	1 329	1 247	749
Total	226 423	227 515	234 945	226 197	237 446	247 703

18. Forests cover about 26.2 million hectares, but only 13.8 million hectares of managed forest is covered by the inventories. Most of the annual forest increment is due to forest management practices. The first forestry inventory was conducted between 1966 and 1974, the second between 1987 and 1996, and the third was initiated in 1997. Officials explained that the results of the latest inventory, which are expected in 2001, will result in some changes to the data for the land-use change and forestry sector. Spain utilizes its own methodology to calculate emissions from this sector. Sink capacity is estimated by splitting the tree stock by class and yield of species. No model is used for these calculations. Sink capacity in 1990 was estimated at 4,178 Gg of CO₂ in the NC1. This figure was revised to 23,170 Gg with methodological refinement. In 1995, sink capacity had increased to 28,970 Gg.

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



B. Methane

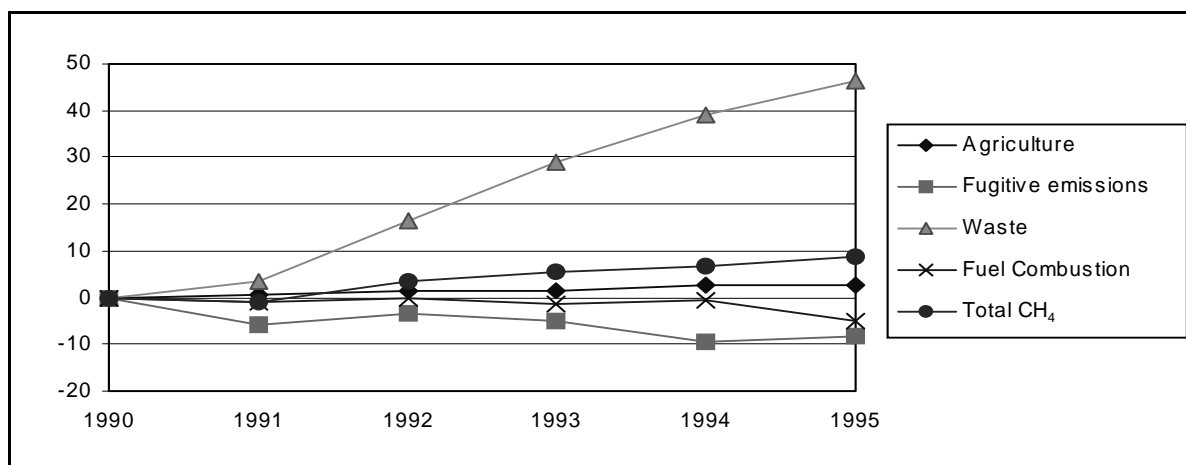
19. CH₄ emissions in Spain are dominated by agriculture, in particular, from enteric fermentation and anaerobic fermentation of waste from livestock, and fugitive emissions from landfilled municipal waste, coal mining operations and to a lesser extent from the gas distribution network. CH₄ emissions in 1995 were 9 per cent above 1990 emission levels, as shown in table 2 and figure II. This is a direct result of increased leakage of CH₄ from landfills, which increased by 46 per cent in that period due to higher waste volumes, since many landfill sites were either not equipped with recovery equipment or they were too small to make recovery economically viable.

20. Officials noted that activity data on livestock are fairly accurate as they are based on a national census of all farm animals conducted by the Ministry of Agriculture, Fisheries and Food. Emission factors for CH₄ from enteric fermentation are based on a literature review and some measurement by research centres and universities. Although the population of dairy cows declined from 1.7 million to 1.3 million between 1990 and 1995, the drop in CH₄ emissions was offset by a 14 per cent and 5 per cent increase in pig and sheep populations, respectively.

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

	1990	1991	1992	1993	1994	1995
Agriculture	925.6	930.1	940.1	939.9	949.4	949.3
Fugitive emissions	686.8	646.8	664.7	653.2	621.3	628.7
Waste	491.3	508	571.8	634.5	683.4	718.5
Fuel Combustion	75.6	74.9	75.5	74.7	75.1	71.9
Other	1.9	2.0	2.1	2.2	2.3	2.0
Total	2 181.2	2 161.8	2 254.2	2 304.5	2 331.5	2 370.4

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



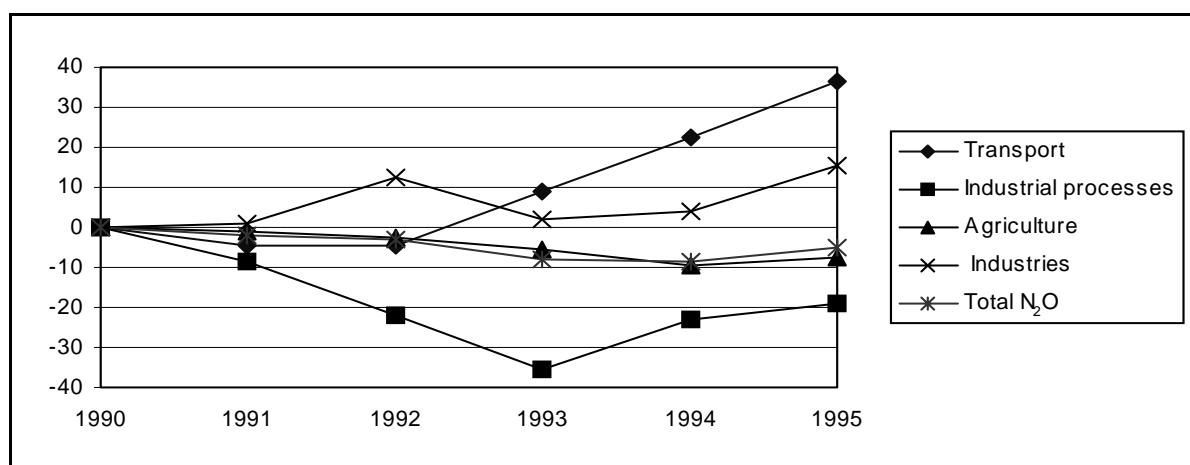
C. Nitrous oxide

21. It can be observed from table 3 that N₂O emissions decreased slightly between 1990 and 1995 (see also figure III). While emissions from transport have been increasing as a result of an increase in the number of catalytic converters in the road vehicle fleet, there were reduced emissions from agriculture and industrial processes. Emissions from agriculture decreased by 8.4 per cent in that period due to the unusual dry conditions of the early nineties. These climate conditions led to a decrease in land area cultivated and lower consumption of nitrogenous fertilizer, and a change from high water-demanding crops to less demanding ones. In the case of industrial process emissions, the 19.2 per cent decrease over the period was attributed to a process change in the manufacture of nitric acid.

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

	1990	1991	1992	1993	1994	1995
Transport	2.2	2.1	2.1	2.4	2.7	3.0
Industrial processes	10.4	9.5	8.1	6.7	8.0	8.4
Agriculture	63.5	62.8	61.9	60.0	57.5	58.6
Industries	10.2	10.3	11.5	10.4	10.6	11.8
Total	86.3	84.7	83.6	79.5	78.8	81.8

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



D. The New Gases (HFCs, PFCs and SF₆)

22. Data on the new gases were provided to the team during the review visit. Officials commented that there is no monitoring of HFC imports, but preliminary estimates presented to the review team for 1990 and 1995, shown in table 4, indicate emissions of HFCs on the increase by 54 per cent. Emissions of PFCs from the aluminium industry and of SF₆ were broadly constant over the period. Magnesium is not produced in Spain so SF₆ emissions from industry are considered to be insignificant.

Table 4. Emissions of HFCs, PFCs and SF₆ (Gg) (CO₂ equivalent)

	1990	1995
HFCs	4 103	6 307
PFCs	4 500	4 555
SF ₆	200	200

III. POLICIES AND MEASURES

23. Spain's policies and measures aimed at limiting GHG emissions growth were, in general, well described in the NC2, especially for key sectors such as industry, energy, residential, transport and forestry. As required by the 1995 UNFCCC reporting guidelines, the policies are described in relation to the broader policy context of the national climate programme. Little information was provided in the NC2 on the costs associated with measures, the extent of implementation of policies and their specific impact on mitigating GHGs. It is noteworthy that, while the NC2 refers exclusively to programmes designed with main objectives other than GHG mitigation, such as Spain's efforts to achieve economic convergence with the EC and energy security, it also describes CO₂ abatement as a secondary objective of such programmes.

24. The review team was also informed that there is no monitoring mechanism in place for assessing the effects of climate change policies and measures. However, at the time of the review, the National Climate Council was preparing a climate change strategy for consideration by the Government. The strategy contains additional GHG mitigation measures for Spain to meet its Kyoto Protocol target, for which serious consideration will be given to monitoring the quantitative effects of GHG policy options annually and evaluating their impacts on a longer-term basis.

25. Since 1986, Spain has made major and rapid changes in adapting its legislation and industrial organization to market-oriented rules within the context of its economic convergence with the EC. Given that almost 90 per cent of all CO₂ emissions originate in energy-related activities, the optimization of energy consumption has been the focus of most efforts to reduce GHG emissions.

A. Energy and transformation

26. Spain is scarcely endowed with fossil fuels. It imported virtually all of its oil, 83 per cent of its natural gas and more than 45 per cent of its coal requirements in 1995, when oil accounted for 55 per cent of total energy demand, followed by coal 16 per cent, nuclear 14 per cent, gas 8 per cent and hydro 4 per cent. Current energy policy is guided by the National Energy Plan 1991-2000. Responsibility for energy policy rests with the Secretary-General for Energy and Mineral Resources of the Ministry of Industry and Energy, which has taken the lead in transforming the sector so as to improve its competitiveness in terms of price and quality. This has been done by liberalizing and deregulating the various subsectors, namely electricity, oil, coal, and nuclear. To date, the most notable changes have taken place in the electricity subsector.

27. As in other developed countries, electricity continues to take a greater share of final energy consumption as the economy grows. During the 1990s, electricity demand has been growing at a slightly faster rate than GDP, at an average of 3 per cent annually. In the 1995 energy balance, electricity accounted for 40 per cent of final energy demand. Nuclear accounted for 32 per cent of electricity generation, followed by coal with 31 per cent, hydropower 23 per cent, oil 8 per cent, natural gas 5 per cent and renewables 1 per cent. At that time, Spain's electricity industry was characterized by vertical integration both in electricity generation and distribution. In 1990, 20 utilities provided 98 per cent of electricity generation and distribution services.

28. The largest generator was ENDESA, a government-owned company which accounted for 25 per cent of generation, and the distribution grid was operated autonomously by the government-controlled company, Red Eléctrica. The first steps toward restructuring and consolidating the power sector took place in 1991. Since then, substantial progress has been made. The NC2 reported that in 1994 the parliament had adopted an electricity law (Law 40/94) aimed at improving efficiency, transparency and competition in the electricity sector. Then in

December 1996, the Government signed a protocol with all the utilities to introduce greater competition in the power market in an effort to reduce production costs.

29. In November 1997, the new model for the regulation of Spain's electricity system was introduced (on adoption of Law 54/97), which reflects all criteria established by the EC in its directive on Common Principles for National Electricity Markets, and which reduces state intervention in the electricity markets to a minimum. The Law, however, also established a National Commission for the Electricity System under the Ministry of Industry and Energy to ensure that operations were effective in meeting the objectives set out and were transparent. In October 1998, the former National Commission for Energy (Law 34/98) was created, and will assume the functions of the National Commission for the Electricity System.

30. The agreement signed with the main electricity producers in December 1996 to liberalize the electricity sector in accordance with Law 54/97 stipulates that electricity prices should decrease in nominal terms by 3 per cent in 1997, 2 per cent in 1998 and 1 per cent every year from 1999 to 2001. These prices are expected to decrease more for small and medium enterprises. By 2008, the market should determine the price of electricity. Since the introduction of competition in the generation and sale of electricity, prices have been falling for most consumers. It is expected that they will decrease by 3 per cent in 1999 and by 1 per cent annually after 2000. This may lead to an increase in electricity consumption and possibly an increase in CO₂ emissions.

31. A gradual increase in the share of natural gas in Spain's energy balance and in electricity generation as a substitute for coal and oil constitutes a major policy for GHG mitigation. The Hydrocarbon Law (Law 34/98), which came into effect in October 1998, outlines the basis for deregulation of the energy sector and the rate of increase in the use of natural gas. These developments will depend in part on the coverage of the gas network and the ability of gas companies to supply. While the Government expects to increase the share of natural gas in the energy balance from 8 per cent in 1995 to 12 per cent by 2000, this figure will still be below the projected EC average for 2000 of 20 per cent.

32. To meet the 12 per cent objective, the security of gas supplies was improved through the opening of a pipeline from Algeria in November 1997, which supplies 10 million cubic metres annually. This pipeline will be extended to the west and north of Spain. Facilities for the storage of liquefied natural gas were also expanded and upgraded in 1997. Gas import, transport and distribution is undertaken by the state monopoly, Enagás-Gas Natural, which is responsible for constructing the entire gas infrastructure in Spain. By 2000, the gas grid supplying all Autonomous Communities is expected to be completed. Officials commented that after this step, the part played by gas in the energy balance would become significant and would assist in slowing the growth of GHG emissions.

33. Since 1980, Spain has been attempting to reduce its dependence on oil. In the oil sector, three companies - Repsol, Cepsa and BP-Oil - hold nearly 90 per cent of the retail market, while the CLH company has a quasi-monopoly of oil transportation. In 1998, the Government

removed the price ceiling on some oil products. The decision by the Government to increase gas imports has led to further fuel diversification and a possible reduction in oil imports.

34. In 1990, the Government launched two plans to restructure the coal sector, which have increased productivity, and introduced a major price reform in the sector. Coal production decreased by 4 per cent in 1996 to 10.2 million tonnes of oil equivalent (toe). Currently, national coal production is still subsidized through the state budget. In 1998, the Government initiated plans to substantially reduce state subsidies to coal by 2005. In 1998, a round of negotiations was held between the Government and the coal mining sector. These negotiations concluded in the Coal Mining and Mining Communities Alternative Development Plan. This eight-year plan covering the period 1998-2005 will include further restructuring of the coal sector in order to bring national coal production costs down to international levels, thereby making Spanish coal competitive on the world markets. The restructuring will also follow the policies and guidelines set out by the EC for the coal sector. The Government has been encouraging the closure of high-cost underground mines since 1989. Between 1989 and 1995, 80 mines were closed, leaving about 90 in operation. Under the restructuring plan of 1998-2005 more mines are expected to close, thus further reducing coal output and the associated CO₂ emissions, not to mention the leakage of CH₄ emissions from mines, which accounted for 22 per cent of total CH₄ emitted nationally in 1995.

35. With the indefinite moratorium on the further development of nuclear energy, the share of this energy source in power generation is expected to fall from current levels of 32 per cent to around 20 per cent by 2000 and thereafter. The national experts were of the opinion that nuclear energy will be replaced by natural gas as these plants are retired in the future, which may lead to more GHG emissions.

36. The Energy Conservation and Efficiency Plan (PAEE) has been the main focus of the Ministry of Industry and Energy in addressing fuel substitution and energy conservation as a means of reducing GHG emissions. The Plan is divided into four main programmes: saving, substitution, cogeneration and renewable energy. Energy efficiency and savings programmes are conducted by the Institute for the Diversification and Saving of Energy (IDAE), acting mainly as a commercial company, and by means of government and regional subsidies. Since energy intensity increased from 1987 onwards, the Government resolved in 1995 to strengthen the energy savings policy set out in the 1991 Plan for Energy Savings and Efficiency (PAEE), as reported in the NC1. Earlier efforts concentrated on energy supply. In 1998, the Government redirected its efforts towards the transport and residential and commercial sectors, where energy consumption is increasing at unprecedented average annual rates of 4 and 3 per cent, respectively.

37. The PAEE, which covered the period 1991-2000, was prepared in 1991 and included investments and subsidies totalling Ptas 1,200 billion, mainly for industry. Under the Plan, annual savings of 10.8 million toe were expected, of which 2.0 million toe would be achieved through the replacement of coal and oil with natural gas, and 0.4 million toe from the expansion of renewables. The Plan includes the expansion of renewable capacity by 1,200 MW by

auto-producers mainly. It also included the production of 1,200 MW of electricity by means of cogeneration.

38. In terms of emissions reduction, these efforts signified a reduction of 26,000 Gg of CO₂, 100 Gg of NO_x and 400 Gg of SO₂ in Spain's annual emissions. The team was informed that by 1996, around 70 per cent of the investment objectives had been achieved. The Plan is on track to be completed on schedule. The cogeneration and auto-producing (renewables) programmes have exceeded initial expectations. In terms of funding, the public sector budget for improving end-use energy efficiency increased from Ptas 2.6 billion in 1995 to Ptas 8.7 billion in 1996 to cover extra costs envisaged under the 1995-2000 energy efficiency programme. These figures include regional funding amounting to Ptas 1.4 billion in 1995 and Ptas 1.9 billion in 1996.

39. In 1996, non-hydro renewable energy accounted for 4 per cent of Spain's primary energy balance. Of this 4 per cent, biomass comprised a significant portion, mainly from the pulp and paper industry and domestic waste, and the rest was made up evenly of municipal solid waste, solar thermal, photovoltaics, wind, and geothermal energy. The NC2 reported that the total installed capacity of renewables in 1996 was 18,555 MW, from which 42,432 GWh of electricity were produced. Of this total installed capacity, 246 MW utilize biomass and solid waste. Ptas 25 billion are spent on the development of renewable energy in Spain annually and over 300 companies are involved in providing services and equipment for this purpose.

40. Under the PAEE, the development of renewable sources such as wind and photovoltaics and clean combustion technologies has had some success in the past four years. In an effort to promote the further penetration of these renewable sources, the Spanish Administrations have allocated Ptas 15 billion to their development in the 1991-1996 period and another Ptas 8 billion by EC. The installed capacity of wind power is increasing; in 1997, Spain was ranked as the third largest wind power generator in the EC. Wind power capacity reached 380 MW in 1997 and there are plans to increase capacity to 1,700 MW after 2000. The Autonomous Communities where wind power is most predominant include Galicia, Andalucía, Aragón, and Navarra and Canarias. In 1998, the public power companies were mandated to purchase electricity generated by renewables in order to increase the share of these sources to 12 per cent in the primary energy balance. At the time of the review, the Ministry of Industry and Energy, in collaboration with the Autonomous Communities, was preparing a plan for renewables to ascertain how this objective may be achieved.

B. Transport

41. The transport sector's share of total final energy consumption has been growing rapidly. Between 1980 and 1995, its energy consumption increased by more than 70 per cent and accounted for 37 per cent of final energy consumption in 1995. For this reason, energy use in transport directly affects increases in national GHG emissions. Transport-related CO₂ emissions increased by about 20 per cent between 1990 and 1996. There was significant growth in road transport and little change in the use of railways. Road transport accounted for 90 per cent of all energy consumed by the sector, half of that percentage being consumed by private vehicles.

With more tourism, local air transport is also increasing and is expected to rise even further in the future. Sea and rail transport on the other hand have been almost constant since 1990, as road infrastructure was developed during the 1980s. Between 1990 and 1995 the road transport of goods increased from 189×10^9 tonne-km to 240×10^9 tonne-km.

42. The rapid increase in tourism was also cited as a factor contributing to increased road transport demand. National experts explained that, although the road fleet was overestimated by around 20 per cent in the national transport statistics, private car transport has been increasing at around 2 per cent annually during the nineties, mainly because of increased car ownership among the younger population (aged 18-30 years).

43. As a result of the unprecedented increase in GHG emissions in this sector, the Government is concentrating its efforts on restraining at only a 41 per cent increase in GHG emissions from transport by 2010 compared to 1990, through the introduction of more fuel-efficient cars, renewal of the automotive fleet, speed control, and development of more efficient transport infrastructure for trucks and trains, in particular. In 1998, there were only 12,300 km of railway in Spain, absorbing around 10 per cent of freight demand. Transport experts reported that there is a great potential for shifting freight transport from road to rail, and this will be considered as a future option for GHG mitigation. To this end, Ptas.2,400 billion have been allocated to expand the rail infrastructure by 2006.

C. Residential sector

44. The local governments of the Autonomous Communities and Cities are responsible for the implementation of housing programmes. In 1995, the residential sector accounted for 14 per cent of final energy consumption. Electricity consumption in particular has been increasing rapidly, at an average annual rate of 4 per cent. In 1995, households accounted for 22 per cent of final electricity consumed. This phenomenon was attributed to the unprecedented increase in the number of electrical appliances in households for cooking, heating and air conditioning during the late 1980s and early 1990s.

45. There are few specific programmes in the residential sector for the reduction of GHG emissions. The sector accounted for 11 per cent of CO₂ emissions in 1995. However, energy efficiency and renewable energy programmes, such as solar water heating, have made some impact on reducing energy consumption in the sector. The Law for the Reorganization of the Building Industry (Law 34/97) sets the technical standards for building construction, such as energy savings, thermal insulation and ventilation. Building certificates are now being issued under the 1996-1999 Housing and Building Quality Plan which provides technical guidance such as an optional energy rating system for new homes and informs customers of their potential energy requirements.

46. Under the EC THERMIE programme, the Government of Spain will incorporate the latest directives of the EC on construction, minimum efficiency standards for heat production,

air-conditioning and water-heating for all types of buildings, and as a consequence this should result in a reduction of CO₂ emissions.

D. Forestry

47. The policies in the forestry sector are part of Spain's overall strategy to improve forest cover, control erosion, prevent desertification and regularize the hydrological cycle. In so doing, GHG mitigation objectives are also addressed. Since 1990, the Government has been implementing afforestation and forest improvement programmes. Its main forestry initiative was the Programme for Restoration of the Vegetation Cover and the Reduction of Soil Erosion, which started in 1991 and was completed in 1996. Its objectives included the detection and control of erosion, treatment against disease and reforestation of woodlands with ecologically suitable species. At the end of the programme, around 55 per cent of the reforestation had been carried out.

48. The Autonomous Communities implement the Programme, with national coordination by the General Directorate for Nature Conservation (DGCONA). Between 1993 and 1998, 146 sq km of land were reforested and 215 sq km of woodland improved. The Government has also drawn up a long-term forest strategy aimed at further reforestation and conservation of forest cover over the period 1996-2032. The central Government, Autonomous Communities and the EC will share the total investment estimated at Ptas 3,915 billion. It is estimated that by 2032, 84,000 sq km of land area will have been reforested and 67,700 sq km of forest conserved. Cooperation agreements between the State and the Autonomous Communities to restore forests and the hydrological basins of the major rivers will continue to serve as the basis for execution of this strategy. In support of this initiative, the Government has developed a subsidy system to encourage the development of forest in farming areas and to generate more employment in the forestry sector.

49. The NC2 highlighted the problem of forest fires and diseases affecting forest growth. There are 15,000 to 20,000 forest fires annually. These destroy approximately 1 per cent of Spain's total forested area of 27 million hectares each year. Although the GHG effects of these occurrences were not described explicitly in the NC2, they are reflected and taken into account in the forestry inventories. Moreover, the forestry experts explained that remedial measures are being taken in collaboration with the EC.

E. Agriculture

50. The emphasis of government policy in agriculture is on improving productivity. Some measures in this sector have the effect of reducing emissions of CH₄ and N₂O such as declines in animal populations and density, manure application and the introduction of taxes on nitrogenous fertilizers. Approximately 40 per cent of CH₄ emissions and 72 per cent of N₂O emissions were attributed to this sector in 1995. The Ministry of Agriculture, Fisheries and Food is currently preparing a group of studies on the analysis of CH₄ and N₂O emissions in agriculture as Spain's policies in this sector converge with the Common Agricultural Policy (CAP) of the EC. The

level of emissions from agriculture is highly dependent on animal numbers, which in turn, are strongly influenced by national and EC policy decisions. In 1995, almost 35 per cent of CH₄ emissions came from enteric fermentation and animal waste. Between 1990 and 1995, sheep and pig populations both rose, a trend that is expected to boost CH₄ emissions in the future.

51. Rice growing also produces CH₄ emissions. In 1995, 5 per cent of such emissions came from rice production. Due to abnormal dry conditions in 1995, the available water for irrigation in traditional rice production suffered a significant decrease. A period of extreme drought had followed the less intense drought cycle of the previous two years, resulting in a reduction of the area under rice to 48,000 hectares. In 1996 climatic conditions improved and the area under rice cultivation has returned to normal levels of around 110,000 hectares.

52. The 1995 climate conditions reduced the use of nitrogenous fertilizers: the significant drought which affected the Spain's agricultural output in 1995, also resulted in a decrease in the total amount of fertilizer used from 1.1 million tonnes (nitrogen equivalent) in 1990 to 0.8 million tonnes in 1995. Conversely, as a result of copious rainfall in 1996, the amount of fertilizer used returned to its level prior to the drought. However, it is necessary to note that the application of the current EC environmental legislation, and particularly legislation on water protection from agricultural nitrogen pollution, will encourage a better use of nitrogen fertilizer, thereby reducing its consumption and, consequently, N₂O emissions.

F. Waste

53. In Spain, landfill has been the primary method of disposal of household, commercial and industrial wastes. Landfill accounted for 28 per cent of CH₄ emissions in 1995, one of the largest single sources of this gas. During the review, the national team outlined a number of measures, which are in line with the EC Waste Directive, designed to prevent waste production, reduce quantities of non-recoverable waste, recycle waste where possible, and dispose safely of non-recyclable wastes. The National Plan for Solid Domestic Refuse outlines various measures for the control of CH₄ and other emissions from landfills. Under this Plan, Ptas 5.4 billion have been allocated to recover and use CH₄ emissions from landfills having a minimum capacity of 100 kilotonnes.

54. The use of solid waste for electricity generation has been very successful to date. Around 14.3 million tonnes of waste have been produced annually since 1995. The Autonomous Communities of Cataluña, Andalucía and Madrid generate more than 2 million tonnes annually of domestic waste. The NC1 reported that in 1990 there were only four solid urban waste incinerators with energy recovery facilities. By 1996, this number had doubled. The total installed capacity of energy-producing incinerators was 93.7 MW in 1996. Between 1997 and 1999 three new incinerators with energy production were expected to be installed, in La Plana, Ceuta and Zabalgardi.

55. With respect to livestock farming waste, the Ministry of Agriculture, Fisheries and Food introduced a programme in 1993 for treating, recycling and purifying livestock farming waste. As a follow-up to this programme, the Ministry prepared a national plan containing policies for reducing CH₄ emissions. The plan outlines, among other things, measures for reducing the amount of waste generated per animal and the installation of biodigestors using livestock waste as feedstock.

G. New gases

56. As of 1998, work was under way to identify most sources and quantify actual and potential emissions of HFCs, PFCs and SF₆. Under the Industrial and Technological Environmental Programme (PITMA) and the Initiative to Support Technology, Security and Quality in the Industrial Sector (ATYCA) of the Ministry of Industry and Energy, several projects were implemented for the replacement of chlorofluorocarbons, totalling Ptas 1.6 billion in 1995.

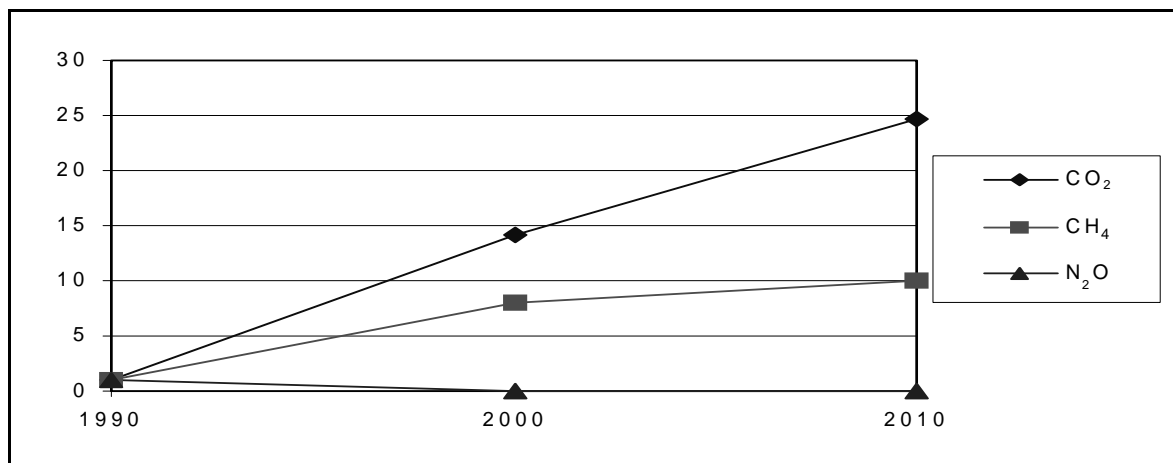
IV. PROJECTIONS AND ESTIMATES OF THE EFFECTS OF MEASURES

57. The NC2 contains projections of the three main direct greenhouse gases, CO₂, CH₄ and N₂O. When the NC2 was prepared, the forecasting group, which comprises experts from the Directorate-General of Energy, the Institute for Diversification and Saving of Energy and the Ministry of Economy and Finance, were preparing a new set of projections of energy-related CO₂ emissions using the MED-PRO model (MEDEE family). These projections extend to 2020 and include a baseline scenario, BASE, and three other scenarios. A provisional simulation of the BASE scenario was completed between NC2 and its in-depth review. The NC2 projections were presented relative to 1990 emissions levels estimated in the national GHG inventory. The team noted that there was a great improvement in projections between the NC1 and the NC2, in that the three main GHGs were included, as well as data for 2000 and 2010 and for carbon sinks. Since publication of the NC2, projections data have changed, taking into account recent growth rates and economic trends within the EC, especially due to Spain's adoption of EC policies. As a result, the projections have also been revised and updated. Projected estimates of HFC and PFC emissions for 2000 and 2010 were provided during the review. Two documents prepared by the forecasting group of the Ministry of Industry and Energy, containing details of energy-related emission projections were also made available, namely, Provisional Simulation of the BASE scenario and an annex. These documents enhance the transparency of projections in Spain and illustrate that much work has been done in improving projection methodologies and results since publication of the NC1.

58. Projections presented in the NC2 indicate that CO₂ emissions will increase by 14 per cent and 24.7 per cent in 2000 and 2010, respectively, over 1990 levels. CH₄ emissions are projected (see figure IV) to increase by 8 per cent and 10 per cent over 1990 levels in 2000 and 2010, but after 2000, the rate of increase is expected to be less marked than in the 1990-2000 period. N₂O emissions are projected to remain at 1990 levels until 2010. HFC emissions are not shown

but have been projected to double by 2010 to 10,300 Gg while PFCs would be reduced by 44 per cent from their 1990 level, to 2,500 Gg.

Figure IV. Projections of the main GHGs, percentage change from 1990



59. The new energy-related CO₂ projections were prepared by the forecasting group. The provisional simulation of the BASE scenario indicates that CO₂ emissions from the energy combustion subcategory will increase by 19.8 per cent and by 25.7 per cent in 2000 and 2010, respectively, over 1990 levels. During the review, the team learned that these CO₂ emissions are modelled using a model belonging to the MEDEE family called MED-PRO, which simulates final long-term energy demand. Separate consideration is given to CH₄, N₂O and the new gases, where projections are based on simple trend analysis and expert knowledge and input from various ministries.

60. MED-PRO is a very complex model, comprising 450 equations, which take 900 variables into consideration. The team noted that the energy-related CO₂ projections are based on robust procedures, involving good modelling practices and an extensive and highly disaggregated information base covering the major fuel types (coal, oil, nuclear and natural gas) and primary end-use sectors which form five submodules for industry, transport, the residential sector, services and agriculture. The results of this bottom-up model are used to estimate energy demand growth for all sectors. After this exercise is completed, total energy demand is translated into an energy transformation submodule for electricity and oil refineries and, finally, energy supply needs and their corresponding CO₂ emissions are calculated. While the model is considered to be very reliable in projecting energy demand, it is limited in its ability to simulate technological and regulatory changes. It is therefore necessary to run other scenarios using the same model and taking into account these variables as well as the effects of environmental regulation on future energy consumption and the inherent uncertainties associated with a unified Europe and its effects on the world economy.

61. The projections obtained from the MED-PRO model for electricity in the BASE scenario were checked against results obtained from independent forecasting studies carried out by technicians of the Commission for the National Electricity System, using an econometric model which projects electricity demand for 2000. Other studies used for the projections include the forecasting studies of the European Commission (European Energy 2020 - A Scenario Approach), the Energy Conservation and Efficiency Plan and the National Energy Plan 1991-2000. On the basis of all these studies, four energy demand scenarios have been defined. The first is the baseline or reference scenario (BASE). The second assumes a low energy demand (DEBA), the third assumes energy demand with minimum environmental impacts (MIMA) and the fourth strong economic growth (MERI). The primary difference among the four is the changing value of GDP, assumptions on the energy market, technological development and energy prices applied during the period analysed.

62. While the key assumptions associated with each scenario were presented in the NC2, a considerable amount of additional information was presented during the review week to fill data gaps. The principal assumptions are built around macroeconomic variables. The BASE scenario assumes that by 2000 Spain will be fully integrated into the EC, in terms of having harmonized monetary and economic policies. With this is associated high GDP growth, in real terms, of 3.1 per cent between 1995 and 2000, 2.2 per cent from 2000 to 2010, 2.5 per cent between 2010 and 2015, and 2.9 per cent from 2015 to 2020. Average annual economic growth within the EC in real terms is set at 2.9 per cent in the period 1995-2000, 2.4 per cent from 2000 to 2005, 2.2 per cent from 2005 to 2010, 1.9 per cent from 2010 to 2015 and 1.8 per cent from 2015 to 2020.

63. Crude oil prices are assumed to increase asymptotically in real terms, with an annual growth of 1.98 per cent from US\$ 15 in 1995 to US\$ 31 in 2020, most of the oil being supplied by the Middle East. Gas prices are maintained below the price of petroleum products during the projected period, with an average annual growth rate of 1.97 per cent (in pesetas) until 2020. However, growth in gas demand is expected to exceed that of oil demand. Coal prices are assumed to increase at only 1.26 per cent annually until 2020. Spain's main economic problem, unemployment, is expected to fall gradually from around 23 per cent in 1995 to 12 per cent by 2020. Inflation is projected to increase at the same rate as the EC average as a result of more costly primary commodities and increased economic activity. Other economic indicators such as fiscal policy are projected to be maintained without much change, as the public deficit continues to decrease while maintaining low interest rates.

64. For the projection, population figures from the National Institute of Statistics were used, with an average annual growth rate of 0.1 per cent between 1995 and 2010, followed by a slight reduction. One of the more important energy-related assumptions relates to decreasing taxes on the final price of energy products to the industrial and transport sectors. In the BASE scenario, environmental assumptions relate to international legislation and norms of the EC which are expected to affect energy consumption.

65. Efficiency improvements are expected in industry as most processes become fully automated and electricity and natural gas replace oil and coal. For households, electricity consumption is projected to drop as more efficient appliances are introduced through the equipment labelling programme, and saturation levels are reached by 2010. Coal and oil used for domestic heating are also assumed to be gradually replaced by natural gas. Energy efficient lighting in homes and streets is assumed to replace current incandescent light bulbs and in transport greater fuel efficiency is assumed over the forecasting period.

66. Under the BASE scenario, energy intensity in industry continues to fall for certain products such as aluminium, iron and chemicals, thereby maintaining a moderate increase in energy use, while a marked increase in energy consumption is projected in the services sector. In transport, the number of road vehicles, which tripled between 1975 and 1995, is expected to continue this trend at least until 2005.

67. Taking into account all the above trends, Spain would be emitting 21 per cent more GHGs than in 1990 by the year 2010. The BASE scenario does not include the law on the electricity sector (Law 54/1997), which stipulates that by 2010 renewable energy should account for a minimum of 12 per cent of total electricity supply.

68. Modelling results show that in 2020 total final energy consumption rises to 103,715 million toe, signifying a 1.5 per cent annual increase between 1995 and 2020, while GDP grows at 2.6 per cent annually and the energy intensity of the economy decreases in the same period.

69. In the first in-depth review, it was indicated that CO₂ sequestration would increase from 23,170 Gg in 1990 to 25,700 Gg in 2000. Preliminary projections for 2005 and 2010 indicated a CO₂ uptake of 26,000 Gg and 27,900 Gg, respectively. No new figures were presented in the NC2 and, at the time of the review, officials were still working on these emission estimates.

70. Projections of CH₄ and N₂O were based only on a simple trend analysis. It is expected that in the near future, some modelling may be done to determine future emissions of these gases.

71. The review team felt that the projections of energy-related emissions had improved substantially. However, it was the opinion of the team that a detailed assessment of the validity of the models and other support tools may be useful so as to identify any improvements that may be needed for better estimating GHG emissions. The model used seems to be reliable, but it would have been helpful to include information about it in the communication (type of model, level of sectoral disaggregation, definition of macroeconomics parameters, elasticity of demand for different transport categories and hence the likely effectiveness of transport sector strategies and effects of the PAEE energy saving strategy). Nevertheless, the team received this information during the NC2 in-depth review. Despite the fact that the creation of the National Climate Council has largely improved coordination, the members of the team reached the

conclusion that better coordination among the different sectors and experts involved in projecting future GHG emissions is still desirable.

V. EXPECTED IMPACTS OF CLIMATE CHANGE AND ADAPTATION MEASURES

72. Spain conducts periodic studies on the possible impacts of climate change on its territory, mainly based on the Global Hadley Center model outputs (HadCM2 experiments). It also uses global models which simulate the global effects of climate change. The results of these modelling activities are still preliminary. However, scenarios to date suggest that for changes in average temperatures and precipitation levels there are associated negative impacts. These include soil degradation and desertification, associated with increased severity and duration of seasonal droughts and Mediterranean storm flooding.

73. In 1996 the Ministry of Agriculture, Fishery and Food initiated the second characterization of the agro climate in Spain, by means of the use of the up-to-date climate data provided by the National Institute of Meteorology. Besides being necessary for programming agricultural productions, this characterization becomes an important tool for highlighting those agricultural areas which are most susceptible to soil erosion. Regarding GHG emissions, it is also useful in the designing of good agricultural practice guidance which, among other advantages, helps to reduce the use of nitrogen fertilizers and consequently the production of N₂O emissions. Moreover, the agro climate characterization studies may constitute an additional variable in the research programme on the impacts of climate change on agriculture.

74. The consideration of climate change impacts has not yet led to specific adaptation measures in most sectors. However, an area potentially vulnerable to the effects of climate change is the coastal zone, where sea level rise or changes in wave height or direction can lead to accelerated erosion rates in the Mediterranean coast. A coastal zone plan has been developed which includes, among other things, rehabilitation of the coastline in the provinces of Huelva and Castellón, which are considered to be the areas that would be most affected by sea-level rise.

VI. RESEARCH AND SYSTEMATIC OBSERVATION

75. Funds are available from a variety of government departments and from the EC for both national and international projects on systematic observation. Research efforts are also geared to EC programmes such as the ENVIRONMENT AND CLIMATE, JOULE and THERMIE research and technological development programmes. In addition, work has been carried out under the Fourth Framework Programme of the EC, in conjunction with national universities and Spain's public research centres, concentrating on the basic processes of climate change, past climate systems, and the associated hydrological risks. The National Research and Development Programme on Climate, which will run from 1996 to 1999, will provide scientists with a more comprehensive database for understanding and characterizing the climate system. Spain is involved in the International Geosphere-Biosphere Programme and the World Climate Research Programme as well as the EC Global Change Research Network. Spain continues to expand its vast systematic observation network. In 1997 the synoptic observation network have 89 surface

stations, 7 upper air stations, 238 automatic weather stations and 13 weather radar, mostly located along the coastline.

VII. FINANCIAL ASSISTANCE AND TECHNOLOGY TRANSFER

76. With regard to official development assistance, Spain is making steady progress towards achieving the United Nations recommended target of 0.7 per cent of gross national product. In 1997, Ptas 190.4 billion or 0.24 per cent of GDP was allocated to overseas aid, compared to Ptas 168.1 billion or 0.24 per cent of GDP in 1995.

77. Spain's bilateral aid programme in the 1994-1995 period specifically related to climate change mitigation and adaptation amounted to Ptas 5 billion. Most of these projects were in the area of renewable energy and energy efficiency, reforestation and soil conservation in developing countries in Latin America, Africa, the Middle East and the Asia-Pacific region.

78. Spain is also a member of the Global Environment Facility. For the period 1994-1997, Spain contributed Ptas 12.36 million of special drawing rights, equivalent to approximately Ptas 2 billion. For the replenishment budget, Spain has contributed some Ptas 3.5 billion.

VIII. EDUCATION, TRAINING AND PUBLIC AWARENESS

79. The National Centre for Environmental Education, within the Ministry of the Environment (MIMAM), coordinates the preparation and dissemination of educational material intended to inform the general public on global environmental issues and enhance their role in taking responsible action. Of particular importance are the 40 training courses and seminars conducted annually by the Ministry of Education and Culture in collaboration with MIMAM, covering several topics, including strategies and techniques applied for environmental protection. Already, Ptas 20 million have been spent annually on these programmes. The Ministry of Energy is also involved in other public awareness activities and preparing educational material on energy efficiency and energy conservation. In 1997, approximately Ptas 70 million have been spent by IDAE on producing publications on energy efficiency and renewable energies.

IX. CONCLUSIONS

80. Spain, as a member of the EC, had an objective to limit the growth of CO₂ emissions to 20 per cent between 1990 and 2000 (25 % growth for energy-related CO₂). In 1995, as a result of economic recession and reduced energy use, CO₂ emissions increased less than expected, allowing Spain to lower its CO₂ emissions target for 2000 to an increase of 13-15 per cent over the 1990 level rather than 20 per cent. Between 1990 and 1995, total CO₂ emissions increased by 9.4 per cent. CH₄ emissions increased by 8.7 per cent and N₂O emissions decreased by 5.2 per cent. Recent projections indicate that CO₂ emissions may be 14.1 per cent higher by 2000 and 24.7 per cent higher in 2010 compared to 1990 levels. A modest increase of 8 per cent and 10 per cent over the 1990 level is projected for CH₄ emissions in 2000 and 2010

respectively, while N₂O emissions are expected to be maintained at 1990 levels in 2000 and 2010.

81. The review team felt that, while the basic activity data for compilation of the GHG inventory and projections presented in the NC2 have not as yet been fully adapted to the IPCC Guidelines, several studies are under way to address these small deficiencies. The team also noted that the limited coordination between institutions, which was mentioned in the first in-depth review report, remains a problem. This partly explains the many data gaps in the NC2 and the inability to follow the IPCC Guidelines, especially in the GHG inventory and projections sections. The establishment of four working groups of the National Climate Council (on industry and energy, transportation, agriculture and environment, and institutional relationships) may play an important role in improving coordination among agencies.

82. The Spanish team is aware that the fulfilment of their national target of limiting GHG emissions in 2000 to a level 12 per cent over the 1990 level will only be possible by adopting a whole range of additional policies and measures. It is for that reason that the Government has drawn up the Spanish Climate Change Strategy, which in the energy sector is aimed at strengthening voluntary agreements with industry, pursuing coal-to-gas fuel substitution in the power sector and boosting the market penetration of renewables to at least 12 per cent by 2010. The rebound effects associated with liberalization of the power sector have not been studied but the review team felt that a lowering of electricity tariffs may lead to more consumption of electricity and as a result more emissions. In addition, there were no clear policies for reducing emissions from the transport sector. The team felt that current transport policies may have to be strengthened considerably for visible reductions in emissions to be achieved. The Strategy also contains guidelines for monitoring the mitigation effects of existing and future measures across all sectors. In so doing, the effectiveness of measures will be assessed periodically to ascertain their performance.

83. Spain has witnessed a significant improvement in its economic growth and standard of living in recent years. One repercussion of this has been increased GHG emissions in the transport, industry and residential sectors. Growth of GHG emissions in the energy supply sector has been diminished, owing to the progressive replacement of coal with natural gas in power generation and the high proportion of nuclear power in its energy balance, and increased use of the combined cycle. If energy growth in the transport, industry and residential sectors is not addressed in the near future, and natural gas is earmarked to substitute nuclear power in the medium term, GHG emissions may increase to higher-than-projected levels.

84. Spain's work on the potential effects of climate change is reflected in the concerns that it has about possible impacts on agriculture and a diminution of the natural recharge of reservoirs, a reduction in the output of hydroelectric plants, deterioration in water quality, sea-level rise, eroding coastlines and a possible reduction of tourist flows to the country. Spain has every incentive to strengthen its current efforts at reducing GHG emissions, given its long list of possible effects of climate change.

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