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

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I. INTRODUCTION AND NATIONAL CIRCUMSTANCES

1. France ratified the United Nations Framework Convention on Climate Change (UNFCCC) on 25 March 1994. Its first national communication (NC1) was received by the secretariat in February 1995 and its second national communication (NC2) was submitted in November 1997. In general, the NC2 covered the main requirements of the UNFCCC reporting guidelines.
2. The in-depth review was carried out between March 1998 and December 1999 and included a review team visit to Paris from 23 to 26 March 1998. The team consisted of Mr. Thiam Amadou (Senegal), Ms. Pascale Collas (Canada), Ms. Jane Ellis International Energy Agency (IEA) and Mr. Vitaly Matsarski (UNFCCC secretariat, coordinator). During the visit, the team met officials from government ministries and agencies, and representatives of environmental non-governmental organizations and industry.
3. France is located in the west of Europe and is situated between the Atlantic and the Mediterranean Sea. It is the largest country in the European Community (EC), with an area of 550,000 square kilometres, and has varied geographic characteristics. There are two mountain barriers in the east and south, namely, the Alps and the Pyrenées. These factors lead to regional variation in climatic conditions. The west is relatively temperate, with lower contrasts between winter and summer temperatures than elsewhere in the country. The east has a continental climate with harsh winters, hot summers and frequent storms. The south of France has a Mediterranean climate with dry warm summers, heavy precipitation in spring and autumn, and mild winters. The average temperature varies from about 10°C in eastern France to 15°C in south-eastern France.
4. In 1996 France's population was over 58 million. The population has been growing since 1970 at about 0.5 per cent annually and is mostly concentrated in cities, industrial centres and also along the Mediterranean coast. France has 3,200 kilometres of coastline, making it potentially vulnerable to sea level rise.
5. Farmland and forests cover 80 per cent of the land area. Over the period 1970 to 1995, the area of land devoted to agriculture decreased by 7 per cent; the area of permanent grassland has declined as cereal, oilseed and protein crops have grown in importance.
6. France is a presidential republic with an elected parliament and a government appointed by the President. The parliament holds legislative power, whilst the government proposes laws and ordinances. Since the early 1980s the central government has decentralized some authority to local levels, for example for urban transport and waste. There are 22 regions, 95 districts and 36,560 communes.
7. France is a highly industrialized country. Income, measured as gross domestic product (GDP), has trended upward since 1970 with a general trend away from manufacturing such that by 1995 services accounted for almost two thirds of GDP. Structural changes in industrial patterns, especially a reduction in heavy industry, as well as public policies aimed at saving

energy in order to mitigate the impact of the two oil shocks, have resulted in a reduction in energy intensity since the 1970s. In addition, the large-scale move toward nuclear power has resulted in emissions per capita being relatively low and officials noted that, consequently, the cost of greenhouse gas (GHG) mitigation in France is relatively high. Further increases in energy tax levels may have limited impact on demand, so efforts focus more on regulations to encourage more efficient use of energy in buildings, especially for heating, promotion of renewable energy sources, development of cogeneration and voluntary agreements with industry. France is an advocate of closer harmonization of tax and other policies and measures related to climate change mitigation between Annex I Parties to the UNFCCC.

8. Since the 1970s, France has made major investments in the construction of nuclear power stations, which has made it significantly less dependent on imported fossil fuel. By 1995 nuclear energy provided over 72 per cent of electricity production. According to the NC2, in 1995, oil accounted for 41 per cent, electricity 38 per cent, gas 13 per cent, coal 6 per cent and renewable energy almost 2 per cent of energy consumption. Coal consumption has experienced a significant decline for electricity generation since the nuclear programme began, but natural gas consumption has been increasing. The transport sector has grown in recent years and it accounted for over a quarter of energy consumption in 1995, more than the industrial sector. The residential and commercial sectors combined account for 45 per cent and this share is expected to continue growing.

9. Average housing space (square metres per dwelling) is increasing, whilst average household size (number of people per dwelling) is decreasing. This increases average heating requirements. By 1993 over three quarters of households owned at least one car. France has a well developed urban transport infrastructure and high-speed rail network. Passenger car and freight vehicle usage has increased, whilst demand for public transport, since the 1980s, has changed little.

10. France launched its climate change abatement strategy in the early 1990s, with the objective of limiting per capita carbon dioxide (CO₂) emissions to no more than 2 tonnes of carbon by 2000. This was set in the context of a EC commitment to stabilize CO₂ emissions at 1990 levels by 2000 for the EC as a whole. For the purposes of the EC burden-sharing agreement under Article 4 of the Kyoto Protocol, in June 1998 France agreed that emissions of the six GHGs under the Kyoto Protocol would be stabilized at the 1990 level over the period 2008 to 2012.

11. Climate change related policies in France are coordinated by the *Mission interministérielle de l'effet de serre* (Inter-ministerial Committee on the Greenhouse Effect). This committee is now part of the Office of the Prime Minister which, in the opinion of government officials, should assist in promoting climate change policies more vigorously and successfully.

II. INVENTORIES OF ANTHROPOGENIC EMISSIONS AND REMOVALS

12. The NC2 provides inventory data in accordance with the 1996 Intergovernmental Panel on Climate Change (IPCC) summary reporting format for the direct greenhouse gases, carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). It also quantifies emissions of the indirect gases, nitrogen oxides (NO_x), carbon monoxide (CO), non-methane volatile organic compounds (NMVOCs) and sulphur dioxide (SO₂) for 1990 to 1995 inclusive on a gas-by-gas basis. In addition, the direct gases are also presented in aggregate using 100 year global warming potentials (GWPs). Estimates of CO₂ sequestration and emissions from international marine and air transport are reported separately, as required by the UNFCCC reporting guidelines. Additional information for 1996 and 1997 was provided during and after the review along with updated data for the years 1990 to 1995. The latest available emission data are used in this report.

13. The NC2 does not contain data for the "new gases". An inventory for perfluorinated hydrocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF₆) was conducted in 1997 and submitted to the secretariat and these data are shown below.

14. Officials have constructed two inventories, one for continental France and one for overseas districts and territories. The figures presented below aggregate these two inventories. Estimated emissions from French overseas departments and territories account for less than 2 per cent of the aggregate. The inventory covers Guadeloupe, Martinique, French Guiana, Reunion, Mayotte, New Caledonia, French Polynesia and Wallis and Futuna. For these areas, data are more limited than for metropolitan France, so the same methodologies for emission estimation could not be applied in many cases. For the same reason the uncertainty of emission estimates is likely to be higher.

15. France uses the CORINAIR methodology to prepare its inventory. French inventory experts noted that almost without exception the detail is sufficient in this approach to achieve compatibility with the requirements of the 1996 IPCC inventory guidelines. An interface has been developed to ensure that the CORINAIR results can be presented in accordance with the IPCC reporting format. In the case of CO₂ emissions from fuel combustion, the inventory relies upon default values, but to a large extent national emission factors are used in preference to default values for other sources. For some sources of N₂O, SO₂, NO_x and NMVOCs direct measurements of emissions have been used in the inventory.

16. There has been no analysis of the uncertainty associated with the estimation of the emissions of different gases. The officials noted however that estimates of CO₂ emissions from fuel combustion have an uncertainty of around 5 per cent. Estimates of CH₄ and N₂O are considered to be 'not very accurate', especially for emissions from agriculture and landfills.

17. On a CO₂ equivalent basis, in 1997, CO₂ accounted for about 68 per cent of total aggregated GHG emissions, N₂O 19 per cent, CH₄ 11 per cent, HFCs less than 1 per cent and PFCs and SF₆ less than half of 1 per cent each.

18. The French inventory does not include any adjustments for temperature or other factors. Studies have shown little correlation between temperature, energy use and emissions, primarily due to the significant role of nuclear energy in electricity generation and electricity in space heating.

A. Carbon dioxide

19. As observed in figure I, CO₂ emissions increased by 2 per cent between 1990 and 1997. The trend in overall CO₂ emissions is, in part, explained by the economic cycle as there was a slowdown of activity followed by recession in 1993. Another factor affecting the trend in CO₂ emissions is the greater availability of nuclear power after 1992.

20. As in the majority of Annex I Parties, fossil fuel combustion is the most significant source of CO₂ emissions, but the breakdown within this category is atypical of Annex I Parties because a large part of France's electricity demand is met by nuclear power. Although emissions from power generation have declined, this decrease has been offset by growing transport emissions, whilst industry and other sectors' emissions have been broadly stable over time.

Table 1. Carbon dioxide emissions and removals, by sector, 1990-1997 (Gg)

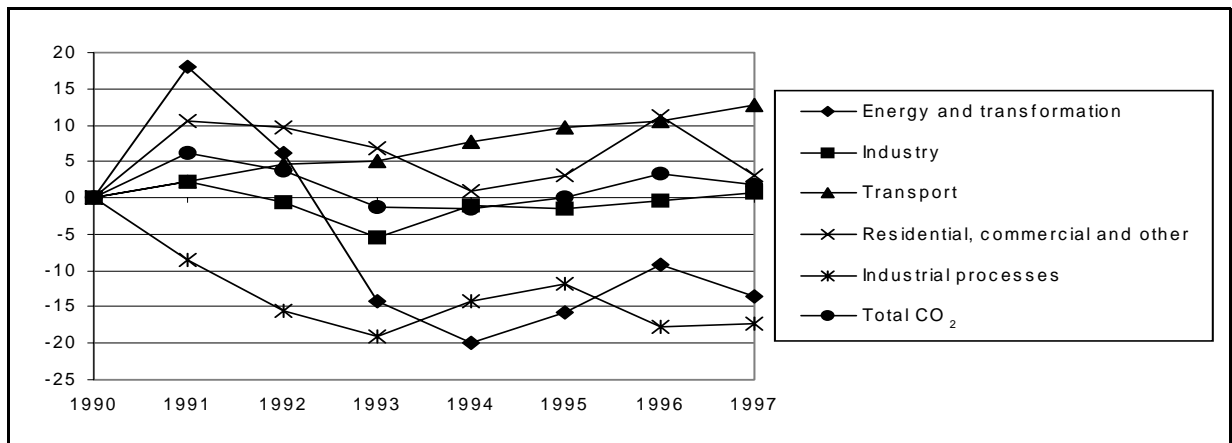
	1990	1991	1992	1993	1994	1995	1996	1997
Energy and transformation	65 495	77 232	69 530	56 161	52 439	55 169	59 476	56 654
Industry	82 266	84 097	81 660	77 694	81 418	81 043	81 883	82 917
Transport	122 566	125 153	128 302	128 727	132 106	134 384	135 592	138 144
Residential, commercial and other sectors	93 987	103 844	103 038	100 465	94 738	96 820	104 498	96 824
Fugitive	4 304	4 597	4 386	4 595	4 456	3 871	4 005	4 237
Industrial processes	21 211	19 379	17 904	17 150	18 204	18 685	17 429	17 543
Solvent and other product use	2 189	2 108	2 065	1 962	2 010	2 029	2 022	2 063
Waste	3 485	3 525	3 637	3 667	3 845	3 850	3 859	3 856
Total	395 506	419 935	410 523	390 419	389 215	395 852	408 764	402 237
Land-use change and forestry	-59 617	-56 488	-61 246	-65 865	-67 495	-65 615	-67 197	-67 772
International bunkers	16 384	16 230	17 287	17 210	16 786	16 896	17 833	18 803

21. The CORINAIR approach used to estimate GHG emissions from energy corresponds to the IPCC sectoral approach. A comparison has been conducted between the IPCC reference approach and the sectoral approach to CO₂ estimation. It was found that for 1990 to 1997 these estimates differed by only 0.3 to 2.7 per cent and in most years the difference was less than 1 per cent.

22. The most recent estimate of total CO₂ emissions for 1990 is 6 per cent higher than the estimate in the NC1. Previously there was no estimate of emissions from solvents and other product use. (In the NC1 emissions from energy transformation were estimated to be 60,813 Gg, industry 71,056 Gg, transport 128,124 Gg, fugitive 181 Gg, industrial processes 16,695 Gg, waste 8,038 Gg and sequestration by land-use change and forestry (LUCF) -32,168 Gg.)

23. CO₂ emissions from international bunkers remained relatively stable until the mid-1990s but exhibited a tendency to grow after that. In 1997 they were about 15 per cent higher than in 1990.

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



24. CO₂ sequestration increased 14 per cent between 1990 and 1997 to reach a level equivalent to 17 per cent of total CO₂ emissions. The increase was due to increasing annual biomass production and a reduction in harvesting. It should be noted that 1990 was a peak year for timber harvesting thus resulting in a lower amount of sequestration than otherwise. The sequestration estimates are based on data from a forest inventory which involves surveys that cover the complete forest on a 10-year cycle. An adjustment is made for that part of the tree below 7 cm in diameter not included in the forest inventory. An annual 1.6 per cent growth rate for the forest is assumed. The inventory experts noted that uncertainties in the forest volume and growth rate affect the uncertainty of the sequestration estimated. It has been estimated that a further 1,000 to 2,000 Gg may be sequestered in soils annually. The soil carbon estimate was based on measurements of soil carbon content at various sites, resulting in an average estimate of 80 tonnes of carbon per hectare.

B. Methane

25. Emissions of CH₄ decreased by over 13 per cent between 1990 and 1997. Agriculture was the most important source, accounting for about 59 per cent of CH₄ emissions in 1997. These emissions are mainly attributable to livestock. An increase in emissions from animal waste over the period was offset by a reduction in emissions from enteric fermentation. Fugitive emissions are relatively low due to an extensive mine closure programme launched in the 1970s and improvements in the gas distribution network. The policy, initiated in 1992, to limit landfilling was at the origin of the downward trend observed in emissions from waste. The emission estimate takes into account the fact that only half the waste placed in non-compacted dumps undergoes anaerobic decomposition, whereas waste placed in compacted dumps will decompose under fully anaerobic conditions. A value for the organic content of waste is based

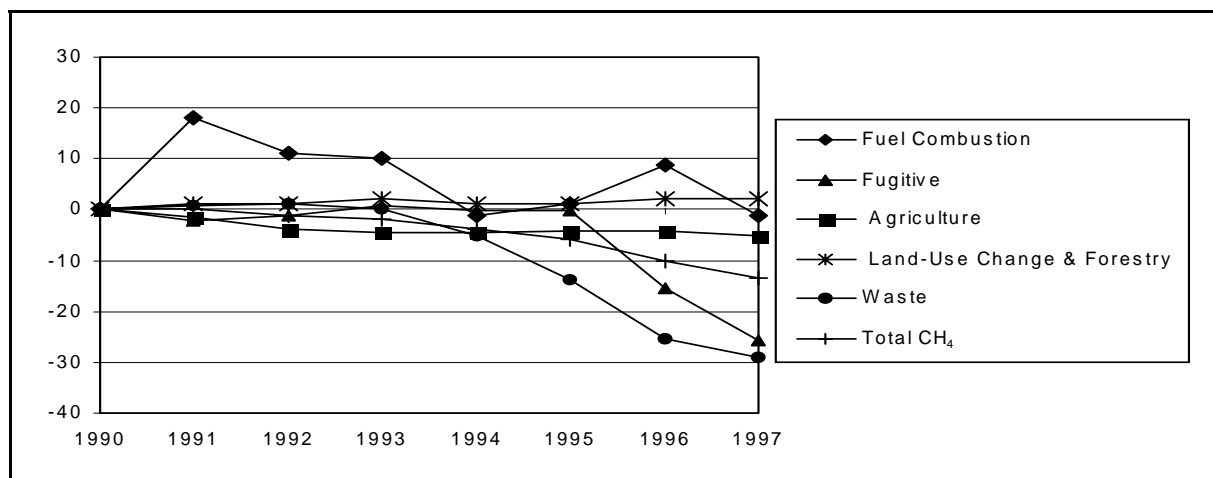
on survey information. It is further assumed that waste produces CH₄ for a period of 30 years. More information is available on municipal waste than on industrial waste for the inventory calculations.

26. Compared to the NC1, there has only been a very modest increase of 127 Gg in the estimate of total CH₄ emissions for 1990 and underlying this no significant changes to any particular source other than land-use change and forestry, which has increased from almost zero in the NC1.

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

	1990	1991	1992	1993	1994	1995	1996	1997
Fuel combustion	161	190	179	177	159	163	175	159
Fugitive fuel emissions	311	304	307	314	310	310	263	231
Industrial processes	3	2	2	2	2	3	3	3
Agriculture	1 631	1 604	1 570	1 557	1 555	1 564	1 565	1 547
Land use change & forestry	99	100	100	101	100	100	101	101
Waste	819	826	828	820	778	707	612	580
Total	3 023	3 025	2 987	2 972	2 905	2 846	2 719	2 619

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



C. Nitrous oxide

27. Emissions of N₂O decreased by almost 2 per cent over the period 1990 to 1997. The agricultural sector is the most important source of N₂O emissions. Industrial processes are also important, with emissions resulting from the production of adipic and nitric acid and releases from denitrification facilities.

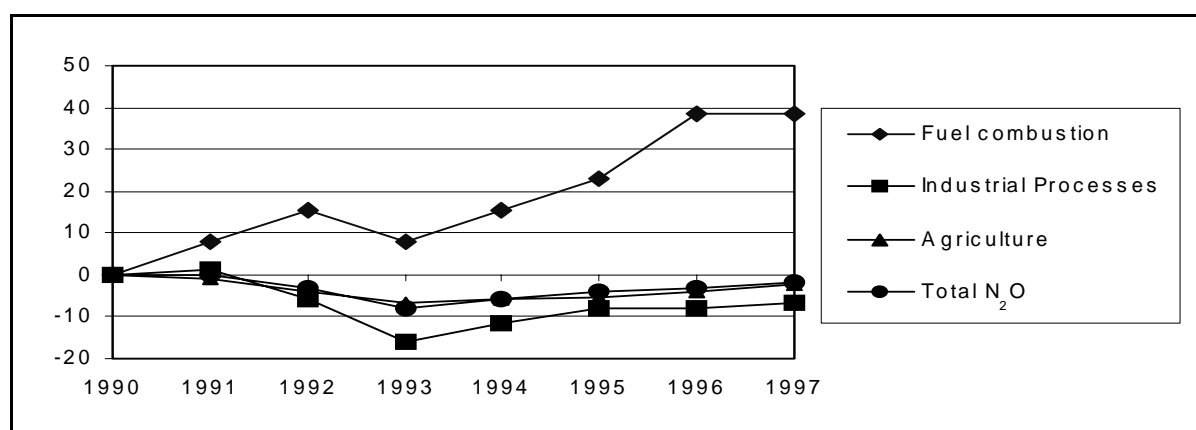
28. In comparison with the NC1, the estimate of total N₂O emissions has increased by 128 Gg or 72 per cent. Underlying this change, emissions from agriculture, which were estimated in

the NC2 according to the IPCC 1996 Revised Guidelines, have approximately tripled. Furthermore, emissions from LUCF were not estimated for the NC1.

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

	1990	1991	1992	1993	1994	1995	1996	1997
Fuel combustion	13	14	15	14	15	16	18	18
Industrial processes	87	88	82	73	77	80	80	81
Solvent and other product use	2	2	2	2	2	2	2	2
Agriculture	182	180	175	170	171	172	175	178
Land-use change and forestry	18	18	18	18	18	18	18	18
Waste	3	3	3	3	3	3	3	3
Total	305	305	295	281	287	292	296	300

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



D. New gases

29. Over the period 1990 to 1997, based on CO₂ equivalent data, emissions of HFCs increased by about 74 per cent, whilst emissions of PFCs and SF₆ fell by 47 per cent and almost 10 per cent respectively. HFCs are mostly used as replacements for chlorofluorocarbons controlled by the Montreal Protocol and are found in refrigerating and air-conditioning units and aerosols. PFC emissions are generated by the production of aluminium and are used in production processes by the electronics industry. The inventory includes SF₆ emissions from magnesium production and from its use by the electronics and metals industries.

Table 4. New gas emissions, on a CO₂ equivalent basis, 1990 to 1997 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997
HFCs	2 200	1 500	1 000	800	900	1 600	2 700	3 900
PFCs	3 000	2 300	2 000	1 400	1 200	1 300	1 500	1 600
SF ₆	2 500	2 400	2 400	2 400	2 400	2 300	2 300	2 200

III. POLICIES AND MEASURES

30. Policies and measures to mitigate CO₂, CH₄ and N₂O emissions are well described in the NC2. It usefully provides summary information in a tabular format as required by the UNFCCC reporting guidelines, including the estimated effects of policies and measures, although it is not always easy to link the information in the text with that in the table. Limited information is provided on the cost of policies and measures. The NC2 also describes several policies which may lead to greater levels of GHG emissions than would otherwise occur. There is much continuity in the implementation of policies and measures over time as many of the policies in the NC2 are also described in the NC1. It was noted during the review that France intended to conduct a thorough assessment of all its policies related to climate change mitigation as a follow-up to its commitments under the Kyoto Protocol.

A. Energy and transformation

31. The French Government controls and regulates the energy supply industries, in particular the electricity and gas sectors. *Electricité de France* (EdF) has monopoly rights over imports, exports and transmission of electricity, and *Gaz de France* (GdF) has exclusive rights over imports, exports, transportation and distribution of natural gas. The review team were informed that privatization of these sectors is not envisaged although some liberalization may occur to bring energy policies into line with the directives of the EC. The decision-making process related to energy policies is highly centralized and fully controlled by the Government, although some measures make this process more open and transparent. For example, recent publications, such as *La Maîtrise de l'énergie* prepared in 1998 by the Inter-Agency Committee on the Evaluation of Public Policies, or *Énergie 2010-2020* contribute to involving the general public in the debate on future energy policies.

32. France's electricity supply is dominated by nuclear power, which is not associated with direct GHG emissions. The 378 TWh of electricity produced by nuclear power in 1996 covered more than 74 per cent of the country's electricity needs. The nuclear infrastructure programme for the period 1990 to 2000 planned an additional 13,600 MW in generating capacity maintaining an overcapacity in nuclear plants. In the near future many of the older plants will reach the end of their 30 years administrative lifetime and may need to be retired and replaced - possibly by more carbon-intensive plants. This creates a substantial uncertainty related to future trends in CO₂ emissions and is discussed in more detail in the projections section.

33. One of the measures in place that aims to reduce peak electricity demand is a system developed by the state utility, EdF, whereby electricity prices increase sharply at times of peak load. The initial target was to have 300,000 such accounts in place by the end of 1996. However, only 70,000 accounts had been opened by that time. The original target of 1,000,000 such accounts by 2000 has not been changed, but looks unlikely to be met on time, so the projected effects of this measure are likely to be smaller than those presented in the NC2.

34. France has limited reserves of natural gas and its indigenous production covers about one tenth of the consumption. The remainder is covered by imports from the Russian Federation,

Algeria, Norway and the Netherlands. Natural gas is mostly used in the residential and commercial sector and in industry. Its current share in power generation is negligible. In the residential sector, gas accounts for no more than a quarter of total final consumption, which is partly explained by the fact that electricity plays an important role in the field of residential heating. The total gas distribution network in 1997 amounted to over 28,000 km, with more than 70 per cent of the population in metropolitan France connected.

35. In general, fugitive CH₄ emissions from the gas network are low but leakages do occur, especially in cast iron pipes and due to accidental venting during operations. The French gas utility GdF has been pursuing a policy of renovating the distribution network. The replacement of metal pipes with polyethylene should reduce losses and, furthermore, efforts to improve operating procedures and safety should reduce accidental emissions. Despite the expected rapid expansion in natural gas demand, a 30 per cent reduction in leakage is estimated over the period 1990 to 2010.

36. EOLE is a policy introduced in 1996, which aims to install 250-500 MW of wind-power capacity by 2005. Projects are chosen via competitive bid processes by a selection team comprising EdF and government officials. The first competitive bid process resulted in more successful bids being retained than had been anticipated (77.5 MW compared to 50 MW), and a second bid for 100 MW was launched in spring 1998. Because of the predominantly non-fossil nature of electricity generation at present, this measure has only a limited short-term effect on greenhouse gas emission mitigation although impacts could be much larger in the longer term if it results in a significant take-up of wind electricity. These potential long-term impacts were not estimated.

37. France also encourages the use of other renewable energies, notably wood, via its *Plan bois énergie*, that aims to have approximately 250 wood heaters in place by 2000. The uptake of this technology is encouraged by capital subsidies of up to 30 per cent from the State via ADEME (*l'Agence de l'environnement et de la maîtrise de l'énergie*), and can in some cases be supplemented by regional and/or European funds. Interest in these systems has recently increased, and with 132 such systems planned, the target is likely to be met on time. European Union regulations also play an important role in wood energy use, and the recent reduction of the value added tax on wood use (5.5 per cent instead of 20.6 per cent) should help encourage its use.

38. The state policy of requiring equal electricity rates over the entire national territory means that electricity is sold below cost in Corsica and the DOM-TOM (overseas departments and territories). This policy is acknowledged as hindering the uptake of renewable electricity systems in markets where they are most cost-competitive, but EdF is not in a position to change its pricing policy for social reasons, so this cross-subsidization is expected to remain. However, the newest EOLE bid includes a ring-fenced capacity target for renewables in the DOM, and if bids are successful in this area it should go some way toward rectifying this situation.

39. The importance of coal has been decreasing in France for a number of years. About 80 per cent of the CH₄ released through coal-mining activities is captured and used for heat

generation. By 2005 coal production should cease, as government support is gradually removed, so fugitive emissions should decrease accordingly.

40. France has a long-standing public policy of energy conservation. Since 1974, a state agency, ADEME, has existed, responsible for managing energy at the national level in an optimal way. Public policy in the field of energy saving is implemented mainly in the following three directions: requirements for big energy consumers to periodically audit the conditions of their energy use; provision of subsidies for conducting studies of energy use by external consultants; and dissemination of information on optimal energy use by ADEME and its local offices.

41. Officials indicated that the agency's performance had in general been satisfactory but limited, mostly due to the decline in world energy prices in the 1990s, which was not conducive to austere energy-saving measures. It was difficult for the officials to estimate the amount of public funds spent on energy-saving programmes; nevertheless, they indicated that on the average during the years 1974-1994 it was about 1 per cent of the total cost of energy in France.

B. Transport

42. Transport is responsible for an increasing share of GHG emissions yet there are few national GHG mitigation policies and measures in this sector. This is an area where France expresses a desire for EC action in preference to domestic policies, especially since measures have been implemented to increase EC-wide competition in the freight sector. Fuel taxation is relatively high in France and further increases are not anticipated in the absence of EC action.

43. The 1996 law on air and rational energy use made it compulsory for all cities with populations in excess of 100,000 to draft urban transport plans with the intention of improving public transport and parking and, in particular, reducing traffic flows. Whilst by 2000 this was not expected to have much impact, thereafter the effect of related measures enacted by local authorities could reach up to 3,500 Gg of CO₂ mitigation annually by 2020. In Paris, when local pollution levels exceed certain thresholds, restrictions are placed on car use and free public transport is provided, which could have some impact on limiting GHG emissions.

44. As a result of technical advances and an increase in truck size, average fuel efficiency has improved in recent years, but there are no specific national measures to advance this process. Emissions from passenger cars and light trucks have also not increased at the same rate as traffic growth since 1990, reflecting the retirement of vehicles produced before the 1986 oil crisis, after which efficiency improvements were made. However, during the 1990s, it has been noted that the average fuel consumption of new cars is increasing as average weight and engine power rises. The French car manufacturers, in the context of EC-wide negotiations with European car manufacturers, have made voluntary commitments to lower CO₂ emissions from new cars to 140 g/km by 2008. The manufacturers, at the time of the review, were also negotiating with the French Government possible voluntary limits on HFC use in air-conditioning units. Under the programme of research and development for innovation and technology in road transport (PREDIT), around FF 2 billion was expected to be spent on activities related to the efficiency of new vehicles over the period 1996 to 2000.

45. About three-quarters of freight travels by road. An objective was established to double the volume of combined road-rail transport by 2000, compared to 1990. At the time of the review, for journeys over 500 km, about 13 per cent of freight traffic, in terms of freight kilometres, used this mode and this goal had already been achieved. A new goal aims to double the use of combined road-rail transport by 2002, compared to 1995 levels. The achievement of the goal, thus far, has required the expansion of the necessary infrastructure. About FF 950 million was allocated for upgrading railway lines for the 1990s and a further FF 100 million has been allocated for the period 1994 to 2000 in order to construct transfer platforms at four of the ten major combined-transport terminals, considerably more than in preceding years. In 1990 a programme began to provide cheap finance to encourage freight companies to purchase combined transport equipment. By 1996, around FF 17 million had been provided in the form of leasing at low interest rates, combined with targets and penalties if associated targets are not achieved, and investments totalling around FF 102 million had been made. Under PREDIT, around FF 400 million in public funding was allocated for the period 1996 to 2000 toward inter-modal freight transportation research.

46. The first high-speed train line was opened in 1981 and by 1991 a major plan existed for national high-speed rail links providing for 4,700 km of new lines (of which 1,260 km were operational by 1995) with annual spending at around FF 5.5 billion. Under PREDIT, between 1990 and 1994, FF 445 million was allocated specifically for research related to high-speed trains and a further FF 500 million had been allocated at the time of the review. By 2000, the diversion of air and road passengers to rail could save around 160,000 tonnes of oil equivalent or 3,700 Gg of CO₂ emissions annually.

47. Safety inspections of passenger cars covering emissions of various pollutants have been implemented since 1985, with the result that engine tuning has generally improved. Emission pollutant tests have been in existence since July 1994 for trucks. The overall efficiency of the vehicle fleet may have improved slightly as a result of such tests and hence GHG emissions may be somewhat lower as a result. Between 1994 and 1996, two different bonus schemes were employed to encourage consumers to scrap cars older than 10 then 8 years of age, which may also have improved the average efficiency of the vehicle fleet.

48. At the time of the review, efforts to promote electric cars had resulted in a few thousand being in operation, yet officials hoped that by 2000 manufacturers would be able to produce and market such cars on a larger scale. Following the 1996 law on air and rational energy use, a number of measures were implemented to foster the development of alternatively fuelled vehicles, the main measure being an exemption or reduction in company car taxation and a requirement that public managers of vehicle fleets ensure that such vehicles account for a minimum 20 per cent of purchase orders.

49. Various recent EC directives relating to standards for all new gasoline vehicles are particularly aimed at reducing NO_x emissions and, compared to 1990, could result in a 35 per cent reduction in the transport sector.

C. Residential sector

50. Nearly all of the GHG emissions attributable to the buildings sector are due to heating, given that electricity meets most other energy requirements and is primarily of nuclear origin. At the time of the review, electricity also covered about a third of heating requirements.

51. Since the first oil crisis, France has implemented various policies designed to save energy in both new and existing buildings. For new residential housing, mandatory heat insulation requirements were first applied in 1974 and have been gradually strengthened over time, whilst their scope has also widened to encompass most aspects of space and water heating. This has halved the average specific energy consumption in new housing and it is estimated that total residential heat energy consumption is now about 15 per cent lower than it would have been otherwise. Thermal insulation regulations are formulated taking into account both the investment costs and the resultant savings in energy bills. The implementation of more stringent standards for double glazing was postponed from 1997 to early 1999, at which time resultant savings of 5 to 10 per cent in the heating needs of new houses was anticipated. A 7.5 per cent energy saving in the 270,000 new houses built annually, on average, is equivalent to about 16,000 tonnes of oil equivalent.

52. Existing thermal regulatory standards applying to the commercial sector are lower than those for residential buildings. Given the large variety of building types and sectors involved, the design and revision of regulations is a complex task and their implementation has suffered delays, although regulations for non-air-conditioned and air-conditioned buildings were due to come into effect in 1999 and 2000, respectively. These regulations should save about a quarter of energy use in new buildings and, given existing construction levels, could yield an additional saving of 60,000 tonnes of oil equivalent each year. In order to encourage the construction of more energy-efficient buildings than the regulations require, between 1992 and 1997, ADEME, along with the Association of Air-conditioning, Ventilation and Refrigeration Engineers, published eight design guides relating to different industry sectors.

53. The 1996 law on air and rational energy use required a standardized estimate of annual energy costs to be provided to potential buyers or lessors of new or old commercial and residential property. However, the decree has not yet been issued to establish methods to compute these estimates.

54. About three quarters of France's 27 million residential houses and two thirds of the 720 million m², in terms of floor space, of commercial buildings were built before 1975, when the first thermal building regulations came into effect. Various policies to encourage energy efficiency measures are estimated to have resulted in a 10 per cent reduction in total heat consumption in such buildings, by the time of the review. Policies have covered the encouragement of owners to carry out improvements, regulation and standardization of energy-saving technologies and subsidy schemes. Tax credits were given between 1990 and 1995 for heat insulation improvements and boiler replacements. At the time of the review, low-income households were being provided with subsidies to improve homes over 20 years old, the National Housing Improvement Agency provided subsidies for private rental housing, and

organizations managing low-income housing over 15 years old could also benefit from state subsidies for improvement work.

55. Since 1991, each ministry has been required to implement an energy-savings programme, and, since 1995, this has been based on the criterion of investments with a six-year payback. By 2000, it is expected that this may result in a 12 per cent reduction in energy consumption, compared to 1995.

56. Market research has shown a significant potential to increase the use of wood in building construction in France and a number of initiatives were launched in 1993 to achieve this in cooperation with the National Committee for Timber Use. Regional state departments have been asked to ensure that local regulations do not discriminate against timber, some of the public housing improvement schemes use timber, and there have been various research activities. By 2000, it was anticipated that legal minimum requirements will be in place for wood use in new construction. These measures are all expected to contribute to CO₂ sequestration, given that wood use in buildings can generally be viewed as 'permanent'.

D. Industry

57. Policies and measures aiming to limit emissions from industry are based on voluntary agreements with industrial users, although limited financial incentives (e.g. tax exemptions) and research and development funds are also available and regular energy audits are carried out on large energy users. Six voluntary agreements have been signed with industry to date (mainly covering action to the end of the century), and indicate a reduction in per unit CO₂ emissions of between 5 and 19 per cent between 1990 and 2000.

58. More than three quarters of industrial CO₂ emissions are caused by a few industrial sectors in which energy is a major cost component, including the production of non-ferrous metals, iron and steel, building materials, paper, glass and chemicals. Given the potential harmful effect to competition of measures in these sectors which would raise industry costs, the Government has few specific measures and instead promotes the idea of harmonized EC policies. However, at the time of the review, some sectors, accounting for about 12 per cent of total industry emissions, had signed up to voluntary agreements to reduce their CO₂ emissions per unit of production by between 5 and 19 per cent by 2000, compared to 1990 levels. In addition, an aluminium producer voluntarily agreed to reduce its emissions of carbon tetrafluoride, a PFC, by 73 per cent over this period. The chemical industry has not yet signed any voluntary agreements, although they have recently indicated an interest in doing so regarding N₂O reduction.

59. Since 1974, industrial plants consuming more than 300 tonnes of oil equivalent per annum have been required to conduct energy audits by publicly approved experts, although there has been no obligation to act on the outcome of the audits. ADEME provided support for research and development activities related to industrial energy efficiency improvement during the 1990s. Public funds have also been available for the use of consultants in measuring energy use and assistance for demonstration projects. Various tax breaks are available which may be applicable for certain energy efficiency investments.

60. Developing small, independent cogeneration units in industry and the commercial/institutional sector is a relatively recent measure, and could reduce CO₂ emissions by 1.6 Mt in the short term (to 2000) by replacing up to 1 GW of older coal-fired generation in the electricity sector.

61. Measures are in place to reduce emissions of N₂O from industry. However, some measures to reduce NO_x emissions may result in higher N₂O emissions, before counter-measures are put in place. Adipic acid production at a single site is responsible for the majority of N₂O emissions. A 1993 regulation on industrial emissions, which came into effect in 1997, should result in a 50,000 tonne annual reduction in emissions compared to actual emissions of 56,600 tonnes in 1995. Emissions from nitric acid production almost halved from 25,600 tonnes in 1990 to 13,600 tonnes in 1995 and as a result of regulations issued in 1998 were expected to fall to about 9,000 tonnes by 2000. A regulation imposed in 1996 on the company operating glyoxylic acid and glyoxal production should result in a 90 to 95 per cent reduction in N₂O emissions from this source from a level of 9,000 tonnes in 1990. Overall, industrial emissions of N₂O are expected to fall 82 per cent between 1990 and 2000.

E. Agriculture

62. The main sources of CH₄ emissions in the agricultural sector are enteric fermentation of ruminant livestock and anaerobic fermentation of animal waste from livestock production. Officials noted that limited knowledge about these emissions has been a factor in restricting policy development and hence emphasis has been placed upon research.

63. Milk production was expected to remain broadly constant over the period 1990 to 2000, but with improvements in efficiency such that overall emissions from this source could fall by 15 per cent. In contrast, changed methods in beef production and beef livestock numbers were expected to increase CH₄ emissions by about 12 per cent over this period. These changes should broadly offset one other. Pig and chicken numbers rose over the period 1990 to 1995 and were expected to continue rising up to 2000 and hence increase emissions.

64. A major programme was initiated in 1994 to reduce agricultural pollution, with particular emphasis on water pollution. As a result, there have been significant increases in waste storage facilities and changes to waste spreading practices. Consequently, the average storage time has increased, leading to higher CH₄ emissions. In areas where an excess of waste is produced, compared to spreading capacities, manure processing plants could be constructed which would lead to a reduction in emissions. Between 1990 and 2000, overall, a 28 per cent increase in CH₄ emissions from animal waste fermentation was expected, despite the general expectation that continued improvements in animal productivity would decrease waste production per animal. Underlying this figure, the increases for beef cattle, pigs and poultry were estimated at 20 per cent, 68 per cent and 65 per cent respectively.

65. Until 1993, there was an incentive for farmers to increase agricultural production, which directly impacted on CO₂ emissions from soil. A change in the price support mechanism should have reversed this trend so conversion of pastures and forest to farmland should have ceased, yet

the economic advantage associated with intensified farming is such that this has not occurred and no change was expected before 2000. However, officials noted that the latest mechanism to pay farmers for set-aside land would influence organic matter and hence emissions from soils.

66. Emissions of N_2O from soil are directly proportional to nitrogen fertilizer use and there are a number of factors influencing this in France. Total farmland will decrease in line with mandatory set-aside provisions under the Common Agricultural Policy (CAP), although about one third of this land will be used for non-food production and will still require nitrogen fertilizer application. Another reform which partially de-links subsidies from production levels should result in less intensive production and hence lower fertilizer demand. An EC directive on water pollution from nitrates in sensitive areas, amounting to about 10 million hectares in France, places a restriction of 210 units of nitrogen per hectare up to 2000 and 170 units per hectare thereafter. The 'Fertimieux' programme, implemented since 1991, is educating farmers in the best management of nitrogen fertilizer in order to reduce pollution and, by 1996, 24,000 farmers responsible for about 1.3 million hectares were participating. As a result of these changes, overall nitrogen fertilizer use fell by 10 per cent between 1990 and 1996 and by 2000 the overall reduction is expected to be 15 per cent.

F. Waste

67. In 1990, of over 20 million tonnes of municipal waste, just over half was landfilled, 9 million tonnes incinerated and the remainder composted. Twice the amount of industrial waste was produced, of which a quarter was landfilled, an undetermined amount placed in company landfills and the remainder recycled, especially in the agricultural sector. A law passed in July 1992 should radically alter this situation through the promotion of recycling, such that only what is termed 'ultimate' waste should be landfilled by 2002, that being waste that is not suitable for recycling or processing, based on best available technology not involving excessive cost. Preference will be given to incineration of waste that cannot be recycled. Subject to acceptance by the general public of incinerators being sited close to urban areas, there were plans to make use of the energy produced for district heating purposes, which could result in a saving of 2,800 Gg of CO_2 emissions by 2000. Otherwise, where the energy is only used to produce electricity this is likely to displace nuclear power generation and hence not impact on CO_2 emissions.

68. It has been estimated that the cost to local authorities of infrastructure investment to upgrade and expand waste processing plant in implementing the landfill waste law could range from FF 40 to 50 billion. To help finance these costs, a tax of FF 20 per tonne of landfilled waste was imposed, increasing to FF 35 per tonne in 1997 and FF 40 per tonne in 1998.

69. The landfill waste law should reduce the volume of waste landfilled and hence CH_4 emissions generated, resulting in estimated savings of 160 tonnes in 2000 and 580 tonnes in 2010. In addition, a ministerial order made it compulsory for all operating landfills to install CH_4 recovery and flaring systems by 1999, whereas in 1996 only about 72 landfills, accounting for around a quarter of total landfilled volume, had CH_4 recovery systems. Furthermore, ADEME has a programme to assist in the restoration of closed landfills, including the installation of CH_4

recovery equipment. All landfills closed after 1995 should have such equipment installed. These measures are estimated to result in the mitigation of 0.4 million tonnes of CH₄ in 2000 and 2010.

G. Land-use change and forestry

70. French forests have expanded since the early nineteenth century so that by 1990 they covered about 27 per cent of the land area. Since the National Forestry Fund was established in 1947, natural expansion and tree planting has averaged 63,000 hectares annually. The amount of planting subsidized by the Fund gradually fell to reach about 10,000 hectares annually by the end of the 1980s. In 1993, the Government decided to raise this rate to 30,000 hectares by 1998. In the following two years 12,000 hectares and 11,000 hectares were subsidized but, as a result of budget constraints, the objective was abandoned such that a similar planting rate would be maintained until 2000.

71. Public assistance has been available for both reforestation of forest land and expansion of the forest cover. Since 1994, the subsidy scheme has related to revenue forgone if the land has not been used for agricultural purposes, half of which has been provided by the EC in the context of CAP reforms. The scheme has been complemented with various tax breaks for farmers converting agricultural land to forest.

72. The tree planting policy resulting in higher annual biomass production, in conjunction with falling harvesting, should result in an increase in annual carbon sequestration from 44,000 Gg of CO₂ emissions in 1990 to 62,000 Gg in 2000. The impact of policies on carbon sequestration on soils is not known, although at the time of the review studies were under way.

73. Forests, particularly in southern France, are vulnerable to forest fires. Policies, including raising public awareness of how to reduce the risk of fire, the establishment of observation posts and firebreaks and the provision of firefighting teams, limit annual damage to about 0.3 per cent of forest subject to risk, compared to an EC average of over 1 per cent.

IV. PROJECTIONS AND EFFECTS OF POLICIES AND MEASURES

74. The NC2 presents projections of CO₂, CH₄ and N₂O emissions for the years 2000, 2010 and 2020 alongside actual data for 1990 and 1995. No projections for “new gases” were provided. The actual data have been temperature adjusted. If non-adjusted data were used, percentage increases in projected emissions compared to 1990 would be higher. Energy and non-energy CO₂ emission projections are shown separately. All figures presented below exclude emissions from French overseas departments and territories due to the incomplete nature of statistical data for these regions. However, the NC2 observes that emissions in these regions increased, on average, by 4.7 per cent annually between 1990 and 1995 and that this trend may be expected to continue up to 2000 at least.

75. During the visit, the team was preliminarily informed of new energy-related projections for the time horizon 2010-2020 prepared for the *Commissariat général du plan* by a special working group. The projections relating to CO₂ emissions from energy included in the NC2 were

based on preliminary results of this working group. After the visit, the secretariat received a copy of the publication *Énergie 2010-2020 (Three energy scenarios for France)*, on which the following discussion is based.

76. The first scenario (S1, “*market society*”) treats energy as a common good subject to market forces and does not envisage active intervention of the State in the energy market. The second scenario (S2, “*industrial State*”) envisages stricter state control of industrial development with priority given to regulatory actions and to careful analysis of the impact of these actions on the competitiveness and growth rates of industry. The third scenario (S3, “*State as protector of the environment*”) takes into account environmental considerations and specifically examines the conditions of the implementation of the UNFCCC and the Kyoto Protocol; it differs from scenario S2 in respect of the degree of state intervention in the control of energy demand in the context of the regulated market. Each of these three scenarios is further subdivided into versions V30 and V40, corresponding respectively to 30 or 40 years lifetime of existing nuclear power plants. Thirty years is the standard period of operation as defined by the safety authorities but it is expected that this period could be extended to 40 years, hence the need for the two versions of each energy scenario.

77. Projections of CO₂ emissions from energy are based on the results of several models. The so called DIVA model is used to illustrate, for an assumed GDP growth rate, the likely pattern of economic growth by activity sector. An energy model entitled MEDEE, based on technology and cost optimization, provides disaggregated scenarios of energy demand based on actual historical trends. These results were supplemented by simulations with the MIDAS partial equilibrium model of the energy sector.

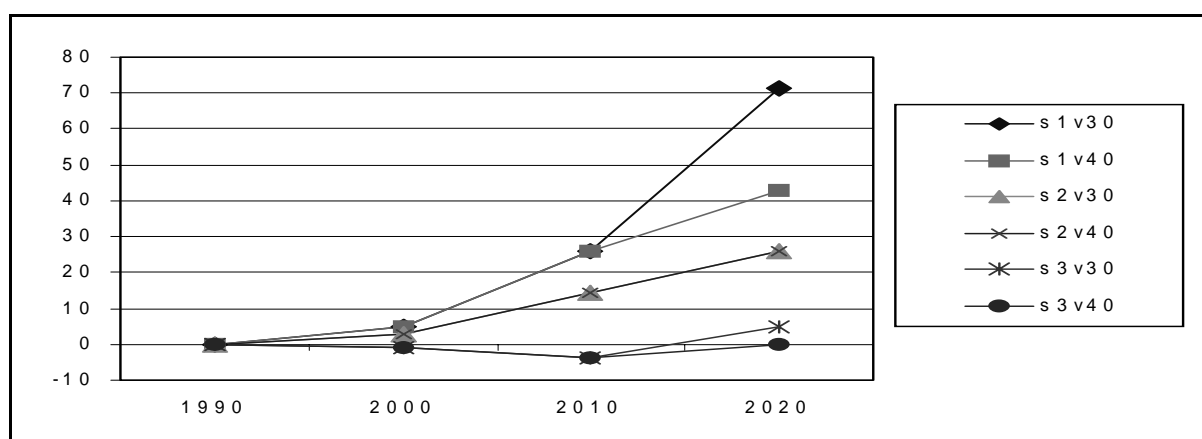
78. Underlying the projections for all scenarios is the assumption that, in real terms, world oil prices will be around the 1990 price level of about \$24 by 2005 and will remain at this level until 2020. Economic growth is estimated to be around 2.3 per cent annually up to 2020. Population is expected to grow at an uneven rate over the period (+0.5 per cent in 1995-2005, +0.4 per cent in 2005-2010, + 0.3 per cent in 2010-2015 and + 0.18 per cent in 2015-2020) to reach 63.5 million by 2020, whilst average family size declines, thereby requiring the construction of new dwellings at a rate of about 270,000 in 2000 falling to around 220,000 by 2020. This indicates that average heating requirements will be greater. In terms of annual kilometers, passenger car traffic is expected to increase by 56 per cent over the period 1990 to 2020, freight traffic by 110 per cent and transit traffic by 291 per cent. It is also expected that the road network will double between 1995 and 2020, reaching 14,000 km. Additional high-speed railways are to be constructed, about 2,000 km in 2020 (compared with 700 km in 1992).

79. The main results of the energy projections are presented in figure IV, which illustrates possible trends in future energy-related CO₂ emissions in terms of percentage change relative to 1990 (scenarios S2V30 and S2V40 coincide). It can be observed that only the “*State as protector of the environment*” scenarios or S3 would lead to emission levels below 1990 in 2010, although even these scenarios project a further increase in emissions by 2020.

80. It is projected that energy intensity in terms of energy use per unit of GDP could decrease by 6, 13 and 22 per cent in 2010, and by 22, 26 and 38 per cent in 2020 for scenarios S1, S2 and S3 respectively. According to the same scenarios, the primary consumption of coal could decline by 11, 21 and 63 per cent in 2010, and by 21, 22 and 53 per cent in 2020. In the S3 scenario, primary petrol consumption is projected to remain stable slightly above the 1990 level, whereas in the S1 and S2 scenarios it could increase by 24 and 30 per cent in 2010 and by 33 and 42 per cent in 2020 compared to 1990. Consumption of natural gas is projected to continue on the almost linear growth trend exhibited since the early 1960s up to 2010 but to increase sharply from 2010 on in the S1 scenario: almost threefold relative to the 1990 level in 2020 according to the V40 version and more than five times according to the V30 version. This is explained by the fact that after 2010 a number of nuclear power plants will reach their 30 years lifetime limit and in the S1 scenario it is envisaged that they will be replaced mainly by gas-fired plants. For this reason, the gross electricity generation of nuclear power plants is projected to decline to one seventh of its 2010 level in 2020 in S1V30, versus only a modest decline of 12 per cent in S1V40. The review team was informed that a decision on the possible extension of the lifetime of existing nuclear power plants from 30 to 40 years could be taken only after careful consideration of a number of political, economic, social and environmental factors.

81. French experts stressed that these projections serve only as an outline of possible ways for further development. They also provide an indirect assessment of the possible effects of policies and measures, since detailed projections have been prepared for individual sectors. For industry, for example, it has been estimated that its share in total CO₂ emissions would decrease from about 31 per cent in 1990 to 23-25 per cent in 2010, implying a total CO₂ reduction of 3,500 to 18,000 Gg. CO₂ emissions from transport are projected to increase in all scenarios; this increase could be in the range of 16 per cent (scenario S3) to 44 per cent (scenario S1) by 2010, and 31 per cent (S3) to 73 per cent (S1) by 2020 compared to 1990.

Figure IV. Projected energy-related CO₂ emissions, percentage change from 1990



82. Non-energy CO₂ emissions relate to industrial processes, LUCF and waste incineration. Single scenario projections were presented in the NC2 for the former whereas a ‘with’ and ‘without measures’ scenario was produced for the waste sector. Estimated emissions from

industrial processes were based on projections of activity levels used in the energy projections. Emissions from waste were based on simple trend analysis of waste production with the assumption that, without measures, the level of waste incineration would remain constant over the period 1990 to 2020. Projections for LUCF were also based on simple trend analysis, although at the time of the review work on more sophisticated methodology was being conducted.

83. Having shown a small decline between 1990 and 1995, industrial process emissions are expected to continue declining to reach 13 per cent below the 1990 level by 2000 and thereafter remain broadly stable. 'Without measures' CO₂ emissions from waste incineration are expected to show only a very slight increase over the projection period. However, 'with measures' emissions from this source can be expected to increase sevenfold by 2020 due to proposals to reduce the quantity of landfilled waste and increase incineration.

84. Having increased between 1990 and 1995, CO₂ sequestration is expected to continue increasing due to forest growth and grassland conversion, such that by 2010 it should be around 84 per cent higher than in 1990. However, officials acknowledge significant uncertainty with this figure as it is hard to estimate forest growth rates and the effect of changing silviculture practices. Consequently, projections have not been provided beyond 2010.

85. Projections of CH₄ and N₂O are only provided for the most important sectors. They are based on the energy projections, where relevant, and otherwise on simple trend analysis. For some sectors, a single scenario is provided and in other cases a 'with' and 'without measures' scenario is given. Due to uncertainties about the future of the EC common agricultural policy and whether mitigation measures will be employed in this sector, it is simply assumed that agricultural emissions will remain broadly constant over the period for both gases. In the waste sector, the 'without measures' scenario assumes the continuation of existing practices with the result that CH₄ emissions increase by two thirds between 1990 and 2020, whereas in the 'with measures' scenario emissions rapidly diminish to minimal levels by 2020. Fugitive CH₄ emissions, excluding those from coal, are expected to increase by over a third without measures, or remain broadly stable with measures. Emissions from coal mining are expected to be eliminated by 2020, in line with the decline in production. Total CH₄ emissions are expected to be either slightly lower or slightly higher than the 1990 level by 2000 according to the 'with' and 'without measures' scenarios and be either 25 per cent lower or 13 per cent higher by 2020.

86. Projections of N₂O emissions related to industrial processes and transport take into account forecasts of activity levels made for the energy projections and further take into account the increased market penetration of catalytic convertors in cars. 'Without measures' emissions from industrial processes are assumed to remain constant per unit of production at 1990 levels, resulting in an 80 per cent increase by 2020 compared to 1990. However, 'with measures' emissions from this source may decline by two thirds over the same period. In the transport sector, an almost fivefold increase in emissions is expected compared to 1990 by 2020. Overall, 'without measures' N₂O emissions are expected to decrease 7 per cent by 2000 and increase over 50 per cent by 2020, whilst 'with measures' emissions may be expected to decrease by around 47 per cent by 2000 and about 34 per cent by 2020, compared to 1990.

V. EXPECTED IMPACTS OF CLIMATE CHANGE AND ADAPTATION MEASURES

87. Since 1993, France has expanded its studies on the regional effects of climate change. The key objectives of the research are to construct plausible scenarios of regional climate impacts, assess the likely consequences on natural and socio-economic systems, and identify possible adaptation strategies. Climate modelling has shown that, if atmospheric CO₂ doubles by the year 2060, the average temperature in France could increase by approximately 2°C and that the increase in southern France could exceed the average. Warming could increase winter rainfall by about 20 per cent thereby increasing the likelihood of flooding. A possible 15 per cent decrease in summer rainfall could cause lower soil humidity during the growth season which would adversely affect particular crops and could have a severe impact on the health of forests, especially in southern France. The risk of forest fire, insect infestations and fungus would also increase. Research is not limited to continental France as French overseas territories could also be badly affected, especially by sea level rise, which can result in the submersion of low-lying coast lines, damage to coral reefs, increased cliff erosion, diminishment of fresh groundwater etc. These effects would be worse still if climate change increases the frequency of storms.

88. Tourism in the French Alps could be badly affected by dwindling snow cover as a result of warming and hence suffer adverse socio-economic consequences. Furthermore, greater spring-time melting of the glaciers would increase the risk of avalanches and flash floods.

89. The review team were informed that much of the research related to climate change and possible impacts is at an early stage and that from 1999 onward there were plans to enhance research efforts. Given the state of current research and the timescale involved in adaptation, only precautionary measures are currently being implemented, which include improved water management, restrictions on intensive farming, reductions in forest tree density exposed to water stress and choosing drought-resistant tree species where new planting occurs.

VI. FINANCIAL ASSISTANCE AND TECHNOLOGY TRANSFER

90. In both absolute terms and in terms of official development assistance (ODA) as a proportion of GDP, France ranked relatively highly during the 1990s, although at 0.55 per cent in 1995, it did not achieve the United Nations target of 0.7 per cent of gross national product allocated to ODA. French development assistance is aimed at integrating the world's poorest countries into international trade and also creating the conditions for sustainable development. Over two thirds of its ODA is provided on a bilateral basis, totalling FF 32 billion in 1995. Of this, much went to health, education, basic infrastructure and water management, although environmental projects have been accounting for an increasing share. Some of these activities may result in GHG abatement. Examples include agricultural projects which limit the practice of slash-and-burn cultivation, forestry management, renewable energy projects and rail infrastructure investments.

91. France allocated FF 10 billion in 1995 to multilateral ODA. This was mostly channelled through the United Nations and the European Commission. From its multilateral aid budget, France contributed FF 807 million to the Global Environment Facility for the period 1994 to

1997. In 1994, France established its own global environment facility (FGEF) with funding of FF 440 million for the same period. Approximately half of this went to GHG-related activities. The FGEF gives priority to Africa, focuses on projects which are easily replicable, takes into account the importance of socio-economic development and also aims to boost innovation.

92. Through various specialized research projects and organizations, France is contributing to knowledge enhancement in many developing countries and countries with economies in transition (EITs). The French Centre for International Cooperation in Agricultural Science, which employs around 1,800 people in over 50 countries, studies crops and forestry in tropical and subtropical regions and the results of such studies may assist in carbon sequestration. The Overseas Territories Scientific Research Agency, which employs 820 scientists in 40 countries, conducts research on tropical environments, land and ocean systems, agricultural systems and human society. Many of its study activities can be linked to GHG abatement. The French Environment and Energy Management Agency (ADEME) contributes toward technical cooperation in many developing countries. For example, it has been involved in decentralized rural electrification projects, renewable energy projects and activities related to energy saving in buildings in several African, South-East Asian and Latin American countries. France has taken a lead role in international efforts to improve nuclear safety in EITs, which, in effect, may assist in maintaining the nuclear electricity production instead of fossil fuel based electricity generation. Furthermore, ADEME and Gaz de France are also promoting activities in several EITs which should result in energy savings, including institutional backing for the establishment of energy management agencies, energy audits, demonstrations of modern gas networks and the provision of French expertise in industrial energy control.

VII. RESEARCH AND SYSTEMATIC OBSERVATION

93. France is involved in a number of international activities, including the World Climate Research Programme, the International Geosphere-Biosphere Programme and the International Programme on the Human Dimensions of Global Change. All activities are coordinated under an umbrella programme, the French Scientific Committee of the new Research Programme on Climate Change. Areas of study under this programme include climate dynamics, ocean flux, atmospheric chemistry, coastal oceanography, remote sensing, biodiversity, soil erosion and hydrology.

94. Under a programme on 'the economy and society faced with global change', funding is provided for economics and sociology research into areas related to climate change, including resource development, the role of tax incentives in stimulating technology change, macro-economic impacts of taxation, institutional frameworks for decision-making etc.

95. ADEME also conducts and promotes research related to energy use and renewables. Funding has been provided for the study of photovoltaics, biomass, geothermal energy, energy-efficient boilers for industry, improved processes in iron and steel production, improved vehicle performance, improved materials for buildings construction, and heating systems. Much of the funding has supported private research in these areas.

96. Given the limited amount of knowledge available about GHG emissions associated with rural activities, this has been designated as a special area of research. Since 1992, the National Agronomic Research Institute has coordinated activities related to soil carbon sequestration, CH₄ emissions from enteric fermentation and waste management, microbiological studies of CH₄ emissions and N₂O emissions from soils.

97. France has a sophisticated and well maintained climate observing network. There are 500 ground-based automatic measuring stations and 14 radars used for tracking the weather. France is also responsible for its satellites that contribute to coordinated activities from European satellite observations.

VIII. EDUCATION, TRAINING AND PUBLIC AWARENESS

98. The NC2 does not describe activities related to education, training, and public awareness, but during the review some information on these subjects was provided.

99. Most activities to inform interest groups such as industry as well as the general public about the environment are carried out through ADEME. Various information sheets and brochures related to climate change issues, including information about energy efficiency, have been produced by ADEME and distributed through its regional agencies. In particular, French and English versions of a brochure were published in 1995 jointly by the Ministry of the Environment and ADEME explaining about global warming and greenhouse gas emissions in France for benefit of the general public. The brochure also described policies and measures to mitigate GHG emissions from energy use in buildings, industry, transport, electricity generation, including via renewable energy, and efforts to increase CO₂ sequestration in forests and soils. Furthermore, ADEME has organized a number of seminars on specific themes, for example emissions trading and the Kyoto Protocol.

100. Once a year, the Ministry of the Environment organizes a national environment day and one of the principal themes in 1998 was global warming. This event attempts to mobilize various stakeholders in the environment, including non-governmental organizations, and helps to increase media coverage of environmental issues.

IX. CONCLUSIONS

101. The review team formed the impression that the Government is fully aware of the difficulties and challenges facing it in meeting France's present commitments under the Convention and future commitments under the Kyoto Protocol and that it is prepared to take the necessary action. The establishment of a special inter-agency committee under the auspices of the Office of Prime Minister was described as an important step towards establishing a coherent national climate change policy.

102. The team concluded that France has a well developed system for estimating national greenhouse gas emissions and removals which allows it to produce reliable data on trends in these emissions. It noted that French experts actively participate in international efforts aimed at

improving the quality of inventory data. It also noted ongoing activities related to harmonization of inventory data produced using CORINAIR methodology with the IPCC approach, including development and refinement of corresponding conversion software tools. The team felt that inventory data provided by France to the UNFCCC secretariat are based on solid background work, although it noted that ongoing research and refinement of methods led to an increase in the estimate of total CO₂ emissions for 1990 of 6 per cent compared to estimates for that year provided in the NC1.

103. CO₂ emissions in metropolitan France did not exhibit a clear trend in the period 1990-1997. They remained relatively stable with some fluctuations relative to the 1990 level. National experts attributed this mainly to the business cycle and, to a lesser extent, to ambient temperature fluctuations which led to changing requirements in seasonal heating. CH₄ emissions decreased in this period by about 13 per cent, mainly due to reductions in emissions from waste and agriculture and fugitive emissions. Estimates of N₂O emissions demonstrated that, after a decrease in 1990-1993, these emissions had a tendency to grow from 1994 onwards, although in 1997 they were about 2 per cent below their 1990 level. Fuel combustion (mainly transport), as a source of this gas, exhibited a growth of about 40 per cent in 1990-1997.

104. The review team acknowledged that a number of policies and measures are being implemented and planned in France to mitigate GHG emissions. It noted that the high degree of centralization and overall government control over major energy supply sectors in principle could facilitate taking action, especially in the fields of improving energy efficiency and energy conservation. The team felt however that these actions could be further facilitated if broader public participation in major policy decisions was encouraged on a larger scale. It noted that further efforts might be needed to improve estimates of the effects of policies and measures and their monitoring. It was understood that a number of measures that are pending or at the planning stage (especially those of a fiscal nature) might be implemented if supported and introduced by other Parties to the Convention, in particular by the members of the European Community.

105. The team was impressed with the important work being done on projections and appreciated its scope and quality. It noted that uncertainties related to possible future trends in energy-related CO₂ emissions are due to difficult decisions that need to be taken on the future of the nuclear industry. Curbing the construction of new nuclear power stations when the older ones reach their decommissioning age (if such a decision is taken at some future time) will have serious consequences for CO₂ emissions, which may then significantly increase by 2020. The team understood that this possible scenario is under close consideration by the Government and that a public debate has started to clarify possible options and chart the course for possible future action.
