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Report on the in-depth review of the second national communication of New Zealand

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I. INTRODUCTION AND NATIONAL CIRCUMSTANCES

1. New Zealand ratified the Convention in September 1993 and submitted its first national communication (NC1) in September 1994. It subsequently submitted its second national communication (NC2) on 27 May 1997. The in-depth review of the NC2 was conducted between July and October 1998, and included a visit by a review team from 31 August 1998 to 5 September 1998. The team members were Dr Rizaldi Boer (Indonesia), Mr Henryk Gaj (Poland), Dr Naoki Matsuo (Japan), Ms June Budhooram (UNFCCC secretariat) and Ms Amrita Narayan Achanta (UNFCCC secretariat, coordinator).
2. The country consists of two large and many smaller islands in the south-west Pacific Ocean with a land area of 270,500 km² and a population of 3.66 million. Twenty-nine per cent of the land area (7.9 million ha) is covered by forest, comprising 24 per cent (6.4 million ha) indigenous and 5.5 per cent (1.5 million ha) planted. The forestry sector contributes approximately 5.3 per cent to gross domestic product (GDP), and products from the sector rank third in terms of commodity exports, accounting for 12 per cent of the country's total exports. Though the export earnings from forestry in 1997 were \$NZ 2.38 billion, the team was informed that the annual volume of trade had also been affected by the Asian economic downturn. The team was informed of the shift in ownership pattern from state-owned forest enterprises (25 per cent in 1991 to 4 per cent in 1997) to registered public companies and private companies. In the 1990s, the average planting rate has been around 60,000 ha per annum. The economy retains its base of primary products, with agricultural, horticultural and forestry products accounting for 66 per cent of the export earnings in 1995.
3. The country has been undergoing major structural reform since 1984, a process which has had and is expected to have a further impact on greenhouse gas (GHG) emissions. Some of the aspects of this reform include the removal of agricultural subsidies, widespread regulatory reform in capital, product and labour markets, some privatization, and public sector reform. In regard to the economic cycle, the economy contracted in the late 1980s and early 1990s (the GDP growth rate in 1990-1994 being 2.8 per cent per year), grew rapidly in 1992-1995 (5.5 per cent GDP growth in 1993 and 1994), and then declined through to 1997. The economy has growing manufacturing and service sectors. At the time of the review, the country was in recession with a budgetary deficit also influencing environmental expenditure, although economic growth was expected to improve.
4. New Zealand is nearly self-sufficient in energy as 83 per cent of its energy needs are met by indigenous resources, with crude and refined oil products being the exception. A feature of the New Zealand energy sector is its diversified energy supply. In 1995, total primary energy supply (TPES) included oil (35 per cent), gas (24.7 per cent), hydro (15.4 per cent), geothermal (11.2 per cent), coal (7.5 per cent), combustible renewables and waste (5.7 per cent). The share of natural gas rose from 3.5 per cent in 1973 to 24.7 per cent in 1995 due to the development of the Maui offshore oilfield, whereas the share of oil declined over the same period. Energy taxes in general are lower in comparison to other International Energy Agency countries. Energy consumption in 1995 by end-use sector was as follows: transport 38.1 per cent, industry

34.5 per cent, residential sector 13 per cent, commercial sector 9.1 per cent, and agriculture 5.3 per cent. A rise in transport and industrial energy demand has primarily led to the growth observed in total final consumption, with the residential and commercial building sector growing at a more moderate pace.

5. New Zealand's primary energy intensity increased by 22 per cent between 1973 and 1995, although a decline has occurred since 1993. The host country attributed the latter occurrence to the significant energy efficiency improvement in the New Zealand economy in recent years. In 1996 the country's energy intensity was 0.32 tonnes of oil equivalent (toe)/US\$ 1000 in comparison to 0.26 toe/US\$ 1000 average for the Organisation for Economic Co-operation and Development (OECD) countries. In terms of per capita energy consumption, New Zealand is one of the fastest growing countries in the OECD group although the absolute level is relatively low in comparison to other OECD countries.

6. Electricity generation is dominated by renewable energy: hydropower (76.1 per cent), geothermal (5.8 per cent), combustible renewables and waste (2.3 per cent). Gas accounts for 13.6 per cent, coal 2.0 per cent and oil 0.1 per cent. The newly committed capacity before 2000 is gas and wood cogeneration, geothermal and gas combined cycle generation, with smaller amounts of wind and biomass generation.

7. During the visit the team addressed, among other issues, the status of the 1994 policy package. The 1994 policy package was intended to meet the UNFCCC stabilization target by using expansion of sinks to achieve 80 per cent of the target, with the remaining 20 per cent coming from reduction of emissions (see section III below). Provision was made in the 1994 package for the Government to introduce a low-level carbon charge, if by mid-1997, the policy measures were not on track to achieve the target. In March 1997 the Government deferred the carbon charge decision until after the Kyoto Protocol negotiations had concluded. The carbon charge planned for introduction at the end of 1997 and later shifted to early 1998 has been further deferred. Public debate has been facilitated through discussion documents on carbon charges and domestic emissions trading. The host country informed the team that the country had realized the problems associated with using a net emissions target (relative to net, as opposed to gross, emissions in 1990) and that the reduction target for non-CO₂ gases in the 1995 Environment 2010 Strategy was a statement of government intent.

8. The country anticipated that the general approach to meeting the commitments under the Kyoto Protocol would continue to be a least-cost approach using economic instruments which could be either a carbon charge or a tradeable permit scheme or a combination thereof, and an open economy approach to trading sink credits, with additional complementary measures. Subsequent to the visit, in 1999, the Government published a document containing the domestic policy options statement on climate change. During the negotiations at the third session of the Conference of the Parties, New Zealand proposed a uniform reduction target for at least CO₂, CH₄ and N₂O up to 5 per cent below the 1990 level for Annex I Parties, conditional on the inclusion of substantively unrestricted international emissions trading, "appropriate" inclusion of sinks, flexibility for countries to identify policies and measures for achieving targets, and

provision for developing countries accepting emission reduction commitments in the future. The Kyoto Protocol set the mean quantified commitment from 2008 to 2012 for New Zealand as 100 per cent of the 1990 level for six GHGs, including sinks after 1990.

9. The country's administrative structure consists of the central executive government and local government composed of 18 regional councils and 74 territorial authorities. The local authorities are financially independent but subordinate to the central government, and derive power from a range of legislation, including the 1991 Resource Management Act (RMA). Issues relating to the environmental effects of water and air discharges come under the regional councils while those relating to the effects of land use and waste management come under the district councils. Regional Councils prepare Regional Land Transport Strategies and have responsibility for passenger transport services. District Councils own and manage all local roads.

10. The group responsible for formulation and implementation of policy and inventory data collection comprises officials from the Ministries of Environment, Commerce, Agriculture and Forestry, Foreign Affairs and Trade, and the Treasury and is termed the Climate Change Steering Group. The Energy Efficiency and Conservation Authority (EECA) and the Ministries of Research, Science and Technology, and Transport are also involved. At the ministerial level the Cabinet Economic Committee is responsible for decision-making. The host country stressed that although having a formal structure, as New Zealand was a small country, there were many opportunities for informal discussions. The Ministry for the Environment, which coordinates the domestic climate change policy programme, was responsible for the preparation of the NC2, and manages the Green Package fund of around \$NZ 1 million, among other functions. Non-governmental organizations were not directly involved in either the preparation or the review of the NC2, although ongoing internal debate is fostered and facilitated through discussion documents. The review team did not meet with local or regional-level councils or Maori representatives.

II. INVENTORIES OF ANTHROPOGENIC EMISSIONS AND REMOVALS

11. The NC2 includes coverage of the greenhouse gases (GHGs) carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF₆) and sulphur dioxide (SO₂) and precursors carbon monoxide (CO), nitrogen oxides (NO_x), and non-methane volatile organic compounds (NMVOCs) for 1990 to 1995. Additional documentation of revised estimates for 1990-1995 and a new estimate for 1996 (together referred to in this document as RV) were electronically submitted to the secretariat before the visit, and estimated energy sector emissions for 1997 (*Energy Greenhouse Gas Emissions 1990-1997*), published in June 1998 (and referred to in this document as REI) prepared by the Ministry of Commerce were provided during the review. The international bunker fuel emissions data were presented by category (marine and aviation) and not included in the national totals.

Table 1. Methodology and emission factors selected in New Zealand inventory

IPCC category	Methodology and emission factors selected
All energy	IPCC methodology with NZ emission factors ^a
Industrial process	IPCC methodology with NZ emission factors
Solvent and other product use	IPCC-based methodology
Agriculture	CH ₄ - IPCC methodology with NZ emission factors ^b
Land-use change and forestry	NZ methodology ^c
Waste	Landfills – IPCC methodology ; Wastewater – methodology IPCC Based
International bunkers	IPCC methodology

a: In the energy sector NZ emission factors were used for CO₂ emissions from coal, gas and oil, geothermal fugitive emissions and industrial process emissions. NZ emission factors were also used for estimates of N₂O and NO_x emissions from mobile sources (transportation) for most types of liquid fuels. IPCC default values were used in the remaining instances. IPCC default used for CH₄ emissions from energy.

b: NZ emission factor was used in agriculture for CH₄.

c: In the land-use change and forestry sector the national forest estate model was used.

IPCC based methodology: Modification or refinement of IPCC methodology was made for solvent and other product use, and waste.

12. Detailed presentations and additional documentation such as New Zealand's revised estimate of CH₄ emissions from waste and wastewater for 1990, and 1995-2020, and an errata sheet for the NC2, were also given during the visit. The team noted that the host country used the 1996 Revised Intergovernmental Panel on Climate Change (IPCC) Guidelines, using a combination of the IPCC default emission factors and country-specific emission factors. Deviations from the IPCC Guidelines were included in the annexes to the report.

13. Table 2 lists the various data submissions for 1990 and 1995. The differences between communications were attributed to changes in activity data, altered emission factors, increased coverage of sources and altered methodology. In particular, the estimates included in the publication, *Energy Greenhouse Gas Emissions 1990-1997*, differed from prior estimates due to revised estimates of coal emissions based on new data on coal consumption, revised SO₂ estimates due to increased coverage and altered methodology, and inclusion of CO₂ emissions, due to combustion of landfill gases (biogas) for electricity generation. In addition CO₂ emissions from biomass combustion were calculated but excluded in the overall calculation of CO₂ emissions from energy sources, as required by the Guidelines.

Table 2. Greenhouse gas emissions data, 1990 and 1995 (Gigagrams)

	1990			1995	
	1998 submission to UNFCCC			NC2	1998 submission to UNFCCC
CO ₂ emissions	25 530	25 475	26 115 ^a	27 368	28 369
CO ₂ removals	16 716	20 571	22 187	13 490	17 802
CH ₄	2 113	1 706	1 673	1 635	1 601
N ₂ O	9.5-45.5	47.5	37.1	46.6	37.6
HFCs	--	--	--	0.141	--
PFCs	0.1	0.089	0.089	0.029	0.027
SF ₆	--	0.023	0.001	0.183	--

Note: Based on the NC1, the NC2, and the revised submission presented to the secretariat prior to the visit.

a: This estimate includes forest and grassland conversion unlike the value for the NC1. Actual values rather than potential values of emissions of HFCs, PFCs and SF₆ have been used in the table. For SF₆, during the review a fresh estimate of actual and potential emissions was submitted for both 1990 and 1995. The actual SF₆ emissions for 1990 and 1995 were 0.0002 Gg respectively. --: negligible.

14. In terms of compliance, the use of the 1996 Revised IPCC Guidelines for reporting was commendable. A clear picture of deviations from the IPCC Guidelines, choice of emission factors, standard data tables and inventory overview tables for 1990 to 1995 (in the NC2) was given. The pre-visit submission to the secretariat contained 1996 data, with the inventory for 1997 limited to the energy sector. Additional documentation was provided for all updated estimates. The NC2 was a significant improvement over the NC1 in terms of transparency, due to the inclusion of comprehensive methodological detail in its annexes.

15. The team gathered that, unlike other Annex I countries where CO₂ assumed a major role, in New Zealand CH₄ was of importance, with a contribution of 48.3 per cent in 1990 and 46.0 per cent in 1996. CO₂ accounted for 35.9 per cent in 1990 and 41.9 per cent in 1996, while N₂O accounted for 15.8 per cent in 1990 and 16.0 per cent in 1996. By source, agriculture accounted for 58.5 per cent in 1990 and 54.7 per cent in 1996, whereas energy accounted for 32.7 per cent in 1990 and 36.2 per cent in 1996. Table 3 gives a broad sectoral picture of CO₂ emissions in 1990-1997 (for 1997 this is limited to energy sector data).

**Table 3. Emissions of carbon dioxide by source, 1990-1997
(Gigagrams)**

Sources	1990	1991	1992	1993	1994	1995	1996	1997
Energy (reference approach)	21 998	22 727	23 826	23 470	22 743	23 304	25 541	n.a
Energy (sectoral approach)	22 855	23 280	25 073	24 278	24 425	24 298	26 267	27 904
Energy and transformation	6 040	6 114	7 574	6 557	5 423	4 695	6 271	6 891
Industry	4 710	5 015	4 824	4 866	5 189	5 281	5 646	6 100
Transport	8 645	8 662	9 048	9 459	10 161	10 869	10 972	11 242
Other sectors ^a	2 733	2 609	2 955	2 668	2 878	2 741	2 624	2 734
Other coal use	113	179	6	98	94	84	81	-
Industrial processes	2 386	2 609	2 647	2 770	2 671	2 736	2 742	2 626
Fugitive emissions from fuels	615	700	667	630	680	627	672	692
Total^b	26 115	26 656	28 687	28 172	28 440	28 369	30 498	n.a
International bunkers ^c	2 384	2 205	2 768	2 189	2 256	2 708	2 580	2 836
Land-use change and forestry removals ^d	-21 313	-20 199	-18 541	-16 940	-16 404	-16 468	-16 530	n.a.

Note: The 1990-1996 values are based on the electronic submission made to the secretariat prior to the visit, while those for 1997 are from a more recent estimation included in *Energy Greenhouse Gas Emissions 1990-1997* (REI). The values for 1997 are limited to the energy sector.

a: Other sectors includes commercial/institutional, residential and agriculture/forestry/fishing.

b: The total includes energy, industrial processes, and emissions from forest and grassland conversion.

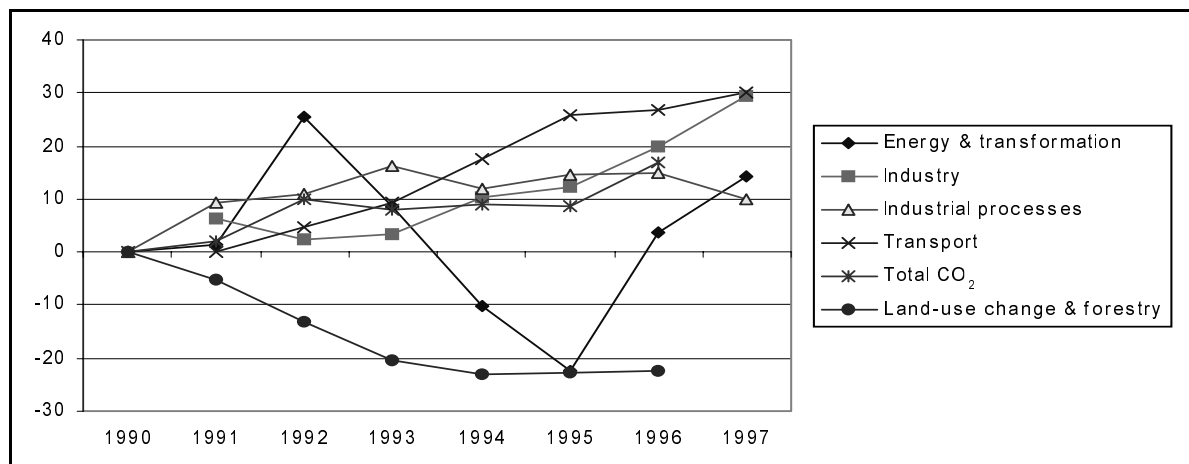
c: This category is not included in the national total.

d: This estimate differs from that in the NC2.

16. The total CO₂ emissions from energy, which include fuel combustion, fugitive emissions, and industrial processes showed a 20.8 per cent increase between 1990 and 1997. Figure 1 depicts the percentage change in CO₂ emissions from 1990, by source. In 1997, transport accounted for 41 per cent of the CO₂ emissions from fuel combustion, industry 23 per cent, thermal electricity generation 21 per cent, other sectors 10 per cent and other transformation (petroleum refining, synthetic petrol production, and oil and gas extraction) 5 per cent. With regard to the growth observed in energy sector emissions between 1990 and 1997, that of thermal electricity generation was 64.1 per cent, industry 31.6 per cent, domestic transport 29.8 per cent,

fugitive fuel emissions 12.5 per cent and industrial processes 10 per cent. The category of other transformation declined by 51.6 per cent due to a reduction in synthetic petrol production. The energy sector emissions of CH₄, N₂O, NO_x, CO and NMVOCs all showed an increase during the same period.

Figure 1. Carbon dioxide emissions, percentage change from 1990, by source



17. CO₂ emissions from domestic transport showed a steep increase of 29.8 per cent for 1990-1997 with the liquid fuels, primarily petrol and diesel, showing a 31.5 per cent increase and compressed natural gas showing a steep decline of 72 per cent for the same period. The modal share of CO₂ emissions from domestic transport in 1997 was 89.5 per cent road, 1.37 per cent rail, 7.21 per cent air and 1.86 per cent marine. The CO₂ emissions from the road category increased by 33.3 per cent and from rail by 100 per cent during 1990-1997.

18. The team gathered that the CO₂ industrial process emissions arose from the iron and steel, aluminium, hydrogen production, cement and lime manufacturing industries. The sector accounted for approximately 8.5 per cent of gross emissions in 1997 and there was a 10 per cent increase during the period 1990-1997, the growth in emissions in the cement industry (37.3 per cent increase) and hydrogen production (13.7 per cent increase) being noteworthy. In the same period within the building sector, CO₂ emissions declined by 28.9 per cent for commercial and institutional buildings, and increased by 21.7 per cent in the residential sector.

19. The LUCF category estimate considered total emissions and removals from changes in forest and woody biomass stocks in the planted forest estate and emissions from on-site burning and forest and grassland conversion. Fuel wood harvest is not separately identified. A substantial proportion of biomass used for energy is sourced from post-harvest slash and wood waste from commercial harvesting. The quantification of carbon sequestration for the managed forests is based on calculating the inventory at two points in time and estimating the difference, which is the net sequestration for the period. Both the National Exotic Forest Description (NEFD) database (annual survey of area of planted forest by region, age class and regime) and the periodic yield table database compilation based on 22,000 permanent sample plots are used to

construct the inventory estimate. More recently the Government has commenced using SPOT satellite imagery on a pilot scale for the forest area and plans to introduce a database. The team learnt that the NEFD estimate could be altered by new satellite data. With regard to data availability, the host country indicated that data on climate and soil carbon were relatively more extensive than data on the current extent of land-use change and associated changes in biomass density.

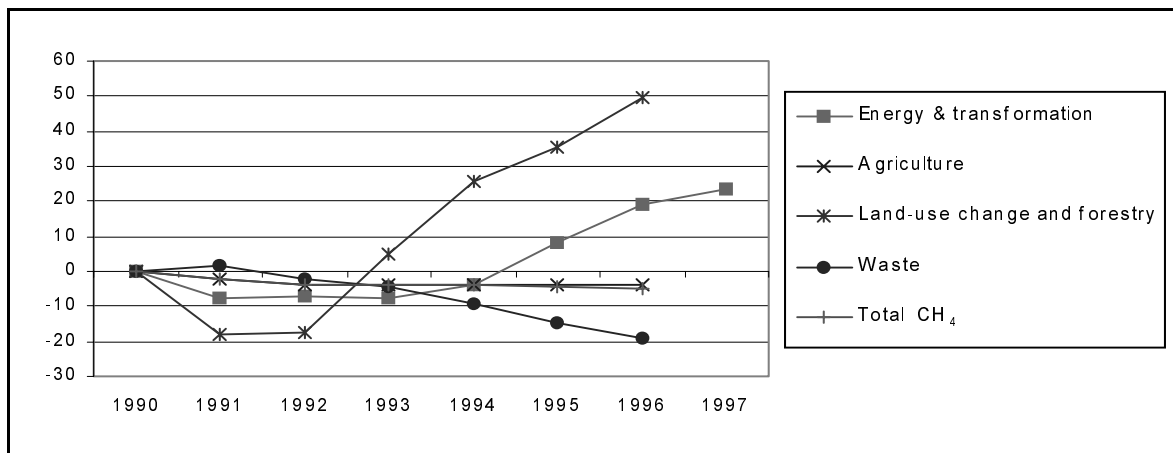
20. Since the NC1, the CO₂ sequestration estimate calculated by the New Zealand Forest Research Institute has been altered twice due to refinements in modelling methodology and improved data on existing forest estate. The estimate provided to the UNFCCC secretariat for LUCF removals for 1990 was -21,313 Gg CO₂, and for 1995 it was -16,468 Gg CO₂, indicating a decline in net CO₂ sequestration during 1990-1995. This decline was attributed to the altered planting rates and the age class distribution. The team was however cautioned that in spite of the inter-annual variability in sequestration, the total planted estate, stand carbon was relatively stable and would increase in the near term. The team was informed that a data gap on the carbon content in indigenous forests was identified during the first in-depth review, leading to a three-year project on "monitoring carbon" with Green Package funding of \$NZ 1.9 million. Among the project's preliminary results were the estimate of carbon sequestered in indigenous vegetation in 1990, which included 938 Mt C contained in indigenous forests and 527 Mt C in scrub and woody vegetation (included standing live wood and excluded dead wood and litter). The relatively minor emissions of non-CO₂ gases as a result of wildfires and on-site burning following land clearance for forest planting are included in New Zealand's inventory. The uncertainty level in the estimate of CO₂ sequestration by planted forests was estimated at +/- 25 per cent, CO₂ emissions from other sources such as scrub clearance and harvesting as +/- 35 per cent and the estimate of non-CO₂ emissions from burning as +/-50 per cent.

21. Agriculture is the dominant source of CH₄ emissions, as shown in table 4. In 1990, (enteric fermentation and manure management) accounted for approximately 89 per cent of the total CH₄ emissions. Eight per cent of the CH₄ emissions came from solid waste disposal, 2 per cent from energy and transformation, and the remainder from the land-use change and forestry sector. There has been a significant decline in sheep and cattle numbers since 1990, due to the removal of agricultural subsidies and an unfavourable international market situation, leading to a 4 per cent decrease in emissions from enteric fermentation and manure between 1990 and 1996.

**Table 4. Emissions of methane by source, 1990-1997
(Gigagrams)**

Sources	1990	1991	1992	1993	1994	1995	1996	1997
Energy (sectoral approach)	35.41	32.63	32.84	32.80	34.08	38.24	42.08	43.77
Industrial processes	0.12	0.12	0.1	0.12	0.12	0.12	0.1	n.a
Agriculture	1 492	1 458	1 435	1 433	1 439	1 437	1 431	n.a
Land-use change and forestry	3.78	3.09	3.13	3.97	4.74	5.12	5.66	n.a
Waste	141	143	138	135	128	120	114	n.a
Total	1 673	1 637	1 609	1 605	1 607	1 601	1 593	n.a

Figure 2. Methane emissions, percentage change from 1990, by source



22. For CH₄ emissions originating from animal waste, the NC2 reported that field measurements had shown that a limited proportion of waste decomposed under anaerobic conditions. The team was also informed that the country emission factor for enteric fermentation was higher than the IPCC default. CH₄ emissions from the waste sector declined by 19 per cent over the 1990-1996 period. Figure 2 depicts the percentage change in CH₄ emissions, from 1990, by source. Additionally, the team learnt of ongoing research involving comparison of the bottom-up estimates with those based on measurements of emissions in the ambient environment and observed variation in CH₄ emissions between individual sheep at the same feed intake level.

23. Subsequent to the NC2 and the 1998 submission to the secretariat, a revised estimate of CH₄ emissions from landfills and waste-water handling and N₂O emissions from waste-water was presented to the review team. This revised estimate for emissions from landfills incorporated new waste generation and analysis data, and the revised estimate from waste-water handling included private septic tanks and improved industrial sector coverage. Accordingly, the estimated CH₄ emissions from landfills for 1995 were 131.1 Gg (127.4 Gg in the NC2) and for 1990 136.5 Gg (150.8 Gg); and emissions from waste-water for 1995 were 6.6 Gg (4.3 Gg in the NC2) and for 1990 6.1 Gg (4.3 Gg in NC2).

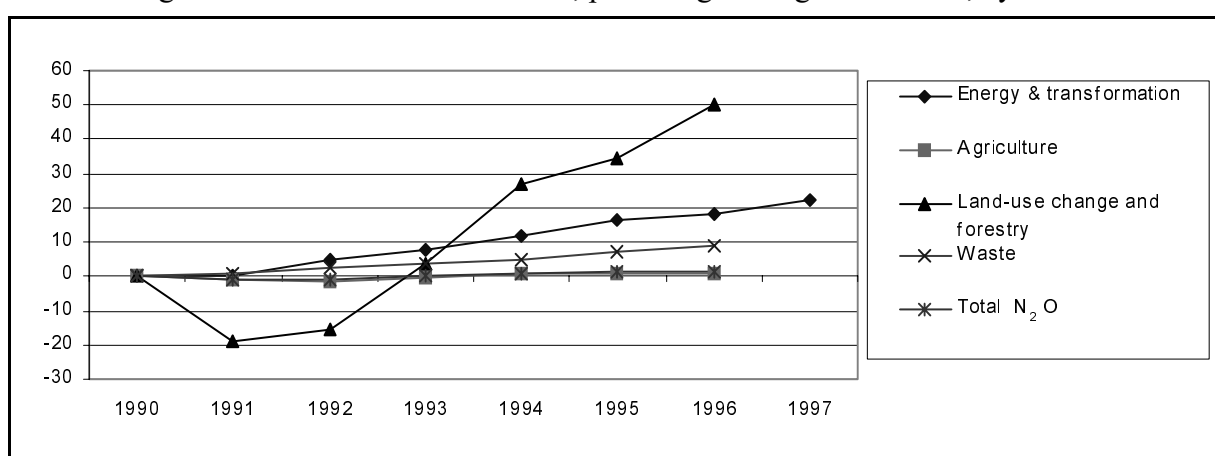
24. The sources of N₂O (table 5 and figure 3) considered in the agricultural category, which is the dominant source, included manure management, agricultural soils and field burning of agricultural residues, with agricultural soils contributing 97 per cent. The amount of emissions from this category was relatively stable over the period 1990-1997, as seen in figure 3. N₂O emissions from agricultural soils in New Zealand generally do not come from the application of inorganic nitrogenous fertilizer, although there has been a slight increase in N₂O emissions from fertilizer since 1990, of 4.9 per cent per year.

**Table 5. Emissions of nitrous oxide, by source, 1990-1997
(Gigagrams)**

Sources	1990	1991	1992	1993	1994	1995	1996	1997
Energy (sectoral approach)	0.610	0.611	0.641	0.656	0.681	0.710	0.721	0.746
Agriculture	36.269	35.848	35.804	36.193	36.553	36.625	36.523	n.a
Land-use change and forestry	0.026	0.021	0.022	0.027	0.033	0.035	0.039	n.a
Waste	0.203	0.205	0.208	0.21	0.213	0.217	0.221	n.a
Total	37.1	36.7	36.7	37.1	37.5	37.6	37.5	n.a

Note: Estimates for 1990-1996 were taken from the submission made prior to the visit to the secretariat, while the value for 1997 was taken from the *Energy Greenhouse Gas Emissions 1990-1997*

Figure 3. Nitrous oxide emissions, percentage change from 1990, by source



25. N₂O emissions from soils as a result of application of synthetic nitrogen fertilizer made up only 3.1 per cent in 1990 and 4.1 per cent in 1996 of the total N₂O emissions. The limited application of nitrogenous fertilizer reflected the practice of growing nitrogen fixing legumes as an integral part of pastures. The main drivers of N₂O emissions from agricultural soils were animal waste deposition in pasture, range land and paddocks and waste management systems such as anaerobic lagoons, solid storage and drylots. 1998 marked the first estimates (excluded from the NC2) of N₂O emissions from waste-water, which were 0.44 Gg N₂O for 1990 and 0.46 Gg in 1995. The non-energy sector contribution to total emissions of other non-CO₂ gases (CO and NO_x) was insignificant.

26. Estimates of potential emissions of (HFCs) and (SF₆) were limited to industry. For (PFCs), both potential and actual emissions were estimated from industry. The estimate of SF₆ (table 2) provided during the visit differed significantly from the NC2 estimate due to incorrect reporting of activity data. The 1998 submission to the secretariat reported negligible emissions.

27. Quantitative information on uncertainty by source for most sectors and in aggregate for the main GHGs was provided in an annex to the NC2. The estimated uncertainties combined the uncertainties of both the emission factors and activity data used. No description of the improvement in confidence levels in comparison to the NC1 was included. Broadly the

uncertainty levels for CO₂ were estimated at approximately 5 per cent whereas for the non-CO₂ gases they ranged from 6 to 80 per cent. Further research on improved quantification of CH₄ and N₂O emissions was expected to reduce the associated uncertainty. Future inventory improvement included the continuance of Green Package funded research on reduction of uncertainty and improved source coverage. There were no definite plans for improvement of estimates of new gases.

III. POLICIES AND MEASURES

28. Information on both planned and implemented policies and measures, organized by gas and sector, was provided in the NC2. Some information on the effects of measures was contained in the NC2 section on emission projections and effects of policies and measures, although the Government suggested that these estimates be treated with caution. While the review discussions included information on the functioning of the policy instruments, the team felt that more information on the relative importance of each measure, in particular those measures related to regulatory reform, could be provided.

29. The national target of “stabilizing net CO₂ emissions in 2000 at the 1990 level and maintaining emissions at that level thereafter” was adopted by New Zealand in 1994. This stabilization target was to be attained using expansion and enhancement of sinks to achieve 80 per cent of the target with 20 per cent from emission reduction measures. This included using voluntary agreements with industry, pursuing an energy efficiency strategy, deregulating the energy sector and establishing a more competitive wholesale electricity market. Provision was made in the 1994 package for the Government to introduce a low-level carbon charge if, by mid-1997, the policy measures were not on track to achieve the target. In March 1997 the Government deferred the carbon charge decision until after the Kyoto Protocol negotiations had concluded. A carbon charge is still one of the options currently being considered. The hosts also spoke of the 1995 Environment 2010 strategy, a policy statement which referred to the reduction of other GHG emissions, particularly CH₄, by the year 2000 and maintaining them at those levels thereafter.

30. Subsequent to the negotiations at the third session of the Conference of the Parties, the country has promoted a general market-oriented least-cost economy wide approach rather than working at the sectoral level. The team noted the high likelihood of the adoption of a domestic tradable permit scheme (finding some favour with industry) linked to the international emissions market, instead of a carbon charge (favoured by environmental organizations). Additionally an open economy approach to international trading of sink “credits”, with additional complementary measures (education, regulations) was expected. The host country mentioned that stemming from the Crown’s position as partners with Maori (the indigenous people of New Zealand) to the 1840 Treaty of Waitangi, consultation with Maori on policy options is expected. The Treaty of Waitangi covers use of, access to and ownership, of land and other natural resources. The elements of New Zealand’s approach to meeting the Kyoto Protocol commitments are contained in the 1999 “Domestic Policy Options Statement”.

A. Cross -sectoral policies

31. Given that the country relies on an economy-wide, cross-sectoral least-cost approach the team examined the various elements of the deregulation and market reform which has been under way since the mid-1980s. Most climate-related policies are in line with this concept. In the agricultural sector, the removal of subsidies for economic reasons has led to the decline observed in CH₄ emissions. The removal of agricultural subsidies, reform of land-use controls, changes to the taxation regime and increased international log prices were among the reasons for the increased conversion of pastoral land to planted forest. In light of the fact that methane is the major GHG for New Zealand and most of it arises from the agricultural sector and the fact that the total annual CO₂ sequestration by forests is more than half that of gross CO₂ emissions, the impact of removal of subsidies and prevalent regulations in agriculture and forestry is evidently great.

32. In the electricity sector where at the time of the review there were two main power generators, the Electricity Corporation of New Zealand and Contact Energy, the country has taken steps to make the sector more competitive, an example being the recent splitting of the above-mentioned corporation into three competing state-owned enterprises. This is expected to avoid over-investment in new plants and also lead to increased investment over time in demand-side energy management. Various measures taken by the government are aimed at increasing the competition in electricity retailing. This energy sector reform and establishment of the wholesale electricity market are expected to enhance opportunities for cogeneration and non-traditional renewables through expanded access to the grid. The team noted the difficulty of precisely estimating the effect of this ongoing reform on GHG emissions. Although lowering of energy prices could lead to an increase in demand, it is uncertain what other counter-factors would come into play affecting demand. Energy sector reforms are expected to promote energy efficiency.

33. The 1991 Resource Management Act was originally enacted to sustainably manage natural and physical resources at the local and regional level. Local and regional governments grant resource consents, which in this instance involve air discharge consents for significant emissions of CO₂ and perfluorocarbons. The conditions under which consent has been granted have included provision of information on emissions, adoption of the best practicable technology option, and review on the bases of changes in government policy. Due to the Act's reliance on regional decision-making, there could be a danger that different regions may adopt different measures and eventually influence the country's ability to meet its climate change related commitments. During the review the team gathered that the Act was under review to examine whether its case-by-case approach conflicted with the economy-wide climate change approach adopted by the Government, apart from examination of defined roles of the regional and district councils binding them to act. Some of the concerns expressed by non-governmental organizations related to the possibility that the review process in progress could lead to a reduction of the Act's environmental control role.

B. Energy supply and transformation

34. The ongoing energy market regulatory reform discussed earlier is the major contributing measure within this sector. Renewable energy supplies the base load of electricity. Due to the fluctuations in precipitation, hydropower is supplemented by fossil fuels and geothermal energy. The share of natural gas in the generation mix fell from 17 per cent in 1990 to 12.9 per cent in 1995. During the same period other thermal power generation (i.e. oil and coal) showed an increase from 1.7 per cent in 1990 to 2.1 per cent in 1995, a fact attributed to weather conditions, and strategic decisions with regard to the use of coal. Oil use for electricity generation on the other hand has been declining since the 1980s and is now zero. Though the potential for fuel switching is clearly limited (because of the high share of hydropower and geothermal energy) in comparison to other countries, the country's officials suggested that the regulatory reform had increased the potential. The team learnt that there was limited demand for additional electricity in New Zealand.

35. In the electricity generation sector, deregulation and corporatisation has been undertaken. The operation of a self-regulated wholesale electricity market since 1996 is expected to encourage the development of renewables such as wind and biomass by providing open access to the grid, access to a wide market and backup supply, within the limited scope for fuel switching. The experts were uncertain about the expected environmental impacts of market reform due to the associated uncertainties and difficulties of estimation. For example, the GDP growth and lowered electricity price could result in increasing emissions. On the other hand, efficient use of energy, open-access to the grid and fuel switching from coal to gas or renewables could be positive for emissions reduction. It would be premature for the team to judge the effects of market reform.

36. New Zealand has one of the highest shares of renewables in TPES among the International Energy Agency countries. In 1996, the contribution of renewable energy to electricity generation was approximately 85 per cent (79 per cent hydro and 6 per cent geothermal). In the case of hydropower, although it is likely that some efficiency improvements may be made in existing plants, no further additions to existing capacity are envisaged due to prevalent water conservation orders which prevent damming of rivers. The team recognized that New Zealand has a large potential for non-conventional renewables, with wind energy and bioenergy being the sources generally most competitive for energy generation. The host country experts informed the team that a 3.5 MW commercial wind farm had been set up in the Wairarapa, a 32 MW wind farm was commissioned in 1999 and resource consents had been obtained for an additional 45 MW. According to the experts, several potential wind sites were under active investigation, and they stated that the concern of supply stability was not an issue for most parts. The Energy Efficiency and Conservation Authority (EECA), established in 1992 under the Ministry of Commerce, has been promoting the penetration of renewable energy through the development of improved wind turbine tax depreciation rules, enhancing the share of research funding, provision of planning guidelines for wind and small hydro, publication of a wind turbine noise standard, and formation of various associations and networks such as the Bioenergy Network, the New Zealand Wind Energy Association, and the Solar Industries

Association. The team learnt of a major study to identify new and renewable energy opportunities conducted jointly by the Authority and the Centre for Advanced Engineering in 1996. The government approach has focussed on identification and removal of barriers to renewable energy commercialization and research funding for non-conventional renewables rather than promotion by way of output or capital subsidies.

37. Geothermal energy, which provides approximately 6 per cent of the electricity generated, has had a steady share in electricity generation. Cogeneration with biomass feedstock (gasified wood) has increased steeply over the last 20 years but is expected to be directly affected by developments in the forestry sector. The team was told that there will be substantial further investment in timber processing in the next 10 years in the form of new plants and retrofits. The economics of cogeneration are driven by disposal of wood waste and bark and potential energy benefits. Solar power generation remains limited to small-scale independent producers.

38. EECA's baseline funding has been \$NZ 2.4 million since its establishment in 1992/93. Funding for other programmes is additional to this baseline. The team was informed of the integrated Energy Efficiency Strategy implemented by EECA, to develop cost-effective ways of improving energy efficiency. This three year programme was extended for 1997/98. Total funding from 1993/94 to 1997/98 was \$NZ 11.9 million. The Strategy includes provision for tightening of the energy efficiency elements of the mandatory residential building code, and development of building standards for commercial buildings; development of mandatory minimum energy performance standards for selected domestic and commercial appliances and equipment; programmes to improve energy use in domestic hot water systems, commercial lighting, motors and variable speed drives; implementation of the Energy Wise Practice programme to aid industry to improve energy management techniques; technology demonstrations; increased information dissemination for commercializing energy efficient and renewable energy technology; formulation of a strategy for research and development in renewable energy to accelerate innovation and application of new technology to New Zealand conditions; as well as energy end-use monitoring and analysis.

39. The team also learnt that EECA administers an Energy Saver Fund targeting the residential sector and Crown Energy Efficiency Loans targeting the public sector (\$NZ 2.5 million and \$NZ 1 million in 1998/99, respectively). Other diverse activities in which EECA is involved include the provision of timely and useful information to the industry (built around a corporate commitment programme entitled the Energy-Wise Companies Campaign). The team was encouraged to learn that the readily quantifiable benefits which had accrued from EECA's activities were estimated to be approximately five times the programme costs. This emphasizes the role EECA has played and could continue to play in harnessing the "no regrets" options available. The team was informed of changes to the funding of some of EECA's programmes, and of a Government review of EECA's governance and structure to ensure the optimal future structure for the delivery of the Government's energy efficiency and conservation outcomes. In spite of EECA's major role, and effective functioning and the commitment by the Government to encourage energy efficiency, the team notes the decline in funding for some EECA programmes including the Energy Saver Fund.

C. Industry

40. Nearly 73 per cent of the industrial energy use is concentrated in the energy-intensive basic metals, food and paper products sub-sectors. The energy sources of industry in 1996 comprised wood and coal (35 per cent), electricity (31 per cent), gas (20 per cent), and geothermal and liquid fuels, each at 7 per cent. The team was informed that total energy use in industry increased over the period 1996 to 1998, mainly due to the increase in cogeneration which partially offset the decrease in other energy sources. In 1998 more wood and less coal was used than in 1996, electricity use had increased to 33 per cent, gas use had dropped to 15 per cent, and use of geothermal and liquid fuels was around 8 per cent. In spite of the improvement in industrial energy use, significant scope for further improvement is still believed to exist. The Government has targeted this sector through the voluntary agreements (VAs) programme and the Energy-Wise Companies Campaign. The VAs together with the energy efficiency strategy and the energy sector reforms, contribute to the target of twenty per cent reduction of CO₂ from the baseline.

41. Initiated as part of the 1994 policy package, VAs are implemented either directly with companies or through industry associations or similar bodies (facilitating VAs). At the time of the review in 1998, 24 agreements (20 individual, 3 sectoral and 1 facilitating type) had been negotiated in fuel transformation, petrochemicals, electricity generation, base metals, the dairy, meat, and cement industries and forestry processing. Current VA coverage extends to around 50 per cent of the total CO₂ emissions and 80 per cent of the energy and industrial process emissions. The VAs signed to date are estimated to result in projected annual emissions savings against baseline projections in 2000 of approximately 2 Mt CO₂. The Ministry of Commerce is responsible for the negotiation of VA targets with industry and the coordination of the programme. EECA provides technical support and audits of the 1990 and subsequent data and annual reports. The targets are based on industry targets for production levels till 2000 and associated intensity of production (emissions per unit output) based on frozen efficiency, rather than absolute values of carbon reduction. The team noted that the premise of the VAs was that for the decade till 2000 a 25.5 per cent increase in aggregate output was expected, which under the frozen efficiency condition was expected to lead to a 29 per cent increase in CO₂ emissions. The VAs were expected to hold the increase to approximately 9 per cent for the decade. Preliminary results for the original 19 agreements indicated that the mitigation achieved till 1997 was 626 Gigagrams (7.4 per cent), which would be an underestimate because not all annual reports from VA signatories were available at that time. This estimate excludes the electricity industry (originally the ECNZ agreement) which had a claimed mitigation of 609 Gigagrams by ECNZ and Contact Energy up to 1997. Due to the methodology employed in these electricity industry agreements, it is difficult to calculate an appropriate percentage reduction off business as usual emissions.

42. The review discussions indicated that, due to the use of "frozen efficiency" baselines (which are likely to be higher than business as usual) the effect of the VAs is likely to be overestimated. EECA audits also showed that the actual CO₂ emissions were significantly lower than predicted by signatories, reflecting lower output than planned. The host country experts

stated that lack of monitoring during the process by the technical working group drafting the guidelines, had led to the use of different methodologies. The team noted that, though the participating companies had no commitment to report data, most did. Importantly, however, emissions data can be audited at any time at the request of the Ministry of Commerce and EECA. The VA programme has no penalties for underachievement although the team was told that signatories take the agreements very seriously. The programme has led to the adoption of “no regrets” options” which in the absence of VAs may not have been implemented. The VAs have played a catalytic role and enhanced awareness, and improved quality of emissions data at firm level. Stakeholder response to existing VAs was variable with non-governmental organizations questioning the methodology of the base year calculation and the business sector evaluating current performance and continuance beyond 2000. The Government itself indicated that they were examining issues relating to increased stringency, the interface between international emissions trading and VAs and the handling of sectors such as agriculture and transport. For industry, the VA initiative might be attractive in preference to other mandatory measures due to its voluntary and “no-regrets” nature, in line with a market-oriented, least-cost approach. It is premature to judge whether this initiative is successful, but the trend is in line with the target.

43. The second government programme, the Energy-Wise Companies Campaign, involving around 700 of the country’s companies extends to the larger energy users (70 per cent of industrial and commercial energy), and voluntarily commits them to a staged adoption of various energy efficiency activities comprising a charter. Some of the charter principles are: management accountability for energy management, targets for energy performance, use of monitoring equipment, energy performance reviews, training and employee awareness, inclusion of energy efficiency concerns in new project specification, among others. Technical support is provided to member companies by EECA. There are annual energy-wise company awards to recognize and publicize outstanding energy saving achievements. Other sectoral climate change initiatives include the plans to establish a business council on sustainable development and the work being done by the forest industry’s council on the post-Kyoto forestry implications.

D. Transport

44. Domestic transport accounted for 41 per cent of the 1997 CO₂ emissions from fuel combustion. Of this around 72 per cent was due to passenger transport and 28 per cent to freight transport. During 1991-1996 a steep increase in private car ownership as a result of lower imported car prices following the lifting of duties on such vehicles led to a 23.7 per cent growth in energy use in transport. For the period 1990-1997 the growth rate of sectoral emissions was 29.8 per cent. The increase in private car ownership has in turn impacted the relative share of public transport in total passenger transport, with private cars being the dominant mode (87 per cent), followed by buses (7.8 per cent), domestic air (4.9 per cent) and rail (less than 1 per cent). Public transport has shown an increase since 1994 in comparison to the 1990s. The level of financial support available for urban public transport is currently around \$NZ 94 million. Over half of all urban transport services operate on a commercial basis and are not subsidized.

45. The host country revealed that growth in energy use has been uneven across fuel types, with petrol and diesel use increasing in 1991-1996 by 9.6 per cent and 84.3 per cent respectively. Diesel-fuelled vehicles in 1996 consumed around 24 per cent of the energy used by the entire vehicle fleet. Over the same period there was a decline in the consumption of compressed natural gas in vehicles of around 44 per cent. The team noted that the “ex-tax” part of the petrol price is comparable to European OECD countries whereas the tax component is relatively lower. The excise tax on diesel (\$NZ 0.004/litre) is negligible compared to that on petrol (\$NZ 0.329/litre) and the total price of diesel is less than half that of petrol for commercial use. However, all diesel powered vehicles must pay Road User Charges (RUC). This is a charge based upon distance travelled and the weight and axle configuration of the vehicle. The RUC system ensures that the total charges imposed on diesel vehicles are comparable with those for petrol vehicles.

46. The review team learnt of the establishment of Transfund, the agency responsible for allocation of the dedicated Land Transport Fund. The revenue for Transfund arises from road user charges from diesel vehicles and a portion of the petrol tax. Transfund allocates money from the Land Transport Fund on a cost benefit basis to: Transit NZ, for the maintenance and construction of the national State Highway system; District Councils for the maintenance and construction of local roads; and to Regional Councils to subsidise urban passenger transport services. The team gathered that numerous policy studies and strategies had been initiated relating to this sector such as the Land Transport Pricing Study, the Vehicle Fleet Emissions Control Strategy, though there did not appear to be any explicit or effective policies in place at the time of the visit. Additionally, the team observed that there were no fuel economy standards in place nor were there any plans to introduce them in the near future.

E. Residential and commercial sector

47. Water and space heating are the largest two energy end-uses in New Zealand households, together accounting for around 74 per cent of the total energy currently used in this sector. Additionally the residential sector accounts for approximately 37 per cent of the electricity consumed. Based on the limited information available to the team on this sector, the team gathered that EECA had been involved in the revision of the energy efficiency provisions contained in the building code. Three new standards relating to small and large buildings and domestic hot water systems had been submitted for government approval and were voluntary until incorporated into the New Zealand Building Code. Other initiatives include the establishment of the Energy Saver Fund and the ongoing work on the technical basis for equipment energy efficiency standards.

48. The Energy Saver Fund, with a total funding allocation of \$NZ 13.5 million for its lifetime until July 2000, targets the residential sector to achieve cost-effective improvements in end-use energy efficiency, and achieve energy savings. Established to correct the perceived market barriers such as lack of consumer information and high transaction costs, related to the ongoing wholesale electricity market reform. The fund provides full and partial financial assistance for a wide range of energy efficiency measures, including, insulation of ceilings, floors

and hot water cylinders. Over the first three years of implementation, the fund provided 28,500 householders with an associated estimated saving of \$NZ 30 million. The team noted that, in spite of such encouraging results, this programme was being phased out.

49. Minimum energy performance standards for three product classes (fluorescent lamps, ballasts and domestic electric water storage heaters) have been shown to be beneficial. These are currently being considered as part of the Government's new policy package. As to public awareness campaigns, the host country experts indicated that limited success had been achieved in the campaign targeting domestic water heating. The team was also informed of the significant energy wastage in commercial buildings. One area which had been targeted in this sector was that of office machines left on outside working hours. The "Switch Off" campaign had been extended to 1,200 New Zealand companies using office equipment extensively, and the electricity savings expected over a year were worth \$NZ 3.2 million.

F. Land-use change and forestry

50. The team recognized that the removal of the agricultural subsidy, and other measures such as a return to tax deductibility, introduction of a qualifying company regime (giving investors limited liability while being treated as individuals for tax purposes, leading to the possibility of an unlimited number of individuals investing in a project), abolition of lease duty on forest rights, amendment of the forest rights legislation to improve opportunities for forestry, and the Resource Management Act and promotion of market development have led to an increase in the area of planted forests. Furthermore, the team noted that in spite of some legal, taxation and institutional constraints to future planting, provisional estimates of planting rates were set at 70,000 hectares per annum up to 2000, and at 55,000 ha per annum thereafter. This is in contrast to the earlier planting estimate of 100,000 ha per annum. New planting activity has also been considerably favoured by the 8 per cent rate of return on the investment. The experts assured the review team that land availability was not a concern until 2025 and that current trend of change from pastoral land to forestry would only reinforce this trend. The country experts estimated that an amount of 18,944 Gg CO₂ would be sequestered by the estimated average planted area in 2000, allowing for emissions from forest fires and scrub land clearance. CO₂ sequestration in the planted forest was expected to continue to rise up to around 2002, based on the past planting activity.

51. The host country experts stated that the 1992 East Coast Forestry Project was the only new measure aimed at commercial planted forests launched since the NC1. The project, which aimed to establish forestry on 200,000 ha of eroding land in the East Coast region of the North Island, was currently under government review. Apparently the project had failed to meet the anticipated planting rate of 7,000 ha per annum in the first three years of operation. At the time of the review it was estimated that approximately 24,000 ha in total had been planted as a result of the project. The project was the only subsidized forestry project, because the topography is relatively hostile and operational costs therefore higher and also because of its perceived employment potential. Some concerns expressed by non-governmental organizations related to the scrub species of indigenous forest being cleared, the absence of consultation prior to project

introduction, and the fact that high-risk lands had not been included in the project, as had been the intention of the Government.

52. The Government did indicate that, though some measures had been implemented to conserve the indigenous forests such as the Forest Accord, the RMA and control of such pests as possum, no estimate was yet available of the consequent changes in carbon storage over time in these forests. The Government has allocated Green Package funding of \$NZ 3.4 million over 5 years to monitor carbon in forests, scrubland and in soils. This is due to the high relative share of carbon contained in indigenous forests compared with planted forests, and likely increases in the extent of scrub vegetation. The Forest Accord is a voluntary agreement which extends to 95 per cent of the commercially planted forest, and prohibits the clearance of mature and regenerating indigenous forest for planting. The review team learnt from the non-governmental organizations that the protection provided by the Accord had been limited by the fact that a significant proportion of the new planting was being done by small companies or foreign operators which were not a party to it. Apart from the Accord, the role of the RMA in regulating forestry activities such as logging, planting and thinning in indigenous forests was mentioned. The team learnt that estimated expenditure on wild animal control had increased from approximately \$NZ 4 million to \$NZ 19.5 million between 1995 and 1996.

G. Agriculture

53. As a part of the economy-wide reform, removal of the agricultural subsidy might be the single largest contributing policy option promoting CO₂ sequestration and CH₄ emission reduction, as the number of livestock falls with the conversion of pasture to forest. This trend is attributed to the lower profitability of sheep and beef farms and the replacement of upland country farms with exotic forest plantations. There has been a simultaneous though limited increase in dairy cattle numbers due to higher dairy prices. It is likely that any increase in the price of timber on the international market will positively influence this trend. Additionally the team learnt that some regional and district councils were cautioning farmers against excessive use of fertilizer. The host country also informed the team that options such as the use of feed additives for reduction of methane emissions were difficult and expensive to implement due to the extensive nature of the country's pastoral system. The Government had instead placed emphasis on the provision of Green Package funding for reduction of uncertainties in emission sources and sinks of CH₄ and N₂O and technical solutions for methane reduction from livestock. The host country stressed that the focus on removing uncertainty as regards emissions and removals of these two GHGs was intended to identify future reduction options.

H. Waste

54. The broad approach adopted in the waste sector is that the waste generator pays and that waste is reduced, reused, recycled and recovered before final disposal. The host country mentioned that the Sustainable Management Fund, administered by the Ministry of the Environment since 1995, has financed waste projects such as waste analysis surveys, cleaner production programmes, dairy shed waste-water treatment and effluent management and

assessment of landfill gas. The total cost of these projects in 1996-1997 was approximately \$NZ 2.5 million, including money from the Fund. In the case of animal waste, given that New Zealand has extensive pastoral systems most animal waste decomposes aerobically. In the case of liquid-based systems where waste is decomposed anaerobically, the discharge of treated dairy shed effluent is regulated by the city, regional or district councils under the RMA. The land disposal of treated or untreated dairy shed waste-water is also encouraged. In the case of landfill waste, the Government has developed guidelines which make methane more accessible to capture or flaring and anticipates that approximately 40 to 65 Gg of landfill CH₄ will be recovered for energy production in 2000.

I. HFCs, PFCs and SF₆ Related Measures

55. There has been a decrease in PFC emissions from the New Zealand aluminium smelters due to changes in process control. The RMA air discharge consent process, sets conditions for discharge of PFCs. It is expected that these conditions will keep PFC emissions at or below 1990 levels in 2000.

IV. PROJECTIONS AND THE EFFECTS OF POLICIES AND MEASURES

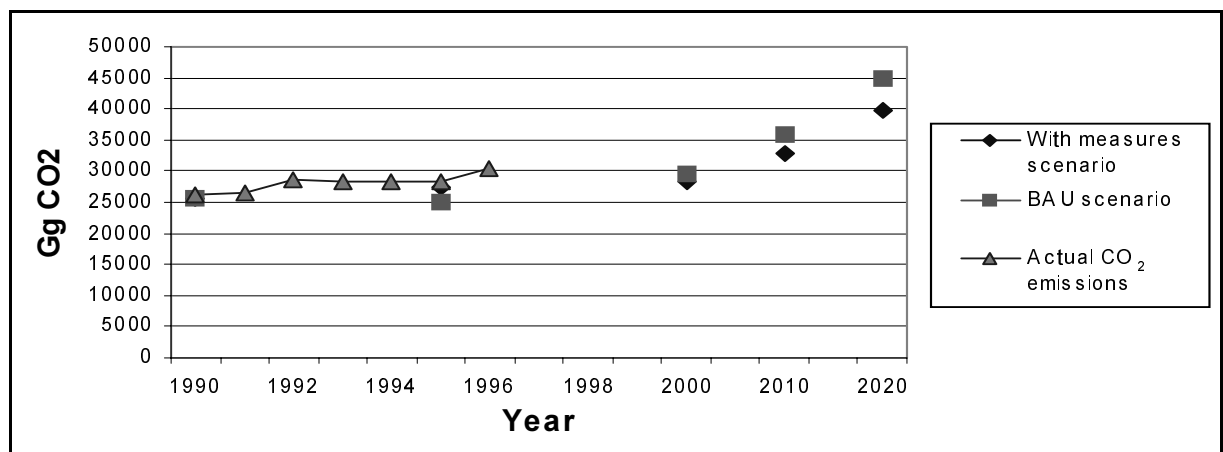
56. The NC2 contained projections of emissions of CO₂, CH₄, N₂O, PFCs, HFCs, SF₆, CO, NO_x, NMVOCs, and SO₂, and sinks of CO₂ for the period till 2020. Projections of emissions from international bunkers were also included. SF₆ emission projections revised after the NC2 were also provided. The NC2 projections were a significant improvement on those of the NC1 in scope and detail in view of the team. The team felt that the projections were well documented and adequately reflected the underlying set of exogenous macroeconomic assumptions relating to: GDP growth, exchange rate, population growth (including immigration), and oil and coal international prices. The team was provided with details of the modelling tools and procedures which the team felt could be reflected in the NC2. The modelling approach had not changed between the NC1 and the NC2 though the model had undergone continuous improvement.

57. The projections of GHG emissions from energy and CO₂ emissions from industrial processes were prepared by the Energy Modelling and Statistics Unit of the Energy and Resources Division of the Ministry of Commerce using the Supply and Energy Demand Model (SADEM), a hybrid model which combined a top-down and a bottom-up approach. The section in the NC2 on projections for the energy sector and industrial processes also included updates for realized statistical data for key (exogenous) drivers of energy supply and demand such as GDP, oil prices and exchange rates. National energy balances for the period up to 2020 were also used in the projection exercise. The macroeconomic top-down modelling approach may be classified as a partial equilibrium one, as all the sectors of the economy are modelled only from an energy supply and demand perspective. The model balances supply and demand for energy through prices, which are endogenized in the model with the exception of oil and coal prices, which are assumed to be determined by the international market. Energy demand is calculated using econometric sub-models based on historical data or with quantitative sub-models of industry.

58. The CO₂ projections were prepared for both a “business-as-usual” (BAU) scenario and a “with measures” scenario wherein the effects of policy were assessed. The assumptions which underlie the current BAU are: (a) future GDP growth will be 3 per cent per annum, (b) new discoveries of gas will be sufficient to supply about 85 PJ/year from 2000, and remain constant thereafter, with wholesale gas price rising to \$NZ 3.36/GJ by 2000 and \$NZ 5.32/GJ by 2020. (c) oil prices rise to around US\$ 25 per barrel by 2005 and remain constant thereafter, (d) the coal price remains constant at around \$NZ 3.70/GJ and (e) the petrochemicals plant closes when the Maui gas supply contracts expire. The host country experts indicated that projection updates contained in the NC2 BAU scenario had considered the GDP outlook, the structure of the energy sector, and energy prices. It was pointed out to the team that in the recent past the GDP growth had been less than the 3 per cent rate assumed in the BAU scenario. The outlook is also for lower prices than those assumed in the NC2 due to overcapacity and reforms in the electricity sector, improved gas reserves, and the freeing-up of coal capacity due to weak export markets.

59. The review team observed that the limited degree of detail presented on the industrial sector in the review did not allow for an analysis of the structural change and projected future energy consumption in this sector. The hosts attributed this lack of detail to the quality of disaggregated input data disallowing separate modelling or analysis, and additionally leading to identification of specific companies, which was not acceptable. During the visit the host experts gave the team data on the volume and structure of energy consumption in the industrial sector. The CO₂ and non-CO₂ emissions from the energy sector and industrial processes were calculated by multiplying energy quantities by appropriate emission factors taken from the national greenhouse gas inventories.

Figure 4. Projected emissions of carbon dioxide from energy and industrial processes under the BAU” and “with measures” scenarios and actual total carbon dioxide emissions



60. For the transport sector specific measures were not used in the modelling of transport sector energy use and emissions as sufficient data was not available to include in the econometric estimates. The team suggested that the projection of energy and industrial processes could be strengthened by the explicit inclusion of certain assumptions and intermediate modelling results

such as anticipated energy consumption and structure and anticipated changes in economic structure.

61. The estimates of effects of measures in reducing CO₂ emissions were based on the difference between the “with measures” and BAU projections. The team observed that all the differences should not be attributed to the effect of measures as there were independent occurrences such as technology uptake which were also captured. An approach of “with measures” modelling approach was used, rather than estimates based on analysis of individual measures. Only if the effect of a measure was measurable and significant was an attempt made to isolate its potential impact. Both cross-sectoral and specific measures were assessed. The Energy Efficiency Strategy and cooperative programmes (reduction potential approximately 300 Gg CO₂) were among the cross-sectoral measures assessed, with others such as the RMA, energy sector reforms, and renewable energy measures being more difficult to quantify. The specific sectoral measures assessed included voluntary agreements with industry (company targets included in the NC2). The actions by local authorities listed in the NC2 were excluded for various reasons. Preliminary estimates of reductions were made for the significant direct influence activities (those activities that exert a direct influence on known and identifiable energy consumers) implemented, such as the Energy Saver Fund, the Crown Energy efficiency loan scheme, and the lighting and office equipment “Switch Off” campaign. The estimates of reduction potential for other direct influence programmes listed in the NC2, such as the Building Code energy efficiency provisions and mandatory minimum energy performance standards not yet implemented, were also taken into account. The country experts clearly indicated that it was difficult to estimate and attribute reduction potential in the case of programmes with indirect impact (those activities that exert an indirect influence on specific markets and areas of activity, increasing energy efficiency) such as the Energy-Wise Companies Campaign.

62. Under the BAU, emissions of CO₂ from the energy sector and industrial processes were expected to rise by 28 per cent between 1990 and 2000 if GDP growth averaged 3 per cent from 1995 to 2000, in contrast with the NC1 forecast of 21.6 per cent. This difference is attributed to the assumptions of higher GDP growth. The “with measures” projection of CO₂ emissions from the energy sector and industrial processes shows an increase in emissions of 22 per cent (over 1990 levels) by 2000, or around 6 per cent below the BAU growth path in 2000.

63. For the projections of CO₂ emissions and removals from land-use change and forestry, the team was presented some revised estimates based on a combination of modelling, expert opinion and actual surveys. No BAU scenario was constructed, a fact questioned by the review team. Three “with measures” scenarios were constructed using different forest planting rates, which constituted the main driver in these projections. The planting rates in the 1990s have been above the average of 40,000 ha of the 1970s and 1980s, the provisional figures for 1996 and 1997 being 70,900 and 77,800 ha per annum in contrast to the planting rate of 100,000 ha per year, assumed in earlier projections. These revised estimates of planting rates were based on surveys of actual planting by representative forest owners. The revised projections of CO₂ sequestration also took into account the revision of the 1990 inventory estimate based on improved data and assumptions on the distribution of forest age classes in the national forest estate. The revised projection

results did not appear to differ markedly from those previously presented in the NC2. The sensitivity of CO₂ sequestration to changes in planting rates was examined under three levels of planting rates for new forest planting during the period 1998 to 2000. The team queried whether the modellers could additionally undertake a sensitivity analysis of the different developments on the international market.

64. The CO₂ sequestration projected in commercial forests for 2000 is 18,944 Gg, based on an average planting rate of 70,000 ha per year from 1997 and 55,000 ha per year from 2001. According to the country's analysis, the annual rate of sequestration declined between 1990 and 1996. Since 1996 it has started increasing but the 1990 level of sequestration is not expected to be reached earlier than 2002. For the post-2002 period the uncertainty of predictions reaches 50 per cent. The team observed that the annual CO₂ sequestration was variable but declining, with the new projections based on revised planting rates causing them to decline further. On the other hand, the host country experts stated that the model results demonstrated that the total stand carbon or cumulative total carbon stored in the planted forest stocks was increasing.

65. Projections of emissions of non-CO₂ GHGs arising from wildfires and prescribed burning were also considered, based on a 10-year average for the area burnt in wildfires and by prescribed burning, and the fraction of forest planting where fire is used for removal of on-site scrub before planting. For the non-CO₂ GHGs from the land-use change and forestry sector, the emissions remain relatively constant beyond 2005.

66. A pastoral supply response model was used to predict sheep, beef and dairy stock numbers and production. Since 1990, the ruminant-related CH₄ emissions in the agricultural sector have decreased almost continuously. This decreasing trend (due to low prices for beef and sheep meat and increased conversion of pasture land to planted forests) is expected to reverse from 2000, though emissions are not expected to reach the 1990 level by 2020. The total N₂O emissions remain at practically the same level over the entire period.

67. The review team gathered that under free market conditions, future developments within the agriculture and forestry sectors strongly depend on future prices of their products in the international markets. The CO₂ and CH₄ emission projections are based on numerous assumptions including anticipated prices for beef and sheep meat and changes in the pasture land due to increased afforestation. The host country acknowledged the considerable uncertainty in the underlying assumptions, even beyond the next two or three years, particularly with regard to prices, which drive the supply response and production.

68. The projections for waste sector CH₄ emissions from landfills and waste-water handling in 2020 were revised subsequent to the NC2 submission. These revised projections allow for population growth, and increased use of landfill gas for energy purposes (0 in 1990 to approximately 65 Gg CH₄ in 2020). Consequently, CH₄ emissions from landfills in 2000 are expected to be 114.6 Gg, compared to the 1990 value of 136.5 Gg. CH₄ emissions from waste-water are projected to increase with population, from 6.1 Gg in 1990 to 6.8 Gg in 2000.

69. Projections for N₂O, NO_x, CO, PFCs, HFCs and SF₆ for 2000 were included in the NC2. Projected emissions of international bunker emissions were also included and show a more rapid growth in aviation bunkers than in marine bunkers.

70. On the basis of the projection results presented and the most recent revisions to the 1995 inventory data, the review team formed the opinion that New Zealand was unlikely to achieve its CO₂ stabilization target.

V. EXPECTED IMPACTS OF CLIMATE CHANGE AND ADAPTATION MEASURES

71. A computer model for national-scale, integrated assessment of the environmental implications of climate variability, called CLIMPACTS, has been developed. The CLIMPACTS system has been adapted for the Pacific region as part of a training programme (see paragraph 73) and domestic local councils have requested outputs to facilitate policy decisions. A programme on coastal hazard management and planning on the lines of CLIMPACTS has started. Future funding is likely to be directed towards improved economy-wide models, pests and diseases of biological systems including human health, and climate change research on plants of economic importance.

VI. FINANCIAL ASSISTANCE AND TECHNOLOGY TRANSFER

72. In 1998 the budget allocation for New Zealand's Official Development Assistance (NZODA) amounted to 0.27 per cent of GNP, over 35 per cent of which is directed to the South Pacific region. In 1997 New Zealand adopted a new official development assistance programme, the Pacific Initiative for the Environment (PIE), which targets global environment issues, including climate change, in the Pacific region. The PIE has an indicative funding level of \$NZ 1.2 million for 1998-1999, and focuses on capacity building. Assistance has also gone to the International Global Change Institute (IGCI) Certificate Training Programme on Vulnerability and Adaptation Assessment (\$NZ 314,000), the South Pacific Regional Environment Programme (SPREP), the South Pacific Applied Geoscience Commission (SOPAC), and the South Pacific Forum Secretariat.

73. The IGCI Certificate Training Programme on vulnerability and adaptation is directed at representatives of Pacific Island countries. Considered a prototype model, it is expected to facilitate the submission of related information in those countries' respective national communications. In 1998, \$NZ 1,750,000 and \$NZ 850,000 was contributed to SPREP and SOPAC, respectively. The purposes of the latter included policy advice on scientific research and monitoring sea level rise. Projects to reduce Pacific Island country dependency on petrol through alternative fuels and to increase use of natural gas in South-East Asia were mentioned. An increase in funding for forestry and conservation projects was observed. New Zealand's contribution to the second replenishment of the Global Environment Facility was around \$NZ 8.35 million. Additionally, a contribution of \$NZ 32,000 was made to the UNFCCC secretariat for supplementary activities. With regard to compliance with the current reporting

guidelines, the country expressed difficulty in defining “new and additional” resources and in distinguishing private sector initiatives. There is an interest in activities implemented jointly though no policy framework is in place nor is there any involvement in related activities.

VII. RESEARCH AND SYSTEMATIC OBSERVATION

74. The National Science Strategy Committee for Climate Change (NSSCCC) established in 1991 determines the climate change research priorities by identifying target research areas and gaps, coordinating research and identifying level of funding. The team acknowledged that the Committee has played a significant role in directing the national climate research programme and is also responsive to short- and long-term requests of policy makers. The target areas of research have included the oceanic circulation, regional ocean-atmosphere interactions, and the spatial distribution of terrestrial sources and sinks of GHGs. Work is also being done on trace gas measurement and their atmospheric chemistry. Development of climate change indicators such as average temperature and atmospheric concentrations of CO₂, CH₄ and N₂O has commenced, with future indicators likely to extend to physical climate and climate change impacts.

75. The Minister of Research, Science and Technology sets the broad priorities for research and development, including in the energy sector, where research on wind power, bioenergy, solar energy, and an energy-efficient sterling engine prototype has been funded. Public expenditure on research and systematic observation in 1997-1998 totalled \$NZ 17.1 million with the focus of research being responses, processes (reduced funding compared with 1996-1997) and effects of climate change (identical funding). Most of this research is carried out by the nine independent Crown Research Institutes. New Zealand is also active in international research programmes such as the International Geosphere-Biosphere Programme, the World Climate Research Programme, the Global Climate Observing System (GCOS), the Valdivia group on climate change, and the IPCC process, including providing 8 authors for the Third Assessment Report (TAR). New Zealand has assisted in adaptation efforts by providing technical and financial assistance to Pacific Island meteorological services, and regional vulnerability assessments by SPREP. New Zealand scientists are collaborating with the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) Division of Atmospheric Research and the Hadley Centre in the United Kingdom, on validation of general circulation models and applications in the South Pacific.

76. The first in-depth review led to the Ministry of the Environment providing \$NZ 1 million for research on data gaps on soil carbon and indigenous forests, minor gases from industrial processing and solvent use, reduction of uncertainties in the area of agricultural emissions, and analysis of the economic impact of policies and measures. Ongoing research on CH₄ release by sheep and variations among individual animals, is expected to result in an improvement in country-specific emission factors for livestock, which could aid in directing future mitigation research and associated policies. Additionally, impact research included assessments of impact of ultra-violet-B, CO₂ and climate variability on pasture, effects of elevated CO₂ on *Pinus radiata*, sensitivity of fish populations, response of snow and glaciers to climate variability, coastal hazards, and various health impacts.

VIII. EDUCATION, TRAINING AND PUBLIC AWARENESS

77. The review team gathered that public consultations, including submissions, had been undertaken by the Working Group on CO₂ Policy. The host country informed the team that regular meetings were held by the Environment, Commerce, and Foreign Affairs and Trade ministries with business and environmental non-governmental groups. The Government had also participated in the Asia-Pacific seminar series on climate change. The review team was presented with discussion papers on technical design issues for a domestic emissions regime, which were meant to facilitate informed public debate. A similar exercise has accompanied the release of the Domestic Policy Options Statement.

78. In 1995/1996, a curriculum kit targeted at intermediate and secondary schools on energy efficiency was developed by EECA, various educationalists and participants from the energy supply sector. The kit comprises activity cards, which are used in social science, economics and science curricula to encourage students to undertake practical experiments demonstrating energy efficiency and also familiarized them with energy terminology.

IX. CONCLUSIONS

79. The team was particularly impressed by the host country's compliance with the IPCC inventory reporting requirements. The country had used the 1996 Revised IPCC Guidelines but had also provided a picture of where deviations had occurred in the use of the guidelines. The team noted that the inventory was made transparent by the provision of the methodological detail in the annexes, separate additional documentation, detailed presentations, standard data tables and inventory overview tables. The team acknowledged that continuous efforts were being made by New Zealand to improve upon existing estimates of carbon content in indigenous forests and reduce uncertainties relating to the quantification of methane and nitrous oxide sources and sinks. The continuance of green package funding and extended source coverage were efforts in this direction.

80. New Zealand reported information on both implemented and planned policies and measures by gas and sector in keeping with the guidelines, including the use of summary tables. However, it would be of use to provide more information on the relative importance of various identified measures.

81. The country has promoted an economy-wide, cross-sectoral, least-cost approach. The ongoing reforms in both the agricultural and forestry sector were expected to lead to an increased conversion of pastoral land to forest area. Reforms in the electricity sector are expected to prevent over-investment in new plants, encourage new investment in demand-side management and enhance the access of cogeneration and renewables to the grid. Currently the country's high share of renewables in TPES is noteworthy in light of the Government's approach of identifying and removing barriers to commercialization and funding research on non-conventional renewables instead of providing subsidies. Simultaneously, the Government's commitment to

improving energy efficiency is evident from the extended funding (although at a reduced level) devoted to the programme on the integrated energy efficiency strategy, which includes elements affecting the energy efficiency in residential and commercial buildings and the industrial sector. Among the programmes still under consideration are selected mandatory minimum energy performance standards, which had an estimated mitigation potential of 1 million tonnes CO₂ in the fifteen years following introduction. There have also been some encouraging results from the Energy Saver Fund targeting the residential sector.

82. In the industrial sector, the participation of some of New Zealand's key sub-sectors in voluntary agreements assumed importance from the standpoint of the enhanced awareness and improved quality of emission data at the enterprise level, though there are no penalties in the event of underachievement. Simultaneously, there did not appear to be any explicit or effective policies to tackle the emissions from the transport sector in spite of their large contribution to total emissions. The Government approach to methane and nitrous oxide reduction in the agricultural sector was currently focussed on removing uncertainties. This was expected to lead at a future stage to the identification of mitigation measures in this sector.

83. The NC2 projections showed a considerable improvement over those in the NC1 in scope and detail. New Zealand only incorporated those measures which were considered measurable and significant, with a focus on the "direct influence activities" such as the Energy Saver Fund, and the Crown Energy efficiency loan scheme. Among the other sectoral measures modelled were the voluntary agreements with industry. The revised projections for the land-use change and forestry sector based on revised planting rates indicated that annual sequestration was variable but on the decline, whereas total stand carbon was on the increase. Based on an overall assessment of the results it is unlikely that New Zealand will meet the UNFCCC stabilization target at present levels of growth.
