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Report on the in-depth review of the third national communication of Australia

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I. NATIONAL CIRCUMSTANCES RELEVANT TO GREENHOUSE GAS EMISSIONS AND REMOVALS

A. Introduction

1. The secretariat of the United Nations Framework Convention on Climate Change (UNFCCC) received Australia's third national communication (NC3) in June 2003. An in-depth review of the NC3 was carried out between April and June 2004, including a visit to Canberra from 17 to 21 May 2004. The members of the review team were Mr. Hongwei Yang (China), Mr. Javier Gonzales Iwanciw (Bolivia), Mr. Mikhail Gytarsky (Russian Federation), Mr. Adrian Gault (United Kingdom), Ms. Jane Ellis (Organisation for Economic Co-operation and Development) and Ms. Katia Simeonova (UNFCCC secretariat, coordinator).

2. During the country visit, the review team discussed the key aspects of Australian climate policy with officials from the national government (Commonwealth) and from the states and territories,¹ academia and business and environmental non-governmental organizations (NGOs). The review team was provided with further clarifications on the NC3, additional material supporting the information it contains, and information on developments since publication of the NC3. This allowed the review team to review the NC3 thoroughly and reach a better understanding of the developments in climate change policy and policy goals in Australia that occurred up to June 2004.

B. National circumstances

3. **Geography and climate:** Australia is a large country, and the only one that covers an entire continent; its land area of 7,682,300 km² extends from approximately 5° to 40° south of the equator. Although it is the driest inhabited continent, it has a wide range of climates and landscapes, ranging from tropical rainforest to sandy desert. It also has a diverse marine environment along its 36,700 km coastline. The oceans have a major influence on the continental climate, which is temperate in the south, subtropical and tropical in the north, and hot and dry inland. Australia is one of the oldest, lowest and flattest continents, although there are mountainous areas in the south-east.

4. **Population:** The population of Australia was 19.88 million in 2003, having increased by 15.7 per cent since 1990. This growth is expected to slightly slow down, and the population is expected to be 32.2 per cent higher in 2020 than in 1990. As the birth rate is relatively low, the main driver for this population increase is immigration. This population growth is higher than in other developed countries and will exert an increasing pressure on energy and other resource use, and on emissions of greenhouse gases (GHGs). Although the overall population density is low (around 3 people/km²), Australia is a highly urbanized country, with most of the population living in a relatively few large cities near the coast.

5. **Economy:** Australia's economy is the fourteenth largest in the world, with a gross domestic product (GDP) of USD 502.9 billion (AUD 748 billion) in the 2002–2003 financial year. The economy grew by 51 per cent between 1990 and 2002 (table 1). Although the growth slowed down slightly to 3 per cent annually in 2002 and 2003, the economy continued to expand, strongly underpinned by consumer spending and export growth that altogether led to a solid growth in employment. Australia's economy is very outward-looking. Exports of goods and services accounted for 69 per cent of GDP in 2002 and imports for 83 per cent, providing around 20 per cent of employment in the country. The majority of trade is with countries on the Pacific rim, particularly Japan and the Association of SouthEast Asian Nations (ASEAN), followed by the European Union and the United States of America.

¹ The review team met with representatives from the Australian Capital Territory (ACT), Tasmania, New South Wales (NSW) and Queensland, and had a telephone conference with representatives from the Northern Territory and Western Australia.

6. Australia is richly endowed with mineral wealth, having large and readily accessible reserves of fossil fuels (particularly coal, but also oil and natural gas) and uranium ore. It also has a large agricultural sector. Unlike most other OECD countries, it is a large net energy exporter, with almost half of its energy production being exported. Australia's large energy reserves result in relatively cheap energy, and consequently a national economic structure geared towards activities that are intensive in terms of energy (and emissions), such as metal processing, resource extraction and agriculture. Indeed, Australia is the world's largest exporter of coal, barley and wool, as well as the world's largest producer of bauxite and aluminium. As in most other OECD countries, services are by far the most important sector of the economy, accounting in 2003 for nearly 80 per cent of GDP, followed by the manufacturing sector with 10.7 per cent, mining with 4.6 per cent, agriculture with 2.8 per cent, and electricity, gas and water utilities making up the rest. Though agriculture and mining are small in terms of share of GDP, they are important in that they contribute a large share of exports.

Table 1. Main macroeconomic indicators and GHG emissions

	1990	2000	2002	Change 1990–2002 (%)
Population (millions)	17.18	19.27	19.75	15.0
Gross domestic product – GDP ^a	325.3	461.0	492.3	51.3
Total primary energy supply – TPES (Mtoe)	87.5	109.8	112.7	28.8
Electricity consumption (TWh)	144.3	192.6	207.4	43.7
GHG emissions with land use change and forestry (LUCF) (Gg CO ₂ equivalent)	515.9	529.6	539.2	4.5
GHG emissions per capita with LUCF (kg CO ₂ equivalent)	30.0	27.5	27.3	–9.2
GHG emissions per GDP unit with LUCF ((kg CO ₂ equivalent per USD of 1995)	1.6	1.1	1.1	–31.0
GHG emissions without LUCF (Gg CO ₂ equivalent)	430.5	512.9	526.0	22.2
GHG emissions per capita without LUCF (kg CO ₂ equivalent)	25.1	26.6	26.6	6.0
GHG emissions per GDP unit without LUCF (kg CO ₂ equivalent per USD of 1995)	1.3	1.1	1.1	–15.4

Sources: Population, energy and GDP data are taken from the IEA database, and GHG emission data from the NC3 and the UNFCCC emission database.

^a Billions of USD of 1995 using purchasing power parities (PPPs).

7. **Total final energy consumption:** Between 1990 and 2002 the total final energy consumption (TFC) grew by 22 per cent, reaching 70.7 million tonnes of oil equivalent (Mtoe) in 2002, while GDP grew by close to 51 per cent and the population grew by 15 per cent. This helped to reduce the energy intensity of the economy. Due to national circumstances, including its export orientation, Australia still had one of the highest energy intensity levels of the OECD countries. Together with heavy reliance on fossil fuels in the primary energy mix, the high energy intensity led to a very high emission intensity of the economy compared to most other countries (table 1).

8. The transport sector accounted for almost 40 per cent of the TFC in 2002. With a growth of over 24 per cent, it was the second fastest growing sector over the period 1990–2002. Industry, which accounted for 33 per cent of the TFC, grew by 12 per cent over the same period. Other sectors making up the rest of the TFC, including agriculture, commercial and services and the residential sectors, showed the highest growth – almost 40 per cent between 1990 and 2001.

9. **Total primary energy supply (TPES):** Between 1990 and 2002 the TPES grew by 29 per cent, totalling 112.7 Mtoe in 2002. In 2002, coal, which is predominantly used for electricity production, accounted for 43 per cent of the TPES, followed by oil and oil products with 31 per cent, natural gas and liquefied petroleum gas (LPG) with 18 per cent, and renewables making up the remaining 8 per cent, including 6.8 per cent combustible renewables and waste and 1.2 per cent traditional hydro energy. The 1990s saw continued growth: by 35 per cent in coal; by 32 per cent in non-traditional renewables, although starting from low levels; by 23 per cent in natural gas and LPG; and finally, by 9 per cent in oil. The pattern of the TPES is underpinned by the vast energy reserves, especially coal. Although Australia extracts large quantities of uranium ore, it is all exported as nuclear development is not part of the national energy supply. There is also considerable potential for renewable energy: although the

economically viable sites for hydro power have already been exploited, the rest of this potential remained largely untapped.

10. **Electricity:** Coal dominates the electricity sector and represented about 78 per cent of total electricity generation in 2002, followed by gas with 12 per cent, hydro energy with 7 per cent, non-traditional renewables with 1 per cent and oil making up the rest. Electricity production grew by 44 per cent between 1990 and 2002 to reach 222 TWh, mostly propelled by the strong economic growth, although its energy base remained largely unchanged. Expectations are that this growth rate will be maintained until 2010 and that at least half of it will be met by gas-fired power plants.

C. Institutional framework and recent developments in climate policies

11. **Government structure and climate change issues:** The Commonwealth of Australia is a democratic federation that consists of a national government and eight self-governing states and territories. Each state is governed by a state premier, and territories are governed by territory chief ministers. There are also 730 local governments. All three levels of government share responsibility for reducing emissions of GHGs and enhancing sinks, which renders the constitutional arrangements for developing and implementing a coordinated set of climate policies quite complex. Strong cooperation among different levels of jurisdiction on climate change, despite some differences in the policy agendas and interests, help to deal with this complexity.

12. The Australian Greenhouse Office (AGO), established in 1998, is the agency responsible for coordinating domestic climate change policy at the national level. At the time of the review, the AGO had a dual and equal line of reporting – to the Minister for the Environment and Heritage and to the Minister for Industry, Tourism and Resources.² The Minister for the Environment and Heritage, the Minister for Industry Tourism and Resources, the Prime Minister, the Deputy Prime Minister and several other ministers are members of the Sustainable Environment Committee of the Cabinet (the decision-making body of the national government), which recommends decisions to the Cabinet. This committee is advised by the Secretaries Group on Greenhouse, which provides senior-level advice from, inter alia, nine government departments, and for which the AGO acts as the secretariat. The AGO is also the secretariat for the High Level Group on Greenhouse (HLGG), one of the bodies reporting to the Council of Australian Governments (COAG), which deals with a range of inter-jurisdictional matters between national government and the governments of the states and territories. At the international level, the Department of Foreign Affairs and Trade has the leading role, with support from the AGO.

13. All levels of government endorsed the National Greenhouse Strategy (NGS) in 1998. In addition to the implementation of regulation and other policies and measures by the national government, the states and territories are also able to set policies and measures in several areas (e.g. energy efficiency, land clearing, transport, electricity generation), and all of them except Tasmania have established a state-specific GHG strategy or plan. Some of the measures contained in these state-wide plans are very ambitious, have a strong regulatory element and in some cases leading in innovation. The states and territories sometimes work together to develop concrete policies and actions, e.g. some states are considering the development of an inter-jurisdictional emission trading scheme.

14. **The UNFCCC, the Kyoto Protocol and policy development milestones:** Australia ratified the UNFCCC on 30 December 1992. It signed the Kyoto Protocol on 29 April 1998, but decided in June 2002 not to pursue its ratification and to initiate a process for development of a long-term climate response strategy. This is because the Australian Government does not believe that the Kyoto Protocol will be environmentally effective or meets Australia's long-term interests, as it does not include

² In late 2004, the AGO was placed within the Department of the Environment and Heritage, reporting only to the Minister for the Environment and Heritage, but retaining its role in developing and coordinating policy on climate change issues at national level and for the whole of government.

commitments for all countries where substantial GHG emissions occur. Nevertheless, it recognizes that the country is greatly exposed to the potential impacts of climate change, and remains committed to meeting the target under the Kyoto Protocol of 108 per cent of net 1990 emissions (the Kyoto target). The use of the flexible mechanisms of the Kyoto Protocol is likely to be limited, for instance to the involvement of private companies in project activities under the clean development mechanism (CDM).

15. The 1998 NGS provided a foundation for Australia's current climate change policy, and included measures announced in the 1997 *Safeguarding the Future* package. This was followed by the Australia's Government's 1999 *Measures for a Better Environment* package, which allocated almost AUD 1 billion for climate response measures.³ In May 2004, the Australian Government's new Climate Change Strategy (CCS) was launched, with AUD 464 million funding over 2004–2005 to 2007–2008. In June 2004, Australia launched its new energy policy in the 2004 Energy White Paper *Securing Australia's Energy Future*, which has major implications for climate change policy, including additional funding of AUD 749 million for low emissions and renewable energy technologies. Altogether, as of 2004, the Australian Government has now committed almost AUD 1.8 billion to combat climate change. Further funding has been committed by state and territory governments to support the state-wide climate strategies.

II. GREENHOUSE GAS INVENTORY INFORMATION

A. Inventory preparation

16. ***Institutional framework:*** The AGO is responsible for coordination and compilation of the national GHG inventory and its submission to the UNFCCC secretariat on behalf of the Commonwealth. The AGO engages external institutions and individual consultants to collect activity data and estimate GHG emissions by source and removals by sink. In particular, the activity data mainly come from the Australian Bureau of Statistics (ABS), the Australian Bureau of Agricultural and Resources Economics (ABARE), industry associations, and the AGO's National Carbon Accounting System (NCAS).⁴ The inventory is reviewed by the National Greenhouse Gas Inventory Committee, which is made up of representatives from national, state and territory governments. The AGO regularly publishes and updates inventory methodology workbooks that provide transparent descriptions of the national methods applied and ensure consistency in data collection and emission estimates. The consistency of the inventory is also ensured by continuous involvement of the same institutions and consultants in its preparation.

17. The national GHG inventory is prepared every year according to the UNFCCC requirements. Time series are updated periodically as new data and emission factors (EFs) become available, and when methodologies change. The states and territories have previously prepared their own inventories. This is now done by the AGO.

18. ***Coverage:*** The NC3 reports inventory data that are derived from the 2002 National Inventory Report (NIR2002) and contains estimates for 1990–2000. It covers all significant categories of emission sources and sinks for carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) and some sources of fluorinated gases – hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆). Emissions of gases with indirect effect, known as precursors,⁵ as well as sulphur dioxide (SO₂), are also reported in the NC3. Emissions from international bunkers and CO₂ emissions from biomass combustion

³ 1 AUD approximately equals 0.75 USD.

⁴ Other sources of activity data include Australian Petroleum Production and Exploration Association, Australian Gas Association, Cement Industry Federation, National Lime Association, Wesfarmers, Orica (Incitec), Queensland Nitrates, Australian Aluminium Council, BlueScope Steel, OneSteel, Qmag and Causmag.

⁵ These include nitrous oxide (NO_x), carbon monoxide (CO), and non-methane volatile organic compounds (NMVOC).

are estimated, and in accordance with the IPCC Guidelines⁶ are reported separately. Australia provided the review team with its recent inventory submission to the UNFCCC secretariat (NIR2004) with 2002 data.

19. **Compliance with the guidelines:** The review team noted that inventory section of the NC3 conforms in all major respects with the UNFCCC guidelines.⁷ It encompasses an overview of emissions, information by gas and summary reporting tables with emission estimates and trends. It also encompasses useful information on factors and key drivers underlying emission trends. Further information on this matter is provided in the NIR2002, NIR2004 and the report *Analysis of Trends and Greenhouse Indicators*. The review team noted that Australia could provide more such information in its NC. It also noted that some source categories in a few sectors were marked as “not estimated” in the NC3. This included HFC emissions that appeared as a key source in the NIR2004. It further noted that the total CO₂ emissions without land-use change and forestry (LUCF) reported in the NC3 are somewhat different from those in the NIR2002, due to the erroneous exclusion in the NC3 of total emissions from LUCF instead of CO₂ only. These estimates were corrected through an additional submission by Australia. Finally, the review team noted a few cases of inconsistent use of indicators explaining the data gaps in the inventory.⁸

20. **Emission sources:** The inventory includes estimates from all major sources, as required by the IPCC Guidelines. The review team acknowledged Australia’s ongoing efforts to improve the inventory coverage by including emission estimates for HFCs through improving the collection of activity data stemming from the Ozone Protection and Synthetic Greenhouse Gas Management Act of 2003.

21. The following were not reported in the NC3 or the NIR2004: emissions of HFCs, PFCs and SF₆ from consumption of halocarbons and SF₆; CO₂ from road paving with asphalt, food and drink, polymers and other chemicals; N₂O from polymers and other chemicals, indirect emissions from agricultural soils and industrial waste water; and CH₄ from some manure management (buffalo, sheep, goats, camels and llamas, horses, mules and asses), and agricultural soils. The review team encouraged Australia to improve further coverage of emission sources and provide a clear explanation of sources not included there.⁹

22. **Methodology:** The NC3 inventory estimates are reported in accordance with the UNFCCC and IPCC guidelines. The IPCC good practice guidance¹⁰ is applied for uncertainty assessment, key source analysis and inventory quality assurance and control (QA/QC). A combination of country-specific and IPCC methods have been used, together with both national and IPCC default EFs. More comprehensive IPCC (higher tier) and country-specific methods and EFs are applied to key sources identified in accordance with IPCC good practice guidance. To improve completeness of the inventory, the review team encourages Australia to apply the IPCC Guidelines and IPCC good practice guidance to estimate emissions from source categories currently reported as not estimated (“NE”).

⁶ Intergovernmental Panel on Climate Change (IPCC). *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*.

⁷ UNFCCC guidelines for the preparation of national communications by Parties included in Annex I to the Convention,

Part II: UNFCCC reporting guidelines on national communications.

⁸ Emissions from livestock category, other than cattle and swine are one such case. Emissions there are marked as “NE”, while they are actually negligible and should be marked as “0”.

⁹ For example, no explanations were provided in the NIR2004 for the missing sources of CH₄ from manure management (buffalo, sheep, goats, camels and llamas, and horses), indirect N₂O emissions from agricultural soils, CO₂ and N₂O from polymers and other chemicals, and PFCs from consumption of halocarbons and SF₆.

¹⁰ Intergovernmental Panel on Climate Change (IPCC). *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*.

23. **Comparison of inventory estimates:** The emission estimates for 1990–1995, covered in the NC2, the NC3 and the NIR2004, differ slightly as a result of recalculations as the new activity data, methods, EFs and estimates from new sources, not covered in the previous inventories, became available (table 2). For example, emissions from LUCF have been included in the NC3 and emissions of HFCs from refrigeration and air-conditioning equipment have been included in the NIR2004.

Table 2. Comparison of 1990 and 1995 emissions, as given in the NC2, NC3 and 2001 inventory (Gg CO₂ equivalent)

	NC2 ^a		NC3 ^b		NIR 2004 ^b	
	1990	1995	1990	1995	1990	1995
Net CO ₂ emissions and removals	368 600	348 589	355 991	336 265	363 239	338 394
CO ₂ emissions (without LUCF)	242 000	296 723	277 867	301 101	277 869	301 036
Confidential emissions reported as CO ₂ eq.	NE	NA	1 170	1 292	1 741	2 407
CH ₄	108 300	110 508	118 863	115 544	121 938	119 653
N ₂ O	24 400	26 510	23 182	25 437	23 900	26 289
HFCs	NE	NE	NE	NE	1 126	977
PFCs	4 900	1 432	4 093	1 368	3 938	1 309
Total with LUCF (Gg equivalent)	506 200	487 039	503 299	479 905	515 883	489 029
Total without LUCF (Gg equivalent)	379 600	435 173	425 175	444 741	430 513	451 671

Note: Discrepancies in totals are due to rounding errors.

NA = not available.

^a For comparability, data taken from Table 3.10 from the NC2 have been rearranged in this table.

^b Some data referred to NC3 and NIR 2004 included in this table are different from data reported in these documents, as they include some changes provided to the review team during the review visit.

24. **New developments:** Compared to the NC2, the new developments in the NC3 mainly refer to the LUCF sector. Emissions from land clearing in the LUCF, which were reported separately in the NC2 because of their high uncertainty, have been included in the national totals in NC3. In addition to the inventories that follow the UNFCCC accounting, the NC3 also includes an inventory that follows the Kyoto Protocol accounting for land use, land-use change and forestry (LULUCF). There is also a report of the ongoing AGO work on a new GHG Information System for data collection and archiving.

25. **Uncertainty estimates:** Uncertainties are estimated using a mix of expert judgement and quantitative analysis. The quantitative uncertainty assessments are carried out using Latin Hypercube and Monte Carlo methods, in line with the IPCC good practice guidance. The uncertainties of estimates reported in the NC3 by gas are less than 10 per cent for CO₂ and more than 20 per cent for other gases from fuel combustion. By sector, the highest uncertainty was reported for agriculture (from 20 per cent for livestock to more than 80 per cent for other sources); less than 20 per cent for LUCF; and more than 50 per cent for waste. The overall uncertainty for the inventory was not assessed. In the NIR2004, Australia reported a considerable improvement in uncertainty estimates for emissions from livestock of between ±5 and ±10 per cent, and land clearing of ±4 per cent. There are plans to apply the Monte Carlo tier 2 approach for the overall inventory uncertainty estimate for future inventories.

26. **Quality assurance/quality control and national system:** Several elements of QA/QC are in place, including systematic checks of input data and calculations, documentation and archiving of inventory estimates as in tier 1 of the IPCC good practice guidance. The inventory methods and EFs are regularly peer-reviewed, revised and published in sectoral workbooks. A QA/QC plan as required by this guidance is yet to be developed. The review team was informed of the work on further development of the NCAS, introduced in 2001 to estimate emissions from forest and grassland conversion, the major contributor to the LUCF sector. It is a sophisticated model-based system that corresponds to the IPCC tier 3 method, using data from the resource census, field studies and remote sensing. It allows estimation of emissions and removals for the LUCF sector and reduction of related uncertainty.

B. Emission profile and trends

27. Australia's GHG emissions without LUCF totalled 512,946 Gg CO₂ equivalent in 2000 and 526,042 Gg CO₂ equivalent in 2002 under the UNFCCC accounting. With LUCF these numbers were

529,618 and 539,155 Gg CO₂ equivalent respectively (table 3). In the context of the aim of the UNFCCC according to its Article 4.2(b) to return to the 1990 emission levels by the year 2000, the review team noted an increase of 3 per cent in the overall emissions with LUCF and 19 per cent without LUCF. From 1990 to 2002, the overall emissions without LUCF rose by 22 per cent, underpinned chiefly by the 30 per cent growth in emissions from the energy sector, including transport, 15 per cent in waste, and 11 per cent in agriculture. The decrease in net emissions from LUCF by 81 per cent helped to moderate the overall growth in emissions to 5 per cent. According to the Kyoto accounting, used to follow the progress towards meeting the 108 per cent Kyoto target for Australia, the total emissions in 2002 amounted to 550 Mt CO₂ equivalent, which is 1.3 per cent higher than in 1990.

Table 3. Total GHG emissions and emissions by gas, 1990–2002 (Gg CO₂ equivalent)

GHG emissions	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Net CO ₂ emissions/removals	363 239 341 293 327 947 332 710 340 566 338 394 344 309 348 489 372 753 369 593 365 653 361 210 371 569												
CO ₂ emissions (without LUCF)	277 869 279 608 282 055 285 525 291 325 301 036 310 855 318 167 334 475 344 147 348 981 353 663 358 455												
Confidential emissions (CO ₂ eq.) ^a	1 741 1 603 1 754 2 308 2 460 2 407 2 593 2 564 2 784 2 666 2 765 3 477 3 748												
CH ₄	121 938 121 284 120 182 118 949 117 522 119 653 118 539 120 795 122 494 121 901 124 517 124 553 124 286												
N ₂ O	23 900 24 269 24 236 25 123 25 769 26 289 26 539 28 279 29 604 31 397 33 493 34 523 35 300												
HFCs	1 126 1 126 1 054 1 447 936 977 603 907 1 311 1 694 2 085 2 345 2 744												
PFCs	3 938 3 941 3 935 2 833 1 848 1 309 1 205 1 051 1 397 982 1 103 1 556 1 507												
SF ₆	NE NE NE NE NE NE 9 6 4 4 2 NE NE												
Total (with net CO₂ emissions/removals)	515 883 493 516 479 109 483 371 489 100 489 029 493 797 502 091 530 347 528 237 529 618 527 664 539 155												
Total (without CO₂ from LUCF)	430 513 431 831 433 217 436 186 439 859 451 671 460 343 471 768 492 069 502 791 512 946 520 117 526 042												

Note: Discrepancies in totals are due to rounding errors.

NE = not estimated.

^a Australia reported confidential emissions of CO₂ from soda ash production and use, magnesia production and ammonia production, and N₂O from nitric acid.

28. Australia's emissions profile is dominated by CO₂ emissions from energy. In 2002, CO₂ remained the most important gas with a share of 69 per cent of total emissions with LUCF (68 per cent without LUCF), followed by CH₄ with 23 per cent and N₂O with 7 per cent, fluorinated gases and confidential emissions making up the rest.¹¹ In the same year, the energy sector, including transport, accounted for 69 per cent of emissions, followed by agriculture with 20 per cent, industrial processes with 5 per cent, LUCF and waste with equal shares of 3 per cent. The LUCF sector is a net source of emissions in Australia and is the most dominant element in the overall trend. Emissions from international bunkers (not included in the national totals) showed the greatest increase, of 73 per cent: emissions from aviation almost doubled, and emissions from marine bunker fuels grew by 23 per cent.

29. For the LUCF sector, Australia submits a GHG inventory under the UNFCCC and includes estimates following the Kyoto Protocol rules. In 2002, the LUCF sector under the UNFCCC was a net source of 18,189 Gg CO₂ equivalent, which is 81 per cent lower than in 1990. According to the Kyoto Protocol, Australia is eligible to include in its base year estimate net emissions from LULUCF that constituted a net GHG emission source in 1990 (Article 7).¹² To this end, Australia reports on Article 3.3 human-induced emissions from forest and grassland conversion (deforestation) and removals in forest plantations (afforestation and reforestation). In 2002, the LULUCF sector under the Kyoto Protocol was a net source of 29,159 Gg CO₂ equivalent (5 per cent of national totals), which is 76 per cent lower than in 1990. The emission estimates in this report follow the UNFCCC accounting, unless noted otherwise.

¹¹ All shares are given relative to total emissions, with LUCF following the UNFCCC accounting, unless noted otherwise. For 2002, the total emissions, with LUCF following the UNFCCC accounting, were 539,155 Gg CO₂ equivalent.

¹² However, Australia is not eligible to report on additional activities related to Article 3.4 of the Protocol as outlined in decision 11/CP.7. Also, based on decision 11/CP.7, Australia is eligible to annually apply 9.0 Mt C (33 Mt CO₂) removals within Article 3.4 to compensate emissions from deforestation under Article 3.3.

30. **Carbon dioxide:** In 2002, Australia’s total emissions of CO₂ were 371,569 Gg with LUCF and 358,455 Gg without LUCF (table 4 and figure 1). Energy industries contributed 54 per cent of these emissions. The main reason for such a high share is the dominance of coal as a fuel of choice for electricity generation in Australia. The second largest sector is transport, accounting for 20 per cent of emissions, followed by energy use in industry including manufacturing industries and construction with 12 per cent, industrial processes with 5 per cent, and LUCF with 4 per cent.

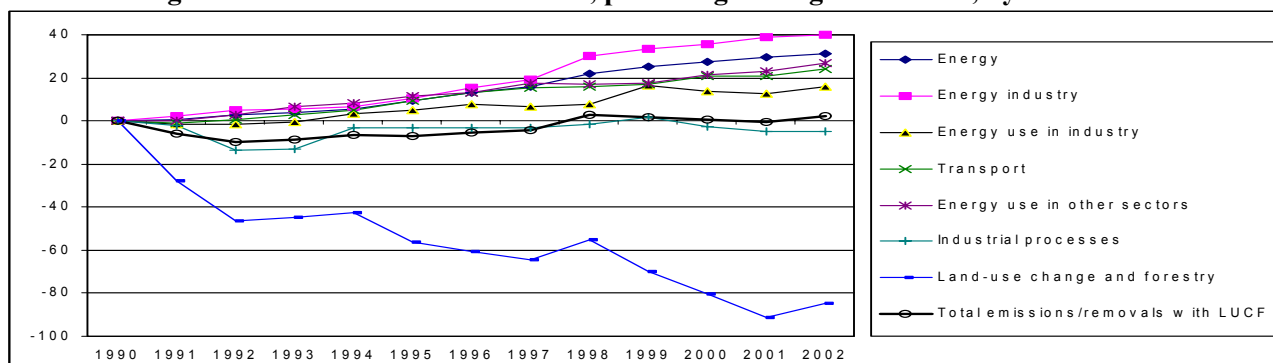
Table 4. Carbon dioxide emissions by source, 1990–2002 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Energy	258 623	260 717	265 402	268 805	272 700	282 425	292 173	299 492	315 518	324 581	330 223	335 381	340 142
Energy industry	141 806	145 296	148 512	149 791	150 851	156 807	163 335	169 403	184 779	189 112	192 391	197 224	198 871
Energy use in industry	37 385	36 830	36 707	37 143	38 645	39 169	40 315	39 856	40 223	43 601	42 589	42 035	43 249
Transport	59 727	59 077	60 194	61 358	62 765	65 367	67 711	69 060	69 123	69 970	72 095	72 260	74 087
Energy use in other sectors	13 743	13 770	14 147	14 665	14 866	15 366	15 563	16 124	16 104	16 164	16 660	16 939	17 474
Fugitive emissions from fuels	5 963	5 745	5 841	5 847	5 573	5 715	5 251	5 049	5 289	5 734	6 488	6 924	6 462
Industrial processes	19 235	18 879	16 642	16 709	18 613	18 594	18 669	18 658	18 940	19 549	18 742	18 265	18 297
Land-use change and forestry (LUCF)	85 370	61 685	45 892	47 185	49 241	37 358	33 454	30 322	38 278	25 446	16 672	7 547	13 113
Waste	12	12	12	12	12	17	14	17	17	17	16	16	16
Total with CO₂ from LUCF	363 239	341 293	327 947	332 710	340 566	338 394	344 309	348 489	372 753	369 593	365 653	361 210	371 569
Total without CO₂ from LUCF	277 869	279 608	282 055	285 525	291 325	301 036	310 855	318 167	334 475	344 147	348 981	353 663	358 455

Note: Discrepancies in totals are due to rounding errors.

31. The 29 per cent growth of total emissions without LUCF between 1990 and 2002 was underpinned by the 40 per cent growth in emissions from energy industries. This growth stemmed from the overall increase in electricity production and consumption of around 40 per cent, and also from some shift in electricity generation from black coal to brown coal¹³ as a result of energy market reform. With a growth of 28 per cent between 1990 and 2002, energy use in other sectors (residential, commercial and agriculture) ranked second in terms of emission growth, followed by transport with 24 per cent and energy use in industry with 16 per cent. Emissions from industrial processes declined by 5 per cent, but because of their small share (only 5 per cent) this did not considerably influence the overall trend.

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



32. The only sector where the net emissions declined rapidly was LUCF, with a decrease of 81 per cent between 1990 and 2002, which contributed to the slowing down of the overall CO₂ emissions growth between 1990 and 2002 to only 2 per cent. The drop in CO₂ emissions from LUCF was driven by the decrease in emissions from forest and grassland conversion, which was the only source of emissions within the sector (it is also a key source), while the level of removals from the other subcategories within LUCF remained broadly the same. The review team learned that the drop in emissions mainly occurred

¹³ Use of brown coal for electricity generation leads to a lower thermal efficiency and higher losses, and therefore to a higher carbon intensity of electricity production.

from 1990 to 1992 and from 1999 to 2001 and was underpinned by the decrease in land clearing, which in turn was determined by the decrease in market demand for agricultural products developed on cleared lands. It noted that sizeable differences in annual increment rates in biomass in native forests and plantations are not sufficiently explained in the NIR2004. The review team also noted that CO₂ removal rates in soil in the category “CO₂ emissions and removals from soil” are different from the IPCC defaults, and are derived using expert judgement. Australia is encouraged to review CO₂ removal rates in soil and annual increment rates in biomass used for inventory, and to document them in future inventories.

33. **Methane:** In 2002, CH₄ emissions totalled 5,918 Gg (table 5 and figure 2). The share of agriculture was the largest, with 62 per cent, followed by energy with 21 per cent, waste with 14 per cent and the LUCF sector making up the rest. In agriculture, enteric fermentation is the main source of CH₄ with 83 per cent, followed by 13 per cent from prescribed savannah burning; manure management, rice cultivation and field burning of agricultural residues altogether account for only 4 per cent. Emissions from the energy sector mainly came from fugitive emissions from fuels (92 per cent).

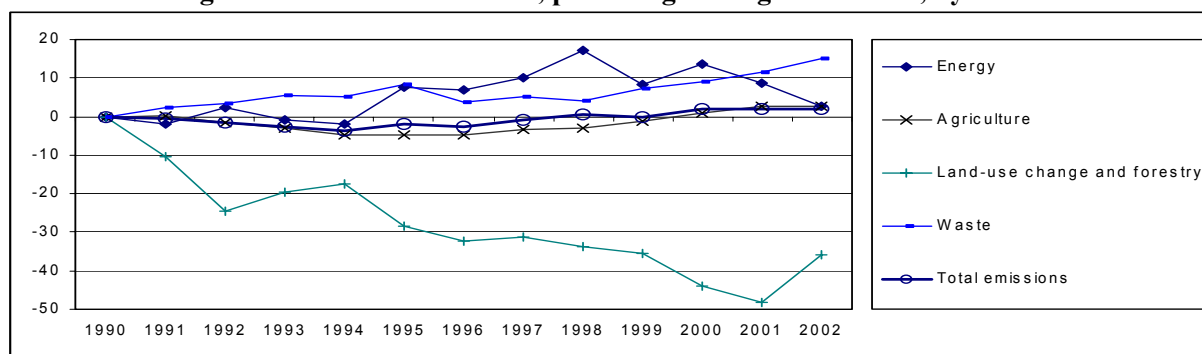
Table 5. Methane emissions by source, 1990–2002 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Energy	1 198	1 174	1 226	1 186	1 175	1 290	1 279	1 321	1 405	1 299	1 361	1 301	1 228
<i>Fuel combustion (sectoral approach)</i>	114	115	118	119	118	116	114	116	111	108	105	99	99
<i>Fugitive emissions from fuels</i>	1 084	1 059	1 108	1 067	1 057	1 175	1 165	1 206	1 294	1 190	1 256	1 203	1 129
Industrial processes	3	3	3	3	4	4	4	4	4	4	3	3	3
Agriculture	3 580	3 591	3 524	3 473	3 412	3 411	3 414	3 465	3 478	3 539	3 618	3 676	3 672
<i>Enteric fermentation</i>	3 214	3 225	3 165	3 096	3 023	2 994	2 983	3 007	3 011	3 049	3 063	3 082	3 059
<i>Other</i>	366	365	360	377	389	417	430	458	466	490	555	594	614
Land-use change and forestry	320	287	241	257	264	229	217	220	212	206	179	166	205
Waste	705	721	729	745	742	764	731	742	734	757	768	785	810
Total emissions	5 807	5 775	5 723	5 664	5 596	5 698	5 645	5 752	5 833	5 805	5 929	5 931	5 918

Note: Discrepancies in totals are due to rounding errors.

34. Total CH₄ emissions remained relatively stable, with an overall increase of only 2 per cent between 1990 and 2002. However, within this there was a substantial decrease in emissions from LUCF by 36 per cent, primarily due to decline in land clearing, and an increase in emissions from all other sources, including 15 per cent in waste, 4 per cent in fugitive emissions and 3 per cent in agriculture. The increase in CH₄ emissions from agriculture was mainly driven by an increase in prescribed savannah burning, which is a key source. Emissions from enteric fermentation fell slightly as a result of a decline in numbers of sheep since the 1990s as a result of deregulation of the price of wool, although there was a small increase in cattle numbers. The increase in emissions from waste was related to the increase in both the population and per capita waste disposal.

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



35. Within CH₄ emissions from livestock manure management, which is a key source, the review team noted that only emissions from dairy and feedlot cattle and swine have been included. Emissions from other animals, such as sheep, have not been included. Australian inventory experts explained that

they assumed these emissions to be negligible because of the dry conditions of the country (they are indicated erroneously as “not estimated”). Emissions from organic soils have also not been included either. To ensure complete and transparent inventory reporting, the review team encourages Australia to document underlying assumptions for emissions from manure management, particularly for CH₄ from sheep manure, and to include emissions from organic soils in future submissions of its GHG inventory.

36. **Nitrous oxide:** In 2002, total N₂O emissions amounted to 113.87 Gg. Agriculture, with a share of 81 per cent, was by far the most important source of emissions, followed by energy including transport with 15 per cent; LUCF and waste with shares of 2 per cent each made up the rest (table 6). Within the energy sector, transport accounts for around 80 per cent of the emissions.

Table 6. Nitrous oxide emissions by source, 1990–2002 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Energy	7.95	8.85	9.65	10.55	11.44	12.39	13.22	14.02	15.00	15.88	16.79	17.17	17.49
Industrial processes	0.09	0.09	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.07
Agriculture	64.26	64.79	64.29	66.13	67.26	68.23	68.29	73.04	76.38	81.35	87.48	90.51	92.03
Agricultural soils	48.86	49.31	48.98	49.93	50.33	49.76	49.29	52.56	55.39	58.63	61.45	62.56	62.81
Other	15.4	15.49	15.31	16.20	16.93	18.47	19.00	20.48	20.99	22.72	26.03	27.94	29.22
Land-use change and forestry	3.24	2.98	2.57	2.69	2.72	2.46	2.34	2.40	2.33	2.25	1.95	1.85	2.50
Waste	1.56	1.58	1.60	1.61	1.63	1.65	1.67	1.69	1.71	1.73	1.75	1.77	1.79
Total emissions	77.10	78.29	78.18	81.04	83.13	84.80	85.61	91.22	95.50	101.28	108.04	111.36	113.87

Note: Discrepancies in totals are due to rounding errors.

37. Emissions of N₂O increased by 48 per cent between 1990 and 2002, mainly due to a 120 per cent increase in emissions from energy and a 43 per cent from agriculture. The increase in the energy sector was underpinned by a 163 per cent increase in emissions from transport, resulting from the rise in the number of vehicles with three-way catalytic converters. The growth in emissions from agriculture is explained by changes in three key sources: application of fertilizers and animal waste to agricultural soils, accounting for 68 per cent of emissions from agriculture in 2002; intensive savannah burning, accounting for 27 per cent; and by manure management, accounting for 5 per cent. The review team noted Australia's efforts to improve emission estimates and reduce uncertainties from these sources.

38. **Fluorinated gases:** In 2002, emissions of fluorinated gases amounted to 4,252 Gg CO₂ equivalent, made up of 65 per cent HFCs and 35 per cent PFCs (table 3). As noted in paragraph 18 above, some sources of fluorinated gases are still to be included in the national inventory (emissions of HFCs from refrigeration and air-conditioning equipment were reported in the NIR2004). Based on Australia's current estimates, total emissions of fluorinated gases decreased by 16 per cent, resulting from a 62 per cent decline in PFCs that was partly offset by a 144 per cent increase in HFCs. The increase in emissions of HFCs was dominated by the growth in emissions from refrigeration and air-conditioning equipment. HFC-22 was produced in Australia only between 1990 and 1995. The use of HFCs in refrigeration and air-conditioning equipment began in 1994, and emissions from this source have been growing since then. The decline in PFCs was due to a decrease in emissions of these gases from aluminium processing, which was attributed to better management of the smelting process and a shift of production to smelters with lower PFC emission rates.

III. POLICIES AND MEASURES

39. **Institutional framework:** As described in section I, the AGO has the role of a **central agency** responsible for coordinating domestic climate change policy at the national level. Reflecting the different roles and responsibilities at different levels of government, policies and measures to mitigate emissions of GHGs are put in place at the national, state and territory, and local levels. The NC3 focused on national policies and measures, although it also included information on some policies and measures implemented at state and territory level, and at local level. Importantly, the NC3 outlines the 1998 NGS that aimed to ensure a coordinated approach by all levels of government. It also outlines the follow-up national

programmes announced in 1999 *Measures for a Better Environment*. In particular, the NGS required coordination between relevant portfolios at the national level, such as environment and heritage, industry, tourism and resources, and agriculture, fisheries and forestry, and relevant ministerial councils. It also required coordination between the national government and the governments of state and territories, which was implemented chiefly through the HLG. The Australian Government consulted business, other levels of government and the wider community to help develop its new CCS. The Government's 2004 Energy White Paper sets out Australia's future energy strategy and reflects the close integration of policy on industry and climate change.

40. **Coverage:** The NC3 provides an outline of policies, measures and action plans on energy, transport, industrial processes, waste, agriculture and LUCF. This includes policies and measures which are relevant to the mitigation of emissions and enhancement of sinks. It details GHGs affected, type of measure, the status of the measure and level of government at which a measure is implemented. For most of the key measures, the NC3 also outlines the expected mitigation effect in 2010. The NC3 broadly outlines the progress made in implementing the NGS to achieve the overarching policy goals in three major areas – fostering knowledge and understanding of climate change, mitigation and adaptation – and provides some information on the progress in implementing individual NGS measures. The NGS included 8 modules and 86 measures across different sectors, including those taken at the national level and state and territory level, and joint actions. The review team noted that, for greater transparency, information on the names and scope of the NGS modules could be provided in the NC3 itself, although several pointers to relevant web sites have been included there.

41. **Compliance with the guidelines:** The reporting on policies and measures in the NC3 broadly conforms to the UNFCCC reporting guidelines. Cross-cutting and energy-related policies and measures were not subdivided by gas. For the key policies and measures, estimates of effects were provided for 2010 only. (Since the publication of the NC3, the effects of two cross-cutting measures have been subdivided by sector.) However, the information in the NC3 on the progress in the implementation of sector-specific policies was limited. There was also little detail on the monitoring and evaluation of these policies; on estimated effects of individual policies and measures, or collections thereof; on their cost; on non-GHG mitigation benefits; and on possible interactions between policies and measures.

42. More information on some of these issues was presented to the review team during their visit. The overall impression of the review team was that there is an increased attention to the issues of monitoring and evaluation of the national strategies and the effects of policies and measures. This stemmed from the need to demonstrate that the programmes in place are delivering sizeable reductions in emissions, and from the need to develop more focused and cost-effective longer-term approaches to climate change. One such example is the strategic review conducted in 2003 of the NGS and the 1999 *Measures for a Better Environment* package. The main outcome from this review was a recommendation to develop the next generation of the national climate change policy framework, with a focus on a limited number of nationally coordinated actions that could help not only to attain the Kyoto Protocol target, and in the longer term to facilitate the transition to a carbon-constrained future. Another example is the 2003 projections, which contain a more detailed assessment of the effect of individual measures than the NC3.

43. The review team noted that the NC3 presents policies by groups of gases affected. This is not in full adherence with the guidelines, but could be a way of organizing information on policies and measures that affect multiple gases. The team also noted that the NC3 does not systematically contain information on policies and measures that are no longer in place; on some policies and measures reported in the NC2; and on policies and measures that may lead to greater level of emissions. It encouraged Australia to report on these issues in future.

44. **Overview of policy development:** Launched in 1998, the NGS provided the strategic framework for developing mitigation policies and measures. It was developed by the national government and state

and territory governments with input from local governments, industry and the community. In 1999, the measures included in the NGS were supplemented by the *Measures for a Better Environment* package.

45. There have been important policy developments since the publication of the NC3, at the national level, and at state and territory level. In November 2002 the Minister for the Environment and Heritage outlined the national government's intention to develop a long-term policy on climate change. Following on from the 2003 strategic review of the NGS and the *Measures for a Better Environment* package, the new CCS was announced in the May 2004 budget, which allocated AUD 464 million to combat climate change over 2004/2005 to 2007/2008 budget years, including funding for existing measures.

46. Shortly after the review team's visit, the new energy strategy *Securing Australia's Energy Future* was released; this has also changed the policy context and funding. This AUD 749 million policy package has a major impact on climate policy in that it addresses the full range of energy-related aspects of climate policy, including energy markets, energy efficiency and new technologies, such as renewables.

47. Altogether, ***these new developments have an impact on the scope, structure, aims and funding for domestic climate change policies and measures, that altogether amounts to almost AUD1.8 billion.*** Also, as was indicated to the review team the CCS aims to refocus and streamline the plethora of climate change actions developed in previous strategies and plans, and drawing on lessons learned from their implementation, will influence the effectiveness of the overall climate change policy package.

48. ***Several states and territories have already developed greenhouse strategies***, including some drawn up after the publication of the NC3. Some of these strategies include measures that go beyond the scope of the 1998 NGS that was agreed by the national, state and territory governments. These include the Victorian Greenhouse Strategy, and its commitment in 2004 to the coalition of reducers; the 2003 mandatory efficiency benchmarking scheme in the electricity sector of New South Wales (NSW); and the mandatory scheme in Queensland that, among other things, requires electricity retailers to source at least 13 per cent of the electricity they sell or use in Queensland from gas-fired power generation. All states and territories (but not the national government) also participate in a working group that aims to develop a model for emissions trading to be presented to ministers by the end of 2004.

49. Along with the development of some new national and state-level policies and strategies, ***some policies outlined in the NC3 have since been discontinued.*** These include the Compressed Natural Gas Infrastructure Programme, which aimed to support the development of a commercially sustainable and publicly accessible network of compressed natural gas (CNG) refuelling stations, but where 16 of the 19 successful tenderers decided not to proceed. The National Bicycle Strategy has also been discontinued (although individual states have developed bicycle strategies since the publication of the NC3). The Waste Management Awareness Programme has also been discontinued.

A. Cross-cutting issues

50. ***Balance of policy instruments at national level:*** The focus of national measures presented in the NC3 was on voluntary measures, education and awareness-raising, although it also included some regulatory and economic measures, which were expected to deliver most of the emission savings. In the stationary energy sector, for example, the small number of regulatory policies was expected to account for two thirds of 31.2 Mt CO₂ equivalent reductions in this sector, which accounts for the bulk of emissions. Regulatory measures were expected to deliver more than half the 10.7 Mt CO₂ equivalent reductions expected in 2010 from industrial processes, according to the 2003 projections. In contrast, voluntary measures were expected to play a larger role in the agricultural sector and fugitive emissions. Altogether, the overall approach to climate policy could be characterized as a "portfolio approach", as policies target both demand and supply in the energy, industry and transport sectors, and are implemented through a diverse set of policy instruments that seek to complement each other.

51. ***Balance of policy instruments at state and territory level:*** Policies and measures introduced by state and territory governments included in the NC3 and those developed since its publication focus more on regulatory measures and financial incentives. New South Wales, for example, has set a GHG target for emissions by state government agencies; set up a mandatory electricity benchmarking scheme that is projected to deliver 18.1 Mt CO₂ equivalent reductions in 2010 (including 12.7 Mt CO₂ overlap with the measures such as MRET); developed strict building standards for new dwellings; and is considering a differentiated stamp duty on cars. NSW and Queensland have enacted new legislation on vegetation management, which stops the broad scale clearing of remnant vegetation. This will have a noticeable effect on national emissions. Victoria also has a target for emissions by state government agencies. The ACT adopted mandatory minimum energy efficiency levels for houses and a target to phase out waste landfilling by 2010.

52. The ***Greenhouse Gas Abatement Programme*** (GGAP) is one of the key Australian Government programmes set up as a part of the 1999 *Measures for a Better Environment* package that aims at emission mitigation by supporting individual industry and community activities. The programme leverages private sector investment in projects that are likely to result in substantial reductions in greenhouse gas emissions or substantial sink enhancement, particularly in the period 2008–2012. GGAP projects approved to date are in the area of co-generation, energy efficiency, travel demand management, alternative fuels, coal mine gas technologies and fuel conversion. The GGAP funding is allocated through competitive funding rounds. The assessment and approval process for two funding rounds have been completed and a third is under way (50 project proposals). As of mid-2004, twelve approved projects are on track to deliver abatement in the period 2008–2012.

53. The NC3 outlined that AUD 400 million was initially allocated to the GGAP as a whole, between the 2000/2001 and 2003/2004 financial years. By mid-2004, approximately AUD 130 million had been allocated to projects in different sectors. The GGAP was one of the seven AGO programmes audited by the Australian National Audit Office (ANAO) in 2003, referred to hereinafter as the 2003 audit. This audit noted that because project grant funding is only disbursed once projects reach agreed implementation milestones and there had been implementation delays for a number of projects, there had also been delays in expending project funding under the programme. The average GGAP project requires 5–7 years from the time the proposal is received until it is completed. As of mid 2004 the first Kyoto period was only three and a half years away and it was unlikely that new projects from rounds beyond the third round of funding would be completed before 2008. Consequently, in the May 2004 budget, the Government announced that the third funding round of the GGAP would be the last and re-allocated uncommitted GGAP funds to the CCS.

54. The GGAP is expected to generate cost-effective emissions reductions during the first Kyoto Protocol period 2008–2012. The estimated abatement cost (from government funding) is AUD 5.5 per tonne of CO₂ based on 2003 projections. Overall, the mitigation effect of the GGAP is expected to grow over time, but it is difficult to assess its current mitigation performance. According to the 2003 projections the abatement estimated in 2010 is 10.3 Mt CO₂ equivalent.

55. The 1995 ***Greenhouse Challenge*** programme was expanded in the 1997 *Safeguarding the Future* package. It is a voluntary cooperative partnership between national government and industry to abate GHG emissions. It covers several sectors, including efficiency in energy end-use sectors, oil and gas extraction, cement manufacture, electricity generation, coal mining and the aluminium industry. The targets for membership of the programme, as outlined in the NC3, were for 500 members in 2000 (which was met) and 1000 members in 2005. In March 2004 the number of members was 785, including companies responsible for at least 98 per cent of emissions from aluminium and cement production, oil and gas production, and electricity generation. The mitigation effect in 2010 was revised downwards in the 2003 projections (table 7).

56. In its budget of May 2004 the Australian Government announced its enhanced partnership programme – Greenhouse Challenge Plus – with new funding of AUD 32 million for the four years from July 2004. The new Challenge Plus programme includes separate levels of membership related to the levels of mitigation effort and/or disclosure rules, and integrates three programmes (the former Greenhouse Challenge, Greenhouse Friendly offsets initiative and the Generator Efficiency Standards, discussed below) into a single stream-lined programme. Web-based reporting is being introduced to reduce reporting costs and to encourage comparability in data-sets.¹⁴

57. Although in 2004 the national government ruled out participation in an *emissions trading scheme*, such a scheme may be introduced at state and territory level in future. However, as no such scheme had yet been set up in 2004, the effect of such measures could not be estimated. Another cross-cutting programme is the *Greenhouse Friendly* programme, a voluntary certification and labelling initiative applying to products and services that encourages industry to offset life-cycle emissions.

Table 7. Key cross-cutting policies and measures and their mitigation effect

Measure	Type	Projected effects in 2010 (Mt CO ₂)	
		In NC3	In 2003 projections
Greenhouse Gas Abatement Programme	Economic	10.8	10.3
Greenhouse Challenge	Voluntary/Negotiated agreements	16.1	13.2
Greenhouse Friendly	Voluntary	NA	0.4
Emissions trading	Economic	NE	NE

Note: NA = not available; NE = not estimated.

B. Energy

58. The large share of emissions from the energy sector in Australia – 48 per cent of the sector in 2002 (without transport) – is mainly due to a heavy dependence on coal for electricity generation, the importance of electricity-intensive industries for the economy, and the levels of energy efficiency in energy end-use sectors other than industry. Still, this share is less than in many other developed countries because of the relatively large share of emissions from agriculture. The cross-cutting programmes outlined above have a substantial energy component. In addition to these programmes, there are several other policies and measures in place directed specifically towards mitigating emissions from the energy sector, some at the national level and others at the state or territory level. In particular, the 2004 Energy White Paper has implications for climate change in that it addresses energy markets, energy efficiency and new technologies, particularly renewables.

59. Australia's rich endowment of fossil fuel resources underpins the interest in innovative low-emission technologies and geological sequestration and the interest in international cooperation to foster the research, development and deployment of such technologies. The 2004 Energy White Paper introduced the AUD 500 million Low Emission Technology Demonstration Fund which will leverage at least AUD 1 billion in private sector investment in new technologies to demonstrate both renewable and fossil fuel low emission technologies with significant long-term greenhouse gas abatement potential. The Australian Government has also allocated AUD 27 million over four years through the CCS for the Low Emissions Technology Abatement programme to encourage investment in the development, demonstration and deployment of smaller-scale low emission technologies and other cost-effective abatement activities, including carbon capture and storage projects. Work on a trial to demonstrate the commercial development of geological storage of CO₂ has been initiated, and in mid-2004 a potential project at Barrow Island was undergoing an environmental impact assessment. As of June 2004, there

¹⁴ After the review visit, the IDR team was informed that the 2004 Energy White Paper introduced a new requirement for mandatory membership in the Greenhouse Challenge Plus for businesses with large fuel consumption.

were no estimates available of the potential of these technologies to reduce emissions or on interactions of technology research and development policies with other environmental policies and programmes.

1. Energy supply

60. **Energy market liberalization:** At the time of the 1998 NGS, it was indicated that national energy market reform was expected to promote energy savings and increased use of natural gas as a fuel in the power sector. By the time the NC3 was drawn up, the expected long-term GHG effects of liberalization were less clear, as in the initial stages of the reform there was an excess electricity supply in the market and relatively low electricity prices, among the lowest in the OECD. These conditions favoured low-cost and high-emission incumbents, i.e. power stations using brown coal in Victoria, rather than new gas-fired generators, renewable electricity generators or energy efficiency projects. Moreover, an (unofficial) report to the COAG¹⁵ indicated that structural barriers impede the uptake of co-generation and distributed generation. Indeed, since liberalization, the GHG intensity of the electricity supply has increased from 0.811 kg CO₂/kWh in 1990 to 0.973 kg CO₂/kWh in 2001 for Australia as a whole.

61. The 2003 projections of the effect of policies and measures indicate that energy market reform is expected to increase Australia's emissions by 1.2 Mt CO₂ in 2010, while the NC2 had anticipated that reform would decrease emissions by 14 Mt CO₂ by that date. The NC2 also mentioned that reform would have a positive impact on energy subsidies. However, this impact was not detailed in the NC3 or during the review team's visit. The difference from the originally anticipated outcomes of the reform in terms of emission mitigation suggests the need for a careful consideration of the links between energy market reform and climate change strategies.

62. The Ministerial Council on Energy recommended a further round of energy market reform to the COAG in December 2003. This includes changes to the governance of energy markets; economic regulation and rule-making; electricity transmission; user participation; natural gas penetration and consideration of greenhouse emissions from the energy sector. As noted above, the development of a new energy policy was under way during the team's visit. This policy, as outlined in the 2004 Energy White Paper introduced a new governance structure for the energy market to be put in place within a year. This may have a further impact on emissions from the electricity sector, although the review team did not have any information on the magnitude or direction of such impact. Yet, the administration of the energy market remains a shared responsibility between the States and Commonwealth, whereby the States have responsibility for investment decisions in plant and transmission, and in retail energy pricing.

63. **Electricity:** Emissions from electricity generation accounted for the majority (69 per cent) of emissions from stationary combustion in 2002, and their share is projected to remain broadly the same by 2012. Thus, limiting emissions from electricity generation is an important element of Australia's national climate strategy, and the focus of many policies at national and state level.

64. The NC3 outlines national **Generator Efficiency Standards** (GES), which were introduced in 2000 as a voluntary measure whereby the national government enters into legally binding agreements with electricity generators to achieve agreed best practice standards through the implementation of action plans. The individual standards vary according to plant specifications to reflect the different technologies being used and the age of the plant.¹⁶ By May 2004, 17 companies, representing 85 per cent of Australian electricity generation capacity, had signed up to the standards. Information presented to the

¹⁵ The report entitled "Strategic review of the 1998 national greenhouse gas strategy" was provided to the review team during the country visit.

¹⁶ This measure applies only to generators that meet all the following criteria: capacity of 30 MW or above, annual generation of 50 GWh or more, capacity factor of 5 per cent or more in each of the last three years. The 2004 best-practice efficiency guidelines for new plants define the following efficiency levels for different power plants: natural gas 52 per cent, black coal 42 per cent, brown coal 31 per cent.

review team indicated that some of these companies had already started implementing their action plans. As companies are allowed up to two years to develop such a plan, this leads to a delay in implementing the measure, and somewhat limits the mitigation effect in the short term. The budget announcement in May 2004 indicated that the GES will be reinforced as part of *Greenhouse Challenge Plus*. As it is a voluntary measure, companies reporting to the AGO and monitoring of implementation is critical for a successful outcome.

65. From January 2003, electricity retailers in NSW (by far the largest producers of electricity in Australia) are required to meet mandatory targets for abating GHG emissions for electricity production and use for the period 2003–2012. This *greenhouse benchmarking scheme* requires its participants to reduce the emissions to an agreed benchmark to achieve the NSW state-wide benchmark of reducing per capita emissions to 7.27 tonnes by 2007. This represents a 5 per cent reduction below the 1990 level. The penalty for exceeding the benchmark is AUD 10.5 per tonne. Surrendering abatement certificates bought from low-emission electricity generators, demand-side abatement, carbon off-set through “sinks”, or mitigation activities carried out on-site can be used to offset excess emissions. Introduced as a voluntary measure, the scheme’s status was changed to that of a regulation in 2003, as uptake was slower than desired. As NSW is not only the largest electricity producer, but also the most populous state, the strengthening of this measure is expected to have a large mitigation effect at the national level. The scheme gave rise to much debate on emissions trading at state and territory level. Importantly, in 2004 in response to climate change concerns, the building of a new coal power plant was rejected in NSW for the first time ever. A summary of the key policies and measures in energy supply is provided in table 8.

Table 8. Key policies and measures in energy supply and their mitigation effect^a

Measure	Type	Projected effects in 2010 (Mt CO ₂)	
		In NC3	In 2003 projections
Energy market reform	Regulation	-0.1	-1.2
Generator efficiency standards	Voluntary/negotiated agreements	4.5	3.6
NSW greenhouse benchmarking scheme ^b	Regulation	NA	18.1 (including 12.7 overlap)

Note: NA = not available.

^a Measures to promote renewable energy also belong to the key measures in energy supply and are shown in a separate table 9.

^b Includes an overlap with Australian Government measures.

2. Renewable energy

66. Australian support to promote renewable energy is outlined in the NC3 as one of the main policy goals in the energy supply sector. This encompasses three main measures: the Mandatory Renewable Energy Target (MRET), supporting renewable energy industry development activities, and the national green power accreditation programme (which is run through state and territory governments). Since the NC3 publication, the policies to promote renewable energy have been reviewed and evaluated. Also, the 2004 Energy White Paper introduced new measures to support renewable energy. These include the AUD 100 million Renewable Energy Development Initiative to support research and development of small scale renewable energy projects with strong commercial potential; the AUD 75 million Solar Cities programme to fund sustainable energy demonstration projects in urban Australia; an AUD 20 million programme to support development of Advanced Electricity Storage Technologies for renewable energy; and an AUD 14 million programme to develop and install a Wind Energy Forecasting Capability to help electricity networks to more effectively utilize wind power.

67. The *Mandatory Renewable Energy Target* (MRET), **announced in 1997**, aims to increase the contribution of renewable electricity by an additional 9500 GWh by 2010 and to maintain this level to 2020. When achieved, the share of renewables in electricity generation is expected to comprise approximately 10 per cent of the overall generation in 2010. The Renewable Energy (Electricity) Act 2000, which supports the implementation of the MRET, entered into force in April 2001. It places a legal liability on wholesale purchasers of electricity in states and territories to contribute proportionately to achieving the target. The MRET is being implemented through a system of tradable certificates – a

highly innovative policy solution. The certificates are supplied by eligible accredited renewable energy generators and are required by wholesale purchasers of electricity to discharge their liability. There is a penalty for non-compliance of AUD 40/MWh (around AUD 57/MWh at company rate after tax).

68. Information provided to the review team indicated that the interim targets under the MRET for 2001–2003 have easily been surpassed: in 2003 over 4,900 GWh was generated compared to a target of 2,600 GWh. The overall target of an additional 9,500 GWh is expected to be met three years ahead of schedule (i.e. in 2007), with a total budget allocation for administration of AUD 6 million. The main sources predicted to benefit from the MRET in 2010 are wind (24 per cent), wood waste (21 per cent), hydro (19 per cent), bagasse (14 per cent), and biomass and solar (22 per cent). The review team noted that a large technical potential for biomass use remains untapped so far. In May 2004, renewable energy certificates were trading at AUD 39, and there was approximately 96 per cent compliance.

69. The total cost of the measure as reported in the NC3 was predicted to be AUD 3 billion over its lifetime. The adoption of a flexible approach, which is associated with a low compliance cost, has helped the MRET scheme to achieve its goal. By providing an additional income stream, it also helped to reduce the net cost of renewable energy and to bring it close to the competitive edge of the average cost for electricity generation, 30–35 AUD/MWh. A 2003 review of the MRET recommended increasing the target to 20,000 GWh by 2020. However, the national government announced in the 2004 Energy White Paper that it would not increase the MRET on the basis that it imposes significant economic costs through higher electricity prices. Instead, it has announced a number of amendments to strengthen the MRET scheme and improve its efficiency and administration.

70. Although Australia has huge reserves of fossil fuels, it also has vast potential for development of renewable energies. Information on programmes supporting renewable energy industry development presented in the NC3 grouped together a number of separate initiatives that include emissions abatement in the short and medium term, as well as building capacity for the domestic renewable energy industry and commercializing promising renewable energy options. In a country such as Australia where electricity is generated predominantly (85 per cent) from coal, any increase in the market share of renewables has a substantial mitigating effect on emissions of GHGs. The NC3 outlined that the national government had committed funding of up to AUD 382 million between 1998 and 2010 for these different programmes, which are primarily grant-based and complement the effect of the MRET.

71. The **Renewable Energy Commercialisation Programme** (RECP) is a grant programme supporting innovative renewable energy equipment, technologies, systems or processes that have strong commercial application and the prospect of substantial abatement of longer-term GHG emissions. The 2003 audit of the programme concluded that of the 223 applications, 53 projects were approved, and 21 had been completed by mid-2004. The RECP has been successful in attracting proposals and committing expenditure to particular projects. However, because of the long lead time of projects and even longer lead time for technology uptake and diffusion, it takes some time before the full mitigation impact of this measure is felt. For the 14 projects completed by June 2003, an estimated 0.38 Mt CO₂ equivalent were saved. This is expected to increase to 0.5 Mt CO₂ equivalent (combined with the programme below) by 2010, over and above the abatement which is counted under MRET.

72. The NC3 outlined that the largest amount of funding committed to renewable energy is in the **Renewable Remote Power Generation Programme** (RRPGP), launched in 2001 for 10 years. This programme provides grants to increase the uptake of renewable energy technologies in remote areas. Progress under the RRPGP has been slower than expected. To the end of June 2003, more than 2,000 small to medium renewable generation power systems had been approved, mainly in Queensland and Western Australia, and seven major projects were approved in Western Australia, Northern Territory, Tasmania and Antarctica. Though short-term mitigation is not the focus, in June 2003 it was estimated that the programme would reduce emissions by 0.9 Mt CO₂ equivalent.

73. Descriptions of other (smaller) national and state-level measures to promote the development and uptake of renewable energy are also included in the NC3, but no estimate of effects was provided. Since the NC3 publication, new measures to promote renewable energy have been initiated at the state level. For example, Victoria has allocated AUD 8.45 million for a renewable energy support fund. The Australian Government also works with states and territories through the Ministerial Council on Energy to overcome barriers to the uptake of smaller-scale distributed generation, such as renewable energy.

Table 9. Key policies and measures to promote renewable energy and their mitigation effect^a

Measure	Type	Projected effects in 2010 (Mt CO ₂)	
		In NC3	In 2003 projections
Mandatory Renewable Energy Target (MRET)	Regulatory and market based	7.3	6.5
Renewable Energy Commercialization Programme and Renewable Remote Power Generation Programme (outside MRET) ^b	Voluntary/economic	NA	0.5
Green power	Voluntary/economic	inc in MRET	0.9

Note: NA = not available.

^a Under the new budget announced in May 2004, renewable energy activities are covered under the umbrella of “low emission technology and abatement”.

^b The estimates for these programmes only includes abatement which is additional to that included in the estimate for MRET.

3. Energy use in industry, residential and commercial sectors, and in government operations

74. Energy use in industry accounted for 17 per cent of emissions from stationary combustion in 2002, and energy use in residential, commercial and agricultural sectors, and in government operations accounted for 7 per cent. An array of national-level policies and measures to enhance the energy efficiency of industry, domestic appliances, commercial and industrial equipment and residential and commercial buildings accounts for a major component of the expected emission mitigation effect of the package of policies presented in the NC3, as well as in further action under the Climate Change Strategy as part of the May 2004 budget. The effects of these measures (e.g. voluntary measures) were reduced between the NC3 and the 2003 projections (table 10).

75. The most significant current measure in terms of expected mitigation effect in 2010 (estimated at 6.9 Mt CO₂ equivalent by 2010, compared to the NC3 estimate of 7.2 Mt CO₂ equivalent), is the regulation setting the Minimum Energy Performance Standards (**MEPS**) for domestic appliances and commercial and industrial equipment. This is a joint national, state and territorial government programme implemented together with a **mandatory energy efficiency labelling scheme**, estimated to result in a reduction of 1.4 Mt CO₂ by 2010.

76. Evaluations have indicated that the MEPS are the most cost-effective measures of all. Indeed, they resulted in a net benefit of AUD 31 per tonne CO₂ equivalent saved. As a result of these measures the proportion of the most energy-efficient products has steadily risen every year – to the extent that the “star rating” has had to be made more stringent to differentiate between items whose performance had moved to the higher efficiency levels. Given the success of this programme, particularly for electrical equipment rather than gas appliances, it is being extended to cover other types of equipment. The 2004 Energy White Paper indicated that the MEPS will be extended to a greater range of appliances and more stringent standards will be applied to appliances already included.

77. In July 2000, an agreement was reached for the first time between the national, and state and territory governments to introduce **energy efficiency standards** as minimum energy performance requirements into the Building Code of Australia. This is expected to increase the energy efficiency of new buildings, and will have a significant long-term impact, given that there is a 2 per cent annual growth in the housing stock and that residential energy consumption accounted for 13 per cent of total consumption in 2002. Major progress has been made since the NC3, with such standards being introduced for houses in 2003 and plans for further tightening of energy standards in 2006. The team noted that some states (Victoria and the ACT) are introducing energy efficiency standards that go beyond

the national standards. National energy efficiency standards are being planned for other residential buildings (2005), commercial office buildings (2006) and other commercial buildings (2006). Progress has also been made on some smaller energy-efficiency programmes, such as those on *improving energy efficiency of government operations*.

Table 10. Selected energy efficiency policies and measures and their mitigation effect

Measure	Type	Projected effects in 2010 (Mt CO ₂)	
		In NC3	In 2003 projections
Minimum energy performance standards	Regulatory	7.2	6.9
Greenhouse challenge (energy efficiency component)	Voluntary/negotiated agreements	8.5	1.8
Energy efficiency standards for buildings	Regulatory	2.1	1.4
Energy Efficiency Best Practice Programme	Voluntary	1.5	0.2
Other state and territory actions	Various	2.5	1.9
Overlap between measures		-5.6	-

C. Transport

78. Emissions from the transport sector are growing rapidly. Although this sector only accounted for 14 per cent of net emissions in 2002 (79 Mt CO₂ equivalent), further policies and measures are deemed necessary to limit emission growth. According to recent estimates policies and measures are expected to mitigate only 3 Mt CO₂ equivalent in 2010 (compared to the 3.9 Mt CO₂ equivalent reported in the NC3), almost half of which is expected to come from state and territory actions (table 11). Indeed, several states have initiated an array of transport policies of different types, including mandatory standards and benchmarks, financial incentives, cycle strategies and education. They have increasingly moved to *strategic transport planning*, and have initiated reforms that link transport planning to the planning of cities. Since the role of the national government in transport planning is limited, its role in developing GHG mitigation measures in the transport sector is seen as relatively small. Still, the strategy for reducing transport-related emissions at the national level as well as the state and territory level, noted in the NC3, appears important.

79. Mitigation measures introduced in the transport sector focus mainly on efficiency improvement and some modal shift (particularly at state level), rather than on activity levels. For example, the *national average fuel consumption target* for new passenger cars agreed with industry in 2003 was around half the level previously proposed and the expected effect is also now reduced by half compared to the effect reported in the NC3 (the reduced effect could be partly due to delay in implementation).

80. Since the publication of the NC3, the 2001 mandatory *fuel consumption labelling scheme* has been extended in January 2004 to vehicles up to 3.5 tonnes. Thus, it now covers four-wheel-drive diesel and liquified petroleum gas (LPG) vehicles, whereas previously it applied only to petrol-driven vehicles. The label associated with the scheme now also includes figures on CO₂ emissions and fuel consumption. No evaluation of the scheme was available, as it is a new one.

81. Some policies and measures aiming to increase the market share of alternative fuels were also outlined in the NC3. These programmes, e.g. the *alternative fuels conversion programme*, provide economic incentives to convert vehicles to compressed natural gas (CNG), liquefied natural gas (LNG) or LPG. Applications for support under this programme have increased from 550 vehicles (as noted in the NC3) to over 1000 vehicles, mainly buses. However, the take-up under this programme was slower than expected due to technical challenges and difficulty (despite government allocating a tender) of encouraging the development of CNG infrastructure. Thus, the AUD 75 million funding initially allocated to the programme was cut by AUD 40 million and the program is now focused on demonstrating the commercial viability of engines in different applications and commercial environments.

Table 11. Key policies and measures in transport and their mitigation effect

Measure	Type	Projected effects in 2010 (Mt CO ₂)	
		In NC3	In 2003 projections
Environmental Strategy for Motor Vehicle Industry	Information/regulatory	2	1
Alternative fuels conversion programme	Voluntary	0.5	0.04
Strategic transport planning and other measures at state and territory level	Various	1.4	1.4
GGAP	Economic	NA	0.5

Note: NA = not available.

D. Industrial processes

82. Emissions from industrial processes, including CO₂, CH₄, N₂O, HFCs, PFCs and SF₆, accounted for 5 per cent of Australia's net emissions in 2002. However, this is a fast-growing sector, particularly for fluorinated gases. Climate action partnerships in the framework of the *Greenhouse Challenge* may have an increasingly important role in reducing emissions in this sector in the longer term, in particular for emissions from aluminium and clinker production. The projected effect of this in 2010 is a reduction of 4.9 Mt CO₂. There has been important policy development in this sector since the NC3: in 2003, Australia passed the *Ozone Protection and Synthetic Greenhouse Gas Management Act*, which allows the national government to develop country-wide regulations to control both the import and the end use of fluorinated ozone-depleting and synthetic greenhouse gases. This act is expected to have a substantial mitigating effect, 5.8 Mt CO₂ equivalent in 2010.

E. Agriculture

83. Agriculture is an important sector in Australia's economy in terms of its contribution to GDP and exports, as well as in the context of social development at a regional level. The overall emissions, which reached 106 Mt CO₂ equivalent in 2002, corresponding to 20 per cent of net national emissions, consist mainly of CH₄ emissions from livestock enteric fermentation and manure management. They also include N₂O emissions from agricultural soils, which followed a strong upwards trend due to the shift to more intensive agriculture, and CH₄ and N₂O emissions from prescribed savannah burning.

84. The period between 1996 and 2004 saw a shift in focus of mitigation in agriculture from increasing efficiency, as reflected in the NC2, through development of concrete mitigation measures, reflected in the NC3, to the most recent approach for developing policies and measures within a strategic national policy framework. This approach builds on the twin pillars of technical solutions and industry partnership. However, given the importance of emissions from the agricultural sector, the use of market instruments, incentives and regulations could be further enhanced to encourage carbon sequestration.

85. The NC3 outlines the Greenhouse Sinks and Sustainable Land Management Programme under the NGS, which contains the major actions for emission mitigation in agriculture. Of seven measures reported, four are voluntary agreements under the *Greenhouse Challenge Agricultural Strategy* based on industry partnership. The strategy aims to promote agricultural practices leading to reduced stubble burning and fertilizer application, enhanced use of fertilizer additives to inhibit N₂O emissions, and improved waste management systems to reduce CH₄ emissions. The measures are expected to affect both CH₄ and N₂O, with an overall saving of 1.1 Mt CO₂ equivalent by the year 2010 according to the NC3.

86. Two measures, the *Greenhouse and Agriculture Taskforce* and the *Agriculture Work Sector Programme*, are initiatives aimed at coordinating national approaches for emission mitigation in agriculture and incorporating abatement activities into existing natural resource management policies and programmes, through exchange of information. The review team noted that as part of this effort a Working Group on Agriculture and Natural Resources was set up under the Natural Resource Management Ministerial Council for better coordination of activities within the agricultural sector. Finally, the research programme *Reducing Methane Emissions from Livestock* aims to develop a vaccine

to reduce these emissions. Funding of AUD 1 million was provided for it under the 1997 *Safeguarding the Future* package, and work is ongoing to make the vaccine commercially available.

F. Land-use change and forestry

87. The LUCF sector accounted for only 3 per cent of Australia's net emissions in 2002 (18 Mt CO₂ equivalent). The NC3 outlines the Greenhouse Sinks and Sustainable Land Management Programme under the NGS, which encompasses the major policies and measures to reduce GHG emissions and enhance sinks from the LUCF sector. The programme includes four national measures, which contain economic and information elements, including the Natural Heritage Trust, Plantations for Australia – the 2020 vision, Bush for Greenhouse, and the National Action Plan for Salinity and Water Quality. The principal goal of the programme is to reduce land clearing and increase re-vegetation; emission reduction and sink enhancement were seen as co-benefits, but their total effect has not been estimated. There was, however, a noticeable increase in new plantations between 1995 and 2002 with related increase of net removal by around 10 Mt CO₂ equivalent, to which the programme contributed.

88. The *Natural Heritage Trust* is a key Australian Government funding programme with a total budget of AUD 3 billion from 1996 to 2008. Its primary focus is on biodiversity conservation, sustainable land management and enhancement of re-vegetation activities through 56 regional management plans. It also aims at integration of commercial tree growing on cleared agricultural land into farming systems, for the purpose of increasing wood and non-wood production.

89. *Plantations for Australia – the 2020 vision* programme aims at implementing key national goals to increase Australia's plantation estate and establish up to 80,000 ha of plantations annually by 2020. Since 1997, when the programme was launched, investments of around AUD 3 billion have been made in plantation development and AUD 2.5 billion in related processing infrastructure. In 2000, this resulted in 125,000 ha of new plantations established with the concerted effort of states and territories and the timber industry. With a budget of AUD 5.5 million over 5 years, the 1999 *Bush for Greenhouse* programme has helped to remove barriers in forest activities aimed at natural resource management and climate benefits by providing information, technical, legal and administrative tools to facilitate forest investment.

90. The *National Action Plan for Salinity and Water Quality* for the period 2001–2008 aims to prevent, stabilize and reverse trends in dry-land salinity and has a total budget commitment by all national, state and territory governments of AUD 1.4 billion. It focuses on improving water quality and preventing salinity in 21 priority regions. Enhanced CO₂ removals are important co-benefits of the plan that could be achieved, e.g. through mandatory activities in improving existing native vegetation and establishing multiple-purpose perennial vegetation.

91. The NCAS, mentioned in paragraph 16, commenced in 1998 with a budget of AUD 12.5 million over 5 years. The NCAS aims to provide a complete accounting and forecasting capability for human-induced sources and removals over Australian land-based systems. The first major output from the NCAS was producing robust national estimates of emissions from deforestation activities in 2002. Several states and territories actively participated in the NCAS. In May 2004 the Australian Government extended the funding for the NCAS for another four years.

G. Waste

92. Emissions from waste (largely CH₄) are a relatively small component of the Australian GHG inventory, accounting for 3 per cent of total emissions in 2002. In Australia, waste management is generally the responsibility of state, territory and local governments, so most waste-related policies and measures are implemented at this level. Information on such policies is relatively limited in the NC3, which mainly reflects national activities. Some of these activities are overseen through the Environment

Protection and Heritage Council (made up of Australian and New Zealand environment ministers). In 2004, the 2002 Waste Management Awareness Programme reported in the NC3 was discontinued.

93. Some states have ambitious waste-management plans, for example ACT's target of no landfill by 2010. Victoria is also developing a solid waste strategy, and is aiming to improve the management of CH₄ emissions from landfills by introducing requirements relating to GHG emissions from landfills. Waste is one of the few areas where the 2003 projections of the effects of policies and measures expect increased mitigation: the 2003 projections estimate mitigation of 9.9 Mt CO₂ equivalent in the waste sector in 2010, compared to an estimate of 7.7 Mt CO₂ equivalent in the NC3).

IV. PROJECTIONS AND THE TOTAL EFFECT OF POLICIES AND MEASURES

A. Preparation of projections

94. ***Institutional framework:*** The AGO is responsible for co-ordinating the preparation of the NC3 projections. The projections draw on a number of models, both top-down and bottom-up. Other than models used by the AGO for estimates of LUCF emissions and removals, the models are provided by a number of institutions under contract to the AGO. A Greenhouse Projections Group, with membership drawn from the AGO and other national government departments including Treasury, Industry, Tourism and Resources, and Transport, agrees on assumptions and choice of contractors, and signs off the results.

95. New "with measures" emissions projections were prepared in 2001 and reported in the NC3. Business-as-usual projections were also prepared (other than forestry), and supplemented by emission estimates for LUCF from the NCAS. A further set of projections was prepared in 2003, hereinafter called the "2003 projections". Projections are updated and improved on an annual cycle for most sectors, according to an ongoing projection programme run by the AGO.

96. ***Coverage:*** The NC3 projections cover the period to 2020, though projections for agriculture and LUCF only go to 2010. Only a baseline (BAU) projection for LUCF was prepared because at the time of the NC3 there had not been significant new measures over recent years. Broadly, information is reported on a gas-by-gas basis for all sectors according to the IPCC categorization. There are some gaps: N₂O projections are not prepared for the waste sector; CH₄ and N₂O projections have not yet been prepared for LUCF; and CH₄ and N₂O projections in agriculture run to 2010 only. The 2003 projections provide improved coverage including projections for agriculture to 2020 and N₂O from waste water (though further research is required before N₂O from landfill can be covered).

97. ***Compliance with the guidelines:*** The reporting of projections generally conforms with the UNFCCC guidelines, and the coverage of emissions and sources is good. The NC3 projections are provided on both UNFCCC and Kyoto Protocol bases, the 2003 projections on a Kyoto Protocol basis only. Projections of emissions from bunker fuels are reported in the NC3. Aggregated national emissions expressed in CO₂ equivalent using the global warming potential (GWP) were presented by gas and by sector. A variety of different models is used, with the results for different sectors available at different times. The emission figures in the tables seem mostly complete, and graphical presentations of emission trends are included. Quantitative estimates are provided in the NC3 for the aggregated effects of policies and measures, though savings from the GGAP are not yet fully broken down by sector because not all funds have been allocated to projects. In the 2003 projections 5.1 Mt CO₂ equivalent savings from the GGAP in 2010 remains unallocated to any sector.

98. Some sensitivity analysis has been performed – specifically to report a range of projections from a "with measures – high" to "with measures – low" scenario. In these cases the high scenario combines a high BAU projection with associated estimates for impact of measures, and the low scenario combines a low BAU projection with associated estimate for impact of measures. High and low scenario variants of

BAU are also separately presented in the more detailed papers provided for the 2003 projections. Further information on sensitivities and uncertainties is provided by the use of different models.

B. Scenarios, models and assumptions underlying future emission trends

99. **Scenarios:** In addition to BAU, “with measures” scenarios are reported in the NC3, including implemented measures. The review team noted that a “with additional measures” scenario is not reported. This is not obligatory under the UNFCCC guidelines, but might be informative in assessing how the gap to the Kyoto target, which Australia remains committed to achieve, might be bridged.

100. **Methodology:** A number of models have been used, within and across sectors. For most sectors, sectoral best estimates are derived by averaging results from a number of models. The averages for each sector are then cumulated to give overall projection numbers across the economy as a whole. Both, top-down and bottom-up approaches have been used.¹⁷ The review team noted that it is unlikely that the various models used are fully independent, so the method of averaging results to provide an overall best estimate may not have explicit statistical validity. However, consensus forecasts of this type are widely used in areas other than emission projections, and in some cases have a better track record than reliance on particular models. The use of a number of different models for a single sector also provides additional information – the differences in model results provides some indication of uncertainties.

101. Many of the models used for the NC3 were retained for the 2003 projections, some new models were added and others dropped (table 12). The review team noted that the change in the set of models could produce changes in results. In the transport sector, for example, the BAU estimates in 2010 changed from 94.7 Mt CO₂ equivalent in the NC3 to 90.3 Mt CO₂ equivalent in the 2003 projections. This decline can be almost entirely explained by a change in the set of models used, so this choice is potentially sensitive. The choice of models is determined through a tendering exercise, in response to a specification with criteria for choice of model set by the AGO. For the 2004 and 2005 projection exercise the AGO has decided to use the projection approaches used in the 2004 Energy Strategy. The review team noted that where stability in choice of models can be obtained, this may be useful.

Table 12. Models used in 2003 projections

	Top-down	Bottom-up
Stationary energy	G-cubed (MSG), GTEM (ABARE), MMRF-Green	E4cast (ABARE), NIEIR
Transport	BTRE (COPS)	BTRE, ACG
Fugitive emissions		Energy Strategies et al
Agriculture		ABARE (Aglink), CIE-GMI (and AGO model for savannah burning)
Waste	AGO update of Meinhardt Pty Ltd	
Industrial processes		Burnbank Consulting

102. Estimates of the impacts of measures are prepared by the AGO. However, within sectors, there may be some variation in the measures that particular modellers have included in their projections. For the 2003 projections, where some measures had been included the AGO stripped these out, using government estimates of impact, to provide BAU projections. The review team noted that this process introduces some approximations, since it is unlikely that the estimate of impact of measure embedded within the model will equate to the AGO estimates, and this makes the process less transparent. It is encouraging that in the recent 2004 modelling exercise the AGO has requested the modellers to provide projections on both BAU and a “with measures” basis, including effects of all measures in the models.

103. **Assumptions underlying the future emission trends:** Table 13 summarizes key assumptions for the energy sector for the NC3 and the 2003 projections, related to GDP and population growth, oil price

¹⁷ Where both types of model are used within a sector (as is the case for the stationary energy and transport projections), the average of the bottom-up models is estimated, and the average of the top-down models is also estimated. The best sectoral estimate is then taken as the average of the two.

and efficiency improvement due to technological change. Apart from technological change, the NC3 did not elaborate on how technological progress is considered in the projections. Overall, there was some upwards revision of the GDP growth in the NC3 and 2003 projections compared to the NC2 projections. Still, it remained below the historical levels, that may lead to an underestimate of the growth in emissions.

104. The range of assumptions are made by each modeller, based on their own judgement. This allows a divergence of independent views to feed through to results, contributing to understanding of uncertainties. The AGO is conscious that since each modeller may make different assumptions for key input variables, it has to pay great attention to consistency in the production and aggregation of results. It achieves this by ensuring, for example, that the projections of fugitive emissions reflect the average results for fossil fuel demand from the stationary energy sector. The range of assumptions can be quite wide, e.g. on GDP growth. The BAU and “with measures” projections that emerge from the averaging process outlined above reflect an averaging of emissions profiles. It is not possible to ascertain what rate of growth of GDP, or other input assumption, is consistent with this profile.

Table 13. Comparison of actual growth or values of some key parameters and assumptions for these parameters for 2010 in the NC2, NC3 and 2003 projections

	Actual development 1995–2000	NC2 assumptions 1995–2010	NC3 assumption 1999–2010	2003 projections 2000–2010
Economic growth (GDP) (%/year)	3.7	2.3–3.1	2.4–3.7	2.9–3.5
Population growth (%/year)	1.16 (from 1990)	0.91	0.7–1.2	0.75–1.3
World oil price (USD/bbl)	19	1.2% annual growth	NA	25
Technological change (%/year) ^a	NA	0.8	0.5–1.1	1

^a Technological change implies autonomous energy efficiency improvement, excluding structural changes and fuel switching.

105. The review team noted that in some areas the approach used could detract from an understanding of results and key drivers compared to using a single model, given that differences in results between modellers would reflect differences in underlying input assumptions as well as differences in estimated relationships within models. Australian agencies believe that this needs to be balanced against the limitations involved in employing a single model. In the recent 2004 modelling exercise the modellers were asked to provide results on a set of common reference assumptions for key input variables for the energy sector, as well as on their own best view. The review team noted that this should help in the understanding of key drivers.¹⁸

C. Results of projections

106. **Results:** On a “with measures” basis, total annual emissions are estimated in the 2003 projections to rise from 540 Mt CO₂ equivalent in 1990 to 596 Mt CO₂ equivalent on average in 2008–2012 (reflected here as a projections value in 2010), a 10 per cent increase, and to 678 Mt CO₂ equivalent in 2020, a 26 per cent increase (table 14). On Australia’s commitment to meet its Kyoto target of limiting the emissions rise to 8 per cent above 1990 levels over the 2008–2012 period, the review team noted that on the basis of 2003 projections, the emissions gap to its Kyoto target is only 2 percentage points, or 13 Mt CO₂ equivalent. The estimated gap has changed little (by 1 per cent only) between the NC3 and the latest 2003 projections. Whilst projections of total emissions changed little between the NC3 and the 2003 projections, this masks some noticeable sectoral changes, including estimates of effects of measures. Figure 3 illustrates how emissions have changed since 1990 and are projected to change to 2010. After the review visit, the review team was informed that according to the latest 2004 projections, Australia is on track to meet its Kyoto target.

¹⁸ Such common reference point assumptions need not detract from the variation produced by allowing modellers to choose assumptions for key variables, since sensitivities around a reference point can still be explored.

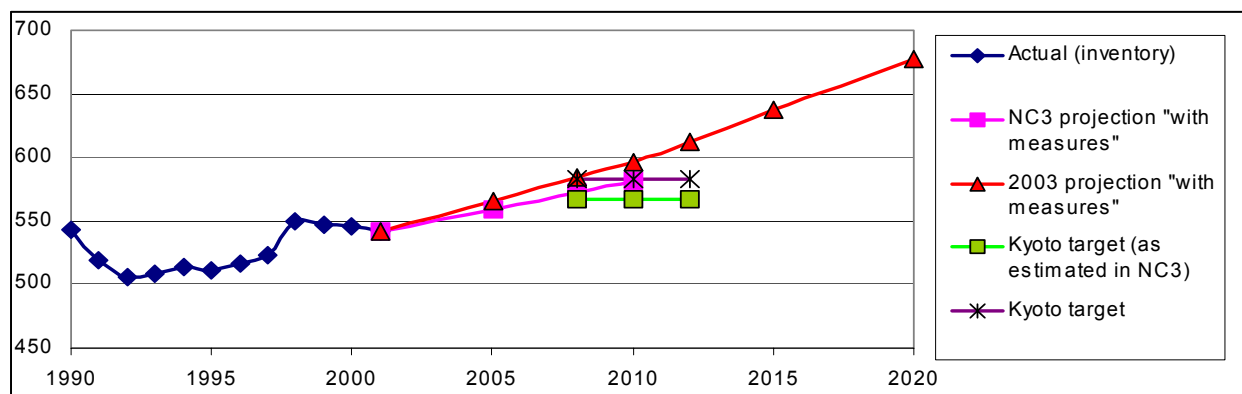
Table 14. Emissions in 2010 as estimated in the NC3 and 2003 projections (Mt CO₂ equivalent)

	NC3 UNFCCC accounting with LUCF	NC3 UNFCCC accounting without LUCF	NC3 Kyoto accounting	2003 projections
Emissions in 1990	498	418	525	540
Emissions in 2010	580	541	581	596
Kyoto target (maximum 8% increase)	NA	NA	567	583
Deficit	NA	NA	14	13
Growth 1990–2010	116	130	111	110
Effect of policies and measures	59	59	59	67

Note: NA = not available.

107. **Consistency between projections 1995–2000 and actual developments:** Although energy and climate change policy has continued to develop, there is a lack of new data since the preparation of the NC3 and 2003 projections to assess the performance. Comparison with the projections prepared for the 1997 NC2, however, indicates that actual emissions growth since then, excluding LUCF, has tracked the 1997 BAU as opposed to the “with measures” projection. This is a reflection of a number of factors: higher GDP (and population) growth leading to higher energy demand, particularly electricity, which led to an increase in the BAU scenario by 15 Mt CO₂ equivalent in 2010. Importantly, the effect of measures reported in the energy sector in the 1997 NC2 was revised downwards by 25 Mt CO₂ equivalent.

Figure 3. Projections of total emissions and Australia’s Kyoto target



Note: The actual (inventory) data (2001 National Greenhouse Gas Inventory Kyoto accounting) is consistent with the 2003 projections only. The NC3 projections and Kyoto target (as estimated in NC3) use 1999 National Greenhouse Gas Inventory (Kyoto accounting) data.

108. **Uncertainty levels of projections and sensitivity to key variables:** High and low emissions scenarios, by sector, are developed as a means of exploring uncertainty in projections. This does not allow for estimation of the probability that emissions will fall within the resulting range. However, it does allow for some exploration of sensitivities and indicates a range of uncertainties associated with the projections. Taking the stationary energy sector as an example, the 2003 projections developed low and high emission scenarios based on key assumptions. This includes GDP growth within a range of 2–4 per cent, growth in electricity demand within a range of 1.5–4 per cent, and autonomous energy efficiency improvement within a range of 0.6–0.8 per cent. The key assumptions were set at a workshop with participation of modellers, AGO and other government officials, and industry stakeholders.

109. The impact that policies and measures may have on emissions may vary in these scenarios, compared to the central BAU. The high and low projections are adjusted for this on the basis of estimates made by the AGO. Allowing for that refinement, uncertainty is then reported by averaging the results of the different model results for each of the high and low scenarios (though the range attached to the individual models is also available). This averaging removes some of the variation which reflects different model specifications – but which may itself be of interest – to concentrate on the uncertainty

attached to key drivers in terms of input assumptions. For the stationary energy sector, this uncertainty is ± 6 per cent on the central “with measures” projection in 2010 around the average 293 Mt CO₂). Uncertainty is particularly high for industrial processes and fugitive emissions, the latter being linked to uncertainty relating to major projects – particularly potential large oil and gas projects.

D. Projections by sector and estimated effect of policies and measures

110. Projected emissions by sector and the change since 1990 are shown in table 15. Emissions from the energy sector – which constituted 55 per cent of overall emissions in 1990 – and for industrial processes are rising strongly. Overall emissions growth is moderated principally by the impact of forest sinks and lower emissions projected for land-use change: compared to 1990 the overall emissions will increase by 2010 by 10 per cent with LUCF and by 27 per cent without LUCF.

111. Emissions from the *energy sector* are projected to grow by 40 per cent from 1990 to 2010, increasing their share to 70 per cent of the total. This is an upward revision of the NC3 estimates of 36 per cent growth from this sector. In the stationary combustion sector the key drivers are GDP and population growth, leading to higher energy demands, particularly for electricity (accounting for around 70 per cent of emissions from stationary combustion). The mix of fuels in electricity generation is projected to move away from coal a little. Still, emissions from electricity generation are expected to be higher in the 2003 projections than in the NC3. This, together with some increase in emissions from final energy consumption (mainly new industry projects), led to an increase in the baseline emissions. Upwards revision of the effects from policies by 2.4 Mt CO₂ equivalent helped to offset this increase.

Table 15. GHG emissions in 1990 and projections in 2010, by sector, according to the 2003 projections (Mt CO₂ equivalent)

Sector	1990	2010			
		BAU scenario	Effect of measures	With measures scenario	With measures % change from 1990
Energy	299	459	-40	419	+40
Stationary combustion	209	325	-31	293	+41
Transport	61	90	-3	87	+42
Fugitive emissions	29	44	-6	38	+32
Agriculture	91	99	-1	99	+8
Waste	15	25	-10	15	-1
Industrial processes	14	37	-11	26	+84
Impact of GGAP	-	NA	-5	-5	NA
Forestry	0	-21	0	-21	NA
Land-use change	120	64	0	64	-47
Total emissions	540	662	-67	596	+10

Note: Discrepancies in totals and percentages are due to rounding errors.

NA = not available.

112. Road transport accounts for the bulk, around 88 per cent, of emissions from the *transport* sector. Growth in emissions from transport, which is almost equal to those from stationary combustion, is driven by increasing population and activity levels, and – for freight particularly – rising GDP. The review team noted the increased attention to modelling emissions from transport as a separate sector. Emissions from transport are expected to grow by 42 per cent between 1990 and 2010 in the 2003 projections, compared to the 44 per cent growth estimated in the NC3. The difference stems partly from the assumption of some saturation of the travel that people could undertake as a function of increase in disposable income.

113. *Fugitive emissions* include emissions from the mining and handling of black coal (about 60 per cent) and from oil and natural gas production, processing and distribution (about 40 per cent). The growth in emissions reflects expected increases in production of both black coal and natural gas. It is sensitive to alternative scenarios for the scale of development and location of major gas fields. The BAU projections have been revised downwards and effects from measures have been revised upwards in the 2003 projections compared to the NC3, leading to a lower emission growth of 32 per cent.

114. **Agriculture** is a sector where the review team noted an improvement in projections since the NC2, including coverage of all key sources, underlying assumptions and associated uncertainties. Since most of the agricultural production is exported, emission projections are underpinned by assumptions on the growth of beef exports, world GDP and population growth, and currency exchange together with historical growth rates (a period of low agricultural growth in the 1990s, high rates of savannah burning in 1998–2000). Under the BAU scenario in the 2003 projections, emissions were expected to initially drop slightly because of a decrease in cattle numbers, to increase thereafter by 9 per cent and in 2010 to reach 99 Mt CO₂ equivalent above the 1990 level. The impact of measures was small, only 0.7 Mt CO₂ equivalent, and it was revised downwards compared to the NC2 to reflect their actual adoption rate. The review team noted the higher than usual rate of savannah burning and the plans to consider this in the future projections for this sector, as it may affect the overall emission trend.

115. **Waste** sector emissions, principally CH₄, come from solid waste disposal (almost 90 per cent of the waste emissions), domestic and industrial wastewater treatment and waste incineration. Population growth is the main driver of increase for domestic waste, and GDP for other wastes. The increase is offset by 10 Mt CO₂ equivalent from measures aimed at organic waste diversion and CH₄ capture.

116. Emissions from **industrial processes** include emissions from mineral products such as cement clinker and lime production, the chemical industry and metal production. Emissions of HFCs from refrigeration and air conditioning and SF₆ emissions from electrical switchgear and circuit breakers, are also important. The principal driver of growth in these emissions is HFCs in refrigeration and air conditioning. From a small base in 1990, these emissions will grow to around half of sectoral emissions in 2010. Overall, under the BAU projections emissions from this sector are expected to grow by 186 per cent between 1990 and 2010. The effects of policies have been revised from 4.9 Mt CO₂ equivalent in the NC3 to 10.7 Mt CO₂ equivalent in the 2003 projections, to reflect the effect of the new 2003 legislation on fluorinated gases. These measures more than halve the projected emissions growth.

117. For **LUCF** the NC3 indicates substantial differences in projections developed following the UNFCCC and the Kyoto accounting, due to the introduction of narrower definitions of forestry under the Kyoto Protocol and resulting reduction of the 1990 baseline. Under UNFCCC accounting, major drivers for projections were rapid expansion of plantation forestry in the 1990s, excision of major areas of forestlands from commercial native forests for conservation purposes under Regional Forest Agreements, and environmental plantings, e.g. under the Natural Heritage Trust (effect estimated at 3.9 Mt CO₂). The projections include short- and long-term rotation forest plantations, forestry operations, environmental tree plantings, carbon sequestration in agricultural soils, prescribed burning of forests and wildfires. Only a “with measures” projection was provided, and this indicated sequestration of 21 Mt CO₂ in 2010, resulting in reduction of emissions in the sector by almost 2 per cent.

118. Under the Kyoto accounting rules, no forestry sinks were included in the 1990 baseline. Removals through afforestation and reforestation activities occurring since 1 January 1990 are projected to be 21 Mt CO₂ in 2010. The estimate is highly uncertain and will be improved during future work within NCAS. The projections of GHG emissions due to land-use change (deforestation) were made for CO₂ only, following the NCAS results on emission decrease in the early 1990s and simple extrapolation of emissions over the period 1995–1998. The BAU was the same as the “with measures” figure, providing a conservative estimate of measures, and resulted in emission of 64 Mt CO₂ in 2010. This is 47 per cent lower than the 1990 level.

V. VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

119. **Institutional framework:** The AGO is the leading institution working on issues of impact assessment and adaptation in Australia. It promotes scientific research and public information and

facilitates adaptation. To consult on the overall climate change adaptation policy, an interdepartmental committee and a high-level group on adaptation involving states and territories have been established. This committee includes key governmental agencies in the field of tourism, environment, agriculture and transport. Governments of states and territories have responsibilities for impacts and adaptation at the level of their competencies. The CSIRO, which is the leading scientific body in Australia, and other Commonwealth research agencies underpin national efforts by conducting scientific assessment.

120. **Overall assessment and compliance with the guidelines:** The official recognition that Australia is greatly exposed to the potential impacts of climate change encouraged the national government to increase its attention to issues of climate change vulnerability and adaptation. As emphasized in the NC3, one of the major drivers of Australia's adaptation policy has been the need to develop robust science for decision-making. The review highlighted that science and research remain the focus of Australia's adaptation policy, and that the reporting on this section followed the UNFCCC guidelines.

121. **Climate change impact and vulnerability assessment:** Extensive assessments of impacts and vulnerability have been carried out in Australia, including assessments across natural, managed and human ecosystems. The NC3 reports on research that comprehensively covers different sectors and regions, including water supply and hydrology, natural ecosystems (coral reefs and alpine ecosystems, wetlands, rivers and aquatic ecosystems), forest, rangelands and agriculture, human settlements and health, and industry. In the last 20–30 years, Australia has experienced decreased rainfall in most parts of eastern Australia, associated to some extent with “el Niño” events, and a step-wise reduction in rainfall in southwest Western Australia. While the causes of reduced rainfall in eastern Australia are unclear, there is evidence that increased GHG concentrations may be contributing to the step-wise reduction on south-west Western Australia. The Murray–Darling Basin, Australia's most important agricultural region, is already affected by reductions in rainfall and streamflow, especially in winter. A further decline in rainfall as a consequence of climate change is expected to cause major stress, and this has attracted the attention of different government agencies.

122. Climate change will have a major impact on *fragile natural ecosystems* and in particular the unique systems such as Great Barrier Reef. Australia may face the challenge of protecting some of its unique plants and animals and their habitat. Also, as supplies of nitrogen and water are limited, Australian *agriculture is highly vulnerable* to climate change. Changes in temperature and precipitation intensity may lead to deterioration of soil nutrition status and activate salinity processes that could result in abandonment of agricultural lands. The impact of climate change on agriculture is a serious concern for Australia, because of the importance of this sector for the national economy.

123. In 2004 the CSIRO released its latest global warming impacts report focusing on Australia as a whole. The report concluded that for the whole country temperatures have risen by nearly 1°C in the past 50 years. If this trend continues, an increased frequency and intensity of droughts could be expected, with associated adverse impacts on farming.

124. **Adaptation:** The integration of climate change issues into key policies and programmes across agriculture and other vulnerable sectors is expected to be achieved through the National Climate Change Adaptation Programme announced in May 2004, with a budget of AUD 14.2 million over four years. This programme envisions a national risk assessment, building the capacity of governments and vulnerable industries and communities to plan for adaptation, promotion of scientific research to fill key knowledge gaps, and provision of targeted information to industry sectors and regions. Overall, Australia is still at the stage of considering possible adaptation measures and policy. At a state level, the risk of increasing intensity of tropical cyclones in the north-eastern coastal areas has already required a response from the relevant state governments. The review acknowledged emerging climate change adaptation responses in the east of the country, in particular for agriculture and water resources. It also

acknowledged the contribution by Australia to the adaptation efforts in the South Pacific region, in particular efforts by the small island developing states (SIDS) to cope with the impacts of sea-level rise.

VI. FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

125. ***Institutional framework and compliance with the guidelines:*** Most of the activities relating to the provision of financial resources and technology transfer are coordinated by the Australian Agency for International Development (AUSAID), which was also responsible for the preparation of the relevant chapter of the NC3. A number of other agencies participate in the organization and implementation of these activities, notably the AGO. The NC3 contains a detailed description of these activities, together with information on financial flows that follows the requirements of the UNFCCC guidelines. The review team noted that the NC3 does not contain a clarification on “new and additional” resources pursuant to Article 4.3 of the UNFCCC. The NC3 also reported on the assistance provided by Australia to the South Pacific SIDS, countries that are particularly vulnerable to climate change.

126. ***Assistance through multilateral channels:*** Most of the support for the UNFCCC process has been channelled through the GEF, given that around one third of the GEF has been directed to climate change. This support has increased steadily since 1999 to reach AUD 21 million for 2003–2004. For the third GEF replenishment (2003–2006), Australia has committed AUD 68 million. Since the setting up of the GEF in 1991, the total commitment of Australia has been AUD 184 million. Other multilateral assistance has been provided through the World Bank National Strategy Studies Program, which has since been rolled into a new programme called Carbon Finance Assist. It aims to cover activities in more than 10 developing countries in the region, including Indonesia and several SIDS. The Australian Government supports private sector involvement in GEF activities.

127. ***Bilateral and regional assistance:*** This has been provided mainly to countries in the Asia–Pacific region. It was provided mostly for sustainable forestry, cleaner production, environmental regulation and renewable energy activities and was tailored to meet specific needs of the recipient countries. Most of the support was allocated for mitigation activities, but recently adaptation has gained prominence. Between the financial years 1996/1997 and 1997/1998 the amount of bilateral and regional assistance decreased noticeably, to AUD 16 million, and has since fluctuated around this figure. In total Australia provided AUD 98 million between 1996–97 and 2000–01 for bilateral and regional activities.

128. ***Capacity-building*** is a recurrent theme in most support activities and forms a significant component of Australia’s bilateral partnerships with developing countries. Between 1999 and 2001, Australia supported a range of activities in more than 20 developing countries to increase their capacity to participate in the CDM and also through the World Bank National Strategy Studies Program. Also, support was provided to several countries in the Asia–Pacific region to strengthen their capacity in the management and monitoring of climate data.

129. ***Technology transfer:*** Australia has been active in facilitating “soft” and “hard” components of technology transfer, focusing mainly on renewable energy and pollution control technology. The National Centre for Application of Solar Energy and the Australian Centre for Agricultural Research contributed to this activity. Recognizing that as in other countries, ***most of the technology transfer occurs through private sector investments*** the government provides a policy framework to facilitate the transfer of climate-friendly technologies through this sector. However, some NGOs noted that support through the export credit agency has been provided for clean coal technology rather than for carbon-free technologies such as renewables.

130. ***Bilateral and multilateral partnerships:*** In addition to the programmes facilitating technology transfer to developing countries, Australia is also actively involved in forming bilateral partnerships with developed countries such as the European Community, Japan, New Zealand and the United States of

America, but also with China under a programme coordinated by the AGO. These partnerships are deemed essential to improve scientific understanding of climate change, to facilitate emission reductions, to enhance capacity for adaptation and mitigation, and to build capacity for an effective global response. Given that these partnerships aim to share data, information, expertise, expenses and resources, Australia believes that they help to advance climate change goals, reduce cost, and avoid duplication of effort.

131. Examples of such partnerships, which seek to actively engage the scientific and business community, include the partnership with the United States of America on gases with high GWP, and with New Zealand on a Climate Information System and on measurement and abatement of emissions from agriculture. Most of the other partnerships centre on research and development of new technology. The Regional Energy Cooperation with Asia-Pacific Economic Cooperation (APEC) countries is an example of a partnership with a wider scope, including setting up of an energy standards information system and a variety of activities on sustainable development, including capacity-building. The scientific programme Capacity-Building for Sustainable Development in developing countries is another prominent example.

VII. RESEARCH AND SYSTEMATIC OBSERVATION

132. ***Institutional framework:*** Climate research in Australia has been conducted by a number of institutions and organizations. The Bureau of Meteorology is responsible for meteorological and climate observations and the relation with international networks of systematic observation such as the Global Climate Observing Systems (GCOS). The CSIRO, Bureau of Meteorology, universities, cooperative research centres and other national and state government bodies are involved in different climate research activities in various ways. The participation of Australia in international research and observation networks in the context of the World Climate Research Programme, the International Geosphere-Biosphere Programme and the GCOS is coordinated by the Australian Academy of Science and the Bureau of Meteorology. A major part of the GHG research is carried out through the Australian Climate Change Science Programme.

133. ***Research:*** Climate research in Australia is extensive and impressive. It aims to increase understanding of climate systems, human interference and related impacts, and to develop models for the climate process and studies of climate impacts, climate change projection and seasonal predictions. Research also addresses a wide range of issues of mitigation and adaptation to climate change. Australia's contribution to aerosol and carbon cycle research, as noted in the NC3, is commendable.

134. ***Systematic observation:*** Australia maintains a variety of atmospheric and oceanographic observing systems in the GCOS Surface Network, the GCOS Upper Air Network and the Global Atmosphere Watch with stations located on the Australian mainland and Tasmania, in remote islands and in Antarctica. Thanks to its geographic location and extent, and the quality of its data-sets supported by world-class research, Australia has the southern hemisphere's most comprehensive monitoring and research activities on climate change. It has one of the earliest established national coverage temperature data-sets in the southern hemisphere, with reliable records starting from 1910. Other climate observations relate to monitoring of sea ice in the Antarctic region, and observations of atmospheric composition.

135. ***Implementation of Article 5 of the UNFCCC:*** Australia has a leading role in activities relating to systematic observation in the Pacific region, in particular climate data management and monitoring, including monitoring of sea-level rise. The National Tidal Facility manages a network of 11 stations in the Pacific region. This may help to enhance the long-lead sea-level prediction capacity for the countries of the Asia-Pacific region, supported by data gathered from networks in the Pacific and Indian oceans.

VIII. EDUCATION, TRAINING AND PUBLIC AWARENESS

136. ***Institutional framework:*** Under Australia's federal system the states and territories are responsible for primary and secondary education, but informal educational and training programmes relating to climate change are major responsibilities of national government, NGOs and the academic sector. The overarching goal of the AGO's education and public awareness strategy is to foster understanding of climate change among the general public and provide the instruments to include climate change elements in the curriculum of primary, secondary and tertiary education.

137. ***Education and training:*** Australia has a long tradition of promoting environmental education within the school system and in university programmes. This was also encouraged by the NGS. The government, together with the academic sector, has produced educational materials for teachers on energy, GHG emissions and climate change, and is helping schools in dealing with climate change issues. Research, university education and industry training activities emphasize renewable energy technologies and household energy efficiency.

138. ***Public awareness and participation:*** Australia has directed its official public awareness activities mainly to supporting current policies and measures. The promotion of community participation and stakeholder involvement in "Cool Communities" campaign launched by the AGO and a network of NGOs, and "The Cities for Climate Protection" and the "Travel Demand Management" programmes were seen by the review team as a good example of how to encourage community action, enhance debate and dialogue among officials and the public at large, and promote innovation using the dynamics and motivations from communities and local governments involved.

139. "The Cities for Climate Protection" programme, which includes a range of activities in different GHG action areas, has progressed since publication of the NC3. In May 2004 it already included 187 local governments covering over 75 per cent of Australia's population. This is still lower than the target of 300 councils by 2003 mentioned in the NC3, but the sheer size of Australia may limit further expansion of this measure. The links between the behaviour of individuals, natural resources and the environment, energy and emission saving, and climate change have formed part of some broader public campaigns such as *Together, Let's Give Our Land a Hand*. The review team noted that in launching such campaigns it could be useful to emphasize the link between the impacts of climate change that are already being observed in Australia and the need to strengthen mitigation efforts. It also noted the lack of information at the time on the assessment of the level of public awareness of climate change.

IX. CONCLUSIONS

140. After reviewing the information included in the NC3 and the additional information used to prepare this document, the review team concluded that there are no major gaps and that Australia conformed with the UNFCCC reporting guidelines. It noted the enhanced comprehensiveness and transparency in the information reported in the NC3 compared to the previous national communications. It also noted that the NC3 contains a sufficient level of detail of all aspects of climate policy, including elements of analysis that underline the design and implementation of this policy.

141. Reporting on projections is clearly an area where noticeable progress was made. Also, detailed information was reported on policies and measures, including assessing the effects from the key policies and measures. The review team noted with appreciation the recent increased attention to the monitoring and evaluation of policies and measures. This includes the update of projections on an annual basis, which allows improved tracking of progress towards achieving the objectives of climate strategy and the key policies. Still, there are some areas where further efforts to improve reporting are warranted: for example, reporting could cover effects of policies already achieved and expected, and effects of policies affecting different gases, instead of the current approach of reporting only on overall effects from policies

on multiple gases affected and only in the future. Also, reporting on inventories in the national communications should strictly follow the reporting in the annual inventories. Other specific issues related to reporting are noted in the various sections in this report.

142. In the context of the aim of the UNFCCC, in accordance with its Article 4.2(b), to return to 1990 emission levels by the year 2000, the review team noted an increase of 3 per cent in overall emissions with LUCF and 19 per cent without LUCF. Up to 2002, the last year for which emission estimates are available, this growth increased to 5 per cent with LUCF and 22 per cent without it. The overall growth in total emissions between 1990 and 2002 was underpinned by the growth in emissions from practically all sectors, especially energy, where emissions have risen by 30 per cent. The review team was unable to ascertain to what extent measures implemented in these sectors helped to slow down their emission growth. The decline in net emissions from LUCF helped to almost offset the growth from these sectors.

143. This growth in emissions is expected to extend in the future. According to the 2003 projections, by 2010 compared to 1990 the overall emissions will increase by 10 per cent with LULUCF and by 27 per cent without LULUCF. Emissions from the energy sector are expected to grow, following the existing trend, with the growth being partly offset by the effects of policies and measures, and emissions from industrial processes are expected to almost double despite the recently introduced strict regulations. The growth in emissions from these sectors will continue to be partly offset by the LULUCF sector. Emissions from waste are expected to stabilize as a result of policy efforts.

144. Important new policy developments occurred between the publication of the NC2 and NC3 and also after the publication of the NC3, at all levels of government. New policies and policy initiatives were launched, such as the 2004 *Climate Change Strategy*, which streamlined and focused existing policies, and the 2004 Energy White Paper *Securing Australia's Energy Future* which introduced a range of new initiatives. Nevertheless, the Australian Government decided not to proceed with ratification of the Kyoto Protocol, while remaining committed to its Kyoto target. According to the 2003 projections, where emissions between 2008 and 2012 are expected to be 110 per cent of the 1990 level following the Kyoto Protocol accounting for LULUCF, Australia is close to achieving its Kyoto target of an 8 per cent increase between 1990 and the first commitment period under the Kyoto Protocol. This is at least partly due to the overall effect of policies and measures, which was revised upwards after the publication of the NC3 to 67 Mt CO₂ equivalent saved in 2010. This reflected the recent policy changes and new policies being launched, which altogether off-set the downwards revision of effects or discontinuation of several existing policies.

145. Some of the policies and policy approaches implemented by Australia have been innovative and noteworthy, such as the MRET, which aimed at an increased uptake of renewable energy through a combination of regulatory and market-based approaches. These provide flexibility in achieving the targets set, at minimal cost, hence minimizing the overall compliance cost. Another noteworthy measure is generator efficiency standards, although these will require careful monitoring to ensure compliance. Overall, finding the optimal mix of voluntary, regulatory and economic approaches in shaping the long-term national responses was still under consideration during the review team's visit. So far, the emphasis within the evolving national climate change strategy has been on voluntary and incentive-based approaches, with a limited use of regulatory and market-based approaches.

146. In addition to the effort at national level, since the outset of the implementation of Australia's national climate strategy the states and territories have been active in implementing policies and measures in the area of their jurisdictions. The single most effective state measure was implemented in NSW: this is the greenhouse benchmarking scheme, which is expected to deliver 18.1 Mt CO₂ saved, or around 30 per cent of the entire national mitigation package (it includes 12.7 Mt CO₂ equivalent overlap with Australian Government measures). A considerable variation of policy approaches was observed: in some cases state and territories were leading in innovation, but sometimes differences in the design and

implementation of policies and measures at their level was deemed to have led to inefficiency. A need for greater consistency in approaches in different jurisdictions to achieve sizeable emission reductions for specific policies and/or sectors seem to have been recognized, at least for some key measures, such as the NSW greenhouse benchmarking scheme. A need for further consideration of climate change issues in the mainstream policies of the key relevant sectors, in particular energy, transport and agriculture, has also been recognized. As to the energy sector, there seems to be a need for a careful consideration of the links between energy market reform and the evolving climate change strategy given the potential sizeable impact of the former on emissions.

147. Australia is among the leading countries in the southern hemisphere in advancing the scientific understanding of climate change phenomena through climate-related research and systematic observation and in sharing this understanding with other countries, especially developing countries. It is also among the leading countries in advancing the scientific understanding of climate change impacts and adaptation, which is understandable given that it is among the developed countries already experiencing noticeable impacts of climate change. Most of the research results on climate change are made available to the general public through the media, and the review team noted a growing awareness of climate change, although the changing level of public awareness was yet to be systematically assessed. Also, most of the current climate change policies are accompanied by public awareness campaigns. The review team acknowledged Australia's contribution to international cooperation on climate change by providing developing countries with technical and financial support, as well as support for capacity-building.
