

Climate change, coal and CCS

- 2.1 There is now compelling evidence that human activity is changing the global climate. The majority of scientists, and the community at large, agree that global action is needed, otherwise we risk reaching a point where it is too late to reverse the damage.¹
- 2.2 The leading international body investigating the impact of climate change, the Intergovernmental Panel on Climate Change (IPCC), has progressively hardened its view on the human contribution to climate change. Its most recent report stated that:
- Most of the observed increase in globally averaged temperatures since the mid-20th century is *very likely* [>90 per cent] due to observed increase in anthropogenic greenhouse gas concentrations.²
- 2.3 The world's major greenhouse gas emitters are the United States (24.3%), China (15.3%), Russia (5.9%), India (5.1%), Japan (5.0%) and collectively, the countries of the European Union (15.3%).

1 For example see: House of Commons Science and Technology Committee, *Meeting UK Energy and Climate Change Needs: The Role of Carbon Capture and Storage*, First Report, Session 2006-06, vol. 1, p. 9; Mr A. Zapantis, *Transcript 26 February 2007*, p. 1; Centre for Energy and Environmental Markets, UNSW, *Submission No. 33*, p. 3; BP, *Submission No. 43*, p. 3.

2 IPCC, *Climate Change in 2007: The Physical Science Basis, Summary for Policy Makers*, February 2007, p.10.

- 2.4 In 2005, Australia contributed 1.4 per cent of global greenhouse gas emissions, or a total of 559 million tonnes of CO_{2-e}³ (CO_{2-e} is the standard accounting provision for the measurement of greenhouse gas emissions). This was 102 per cent of 1990 emission levels. Between 1990 and 2005 Australia reduced its per capita emissions from 32.3 to 27.6 tonnes of CO_{2-e}.⁴
- 2.5 Six gases produced by human activity are commonly recognised as major contributors to climate change: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride.⁵ Of all anthropogenic (human induced) gases, carbon dioxide is the largest contributor to global warming. For example, 74.3 per cent of Australia's greenhouse gas emissions are made up of CO₂.⁶
- 2.6 Fossil fuels, which account for 75–80 per cent of the world's current energy use, are responsible for 75 per cent of manmade carbon dioxide emissions and the use of fossil fuels is expanding.⁷
- 2.7 The IPCC's Special Report on Carbon dioxide Capture and Storage concluded:

Without specific actions to minimize our impact on the climate, carbon dioxide emissions from fossil-fuel energy are projected to swell over the course of 21st century. The consequences – a global temperature rise of 1.4 – 5.8°C and shifting patterns of weather and extreme events – could prove disastrous for future generations.⁸

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- 3 Department of Environment and Water Resources, Australian Greenhouse Office, *National Greenhouse Gas Inventory 2005*, p. 1.
- 4 Department of Environment and Water Resources, Australian Greenhouse Office, *National Greenhouse Gas Inventory 2005*, p. 1; Australia is often regarded as having the highest per capita emissions. Among the world's 25 highest greenhouse gas emitting countries, Australia has the highest per capita emissions. Globally, however, Australia ranks fourth in per capita emissions. See, World Resources Institute, *Navigating the Numbers: Greenhouse gas data and international climate change policy*, pp. 21-22.
- 5 European Environment Agency, *Glossary*, <http://glossary.eea.europa.eu/EEAGlossary/G/greenhouse_gas>, accessed 30 May 2007.
- 6 Department of Environment and Water Resources, Australian Greenhouse Office, *National Greenhouse Gas Inventory 2005*, p. 3.
- 7 UNEP, *Can carbon dioxide storage help cut greenhouse emissions?: A simplified guide to the IPCC's "Special Report on Carbon Dioxide Capture and Storage"*, April 2006, p. 1; the other important source of manmade carbon dioxide emissions is land use and deforestation. See Department of Environment and Water Resources, Australian Greenhouse Office, *National Greenhouse Gas Inventory 2005*, p. 17.
- 8 UNEP, *Can carbon dioxide storage help cut greenhouse emissions?: A simplified guide to the IPCC's "Special Report on Carbon Dioxide Capture and Storage"*, April 2006, p. 1.

- 2.8 Between 1970 and 2004 there has been an 80 per cent growth in global CO₂ emissions, with 28 per cent of this growth occurring between 1990 and 2004. The largest growth in emissions has come from the energy supply sector with an increase of 145 per cent during this period.⁹
- 2.9 A recent study by the leaders of Princeton University's Carbon Mitigation Initiative, Robert Socolow and Stephen Pacala, estimated that if emissions continue to grow at the pace of the past 30 years, by 2056 the annual global rate of emissions would be approximately 14 billion tonnes of carbon per annum.¹⁰
- 2.10 To put these figures into an Australian context, Table 2.1 provides a breakdown of Australia's greenhouse gas emissions from 1990 to 2010. They show a substantial increase in emissions from the energy sector, particularly in stationary energy and transport.

9 IPCC, *Fourth Assessment Report, Working Group Three: Summary for Policy Makers*, May 2007, p. 3.

10 Robert Socolow and Stephen Pacala, *"A Plan to Keep Carbon in Check"*, *Scientific American*, September 2006, p. 50.

Table 2.1 Greenhouse Gas emissions: 1990, 2005 and 2010¹¹

	1990	2005	2010 ('with Measures' best estimate)	
	MT CO _{2-e}	MT CO _{2-e}	MT CO _{2-e}	% of 1990
Energy	287	391	430	150
Stationary	196	279	306	156
Transport	62	80	86	140
Fugitive	30	31	38	127
Industrial Processes	25	30	38	150
Agriculture	91	88	96	105
Waste	19	17	16	81
Land use, land use change & forestry	129	34	24	18
Total	552	559	603	109

Source Australian Greenhouse Office: *Tracking to the Kyoto Target 2006*, p. 4.

Note: These projections are made under Kyoto Protocol accounting rules, which differ to those of the UNFCCC, notably in their treatment of forestry sinks. 2010 emissions projections are equivalent to the 2008-2012 average. Columns may not sum due to rounding.

Australia's reliance on coal

2.11 Australia's domestic and export energy sector is heavily reliant on low cost black and brown coal.¹²

2.12 Australia has 78 500 million tonnes of black coal reserves, or approximately 8.6 per cent of world reserves. At current production levels, these reserves would last 215 years.¹³ Australia – specifically the La Trobe valley in Victoria – also has 53 000 million tonnes of

11 Stationary energy includes emissions from fuel consumption for electricity; Transport includes emissions from fuels by road, rail, domestic air transport and shipping; Fugitive includes methane, CO₂ and nitrous oxide emission that arise from the production, processing, transport, storage and distribution of raw fossil fuels; Industrial processes include all the non-energy emissions from all the industrial processes; Agriculture emissions include the methane and nitrous oxide produced by livestock, cereal production and other agricultural residues; Waste includes emissions from solid waste disposal to land fill and from the treatment of waste water; Land use, land use change and forestry emissions from activities including land clearing, decay of vegetation, disturbance of the soil. Reafforestation and revegetation provide offsets.

12 Department of Prime Minister and Cabinet, *Securing Australia's Energy Future*, 2004, p. 1.

13 AGL, *Submission No. 39*, p. 2.

- brown coal reserves, enough to last for over 800 years at current rates of production.¹⁴
- 2.13 Australia is the largest exporter of coal in the world.¹⁵ The Australian Coal Association (ACA) told the Committee that the black coal industry, in particular, is predominantly an export industry. In 2005, this export was worth \$24 billion representing Australia's largest commodity export.¹⁶
- 2.14 Australia is the world's fourth largest coal producer (301 million tonnes) behind China (2226 million tonnes), the US (951 million tonnes) and India (398 million tonnes).¹⁷
- 2.15 Black coal-fired capacity provides over 58 per cent of Australia's electricity, brown coal 25.8 per cent, gas 6.6 per cent, hydro 7 per cent, with the remaining capacity being met by alternative technologies such as wind and solar.¹⁸
- 2.16 Coal-fired power stations emit nearly 170 million tonnes CO_{2-e} per year, approximately 30 per cent of Australia's total greenhouse gas emissions.¹⁹ The Australian Greenhouse Office (AGO) has forecast that, under a business as usual scenario (that is, emissions in the absence of mitigation measures), by 2020 Australia will be emitting approximately 837 million tonnes CO_{2-e} annually. The stationary energy sector is forecast to account for over half these emissions (423 million tonnes).²⁰
- 2.17 Internationally, CO₂ emissions are expected to grow by over 50 per cent from 24 to 37 billion tonnes per year in 2030.²¹

14 Department of Industry, Tourism and Resources, *Regional Minerals Program Report: Latrobe Valley 21000 Coal Resources Project*, <<http://www.industry.gov.au/content/itrinternet/cmscontent.cfm?objectID=21523D51-0EE1-E185-7ABF7A995BE5A293>>, accessed 8 May 2007.

15 Australian Coal Association, *Transcript of Evidence*, 27 November 2006, p. 1.

16 Australian Coal Association, *Transcript of Evidence*, 27 November 2006, p. 1.

17 Australian Coal Association, *Transcript of Evidence*, 27 November 2006, p. 1; Coal producing figures represent estimated 2005 figures and can be found at, World Coal Institute, *Coal Facts 2006 Edition*, <<http://www.worldcoal.org/pages/content/index.asp?PageID=188>>, accessed 6 June 2007.

18 Energy Supply Association of Australia, *Submission No. 16*, pp. 1-2.

19 Saddler, Riedy and Passey, "Geosequestration: What is it and how much can it contribute to a sustainable energy policy for Australia", *Discussion Paper No. 72*, Australia Institute, September 2004, p. ix.

20 AGO, *Tracking to the Kyoto Target 2006*, p. 19.

21 Centre for Low Emissions Technology, *Submission No. 7*, p. 1.

Responses to climate change

- 2.18 The challenge for the international community, including Australia, is to find ways to stabilise or reduce CO₂ emissions so that future generations are not faced with insurmountable climate change problems.
- 2.19 Many submissions to the Committee highlighted the global nature of climate change and the need to engage all countries.²² Australia participates in numerous international activities and negotiations related to climate change, in addition to its domestic response.

Australia's participation in international initiatives

United Nations Framework Convention on Climate Change (Convention)

- 2.20 The Convention established an international framework to consider strategies to reduce global warming and measures to respond to temperature increases. It came into force on 21 March 1994 and has been ratified by 189 countries, including Australia.
- 2.21 The Convention recognises that the climate system is a shared resource and that its stability can be affected by anthropogenic emissions of carbon dioxide and other greenhouse gases. Under the Convention, governments:
- gather and share information on greenhouse gas emissions, national policies and best practices;
 - launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries; and
 - cooperate in preparing for adaptation to the impacts of climate change.²³

22 ExxonMobil, *Submission No. 19*, p. 5; Rio Tinto, *Submission No. 31*, p. 6; Australian Coal Association and Minerals Council of Australia, *Submission No. 40*, p. 3.

23 UNFCCC, <http://unfccc.int/essential_background/convention/items/2627.php>, 24 July 2006.

2.22 The Convention sets an ultimate objective of stabilising greenhouse gas emissions at 'a level that would prevent dangerous anthropogenic interference with the climate system.'²⁴ It states that:

- such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner;
- The Convention requires precise and regularly updated inventories of greenhouse gas emissions from industrialized countries ... With a few exceptions, the 'base year' for tabulating greenhouse gas emissions has been set as 1990. Developing countries also are encouraged to carry out inventories;
- Countries ratifying the treaty... agree to take climate change into account in such matters as agriculture, industry, energy, natural resources, and activities involving sea coasts. They agree to develop national programmes to slow climate change; and
- The Convention recognises that it is a 'framework' document -- something to be amended or augmented over time so that efforts to deal with global warming and climate change can be focused and made more effective.²⁵

2.23 The Kyoto Protocol was the first addition to the Convention and was adopted in December 1997. The Kyoto Protocol:

... strengthens the Convention by committing Annex I Parties to individual, legally-binding targets to limit or reduce their greenhouse gas emissions. Only Parties to the Convention that have also become Parties to the Protocol (i.e. by ratifying, accepting, approving, or acceding to it) will be bound by the Protocol's commitments. 173 countries have ratified the Protocol to date ... The individual targets of the Annex 1 parties add up to a total cut in greenhouse-gas emissions of at least 5% from 1990 levels in the commitment period 2008-2012.²⁶

24 UNFCCC, <http://unfccc.int/essential_background/feeling_the_heat/items/2914.php>, accessed 25 July 2006.

25 UNFCCC, <http://unfccc.int/essential_background/feeling_the_heat/items/2914.php>, accessed 25 July 2006.

26 UNFCCC, <http://unfccc.int/kyoto_protocol/items/2830.php>, accessed 30 April 2007.

- 2.24 The Australian Government supports the underlying objective of the Convention and has signed but not ratified the Kyoto Protocol, stating that:

The Government has decided not to ratify the Kyoto Protocol because, while it has some positive elements, it does not provide a comprehensive or environmentally effective long-term response to climate change. There is no clear pathway for action by developing countries, and the United States has indicated that it will not ratify. Without commitments by all major emitters, the Protocol will deliver only about a 1% reduction in global greenhouse gas emissions.

The Government is committed to Australia's internationally agreed target of limiting emissions to 108% of 1990 levels between 2008 and 2012. Due to strong action by the Australian Government, including around \$1.8 billion domestic climate change programme, Australia is on track to meet this target.²⁷

- 2.25 In May 2007, the Australian Government announced that the most recent emissions projections by the Australian Greenhouse Office show that Australia is within one percentage point of meeting its Kyoto target of 108 per cent of 1990 levels.²⁸ The latest figures show that Australia's greenhouse gas emissions in 2005 were 102 per cent above 1990 levels,²⁹ whereas under a "business as usual" scenario, Australia was projected to be 125 per cent above 1990 levels by 2010.³⁰

Intergovernmental Panel on Climate Change

- 2.26 The IPCC assesses scientific, technical and socio-economic information relevant for the understanding of climate change, its potential impacts, and options for adaptation and mitigation. It was set up by the World Meteorological Organization and the United Nations Environment Programme in 1988 and consists of scientists and researchers. It is acknowledged by governments around the

27 Department of Environment and Heritage, Australian Greenhouse Office, <<http://www.greenhouse.gov.au/international/kyoto/index.html>>, accessed 21 July 2006.

28 Australian Government Press Release, 2 May 2007; AGO, *National Greenhouse Gas Inventory 2005*, p. 1.

29 AGO, *National Greenhouse Gas Inventory 2005*, p. 1.

30 Australian Greenhouse Office, *2006 Tracking to the Kyoto Target*, December 2006, p. 4.

world, including the Australian Government, as the authoritative source of advice on climate change science.³¹

- 2.27 In January 2001, the IPCC approved the Third Assessment Report which updated the current level of understanding of the climate system and future challenges.³² Its findings included:
- average global surface temperature has increased over the 20th century by about 0.6°C;
 - snow cover and ice extent has decreased;
 - global average sea levels have increased and ocean temperatures have increased; and
 - rainfall patterns have changed in various parts of the world.³³
- 2.28 In September 2005, the IPCC released its Special Report on Carbon Dioxide Capture and Storage which assessed the scientific, technical, economic and policy dimensions of separating, capturing, transporting and storing the CO₂ that is produced in the combustion of fossil fuels. The Summary for Policymakers received line-by-line approval by governments at the IPCC Working Group III Session held in September 2005.³⁴
- 2.29 The Australian Government submission notes Australia's significant contribution to the development of the report and also states that the report:
- ... not only reinforces the strategic direction of CCS in Australia as outlined in *Securing Australia's Energy Future* but also gives further technical legitimacy to its future application in Australia as a large scale mitigation option for fossil fuel energy supply.³⁵
- 2.30 On 2 February 2007, the IPCC released its Fourth Assessment Report on climate change. This report painted a more pessimistic picture than its predecessor. It concluded that its earlier predictions understated

31 Australian Government, *Submission No. 41*, p. 8. Direct quote: 'The IPCC collates scientific advice on climate change and the conclusions of the IPCC are generally accepted by the Australian Government as being the most authoritative science available'.

32 IPCC, *Third Assessment Report, Working Group I, The Scientific Basis: Summary for Policy Makers*, January 2001, p. 2.

33 IPCC, *Third Assessment Report, Working Group I, The Scientific Basis: Summary for Policy Makers*, January 2001, p. 2.

34 IPCC, *Special Report on Carbon Dioxide Capture and Storage*, pp. ix, 53-54.

35 Australian Government, *Submission No. 41*, p. 9.

the impact anthropogenic emissions were having on changes to the global climate:³⁶

Most of the observed increase in global average temperatures since the mid 20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations. This is an advance since the TAR's conclusions ... Discernable human influences now extend to other aspects of climate including ocean warming, continental-average temperatures, temperature extremes and wind patterns.³⁷

International Energy Agency

- 2.31 Since its inception in 1974, the International Energy Agency (IEA) has acted as an energy policy advisor to its 26 member countries. Its current focus is on climate change policies as well as energy technology collaboration and global outreach.³⁸
- 2.32 The IEA biennial conference on Greenhouse Gas Technologies has become a major forum for knowledge transfer in relation to CCS technology and policy.³⁹ In addition, the IEA's Clean Coal Centre is a collaborative project to help members support the production, transportation and use of coal in an environmentally sustainable manner.

Asia Pacific Partnership on Clean Development and Climate

- 2.33 In 2006, the Australian Government hosted the launching of the Asia Pacific Partnership on Clean Development and Climate (AP6), announcing a commitment of \$100 million to the partnership.⁴⁰ The member countries, Australia, China, India, Japan, Republic of Korea and the United States, account for nearly 50 per cent of global energy consumption and greenhouse gas emissions.⁴¹ The principles

36 IPCC, *Climate Change 2007: The Physical Science Basis. Contribution of Working Group 1 to the Fourth Assessment Report, Summary for Policy Makers*, February 2007, p. 10.

37 IPCC, *Climate Change 2007: The Physical Science Basis. Contribution of Working Group 1 to the Fourth Assessment Report, Summary for Policy Makers*, February 2007, p. 10.

38 International Energy Agency, <<http://www.iea.org/textbase/about/index.asp>>, accessed 13 April 2007.

39 Australian Government, *Submission No. 41*, p. 9.

40 Australian Government, *Submission No. 41*, p. 7.

41 ABARE, *Report 06.6, Technology-its role in economic development and climate change*, July 2006, p. 5.

underpinning the work of AP6 include environmental effectiveness, economic efficiency and equity.⁴²

2.34 The AP6 has established eight public-private sector taskforces to study and report on the cleaner use of fossil fuels, renewable energy and distributed generation, power generation and transmission, steel, aluminium, cement, coal mining as well as buildings and appliances. The clean fossil energy taskforce aims to promote an environment which will foster cleaner technologies and practices, including CCS.⁴³

2.35 Evidence to the inquiry has indicated broad support for AP6.⁴⁴ According to the Australian Bureau of Agriculture and Resource Economics (ABARE):

The partnership offers significant potential to reduce growth in greenhouse gas emissions because it includes key developing countries that are responsible for a significant proportion of global emissions, and also because it brings together considerable interregional expertise in a broad range of energy efficient and low emissions technologies.⁴⁵

42 ABARE, *Report 06.6, Technology-its role in economic development and climate change*, July 2006, p. 7.

43 Australian Government, *Submission No. 41*, p. 7.

44 ExxonMobil, *Submission No. 19*, p. 5.

45 ABARE, *Report 06.6, Technology-its role in economic development and climate change*, July 2006, p. 5.

Carbon Sequestration Leadership Forum

2.36 In 2003, Australia became a founding member of the Carbon Sequestration Leadership Forum (CSLF) – a collaboration between governments, non-government organisations, industry and researchers on carbon dioxide capture and storage:⁴⁶

The Carbon Sequestration Leadership Forum is an international climate change initiative that is focused on development of improved cost-effective technologies for the separation and capture of carbon dioxide for its transport and long-term safe storage. The purpose of the CSLF is to make these technologies broadly available internationally; and to identify and address wider issues relating to carbon capture and storage. This could include promoting the appropriate technical, political, and regulatory environments for the development of such technology.⁴⁷

2.37 The CSLF Technical Group's technology roadmap outlines individual and technical issues that it wishes to address. These include:

- Achieving cost reduction for CO₂ capture, transport and storage technologies
- Developing an understanding of global storage potential
- Matching CO₂ sources with potential storage sites
- Demonstrating the effectiveness of CO₂ storage
- Building technical competence and confidence through multiple demonstrations.⁴⁸

2.38 The roadmap, outlined in Table 2.2, identifies key milestones for the development of CO₂ capture, transport and storage that individual CSLF members can utilise.⁴⁹

46 Australian Government, *Submission No. 41*, p. 5.

47 Carbon Sequestration Leadership Forum, <<http://www.cslforum.org/about.htm>>, accessed 25 July 2006.

48 Carbon Sequestration Leadership Forum, *CSLF Technology Roadmap*, p. 1.

49 Carbon Sequestration Leadership Forum, *CSLF Technology Roadmap*, p. 27.

Table 2.2 Carbon Sequestration Leadership Forum - ROAD MAP

Topic/timescale	2004-2008	2009-2013	2014+
Lower costs	Identify most promising pathways Set ultimate cost goals	Initiate pilot or demonstration projects for the promising pathways	Achieve cost goals
Secure Reservoirs	Initiate field experiments Identify most promising reservoir types	Develop reservoir selection criteria Estimate worldwide reservoir "reserves"	Large scale implementation
Monitoring and Verification Technologies	Identify needs Assess potential options	Commercially available technologies	

Source CSLF Technology Roadmap, p. 25.

Australia's domestic response

2.39 Australia has established a wide ranging set of measures as its domestic response to climate change including:

- The AGO, an agency of the Department of Environment and Water Resources, was formed in 1998 and delivers the majority of programmes under the Australian Government's climate change strategy; and
- The 2004 Australian Government White Paper, *Securing Australia's Energy Future*, set out the Government's approach to meeting Australia's energy objectives of 'prosperity, security and sustainability'.⁵⁰ The White Paper acknowledged the importance of addressing human-induced climate change, particularly those caused by greenhouse gas emissions.

50 Australian Government White Paper (2004), *Securing Australia's Energy Future*, p. 2.

- 2.40 Government initiatives which have provided support for addressing CCS and climate change generally include:
- In 2001, Council of Australian Government (COAG) agreed to establish a National Energy Policy Framework;
 - In 2001, funding provided for the Cooperative Research Centre (CRC) for Coal in Sustainable Development and CRC for Cleaner Power from Lignite (ceased in June 2006);
 - In 2002, Prime Minister's Science, Engineering and Innovation Council (PMSEIC) released *Beyond Kyoto – Innovation and Adaptation*; Australia's National Research Priorities for 2002 also included *An Environmentally Sustainable Australia*;
 - In 2003, \$21.7 million funding for the Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC);
 - In 2004, Government announced \$500 million for the Low Emissions Technology Demonstration Fund (LETDF), a fund intended to leverage at least \$1 billion in additional private investment to demonstrate new low emissions technology (renewables and fossil fuel);
 - On 25 November 2005, the Ministerial Council on Mineral and Petroleum Resources (MCMPR) endorsed a set of Regulatory Principles for CCS;
 - In March 2007, the \$200 million Global Initiative on Forests and Climate was launched by the Australian Government. This initiative promotes practical international action to help sustain the world's forests and reduce deforestation;
 - Also in March this year, the Government allocated \$52.8 million to assist households and small businesses in becoming carbon neutral through increased energy efficiency; and
 - The 2007/08 Budget includes an allocation of \$150 million for the installation of solar panels in Australian households and in schools and other community facilities.

Industry's response to greenhouse gas emissions

- 2.41 The response of the private sector to emission reduction, as outlined in the submissions, is proceeding across a broad front. A range of industry responses relating to existing and proposed CCS projects in

Australia is discussed at length in Chapter 4. The following are illustrative of industry responses both globally and locally.

- 2.42 ExxonMobil highlighted its involvement with Global Climate and Energy Project (GCEP) which was launched in the US in 2002. The project is:
- ... a major long-term research program designed to accelerate development of commercially viable energy technologies that can lower GHG [green house gas] emissions on a worldwide scale. Current GCEP research areas include CO₂ sequestration, hydrogen, solar energy, biomass, advanced combustion and advanced materials.⁵¹
- 2.43 ExxonMobil is also a major supporter of the University of Texas Geological CO₂ Storage Research Program which is 'carrying out state-of-the-art simulations to evaluate the feasibility and reliability of subsurface storage schemes'.⁵²
- 2.44 In Australia, ExxonMobil is an advisory partner to CO2CRC in a feasibility study for the storage of emissions in the Gippsland Basin.⁵³
- 2.45 In May 2006, Anglo American and Shell formed the Clean Coal Energy Alliance to address benefits from the emerging clean coal technologies.⁵⁴ In September 2006, the Alliance committed itself to progressing the Monash Energy Project, using Anglo's coal resources and Shell's proprietary coal gasification process. The Monash Energy Project is discussed in more detail in Chapter 4.
- 2.46 BP Australia, through its parent company, has been involved in several projects around the world. The In Salah project, located in Algeria, was commenced in 2004 to separate the CO₂ from natural gas and sequester it 1800 metres deep into a lower level of one of the gas reservoirs. One million tonnes of CO₂ is injected into the reservoir each year.⁵⁵
- 2.47 In 2005, BP commenced planning the development of a clean energy plant at Peterhead in Scotland to split natural gas into hydrogen and CO₂. The hydrogen would fuel a 460MW (base load power) station.⁵⁶

51 ExxonMobil, *Submission No. 19*, p. 4.

52 ExxonMobil, *Submission No. 19*, p. 4.

53 ExxonMobil, *Submission No. 19*, p. 7.

54 Anglo American, *Media Release*, 21 September 2006.

55 BP Australia, *Submission No. 43*, p. 5.

56 BP Australia, *Submission No. 43*, p. 5.

The CO₂ will be piped 240 kilometres to an oil reserve in the North Sea to be used for enhanced oil recovery (EOR) and ultimately for storage.⁵⁷ It is due to commence in 2009 and will require a capital investment of around US\$600 million. The go-ahead depends upon public/government support, which is not yet guaranteed.⁵⁸ BP is also planning a similar hydrogen power and geosequestration project for California, albeit using petroleum coke, a refinery by-product, instead of natural gas.⁵⁹

- 2.48 The FutureGen Alliance, a public-private partnership between twelve companies including BHP Billiton, Anglo American, China Huaneng Group, Rio Tinto, and Xstrata Coal, has been established to design, build and operate the world's first Integrated Gasification Combined Cycle (IGCC) plant with CCS in the US. It is estimated to cost around US\$1 billion with construction due to commence in 2009 and the full-scale plant operational by 2012 /2013.⁶⁰
- 2.49 The CO₂ Capture Project aims to find methods of reducing the cost of CO₂ capture technologies and improve methods of safely storing CO₂ underground.⁶¹ The Project was created by eight of the world's largest energy companies, including BP, Chevron and Shell and in collaboration with governments, including the US Department of Energy, EU and Klimatek-Norway, NGOs and other stakeholders.
- 2.50 The ACA in March 2003 brought together representatives from the coal and electricity industries, unions, federal and state governments and the research community to form the COAL21 Partnership.⁶² One of the aims of the partnership is to accelerate the demonstration and deployment of clean coal technologies. The Australian Government committed \$500 000 to support the initial research.⁶³ This was followed up by the establishment of the COAL21 fund in March 2006 which will raise over \$300 million over the next five years to support further research, development and demonstration (RD&D).⁶⁴

57 BP, *Media Release, BP and Partners Plan Clean Energy Plant in Scotland*, 30 June 2005.

58 BP, *Media Release, BP and Partners Plan Clean Energy Plant in Scotland*, 30 June 2005; Rio Tinto, *Transcript*, 26 February 2007, p. 6.

59 BP Australia, *Submission No. 43*, p. 6.

60 The FutureGen Alliance, <<http://www.futuregenalliance.org>>, accessed 15 May 2007.

61 CO₂ Capture Project, <<http://www.co2captureproject.org/overview/overview.htm>>, accessed 15 May 2007.

62 Australian Coal Association, *Submission No. 40*, p. 5.

63 Australian Government, *Submission No. 41*, p. 5.

64 Australian Coal Association, *Submission No. 40*, p. 5.

2.51 The Centre for Low Emission Technology (cLET) is an unincorporated joint venture partnership between the State of Queensland through the Department of State Development Trade and Innovation, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australian Coal Research, Stanwell Corporation, Tarong Energy Corporation and the University of Queensland. Launched in November 2003, its aim is to advance 'the development of enabling technologies for the production of low emission electricity and hydrogen from coal'.⁶⁵

CCS: one possibility in a suite of options

- 2.52 The international and national responses to reduce CO₂ emissions embrace a variety of participants and a wide array of mitigation strategies. The focus of this report, given the Committee's terms of reference, is on the science and the economic potential of CCS.
- 2.53 The Committee does not view CCS as a magic bullet for reducing global CO₂ emissions. The consensus of the submissions is that a suite of options will be needed to combat climate change and that this has to be a global endeavour. Nonetheless, as fossil fuels will play a major role in power generation worldwide in the 21st century, CCS has the potential to become an essential component of any future global CO₂ mitigation strategy.
- 2.54 The Australian Government submission to this inquiry notes that CCS has been supported both at a Federal and State level, as part of a suite of options to reduce CO₂ emissions from the energy sector.⁶⁶
- 2.55 Socolow and Pacala offer another perspective on the role that CCS may play in reducing CO₂ emissions. Their model aims to show the extent of measures needed across a range of options in order to achieve equivalent levels of greenhouse gas emission reductions (see Figure 2.3). Each measure detailed in Socolow and Pacala's model, if phased in over the next 50 years, could potentially contain 25 billion tonnes of carbon.⁶⁷ CCS is one of 15 possible strategies, and would

65 Centre for Low Emission Technology, *Submission No. 7*, attachment p. 2.

66 Australian Government, *Submission No. 41*, p. 3.

67 Robert Socolow and Stephen Pacala, *"A Plan to Keep Carbon in Check"*, Scientific American, September 2006, p. 54.

require the installation of CCS at 800 coal-fired plants to capture 90 per cent of the CO₂.⁶⁸

2.56 Other options in the Socolow and Pacala model include:

- increasing electricity efficiency;
- doubling nuclear power generation;
- a 700-fold increase in solar power;
- a 40-fold increase in wind power;
- the replacing of '1400 large coal-fired power plants with gas-fired plants';
- the widespread use of ethanol to power cars; and
- the end of deforestation.⁶⁹

68 Robert Socolow and Stephen Pacala, *"A Plan to Keep Carbon in Check"*, *Scientific American*, September 2006, p. 54.

69 Robert Socolow and Stephen Pacala, *"A Plan to Keep Carbon in Check"*, *Scientific American*, September 2006, p. 54.

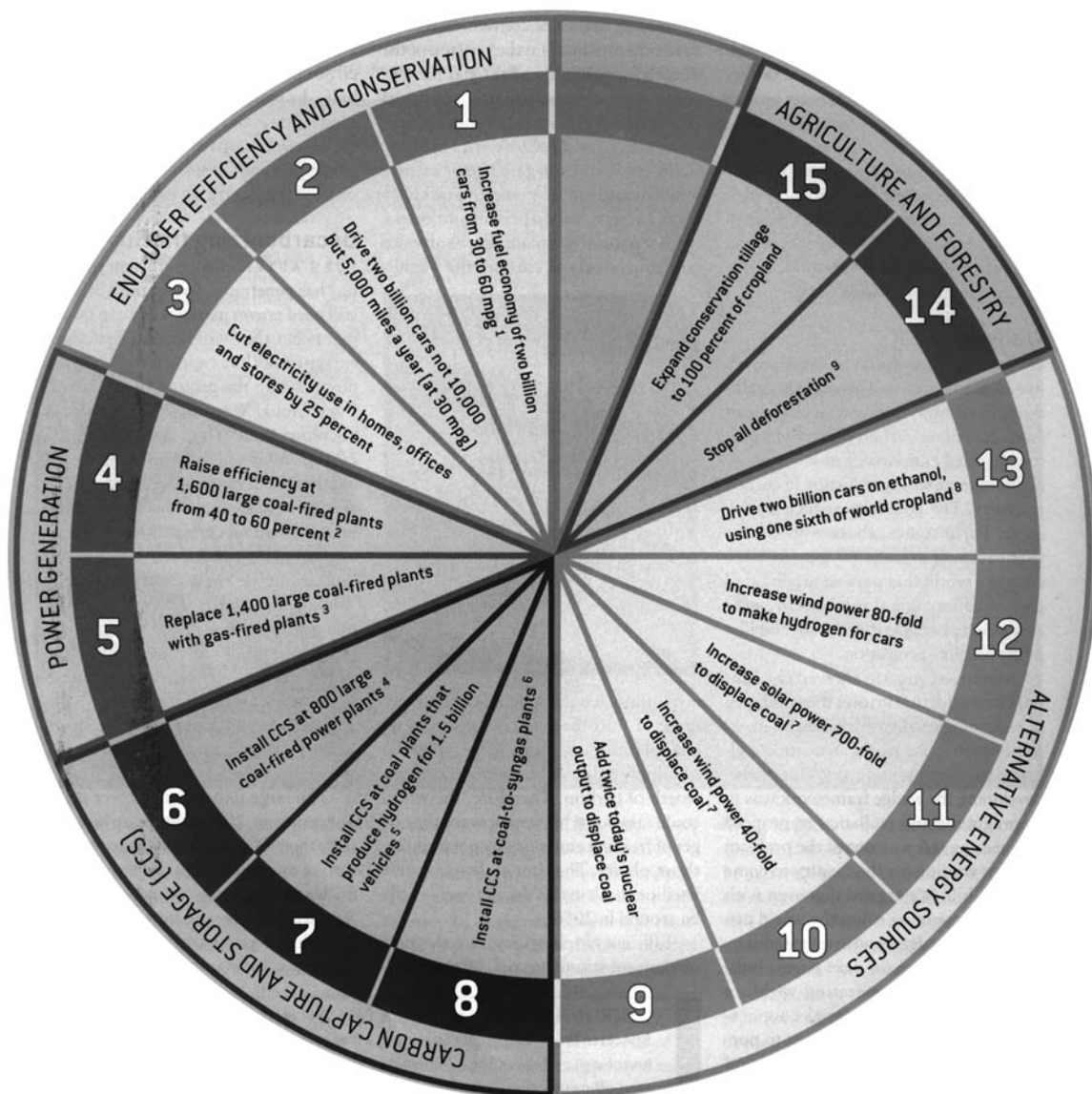


Figure 2.3 sourced from: Robert Socolow and Stephen Pacala, "A Plan to Keep Carbon in Check", Scientific American, September 2006.

- 2.57 CSIRO suggests that it would be difficult for renewable energy sources to meet Australia's base-load demands.⁷⁰
- 2.58 CCS is not a universally preferred option. Some evidence to the inquiry has expressed concern that while CCS has the potential to reduce CO₂, it does not address the other noxious emissions such as sulphur dioxide, nitrogen oxide, arsenic, mercury, dioxins, cadmium, radionucleotides and lead.⁷¹
- 2.59 Furthermore making coal 'cleaner' through the introduction of CCS will result in a continuing reliance on coal.⁷² For example, Friends of the Earth Australia states:

Choosing geosequestration and its associated 'clean coal' technologies is committing Australia to an emissions heavy coal-reliant future. It will mean further financial commitment to fossil fuels and the infrastructure that supports them at the cost of cleaner and less costly renewable energy choices. Renewable energy, energy efficiency and demand management remain the fastest, safest, most cost effective, environmentally and socially responsible ways to reduce greenhouse gas emissions. These technologies already exist, are proven, and could put Australia at the forefront of curbing greenhouse emissions.⁷³

70 CSIRO, *Submission No. 10*, p. 7.

71 Friends of the Earth Australia, *Submission No. 13*, p. 6.

72 Friends of the Earth Australia, *Submission No. 13*, p. 5.

73 Friends of the Earth Australia, *Submission No. 13*, p. 5.