6

The economic benefits and costs of CCS

Introduction

6.1 There is a consensus that taking action on climate change will have a cost impact on the global economy. The IPCC's Fourth Assessment Report estimates that if the world is to stabilise greenhouse gas emissions between 535-590 parts per million (ppm)[1] $CO_{2\text{-}e}$, this will result in a global median Gross Domestic Product (GDP) reduction of 0.6 per cent in 2030. [2] The Stern Review estimates the annual cost of reducing total greenhouse gas emissions, to a level consistent with a 550ppm $CO_{2\text{-}e}$ stabilisation level by 2050, will range from between -1.0 to +3.5 per cent of GDP. That is, an average of around 1 per cent of GDP each year now and for the foreseeable future.[3]

6.2 There is also general agreement that the costs of addressing climate change will be less if CCS is included in the suite of mitigation strategies.[4] If CCS is not included in the mix, then other, potentially more expensive technologies will have to be utilised to reduce CO_2 emissions. The IPCC estimates that, in the long term, including CCS

1 Discussions about climate change tend to focus on the need to limit $CO_{2\text{-}e}$ levels to 550ppm or less (approximately double pre-industrial levels) if human societies are to be safe-guarded from dangerous interference in the climate system that is limiting global temperature rises to 2˚C from current levels. However, the UN Framework Convention on Climate Change has avoided stating a desirable stabilisation level. Today's global $CO_{2\text{-}e}$ levels stand at 380ppm, an increase of 100ppm since pre-industrial times.

2 IPCC Working Group III, Fourth Assessment Report, *Mitigation of Climate Change.*

3 The Stern Review, *The Economics of Climate Change,* 30 October 2006, pp. vi & 211.

4 ESAA, *Submission No. 16*, p. 2.

in the range of mitigation strategies will reduce the cost of stabilising CO_2 by upwards of 30 per cent.[5]

6.3 In the Australian context, ABARE estimates that if early action, including CCS, is taken to abate climate change, Australia's GDP in 2050 will be 2.5 per cent less than its projected GDP under a "business as usual" scenario. Without CCS in the mix, ABARE predicts that carbon abatement will reduce our 2050 GDP a further 0.7 per cent, falling to a total of 3.2 per cent.[6]

6.4 CO2CRC modelling suggests a similar scenario. Their findings indicate that, to achieve carbon mitigation without CCS, it will cost the Australian economy about $2 billion a year more than if CCS is deployed. This is premised on predictions that the cost of avoiding CO_2 emissions will reduce by 30 per cent over time and that CCS will be able to store 140 million tonnes (approximately half) of Australia's total stationary $CO_{2\text{-}e}$ emissions per year.[7]

6.5 By contrast, Greenpeace Australia notes that the cost CCS poses to Australian power stations is one of the major flaws of CCS technology. They state that 'there is no evidence available that indicates CCS is the most economical mitigation option'.[8]

6.6 At this stage, it is extremely difficult to accurately estimate the costs of CCS. The cost estimates for CCS that are made are marked by very wide variations.

5 IPCC quoted in cLET, *Submission No. 7*, p. 4.

6 Australian Government, *Submission No. 41*, p. 16.

7 CO2CRC, *Submission No. 36*, p. 17.

8 Greenpeace Australia Pacific, *Submission No. 15*, pp. 3-5.

6.7 As the Australian Government stated in its submission:

> There is no simple answer to the question of how much CCS costs or what its net economic impact will be (either now or in the future). This is due to the heterogeneous nature of the technical options available (including capture and compression; transport; storage), the variability of its application (e.g. industry sectors and markets; technical options; policy and regulatory environments); the technical and financial complexity of integration; and the still largely speculative nature of the risk profiles being attached to the deployment of these nascent systems by governments and markets… [Moreover] the sum of the costs of individual components does not necessarily add up to the overall system cost (mainly due to the energy penalties of CO_2 capture). This suggests …that each CCS project will have its own unique set of cost estimates and economic impacts.[9]

6.8 These issues are compounded by the lack of commercial-scale, integrated CCS operations worldwide. In its *Special Report on Carbon dioxide Capture and Storage*, the IPCC noted that:

> There is still relatively little experience with the combination of CO_2 capture, transport and storage in a fully integrated CCS system …CCS has still not been used in large-scale power plants (the application with most potential).[10]

The economic cost of inaction

6.9 There are economic costs involved with the deployment of CCS, however, there are also significant economic costs associated with taking no action to address greenhouse gas emissions.

6.10 CO2CRC looked at risk from the point of view if no action was taken:

> Perhaps the greatest, but so far unquantified risk would arise if we took no action, or inadequate action, to limit greenhouse gas emissions, resulting in major (and expensive) consequences arising from climate change.[11]

9 Australian Government, *Submission No. 41*, p. 17.

10 IPCC, *Special Report On Carbon dioxide Capture and Storage, Summary for Policy Makers and Technical Summary*, p. 38.

11 CO2CRC, *Submission No. 36*, p. 18.

6.11 According to the Stern Review, continuing a "business as usual" approach will pose a major economic risk to the global economy, costing trillions of dollars:

> …the Review estimates that if we don't act, the overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP each year, now and forever. If a wider range of risks and impacts is taken into account, the estimates of damage could rise to 20% of global GDP or more.[12]

6.12 The Prime Ministerial Task Group on Emissions Trading notes that 'without action, there are likely to be increasingly adverse economic, social and environmental consequences. These risks need to be managed. They require an economic solution.'[13]

6.13 Available research suggests that the Australian economy could be 'more adversely affected [by global warming] than other developed countries'.[14] This could be the result of a range of factors—Australia's agricultural production is often located in low lying, warm areas and would be adversely affected by even moderate increases in temperature. Additionally, Australia's high rainfall variability means that evaporation is relatively high, therefore large dam storage capacities are necessary.[15]

6.14 It should be noted, however, that conclusions such as these are based on a limited amount of research. The Australian Productivity Commission believes that there is a lack of research which 'systematically and comprehensively compares the costs and benefits of climate change impact in Australia with those in other developed countries.'[16]

6.15 Despite that paucity of research in this area, there are many who are of the opinion that inaction on climate change will have a detrimental impact on Australian industry.[17]

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12 The Stern Review, *The Economics of Climate Change*, 30 October 2006, p. vi.

13 Prime Ministerial Task Group on Emissions Trading, *Report of the Task Group on Emissions Trading*, May 2007, p. 5.

14 Australian Productivity Commission, *Submission to the Prime Ministerial Task Group on Emissions Trading, No. 28*, p. 20.

15 Australian Productivity Commission, *Submission to the Prime Ministerial Task Group on Emissions Trading, No. 28*, p. 20.

16 Australian Productivity Commission, *Submission to the Prime Ministerial Task Group on Emissions Trading, No. 28*, p. 20.

17 Australian Business Roundtable on Climate Change, <http://www.businessroundtable.com.au/html/jointceo.html>, accessed 5 June 2007.

6.16 For example, the following economic impacts have been predicted as a result of climate change:

- Australia's $32 billion tourist industry is highly climate dependent. A 2-3°C temperature rise would bleach 97 per cent of the Great Barrier Reef, which supports a tourist industry valued at $1.5 billion;
- The livestock industry's $17 billion export trade would face risks from increased heat stress, disease and pests; and, if temperatures increase by 2°C, national livestock capacity in native pasture systems would drop by 40 per cent; and
- If, as a consequence of reduced water flows, Australian irrigation allocations were reduced by 20 per cent reduction, Australia's GDP would fall by around $750 million in 2009/10.[18]

Cost estimates

CCS: integrated system

6.17 The IPCC has estimated that the cost of producing a kWh of electricity from a coal-fired power plant (PC and IGCC) ranges from 4-6 US cent without CCS and from 5-10 US cents with CCS.[19] The IPCC estimates that the cost of electricity, with CCS at a pulverised coal station, would increase by between 43 and 91 per cent. At an IGCC power plant that increase would be between 21 and 78 per cent.[20]

18 CSIRO research cited in, Australian Business Roundtable on Climate Change, *The Business Case for Early Action*, April 2006, p. 4.

19 IPCC, *Special Report On Carbon dioxide Capture and Storage, Summary for Policy Makers and Technical Summary*, p. 9.

20 IPCC, *Special Report On Carbon dioxide Capture and Storage, Summary for Policy Makers and Technical Summary*, p. 28.

6.18 Table 6.1 sets out the range of cost estimates (in US$) for PC and IGCC plants with CCS.

Table 6.1 Cost Variations in Applying CCS to a Range of Power Plants

Plant performance & cost parameters	Pulverized Coal	IGCC
Reference plant without CCS	0.043 - 0.052	0.041 – 0.061
Cost of electricity (US$/kWh)		
Power plant with capture		
Increased fuel requirement (%)	24 – 40	14 – 25
CO_2 captured (kg/kWh)	0.82 -0.97	0.67 – 0.94
CO_2 avoided (kg/kWh)	00.62 – 0.70	0.59 – 0.73
%CO_2 avoided	81 – 88	81 – 91
Power with CCS		
Cost of electricity (US$/kWh)	0.063 – 0.099	0.055 – 0.091
Cost of CCS (US$/kWh)	0.019 – 0.047	0.010 – 0.032
% increase in COE	43 – 91	21 - 78
Mitigation cost (US$/tonne CO_2 avoided)	30 - 71	14 - 53

Source *Compiled from: IPCC, Special Report on Carbon Dioxide Capture and Storage, Technical Report*, p.40.

6.19 The British House of Commons report estimated that producing a kWh of electricity at a coal-fired power station (PC and IGCC) without CCS would be approximately 2.6 GB pence. With CCS it would cost approximately 3.7 GB pence.[21] On the basis of these cost estimates, the House of Commons report states that 'the cost of electricity generation using CCS seems to be comparable with, or even less than, published costs from other carbon abatement or low carbon technologies such as nuclear or renewables'.[22]

6.20 In Australia, the cost of a kWh of electricity from a coal-fired power station is between 3.1-4.0 Australian cents.[23] This is less than the cost of electricity production estimated by the IPCC and the British House of Commons report, (4-6 US cents and 2.6 GB pence) because coal is

21 House of Commons, Science and Technology Committee, *Meeting UK Energy and Climate Needs: The Role of Carbon Capture and Storage, First Report of Session 2005-06, Volume 1*, 1 February 2006, p. 51.

22 House of Commons, Science and Technology Committee, *Meeting UK Energy and Climate Needs: The Role of Carbon Capture and Storage, First Report of Session 2005-06, Volume 1*, 1 February 2006, p. 51.

23 Australian Government, *Submission No. 41*, p. 18.

cheaper in Australia.[24] Australian Government figures estimate that the cost of producing a kWh of electricity from a new pulverised coal power station with capture is between 8 Australian cents and 10.6 Australian cents,[25] and an average cost of between A$5 and A$45 per tonne of CO_2 transported. Table 6.2 illustrates the predicted costs for transporting CO_2 in US$.

Table 6.2 Indicative CO_2 Transport Costs in USD per tonne

Distance	**Average costs US$t/$CO_2$**
Under 50km	1
50 – 200km	4
200 – 500km	6
500 – 2000km	12
Over 2000km	35

Source *Compiled from:* ABARE, eReport 05.1, *Near Zero Emission Technologies*, January 2005, p. 20.

6.21 The Australian Government submission also notes that ABARE presents a general estimated cost for storage and on-going monitoring, calculating average costs to be anywhere between A$1 and A$17 per tonne of CO_2.[26]

6.22 Table 6.3 summarises the IPCC's cost estimates for storage under various conditions: those for ocean storage [that is CO_2 stored at an ocean depth of 3000m] include the cost of transport by pipeline, thereby accounting for some of the cost variations between the two sources. Such cost variables are discussed in greater detail later in the chapter.

24 Centre for Energy and Environmental Markets, *Submission No. 16*, p. 15.

25 Centre for Energy and Environmental Markets, *Submission No. 16*, p. 15. The submission converts a US$ figure sourced from ABARE (*Near Zero Emission Technologies*, p. 17) to Australian dollars using a conversion rate of US$1 = 75 Australian cents.

26 Australian Government, Submission No. 41, p. 18.

Table 6.3 CCS Cost Breakdown: Storage and Monitoring

CCS system components	Cost Range US$/tonne CO_2	
Storage		
Geological	0.5 – 8.0	Excludes EOR or ECBM*
Ocean storage – pipeline	6.0 – 31.0	Range represents 100-500km distance offshore and 3000m depth. **
Ocean storage – ship/platform	12 - 16	Range represents 100-500km distance offshore and 3000m depth. **
Geological Monitoring & Verification	0.10 – 0.30***	

Source Compiled from: IPCC Special Report on Carbon Dioxide Capture and Storage, p. 346.

** EOR refers to Enhanced Oil Recovery and ECBM refers to Enhanced Coal Bed Methane recovery*

*** Includes offshore transportation costs*

****Source IPCC Special Report on Carbon Dioxide Capture and Storage, Summary for Policy Makers and Technical Summary, p. 39.*

6.23 The IEA and ABARE estimate that the cost for electricity produced by an IGCC plant with the full range of CCS technology will range between A$ 51- 107 per MWh in 2010, with costs decreasing over time.[27] The Committee has not received an estimate for the total cost of CCS at a pulverised coal power station in Australia.

Cost variables: capture, transport, storage and monitoring

Capture

6.24 Capture is the most expensive component of CCS accounting for between 70 and 80 per cent of the total costs.[28]

6.25 The cost of capture will vary depending on:

- technology choice and design;
- the integration and flexibility of new technology;
- the type and quality of coal and its effect on generating efficiency;
- the energy demands of the capture process;

27 Australian Government, Submission No. 41, p. 19.

28 Saddler et al, The Australia Institute, *Geosequestration: What is it and how much can it contribute to sustainable energy policy for Australia?*, Discussion Paper No. 72, September 2004, p. 27; CO2CRC, *Submission No. 36*, p. 14.

- variant capital costs; and
- the overall performance of the plant with capture deployment.

6.26 As discussed in Chapter 3, there are three types of capture technology: pre-combustion, post-combustion and oxyfuel combustion.

6.27 Pre-combustion technology can only be applied to IGCC. Australia has no IGCC plant (though an IGCC demonstration plant is planned for QLD). IGCC is, however, the basis for many clean coal technology programmes worldwide, many of which envision IGCC as the first step to a hydrogen economy.[29] An MIT study notes that cost competitiveness has made IGCC plants the preferred candidate for electricity generation with CCS.[30]

6.28 The cost of generating electricity from an IGCC plant compared to a conventional pulverised coal plant is, however, considerably more expensive. The Cooperative Research Centre for Coal in Sustainable Development (CCSD) commissioned a techno-economic assessment of power generation options for Australia and concluded that IGCC 'is likely to remain significantly more expensive than advanced pf [pulverised fuel], even with CO_2 capture, for electricity generation'.[31] Yet the report also noted that 'learning rates from increased implementation, and the need for CO_2 capture and other emissions controls, will give the technology [IGCC] an overall cost advantage in the longer term'.[32]

6.29 The costs of pre-combustion capture may also be potentially offset by the considerable economic benefits of converting coal into a liquid fuel. The House of Commons inquiry concluded that 'for new a plant, pre-combustion capture offers a significant advantage, in a carbon constrained world, as a potential source of hydrogen'.[33]

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29 Cooperative Research Centre for Coal in Sustainable Development, *Techno-economic assessment of power generation options in Australia*, Technology Assessment Report 52, April 2006 (parts updated August 2006), p. 26.

30 MIT, The Future of Coal, March 2007, p. xiii.

31 Cooperative Research Centre for Coal in Sustainable Development, *Techno-economic assessment of power generation options in Australia*, Technology Assessment Report 52, April 2006 (parts updated August 2006), p. ii.

32 Cooperative Research Centre for Coal in Sustainable Development, *Techno-economic assessment of power generation options in Australia*, Technology Assessment Report 52, April 2006 (parts updated August 2006), p. 26.

33 House of Commons, Science and Technology Committee, *Meeting UK Energy and Climate Needs: The Role of Carbon Capture and Storage, First Report of Session 2005-06, Volume 1*, 1 February 2006, p. 17.

6.30 In the case of current post-combustion technologies, the costs are substantial. Stanwell Corporation told the Committee that, without significant technological improvements, the cost of post-combustion capture would probably make it more attractive to build a new generation plant from scratch.[34] Terry Daly, researcher at the University of NSW's Centre for Energy and Environmental Markets, told the Committee that the high energy penalty of up to 30 per cent on a retrofitted power station makes the cost of retrofitting unviable.[35]

6.31 Whichever technology is chosen, the different operating conditions and diversity of coal type mean significant variability in cost.[36] For example, the Centre for Energy and Environmental Markets noted that the cost of CCS for Victorian brown coal based generators is likely to be higher because of the need for offshore storage and the high moisture content of Victoria's brown coal, which would require an additional coal drying process for IGCC and oxyfuel application.[37]

6.32 According to the MIT study, the effect of coal type on capture application means that 'multiple technologies will likely be deployed'.[38] The study notes, for example, that, with further technological developments, oxyfuel pulverised coal combustion could prove as attractive as IGCC, especially with lower quality coals.[39]

Transport

6.33 There are differences in views relating to the expenses involved in transportation, and these are primarily in terms of distance. The Centre for Energy and Environmental Markets at the University of NSW states that transporting CO_2 over distances greater than 500 km may not be economically viable.[40] CSIRO suggest that transport of CO_2 over distances of more than 100 kilometres can become expensive and uneconomical.[41]

6.34 Transport costs will be dependent on factors such as the method and pressure of the CO_2 to be transported, whether the pipeline has to

34 Stanwell Corporation, *Transcript, 11 September 2006*, p. 17.
35 Centre for Energy and Environmental Markets, *Transcript, 30 October 2006*, p. 6.
36 MIT, The Future of Coal, March 2007, p. 22.
37 Centre for Energy and Environmental Markets, *Submission No. 33*, p. 15.
38 MIT, The Future of Coal, March 2007, p. xiii.
39 MIT, The Future of Coal, March 2007, p. xiii.
40 Centre for Energy and Environmental Markets, *Submission No. 33*, p. 12.
41 CSIRO, *Submission No. 10*, p. 4.

pass through heavily populated areas, and the nature of the terrain over which the pipeline is constructed.

6.35 The pipeline costs will also vary depending on whether the pipeline is onshore or offshore. Onshore pipelines cost estimates are lower than offshore pipelines. If storage is to take place offshore, then shipping rather than pipeline becomes more economical for distances over 1 000 kilometres.[42] However, for the foreseeable future, transport of CO_2 by pipeline is the most practical and economic option.[43]

6.36 Another variable in the cost of transport is the fluctuating price of steel, which accounts for a major part of the total transport cost. Pipelines need to be constructed from special steel as any water that infiltrates the pipeline will turn the CO_2 into a corrosive carbonic acid.[44]

6.37 The other factor that will influence the final transport cost is the CO_2 mass flow rate.[45] The greater the flow rate and quantity transported the lower the overall unit cost.

Storage and monitoring

6.38 Storage, monitoring and verification costs are likely to be the least costly component in the CCS chain. Variation in storage costs will arise depending on the geological features of the storage site and whether there is a need to cap any potential leakage points.

Future cost reductions

6.39 While there is no real consensus about the costs of the separate components of CCS, it is widely anticipated that costs will decrease over time. Capture costs, currently by far the most expensive component of CCS technology, will experience the greatest decrease as the technology matures. The costs of transport and storage are less likely to dramatically fall because of the maturity of these technologies.

42 IPCC, *Special Report On Carbon dioxide Capture and Storage, Summary for Policy Makers and Technical Summary*, p. 28

43 CO2CRC, *Submission No. 36*, p. 9.

44 CSIRO, *Submission No. 10*, p. 4.

45 Mass flow rate, in this instance, refers to the movement of CO_2 through a pipeline per unit of time.

6.40 The IEA states that the current costs of capturing and storing CO_2 are likely to be reduced by around 50 per cent by 2030.[46] The IPCC states that over the next decade, 'the cost of capture could be reduced by 20-30 per cent and more should be achievable by new technologies still in the research or demonstration phase'.[47]

6.41 In addition to the development of new technologies, cost reductions in CCS may occur where it is possible to develop shared storage facilities. Australia does have natural regions where it may be possible to create transport and storage hubs. As the CO2CRC has stated, many of Australia's emissions point sources are located within 200-500 kilometres from adequate storage sites.[48]

6.42 There is a consensus that such hubs would substantially reduce costs by harnessing existing infrastructure, including storage reservoirs, as well as utilising existing skills and technical expertise.[49] The Western Australian Government believes that, based on the current costs of establishing CCS projects, CCS will only be economically viable when it is applied to sources of emissions in existing heavy industrial areas, which would allow it to utilise existing industrial infrastructure.[50]

6.43 Such an assessment is endorsed by Anglo Coal, which points out in its submission that one of Australia's biggest and most suitable storage resources is in the offshore Gippsland Basin, which is in relatively close proximity to the Latrobe Valley brown coal deposits of the onshore Gippsland Basin.[51] The closely bunched nature of the onshore Gippsland Basin coal deposits could, according to Anglo Coal, facilitate 'the development of a joint-use pipeline hub system to gather CO_2 from the Latrobe Valley sources and transport it to the storage sites for injection'.[52]

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46 OECD/IEA, *Energy Technology Analysis: Prospects for CO2 Capture and Storage*, Paris: 2004, p. 17.

47 IPCC quoted in, CO2CRC, *Submission No. 36*, p. 16.

48 CO2CRC, *Submission No. 36*, p. 19.

49 Santos, *Submission No. 25*, p. 3.

50 Department of Industry and Resources, Government of Western Australia, *Submission No. 26*, p. 5.

51 Anglo Coal, *Submission No. 24*, p. 8.

52 Anglo Coal, *Submission No. 24*, p. 8.

Economic viability and government incentives

6.44 The difficulties in estimating realistic costs of CCS deployment, given the wide range of variables and the still untested nature of large-scale CCS application, are manifold. What is clear, however, is that CCS deployment significantly increases the cost of electricity production and that technological uncertainties and unknowns in cost estimation make industry investment in CCS on a wide scale unlikely in the current environment.

6.45 In evidence to the Committee, the National Generators Forum said that 'at this early stage of development, the investment risk of new coal based technology with carbon capture and storage is large'.[53] Stanwell Corporation's analysis indicated 'that the capture and storage of CO_2 produced in electricity generation is not economically viable in Australia at this time'.[54]

6.46 Industry submissions overall signalled that economic incentives need to be in place for CCS technology to be invested in by energy producers.[55] The Energy Supply Association of Australia (ESAA) notes that:

> … given CCS is at a clear cost disadvantage to existing generation technologies, carbon emission constraints are the only reason CCS technologies would be adopted by the energy supply industry.[56]

6.47 Members of the AP6 and the Australian coal industry are also 'calling for a carbon price signal to support the technology approach to abating and mitigating greenhouse gas emissions'.[57]

6.48 According to the IPCC:

> Most energy and economic modelling done to date suggests that the deployment of CCS systems starts to be significant when carbon prices begin to reach approximately 25-30 US$/t CO_2 … [this modelling suggests that] the large-scale deployment of CCS systems [will begin] within a few decades

53 National Generators Forum, *Transcript, 4 December 2006*, p. 2.

54 Stanwell Corporation, *Submission No. 32*, p. 4.

55 AGL, *Submission No. 39*, p. 3; BP Australia, *Submission No. 43*, pp. 14-15; CRC for Greenhouse Accounting, *Submission No. 14*, p. 1.

56 ESAA, *Submission No. 16*, p. 2.

57 Environment Business Australia, *Submission No. 37*, p. 2.

> from the start of any significant regime for mitigating global warming.[58]

6.49 The CO2CRC believes that a carbon price of A$20/tonne of CO_2 avoided would make CCS technology economically viable.[59] This would depend on a range of conditions including the concentration of the CO_2 stream and proximity to the storage site.[60] If such favourable conditions are not present, for example if the emissions stream is low in CO_2 and the storage site is hundreds of kilometres away, CCS deployment could cost a power station as much as A$100 or more a tonne per CO_2 avoided. As such, CCS deployment would become economically 'non-viable'.[61]

6.50 In terms of establishing the form a carbon price should take, the introduction of an emissions trading scheme has received the greatest support from industry. As Dr Peter Cook points out, such a scheme 'has the benefit of being technology neutral and is likely to produce the least cost outcome in the short term'.[62]

6.51 On the other hand, Chevron and BP give only qualified support to the introduction of an emissions trading scheme, arguing that such a scheme is dependent on government support and regulation.[63] Both suggest that the Australian Government's LETDF be extended beyond the demonstration phase either through the provision of direct grants, interest free funding or tax reform (for example allowing immediate capital deduction or accelerated depreciation).[64]

6.52 Rio Tinto expressed the view that CCS should be encouraged via a 'push' policy by which the government provides ongoing support to help achieve the public goal of reducing greenhouse gas emissions.[65]

> If the government would like these technologies to be deployed, the government is going to have to support their deployment. It really is as simple as that. The economics simply do not stack up without that support.[66]

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58 IPCC, *Special Report On Carbon dioxide Capture and Storage,* p. 341.

59 CO2CRC, *Submission No. 36*, p. 14.

60 CO2CRC, *Submission No. 36*, p. 14.

61 CO2CRC, *Submission No. 36*, p. 14.

62 CO2CRC, *Supplementary Submission No. 36.1*, p. 9.

63 Chevron Australia, *Submission No. 12*, p. 14; BP Australia, *Submission No. 43*, p. 15.

64 Chevron Australia, *Submission No. 12*, p. 14; BP Australia, *Submission No. 43*, p. 15.

65 Rio Tinto, *Transcript, 26 February 2007*, pp. 4, 5 & 7.

66 Rio Tinto, *Transcript, 26 February 2007*, p. 8.

Emissions trading in Australia

6.53 On 10 December 2006, the Prime Minister announced the establishment of a joint government-business Task Group on Emissions Trading. The terms of reference were:

- To advise on the nature and design of a workable global emissions trading scheme in which Australia would be able to participate; and
- To advise and report on additional steps that might be taken, in Australia, consistent with the goal of establishing such a system.

6.54 The Task Group reported on 31 May 2007 and made a number of findings, Key findings include:

- Australia should not wait until a genuinely global agreement on emissions reduction has been reached. Therefore, Australia should adopt early emissions constraints;
- the most efficient way to manage risk is through market mechanisms. Therefore, an Australian emissions trading scheme would allow the nation to respond to future carbon constraints at least cost;
- the Australian Government should set a national framework for reducing greenhouse gases and then let the market set the carbon price;
- emissions trading enables the market—not the government—to decide which new or existing technologies will reduce emissions as least cost. Therefore, favouring particular technologies over others will increase the costs we impose on ourselves;
- an Australian emissions trading scheme should be as comprehensive as possible. However, it should not prejudice the competitiveness of Australia's trade-exposed, emissions-intensive industries;
- a long-term aspirational goal should be set for reducing Australia's production of greenhouse gases; and
- an emissions trading scheme should form the principal mechanism to achieve emissions-reduction goals. However, complementary

measures will be required as part of a comprehensive mitigation strategy.[67]

6.55 For the purpose of this report, it is important to note the Task Group's findings in relation to CCS. Specifically, it is the Task Group's conclusion that:

- the Government's role in supporting research and development (R&D) should be one of a technology 'push' through significant funding for basic and applied R&D, followed by a clear long-term price signal for carbon which will encourage market investment in the development of low-emission technology; and
- resource related technologies should be Australia's R&D priority. Therefore, given the importance of coal to Australia's economy, CCS technologies should be a primary focus of R&D.[68]

6.56 On 4 June 2007, the Prime Minister outlined his response to the Task Group's report. This response included four key points:

- Australia will move towards a domestic, cap and trade emissions trading system beginning no later than 2012;
- Australia will set a long-term aspirational goal for reducing carbon emissions, after carefully accessing with detailed economic modelling the impact any target will have on the Australian economy and Australian families. This target will be set in 2008;
- the scheme will be national in scope and as comprehensive as practicable, designed to take account of global developments and to preserve the competitiveness of Australia's trade exposed emissions intensive industries; and
- governments need to let the market sort out the most efficient means of lowering emission with all low emissions technologies on the table, including nuclear power.[69]

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67 Prime Ministerial Task Group on Emissions Trading, *Report of the Task Group on Emissions Trading*, May 2007, pp. 6-7.

68 Prime Ministerial Task Group on Emissions Trading, *Report of the Task Group on Emissions Trading*, May 2007, pp. 127-29.

69 Prime Minister Howard, Address to the Liberal Party Federal Council, 4 June 2007, <http://www.pm.gov.au/media/Speech/2007/Speech24350.cfm>, accessed 6 June 2007.

Conclusion

6.57 Coal accounts for around 80 per cent of electricity generation in Australia. The comparatively inexpensive power derived from coal supports domestic and commercial users, as well as many large, energy intensive industries in Australia. The coal industry also provides employment. For example, in Queensland, 1 in 8 jobs depend on the resources industry; in Central Queensland the figure is 1 in 4.[70]

6.58 Given the impact that the coal industry has on the Australian economy and Australian families, any reduction in coal use would be detrimental to Australia. For example, modelling undertaken by MIT indicates that, without CCS and under carbon constraint, coal use in 2050 would fall by 28 per cent. It is therefore important that Australia consider the employment of CCS technology.

6.59 There is also international consensus on the importance of CCS technology, because fossil fuels will remain a significant part of the world energy mix well into the future. As noted in this Chapter's introduction, the IPCC argues that including CCS in the range of mitigation strategies adopted will reduce the cost of stabilising global CO_2 levels by at least a third.[71] The British House of Commons report found the cost of electricity generation using CCS to be comparable to, or less than, other forms of low carbon electricity generation.

6.60 In the Australian context, the ESAA, ABARE and CO2CRC all found that the deployment of CCS would reduce the cost of carbon abatement to the Australian economy.

6.61 However, the Committee notes the very real difficulty of putting a dollar value on the potential costs and ultimate economic benefits of CCS deployment.

6.62 Whatever the eventual costs of CCS, everyone accepts that the price of electricity will rise as the world attempts to combat global warming and reduce CO_2 emissions. Clean energy comes at a price, whether it will be from clean coal, renewables or nuclear,[72] but in the case of CCS, the size of the price increase is not clear. Available data suggests that CCS might double the cost of electricity generation from coal,

70 Queensland Resources Council, *Submission No. 20*, p. 3.

71 IPCC quoted in cLET, *Submission No. 7*, p. 4.

72 Friends of the Earth, *Submission No. 13*, p. 8; National Generators Forum, *Transcript, 4 December 2006*, p. 7; Australian Coal Association, *Transcript, 27 November 2006*, p. 17.

however, as CSIRO notes, the cost of implementing capture technology is 'only a proportion of the costs consumers pay.'[73] Robert Socolow has predicted that as 'the costs of distribution and transmission [of electricity] are hardly affected [by CCS] … the retail cost of electricity would increase by just 20%'.[74]

6.63 Despite the potential for rising electricity costs, CCS must be seriously considered. Given that Australia is the world's biggest coal exporter, a dramatic drop in coal consumption occasioned by international carbon constraint without CCS deployment, would have a significant detrimental impact on the Australian economy.

6.64 The future deployment of CCS globally, and its ramifications for the coal industry, will depend on an international research and demonstration effort now to which, as argued in Chapter 4, Australia has the ability to make a significant and leading contribution.

6.65 The Committee recognises that there is little economic incentive at present for the power generating sector to embrace CCS technology, as this technology which would add significantly to their operating costs and impact on their profitability. If a carbon price is introduced, and if the cost of CCS is at the lower end of the estimated range, then it is likely that incorporating CCS technology into the next generation of coal-fired power stations would be competitive with other forms of low emission power generation.

6.66 Initially additional support will be needed to facilitate the deployment of CCS at different sites and determine the total and ongoing costs of clean coal. Until more research and demonstration has been undertaken, there will continue to be speculation about the true costs of CCS technology.

6.67 The Committee considers that CCS should be viewed as a necessary component of a broader Australian Government response to the challenge of climate change. Within that broader response, there is a role for financial incentives, both direct and tax based, which the Government can use to encourage a range of measures targeting global warming. Previous recommendations in this report have stressed the need for further research and demonstration in the field of CCS. Therefore, the Committee recommends that the Australian Government, as part of its broader fiscal response to climate change,

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73 CSIRO, *Supplementary Submission No. 10.1*, p. 2.

74 Robert Socolow quoted in, Quirin Schiermeier, *Putting the carbon back: the hundred billion tonne challenge*, Nature Vol. 442, Iss. 7103 (10 August 2006), p. 623.

employ financial incentives, both direct and tax based, in an effort to encourage science and industry to continue developing and testing CCS technology.

Recommendation 4

The Committee recommends that the Australian Government, as part of its broader fiscal response to climate change, employ financial incentives, both direct and tax based, in an effort to encourage science and industry to continue developing and testing CCS technology.