

COOPERATIVE RESEARCH CENTRE FOR GREENHOUSE GAS TECHNOLOGIES (CO2CRC)

SUBMISSION TO THE GARNAUT REVIEW ISSUES PAPER 4: RESEARCH AND DEVELOPMENT: LOW EMISSIONS ENERGY TECHNOLOGIES.

Summary

Australia is a small economy with limited resources to apply to development of low emission technologies but it nonetheless has developed an outstanding CCS research and development (R&D) base. Whilst an ETS will send a clear and consistent signal to industry about the need for long term transformation to a low emission economy, by itself this will not provide direct support for research, development and demonstration (RDD) in the short term.

Based on current trends, there are only likely to be small scale CCS demonstration projects in Australia over the next five years, with large demonstration projects not coming on stream until later in the decade.

There is a need for increased funding to continue the applied research and demonstration to reduce costs of technologies; identify and develop new capture and storage technologies; further develop monitoring and verification methodologies; build knowledge to underpin regulation; and facilitate commercial deployment. There is also a need to improve coordination between research funding agencies and continue to build public confidence in CCS technology.

CCS should be included in an ETS; indeed exclusion of this technology from ETS could well inhibit its uptake and prevent it from reaching its full potential for mitigation. Also given that CCS is likely to be included in CDM in the future, it would be illogical to exclude it from a national ETS.

Background

The CO2CRC is a world leading research group that has been researching and demonstrating carbon capture and storage (CCS) technologies since 1999. Much of its research effort is focused on the development and application of technologies to more efficiently and cost effectively capture carbon dioxide from large stationary sources. The organisation includes membership from Australian government agencies including CSIRO and Geoscience Australia, three State governments, five universities and seventeen multinational and small companies. It has established the Otway project which the Australia's first CCS project and which is focused on demonstrating the technology, and identifying monitoring and verification technologies and methodologies to guide the development and deployment of CCS. It also has two capture demonstration projects under development. The CO2CRC is based on public private cooperation across a number of relevant industry sectors including research, coal, oil and gas, power generation and high emitting industries such as cement and steel making.

The section headings and descriptions used below are consistent with those identified in the Garnaut Review Issues Paper Number 4.

SECTION 3: HOW INNOVATION HAPPENS

What is the role of an emissions trading scheme in driving innovation?

How large are the market failures in innovation?

Are there alternative frameworks that may be useful in the processes of policy analysis and development?

Current market and policy settings are have not been conducive to high levels of investment in research and development of low emission technologies in Australia. Australian Government and OECD analyses have highlighted declining research investment by both public and private sectors in Australia. This has been particularly noticeable in the energy sector where this decline has been a consequence of the privatisation and corporatisation of energy utilities over the past decade; specific decisions by governments to reduce research expenditure; and the growing international ownership in the energy sector which has resulted in some consolidation of energy research largely outside Australia. By June 2008, at a time when Government and industry are faced with a challenge of reducing emissions from fossil fuel production and use, only one of four Cooperative Research Centres that were focused, inter alia, on research to underpin the technologies to reduce emissions from fossil fuels will continue to exist in Australia. That CRC is the Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC) which is only guaranteed funding until 2010. Whilst the Australian government, some state governments and the coal industry have announced and/or implemented a range of new measures in the energy sector, the vast majority of this funding has been directed at demonstration and/or deployment, with only limited support for underpinning RDD.

With international agreement on the need for large scale reductions in greenhouse gas emissions given the likelihood that there will be more rather than less use of fossil fuels in the future (IEA, IPCC projections), capture and geological storage (CCS) of CO₂ from the burning of fossil fuels represents the only option available that can reduce energy sector emissions at the scale necessary. Much of the technology needed for CCS exists although most was developed for other purposes. There is a need for fundamental and applied research to reduce costs of technologies, to identify and develop new capture and storage technologies, for development of monitoring and verification methodologies, knowledge to underpin regulation, and technologies to facilitate commercial deployment.

Implementation of an emissions trading scheme (ETS) is an important step in establishing the framework for reduction greenhouse gas emission targets by placing price on carbon. It will provide a mechanism through which Governments can respond to the growth in the emission profile by setting emission targets and a consequential price signal to reduce emissions over time. Although this will provide flexibility for industry to develop appropriate response measures to reduce their emissions, an ETS alone will not provide direct support for necessary investment in the research, development and demonstration (RDD). Rather it is likely to maintain CCS once deployed but is unlikely to facilitate deployment in the first instance. This is likely to be a particularly significant issue in the early years of an ETS when the price is low and “low hanging fruit” measures and low-cost offsets, such as conservation of tropical rainforests, are expected to be available to reduce liability of emitters.

Although an ETS is likely to be the most effective mechanism to ensure emission reductions in the long term, regulation might conceivably play a role in managing emission reductions in the

future. Some regulation will be necessary in any event to control the allocation of geological reservoirs and ensure environmental and safety performance of facilities and projects, although this may be covered through existing legislative framework. Regulation may not provide support for RDD, but a mandated minimum generation from low emission fossil fuels with CCS could be an effective complementary measure for the energy sector. Such a system already supports renewable energy technologies through the Mandatory Renewable Energy Target (MRET) and an extension to include CCS could be an option to provide the necessary stimulus and support for development of this technology in the early years of ETS.

There is a need for complementary public and private investment in RDD to address what is widely acknowledged as a key market failure to ensure that activity continues at an increased rate by raising the level of funding for RDD. This could be appropriately a high priority for recycling of revenue raised under an ETS.

SECTION 4: MARKET FAILURES AND BARRIERS ACROSS THE INNOVATION SYSTEM

4.1 Policy clarity, continuity and coherence

How can Australian governments improve policy clarity, continuity and coherence for businesses for looking to invest in new energy technologies, or in other sectors with the potential to contribute to mitigation or adaptation?

How will this be improved with the implementation of an Australian emissions trading scheme?

What areas of uncertainty might remain?

The international and domestic policy settings to encourage investment in low emissions technologies as a key response to climate change have been inconsistent and largely ineffective. Government and industries have introduced a wide range of innovative measures which have been of benefit to niche technologies and industries. Although it could be argued that in addition to niche benefits, the range of measures have played an important role in changing the political perception of the need for climate change responses, they certainly have not lead to the market transformations that have been identified as necessary to reduce greenhouse gas emissions at the scale identified by the IPCC. This has been caused in part by the relatively low level of funding of measures and the stop-start nature of the decision making.

Implementation of a broad-based emissions trading scheme should provide a clear and consistent policy signal by governments on the needed for long term market transformation to a low emission economy. However, for an ETS to have the desired impact of reducing our emissions profile through introduction of low emission technologies there is need to find the balance between the economic impact of a high price signal and the relatively high cost of alternative low emission technologies in the energy sector. A relatively low price signal will not provide an incentive for development and deployment of low emission technologies (LETs). There could also be a risk of a low price having an unintended consequence of further reducing the funding for research development and demonstration of LETs. This could occur as a result of increased competition for funds if an offsets market provides liable parties with a low cost alternative to reducing their liability in the short to medium term. Alternatively if

liable parties perceive the ETS to be focused on revenue rather than long term emissions reduction, their response to need for additional investment in research may be negative.

The design of an ETS and the identification of appropriate complementary measures should aim to address this uncertainty. Recycling of ETS revenue into RDD of LETs with a requirement for matching industry funding would provide a clear signal for the market to continue and increase funding into LETs. Funding of RDD through such an initiative would be most effective if coupled with clear policy commitments by governments and industry of the need for continuing public and private investment.

There is no technical reason to exclude CCS from a national ETS, given that geological sequestration can be verified using a range of techniques. Indeed, given that forest sequestration is likely to be allowable as an ETS credit, it would be entirely appropriate to include geological sequestration. Also, there are moves afoot to include CCS in CDM and inclusion of CCS in a national ETS scheme would be consistent with such a move. It is therefore important that CCS is included in a national ETS; indeed, its exclusion would probably inhibit its uptake and prevent it from reaching its full potential as a mitigation option with the potential to make deep cuts in emissions.

4.2 Risk management and diversification through a portfolio of technological options

How can the Australian Governments avoid ‘picking winners’ while encouraging increased innovation? What is current best practice for technology neutral innovation policy?

How can the Australian Governments balance the need for diversity and option value with the increasing returns from uniformity and specialisation?

How can policy promote diversity without falling into the trap of needing to specify at a technical level what such diversity should include?

Concern about “picking winners” can be distorted if it is being extended from decisions about specific projects or companies to the broader issue of technology choice and policy measures where the range of options is narrow but better analysed and understood. There is nothing inherently wrong with picking winners – governments and industry players are in the business of choosing options for future investment on the basis of careful analysis and consideration based on IPCC concerns about possible rates of climate change and potential impacts. Learning by doing will always result in identification of options that do not proceed – that can be just as much a success as a technology that does get deployed, because rejection after initial RDD is a realistic way of minimising risk, thereby avoiding inappropriate large scale investment later. Provided such decisions are based on careful analysis and consideration of what we know at the time of decision making, they should be viewed as part of the cost inherent in finding solutions to a complex problem.

Australia is small economy with a limited number of research institutions and potential for technology demonstration. We should not expect that every technology will have the same likelihood of deployment in the long term. Judgements will have to be made about where best to invest the relatively limited RDD resources using a number of criteria including natural endowment, national economic interest, research and industrial experience and capacity. It will be necessary to make decisions about investing in Australia’s strengths and allow some

technologies to be developed elsewhere in the world where natural or economic circumstances make the more cost effective for deployment in different markets.

It would greatly facilitate the development of a CCS technology roadmap for Australia if government and industry established clear policy goals and ensure that any measures introduced to complement ETS have transparent and open process so that all players understand the rules. In a market economy such as Australia, industries can be expected to respond to clear policy settings and find and deploy the most cost effective and efficient technologies need for low emission scenarios.

There is nevertheless a sound argument for public investment in early stage RDD based on the fact that governments have established or supported the existing market framework which by necessity favors the incumbent energy technologies. Public investment then becomes a tool to assist any necessary reshaping of the market to achieve public good objective. This is perhaps especially true for the Australian power generation sector where power generation was previously the sole domain of government utilities.

Government policy focused on setting the policy framework for reducing emissions and supporting RDD for all low emission technologies will encourage increased investment in a range of technologies appropriate to Australia and result in the long term deployment of the most cost effective technologies with least impact on the economy.

4.3 Technological lock-in

What are the barriers to entry that create uncompetitive incumbency advantages in the Australia?

What are the appropriate policies for minimising barriers to market entry without undermining the competitive advantage of established firms?

The National Electricity Market NEM was established at a time when coal-based power was the only economically feasible option for large scale investment and deployment. The issue of CO₂ emissions is changing the industry perceptions about need for new low emission technologies but a natural cost advantage remains in-built for coal based power generation. Of particular significance is the issue of location of new LET technologies and the need for access to efficient transmission systems. Whilst location and access is a current concern for renewable energy technologies which may require power generation at points far away from the existing grid, CCS may face similar issues. Depending on the relative costs of access to markets of new fuels (e.g. syngas or hydrogen), fuel transport, electricity transmission or transport of capture CO₂, the locations of new low emission fossil fuel power stations might be at some distance from the electricity grid and away from coal mines where most power stations are currently located. Governments may wish to review market access arrangements and invest in RDD to reduce transmission costs and losses as well as CO₂ transportation.

SECTION 5: MARKET FAILURES ALONG THE INNOVATION CHAIN

5.1 National public good research

What criteria, processes and institutional structures are most desirable for allocating funding to public good research?

What types of reforms are needed to ensure that public funding is allocated to the most appropriate and highest-value uses?

Australia has a good record of allocating RDD funds on the basis of open and transparent processes. This had led to an institutional framework in the energy sector based on a mix of public and private organisations including CSIRO, universities and cooperative research centres. The CRCs in particular have enabled public and private resources to be brought together in a focussed manner to address specific themes. In this context the CO2CRC has flourished as a public private research partnership that is recognised internationally for its science and leadership in the field of carbon capture and storage. Government needs to build on the success of the CO2CRC by ensuring continuation of funding on priority research for CCS focused on reducing the cost of capture, separation and storage technology, understanding the behaviour of storage reservoirs and stored CO₂ as well as the development of technical standards for monitoring and verification of storage and establishment of a knowledge-based regulatory framework. This needs to continue to be underpinned by communication and public education.

Because the CCS and LET research community is relatively small in number and subject to ongoing evaluations by government funding agencies, industry partners and scientific peer review, major reforms of the research expenditure and structural framework are not required. Continuation of an effective research effort does however require close coordination between policy makers, research agencies and industry to ensure research remains focused on achieving clear policy and market goals. Coordination between governments, industry and researchers on priorities will assist in allaying any concern about relevance of RDD efforts and perceptions of research becoming an end in itself.

The institutional framework for allocating research funding is however an area of increasing concern as is addressed in the next section.

5.2 Early mover disadvantage

What are the spillovers faced by firms at the marketisation phase and how large are these spillovers?

Are there significant spillovers at other stages?

Are patents adequate for internalising knowledge spillovers from new abatement or adaptation technologies?

What policy alternatives are available to increase the incentives for firms to undertake more demonstration or commercialisation activities?

What are the appropriate instruments available to government to reward early-movers for spillovers resulting from marketisation activities?

RDD for CSS presents some unique challenges in regards to spillovers, but the patents system provides an effective arrangement for internalising knowledge spillovers. This will be particularly the case with technology options for capture and perhaps some aspects of storage technology. However the key is use with research and demonstrating storage relates to confidence with the general public and regulators rather than with patented technologies which

may only be a minor outcome of this aspect of CCS systems. Whilst governments provide appropriate policy framework and a level of investment in technology, developing specific measures to award early movers may be a questionable strategy given the need for a learning period and the scale of investment and ideas and resources needed to respond to climate change. Rather the aim should be an effective market framework that encourages uptake of low emission technologies. This is especially true in developing responses to climate change where the public policy objective is to avoid “dangerous” climate change.

One clear challenge for CCS lies in the issues of data ownership and access needed to identify the most appropriate sites for CO₂ storage. Private companies have very large volumes of geological data obtained through drilling programs but which may not be publicly available. To facilitate the identification for suitable geological storage options governments need to consider arrangements with companies, particularly in the oil and gas sectors to enable access to such data to support a public policy objective whilst still protecting the private interests reflected in the investment by companies in collecting the data for resource identification and exploitation.

5.3 Coordination failure

Does coordination improve research outcomes and thereby outcomes for society?

How large are the coordination failures in Australia?

How can government create more cohesive research environments and promote genuine cooperation between rival firms or organisations?

Is this a role for government?

Funding and policy support for CCS currently comes through a diverse range of funding mechanisms in government and industry. As the priority for emissions reduction has increased with a commensurate increase in the availability of funding, there has been tendency for the number of funding mechanisms to increase. It has also become more difficult to retain a “Team Australia” approach amongst the scientific community. This can lead to research effort being spread too thinly in order to meet specific objectives of industry sectors and different jurisdictions. As such it can undermine the need for a critical mass to be applied to resolve key science needed for technology development. This is not conducive to long term planning of research priorities nor is it a secure environment in which to encourage long term commitment by the world best scientists. Allied with this is the need for security of research institutions to build a skills development program to ensure knowledgeable and skilled staffs are available for industry and government in the future.

A significant issue that the government should seek to address with industry is the tendency for new funding mechanisms to emerge with a lack of national coordination. In the area of CCS there are now more funding agencies and mechanisms in Australia than there are CCS research institutions. This could lead to higher administrative costs per dollar of research and potential duplication between governments and industry. It is also likely to lead to confusion over the purpose of research funding, with the research objective potentially relegated to a lower priority than the measure itself.

There is a need for improved coordination of research funding across jurisdictions and the private sector. This could involve integration of some RDD funding measures.

5.4 International public good research and coordination

*In what areas would coordinated international public good research be warranted?
What are the appropriate institutional arrangements for shared public good research that will ensure the best outcomes at minimal administrative costs?
How can governments encourage the diffusion of technology internationally without diluting the incentives for innovation?*

Tackling the problem of global CO₂ emissions requires a global partnership. Whilst Australian innovations may have domestic applications, it will only be through the application of new ideas in larger economies that global CO₂ emissions will be reduced. International cooperation in CCS is essential for development and deployment of this technology and is already a key feature of the RDD activities in Australia through organisations such as the CO₂CRC which has international collaboration as a key component of its strategy. The companies that operate in the coal, oil and gas sectors are mostly multinational and international ownership of the power generation industry has increased rapidly as a consequence of privatisation of power utilities. In addition, fossil fuels are traded internationally and Australian RDD efforts are impacted on by the demands of the international markets where there is clearly less commitment to finding LETs to reduce growth in greenhouse gas emissions.

This international context provides some key opportunities for Australian RDD efforts. We are able to bring some of the world leading scientists and industrialists to RDD projects. Additionally we are well positioned to quickly learn and apply experience gained in other countries. Equally the established linkages through governments, industries and research institutions enable our innovations to be taken and applied elsewhere as a contribution to a global effort to reduce emissions.

The CO₂CRC has significant international linkages best reflected our involvement and contributions to the International Energy Agency (IEA), the Intergovernmental Panel on Climate Change (IPCC), the Asia Pacific Partnership on Clean Development and Climate and the Carbon Sequestration Leadership Forum (CSLF). There is direct participation of research and industry interest in the CO₂CRC from NZ, USA, Canada South Korea in the Otway project.

5.5 Capital market failures

*What are the weaknesses of capital markets in Australia?
What has been the experience of innovators in Australia in transitioning from public to private funding?
How can government improve the transition process and reduce the capital shortfall for firms passing through the ‘valley of death’?
Can government assist in reducing information asymmetries?*

A weakness in Australian capital markets is the conservative approach to risk inherent in application new technologies and the lack of a strong venture capital market to provide support for emerging technologies. This has been recognised by successive government through a number of funding measures designed to address this gap and build market confidence by

sharing some of the risk. Climate change policies and the issue of proposed targets have added to market uncertainty about risks and is clearly holding back investment in the RDD field. CO2CRC, CSIRO, GA and State geology agencies all undertake CCS investigations although much of their work until recently was dependent on funding through CO2CRC, which has not been at the scale necessary given the imperative of bringing LETS into the market sooner rather than later. In recent years the Australia coal industry has announced significant funding and there is expenditure by the oil and gas industry in the CO2CRC and into commercial projects such as the Gorgon project. Governments have also provided new funding to Government organizations, although as pointed out earlier, this can potentially have the reverse effect of discouraging a “Team Australia” approach.

The “valley of death” issue that sees many technologies failing between their initial development and their commercial deployment is a particular concern with new and emerging technologies that have to establish new markets. It may not be a significant issue for CCS because the industries that will deploy and benefit from new technology will have a strong incentive to avoid emissions and the consequential liability under an ETS. In this context the key issue relates to reducing the cost of technology through RDD.

CONCLUSION

- A range of mitigation technologies will be required to decrease Australia’s greenhouse footprint.
- CCS has a key role to play in decreasing CO₂ emissions for as long as we continue to use fossil fuels.
- Some components of the CCS “system” are technologically mature but others require more R&D. The price of capture needs to decrease significantly and there is also a need to identify more large scale storage sites.
- There is a need to accelerate the demonstration and deployment of CCS in Australia, and this will require government measures.
- ETS will be a critical component of maintaining CCS as a mitigation option.
- Just as forest sequestration will be part of an ETS, it is appropriate that CCS should generate tradable credits under an ETS – just as they are likely to do so in the future as part of a CDM.
- Whilst more R&D is needed, there are no insurmountable technical barriers to the verification of CCS carbon credits.
- Support for RDD will be crucial to the deployment and commercial deployment of CCS.