Supplementary Submission

No 10a

INQUIRY INTO INQUIRY INTO THE ECONOMICS OF ENERGY GENERATION

Organisation: Delta Electricity

Name: Mr David Hogg

Date Received: 7/03/2012

Inquiry into the Economics of Energy Generation

Supplementary Submission on Carbon Capture and Storage in NSW

Delta Electricity

Authorised by:

Greg Everett – Chief Executive

5 March 2012

CARBON CAPTURE AND STORAGE IN NSW

Executive Summary

Carbon capture and storage (CCS) is a technology which has the potential to significantly reduce greenhouse emissions from new and existing coal and gas fired power stations, industrial processes and other stationary sources of carbon dioxide (CO_2). CCS is an important part of the lowest-cost greenhouse gas mitigation portfolio, including renewables and improved energy efficiencies, which will be required to provide energy security to meet growing energy demand while reducing CO_2 emissions in the future. The significance of the technology is emphasised in the Commonwealth's Clean Energy Future package. Its modelling shows that CCS is expected to make a substantial contribution to the reduction in CO_2 emissions in all future scenarios.

CCS technology is at an early stage of development in NSW. Other states such as Queensland and Victoria have progressed CCS further by developing CO_2 injection and storage legislation and identifying suitable geosequestration sites. The most significant barrier to the establishment of CCS in NSW is the potential lack of suitable storage sites and, therefore, state wide exploration activities should be accelerated to address this risk.

Over 80% of electricity generated in NSW is derived from coal-fired power stations using black coal. Developing options for reducing emissions from power generation is therefore strategically important for NSW. Without viable geosequestration in NSW there is a risk that the economic activity anticipated with the construction of CCS infrastructure will be transferred to other states. The availability of CCS will also reduce the carbon tax liability and increase the market competiveness for NSW generators which will, in turn, lead to lower electricity costs for NSW consumers.

It is also likely that any new coal power station would be located near a suitable CO_2 storage site. If NSW has not identified geosequestration sites, any new power stations may be constructed outside NSW which may result in reduced system security.

The preparation of a roadmap for the development of CCS is important to ensure the economic and greenhouse gas reduction benefits of the technology are realised by NSW.

CCS – Technology and Process

CO_2 captured by the CCS process is compressed to a liquid and transported to a geological storage site. At the storage site, CO_2 will be injected underground and stored permanently in natural containment areas created by unique rock formations. This is the same process that has held CO_2 and natural gas in the ground for millions of years. A comprehensive program to monitor the effectiveness and integrity of the storage site will be implemented for the duration of the project and continued for a sufficient period of time to verify the safety and predicted behaviour of the storage reservoir.

Each of the technologies required to proceed with a CCS project (capture, transportation and storage) are in operation individually worldwide, but they have not been proven as an integrated process for capturing the CO_2 from a coal powered electricity generation plant at a commercial scale.

The capture technology has been successfully used for CO_2 removal from sour gas in the oil and gas industry for decades. Natural gas and LNG projects such as Sleipner (Norway) and In Salah (Algeria) have been injecting more than 1 million tonnes of CO_2 each year into saline aquifers. There is also extensive operational experience with CO_2 transport, injection and storage in the US enhanced oil recovery (EOR) industry where nearly 10 million tonnes of CO_2 is injected underground each year to increase subsurface reservoir pressures to improve oil extraction rates. The Gorgon LNG Project in Western Australia will soon be one of the largest storage projects in the world, storing over 3 million tonnes of CO_2 per year.

While the capture and storage technical knowledge exists, the application of CCS on a power station at the scale required[1] remains largely untested and therefore commercial and technical risks remain as obstacles to large scale deployment. Successful demonstration of a large scale integrated process under Australian conditions is critical to assess the commercial viability of the technology.

The latest Global CCS Institute (GCCSI) report on the *Global Status of CCS: 2011* identified 74 large scale integrated CCS projects (LSIPs) around the world, including 15 that are currently operating or in construction, totalling a confirmed capture capacity of 35.4 million tonnes per annum (Mtpa) of carbon dioxide (CO_2). A further 59 LSIPs are in the planning stages of development with an additional potential capture capacity of more than 122 Mtpa. The GCCSI also estimates there are currently 234 CCS projects at various stages of development globally, with over US$40 billion in funding commitments by governments.

Why does NSW need CCS?

NSW generates about 20% of Australia's electricity, over 80% of which is derived from coal-fired power stations using black coal. NSW coal fired generators produce 65million tonnes of CO_2 each year (2009) which is approximately 40% of all NSW greenhouse gas emissions[1]. Developing options for reducing emissions from power generation is therefore strategically important for NSW. Given the significant generation base that uses black-coal as a primary fuel source it is strategically important to develop a retrofit technology such as post combustion carbon capture and storage that can be proven and rolled-out to other black coal generation assets throughout Australia, and potentially internationally.

NSW is a major producer of black coal for export as well as domestic use. In the future, the identification of suitable CO_2 storage reservoirs will be equally important as proximity to fuel supply and other essential infrastructure required for the planning and development of future coal fired power stations in NSW. A power station with a long term coal supply and suitable geosequestration site nearby can supply base load low emission electricity at the capacity required to ensure energy security and a reduction in greenhouse gas emissions for NSW. The only comparable technology to supply base load power in terms of capacity, reliability and low emissions is gas fired power with CCS or nuclear. For these reasons, NSW has an economic interest in seeing the development of commercially viable CCS technologies.

NSW Coal Innovation (formerly NSW Clean Coal Council)

NSW Coal Innovation (formerly NSW Clean Coal Council) was set up in 2006 by the NSW Department of Primary Industries (DPI) in response to the NSW Government State Plan Priority E3(b), for the reduction of greenhouse gas emissions. The NSW Coal Innovation working group comprising representatives from the NSW DPI, the coal industry, the electricity generation industry, the Cooperative Research Centre for Greenhouse Gas Emissions (CO2CRC) and the CSIRO was established in 2007.

The Functions of NSW Coal Innovation are to:

1. provide advice and make recommendations to the NSW Government concerning the funding of projects and policies that encourage the development of low emission coal technologies;
2. advise the NSW Government on policies to encourage the development and implementation of low emission coal technologies;

[1] Source: Australian Dept. of Climate Change and Energy Emissions Overview 2009.

3. make recommendations to the NSW Government concerning opportunities for involvement by private and public sector entities in interstate, national and international research projects involving low emission coal technologies; and
4. advise the NSW Government on such other matters concerning low emission coal technologies as the NSW Government may refer to the Council.

Coal Innovation Fund (formerly Clean Coal Fund)

The NSW Government has committed $100 million over four years to the Coal Innovation Fund. The NSW Coal Innovation Council gives advice to the Minister for Energy and Resources in administering this fund. This funding is provided:

1. for research into, and development of, low emission coal technologies;
2. to demonstrate low emission coal technologies;
3. to increase public awareness and acceptance of the importance of reducing greenhouse gas emissions through the use of low emission coal technologies; and
4. for the commercialisation of low emission coal technologies.

A priority of the program is to commence operation of a demonstration scale carbon capture and storage plant and to provide options for long term geo-sequestration of CO_2 for NSW.

Munmorah Power Station Carbon Capture Pilot Plant – a Delta Electricity and CSIRO Collaboration

Delta Electricity has collaborated with the CSIRO on a successful research scale project to test the capture and release of up to 3000 tonnes of CO_2 per year at its Munmorah power station. The project investigated the potential to adapt the post carbon capture (PCC) aqueous ammonia absorption technology in Australian power plant conditions. The $7 million research scale pilot facility was used for a series of experimental campaigns in which the technical and operational characteristics of the process were established. A CO_2 removal efficiency rate in excess of 85% was achieved, a high purity of CO_2 (between 99-100%) was obtained and ammonia was also shown to be an effective solvent for SO_2 removal, providing evidence of multispecies removal capability. The experimental program was completed in August 2010.

The operational experience with the aqueous ammonia pilot plant has confirmed the potential for PCC as a low emission technology, but also revealed further challenges of low absorption rates, ammonia losses from the system under some operating conditions and a large process cooling

requirement. The pilot plant facility will be relocated to Vales Point Power Station in 2012 to enable research to continue to address these challenges. Importantly, the pilot plant activity will also focus on environmental emissions from the facility which will inform the environmental approvals process for large scale demonstrations of the PCC technology in NSW.

NSW CCS Demonstration Project

Delta Electricity's Carbon Capture and Storage (CCS) Demonstration project will be the first in Australia to demonstrate integrated post combustion capture, transport and permanent geological storage of CO_2 from a black coal power station, storing 100,000 tonnes of CO_2 per year in a saline aquifer.

The demonstration project will provide a roadmap for commercialisation by pioneering the development and approval pathways for CCS in NSW and aims to demonstrate that the operating process is a safe and permanent method of emission reduction. To achieve this goal the project must ensure equipment suppliers, generators and regulatory bodies build sufficient confidence in the technology on completion of the demonstration to offer, purchase and approve it on a commercial basis. A successful demonstration will rely on collaboration between those who may ultimately be part of the technology commercialisation and could include generators, equipment suppliers, and specialist drilling contractors, petroleum production companies and pipeline operators. Involvement of research bodies and regulators such as planning bodies and the EPA is also essential.

The NSW Coal Innovation, the Commonwealth Government through the Department of Resources, Energy and Tourism (DRET) and the Australian Coal Association has granted Delta $28.3 million to undertake Stage 1 of the project. Stage 1 will gain development approvals, undertake detailed characterisation of geological storage sites and complete front end engineering and design studies. These funds will be drawn from a $150 million allocation set aside by the funding agencies for a PCC project in NSW. Stage 1 outcomes will form the foundation for a future grant application to fund construction of the physical assets and their operation for two years (Stage 2 of the project).

A decision to proceed with the second stage construction and operation of the project will depend on the results of the geology exploration program, regulatory and environmental approval processes, the final project cost estimate, and consultation with key stakeholders.

CO_2 Geo-sequestration Exploration

Subsurface characterisation uses analytical techniques established in oil and gas exploration to evaluate data to identify potential geological formations for CO_2 storage. The potential storage unit must have sufficient pore volume to store all the injected material, the formation needs sufficient injectivity to permit fluids to flow through the system at the required injection rate, and the overlying rock strata must be capable of adequately containing the injected fluids.

There are three generic phases of work common to subsurface characterisation activities in oil and gas exploration and production that can be applied to CO_2 storage:

1. Regional screening studies - to identify potential areas for the injection and storage of CO2. The objective, taking account of analysis, modelling and risk assessment is to identify one or more sites for detailed site qualification;
2. Site qualification - involves detailed subsurface studies to demonstrate the feasibility of injection and storage. This stage will typically include appraisal drilling (if appropriate wells do not already exist) and more detailed data acquisition, baseline testing to assist planning for future monitoring, and detailed risk assessment; and
3. Development phase - involves further refinement of the field development plan and understanding more precise details of the target formations such as their petrophysical properties or injection capacity.

As is well-understood in the context of geological assessment and oil field development, a level of risk and uncertainty is inherent and must be accepted in decision-making about site selection and qualification for potential CO2 storage sites.

Geo-sequestration in NSW

Despite the economic importance of the Sydney – Gunnedah Basin to the State, there is still a lack of data and a relatively poor understanding of the detailed geology of the Basin over wide areas and in all areas at depths greater than 600m. Compared to most other Australian states the deep sedimentary basins of NSW are virtually unexplored due to a historical lack of investment by traditional petroleum exploration companies. This is due to the focus on shallow depth exploration for coal mining in NSW.

Regional assessments of the State's sedimentary basins for geo-sequestration prospectivity commenced during 2006 and 2007. In a study funded by the NSW generators, FrOG Tech Pty Ltd was commissioned to undertake reservoir assessments of the Daring and Sydney Basins. The studies

identified several target areas with potential for permeable reservoirs suitable for CO_2 storage. This study conducted a broad review of the available coal, petroleum and stratigraphic geological and geophysical data. The reports informed the selection of a number of sites for a state-wide exploration and drilling program to assess the potential for deep geological storage of CO_2 in NSW.

A Regional Stratigraphic Drilling Program was initiated within the NSW Department of Trade and Investment (DTI), Mineral Resources Development Branch. The program started deep core drilling at Delta's power station sites on the NSW Central Coast in 2009. Stratographic wells were drilled within the site boundaries at both Munmorah and Vales Point Power Stations. Although the wells were the deepest drilled in the Sydney Basin and provided valuable regional data, preliminary testing of the reservoir rocks indicated there was no prospectivity for CO_2 storage in the region close to these power stations.

Exploration then moved to the upper Hunter Valley and a further two stratigraphic wells were drilled near Merriwa (2009) and Cattle Creek (2010). Based on some more promising preliminary evaluation results, further detailed injectivity modelling was completed on potential target formations in the area. However, the modelling and subsequent assessment indicated that this area is likely to be unfavourable for geological storage of CO_2.

One of the key objectives for the Regional Exploration Program is to identify a potential storage site for the NSW CCS Demonstration Project. The demonstration project will undertake its own proving and characterisation surveys to establish specific storage reserves within the regions identified as prospective for geological storage by the NSW DTI. Currently, no region has been identified for further detailed evaluation for storage prospectivity.

The Regional Exploration Program will now move to western NSW to assess the Darling Basin for large scale storage prospectivity while the demonstration project will assess existing data closer to NSW power stations to identify a potential project specific storage location.

The Future Role of CCS

Carbon capture and storage (CCS) is an important part of the lowest-cost greenhouse gas mitigation portfolio. The International Energy Agency (IEA) Technology Perspectives Report (2008) illustrates that CCS can deliver 20% of the lowest cost greenhouse gas solution in the BLUE Map scenario[2] which aims for a 50% reduction in global emissions by 2050. Further IEA analysis suggests that,

[2] The IEA's BLUE map scenario sets the goal of halving global energy-related CO2 emissions by 2050 (compared to 2005 levels) and examines the least-cost means of achieving that goal through the deployment of existing and new low-carbon technologies.

without CCS, overall costs to reduce emissions to 2005 levels by 2050 increase by 70% (IEA CCS Technology Roadmap, 2009).

The Commonwealth Carbon Tax Modelling Report (2011)[3] discusses several emission trajectories dependent on international global action to reduce greenhouse gas emissions. Chart 1 overleaf shows that in both the core policy and high price scenario, CCS becomes viable in the mid 2020s to 2030 and is utilised by approximately 30% of the total generation in 2050. This emphasises the importance of the development and commercialisation of CCS as the technology is required under all future emission target scenarios.

Without viable geosequestration in NSW there is a risk that the economic activity anticipated with the construction of CCS infrastructure, including new power stations, CO_2 capture facilities and pipeline networks, will be transferred to other states with suitable storage sites such as Queensland and Victoria. The availability of CCS will reduce the carbon tax liability and increase the market competiveness for NSW generators which will, in turn, lead to comparatively lower electricity costs for NSW consumers. It is likely that any new coal power stations would be located near a suitable storage site and, therefore, it is possible that any new build power stations may be constructed outside NSW which would result in a lower level of system security for NSW.

It is recommended that the following issues be addressed to assist the development of CCS in NSW:

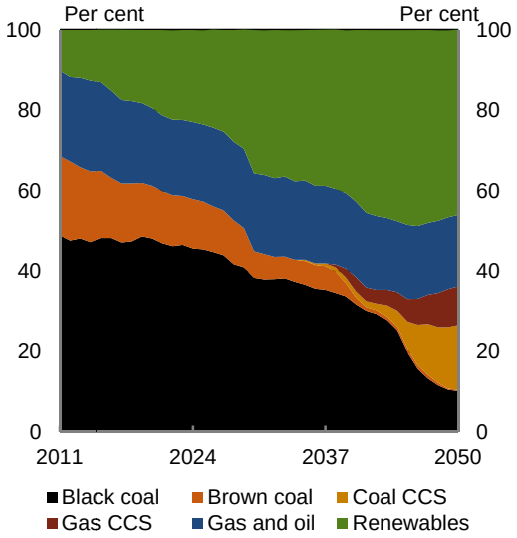
1. Accelerate the exploration for suitable large scale geosequestration sites in NSW;
2. Establish greenhouse gas storage legislation that defines the long term storage liability and provides the regulatory framework under which future CCS projects will operate; and
3. Develop a concept plan and roadmap for the development of CCS in NSW. The planning should focus on linking a network of emission sources using common CO_2 transport (ie. pipelines) and storage infrastructure. The analysis could include an assessment of the required pipeline network and a further option could be included to investigate the prospect of building a pipe network to either Queensland or Victoria should geological storage in NSW prove unviable.

[3] The Commonwealth used two companies, SKM-MMA and ROAM Consulting, to model a range of scenarios which explore different environmental targets and design features of a carbon scheme.

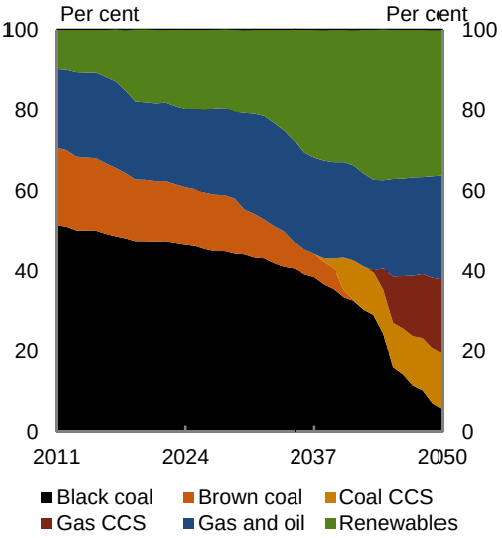
Chart 1: Sources of electricity generation (Strong Growth, Low Pollution – Modelling a carbon price, 2011).

SGLP Core Scenario

SKM-MMA

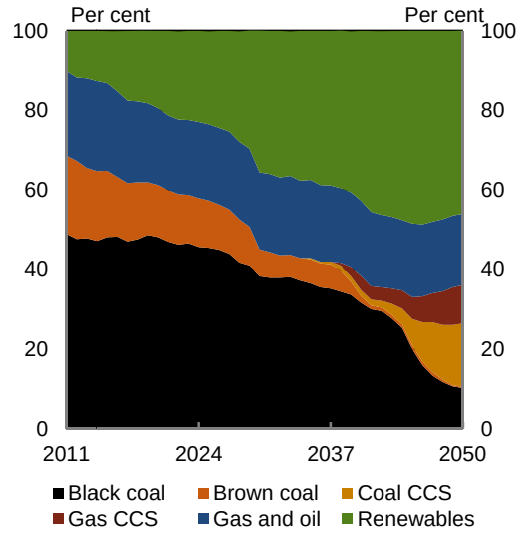


ROAM

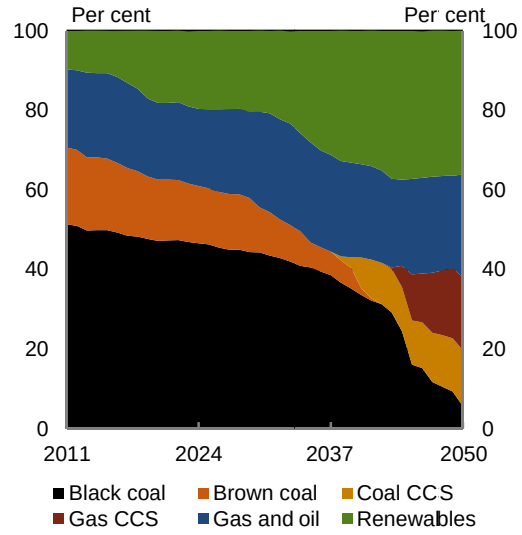


Government Policy

SKM-MMA

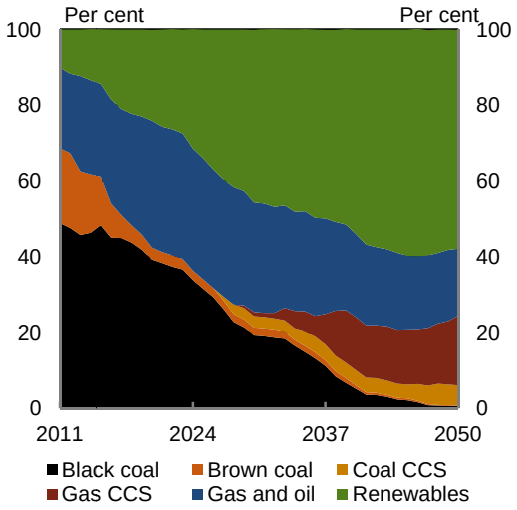


ROAM



High Price Scenario

SKM-MMA



ROAM