Mt Piper Power Station Extension

ENVIRONMENTAL ASSESSMENT

CHAPTER 10 – GREENHOUSE GASES

- September 2009

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10. Greenhouse Gases

The Director-General's requirements

The Environmental Assessment must include a comprehensive greenhouse gas assessment undertaken in accordance with the methodology specified in the National Greenhouse Accounts (NGA) Factors (DECC, November 2008) including:

- *Quantification of emissions (in tonnes of carbon dioxide equivalent) in accordance with the Greenhouse Gas Protocol: Corporate Standard (World Council for Sustainable Business Development & World Resources Institute) including direct emissions (Scope 1), indirect emissions from electricity (Scope 2) and any significant up or down stream emissions (Scope 3) considering all stages of the project;*
- *Comparison of predicted emissions intensity and thermal efficiency against: best achievable practice and current NSW averages for the activity, and of predicted emissions against total annual national emissions;*
- *Evaluation of the availability and feasibility of measures to reduce and/or offset the greenhouse emissions including options for carbon capture and storage. Where current available mitigation technology is not technically or economically feasible, the Environmental Assessment must demonstrate that the proposal will use best available technology, including carbon capture readiness, and identify options for triggers that would require staged implementation of emerging mitigation technologies; and*
- *Evaluation of the project in the light of carbon emission prices of $10, $25 and $50 per tonne under the proposed Commonwealth Carbon Pollution Reduction Scheme, both with and without proposed mitigation measures.*

10.1 Project Greenhouse Gas Emissions

10.1.1 Methodology

The greenhouse gas assessment is provided in **Appendix F**. The assessment of greenhouse gas emissions was undertaken in accordance with the methodology specified in the *National Greenhouse Accounts* (NGA) *Factors* (DECC, 2008).

The quantification of greenhouse gas (GHG) emissions is in accordance with *GHG Protocol: Corporate Standard (*World Business Council for Sustainable Development and World Resource Institute) including direct emissions (Scope 1), indirect emissions from electricity (Scope 2) and any significant up or downstream emissions (Scope 3) considering all stages of the project (construction, operation and decommissioning).

The *GHG Protocol Corporate Standard* (the Protocol) provides standards and methodologies for organisations preparing GHG emissions inventories. It presents methods for accounting and reporting the six greenhouse gases covered by the Kyoto Protocol - carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride.

The proposed methodology was developed in accordance with the GHG Protocol. The project boundary was defined to include the Mt Piper Power Station extension and the emissions associated with construction, operational and decommissioning phase emissions. The assessment methodology for calculating GHG emissions is based on accurate estimates of activity data, fuel consumption and material quantities. A test of significance was applied to determine the range of GHG emission sources to be considered in the assessment, and emissions considered to be insignificant would not be included in the assessment.

10.1.2 Scope 1 Emissions – Power Station

Emissions from 2 x 1000 MW Ultra Super Critical (USC) Coal Plant

The GHG emissions per year associated with the proposed ultra-supercritical technology was estimated for the coal plant using the NGA Factors. The emissions intensity has been determined as an annual average for a plant operating at a capacity factor of 80% (sourced from Connell Wagner Plant Definition Study, 2008) by adjusting the design efficiency for variation in ambient conditions and part load operation.

It was estimated that around 10.475 Mt CO_2-e per year would be produced from the proposed coal plant at 80% capacity factor. The net GHG emissions (CO_2-e) for stationary sources from the energy sector in 2006 were 287 Mt and for the total energy sector was 401 Mt. The estimated GHG emissions from the combustion of fuel by the proposed Mt Piper extension equate to less than 4% of the CO_2 emissions calculated in 2006 for stationary sources and the total energy sector.

Emissions from 6 x 400MW Combined Cycle Gas Turbine (CCGT) Plant

The GHG emissions per year associated with the proposed CCGT was estimated using the NGA Factors. The emissions intensity has been determined as an annual average for a plant operating at a capacity factor of 80% by adjusting the design efficiency for variation in ambient conditions and part load operation.

It was estimated that around 5.76 Mt CO_2-e per year would be produced from the proposed gas plant at 80% capacity factor. The estimated GHG emissions from the combustion of fuel by the proposed Mt Piper extension equate to 2% of the CO_2 emissions for stationary sources and less than 2% of the total energy sector calculated in 2006.

10.1.3 Scope 2 Emissions – Electricity Consumption

Scope 2 GHG emissions from the consumption of purchased electricity would be negligible as electricity consumed at the power station site would be generated on-site.

10.1.4 Scope 3 Emissions – Upstream and Downstream Processes

GHGs from Embodied Energy of Construction Materials

It is assumed that the majority of construction materials would comprise of concrete and steel.

For the coal option, about 48,800 tonnes of steel would be required for the power station and air cooled condenser and approximately 21,400 cubic metres of concrete would be required for the stack and foundation. The embodied emissions for the coal fired power station was determined to be 129,320 t CO_2-e for steel and 5,824 t CO_2-e for concrete; totalling 135,144 t CO_2-e.

For the coal option, about 12,200 tonnes of steel would be required for the heat recovery steam generator, gas and steam turbines, stacks and air cooled condenser and about 10,200 cubic metre of concrete would be required for the foundation. The total estimated embodied energy of construction materials required for the proposed gas fired power station are lower than the coal option at 32,330 t CO_2-e for steel and 2,776 t CO_2-e for concrete, totalling 35,106 t CO_2-e.

Transportation of Construction Materials

Scope 3 emissions resulting from the transport of construction materials to the site, including return trips, were assessed. It was assumed that steel would be sourced from Wollongong, approximately 217 km from the study area and concrete would be sourced from Lithgow, approximately 18 km from the study area. It is estimated that about 1,664 t CO_2-e.would be generated from the transport of steel and concrete for the coal option, and about 431 t CO_2-e would be generated from the transport of steel and concrete for the gas option.

Transport and Disposal of Waste to Landfill

Given that the construction site is a essentially a greenfield site, waste generation would be minimal, and therefore, associated energy and GHG emissions from waste would be negligible.

Fuel Supply

For the coal option, the proposed extension would increase the coal usage by 5.7 Mtpa to around 9 Mtpa. Coal for the proposed extension is likely to be sourced from the Cobbora mine, approximately 200 km northwest of Mt Piper. The additional coal is likely be supplied by rail, using the existing (but incomplete and disused) rail infrastructure.

It has been assumed that the Cobbora mine would be an open-cut operation. Additional fugitive emissions from open-cut mining to supply coal to Mt Piper power station are estimated to be 256,500 t CO_2-e.

The total CO_2-e emissions from the transportation of coal by rail from Cobbora to Mt Piper were calculated to be 55,601 t CO_2-e/year for 2 x 1000 MW, for the coal option. The total CO_2-e emissions likely from rail transport associated with the proposed Mt Piper Power Station extension is less than 0.07 % of total transportation CO_2 emissions in 2007.

The CCGT plant option would require approximately 133 PJ per annum of natural gas. This gas would be delivered to Mt Piper via a new gas pipeline. The Scope 3 emissions associated with natural gas extraction and supply are estimated to be 2,088,100 t CO_2-e.

Transport and Disposal of Ash

Under the USC extension option, a new pneumatic extraction and transportation system would extract flyash from the fabric filter hoppers and transport it to a new flyash storage silo. The new flyash silo would be equipped with a truck loading facility to allow truck transport off-site or to the ash disposal areas. Approximately 20% or 150,000 tonnes per year of flyash is transferred from the existing flyash silo to Flyash Australia’s on-site plant.

There is an ash storage area for the existing plant located on the north-east side of the site. This is estimated to have approximately 5-6 years capacity, after which an alternative ash placement area would be required. The options for future ash placement from the existing plant and ash placement for the extension project are subject to a separate study and approval process.

Purchased electricity for operation of the ash transport and conveyor systems would be negligible as electricity consumed would be generated on-site. The GHGs associated with trucks transporting ash from the site to the ash placement area would also be small, relative to the plant operation emissions, due to the small travel distances involved. No estimates of GHGs from the transport and placement of ash activities have been made.

Decommissioning

Actual GHG emissions for decommissioning of the power station are difficult to estimate, given the timing of the works and the market for recycled materials in particular steel and crushed concrete products. Typical sources of GHG emissions associated with decommissioning include:

- Fuel use in cranes and other mobile plant used to dismantle the power station;
- Crushing plant used to break up concrete foundations; and

- Fuel use in trucks that are transporting waste materials away from the site, either to land fill or other recycling facilities.

It is expected that at the time of decommissioning the Australian and NSW economy would be carbon constrained and a high priority will be placed on recycling material in particular steel and it is expected that significant proportion of power station materials would be recycled.

10.1.5 Incidental GHG Emissions

There would be other GHG emissions associated with the power station development, however, they would make up a very small percentage of total GHG emissions (for example, 0.5 % of total emission as defined as "incidental" within the NGERS framework). Some of these emissions sources include:

- Fuel use from the transport of workers and maintenance personnel to and from the site;
- Fuel use from power station deliveries; and
- Embodied emissions from chemicals and other materials associated with power station operations.

10.1.6 Summary of GHG Emissions

Table 10-1 summarises the Scope 1, 2 and 3 GHG emissions associated with the Mt Piper power station extension.

- **Table 10-1 GHG Emissions Summary**

Source	USC (t CO_2-e/y)	CCGT (t CO_2-e/y)
Scope 1		
Operations (fuel combustion)	10,470,000	4,910,000
Scope 2		
Electricity usage	Negligible	Negligible
Scope 3		
Construction (embodied energy of materials)	135,144	35,106
Construction (transportation of materials)	1,664	431
Transport and disposal of waste to landfill	Negligible	Negligible
Fuel supply (coal mining)	256,500	0
Fuel supply (coal transport by rail)	55,601	0
Fuel supply (natural gas extraction and supply)	0	2,088,100
Transport and disposal of ash	Negligible	0
Decommissioning	Not calculated	Not calculated
Total (Scope 1, Scope 2 and Scope 3)	**10,918,909**	**7,033,637**

Greenhouse gas emissions have been estimated for the two project options, namely an ultra-supercritical coal-fired plant or a combined cycle gas turbine plant. The direct (Scope 1) and indirect (Scope 2 and 3) emissions have been estimated, and are summarised as follows:

- 10.47Mt CO_2-e of direct emissions for the USC proposal (Scope 1)
- 4.91Mt CO_2-e of direct emissions for the CCGT proposal (Scope 1)
- 10.92Mt CO_2-e of total (direct and indirect) emissions for the USC proposal (Scope 1,2,3)
- 7.03Mt CO_2-e of total (direct and indirect) emissions for the CCGT proposal (Scope 1,2,3)

These estimates can be compared Australia's net GHG emission estimates for 2006 of 287 Mt CO_2-e for stationary sources from the energy sector and 401 Mt CO_2-e for the total energy sector.

The NSW Greenhouse Gas Abatement Scheme (GGAS) estimated NSW pool coefficient for 2009 is 0.967tCO_2-e/MWh. Applying the GGAS emissions calculation methodology to Mt Piper Extension gives an emissions intensity of 0.838tCO_2-e/MWh (including coal mine fugitive emissions), well below the current estimated pool coefficient.

10.2 Greenhouse Gas Management

The management of greenhouse gas emissions through reductions or offsets include sequestration through carbon capture and storage, the use of carbon sinks and or geosequestration, carbon credit trading and renewable energy production.

10.2.1 Carbon Capture and Storage

Carbon Capture and Storage (CCS) is suggested as the means by which greenhouse emissions from the proposed extension would be considered. Although the technology is relatively mature, currently there are no fully integrated commercial scale CCS projects in operation. Carbon capture technologies are based on those that have been applied in the chemical and refining industries for many years, but the incorporation of this technology in the specific context of power generation remains to be demonstrated.

10.2.2 Carbon Emission Prices

Initially CCS costs are expected to be of the order of €60-90/tCO_2 (McKinsey, 2008) or approximatelyAUD100-150/t CO_2, though decreasing as the technology develops. The trigger point for the implementation of carbon capture and storage will be when the cost of implementing CCS reduces to less than the cost of carbon emissions under the operating carbon trading scheme. Given the uncertainty in the capital costs of CCS technology due to its pre-commercial status and also the uncertainty in projected cost of CO_2 emissions under the Federal Government's proposed Carbon Pollution Reduction Scheme (CPRS) it is not possible to make a reasonable assessment of the trigger point for CCS implementation. However as CCS technology matures and the CPRS becomes operational assessment of whether the trigger point has been reached should be made periodically.

As CCS in not currently commercially available, the Mt Piper Extension USC coal power plant would need to be built as CCS ready to facilitate future retrofit of CCS.

With the implementation of a Carbon Pollution Reduction Scheme a CPRS cost of \$50/tCO_2 may be sufficient to make the retrofitting of CCS to the plant economic. CPRS costs of \$10/tCO_2 or \$25/tCO_2 would be insufficient to support retrofit of CCS and the cost to the plant would be \$105 million and \$264 million per annum respectively.

As the retrofit cost of CCS for natural gas fired CCGT plant is likely to be significantly higher than a CPRS cost of \$50/tCO_2 it would not be economic. The cost to the plant would be \$50, \$125 and \$250 million per annum respectively for CPRS costs of \$10/tCO_2, \$25/tCO_2 and \$50/tCO_2 respectively.