Final Report

Fuel resource, new entry and generation costs in the NEM

Prepared for the Inter-Regional Planning Committee

April 2009

ACIL Tasman

Economics Policy Strategy

Reliance and Disclaimer

ACIL Tasman Pty Ltd

ABN 68 102 652 148
Internet www.aciltasman.com.au

Melbourne (Head Office)

Level 6, 224-236 Queen Street
Melbourne VIC 3000

Telephone (+61 3) 9600 3144
Facsimile (+61 3) 9600 3155
Email melbourne@aciltasman.com.au

Darwin

Suite G1, Paspalis Centrepoint
48-50 Smith Street
Darwin NT 0800
GPO Box 908
Darwin NT 0801

Telephone (+61 8) 8943 0643
Facsimile (+61 8) 8941 0848
Email darwin@aciltasman.com.au

Brisbane

Level 15, 127 Creek Street
Brisbane QLD 4000
GPO Box 32
Brisbane QLD 4001

Telephone (+61 7) 3009 8700
Facsimile (+61 7) 3009 8799
Email brisbane@aciltasman.com.au

Perth

Centa Building C2, 118 Railway Street
West Perth WA 6005

Telephone (+61 8) 9449 9600
Facsimile (+61 8) 9322 3955
Email perth@aciltasman.com.au

Canberra

Level 1, 33 Ainslie Place
Canberra City ACT 2600
GPO Box 1322
Canberra ACT 2601

Telephone (+61 2) 6103 8200
Facsimile (+61 2) 6103 8233
Email canberra@aciltasman.com.au

Sydney

PO Box 1554
Double Bay NSW 1360

Telephone (+61 2) 9389 7842
Facsimile (+61 2) 8080 8142
Email sydney@aciltasman.com.au

For information on this report

Please contact:

Owen Kelp
Telephone: (07) 3009 8700
Email: o.kelp@aciltasman.com.au

Contents

Figures and tables

Glossary

CCGT	Combined cycle gas turbine
CPRS	Carbon Pollution Reduction Scheme
Cogen	Abbreviation for cogeneration (the joint production of electrical and heat energy)
CSG	Coal seam gas – hydrocarbon gas (principally methane) that is contained within coal seams and able to be produced by drilling from the ground surface or within mine workings
ESAS	Electricity Sector Adjustment Scheme
GJ	Gigajoule, 10^9 (or one billion) joules, a measure of energy
GT	Gas turbine (power station)
GWh	Gigawatt hours, 10^9 (or one billion) watt hours, a unit of electrical energy
MDQ	Maximum Daily Quantity: the maximum quantity of gas (usually expressed in TJ/day) that a shipper is contractually entitled to transport through a pipeline
MJ	Megajoule, 10^6 (or one million) joules, a measure of energy
MW	Megawatts, 10^6 (or one million) watts, a unit of electrical power
MWh	Megawatt hour, 10^6 (or one million) watt hours, a unit of electrical energy
NEM	National Electricity Market
NEMMCO	National Electricity Market Management Company
O&M	Operations and maintenance (costs)
PJ	Petajoule, 10^{15} (or one million billion) joules, a measure of energy
TJ	Terajoule, 10^{12} (or one thousand billion) joules, a measure of energy
VOM	Variable operating and maintenance costs (costs which are directly related to power station output)
ROM	Run of mine, raw coal produced from a coal mine
FOM	Fixed operating and maintenance costs (those costs which do not vary with power station output)
FOB	Free on board, a price that includes all delivery and costs involved in loading commodities on board a ship
Line pack	The gas contained within a transmission pipeline from time to time in order to maintain operating pressure
MDQ	Maximum Daily Quantity: the maximum quantity of gas (usually expressed in TJ/day) that a shipper is contractually entitled to transport through a pipeline

1 Introduction

This report has been prepared by ACIL Tasman for the Inter-regional Planning Committee (IRPC) as part of the 2008-09 generator cost project. The consultancy is aimed at providing the data required to model bidding behaviour of the NEM's existing generation assets and the costs of investment in new generation assets.

This data is to be used by NEMMCO to conduct market simulation studies as part of the upcoming transmission assessment (formerly called the Annual National Transmission Statement or ANTS). The intent of this study is to identify the requirement for additional transmission infrastructure in the NEM, given the projected generation expansion scenarios.

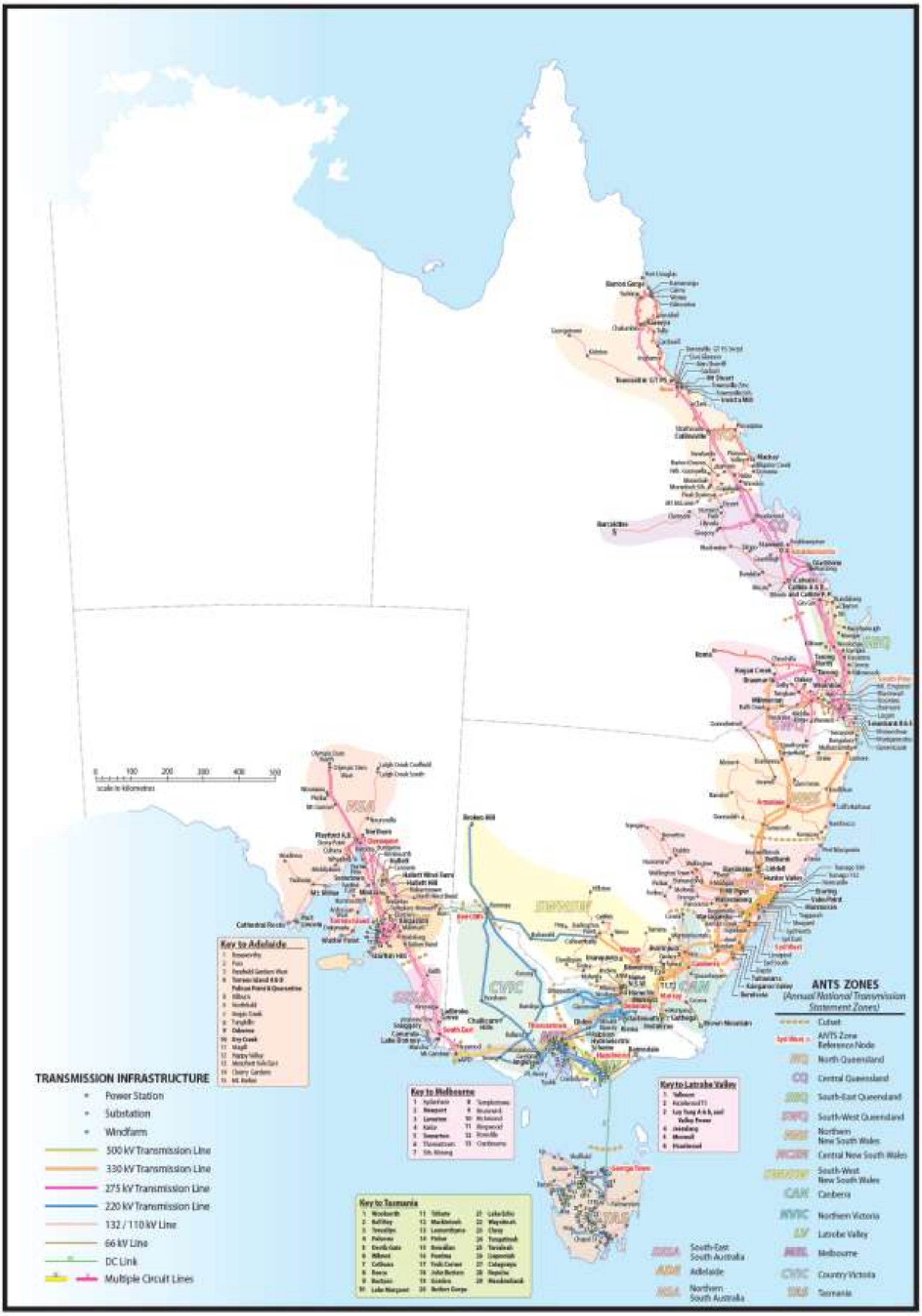
The transmission assessment requires cost data for existing and potential new entrant generation plant in the NEM for each of the 16 identified NEM zones as shown in Figure 1. Cost data is required for all scheduled existing and committed generators as well as for advanced proposals and various new entrant technologies. A complete list of the data elements requested under this project is outlined within the scope of work which is attached as Appendix A.

This report represents the output of ACIL Tasman's analysis. The report is accompanied by an excel spreadsheet which provides more detail in relation to the cost data than is able to be provided within the written document.

This report is structured as follows:

- Chapter 2 provides the working definitions of SRMC and LRMC as used within the analysis and also discusses the methodology used in the collection and treatment of the data elements
- Chapter 3 provides information and data on the existing, committed NEM-scheduled generators and those projects deemed to be advanced proposals. This includes type and capacity, thermal efficiencies, auxiliaries, O&M costs, emission factors, fuel costs and SRMC.
- Chapter 4 examines the attributes and costs for a range of new entrant technologies including both short-run and long-run cost elements. Costs for new entrants are also provided on an annualised basis in $/kW.
- Appendix A details the scope of work for this project.

Figure 1 **16 NEM zones**



Map source: NEMMCO

2 Definitions and methodology

This chapter provides the working definitions that have be used for the Short-run Marginal Cost (SRMC) and Long-run Marginal Cost (SRMC) for power stations as part of this project.

2.1 Short-run marginal cost (SRMC)

The short-run is defined as a period of time where at least one input variable remains fixed. In the case of power generation, the short-run is typically defined as being a period where generation capacity remains fixed. Therefore the SRMC is the incremental cost incurred from an increment of output (ie 1 MWh) from the existing generation fleet. SRMC will vary from station to station.

Using this definition, the SRMC for each station will vary over the short-run as the incremental cost for an increment of output depends on whether the plant is operating and the level of output at which it is operating. For example, a plant that needs to be started incurs additional costs in terms of fuel and other inputs. Similarly, a plant operating at 60% output will have a different incremental cost for an increment of output than if it was operating at 80% because of different thermal efficiencies at different levels of output.

For the purpose of this project we have defined the 'short-run' to mean a period of 1 year. Therefore the SRMC is defined as being the additional cost incurred of producing an additional MWh on average over the course of the year.

With this definition in mind, the relevant inputs that form the SRMC are:

- The average marginal thermal efficiency for a station over the year
- The average marginal fuel cost incurred over the year
- The average marginal variable O&M costs incurred over the year
- The average marginal emission factors over the year.

One could argue that the above definition is better described as the Short-run Average Cost (SRAC), rather than the SRMC. In the majority of circumstances this may be true in that SRMC would equal SRAC. However there are significant differences for some plant. For example, the SRMC for Victorian brown coal generators would not include overheads and capital items that relate to operation of the mine, whereas these would be included in the SRAC. In general we would expect differences between SRMC and SRAC in situations where a generator owns and operates its own fuel supply.

We have provided the components to estimate the SRMC in gross (or 'as generated') and sent-out terms. It should be noted however that the sent-out SRMC is the value that we expect that generators actually use when constructing their offer curves since the generator is paid for the sent-out energy and not the 'as generated' energy. Using the 'as generated' SRMC in formulating the offer curve would in effect result in the generator not fully recovering their avoidable costs where their SRMC offer set the market price for a given trading interval.

The estimated SRMC for each station is calculated using the following formulae:

$$SRMC_{SO} = TE_{SO} \times FC + VOM + TE_{SO} \times \left(\frac{CEF + FEF}{1000}\right) \times EPP - NGAC - GEC$$

$$SRMC_G = SRMC_{SO} \times (1 - Aux)$$

Where:

- $SRMC_{SO}$ is the short-run marginal cost on a sent-out basis (in $/MWh)
- $SRMC_G$ is the short-run marginal cost on a generated basis (in $/MWh)
- TE_{SO} is the thermal efficiency on a sent-out basis (in GJ/MWh)
- FC is the fuel cost (in $/GJ)
- VOM is the variable operating and maintenance cost on a sent-out basis (in $/MWh)
- CEF is the combustion emission factor (in kg CO_2-e/GJ)
- FEF is the fugitive emission factor (in kg CO_2-e/GJ)
- EPP is the emission permit price (in $/tonne CO_2-e/MWh)
- NGAC is any benefit derived from the production of certificates under the NSW Greenhouse Gas Abatement Scheme (in $/MWh)
- GEC is any benefit derived from the production of certificates under the Queensland gas scheme (in $/MWh)
- Aux is the station's auxiliaries (as a ratio of auxiliaries to total energy generated).

The above definition differs slightly from the 2007 cost report in that fugitive emissions (emissions resulting from the production and transport of fuel) are included. This is valid where the fuel costs used do not already include costs associated with emissions on production and transport of the fuel (ie no double counting). The benefit of including the fugitive emission factors directly within the SRMC formula as opposed to the fuel prices is that different carbon price scenarios can be tested without the need to adjust fuel costs.

With the anticipated introduction of the Carbon Pollution Reduction Scheme (CPRS) in July 2010, ACIL Tasman expects both the NSW Greenhouse Gas Abatement Scheme and the Queensland GEC scheme to cease operation. As a result, the impact of NGACs and GECs upon generator's SRMC is only expected to occur for the first year of the projection (2009-10).

2.2 Long-run marginal cost (LRMC)

The long-run is usually defined as a period of time in which all inputs can be varied. In the case of the generation sector the key difference in inputs that can be varied is the capacity of the generation fleet. Therefore, the LRMC is defined as the cost of an incremental unit of generation capacity, spread across each unit of electricity produced over the life of the station.

When calculating LRMC for new generation, the costs considered include all costs relevant to the investment decision. These costs are:

- The capital cost (including connection and other infrastructure)
- Other costs including legal and project management costs
- Fixed operating and maintenance costs
- Variable costs over the life of the station
- Tax costs (if using a post-tax discount rate).

ACIL Tasman estimates LRMC for plant based on a Discounted Cash Flow (DCF) new entrant model which is discussed in the following section.

2.2.1 New entrant model

The new entrant model utilised by ACIL Tasman is a simplified DCF model for a greenfield generation project. It is significantly simpler than a DCF model which would be utilised to evaluate an actual investment decision for a specific project due to the fact that it is by definition generic and designed to be suitable for a range of projects and proponents.

Cash flows within the model are evaluated on an un-geared post-tax basis and include the effect of depreciation. A geared project post tax WACC is used as the project discount rate in effect incorporating gearing upstream. However, the cash flows do not directly include the effects of the interest tax shield and dividend imputation credits.

2.2.2 Discount rate

ACIL Tasman uses a calculated WACC as a conservative proxy for an investment decision hurdle rate for electricity market modelling. This is appropriate for a number of reasons:

- Most work in relation to market modelling relates to pool price projections. In the medium-to-long term prices will trend toward new entry levels and having conservative projections is desirable in due diligence and advisory work.
- In our experience, generation proponents who actually proceed with development tend to do so earlier than so called rational models would predict. This implies that either:
  - proponents that proceed are necessarily aggressive and use settings within their evaluation models which unduly favour their project
  - proponents overestimate the revenues and/or underestimate the costs of their investments
  - they are looking to capture other strategic benefits from market entry (early-mover or synergistic advantages) which are not apparent to external observers.

The discount rate used by ACIL Tasman within its new entrant model is a calculated post-tax real WACC. A post-tax WACC is used because of the importance of depreciation for capital intensive plant such as power stations. A pre-tax WACC makes simplifications on the effects of depreciation and is in ACIL Tasman's view, an inferior method for estimating the LRMC of generation.

When using a DCF a number of WACC derivations and cash flow models can be used. Choices need to be made as to whether the analysis is performed on a real or nominal, pre or post-tax basis. Once this has been decided, the model can either incorporate items such as the tax shield (recognition of the deductibility of interest payments for tax purposes) and imputation credits explicitly within the cash flows, or alternatively via adjustment to the WACC itself.

There are a number different expressions for post-tax WACC, the most common ones include:[1]

- Vanilla
- Monkhouse
- Officer.

The Officer formula is the most complex of these owing to the fact that it incorporates all tax effects in the WACC calculation itself and is applied to simple post-tax cash flows. The Officer WACC is the most widely cited as the

[1] It should be noted that each of these formulas are equivalent if the analysis is performed on a pre-tax basis.

target post-tax WACC because this definition of WACC is commonly used for asset valuation and project evaluation.

As the Officer WACC formula includes the interest tax shield and imputation credits there is potential for inaccuracies to exist as it is essentially a simplification. This is particularly so in the case of finite projects which have different amounts of depreciation and tax payable throughout the project life. A more accurate means of accounting for these elements can be achieved by incorporating them explicitly into the cash flows and using a Vanilla WACC. However, one must then make assumptions regarding the type, structure and tenure of debt finance for the project which does not lend itself to the generic analysis that we undertake with the LRMC model.

ACIL Tasman utilises a post-tax real Officer WACC within its new entrant model and applies it to un-geared cash flows that do not include the effects of the interest tax shield or dividend imputation credits.

The post-tax nominal Officer WACC as used by ACIL Tasman is expressed as:

$$WACC_{Officer\ (post-tax\ nominal\ )} = \frac{E}{V} \times R_e \left(\frac{(1-T_E)}{\left(1-T_E(1-G)\right)} \right) + \frac{D}{V} \times R_d(1-T_E)$$

Where:

- E is the total market value of equity
- D is the total market value of debt
- V is the total enterprise value (value of debt plus equity)
- R_e is the nominal post-tax cost of equity
- R_d is the nominal post-tax cost of debt
- T_E is the effective corporate tax rate
- G (Gamma), which is the value of imputation tax credits as a proportion of the tax credits paid.

The nominal post-tax WACC is adjusted into real terms using the Fischer equation as follows:

$$WACC_{Officer\ (post-tax\ real\ )} = \left(\frac{\left(1 + WACC_{Officer\ (post-tax\ nominal\ )}\right)}{(1+F)} \right) - 1$$

Where:

- F is the relevant inflation rate.

The Officer WACC is applied to cash flows that do not include the effects of the interest tax shield and dividend imputation credits. That is, cash flows are un-geared and defined simply as:

$$Cash\ Flows_{(Officer\ )} = X \times (1 - T)$$

Where:

- X is the project cash flow
- T is the statutory corporate tax rate.

2.2.3 Conversion to annual equivalent cost

The LRMC derived from the new entrant model is expressed in $/MWh terms, assuming a given capacity factor and other variable cost components. It is useful to convert the LRMC into an annual equivalent fixed cost by stripping out these variable components.

In converting LRMC (in $/MWh) to an annual equivalent fixed cost (in $/kW/year) the following process is used:

$$Annual\ cost = (LRMC - SRMC) \times \left(8.76 * CF * (1 - Aux)\right)$$

Where:

- LRMC is the long-run marginal cost in $/MWh as discussed above
- SRMC is the short-run marginal costs (fuel, variable O&M and emission costs) in $/MWh
- CF is the assumed capacity factor (%) used to derive the LRMC
- Aux is the station's auxiliary requirements (%).

This provides a measure of fixed costs in $/kW/year that is suitable for use by NEMMCO in evaluating suitable timing for new entry.

2.3 Methodology

This section outlines the methodology used in the estimation of cost data for existing and new entrant plant. Each component of SRMC is discussed briefly, outlining ACIL Tasman's approach in gathering the necessary data.

2.3.1 Fuel costs

The marginal fuel cost is dependent on a number of factors including:

- Contractual arrangements including pricing, indexation, tenure and take or pay provisions
- Mine/gas field and power station ownership arrangements

- The availability of fuel through spot purchases or valuation on an opportunity cost basis
- Projected prices for new long-term contracts.

Each of these factors is taken into account in evaluating the fuel cost component of SRMC as discussed below.

Contractual arrangements

Where the power station is dependent on a third party to supply fuel under contract then the cost of incremental fuel is deemed to be the estimated average contract price on a delivered basis.

As prices under contractual arrangements are almost never publicly available, contract prices will be estimated based on a weighted-average of known contract volumes and estimated prices.

We understand that there are instances in the NEM where the price paid for fuel has been wholly or partially linked in some way to the regional reference price (RRP) for electricity. This potentially results in the incremental fuel price varying over time in line with the prevailing wholesale spot price. In these instances we have assumed that the marginal cost of fuel is the average cost.

Vertically integrated fuel supply

Stations which are fully vertically integrated with their fuel supply have lower fuel costs as a small increment in fuel use is unlikely to require additional capital and maintenance and hence this incremental fuel does not include these costs. Most brown coal stations in Victoria fall into this category.

More recently, there have been a number of proposed power stations in Queensland involving an integrated coal seam gas development. These stations would have similar incremental fuel cost advantages as the field development costs are usually capitalised as part of the project.

For station owners who also own the associated coal mine and deposit but use contract miners, the marginal fuel cost will be dependent on the contractual arrangements with the contract miner and may not reflect the marginal cost that would apply if mining activities were carried out in-house. For stations such as these, the estimated mining contractor costs are used as the marginal cost of fuel.

Spot market for fuel

There is currently no liquid spot market for either coal or gas in Australia. Therefore, basing fuel costs on an opportunity cost basis (i.e. the current market price as distinct from actual contracted cost) is rarely appropriate. This approach would be more relevant for market such as the United States which has transparent and actively traded spot fuel markets operating.

ACIL Tasman maintains an approach which relies upon the use of estimated actual contracted costs for fuels, with rollover onto market based rates upon expiry.

Projecting prices for new long-term contracts

The following section outlines the approach used in projecting fuel prices for new long-term contracts. Coal, natural gas and liquid fuels are discussed separately.

Coal

New long-term coal prices depend upon whether the coal can be exported and whether the power station is located as a mine mouth or remote from the mine from which it is supplied.

Our analysis of coal prices relies principally upon estimates of costs of production and transport (if relevant) to the station in question. This analysis is undertaken on a deposit-by-deposit basis and takes into consideration the coal resources available.

Where coal is exportable, the netback price available for the coal producer becomes a factor in considering prices that may be made available for power generation. However, given the stability offered from domestic contracts, which offer long-terms at fixed prices, we assume that domestic coal receives a 20% discount over the export parity value of the Run-of-Mine (ROM) coal.

Hence the projected coal prices for new contracts for each NEM zone will be determined by one of three factors:

- 80% of the export parity value of the ROM coal where it is greater than the ROM coal mining cost. This generally applies to deposits which are higher quality coal and/or are generally closer to the export terminals.
- ROM coal mining costs where 80% of the export parity value of the ROM coal is less than the mining costs and the coal is delivered to a mine-mouth power station. This usually applies to deposits which are relatively inferior in quality and/or some distance from export terminals while being relatively close to major transmission links (Felton, New Acland, Ulan etc).
- ROM coal mining costs plus transport costs to a power station site remote from the mine but closer to transmission infrastructure and where 80% export parity value of the ROM coal is again less than the mining costs but where the deposit is greater than 100 km from the transmission system (Wandoan, Alpha, Pentland).

The delivered prices can switch from one basis to another as export prices and ROM coal mining costs are projected to vary. This is particularly the case as export prices are projected to fall in real terms while mining costs are projected to remain relatively constant in real terms (at a level somewhat below the elevated costs seen in 2007 and into 2008 when fuel, tyre and equipment costs were all affected by strong worldwide demand).

Natural gas

Long-term price projections for gas have been provided as output from our proprietary gas market model – *GasMark*. GasMark incorporates a complete input database containing data and assumptions for every gas producing field, transmission pipeline and major load/demand centre in Australia. It is used by ACIL Tasman internally, and is also licensed to a number of external gas market participants.

GasMark provides price projections for each defined node on the Eastern Australian gas grid, which are mapped to each of the 16 NEM zones.

The availability of gas to support generation in each NEM zone is determined by a number of factors, namely:

- The reserves and production capability of various fields (locally and in an aggregate sense throughout Eastern Australia)
- Existing transmission capacity into the zone (if the zone does not have indigenous gas resources)
- The potential for new or additional transmission capacity.[2]

Other fuels

The price for liquid fuels (distillates and oils) is based on the global oil price, converted to Australian dollars per GJ. As transportation costs for liquid fuels are a relatively small proportion of the total cost, these have been ignored and a single price for liquid fuel has been provided for all NEM zones. See section 2.4 for details on the oil price assumption used for this project.

Summary of approach in estimating fuel costs

Table 1 summarises the proposed approach in relation to each fuel and possible supply arrangements.

---

[2] The planning and development of additional pipeline capacity is generally shorter than the station itself and therefore does not impact upon the lead-time for gas plant development.

Table 1 **Summary of fuel cost treatment and data sources**

Fuel	Supply arrangements	Treatment	Data source	Examples
Coal	Third-party supply	Estimated weighted-average coal price under existing contracts, supplemented with projected new contract prices as existing contracts expire	Coal company reporting, estimated mining and transport costs	Bayswater, Mt Piper, Gladstone, Loy Yang B
Coal	Vertically integrated mine/power station utilising contract miners	Estimated average contractor costs, supplemented with projected new contract prices if existing mine reserves are exhausted	Power station owner reporting, estimated mining costs	Kogan Creek, Millmerran
Coal	Vertically integrated mine/power station	Estimated marginal mining costs (fuel, electricity and other consumables)	Estimated mining costs	Loy Yang A, Yallourn, Hazelwood
Natural gas	Third-party supply	Estimated weighted-average coal price under existing contracts, supplemented with projected new contract prices as existing contracts expire	Gas company reporting, estimated production and transport costs	Swanbank E, Pelican Point, Tallawarra
Natural gas	Vertically integrated gas field/power station	Estimated marginal production costs (gas used in compression, field operating costs, in-fill drilling)	Estimated marginal production costs	Condamine
Liquid fuels	Third-party supply	Estimated average spot price	Projected price based on oil price forecast	Mt Stuart, Hunter Valley

2.3.2 Thermal efficiencies

The thermal efficiency/heat rate for each existing station and new plant type has been estimated in both net and gross terms. These values are presented as a percentage (amount of energy converted from the fuel into electricity) and also in GJ/MWh.

Thermal efficiency is presented on Higher Heating Value (HHV) basis which includes the energy required to vaporize water produced as a result of the combustion of the fuel. Efficiencies presented on a HHV basis (as opposed to Lower Heating Value or LHV) are the appropriate measures to calculate fuel use and the marginal costs of generation.[3]

Thermal efficiency for a given turbine can degrade over time. The extent of the degradation depends on the nature of the maintenance program and the way in which the plant is operated. An estimate of the current heat rate for existing stations is based on typical historically observed capacity factors. For simplicity these are assumed to remain constant over the remaining life of each station.

It is expected that with the introduction of the CPRS, capacity factors of existing stations are likely to change considerably and this may have some effect on estimated thermal efficiencies. For CCGT plant running at capacity factors higher than observed historically we would expect thermal efficiencies to improve slightly. Conversely, emission intensive coal-fired plant may experience lower capacity factors going forward and this could result in lower thermal efficiencies. While the impact upon CCGT plant is reasonably clear, lower capacity factors for coal plant may not necessarily result in lower thermal efficiencies. Operators are likely to decommit individual units rather than run an entire station at low output levels. As a result, the impact upon thermal efficiencies for coal plant is likely to be small or negligible. Recognising the difficulties involved in estimating thermal efficiencies for different capacity factors, ACIL Tasman has provided a single value based on historical operation.

Thermal efficiency for new entrants is expected to improve over time through technology and design advancements and a projection of this improvement in efficiency for new entrant plant has been estimated. The starting thermal efficiency for new entrants is also assumed to remain constant over the life of the station (i.e. no heat rate decay).

---

[3] LHV values are often used by turbine manufacturers for comparison as these values are independent of the type of fuel used. Efficiencies in LHV terms are higher when quoted as a percentage (more efficient) than efficiencies in HHV terms.

As mentioned in the definition of SRMC (section 2.1), the thermal efficiency that will be provided will represent an estimate of the average marginal efficiency over the course of a typical year. It is not practical to estimate instantaneous heat rate curves.

2.3.3 Operation and maintenance costs

Operating and maintenance (O&M) costs comprise of both fixed and variable components. Variable O&M (or VOM), is required for the estimation of SRMC, while Fixed O&M (FOM) costs are required for new entrant costs and decisions relating to retirements of incumbent plant.

Variable O&M

The additional operating and maintenance costs for an increment of electrical output depends on a number of factors, including the size of the increment in generation, the way in which wear and tear on the generation units is accrued between scheduled maintenance (hours running or a specific number of start-stop cycles) and whether operation is as a base load or peaking facility. Generally, VOM is a relatively small portion of overall SRMC.

For coal, VOM includes additional consumables such as water, chemicals and energy used in auxiliaries and incremental running costs such as ash handling.

For gas, in addition to consumables and additional operating costs, an allowance is also included for major maintenance. The reason for including an allowance for major maintenance in the VOM for gas turbines is because this maintenance is not periodic, as it is for coal plant, but rather is generally determined by hours of operation and specific events such as starts, stops, trips etc.

It is these additional starts that mean that an OCGT peaking plant has a higher VOM per MWh than either a CCGT base or intermediate load plant.

The VOM value is usually expressed in sent-out terms to account for internal usage by the station (see below) rather than in 'as generated' terms.

Fixed O&M

FOM represents costs which are fixed and do not vary with station output, such as major periodic maintenance, wages, insurances and overheads. For stations that are vertically integrated with their fuel supply, fixed O&M costs can also include fixed costs associated with the coal mine/gas field. These costs are presented on a $/MW installed/year basis.

As major maintenance expenditure may not occur every year – major maintenance may only occur every second, third or fourth year – the estimated FOM values represent an annualised average for each station. Estimating FOM costs for existing stations is difficult as reporting of financial information is relatively scarce in the NEM. Costs for existing stations have been estimated with reference to new entrant FOM costs, with adjustments made for the plants age and size. It should be noted that FOM costs do not affect the bidding behaviour of existing plants as the FOM does not vary with the output of the station. However if the station operation was to cease, FOM would be avoided by the station owner. Hence it is included when evaluating when existing plants may cease operation. This is particularly relevant for emission intensive coal-fired stations in response to the introduction of the CPRS.

2.3.4 Auxiliaries

Auxiliary load is an electricity load used within a power station as part of the electricity generation process – that is, it is an electricity load used in the making of electricity (also called a parasitic load). The usual way of expressing the station auxiliaries is in percentage form and when applied to the gross capacity of the station provides a measure of the net capacity or sent-out capacity of the station.

Station auxiliaries also impact the sent-out or net thermal efficiency of the station, and therefore the station's SRMC.

To convert SRMC from gross to sent-out basis the following formula is used:

$$SRMC_{SO} = SRMC_G \times (1 - Aux)$$

Where:

- $SRMC_{SO}$ is the short-run marginal cost on a sent-out basis (in $/MWh)
- $SRMC_G$ is the short-run marginal cost on a generated basis (in $/MWh)
- Aux is the station's auxiliaries (in percent).

ACIL Tasman has provided estimated auxiliary factors for all existing and new entrant technologies. Auxiliary factors are assumed to remain constant over time.

2.3.5 Emission factors

An estimate of the combustion emissions factors (in kg CO_2-e/GJ of fuel) are provided for each existing station as well as for new stations by plant type. In addition, the fugitive emission factor – that is, emissions relating to the production and transport of fuel – are also provided (in kg CO_2-e/GJ of fuel). The majority of these emission factors have been sourced from the 2008

National Greenhouse Accounts NGA Factors workbook[4], however figures for coal-fired stations have also been derived from other data sources, such as company environmental reporting.

Fugitive emission factors have been explicitly accounted for within the SRMC formula. This is due to the fuel price series being provided exclusive of emission costs relating to production and transport. The benefit of this approach is that alternate carbon price scenarios can be run without requiring different fuel cost series for coal and natural gas. However, it does imply that producers will be able to fully pass on any emission costs through provisions within fuel supply agreements. It is anticipated that this will be the case in the vast majority of contracts.

Combustion and fugitive emission factors do not vary with capacity factor as they are expressed in kg CO_2-e/GJ of fuel. They may however vary over time due to changes in fuel composition (particularly the case for coal). This report provides a single point estimate only.

ACIL Tasman has also provided emission intensity figures for each plant (expressed in tonnes CO_2-e/MWh) both on a generated and sent-out basis.

2.3.6 Retirement criteria

In the modelling to be undertaken by NEMMCO on behalf of the IRPC a key consideration is the potential for the early retirement of incumbent generators in response to the CPRS.

ACIL Tasman's approach to this modelling issue is to retire plants that exhibit negative earnings before interest, tax, depreciation and amortisation (EBITDA) on an ongoing basis. That is, plant which have 'net revenues' that turn negative and are unlikely to turn positive over the foreseeable future.[5]

In this context 'net revenue' is defined as:

- Pool revenues (dispatch-weighted spot price multiplied by sent-out dispatch adjusted for MLF), minus
- Operating costs (fuel, total operating & maintenance and emission costs).[6]

[4] Department of Climate Change, *National Greenhouse Accounts (NGA) Factors*, January 2008

[5] The potential for retro-fitted carbon capture and storage technology to become available also needs to be considered. For example, it may be possible to temporarily mothball a station until retro-fit CCS technology is available.

[6] Note also that there may be differences between marginal costs (as used to determine generator bidding behaviour) and average costs – particularly for elements such as fuel for integrated fuel-generation projects.

ACIL Tasman recommends NEMMCO also use this criterion when evaluating the potential retirements of incumbent generators. Where average costs differ from marginal costs ACIL Tasman has included the differential within the FOM values for calculating EBITDA.

Impact of compensation under CPRS

A number of coal-fired generators are expected to receive a free allocation of emission permits under the CPRS Electricity Sector Adjustment Scheme (ESAS) as outlined within the Government's CPRS White Paper.

The purpose of the assistance package presented in the white paper is designed to partially offset the most extreme losses in asset value, rather than attempting to precisely offset all modelled losses in value. Assistance is to be provided via an administrative allocation of a fixed quantity of permits (130.7 million in aggregate) over a 5 year period, estimated to be worth around $3.5 billion in 2008-09 dollars. Assistance is calculated based on eligible generators emission intensity relative to a set benchmark of 0.86 tonnes CO_2-e/MWh as generated. Assistance will be provided conditional upon a windfall gains provision which will be determined via a review by the Schemes regulator in 2012-13.

Assistance is conditional upon the recipient generator remaining registered with NEMMCO (and therefore obligated to follow NEMMCO market directions) at the same actual or planned capacity as at 3 June 2007 unless there is adequate reserve plant margin to allow a reduction in capacity without breaching reliability standards.

Table 2 details the estimated compensation entitlements under the ESAS based on the emission intensity factors within this report. Permits are to be allocated to the eligible party for each generator in equal quantities across the five year period. The value of these permits is determined by the assumed carbon prices as set out within Table 5.

Table 2 **Estimated compensation entitlements under ESAS**

Station	Total value of compensation (Nominal $m)	Permits allocated 2010-11 to 2014-15 (million)	Proportion of total compensation package
Angelsea	53.7	1.8	1.4%
Callide B	2.4	0.1	0.1%
Collinsville	20.8	0.7	0.5%
Energy Brix	83.0	2.8	2.1%
Gladstone	54.1	1.8	1.4%
Hazelwood	1,108.6	37.4	28.6%
Liddell	158.2	5.3	4.1%
Loy Yang A	782.8	26.4	20.2%
Loy Yang B	446.7	15.1	11.5%
Muja C	17.7	0.6	0.5%
Muja D	7.8	0.3	0.2%
Munmorah	33.6	1.1	0.9%
Northern	25.5	0.9	0.7%
Playford B	56.5	1.9	1.5%
Redbank	32.4	1.1	0.8%
Swanbank B	51.2	1.7	1.3%
Vales Point B	13.6	0.5	0.4%
Wallerawang C	21.7	0.7	0.6%
Yallourn W	908.3	30.6	23.4%
	3,878.7	**130.7**	**100.0%**

Note: Assumes no windfall gains are deemed to have occurred by the Schemes regulator
Data source: ACIL Tasman analysis

As the allocated permits are effectively a separate asset and have an explicit opportunity cost, they are not expected to have any impact upon generator bidding behaviour. The condition that generators remain registered with the market operator in order to receive compensation is also unlikely to result in any material market impact. This is because large-scale retirements are generally not expected to occur within the first 5 years of the scheme (unless carbon prices are significantly higher than anticipated) and it is expected that gas-fired generation proponents to be quite aggressive in entering the market to displace coal-fired capacity, such that there is unlikely to be large reserve margin deficits.

Even if it did transpire that a coal-fired station wanted to retire but did not want to lose its remaining compensation payments due to lack of reserve margin, the station could effectively mothball, but remain registered as a backup unit. While this strategy would entail costs to keep the station operational if required by NEMMCO, these costs may be less than the remaining compensation payments.

Based on the above discussion ACIL Tasman does not see compensation through the ESAS as having a major impact upon the timing of coal-fired retirements.

Most market modelling exercises consider reserve plant margins as one of the constraints upon new entrant plant decisions (ie reserve margins must be maintained). If NEMMCO uses this approach then the ESAS will have no impact whatsoever. If however, NEMMCO's new entrant decisions are based purely upon commercial new entry (which at times can result in reserve margins being violated), the impact of the ESAS should be considered when evaluating coal-fired retirements within the first 5 years of the scheme.[7]

2.3.7 New entrant cost estimates

Estimates of LRMCs (and SRMCs) have been provided for the following new entrant technologies:

- Combined Cycle Gas Turbine (CCGT)
- Open Cycle Gas Turbine (OCGT)
- Supercritical black coal
- Supercritical brown coal
- Ultra-supercritical coal (USC)
- Nuclear
- Integrated gasification combined cycle (IGCC)
- Carbon capture and storage variants (CCS).

Capital costs

The market has experienced a marked increase in capital costs for new build plant over the past 24 months. Increased prices for inputs such as steel and labour and full manufacturer order books have contributed to the rise in costs. More recently, the global financial crisis has led to a significant drop in commodity prices and in expected electricity demand growth which may result in some easing of EPC costs. For Australian proponents this has been offset to some degree by the devaluation of the Australian dollar relative to the US dollar.

In arriving at the estimates of project capital costs ACIL Tasman has reflected upon the sharp increases in prices witnessed through 2007 and 2008, but also the more recent fall as a result of the economic downturn. We recognise that some proponents would have been exposed to prices significantly higher than those quoted herein in recent times, however we do not feel that these price levels are sustainable in the longer-term. Price levels during this period reflected an overheated global economy, with economic activity pushing the

[7] Note that this does not necessarily mean that retirements will not still occur within this period, if the lost compensation is relatively small compared with avoided operating costs.

limits of capital and labour constraints in developed and developing countries alike. Conversely, depending upon the severity and length of the global economic downturn, capital costs may fall below historical levels for a period of time as demand for turbines falls and slots are re-traded or surrendered.

ACIL Tasman's estimates of project capital costs reflect a long-run equilibrium level around which shorter-term perturbations (such as those described above) may occur.

The capital cost estimates include the following cost elements:

- engineering, procurement and construction (EPC)
- planning and approval
- professional services
- land acquisition
- infrastructure costs (incl. water)
- spares and workshop etc
- connection to the electricity network
- fuel connection, handling and storage.

Costs are expressed in A$/kW for each technology and where appropriate have been differentiated based on the method of cooling. The capital cost estimates exclude interest during construction (IDC) and costs relating to IDC are implicitly included within ACIL Tasman's new entrant model.

An international database of published capital costs for new entrant power plant has also be used to provide an informed view of capital costs for new plant in the NEM.

For the emerging technologies published research reports, which include estimates of capital costs as well as projections in the capital costs to account for the learning curve effect, have been relied upon.

Power station capital cost estimates also take into account recent work with potential new entrant power stations (within confidentiality bounds).

2.4 Key assumptions

Table 3 details a selection of key assumptions that were used for this exercise.

Table 3 **Key assumptions used within the analysis**

Assumption	Value	Comments
Inflation (CPI)	2.50%	Long-term inflation rate at the mid-point of the RBA targeted inflation band. While near-term forecasts exist for CPI (Treasury, RBA etc) a single long-term value is preferable. 2.5% is in-line with Treasury's latest Mid-year Economic and Fiscal Outlook report for years 2010-11 and 2011-12 (p6)
Exchange rate (USD/AUD)	0.75	Long-term assumption
International oil price (US$/bbl)	$80	ACIL Tasman assumption which aligns with EIA International Energy Outlook 2008 forecast on average over the period to 2020 (real 2008 dollars)
Internationally traded thermal coal price (A$/tonne)	$80	ACIL Tasman projection (in nominal dollars) for FOB Newcastle. Implies FOB price declining in real terms
Permit prices under the Carbon Pollution Reduction Scheme	~$23/tonne, rising to ~$37/tonne by 2020 in real terms	Scheme assumed to commence July 2010. Carbon prices broadly in-line with those projected within Treasury modelling for the CPRS5 scenario (real 2009-10 dollars)
LNG export facilities developed in Queensland	Total of 8 Mtpa capacity	Assumed two proposals reach FID: 4 Mtpa operational by 2014; further 4 Mtpa by 2018
Upstream gas developments	ACIL Tasman base case assumptions	Base case assumptions relating to level of CSG development and conventional exploration success
Discount rate for new entrants	6.81%	Post-tax real WACC

2.4.1 Exchange rates

For this exercise the assumed exchange rate is US$0.75/AUD as shown in Table 3. This figure has been factored into to all estimates of capital costs.

A change to the assumed exchange rate would require new estimates for capital costs to be derived based on the proportion of imported content for each technology. Technologies which have a large portion of cost denominated in US dollars (such as OCGT) will be more sensitive to any changes.

2.4.2 WACC for new entrants

Table 4 detail the parameters to be used in the calculation of the WACC of 6.81% (post-tax real) as set out in Table 3.

The WACC is calculated as follows:

$$WACC_{Officer\ (post-tax\ nominal\ )} = \frac{E}{V} \times R_e \left(\frac{(1-T)}{(1-T(1-G))} \right) + \frac{D}{V} \times R_d(1-T)$$

Where: E = 0.4; D=0.6; V=1; T=22.5%; G=0.5; Re=16.2%; Rd=8%

This gives a post-tax nominal result of 9.48%.

This is converted into real terms using the Fischer equation:

$$WACC_{Officer\ (post-tax\ real)} = \left(\frac{\left(1 + WACC_{Officer\ (post-tax\ nominal)}\right)}{(1+F)}\right) - 1$$

Where: F = 2.5%, giving a post-tax real WACC of 6.81%.

While this WACC may be considered to be low in the context of the current global financial crisis – particularly the debt basis point premium – ACIL Tasman consider these settings to be appropriate in the longer-term which is the focus of this study and most market modelling exercises.

Table 4 **WACC parameters**

	Parameter	Value
D+E	Liabilities	100%
D	Debt	60%
E	Equity	40%
rf	Risk free RoR	6.0%
MRP = (rm-rf)	Market risk premium	6.0%
rm	Market RoR	12.0%
T	Corporate tax rate	30%
Te	Effective tax rate	22.5%
	Debt basis point premium	200
rd	Cost of debt	8.0%
G	Gamma	0.50
ba	Asset Beta	0.80
bd	Debt Beta	0.16
be	Equity Beta	1.75
re	Required return on equity	16.5%
F	Inflation	2.50%

2.4.3 Emission permit price

Table 5 details the assumed emission permit prices under the Carbon Pollution Reduction Scheme (CPRS), which is anticipated to commence in July 2010. These values have been sourced from Treasury's modelling of the CPRS scheme under a 5% abatement scenario (CPRS -5).

Table 5 **Assumed emission permit prices**

	Emission permit price ($/tonne CO2-e)
2009-10	0.00
2010-11	23.39
2011-12	24.19
2012-13	26.14
2013-14	28.09
2014-15	30.04
2015-16	31.99
2016-17	33.82
2017-18	35.43
2018-19	37.03
2019-20	38.75
2020-21	40.36
2021-22	42.19
2022-23	43.91
2023-24	45.75
2024-25	47.58
2025-26	49.07
2026-27	51.14
2027-28	53.09
2028-29	55.26

Note: Real 2009-10 dollars.

Data source: ACIL Tasman based on Treasury figures

3 Existing, committed and advanced proposals

This chapter presents the relevant data on capacity, thermal efficiency, O&M costs and emission factors for existing, committed and advanced proposals for scheduled thermal plant in the NEM.

3.1 Plant type and capacities

Table 6 through to Table 11 provides an overview of the existing and committed thermal plant in each region of the NEM. The tables provide information on generator type, primary fuel, plant configuration and capacity.

Table 6 **Type and capacity of existing and committed plant in NSW**

Station	Type	Fuel	Configuration	Size (MW)	Registered capacity (MW)
Bayswater	Steam turbine	Black coal	Steam turbine (4x660 MW)	2,640	2,640
Colongra	OCGT	Natural gas	OCGT (4x166 MW)	664	664
Eraring	Steam turbine	Black coal	Steam turbine (4x660 MW)	2,640	2,640
Hunter Valley GT	OCGT	Fuel oil	OCGT (2x25 MW)	50	50
Liddell	Steam turbine	Black coal	Steam turbine (4x500 MW)	2,000	2,000
Mt Piper	Steam turbine	Black coal	Steam turbine (2x660 MW)	1,320	1,320
Munmorah	Steam turbine	Black coal	Steam turbine (2x300 MW)	600	600
Redbank	Steam turbine	Black coal	Steam turbine (1x150 MW)	150	150
Smithfield	CCGT/Cogen	Natural gas	OCGT (3x38 MW), Steam turbine (1x62 MW)	176	160
Tallawarra	CCGT	Natural gas	OCGT (1x260 MW), Steam turbine (1x160 MW)	435	435
Uranquinty	OCGT	Natural gas	OCGT (4 x 166 MW)	664	664
Vales Point B	Steam turbine	Black coal	Steam turbine (2 x 660 MW)	1,320	1,320
Wallerawang C	Steam turbine	Black coal	Steam turbine (2 x 500 MW)	1,000	1,000
				13,659	**13,643**

Data source: ACIL Tasman, NEMMCO Registration list

Table 7 **Type and capacity of existing and committed plant in QLD**

Station	Type	Fuel	Configuration	Size (MW)	Registered capacity (MW)
Barcaldine	CCGT	Natural gas	OCGT (1x37 MW), Steam turbine (1x18 MW)	57	55
Braemar	OCGT	Natural gas	OCGT (3x168 MW)	504	504
Braemar 2	OCGT	Natural gas	OCGT (3x168 MW)	504	504
Callide B	Steam turbine	Black coal	Steam turbine (2x350 MW)	700	700
Callide C	Steam turbine	Black coal	Steam turbine (2x420 MW)	840	840
Collinsville	Steam turbine	Black coal	Steam turbine (4x32 MW; 1x66 MW)	195	195
Condamine A	CCGT	Natural gas	OCGT (2x45 MW), Steam turbine (1x45 MW)	135	135
Darling Downs	CCGT	Natural gas	OCGT (3x120 MW), Steam turbine (1x270 MW)	630	630
Gladstone	Steam turbine	Black coal	Steam turbine (6x280 MW)	1,680	1,680
Kogan Creek	Steam turbine	Black coal	Steam turbine (1x781.2MW)	781	750
Mackay GT	OCGT	Fuel oil	OCGT (1x30 MW)	30	30
Millmerran	Steam turbine	Black coal	Steam turbine (2x426 MW)	852	852
Mt Stuart GT	OCGT	Kerosene	OCGT (2x146 MW; 1x126 MW)	418	418
Oakey	OCGT	Natural gas	OCGT (2x141 MW)	282	282
Roma GT	OCGT	Natural gas	OCGT (2x40 MW)	80	80
Stanwell	Steam turbine	Black coal	Steam turbine (4x350 MW)	1,400	1,400
Swanbank B	Steam turbine	Black coal	Steam turbine (4x125 MW)	500	500
Swanbank E	CCGT	Natural gas	CCGT (1x385 MW)	385	385
Tarong	Steam turbine	Black coal	Steam turbine (4x350 MW)	1,400	1,400
Tarong North	Steam turbine	Black coal	Steam turbine (1x450 MW)	450	443
Townsville	CCGT	Natural gas	OCGT (1x165 MW), Steam turbine (1x82 MW)	247	242
Yarwun	Cogen	Natural gas	OCGT (configuration as yet unknown)	160	160
				12,230	**12,185**

Data source: ACIL Tasman, NEMMCO Registration list

Table 8 **Type and capacity of existing and committed plant in SA**

Station	Type	Fuel	Configuration	Size (MW)	Registered capacity (MW)
Angaston	Engines	Diesel	Reciprocating engines (30 x 1.66 MW)	50	50
Dry Creek GT	OCGT	Natural gas	OCGT (3x52 MW)	156	156
Hallett	OCGT	Distillate	OCGT (8x16.8 MW; 2x25.2 MW; 2x17.9 MW)	221	180
Ladbroke Grove	OCGT	Natural gas	OCGT (2x40 MW)	80	80
Mintaro GT	OCGT	Natural gas	OCGT (1x90 MW)	90	90
Northern	Steam turbine	Brown coal	Steam turbine (2x265 MW)	530	530
Osborne	Cogen/CCGT	Natural gas	OCGT (1x118 MW), Steam turbine (1x62 MW)	180	180
Pelican Point	CCGT	Natural gas	OCGT (2x160 MW), Steam turbine (1x158 MW)	478	478
Playford B	Steam turbine	Brown coal	Steam turbine (4x60 MW)	240	240
Port Lincoln GT	OCGT	Distillate	OCGT (2x25 MW)	50	50
Quarantine	OCGT	Natural gas	OCGT (4x24 MW; 1x120 MW)	216	216
Snuggery	OCGT	Distillate	OCGT (3x21 MW)	63	63
Torrens Island A	Steam turbine	Natural gas	Steam turbine (4x120 MW)	480	480
Torrens Island B	Steam turbine	Natural gas	Steam turbine (4x200 MW)	800	800
				3,633	**3,593**

Data source: ACIL Tasman, NEMMCO Registration list

Table 9 **Type and capacity of existing and committed plant in TAS**

Station	Type	Fuel	Configuration	Size (MW)	Registered capacity (MW)
Bell Bay	Steam turbine	Natural gas	Steam turbine (2x120 MW)	240	240
Bell Bay Three	OCGT	Natural gas	OCGT (3x35 MW)	105	105
Tamar Valley OCGT	OCGT	Natural gas	OCGT (1x75 MW)	75	75
Tamar Valley	CCGT	Natural gas	OCGT (3x40 MW), Steam turbine (1x80 MW)	200	200
				620	**620**

Data source: ACIL Tasman, NEMMCO Registration list

Table 10 **Type and capacity of existing and committed plant in VIC**

Station	Type	Fuel	Configuration	Size (MW)	Registered capacity (MW)
Anglesea	Steam turbine	Brown coal	Steam turbine (1x150 MW)	150	150
Bairnsdale	OCGT	Natural gas	OCGT (2x47 MW)	94	94
Energy Brix	Steam turbine	Brown coal	Steam turbine (1x90 MW; 1x30 MW; 1x75 MW)	195	195
Hazelwood	Steam turbine	Brown coal	Steam turbine (8x200 MW)	1,600	1,600
Jeeralang A	OCGT	Natural gas	OCGT (4x51 MW)	204	204
Jeeralang B	OCGT	Natural gas	OCGT (3x76 MW)	228	228
Laverton North	OCGT	Natural gas	OCGT (2x156 MW)	312	312
Loy Yang A	Steam turbine	Brown coal	Steam turbine (2x500 MW; 2x560 MW)	2,120	2,120
Loy Yang B	Steam turbine	Brown coal	Steam turbine (2x500 MW)	1,000	1,000
Mortlake	OCGT	Natural gas	OCGT (2x275 MW)	550	550
Newport	Steam turbine	Natural gas	Steam turbine (1x500 MW)	500	500
Somerton	OCGT	Natural gas	OCGT (4x40 MW)	160	160
Valley Power	OCGT	Natural gas	OCGT (6x50 MW)	300	300
Yallourn	Steam turbine	Brown coal	Steam turbine (2x360 MW; 2x380 MW)	1,480	1,480
				8,893	**8,893**

Data source: ACIL Tasman, NEMMCO Registration list

Table 11 **Type and capacity of advanced proposals**

Station	Type	Fuel	Configuration	Size (MW)	Registered capacity (MW)
Mortlake 2	CCGT	Natural gas	Unknown	400	n/a
Spring Gully	CCGT	Natural gas	Unknown	1000	n/a
				1400	**n/a**

Data source: ACIL Tasman, NEMMCO Registration list

3.2 Thermal efficiency, auxiliaries and O&M costs

Table 12 through to Table 17 present estimates of the thermal efficiencies, auxiliary usage and operating and maintenance (O&M) costs for the existing scheduled thermal stations in the NEM. A separate table is provided for stations within each NEM region and for advanced proposals.

For information on the definitions and estimation of these elements refer to sections 2.3.2, 2.3.3 and 2.3.4 for thermal efficiency, O&M costs and auxiliaries respectively.

Table 12 **Estimated thermal efficiency, auxiliaries and O&M costs for NSW stations**

Generator	Thermal efficiency HHV (%) sent-out	Thermal efficiency HHV (GJ/MWh) sent-out	Auxiliaries (%)	Thermal efficiency HHV (%) as generated	Thermal efficiency HHV (GJ/MWh) as generated	FOM ($/MW/year) for 2009-10	VOM ($/MWh sent-out) for 2009-10
Bayswater	35.9%	10.03	6.0%	38.2%	9.43	49,000	1.19
Colongra	32.0%	11.25	3.0%	33.0%	10.91	13,000	10.10
Eraring	35.4%	10.17	6.5%	37.9%	9.51	49,000	1.19
Hunter Valley GT	28.0%	12.86	3.0%	28.9%	12.47	13,000	9.61
Liddell	33.8%	10.65	5.0%	35.6%	10.12	52,000	1.19
Mt Piper	37.0%	9.73	5.0%	38.9%	9.24	49,000	1.32
Munmorah	30.8%	11.69	7.3%	33.2%	10.84	55,000	1.19
Redbank	29.3%	12.29	8.0%	31.8%	11.30	49,500	1.19
Smithfield	41.0%	8.78	5.0%	43.2%	8.34	25,000	2.40
Tallawarra	50.0%	7.20	3.0%	51.5%	6.98	31,000	1.05
Uranquinty	32.0%	11.25	3.0%	33.0%	10.91	13,000	10.10
Vales Point B	35.4%	10.17	4.6%	37.1%	9.70	49,000	1.19
Wallerawang C	33.1%	10.88	7.3%	35.7%	10.08	52,000	1.32

Note: FOM and VOM costs are assumed to escalate at 2.5% per annum (i.e. 100% of the CPI assumption)

Data source: ACIL Tasman, various sources

Table 13 **Estimated thermal efficiency, auxiliaries and O&M costs for QLD stations**

Generator	Thermal efficiency HHV (%) sent-out	Thermal efficiency HHV (GJ/MWh) sent-out	Auxiliaries (%)	Thermal efficiency HHV (%) as generated	Thermal efficiency HHV (GJ/MWh) as generated	FOM ($/MW/year) for 2009-10	VOM ($/MWh sent-out) for 2009-10
Barcaldine	40.0%	9.00	3.0%	41.2%	8.73	25,000	2.40
Braemar	30.0%	12.00	2.5%	30.8%	11.70	13,000	7.93
Braemar 2	30.0%	12.00	2.5%	30.8%	11.70	13,000	7.93
Callide B	36.1%	9.97	7.0%	38.8%	9.27	49,500	1.20
Callide C	38.0%	9.47	4.8%	39.9%	9.02	49,500	1.20
Collinsville	27.7%	13.00	8.0%	30.1%	11.96	65,000	1.32
Condamine	48.0%	7.50	3.0%	49.5%	7.28	31,000	1.05
Darling Downs	46.0%	7.83	6.0%	48.9%	7.36	31,000	1.05
Gladstone	35.2%	10.23	5.0%	37.1%	9.72	52,000	1.19
Kogan Creek	37.5%	9.60	8.0%	40.8%	8.83	48,000	1.25
Mackay GT	28.0%	12.86	3.0%	28.9%	12.47	13,000	9.05
Millmerran	37.5%	9.60	4.5%	39.3%	9.17	48,000	1.19
Mt Stuart GT	30.0%	12.00	3.0%	30.9%	11.64	13,000	9.05
Oakey	32.6%	11.04	3.0%	33.6%	10.71	13,000	9.61
Roma GT	30.0%	12.00	3.0%	30.9%	11.64	13,000	9.61
Stanwell	36.4%	9.89	7.0%	39.1%	9.20	49,000	1.19
Swanbank B	30.5%	11.80	8.0%	33.2%	10.86	55,000	1.19
Swanbank E	47.0%	7.66	3.0%	48.5%	7.43	31,000	1.05
Tarong	36.2%	9.94	8.0%	39.3%	9.15	49,500	1.43
Tarong North	39.2%	9.18	5.0%	41.3%	8.72	48,000	1.43
Townsville	46.0%	7.83	3.0%	47.4%	7.59	31,000	5.09
Yarwun	34.0%	10.59	2.0%	34.7%	10.38	25,000	0.00

Note: FOM and VOM costs are assumed to escalate at 2.5% per annum (i.e. 100% of the CPI assumption)

Data source: ACIL Tasman, various sources

Table 14 **Estimated thermal efficiency, auxiliaries and O&M costs for SA stations**

Generator	Thermal efficiency HHV (%) sent-out	Thermal efficiency HHV (GJ/MWh) sent-out	Auxiliaries (%)	Thermal efficiency HHV (%) as generated	Thermal efficiency HHV (GJ/MWh) as generated	FOM ($/MW/year) for 2009-10	VOM ($/MWh sent-out) for 2009-10
Angaston	26.0%	13.85	2.5%	26.7%	13.50	13,000	9.61
Dry Creek GT	26.0%	13.85	3.0%	26.8%	13.43	13,000	9.61
Hallett	24.0%	15.00	2.5%	24.6%	14.63	13,000	9.61
Ladbroke Grove	30.0%	12.00	3.0%	30.9%	11.64	13,000	3.60
Mintaro GT	28.0%	12.86	3.0%	28.9%	12.47	13,000	9.61
Northern	34.9%	10.32	5.0%	36.7%	9.80	55,000	1.19
Osborne	42.0%	8.57	5.0%	44.2%	8.14	25,000	5.09
Pelican Point	48.0%	7.50	2.0%	49.0%	7.35	31,000	1.05
Playford B	21.9%	16.44	8.0%	23.8%	15.12	70,000	3.00
Port Lincoln GT	26.0%	13.85	8.0%	28.3%	12.74	13,000	9.61
Quarantine	32.0%	11.25	5.0%	33.7%	10.69	13,000	9.61
Snuggery	26.0%	13.85	3.0%	26.8%	13.43	13,000	9.61
Torrens Island A	27.6%	13.04	5.0%	29.1%	12.39	40,000	2.26
Torrens Island B	30.0%	12.00	5.0%	31.6%	11.40	40,000	2.26

Note: FOM and VOM costs are assumed to escalate at 2.5% per annum (i.e. 100% of the CPI assumption)

Data source: ACIL Tasman, various sources

Table 15 Estimated thermal efficiency, auxiliaries and O&M costs for TAS stations

Generator	Thermal efficiency HHV (%) sent-out	Thermal efficiency HHV (GJ/MWh) sent-out	Auxiliaries (%)	Thermal efficiency HHV (%) as generated	Thermal efficiency HHV (GJ/MWh) as generated	FOM ($/MW/year) for 2009-10	VOM ($/MWh sent-out) for 2009-10
Bell Bay	32.0%	11.25	5.0%	33.7%	10.69	40,000	7.93
Bell Bay Three	29.0%	12.41	2.5%	29.7%	12.10	13,000	7.93
Tamar Valley OCGT	29.0%	12.41	2.5%	29.7%	12.10	13,000	7.93
Tamar Valley	48.0%	7.50	3.0%	49.5%	7.28	31,000	1.05

Note: FOM and VOM costs are assumed to escalate at 2.5% per annum (i.e. 100% of the CPI assumption)

Data source: ACIL Tasman, various sources

Table 16 Estimated thermal efficiency, auxiliaries and O&M costs for VIC stations

Generator	Thermal efficiency HHV (%) sent-out	Thermal efficiency HHV (GJ/MWh) sent-out	Auxiliaries (%)	Thermal efficiency HHV (%) as generated	Thermal efficiency HHV (GJ/MWh) as generated	FOM ($/MW/year) for 2009-10	VOM ($/MWh sent-out) for 2009-10
Anglesea	27.2%	13.24	10.0%	30.2%	11.91	81,000	1.19
Bairnsdale	34.0%	10.59	3.0%	35.1%	10.27	13,000	2.26
Energy Brix	24.0%	15.00	15.0%	28.2%	12.75	60,000	1.19
Hazelwood	22.0%	16.36	10.0%	24.4%	14.73	84,030	1.19
Jeeralang A	22.9%	15.72	3.0%	23.6%	15.25	13,000	9.05
Jeeralang B	22.9%	15.72	3.0%	23.6%	15.25	13,000	9.05
Laverton North	30.4%	11.84	2.5%	31.2%	11.55	13,000	7.93
Loy Yang A	27.2%	13.24	9.0%	29.9%	12.04	79,000	1.19
Loy Yang B	26.6%	13.53	7.5%	28.8%	12.52	51,200	1.19
Mortlake	32.0%	11.25	3.0%	33.0%	10.91	13,000	8.33
Newport	33.3%	10.81	5.0%	35.1%	10.27	40,000	2.26
Somerton	24.0%	15.00	2.5%	24.6%	14.63	13,000	9.61
Valley Power	24.0%	15.00	3.0%	24.7%	14.55	13,000	9.61
Yallourn	23.5%	15.32	8.9%	25.8%	13.96	82,400	1.19

Note: FOM and VOM costs are assumed to escalate at 2.5% per annum (i.e. 100% of the CPI assumption)

Data source: ACIL Tasman, various sources

Table 17 Estimated thermal efficiency, auxiliaries and O&M costs for advanced proposals

Generator	Thermal efficiency HHV (%) sent-out	Thermal efficiency HHV (GJ/MWh) sent-out	Auxiliaries (%)	Thermal efficiency HHV (%) as generated	Thermal efficiency HHV (GJ/MWh) as generated	FOM ($/MW/year) for 2009-10	VOM ($/MWh sent-out) for 2009-10
Mortlake 2	50.0%	7.20	3.0%	51.5%	6.98	31,000	1.05
Spring Gully	50.0%	7.20	2.4%	51.2%	7.03	31,000	1.05

Note: FOM and VOM costs are assumed to escalate at 2.5% per annum (i.e. 100% of the CPI assumption)

Data source: ACIL Tasman, various sources

3.3 Emission factors

Table 18 through to Table 23 provide the estimated emission factors and emission intensity for existing, committed and advanced proposals. Emission factors and emission intensities are provided on a carbon dioxide equivalent (CO_2-e) basis. As discussed in section 2.3.5, the emission intensity figures include fugitive emissions (emissions from the production and transport of fuel).

Table 18 **Emission factors and intensity for existing and committed NSW stations**

Generator	Combustion emission factor (kg CO2-e/GJ of fuel)	Fugitive emission factor (kg CO2-e/GJ of fuel)	Total emission factor (kg CO2-e/GJ of fuel)	Total emission intensity (tonnes CO2-e/MWh sent-out)	Total emission intensity (tonnes CO2-e/MWh generated)
Bayswater	90.2	8.7	98.9	0.99	0.93
Colongra	51.3	14.2	65.5	0.74	0.71
Eraring	89.5	8.7	98.2	1.00	0.93
Hunter Valley GT	69.7	5.3	75.0	0.96	0.94
Liddell	92.8	8.7	101.5	1.08	1.03
Mt Piper	87.4	8.7	96.1	0.94	0.89
Munmorah	90.3	8.7	99.0	1.16	1.07
Redbank	90.0	8.7	98.7	1.21	1.12
Smithfield	51.3	14.2	65.5	0.58	0.55
Tallawarra	51.3	14.2	65.5	0.47	0.46
Uranquinty	51.3	14.2	65.5	0.74	0.71
Vales Point B	89.8	8.7	98.5	1.00	0.96
Wallerawang C	87.4	8.7	96.1	1.05	0.97

Data source: ACIL Tasman, various sources

Table 19 **Emission factors and intensity for existing and committed QLD stations**

Generator	Combustion emission factor (kg CO2-e/GJ of fuel)	Fugitive emission factor (kg CO2-e/GJ of fuel)	Total emission factor (kg CO2-e/GJ of fuel)	Total emission intensity (tonnes CO2-e/MWh sent-out)	Total emission intensity (tonnes CO2-e/MWh generated)
Barcaldine	51.3	5.4	56.7	0.51	0.49
Braemar	51.3	5.4	56.7	0.68	0.66
Braemar 2	51.3	5.4	56.7	0.68	0.66
Callide B	93.0	2.0	95.0	0.95	0.88
Callide C	95.0	2.0	97.0	0.92	0.87
Collinsville	89.4	2.0	91.4	1.19	1.09
Condamine	51.3	2.0	53.3	0.40	0.39
Darling Downs	51.3	2.0	53.3	0.42	0.39
Gladstone	92.1	2.0	94.1	0.96	0.91
Kogan Creek	94.0	2.0	96.0	0.92	0.85
Mackay GT	69.7	5.3	75.0	0.96	0.94
Millmerran	92.0	2.0	94.0	0.90	0.86
Mt Stuart GT	69.7	5.3	75.0	0.90	0.87
Oakey	51.3	5.4	56.7	0.63	0.61
Roma GT	51.3	5.4	56.7	0.68	0.66
Stanwell	90.4	2.0	92.4	0.91	0.85
Swanbank B	90.4	2.0	92.4	1.09	1.00
Swanbank E	51.3	5.4	56.7	0.43	0.42
Tarong	92.1	2.0	94.1	0.94	0.86
Tarong North	92.1	2.0	94.1	0.86	0.82
Townsville	51.3	5.4	56.7	0.44	0.43
Yarwun	51.3	5.4	56.7	0.60	0.59

Data source: ACIL Tasman, various sources

Table 20 **Emission factors and intensity for existing and committed SA stations**

Generator	Combustion emission factor (kg CO2-e/GJ of fuel)	Fugitive emission factor (kg CO2-e/GJ of fuel)	Total emission factor (kg CO2-e/GJ of fuel)	Total emission intensity (tonnes CO2-e/MWh sent-out)	Total emission intensity (tonnes CO2-e/MWh generated)
Angaston	67.9	5.3	73.2	1.01	0.99
Dry Creek GT	51.3	18.6	69.9	0.97	0.94
Hallett	51.3	18.6	69.9	1.05	1.02
Ladbroke Grove	51.3	18.6	69.9	0.84	0.81
Mintaro GT	51.3	18.6	69.9	0.90	0.87
Northern	91.0	0.9	91.9	0.95	0.90
Osborne	51.3	18.6	69.9	0.60	0.57
Pelican Point	51.3	18.6	69.9	0.52	0.51
Playford B	91.0	0.9	91.9	1.51	1.39
Port Lincoln GT	67.9	5.3	73.2	1.01	0.93
Quarantine	51.3	18.6	69.9	0.79	0.75
Snuggery	67.9	5.3	73.2	1.01	0.98
Torrens Island A	51.3	18.6	69.9	0.91	0.87
Torrens Island B	51.3	18.6	69.9	0.84	0.80

Data source: ACIL Tasman, various sources

Table 21 **Emission factors and intensity for existing and committed TAS stations**

Generator	Combustion emission factor (kg CO2-e/GJ of fuel)	Fugitive emission factor (kg CO2-e/GJ of fuel)	Total emission factor (kg CO2-e/GJ of fuel)	Total emission intensity (tonnes CO2-e/MWh sent-out)	Total emission intensity (tonnes CO2-e/MWh generated)
Bell Bay	51.3	5.8	57.1	0.64	0.61
Bell Bay Three	51.3	5.8	57.1	0.71	0.69
Tamar Valley OCGT	51.3	5.8	57.1	0.71	0.69
Tamar Valley	51.3	5.8	57.1	0.43	0.42

Data source: ACIL Tasman, various sources

Table 22 **Emission factors and intensity for existing and committed VIC stations**

Generator	Combustion emission factor (kg CO2-e/GJ of fuel)	Fugitive emission factor (kg CO2-e/GJ of fuel)	Total emission factor (kg CO2-e/GJ of fuel)	Total emission intensity (tonnes CO2-e/MWh sent-out)	Total emission intensity (tonnes CO2-e/MWh generated)
Anglesea	91.0	0.3	91.3	1.21	1.09
Bairnsdale	51.3	5.8	57.1	0.60	0.59
Energy Brix	99.0	0.3	99.3	1.49	1.27
Hazelwood	93.0	0.3	93.3	1.53	1.37
Jeeralang A	51.3	5.8	57.1	0.90	0.87
Jeeralang B	51.3	5.8	57.1	0.90	0.87
Laverton North	51.3	5.8	57.1	0.68	0.66
Loy Yang A	91.5	0.3	91.8	1.22	1.11
Loy Yang B	91.5	0.3	91.8	1.24	1.15
Mortlake	51.3	5.8	57.1	0.64	0.62
Newport	51.3	5.8	57.1	0.62	0.59
Somerton	51.3	5.8	57.1	0.86	0.84
Valley Power	51.3	5.8	57.1	0.86	0.83
Yallourn	92.5	0.3	92.8	1.42	1.30

Data source: ACIL Tasman, various sources

Table 23 **Emission factors and intensity for advanced proposals**

Generator	Combustion emission factor (kg CO2-e/GJ of fuel)	Fugitive emission factor (kg CO2-e/GJ of fuel)	Total emission factor (kg CO2-e/GJ of fuel)	Total emission intensity (tonnes CO2-e/MWh sent-out)	Total emission intensity (tonnes CO2-e/MWh generated)
Mortlake 2	51.3	5.8	57.1	0.41	0.40
Spring Gully	51.3	1.0	52.3	0.38	0.37

Data source: ACIL Tasman, various sources

3.4 Fuel supply for existing generators

This section examines the fuel supply for existing generators for coal, gas and liquid fuelled plant.

3.4.1 Coal

Coal is currently the predominant fuel used in the NEM. In 2007-08, coal fired generation produced around 84% of the NEM scheduled electricity.

The coal supply arrangements vary from power to power station:

- in NSW the coal is all supplied under a variety of contractual arrangements with third party coal producers
- in Victoria the coal mine is usually integrated with the power station although there are exceptions where power Stations buy from a mine owned and operated by another party, usually another power station
- in South Australia the coal mine and rail infrastructure are owned and operated by the power station and rail haulage of coal is provided by a third party haulier.
- in Queensland there are both integrated coal mines using independent mining contractors and contractual arrangements with independent coal producers and transport providers.

The types of coal supply arrangements have a marked impact on the marginal cost of coal at individual power stations. Furthermore, the quality of coal and distance between the supplying mines and power stations can have a marked influence on coal costs/prices in terms of delivered energy costs.

Coals used in power generation in the NEM vary greatly in their characteristics including moisture, ash, volatile matter and energy content which affect the price of coal into power stations. Mining costs also are an important determinant in setting the coal price in some cases.

Given the high capital content in coal supply costs, contract prices have tended to escalate at less than inflation. ACIL Tasman is aware of escalation provisions varying from 70% to 100% of the consumer price index (CPI). For this study contract price escalation has been generally applied at 90% of CPI.

The marginal price/cost of coal is quoted in this report. In the case of coal supplied by independent or third parties, it is the contract (or average) price that is quoted as the marginal price. For the purpose of calculating the marginal coal price, the impact of take or pay provisions in supply contracts has been ignored. Where a power station is supplied by more than one contract then the price is taken as the weighted average of the contract prices. For coal supplied by an integrated mine, fixed costs are not included in the coal price, but rather incorporated into the fixed O&M estimate.

In arriving at the coal price projections for each power station (each generation portfolio in NSW) ACIL Tasman considered:

- existing contractual and other supply arrangements

- mine / power station ownership arrangements
- source and cost of new/replacement coal supply sources in the future taking into account:
  - nature and ownership of nearby coal reserves and mines
  - potential for development of new resources
  - future export prices
  - mining costs
  - transport costs.

Table 24 summarises the types of coal supply arrangements currently in place and the methodology used by ACIL Tasman in projecting coal prices for the various types of arrangements in place.

Table 24 **Method of projecting coal prices in the NEM**

Coal supply arrangement	Stations affected	Price setting mechanism
Existing NSW black coal - third party contracts	All existing stations in NSW	Existing contracts assumed to run full term at contracted prices with new contract prices at the greater of ROM mining costs and 80% of export parity price
New NSW black coal - captive mine	Any new stations in NSW	Prices set at the greater of ROM mining costs and 80% of the export parity price
Existing Qld Black coal - own mine	Tarong, Millmerran, Kogan Creek	Price set at marginal cost of production using an efficient mining contractor (currently less than $1.00/GJ)
Existing Qld Black coal - captive mine	Callide, Stanwell, Collinsville	Prices set at the greater of ROM mining costs and 80% of the export parity price
Existing Qld Black coal - third party contracts	Gladstone	Existing contracts assumed to run full term at contracted prices with new contract prices at the greater of ROM mining costs and 80% of export parity price
New Qld black coal - captive mine	Any new stations in Qld	Prices set at the greater of ROM mining costs and 80% of the export parity price
Vic brown coal - own mine	Loy Yang A, Hazelwood, Yallourn	Price set at marginal cost of production (currently less than $0.10/GJ)
Vic brown coal - third party mine	Energy Brix, Anglesea, Loy Yang B	Prices set to reflect efficient mining costs (currently less than $0.60/GJ)
New IGCC using coal from third party	Any new IGCC	Prices set to reflect efficient mining costs (currently less than $0.60/GJ)
SA black coal - own mine	Northern, Thomas Playford	Marginal price including cost mining, handling and railing coal 250km

The coal prices for new coal supply to existing or new NEM power stations are one of the following:

- ROM coal mining costs: where 80% of the export parity value of the ROM coal is less than the mining costs and the coal is delivered to a mine-mouth power station – this usually applies to deposits which are of relatively inferior quality and/or some distance from export terminals but are relatively close to major transmission links (Felton, New Acland, Ulan etc)
- ROM coal mining costs plus transport costs: to a power station site closer to transmission infrastructure where the 80% export parity value of the

ROM coal is again less than the mining costs but where the deposit is greater than 100km from the transmission system (Wandoan, Alpha, Pentland)

- 80% of the export parity value of the ROM coal: where it is greater than the ROM coal mining cost - this generally applies to deposits which are high quality coal and/or are generally closer to the export terminals (most Hunter Valley and Newcastle mines).

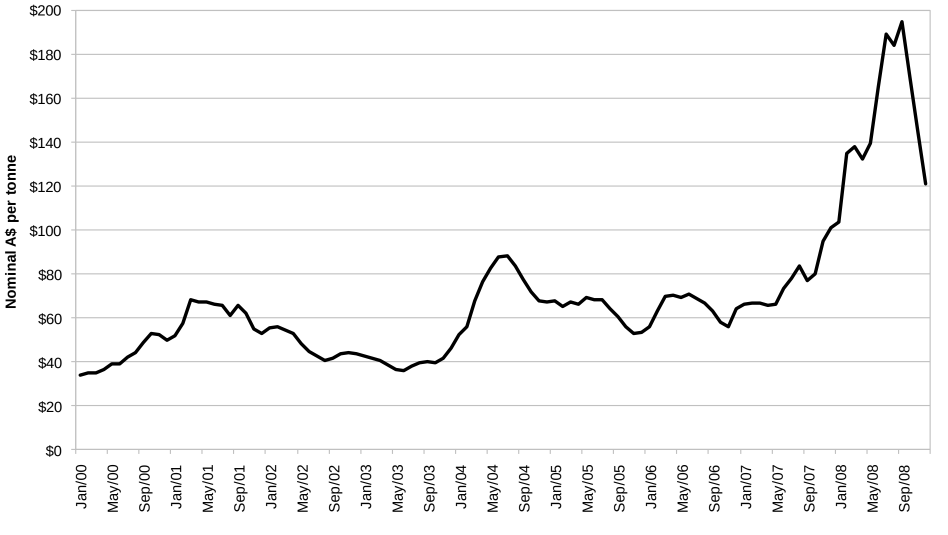
The delivered prices may switch from one price setting method to another as the export price is projected to fall in real terms to while mining costs are projected to remain constant in real terms.

Projected price for export thermal coal

The FOB price for thermal coal is an important consideration in the price formation for new coal contracts in Queensland and NSW. It is the projection of these prices which underlies the future export parity value of the ROM coal at each location which in most instances sets the delivered price into local power stations.

Thermal coal spot and contract prices peaked in 2008 but the ensuing economic turmoil caused the spot price to decline noticeably in the latter months of the year as seen in Figure 2. ACIL Tasman anticipates that the spot price will continue to abate in the coming years with subdued demand and as new mines are brought into production and export infrastructure bottle necks are eased.

Figure 2 **Historic spot prices for thermal coal export**



Data source: Australian Coal Report and Global Coal website

Projecting thermal coal export prices, particularly in the current volatile world economic environment is necessarily subject to a great deal of uncertainty. The future price trend is dependent on many factors including *inter alia*:

- demand and supply balance in the coal market
- world economic growth
- cost of coal of production
- price and availability of substitutes such as oil and gas
- technology changes in coal usage
- environmental policies potentially affecting coal usage
- increasing low cost production, including that from Australia, China and Indonesia.

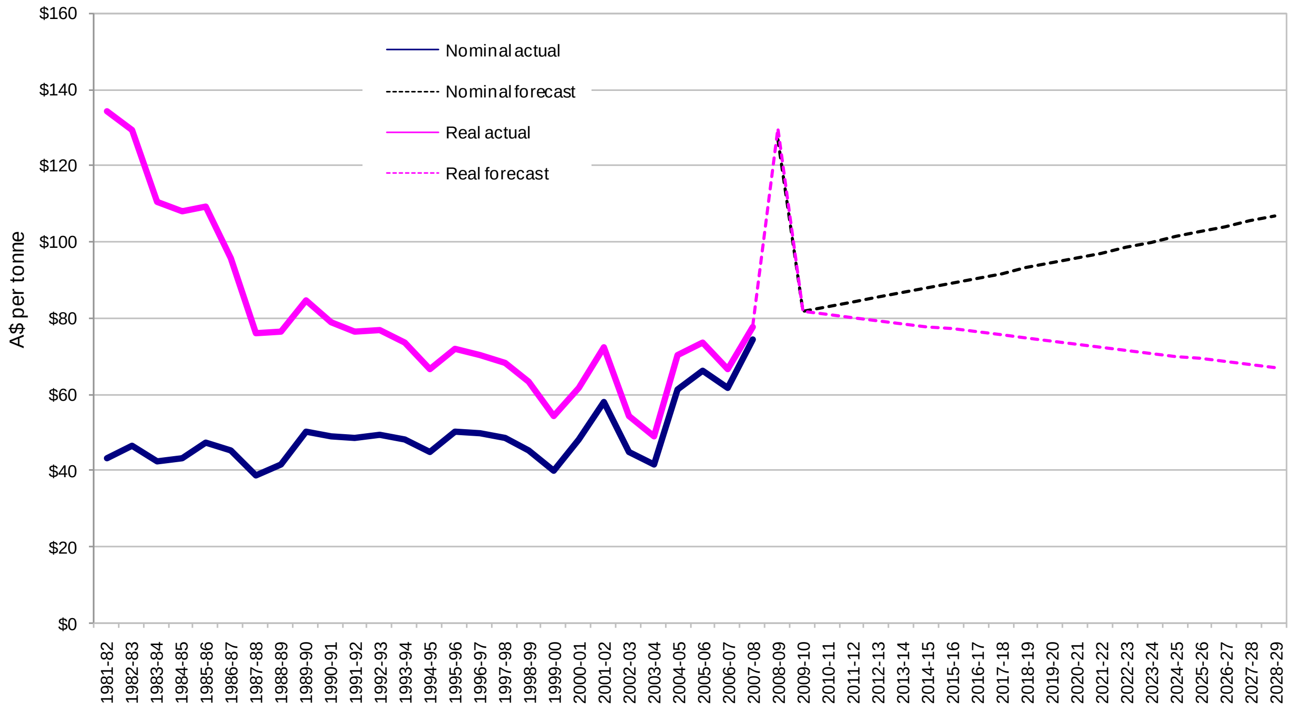
ACIL Tasman expects that the past trends of gradually declining real A$ coal prices are likely to continue. However a combination of current very high prices, recent falls in the Australian dollar, the time required to bring on new production, and ease of infrastructure bottlenecks imply that coal prices are expected to remain strong for one to two years. In the longer term as supply and demand move towards balance, ACIL Tasman projects that thermal coal export prices will return to a trend of real price reduction. This real reduction in export coal prices is likely to be reinforced by the widespread introduction of limits on CO_2-e production through among other things emissions trading, in which coal is disadvantaged against other fuel options including gas and renewable sources.

In summary, an ongoing gradual decline in real coal prices can be expected on the basis of:

- ongoing real reduction in production costs due to:
  - continued technological improvements
  - improving economies of scale
  - ongoing development of new lower cost developments
- subdued growth in demand for thermal coal because of:
  - increased use of alternative fuels including renewable
  - reducing energy intensity in industry due to innovation and more efficient use of material inputs
  - technology developments in coal usage
  - electricity demand management
  - the widespread introduction of emissions trading.

The ACIL Tasman projection of export thermal coal prices in nominal and real A$ is shown in Figure 3.

Figure 3 **Forecast of average annual export thermal coal prices (A$/tonne FOB)**



Note: Real prices are expressed in 2009-10 dollars
Data source: ACIL Tasman analysis

Coal prices into existing NSW power stations

In NSW all coal is supplied to the power stations by independently owned coal mines under a variety of contractual arrangements with varying terms, prices and transport arrangements. These contracts vary from relatively short term (1 to 2 years) to very long term (20 years or more). Generally these contracts were written before the surge in export coal prices from early 2004 and carry contract prices which are generally well below the export parity value being experienced in today's export market.

New tonnage however will need to be sourced in a setting of higher export coal prices. There are a number of strategies which local power stations will employ to keep prices of new tonnage lower than export parity price and these include:

- gaining access to undeveloped resources and employing a contract miner to produce the coal. (there are many unallocated resources available in NSW for this purpose)
- offering firm contracts to potential new developments in order to achieve discounted prices by lowering the market and infrastructure risks associated new developments

- entering into long term contractual arrangements with mines aimed at achieving cost related pricing
- offering to take non-exportable high ash coal, oxidised coal and washery rejects and middlings.

We expect these purchase strategies to result in reductions of around 20% on the export parity price of coal at most locations. The resultant price forecasts for the NSW portfolios are shown Table 25. The power stations in each of the generation portfolios shown in Table 25 are as follows:

- Macquarie Generation (Bayswater and Liddell)
- Eraring Energy (Eraring)
- Delta Coastal (Vales Point and Munmorah)
- Delta western (Mt Piper and Wallerawang)
- Redbank (Redbank).

Table 25 **Projected marginal coal prices into NSW stations ($/GJ)**

	Macquarie Generation	Eraring Energy	Delta Coastal	Delta Western	Redbank
2009-10	1.29	1.72	1.75	1.80	1.01
2010-11	1.24	1.71	1.73	1.78	1.01
2011-12	1.22	1.71	1.72	1.76	1.01
2012-13	1.31	1.70	1.71	1.75	1.00
2013-14	1.31	1.68	1.69	1.67	1.00
2014-15	1.30	1.73	1.68	1.39	1.00
2015-16	1.29	1.71	1.67	1.37	1.00
2016-17	1.29	1.70	1.65	1.35	0.99
2017-18	1.28	1.71	1.64	1.33	0.99
2018-19	1.27	1.69	1.63	1.31	0.99
2019-20	1.27	1.67	1.61	1.29	0.99
2020-21	1.26	1.65	1.65	1.27	0.98
2021-22	1.28	1.63	1.63	1.25	0.98
2022-23	1.31	1.61	1.61	1.24	0.98
2023-24	1.30	1.58	1.58	1.22	0.98
2024-25	1.28	1.56	1.56	1.20	0.97
2025-26	1.27	1.54	1.54	1.18	0.97
2026-27	1.41	1.52	1.52	1.16	0.97
2027-28	1.39	1.50	1.50	1.15	0.97
2028-29	1.37	1.48	1.48	1.13	0.96

Note: Real 2009-10 dollars per GJ

Data source: ACIL Tasman

Coal prices into existing VIC and SA power stations

Victorian brown coal

Extensive deposits of brown coal occur in the tertiary sedimentary basins of Latrobe Valley coalfield which contains some of the thickest brown coal seams in the world. The coal is up to 330 m thick and is made up of 4 main seams, separated by thin sand and clay beds. The total brown coal resource in the Latrobe Valley is estimated to be 394,000 million tonnes, with an estimated useable brown coal reserve of 50,000 million tonnes.

Anglesea's brown coal reserves are estimated at around 120 million tonnes. Average coal thickness is 27 metres. The coal is a high quality brown coal, with a heat value of just over 15 MJ/kg.

Mine mouth dedicated coalmines supply all the power stations. The coalmines are owned by the same entities that own the power stations with two exceptions. The exceptions are: the Loy Yang B power station supplied by the adjacent Loy Yang Mine owned and operated by Loy Yang Power (owners and operators of the Loy Yang A power station); and Energy Brix which is supplied by the Morwell mine (owned and operated by International Power – Hazelwood).

The marginal price of coal for the Victorian power stations is generally taken as the incremental cash costs of mining each increment of coal. Table 26 details the estimated total and variable costs for coal at each power station. The variable costs for coal are based on the cost of electricity required to produce the marginal tonne and the royalty charges.

Table 26 **Estimated coal costs for Victorian generators in 2009-10**

Power Station / Mine	Total Cash Cost ($/tonne)	Variable Cost ($/tonne)	Energy Content (GJ/tonne)	Variable Cost ($/GJ)
Yallourn/Yallourn	3.24	0.62	6.8	0.10
Loy Yang A - directly from Loy Yang mine	3.00	0.65	8.2	0.08
Loy Yang B - purchased from Loy Yang mine	3.00	3.00	8.2	0.37
Hazelwood/Morwell	4.19	0.60	7.0	0.08
Anglesea/Anglesea	5.99	5.99	15.0	0.40
Energy Brix – purchased from Morwell	4.19	4.19	7.0	0.60

Data source: ACIL Tasman estimates

The variable cost of coal as calculated in Table 26 is used to calculate the marginal cost for each Victorian Power station operating in the NEM. In the cases where the coal mine is owned by the power station (Yallourn, Hazelwood and Loy Yang A) the short run marginal costs mainly consists of the additional electricity and royalty costs involved in mining the marginal tonne of coal. For Anglesea the marginal cost of coal is taken to be the cost of extraction using trucks and shovels. The marginal price of coal for the two stations that purchase coal from nearby mines (Loy Yang B and Energy Brix) is taken to be the estimated cost per unit of production.

South Australian black coal

The only currently producing coalfield in South Australia is near Leigh Creek based on low-grade sub-bituminous black coal. The mining operation involves drilling, blasting and removal of overburden and coal by shovels and trucks. After mining, the crushed coal is railed to the Port Augusta power stations. Due to the steeply dipping seams, it is likely that economic recovery of coal will be limited to between 70 and 100 Mt at depths of 150–200 m.

The Leigh Creek mine is about 250 km from the Northern power station. A long-term freight contract is in place with Pacific National. The delivered cost of coal is estimated at $1.40/GJ. The marginal cost of coal in South Australia is taken as the average cash costs of production and transport. The life of the Leigh Creek mine is constantly under review and will depend on the cost of mining and transport.

Coal price projection in Vic and SA

The projection for the next ten years is shown in Table 27. It has been assumed that these costs would increase at about CPI so the real variable cost over 20 year period of this study is the same as 2009-10 cost.

Table 27 **Projection of marginal cost of coal into VIC and SA power stations ($/GJ)**

	Victoria						South Australia [a]	
	Yallourn	Loy Yang A	Loy Yang B	Hazelwood	Anglesea	Energy Brix	Northern	Thomas Playford
2009-10	0.10	0.08	0.37	0.08	0.40	0.60	1.52	1.52
2010-11	0.10	0.08	0.37	0.08	0.40	0.60	1.52	1.52
2011-12	0.10	0.08	0.37	0.08	0.40	0.60	1.52	1.52
2012-13	0.10	0.08	0.37	0.08	0.40	0.60	1.52	1.52
2013-14	0.10	0.08	0.37	0.08	0.40	0.60	1.52	1.52
2014-15	0.10	0.08	0.37	0.08	0.40	0.60	1.52	1.52
2015-16	0.10	0.08	0.37	0.08	0.40	0.60	1.52	1.52
2016-17	0.10	0.08	0.37	0.08	0.40	0.60	1.52	1.52
2017-18	0.10	0.08	0.37	0.08	0.40	0.60	1.52	1.52
2018-19	0.10	0.08	0.37	0.08	0.40	0.60	1.52	1.52
2019-20	0.10	0.08	0.37	0.08	0.40	0.60	1.52	1.52
2020-21	0.10	0.08	0.37	0.08	0.40	0.60	1.52	1.52
2021-22	0.10	0.08	0.37	0.08	0.40	0.60	1.52	1.52
2022-23	0.10	0.08	0.37	0.08	0.40	0.60	1.52	1.52
2023-24	0.10	0.08	0.37	0.08	0.40	0.60	1.52	1.52
2024-25	0.10	0.08	0.37	0.08	0.40	0.60	1.52	1.52
2025-26	0.10	0.08	0.37	0.08	0.40	0.60	1.52	1.52
2026-27	0.10	0.08	0.37	0.08	0.40	0.60	1.52	1.52
2027-28	0.10	0.08	0.37	0.08	0.40	0.60	1.52	1.52
2028-29	0.10	0.08	0.37	0.08	0.40	0.60	1.52	1.52

a There is considerable uncertainty over the life of the Leigh Creek mine beyond around 2017. Prices have been projected beyond 2017 on the basis of a continuation of the existing mining regime for the purposes of modelling. The point at which the mine operation ceases is a decision for the modelling case in question

Note: Real 2009-10 dollars per GJ

Data source: ACIL Tasman estimates

Coal prices into existing QLD power stations

In Qld there are four types of coal supply arrangement:

- mine mouth - own mine: Tarong, Kogan Creek, Millmerran
- mine mouth - captive independent mine: Callide B, Callide Power, Collinsville
- transported from captive independent mine: Stanwell
- transported from independent mine: Gladstone, Swanbank B.

Power stations in Queensland relying on their own mine mouth coal supply are least likely to be affected by the high export prices and it has been assumed that they will offer marginal fuel costs into the market which are currently less than A$1.00/GJ. However they will be affected by mining costs which have increased rapidly in recent years in response to strong demand and high oil and tyre prices.

Power stations with an independently owned/operated mine mouth operation are likely to be under pressure to accept higher prices more in line with export parity particularly with price reviews and contract renewal. However we understand that the existing contractual arrangements for the larger Callide power stations have around two decades to run.

In 2004 Stanwell entered a 16 year arrangement with the Curragh mine which is not linked to export prices. We expect that Stanwell will be actively seeking advantageous alternative arrangements when these current arrangements expire.

Gladstone and Swanbank which rely on transported coal from third party mines are at greatest risk of pass through of export prices. However Gladstone has a long term arrangement with Rolleston to take lower quality coal. Swanbank is likely to continue on similar arrangements beyond the current three year contract as the export infrastructure in the Brisbane region is at capacity with limited prospect for an increase in the medium term.

Table 28 **Projection of marginal cost of coal into QLD power stations ($/GJ)**

	Gladstone	Stanwell	Tarong	Swanbank B	Callide B & C	Collinsville	Millmerran	Kogan Creek
2009-10	1.56	1.40	1.01	2.20	1.32	2.10	0.85	0.75
2010-11	1.56	1.39	1.00	2.19	1.32	2.09	0.85	0.75
2011-12	1.56	1.39	1.00	2.18	1.31	2.09	0.85	0.75
2012-13	1.55	1.39	1.00	2.18	1.31	2.08	0.84	0.74
2013-14	1.55	1.38	1.00	2.17	1.31	2.08	0.84	0.74
2014-15	1.55	1.38	0.99	2.17	1.30	2.07	0.84	0.74
2015-16	1.54	1.38	0.99	2.16	1.30	2.07	0.84	0.74
2016-17	1.54	1.37	0.99	2.16	1.30	2.06	0.84	0.74
2017-18	1.53	1.37	0.99	2.15	1.29	2.06	0.83	0.74
2018-19	1.53	1.37	0.98	2.15	1.29	2.05	0.83	0.73
2019-20	1.53	1.36	0.98	2.14	1.29	2.05	0.83	0.73
2020-21	1.52	1.36	0.98	2.14	1.28	2.04	0.83	0.73
2021-22	1.52	1.36	0.98	2.13	1.28	2.04	0.83	0.73
2022-23	1.52	1.35	0.97	2.13	1.28	2.03	0.82	0.73
2023-24	1.51	1.35	0.97	2.12	1.27	2.03	0.82	0.72
2024-25	1.51	1.35	0.97	2.12	1.27	2.02	0.82	0.72
2025-26	1.50	1.34	0.97	2.11	1.27	2.02	0.82	0.72
2026-27	1.50	1.34	0.97	2.11	1.27	2.01	0.82	0.72
2027-28	1.50	1.34	0.96	2.10	1.26	2.01	0.81	0.72
2028-29	1.49	1.33	0.96	2.10	1.26	2.00	0.81	0.72

Note: Real 2009-10 dollars per GJ. Assumes long-term contracts contain price escalation of around 90% of CPI.

Data source: ACIL Tasman estimates

3.4.2 Natural gas

Gas market prices are not directly observable, as no formal market structure exists outside the Victorian system.[8] Supply and transportation contracts for existing gas-fired plant are generally held under long-term bilateral take-or-pay agreements with gas suppliers or aggregators/intermediaries. The prices paid for gas and transportation under these contracts are commercially sensitive and therefore not publicly available.

Through examination of related data, industry knowledge and experience ACIL Tasman has been able to estimate the gas costs to existing plant in the NEM.

The characteristics of gas supply including price for CCGT are dependent upon a number of factors including:

- gas demand and supply balance and production costs
- pipeline capacity and cost of increasing capacity

[8] Even the Victorian gas market, which is run by VENCorp, represents only a small proportion of the total gas consumed each year in the state.

- physical plant location relative to gas supply sources and transmission infrastructure
- supply availability, pipeline transmission capacity and tariffs, availability of linepack, pipeline overrun charges
- expected plant capacity factors.

This section details the estimated fuel costs for existing and committed generators which utilise natural gas as the primary fuel source. As discussed in section 2.3.1, the prices to each station represent the estimated *average* contract price. It therefore includes fixed components such as capacity reservations and take-or-pay commitments, which at times, may not be strictly applicable in the calculation of SRMC for bidding purposes.

Estimates have been made for stations which have existing gas supply agreements in place, with these assumed to rollover to market-based rates upon expiry. In most cases the transmission pipeline charges applied refer to the quoted reference tariffs (where available) – even when gas transport costs are internalised (ie the power station owner also owns the gas transmission pipeline servicing the station).

The gas commodity price for peaking stations has generally been estimated to be at a premium over the projected price for CCGT stations. Exceptions have been made for peaking stations which are operated by entities which can incorporate swing volumes within a gas supply portfolio or stations which are able to utilise the Victorian spot market.

Table 29 provides the estimated delivered gas price to each existing and committed NEM station in real terms for the period 2009–10 through to 2028–29. As existing contracts expire it is assumed that the price to each station is the same as that available to new entrants (discussed in section 4.2.1).

Table 29 **Estimated delivered gas costs to existing, committed and advanced proposals (Real $/GJ)**

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
Queensland																				
Barcaldine	6.67	6.64	6.62	6.60	6.58	8.27	8.28	8.30	8.67	8.70	8.75	8.74	8.79	8.81	8.83	8.84	8.86	8.93	9.10	9.11
Braemar	2.67	2.67	2.67	2.67	2.67	2.67	2.67	3.33	4.14	4.17	4.20	4.21	4.35	4.86	4.93	4.95	4.98	5.04	5.19	5.21
Braemar 2	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89
Condamine	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Darling Downs	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41
Oakey	4.24	4.23	4.22	4.21	4.20	6.02	6.05	6.08	6.46	6.51	6.57	6.57	6.64	6.67	6.70	6.72	6.76	6.84	7.02	7.05
Swanbank E	3.53	3.43	3.44	3.44	3.44	3.45	4.21	4.23	4.24	4.26	4.27	4.54	4.81	4.83	4.85	4.86	4.89	4.92	4.95	4.97
Roma	4.70	4.69	4.20	4.22	4.38	4.39	4.41	4.44	4.74	4.78	4.83	4.83	4.88	4.91	4.93	4.95	4.98	5.04	5.19	5.21
Townsville	4.05	4.04	4.03	4.02	4.02	4.01	4.00	3.99	3.98	3.97	5.59	5.60	5.63	5.64	5.64	5.66	5.71	5.71	5.90	5.90
Yarwun	3.55	3.57	3.55	3.53	3.52	3.50	3.52	3.50	3.49	3.47	3.45	3.47	3.45	3.44	3.42	3.41	3.42	3.41	3.39	3.38
New South Wales																				
Colongra	7.42	7.09	7.05	7.02	7.03	7.05	7.07	7.08	7.16	7.26	7.37	7.37	7.44	7.49	7.60	7.83	7.88	8.01	8.16	8.41
Smithfield	4.19	4.18	4.18	4.17	4.16	4.16	5.61	5.64	5.74	5.94	6.02	6.02	6.01	6.20	6.21	6.41	6.48	6.61	6.94	7.15
Tallawarra	3.80	3.80	3.79	3.79	3.78	3.78	3.77	3.77	3.76	3.76	3.75	3.75	6.01	6.20	6.21	6.41	6.48	6.61	6.94	7.15
Uranquinty	6.22	6.28	6.32	6.29	6.30	6.32	6.33	6.34	6.40	6.49	6.59	6.58	6.64	6.68	6.77	6.97	7.02	7.12	7.25	7.47
Victoria																				
Bairnsdale	4.29	4.29	4.29	4.29	4.89	4.91	5.22	5.25	5.35	5.55	5.64	5.63	5.63	5.82	5.83	6.04	6.11	6.24	6.57	6.78
Jeeralang	3.88	3.88	3.88	4.46	4.49	4.51	4.82	4.85	4.95	5.16	5.24	5.24	5.24	5.43	5.45	5.66	5.73	5.87	6.20	6.41
Laverton North	4.11	4.11	4.10	4.69	4.71	4.73	5.04	5.07	5.17	5.38	5.46	5.46	5.46	5.65	5.67	5.87	5.95	6.08	6.41	6.62
Mortlake OCGT	5.00	5.00	5.02	5.05	5.34	5.36	5.67	5.70	5.80	6.01	6.10	6.10	6.10	6.29	6.31	6.52	6.59	6.72	7.02	7.09
Newport	4.08	4.08	4.08	4.66	4.68	4.71	5.01	5.04	5.14	5.35	5.44	5.43	5.43	5.62	5.64	5.85	5.92	6.05	6.38	6.59
Somerton	4.12	4.11	4.11	4.70	4.72	4.74	5.05	5.08	5.18	5.38	5.47	5.47	5.47	5.66	5.67	5.88	5.95	6.09	6.42	6.63
Valley Power	3.87	3.87	3.87	4.46	4.48	4.50	4.81	4.84	4.94	5.15	5.24	5.24	5.24	5.43	5.45	5.65	5.73	5.86	6.19	6.40
South Australia																				
Torrens Island	4.04	4.03	4.02	4.01	4.01	4.00	3.99	3.98	6.19	6.39	6.47	6.47	6.46	6.65	6.66	6.86	6.93	7.06	7.35	7.41
Pelican Point	3.98	3.97	3.96	3.95	5.75	5.77	6.07	6.09	6.19	6.39	6.47	6.47	6.46	6.65	6.66	6.86	6.93	7.06	7.35	7.41
Ladbroke Grove	5.05	5.04	5.06	5.09	5.37	5.39	5.70	5.73	5.83	6.03	6.11	6.11	6.11	6.30	6.31	6.52	6.59	6.72	7.01	7.08
Osborne	4.14	4.13	4.12	4.11	4.10	5.77	6.07	6.09	6.19	6.39	6.47	6.47	6.46	6.65	6.66	6.86	6.93	7.06	7.35	7.41
Quarantine	5.98	5.97	5.99	6.02	6.33	6.34	6.68	6.70	6.81	7.03	7.12	7.11	7.11	7.31	7.33	7.55	7.62	7.77	8.08	8.16
Mintaro	6.61	6.61	6.63	6.67	7.02	7.05	7.43	7.46	7.59	7.84	7.95	7.95	7.94	8.18	8.20	8.46	8.55	8.71	9.08	9.16
Dry Creek	4.72	4.71	4.69	4.68	7.19	7.21	7.59	7.62	7.74	7.99	8.09	8.08	8.08	8.31	8.33	8.58	8.66	8.83	9.18	9.27
Hallett	6.61	6.61	6.63	6.67	7.02	7.05	7.43	7.46	7.59	7.84	7.95	7.95	7.94	8.18	8.20	8.46	8.55	8.71	9.08	9.16
Tasmania																				
Bell Bay	5.52	5.52	5.54	5.56	5.58	5.61	5.91	5.94	6.05	6.25	6.34	6.34	6.34	6.53	6.55	6.76	6.83	6.97	7.30	7.51
Bell Bay Three	5.52	5.52	5.54	5.56	5.58	5.61	5.91	5.94	6.05	6.25	6.34	6.34	6.34	6.53	6.55	6.76	6.83	6.97	7.30	7.51
Tamar Valley OCGT	5.52	5.52	5.54	5.56	5.58	5.61	5.91	5.94	6.05	6.25	6.34	6.34	6.34	6.53	6.55	6.76	6.83	6.97	7.30	7.51
Tamar Valley	5.52	5.52	5.54	5.56	5.58	5.61	5.91	5.94	6.05	6.25	6.34	6.34	6.34	6.53	6.55	6.76	6.83	6.97	7.30	7.51
Advanced Proposals																				
Mortlake 2	4.58	4.58	4.60	4.63	4.92	4.94	5.25	5.28	5.38	5.59	5.68	5.68	5.68	5.87	5.89	6.10	6.17	6.30	6.60	6.67
Spring Gully	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80

Note: Real 2009-10 dollars

Data source: ACIL Tasman estimates

3.4.3 Liquid fuel

Liquid fuels, usually in the form of distillate, kerosene or fuel oil, are commonly stored onsite at gas-fired peaking stations as a backup fuel when gas supply or pipeline capacity is not available.[9] However, a number of NEM scheduled plant utilise liquid fuels as their primary fuel source. As outlined in section 3.1, these stations are:

- Hunter Valley GT (NSW)
- Mackay GT (QLD)
- Mt Stuart (QLD)
- Angaston (SA)
- Port Lincoln (SA)
- Snuggery (SA).

The very high cost of liquid fuels compared with coal or gas means that liquids are rarely used as fuel for generation in the NEM. Aggregate liquid fuel consumption by NEM scheduled plant is generally less than 0.5 PJ/a.

We have assumed a $30/GJ price for petroleum products (constant in real terms) for each of the stations above which is reasonably consistent with the assumed international oil price of US$80/bbl in the long-term (roughly $1.20/litre of product).[10] This cost would include transport costs and storage on-site.

3.5 Government schemes

There are currently two government schemes that explicitly impact the SRMC of certain generators and therefore the way these generators offer energy into the NEM, namely the Queensland 13% Gas Scheme[11] (part of the Queensland Clean Energy Policy) which is based on creation and surrender of Gas Electricity Certificates (GECs) and the NSW Greenhouse Abatement Scheme which is based on creation and surrender of NSW Greenhouse Gas Abatement Certificates (NGACs).

With the introduction of the CPRS anticipated for 1 July 2010, ACIL Tasman expects that both of these schemes will cease operation and transition into the CPRS. The transition to CPRS may or may not involve some form of

[9] Oil is also used in coal fired generators for start-up but this is a relatively small amount.

[10] Energy content of liquid fuels (such as distillate, kerosene and fuel oil) typically ranges from 0.035 GJ/litre to 0.045 GJ/litre.

[11] Queensland Government announced the intention of increasing the amount of required gas-fired generation from 13% to 18% by 2020.

compensation paid to recipients of these schemes if the benefits of CPRS are less than the State-based schemes.

Therefore within NEMMCO's modelling, prices for GEC and NGACs will only be an influence for the first year (2009-10). ACIL Tasman has allowed for a GEC benefit of $9.30/MWh for eligible gas-fired plant in Queensland and an NGAC benefit of $4.90/MWh for eligible plant for 2009-10 only.

3.6 SRMC

The following tables detail the calculated SRMC values for each of the existing, committed and advanced proposals. Table 30 provides SRMCs on an 'as generated basis' exclusive of carbon costs while Table 31 provides the SRMCs on a generated basis including carbon costs.

Table 30 **SRMC of existing, committed and advanced proposals excluding carbon costs ($/MWh generated)**

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
NSW																				
Bayswater	13.25	12.78	12.65	13.48	13.46	13.38	13.30	13.28	13.19	13.11	13.05	12.97	13.15	13.44	13.34	13.23	13.13	14.43	14.25	14.06
Colongra	90.77	87.19	86.70	86.36	86.56	86.78	86.97	87.10	87.93	89.03	90.27	90.26	91.04	91.49	92.69	95.24	95.84	97.21	98.82	101.59
Eraring	17.50	17.42	17.35	17.25	17.13	17.57	17.41	17.24	17.38	17.18	16.98	16.78	16.58	16.38	16.18	15.98	15.79	15.59	15.40	15.21
Hunter Valley GT	383.47	383.47	383.47	383.47	383.47	383.47	383.47	383.47	383.47	383.47	383.47	383.47	383.47	383.47	383.47	383.47	383.47	383.47	383.47	383.47
Liddell	14.15	13.65	13.51	14.40	14.38	14.29	14.21	14.18	14.09	14.00	13.94	13.86	14.05	14.36	14.24	14.13	14.03	15.42	15.22	15.02
Mt Piper	17.87	17.70	17.57	17.45	16.73	14.07	13.89	13.72	13.54	13.37	13.20	13.03	12.86	12.69	12.52	12.35	12.19	12.02	11.86	11.69
Munmorah	20.04	19.87	19.77	19.60	19.42	19.29	19.16	19.02	18.87	18.73	18.58	18.95	18.72	18.50	18.27	18.05	17.82	17.60	17.38	17.16
Redbank	12.51	12.49	12.46	12.43	12.40	12.37	12.35	12.32	12.29	12.27	12.24	12.21	12.18	12.16	12.13	12.10	12.08	12.05	12.02	12.00
Smithfield	37.22	37.16	37.11	37.05	37.00	36.94	49.10	49.31	50.12	51.81	52.50	52.46	52.41	53.97	54.08	55.78	56.34	57.44	60.13	61.88
Tallawarra	27.58	27.54	27.51	27.47	27.44	27.40	27.37	27.34	27.30	27.27	27.24	27.20	43.00	44.30	44.39	45.82	46.28	47.21	49.46	50.92
Uranquinty	77.64	78.32	78.73	78.41	78.56	78.73	78.85	78.93	79.67	80.61	81.67	81.61	82.27	82.64	83.67	85.87	86.35	87.53	88.92	91.32
Vales Point B	18.09	17.94	17.85	17.70	17.54	17.42	17.30	17.18	17.04	16.92	16.79	17.12	16.91	16.71	16.51	16.31	16.11	15.91	15.71	15.51
Wallerawang C	19.34	19.16	19.02	18.89	18.11	15.20	15.01	14.82	14.63	14.44	14.25	14.07	13.88	13.70	13.51	13.33	13.15	12.97	12.79	12.61
QLD																				
Barcaldine	60.53	60.33	60.13	59.93	59.73	74.50	74.60	74.79	77.99	78.26	78.70	78.62	79.07	79.27	79.37	79.49	79.70	80.25	81.72	81.88
Braemar	38.98	38.96	38.96	38.95	38.95	38.95	38.94	46.64	56.22	56.51	56.93	56.95	58.62	64.56	65.45	65.69	66.04	66.75	68.45	68.73
Braemar 2	41.53	41.53	41.53	41.53	41.53	41.53	41.53	41.53	41.53	41.53	41.53	41.53	41.53	41.53	41.53	41.53	41.53	41.53	41.53	41.53
Callide B	13.35	13.32	13.29	13.26	13.23	13.20	13.17	13.14	13.11	13.08	13.06	13.03	13.00	12.97	12.94	12.91	12.88	12.85	12.82	12.80
Callide C	13.04	13.01	12.98	12.95	12.92	12.90	12.87	12.84	12.81	12.78	12.75	12.72	12.70	12.67	12.64	12.61	12.58	12.56	12.53	12.50
Collinsville	26.33	26.27	26.21	26.14	26.08	26.02	25.96	25.90	25.84	25.78	25.72	25.66	25.60	25.54	25.48	25.42	25.37	25.31	25.25	25.19
Condamine	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90
Darling Downs	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11
Gladstone	16.34	16.30	16.26	16.22	16.19	16.15	16.11	16.08	16.04	16.00	15.97	15.93	15.90	15.86	15.82	15.79	15.75	15.72	15.68	15.65
Kogan Creek	7.77	7.76	7.74	7.72	7.71	7.69	7.68	7.66	7.64	7.63	7.61	7.60	7.58	7.56	7.55	7.53	7.52	7.50	7.49	7.47
Mackay GT	382.92	382.92	382.92	382.92	382.92	382.92	382.92	382.92	382.92	382.92	382.92	382.92	382.92	382.92	382.92	382.92	382.92	382.92	382.92	382.92
Millmerran	8.93	8.91	8.89	8.87	8.86	8.84	8.82	8.80	8.78	8.76	8.74	8.72	8.71	8.69	8.67	8.65	8.63	8.61	8.60	8.58
Mt Stuart GT	357.98	357.98	357.98	357.98	357.98	357.98	357.98	357.98	357.98	357.98	357.98	357.98	357.98	357.98	357.98	357.98	357.98	357.98	357.98	357.98
Oakey	54.74	54.60	54.50	54.41	54.31	73.81	74.09	74.46	78.53	79.01	79.69	79.73	80.43	80.81	81.08	81.36	81.76	82.57	84.51	84.83
Roma GT	64.00	63.96	58.23	58.50	60.31	60.43	60.67	61.00	64.53	64.95	65.55	65.58	66.19	66.52	66.75	67.00	67.34	68.05	69.74	70.02
Stanwell	13.96	13.93	13.90	13.87	13.83	13.80	13.77	13.74	13.71	13.68	13.65	13.62	13.59	13.56	13.53	13.50	13.47	13.44	13.41	13.38
Swanbank B	24.94	24.88	24.82	24.76	24.71	24.65	24.59	24.53	24.48	24.42	24.36	24.31	24.25	24.19	24.14	24.08	24.02	23.97	23.91	23.86
Swanbank E	27.23	26.51	26.54	26.57	26.60	26.63	32.32	32.42	32.52	32.63	32.73	34.72	36.72	36.88	37.05	37.16	37.36	37.55	37.77	37.97
Tarong	10.52	10.50	10.48	10.46	10.43	10.41	10.39	10.37	10.35	10.32	10.30	10.28	10.26	10.24	10.21	10.19	10.17	10.15	10.13	10.11

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
Tarong North	10.14	10.12	10.10	10.08	10.05	10.03	10.01	9.99	9.97	9.95	9.93	9.91	9.89	9.87	9.84	9.82	9.80	9.78	9.76	9.74
Townsville	35.68	35.61	35.55	35.49	35.42	35.36	35.29	35.23	35.17	35.11	47.40	47.48	47.69	47.73	47.71	47.92	48.26	48.27	49.69	49.70
Yarwun	36.80	37.03	36.84	36.66	36.49	36.31	36.50	36.33	36.16	36.00	35.84	36.00	35.84	35.68	35.53	35.38	35.52	35.37	35.22	35.08
SA																				
Angaston	414.37	414.37	414.37	414.37	414.37	414.37	414.37	414.37	414.37	414.37	414.37	414.37	414.37	414.37	414.37	414.37	414.37	414.37	414.37	414.37
Dry Creek GT	72.67	72.52	72.38	72.24	105.86	106.16	111.21	111.63	113.25	116.63	118.01	117.91	117.81	120.95	121.14	124.56	125.66	127.88	132.68	133.79
Hallett	106.07	105.98	106.34	106.90	112.08	112.46	118.02	118.54	120.37	124.10	125.66	125.62	125.57	129.04	129.31	133.09	134.35	136.82	142.10	143.37
Ladbroke Grove	62.22	62.16	62.39	62.74	66.03	66.27	69.81	70.13	71.30	73.67	74.67	74.64	74.60	76.81	76.98	79.38	80.18	81.75	85.11	85.91
Mintaro GT	91.78	91.71	92.01	92.49	96.90	97.23	101.97	102.41	103.98	107.16	108.49	108.45	108.41	111.37	111.60	114.83	115.90	118.01	122.51	123.59
Northern	16.06	16.06	16.06	16.06	16.06	16.06	16.06	16.06	16.06	16.06	16.06	16.06	16.06	16.06	16.06	16.06	16.06	16.06	16.06	16.06
Osborne	38.52	38.44	38.36	38.29	38.21	51.80	54.25	54.45	55.24	56.88	57.55	57.50	57.45	58.97	59.07	60.73	61.26	62.34	64.66	65.20
Pelican Point	30.26	30.20	30.13	30.07	43.29	43.42	45.63	45.82	46.53	48.01	48.61	48.57	48.52	49.90	49.98	51.48	51.96	52.93	55.03	55.52
Playford B	25.80	25.80	25.80	25.80	25.80	25.80	25.80	25.80	25.80	25.80	25.80	25.80	25.80	25.80	25.80	25.80	25.80	25.80	25.80	25.80
Port Lincoln GT	391.00	391.00	391.00	391.00	391.00	391.00	391.00	391.00	391.00	391.00	391.00	391.00	391.00	391.00	391.00	391.00	391.00	391.00	391.00	391.00
Quarantine	73.04	72.94	73.13	73.45	76.73	76.94	80.48	80.77	81.91	84.27	85.24	85.17	85.10	87.30	87.44	89.83	90.60	92.15	95.51	96.29
Snuggery	412.25	412.25	412.25	412.25	412.25	412.25	412.25	412.25	412.25	412.25	412.25	412.25	412.25	412.25	412.25	412.25	412.25	412.25	412.25	412.25
Torrens Island A	52.23	52.12	52.01	51.89	51.78	51.67	51.56	51.45	78.86	81.35	82.37	82.29	82.22	84.53	84.68	87.20	88.02	89.65	93.19	94.02
Torrens Island B	48.22	48.12	48.02	47.92	47.81	47.71	47.61	47.51	72.72	75.01	75.95	75.88	75.82	77.94	78.08	80.40	81.15	82.65	85.91	86.67
TAS																				
Bell Bay	66.49	66.47	66.71	66.96	67.20	67.44	70.73	71.05	72.15	74.37	75.31	75.31	75.31	77.36	77.55	79.79	80.55	82.02	85.52	87.81
Bell Bay Three	74.50	74.48	74.75	75.03	75.30	75.58	79.30	79.67	80.91	83.42	84.49	84.49	84.49	86.81	87.02	89.56	90.42	92.09	96.05	98.65
Tamar Valley	41.15	41.14	41.30	41.47	41.64	41.80	44.04	44.26	45.01	46.52	47.16	47.16	47.16	48.55	48.68	50.20	50.73	51.73	54.11	55.67
Tamar Valley OCGT	74.50	74.48	74.75	75.03	75.30	75.58	79.30	79.67	80.91	83.42	84.49	84.49	84.49	86.81	87.02	89.56	90.42	92.09	96.05	98.65
VIC																				
Anglesea	5.73	5.73	5.73	5.73	5.73	5.73	5.73	5.73	5.73	5.73	5.73	5.73	5.73	5.73	5.73	5.73	5.73	5.73	5.73	5.73
Bairnsdale	46.30	46.27	46.24	46.21	52.45	52.66	55.78	56.07	57.09	59.19	60.07	60.04	60.01	61.96	62.11	64.23	64.93	66.32	69.66	71.83
Energy Brix	8.57	8.57	8.57	8.57	8.57	8.57	8.57	8.57	8.57	8.57	8.57	8.57	8.57	8.57	8.57	8.57	8.57	8.57	8.57	8.57
Hazelwood	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Jeeralang A	67.91	67.90	67.90	76.86	77.20	77.54	82.22	82.68	84.25	87.40	88.74	88.74	88.73	91.65	91.91	95.10	96.19	98.28	103.27	106.53
Jeeralang B	67.91	67.90	67.90	76.86	77.20	77.54	82.22	82.68	84.25	87.40	88.74	88.74	88.73	91.65	91.91	95.10	96.19	98.28	103.27	106.53
Laverton North	55.16	55.14	55.12	61.90	62.14	62.39	65.92	66.26	67.43	69.80	70.80	70.79	70.77	72.97	73.16	75.56	76.37	77.94	81.71	84.17
Loy Yang A	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08
Loy Yang B	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70	5.70
Mortlake	62.62	62.59	62.84	63.20	66.33	66.58	69.93	70.26	71.39	73.65	74.61	74.61	74.61	76.71	76.90	79.18	79.96	81.46	84.64	85.42
Newport	44.04	44.03	44.02	50.04	50.26	50.48	53.63	53.93	54.97	57.08	57.98	57.96	57.95	59.91	60.08	62.21	62.93	64.33	67.69	69.87
Somerton	69.57	69.55	69.53	78.11	78.42	78.73	83.20	83.63	85.11	88.12	89.39	89.37	89.35	92.13	92.37	95.41	96.44	98.43	103.20	106.31
Valley Power	65.65	65.65	65.64	74.19	74.52	74.85	79.31	79.75	81.25	84.26	85.54	85.53	85.53	88.32	88.56	91.61	92.64	94.64	99.40	102.51

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
Yallourn	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41
ADVANCED PROPOSALS																				
Mortlake 2	32.99	32.97	33.13	33.36	35.36	35.52	37.67	37.88	38.60	40.05	40.66	40.66	40.66	42.01	42.13	43.59	44.09	45.05	47.08	47.58
Spring Gully	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65	6.65

Note: Real 2009-10 $/MWh as generated. Excludes any GEC/NGAC benefits and carbon costs

Data source: ACIL Tasman

Table 31 **SRMC of existing, committed and advanced proposals including carbon costs ($/MWh generated)**

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
NSW																				
Bayswater	13.25	34.59	35.20	37.85	39.65	41.39	43.12	44.81	46.22	47.63	49.18	50.60	52.49	54.38	55.98	57.59	58.88	62.10	63.73	65.58
Colongra	90.77	103.91	103.99	105.04	106.64	108.26	109.84	111.27	113.25	115.50	117.97	119.10	121.20	122.88	125.39	129.25	130.91	133.76	136.76	141.09
Eraring	17.50	39.26	39.94	41.66	43.36	45.62	47.28	48.83	50.46	51.76	53.16	54.46	55.97	57.38	58.90	60.41	61.61	63.34	64.97	66.81
Hunter Valley GT	383.47	405.35	406.10	407.92	409.74	411.57	413.39	415.11	416.61	418.11	419.72	421.22	422.93	424.54	426.26	427.98	429.37	431.30	433.12	435.16
Liddell	14.15	37.67	38.35	41.25	43.23	45.15	47.06	48.92	50.47	52.03	53.74	55.31	57.38	59.46	61.23	63.00	64.42	67.94	69.74	71.78
Mt Piper	17.87	38.47	39.06	40.67	41.69	40.75	42.31	43.76	45.01	46.27	47.62	48.88	50.34	51.70	53.16	54.62	55.78	57.45	59.01	60.78
Munmorah	20.04	44.96	45.72	47.64	49.55	51.51	53.47	55.30	56.87	58.45	60.15	62.24	63.98	65.60	67.34	69.09	70.46	72.46	74.33	76.44
Redbank	12.51	38.58	39.45	41.60	43.74	45.89	48.04	50.06	51.82	53.58	55.48	57.24	59.26	61.15	63.17	65.19	66.83	69.10	71.25	73.65
Smithfield	37.22	49.94	50.32	51.33	52.34	53.36	66.58	67.79	69.48	72.04	73.67	74.51	75.47	77.97	79.07	81.78	83.15	85.38	89.14	92.07
Tallawarra	27.58	38.24	38.57	39.43	40.29	41.14	42.00	42.81	43.51	44.21	44.96	45.66	62.30	64.39	65.32	67.58	68.73	70.60	73.74	76.20
Uranquinty	77.64	95.04	96.03	97.09	98.64	100.20	101.71	103.11	104.99	107.08	109.37	110.46	112.43	114.03	116.37	119.88	121.43	124.09	126.86	130.82
Vales Point B	18.09	40.29	40.97	42.68	44.38	46.12	47.87	49.50	50.90	52.31	53.82	55.68	57.23	58.67	60.23	61.78	63.00	64.78	66.44	68.33
Wallerawang C	19.34	41.82	42.46	44.22	45.32	44.31	46.00	47.59	48.96	50.32	51.80	53.17	54.76	56.24	57.84	59.43	60.70	62.52	64.22	66.16
QLD																				
Barcaldine	60.53	71.91	72.10	72.87	73.63	89.36	90.44	91.53	95.52	96.60	97.89	98.60	99.96	101.01	102.02	103.04	103.99	105.57	108.00	109.23
Braemar	38.98	54.48	55.01	56.30	57.58	58.87	60.16	69.08	79.72	81.08	82.63	83.72	86.61	93.69	95.80	97.26	98.60	100.68	103.67	105.39
Braemar 2	41.53	57.05	57.58	58.87	60.17	61.46	62.75	63.97	65.03	66.10	67.24	68.30	69.52	70.66	71.88	73.10	74.09	75.45	76.75	78.19
Callide B	13.35	33.93	34.61	36.29	37.98	39.67	41.36	42.94	44.33	45.71	47.20	48.58	50.17	51.66	53.25	54.83	56.12	57.91	59.60	61.49
Callide C	13.04	33.47	34.15	35.82	37.50	39.18	40.85	42.43	43.80	45.18	46.66	48.03	49.61	51.09	52.66	54.24	55.52	57.29	58.97	60.85
Collinsville	26.33	51.83	52.64	54.71	56.78	58.85	60.92	62.87	64.56	66.25	68.07	69.77	71.71	73.53	75.48	77.42	78.99	81.19	83.26	85.58
Condamine	7.90	16.97	17.28	18.03	18.79	19.55	20.30	21.01	21.64	22.26	22.92	23.55	24.26	24.93	25.64	26.35	26.93	27.73	28.48	29.33
Darling Downs	26.11	35.28	35.59	36.36	37.12	37.88	38.65	39.37	40.00	40.63	41.30	41.93	42.65	43.32	44.04	44.76	45.35	46.16	46.92	47.78
Gladstone	16.34	37.68	38.38	40.12	41.87	43.62	45.36	47.00	48.43	49.86	51.40	52.83	54.47	56.01	57.65	59.29	60.62	62.47	64.22	66.17
Kogan Creek	7.77	27.59	28.25	29.89	31.52	33.16	34.80	36.34	37.68	39.03	40.47	41.82	43.35	44.80	46.34	47.88	49.13	50.86	52.50	54.33

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
Mackay GT	382.92	404.80	405.55	407.37	409.20	411.02	412.84	414.56	416.06	417.56	419.17	420.67	422.39	424.00	425.71	427.43	428.82	430.75	432.58	434.61
Millmerran	8.93	29.07	29.74	31.40	33.06	34.72	36.39	37.95	39.31	40.68	42.14	43.51	45.07	46.53	48.09	49.66	50.92	52.68	54.35	56.20
Mt Stuart GT	357.98	378.40	379.10	380.80	382.50	384.20	385.91	387.51	388.91	390.31	391.81	393.21	394.81	396.32	397.92	399.52	400.82	402.62	404.32	406.23
Oakey	54.74	68.81	69.20	70.29	71.37	92.05	93.51	95.00	100.05	101.50	103.23	104.24	106.06	107.48	108.86	110.26	111.56	113.63	116.75	118.40
Roma GT	64.00	79.40	74.19	75.75	78.85	80.26	81.79	83.32	87.92	89.40	91.12	92.22	94.03	95.50	96.94	98.40	99.73	101.80	104.77	106.49
Stanwell	13.96	33.81	34.46	36.08	37.71	39.33	40.96	42.49	43.82	45.15	46.58	47.92	49.45	50.88	52.41	53.94	55.17	56.90	58.52	60.34
Swanbank B	24.94	48.35	49.10	50.99	52.89	54.79	56.69	58.47	60.03	61.58	63.25	64.80	66.59	68.25	70.04	71.82	73.26	75.28	77.18	79.31
Swanbank E	27.23	36.37	36.73	37.58	38.43	39.28	45.80	46.67	47.45	48.24	49.06	51.72	54.50	55.38	56.32	57.21	58.04	59.09	60.13	61.25
Tarong	10.52	30.64	31.31	32.96	34.62	36.27	37.93	39.49	40.85	42.21	43.67	45.03	46.58	48.04	49.60	51.16	52.42	54.17	55.83	57.69
Tarong North	10.14	29.32	29.96	31.54	33.12	34.69	36.27	37.76	39.06	40.35	41.74	43.04	44.53	45.92	47.40	48.89	50.09	51.76	53.34	55.11
Townsville	35.68	45.68	45.96	46.74	47.51	48.29	49.06	49.79	50.42	51.05	64.08	64.85	65.86	66.63	67.41	68.40	69.39	70.28	72.54	73.49
Yarwun	36.80	50.79	51.08	52.04	53.01	53.99	55.32	56.23	57.01	57.79	58.64	59.74	60.66	61.52	62.45	63.38	64.39	65.45	66.46	67.60
SA																				
Angaston	414.37	437.49	438.28	440.21	442.13	444.06	445.99	447.80	449.38	450.97	452.67	454.26	456.07	457.77	459.58	461.39	462.87	464.91	466.83	468.99
Dry Creek GT	72.67	94.48	95.09	96.78	132.24	134.36	141.24	143.38	146.52	151.40	154.39	155.80	157.42	162.17	164.09	169.23	171.73	175.89	182.51	185.67
Hallett	106.07	129.89	131.07	133.63	140.79	143.17	150.72	153.11	156.59	161.96	165.28	166.88	168.70	173.93	176.08	181.74	184.52	189.10	196.37	199.86
Ladbroke Grove	62.22	81.19	82.07	84.01	88.89	90.71	95.84	97.65	100.12	103.81	106.20	107.47	108.93	112.54	114.20	118.10	120.11	123.36	128.30	130.88
Mintaro GT	91.78	112.10	113.10	115.28	121.39	123.42	129.86	131.90	134.86	139.45	142.28	143.64	145.19	149.65	151.49	156.31	158.68	162.58	168.78	171.77
Northern	16.06	37.13	37.85	39.60	41.36	43.11	44.87	46.52	47.97	49.41	50.96	52.41	54.06	55.61	57.26	58.91	60.25	62.11	63.87	65.83
Osborne	38.52	51.75	52.13	53.17	54.20	68.90	72.46	73.71	75.41	77.96	79.61	80.47	81.47	83.97	85.11	87.81	89.19	91.44	94.88	96.66
Pelican Point	30.26	42.22	42.56	43.50	57.73	58.86	62.07	63.19	64.73	67.03	68.52	69.30	70.20	72.46	73.49	75.93	77.17	79.21	82.31	83.91
Playford B	25.80	58.31	59.42	62.13	64.84	67.55	70.26	72.81	75.04	77.27	79.66	81.89	84.44	86.83	89.38	91.93	94.00	96.87	99.58	102.61
Port Lincoln GT	391.00	412.81	413.56	415.37	417.19	419.01	420.83	422.54	424.03	425.53	427.14	428.63	430.34	431.95	433.66	435.37	436.76	438.68	440.50	442.53
Quarantine	73.04	90.41	91.20	92.98	97.72	99.38	104.38	106.04	108.38	111.94	114.19	115.32	116.62	120.10	121.61	125.38	127.26	130.36	135.17	137.58
Snuggery	412.25	435.24	436.03	437.95	439.87	441.78	443.70	445.50	447.08	448.66	450.35	451.93	453.73	455.42	457.23	459.03	460.49	462.52	464.44	466.58
Torrens Island A	52.23	72.38	72.96	74.54	76.11	77.69	79.27	80.75	109.54	113.43	115.93	117.25	118.77	122.57	124.31	128.42	130.52	133.95	139.17	141.88
Torrens Island B	48.22	66.76	67.30	68.75	70.20	71.65	73.10	74.46	100.95	104.52	106.83	108.04	109.44	112.94	114.53	118.32	120.25	123.40	128.21	130.70
TAS																				
Bell Bay	66.49	80.75	81.48	82.91	84.34	85.77	90.25	91.70	93.77	96.97	98.96	99.94	101.06	104.16	105.47	108.82	110.50	113.23	117.92	121.54
Bell Bay Three	74.50	90.64	91.47	93.09	94.72	96.34	101.41	103.04	105.40	109.02	111.27	112.38	113.65	117.16	118.64	122.44	124.34	127.43	132.74	136.84
Tamar Valley	41.15	50.86	51.35	52.33	53.30	54.28	57.33	58.31	59.73	61.90	63.26	63.92	64.69	66.80	67.69	69.97	71.11	72.97	76.16	78.63
Tamar Valley OCGT	74.50	90.64	91.47	93.09	94.72	96.34	101.41	103.04	105.40	109.02	111.27	112.38	113.65	117.16	118.64	122.44	124.34	127.43	132.74	136.84
VIC																				
Anglesea	5.73	31.17	32.04	34.16	36.28	38.40	40.52	42.52	44.26	46.01	47.88	49.63	51.62	53.49	55.49	57.48	59.10	61.35	63.47	65.84
Bairnsdale	46.30	59.99	60.43	61.54	68.93	70.27	74.54	75.90	77.87	80.91	82.80	83.71	84.76	87.71	88.93	92.13	93.71	96.31	100.79	104.24
Energy Brix	8.57	38.18	39.20	41.67	44.14	46.60	49.07	51.39	53.43	55.46	57.64	59.67	61.99	64.17	66.49	68.81	70.70	73.31	75.78	78.54
Hazelwood	2.30	34.43	35.54	38.22	40.89	43.57	46.25	48.77	50.98	53.18	55.54	57.75	60.27	62.63	65.16	67.68	69.72	72.56	75.24	78.23

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
Jeeralang A	67.91	88.27	88.96	99.62	101.66	103.70	110.08	112.14	115.10	119.65	122.49	123.88	125.47	129.89	131.75	136.53	138.92	142.81	149.49	154.65
Jeeralang B	67.91	88.27	88.96	99.62	101.66	103.70	110.08	112.14	115.10	119.65	122.49	123.88	125.47	129.89	131.75	136.53	138.92	142.81	149.49	154.65
Laverton North	55.16	70.56	71.07	79.13	80.66	82.19	87.01	88.55	90.78	94.22	96.35	97.40	98.59	101.92	103.32	106.93	108.72	111.65	116.71	120.60
Loy Yang A	2.08	27.95	28.83	30.99	33.14	35.30	37.45	39.48	41.26	43.03	44.93	46.71	48.74	50.64	52.67	54.69	56.34	58.62	60.78	63.19
Loy Yang B	5.70	32.58	33.51	35.75	37.99	40.23	42.47	44.57	46.42	48.26	50.24	52.08	54.19	56.17	58.28	60.39	62.10	64.47	66.71	69.21
Mortlake	62.62	77.17	77.92	79.49	83.83	85.29	89.86	91.34	93.46	96.72	98.76	99.76	100.90	104.07	105.40	108.83	110.54	113.33	117.72	119.86
Newport	44.04	57.75	58.20	65.37	66.74	68.10	72.39	73.76	75.75	78.80	80.70	81.63	82.69	85.66	86.90	90.12	91.71	94.32	98.82	102.28
Somerton	69.57	89.08	89.73	99.94	101.88	103.82	109.92	111.88	114.70	119.05	121.75	123.07	124.58	128.81	130.57	135.14	137.42	141.13	147.53	152.46
Valley Power	65.65	85.08	85.74	95.91	97.86	99.81	105.89	107.86	110.68	115.02	117.73	119.06	120.58	124.80	126.57	131.14	133.41	137.12	143.50	148.43
Yallourn	2.41	32.70	33.74	36.27	38.79	41.31	43.84	46.21	48.29	50.37	52.60	54.68	57.05	59.28	61.66	64.03	65.96	68.64	71.16	73.98
ADVANCED PROPOSALS																				
Mortlake 2	32.99	42.30	42.78	43.79	46.57	47.50	50.43	51.37	52.73	54.82	56.12	56.76	57.49	59.52	60.37	62.56	63.66	65.44	68.25	69.62
Spring Gully	6.65	15.24	15.54	16.25	16.97	17.69	18.40	19.08	19.67	20.26	20.89	21.48	22.15	22.79	23.46	24.13	24.68	25.44	26.16	26.96

Note: Real 2009-10 $/MWh as generated. Includes emission permits prices as per Table 5. Excludes any GEC/NGAC benefits for 2009-10

Data source: ACIL Tasman

4 New entrant technologies

This chapter provides estimates of LRMC and SRMC for the following new entrant technologies:

- Combined Cycle Gas Turbine (CCGT)
- Open Cycle Gas Turbine (OCGT)
- Supercritical coal (SC)
- Ultra-supercritical coal (USC)
- Integrated gasification combined cycle (IGCC)
- Carbon capture and storage variants (CCS)
- Nuclear.

Table 32 provides some of the details of each technology including capacity, auxiliaries, thermal efficiency and O&M costs from ACIL Tasman's analysis. Some points to note from Table 32:

- Some of the new entrant technologies have been differentiated based on their cooling method, with air cooled stations generally attracting higher capital costs and auxiliary usage rates. This recognises that access to cooling water for coal plant may be limited within some areas of the NEM.
- The typical new entrant size is a relatively nominal figure. In reality plant configurations can be quite different depending upon the individual project circumstances. We note the potential for larger or smaller new entrant projects (sizing of CCGTs is somewhat flexible, while new coal projects may be larger than the nominal 500 MW).
- Auxiliary loads for plants which incorporate CCS technology are significantly higher reflecting the energy required to capture and compress CO_2 from flue gas streams
- Thermal efficiencies are anticipated to improve over time as a result of technological improvements. The projected change in thermal efficiencies over time is shown in Table 36 (on a sent-out basis) and Table 37 (on a generated basis).
- O&M costs are somewhat higher than the previous study – particularly for FOM – as a result of cost increases seen over recent years for Australian plant.
- ACIL Tasman has taken a slightly different approach in relation to the treatment of VOM and FOM for CCGT plant. Within the 2007 study, it was assumed that CCGT would continue to play an intermediate role in the NEM (a result of no explicit carbon signal) and hence the estimated split of O&M between fixed and variable components was such that VOM contained some elements of maintenance. Owing to the anticipated introduction of the CPRS, it is now anticipated that CCGT plant will

operate in a more baseload fashion, and hence the split between FOM and VOM has been adjusted to reflect this mode.

Table 33 provides the assumed economic life, earliest likely build date, lead times and construction profiles for each of the new entrant technologies examined. Some points to note from Table 33:

- While the economic life of some technologies extends beyond 30 years, ACIL Tasman only uses a 30 year life within its calculation of LRMC. This is due to the fact that in order to reach 40 years, stations typically require a significant capital injection for refurbishment, which is not included within the DCF
- The earliest likely build date incorporates not only the construction and planning lead times required, but also technological development (in the case of geothermal or CCS equipped plant) and changes in government policy (in the case of nuclear).
- The construction profile gives an approximation of the percent of the headline capital cost expended in each year which has the effect of explicitly incorporating interest during construction within the DCF.

The matrix in Table 34 shows ACIL Tasman's assessment of the potential for construction of the different technologies within each of the 16 NEM zones. Points to note from Table 34 are:

- The location of coal-fired technology has been limited to zones that contain suitable coal resources for mine mouth development (see section 4.2.2). Although coal can be transported by rail to other zones, the cost of transport would generally make the uneconomic relative to transmission development
- The development of gas-fired units has not been restricted on the basis that gas transmission is a much smaller component of delivered costs than for coal and a ready gas transmission network already exists throughout Eastern Australia
- Water cooled coal-fired units have been assessed to only be likely within the NQ and LV zones as a result of the repricing and enhanced value attached to water resources throughout the NEM. The likelihood of water cooled coal-fired units in the NQ and LV zones is based on relatively abundant water availability in the NQ zone and water likely to be available in the LV zone following the closure of existing brown coal-fired plant
- Geothermal hot dry rock developments have been restricted to zones where geothermal exploration is particularly advanced. We note however that if the technology is proven to be viable at lower insitu temperatures, this would open up the possibility of generation developments in other NEM zones.
- Development of nuclear plants is assumed to only occur in more sparsely populated zones of the NEM.

Table 35 details the projection of capital costs for each of the new entrant technologies over the period 2009-10 through to 2028-29 in real terms.

Table 36 and Table 37 detail the projected thermal efficiencies for each new entrant technology in set-out and generated terms respectively.

Table 32 **New entrant technologies: capacity, auxiliaries, thermal efficiency and O&M costs**

Technology	Typical new entrant size (MW)	Minimum stable generation level (%)	Average availability (%)	Auxiliary load (%)	Thermal efficiency (sent-out HHV)	Thermal efficiency HHV (GJ/MWh) sent-out	Thermal efficiency (generated HHV)	Thermal efficiency HHV (GJ/MWh) as generated	FOM ($/MW/year) for 2009-10	VOM ($/MWh sent-out) for 2009-10
CCGT (WC)	400	40%	92%	1.5%	52.0%	6.92	52.8%	6.82	31,000	1.05
CCGT (AC)	400[a]	40%	92%	4.0%	50.0%	7.20	52.1%	6.91	31,000	1.05
OCGT	150	0%	97%	1.0%	31.0%	11.61	31.3%	11.50	13,000	7.70
SC BLACK (WC)	500	50%	93%	7.5%	42.0%	8.57	45.4%	7.93	48,000	1.25
SC BLACK (AC)	500	50%	93%	9.5%	40.0%	9.00	44.2%	8.15	48,000	1.25
SC BROWN (WC)	500	50%	93%	9.5%	34.0%	10.59	37.6%	9.58	55,000	1.25
SC BROWN (AC)	500	50%	93%	11.0%	32.0%	11.25	36.0%	10.01	55,000	1.25
USC BLACK (WC)	500	50%	93%	7.0%	45.0%	8.00	48.4%	7.44	48,000	1.25
USC BLACK (AC)	500	50%	93%	8.5%	43.0%	8.37	47.0%	7.66	48,000	1.25
USC BROWN (WC)	500	50%	93%	9.0%	37.0%	9.73	40.7%	8.85	55,000	1.25
USC BROWN (AC)	500	50%	93%	10.5%	35.0%	10.29	39.1%	9.21	55,000	1.25
Geothermal (HDR)	500	50%	90%	2.5%	70.0%	5.14	71.8%	5.01	35,000	2.05
IGCC	500	50%	92%	15.0%	41.0%	8.78	48.2%	7.46	50,000	4.10
IGCC - CCS	500	50%	90%	20.0%	33.0%	10.91	41.3%	8.73	75,000	5.15
USC CCS BLACK (WC)	500	50%	90%	25.0%	33.0%	10.91	44.0%	8.18	80,000	2.40
USC CCS BLACK (AC)	500	50%	90%	26.0%	31.0%	11.61	41.9%	8.59	80,000	2.40
USC CCS BROWN (WC)	500	50%	90%	25.0%	29.0%	12.41	38.7%	9.31	92,000	2.40
USC CCS BROWN (AC)	500	50%	90%	26.0%	28.0%	12.86	37.8%	9.51	92,000	2.40
Nuclear	1,000	50%	90%	8.0%	34.0%	10.59	37.0%	9.74	84,000	5.90

a A smaller nominal size of 200 MW would be appropriate for South Australian and Tasmanian zones.

Note: WC denotes water cooled; AC denotes air cooled. CCGT = combined cycle gas turbine; OCGT = open cycle gas turbine; SC = supercritical coal; USC = ultra-supercritical coal; IGCC = integrated gasification combined cycle; CCS = carbon capture and storage. Thermal efficiencies represent 2009-10 values assuming the technology was available. Efficiencies for existing and new technologies are expected to improve over time as detailed in Table 36. Both FOM and VOM costs are assumed to escalate at CPI (2.5%).

Data source: ACIL Tasman

Table 33 **New entrant technologies: economic life, lead times and construction profiles**

Technology	Economic life (years)	Economic life within DCF (years)	Technology stage	Earliest likely build date	Lead time for development (years)	Construction profile % of capital cost				
						Yr-5	Yr-4	Yr-3	Yr-2	Yr-1
CCGT (WC)	30	30	Available	2012	3				40%	60%
CCGT (AC)	30	30	Available	2012	3				40%	60%
OCGT	30	30	Available	2011	2					100%
SC BLACK (WC)	40	30	Available	2014	4		10%	20%	35%	35%
SC BLACK (AC)	40	30	Available	2014	4		10%	20%	35%	35%
SC BROWN (WC)	40	30	Available	2014	4		10%	20%	35%	35%
SC BROWN (AC)	40	30	Available	2014	4		10%	20%	35%	35%
USC BLACK (WC)	40	30	Emerging	2017	4		10%	20%	35%	35%
USC BLACK (AC)	40	30	Emerging	2017	4		10%	20%	35%	35%
USC BROWN (WC)	40	30	Emerging	2017	4		10%	20%	35%	35%
USC BROWN (AC)	40	30	Emerging	2017	4		10%	20%	35%	35%
Geothermal (HDR)	30	30	R&D stage	2015	4		20%	20%	20%	40%
IGCC	40	30	Emerging	2015	4		10%	20%	40%	30%
IGCC - CCS	40	30	R&D stage	2020	4		10%	20%	40%	30%
USC CCS BLACK (WC)	40	30	R&D stage	2022	4		10%	20%	35%	35%
USC CCS BLACK (AC)	40	30	R&D stage	2022	4		10%	20%	35%	35%
USC CCS BROWN (WC)	40	30	R&D stage	2022	4		10%	20%	35%	35%
USC CCS BROWN (AC)	40	30	R&D stage	2022	4		10%	20%	35%	35%
Nuclear	50	30	Available	2025	5	10%	20%	20%	25%	25%

Note: WC denotes water cooled; AC denotes air cooled. CCGT = combined cycle gas turbine; OCGT = open cycle gas turbine; SC = supercritical coal; USC = ultra-supercritical coal; IGCC = integrated gasification combined cycle; CCS = carbon capture and storage.

Data source: ACIL Tasman

Table 34 **New entrant technology availability by NEM zone**

Technology	NQ	CQ	SEQ	SWQ	NNSW	NCEN	SWNSW	CAN	NVIC	LV	MEL	CVIC	NSA	ADE	SESA	TAS
CCGT (WC)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CCGT (AC)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
OCGT	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SC BLACK (WC)	Y															
SC BLACK (AC)	Y	Y		Y	Y	Y	Y									
SC BROWN (WC)										Y						
SC BROWN (AC)										Y						
USC BLACK (WC)	Y															
USC BLACK (AC)	Y	Y		Y	Y	Y	Y									
USC BROWN (WC)										Y						
USC BROWN (AC)										Y						
Geothermal (HDR)					Y							Y	Y	Y		
IGCC	Y	Y		Y	Y	Y	Y			Y						
IGCC - CCS	Y	Y		Y	Y	Y	Y			Y						
USC CCS BLACK (WC)	Y															
USC CCS BLACK (AC)	Y	Y		Y	Y	Y	Y									
USC CCS BROWN (WC)										Y						
USC CCS BROWN (AC)										Y						
Nuclear	Y	Y		Y	Y	Y	Y	Y	Y	Y		Y	Y		Y	

Note: WC denotes water cooled; AC denotes air cooled. CCGT = combined cycle gas turbine; OCGT = open cycle gas turbine; SC = supercritical coal; USC = ultra-supercritical coal; IGCC = integrated gasification combined cycle; CCS = carbon capture and storage.

Data source: ACIL Tasman

Table 35 **Capital cost projection by technology (Real 2009-10 $/kW)**

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
CCGT (WC)	1,314	1,224	1,222	1,200	1,185	1,181	1,177	1,173	1,168	1,164	1,159	1,154	1,150	1,145	1,141	1,136	1,132	1,127	1,123	1,118
CCGT (AC)	1,368	1,275	1,273	1,251	1,235	1,233	1,229	1,225	1,221	1,216	1,212	1,208	1,203	1,199	1,195	1,191	1,187	1,182	1,178	1,174
OCGT	985	918	916	900	888	886	883	880	876	873	869	866	862	859	856	852	849	845	842	839
SC BLACK (WC)	2,239	2,162	2,124	2,087	2,074	2,060	2,057	2,053	2,049	2,045	2,040	2,036	2,032	2,027	2,023	2,018	2,014	2,010	2,005	2,001
SC BLACK (AC)	2,291	2,213	2,174	2,137	2,123	2,110	2,107	2,104	2,100	2,096	2,092	2,089	2,085	2,081	2,077	2,073	2,069	2,065	2,061	2,057
SC BROWN (WC)	2,463	2,379	2,336	2,296	2,281	2,266	2,263	2,259	2,254	2,249	2,244	2,240	2,235	2,230	2,225	2,220	2,215	2,211	2,206	2,201
SC BROWN (AC)	2,520	2,434	2,391	2,350	2,336	2,321	2,318	2,314	2,310	2,306	2,302	2,297	2,293	2,289	2,284	2,280	2,276	2,271	2,267	2,262
USC BLACK (WC)	2,396	2,314	2,272	2,233	2,219	2,204	2,201	2,197	2,192	2,188	2,183	2,179	2,174	2,169	2,165	2,160	2,155	2,150	2,146	2,141
USC BLACK (AC)	2,451	2,368	2,326	2,286	2,272	2,258	2,255	2,251	2,247	2,243	2,239	2,235	2,231	2,226	2,222	2,218	2,214	2,209	2,205	2,201
USC BROWN (WC)	2,635	2,545	2,500	2,456	2,441	2,425	2,421	2,417	2,412	2,407	2,402	2,396	2,391	2,386	2,381	2,376	2,371	2,365	2,360	2,355
USC BROWN (AC)	2,697	2,604	2,558	2,515	2,499	2,484	2,480	2,476	2,472	2,467	2,463	2,458	2,454	2,449	2,444	2,440	2,435	2,430	2,426	2,421
Geothermal (HDR)	5,330	5,369	5,300	5,232	5,165	5,099	5,034	4,969	4,905	4,842	4,780	4,719	4,658	4,599	4,540	4,481	4,424	4,367	4,311	4,256
IGCC	3,705	3,481	3,324	3,173	3,060	2,948	2,851	2,754	2,657	2,560	2,532	2,527	2,522	2,518	2,513	2,508	2,503	2,498	2,494	2,489
IGCC - CCS	5,001	4,699	4,487	4,283	4,130	3,979	3,849	3,718	3,587	3,455	3,418	3,399	3,380	3,361	3,342	3,323	3,304	3,285	3,267	3,248
USC CCS BLACK (WC)	3,833	3,679	3,591	3,506	3,461	3,417	3,389	3,361	3,332	3,304	3,275	3,246	3,217	3,189	3,160	3,132	3,103	3,075	3,047	3,019
USC CCS BLACK (AC)	3,922	3,764	3,675	3,589	3,544	3,500	3,472	3,445	3,416	3,387	3,358	3,330	3,301	3,273	3,244	3,216	3,188	3,159	3,131	3,103
USC CCS BROWN (WC)	4,314	4,114	3,948	3,853	3,762	3,714	3,667	3,637	3,607	3,576	3,545	3,514	3,484	3,453	3,422	3,391	3,361	3,330	3,300	3,270
USC CCS BROWN (AC)	4,415	4,209	4,040	3,944	3,852	3,803	3,756	3,727	3,697	3,666	3,635	3,604	3,573	3,543	3,512	3,482	3,451	3,421	3,390	3,360
Nuclear	5,207	5,182	5,156	5,131	5,106	5,081	5,056	5,032	5,007	4,983	4,959	4,934	4,910	4,886	4,862	4,839	4,579	4,454	4,333	4,263

Note: WC denotes water cooled; AC denotes air cooled. CCGT = combined cycle gas turbine; OCGT = open cycle gas turbine; SC = supercritical coal; USC = ultra-supercritical coal; IGCC = integrated gasification combined cycle; CCS = carbon capture and storage.

Data source: ACIL Tasman analysis

Table 36 **Thermal efficiency projection for new entrant technologies (sent-out HHV)**

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
CCGT (WC)	52%	52%	53%	53%	54%	54%	54%	55%	55%	55%	55%	55%	55%	56%	56%	56%	56%	56%	56%	56%
CCGT (AC)	50%	50%	51%	51%	52%	52%	52%	53%	53%	53%	53%	53%	53%	54%	54%	54%	54%	54%	54%	54%
OCGT	31%	32%	32%	32%	32%	33%	33%	33%	33%	34%	34%	34%	34%	35%	35%	35%	35%	36%	36%	36%
SC BLACK (WC)	42%	42%	42%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	44%	44%	44%	44%	44%	44%	44%
SC BLACK (AC)	40%	40%	40%	41%	41%	41%	41%	41%	41%	41%	41%	41%	41%	42%	42%	42%	42%	42%	42%	42%
SC BROWN (WC)	34%	34%	34%	34%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%	36%	36%	36%
SC BROWN (AC)	32%	32%	32%	32%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	34%	34%	34%
USC BLACK (WC)	45%	45%	46%	46%	46%	47%	47%	47%	48%	48%	48%	49%	49%	49%	50%	50%	51%	51%	51%	51%
USC BLACK (AC)	43%	43%	44%	44%	44%	45%	45%	45%	46%	46%	46%	47%	47%	47%	48%	48%	49%	49%	49%	49%
USC BROWN (WC)	37%	37%	38%	38%	38%	39%	39%	39%	39%	39%	39%	40%	40%	40%	41%	41%	42%	42%	42%	42%
USC BROWN (AC)	35%	35%	36%	36%	36%	37%	37%	37%	37%	37%	37%	38%	38%	38%	39%	39%	40%	40%	40%	40%
Geothermal (HDR)	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
IGCC	41%	41%	41%	42%	42%	42%	42%	42%	43%	43%	43%	43%	43%	44%	44%	44%	44%	44%	45%	45%
IGCC - CCS	33%	33%	33%	34%	34%	34%	34%	34%	34%	34%	37%	37%	37%	37%	37%	39%	39%	39%	40%	40%
USC CCS BLACK (WC)	33%	33%	34%	34%	34%	34%	34%	37%	37%	37%	37%	37%	39%	39%	39%	39%	39%	39%	41%	41%
USC CCS BLACK (AC)	31%	31%	32%	32%	32%	32%	32%	35%	35%	35%	35%	35%	37%	37%	37%	37%	37%	37%	39%	39%
USC CCS BROWN (WC)	29%	29%	30%	30%	30%	30%	30%	33%	33%	33%	33%	33%	34%	34%	34%	34%	34%	34%	36%	36%
USC CCS BROWN (AC)	28%	28%	29%	29%	29%	29%	29%	32%	32%	32%	32%	32%	33%	33%	33%	33%	33%	33%	35%	35%
Nuclear	34%	34%	34%	34%	34%	34%	34%	34%	34%	34%	34%	34%	34%	34%	34%	34%	34%	34%	34%	34%

Note: WC denotes water cooled; AC denotes air cooled. CCGT = combined cycle gas turbine; OCGT = open cycle gas turbine; SC = supercritical coal; USC = ultra-supercritical coal; IGCC = integrated gasification combined cycle; CCS = carbon capture and storage.

Data source: ACIL Tasman analysis

Table 37 **Thermal efficiency projection for new entrant technologies (generated HHV)**

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
CCGT (WC)	53%	53%	54%	54%	55%	55%	55%	56%	56%	56%	56%	56%	56%	57%	57%	57%	57%	57%	57%	57%
CCGT (AC)	52%	52%	53%	53%	54%	54%	54%	55%	55%	55%	55%	55%	55%	56%	56%	56%	56%	56%	56%	56%
OCGT	31%	32%	32%	32%	32%	33%	33%	33%	33%	34%	34%	34%	34%	35%	35%	35%	35%	36%	36%	36%
SC BLACK (WC)	45%	45%	45%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	48%	48%	48%	48%	48%	48%	48%
SC BLACK (AC)	44%	44%	44%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	46%	46%	46%	46%	46%	46%	46%
SC BROWN (WC)	38%	38%	38%	38%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	40%	40%	40%
SC BROWN (AC)	36%	36%	36%	36%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	38%	38%	38%
USC BLACK (WC)	48%	48%	49%	49%	49%	51%	51%	51%	52%	52%	52%	53%	53%	53%	54%	54%	55%	55%	55%	55%
USC BLACK (AC)	47%	47%	48%	48%	48%	49%	49%	49%	50%	50%	50%	51%	51%	51%	52%	52%	54%	54%	54%	54%
USC BROWN (WC)	41%	41%	42%	42%	42%	43%	43%	43%	43%	43%	43%	44%	44%	44%	45%	45%	46%	46%	46%	46%
USC BROWN (AC)	39%	39%	40%	40%	40%	41%	41%	41%	41%	41%	41%	42%	42%	42%	44%	44%	45%	45%	45%	45%
Geothermal (HDR)	72%	72%	72%	72%	72%	72%	72%	72%	72%	72%	72%	72%	72%	72%	72%	72%	72%	72%	72%	72%
IGCC	48%	48%	48%	49%	49%	49%	49%	49%	51%	51%	51%	51%	51%	52%	52%	52%	52%	52%	53%	53%
IGCC - CCS	41%	41%	41%	43%	43%	43%	43%	43%	43%	43%	46%	46%	46%	46%	46%	49%	49%	49%	50%	50%
USC CCS BLACK (WC)	44%	44%	45%	45%	45%	45%	45%	49%	49%	49%	49%	49%	52%	52%	52%	52%	52%	52%	55%	55%
USC CCS BLACK (AC)	42%	42%	43%	43%	43%	43%	43%	47%	47%	47%	47%	47%	50%	50%	50%	50%	50%	50%	53%	53%
USC CCS BROWN (WC)	39%	39%	40%	40%	40%	40%	40%	44%	44%	44%	44%	44%	45%	45%	45%	45%	45%	45%	48%	48%
USC CCS BROWN (AC)	38%	38%	39%	39%	39%	39%	39%	43%	43%	43%	43%	43%	45%	45%	45%	45%	45%	45%	47%	47%
Nuclear	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%

Note: WC denotes water cooled; AC denotes air cooled. CCGT = combined cycle gas turbine; OCGT = open cycle gas turbine; SC = supercritical coal; USC = ultra-supercritical coal; IGCC = integrated gasification combined cycle; CCS = carbon capture and storage.

Data source: ACIL Tasman analysis

4.1 Emission factors

Emission factors for each of the new entrant technologies are detailed for combustion (Table 38), fugitive (Table 39) and total emissions (Table 40). These factors are presented in kilograms of CO_2-e per GJ of fuel consumed. Combustion emissions relate to the emissions from burning of the fuel at the power station, while fugitive emissions relate to emissions resulting from the production and transport of fuel. The sum of these two factors gives the total emission factor, which is used in the calculation of SRMC.

Table 38 **Combustion emission factors for new entrant technologies (kg CO_2-e per GJ of fuel)**

	QLD	NSW	VIC	SA	TAS
CCGT (AC)	51.3	51.3	51.3	51.3	51.3
CCGT (AC)	51.3	51.3	51.3	51.3	51.3
OCGT	51.3	51.3	51.3	51.3	51.3
SC BLACK (WC)	91.1	89.3	n/a	n/a	n/a
SC BLACK (AC)	91.1	89.3	n/a	n/a	n/a
SC BROWN (WC)	n/a	n/a	93.2	n/a	n/a
SC BROWN (AC)	n/a	n/a	93.2	n/a	n/a
USC BLACK (WC)	91.1	89.3	n/a	n/a	n/a
USC BLACK (AC)	91.1	89.3	n/a	n/a	n/a
USC BROWN (WC)	n/a	n/a	93.2	n/a	n/a
USC BROWN (AC)	n/a	n/a	93.2	n/a	n/a
Geothermal (HDR)	0.0	0.0	0.0	0.0	0.0
IGCC	91.1	89.3	93.2	n/a	n/a
IGCC - CCS	4.6	4.5	4.7	n/a	n/a
USC CCS BLACK (WC)	4.6	4.5	n/a	n/a	n/a
USC CCS BLACK (AC)	4.6	4.5	n/a	n/a	n/a
USC CCS BROWN (WC)	n/a	n/a	4.7	n/a	n/a
USC CCS BROWN (AC)	n/a	n/a	4.7	n/a	n/a
Nuclear	0.0	0.0	0.0	0.0	0.0

Note: WC denotes water cooled; AC denotes air cooled. CCGT = combined cycle gas turbine; OCGT = open cycle gas turbine; SC = supercritical coal; USC = ultra-supercritical coal; IGCC = integrated gasification combined cycle; CCS = carbon capture and storage. Plants with CCS capability are assumed to capture 95% of combustion emissions.

Data source: ACIL Tasman analysis

Table 39 **Fugitive emission factors for new entrant technologies (kg CO_2-e per GJ of fuel)**

	QLD	NSW	VIC	SA	TAS
CCGT (AC)	5.4	14.2	5.8	18.6	5.8
CCGT (AC)	5.4	14.2	5.8	18.6	5.8
OCGT	5.4	14.2	5.8	18.6	5.8
SC BLACK (WC)	2.0	8.7	n/a	n/a	n/a
SC BLACK (AC)	2.0	8.7	n/a	n/a	n/a
SC BROWN (WC)	n/a	n/a	0.3	n/a	n/a
SC BROWN (AC)	n/a	n/a	0.3	n/a	n/a
USC BLACK (WC)	2.0	8.7	n/a	n/a	n/a
USC BLACK (AC)	2.0	8.7	n/a	n/a	n/a
USC BROWN (WC)	n/a	n/a	0.3	n/a	n/a
USC BROWN (AC)	n/a	n/a	0.3	n/a	n/a
Geothermal (HDR)	0.0	0.0	0.0	0.0	0.0
IGCC	2.0	8.7	0.3	n/a	n/a
IGCC - CCS	2.0	8.7	0.3	n/a	n/a
USC CCS BLACK (WC)	2.0	8.7	n/a	n/a	n/a
USC CCS BLACK (AC)	2.0	8.7	n/a	n/a	n/a
USC CCS BROWN (WC)	n/a	n/a	0.3	n/a	n/a
USC CCS BROWN (AC)	n/a	n/a	0.3	n/a	n/a
Nuclear	1.5	1.5	1.5	1.5	1.5

Note: WC denotes water cooled; AC denotes air cooled. CCGT = combined cycle gas turbine; OCGT = open cycle gas turbine; SC = supercritical coal; USC = ultra-supercritical coal; IGCC = integrated gasification combined cycle; CCS = carbon capture and storage.

Data source: ACIL Tasman analysis

Table 40 **Total emission factors for new entrant technologies (kg CO_2-e per GJ of fuel)**

	QLD	NSW	VIC	SA	TAS
CCGT (AC)	56.7	65.5	57.1	69.9	57.1
CCGT (AC)	56.7	65.5	57.1	69.9	57.1
OCGT	56.7	65.5	57.1	69.9	57.1
SC BLACK (WC)	93.1	98.0	n/a	n/a	n/a
SC BLACK (AC)	93.1	98.0	n/a	n/a	n/a
SC BROWN (WC)	n/a	n/a	93.5	n/a	n/a
SC BROWN (AC)	n/a	n/a	93.5	n/a	n/a
USC BLACK (WC)	93.1	98.0	n/a	n/a	n/a
USC BLACK (AC)	93.1	98.0	n/a	n/a	n/a
USC BROWN (WC)	n/a	n/a	93.5	n/a	n/a
USC BROWN (AC)	n/a	n/a	93.5	n/a	n/a
Geothermal (HDR)	0.0	0.0	0.0	0.0	0.0
IGCC	93.1	98.0	93.5	n/a	n/a
IGCC - CCS	6.6	13.2	5.0	n/a	n/a
USC CCS BLACK (WC)	6.6	13.2	n/a	n/a	n/a
USC CCS BLACK (AC)	6.6	13.2	n/a	n/a	n/a
USC CCS BROWN (WC)	n/a	n/a	5.0	n/a	n/a
USC CCS BROWN (AC)	n/a	n/a	5.0	n/a	n/a
Nuclear	1.5	1.5	1.5	1.5	1.5

Note: WC denotes water cooled; AC denotes air cooled. CCGT = combined cycle gas turbine; OCGT = open cycle gas turbine; SC = supercritical coal; USC = ultra-supercritical coal; IGCC = integrated gasification combined cycle; CCS = carbon capture and storage. Plants with CCS capability are assumed to capture 95% of combustion emissions. Total emission factor is the sum of combustion and fugitive emission factors.

Data source: ACIL Tasman analysis

Table 41 **Emission intensity for new entrant technologies (tonnes CO_2-e per MWh sent-out)**

	QLD	NSW	VIC	SA	TAS
CCGT (AC)	0.39	0.45	0.40	0.48	0.40
CCGT (AC)	0.41	0.47	0.41	0.50	0.41
OCGT	0.66	0.76	0.66	0.81	0.66
SC BLACK (WC)	0.80	0.84	n/a	n/a	n/a
SC BLACK (AC)	0.84	0.88	n/a	n/a	n/a
SC BROWN (WC)	n/a	n/a	0.99	n/a	n/a
SC BROWN (AC)	n/a	n/a	1.05	n/a	n/a
USC BLACK (WC)	0.74	0.78	n/a	n/a	n/a
USC BLACK (AC)	0.78	0.82	n/a	n/a	n/a
USC BROWN (WC)	n/a	n/a	0.91	n/a	n/a
USC BROWN (AC)	n/a	n/a	0.96	n/a	n/a
Geothermal (HDR)	0.00	0.00	0.00	0.00	0.00
IGCC	0.82	0.86	0.82	n/a	n/a
IGCC - CCS	0.07	0.14	0.05	n/a	n/a
USC CCS BLACK (WC)	0.07	0.14	n/a	n/a	n/a
USC CCS BLACK (AC)	0.08	0.15	n/a	n/a	n/a
USC CCS BROWN (WC)	n/a	n/a	0.06	n/a	n/a
USC CCS BROWN (AC)	n/a	n/a	0.06	n/a	n/a
Nuclear	0.02	0.02	0.02	0.02	0.02

Note: WC denotes water cooled; AC denotes air cooled. CCGT = combined cycle gas turbine; OCGT = open cycle gas turbine; SC = supercritical coal; USC = ultra-supercritical coal; IGCC = integrated gasification combined cycle; CCS = carbon capture and storage. Plants with CCS capability are assumed to capture 95% of combustion emissions. Emission intensity includes fugitive emissions. Based on thermal efficiencies for 2009-10.

Data source: ACIL Tasman analysis

4.2 Fuel supply for new entrants

4.2.1 Natural gas

Since the 2007 cost report there has been significant movement in the outlook for gas prices, driven by a number of factors including:

- Steeply rising prices and widening specifications for internationally traded thermal coal which has impacted upon domestic coal prices (the main competitor for domestic gas)
- Significant increases in mining, petroleum development and construction cost indices. This has implications for the development of new fuel resources (particularly coal and offshore gas developments)
- Policy developments relating to the imminent commencement of the Carbon Pollution Reduction Scheme (CPRS) and the announced increase of the Renewable Energy Target to 60,000 GWh
- Announcement of a number of proposals to export LNG using Coal Seam Gas (CSG) as feedstock from Gladstone.
- The entrance of a number of major international oil and gas companies such as Shell, ConocoPhillips, BG Group and Petronas entering into joint

ventures with local CSG producers in a significant vote of confidence in the local industry.

While some of the cost pressures mentioned above have now abated as a result of the recent downturn in economic conditions, the outlook for domestic gas still remains significantly different than within the last generator cost report produced in early 2007. Within the last report, ACIL Tasman's analysis anticipated a highly successful CSG sector placing downward pressure on domestic prices throughout the projection period. The analysis did not however, anticipate the emergence of LNG export as a potential outlet for the abundant CSG resources.

With the prospect of being able to achieve higher netback prices by directing production into LNG manufacture, Queensland CSG producers are now much less likely than in the recent past to discount prices in order to attract domestic customers, either locally or in southern states. Due to the importance of CSG in Eastern Australia's gas supply mix, the influence of LNG export will also flow through to conventional gas pricing in southern States.

Potential for LNG export

Until recently, Eastern Australia has not been considered a prospective location for LNG manufacture, principally because uncommitted conventional gas resources in the region are inadequate to support a world-scale LNG facility. However, the surge in international energy prices through 2007 and 2008, together with the identification of large resources of CSG in southern and central Queensland, has changed the prospects for East Coast LNG. Since early 2007, six LNG proposals based on coal seam gas (CSG) feed from the Bowen and Surat Basins have been announced as detailed in Table 42.

The projects range in size from 0.5 to 4 million tonnes per year, with potential in each case for increased production with the replication of the initial liquefaction plant. Total proposed capacity is initially 16.8 Mtpa, rising to 40.6 Mtpa if plans are fully developed to their ultimate potential.

While posing many technical and commercial challenges for the proponents, there is a compelling logic to the attempts of the proponents to access large, high value international markets at a time of burgeoning demand and tight supply.

The proposed LNG developments have the potential to influence the availability of gas for domestic use. A 4 Mtpa LNG plant would require gas supply of between 225 and 250 PJ/a (after allowing for gas used in processing and transportation). In order to provide a twenty year reserve backing, such a development would therefore require dedication of up to 5,000 PJ of proven and probable gas (2P) resources. Given the rate of reserves build up over the past five years, there is every reason to believe that significantly more CSG reserves can be established. However, it is clear that the LNG proposals have the potential to divert to exports significant quantities of gas that might otherwise be available to domestic markets. This does not necessarily mean that the domestic market will be left short of supply. However it does mean that domestic supply will have to rely on higher cost, less productive sources of CSG supply sooner than would be the case in the absence of the LNG projects, which in turn has implications for domestic gas prices.

Whether or not any of these LNG proposals actually proceed to development, the fact that they offer a credible alternative market pathway for local gas suppliers means that they are already starting to impact on domestic gas prices.

Table 42 **Overview of Queensland LNG export proposals**

Proponent	Announced	Capacity	Schedule for first cargoes	Gas feed required	Liquefaction Technology	Comments
Arrow Energy / Shell	May-07	1.3 Mtpa	2011	78 PJ/a	Unknown	Project located at Fisherman's Landing Gladstone. Estimated capital costs of US$400 million. Potential for a second train of the same size. FID originally anticipated late 2008.
Santos/Petronas	Jul-07	3-4 Mtpa	Early 2014	170-220 PJ/a	ConocoPhillips Optimised Cascade	Target Final Investment Decision by the end of 2009. The project will initially produce 3 to 4 Mtpa, with a maximum potential production of 10 Mtpa. Reported capital cost of $7.7 billion. In May 2008 Santos sold a 40% interest in the GLNG project to Petronas for US$2.008 billion plus US$500 million upon FID of GLNG Train 2 using JV gas
Sojitz	Dec-07	0.5 Mtpa	Early 2012	30 PJ/a	Unknown	Proposed LNG plant at Fisherman's Landing Gladstone, previously joint ventured with Sunshine Gas. FID initially intended for end 2008, with first cargoes in early 2012. Train size of 0.5 Mtpa which can be developed as modules. Takeover of Sunshine Gas by QGC and subsequently BG may result in Sojitz looking for other feedstock gas.
BG Group	Feb-08	3-4 Mtpa	Early 2014	170-220 PJ/a	ConocoPhillips Optimised Cascade	Final investment decision scheduled for early 2010. Initial design for 3-4 Mtpa, with potential expansion to up to 12 Mtpa subject to additional gas reserves. Estimated capital cost of $8 billion including 380km pipeline. Initally a joint venture between QGC and BG Group, BG has since acquired QGC.
LNG Impel	May-08	0.7-1.3 Mtpa	2013	42-78 PJ/a	Unknown	To be constructed in modules of between 0.7 and 1.3 Mtpa. Site at Curtis Island has been scoped for up to 3 trains. Open-access LNG plant projects to be designed on a toll for service basis with 15 to 20 year contracts
Origin/ConocoPhillips	Sep-08	3.5 Mtpa x 2	Early 2014	195 PJ/a x 2	ConocoPhillips Optimised Cascade	ConocoPhillips to invest A$9.6 billion for a 50% share in CSG to LNG project proposed for Gladstone. Plans for ultimately up to 4 x 3.5 Mtpa LNG trains. 50/50 joint venture alignment for whole project.

Data source: ACIL Tasman based on company announcements

Gas market scenario

In projecting gas prices available for generation, ACIL Tasman has utilised its proprietary *GasMark* model. GasMark incorporates a complete input database containing data and assumptions for every gas producing field, transmission pipeline and major load/demand centre in Australia.

The scenario used for this exercise represents ACIL Tasman's base case view on supply and load developments throughout Eastern Australia over the period 2009-10 to 2028-29. It includes the development of two LNG export facilities of 4 Mtpa each, with assumed start-up in 2014 and 2018.

On the demand-side the scenario includes assumed growth in domestic demand, both through large industrial loads and general growth in reticulated gas to residential and commercial premises. The total assumed growth in gas demand – excluding NEM-scheduled power generation – is relatively modest at around 130 PJ/a (growth rate of 2.6% per annum).

The supply assumptions include all existing and known, but undeveloped field developments and an assessment of undiscovered conventional and yet-to-be certified CSG resources.

For each NEM zone a network node has been selected that reflects the likely location for additional NEM scheduled generation. The gas network locations for each NEM zone are detailed in Table 43. Where pipelines don't currently exist to these zones, the costs reflect an estimate for a new build pipeline to service power generation loads.

Table 43 **NEM zones and gas price points**

NEM zone	Location on gas network
NQ	Townsville
CQ	Gladstone
SEQ	Swanbank
SWQ	Braemar
NNSW	Tamworth
NCEN	Wilton
SWNSW	Wagga
CAN	Canberra
NVIC	Chiltern
LV	Latrobe
MEL	Melbourne
CVIC	Geelong
NSA	Port Pirie
ADE	Adelaide
SESA	Ladbroke
TAS	Bell Bay

Table 44 shows the projected delivered gas prices for new CCGT and OCGT plant in each NEM zone in real 2009-10 $/GJ. For CCGT plant the delivered cost assumes a gas load factor of 80% (for transportation costs). Prices for OCGT plant are at a premium to CCGT costs, reflecting higher transportation and commodity costs for low gas load factor users.

Prices in 2009-10 reflect a significant premium over historical gas prices under existing contracts. This reflects the existing state of the market, whereby significant upstream consolidation has occurred and those players that remain are primarily focussed upon developing LNG export projects. Anecdotal evidence suggests that gas producers have already begun to raise price expectations ahead of the introduction of the CPRS and LNG export projects being sanctioned.

Prices are projected to increase slightly in real terms, converging to what could be considered a new long term equilibrium level with the inclusion of significant LNG export facilities.

The following section examines existing gas resources and how gas prices might be expected to vary as demand from power generation changes.

Table 44 **Estimated delivered gas costs for new entrant CCGT and OCGT by NEM zone (Real $/GJ)**

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
New CCGT																				
New_CCGT_NQ	5.37	5.34	5.04	5.49	5.50	5.52	5.54	5.55	5.56	5.57	5.59	5.60	5.63	5.64	5.64	5.66	5.71	5.71	5.90	5.90
New_CCGT_CQ	5.44	5.41	5.00	5.04	5.47	5.45	5.45	5.50	5.78	5.79	5.82	5.84	5.87	5.88	5.88	5.91	5.96	5.96	6.15	6.16
New_CCGT_SEQ	5.17	4.58	4.60	4.62	4.65	4.67	4.69	4.71	4.73	4.75	4.76	4.79	4.81	4.83	4.85	4.86	4.89	4.92	4.95	4.97
New_CCGT_SWQ	4.70	4.69	4.20	4.22	4.38	4.39	4.41	4.44	4.74	4.78	4.83	4.83	4.88	4.91	4.93	4.95	4.98	5.04	5.19	5.21
New_CCGT_NNSW	4.00	4.14	4.16	4.18	4.21	4.23	4.25	4.27	4.29	4.31	4.32	4.34	4.36	4.39	4.41	4.42	4.45	4.47	4.50	4.53
New_CCGT_NCEN	5.81	5.54	5.50	5.48	5.49	5.51	5.52	5.53	5.60	5.68	5.78	5.78	5.84	5.87	5.96	6.16	6.20	6.31	6.43	6.64
New_CCGT_SWNSW	5.92	5.98	6.02	5.99	6.00	6.02	6.03	6.03	6.10	6.18	6.27	6.27	6.32	6.36	6.45	6.64	6.68	6.78	6.91	7.11
New_CCGT_CAN	5.46	5.31	5.23	5.25	5.27	5.29	5.30	5.31	5.38	5.47	5.56	5.56	5.62	5.74	5.75	5.96	6.03	6.16	6.49	6.70
New_CCGT_NVIC	5.32	5.35	5.41	5.43	5.45	5.48	5.78	5.81	5.92	6.12	6.21	6.21	6.21	6.40	6.42	6.63	6.70	6.84	7.17	7.38
New_CCGT_LV	4.46	4.47	4.50	4.52	4.54	4.56	4.87	4.90	5.01	5.21	5.30	5.30	5.30	5.49	5.51	5.72	5.79	5.93	6.26	6.47
New_CCGT_MEL	4.81	4.83	4.87	4.89	4.92	4.94	5.25	5.28	5.38	5.59	5.68	5.68	5.68	5.87	5.89	6.10	6.17	6.30	6.63	6.85
New_CCGT_CVIC	4.58	4.58	4.60	4.63	4.92	4.94	5.25	5.28	5.38	5.59	5.68	5.68	5.68	5.87	5.89	6.10	6.17	6.30	6.60	6.67
New_CCGT_NSA	5.65	5.64	5.66	5.68	5.96	5.98	6.28	6.30	6.40	6.60	6.68	6.67	6.67	6.85	6.86	7.07	7.13	7.26	7.55	7.61
New_CCGT_ADE	5.44	5.43	5.44	5.47	5.75	5.77	6.07	6.09	6.19	6.39	6.47	6.47	6.46	6.65	6.66	6.86	6.93	7.06	7.35	7.41
New_CCGT_SESA	5.05	5.04	5.06	5.09	5.37	5.39	5.70	5.73	5.83	6.03	6.11	6.11	6.11	6.30	6.31	6.52	6.59	6.72	7.01	7.08
New_CCGT_TAS	5.28	5.28	5.30	5.33	5.35	5.37	5.68	5.71	5.81	6.02	6.11	6.11	6.11	6.30	6.32	6.53	6.60	6.74	7.06	7.23
New OCGT																				
New_OCGT_NQ	6.72	6.68	6.29	6.86	6.88	6.90	6.92	6.93	6.95	6.96	6.99	7.00	7.04	7.05	7.04	7.08	7.13	7.13	7.37	7.37
New_OCGT_CQ	6.80	6.77	6.26	6.30	6.83	6.82	6.82	6.87	7.22	7.24	7.28	7.30	7.34	7.35	7.35	7.39	7.45	7.45	7.69	7.70
New_OCGT_SEQ	6.46	5.72	5.75	5.78	5.81	5.84	5.87	5.89	5.91	5.93	5.95	5.98	6.01	6.03	6.06	6.08	6.11	6.15	6.18	6.22
New_OCGT_SWQ	5.87	5.87	5.25	5.28	5.47	5.49	5.51	5.55	5.93	5.97	6.04	6.04	6.11	6.14	6.17	6.19	6.23	6.31	6.49	6.52
New_OCGT_NNSW	4.99	5.17	5.20	5.23	5.26	5.29	5.32	5.34	5.36	5.38	5.40	5.43	5.45	5.48	5.51	5.53	5.56	5.59	5.63	5.67
New_OCGT_NCEN	7.27	6.93	6.88	6.85	6.87	6.89	6.91	6.92	7.00	7.10	7.22	7.22	7.29	7.34	7.45	7.69	7.75	7.88	8.04	8.30
New_OCGT_SWNSW	7.40	7.48	7.52	7.48	7.50	7.52	7.53	7.54	7.62	7.72	7.84	7.83	7.91	7.95	8.06	8.30	8.35	8.48	8.63	8.89
New_OCGT_CAN	6.82	6.64	6.54	6.57	6.59	6.61	6.63	6.64	6.72	6.83	6.95	6.95	7.03	7.17	7.19	7.45	7.53	7.70	8.11	8.38
New_OCGT_NVIC	6.65	6.69	6.76	6.79	6.82	6.84	7.23	7.27	7.40	7.65	7.76	7.76	7.76	8.00	8.03	8.29	8.38	8.55	8.96	9.23
New_OCGT_LV	5.58	5.58	5.62	5.65	5.68	5.71	6.09	6.13	6.26	6.52	6.63	6.63	6.63	6.87	6.89	7.15	7.24	7.41	7.82	8.09
New_OCGT_MEL	6.01	6.03	6.09	6.12	6.15	6.18	6.56	6.60	6.73	6.99	7.10	7.10	7.10	7.34	7.36	7.62	7.71	7.88	8.29	8.56
New_OCGT_CVIC	5.72	5.72	5.75	5.79	6.15	6.18	6.56	6.60	6.73	6.99	7.10	7.10	7.10	7.34	7.36	7.62	7.71	7.88	8.24	8.33
New_OCGT_NSA	7.07	7.05	7.07	7.11	7.45	7.47	7.85	7.88	8.00	8.25	8.35	8.34	8.33	8.56	8.58	8.83	8.91	9.08	9.43	9.51
New_OCGT_ADE	6.79	6.78	6.80	6.84	7.19	7.21	7.59	7.62	7.74	7.99	8.09	8.08	8.08	8.31	8.33	8.58	8.66	8.83	9.18	9.27
New_OCGT_SESA	6.31	6.30	6.32	6.36	6.72	6.74	7.12	7.16	7.28	7.54	7.64	7.64	7.64	7.87	7.89	8.15	8.24	8.40	8.76	8.85
New_OCGT_TAS	6.60	6.60	6.63	6.66	6.69	6.71	7.10	7.14	7.27	7.52	7.63	7.63	7.63	7.87	7.90	8.16	8.25	8.42	8.83	9.04

Note: Real 2009-10 dollars

Data source: ACIL Tasman estimates

Gas resources

Table 45 details the current gas reserves for each of the NEM states for both conventional natural gas (at the 2P level) and CSG (at 2P and 3P levels).[12] The aggregate reserves in Eastern Australia total around 27,000 PJ at the 2P level, of which, CSG accounts for around 57%. There are also significant gas volumes currently reported as contingent reserves – somewhere in the order of a further 50,000 PJ in Queensland which may be proven up over time.

Table 45 **Current gas reserves by NEM region (PJ)**

Region	Conventional reserves (2P)	CSG reserves (2P)	CSG reserves (3P)
QLD	458	14,729	33,094
NSW	0	900	3,329
VIC	9,695	0	0
SA	871	0	0
TAS	430	0	0
Total	**11,455**	**15,629**	**36,422**

Note: 2P = proven and probable reserves; 3P = proven, probable and possible reserves. Current as at December 2008.

Data source: ACIL Tasman compilation of company reporting

Since the last iteration of this report produced in early 2007, aggregate CSG reserves have increased by around 350% at the 2P level and by around 270% at the 3P level. Over the same time conventional gas reserves have declined slightly.

The majority of this CSG resource is located in Queensland, although NSW does have access to large areas of prospective coal-bearing acreage. The majority of conventional gas reserves are located in the offshore Gippsland and Otway Basins of Victoria.

Based upon the above reserve numbers and the level of LNG export assumed within this scenario, ACIL Tasman does not see gas availability to be a constraining factor for gas-fired developments in the NEM. Given the distribution of resources however, it is increasingly likely that CSG, primarily from Queensland but also from NSW to a lesser extent, will be required to be transported to southern regions.

While there is no logical limit to the amount of gas-fired capacity that can be developed in any one NEM zone (pipeline capacity can be easily augmented in the majority of circumstances), the sheer size of potential gas-fired generation developments may result in changes to the overall price level for gas. The gas prices presented in the previous section are the result of a gas scenario which

[12] Conventional reserves are generally not reported at the 3P level.

included gas demand derived from ACIL Tasman electricity market modelling. It should be recognised that the modelling that NEMMCO is undertaking may result in a different level of gas-fired generation than that assumed within the ACIL Tasman GasMark scenario.

To examine whether changes in gas demand for power generation has a material impact upon modelled price outcomes, ACIL Tasman has constructed a gas price index for Eastern Australia based upon weighted nodal prices in each State. A number of different demand scenarios were then constructed by varying the level of gas demand from CCGT developments in the NEM. Gas price indices were also constructed for these scenarios.

Table 46 details the results of the gas analysis and the resulting gas price index under a range of different demand points for two separate spot years: 2013-14 and 2023-24. As shown in Table 46 gas price outcomes are relatively stable for moderate level of CCGT development, however these increase rapidly once gas penetration becomes significant. At high levels of CCGT development, gas consumption in other sectors such as industrial and commercial applications becomes increasingly constrained. In the most extreme demand scenarios, CCGT development also begins to restrict LNG exports, with resulting prices rising accordingly.

Table 46 **Gas price index as a function of gas demand**

Installed CCGT (MW)	0	4,000	8,000	12,000	16,000	20,000	30,000
Implied additional gas consumption (PJ/a)	0	200	400	600	800	1,000	1,500
Index 2013-14	0.99	1.04	1.11	1.13	1.24	1.37	2.42
Index 2023-24	0.93	1.00	1.10	1.13	1.27	1.36	1.72

Note: Implied gas consumption based on 25PJ/a per 500 MW of CCGT capacity running at approx 85% capacity factor
Data source: ACIL Tasman analysis

The index is designed to be used as a multiplier to the gas prices provided in Table 44 for each demand tranche. Once each tranche is utilised, prices would rise according to the multiplier for subsequent gas-fired developments. While Table 46 provides for seven different tranches, it may be prudent to aggregate these into a smaller number of tranches to ease analysis. In addition, while the indices have been provided for two spot years, the differences between them are relatively small (aside from the extreme demand case), and hence it may also be easier to assume that the same index applies for all years across the 20 year timeframe.

One shortcoming of this approach is that the price relativities between NEM zones will remain constant, which in reality may not occur due to the changes in network flows.

The number, size and location of OCGT peaking plant should not be limited by availability of gas as generally OCGTs will be dual fuelled using distillate when gas may not be available at critical high price times. It is not generally economically viable for a peaking plant to reserve adequate firm pipeline capacity for the low level of operation for the very limited times when high price electricity events may occur. OCGT plants are more likely to be established with lower cost interruptible pipeline capacity and distillate as a backup fuel. The location of peaking plant will normally be determined by consideration of access to flexible gas supplies, shape of the electricity load, transmission constraints and access to generation sites.

4.2.2 Coal

Examination of quality and location of coal resources in each of the 16 zones suggests that only seven zones would be suitable for locating new coal fired capacity; three in Queensland, three in NSW and one in Victoria. This is illustrated in Table 47.

Table 47 **NEM zones where coal fired generation is an option**

Zone	Coal source	Possible power station locations	Potential
NQ	Northern Bowen Basin (Lake Elphinstone, Nebo West, Bee Creek, and others)	via Nebo	Several economic coal deposits which could support further new base load generation but would compete with export market
	Northern Galilee Basin (Pentland)	250km west of Collinsville	Significant open cut resource with no export infrastructure
CQ	Central Bowen Basin (Minerva, Togara, Valeria, Ensham, Cullin-la-ringo, and others)	via Emerald	A number of economic coal deposits which could support further new base load generation but would compete with the export market
	Southern Galilee Basin (Alpha, Kevins Corner)	via Alpha - west of Emerald	Significant low strip-ratio resource with no coal export infrastructure
SWQ	Surat Basin (Felton and New Acland in the east and around Chinchilla and Wandoan in the west and others in between)	Many options all along the Surat Basin west of Toowoomba	Extensive low cost coal reserves which could support significant additional new base load generation and only very limited export Infrastructure
NNS	Gunnedah Basin (Maules Creek, Boggabri)	Between Narrrabri and Gunnedah	Extensive undeveloped mainly underground thermal coal deposits with limited export infrastructure
NCEN	Hunter and Western (Ulan, Bylong, Anvil Hill, Saddlers Creek and others)	Ulan/Muswellbrook	Many well located undeveloped coal deposits which could support additional new base load generation
SWNSW	Oaklands	Oaklands, 100km west of Albury	Large low strip ratio deposit suitable for large power station development
LV	Latrobe Valley	Latrobe Valley	Estimated useable reserve of 50,000 million tonnes which could support significant additional new base load generation

Data source: ACIL Tasman assessment

Table 47 also identifies the potential for additional base load coal fired capacity in each of the zones. The zones with greatest potential for additional coal fired generation are SWQ based on the extensive low cost black coal deposits in the

Surat Basin and LV in based on an estimated 50,000 million tonnes of usable brown coal resources. NQ, CQ and NCEN all contain significant coal resources that could support significant further coal-fired generation.

Some NEM zones contain coal resources (such as MEL between Melbourne and Bacchus Marsh and CVIC at Anglesea), but the amount of the economic recoverable coal and the fact that there has been no interest shown in locating a new coal fired power station in these areas, has led to the conclusion that these areas are not likely sites for new coal fired generation.

Undeveloped deposits in NSA around Leigh Creek and central Eyre Peninsula, because of their location, quality and mineability, are regarded as non-economic as a fuel source for a new base load station in the NEM.

Table 49 shows the most likely coal deposits which could economically supply coal to a major base load generator and the potential number of 500 MW units which could potentially be installed in the coming 10 and 20 years.

Based on a high level assessment of the potential coal resources and associated mining costs and using industry knowledge and deposit information, the projected cost of coal to new entrants in each NEM zone is shown in Table 48.

Table 48 **Projection of coal costs for new entrant stations ($/GJ)**

	NQ	CQ	SWQ	NNS	NCEN	SWNSW	LV
2009-10	1.84	1.41	1.47	1.54	1.30	1.06	0.57
2010-11	1.89	1.42	1.49	1.55	1.31	1.08	0.58
2011-12	1.93	1.44	1.52	1.57	1.33	1.11	0.60
2012-13	1.98	1.45	1.55	1.59	1.34	1.14	0.61
2013-14	2.03	1.46	1.57	1.61	1.36	1.16	0.62
2014-15	2.08	1.48	1.60	1.63	1.38	1.19	0.64
2015-16	2.13	1.49	1.63	1.65	1.39	1.22	0.65
2016-17	2.18	1.50	1.66	1.67	1.41	1.25	0.67
2017-18	2.23	1.51	1.69	1.69	1.43	1.29	0.68
2018-19	2.28	1.53	1.72	1.71	1.44	1.32	0.70
2019-20	2.34	1.54	1.75	1.73	1.46	1.35	0.71
2020-21	2.40	1.56	1.78	1.75	1.48	1.38	0.73
2021-22	2.46	1.57	1.81	1.77	1.50	1.42	0.74
2022-23	2.51	1.59	1.84	1.79	1.52	1.45	0.76
2023-24	2.58	1.61	1.88	1.81	1.53	1.49	0.78
2024-25	2.64	1.64	1.91	1.84	1.55	1.53	0.80
2025-26	2.70	1.67	1.95	1.86	1.57	1.57	0.81
2026-27	2.77	1.70	1.98	1.88	1.59	1.61	0.83
2027-28	2.84	1.72	2.02	1.90	1.61	1.65	0.85
2028-29	2.90	1.75	2.06	1.93	1.63	1.69	0.87

Note: Real 2009-10 dollars. Assumes prices under existing contracts escalate at 90% of CPI

Data source: ACIL Tasman analysis

Table 49 **Summary of potential black coal deposits suitable for large scale base load generation**

Zone	Deposit	Basin	Location	Resource (Mt)	Specific energy (GJ/t as)	Resource (PJ)	Strip ratio (bcm/ ROM t)	Mining method	Estimated ROM mining cost (2009-10 $/GJ)	MW Supported[1]	Number of potential 500MW units over next 10 years	Number of potential 500MW units over next 20 years
NQ	Pentland[2]	Galilee	220km SW Townsville	645	18.0	11,610	4.7	OC	1.50	4,102	0	3
CQ	Alpha	Galilee	55km N Alpha	665	25.7	17,100	2.6	OC	0.89	6,042	2	4
	Kevins Corner[2]	Galilee	70km N Alpha	910	24.8	22,612	4.2	OC	1.05	7,990	2	4
SWQ	Felton[2]	Clarence-Moreton	40km SW Toowoomba	1,090	15.5	16,910	3.4	OC	1.57	5,975	2	4
	New Acland	Clarence-Moreton	12km N Oakey	328	20.2	6,623	2.6	OC	1.13	2,340	0	2
	Horse Creek[2]	Surat	25km N Chinchilla	295	24.6	7,258	7.7	OC	1.34	2,565	0	2
	Wandoan[2,3]	Surat	60km N Miles	1,893	20.5	38,713	4.1	OC	1.27	13,680	4	6
NNS	Maules Creek	Gunnedah	20km NE Boggabri	520	27.9	14,508	na	OC	<1.30	5,127	0	2
	Boggabri	Gunnedah	17km NE Boggabri	576	28.3	16,301	na	OC & UG	~1.30	5,760	0	2
	Caroona	Gunnedah	256km S Gunnedah	930	27.6	25,668	na	OC & UG	~1.30	9,070	0	2
	Narabri	Gunnedah	SW Narrabri	1,205	27.9	33,620	na	UG	>1.30	11,880	0	4
NCN	Moorlarben	Sydney	45km NE Mudgee	453	23.0	10,419	na	OC & UG	>1.20	3,682	2	3
	Ulan	Sydney	40km NE Mudgee	847	23.0	19,481	na	OC & UG	<1.20	6,884	2	4
SWNSW	Oaklands	Oaklands	100km W Albury	880	17.5	15,400	4.0	OC	1.20	5,442	2	4

Note: SE (a.s.) = specific energy (as supplied); ROM = 'Run of mine' (raw)
1. Based on PS life of 40 years @ 85% CF and 9.5GJ/MWh (2.83PJ/MW)
2. Resource based on "Measured" + "Indicated"
3. Austinvale, Woleebee and Summer Hill (640Mt) - additional 165Mt for Frank Creek, Wubagul and Glen Laurel
Data source: *ACIL Tasman assessment based on a variety of data sources*

4.2.3 Nuclear

In 2006 the Prime Ministerial Uranium Mining, Processing and Nuclear Energy Review (UMPNER) Task Force engaged the Electric Power Research Institute (EPRI) to conduct an independent review and analysis of nuclear energy in the Australian context.

As reported by the EPRI[13], estimates of nuclear fuel costs vary across a number of previous studies examined by the report. Within this study we have adopted the estimate from the Gittus report prepared for the Australian Nuclear Science and Technology Organisation of $4.65/MWh, given that the report was prepared in an Australian context. This value has been escalated to 2009-10 prices, yielding a fuel cost of $4.90/MWh sent-out. This equates to approximately $0.46/GJ based upon the sent-out thermal efficiency of 34% (as detailed in Table 36).

4.3 SRMC for new entrant technologies

Table 50 provides the projected SRMC for each new entrant technology by NEM zone excluding carbon costs. These costs vary across regions for the same technology due to differences in fuel costs. The calculated SRMC is comprised of fuel and VOM costs.

Table 51 provides the projected SRMC for each new entrant technology by NEM zone including carbon costs (using emission permit prices as set out in Table 5).

[13] Electric Power Research Institute, *Review and Comparison of Recent Studies for Australian Electricity Generation Planning*, October 2006

Table 50 **Projected SRMC for new entrant technologies excluding carbon costs (Real 2009-10 $/MWh as generated)**

Technology and Zone	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
CCGT (WC)_NQ	37.67	37.48	34.72	37.74	37.17	37.29	37.39	36.79	36.86	36.94	37.10	37.16	37.35	36.73	36.72	36.88	37.18	37.18	38.36	38.38
CCGT (WC)_CQ	38.12	37.95	34.52	34.76	36.92	36.85	36.85	36.46	38.29	38.39	38.58	38.67	38.88	38.26	38.27	38.46	38.77	38.80	40.01	40.04
CCGT (WC)_SEQ	36.29	32.25	31.82	31.98	31.56	31.72	31.86	31.40	31.51	31.64	31.75	31.89	32.01	31.60	31.74	31.84	32.01	32.17	32.35	32.53
CCGT (WC)_SWQ	33.07	33.04	29.14	29.30	29.79	29.87	30.00	29.66	31.61	31.85	32.17	32.19	32.53	32.15	32.27	32.41	32.59	32.98	33.90	34.05
CCGT (WC)_NNSW	28.28	29.24	28.86	29.02	28.66	28.82	28.96	28.56	28.67	28.79	28.90	29.04	29.17	28.81	28.95	29.04	29.21	29.37	29.56	29.73
CCGT (WC)_NCEN	40.69	38.82	37.86	37.68	37.11	37.22	37.31	36.72	37.13	37.67	38.28	38.27	38.66	38.20	38.78	40.01	40.30	40.97	41.75	43.09
CCGT (WC)_SWNSW	41.41	41.82	41.29	41.10	40.44	40.54	40.61	39.93	40.35	40.88	41.47	41.44	41.81	41.29	41.86	43.07	43.34	43.99	44.76	46.09
CCGT (WC)_CAN	38.24	37.26	36.06	36.18	35.64	35.76	35.86	35.30	35.72	36.27	36.89	36.89	37.29	37.36	37.45	38.76	39.20	40.06	42.12	43.46
CCGT (WC)_NVIC	37.31	37.52	37.21	37.36	36.84	36.99	39.01	38.51	39.18	40.51	41.08	41.08	41.08	41.58	41.69	43.02	43.47	44.34	46.42	47.77
CCGT (WC)_LV	31.47	31.50	31.12	31.27	30.86	31.01	33.03	32.64	33.30	34.64	35.21	35.21	35.21	35.81	35.93	37.25	37.70	38.57	40.65	42.01
CCGT (WC)_MEL	33.81	33.95	33.63	33.78	33.33	33.48	35.50	35.07	35.73	37.06	37.63	37.63	37.63	38.20	38.31	39.63	40.09	40.96	43.03	44.39
CCGT (WC)_CVIC	32.25	32.24	31.80	32.02	33.33	33.48	35.50	35.07	35.73	37.06	37.63	37.63	37.63	38.20	38.31	39.63	40.09	40.96	42.80	43.25
CCGT (WC)_NSA	39.58	39.51	38.89	39.06	40.19	40.30	42.27	41.67	42.29	43.58	44.10	44.06	44.01	44.42	44.49	45.77	46.18	47.01	48.81	49.23
CCGT (WC)_ADE	38.10	38.04	37.45	37.64	38.79	38.91	40.89	40.32	40.95	42.24	42.77	42.73	42.70	43.13	43.21	44.50	44.91	45.75	47.56	47.98
CCGT (WC)_SESA	35.44	35.40	34.89	35.09	36.32	36.45	38.45	37.95	38.59	39.91	40.46	40.44	40.42	40.92	41.01	42.32	42.75	43.61	45.44	45.87
CCGT (WC)_TAS	37.06	37.04	36.52	36.67	36.16	36.31	38.33	37.84	38.51	39.84	40.41	40.41	40.41	40.93	41.04	42.36	42.81	43.69	45.76	46.84
CCGT (AC)_NQ	38.15	37.95	35.13	38.18	37.58	37.70	37.80	37.17	37.24	37.33	37.48	37.55	37.74	37.09	37.07	37.24	37.54	37.54	38.74	38.75
CCGT (AC)_CQ	38.60	38.43	34.92	35.17	37.33	37.26	37.26	36.84	38.68	38.78	38.99	39.08	39.29	38.63	38.64	38.83	39.15	39.18	40.40	40.44
CCGT (AC)_SEQ	36.74	32.65	32.19	32.35	31.90	32.06	32.20	31.72	31.83	31.96	32.07	32.21	32.34	31.90	32.04	32.14	32.31	32.47	32.66	32.84
CCGT (AC)_SWQ	33.48	33.45	29.48	29.63	30.12	30.19	30.33	29.96	31.94	32.17	32.50	32.52	32.86	32.45	32.58	32.72	32.91	33.30	34.22	34.38
CCGT (AC)_NNSW	28.62	29.60	29.19	29.36	28.97	29.13	29.27	28.85	28.96	29.08	29.19	29.33	29.46	29.08	29.22	29.31	29.49	29.65	29.84	30.01
CCGT (AC)_NCEN	41.20	39.31	38.31	38.13	37.52	37.63	37.73	37.10	37.51	38.06	38.68	38.67	39.06	38.58	39.16	40.41	40.70	41.37	42.16	43.51
CCGT (AC)_SWNSW	41.94	42.35	41.78	41.58	40.89	40.99	41.06	40.35	40.77	41.31	41.91	41.87	42.25	41.70	42.27	43.50	43.77	44.43	45.20	46.54
CCGT (AC)_CAN	38.72	37.73	36.48	36.60	36.03	36.15	36.26	35.66	36.09	36.65	37.27	37.27	37.67	37.72	37.82	39.14	39.58	40.45	42.53	43.89
CCGT (AC)_NVIC	37.78	37.99	37.65	37.80	37.25	37.40	39.44	38.92	39.59	40.94	41.51	41.51	41.51	41.99	42.10	43.44	43.90	44.78	46.88	48.25
CCGT (AC)_LV	31.86	31.89	31.48	31.63	31.19	31.34	33.39	32.97	33.65	35.00	35.57	35.57	35.57	36.16	36.27	37.61	38.07	38.95	41.05	42.42
CCGT (AC)_MEL	34.23	34.37	34.02	34.18	33.69	33.84	35.89	35.43	36.10	37.45	38.02	38.02	38.02	38.57	38.68	40.02	40.48	41.36	43.45	44.83
CCGT (AC)_CVIC	32.65	32.63	32.17	32.39	33.69	33.84	35.89	35.43	36.10	37.45	38.02	38.02	38.02	38.57	38.68	40.02	40.48	41.36	43.22	43.68
CCGT (AC)_NSA	40.07	40.01	39.35	39.53	40.64	40.75	42.74	42.11	42.73	44.04	44.56	44.52	44.48	44.86	44.93	46.23	46.64	47.48	49.30	49.72
CCGT (AC)_ADE	38.58	38.52	37.90	38.08	39.22	39.34	41.34	40.74	41.37	42.69	43.22	43.18	43.14	43.56	43.63	44.94	45.36	46.20	48.03	48.46
CCGT (AC)_SESA	35.88	35.85	35.30	35.50	36.72	36.85	38.88	38.34	38.99	40.33	40.88	40.86	40.84	41.32	41.41	42.74	43.18	44.04	45.88	46.33
CCGT (AC)_TAS	37.52	37.51	36.95	37.10	36.56	36.71	38.75	38.24	38.91	40.26	40.84	40.84	40.84	41.33	41.44	42.78	43.24	44.12	46.21	47.30
OCGT_NQ	84.84	82.03	77.73	83.99	84.23	82.15	82.35	82.50	82.64	80.61	80.92	81.05	81.43	79.38	79.35	79.69	80.27	78.26	80.58	80.60
OCGT_CQ	85.78	82.99	77.29	77.80	83.71	81.26	81.25	81.81	85.62	83.53	83.94	84.12	84.54	82.46	82.47	82.85	83.49	81.42	83.79	83.86
OCGT_SEQ	81.92	71.35	71.68	72.01	72.34	70.70	70.99	71.22	71.44	69.82	70.04	70.33	70.59	69.07	69.35	69.54	69.89	68.46	68.83	69.17
OCGT_SWQ	75.13	72.97	66.11	66.44	68.60	66.90	67.18	67.55	71.65	70.24	70.91	70.95	71.63	70.16	70.42	70.69	71.06	70.05	71.85	72.15
OCGT_NNSW	65.04	65.20	65.53	65.86	66.19	64.74	65.03	65.25	65.48	64.03	64.26	64.54	64.80	63.45	63.73	63.92	64.27	63.00	63.37	63.71
OCGT_NCEN	91.19	84.77	84.25	83.88	84.10	82.01	82.21	82.34	83.20	82.08	83.32	83.30	84.08	82.34	83.50	85.98	86.56	85.67	87.19	89.81
OCGT_SWNSW	92.72	90.88	91.38	90.98	91.17	88.84	88.98	89.08	89.94	88.60	89.81	89.74	90.50	88.54	89.68	92.13	92.67	91.58	93.07	95.67
OCGT_CAN	86.03	81.59	80.50	80.75	80.99	79.01	79.23	79.37	80.25	79.24	80.49	80.49	81.30	80.64	80.83	83.46	84.35	83.89	87.92	90.54
OCGT_NVIC	84.08	82.12	82.90	83.22	83.53	81.54	85.69	86.10	87.49	87.86	89.01	89.01	89.01	89.13	89.35	92.02	92.93	92.26	96.32	98.97
OCGT_LV	71.77	69.82	70.22	70.53	70.85	69.24	73.39	73.80	75.19	75.92	77.08	77.08	77.08	77.54	77.76	80.42	81.33	80.99	85.04	87.69
OCGT_MEL	76.69	74.82	75.45	75.77	76.09	74.32	78.47	78.88	80.27	80.85	82.01	82.01	82.01	82.32	82.55	85.21	86.12	85.64	89.70	92.35
OCGT_CVIC	73.41	71.32	71.64	72.10	76.09	74.32	78.47	78.88	80.27	80.85	82.01	82.01	82.01	82.32	82.55	85.21	86.12	85.64	89.25	90.13

Technology and Zone	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
OCGT_NSA	88.85	86.18	86.39	86.76	90.63	88.34	92.39	92.71	94.00	94.09	95.15	95.06	94.97	94.84	94.97	97.55	98.38	97.48	101.00	101.81
OCGT_ADE	85.74	83.18	83.41	83.79	87.68	85.49	89.55	89.89	91.19	91.37	92.45	92.37	92.29	92.25	92.40	94.99	95.83	95.01	98.55	99.37
OCGT_SESA	80.13	77.79	78.06	78.49	82.43	80.43	84.54	84.92	86.26	86.63	87.75	87.71	87.67	87.80	87.98	90.61	91.49	90.83	94.40	95.25
OCGT_TAS	83.54	81.14	81.45	81.77	82.09	80.14	84.29	84.70	86.09	86.50	87.65	87.65	87.65	87.81	88.03	90.70	91.61	90.98	95.03	97.14
SC BLACK (WC)_NQ	15.76	15.75	15.74	15.39	15.38	15.37	15.36	15.35	15.34	15.32	15.31	15.30	15.29	14.96	14.95	14.94	14.93	14.92	14.91	14.90
SC BLACK (AC)_NQ	16.13	16.12	16.11	15.73	15.72	15.71	15.70	15.69	15.68	15.67	15.66	15.65	15.64	15.28	15.27	15.26	15.25	15.24	15.23	15.22
SC BLACK (AC)_CQ	12.63	12.45	12.28	11.83	11.67	11.50	11.33	11.16	11.00	10.85	10.70	10.56	10.41	10.05	9.98	9.91	9.84	9.78	9.71	9.64
SC BLACK (AC)_SWQ	13.10	13.00	12.91	12.54	12.46	12.37	12.29	12.21	12.13	12.05	11.98	11.91	11.84	11.51	11.44	11.38	11.31	11.24	11.18	11.14
SC BLACK (AC)_NNSW	13.64	13.48	13.33	12.88	12.73	12.58	12.43	12.29	12.14	11.99	11.85	11.72	11.59	11.21	11.09	10.96	10.84	10.72	10.60	10.48
SC BLACK (AC)_NCEN	11.69	11.56	11.43	11.05	10.93	10.81	10.68	10.56	10.44	10.32	10.19	10.08	9.98	9.66	9.56	9.45	9.35	9.25	9.15	9.05
SC BLACK (AC)_SWNSW	9.72	9.72	9.72	9.51	9.51	9.51	9.51	9.51	9.51	9.51	9.51	9.51	9.51	9.32	9.32	9.32	9.32	9.32	9.32	9.32
SC BROWN (WC)_LV	6.59	6.58	6.57	6.55	6.39	6.37	6.36	6.35	6.33	6.32	6.31	6.30	6.28	6.27	6.26	6.25	6.23	6.08	6.07	6.06
SC BROWN (AC)_LV	6.82	6.81	6.79	6.78	6.59	6.58	6.57	6.55	6.54	6.53	6.51	6.50	6.49	6.47	6.46	6.45	6.43	6.27	6.25	6.24
USC BLACK (WC)_NQ	14.86	14.85	14.55	14.54	14.53	14.23	14.22	14.21	13.93	13.92	13.91	13.65	13.64	13.63	13.37	13.36	13.11	13.10	13.10	13.09
USC BLACK (AC)_NQ	15.25	15.24	14.91	14.90	14.89	14.58	14.57	14.56	14.25	14.25	14.24	13.95	13.94	13.93	13.65	13.64	13.38	13.37	13.36	13.35
USC BLACK (AC)_CQ	11.96	11.79	11.39	11.23	11.07	10.69	10.54	10.39	10.04	9.90	9.77	9.46	9.33	9.21	8.97	8.91	8.69	8.64	8.58	8.52
USC BLACK (AC)_SWQ	12.40	12.30	11.97	11.89	11.81	11.50	11.42	11.35	11.05	10.99	10.92	10.65	10.59	10.52	10.27	10.21	9.96	9.91	9.85	9.82
USC BLACK (AC)_NNSW	12.91	12.76	12.35	12.21	12.07	11.69	11.55	11.42	11.06	10.93	10.80	10.48	10.36	10.25	9.95	9.84	9.56	9.45	9.35	9.25
USC BLACK (AC)_NCEN	11.07	10.95	10.61	10.49	10.37	10.06	9.94	9.83	9.53	9.42	9.31	9.04	8.94	8.85	8.60	8.51	8.27	8.18	8.09	8.01
USC BLACK (AC)_SWNSW	9.23	9.23	9.04	9.04	9.04	8.87	8.87	8.87	8.70	8.70	8.70	8.54	8.54	8.54	8.38	8.38	8.24	8.24	8.24	8.24
USC BROWN (WC)_LV	6.18	6.17	6.03	6.02	6.00	5.87	5.86	5.84	5.83	5.82	5.81	5.68	5.67	5.66	5.54	5.53	5.41	5.40	5.39	5.38
USC BROWN (AC)_LV	6.37	6.35	6.20	6.18	6.17	6.02	6.01	6.00	5.99	5.97	5.96	5.82	5.81	5.80	5.67	5.66	5.53	5.52	5.51	5.50
Geothermal (HDR)_NNSW	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Geothermal (HDR)_CVIC	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Geothermal (HDR)_NSA	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Geothermal (HDR)_ADE	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
IGCC BLACK_NQ	17.23	17.22	17.21	16.87	16.86	16.85	16.84	16.83	16.51	16.50	16.50	16.49	16.48	16.17	16.16	16.15	16.14	16.14	15.85	15.84
IGCC BLACK_CQ	14.02	13.86	13.70	13.30	13.14	12.99	12.84	12.68	12.32	12.19	12.06	11.93	11.80	11.48	11.42	11.36	11.30	11.24	11.00	10.94
IGCC BLACK_SWQ	14.45	14.36	14.28	13.94	13.87	13.79	13.72	13.64	13.33	13.27	13.20	13.14	13.07	12.79	12.73	12.67	12.61	12.55	12.29	12.26
IGCC BLACK_NNSW	14.95	14.80	14.66	14.26	14.12	13.98	13.85	13.71	13.34	13.21	13.08	12.96	12.85	12.52	12.41	12.30	12.19	12.08	11.79	11.68
IGCC BLACK_NCEN	13.16	13.04	12.92	12.58	12.47	12.35	12.24	12.13	11.82	11.71	11.60	11.50	11.41	11.13	11.04	10.95	10.86	10.76	10.52	10.43
IGCC BLACK_SWNSW	11.36	11.36	11.36	11.17	11.17	11.17	11.17	11.17	10.99	10.99	10.99	10.99	10.99	10.82	10.82	10.82	10.82	10.82	10.66	10.66
IGCC BLACK CCS_NQ	20.19	20.18	20.17	19.69	19.67	19.66	19.65	19.64	19.63	19.62	18.35	18.34	18.33	18.32	18.31	17.57	17.56	17.55	17.21	17.20
IGCC BLACK CCS_CQ	16.44	16.25	16.06	15.53	15.35	15.17	14.99	14.82	14.64	14.48	13.50	13.35	13.21	13.07	13.00	12.48	12.41	12.35	12.08	12.02
IGCC BLACK CCS_SWQ	16.94	16.83	16.74	16.28	16.19	16.10	16.02	15.93	15.84	15.76	14.75	14.68	14.61	14.54	14.47	13.87	13.81	13.75	13.44	13.41
IGCC BLACK CCS_NNSW	17.52	17.35	17.19	16.64	16.48	16.32	16.17	16.01	15.85	15.70	14.62	14.49	14.36	14.23	14.11	13.48	13.36	13.25	12.91	12.80
IGCC BLACK CCS_NCEN	15.43	15.29	15.16	14.70	14.56	14.43	14.30	14.17	14.04	13.91	13.00	12.89	12.78	12.68	12.57	12.04	11.95	11.85	11.56	11.47
IGCC BLACK CCS_SWNSW	13.33	13.33	13.33	13.06	13.06	13.06	13.06	13.06	13.06	13.06	12.33	12.33	12.33	12.33	12.33	11.91	11.91	11.91	11.72	11.72
IGCC BROWN_LV	7.74	7.73	7.72	7.61	7.60	7.59	7.58	7.57	7.46	7.45	7.44	7.43	7.42	7.33	7.32	7.31	7.30	7.29	7.19	7.19
IGCC BROWN CCS_LV	9.09	9.08	9.07	8.91	8.90	8.89	8.88	8.87	8.85	8.84	8.45	8.44	8.43	8.42	8.41	8.18	8.17	8.16	8.05	8.04
USC CCS BLACK (WC)_NQ	16.87	16.86	16.40	16.39	16.38	16.37	16.36	15.17	15.16	15.15	15.14	15.13	14.44	14.43	14.42	14.41	14.40	14.39	13.77	13.76
USC CCS BLACK (AC)_NQ	17.60	17.59	17.09	17.07	17.06	17.05	17.04	15.72	15.71	15.70	15.69	15.68	14.92	14.91	14.90	14.89	14.88	14.87	14.19	14.18
USC CCS BLACK (AC)_CQ	13.91	13.72	13.17	12.99	12.81	12.64	12.46	11.39	11.23	11.09	10.94	10.80	10.18	10.06	9.99	9.93	9.86	9.80	9.33	9.27
USC CCS BLACK (AC)_SWQ	14.40	14.29	13.82	13.73	13.64	13.55	13.47	12.39	12.31	12.24	12.17	12.10	11.48	11.41	11.35	11.28	11.22	11.16	10.62	10.59
USC CCS BLACK (AC)_NNSW	14.97	14.81	14.24	14.08	13.93	13.77	13.62	12.46	12.32	12.18	12.04	11.91	11.25	11.13	11.02	10.90	10.79	10.68	10.11	10.01
USC CCS BLACK (AC)_NCEN	12.92	12.78	12.30	12.17	12.04	11.91	11.78	10.81	10.69	10.57	10.46	10.35	9.79	9.69	9.60	9.50	9.41	9.31	8.84	8.75
USC CCS BLACK (AC)_SWNSW	10.84	10.84	10.56	10.56	10.56	10.56	10.56	9.81	9.81	9.81	9.81	9.81	9.37	9.37	9.37	9.37	9.37	9.37	8.98	8.98

Technology and Zone	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
USC CCS BROWN (WC)_LV	7.11	7.09	6.91	6.89	6.88	6.87	6.86	6.38	6.37	6.36	6.35	6.34	6.20	6.19	6.17	6.16	6.15	6.14	5.89	5.88
USC CCS BROWN (AC)_LV	7.20	7.19	6.99	6.97	6.96	6.95	6.94	6.44	6.43	6.42	6.41	6.40	6.24	6.23	6.22	6.21	6.20	6.19	5.93	5.92
Nuclear_NQ	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94
Nuclear_CQ	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94
Nuclear_SWQ	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94
Nuclear_NNSW	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94
Nuclear_NCEN	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94
Nuclear_SWNSW	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94
Nuclear_CAN	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94
Nuclear_NVIC	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94
Nuclear_LV	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94
Nuclear_CVIC	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94
Nuclear_NSA	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94
Nuclear_SESA	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94

Note: WC denotes water cooled; AC denotes air cooled. CCGT = combined cycle gas turbine; OCGT = open cycle gas turbine; SC = supercritical coal; USC = ultra-supercritical coal; IGCC = integrated gasification combined cycle; CCS = carbon capture and storage. SRMC includes fuel and VOM. Real 2009-10 $/MWh generated.

Data source: ACIL Tasman analysis

Table 51 **Projected SRMC for new entrant technologies including carbon costs (Real 2009-10 $/MWh as generated)**

Technology & Zone	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
CCGT (WC)_NQ	37.67	46.53	43.90	47.65	47.63	48.47	49.30	49.16	49.81	50.48	51.27	51.92	52.77	52.50	53.14	53.97	54.79	55.54	57.42	58.22
CCGT (WC)_CQ	38.12	47.00	43.69	44.68	47.38	48.04	48.76	48.83	51.24	51.92	52.75	53.43	54.31	54.03	54.69	55.54	56.39	57.16	59.07	59.89
CCGT (WC)_SEQ	36.29	41.29	41.00	41.89	42.02	42.90	43.77	43.77	44.46	45.18	45.91	46.64	47.44	47.37	48.17	48.92	49.63	50.53	51.41	52.37
CCGT (WC)_SWQ	33.07	42.09	38.32	39.22	40.25	41.05	41.91	42.02	44.56	45.38	46.34	46.95	47.95	47.91	48.70	49.49	50.21	51.34	52.96	53.89
CCGT (WC)_NNSW	28.28	39.69	39.47	40.48	40.74	41.74	42.72	42.84	43.63	44.43	45.27	46.09	46.99	47.02	47.92	48.78	49.57	50.58	51.58	52.65
CCGT (WC)_NCEN	40.69	49.27	48.46	49.14	49.19	50.14	51.07	51.00	52.09	53.31	54.64	55.31	56.47	56.42	57.76	59.75	60.66	62.18	63.76	66.01
CCGT (WC)_SWNSW	41.41	52.26	51.89	52.55	52.52	53.46	54.37	54.22	55.31	56.52	57.84	58.48	59.63	59.50	60.83	62.81	63.69	65.20	66.78	69.01
CCGT (WC)_CAN	38.24	47.71	46.66	47.63	47.72	48.68	49.62	49.58	50.68	51.91	53.25	53.93	55.10	55.57	56.43	58.50	59.55	61.27	64.14	66.38
CCGT (WC)_NVIC	37.31	46.63	46.45	47.35	47.37	48.25	51.00	50.97	52.22	54.15	55.35	55.94	56.62	57.46	58.23	60.22	61.22	62.83	65.61	67.76
CCGT (WC)_LV	31.47	40.61	40.36	41.25	41.39	42.27	45.02	45.09	46.35	48.27	49.48	50.07	50.74	51.69	52.47	54.45	55.45	57.06	59.84	61.99
CCGT (WC)_MEL	33.81	43.05	42.87	43.77	43.86	44.74	47.49	47.52	48.77	50.70	51.90	52.49	53.17	54.07	54.85	56.84	57.83	59.45	62.22	64.37
CCGT (WC)_CVIC	32.25	41.34	41.04	42.01	43.86	44.74	47.49	47.52	48.77	50.70	51.90	52.49	53.17	54.07	54.85	56.84	57.83	59.45	61.99	63.24
CCGT (WC)_NSA	39.58	50.66	50.20	51.29	53.08	54.09	56.95	56.91	58.25	60.27	61.57	62.25	63.03	63.86	64.74	66.83	67.90	69.65	72.31	73.69
CCGT (WC)_ADE	38.10	49.19	48.77	49.86	51.69	52.70	55.57	55.56	56.91	58.93	60.24	60.92	61.71	62.57	63.46	65.56	66.63	68.38	71.06	72.44
CCGT (WC)_SESA	35.44	46.55	46.20	47.31	49.21	50.24	53.13	53.19	54.56	56.60	57.92	58.63	59.44	60.35	61.26	63.38	64.47	66.24	68.93	70.33
CCGT (WC)_TAS	37.06	46.15	45.76	46.65	46.69	47.57	50.32	50.30	51.55	53.48	54.68	55.27	55.95	56.80	57.58	59.57	60.56	62.17	64.95	66.82
CCGT (AC)_NQ	38.15	47.12	44.43	48.22	48.17	49.02	49.85	49.68	50.34	51.02	51.81	52.47	53.34	53.02	53.67	54.51	55.34	56.09	58.00	58.81
CCGT (AC)_CQ	38.60	47.59	44.21	45.21	47.92	48.58	49.31	49.35	51.78	52.48	53.31	54.00	54.89	54.57	55.24	56.10	56.96	57.73	59.66	60.49
CCGT (AC)_SEQ	36.74	41.81	41.48	42.39	42.49	43.38	44.26	44.23	44.93	45.65	46.40	47.14	47.94	47.84	48.65	49.41	50.12	51.03	51.93	52.89
CCGT (AC)_SWQ	33.48	42.62	38.77	39.68	40.70	41.51	42.38	42.46	45.03	45.86	46.83	47.44	48.46	48.39	49.18	49.98	50.71	51.85	53.49	54.43
CCGT (AC)_NNSW	28.62	40.18	39.93	40.96	41.20	42.20	43.20	43.29	44.09	44.90	45.74	46.57	47.48	47.49	48.40	49.26	50.06	51.08	52.09	53.18

Technology & Zone	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
CCGT (AC)_NCEN	41.20	49.90	49.04	49.73	49.75	50.71	51.65	51.54	52.64	53.88	55.23	55.91	57.08	56.98	58.34	60.35	61.27	62.81	64.41	66.68
CCGT (AC)_SWNSW	41.94	52.94	52.52	53.19	53.12	54.07	54.99	54.80	55.90	57.12	58.46	59.11	60.27	60.10	61.45	63.45	64.34	65.86	67.45	69.71
CCGT (AC)_CAN	38.72	48.32	47.22	48.21	48.26	49.23	50.18	50.11	51.22	52.46	53.82	54.51	55.69	56.13	57.00	59.09	60.16	61.89	64.79	67.06
CCGT (AC)_NVIC	37.78	47.22	47.01	47.92	47.91	48.80	51.58	51.51	52.78	54.73	55.94	56.54	57.22	58.04	58.82	60.83	61.83	63.47	66.28	68.45
CCGT (AC)_LV	31.86	41.12	40.84	41.74	41.85	42.74	45.53	45.57	46.84	48.79	50.00	50.60	51.28	52.21	52.99	55.00	56.00	57.64	60.45	62.61
CCGT (AC)_MEL	34.23	43.60	43.39	44.29	44.35	45.24	48.03	48.02	49.29	51.24	52.45	53.05	53.73	54.62	55.40	57.41	58.41	60.05	62.85	65.02
CCGT (AC)_CVIC	32.65	41.87	41.53	42.51	44.35	45.24	48.03	48.02	49.29	51.24	52.45	53.05	53.73	54.62	55.40	57.41	58.41	60.05	62.62	63.88
CCGT (AC)_NSA	40.07	51.31	50.81	51.91	53.69	54.70	57.60	57.52	58.88	60.92	62.23	62.92	63.71	64.50	65.39	67.51	68.59	70.35	73.05	74.44
CCGT (AC)_ADE	38.58	49.82	49.35	50.46	52.27	53.30	56.20	56.16	57.52	59.57	60.88	61.58	62.38	63.20	64.10	66.22	67.31	69.08	71.78	73.18
CCGT (AC)_SESA	35.88	47.15	46.75	47.88	49.77	50.81	53.74	53.76	55.14	57.21	58.55	59.26	60.08	60.96	61.88	64.02	65.13	66.91	69.63	71.05
CCGT (AC)_TAS	37.52	46.74	46.31	47.21	47.22	48.11	50.89	50.83	52.10	54.05	55.26	55.86	56.55	57.37	58.16	60.17	61.17	62.80	65.61	67.50
OCGT_NQ	84.84	96.81	93.00	100.50	101.97	100.54	101.94	103.21	104.33	102.62	103.95	105.04	106.50	104.74	105.76	107.16	108.61	106.96	110.37	111.63
OCGT_CQ	85.78	97.76	92.57	94.30	101.45	99.66	100.84	102.52	107.32	105.54	106.97	108.10	109.62	107.81	108.88	110.33	111.82	110.13	113.59	114.88
OCGT_SEQ	81.92	86.12	86.96	88.52	90.08	89.09	90.58	91.93	93.14	91.83	93.07	94.32	95.66	94.42	95.76	97.01	98.22	97.17	98.63	100.19
OCGT_SWQ	75.13	87.74	81.39	82.94	86.34	85.29	86.76	88.27	93.35	92.25	93.94	94.93	96.71	95.52	96.83	98.16	99.40	98.76	101.65	103.17
OCGT_NNSW	65.04	82.27	83.18	84.93	86.68	85.99	87.66	89.18	90.54	89.46	90.86	92.25	93.77	92.74	94.24	95.66	97.00	96.16	97.79	99.55
OCGT_NCEN	91.19	101.83	101.90	102.95	104.59	103.26	104.84	106.26	108.26	107.50	109.92	111.01	113.05	111.63	114.02	117.72	119.29	118.83	121.61	125.64
OCGT_SWNSW	92.72	107.95	109.03	110.05	111.66	110.09	111.61	113.00	115.01	114.03	116.42	117.45	119.47	117.83	120.19	123.87	125.40	124.74	127.50	131.51
OCGT_CAN	86.03	98.65	98.15	99.82	101.48	100.26	101.86	103.30	105.31	104.66	107.10	108.20	110.27	109.93	111.34	115.20	117.08	117.05	122.34	126.37
OCGT_NVIC	84.08	96.99	98.29	99.84	101.40	100.07	105.42	106.96	109.34	110.02	112.21	113.17	114.27	114.67	115.95	119.69	121.46	121.17	126.33	130.21
OCGT_LV	71.77	84.69	85.60	87.16	88.71	87.77	93.12	94.66	97.04	98.09	100.27	101.23	102.33	103.07	104.36	108.09	109.87	109.90	115.05	118.94
OCGT_MEL	76.69	89.69	90.84	92.39	93.95	92.84	98.20	99.74	102.12	103.01	105.20	106.16	107.26	107.86	109.15	112.88	114.65	114.55	119.71	123.59
OCGT_CVIC	73.41	86.20	87.02	88.72	93.95	92.84	98.20	99.74	102.12	103.01	105.20	106.16	107.26	107.86	109.15	112.88	114.65	114.55	119.26	121.37
OCGT_NSA	88.85	104.39	105.22	107.11	112.50	111.02	116.54	118.24	120.75	121.22	123.54	124.63	125.88	126.09	127.54	131.42	133.31	132.86	137.74	140.05
OCGT_ADE	85.74	101.39	102.24	104.14	109.55	108.17	113.70	115.42	117.94	118.51	120.84	121.94	123.21	123.51	124.96	128.86	130.76	130.40	135.28	137.61
OCGT_SESA	80.13	96.00	96.90	98.84	104.30	103.11	108.69	110.45	113.01	113.76	116.14	117.28	118.59	119.05	120.55	124.48	126.42	126.21	131.13	133.49
OCGT_TAS	83.54	96.01	96.84	98.39	99.95	98.66	104.01	105.56	107.94	108.66	110.85	111.81	112.91	113.34	114.63	118.36	120.14	119.88	125.04	128.38
SC BLACK (WC)_NQ	15.76	33.01	33.59	34.23	35.63	37.02	38.42	39.73	40.88	42.03	43.26	44.40	45.71	45.90	47.19	48.47	49.51	50.95	52.32	53.84
SC BLACK (AC)_NQ	16.13	33.86	34.45	35.07	36.50	37.94	39.37	40.71	41.89	43.07	44.33	45.51	46.85	47.00	48.31	49.63	50.69	52.17	53.57	55.13
SC BLACK (AC)_CQ	12.63	30.19	30.62	31.17	32.45	33.72	35.00	36.19	37.21	38.25	39.37	40.41	41.63	41.77	43.02	44.28	45.28	46.71	48.05	49.55
SC BLACK (AC)_SWQ	13.10	30.73	31.26	31.88	33.24	34.60	35.96	37.23	38.34	39.45	40.65	41.77	43.05	43.23	44.48	45.74	46.75	48.17	49.51	51.05
SC BLACK (AC)_NNSW	13.64	32.15	32.64	33.24	34.61	35.97	37.34	38.63	39.73	40.83	42.03	43.15	44.44	44.59	45.86	47.14	48.15	49.59	50.96	52.49
SC BLACK (AC)_NCEN	11.69	30.23	30.74	31.41	32.80	34.20	35.59	36.90	38.03	39.16	40.37	41.51	42.83	43.04	44.33	45.63	46.66	48.13	49.51	51.06
SC BLACK (AC)_SWNSW	9.72	28.39	29.04	29.87	31.39	32.91	34.43	35.85	37.10	38.35	39.69	40.94	42.37	42.70	44.09	45.49	46.62	48.19	49.67	51.33
SC BROWN (WC)_LV	6.59	27.54	28.24	29.97	30.83	32.52	34.20	35.79	37.17	38.55	40.04	41.42	43.01	44.49	46.08	47.66	48.94	49.35	50.99	52.82
SC BROWN (AC)_LV	6.82	28.70	29.44	31.25	32.09	33.85	35.61	37.26	38.70	40.15	41.69	43.14	44.79	46.34	47.99	49.64	50.98	51.32	53.03	54.93
USC BLACK (WC)_NQ	14.86	31.06	30.94	32.25	33.56	34.16	35.44	36.65	36.94	37.97	39.08	39.32	40.48	41.56	41.89	43.02	43.10	44.36	45.54	46.86
USC BLACK (AC)_NQ	15.25	31.92	31.77	33.12	34.47	35.05	36.37	37.61	37.87	38.93	40.07	40.28	41.47	42.58	42.88	44.05	44.09	45.38	46.59	47.94
USC BLACK (AC)_CQ	11.96	28.47	28.25	29.45	30.65	31.16	32.34	33.44	33.66	34.59	35.60	35.79	36.86	37.86	38.20	39.31	39.41	40.64	41.80	43.11
USC BLACK (AC)_SWQ	12.40	28.98	28.83	30.11	31.39	31.97	33.22	34.40	34.67	35.68	36.76	36.98	38.12	39.18	39.50	40.61	40.68	41.91	43.07	44.41
USC BLACK (AC)_NNSW	12.91	30.32	30.10	31.39	32.68	33.24	34.50	35.68	35.93	36.92	38.00	38.20	39.34	40.41	40.72	41.84	41.89	43.14	44.32	45.66
USC BLACK (AC)_NCEN	11.07	28.51	28.36	29.67	30.98	31.60	32.89	34.09	34.39	35.41	36.51	36.76	37.92	39.01	39.36	40.51	40.60	41.87	43.07	44.42
USC BLACK (AC)_SWNSW	9.23	26.79	26.79	28.22	29.65	30.42	31.81	33.13	33.56	34.69	35.89	36.26	37.52	38.70	39.15	40.38	40.57	41.92	43.21	44.64
USC BROWN (WC)_LV	6.18	25.54	25.53	27.09	28.65	29.46	30.98	32.41	33.66	34.91	36.25	36.59	37.98	39.29	39.72	41.08	41.20	42.70	44.11	45.69
USC BROWN (AC)_LV	6.37	26.49	26.44	28.06	29.68	30.48	32.06	33.54	34.83	36.13	37.52	37.82	39.26	40.61	41.01	42.41	42.49	44.04	45.49	47.12
Geothermal (HDR)_NNSW	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Geothermal (HDR)_CVIC	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00

Technology & Zone	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
Geothermal (HDR)_NSA	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Geothermal (HDR)_ADE	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
IGCC BLACK_NQ	17.23	33.47	34.02	34.61	35.92	37.23	38.54	39.78	39.99	41.04	42.17	43.22	44.43	44.60	45.78	46.96	47.92	49.24	49.45	50.82
IGCC BLACK_CQ	14.02	30.11	30.51	31.03	32.20	33.37	34.53	35.63	35.79	36.72	37.73	38.66	39.75	39.92	41.04	42.17	43.07	44.34	44.61	45.93
IGCC BLACK_SWQ	14.45	30.61	31.09	31.68	32.92	34.17	35.42	36.58	36.81	37.80	38.88	39.88	41.03	41.22	42.35	43.48	44.38	45.66	45.90	47.25
IGCC BLACK_NNSW	14.95	31.91	32.36	32.92	34.18	35.43	36.69	37.86	38.05	39.04	40.11	41.11	42.27	42.45	43.59	44.73	45.64	46.93	47.16	48.51
IGCC BLACK_NCEN	13.16	30.15	30.62	31.25	32.53	33.80	35.08	36.28	36.53	37.54	38.63	39.65	40.83	41.06	42.22	43.38	44.30	45.62	45.89	47.26
IGCC BLACK_SWNSW	11.36	28.47	29.05	29.84	31.23	32.62	34.01	35.32	35.70	36.82	38.02	39.14	40.42	40.75	42.00	43.25	44.27	45.67	46.04	47.49
IGCC BLACK CCS_NQ	20.19	21.52	21.55	21.14	21.23	21.33	21.43	21.52	21.60	21.67	20.33	20.40	20.48	20.56	20.64	19.88	19.94	20.03	19.71	19.81
IGCC BLACK CCS_CQ	16.44	17.59	17.45	16.98	16.91	16.84	16.77	16.69	16.61	16.54	15.47	15.41	15.36	15.31	15.34	14.78	14.79	14.82	14.59	14.63
IGCC BLACK CCS_SWQ	16.94	18.17	18.12	17.73	17.75	17.77	17.79	17.81	17.81	17.82	16.73	16.74	16.76	16.78	16.80	16.18	16.18	16.22	15.95	16.02
IGCC BLACK CCS_NNSW	17.52	20.04	19.97	19.56	19.62	19.67	19.73	19.78	19.80	19.83	18.59	18.62	18.68	18.73	18.80	18.11	18.13	18.22	17.94	18.04
IGCC BLACK CCS_NCEN	15.43	17.98	17.94	17.61	17.70	17.78	17.87	17.94	17.99	18.04	16.97	17.03	17.11	17.18	17.26	16.67	16.72	16.82	16.60	16.71
IGCC BLACK CCS_SWNSW	13.33	16.01	16.11	15.97	16.19	16.41	16.62	16.83	17.01	17.19	16.30	16.47	16.66	16.83	17.02	16.54	16.68	16.88	16.75	16.95
IGCC BROWN_LV	7.74	24.05	24.60	25.42	26.73	28.05	29.37	30.61	31.04	32.09	33.23	34.29	35.50	35.88	37.06	38.25	39.21	40.54	40.95	42.32
IGCC BROWN CCS_LV	9.09	10.09	10.12	10.01	10.08	10.15	10.22	10.29	10.34	10.40	9.95	10.00	10.06	10.11	10.17	9.92	9.97	10.03	9.94	10.01
USC CCS BLACK (WC)_NQ	16.87	18.11	17.66	17.75	17.84	17.94	18.03	16.79	16.86	16.92	16.99	17.06	16.35	16.42	16.50	16.57	16.63	16.71	16.06	16.15
USC CCS BLACK (AC)_NQ	17.60	18.91	18.41	18.50	18.60	18.69	18.79	17.41	17.48	17.55	17.63	17.70	16.91	16.98	17.06	17.14	17.20	17.29	16.57	16.66
USC CCS BLACK (AC)_CQ	13.91	15.04	14.49	14.42	14.35	14.28	14.21	13.07	13.00	12.93	12.88	12.82	12.18	12.13	12.15	12.17	12.18	12.21	11.71	11.74
USC CCS BLACK (AC)_SWQ	14.40	15.61	15.14	15.15	15.17	15.19	15.21	14.07	14.08	14.09	14.10	14.11	13.47	13.48	13.51	13.53	13.54	13.57	13.00	13.07
USC CCS BLACK (AC)_NNSW	14.97	17.45	16.89	16.95	17.01	17.06	17.12	15.85	15.87	15.89	15.92	15.96	15.25	15.29	15.35	15.41	15.44	15.52	14.89	14.98
USC CCS BLACK (AC)_NCEN	12.92	15.43	14.95	15.04	15.12	15.20	15.29	14.20	14.24	14.28	14.34	14.40	13.79	13.86	13.93	14.01	14.06	14.16	13.61	13.72
USC CCS BLACK (AC)_SWNSW	10.84	13.49	13.21	13.42	13.64	13.85	14.07	13.20	13.36	13.52	13.69	13.85	13.37	13.53	13.71	13.88	14.02	14.22	13.76	13.95
USC CCS BROWN (WC)_LV	7.11	8.17	7.98	8.06	8.13	8.21	8.28	7.76	7.81	7.87	7.92	7.98	7.86	7.91	7.98	8.04	8.09	8.16	7.87	7.94
USC CCS BROWN (AC)_LV	7.20	8.29	8.09	8.17	8.24	8.32	8.39	7.84	7.89	7.95	8.01	8.06	7.93	7.99	8.05	8.12	8.17	8.24	7.93	8.00
Nuclear_NQ	9.94	10.28	10.29	10.32	10.35	10.38	10.41	10.43	10.46	10.48	10.50	10.53	10.55	10.58	10.61	10.63	10.66	10.69	10.71	10.75
Nuclear_CQ	9.94	10.28	10.29	10.32	10.35	10.38	10.41	10.43	10.46	10.48	10.50	10.53	10.55	10.58	10.61	10.63	10.66	10.69	10.71	10.75
Nuclear_SWQ	9.94	10.28	10.29	10.32	10.35	10.38	10.41	10.43	10.46	10.48	10.50	10.53	10.55	10.58	10.61	10.63	10.66	10.69	10.71	10.75
Nuclear_NNSW	9.94	10.28	10.29	10.32	10.35	10.38	10.41	10.43	10.46	10.48	10.50	10.53	10.55	10.58	10.61	10.63	10.66	10.69	10.71	10.75
Nuclear_NCEN	9.94	10.28	10.29	10.32	10.35	10.38	10.41	10.43	10.46	10.48	10.50	10.53	10.55	10.58	10.61	10.63	10.66	10.69	10.71	10.75
Nuclear_SWNSW	9.94	10.28	10.29	10.32	10.35	10.38	10.41	10.43	10.46	10.48	10.50	10.53	10.55	10.58	10.61	10.63	10.66	10.69	10.71	10.75
Nuclear_CAN	9.94	10.28	10.29	10.32	10.35	10.38	10.41	10.43	10.46	10.48	10.50	10.53	10.55	10.58	10.61	10.63	10.66	10.69	10.71	10.75
Nuclear_NVIC	9.94	10.28	10.29	10.32	10.35	10.38	10.41	10.43	10.46	10.48	10.50	10.53	10.55	10.58	10.61	10.63	10.66	10.69	10.71	10.75
Nuclear_LV	9.94	10.28	10.29	10.32	10.35	10.38	10.41	10.43	10.46	10.48	10.50	10.53	10.55	10.58	10.61	10.63	10.66	10.69	10.71	10.75
Nuclear_CVIC	9.94	10.28	10.29	10.32	10.35	10.38	10.41	10.43	10.46	10.48	10.50	10.53	10.55	10.58	10.61	10.63	10.66	10.69	10.71	10.75
Nuclear_NSA	9.94	10.28	10.29	10.32	10.35	10.38	10.41	10.43	10.46	10.48	10.50	10.53	10.55	10.58	10.61	10.63	10.66	10.69	10.71	10.75
Nuclear_SESA	9.94	10.28	10.29	10.32	10.35	10.38	10.41	10.43	10.46	10.48	10.50	10.53	10.55	10.58	10.61	10.63	10.66	10.69	10.71	10.75

Note: WC denotes water cooled; AC denotes air cooled. CCGT = combined cycle gas turbine; OCGT = open cycle gas turbine; SC = supercritical coal; USC = ultra-supercritical coal; IGCC = integrated gasification combined cycle; CCS = carbon capture and storage. SRMC includes fuel, VOM and carbon costs. Real 2009-10 $/MWh generated.

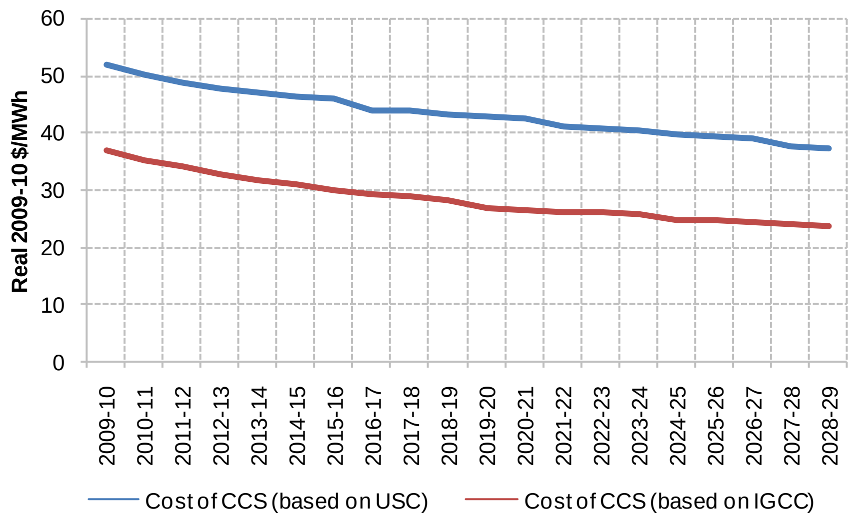
Data source: ACIL Tasman analysis

4.4 LRMC for new entrant technologies

This section provides LRMC for each technology type by NEM zone. These LRMC are presented in real 2009-10 $/MWh and assume a capacity factor of 85% for all stations (for comparability).

The LRMC figures for plants that employ CCS technology include all costs associated with the capture, transport and storage of CO2. Figure 4 shows the implied costs of CCS relative to the same non-CCS equipped plant (defined as being the difference in LRMC in the absence of carbon costs). Costs are shown for post-combustion capture (based on ultra-supercritical technology) and pre-combustion capture (based on IGCC technology). All up CCS costs for IGCC technology are significantly lower than for USC plant (a result of a much simpler capture task), however capital costs for IGCC technology itself is significantly more expensive than a comparable ultra-supercritical unit.

Figure 4 **Implied cost of capture, transport and storage of CO_2**



Note: Based on 85% load factor

Data source: ACIL Tasman analysis.

Table 52 **LRMC for new entrant technologies by NEM zone excluding carbon costs (Real 2009-10 $/MWh as generated)**

Technology & Zone	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
CCGT (WC)_NQ	60.24	58.79	56.00	58.70	57.92	57.99	58.04	57.39	57.39	57.41	57.50	57.50	57.62	56.94	56.86	56.96	57.19	57.13	58.25	58.21
CCGT (WC)_CQ	60.68	59.26	55.79	55.73	57.68	57.56	57.50	57.06	58.81	58.85	58.98	59.00	59.15	58.46	58.41	58.54	58.79	58.75	59.90	59.87
CCGT (WC)_SEQ	58.85	53.56	53.09	52.94	52.31	52.42	52.51	52.00	52.04	52.10	52.14	52.22	52.28	51.80	51.88	51.91	52.02	52.12	52.24	52.36
CCGT (WC)_SWQ	55.63	54.36	50.41	50.27	50.55	50.57	50.66	50.25	52.14	52.31	52.57	52.52	52.80	52.35	52.41	52.48	52.61	52.93	53.79	53.88
CCGT (WC)_NNSW	50.84	50.55	50.14	49.99	49.41	49.52	49.61	49.15	49.19	49.25	49.30	49.37	49.43	49.01	49.09	49.12	49.23	49.32	49.45	49.56
CCGT (WC)_NCEN	63.25	60.13	59.13	58.65	57.86	57.93	57.97	57.31	57.65	58.13	58.67	58.60	58.92	58.41	58.92	60.09	60.32	60.92	61.64	62.92
CCGT (WC)_SWNSW	63.97	63.13	62.56	62.06	61.20	61.25	61.26	60.53	60.88	61.34	61.87	61.77	62.08	61.49	62.00	63.15	63.35	63.94	64.65	65.91
CCGT (WC)_CAN	60.80	58.58	57.33	57.15	56.39	56.46	56.52	55.89	56.25	56.73	57.29	57.22	57.55	57.56	57.59	58.84	59.21	60.01	62.01	63.29
CCGT (WC)_NVIC	59.88	58.83	58.48	58.33	57.59	57.70	59.66	59.11	59.71	60.98	61.48	61.41	61.35	61.79	61.83	63.10	63.49	64.29	66.31	67.60
CCGT (WC)_LV	54.03	52.81	52.39	52.23	51.61	51.72	53.68	53.23	53.83	55.10	55.61	55.54	55.48	56.02	56.06	57.33	57.72	58.53	60.54	61.83
CCGT (WC)_MEL	56.37	55.26	54.91	54.75	54.08	54.18	56.15	55.66	56.26	57.53	58.03	57.97	57.90	58.40	58.45	59.71	60.10	60.91	62.92	64.22
CCGT (WC)_CVIC	54.81	53.55	53.07	52.99	54.08	54.18	56.15	55.66	56.26	57.53	58.03	57.97	57.90	58.40	58.45	59.71	60.10	60.91	62.69	63.08
CCGT (WC)_NSA	62.14	60.82	60.16	60.03	60.94	61.00	62.92	62.26	62.82	64.04	64.50	64.39	64.28	64.62	64.63	65.85	66.19	66.96	68.70	69.06
CCGT (WC)_ADE	60.66	59.36	58.73	58.60	59.55	59.62	61.54	60.92	61.47	62.70	63.17	63.07	62.96	63.34	63.35	64.57	64.93	65.70	67.45	67.81
CCGT (WC)_SESA	58.00	56.72	56.16	56.06	57.07	57.16	59.10	58.54	59.12	60.37	60.86	60.77	60.69	61.12	61.15	62.39	62.77	63.56	65.32	65.70
CCGT (WC)_TAS	59.62	58.36	57.79	57.63	56.91	57.01	58.98	58.44	59.04	60.31	60.81	60.74	60.68	61.13	61.17	62.44	62.83	63.64	65.65	66.67
CCGT (AC)_NQ	61.47	59.98	57.12	59.86	59.05	59.12	59.18	58.49	58.50	58.53	58.62	58.63	58.75	58.05	57.97	58.08	58.32	58.26	59.40	59.36
CCGT (AC)_CQ	61.92	60.45	56.91	56.85	58.80	58.69	58.63	58.16	59.94	59.98	60.12	60.15	60.30	59.59	59.54	59.67	59.93	59.90	61.06	61.05
CCGT (AC)_SEQ	60.07	54.67	54.18	54.03	53.37	53.49	53.58	53.05	53.09	53.16	53.21	53.29	53.36	52.86	52.94	52.98	53.10	53.20	53.33	53.45
CCGT (AC)_SWQ	56.80	55.48	51.47	51.32	51.58	51.61	51.70	51.28	53.20	53.37	53.64	53.60	53.88	53.41	53.48	53.56	53.69	54.02	54.89	54.99
CCGT (AC)_NNSW	51.95	51.62	51.19	51.04	50.43	50.55	50.65	50.17	50.21	50.28	50.33	50.41	50.48	50.03	50.12	50.15	50.27	50.37	50.50	50.62
CCGT (AC)_NCEN	64.53	61.34	60.30	59.81	58.98	59.06	59.10	58.42	58.77	59.26	59.81	59.74	60.08	59.53	60.06	61.24	61.48	62.09	62.82	64.12
CCGT (AC)_SWNSW	65.26	64.37	63.77	63.26	62.36	62.42	62.44	61.67	62.03	62.50	63.05	62.95	63.27	62.65	63.17	64.34	64.55	65.15	65.87	67.15
CCGT (AC)_CAN	62.05	59.76	58.47	58.28	57.50	57.58	57.64	56.98	57.35	57.84	58.41	58.35	58.69	58.68	58.72	59.98	60.37	61.17	63.20	64.50
CCGT (AC)_NVIC	61.11	60.02	59.64	59.48	58.71	58.82	60.82	60.24	60.85	62.13	62.65	62.59	62.53	62.95	63.00	64.28	64.68	65.50	67.54	68.86
CCGT (AC)_LV	55.19	53.91	53.47	53.31	52.66	52.77	54.76	54.30	54.90	56.19	56.71	56.65	56.59	57.12	57.17	58.45	58.85	59.67	61.71	63.03
CCGT (AC)_MEL	57.56	56.39	56.02	55.86	55.16	55.27	57.26	56.75	57.36	58.65	59.16	59.10	59.04	59.52	59.58	60.86	61.26	62.08	64.12	65.44
CCGT (AC)_CVIC	55.98	54.66	54.16	54.07	55.16	55.27	57.26	56.75	57.36	58.65	59.16	59.10	59.04	59.52	59.58	60.86	61.26	62.08	63.89	64.29
CCGT (AC)_NSA	63.40	62.04	61.34	61.21	62.10	62.17	64.12	63.43	63.99	65.23	65.70	65.60	65.49	65.82	65.83	67.06	67.42	68.20	69.97	70.33
CCGT (AC)_ADE	61.91	60.55	59.89	59.76	60.69	60.77	62.72	62.06	62.63	63.88	64.36	64.26	64.16	64.52	64.53	65.78	66.14	66.93	68.70	69.07
CCGT (AC)_SESA	59.21	57.87	57.29	57.18	58.19	58.28	60.25	59.66	60.25	61.52	62.02	61.94	61.86	62.28	62.31	63.57	63.96	64.76	66.55	66.94
CCGT (AC)_TAS	60.85	59.53	58.94	58.78	58.02	58.13	60.13	59.56	60.17	61.46	61.97	61.91	61.85	62.28	62.34	63.62	64.02	64.84	66.88	67.91
OCGT_NQ	99.97	96.26	91.92	97.97	98.05	95.94	96.10	96.20	96.29	94.22	94.48	94.57	94.89	92.80	92.73	93.01	93.56	91.49	93.77	93.75
OCGT_CQ	100.91	97.22	91.49	91.78	97.53	95.05	95.00	95.52	99.28	97.14	97.49	97.63	98.00	95.88	95.85	96.18	96.77	94.65	96.98	97.01
OCGT_SEQ	97.06	85.57	85.87	85.99	86.15	84.49	84.74	84.92	85.10	83.43	83.60	83.85	84.05	82.49	82.73	82.87	83.17	81.70	82.02	82.32
OCGT_SWQ	90.26	87.20	80.30	80.41	82.41	80.68	80.92	81.26	85.31	83.85	84.47	84.46	85.09	83.58	83.80	84.01	84.35	83.28	85.04	85.30
OCGT_NNSW	80.17	79.43	79.73	79.84	80.01	78.53	78.78	78.96	79.13	77.65	77.81	78.06	78.26	76.87	77.11	77.25	77.55	76.23	76.56	76.86
OCGT_NCEN	106.32	98.99	98.44	97.86	97.91	95.80	95.96	96.04	96.85	95.69	96.87	96.82	97.55	95.76	96.88	99.31	99.84	98.90	100.38	102.96
OCGT_SWNSW	107.85	105.11	105.58	104.96	104.98	102.63	102.73	102.78	103.60	102.21	103.37	103.26	103.96	101.97	103.06	105.46	105.95	104.81	106.26	108.82
OCGT_CAN	101.16	95.81	94.70	94.73	94.81	92.80	92.97	93.08	93.90	92.85	94.05	94.01	94.76	94.06	94.21	96.79	97.63	97.12	101.11	103.69
OCGT_NVIC	99.22	96.34	97.10	97.19	97.35	95.33	99.44	99.81	101.14	101.47	102.57	102.53	102.48	102.55	102.74	105.35	106.22	105.49	109.51	112.12

Technology & Zone	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
OCGT_LV	86.90	84.04	84.41	84.51	84.67	83.03	87.14	87.51	88.84	89.53	90.63	90.59	90.54	90.96	91.14	93.75	94.62	94.22	98.23	100.84
OCGT_MEL	91.83	89.04	89.65	89.75	89.90	88.11	92.22	92.59	93.92	94.46	95.56	95.52	95.47	95.75	95.93	98.54	99.41	98.87	102.89	105.50
OCGT_CVIC	88.54	85.55	85.84	86.08	89.90	88.11	92.22	92.59	93.92	94.46	95.56	95.52	95.47	95.75	95.93	98.54	99.41	98.87	102.44	103.28
OCGT_NSA	103.98	100.40	100.59	100.73	104.45	102.13	106.14	106.42	107.66	107.70	108.70	108.58	108.43	108.26	108.35	110.88	111.66	110.71	114.19	114.96
OCGT_ADE	100.87	97.40	97.60	97.76	101.49	99.28	103.30	103.59	104.85	104.98	106.00	105.89	105.76	105.67	105.78	108.32	109.11	108.24	111.74	112.52
OCGT_SESA	95.26	92.02	92.26	92.46	96.24	94.22	98.29	98.62	99.92	100.24	101.30	101.23	101.13	101.22	101.36	103.94	104.77	104.06	107.59	108.40
OCGT_TAS	98.67	95.36	95.65	95.75	95.90	93.93	98.04	98.41	99.74	100.11	101.21	101.17	101.11	101.23	101.41	104.02	104.89	104.21	108.22	110.29
SC BLACK (WC)_NQ	55.15	54.01	53.43	52.54	52.33	52.12	52.07	52.00	51.93	51.86	51.78	51.71	51.63	51.24	51.16	51.09	51.01	50.94	50.86	50.79
SC BLACK (AC)_NQ	56.29	55.12	54.54	53.62	53.41	53.20	53.15	53.09	53.03	52.96	52.89	52.82	52.76	52.34	52.27	52.21	52.14	52.07	52.00	51.93
SC BLACK (AC)_CQ	52.78	51.45	50.71	49.72	49.35	48.99	48.78	48.57	48.35	48.14	47.94	47.73	47.53	47.11	46.98	46.86	46.73	46.60	46.48	46.35
SC BLACK (AC)_SWQ	53.25	52.00	51.34	50.42	50.14	49.87	49.74	49.61	49.48	49.34	49.21	49.08	48.95	48.57	48.45	48.32	48.19	48.07	47.94	47.85
SC BLACK (AC)_NNSW	53.79	52.49	51.76	50.76	50.42	50.07	49.88	49.69	49.49	49.28	49.08	48.89	48.70	48.27	48.09	47.91	47.73	47.55	47.37	47.19
SC BLACK (AC)_NCEN	51.85	50.56	49.86	48.94	48.62	48.30	48.13	47.96	47.78	47.61	47.43	47.26	47.09	46.72	46.56	46.40	46.24	46.08	45.92	45.76
SC BLACK (AC)_SWNSW	49.88	48.73	48.15	47.40	47.20	47.01	46.97	46.92	46.86	46.81	46.75	46.69	46.63	46.37	46.32	46.26	46.20	46.14	46.08	46.02
SC BROWN (WC)_LV	50.22	48.96	48.33	47.72	47.33	47.10	47.04	46.96	46.88	46.80	46.72	46.64	46.55	46.47	46.39	46.30	46.22	45.99	45.91	45.82
SC BROWN (AC)_LV	51.29	50.00	49.36	48.74	48.34	48.12	48.06	47.99	47.92	47.84	47.77	47.69	47.61	47.53	47.46	47.38	47.30	47.07	46.99	46.92
USC BLACK (WC)_NQ	56.56	55.34	54.43	53.84	53.62	53.11	53.05	52.99	52.64	52.56	52.48	52.15	52.07	51.99	51.66	51.58	51.27	51.19	51.11	51.03
USC BLACK (AC)_NQ	57.77	56.52	55.58	54.98	54.76	54.24	54.19	54.13	53.77	53.69	53.62	53.27	53.20	53.13	52.79	52.72	52.40	52.32	52.25	52.18
USC BLACK (AC)_CQ	54.47	53.07	52.06	51.31	50.94	50.36	50.16	49.96	49.55	49.35	49.16	48.78	48.59	48.41	48.12	47.99	47.71	47.59	47.47	47.35
USC BLACK (AC)_SWQ	54.91	53.58	52.64	51.97	51.69	51.17	51.05	50.92	50.56	50.44	50.31	49.98	49.85	49.73	49.41	49.28	48.98	48.86	48.74	48.65
USC BLACK (AC)_NNSW	55.42	54.04	53.02	52.29	51.94	51.36	51.18	50.99	50.57	50.38	50.19	49.81	49.63	49.45	49.09	48.92	48.57	48.41	48.24	48.07
USC BLACK (AC)_NCEN	53.59	52.23	51.28	50.58	50.25	49.72	49.56	49.40	49.04	48.87	48.70	48.37	48.21	48.05	47.74	47.58	47.28	47.13	46.98	46.84
USC BLACK (AC)_SWNSW	51.74	50.51	49.71	49.12	48.92	48.53	48.49	48.44	48.21	48.15	48.09	47.86	47.80	47.74	47.52	47.46	47.25	47.19	47.13	47.06
USC BROWN (WC)_LV	52.34	51.01	50.19	49.54	49.30	48.93	48.86	48.79	48.70	48.62	48.53	48.33	48.24	48.15	47.96	47.87	47.68	47.59	47.50	47.42
USC BROWN (AC)_LV	53.43	52.06	51.23	50.57	50.33	49.95	49.89	49.82	49.74	49.66	49.59	49.38	49.30	49.22	49.02	48.94	48.75	48.67	48.59	48.51
Geothermal (HDR)_NNSW	86.06	86.64	85.62	84.60	83.61	82.62	81.66	80.69	79.74	78.80	77.87	76.97	76.06	75.18	74.30	73.42	72.57	71.72	70.89	70.07
Geothermal (HDR)_CVIC	86.06	86.64	85.62	84.60	83.61	82.62	81.66	80.69	79.74	78.80	77.87	76.97	76.06	75.18	74.30	73.42	72.57	71.72	70.89	70.07
Geothermal (HDR)_NSA	86.06	86.64	85.62	84.60	83.61	82.62	81.66	80.69	79.74	78.80	77.87	76.97	76.06	75.18	74.30	73.42	72.57	71.72	70.89	70.07
Geothermal (HDR)_ADE	86.06	86.64	85.62	84.60	83.61	82.62	81.66	80.69	79.74	78.80	77.87	76.97	76.06	75.18	74.30	73.42	72.57	71.72	70.89	70.07
IGCC BLACK_NQ	78.64	75.33	73.00	70.43	68.75	67.09	65.66	64.21	62.46	61.01	60.59	60.51	60.43	60.06	59.98	59.90	59.82	59.74	59.38	59.30
IGCC BLACK_CQ	75.43	71.96	69.49	66.86	65.03	63.23	61.65	60.06	58.26	56.70	56.15	55.95	55.75	55.37	55.24	55.10	54.97	54.84	54.54	54.41
IGCC BLACK_SWQ	75.86	72.46	70.07	67.51	65.76	64.03	62.53	61.02	59.28	57.77	57.30	57.16	57.03	56.68	56.55	56.42	56.28	56.15	55.82	55.72
IGCC BLACK_NNSW	76.36	72.91	70.45	67.82	66.01	64.22	62.66	61.09	59.28	57.72	57.18	56.99	56.81	56.41	56.23	56.05	55.86	55.69	55.32	55.14
IGCC BLACK_NCEN	74.57	71.15	68.71	66.14	64.36	62.59	61.06	59.51	57.76	56.22	55.70	55.53	55.36	55.02	54.86	54.69	54.53	54.37	54.05	53.89
IGCC BLACK_SWNSW	72.77	69.46	67.15	64.73	63.06	61.41	59.99	58.55	56.94	55.50	55.09	55.02	54.95	54.71	54.64	54.57	54.50	54.43	54.19	54.12
IGCC BLACK CCS_NQ	104.11	99.63	96.49	93.00	90.73	88.49	86.56	84.61	82.66	80.71	78.89	78.60	78.31	78.02	77.73	76.71	76.42	76.13	75.51	75.22
IGCC BLACK CCS_CQ	100.35	95.70	92.38	88.84	86.41	84.00	81.90	79.79	77.67	75.57	74.03	73.61	73.19	72.77	72.42	71.62	71.27	70.93	70.38	70.04
IGCC BLACK CCS_SWQ	100.86	96.28	93.06	89.60	87.25	84.93	82.92	80.90	78.87	76.86	75.29	74.94	74.58	74.23	73.89	73.01	72.67	72.33	71.75	71.44
IGCC BLACK CCS_NNSW	101.44	96.80	93.51	89.96	87.54	85.15	83.07	80.98	78.88	76.79	75.16	74.75	74.34	73.93	73.53	72.62	72.22	71.83	71.21	70.83
IGCC BLACK CCS_NCEN	99.35	94.74	91.48	88.01	85.62	83.26	81.21	79.14	77.07	75.00	73.54	73.15	72.76	72.38	71.99	71.18	70.81	70.43	69.87	69.50
IGCC BLACK CCS_SWNSW	97.24	92.78	89.65	86.37	84.12	81.89	79.96	78.03	76.09	74.15	72.87	72.59	72.31	72.03	71.75	71.05	70.77	70.49	70.02	69.74
IGCC BROWN_LV	69.15	65.83	63.51	61.17	59.49	57.83	56.39	54.95	53.41	51.96	51.54	51.46	51.38	51.21	51.13	51.05	50.97	50.89	50.73	50.65
IGCC BROWN CCS_LV	93.01	88.53	85.39	82.23	79.96	77.72	75.78	73.84	71.88	69.94	68.99	68.70	68.41	68.12	67.83	67.32	67.03	66.74	66.35	66.06
USC CCS BLACK (WC)_NQ	84.01	81.73	79.98	78.72	78.05	77.39	76.98	75.37	74.94	74.50	74.07	73.64	72.52	72.09	71.66	71.23	70.81	70.38	69.34	68.92
USC CCS BLACK (AC)_NQ	86.06	83.72	81.90	80.63	79.95	79.29	78.88	77.15	76.71	76.28	75.85	75.42	74.24	73.81	73.38	72.95	72.53	72.10	71.01	70.58

Technology & Zone	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
USC CCS BLACK (AC)_CQ	82.36	79.85	77.98	76.54	75.70	74.87	74.30	72.81	72.23	71.66	71.10	70.54	69.50	68.95	68.47	67.99	67.51	67.03	66.14	65.67
USC CCS BLACK (AC)_SWQ	82.85	80.43	78.63	77.28	76.53	75.79	75.30	73.81	73.31	72.82	72.33	71.83	70.79	70.31	69.83	69.34	68.87	68.39	67.43	66.99
USC CCS BLACK (AC)_NNSW	83.43	80.94	79.06	77.64	76.82	76.00	75.45	73.88	73.32	72.76	72.20	71.65	70.56	70.03	69.49	68.96	68.43	67.90	66.93	66.41
USC CCS BLACK (AC)_NCEN	81.37	78.91	77.12	75.72	74.93	74.14	73.62	72.23	71.69	71.15	70.61	70.09	69.11	68.59	68.07	67.56	67.05	66.54	65.65	65.15
USC CCS BLACK (AC)_SWNSW	79.30	76.97	75.37	74.11	73.45	72.79	72.39	71.23	70.81	70.39	69.96	69.54	68.69	68.27	67.85	67.43	67.02	66.60	65.80	65.38
USC CCS BROWN (WC)_LV	82.94	79.97	77.35	75.94	74.59	73.87	73.16	72.26	71.80	71.34	70.87	70.40	69.81	69.34	68.88	68.42	67.96	67.50	66.80	66.34
USC CCS BROWN (AC)_LV	84.51	81.47	78.78	77.36	75.99	75.27	74.55	73.63	73.17	72.71	72.24	71.78	71.18	70.71	70.25	69.79	69.33	68.88	68.17	67.71
Nuclear_NQ	101.41	101.01	100.62	100.24	99.85	99.47	99.09	98.71	98.33	97.95	97.58	97.21	96.84	96.47	96.10	95.73	91.74	89.81	87.95	86.86
Nuclear_CQ	101.41	101.01	100.62	100.24	99.85	99.47	99.09	98.71	98.33	97.95	97.58	97.21	96.84	96.47	96.10	95.73	91.74	89.81	87.95	86.86
Nuclear_SWQ	101.41	101.01	100.62	100.24	99.85	99.47	99.09	98.71	98.33	97.95	97.58	97.21	96.84	96.47	96.10	95.73	91.74	89.81	87.95	86.86
Nuclear_NNSW	101.41	101.01	100.62	100.24	99.85	99.47	99.09	98.71	98.33	97.95	97.58	97.21	96.84	96.47	96.10	95.73	91.74	89.81	87.95	86.86
Nuclear_NCEN	101.41	101.01	100.62	100.24	99.85	99.47	99.09	98.71	98.33	97.95	97.58	97.21	96.84	96.47	96.10	95.73	91.74	89.81	87.95	86.86
Nuclear_SWNSW	101.41	101.01	100.62	100.24	99.85	99.47	99.09	98.71	98.33	97.95	97.58	97.21	96.84	96.47	96.10	95.73	91.74	89.81	87.95	86.86
Nuclear_CAN	101.41	101.01	100.62	100.24	99.85	99.47	99.09	98.71	98.33	97.95	97.58	97.21	96.84	96.47	96.10	95.73	91.74	89.81	87.95	86.86
Nuclear_NVIC	101.41	101.01	100.62	100.24	99.85	99.47	99.09	98.71	98.33	97.95	97.58	97.21	96.84	96.47	96.10	95.73	91.74	89.81	87.95	86.86
Nuclear_LV	101.41	101.01	100.62	100.24	99.85	99.47	99.09	98.71	98.33	97.95	97.58	97.21	96.84	96.47	96.10	95.73	91.74	89.81	87.95	86.86
Nuclear_CVIC	101.41	101.01	100.62	100.24	99.85	99.47	99.09	98.71	98.33	97.95	97.58	97.21	96.84	96.47	96.10	95.73	91.74	89.81	87.95	86.86
Nuclear_NSA	101.41	101.01	100.62	100.24	99.85	99.47	99.09	98.71	98.33	97.95	97.58	97.21	96.84	96.47	96.10	95.73	91.74	89.81	87.95	86.86
Nuclear_SESA	101.41	101.01	100.62	100.24	99.85	99.47	99.09	98.71	98.33	97.95	97.58	97.21	96.84	96.47	96.10	95.73	91.74	89.81	87.95	86.86

Note: WC denotes water cooled; AC denotes air cooled. CCGT = combined cycle gas turbine; OCGT = open cycle gas turbine; SC = supercritical coal; USC = ultra-supercritical coal; IGCC = integrated gasification combined cycle; CCS = carbon capture and storage. Life-cycle cost calculated at a constant 85% capacity factor over the stations life. LRMC is presented in $/MWh generated.

Data source: ACIL Tasman analysis

Table 53 **LRMC for new entrant technologies by NEM zone including carbon costs (Real 2009-10 $/MWh as generated)**

Technology & Zone	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
CCGT (WC)_NQ	60.24	67.84	65.17	68.62	68.38	69.18	69.95	69.75	70.34	70.94	71.66	72.25	73.04	72.70	73.28	74.04	74.81	75.49	77.31	78.05
CCGT (WC)_CQ	60.68	68.31	64.97	65.64	68.14	68.75	69.41	69.42	71.76	72.39	73.15	73.76	74.57	74.23	74.83	75.62	76.41	77.11	78.96	79.71
CCGT (WC)_SEQ	58.85	62.60	62.27	62.86	62.77	63.61	64.42	64.36	64.99	65.64	66.31	66.97	67.71	67.57	68.31	69.00	69.64	70.48	71.30	72.20
CCGT (WC)_SWQ	55.63	63.40	59.59	60.18	61.01	61.76	62.57	62.61	65.09	65.85	66.74	67.28	68.22	68.11	68.84	69.57	70.23	71.29	72.85	73.72
CCGT (WC)_NNSW	50.84	61.00	60.74	61.45	61.50	62.44	63.37	63.44	64.16	64.89	65.66	66.42	67.25	67.22	68.06	68.85	69.58	70.53	71.47	72.48
CCGT (WC)_NCEN	63.25	70.58	69.73	70.11	69.94	70.85	71.73	71.59	72.62	73.77	75.04	75.65	76.74	76.62	77.90	79.83	80.67	82.13	83.65	85.84
CCGT (WC)_SWNSW	63.97	73.58	73.16	73.52	73.28	74.17	75.02	74.81	75.84	76.98	78.24	78.82	79.90	79.71	80.97	82.89	83.71	85.15	86.67	88.84
CCGT (WC)_CAN	60.80	69.02	67.93	68.60	68.48	69.39	70.28	70.18	71.21	72.37	73.65	74.27	75.37	75.78	76.57	78.57	79.57	81.22	84.03	86.21
CCGT (WC)_NVIC	59.88	67.94	67.73	68.32	68.13	68.96	71.66	71.56	72.75	74.61	75.75	76.27	76.88	77.66	78.37	80.30	81.23	82.78	85.50	87.58
CCGT (WC)_LV	54.03	61.92	61.63	62.22	62.14	62.98	65.67	65.69	66.87	68.74	69.87	70.40	71.01	71.90	72.61	74.53	75.46	77.02	79.73	81.82
CCGT (WC)_MEL	56.37	64.37	64.15	64.74	64.61	65.45	68.14	68.11	69.30	71.16	72.30	72.82	73.43	74.28	74.99	76.91	77.84	79.40	82.11	84.20
CCGT (WC)_CVIC	54.81	62.66	62.31	62.97	64.61	65.45	68.14	68.11	69.30	71.16	72.30	72.82	73.43	74.28	74.99	76.91	77.84	79.40	81.88	83.06
CCGT (WC)_NSA	62.14	71.97	71.48	72.26	73.84	74.79	77.60	77.51	78.78	80.73	81.96	82.58	83.29	84.06	84.88	86.91	87.92	89.60	92.20	93.52
CCGT (WC)_ADE	60.66	70.51	70.04	70.83	72.44	73.41	76.22	76.16	77.44	79.39	80.63	81.25	81.98	82.77	83.60	85.63	86.65	88.34	90.94	92.27
CCGT (WC)_SESA	58.00	67.87	67.47	68.28	69.97	70.95	73.79	73.78	75.09	77.06	78.32	78.96	79.70	80.56	81.40	83.46	84.49	86.19	88.82	90.16
CCGT (WC)_TAS	59.62	67.46	67.03	67.62	67.44	68.28	70.97	70.89	72.08	73.94	75.08	75.60	76.21	77.01	77.72	79.64	80.57	82.13	84.84	86.65
CCGT (AC)_NQ	61.47	69.15	66.42	69.91	69.63	70.44	71.23	71.00	71.60	72.22	72.95	73.55	74.35	73.98	74.57	75.35	76.13	76.82	78.67	79.42
CCGT (AC)_CQ	61.92	69.62	66.21	66.89	69.39	70.01	70.69	70.67	73.04	73.68	74.45	75.07	75.90	75.53	76.14	76.94	77.74	78.46	80.33	81.10
CCGT (AC)_SEQ	60.07	63.84	63.48	64.07	63.95	64.81	65.64	65.55	66.19	66.85	67.54	68.21	68.96	68.79	69.54	70.25	70.90	71.75	72.59	73.50
CCGT (AC)_SWQ	56.80	64.65	60.76	61.36	62.17	62.93	63.76	63.78	66.29	67.06	67.97	68.52	69.48	69.34	70.08	70.82	71.49	72.58	74.15	75.04
CCGT (AC)_NNSW	51.95	62.21	61.93	62.64	62.66	63.63	64.57	64.61	65.35	66.10	66.88	67.65	68.50	68.44	69.29	70.10	70.84	71.81	72.76	73.79
CCGT (AC)_NCEN	64.53	71.93	71.04	71.41	71.21	72.13	73.03	72.86	73.90	75.08	76.37	76.98	78.10	77.94	79.24	81.19	82.05	83.53	85.08	87.29
CCGT (AC)_SWNSW	65.26	74.96	74.51	74.87	74.59	75.49	76.36	76.12	77.16	78.32	79.60	80.19	81.29	81.06	82.34	84.28	85.12	86.59	88.12	90.32
CCGT (AC)_CAN	62.05	70.35	69.21	69.89	69.73	70.65	71.56	71.43	72.48	73.66	74.96	75.59	76.71	77.09	77.89	79.93	80.94	82.61	85.45	87.67
CCGT (AC)_NVIC	61.11	69.25	69.00	69.60	69.37	70.22	72.96	72.83	74.04	75.92	77.08	77.62	78.24	79.00	79.72	81.67	82.62	84.19	86.94	89.06
CCGT (AC)_LV	55.19	63.15	62.83	63.43	63.32	64.17	66.90	66.89	68.10	69.98	71.14	71.68	72.30	73.17	73.89	75.84	76.79	78.36	81.11	83.22
CCGT (AC)_MEL	57.56	65.63	65.38	65.97	65.82	66.67	69.40	69.34	70.55	72.44	73.59	74.13	74.75	75.57	76.30	78.25	79.19	80.77	83.52	85.63
CCGT (AC)_CVIC	55.98	63.89	63.52	64.19	65.82	66.67	69.40	69.34	70.55	72.44	73.59	74.13	74.75	75.57	76.30	78.25	79.19	80.77	83.29	84.49
CCGT (AC)_NSA	63.40	73.34	72.80	73.59	75.15	76.13	78.98	78.84	80.14	82.11	83.37	83.99	84.72	85.46	86.29	88.35	89.37	91.08	93.71	95.05
CCGT (AC)_ADE	61.91	71.85	71.35	72.14	73.74	74.72	77.58	77.48	78.78	80.76	82.02	82.66	83.39	84.16	85.00	87.06	88.09	89.80	92.45	93.79
CCGT (AC)_SESA	59.21	69.17	68.75	69.56	71.24	72.23	75.11	75.08	76.40	78.40	79.68	80.34	81.09	81.92	82.78	84.86	85.91	87.64	90.30	91.66
CCGT (AC)_TAS	60.85	68.77	68.30	68.90	68.68	69.53	72.27	72.15	73.36	75.25	76.40	76.94	77.56	78.33	79.05	81.01	81.95	83.53	86.28	88.11
OCGT_NQ	99.97	111.03	107.20	114.48	115.79	114.33	115.69	116.92	117.99	116.23	117.51	118.56	119.97	118.16	119.14	120.49	121.89	120.19	123.57	124.77
OCGT_CQ	100.91	111.99	106.76	108.28	115.27	113.44	114.59	116.23	120.97	119.16	120.53	121.62	123.08	121.23	122.26	123.65	125.10	123.36	126.78	128.03
OCGT_SEQ	97.06	100.34	101.15	102.49	103.89	102.88	104.33	105.63	106.79	105.44	106.63	107.83	109.13	107.84	109.14	110.34	111.51	110.40	111.82	113.34
OCGT_SWQ	90.26	101.97	95.58	96.92	100.15	99.08	100.51	101.97	107.00	105.86	107.50	108.45	110.17	108.94	110.21	111.48	112.68	111.99	114.84	116.32
OCGT_NNSW	80.17	96.49	97.38	98.91	100.50	99.78	101.41	102.89	104.20	103.07	104.42	105.77	107.23	106.16	107.62	108.98	110.28	109.39	110.98	112.69
OCGT_NCEN	106.32	116.06	116.09	116.93	118.41	117.05	118.59	119.97	121.91	121.12	123.48	124.53	126.52	125.05	127.40	131.04	132.58	132.06	134.80	138.79
OCGT_SWNSW	107.85	122.17	123.23	124.03	125.48	123.88	125.35	126.71	128.66	127.64	129.98	130.97	132.93	131.26	133.58	137.19	138.68	137.97	140.69	144.65
OCGT_CAN	101.16	112.88	112.35	113.80	115.30	114.05	115.60	117.00	118.97	118.27	120.66	121.72	123.73	123.35	124.72	128.52	130.36	130.28	135.53	139.52
OCGT_NVIC	99.22	111.22	112.48	113.82	115.21	113.85	119.16	120.67	122.99	123.64	125.77	126.69	127.73	128.09	129.33	133.01	134.75	134.40	139.52	143.36
OCGT_LV	86.90	98.92	99.80	101.14	102.53	101.56	106.87	108.37	110.69	111.70	113.83	114.75	115.79	116.49	117.74	121.42	123.15	123.13	128.24	132.08
OCGT_MEL	91.83	103.91	105.03	106.37	107.77	106.63	111.94	113.45	115.77	116.63	118.76	119.68	120.72	121.28	122.53	126.20	127.94	127.78	132.90	136.74

Technology & Zone	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
OCGT_CVIC	88.54	100.42	101.22	102.70	107.77	106.63	111.94	113.45	115.77	116.63	118.76	119.68	120.72	121.28	122.53	126.20	127.94	127.78	132.45	134.52
OCGT_NSA	103.98	118.61	119.42	121.09	126.32	124.81	130.29	131.95	134.40	134.83	137.10	138.15	139.35	139.51	140.92	144.75	146.59	146.10	150.93	153.20
OCGT_ADE	100.87	115.61	116.44	118.12	123.36	121.95	127.45	129.13	131.59	132.12	134.40	135.46	136.67	136.93	138.34	142.19	144.04	143.63	148.47	150.76
OCGT_SESA	95.26	110.23	111.09	112.82	118.11	116.90	122.44	124.16	126.66	127.38	129.70	130.80	132.05	132.47	133.93	137.81	139.70	139.44	144.32	146.64
OCGT_TAS	98.67	110.24	111.04	112.37	113.77	112.45	117.76	119.27	121.59	122.27	124.41	125.33	126.37	126.76	128.01	131.69	133.43	133.12	138.23	141.53
SC BLACK (WC)_NQ	55.15	71.28	71.29	71.39	72.58	73.78	75.13	76.39	77.47	78.56	79.72	80.81	82.05	82.18	83.40	84.61	85.59	86.97	88.27	89.73
SC BLACK (AC)_NQ	56.29	72.86	72.88	72.96	74.19	75.43	76.82	78.12	79.24	80.36	81.56	82.68	83.97	84.06	85.31	86.57	87.58	89.00	90.34	91.84
SC BLACK (AC)_CQ	52.78	69.19	69.05	69.06	70.13	71.21	72.45	73.59	74.56	75.54	76.61	77.59	78.74	78.83	80.02	81.22	82.17	83.53	84.81	86.26
SC BLACK (AC)_SWQ	53.25	69.74	69.68	69.76	70.92	72.09	73.41	74.64	75.69	76.74	77.88	78.94	80.17	80.29	81.48	82.68	83.63	85.00	86.28	87.76
SC BLACK (AC)_NNSW	53.79	71.16	71.07	71.12	72.29	73.47	74.80	76.03	77.08	78.12	79.26	80.32	81.56	81.65	82.87	84.08	85.03	86.42	87.72	89.20
SC BLACK (AC)_NCEN	51.85	69.23	69.17	69.29	70.49	71.69	73.05	74.30	75.37	76.45	77.61	78.69	79.95	80.10	81.34	82.57	83.54	84.95	86.27	87.77
SC BLACK (AC)_SWNSW	49.88	67.40	67.46	67.75	69.08	70.40	71.88	73.26	74.45	75.65	76.93	78.12	79.49	79.76	81.09	82.43	83.51	85.02	86.44	88.04
SC BROWN (WC)_LV	50.22	69.92	70.00	71.14	71.78	73.25	74.88	76.40	77.72	79.03	80.45	81.76	83.28	84.69	86.20	87.71	88.93	89.26	90.83	92.59
SC BROWN (AC)_LV	51.29	71.90	72.01	73.22	73.84	75.39	77.10	78.70	80.08	81.46	82.95	84.33	85.92	87.40	88.99	90.58	91.85	92.13	93.77	95.61
USC BLACK (WC)_NQ	56.56	71.55	70.82	71.55	72.65	73.04	74.27	75.42	75.64	76.61	77.65	77.82	78.91	79.92	80.18	81.25	81.26	82.44	83.56	84.81
USC BLACK (AC)_NQ	57.77	73.20	72.44	73.20	74.34	74.71	75.99	77.18	77.38	78.38	79.46	79.61	80.73	81.78	82.02	83.12	83.11	84.33	85.48	86.77
USC BLACK (AC)_CQ	54.47	69.75	68.92	69.53	70.52	70.83	71.96	73.01	73.17	74.04	74.99	75.12	76.12	77.06	77.34	78.39	78.42	79.59	80.69	81.93
USC BLACK (AC)_SWQ	54.91	70.27	69.50	70.19	71.26	71.64	72.85	73.97	74.18	75.13	76.15	76.31	77.38	78.38	78.64	79.69	79.69	80.86	81.96	83.23
USC BLACK (AC)_NNSW	55.42	71.60	70.77	71.47	72.55	72.91	74.12	75.25	75.44	76.37	77.39	77.53	78.61	79.61	79.86	80.92	80.90	82.10	83.21	84.48
USC BLACK (AC)_NCEN	53.59	69.79	69.03	69.75	70.86	71.27	72.51	73.66	73.90	74.86	75.90	76.09	77.19	78.21	78.50	79.58	79.61	80.82	81.96	83.24
USC BLACK (AC)_SWNSW	51.74	68.07	67.46	68.30	69.52	70.08	71.44	72.70	73.07	74.14	75.28	75.58	76.78	77.90	78.29	79.46	79.58	80.88	82.10	83.47
USC BROWN (WC)_LV	52.34	70.37	69.69	70.62	71.94	72.52	73.99	75.35	76.53	77.70	78.97	79.23	80.55	81.78	82.13	83.42	83.47	84.89	86.22	87.72
USC BROWN (AC)_LV	53.43	72.19	71.47	72.45	73.83	74.41	75.94	77.36	78.59	79.82	81.14	81.37	82.75	84.03	84.36	85.69	85.71	87.18	88.57	90.13
Geothermal (HDR)_NNSW	86.06	86.64	85.62	84.60	83.61	82.62	81.66	80.69	79.74	78.80	77.87	76.97	76.06	75.18	74.30	73.42	72.57	71.72	70.89	70.07
Geothermal (HDR)_CVIC	86.06	86.64	85.62	84.60	83.61	82.62	81.66	80.69	79.74	78.80	77.87	76.97	76.06	75.18	74.30	73.42	72.57	71.72	70.89	70.07
Geothermal (HDR)_NSA	86.06	86.64	85.62	84.60	83.61	82.62	81.66	80.69	79.74	78.80	77.87	76.97	76.06	75.18	74.30	73.42	72.57	71.72	70.89	70.07
Geothermal (HDR)_ADE	86.06	86.64	85.62	84.60	83.61	82.62	81.66	80.69	79.74	78.80	77.87	76.97	76.06	75.18	74.30	73.42	72.57	71.72	70.89	70.07
IGCC BLACK_NQ	78.64	91.58	89.81	88.17	87.81	87.47	87.36	87.16	85.93	85.55	86.27	87.25	88.39	88.49	89.60	90.71	91.59	92.85	92.99	94.28
IGCC BLACK_CQ	75.43	88.22	86.30	84.59	84.09	83.60	83.35	83.01	81.74	81.23	81.83	82.69	83.71	83.80	84.86	85.91	86.74	87.95	88.14	89.39
IGCC BLACK_SWQ	75.86	88.72	86.88	85.24	84.81	84.41	84.23	83.97	82.75	82.31	82.97	83.90	84.98	85.11	86.17	87.22	88.06	89.26	89.43	90.71
IGCC BLACK_NNSW	76.36	90.02	88.14	86.48	86.07	85.67	85.50	85.24	83.99	83.55	84.21	85.14	86.23	86.34	87.41	88.47	89.31	90.54	90.69	91.97
IGCC BLACK_NCEN	74.57	88.25	86.41	84.81	84.42	84.04	83.90	83.66	82.47	82.05	82.73	83.68	84.79	84.95	86.03	87.12	87.98	89.22	89.42	90.72
IGCC BLACK_SWNSW	72.77	86.57	84.84	83.40	83.12	82.86	82.83	82.70	81.64	81.33	82.12	83.17	84.38	84.64	85.82	87.00	87.94	89.28	89.57	90.95
IGCC BLACK CCS_NQ	104.11	100.97	97.87	94.45	92.29	90.16	88.33	86.49	84.63	82.77	80.87	80.66	80.46	80.26	80.06	79.01	78.80	78.61	78.02	77.83
IGCC BLACK CCS_CQ	100.35	97.04	93.77	90.30	87.97	85.67	83.67	81.66	79.64	77.63	76.01	75.67	75.34	75.01	74.75	73.92	73.65	73.41	72.89	72.65
IGCC BLACK CCS_SWQ	100.86	97.62	94.45	91.05	88.81	86.60	84.70	82.78	80.84	78.91	77.26	76.99	76.74	76.47	76.22	75.31	75.04	74.80	74.25	74.05
IGCC BLACK CCS_NNSW	101.44	99.49	96.29	92.87	90.67	88.50	86.64	84.75	82.83	80.92	79.13	78.88	78.66	78.43	78.22	77.24	76.99	76.80	76.24	76.06
IGCC BLACK CCS_NCEN	99.35	97.43	94.26	90.93	88.76	86.61	84.77	82.91	81.02	79.13	77.51	77.28	77.09	76.88	76.68	75.81	75.58	75.40	74.90	74.74
IGCC BLACK CCS_SWNSW	97.24	95.46	92.43	89.29	87.25	85.24	83.53	81.80	80.04	78.28	76.84	76.73	76.63	76.53	76.44	75.67	75.54	75.46	75.05	74.98
IGCC BROWN_LV	69.15	82.16	80.39	78.98	78.62	78.29	78.18	77.99	76.98	76.60	77.33	78.32	79.46	79.77	80.88	81.99	82.88	84.14	84.48	85.78
IGCC BROWN CCS_LV	93.01	89.54	86.44	83.33	81.14	78.98	77.13	75.26	73.37	71.49	70.49	70.26	70.04	69.81	69.59	69.06	68.82	68.61	68.25	68.04
USC CCS BLACK (WC)_NQ	84.01	82.98	81.24	80.08	79.51	78.95	78.64	76.99	76.63	76.27	75.92	75.57	74.44	74.08	73.74	73.39	73.03	72.70	71.63	71.30
USC CCS BLACK (AC)_NQ	86.06	85.04	83.22	82.05	81.49	80.92	80.62	78.83	78.48	78.13	77.78	77.43	76.23	75.88	75.54	75.20	74.84	74.51	73.38	73.06
USC CCS BLACK (AC)_CQ	82.36	81.17	79.30	77.97	77.23	76.51	76.04	74.50	74.00	73.51	73.03	72.55	71.49	71.03	70.63	70.23	69.82	69.44	68.52	68.14
USC CCS BLACK (AC)_SWQ	82.85	81.74	79.95	78.71	78.06	77.43	77.05	75.50	75.08	74.67	74.26	73.85	72.78	72.38	71.98	71.59	71.18	70.80	69.81	69.47

Technology & Zone	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
USC CCS BLACK (AC)_NNSW	83.43	83.59	81.71	80.50	79.90	79.30	78.96	77.27	76.87	76.47	76.08	75.69	74.56	74.19	73.83	73.47	73.08	72.75	71.70	71.38
USC CCS BLACK (AC)_NCEN	81.37	81.56	79.77	78.59	78.01	77.44	77.12	75.62	75.24	74.86	74.50	74.13	73.10	72.75	72.41	72.07	71.70	71.39	70.43	70.12
USC CCS BLACK (AC)_SWNSW	79.30	79.62	78.02	76.98	76.53	76.09	75.90	74.62	74.36	74.10	73.85	73.59	72.69	72.43	72.19	71.94	71.67	71.45	70.57	70.35
USC CCS BROWN (WC)_LV	82.94	81.05	78.43	77.11	75.85	75.21	74.59	73.63	73.24	72.84	72.44	72.04	71.47	71.07	70.68	70.29	69.89	69.51	68.78	68.40
USC CCS BROWN (AC)_LV	84.51	82.58	79.88	78.55	77.27	76.63	76.01	75.02	74.64	74.24	73.84	73.45	72.87	72.47	72.09	71.70	71.30	70.92	70.17	69.80
Nuclear_NQ	101.41	101.36	100.98	100.62	100.26	99.91	99.55	99.20	98.85	98.49	98.14	97.80	97.45	97.11	96.77	96.43	92.46	90.56	88.72	87.67
Nuclear_CQ	101.41	101.36	100.98	100.62	100.26	99.91	99.55	99.20	98.85	98.49	98.14	97.80	97.45	97.11	96.77	96.43	92.46	90.56	88.72	87.67
Nuclear_SWQ	101.41	101.36	100.98	100.62	100.26	99.91	99.55	99.20	98.85	98.49	98.14	97.80	97.45	97.11	96.77	96.43	92.46	90.56	88.72	87.67
Nuclear_NNSW	101.41	101.36	100.98	100.62	100.26	99.91	99.55	99.20	98.85	98.49	98.14	97.80	97.45	97.11	96.77	96.43	92.46	90.56	88.72	87.67
Nuclear_NCEN	101.41	101.36	100.98	100.62	100.26	99.91	99.55	99.20	98.85	98.49	98.14	97.80	97.45	97.11	96.77	96.43	92.46	90.56	88.72	87.67
Nuclear_SWNSW	101.41	101.36	100.98	100.62	100.26	99.91	99.55	99.20	98.85	98.49	98.14	97.80	97.45	97.11	96.77	96.43	92.46	90.56	88.72	87.67
Nuclear_CAN	101.41	101.36	100.98	100.62	100.26	99.91	99.55	99.20	98.85	98.49	98.14	97.80	97.45	97.11	96.77	96.43	92.46	90.56	88.72	87.67
Nuclear_NVIC	101.41	101.36	100.98	100.62	100.26	99.91	99.55	99.20	98.85	98.49	98.14	97.80	97.45	97.11	96.77	96.43	92.46	90.56	88.72	87.67
Nuclear_LV	101.41	101.36	100.98	100.62	100.26	99.91	99.55	99.20	98.85	98.49	98.14	97.80	97.45	97.11	96.77	96.43	92.46	90.56	88.72	87.67
Nuclear_CVIC	101.41	101.36	100.98	100.62	100.26	99.91	99.55	99.20	98.85	98.49	98.14	97.80	97.45	97.11	96.77	96.43	92.46	90.56	88.72	87.67
Nuclear_NSA	101.41	101.36	100.98	100.62	100.26	99.91	99.55	99.20	98.85	98.49	98.14	97.80	97.45	97.11	96.77	96.43	92.46	90.56	88.72	87.67
Nuclear_SESA	101.41	101.36	100.98	100.62	100.26	99.91	99.55	99.20	98.85	98.49	98.14	97.80	97.45	97.11	96.77	96.43	92.46	90.56	88.72	87.67

Note: WC denotes water cooled; AC denotes air cooled. CCGT = combined cycle gas turbine; OCGT = open cycle gas turbine; SC = supercritical coal; USC = ultra-supercritical coal; IGCC = integrated gasification combined cycle; CCS = carbon capture and storage. Life-cycle cost calculated at a constant 85% capacity factor over the stations life. LRMC is presented $/MWh generated.

Data source: ACIL Tasman analysis

4.5 Annualised costs

Table 54 provides the annualised capital, FOM and tax costs for each new entrant technology in real 2009-10 $/kW/year for each year (as discussed in section 2.2.3). This value represents the net revenue (spot revenue minus cash costs) required to repay debt and the necessary returns to equity to justify the investment.

The annualised capital, FOM and tax costs within Table 54 generally decline over time as these cost elements are projected to decline in real terms. They are consistent for each technology regardless of where it is located (the only costs which vary across zones are variable costs – part of the SRMC – and hence are not included within this figure).

Table 55 provides the annualised tax costs for each new entrant technology on a similar basis. It should be noted that the annualised tax cost is a component of the costs within Table 54 (as tax does not form part of the SRMC).

Table 54 **Annualised capital, fixed O&M and tax costs for new entrant technologies (Real 2009-10 $/kW/year)**

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
CCGT (WC)	168	159	158	156	155	154	154	153	153	152	152	151	151	150	150	149	149	149	148	148
CCGT (AC)	174	164	164	161	160	160	159	159	158	158	157	157	156	156	156	155	155	154	154	153
OCGT	113	106	106	104	103	103	102	102	102	101	101	101	100	100	100	99	99	99	98	98
SC BLACK (WC)	293	285	281	277	275	274	273	273	272	272	272	271	271	270	270	269	269	268	268	267
SC BLACK (AC)	299	290	286	282	281	279	279	279	278	278	277	277	276	276	276	275	275	274	274	273
SC BROWN (WC)	325	316	311	307	305	303	303	302	302	301	301	300	300	299	299	298	298	297	297	296
SC BROWN (AC)	331	322	317	312	311	309	309	309	308	308	307	307	306	306	305	305	304	304	303	303
USC BLACK (WC)	310	301	297	293	291	289	289	289	288	288	287	287	286	286	285	285	284	284	283	283
USC BLACK (AC)	317	307	303	298	297	295	295	295	294	294	293	293	292	292	291	291	291	290	290	289
USC BROWN (WC)	344	334	329	324	322	321	320	320	319	319	318	318	317	316	316	315	315	314	314	313
USC BROWN (AC)	350	340	335	331	329	327	327	326	326	325	325	324	324	323	323	322	322	321	321	320
Geothermal (HDR)	626	630	623	615	608	600	593	586	579	572	565	558	551	545	538	532	525	519	513	507
IGCC BLACK	457	433	415	399	386	374	363	353	342	331	328	328	327	327	326	326	325	325	324	324
IGCC BLACK CCS	625	592	568	546	529	513	498	484	469	455	451	449	447	445	442	440	438	436	434	432
IGCC BROWN	457	433	415	399	386	374	363	353	342	331	328	328	327	327	326	326	325	325	324	324
IGCC BROWN CCS	625	592	568	546	529	513	498	484	469	455	451	449	447	445	442	440	438	436	434	432
USC CCS BLACK (WC)	500	483	473	464	459	454	451	448	445	442	439	436	432	429	426	423	420	417	414	411
USC CCS BLACK (AC)	510	492	483	473	468	463	460	457	454	451	448	445	442	439	435	432	429	426	423	420
USC CCS BROWN (WC)	565	543	525	514	504	499	494	491	487	484	480	477	474	470	467	464	460	457	454	450
USC CCS BROWN (AC)	576	553	535	524	514	509	503	500	497	494	490	487	483	480	477	473	470	467	463	460
Nuclear	681	678	675	672	669	667	664	661	658	655	653	650	647	644	642	639	609	595	581	573

Note: WC denotes water cooled; AC denotes air cooled. CCGT = combined cycle gas turbine; OCGT = open cycle gas turbine; SC = supercritical coal; USC = ultra-supercritical coal; IGCC = integrated gasification combined cycle; CCS = carbon capture and storage.

Data source: ACIL Tasman analysis

Table 55 **Annualised tax costs for new entrant technologies (Real 2009-10 $/kW/year)**

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
CCGT (WC)	30	28	28	28	27	27	27	27	27	27	27	27	26	26	26	26	26	26	26	26
CCGT (AC)	32	29	29	29	28	28	28	28	28	28	28	28	28	28	28	27	27	27	27	27
OCGT	22	20	20	20	20	20	20	19	19	19	19	19	19	19	19	19	19	19	19	19
SC BLACK (WC)	55	53	52	51	51	51	51	51	50	50	50	50	50	50	50	50	50	49	49	49
SC BLACK (AC)	56	54	54	53	52	52	52	52	52	52	52	51	51	51	51	51	51	51	51	51
SC BROWN (WC)	61	59	58	57	56	56	56	56	55	55	55	55	55	55	55	55	55	54	54	54
SC BROWN (AC)	62	60	59	58	58	57	57	57	57	57	57	57	56	56	56	56	56	56	56	56
USC BLACK (WC)	59	57	56	55	55	54	54	54	54	54	54	54	54	53	53	53	53	53	53	53
USC BLACK (AC)	60	58	57	56	56	56	56	55	55	55	55	55	55	55	55	55	55	54	54	54
USC BROWN (WC)	65	63	62	60	60	60	60	60	59	59	59	59	59	59	59	58	58	58	58	58
USC BROWN (AC)	66	64	63	62	62	61	61	61	61	61	61	61	60	60	60	60	60	60	60	60
Geothermal (HDR)	133	134	133	131	129	128	126	124	123	121	120	118	117	115	114	112	111	109	108	106
IGCC BLACK	92	86	82	78	76	73	71	68	66	63	63	63	62	62	62	62	62	62	62	62
IGCC BLACK CCS	124	116	111	106	102	98	95	92	89	85	85	84	84	83	83	82	82	81	81	80
IGCC BROWN	92	86	82	78	76	73	71	68	66	63	63	63	62	62	62	62	62	62	62	62
IGCC BROWN CCS	124	116	111	106	102	98	95	92	89	85	85	84	84	83	83	82	82	81	81	80
USC CCS BLACK (WC)	94	91	88	86	85	84	83	83	82	81	81	80	79	79	78	77	76	76	75	74
USC CCS BLACK (AC)	97	93	90	88	87	86	85	85	84	83	83	82	81	81	80	79	78	78	77	76
USC CCS BROWN (WC)	106	101	97	95	93	91	90	90	89	88	87	87	86	85	84	84	83	82	81	81
USC CCS BROWN (AC)	109	104	99	97	95	94	92	92	91	90	89	89	88	87	86	86	85	84	83	83
Nuclear	136	136	135	134	134	133	132	132	131	130	130	129	128	128	127	127	120	116	113	111

Note: WC denotes water cooled; AC denotes air cooled. CCGT = combined cycle gas turbine; OCGT = open cycle gas turbine; SC = supercritical coal; USC = ultra-supercritical coal; IGCC = integrated gasification combined cycle; CCS = carbon capture and storage.

Data source: ACIL Tasman analysis

4.6 Brownfield expansions

Almost all existing station sites provide the opportunity for some form of brownfield development. A brownfield development could include the construction of a new unit on an existing permitted site, through to conversion of existing stations into a different configuration. For example, most existing OCGT could be reconfigured as CCGT with the addition of a heat recovery steam generator and steam turbine.

Table 56 lists a number of potential brownfield conversions and upgrade options that have been suggested over recent years.

Table 56 **Potential brownfield conversions/upgrades**

Site/station	Comments
Mt Stuart	Conversion to gas-fired OCGT; CCGT conversion; potential relocation
Torrens Island A/B	Partial or full conversion to CCGT using the existing steam turbines
Newport	Conversion to CCGT using the existing steam turbine
Tallawarra	Additional OCGT or CCGT developments
Braemar	Additional OCGT or CCGT developments; conversion of existing OCGT to CCGT
Oakey	Conversion to CCGT using existing OCGT
Swanbank	Additional OCGT or CCGT developments
Quarantine	Conversion to CCGT using existing OCGT units, or additional OCGT or CCGT developments
Mt Piper, Eraring, Bayswater, Vales Point	Capacity upgrades of up to 750 MW per unit
Uranquinty, Colongra, Mortlake	Conversion to CCGT using existing OCGT units, or additional OCGT or CCGT developments

Data source: ACIL Tasman

Table 57 provides the capital cost projection for brownfield conversions and upgrades. Table 58 provides the annualised capital, FOM and tax figures that result from the capital costs (FOM for brownfield projects are assumed to be the same as for greenfield projects). Table 59 provides the annualised tax costs only.

Table 57 **Capital cost projection for brownfield upgrades/conversions (Real 2009-10 $/kW)**

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
Brownfield CCGT site	1,163	1,084	1,082	1,063	1,050	1,048	1,045	1,041	1,038	1,034	1,030	1,026	1,023	1,019	1,016	1,012	1,009	1,005	1,002	998
CCGT convert from OCGT	630	627	624	621	618	615	612	609	606	603	600	597	594	592	589	586	583	580	577	574
Black coal upgrade	525	523	520	518	515	513	510	508	505	503	500	498	495	493	491	488	486	483	481	479
Brownfield OCGT site	887	826	824	810	799	797	795	792	788	786	782	779	776	773	770	767	764	761	758	755
CCGT convert from ST	1,064	991	989	972	959	957	954	950	946	943	939	935	931	928	924	920	917	913	909	906

Note: CCGT = combined cycle gas turbine; OCGT = open cycle gas turbine; ST = steam turbine.

Data source: ACIL Tasman analysis

Table 58 **Annualised capital, fixed O&M and tax costs for brownfield upgrades/conversions (Real 2009-10 $/kW/year)**

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
Brownfield CCGT site	152	144	144	142	141	140	140	140	139	139	138	138	138	137	137	137	136	136	135	135
CCGT convert from OCGT	95	94	94	94	94	93	93	93	92	92	92	91	91	91	91	90	90	90	89	89
Black coal upgrade	101	101	101	100	100	100	100	99	99	99	99	98	98	98	98	97	97	97	97	96
Brownfield OCGT site	103	97	96	95	94	94	93	93	93	93	92	92	92	91	91	91	90	90	90	89
CCGT convert from ST	140	133	133	131	130	129	129	129	128	128	127	127	127	126	126	126	125	125	124	124

Note: CCGT = combined cycle gas turbine; OCGT = open cycle gas turbine; ST = steam turbine.

Data source: ACIL Tasman analysis

Table 59 **Annualised tax costs for brownfield upgrades/conversions (Real 2009-10 $/kW/year)**

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29
Brownfield CCGT site	27	25	25	24	24	24	24	24	24	24	24	24	24	23	23	23	23	23	23	23
CCGT convert from OCGT	14	14	14	14	14	14	14	13	13	13	13	13	13	13	13	13	13	13	13	13
Black coal upgrade	12	12	12	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Brownfield OCGT site	20	18	18	18	18	18	18	18	17	17	17	17	17	17	17	17	17	17	17	17
CCGT convert from ST	24	22	22	22	22	22	22	21	21	21	21	21	21	21	21	21	21	21	21	20

Note: CCGT = combined cycle gas turbine; OCGT = open cycle gas turbine; ST = steam turbine.

Data source: ACIL Tasman analysis

A Scope of work

The consultancy required ACIL Tasman to provide:

- short run marginal cost (SRMC) of existing generators and committed and advanced projects in the NEM on a station basis (including fuel, operational and maintenance (O&M) costs and the impact of government schemes such as GECs, NGACs, RECs, etc) over the coming 20-year timeframe. For the SRMC analysis the focus will be on fuel prices, taking into account the following:
  - coal prices and coal contracts
  - gas price versus demand
  - carbon price impact on gas prices
  - LNG and export impacts on fuel prices and availability.
- possibility of existing generators to operate on dual fuels, and the operating costs associated with both fuels
- data and information needed for modelling the impact of the Carbon Pollution Reduction Scheme (CPRS) including:
  - CO2-equivalent emission factors for all existing and anticipated generators to determine the carbon output as an effect of electricity production. This body of work should reconcile with emission factors published by the Australian Greenhouse Office (AGO).
  - SRMC of existing generators, committed and advanced projects and potential new entrant generators (over the coming 20-year period) adjusted for the effects of a carbon tax imposed based on an assumed carbon tax level and CO2-equivalent emissions.
  - Fixed costs of existing generators.
  - Information to assist with the modelling of existing plant retirements.

With this data, the consultant is also required to provide:

- information about the SRMC components (including fuel costs (both commodity and transport costs), heat rates (as generated), variable O&M costs and any other costs making up the SRMC) for all existing generators and committed and advanced projects
- commentary about the costs incorporated including the effect of government schemes and assumed saturations of these schemes with a separate assessment for each scheme
- costs associated with and commentary about the CPRS; and
- a reconciliation of the information provided against that from previous reviews commissioned by the IRPC and a rationalisation of variations.

Provision should be made for costs to be varied based on a range of carbon tax values.

Data is also to be supplied for new entrant technologies including:

- Combined Cycle Gas turbine (CCGT)
- Open Cycle Gas Turbine (OCGT)
- Supercritical black coal
- Supercritical brown coal
- Ultrasupercritical (USC)
- Nuclear
- Coal gasification (IGCC)
- Carbon capture and sequestration (CCS).

The following information is required for the technologies assessed likely to be built in the next 20 year period:

- the earliest likely build date
- the weighted average cost of capital (WACC) expected by a NEM generator
- the physical characteristics of new entry units, including:
  - maximum capacity
  - minimum stable generation
  - auxiliary load (fixed and variable components).
- the capital cost of new generation entry (brownfield expansion, brownfield conversion and greenfield) (presented as a dollar amount per unit installed capacity – ie. $/kW basis) including:
  - "inside the fence" costs - total equipment cost (including cooling arrangements); and
  - "outside the fence" costs – electricity network costs, fuel connection costs, cost of land and development, cost and availability of water, etc.
- availability and location of potentially attractive fuel resources, broken down into brownfield expansion, brownfield conversion and greenfield sites, within each zone (see appendix B), including the number of units of each technology that could connect at each ANTS zone at the costs reported (in capital installed tranches as discussed above)
- the variable costs (SRMC) involved in operating a generator including fuel costs, O&M costs and the effect of the CPRS (and other relevant government schemes) over the coming 20-year timeframe
- possibility of generators to operate on dual fuels, and the operating costs associated with both fuels
- lead time required to build each new project type

- requirement for additional infrastructure to access fuel resource in each zone (see appendix B) which have not been reflected in the variable costs
- any other fixed costs (including annual fixed O&M costs and tax costs) that would be incurred by a new entrant generator that have not been already been captured above; and
- capital costs expressed as an annualised figure for use in estimating capital deferral benefits.

The differences in generation capital costs should vary across the different zones based on the generation technologies used (wet build, dry build, etc).

With this data, the consultant is also required to provide:

- details of the derivation of the WACC and a rationalisation on the appropriateness of this figure as an investment hurdle rate
- assumptions regarding exchange rates and how changes in exchange rates will impact the costs quoted.
- information about the SRMC components (including fuel costs (both commodity and transport costs), heat rates (as generated), variable O&M costs and any other costs making up the SRMC) for all potential new entrants
- costs with and without the impact of the government schemes
- a breakdown of the fixed cost components (capital costs, fixed operational and maintenance costs, etc)
- commentary on the capital cost information, including expectations of the long term trends of input costs and reconciliation with publicly available information
- information about the availability and costs of potential brownfield developments
- capital costs expressed as annualised figures (using the appropriate discount rates and economic lives) to be used as the market benefit of deferring investment
- the total fixed costs (including all costs not in the SRMC figures) expressed as a dollar figure per MW installed capacity to act as a trigger level for new entry investment; and
- a reconciliation of the information provided against that from previous reviews commissioned by the IRPC and a rationalisation of variations.

The consultant is not required to provide information on renewable new entry technologies. Renewable generation forecasts will be generated through a separate process.

The data supplied will cover the 20 year period starting from 2009/10.

To standardise presentation and align with the intended use in the 2009 ANTS, forecast cost data is to be expressed on the following basis:

- in real 2009/10 dollar terms (explicitly stating assumed price escalation assumptions where relevant); and
- exclusive of GST.

Capacity, heat rates, costs, etc are to be expressed on a generator terminal basis (as opposed to 'sent out').