

# 2018-22

## POWERLINK QUEENSLAND REVENUE PROPOSAL

### APPENDIX 5.12

Ernst & Young  
Contingent Project Scenarios and Triggers

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# Contingent Project Scenarios and Triggers

Powerlink Queensland

June 2015



**EY**

Building a better  
working world



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30 June 2015

## Contingent Project Scenarios and Triggers

Dear Greg

In accordance with our Engagement Agreement dated 15 May 2015 (“Agreement”), Ernst & Young (“we” or “EY”) has been engaged by Powerlink Queensland (“you”, “Powerlink” or the “Client”) to provide a Report (the “Report”) identifying projects which may impact the Powerlink network assets during its next revenue reset period.

The enclosed Report sets out the outcomes of our work. You should read the Report in its entirety. A reference to the Report includes any part of the Report.

### Use of our Report

Please refer to a copy of the Agreement for the restrictions relating to the use of our Report.

### Scope and nature of our work

The scope and nature of our work, including the basis and limitations, are detailed in our Agreement and in this Report.

### Limitations

This Report was completed on 30 June 2015. Our Report does not take into consideration any other event or circumstances arising after the date it was first completed.

This letter should be read in conjunction with our Report, which is attached.

Thank you for the opportunity to work on this project for you. Should you wish to discuss any aspect of this Report, please do not hesitate to contact Ian Rose on 07 3227 1415 or 0419 729 584 or Michael Fenech on 07 3243 3753.

Yours sincerely

Michael Fenech  
Partner

Ian Rose  
Executive Director

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## Executive Summary

This Report investigates the current and potential energy market landscape, with particular attention to contingent projects and their effects on power flows within Queensland. The potential projects have been identified on an area basis and identifies each project's maximum demand and likelihood to be installed and operating prior to 2022.

From a high level perspective, the energy landscape was investigated for current drivers in key industries. Current policy, demand forecast projections and the supply demand outlook were considered to understand the market changes in the near future.

- The LNG and mining industries have several large scale projects that have the potential to change the power flows in the transmission network.
- The renewable generation industry is experiencing growth such that several projects are proposed with varying probability and size.
- The metal processing industry is strongly susceptible to global external drivers. Considering projections from the Australian Department of Industry and Science as well as the lack of public information, there are no significant changes expected in electrical demand related to this industry.
- The tourism industry has large projects proposed in the Gold Coast and Cairns areas that may alter the power flows in the transmission network.

Overall, the current energy landscape poses an environment where changes to the supply and demand balance within each area may occur over the period of interest, such that network flows may change. The effects on the transmission network were not investigated. Rather each area is summarised to consider the potential for a contingency trigger. All areas (excluding Metro) are considered to have significant projects which may provide contingent triggers to Powerlink's network development in the next regulated revenue period.

## 1. Introduction

Powerlink is preparing its submission to the Australian Energy Regulator (“AER”) for approval of its revenue requirements from 1<sup>st</sup> July 2017 to 30<sup>th</sup> June 2022. In order to assess its revenue requirements, Powerlink has appointed EY to advise on events within Queensland that may trigger a contingency project.

A contingent project is defined by the AER as “a project assessed by the AER as reasonably required to be undertaken, but which is excluded from the capital expenditure allowance in a revenue determination because of uncertainty surrounding its requirement, timing or costs.”

Although EY has performed a detailed investigation to gather information on projects in Queensland, EY does not guarantee that all major projects have been identified and reported. The information provided in this Report is publicly available with sources provided in the appendices.

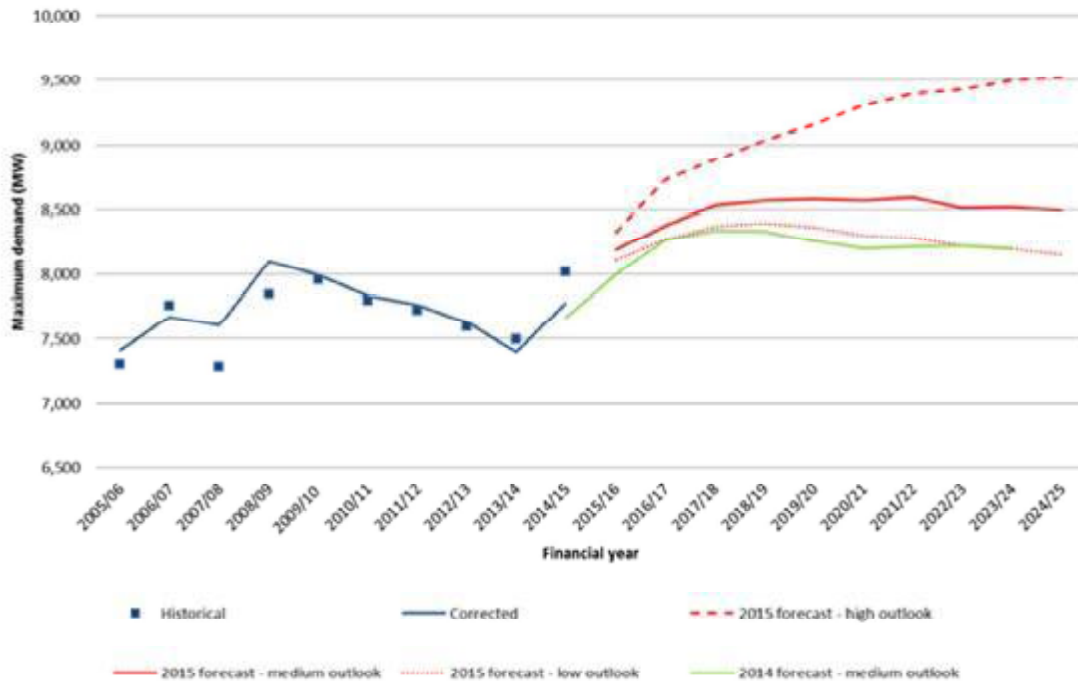
## 2. The Electricity Landscape Overview

This section contains an overview of the industry drivers that will potentially alter the electrical demand and/or supply conditions in areas of Queensland and create the potential for a contingent project, under Powerlink’s regulatory regime.

### 2.1 Demand Forecast

Queensland demand has been forecast by Powerlink for the next ten years under several different economic growth scenarios. This has resulted in forecast 50% Probability of Exceedence (“POE”) maximum demands as illustrated below.

Figure 1: Historical and forecast transmission delivered summer demand



Source: Powerlink 2015 Transmission Annual Planning Report (TAPR)

The high, medium and low scenarios represent different trajectories for energy use based on a range of economic growth forecasts for Queensland. The upper and lower economic growth forecasts set the corresponding boundaries of peak demand projections.

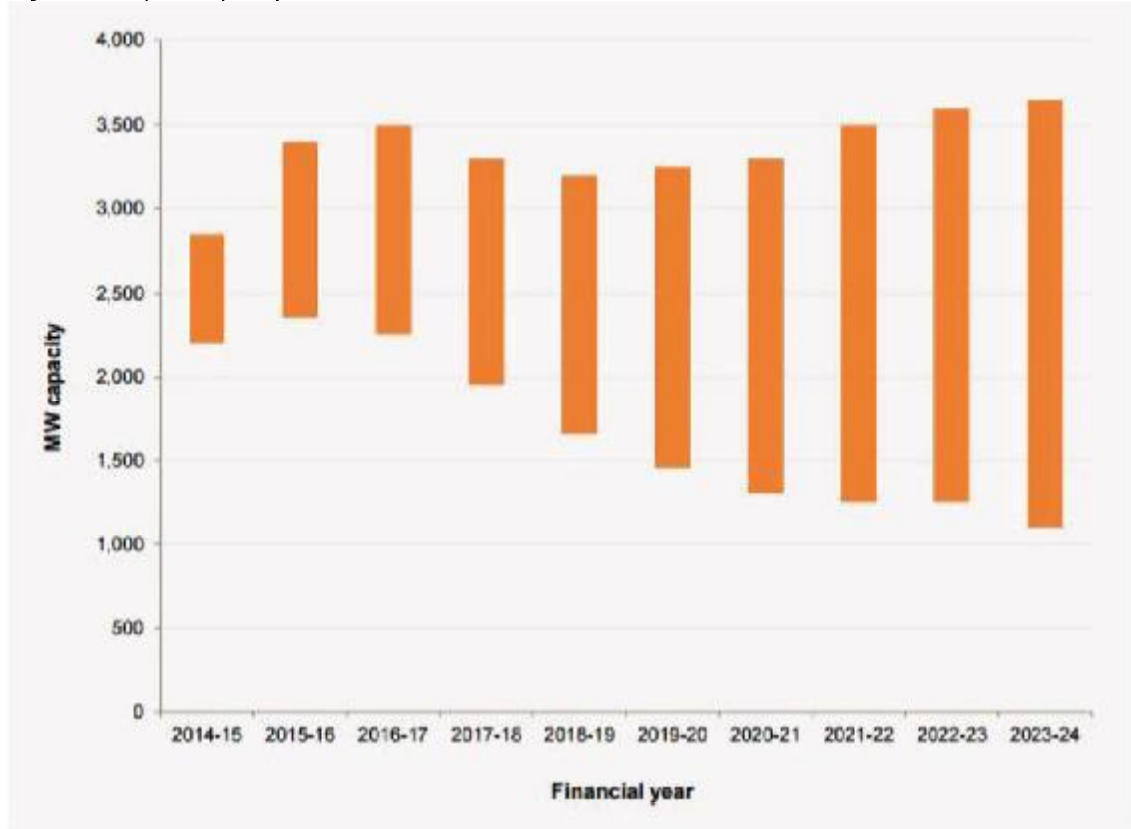
EY understands that Powerlink is using the medium forecast as the basis for planning for the next decade as an input to its 5 year revenue proposal period commencing July 2017. This Report focuses on major projects identified as potential developments which may occur throughout the next 5 to 10 years, which may have a material impact on the Powerlink network during its next revenue reset period.

### 2.2 Supply Demand Outlook

The Australian Energy Market Operator (“AEMO”) publishes annually the outlook of reserve capacity in excess of peak demand requirements to ensure that the NEM Reliability Standard is maintained. This publication, the Electricity Statement of Opportunities (“ESOO”), provides an adequacy assessment of electricity supply to meet consumption by each NEM region across a 10 year outlook period. Figure 2 below shows that across each of the High, Medium and Low scenarios,

as published by AEMO in their 2014 National Electricity Forecasting Report (“NEFR”), there is forecast to be sufficient installed and committed generation capacity in Queensland to meet demand growth.

**Figure 2: Surplus Capacity in Queensland**



Source: AEMO 2014 Electricity Statement of Opportunities

Although there is no low reserve condition in any scenario during Powerlink’s next revenue reset period, Table 1 shows that the level of Unserved Energy (“USE”) in the High scenario by 2023-24 is above zero. This suggests that over time this scenario may require additional capacity beyond that which is already installed and operating. However we note that the forecast level of USE (0.0001%) is well under the 0.002% USE maximum allowed under the Reliability Standard, as specified by the Australian Energy Market Commission’s (“AEMC”) Reliability Panel.

**Table 1: Forecast Low Reserve Condition points in Queensland**

| Region     | Low            |     | Medium         |     | High           |                   |
|------------|----------------|-----|----------------|-----|----------------|-------------------|
|            | First LRC      | USE | First LRC      | USE | First LRC      | USE               |
| Queensland | Beyond 2023–24 | -   | Beyond 2023–24 | -   | Beyond 2023–24 | 34 MWh<br>0.0001% |

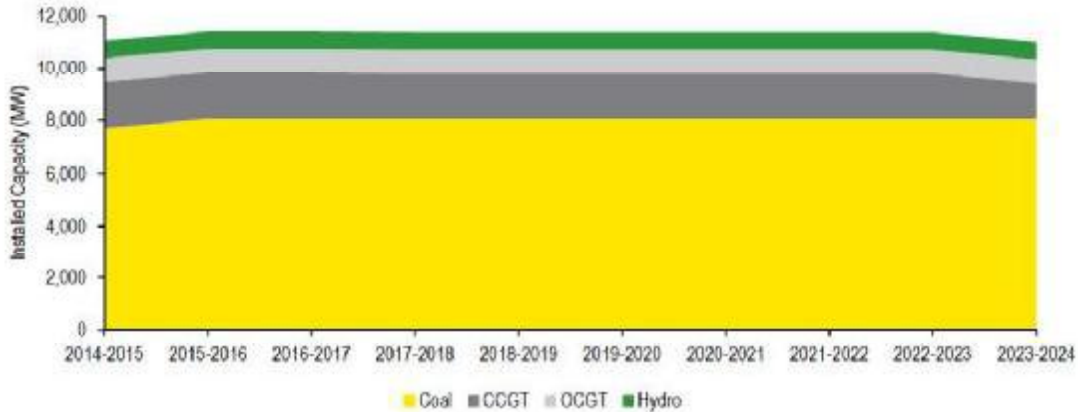
Source: AEMO 2014 Electricity Statement of Opportunities

Despite the significant oversupply of capacity in Queensland that has led to the mothballing and withdrawal of gas and coal fired generation in recent years, the demand growth expected (particularly the increase of material new loads associated with LNG developments) will likely see a return to service for some of the projects previously withdrawn. Furthermore, we expect a reduced utilisation from Queensland’s gas generators, as the domestic gas price rises as LNG exports increase the competition for domestic gas supply. This will likely lead to an increased utilisation from the existing coal generators, reducing the likelihood of further mothballing and/or retirements in the medium term.



Figure 3 below is the forecast of the committed annual generation capacity in Queensland, based on AEMO's present projections.

**Figure 3: Queensland committed annual generation capacity by type**



Source: AEMO, Generation Information for QLD, 2014

There are several overall drivers which may affect the supply and demand for electricity in the next decade and may potentially trigger new developments in transmission. These are discussed in the following sections.

## 2.3 LNG Industry Drivers

Three major commercial projects dominate the liquefied natural gas ("LNG") industry in Queensland with each extracting, compressing, pumping and liquefying coal seam gas ("CSG") for export markets. The three projects include:

- Queensland Curtis LNG ("QCLNG"), a wholly owned venture of Queensland Gas Company ("QGC"), a wholly owned subsidiary of BG Group. We note that Royal Dutch Shell ("Shell") has reached agreement to acquire BG Group.
- Santos GLNG ("GLNG"), a joint venture between Santos, PETRONAS, Total and KOGAS.
- Australia Pacific LNG ("APLNG"), a joint venture between Origin Energy, ConocoPhillips and Sinopec.

Each of the three projects is developing a two LNG train export operation. Two of the three projects also have in place approvals for a third LNG train. The development of this additional capacity will likely depend on the global supply demand outlook for LNG, and the expected return on investment of the Australian assets in a global context.

A fourth LNG project exists – Arrow LNG, proposed by Arrow Energy (a subsidiary of Shell) – however, in January 2015, this project shelved plans to construct LNG trains. Upstream CSG operations are expected to develop as planned.

The QCLNG project recently started exports, while the GLNG and APLNG projects are yet to reach the export stage. GLNG and APLNG are nearing the completion of construction of their downstream assets with their initial gas exports to begin in the near future.

A consequence of the development of LNG export capability is that the price of gas in the NEM, especially Queensland, is expected to increase significantly above historical levels. With the expiry of existing gas contracts with industry and electricity generators, the production of electricity from gas generation in Queensland is expected to decrease significantly in the near future as generators are impacted by these higher fuel prices. This is especially true for gas generators in south west Queensland, as the two Braemar OCGTs and Darling Downs CCGT have enjoyed relatively high

utilisation during the CSG ramp up. Gas fired plants owned by LNG developers, such as the 630 MW Darling Downs Power Station, are expected to reduce electricity production as gas is redirected to higher value customers than the power generators.

## 2.4 Mining Industry Drivers

The mining industry in Queensland encompasses large sources of mineral deposits both within and outside the Powerlink network. However, in considering major electrical loads, the proposed coal mines in the Galilee Basin are of greatest interest.

The outlook for coal-fired generation in Queensland is reasonably positive over the coming decade. The increase in electricity demand, particularly industrial demand associated with CSG extraction and compression, combined with rising gas fuel costs, will put upward pressure on wholesale electricity prices in Queensland and boost the profitability of existing coal generation assets. Unlike the Queensland gas generators, the coal-fired power stations are not likely to experience substantial increases in fuel costs in the near term, particularly for mine mouth generators with limited exposure to global coal price influences.

Queensland has four major coal mine developments proposed within the Galilee Basin. The mines include:

- Carmichael coal mine, owned by Adani Group, is proposing to develop a 60Mtpa thermal coal mine.
- Alpha coal mine is a joint venture major project between GVK and Hancock Prospecting Pty Ltd.
- Kevin's Corner coal mine is a joint venture major project between GVK and Hancock Prospecting Pty Ltd.
- China First coal mine (Galilee Coal Project), owned by Waratah Coal, is a 40Mtpa thermal coal mine.

Carmichael, Alpha, Kevin's Corner and the China First mine, all require mining, transport and export facilities. These mines and associated projects have the potential to significantly increase the electrical demand from the grid. However, these projects are facing pressure related to environmental concerns resulting in proponents struggling to find financiers<sup>1</sup>. With delays spanning several years, approvals are being disputed and some are still being negotiated<sup>2,3</sup>.

Foreign proponents have persisted in their interest in developing the Galilee basin despite falling global coal prices. Meanwhile, existing mines have been reducing production and cutting jobs as a reaction to more challenging market conditions<sup>4,5</sup>. The combination of the development costs of the mines, railways and ports with a low delivered export coal price is substantially weakening the financial viability of the mines<sup>6</sup>.

If domestic coal prices are stable in relation to increases in the electricity pool price, then the utilisation of coal fired generation within Queensland will likely increase. Queensland recently saw the mothballing of two units at Tarong power station as a result of the oversupply of baseload generation in Queensland. One of these two units has since returned to service, while the other is expected to return to service in the near future, with the timing likely to be linked to the increased electrical load associated with the LNG projects.

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<sup>1</sup> <http://www.smh.com.au/business/mining-and-resources/adani-megamine-would-damage-environment-court-20150407-1mftmc.html>

<sup>2</sup> <http://www.abc.net.au/news/2015-03-15/galilee-basin-explainer/6315654>

<sup>3</sup> <http://in.reuters.com/article/2015/01/15/australia-coal-lawsuit-idINKBN0K00A020150115>

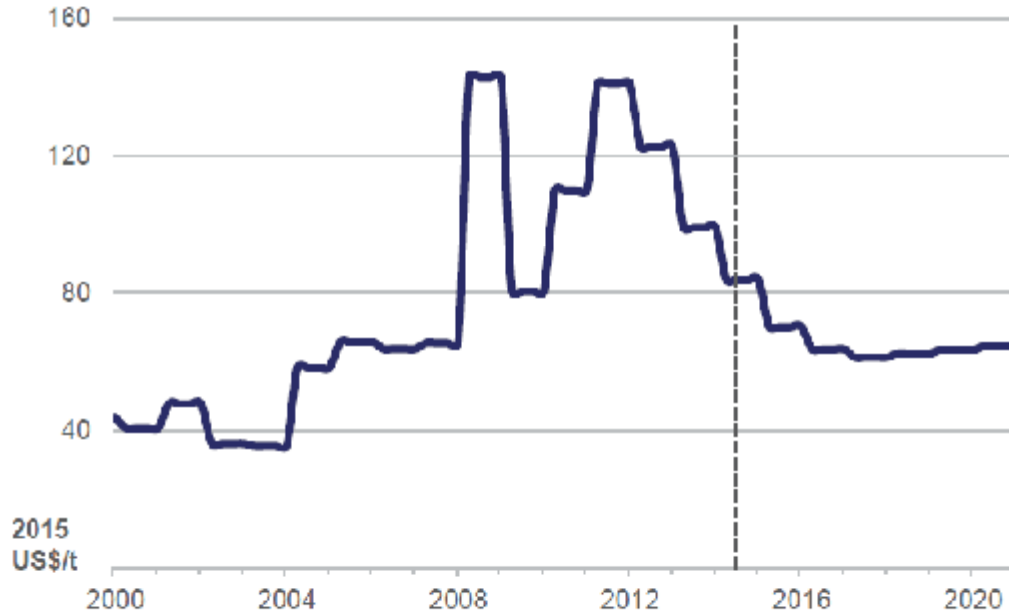
<sup>4</sup> <http://www.smh.com.au/business/mining-and-resources/us-coal-giant-peabody-to-axe-up-to-210-queensland-mine-jobs-cut-production-20150604-ghgjyq.html>

<sup>5</sup> <http://www.abc.net.au/news/2015-02-27/coal-miner-glencore-to-cut-120-jobs2c-reduce-production/6268334>

<sup>6</sup> <http://www.smh.com.au/national/doubts-raised-over-financial-viability-of-galilee-basin-coal-mine-proposal-20140505-zr556.html>

The figure below illustrates the forecast of thermal coal prices to remain relatively low over the medium term.

**Figure 4: Forecast Price of export thermal coal**



Source: <http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/reg/REQ-March15.pdf>

## 2.5 Renewable Industry Drivers

The electricity industry in Australia is experiencing significant change. With the Renewable Energy Target (“RET”) implemented by the federal government, a substantial amount of investment has gone into renewable energy projects. The RET has recently been re-negotiated downwards to a target of 33,000 GWh by 2020, restarting stalled developments. In Queensland, the Labor government has recently announced a target of 50% of power to be sourced from renewable energy systems by 2030<sup>7</sup>. This is considered to be an aspirational target as no detailed plans have been published as to the steps appropriate to achieve this policy.

The RET has resulted in the development of many wind farms across Australia. However, Queensland continues to be seen as a lower resource location for wind projects, and little wind capacity is currently installed in the state. A number of large scale wind projects have been identified in the State and could proceed to assist in meeting the RET. Some large-scale solar generation projects could be developed in Queensland, but these are unlikely to be significant given the higher cost of solar relative to wind projects. Wind power is expected to remain the least cost renewable generation technology to meet the RET.

Government policies have contributed to significant development of embedded solar rooftop photovoltaic (“PV”) systems in Queensland and throughout Australia. Generous feed-in-tariffs and subsidies aimed at reducing capital costs of these systems, as well as the separation of small scale systems from large scale renewables under the small scale renewable energy scheme (“SRES”), have been responsible for the rapid expansion of rooftop solar PV in recent years. Continued embedded solar PV penetration has been factored into Powerlink’s forecast in Figure 1. This growth in embedded solar PV offsets demand growth such that the generation required to flow across the

<sup>7</sup> <http://www.sciencealert.com/queensland-government-pledges-to-reach-50-renewable-energy-by-2030>

transmission system is reduced. We do not consider the rooftop PV developments to provide any material trigger for a contingent transmission project.

## 2.6 Metal Processing Industrial Drivers

Queensland has large processing industries for alumina, aluminium, zinc and nickel, all requiring large electricity consumption. The information presented in this section has been identified in the Resources and Energy Quarterly Report from March 2015 published by the Australian Department of Industry and Science's Office of the Chief Economist ("OCE")<sup>8</sup>.

The global production of aluminium is forecast to decrease in the near future. The likely decrease in production is largely the result of a prolonged period of surplus and the expansion of metal stockpiles. Improving economic conditions are encouraging manufacturing and other consuming industries to increase demand. However, the growth of new international capacity in emerging economies will increase supply and suppress material price increases. Australia's production is forecast to decrease by 9% compared with 2013-2014. With the closure of the Kurri Kurri smelter (NSW) in 2012 and the Point Henry smelter (VIC) in 2014, production is forecast to decrease 3.1 per cent to 1.5 million tonnes in 2019-2020.

Australia's alumina production is forecast to decline at an average annual rate of 1.5 per cent to 19.7 million tonnes in 2019-2020. Australian alumina production may decrease further if the price of aluminium declines, and significantly so if aluminium production decreases.

Australia's refined nickel production was forecast to increase by 3% to 142 000 tonnes in 2014-15. This is aligned with the gradual forecast increase in price due to the rising cost of raw materials. Over the next 5 year period, Australia's refined nickel production is projected to remain relatively stable. No new refined nickel capacity is expected to be developed in Australia over the outlook period as energy costs are high relative to competitors developing new capacity in Asia.

The OCE forecast that international demand for zinc is expected to increase in 2014-15. During the same period, Australian zinc production is also forecast to increase by 12%. The increase in demand is expected to increase the price of zinc on the international market. It is forecast that the refined output of zinc in Australia will marginally decrease by 2020.

## 2.7 Tourism Industrial Drivers

A significant part of the Queensland economy is driven by tourism, both from domestic and international visitors. The tourism industry in Queensland is receiving substantial interest from foreign investors, primarily from China. With major projects potentially being constructed, there is a possibility for electricity demand to substantially increase as a result. Queensland's main tourism hubs, the Gold Coast and the Great Barrier Reef, are expected to benefit from potential foreign investment. New major integrated tourist resorts are proposed for both Cairns and the Gold Coast, including entertainment and gaming infrastructure at new casinos in both locations. The movement in foreign exchange rates could be a significant factor in the investment decisions of these foreign investors, as well as environmental and other approvals from local and State governments.

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<sup>8</sup> <http://www.industry.gov.au/industry/Office-of-the-Chief-Economist/Publications/Documents/reg/REQ-March15.pdf>

### 3. Transmission Network Sensitivities & Potential Loads

Powerlink is using an area classification on which to base its assessment of need for new major transmission projects, as show in Figure 5 below. We have therefore assessed contingent projects on an area basis for this report.

Figure 5: Powerlink's 2015 Area Plan Definitions



If the definitions in Figure 5 are not applicable, Powerlink's 2014 TAPR zonal definitions are used. These zones are described below in Table 2.

**Table 2: Powerlinks 2015 Zonal Definitions**

| Zone         | Area Covered   |
|--------------|--|
| Far North    | North of Tully, including Chalumbin.   |
| Ross         | North of Proserpine and Collinsville, excluding the Far North zone.                                |
| North        | North of Broadsound and Dysart, excluding the Far North and Ross zones.                            |
| Central West | South of Nebo, Peak Downs and Mt McLaren, and north of Gin Gin, but excluding the Gladstone zone.  |
| Gladstone    | South of Raglan, north of Gin Gin and east of Calvale.   |
| Wide Bay     | Gin Gin, Teebar Creek, and Woolooga 275kV substation loads, excluding Gympie.                      |
| Surat        | West of Western Downs and south of Moura, excluding the Bulli zone.                                |
| Bulli        | Goondiwindi (Waggamba) load and the 275/330kV network south of Kogan Creek and west of Millmerran. |
| South West   | Tarong and Middle Ridge load areas west of Postmans Ridge, excluding the Bulli Zone.               |
| Moreton      | South of Woolooga and east of Middle Ridge, but excluding the Gold Coast zone.                     |
| Gold Coast   | East of Greenbank, south of Coomera to the Queensland/New South Wales border.                      |

Source: Powerlink 2015 TAPR

Each project listed in Section 3 has the potential to affect Powerlink's transmission network. However, the materiality of this potential to alter power flows differs each project. To assist in illustrating each project's material effects, they are assigned terms and subsequently ranked. These terms are defined in Table 3 below.

**Table 3: Probability Definitions**

| Term                | Definition  |
|---------------------|---|
| Certain             | The project has received required state/federal/financial approvals (where applicable). It is publicly considered a committed project to begin operations before 2022.  |
| Probable            | The project has received required state/federal approvals (where applicable). It has the resources in place to proceed but is not publicly considered a committed project. There may be some speculation around the date of commencement.   |
| Plausible           | The project may not have received final state and/or federal approvals but it has completed preliminary investigations and reports. There is likely some media attention surrounding the progress of the project. If the project gains momentum it is within reason that it could be operating before 2022. |
| Possible            | The project has not received any final approvals and is considered in the preliminary stages of its development. It is possible that the project could proceed but it may require a change in external circumstances.   |
| No change is likely | This term refers to metal processing plants and their levels of energy demand. This term implies that there is no material change expected in the medium term.  |

## 3.1 Cairns Area

### 3.1.1 Upcoming Projects

Table 4 below lists the potential major changes in on-grid electrical load in the Cairns Area.

**Table 4: List of Potential Projects in Cairns**

| Project Title      | Description   | Potential Change | Max Loading | Potential to occur within the revenue period | Source     |
|--------------------|---|------------------|-------------|--|------------|
| Aquis Project      | Aquis Great Barrier Reef Resort ('Aquis') is intended to be Australia's largest integrated resort   | Increased Demand | 29 MW       | Plausible                                    | Appendix A |
| Lakeland Solar PV  | Lyon Infrastructure is developing a 26 MW solar farm at Lakeland near Cooktown in Far North Queensland.   | Increased Supply | 26 MW       | Plausible                                    | Appendix C |
| Mount Emerald Wind | The Port Bajool and Ratch Australia partnership propose to build the Mt Emerald Wind Farm on private land on the plateau adjacent to the Mt Emerald/ Springmount area. The project has recently received development approval from the Queensland State Government. | Increased Supply | 189 MW      | Probable                                     | Appendix C |
| Archer Point       | The Archer Point Wind Farm, alternatively Jalunji Wind Park or Cooktown Wind Farm, is a proposed wind farm to be located at Archer Point, about 15 km south of Cooktown. It is expected to cost A\$250 million to construct   | Increased Supply | 120 MW      | Plausible                                    | Appendix C |
| PNG Hydro (Purari) | Origin planned to supply power not only to PNG through the project, but also north Queensland through a transmission link to northern Australia.  | Increased Supply | 1800 MW     | Possible                                     | Appendix C |

The Aquis project has the potential to alter power flows in the transmission network through an additional 29MW of electrical demand from the grid. This project is subject to external drivers such as exchange rates and competing projects for investor capital in the Gold Coast. The mega resort has received federal and state approval and is planning construction to begin in 2018, if it proceeds. It is plausible to be operational before 2020.

The Mount Emerald wind farm has received development approval and is planning commercial commencement in 2018. The scale of this wind farm is such that the connection to the 275kV transmission grid between Chalumbin and Cairns may be needed. Archer Point wind farm is a proposed wind farm near Cooktown intending to produce 120MW to the grid. The project is yet to receive planning approval, and little evidence of activity exists in the public domain on the development of this project in recent years; it is unlikely in the medium term. The Lakeland Solar Farm could be developed and operating in the outlook period but is of small scale, although being a solar project it will likely need to compete with lower cost wind farms.

The PNG Hydro (Purari) project proposes to develop a hydroelectric scheme to supply power to Papua New Guinea, as well as develop an undersea transmission link with North Queensland. We understand that the project has been effectively shelved for the time being, but if it does proceed it may change network power flows within Powerlink's network materially.

### 3.1.2 Summary for Cairns Area

Mount Emerald may be a trigger for the Walkamin 275kV connection when combined with additional tourism developments in the Cairns area. Should further supplies enter the Cairns area then this may have an effect on the power flows in the area.

## 3.2 North Queensland Area

### 3.2.1 Upcoming Projects

Table 5 provides a list of upcoming and outgoing projects within the North Queensland area.

**Table 5: List of Potential Projects in North Queensland**

| Project Title                     | Details   | Potential Change                                      | Max Loading | Potential to occur within the revenue period | Source     |
|-----------------------------------|---|---|-------------|--|------------|
| Abbot Point Expansion*            | Since obtaining a 99-year lease of the X50 Abbot Point Coal Terminal, Adani has identified the need to increase terminal capacity. They are proposing a 70 Mtpa expansion of the existing terminal, along with an additional two offshore berths.   | Increased Demand                                      | 100MW       | Plausible                                    | Appendix A |
| Kidston Hydro                     | Genex Power is planning to build a large pumped storage hydro power generator in an old unused gold mine. It has commenced a formal initial public offering ("IPO") to assist in project funding.   | Increased Supply and Demand                           | 330MW       | Plausible                                    | Appendix C |
| Kennedy Wind Farm†                | The Kennedy Wind and Solar Farm Project is a phased development of renewable energy generation near Hughenden, 350kms west of Townsville.   | Increased Supply                                      | 700MW       | Possible                                     | Appendix C |
| Kennedy Solar Farm†               |   | Increased Supply                                      | 600MW       | Possible                                     | Appendix C |
| Clare Solar Farm                  | The proposed Clare Solar Farm will be a large scale grid-connected plant 35km from Ayr in North Queensland.   | Increased Supply                                      | 150MW       | Plausible                                    | Appendix C |
| Mt Stuart Power Station           | The Mount Stuart Power Station is an existing generator which is scheduled to retire mid 2023   | Decreased Supply                                      | 423MW       | Possible                                     | Appendix A |
| Collinsville Power Station        | Collinsville Power Station is an existing generator which is currently mothballed. It will be retired in mid 2016, having ceased to operate for several years. Collinsville Power Station is also considered part of the North Bowen Area according to Powerlink's provided map.            | Decreased Supply Capacity                             | 190MW       | Certain                                      | Appendix A |
| Sun Metals                        | The Zinc Refinery is located South of Townsville  | No information to indicate any changes in near future | 120MW       | No change is likely                          | Appendix A |
| Palmer Nickel and Cobalt Refinery | The Nickel Refinery is located on the North Queensland Coast and operates on a 24hr basis.  | No information to indicate any changes in near future | 40MW        | No change is likely                          | Appendix A |
| Yabulu Power Station              | This Station is adjacent to the Palmer Nickel and Cobalt refinery. The station is capable of operation as a 240MW combined cycle power plant but has generated at only 12% capacity factor in 2013-14 and less than 5% in 2014-15 to date. This is due to competition with other gas users. | Potential to reduce operation further                 | 240MW       | Plausible                                    |            |

\*Abbot Point expansion is dependent on the success of the Carmichael coal and rail project.

†The Kennedy Wind and Solar Farms are dependent on the development of a supporting transmission line.

The most likely change to occur in this area is the official retirement of the Collinsville Power Station, although this generator has not operated for some time. The incoming Kidston Project is an active development, with an IPO underway. The pumped storage hydro facility will generate up to 330MW, while also consuming power to pump between storage ponds depending on market prices. The Mount Stuart Power Station is planned to retire in 2023, and would reduce the available electricity supply capacity by 420MW.



The Kennedy Wind and Solar Farms would face significant connection costs given the distance to the existing transmission grid. The Clare Solar Farm is awaiting a final investment decision but is envisaged to begin in 2017 with a construction time of 18 months if it proceeds.

Within the outlook period, it is plausible that the Abbot Point Expansion will occur as the Environmental Impact Statement (“EIS”) has recently started its investigation.

The changes in production for the North Queensland refineries are expected to be negligible. There is no publicly available information to illustrate any significant changes in the future.

### 3.2.2 Summary for North Queensland

The industrial electricity demand is expected to remain relatively stable with the zinc and nickel refineries providing the bulk of this. Demand increases from the Abbot Point expansion and Kidston Hydro project are possible in the review period.

There are several prospective generation sources that may be introduced. The pumping and generation profile of the Kidston project would be subject to the operating decisions of the operator, although pumping is more likely during low demand periods and generating is more likely during high demand periods, which may change network flows. Powerlink should consider the network impact to the area at both full generation and full pumping.

## 3.3 Northern Bowen Basin Area

### 3.3.1 Upcoming Projects

Table 6 below lists the potential changes in electrical loading in the Northern Bowen Basin Area.

**Table 6: List of Potential Projects in the North Bowen Basin**

| Project Title          | Details  | Potential Change | Max Loading | Potential to occur within the revenue period | Source     |
|------------------------|--|------------------|-------------|--|------------|
| Bowen Gas Project      | Arrow Energy has proposed a gas project involving a phased expansion of CSG production to supply LNG use and/or sell domestically.   | Increased Demand | 80MW        | Plausible                                    | Appendix A |
| Carmichael Coal & Rail | The Carmichael mine is a proposed thermal coal mine in the Galilee basin. It will be designed to produce 60Mtpa of coal. The EIS indicates that the Carmichael mine will take approximately 200MW of electricity from the grid. However, Moray Power is proposing to develop a multi-fuel power station with an initial generating capacity of 150 MW to provide reliable base load power in the Galilee Basin without the need for a grid connection. | Increased Demand | 200MW       | Plausible                                    | Appendix A |

The identified developments in this area are significant. The Carmichael coal and rail project has stated it could demand up to 200MW from the electricity grid, which could materially change the network flow into the area. A 150MW power station, proposed by Moray Power, is another option to support the mine, which would keep the mining load off-grid, but the attractiveness of independent power supply would ultimately depend on the cost and reliability differences of both options.

The Bowen Gas Project proposes to expand Arrow Energy’s CSG capabilities in the Bowen Basin. Its EIS indicates that it would be grid connected. Arrow Energy plan on using up to 80MW to power compression and water treatment facilities. The publicly available information indicates that CSG will be used to power the facilities for the first two years of project operations.

### 3.3.2 Summary for North Bowen Basin Area

With few local generation options in the area, there is likely to be material change to network flows if either identified projects proceed in the review period.

## 3.4 Central West Area

### 3.4.1 Upcoming Projects

Table 7 covers the major projects with the potential to alter the electrical loadings in the Central West Area.

**Table 7: List of Potential Projects in Central West**

| Project Title                            | Details  | Potential Change | Max Loading | Potential to occur within the revenue period | Source     |
|--|--|------------------|-------------|--|------------|
| Alpha Coal Project (GVK & Hancock Coal)  | GVK Hancock is a joint venture proposing to develop the Alpha Coal Project, a 30 Mtpa product open cut thermal coal mine to target the C and D seams in the Upper Permian coal measures of the Galilee Basin.  | Increased Demand | 135MW       | Plausible                                    | Appendix A |
| Kevin's Corner Mine (GVK & Hancock Coal) | GVK Hancock is a joint venture proposing to develop a new coal mine to produce up to 30 Mtpa of thermal coal annually for the export market for a period of 30 years. The coal mine which is comprised of both open-cut and underground workings, is targeting the thermal coal seams in the Upper Permian coal measures of the Galilee Basin. | Increased Demand | 250MW       | Plausible                                    | Appendix A |
| China First Project (Waratah Coal)       | Waratah Coal has proposed the "Galilee Coal Project (Northern Export Facility)" otherwise known as "China First Project" consisting of two open cut operations, four underground longwall mining operations, coal handling preparation plants, a rail transportation network to Abbot Point and a proposed port facility at Abbot Point.       | Increased Demand | 150MW       | Plausible                                    | Appendix A |

The listed projects above are based in the Galilee Basin and have a cumulative power demand of 535MW. If any one of the projects proceed the Central West area would experience a significant increase in its electricity demand.

Federal approvals for each project have been obtained for each mine yet these projects have experienced significant delays. Construction may very well begin within the review period if they proceed, although the timing of the projects, and the potential electrical loading on the Powerlink network during the period of interest, is subject to significant uncertainty.

The Alpha Coal Project plans on sharing its railway project with the Kevin's Corner mine. This suggests a reliance on splitting infrastructure costs between the two projects. If one of these projects were to proceed, then it may increase the likelihood that the other will follow.

Given the extensive transmission and rail infrastructure development needed for the Galilee Basin projects to proceed, it is likely that if one proceeds, more may follow to fully utilise the investment.

### 3.4.2 Summary for Central West Area

If one of the listed projects were to develop, this would constitute a major increase in demand. This large increase in remote demand has the potential to trigger network developments, as identified by Powerlink through the Galilee Basin Transmission Project<sup>9</sup>.

<sup>9</sup> [https://www.powerlink.com.au/Projects/Central/Galilee\\_Basin\\_Transmission\\_Project.aspx](https://www.powerlink.com.au/Projects/Central/Galilee_Basin_Transmission_Project.aspx)

## 3.5 Gladstone Area

### 3.5.1 Upcoming Projects

Table 8 below lists the potential and committed changes in electrical loading in the Gladstone Area.

**Table 8: List of Potential Projects in Central Queensland to South Queensland**

| Project Title                 | Purpose  | Potential Change          | Max Loading  | Potential to occur within the revenue period | Source     |
|-------------------------------|--|---------------------------|--|--|------------|
| QCLNG liquefaction facilities | <p>QCLNG are committed to develop two trains of liquefaction facilities at Curtis Island, Gladstone. The design of these assets typically consumes gas to power the process, and it is not proposed to retrofit a grid connection to these facilities. QCLNG has begun exports (Dec 2014).</p> <p>The development has approval for a third liquefaction train. The acquisition of BG-Group by Shell, merging the CSG resources of the two entities has improved the likelihood of this proceeding, although it is still largely dependent on improved market conditions.</p> | Increased Demand          | <p>Self-sufficient</p> <p>~100MW (likely to be self-sufficient based on existing design)</p> | <p>Certain</p> <p>Plausible</p>              | Appendix A |
| APLNG liquefaction facilities | <p>APLNG are committed to develop two trains of liquefaction facilities at Curtis Island, Gladstone. The design of these assets typically consumes gas to power the process, and it is not proposed to retrofit a grid connection to these facilities. Exports are yet to commence.</p> <p>The development has not yet received approval for a third liquefaction train. This proposed expansion is largely dependent on improved market conditions.</p>   | Increased Demand          | Self-sufficient  | <p>Certain</p> <p>Possible</p>               | Appendix A |
| GLNG liquefaction facilities  | <p>GLNG are committed to develop two trains of liquefaction facilities at Curtis Island, Gladstone. The design of these assets typically consumes gas to power the process, and it is not proposed to retrofit a grid connection to these facilities. Exports are yet to commence.</p> <p>The development has approval for a third liquefaction train. This proposed expansion is largely dependent on improved market conditions.</p>   | Increased Demand          | Self-sufficient  | <p>Certain</p> <p>Possible</p>               | Appendix A |
| Gladstone Power Station       | Gladstone Power Station is one of Queensland's largest coal-fired power stations and is located at Gladstone on the central Queensland coast. Possible shutdown of one or more units.  | Decreased Supply capacity | 560MW  | Possible                                     | Appendix A |
| Boyne Aluminum Smelter        | No information to indicate any changes in near future  | Increased Demand          | No change is likely  | No change is expected                        | Appendix A |
| QAL Alumina Refinery          | No information to indicate any changes in near future  |                           | No change is likely  | No change is expected                        | Appendix A |
| CAR Alumina Refinery          | No information to indicate any changes in near future  |                           | No change is likely  | No change is expected                        | Appendix A |

The construction of the 2 GLNG and the 2 APLNG trains is nearing completion. This process has been off grid and its completion will not affect the transmission network. The potential for each major LNG project to construct a 3<sup>rd</sup> train each is unlikely to affect Powerlink's network as the

standard liquefaction plant design is self-sufficient. The OCLNG, GLNG and APLNG projects in this area will utilise CSG-fired turbines to provide power to their liquefaction facilities as they operate, with no grid connection anticipated.

The Gladstone Power Station is the main power supplier for the Boyne smelter and provides 810MW of its capacity to the smelter. The smelter has not made any recent public announcements stating its intent to change its production levels. Rio Tinto is attempting to sell its Pacific Aluminium division which includes the Boyne Island smelter. A similar sale of these assets was abandoned in 2013. The performance of the aluminium sector generally has increased materially since poor performing smelters were culled<sup>10</sup> and there may be upside potential for electrical load if market conditions continue to improve.

Although we have found no documentation in the public domain which provide explicit plans by CAR, QAL or Boyne to increase production, if market conditions prove favourable the increased demand may affect network flows in the area.

### 3.5.2 Summary for Gladstone Area

The new liquefaction projects in this area are self-sufficient; we expect any additional facilities to service one or more trains would also be self-sufficient. The metal processing facilities have not publicly displayed intent to increase production which might influence their electricity loads, however if market conditions prove favourable, this is possible.

The potential changes to the supply and demand balance within the Gladstone area, as well as in south west Queensland, may lead to changes to network flows from central to southern Queensland.

## 3.6 Surat Zone

### 3.6.1 Upcoming Projects

Table 9 below covers the major projects with the potential to alter the electrical loadings in the Surat Zone.

**Table 9: List of Potential Projects in Surat**

| Project Title   | Purpose  | Potential Change | Max Loading | Potential to occur within the revenue period | Source     |
|---|--|------------------|-------------|--|------------|
| Bulli Creek Solar Farm                                | Construction of this estimated \$1billion project may commence as soon as 2016 at the 200 hectare site at Bulli Creek between Millmerran and Goondiwindi.  | Increased Supply | 2000MW      | Plausible                                    | Appendix C |
| Electrification of LNG Upstream Processing Facilities | This involves the electrification of industrial LNG upstream assets including extraction, compression and water treatment facilities. The APLNG, GLNG and OCLNG projects are partially electrified with significant conversion to grid power to commence soon. | Increased Demand | 893MW       | Certain                                      | Appendix A |
| Wandoan Coal Project*                                 | This project proposes to develop an open cut thermal coal mine, alongside associated infrastructure near the town of Wandoan, 350km west of Brisbane.  | Increased Demand | 150MW       | Plausible                                    | Appendix A |

<sup>10</sup> <http://www.smh.com.au/business/markets/rio-tinto-to-sell-aluminium-assets-in-1b-deal-report-20150517-gh3tnj.html>

|                       |   |                  |                                       |                       |            |
|-----------------------|---|------------------|---------------------------------------|-----------------------|------------|
| GLNG Field Expansion  | The Gas Field Development (GFD) Project extends the approved GLNG Project's gas fields, and will involve the construction, operation, decommissioning and rehabilitation of wells and the associated supporting infrastructure needed to provide additional gas over more than 30 years. This expansion is also occurring in the Northern Bowen Basin Area. | Increased Demand | Up to 200MW                           | Plausible             | Appendix A |
| Kogan Solar Boost     | The Kogan Creek Solar Boost Project will be the largest solar integration with a coal-fired power station in the world when it is operational   | Increased Supply | There is no change in supply capacity | Certain               | Appendix C |
| Braemar 3             | Plans are well advanced for an open-cycle, gas-fired power station of up to 550 MW in capacity and an 80 km high pressure underground gas pipeline.   | Increased Supply | 550MW                                 | Plausible             | Appendix C |
| Braemar 4             | Braemar 4 will be a 500 MW intermediate load power station.   | Increased Supply | 500MW                                 | Plausible             | Appendix C |
| Darling Downs (DDPS1) | The power station comprises three 120MW Frame 9E GTs and a 270MW steam turbine. The steam turbine is expected to be disconnected when converted to an OCGT, reducing both its maximum capacity and the energy produced from the station.  | Decreased Supply | 270MW reduction in supply capacity    | Probable              | Appendix A |
| Darling Downs 2       | This is intended to be an OCGT peaking plant capable of 500MW   | Increased Supply | 500MW                                 | Plausible             | Appendix C |
| Inland Rail           | Inland Mainline freight Upgrade - Queensland border to Acacia Ridge (Federal-QLD government). This project runs through the Tarong and Metro areas as well.   | Increased Demand | Self-Sufficient                       | No change is expected | Appendix A |

\*Project is directly related to Surat Basin Rail Project, Wiggins Terminal Expansion, Balaclava Terminal Expansion.

The introduction of the Bulli Creek Solar farm would be a major contribution to electricity generation. It has received approval from the Toowoomba Regional Council and is intended to be constructed over an eight to ten year period. An initial installation of 550MW is intended if the project is developed.

The GLNG project has obtained approvals for a potential expansion to its fields, and may pursue the developments if market conditions allow. Santos has stated that the project's energy requirements will be met from its own gas supply as well as grid-based power where available. The GFD project released an EIS stating its expansion will supply the gas needs for an expanded three-train LNG facility. The gas fields will require 30-60MW for each field.

The electrification of upstream facilities for the GLNG, QCLNG and APLNG projects is in progress and will continue to increase the demand for electricity in the Surat. This demand is already considered by Powerlink.

The Wandoan Coal Project has not received final approvals from either federal or state governments. In 2013 the proponents, Xstrata, shelved the project and in early 2014 considered the project to be delayed indefinitely. The price of coal may need to return to higher levels for this thermal coal project to proceed during the review period.

Kogan Creek Solar boost is augmenting the existing Kogan Creek coal power station to develop a solar and coal integrated power plant. The changes to sent-out power are related to developments in efficiency. According to AEMO's generation Information it is not expected to provide additional capacity.

Braemar 3 and 4 are proposed gas plants that have been in the planning stage for several years. With approvals in place, they may develop in response to market signals supporting the need for additional peaking generation in Queensland. Given the forecast increases in gas price and

oversupply of capacity, it is just plausible that these plants will be developed in the medium term.

The existing Darling Downs power station may convert to an OCGT plant from its current configuration of a CCGT. This has potential implications for a reduction in power supply of 270MW, reflecting the steam turbine being taken out of service. OCGTs produce significantly less energy than combined cycle generators typically and this change will alter the power flow characteristics in the Surat area. The Darling Downs 2 power station is a proposed OCGT peaking plant with a capacity of 500MW. Its development and operation before 2020 is possible.

The inland rail project was investigated due to its stature and potential for electrical demand. After investigating the energy details of the project, EY can state that this rail project will not be electrified and will not affect the transmission network.

### 3.6.2 Summary for Surat Zone

The demand increase occurring in the medium term is substantial, due to the electrification of the LNG upstream processing and compression facilities. These loads are committed and have started to change power flows in the Powerlink network.

The Surat zone has a number of projects that would potentially increase local generation. There is also the potential for reduced local generation (in terms of energy and capacity) with the potential re-configuration of DDPS1, and the reduced utilisation of Braemar 1 and Braemar 2 when gas prices rise relative to current values.

## 3.7 Tarong Area

### 3.7.1 Upcoming Potential Projects

Table 10 below lists the potential projects that may alter the transmission network flows if they come to fruition.

**Table 10: List of Potential Projects in Tarong**

| Project Title         | Purpose   | Potential Change             | Max Loading         | Potential to occur within the revenue period | Source     |
|-----------------------|---|------------------------------|---------------------|--|------------|
| Coopers Gap Wind Farm | The wind farm is planned to be connected to a new Powerlink substation along the new Western Downs to Halys 275kV transmission line recently built by Powerlink                                 | Increased Supply             | 350MW               | Plausible                                    | Appendix C |
| Tarong Power Station  | The Tarong Power Station has a generating capacity of 1,400 megawatts, generated from four turbines. It is expected to return the final mothballed unit to normal operation in the near future. | Increased Supply Utilisation | 350MW               | Likely                                       | Appendix C |
| QNI Upgrade           | An upgrade to the QNI interconnector would allow an increase in the import capacity from NSW.   | Increased Supply Utilisation | Approximately 200MW | Plausible                                    | Appendix C |

The Coopers Gap Wind Farm would supply up to 350MW of power to the network at full output. The RET review stalled the development of the project, which is yet to receive development approvals. However load growth in Queensland (relative to other states) makes this project (and other Queensland renewable projects) potentially attractive to renewable developers seeking diversification from the established wind development areas in southern Australia.

The Tarong power station is expected to return to service all units in the near future, allowing it to operate at its full capacity. The return of the fourth unit is expected to be driven by improved market dynamics when LNG loads come online and higher gas prices impact on the local gas fired fleet (particularly in the Surat).

With reduced gas-fired generation in southern Queensland, the conditions to satisfy a QNI upgrade may emerge within the outlook period. This is associated with an increase in gas prices coupled with an increase in electricity demand growth. The potential upgrade has been the subject of a number of investigations in recent years, and the higher growth in Queensland, and higher costs for local gas generation, may present renewed opportunity for the project to satisfy the Regulatory Investment Test for Transmission in the review period.

### 3.7.2 Summary for Tarong Area

There is the potential for material change to network flows if the supply projects identified proceed.

## 3.8 Metro Area

### 3.8.1 Upcoming Potential Projects

Table 11 below contains upcoming projects that may alter the electrical loading in the network specific to the Brisbane and south east Queensland Metro area.

**Table 11: List of Potential Projects in the Metro Area**

| Project Title            | Description  | Potential Change | Max Loading | Potential to occur within the revenue period | Source     |
|--------------------------|--|------------------|-------------|--|------------|
| Westlink Power Project   | The Westlink Power Project is a natural gas-fired peaking plant near Gatton, west of Brisbane. The plant's final capacity would be 1000 megawatts, comprising 200-300 megawatt units developed in stages to meet electricity demand. | Increased Supply | 1000MW      | Possible                                     | Appendix C |
| Swanbank E Power Station | The 385 MW gas-fired Swanbank E Power Station is currently mothballed. Its potential return to service will depend on the ongoing market requirements.   | Increased Supply | 385MW       | Plausible                                    | Appendix C |

If Swanbank E power station were to return to service then the power flows of the Metro area would change. This is dependent on market conditions improving, as the CCGT has higher operating costs than coal-fired generators in the Stanwell portfolio. The initial motivation for mothballing Swanbank E was to sell and trade the gas instead of using it for generation. The ramp up of the LNG fields to full operation will reduce the need for third party gas to fill the LNG trains, reducing the capacity for Stanwell to on-sell the contracted supplies at Swanbank. This does not necessarily mean that the plant will return to service, as it may remain in Stanwell's best interest to keep the plant shut down and increase utilisation at their coal generators over the medium term, considering the ongoing subdued growth in residential and commercial loads.

The Westlink Power project was planned to be developed over a four year period from 2018-2022 to supply up to 1000MW. This project is intended to be a natural gas-fired peaking plant near Gatton. The project received significant objection to the development, and while it received planning approval on appeal (after originally having its approvals rejected by council), the oversupply of capacity in Queensland is likely to keep this project shelved in the medium term.

### 3.8.2 Summary for Metro Area

We expect no material change to the supply outlook for the Metro area.

## 3.9 Gold Coast

### 3.9.1 Upcoming Potential Projects

Table 12 covers the major projects with the potential to alter the electrical loadings in the Gold Coast Area.

**Table 12: Upcoming projects in the Gold Coast Area**

| Project Title                 | Description   | Potential Change | Max Loading                | Potential to occur within the revenue period | Source     |
|-------------------------------|---|------------------|----------------------------|--|------------|
| Gold Coast Integrated Resort  | This integrated resort includes an international cruise ship terminal, tourism precinct, luxury hotels, a casino, marinas, extensive waterfront parklands, retail and residential elements. | Increased Demand | No EIS Statement completed | Possible                                     | Appendix A |
| Gold Coast Aquis Casino       | Tony Fung has bought the Sheraton Mirage on the Gold Coast for \$160 million and plans to turn it into a luxury casino resort.  | Increased Demand | No EIS Statement completed | Possible                                     | Appendix A |
| Gold Coast Commonwealth Games | From 4 to 15 April 2018, the Gold Coast will host the 21st Commonwealth Games.  | Increased Demand |                            | Certain                                      | Appendix A |

The Gold Coast integrated resort would be a large electrical demand once it is constructed and fully operational. However, given it has not yet completed an EIS, this indicates it is still in planning stages. An approximate value for power demand has not yet been made public. The project has indicated that if it is approved it will be completed by 2026.

The Sheraton Mirage on the Gold Coast has recently been acquired by international investors with the intention of converting to a second Gold Coast casino. This project is in the planning stage as well as it has not completed an EIS. This strongly indicates that if built, it would not be complete within the review period. While this project and the previous are not the same, the ongoing tourism developments are interrelated, and we would expect that the development of one project may lead to a change in the other. For example, it is plausible that the Gold Coast is large enough to support three Casinos in the medium term. However the development of a cruise terminal, for example, could increase the likelihood of further commercial property developments in and around the Gold Coast, including the projects identified here.

The Commonwealth Games are being hosted by the Gold Coast in 2018. The associated power requirements are expected to be minimal (relative to the Gold Coast total load), associated with the increased tourism numbers in the Gold Coast, Brisbane and surrounding areas. There is no publicly available documentation specifying the Commonwealth games power requirements and the effects this may have on the grid.

### 3.9.2 Summary for Gold Coast Area

The development timeframe for potential new major commercial infrastructure projects is such that major demand changes for the Gold Coast area are plausible in the short to medium term. The area will remain reliant on existing network connections from Metro and the DirectLink DC interconnector with northern New South Wales.



## Appendix A Incoming Projects

| Project Title                                 | Sources  |
|---|--|
| Inland Rail                                   | <a href="http://inlandrail.artc.com.au/wp-content/uploads/2014/09/Inland-Rail-Industry-BriefingSept-2014-BRIS-UPDATE-FINAL.pdf">http://inlandrail.artc.com.au/wp-content/uploads/2014/09/Inland-Rail-Industry-BriefingSept-2014-BRIS-UPDATE-FINAL.pdf</a><br><a href="http://www.artc.com.au/library/iras_final%20report.pdf">http://www.artc.com.au/library/iras_final%20report.pdf</a>   |
| Aquis Project (Cairns)                        | <a href="http://eisdocs.dsdp.qld.gov.au/Active%20Projects/Aquis%20Resort%20at%20the%20Great%20Barrier%20Reef/EIS/Aquis%20EIS_DIGITAL_Chapter%2025.pdf">http://eisdocs.dsdp.qld.gov.au/Active%20Projects/Aquis%20Resort%20at%20the%20Great%20Barrier%20Reef/EIS/Aquis%20EIS_DIGITAL_Chapter%2025.pdf</a><br><a href="http://eisdocs.dsdp.qld.gov.au/Aquis%20Resort%20at%20the%20Great%20Barrier%20Reef/EIS/Aquis%20EIS_DIGITAL_Executive%20Summary.pdf">http://eisdocs.dsdp.qld.gov.au/Aquis%20Resort%20at%20the%20Great%20Barrier%20Reef/EIS/Aquis%20EIS_DIGITAL_Executive%20Summary.pdf</a><br><a href="http://www.cairnspost.com.au/business/work-on-42-billion-aquis-mega-resort-at-yorkeys-knob-may-start-late-next-year/story-fnjpusdv-1226837851541">http://www.cairnspost.com.au/business/work-on-42-billion-aquis-mega-resort-at-yorkeys-knob-may-start-late-next-year/story-fnjpusdv-1226837851541</a><br><a href="http://aquiscasino.com/">http://aquiscasino.com/</a> |
| Abbot Point Expansion                         | <a href="http://www.statedevelopment.qld.gov.au/assessments-and-approvals/abbot-point-coal-terminal-expansion-stage-3.html">http://www.statedevelopment.qld.gov.au/assessments-and-approvals/abbot-point-coal-terminal-expansion-stage-3.html</a><br><a href="https://www.ergon.com.au/_data/assets/pdf_file/0007/6793/Merinda---Newsletter-1.pdf">https://www.ergon.com.au/_data/assets/pdf_file/0007/6793/Merinda---Newsletter-1.pdf</a><br><a href="http://www.miningaustralia.com.au/news/abbot-point-expansion-studies-commence">http://www.miningaustralia.com.au/news/abbot-point-expansion-studies-commence</a>  |
| QCLNG second Train online                     | <a href="http://www.statedevelopment.qld.gov.au/resources/project/queensland-curtis-liquefied-natural-gas-project/executive-summary-seis.pdf">http://www.statedevelopment.qld.gov.au/resources/project/queensland-curtis-liquefied-natural-gas-project/executive-summary-seis.pdf</a><br><a href="http://www.aemo.com.au/Electricity/Planning/Forecasting/National-Electricity-Forecasting-Report/-/media/Files/Other/planning/NEFR/2014/2014%20Supplementary/Jacobs_LNG_Forecast.ashx">http://www.aemo.com.au/Electricity/Planning/Forecasting/National-Electricity-Forecasting-Report/-/media/Files/Other/planning/NEFR/2014/2014%20Supplementary/Jacobs_LNG_Forecast.ashx</a>   |
| QGC 3 <sup>rd</sup> Train / Field Development | <a href="http://www.gladstoneobserver.com.au/news/third-train-curtis-islands-qclng-now-four-years-aw/1870287/">http://www.gladstoneobserver.com.au/news/third-train-curtis-islands-qclng-now-four-years-aw/1870287/</a><br><a href="http://www.qgc.com.au/media/100578/20140407_qclng_project_fact_sheet.pdf">http://www.qgc.com.au/media/100578/20140407_qclng_project_fact_sheet.pdf</a>   |
| GLNG Liquefaction Plant                       | <a href="http://www.santosqlng.com/media/pdf1631/03_project_description_section_3_final_public_1_.pdf">http://www.santosqlng.com/media/pdf1631/03_project_description_section_3_final_public_1_.pdf</a><br><a href="http://www.qmca.com.au/files/documents/QMCA_MPR2015_Final_2_LOWRES.pdf">http://www.qmca.com.au/files/documents/QMCA_MPR2015_Final_2_LOWRES.pdf</a>   |
| APLNG Liquefaction Plant                      | <a href="http://www.aplng.com.au/pdf/eis/Volume_4/Vol_4_Chapter3_Project_descrip.pdf">http://www.aplng.com.au/pdf/eis/Volume_4/Vol_4_Chapter3_Project_descrip.pdf</a><br><a href="http://www.qmca.com.au/files/documents/QMCA_MPR2015_Final_2_LOWRES.pdf">http://www.qmca.com.au/files/documents/QMCA_MPR2015_Final_2_LOWRES.pdf</a>   |
| Arrow's Bowen Gas Project                     | <a href="https://www.arrowenergy.com.au/_data/assets/pdf_file/0013/14026/06-Greenhouse-Gas.pdf">https://www.arrowenergy.com.au/_data/assets/pdf_file/0013/14026/06-Greenhouse-Gas.pdf</a><br><a href="http://www.gikpress.com.au/BGP-EIS-Volume-1/9ba2cd10-8b0b-4e0a-889d-a14100b77970/af3ad58d-0203-4734-a71d-a14100babc86/3f29f63a-9cd8-412a-9a7b-a14700ad670d?searchTerms=electricity#3f29f63a-9cd8-412a-9a7b-a14700ad670d">http://www.gikpress.com.au/BGP-EIS-Volume-1/9ba2cd10-8b0b-4e0a-889d-a14100b77970/af3ad58d-0203-4734-a71d-a14100babc86/3f29f63a-9cd8-412a-9a7b-a14700ad670d?searchTerms=electricity#3f29f63a-9cd8-412a-9a7b-a14700ad670d</a><br><a href="http://iminco.net/adani-carmichael-mine-rcr-tomlinson-power-station-galilee-basin/">http://iminco.net/adani-carmichael-mine-rcr-tomlinson-power-station-galilee-basin/</a>  |
| Carmichael Coal & Rail Project (Adani)        | <a href="http://www.adanimining.com/Common/Uploads/EISDocuments/77_EISDoc_Greenhouse%20Gas%20Emissions.pdf">http://www.adanimining.com/Common/Uploads/EISDocuments/77_EISDoc_Greenhouse%20Gas%20Emissions.pdf</a><br><a href="http://www.adanimining.com/australia-rail-prj">http://www.adanimining.com/australia-rail-prj</a><br><a href="http://www.businessnews.com.au/article/RCR-to-build-power-station-in-Queensland">http://www.businessnews.com.au/article/RCR-to-build-power-station-in-Queensland</a><br><a href="http://www.townsvillebulletin.com.au/business/construction-giant-posco-signs-agreement-to-develop-388km-rail-line/story-fnjfzyqo-1226999623769">http://www.townsvillebulletin.com.au/business/construction-giant-posco-signs-agreement-to-develop-388km-rail-line/story-fnjfzyqo-1226999623769</a><br><a href="http://www.moraypower.com.au/Project">http://www.moraypower.com.au/Project</a>  |
| Alpha Coal & Rail Project (GVK & Hancock)     | <a href="http://gvkhancockcoal.com/our-assets/alpha">http://gvkhancockcoal.com/our-assets/alpha</a><br><a href="http://gvkhancockcoal.com/documents/Publications/EIS/ACPEIS2010/Vol2/Section%2014%20GHG%20&amp;%20Climate%20Change.pdf">http://gvkhancockcoal.com/documents/Publications/EIS/ACPEIS2010/Vol2/Section%2014%20GHG%20&amp;%20Climate%20Change.pdf</a><br><a href="http://gvkhancockcoal.com/documents/Publications/EIS/ACPEIS2010/Vol1/Section%202%20Description%20of%20the%20Project.pdf">http://gvkhancockcoal.com/documents/Publications/EIS/ACPEIS2010/Vol1/Section%202%20Description%20of%20the%20Project.pdf</a><br><a href="http://www.theaustralian.com.au/business/mining-energy/galilee-exports-delayed-until-2017/story-e6frq9df-1226706997266">http://www.theaustralian.com.au/business/mining-energy/galilee-exports-delayed-until-2017/story-e6frq9df-1226706997266</a>   |

|   |  |
|---|--|
| Kevin's Corner Mine (Hancock)                         | <a href="http://gvkhancockcoal.com/documents/Publications/EIS/KeVinsCornerEIS2011/Vol1/Volume%201%20Section%2002%20Project%20Description.pdf">http://gvkhancockcoal.com/documents/Publications/EIS/KeVinsCornerEIS2011/Vol1/Volume%201%20Section%2002%20Project%20Description.pdf</a><br><a href="http://www.dip.qld.gov.au/resources/project/kevins-corner-project/tor-kevins-corner.pdf">http://www.dip.qld.gov.au/resources/project/kevins-corner-project/tor-kevins-corner.pdf</a>   |
| China First (Waratah)                                 | <a href="http://www.waratahcoal.com/galilee-coal-project.htm">http://www.waratahcoal.com/galilee-coal-project.htm</a><br><a href="http://cloud.snappages.com/7d02db4f8251a7a309f60c63fa1c911fdf2eb346/V2%20MINE_CHAP%2001_Project%20Description.pdf">http://cloud.snappages.com/7d02db4f8251a7a309f60c63fa1c911fdf2eb346/V2%20MINE_CHAP%2001_Project%20Description.pdf</a>   |
| Gold Coast Integrated Resort                          | <a href="http://www.goldcoastevolution.com.au/wp-content/uploads/2014/04/004_Environment_FINAL-191214.pdf">http://www.goldcoastevolution.com.au/wp-content/uploads/2014/04/004_Environment_FINAL-191214.pdf</a><br><a href="http://www.abc.net.au/news/2014-12-07/hundreds-rally-against-proposed-gold-coast-resort-and-cruise-sh/5949788">http://www.abc.net.au/news/2014-12-07/hundreds-rally-against-proposed-gold-coast-resort-and-cruise-sh/5949788</a>   |
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| Gold Coast Light Rail - GLinQ                         | <a href="http://www.golding.com.au/">http://www.golding.com.au/</a>  |
| Gold Coast Commonwealth Games                         | <a href="https://www.thecgf.com/games/2018/Gold_Coast_VOL_2.pdf">https://www.thecgf.com/games/2018/Gold_Coast_VOL_2.pdf</a><br><a href="http://www.gc2018.com/the-event">http://www.gc2018.com/the-event</a>   |
| BAT tunnel  | <a href="http://eisdocs.dsdip.qld.gov.au/Underground%20Bus%20and%20Train/EIS/BaT-Executive-Summary.pdf">http://eisdocs.dsdip.qld.gov.au/Underground%20Bus%20and%20Train/EIS/BaT-Executive-Summary.pdf</a><br><a href="http://www.santosgng.com/gfd-eis/SantosGFD-ExecSummary-WEBSITE.pdf">http://www.santosgng.com/gfd-eis/SantosGFD-ExecSummary-WEBSITE.pdf</a>   |
| GLNG Expansion  | <a href="http://www.santosgng.com/gfd-eis/Santos_GLNG_GFD_Project_EIS_Chapter_4_Project%20Description.pdf">http://www.santosgng.com/gfd-eis/Santos_GLNG_GFD_Project_EIS_Chapter_4_Project%20Description.pdf</a><br><a href="http://www.santosgng.com/gfd-eis/Santos_GLNG_GFD_Project_EIS_Chapter_16_Greenhouse%20Gases.pdf">http://www.santosgng.com/gfd-eis/Santos_GLNG_GFD_Project_EIS_Chapter_16_Greenhouse%20Gases.pdf</a>   |
| Electrification of LNG Upstream Processing Facilities | Powerlink, Transmission Annual Planning Report, 2015   |
| Wandoan Coal Project                                  | <a href="http://www.wandoancoal.com.au/en/publicationsandmedia/documents/terms-of-reference.pdf">http://www.wandoancoal.com.au/en/publicationsandmedia/documents/terms-of-reference.pdf</a><br><a href="http://www.statedevelopment.qld.gov.au/resources/project/wandoan-coal-project/coordinator-general-report.pdf">http://www.statedevelopment.qld.gov.au/resources/project/wandoan-coal-project/coordinator-general-report.pdf</a><br><a href="http://www.miningaustralia.com.au/news/glencorexstrata-parks-wandoan-coal-project-cuts-ca">http://www.miningaustralia.com.au/news/glencorexstrata-parks-wandoan-coal-project-cuts-ca</a><br><a href="http://www.qgso.qld.gov.au/products/reports/surat-basin-non-resident-pop-proj/surat-basin-non-resident-pop-proj-2014-2020.pdf">http://www.qgso.qld.gov.au/products/reports/surat-basin-non-resident-pop-proj/surat-basin-non-resident-pop-proj-2014-2020.pdf</a> |

## Appendix B    Outgoing Projects

| Project Title                               | Sources  |
|---|--|
| GLNG<br>Downstream<br>construction<br>ends  | <a href="http://www.santoslng.com/media/pdf1830/santos_lng_project_construction_environmental_management_plan_to_address_matters_of_national_environmental_significance_for_the_lng_facility_and_marine_facilities.pdf">http://www.santoslng.com/media/pdf1830/santos_lng_project_construction_environmental_management_plan_to_address_matters_of_national_environmental_significance_for_the_lng_facility_and_marine_facilities.pdf</a><br><a href="http://www.qmca.com.au/files/documents/OMCA_MPR2015_Final_2_LOWRES.pdf">http://www.qmca.com.au/files/documents/OMCA_MPR2015_Final_2_LOWRES.pdf</a> |
| APLNG<br>Downstream<br>construction<br>ends | <a href="http://www.aplng.com.au/pdf/eis/Volume_4/Vol_4_Chapter3_Project_descrip.pdf">http://www.aplng.com.au/pdf/eis/Volume_4/Vol_4_Chapter3_Project_descrip.pdf</a><br><a href="http://www.qmca.com.au/files/documents/OMCA_MPR2015_Final_2_LOWRES.pdf">http://www.qmca.com.au/files/documents/OMCA_MPR2015_Final_2_LOWRES.pdf</a>   |

## Appendix C Incoming Generation

| Project Title                   | Sources   |
|---------------------------------|---|
| Kidston Hydro                   | <a href="http://www.genexpower.com.au/projects/The_Kidston_Project">http://www.genexpower.com.au/projects/The_Kidston_Project</a>   |
|                                 | <a href="http://www.genexpower.com.au/projects/Connection_to_Network">http://www.genexpower.com.au/projects/Connection_to_Network</a>   |
| Kennedy Solar Farm              | <a href="http://www.kennedywindfarm.com.au/">http://www.kennedywindfarm.com.au/</a>   |
| Kennedy Wind Farm               | <a href="http://www.kennedywindfarm.com.au/home">http://www.kennedywindfarm.com.au/home</a>   |
|                                 | <a href="http://www.copperstring.com.au/">http://www.copperstring.com.au/</a>   |
| Lakeland Solar PV               | <a href="http://www.aussierenewables.com/directory/listing.php?id=244">http://www.aussierenewables.com/directory/listing.php?id=244</a>   |
| Mount Emerald Wind              | <a href="http://mtemeraldwindfarm.com.au/">http://mtemeraldwindfarm.com.au/</a>   |
| Coopers Gap Wind                | <a href="http://www.aql.com.au/about-aql/how-we-source-energy/renewable-energy/coopers-gap-wind-farm/the-project">http://www.aql.com.au/about-aql/how-we-source-energy/renewable-energy/coopers-gap-wind-farm/the-project</a>   |
|                                 | <a href="http://www.aussierenewables.com/directory/listing.php?id=124">http://www.aussierenewables.com/directory/listing.php?id=124</a>   |
| Kogan Solar Boost Solar Thermal | <a href="http://kogansolarboost.com.au/">http://kogansolarboost.com.au/</a>   |
|                                 | <a href="http://arena.gov.au/project/kogan-creek-solar-boost-project/">http://arena.gov.au/project/kogan-creek-solar-boost-project/</a>   |
|                                 | <a href="http://www.csenergy.com.au/content-(50)-kogan-creek-solar-boost.htm">http://www.csenergy.com.au/content-(50)-kogan-creek-solar-boost.htm</a>   |
| Archer Point                    | <a href="http://yes2renewables.org/2011/05/12/cooktown-one-step-closer-to-wind-farm/">http://yes2renewables.org/2011/05/12/cooktown-one-step-closer-to-wind-farm/</a>   |
|                                 | AEMO Generation Information 2014  |
| Sapphire                        | <a href="http://sapphirewindfarm.com.au/about">http://sapphirewindfarm.com.au/about</a>   |
| Ben Lomond                      | <a href="http://www.aql.com.au/about-aql/media-centre/article-list/2009/july/renewable-energy-from-aql-to-power-victorian-desalination-plant">http://www.aql.com.au/about-aql/media-centre/article-list/2009/july/renewable-energy-from-aql-to-power-victorian-desalination-plant</a> |
|                                 | <a href="http://www.planning.nsw.gov.au/asp/pdf/08_0012_ben_lomond_wind_farm_prelimasst.pdf">http://www.planning.nsw.gov.au/asp/pdf/08_0012_ben_lomond_wind_farm_prelimasst.pdf</a>   |
| Moree Solar Farm                | <a href="http://www.theland.com.au/news/agriculture/general/news/solar-farms-future-is-bright-at-moree/2707568.aspx">http://www.theland.com.au/news/agriculture/general/news/solar-farms-future-is-bright-at-moree/2707568.aspx</a>   |
|                                 | <a href="http://www.moreesolarfarm.com.au/Project.htm">http://www.moreesolarfarm.com.au/Project.htm</a>   |
| Bulli Creek solar farm          | <a href="http://www.industrysearch.com.au/1bn-solar-farm-set-to-be-built-in-qld/f/16495">http://www.industrysearch.com.au/1bn-solar-farm-set-to-be-built-in-qld/f/16495</a>   |
|                                 | <a href="http://www.architectureanddesign.com.au/news/\$1-billion-qld-solar-power-farm-produces-enough-en">http://www.architectureanddesign.com.au/news/\$1-billion-qld-solar-power-farm-produces-enough-en</a>   |
|                                 | <a href="http://hotcopper.com.au/threads/mega-1-billion-darling-downs-solar-farm-approved.2455573/#.VVkV5E2JiUk">http://hotcopper.com.au/threads/mega-1-billion-darling-downs-solar-farm-approved.2455573/#.VVkV5E2JiUk</a>   |
| Braemar 3                       | AEMO Generation Information 2014  |
|                                 | <a href="http://www.ermpower.com.au/about-us/future-developments/">http://www.ermpower.com.au/about-us/future-developments/</a>   |
| Braemar 4                       | AEMO Generation Information 2014  |
|                                 | <a href="http://www.ermpower.com.au/about-us/future-developments/">http://www.ermpower.com.au/about-us/future-developments/</a>   |
| Westlink Power Project          | AEMO Generation Information 2014  |
| Darling Downs 2                 | AEMO Generation Information 2014  |
|                                 | BREE 2014   |
| Clare Solar Farm                | <a href="http://reneweconomy.com.au/2015/frv-plans-150mw-solar-farm-for-queensland-cane-growing-region-29391">http://reneweconomy.com.au/2015/frv-plans-150mw-solar-farm-for-queensland-cane-growing-region-29391</a>   |
| Tarong                          | AEMO Generation Information 2014  |
|                                 | <a href="http://www.abc.net.au/news/2014-07-03/electricity-providers-return-to-coal-fired-power-as-natural-gas/5567252">http://www.abc.net.au/news/2014-07-03/electricity-providers-return-to-coal-fired-power-as-natural-gas/5567252</a>   |
|                                 | <a href="http://www.stanwell.com/wp-content/uploads/Tarong-fact-sheet-December-2014.pdf">http://www.stanwell.com/wp-content/uploads/Tarong-fact-sheet-December-2014.pdf</a>   |
| Swanbank E                      | AEMO Generation Information 2014  |
|                                 | <a href="http://stanwell.com/wp-content/uploads/Swanbank-E-December-2014.pdf">http://stanwell.com/wp-content/uploads/Swanbank-E-December-2014.pdf</a>   |

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|-----------------------|--|
| PNG Hydro<br>(Purari) | <a href="http://www.energybusinessnews.com.au/energy/hydropower/png-inks-deal-for-2bn-hydro-project/">http://www.energybusinessnews.com.au/energy/hydropower/png-inks-deal-for-2bn-hydro-project/</a><br><a href="http://reneweconomy.com.au/2014/origin-energy-shelves-5-billion-png-hydro-project-22315">http://reneweconomy.com.au/2014/origin-energy-shelves-5-billion-png-hydro-project-22315</a><br><a href="http://www.aecom.com/Where+We+Are/Australia+-+New+Zealand/Energy/_projectsList/Purari+Hydropower+Scheme">http://www.aecom.com/Where+We+Are/Australia+-+New+Zealand/Energy/_projectsList/Purari+Hydropower+Scheme</a><br><a href="http://www.energybusinessnews.com.au/energy/hydropower/origin-energy-puts-purari-river-hydro-on-hold/">http://www.energybusinessnews.com.au/energy/hydropower/origin-energy-puts-purari-river-hydro-on-hold/</a> |
| QNI Upgrade           | <a href="https://www.powerlink.com.au/Network/Network_Planning_and_Development/QNI_upgrade_study.aspx">https://www.powerlink.com.au/Network/Network_Planning_and_Development/QNI_upgrade_study.aspx</a>  |

## Appendix D    Outgoing Generation

| Project Title              | Sources  |
|----------------------------|--|
| Darling Downs CCGT (DDPS1) | <a href="http://reneweconomy.com.au/2014/origin-confirms-darling-downs-become-peaking-55474">http://reneweconomy.com.au/2014/origin-confirms-darling-downs-become-peaking-55474</a><br><a href="http://effectzrecording.com.au/2014/gas-price-surge-sends-wrecking-ball-through-energy-markets-19541">http://effectzrecording.com.au/2014/gas-price-surge-sends-wrecking-ball-through-energy-markets-19541</a><br>AEMO Generation Information 2014 |
| Mt Stuart GT (1,2,3)       | AEMO Generation Information 2014   |
| Gladstone                  | AEMO Generation Information 2014   |
| Collinsville               | AEMO Generation Information 2014   |

## Appendix E Metals Processing and other loads

| Project Title                     | Sources   |
|-----------------------------------|---|
| Boyne Smelter                     | <a href="http://www.gladstoneobserver.com.au/news/boyne-smelters-power-contract-gives-hope-future/2425986/">http://www.gladstoneobserver.com.au/news/boyne-smelters-power-contract-gives-hope-future/2425986/</a><br><a href="http://www.gladstoneobserver.com.au/news/boyne-hails-labor-on-ret/2600954/">http://www.gladstoneobserver.com.au/news/boyne-hails-labor-on-ret/2600954/</a><br><a href="http://www.boynesmelters.com.au/17/News-and-Publications/view/41/BSL-reduces-production-due-to-increasing-Queensland-electricity-prices">http://www.boynesmelters.com.au/17/News-and-Publications/view/41/BSL-reduces-production-due-to-increasing-Queensland-electricity-prices</a> |
| Sun Metals Metal Fabrication      | <a href="http://www.businessspectator.com.au/article/2014/3/10/energy-markets/alternative-options-north-queensland-baseload">http://www.businessspectator.com.au/article/2014/3/10/energy-markets/alternative-options-north-queensland-baseload</a>   |
| Palmer Nickel & Cobalt Refinery   | <a href="http://www.theaustralian.com.au/news/investigations/clive-palmers-yabulu-refinery-a-reef-risk-says-report/story-fnk76wj3-1226824182234">http://www.theaustralian.com.au/news/investigations/clive-palmers-yabulu-refinery-a-reef-risk-says-report/story-fnk76wj3-1226824182234</a><br><a href="https://www.ausimm.com.au/Content/docs/mono19model_paper.pdf">https://www.ausimm.com.au/Content/docs/mono19model_paper.pdf</a>  |
| QAL Refinery                      | <a href="http://www.qca.org.au/getattachment/95609fc7-914b-4ca5-baea-8b0e287ca406/Blackwater-System-Coal-Railings-Forecast.aspx">http://www.qca.org.au/getattachment/95609fc7-914b-4ca5-baea-8b0e287ca406/Blackwater-System-Coal-Railings-Forecast.aspx</a>   |
| Sugar cane mills                  | <a href="https://www.google.com.au/search?q=sugra+cane+energy+projects&amp;qws_rd=cr&amp;ei=6s9rVYT5IMX88QXlo4O4Aw#q=sugarcane+energy+upcoming+projects+qld">https://www.google.com.au/search?q=sugra+cane+energy+projects&amp;qws_rd=cr&amp;ei=6s9rVYT5IMX88QXlo4O4Aw#q=sugarcane+energy+upcoming+projects+qld</a>   |
| Island / Township electrification | <a href="https://www.google.com.au/webhp?sourceid=chrome-instant&amp;ion=1&amp;espv=2&amp;ie=UTF-8#q=island+electrification+qld">https://www.google.com.au/webhp?sourceid=chrome-instant&amp;ion=1&amp;espv=2&amp;ie=UTF-8#q=island+electrification+qld</a>   |
| Comalco Alumina Refinery          | <a href="https://www.google.com.au/search?q=ify&amp;qws_rd=cr&amp;ei=SLxrVaGHBuSgmwXvwIDQCA#q=comalco%5C+alumina+refinery+CAR+qld+">https://www.google.com.au/search?q=ify&amp;qws_rd=cr&amp;ei=SLxrVaGHBuSgmwXvwIDQCA#q=comalco%5C+alumina+refinery+CAR+qld+</a>   |

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### Career Synopsis

I am an Executive Director in Transactions Advisory Services with EY and based in Brisbane. I have over 40 years of experience in planning and operations of large generation and transmission systems, spanning the physical operation of individual power stations to fifty year planning studies. I was previously Executive Chairman and co-founder of ROAM Consulting, a leading energy market consultancy that integrated with EY in 2014. I advise fossil and renewable generators, large energy consuming industries, coal and gas providers, transmission companies, and other market participants on how to derive additional value from their investments. My particular skills are in modelling electricity grids in any country using advanced mathematical algorithms and high speed computing to gain increased accuracy and confidence in predicting the commercial and technical performance of generators and grid assets.

My career summary is:

1. From 2000 to 2010, as the first Managing Director, and from 2010 to 2014 as Executive Chairman, I built ROAM Consulting to be a leading supplier of market modelling throughout Australia and also New Zealand and the US. This covered almost the entire period from the commencement of the National Electricity Market in Australia through to the emergence of the NEM as one of the most successful electricity markets in the world. I have been responsible for the development and delivery of software systems to forecast reliability of supply throughout the NEM. I have had significant input to the development and refinement of electricity market rules related to loss factor forecasting and setting the reliability parameters and market price cap in the NEM.
2. From 1999 to early 2000, as a General Manager of the Queensland Generation Corporation, I took a leading consultancy role for the Asian Development Bank involving approximately one year full time advising China Huaneng Corporation in preparation for trial electricity markets within China. This included several inspections of power stations in China and visits to the China National Control Centre, and the Shanghai and Beijing control centres.
3. From 1995 to 2000, I was Manager Planning and later General Manager, Technology, Queensland Generation Corporation, trading as Austa Electric. I held this position until the generation sector was split into multiple corporations for the commencement of electricity trading in the NEM. I was responsible for 120 professionals planning and designing several large power station projects in Queensland including Callide C, Tarong North, Kogan Creek, and Swanbank E. I was responsible for planning the first supercritical coal fired power station in Australia (Callide C).
4. From 1988 to 1994, I was Generation Studies Engineer responsible for detailed generation planning for the Queensland Electricity Commission, leading a team of six analysts developing Queensland's fuel requirements for all thermal power stations in consultation with fuel contract negotiators. I also conducted planning of Stanwell power station. I conducted many of the technical and economic investigations to set the sale price of Gladstone power station to the private sector in 1994, working with US consultants appointed by the Queensland Government. I was the Queensland representative on the East Coast Interconnection Modelling Group investigating interconnection of Queensland and New South Wales, and developed advanced techniques for dynamic loss factor modelling across multiple states.
5. From 1984 to 1988 I was responsible for daily dispatch of all Queensland power generation at the state control centre (now AEMO North control centre). I had key roles in managing commissioning Wivenhoe pumped storage station and Tarong power station, which were the latest generation of new power stations in the state.
6. From 1980 to 1984, I took leave from the Queensland Electricity Commission to take a position as leading engineer for power system software development with Leeds and Northrup Australia in the US and Australia. I developed economic dispatch and power system security software for the new Queensland control centre. During this period I jointly commissioned the first digital automatic generation control system in Australia for the three state NSW/Victorian/South

Australian grid. This control system technique now enables generators to trade in the electricity market throughout the NEM.

7. From 1972 to 1980, except for a period of leave for further study, I investigated power production of hydro and thermal power stations in North Queensland. In 1977, I assisted the commissioning and testing the first high voltage 275 kV interconnector between northern and southern Queensland. This integrated the Queensland grid for the first time between the NSW border and Cairns in Far North Queensland.

As a consequence of my experience within the electricity industry, including many years of generation and transmission planning and system operations, I have a comprehensive knowledge of all parameters applicable to the planning and operation of fossil fuel and renewable power stations and associated high voltage electricity networks.

### Recent Experience

**Recent investigations in which I have had a key role and which are publicly available include:**

#### **AEMC - Transmission Frameworks Review - Mar 2012-Mar 2013**

I have had a significant role in conceiving and managing a range of investigations of the impact of a number of different market rules on the development and operation of the NEM using ROAM's market models.

#### **Australian Government - Department of Climate Change - Jun-Sep 2012**

I had a major role in providing consulting services (modelling inputs) to support the Department of Climate Change 100% Renewable Energy Study. In particular I was lead author for the pumped storage hydro modelling report.

#### **Department of the Treasury - Strong Growth, Low Pollution: Modelling a Carbon Price - Nov 2010-Aug 2011**

I managed the conduct of long range studies of the impact of introduction of a carbon price in Australia on the development of the Australian electricity sector, including carbon emissions projections, power costs and power prices to 2050.

#### **AEMC - Reliability Standard and Settings Review and Extreme Weather Review - Nov 2009-Apr 2010**

I managed the conduct of two major market assessments for AEMC, including the market price cap needed to deliver the reliability standard in the NEM in the future. I also managed the review of the impacts of extreme weather on the market parameters of the NEM, resulting from extreme weather in Southern Australia in early 2009.

#### **AEMO - Independent Expert Report for Directions in Queensland and Victoria - Feb-Aug 2009**

I, on behalf of ROAM Consulting, was jointly responsible for assessing compensation for NEM participants directed to operate during a period of high temperatures on 29-30 January 2009 involving major disturbances including shutdown of Basslink and failure of two 500 kV transmission lines in Victoria.

### Publications

#### **Recent Papers**

- ▶ Baker T, **Rose I**, Gall P, Clarke B, Korte R. "Governance, Policy Development and Implementation within the Australian National Electricity Market (NEM)", paper C5-102, CIGRÉ Paris, August 2014.
- ▶ **Rose I**, Gall P, Baker T. "Incentives for Investing in Generation and Transmission in a Contemporary Electricity Market Environment",

### Professional Memberships

- ▶ Certified Professional Engineer
- ▶ Registered Professional Engineer, Queensland (RPEQ)
- ▶ Fellow of the Institution of Engineers Australia (member since 1978)
- ▶ Member of the Institute of Electrical and Electronic Engineers, New York (since 1974)
- ▶ Member of the International Council on Large Electric Systems (CIGRÉ), Paris

### Qualifications

- ▶ Graduate Certificate in Management Mount Eliza Business Management School, 1994
- ▶ PhD in Electrical Engineering University of Waterloo, Canada, 1977
- ▶ Master of Engineering Science in Electrical Engineering University of Queensland, 1974
- ▶ Bachelor of Electrical Engineering [Honours] University of Queensland, 1971

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| <p>paper C5-202, CIGRÉ Paris, August 2008.</p> <ul style="list-style-type: none"> <li>▶ <b>Rose I.A.</b>, Bones D.R. and Pimentel M. "Monte Carlo simulation and its application in modelling electricity market behaviour" Australian Journal of Electrical &amp; Electronics Engineering, Vol 2, No 3, Institution of Engineers Australia, 2005.</li> </ul> <p><b>Recent Presentations</b></p> <ul style="list-style-type: none"> <li>▶ <b>Rose I.A.</b> "Renewable Energy Modelling – Progressing to 100% renewable energy", Queensland Energy Conference, Brisbane, 20-22 February 2013.</li> <li>▶ <b>Rose I.A.</b> "Market Disturbance Workshop – Response of energy only market to market disturbance", CIGRÉ General Session, Paris, August 22-27 2010.</li> </ul> | <ul style="list-style-type: none"> <li>▶ Member of CIGRÉ Australian Panel APC5 Committee - Electricity Markets and Regulation</li> </ul> |  |
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Mr Andrew Turley

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### Career Synopsis

Andrew is a Senior Manager at EY and based in Brisbane. Previously, Principal of Market Modelling at ROAM Consulting, now acquired by EY, he has a breadth of experience within the Australian electricity market over a 10 year career. He has a significant amount of experience in electricity market modelling, supporting public and private sector assessments of market development in the short, medium and long term. This has included due diligence assessments of major coal and gas power stations throughout the Australian National Electricity Market, assisting to develop reliability standards and settings to ensure system reliability, projecting the impact of carbon pricing for the Department of Treasury, and assisting transmission and distribution network service providers to assess the regulatory requirements to develop the electricity network, the backbone of the electricity market.

Andrew has developed strong skills in market forecasting, analytical thinking, model development and client and project management. He is a core developer of many of ROAM's data management, data processing and results analysis tools.

Andrew's roles and experiences at ROAM, and now at EY, have allowed him to establish a depth of experience in market modelling and market analysis through a broad range of consultancy engagements. These projects have been for a range of clients including market operators, network providers, investors, customers and participants.

Relevant project experiences includes such projects as:

- ▶ **Major Gentaier** - Transmission constraint and constrained generation optimisation modelling
- ▶ **Transmission Network Service Providers** - Assistance on regulatory investment tests for transmission in New South Wales, Queensland and South Australia
- ▶ **Generation Investor** - Scenario analysis to identify network congestion risk in the transmission system
- ▶ **Major QLD Generator** - Calculating the implied cost of supplying the Ergon retail load under various scenarios
- ▶ **Major QLD load** - Analysis of option for embedding a smelter load with a direct connection to a power station, including reliability modelling and the costs and benefits of such an arrangement
- ▶ **Various QLD generation clients** - Analysis of potential for avoided TUOS payments

### Recent Experience

**Recent investigations in which I have had a key role, some of which are publicly available include:**

#### **Various Clients - Due Diligence of Generation Assets - 2013, 2014**

Andrew has performed various modelling due diligence consultancies to inform potential purchasers and vendors of the operational expectations for various power stations in the NEM. He led the Market Advisor role in each of these engagements. This work typically provided a detailed review of current market behaviours and a comprehensive opinion of the data room materials provided, or the compilation of these materials for vendors. The modelling component would conduct detailed simulation studies for the medium to long term. Assets have included several coal power stations in Queensland, New South Wales and Victoria.

#### **Powerlink, TransGrid, Western Power, ElectraNet - Probabilistic Assessment of Generation Scenario Planning for use in AER Revenue Proposals - 2012, 2011, 2010**

Andrew led ROAM's Generation Scenario Planning modelling, used to support TNSPs' applications to the Australian Energy Regulator (AER) regarding their 5 year Revenue Proposals.

#### **TransGrid - Calculating the Competition Benefits of a VIC-NSW upgrade - Nov 2012-Feb 2013**

ROAM conducted detailed simulation studies on behalf of TransGrid to identify the potential benefits of an upgrade to the transmission flow path between Victoria and New South Wales north of the Snowy Mountains scheme. This work provided a preliminary analysis akin to a Regulatory Investment Test for Transmission, with the calculation of Competition Benefits being a primary outcome. Andrew was the primary modeller and analyst for this engagement, and managed the team's design and implementation of a Nash equilibrium dynamic bidding model to augment ROAM's 2-4-C software suite. Other RIT-T

investigations include:

- ▶ QNI upgrade
- ▶ Robertstown to Monash (SA)
- ▶ Real time monitoring systems, Adelaide to South East (SA)

**Department of the Treasury - Strong Growth, Low Pollution: Modelling a Carbon Price - Oct 2010-Sep 2011**

I was author and principal analyst for ROAM's 116 page report which supported Treasury's modelling of the carbon policy as one of two expert consultants. Numerous scenarios and sensitivities were modelled, with a comprehensive suite of results provided to Treasury's staff. My skills in model development and results analysis were thoroughly tested throughout this consultancy, as we constantly assessed and enhanced the models used to quantify the impacts of carbon pricing on the electricity market.

**AEMC - Reliability Standard and Settings Review - Sep 2009-Apr 2010**

**AEMC - Extreme Weather Review - Oct 2009-Apr 2010**

I was central to ROAM's engagements with the AEMC investigating the Reliability Standard and Reliability Settings. The scopes of work examined the level of the Market Price Cap (MPC) and validating the effectiveness of the price level at achieving the Reliability Standard; and assessing the impact of extreme weather events on achieving the Reliability Standard and whether the MPC level is sufficient under more extreme circumstances. Both of the Reliability review reports, of which I am a primary author, are available publicly. These projects required a very high standard of modelling, and as senior analyst and modeller my skills in data and model management were exploited effectively throughout the engagement. ROAM attended public forums and meetings with the AEMC's Reliability Panel and we were constantly active in the discussions and negotiations regarding the outcomes of the modelling. ROAM's significant contribution allowed the MPC to increase to \$12,500/MWh in real dollars (indexed with CPI, which was a major change from the nominal price level decided upon in the previous review).

**AEMC - Generator TUOS assessments - Aug 2009-Sep 2009**

I was a key model developer and analyst in ROAM's assessment of a potential rule change to introduce a generator transmission use of system (G-TUOS) charging methodology. The engagement required the development and deployment of a sandbox market model to investigate the magnitude of incentive that a G-TUOS charge would have on relocating major generation projects to avoid transmission congestion.

**Qualifications**

- ▶ Bachelor of Commerce [Dean's Honour Roll]  
University of Queensland  
2004
- ▶ Bachelor of Information Technology  
University of Queensland  
2004



Mr Josh Whiting

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### Career Synopsis

Josh is a Consultant at EY and based in Brisbane. With a background in mechanical engineering and commerce, his expertise lies in energy systems and the national electricity market. He is involved in a range of engagements which involve the modelling, analysis and review of the Australian electricity market. In particular, he has experience in long term modelling to evaluate the impacts of technical, financial and political influences on the operation of existing and new generation technologies in the coming decades. This has been used by market participants including generation and transmission companies to inform future investment or budget decisions.

- ▶ **International Energy Policy Analysis** - Investigate the structure, intent, methodology and resulting market behaviour for energy efficiency policies implemented by international governments.
- ▶ **Transmission Network Service Providers** - Assistance on scenario tests for transmission investment in Western Australia
- ▶ **Generation Investor** - Scenario analysis to identify network congestion risk in the transmission system

### Recent Experience

**Recent investigations in which I have had a key role, some of which are publicly available include:**

#### **Various Clients - Due Diligence of Generation Assets -2015**

Josh has assisted with various modelling due diligence consultancies for potential transactions involving renewable energy assets. Josh has assisted with the long term modelling of the market, analysing the opportunities for renewable developers and reporting on key outcomes to clients to assist with their decision making.

#### **Western Power- Probabilistic Assessment of Generation Scenario Planning - 2015**

Josh assisted in EY's Generation Scenario Planning modelling, used to provide an independent view of the Western Power Network. This focused on scenarios that impact on future transmission network developments.

#### **Power generation development company - 2015**

Josh assisted in the development of a Market review analysis. This assessment forecasted the market behaviour with respect to the entrance of new generation, gas prices, plant closures, plant portfolios and other competitive pressures.

### Qualifications

- ▶ Bachelor of Engineering [Mechanical]  
University of Queensland  
2014
- ▶ Bachelor of Commerce [Finance]  
University of Queensland  
2014