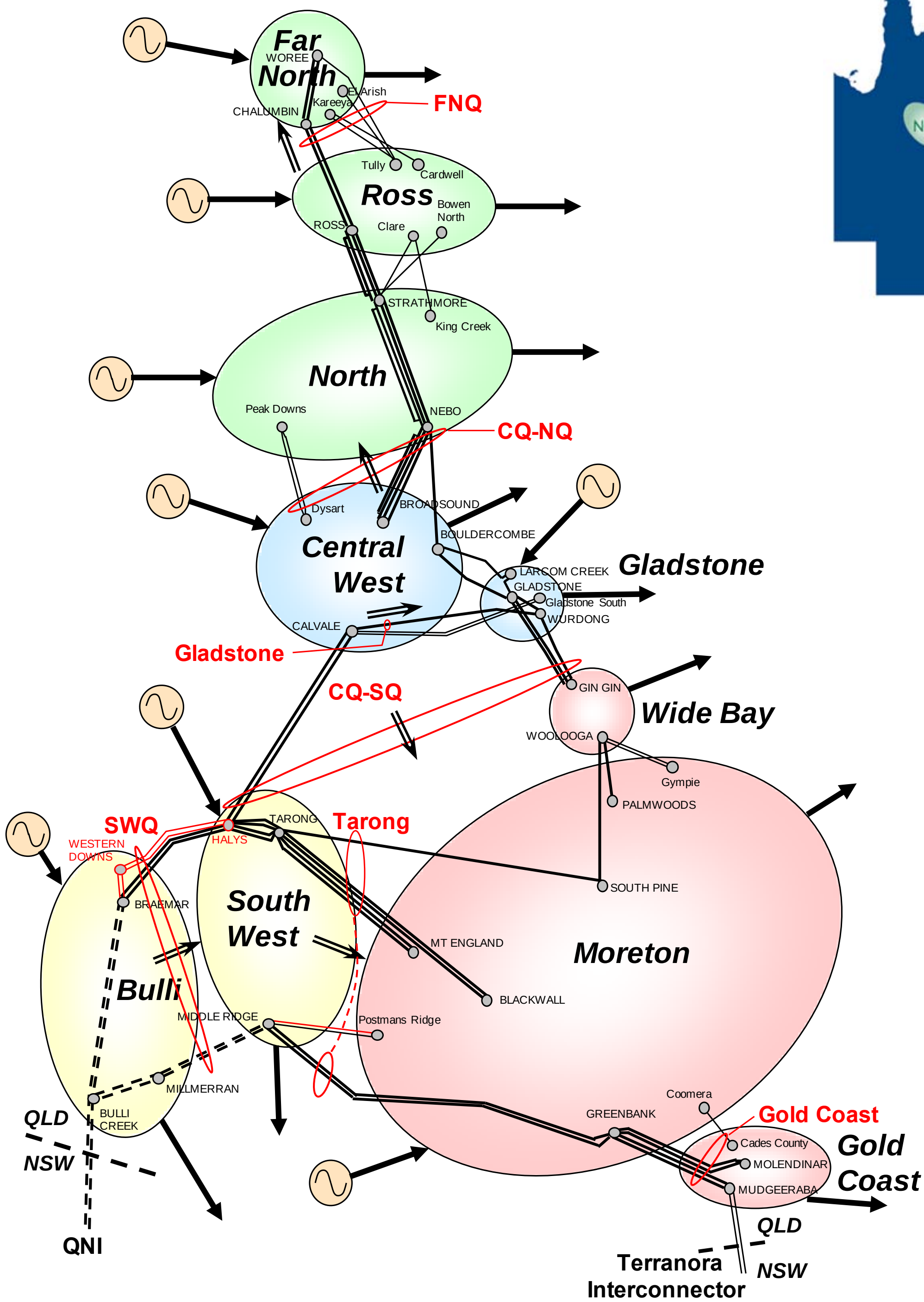
Powerlink has provided this document to the AER in support of its Revenue Proposal

2010 GRID PLAN

VOLUME 1

Network Development

Introduction and Overview



Document Tracking

Revision	Date	Description
1.0	30/03/2011	Initial issue

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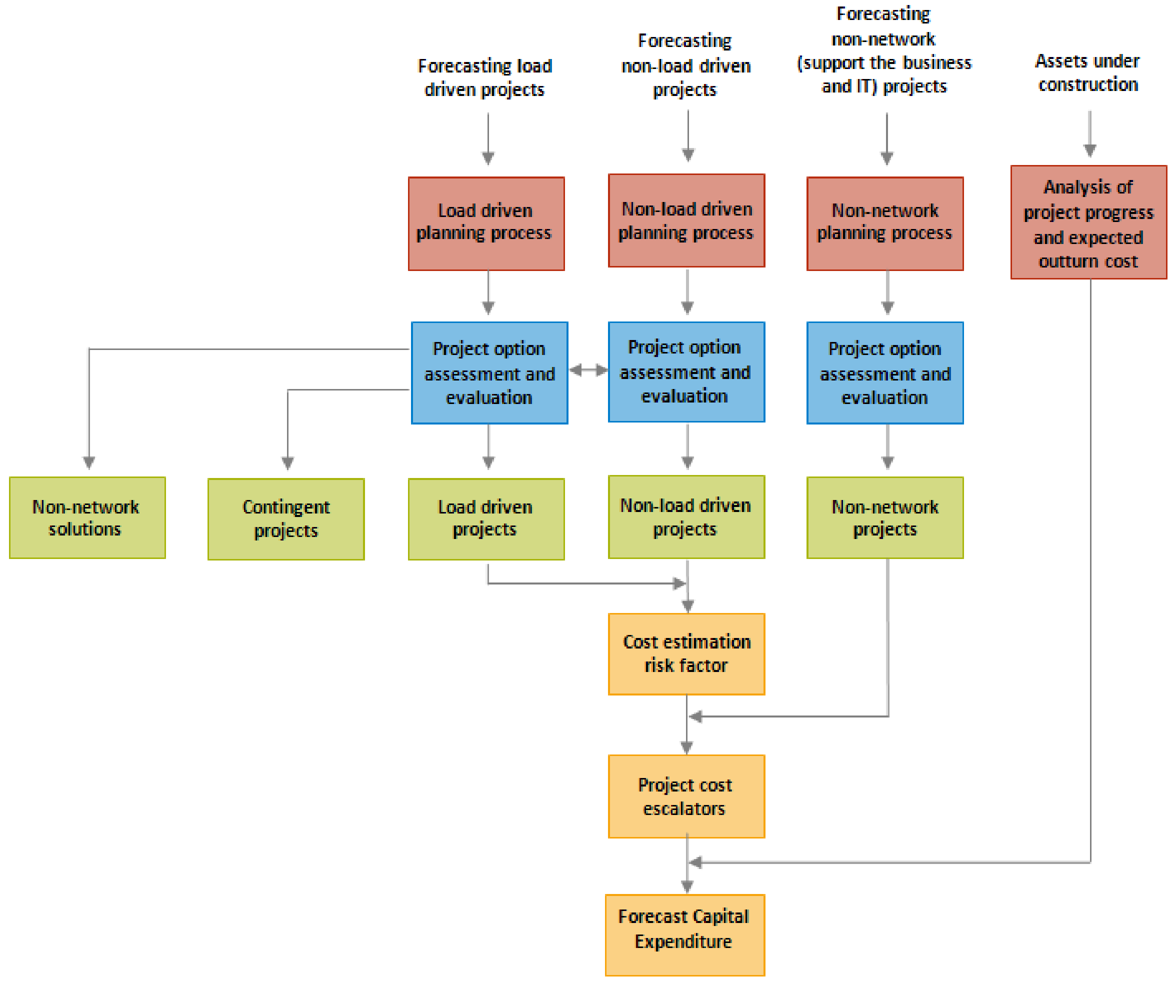
1. Introduction

The 2010 Grid Plan (or Load Driven Plan) provides an analysis of the medium term network development needs of the Powerlink transmission system. This information is prepared to enable accurate capital expenditure and resource forecasting.

Load driven projects include non-network solutions, network augmentations, connections to the distribution networks, easements and land acquisitions. The figure below provides an overview of Powerlink's capital expenditure forecasting methodology.



There is considerable uncertainty with respect to generation developments that could potentially emerge to meet load forecast requirements in the NEM as well as economic, environmental and political factors. To address these and other externally driven uncertainties, Powerlink has (as in previous revenue resets) developed its capital expenditure forecast using a probabilistic approach, with expert assistance from ROAM Consulting.

Key components of ROAM's analysis are to identify the location of generation to service the forecast demand and to develop plausible market development scenarios ([1] ROAM Consulting). ROAM developed 20 plausible market development scenarios, based on similar drivers, or theme sets, to AEMO's 2010 National Transmission Network Development Plan (NTNDP).

Powerlink analysed each of the plausible market development scenarios to identify the limitations that would arise on the Queensland transmission network in the event the development scenario eventuates. The limitation can be driven by thermal, transient and/or voltage stability constraints. Options to overcome these limitations are then devised and estimated. Options considered include both potential network projects and non-network solutions which are technically and economically feasible. Powerlink performs an economic evaluation of the options using techniques consistent with the assessment of options for the Regulatory Investment Test ([2] AER) to determine the preferred option.

Volume one of the Grid Plan provides the background, description of generation scenarios and the 2010 load forecasts. Together with the Planning Criteria ([3] Powerlink), these form the fundamental inputs to the planning analysis.

The second volume of the Grid Plan provides background and network development outlooks for each network area shown in the 2010 Annual Planning Report ([4] Powerlink) (and the cover of this report). It also provides a summary of the augmentation projects identified to efficiently address emerging network needs in each scenario.

The third volume of the Grid Plan contains planning reports detailing the augmentations, options considered and their economic evaluation.

2. Planning Criteria

A salient feature of the arrangements in Queensland is that Powerlink has mandated reliability obligations that drive non-discretionary investment in network augmentations. These mandated obligations include a requirement to apply "good electricity industry practice" which in-turn necessitates a range of supporting technical standards. These mandated obligations along with the technical standards are referred to as the "planning criteria".

Notably, the Queensland State Government issued a Transmission Authority Number T01/98 to Powerlink Queensland. Clause 6.2 of this Transmission Authority requires Powerlink to plan and develop its transmission network according to an "N-1" criterion.

The Document entitled *Powerlink Planning Criteria* ([3] Powerlink) details the practices and standards used by Powerlink for network planning analysis.

The planning criteria have been developed to reflect the mandated statutory obligations prescribed within:

- the National Electricity Rules;
- the Queensland Electricity Act;
- Powerlink Transmission Authority and Licence;
- customer Connection Agreements; and
- other relevant legislations and permitting arrangements.

The planning criteria define the following technical standards that form inputs to planning analysis:

- reliability criteria;
- load forecast;
- generation availability and dispatch;
- reactive device availability;
- plant availability;
- power quality requirements;
- ratings of plant; and
- power system stability.

More detailed information on these components, applied in the analysis of individual areas of the network, is provided in each section of the 2010 Grid Plan Volume 2.

3. Load Forecasts

Load forecasts under low, medium and high economic outlooks used for the 2010 Grid Plan are consistent with those published in Chapter 2 of the 2010 Annual Planning Report (APR) ([4] Powerlink), as required under section 5.6 of the National Electricity Rules.

These load forecasts are prepared based on Powerlink's understanding of existing and future customer requirements, ensuring that major customer loads are reasonable (and included only once) to develop a bottom up forecast. This forecast is then reconciled with independent low, medium and high economic outlooks.

The load forecast is prepared to standard weather conditions, and the first forecast year is largely determined by correcting historical demands to these standard weather conditions. Due to the large geographic area covered by Powerlink's network, the peak demand in some zones may be higher than the zonal demand at time of state peak. These zonal peaks may trigger augmentation in a particular area rather than the demand at state peak.

As prescribed by the Planning Criteria ([3] Powerlink), the main grid transmission system is planned to sustain a single contingency ("N-1") under 10% PoE summer or winter zone peak demand. The main grid transmission system includes assets operating, or designed to operate, between 500kV and 275kV including transformers connected to these voltages.

Unless otherwise agreed with the distribution network service providers or customers, Powerlink's sub-transmission system is planned to sustain a single contingency under 50% PoE summer or winter local peak demand.

Uncommitted load developments not included in the forecast may result in significant network needs. The dependency of such significant projects on these uncommitted loads are identified and recommended as contingent projects in relevant sections of the 2010 Grid Plan.

4. Recent Generator Connections and Retirements

Existing generators are listed in Table 5.1 of the 2010 Annual Planning Report (APR) ([4] Powerlink). Further information on existing generators in each area is provided in relevant sections of volume 2 of the 2010 Grid Plan.

By far the largest increase in generation capacity has occurred in South West Queensland. Over recent years thirteen units have been connected, and detailed interests from proponents continue to focus in the Bulli zone. Presently, ERM have reached an advanced stage of commitment for Braemar 3.

CS Energy announced the retirement of Swanbank B, with two units retired from service in mid 2010. The remaining two units are scheduled to be retired from service in mid 2011 and mid 2012.

Since early 2009, the following registered generators have connected or retired.

Area	Company	Station	As Generated Summer Capacity (MW)
Bulli	Origin	Darling Downs	605
Bulli	ERM	Braemar 2	462
Bulli	QGC	Condamine	135
Gladstone	Rio Tinto Alcan (RTA)	Yarwun	152
Ross	Origin	Mt Stuart 3	387
SEQ	CS Energy	Swanbank B	-240

5. Future Scenarios

Under the current National Electricity Market framework, it is not possible to predict the location, timing and size of new generators. These aspects have a significant impact on power transfers and the future needs of the transmission network.

Considerable uncertainty exists in relation to generation and load developments over the medium term. For example, the recent emergence of large LNG projects was not foreseen a few years ago, yet it will be accompanied by generation development which has a large bearing on the extent of transmission development.

Noting these uncertainties, it may be possible to anticipate potential new generators from information sources such as media statements and the NTNDP published by AEMO. A general view may also be held by parties involved in assessing or processing proponent enquiries. It is common that such views cannot be shared due to obligations of confidentiality.

To enable planning analysis to proceed, Powerlink engaged ROAM Consulting to conduct wholesale market modelling to identify plausible generation patterns for the Queensland region over the next ten years. Accordingly, this report focuses on twenty market development scenarios prepared by ROAM to provide a cross-section of potential transmission developments and easement outcomes for the Queensland region. No single scenario is considered to reflect what will actually unfold in the future.

The following is a relevant extract from ROAM's report entitled "*Generation Scenarios for 2012 Revenue Reset Application"* ([1] ROAM Consulting).

> *Developments in the NEM and Queensland in the next decade are highly uncertain. The most significant factors for consideration in scenario modelling are likely to be:*
>
> *Level of ambition of Australia's likely Carbon Price Trajectory (CPT)*
>
> - *Announced to be 5% to 25% reductions by 2020 from 2000 levels*
> - *5%, 10-15% and 25% reduction scenarios are the most probable trajectories consistent with international developments*
>
> *Demand growth*
>
> - *Powerlink has provided the load growth forecasts*
>
> *Development of the LNG export industry*
>
> - *This could be moderate or extensive*
> - *Moderate development will favour increased gas generation in Queensland in the next decade, compared to extensive LNG development, where available gas resources will be exported in preference to local generation*
> - *To some extent an extensive LNG industry may favour additional gas generation in the next few years to make use of 'ramp' gas during the commissioning phase of LNG trains. This additional gas generation will be offset to some extent by corresponding one-off load growth for electrical pumping and compression associated with coal seam gas extraction.*

A variety of "contingency" events may also eventuate. These are considered unlikely, but may significantly impact transmission planning outcomes and therefore should be noted. These include:

- Connection of Mt Isa to the NEM, particularly from North Queensland

- Development of coal resources in the Galilee Basin

- Augmentation of QNI

Each of these is unique and would require specific investigation. Therefore further detailed consideration of these developments has not been undertaken for this scenario modelling study.

Possible retirement of plant is of very high importance, due to the implications this would have for the grid. Ageing plant in vulnerable parts of the grid are particularly important, including Collinsville, Gladstone and Swanbank B, as generation at these locations may be replaced by new generation in more remote areas of the grid.

5.1 Future Outlooks for Queensland

In developing the scenarios, the most important external drivers for which Powerlink has no control were identified. The combination of these drivers or themes results in plausible outlooks. The resulting outlook probabilities were calculated as the product of the sequentially ascribed probabilities for each theme.

Carbon Price Trajectory

ROAM postulated that the level of the CPT will be relatively independent of other factors in the Australian domestic economy. Three rate bands were considered: 5%; 10-15%; and 25%. However, both the Government and the Opposition have committed to a 5% reduction in emissions from 2000 levels by 2020.

Load Growth

The amount of load growth is likely to be correlated to the CPT outcome. A very deep target for emissions reduction is likely to drive significant investment in energy efficiency and other demand side management technologies.

LNG Industry

The development of an LNG industry is likely to depend upon the level of international commitment to emissions reduction. A very strong commitment to mitigation is likely to produce a strong demand for gas internationally, creating significant incentives for aggressive (AGG) expansion of the LNG industry in Queensland.

Significant investment has occurred with extensive drilling and exploration works, and negotiations on sales agreements are underway. Government support is also significant, with LNG earmarked as a key industry in the Queensland Department of Industries, Federal funding obtained for CSG water feasibility studies, and an increase in training places for students in and around the Surat Basin.

The Queensland Government is encouraging the development of the LNG industry through the creation of an LNG Industry Unit within the Department of Employment, Economic Development and Innovation. Curtis Island is now included in the Gladstone State Development Area and planning for a dedicated pipeline between Gladstone and the Callide Range in underway.

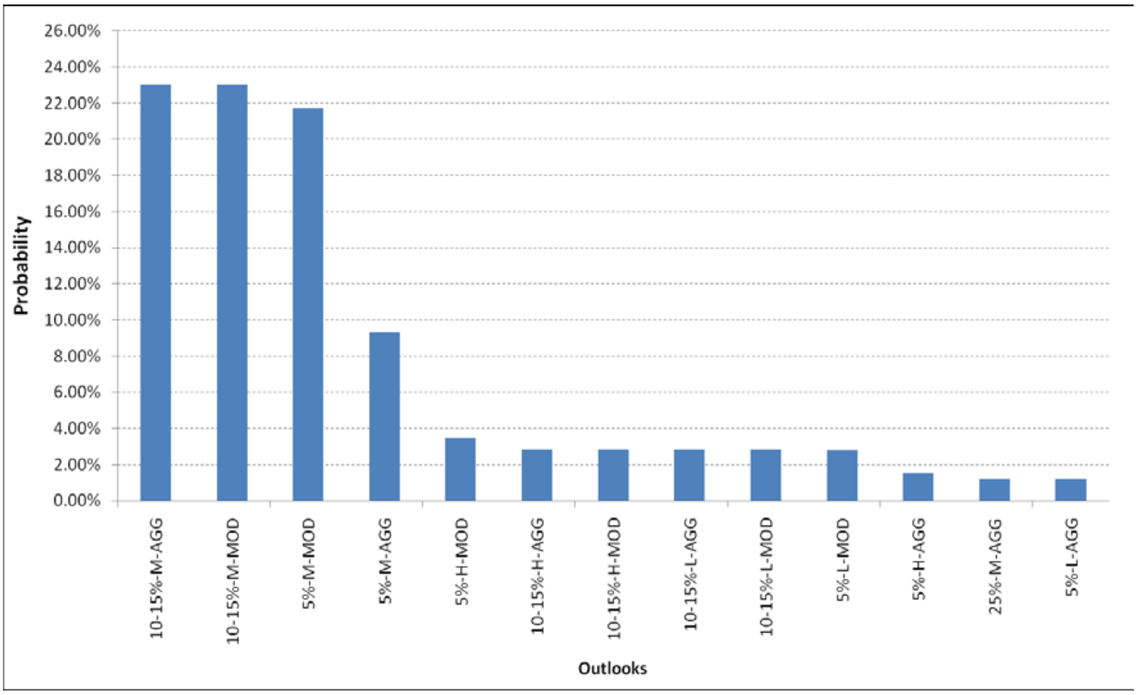
Two alternatives for the development of LNG industry were included:

- modest expansion of the LNG industry, leading to a slow and moderate increase in the price of gas; and
- aggressive expansion of the LNG industry, leading to rapid and high increase in the price of gas.

For aggressive LNG development, substantial additional load for compression and processing was included in the development of scenarios. ROAM used Aggressive LNG load that is greater than the LNG load used for the forecast outlined in the 2010 Annual Planning Report. This ensured that adequate generation capacity was accomplished for the relevant scenarios.

ROAM assumed that 75% of LNG trains will be supplied by gas pipelined using an electrified network of compressors. Each of the extraction and compressor networks is expected to be approximately 200MW in load.

The probability of each resultant outlook is displayed below (in decreasing probability order).



5.2 Future Market Development Scenarios for Queensland

Generators

Future generator plantings were developed for each outlook. Higher probability outlooks had alternative generator plantings developed to capture the uncertainty associated with generator projects.

Plantings include varying degrees of renewable technologies depending on the scenario theme. Queensland has considerably different renewable resources than other states, with relatively poor wind resources but opportunities in sugar cane bagasse. The Queensland Government has released the Queensland Renewable Energy Plan (REP) which articulates the Government's intentions regarding how the renewable sector in Queensland will be supported such that the maximum capacity of renewable capacity is installed in the State.

Generator plantings for each outlook involved a number of iterations and cross-checks in order to reach a plausible outcome for each scenario. The final probability of each proposed generator (and retirement) was calculated as the sum of the scenario probabilities in which the generator is installed.

The probability of each scenario is listed below.

Outlook	Scenario	Description	Final Weighting
1	1	5%-H-AGG [Planting A]	1.52%
2	2	5%-H-MOD [Planting A]	3.55%
3	3	5%-M-AGG [Planting A]	4.72%
3	4	5%-M-AGG [Planting B]	4.70%
4	5	5%-M-MOD [Planting A]	10.49%
4	6	5%-M-MOD [Planting B]	6.91%
4	7	5%-M-MOD [Planting C]	4.58%
5	8	5%-L-AGG [Planting A]	1.22%
6	9	5%-L-MOD [Planting A]	2.84%
7	10	10-15%-H-AGG [Planting A]	2.91%
8	11	10-15%-H-MOD [Planting A]	2.91%
9	12	10-15%-M-AGG [Planting A]	8.95%
9	13	10-15%-M-AGG [Planting B]	8.84%
9	14	10-15%-M-AGG [Planting C]	5.51%
10	15	10-15%-M-MOD [Planting A]	6.56%
10	16	10-15%-M-MOD [Planting B]	10.18%
10	17	10-15%-M-MOD [Planting C]	6.56%
11	18	10-15%-L-AGG [Planting A]	2.91%
12	19	10-15%-L-MOD [Planting A]	2.91%
15	20	25%-M-AGG [Planting A]	1.24%

Generator Retirements

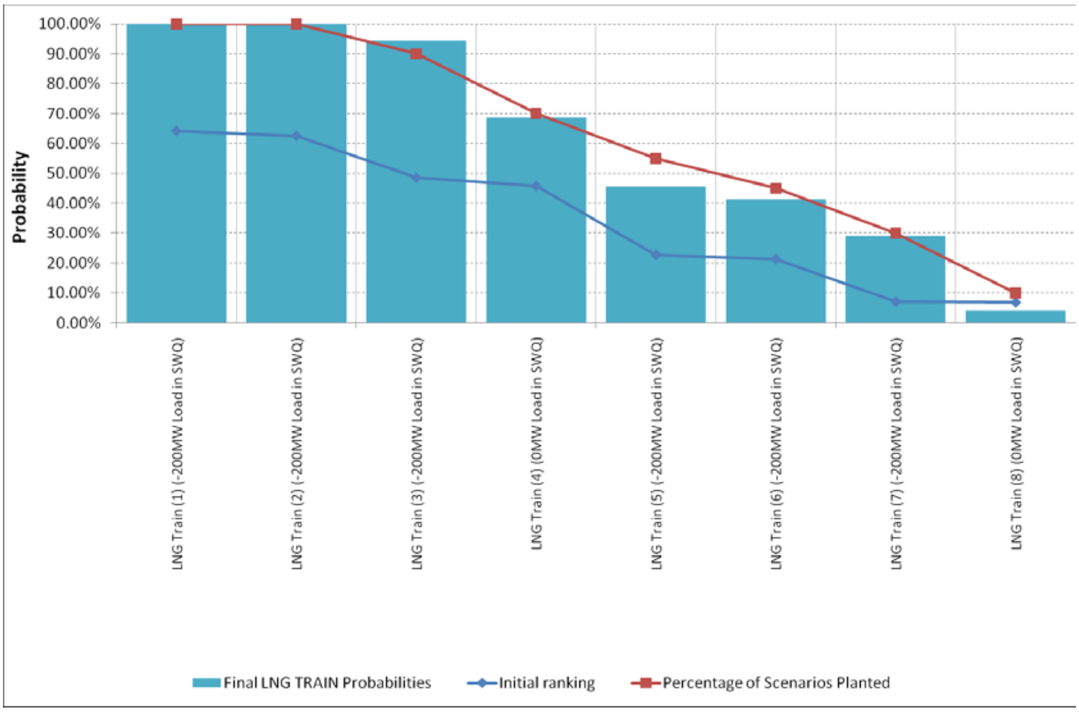
ROAM has included in all scenarios the progressive retirement from service of Swanbank B by mid 2012. Depending on the scenario, the retirement of some Gladstone and Collinsville units are included as described below.

Station	Total Capacity (MW)	Generator Retirements
Collinsville	187	Decommissioned
Gladstone	1680	Up to 4 Units

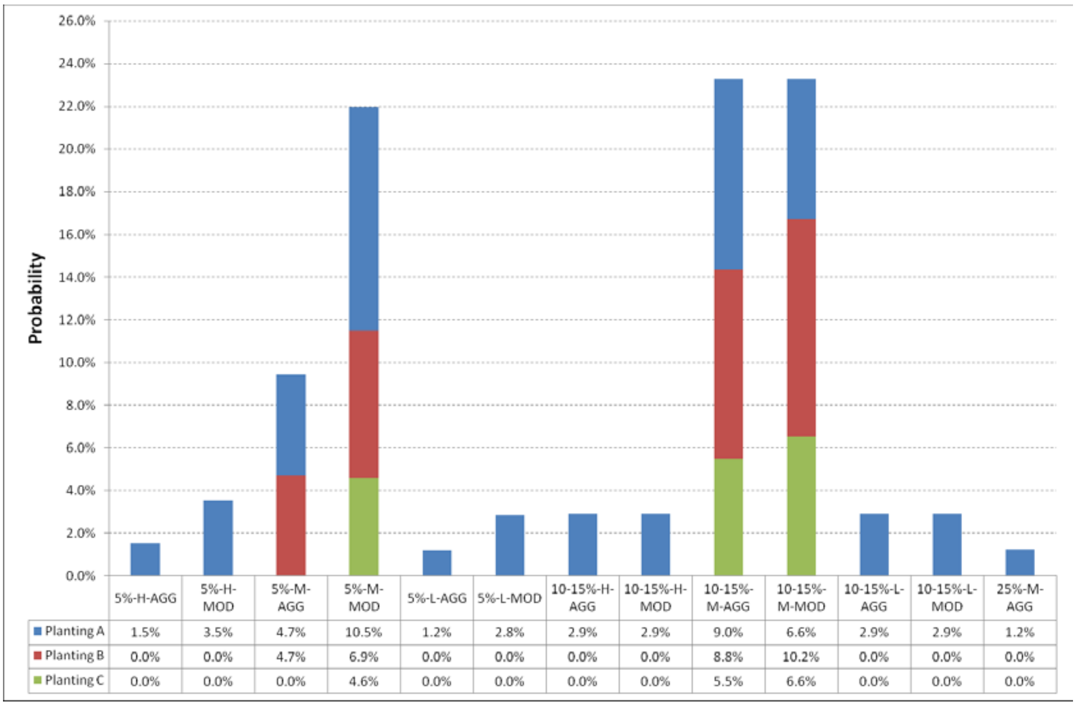
Callide A has been in storage since 2001. One unit (30MW) is being used for experimental purposes and is not included in the scenarios.

LNG Developments

The final project probabilities pertaining to LNG expansion are displayed below.



The probability of each market development scenario is displayed below.



	5%-H-AGG	5%-H-MOD	5%-M-AGG	5%-M-MOD	5%-L-AGG	5%-L-MOD	10-15%-H-AGG	10-15%-H-MOD	10-15%-M-AGG	10-15%-M-MOD	10-15%-L-AGG	10-15%-L-MOD	25%-M-AGG
Planting A	1.5%	3.5%	4.7%	10.5%	1.2%	2.8%	2.9%	2.9%	9.0%	6.6%	2.9%	2.9%	1.2%
Planting B	0.0%	0.0%	4.7%	6.9%	0.0%	0.0%	0.0%	0.0%	8.8%	10.2%	0.0%	0.0%	0.0%
Planting C	0.0%	0.0%	0.0%	4.6%	0.0%	0.0%	0.0%	0.0%	5.5%	6.6%	0.0%	0.0%	0.0%

Appendix A of ROAM's report details each market development scenario. A generator which is installed in many scenarios is likely to have a higher overall probability, depending upon the probability of the scenarios within which it is planted. Individual generator projects are summarised in Appendix B of ROAM's report.

6. Evaluation of Options

According to the AER's Regulatory Investment Test for Transmission (RIT-T) ([2] AER):

> *The preferred option is the credible option that maximises the net economic benefit to all those who produce, consume and transport electricity in the market compared to all other credible options.*
>
> *Where the identified need is for reliability corrective action, a preferred option may have a negative net economic benefit (that is, a net economic cost).*
>
> *Net economic benefit equals the market benefit less costs.*

In the context of Queensland, Powerlink's mandated reliability obligations result in the latest timing for augmentations, inclusion of market benefits can only advance projects. Capturing certain market benefits (such as changes in fuel consumption) is a highly complex and time consuming exercise, which for the purposes of this exercise, has only been pursued for projects where the timing is known to be highly affected by such benefits (e.g. North Queensland projects).

The financial analysis considers all foreseeable cost impacts of the proposed network augmentations to market participants as defined by regulatory processes. The cost to implement each feasible option is estimated using Powerlink's estimating process. Sensitivity studies are carried out using variations in:

- Cost estimates of plus or minus 15%;
- Discount rate 9% plus or minus 3%[1];
- Loss load factor 0.4 plus or minus 0.1; and
- Cost of losses $70/MWh plus or minus $30/MWh[2].

The effect of varying these parameters over their credible range was investigated using standard Monte Carlo techniques. The Monte Carlo analysis assigns a value to each of the above parameters according to its distribution and then ranks the options. This simulation is done many times to cover a large number of combinations of parameters. The analysis identifies the preferred option (the option that has the lowest expected cost on a net present value basis) and provides additional statistics including the frequency for which this option 'wins'.

Capital and operating costs for items that are common to all options are typically not included in the analysis. These common costs include the capital and operating costs of other future works, where these costs are independent of the identified future supply requirements or where they are independent of the proposed augmentation. As such, they have no impact on the relative ranking of options resulting from the analysis. Under the Regulatory Test, it is the ranking of options that is important, rather than the actual net present value results.

[1] As directed by the RIT-T, the present value calculations must use a commercial discount rate appropriate for the analysis of a private enterprise investment in the electricity sector.
[2] Consistent with AEMO's expected average NEM prices during the next regulatory period under a carbon constrained future.

The study period is selected, on a case by case basis, that appropriately compares the options (minimum of 15 years). Considerations include ensuring that the required future network developments under each option are sufficiently represented in the analysis. The study period is made sufficiently long that a longer period will result in a larger difference between the preferred and second closest option.

7. References

[1] ROAM Consulting, Generation Scenarios for 2012 Revenue Reset, May 2010.

[2] AER, Regulatory Investment Test for Transmission, June 2010.

[3] Powerlink, Grid Planning, Planning Criteria Policy, Version 1.1, July 2010.

[4] Powerlink, Grid Planning, Annual Planning Report, June 2010.