Final Report

Proposed New Large Network Asset –

Gold Coast and Tweed Areas

Joint Report by Powerlink Queensland & ENERGEX Limited
6 July 2004

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DOCUMENT PURPOSE

For the benefit of those not familiar with the National Electricity Code (NEC) and the National Electricity Market (NEM), Powerlink and ENERGEX offer the following clarifications on the purpose and intent of this document:

1. The document is produced in accordance with the NEC, which requires Powerlink and ENERGEX, as part of forward planning, to identify foreseeable FUTURE supply requirements in its network, well in advance of them becoming an operational problem.

2. The NEC requires Powerlink and ENERGEX to identify, evaluate and compare both network and non-network solutions to determine which can overcome the future supply requirements at the lowest cost to electricity consumers. This document contains the results of this evaluation in accordance with NEC requirements.

3. The purpose of this document is to recommend a solution, in time for it to be implemented to address future supply requirements, and allow input by industry participants and other interested parties.

What the document does NOT mean:

1. It does NOT mean that the lights are about to go out. The identified supply requirements are expected to arise some years into the future, assuming that demand for electricity continues to grow. There is enough time between now and then to implement a solution.

2. It does NOT mean that Powerlink and ENERGEX have been surprised, or that anything is "out of the ordinary". On the contrary, it is part of the normal, routine planning processes in the NEM.

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EXECUTIVE SUMMARY

Introduction

Electricity demand in the Gold Coast/Tweed area has grown strongly in recent years due to population growth, significant housing and commercial development and other factors, and growth is forecast to continue into the future. Powerlink Queensland, ENERGEX and Country Energy recognise the importance of ensuring a reliable supply to their customers in this area can be maintained, and of ensuring the electricity supply system can cater for future growth.

This document has been prepared as part of a standard National Electricity Code process for the approval of new electricity network developments. It contains recommendations for works to meet reliability of electricity supply obligations in 2005 and 2006. These recommendations have been developed following joint planning activities between Powerlink and ENERGEX, and their NSW counterparts, TransGrid and Country Energy.

Future Supply Requirements

Powerlink, ENERGEX, TransGrid and Country Energy, have identified future supply requirements in the Queensland electricity network supplying the Gold Coast/Tweed zone, and in the New South Wales electricity network supplying the far north coast of New South Wales. This document deals with the "Gold Coast/Tweed zone", which includes the Gold Coast area (south of Cades County) in south-east Queensland and the Tweed Shire in northern New South Wales.

The Gold Coast/Tweed zone is primarily supplied by two single circuit 275kV transmission lines between Swanbank substation near Ipswich and Mudgeeraba/Molendinar substations on the Gold Coast. The existing network has adequate capacity for the present needs of the area. However, with load growth forecast for the Gold Coast/Tweed zone, there will be a need to augment the existing electricity system.

Planning studies have identified that, during periods of peak load, the capability of the existing network to supply the Gold Coast/Tweed zone will be exceeded during a single contingency by late 2005. Interruptions to power supply during single network contingencies are not consistent with the reliability standards which Powerlink must meet in supplying ENERGEX and Country Energy customers. Proposals in this document will prevent such interruptions during critical contingencies, and are therefore 'reliability augmentations' as defined in the National Electricity Code.

The future supply requirements forecast for the NSW transmission and distribution network supplying the Far North Coast area of NSW from Armidale have been considered during joint planning between Powerlink, ENERGEX, TransGrid and Country Energy. Potential solutions to address the northern NSW supply requirements have been taken into account in the analysis of actions to maintain a reliable supply to the Gold Coast/Tweed zone.

Options Considered

Powerlink and ENERGEX carried out a consultation process to identify feasible options, including non-network options (eg - involving demand side management initiatives, market network service providers or local generation) to address the Gold Coast/Tweed zone requirements. Four submissions regarding alternative options were received from ENERGEX Retail, TransEnergie Australia, Delta Electricity and Stanwell Corporation. Powerlink had discussions with these organisations to understand the potential options raised in the submissions. The only viable option identified in those discussions was the potential use of the DirectLink unregulated interconnector to provide network support to augment supply to the Gold Coast/Tweed zone.

In addition to the consultation process, alternative network augmentation options to address the future supply requirements for the Gold Coast/Tweed area were considered. Joint planning studies were carried out between Powerlink, ENERGEX, TransGrid and Country Energy to evaluate these alternatives, and consider the impacts of modelled projects to address the forecast requirements in northern New South Wales.

A total of eight options were evaluated in detail to compare the Net Present Value (NPV) of the costs to market participants, in accordance with the Regulatory Test. The augmentation options to address the Gold Coast/Tweed zone requirements in 2005 and 2006 include:

Option 1	110kV Augmentation Beenleigh – Molendinar in late 2005
Option 2	275kV Augmentation Greenbank - Maudsland in late 2005
Option 3	Network support from DirectLink for the summer of 2005/06, followed by 275kV augmentation Greenbank - Maudsland in late 2006
Option 4	"Double tee" connection Maudsland – Molendinar in late 2005, followed by 275kV augmentation Greenbank - Maudsland in late 2006

For each of these four alternatives to satisfy Gold Coast/Tweed zone needs, a variation to examine the impact of modelled projects to address northern NSW requirements was considered as follows:

Options 1A to 4A: Network support from 2006 onwards, OR;
Options 1B to 4B: Construction of Dumaresq – Lismore 330kV Line in 2006.

Evaluation and Conclusion

The ACCC Regulatory Test requires that, for reliability augmentations, the recommended option represent the lowest Net Present Value cost under most market development scenarios considered. To allow comparison of options on an equivalent basis, the economic analysis was carried out over fifteen years, and included consideration of anticipated/modelled projects that are expected to be required in this period to meet forecast growth in electricity demand in the Gold Coast/Tweed zone. Market development scenarios and other analytical techniques were used to check the sensitivity of the outcome to changes in these assumptions.

Consequently, an Application Notice was published in April 2004 containing a draft recommendation to implement Option 3A - *"Network Support from DirectLink in Summer 2005/06, followed by 275kV Augmentation Greenbank-Maudsland in 2006*" to address the future supply requirements in the Gold Coast/Tweed zone. This recommendation was subject to finalising a satisfactory network support agreement with the owners of DirectLink for the summer of 2005/06, which has now been completed.

Option 3A was the identified as the least cost option over the period of analysis in two of the four scenarios examined, including the most probable Medium Growth scenario. Option 3A comprised the following:

- Provision of network support to the Gold Coast/Tweed zone by DirectLink for the summer of 2005/06 at an estimated total cost of $2.7M
- Establishment of a 275kV switchyard at Greenbank, and construction of a 275kV transmission line between Greenbank and Maudsland by late 2006. Construction of this proposed augmentation, estimated to cost $48.9M, is expected to begin in late 2004, for commissioning by late 2006.

One submission from the DirectLink Joint Venture was received in response to the Application Notice. This submission put forward a new option, "Option 3C", that the DirectLink Joint Venturers suggested has the capability to meet the reliability needs of the Gold Coast/Tweed zone. The submission noted that DirectLink's analysis indicated that Option 3C would provide greater

economic benefits than Option 3A, and for this reason Option 3C would satisfy the Regulatory Test.

Powerlink has considered the proposed new option and has provided in this Final Report a response to the issues raised in the DirectLink submission, in accordance with National Electricity Code requirements. It is Powerlink's view that Option 3C as proposed by the DirectLink Joint Venturers is neither technically nor commercially feasible.

As a consequence, Powerlink considers that no changes to the draft recommendation are necessary as a result of this process. The draft recommendation has therefore been adopted without change as the final recommendation, and immediate steps will now be taken to implement this recommendation.

1. INTRODUCTION

Queensland's Gold Coast and the far northern areas of NSW have seen rapid population growth, and significant housing and commercial development in recent years. Continued growth in electricity demand in these areas is anticipated as a result of these and other factors.

The area supplied from the Queensland electricity network includes the Gold Coast area (south of Cades County) in southeast Queensland and the Tweed Shire in northern New South Wales. As part of their commitment to maintaining a reliable supply to their customers in the area, Powerlink, ENERGEX and Country Energy have determined that action is now required to meet the electricity supply requirements in the Gold Coast/Tweed zone in 2005 and 2006.

This document has been prepared as part of a standard National Electricity Code (NEC) process for the approval of new large electricity network assets. Where a network service provider proposes to establish a new large network asset, it is required to issue an 'Application Notice' under clause 5.6.6 of the National Electricity Code. The Code then requires consideration of any submissions received in response to the Application Notice, and preparation of a Final Report.

This Final Report must contain information regarding:
- the reasons the augmentation is required, including, if relevant, why it is considered a 'reliability augmentation' as defined in the Code;
- feasible options available to address the future supply requirements, including non-network alternatives and options involving other transmission and distribution networks;
- the recommended solution, including the timetable for implementation;
- why the solution satisfies the Regulatory Test prescribed by the Australian Competition and Consumer Commission (ACCC); and
- a summary of submissions received from interested parties and the applicant's response to each submission.

The focus of the Final Report is ensuring a reliable electricity supply to the Gold Coast and Tweed areas can be maintained. However, the NEC requires the consideration of options involving other transmission and distribution networks (ie – network ownership and state boundaries are not barriers to determining a feasible option). In the case of the Gold Coast/Tweed zone, this required Powerlink and ENERGEX to examine options for supply from New South Wales as well as from Queensland. For this reason, Powerlink and ENERGEX have carried out joint planning with their counterparts in New South Wales - TransGrid and Country Energy. This joint planning included consideration of potential actions to address future electricity supply requirements in the northern New South Wales area supplied from Armidale via TransGrid and Country Energy's networks.

This document contains a final recommendation for action to be taken by late 2005 and late 2006 to meet reliability of electricity supply obligations. This final recommendation is based on:

- the assessment that action is now required to maintain a reliable power supply in the Gold Coast/Tweed area during single network contingencies from late 2005 onwards;
- the consultation undertaken by Powerlink and ENERGEX to identify potential solutions to address these future supply requirements;
- the interrelationship between the forecast supply requirements in the Gold Coast/Tweed area and in the far north coast of New South Wales area supplied from Armidale in NSW;
- analysis of feasible options in accordance with the Regulatory Test prescribed by the Australian Competition and Consumer Commission (ACCC); and
- the publication of an Application Notice containing a draft recommendation to address future supply requirements to allow comment by interested parties.

The recommended solution maximises the net economic benefits to participants in the National Electricity Market while meeting the reliability standards required by the National Electricity Code and Powerlink's obligations set out in its transmission licence. These economic benefits arise from maintaining a reliable power supply during single network contingencies at the least cost to the market and therefore to end-use customers.

2. REASONS AUGMENTATION IS REQUIRED

2.1. Supply to the Gold Coast/Tweed Zone

Powerlink and ENERGEX have identified future supply requirements in the electricity network supplying the Gold Coast/Tweed area from Queensland.

The geographic area referred to in this 'Final Report' as the Gold Coast/Tweed zone spans the border between the states of New South Wales and Queensland, and is shown on the map below. It is defined as the Gold Coast area of south-east Queensland (south of Cades County) to Coolangatta, together with the Tweed Shire in northern New South Wales. This includes the entire Gold Coast/Tweed tourism, commercial and residential area.

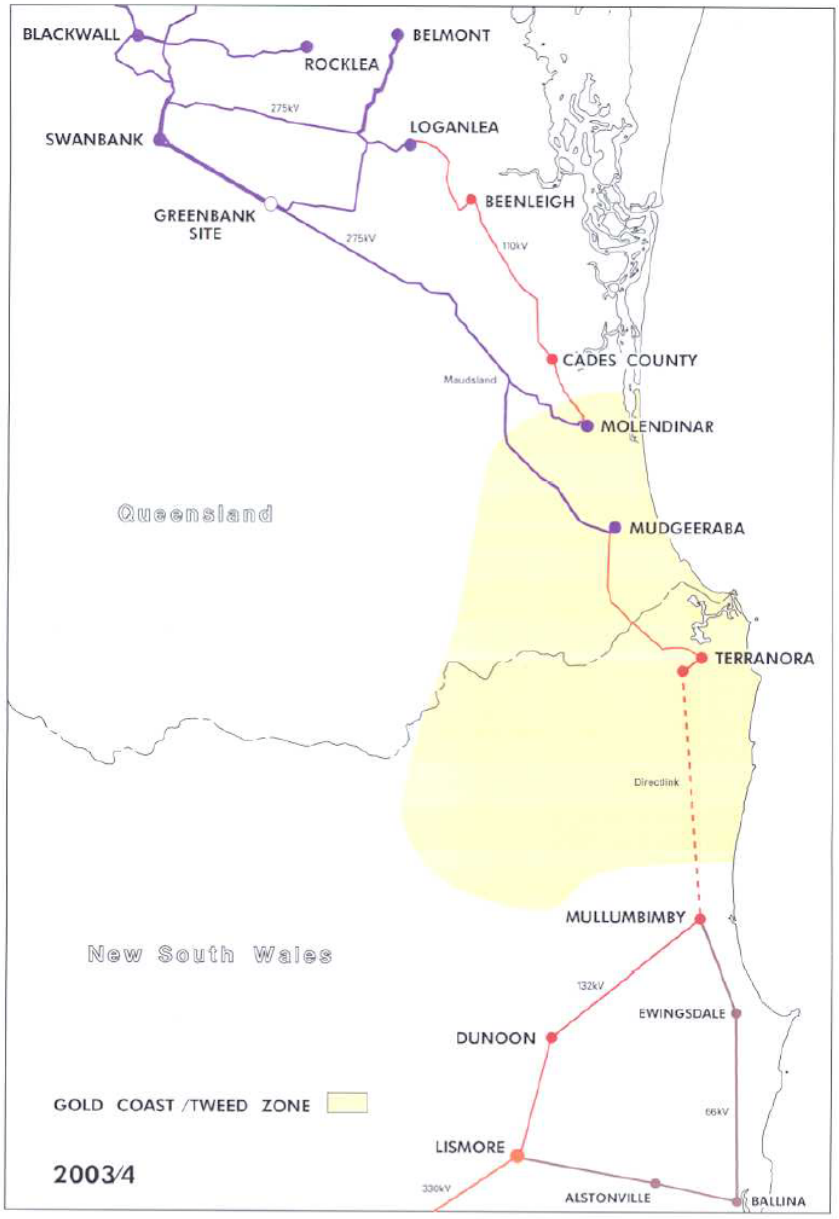


Figure 1: Electricity supply system to Gold Coast/Tweed Area

Customers in the Gold Coast/Tweed zone receive their electricity supply from local distributors in each state, namely ENERGEX in Queensland and Country Energy in New South Wales.

The majority of the electricity used in the area is produced at Queensland power stations. It is transferred to the Gold Coast/Tweed zone via Powerlink's 275kV transmission network, with support from the ENERGEX 110kV network. The primary supply to the Gold Coast/Tweed zone is via two single circuit 275kV transmission lines from Swanbank (near Ipswich west of Brisbane) to Mudgeeraba (on the southern end of the Gold Coast)[1]. Under typical conditions, these high voltage transmission circuits deliver more than 95% of the power used in the area.

A secondary supply path is available from Powerlink's 275kV substations at Belmont and Loganlea to the Gold Coast area via Beenleigh. This path consists of a single circuit 110kV line between Beenleigh and Cades County, and another single circuit 110kV line from Cades County to Molendinar[2]. This 110kV network typically supplies power to areas to the north of the Gold Coast/Tweed zone (only as far south as Cades County). That is, power is transferred south from Beenleigh to Cades County and north from Molendinar to Cades County. However, during a contingency resulting in an outage of one of the 275kV circuits between Swanbank and the Gold Coast, power on the 110kV circuits between Cades County and Molendinar can flow southwards to provide back-up supply to the Gold Coast/Tweed zone.

Additional power supply to the Gold Coast/Tweed zone can be provided by the DirectLink unregulated interconnector, which has the capacity to transmit up to 168MW[3] into the area from power stations in New South Wales. DirectLink is a "market network service provider" connecting the Queensland and New South Wales electricity systems. As such, its operations depend on market conditions. Using DirectLink to support the Queensland network would require a network support agreement between the owners of DirectLink and Powerlink.

Future works in the Gold Coast/Tweed zone are also underway. Powerlink is installing a shunt capacitor bank at Molendinar to assist with managing voltage stability in South East Queensland. This is scheduled for commissioning in October 2004. ENERGEX is also establishing the Coomera 110/33kV substation in 2005, which would transfer a significant portion of the 33kV load currently supplied from Molendinar to the area supplied from Loganlea. The network including these future developments is shown in Figure 2.

2.2. Ownership

There are four regulated electricity network owners relevant to supply to the Gold Coast/Tweed zone:

- Powerlink Queensland is the owner and operator of the Queensland high voltage transmission grid, including the 275kV transmission network supplying the Gold Coast/Tweed zone.
- ENERGEX owns and operates the electricity distribution network in south-east Queensland, including the Gold Coast area.
- Country Energy owns and operates the electricity distribution network in northern New South Wales, including the Tweed area.
- TransGrid is the owner and operator of the New South Wales high voltage transmission network, which provides supply to distribution networks in NSW, excluding the Tweed area.

[1] One of which has a tee connection to Molendinar. Powerlink recently completed construction of this 275kV tee connection to establish a second Gold Coast 275/110kV injection point at Molendinar. This project consisted of a 12.5km transmission line connecting into one of the existing Swanbank-Mudgeeraba 275kV circuits at Maudsland.
[2] Both lines are owned by ENERGEX
[3] Refer discussion regarding DirectLink capability in section 4.4.

The DirectLink market service is owned by a joint venture that includes HQI Australia Pty Ltd, a subsidiary of Hydro Quebec International, and EMMLink Pty Ltd, a subsidiary of Country Energy. Power station ownership in New South Wales and Queensland is in the hands of various private companies and government-owned corporations.

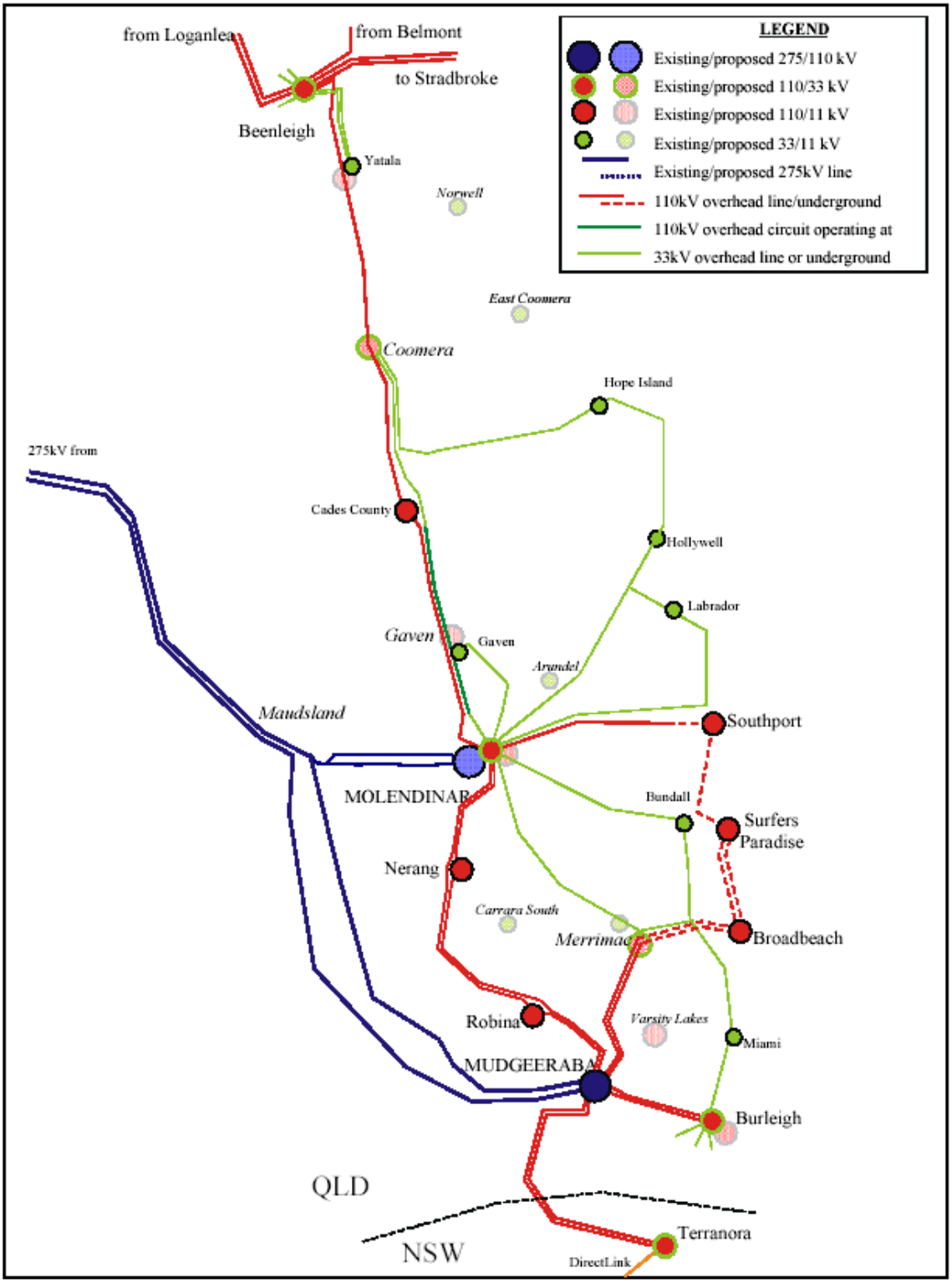


Figure 2: Gold Coast/Tweed 110kV and 275kV Supply

2.3. Future Supply Issues for Gold Coast/Tweed Zone

Powerlink and ENERGEX have identified that action is now required to maintain a reliable power supply to the Gold Coast/Tweed zone from late 2005 onwards, and to cater for future growth in the region.

Planning studies have determined that during periods of peak summer demand, the capability of the existing network to supply the Gold Coast/Tweed zone will be exceeded during a single 275kV contingency by the summer of 2005/06[4][5][6]. For supply to the Gold Coast/Tweed zone, the most critical contingency occurs when the 275kV Swanbank to Mudgeeraba circuit with the Maudsland to Molendinar tee connection is out of service. This circuit provides 275kV supply to both Molendinar and Mudgeeraba. Following an outage of the teed circuit from late 2005 onwards, unstable voltages are forecast to occur, and the 110kV lines between Beenleigh and Coomera would become overloaded.

This would require interruptions to power supply during single network contingencies, which are not consistent with reliability standards which Powerlink and ENERGEX must meet. Action is therefore required by late 2005 to prevent voltage collapse and ensure network overloads do not occur during a 275kV network contingency.

The conclusion that action must be taken by late 2005 is based on forecast demand growth averaging a predicted 3.6% per annum for the next 10 years, with an intense growth period of 6% p.a. over the next three year period (approximately 25 – 40MW per year). Due to heavy use of air conditioning and the distance from major power generation sources, the Gold Coast/Tweed zone also has a high reactive power demand[7] with a consequent impact on voltage stability.

Solutions to the future supply requirements identified in 2005 and 2006 may accommodate further load growth in the Gold Coast/Tweed zone beyond this period. Depending on action taken, additional supply requirements may occur by the summer of 2007/08. By that time, the electricity demand in the Gold Coast/Tweed zone will have grown to the extent that the thermal capability of the existing 275kV lines supplying the area from Swanbank will be exceeded during a single network contingency[8].

Analysis to support these conclusions, including load forecasts and relevant assumptions, was published in the previous document "Request for Information – Emerging Transmission Network Limitations: Electricity Transfer to the Gold Coast and Tweed Area."[9]

Consistent with the National Electricity Code, Powerlink's transmission authority and Connection Agreement requirements, Powerlink is required to plan its network supplying ENERGEX and

[4] The transfer limit is influenced by the pattern of generation in southeast Queensland. The base case assumed in this modelling is that Swanbank E power station is running at 320 MW, three Swanbank B units are running at 100MW each and two Wivenhoe units are running, one generating 100MW and one running as a synchronous condenser. These assumptions are based on a typical market dispatch observed in summer peak periods.

[5] Powerlink and ENERGEX have agreed some short term operational strategies to manage the network prior to the summer of 2005/06 should the demand require power flows which approach the transfer limit of the network. Such operational strategies are only a short-term measure, and from the summer of 2005/06 onwards, action to increase the supply capacity to the Gold Coast/Tweed zone is required.

[6] The output of embedded generation continues to be included as a reduction in forecast peak demand and therefore has already been accounted for.

[7] A technical characteristic of electricity demand in an alternating current system that increases the requirement for voltage support.

[8] In the absence of other action, when one 275kV circuit is out of service, the remaining 275kV circuit and the 110kV lines between Beenleigh and Molendinar will become overloaded.

[9] Published 22 August 2003 - refer Powerlink's website: www.powerlink.com.au

Country Energy so that the reliability and power quality standards of Schedule 5.1 of the Code can be met during the worst single credible network fault or contingency (N-1 conditions) unless otherwise agreed with affected participants. Relevant obligations are outlined below:

i Powerlink must "ensure as far as technically and economically practicable that the transmission grid is operated with enough capacity (and if necessary, augmented or extended to provide enough capacity) to provide network services to persons authorised to connect to the grid or take electricity from the grid" (Electricity Act 1994, S34 (2)).

ii "The transmission entity must plan and develop its transmission grid in accordance with good electricity industry practice such that… the power transfer available through the power system will be adequate to supply the forecast peak demand during the most critical single network element outage" (Transmission Authority No T01/98, S6.2).

iii The Connection Agreement between Powerlink and ENERGEX includes obligations regarding the reliability of supply as required under clause 5.1.2.2 of the Code. Capacity is required to be provided to the Gold Coast area such that forecast peak demand can be supplied with the most critical element out of service, without the necessity to interrupt customer load ie N-1. Country Energy has confirmed that it requires Powerlink to provide the same level of supply reliability to its customers in the Tweed area.

If no action is taken, interruptions to customer supply will need to occur throughout the Gold Coast/ Tweed zone during peak summer periods from October 2005, should an outage occur on a 275kV circuit between Swanbank and Mudgeeraba/Molendinar. This is not consistent with reliability of electricity supply obligations. Powerlink, ENERGEX and Country Energy therefore consider action to address the future supply requirements in the Gold Coast/Tweed zone to be a 'reliability augmentation', as defined in the National Electricity Code[10].

Conclusion on Gold Coast Future Supply Requirement

The discussion above demonstrates the need for action to reinforce supply to the Gold Coast/Tweed zone by late 2005 to avoid voltage instability and line overloads. Because this reinforcement is necessitated solely by the inability to meet reliability of supply obligations, it is a 'reliability augmentation' as defined in the Code.

2.4. Supply to the Far North Coast of New South Wales

TransGrid and Country Energy have identified future supply requirements to the Far North Coast area of New South Wales from Coffs Harbour north to Byron Bay and west to Tenterfield. The relevant area does not include the Tweed Shire, which is normally supplied from the Queensland electricity network.

Because of the interconnected nature of electricity networks, these future NSW supply requirements need to be considered in assessment of action to address future supply requirements in the Gold Coast/Tweed zone. For this reason, Powerlink and ENERGEX carried out joint planning with their NSW counterparts, TransGrid and Country Energy.

[10] A transmission network augmentation that is necessitated solely by inability to meet the minimum network performance requirements set out in schedule 5.1 or in relevant legislation, regulations or any statutory instrument of a participating jurisdiction.

In brief, the Far North Coast of NSW is supplied by a single 330kV transmission line that connects 330/132kV substations at Armidale and Lismore. A 132kV transmission network operates in parallel with this 330kV line. As noted earlier, the DirectLink 'market network service provider' also provides a connection between Queensland and New South Wales.

The capacity of the NSW system to maintain a reliable supply to the Far North Coast area is being approached during a single network contingency on the Armidale – Lismore 330kV line. Readers are referred to a document published by TransGrid and Country Energy in August 2003[11] for further information regarding the future network requirements, load characteristics and forecast growth in the subject area.

Joint planning studies considered inter-relationships between supply to the Gold Coast/Tweed zone and the Far North Coast area of NSW, such as the potential use of DirectLink to provide network support to either Queensland or New South Wales. Modelled projects to address the future supply requirements in northern New South Wales from mid 2006 have been taken into account in evaluation of actions to maintain a reliable supply to the Gold Coast/Tweed zone.

TransGrid and Country Energy received one submission from TransEnergie Australia to their 'Request for Information' document issued in August 2003. An Application Notice regarding supply to the Far North Coast of NSW will be issued in the future, when this is required to meet TransGrid and Country Energy's reliability of supply obligations.

Conclusion on New South Wales Far North Coast Limitation

Action may be required in the future to reinforce supply to the NSW Far North Coast to maintain satisfactory voltage levels and prevent load-shedding during single contingencies. Modelled projects to address this forecast limitation have been considered in the analysis in this Final Report. An Application Notice for a proposed augmentation in NSW will be issued in the future, when this is required to meet TransGrid and Country Energy's reliability of supply obligations.

[11] "Emerging Transmission Network Limitations on the New South Wales Far North Coast", August 2003. This report may be accessed via Powerlink's website at www.powerlink.com.au.

3. RESPONSES TO THE CONSULTATION PROCESS

3.1. Submissions to Application Notice

Powerlink and ENERGEX issued an Application Notice for a Proposed New Large Network Asset on 19 April 2004, which contained a draft recommendation to address future supply requirements in the Gold Coast/Tweed zone. The recommendation was for the following:

- Provision of network support to the Gold Coast/Tweed zone by DirectLink for the summer of 2005/06 at an estimated total cost of $2.7M; and
- Establishment of a 275kV switchyard at Greenbank, and construction of a 275kV transmission line between Greenbank and Maudsland by late 2006. Construction of this proposed augmentation, estimated to cost $48.9M, to begin in late 2004, for commissioning by late 2006.

Subsequent to the publication of the Application Notice, the DirectLink Joint Venture submitted an "Application for Conversion to a Prescribed Service" to the ACCC on 6 May 2004. This application requests the ACCC consider the conversion of the unregulated DirectLink interconnector from a market network service to a regulated interconnector.

On 4 June 2004, the DirectLink Joint Venture made a submission in response to the Application Notice issued by Powerlink and ENERGEX. A summary of this submission is contained in Appendix 3.

Powerlink has reviewed the information contained in the DirectLink Joint Venture response to the Powerlink/ENERGEX Application Notice. Where relevant, we have also examined information in a report by Burns and Roe Worley[12], which was referenced in the DirectLink submission to Powerlink and ENERGEX. The BRW report contains, among other matters, an assessment of supply requirements for the Gold Coast/Tweed zone, including option timings and cost estimates.

An overview of Powerlink's response to this information is provided in section 3.2, with a more detailed discussion of issues raised by the DirectLink Joint Venture contained in Appendix 4. No other submissions in response to the Application Notice were received.

3.2. Overview of Powerlink's Response

The submission by the DirectLink Joint Venture raised a new option, Option 3C. Powerlink considers that Option 3C is neither technically nor commercially feasible for the following reasons:

- Option 3C has not been designed to be capable of meeting the N-1 reliability standard for supply to the Gold Coast/Tweed zone. Powerlink has an explicit statutory requirement to meet N-1 criteria. The Electricity Act 1994 requires Powerlink to comply with its transmission licence. Powerlink's transmission licence states that it must be able to supply peak demand with one network element out of service (N-1). Any options that do not meet this requirement are not feasible solutions to the future supply requirements in the Gold Coast/Tweed zone;

- Option 3C includes a proposed scheme where DirectLink would change operation (within half a second) to provide support to Queensland or New South Wales following a network contingency. Powerlink does not consider it acceptable to rely on the envisaged post-contingent scheme to maintain reliability of supply to the Gold Coast/Tweed zone. The scheme has yet to be designed, and the implementation of a post-contingent response by DirectLink is new and unproven. Powerlink is not aware of any evidence of such a scheme being

[12] Appendix D of the "Application for Conversion to a Prescribed Service" available from www.accc.gov.au

successfully used anywhere in the world on a DC link using Voltage Source Controllers to arrest voltage collapse by rapidly changing real power throughput. Powerlink has onerous liability exposures for loss of supply events, and, under those circumstances, adopting such an unproven, untested scheme is not commercially acceptable;

- The post-contingent response scheme would be technically complex, and its feasibility is doubtful. No design or development of detailed specifications for the post-contingent scheme has begun at this stage. Powerlink is not confident that a technically feasible external detection scheme can be developed to detect a network fault and initiate post-contingent support from DirectLink in the required 'super-fast' timeframe. In addition, even if this scheme could be successfully implemented, technical studies of the dynamics of transient voltage instability in the Gold Coast/Tweed zone indicate that uncertainty exists as to whether this scheme will be able to reliably arrest a voltage collapse under all system conditions. Powerlink's transmission authority and clause 5.2.1 of the Code require it to plan and develop its transmission grid in accordance with good electricity industry practice. We do not consider that using a post-contingent response scheme such as that proposed to maintain a reliable supply to the Gold Coast/Tweed zone would represent good industry practice, due to the significant technical uncertainties involved;

- The Gold Coast/Tweed zone is one of the larger load centres in the Queensland system, with a demand of approximately 650MW. It is a major tourism, residential and commercial area. The consequences if the suggested post-contingent scheme cannot provide the necessary support when required could be severe; eg - total loss of supply to the entire Gold Coast/Tweed zone which could cause instability on the QLD-NSW interconnector, resulting in cascading loss of supply across sections of the National Electricity Market; and

- Finally, there is uncertainty whether there is a proponent for Option 3C. The DirectLink Joint Venture has indicated that its willingness to be a proponent is dependent on the outcome of the application to the ACCC for conversion to regulated status. An option without a proponent is not a feasible solution to a reliability limitation.

For the above reasons, Powerlink considers that Option 3C as put forward by the DirectLink owners is not feasible. It is therefore not a valid option for consideration as an alternative project in accordance with the ACCC Regulatory Test.

In response to other aspects of the DirectLink Joint Venture submission, Powerlink has provided further explanation of its approach to the Regulatory Test financial analysis contained in the Application Notice. For example, no estimated cost for the easement acquisition associated with the proposed 275kV augmentation to the Gold Coast was included in the economic analysis in the Application Notice. The relevant easement was obtained by Powerlink's predecessor organisation in the mid 1980s, and is a sunk cost which cannot be avoided or deferred by alternative options. In addition, the Powerlink/ENERGEX Application Notice included network support payments to DirectLink and transmission charges associated with augmentation options in the financial analysis. DirectLink disagrees with this approach, viewing such charges as 'wealth transfers' that should be excluded from a Regulatory Test evaluation. Powerlink has obtained advice from KPMG which concludes that network support payments are eligible costs which should be included as costs to the market in any Regulatory Test assessment.

Further discussion of these issues, and a more detailed response to the submission by the DirectLink Joint Venture is contained in Appendix 4.

4. OPTIONS CONSIDERED

4.1. Identification and Assessment of Options

Powerlink and ENERGEX have undertaken consultation to identify potential solutions to the future supply requirements in the Gold Coast/Tweed zone.

In conjunction with TransGrid and Country Energy, Powerlink and ENERGEX have also:
- Carried out joint planning studies to consider non-network and network options, including supply from NSW via the DirectLink unregulated interconnector. This included load flow analysis and other technical assessment to determine the capability of potential options to supply future customer electricity needs in the Gold Coast/Tweed zone; and
- Modelled potential solutions to the identified future supply requirements in the Far North Coast of NSW to assess the impact on the Queensland supply requirements.

A summary of the consultation and joint planning outcomes, together with an outline of the options and modelled projects considered, are contained in sections 4.2 to 4.5 and in section 5.0. Further details on feasible options to address the future supply requirements in the Gold Coast/Tweed zone are provided in section 6.0, with economic evaluation of options contained in Appendix 2.

Note that the remainder of the information in section 4.0 repeats what was published in the Application Notice. A response to issues raised in the DirectLink submission is contained in section 3.2 and Appendix 4.

4.2. Summary of Consultation and Joint Planning Processes

Powerlink identified in its 2001, 2002 and 2003 Annual Planning Reports[13] an expectation that action would be required in the relatively short-term to address future supply requirements in the Gold Coast/Tweed zone. No information was put forward by industry participants in response to the Annual Planning Reports.

In August 2003, Powerlink and ENERGEX issued a 'Request for Information'[14] – a consultation document providing more detailed information on future supply requirements in the Gold Coast/Tweed zone. That paper was the first step in meeting regulatory requirements related to proposed network augmentations. It sought information from Code Participants and interested parties regarding potential solutions to address the anticipated network requirements.

Only existing and committed projects that will be operational prior to late 2005 may be viable solutions to maintain a reliable electricity supply to the Gold Coast/Tweed zone.

Submissions were received from four parties in response to the Request for Information:

- Delta Electricity provided a submission regarding its joint venture with the NSW Sugar Mill Cooperative. Delta advised that it expects the 30MW co-generation power station project at the Condong Sugar Mill in the Tweed area to achieve committed status by late 2003/early 2004. It further advised that its 30MW cogeneration project at the Broadwater Sugar Mill south of Ballina[15] is also expected to become committed in 2004. Delta requested further discussion of the network issues to allow an assessment of the potential for the Condong generating unit

[13] Published in July 2001, June 2002 and June 2003 respectively.
[14] "Request for Information – Emerging Transmission Network Limitations: Electricity Transfer to the Gold Coast and Tweed Area", August 2003.
[15] The Broadwater Sugar Mill is located outside the Gold Coast/Tweed zone.

to provide network support services. In subsequent discussions with Powerlink, Delta advised that commissioning of the Condong cogeneration project is being targeted for mid 2006. This generation project will therefore not be in service in the required timeframe to address future supply requirements in the Gold Coast/Tweed zone, which will arise from late 2005 onwards. Local generation options are discussed further in section 4.3.2.

- Stanwell Corporation, the owner of the 28MW Rocky Point Power Plant located near Yatala, provided a submission advising that Stanwell considered that Rocky Point will not provide any additional relief to the identified supply requirements. Powerlink and ENERGEX agree with Stanwell's assessment. Rocky Point is not considered further in this Final Report.

- ENERGEX Retail (ERPL) responded to the Request for Information by providing confidential details of demand side management initiatives it is pursuing in the Gold Coast area. This is discussed in section 4.3.1.

- TransEnergie Australia provided a submission containing details of the capabilities of the DirectLink market network service provider. The submission affirmed that the DirectLink owners are interested to explore a network support agreement with either Powerlink/ENERGEX or TransGrid/Country Energy. Utilising DirectLink for network support to the Gold Coast/Tweed zone is discussed in section 4.4.

During the consultation process, Powerlink also provided information to several other parties regarding the future Gold Coast/Tweed zone supply requirements. No submissions regarding alternative solutions were provided by these parties.

4.3. Non-Network Options

The "Request for Information" paper sought to identify feasible non-network options to be included in the analysis. Powerlink and ENERGEX have considered the submissions to the Request for Information paper and information provided during related discussions regarding potential options to address the future supply requirements.

4.3.1. Demand Side Management

Demand Side Management (DSM) initiatives involve reducing the amount of power that needs to be supplied through the electricity network. This can be achieved through agreements to interrupt customer electricity supply during peak periods, through energy efficiency initiatives or use of alternative fuel sources such as gas.

Powerlink's demand and energy forecasts include all existing and foreseen DSM initiatives incorporated in ENERGEX and Country Energy's load forecast for the Gold Coast/Tweed zone. These initiatives, which include routine hot water switching activities, are therefore already being used to defer augmentations as long as possible.

Information about other demand side initiatives being pursued was put forward by ERPL, on a confidential basis, during the consultation process. At this point in time, such measures are insufficient to defer the requirement for action to maintain a reliable supply to the Gold Coast/Tweed zone from late 2005 onwards. The reason for this is that the total demand able to be offset or reduced by these initiatives amounts to less than one year's load growth in the Gold Coast/Tweed zone. ERPL have also advised this DSM will be initiated on request, and will not normally be operating so as to reduce demand.

While these initiatives are not large enough to provide sufficient capacity to address the supply requirements in the Gold Coast/Tweed zone in 2005 and 2006, Powerlink and ENERGEX are

examining their use as additional short-term operational strategies to assist in managing the network when power flows approach the transfer limit of the network.

4.3.2. New Local Generation

No recently committed local generation projects in the Gold Coast/Tweed zone were advised to Powerlink and ENERGEX following publication of the Request for Information.

An allowance for potential cogeneration and renewable energy developments embedded[16] in the distribution network in the relevant area is already included in ENERGEX and Country Energy's forecasts of electricity demand. Generation above the levels allowed would be required if local generation were to reduce demand on the transmission network and defer the need for other forms of action.

Two generation developers contacted Powerlink during the consultation process. One potential local generation development that was in the very early stages of consideration (ie – pre-feasibility studies) was discussed. There were no indications that this generation proposal could be operational by the required timing of late 2005.

The proposed Condong Sugar Mill cogeneration project was raised in the Delta submission. The anticipated capacity of this project (30MW) is not large in terms of the forecast load growth (25-40MW per year) in the Gold Coast/Tweed zone. As noted above, this project is not a viable solution to the present Gold Coast/Tweed zone requirements, as it is not anticipated to be commissioned until mid 2006.

As noted earlier in this Final Report, the electricity networks in northern NSW and the Gold Coast/Tweed zone are connected by the DirectLink interconnector. Generation proposals may be developed in northern NSW, such as the Broadwater proposal raised in the Delta submission. To meet future supply requirements in the Gold Coast/Tweed zone, these generation proposals would have to be of sufficient capacity to meet local requirements, as well as being able to generate additional power that could be transferred north to the Gold Coast/Tweed zone across DirectLink. Powerlink and ENERGEX are not aware of any well-advanced generation proposals in northern New South Wales that would satisfy these two requirements.

Powerlink and ENERGEX have therefore concluded that there are no additional generation proposals that can be considered as a viable option to reduce the demand on the electricity network supplying the Gold Coast/Tweed area prior to late 2005.

Conclusion on Non Network Options

Powerlink and ENERGEX have concluded that there are no viable non-network options to address the future supply requirements in the Gold Coast/Tweed zone. Demand side management initiatives are insufficient to offset one year's demand growth in the Gold Coast/Tweed zone. There is no indication that sufficient new local generation could be developed by the required timeframe of late 2005.

[16] An embedded generator connects directly to the distribution network. Output from such generators therefore reduces the expected energy that the transmission grid is required to deliver. Embedded generators may also reduce the demand the transmission grid is required to deliver, depending on their mode of operation.

4.4. Network Options – DirectLink Unregulated Interconnector

4.4.1. DirectLink Capability

The DirectLink unregulated interconnector between Terranora and Mullumbimby can transfer power in either direction between the Queensland and New South Wales regions. Hence DirectLink has the potential to provide support to the Gold Coast/Tweed zone by transferring electricity from New South Wales. Maximum operation of DirectLink in a northerly direction can supply the load at Terranora and can transfer some power into the Queensland electricity system at Mudgeeraba. These loads would otherwise be supplied from the Queensland network, and therefore DirectLink, when importing into Queensland, reduces the amount of power that needs to be transferred to the Gold Coast/Tweed zone from power stations in Queensland.

DirectLink can also potentially provide support to the Far North Coast area of NSW. The owners of DirectLink have indicated that the DirectLink interconnector is not presently able to provide support to both Queensland and New South Wales at the same time[17].

Other factors can affect the capability of DirectLink to provide network support to the Gold Coast/Tweed zone in Queensland. The "nominal" 180MW capacity of DirectLink does not equate to the ability to increase the total customer load that can be supplied in the Gold Coast/Tweed zone by 180MW. This is due to a variety of factors associated with DirectLink and the networks to which it is connected, as outlined below.

Losses Across DirectLink

DirectLink has a nominal capacity of 180MW (3 x 60MW modules). After accounting for losses (primarily in the DirectLink converter stations), the maximum amount of electricity that can be transferred across DirectLink to the northern connection point at Terranora in the Tweed area, is 168MW.

Capacity of the networks to which it is connected[18]

Northward flow on DirectLink imposes a significant demand on the northern NSW network to which DirectLink is connected. There is sufficient capacity in the northern NSW network *under normal conditions when all elements of the network are in service* to meet the local northern NSW requirements and to allow for the provision of network support by DirectLink for many years[19].

However, if critical lines in the NSW transmission and distribution network are not in service, the capability of DirectLink to flow northwards will be restricted. From DirectLink's northern connection point at Terranora, electricity is transferred to customers in the Gold Coast/Tweed zone via the ENERGEX and Country Energy distribution networks. If any element of the network between Terranora and Mudgeeraba is out of service, this may restrict the amount of electricity that can be transferred north across DirectLink. Under outages of critical lines providing supply to

[17] Refer also discussion in Appendix 4.

[18] Only restrictions relevant to import into Queensland to provide support to the Gold Coast/Tweed zone are discussed in this section. Southward flow on DirectLink can also be restricted by the capacity of the Queensland network which supplies the Gold Coast/Tweed area and DirectLink.

[19] The future supply requirements in northern New South Wales are determined based on contingency conditions for which northward flows on DirectLink will be curtailed. The option where DirectLink is utilised to provide network support to the Gold Coast/Tweed zone therefore has no impacts on these future supply requirements in northern NSW.

DirectLink's southern connection point at Mullumbimby in northern NSW[20], northward flow on DirectLink would also have to be reduced or completely curtailed[21].

Impact on Voltage Stability

As noted above, potential power transfers of up to 168MW into Queensland across DirectLink are technically possible – assuming the entire northern NSW network and the Terranora – Mudgeeraba lines are in service.

However, the capability of DirectLink to provide a viable solution to the Gold Coast/Tweed zone future supply requirements also depends on the impact of this power transfer on the voltage stability of the network supplying the Gold Coast[22].

DirectLink northwards operation increases the total amount of customer load that can be supplied in the Gold Coast/Tweed zone. However, DirectLink injects power at a single location at the southern extremity of the Gold Coast/Tweed supply network. It therefore provides limited benefits in addressing future voltage stability limitations that will be caused by insufficient capacity between the source of power for the Gold Coast (primarily power stations in the Brisbane area and west of Brisbane) and customers. As more electricity is transferred into the Gold Coast/Tweed zone across DirectLink, the amount of electricity that can be transferred to the area across the Powerlink and ENERGEX networks, without risking voltage instability, is reduced[23].

This limits the effectiveness of import across DirectLink to meet forecast load growth in the Gold Coast/Tweed zone. The maximum import of 168MW is equivalent to 42MW of net additional supportable load during peak summer periods in the Gold Coast/Tweed zone[24].

4.4.2. Network Support From DirectLink

The above factors were considered in joint planning studies. It has been determined that DirectLink is capable of providing network support to the Gold Coast/Tweed zone to meet supply requirements between late 2005 and late 2006. This recognises the maximum contribution DirectLink is able to make to meeting the annual load growth (25-40MW) in the area. An option comprising a combination of DirectLink network support for the Gold Coast/Tweed zone for the summer of 2005/06 and other action after that time is discussed further in section 5.0.

Southerly transfer across DirectLink may be a potential option to address NSW supply requirements from mid 2006 onwards. DirectLink is not able to supply power to Queensland and NSW simultaneously[25]. However, the Queensland network support requirements are anticipated to occur primarily during the peak summer period, from October 2005 to March 2006, so this should

[20] Critical outages affecting the capacity of the TransGrid and Country Energy system to supply the Far North Coast region of New South Wales are discussed in the "Emerging Transmission Network Limitations on the New South Wales Far North Coast" document published in August 2003.

[21] An emergency tripping scheme (ETS) is in place in the event of a Lismore-Mullumbimby 132kV or Armidale – Lismore 330kV outage. Other alternative tripping schemes may also be needed if DirectLink is utilised to provide network support to the Gold Coast/Tweed zone.

[22] The thermal capability of the network supplying the Gold Coast also needs to be considered as outlined in section 2.3

[23] Refer voltage stability equation published by NEMMCO and implemented in National Electricity Market dispatch systems. This equation describes maximum power transfer limits from South Queensland to the Gold Coast/Tweed zone, and has been revised since the publication of Powerlink's 2003 Annual Planning Report to take account of recent work at Mudgeeraba.

[24] In the relevant constraint equation, the DirectLink MW coefficient of –0.7469 means that for every 1MW of DirectLink export to Queensland, the Gold Coast transfer limit reduces by 0.7469 MW. This means the maximum increase in supportable load in the Gold Coast/Tweed zone resulting from 168MW of DirectLink import to Queensland is therefore (1-0.7469)*168, or 42MW. If maximum reactive support (~40MVAr) is provided, this increases the supportable load by 14MW (coefficient of 0.35x40MVAr).

[25] Refer discussion Appendix 4.

not prevent DirectLink from being utilised to address the northern NSW requirements from mid 2006 onwards[26]. The utilisation of DirectLink in a southerly direction will be assessed as part of a separate economic evaluation to be carried out by TransGrid and Country Energy as necessary to meet their reliability of electricity supply obligations.

If DirectLink is used to meet future Gold Coast/Tweed zone supply requirements, this would require a network support agreement between the owners of DirectLink and Powerlink. Such an agreement would provide for import into Queensland across DirectLink[27] when the network flows approach the capability[28] of the existing Powerlink and ENERGEX networks supplying the Gold Coast/Tweed zone. Market participants are advised that dispatch of DirectLink to provide network support would occur when the market network service provider is not otherwise transferring the required amount of power in a northerly direction as a result of market price outcomes[29].

An arrangement for operating DirectLink under such a commercial network support agreement has been negotiated between Powerlink and the owners of DirectLink. Details of the proposed contractual arrangements are confidential, but because of the ACCC Regulatory Test requirements for transparency of analysis, the following information is disclosed. Powerlink has determined that imports of up to 160MW[30], will be required from DirectLink for this option to ensure a reliable supply to the Gold Coast/Tweed zone can be provided in 2005/06. The total estimated cost of network support for the 2005/06 summer period is $2.7 Million.

The network support cost comprises fixed and variable components. The actual total cost of the variable component is uncertain. The network support costs will vary depending on bidding patterns in the National Electricity Market (NEM), as the actual cost of network support is dependent on wholesale market price differentials between the NSW and Queensland regions of the NEM (refer additional information section 8.4). The variable network support cost will also vary due to uncertainty with the amount of energy that will be required to meet Gold Coast/Tweed zone customer load. The actual energy unable to be supplied from the Queensland transmission and distribution networks is dependent on half hourly electricity demand, generation pattern, unplanned generator outages, and other factors.

While network support from DirectLink is able to address both voltage stability and forecast thermal limitations in 2005/06, the following year requires a significant increase in the amount of network support. It has been determined that the Queensland requirement for network support in 2006/07 will be beyond the capability of DirectLink under most scenarios due to the factors outlined in section 4.4.1. Hence, augmentation of the Queensland system is required by late 2006. As noted above, DirectLink may then be utilised in a southerly direction to support northern NSW in 2006.

Conclusions on Network Support via DirectLink:

Powerlink and ENERGEX have concluded that network support from New South Wales via the DirectLink market network service is a viable option to address the Gold Coast/Tweed zone supply requirements for the summer of 2005/06. The additional customer load that network support from DirectLink can support is restricted by a variety of factors associated with DirectLink and the networks to which it is connected.

[26] Peak demand occurs in winter in most areas in northern NSW.
[27] assuming all elements of the NSW network supplying DirectLink are in service. TransGrid and Country Energy have agreed to coordinate all planned outages on network elements during the critical summer period between November 2005 and March 2006 to ensure DirectLink's northerly transfer capacity is not unnecessarily compromised.
[28] allowing for a critical contingency on one of the 275kV lines from Swanbank to Mudgeeraba/Molendinar
[29] It is difficult to predict the direction of DirectLink flow in 2005/06, as this depends on the response by the owners of DirectLink to future generation patterns. Therefore, the network support arrangement may or may not result in counter-price flows across DirectLink between the New South Wales and Queensland regions of the NEM.
[30] The MW requirement can be reduced if reactive support is available from DirectLink.

An arrangement for obtaining network support from DirectLink between the owners of DirectLink and Powerlink has been finalised. The terms of this agreement would involve DirectLink network support of up to 160MW during the 2005/06 summer period. The estimated cost of this arrangement would be $2.7 Million.

Maximum northerly transfer across DirectLink is unable to meet forecast peak demand in the Gold Coast/Tweed zone for the 2006/07 summer. Therefore, a further augmentation would need to be in service by late 2006. Network options able to address this requirement are discussed in the next section.

4.5. Network Options – Queensland Transmission/Distribution

In addition to the consultation process to identify possible alternatives, Powerlink, ENERGEX, TransGrid and Country Energy have carried out joint planning to determine the most appropriate transmission/distribution network option to address the future supply requirements in the Gold Coast/Tweed zone.

4.5.1. Infeasible Options

Multiple options were considered during the joint planning studies. After preliminary analysis, it was concluded that some options are not feasible. These infeasible options are summarised below for the information of interested parties and are not considered further in this Final Report.

Upgrade existing Swanbank – Mudgeeraba circuits by raising tower structures and retensioning lines where necessary.	This option was rejected because: ♦ It would not address either the voltage stability limitation or the overloading of 110kV circuits between Beenleigh and Molendinar that are the critical determinants of network capability in 2005 and 2006. ♦ Existing lines would need to be temporarily taken out of service many times to permit the upgrade work. It is estimated that about 54 outages of six hours duration and another ten outages of nine hours duration would be required to complete this work. This would carry a very high risk of customer electricity supply interruptions, without addressing the future supply requirements. This option therefore represents significant non-compliance with the reliability standards.
Additional shunt capacitors (static devices which assist with voltage control)	The addition of further 110kV or 275kV shunt capacitors in the existing Gold Coast/Tweed network was rejected because: ♦ It would not address either the voltage stability limitation or the overloading of 110kV circuits between Beenleigh and Molendinar that are the critical determinants of network capability in 2005 and 2006. ♦ Reactive load is already heavily compensated by existing capacitor banks[31]. Additional capacitor banks could only be switched into service in the existing system after a critical

[31] A total of 320MVAr of compensation is located at the transmission substations of Mudgeeraba and Molendinar. Added to this are power factor correction capacitors at local 110/33kV and 110/11kV substations.

	contingency has occurred to avoid excessively high voltages prior to the contingency. Technical limitations associated with automatic reclosing of the transmission circuits would limit the switching times for such additional capacitor banks to about 8 seconds. This would not be fast enough to arrest voltage collapse in all circumstances. ♦ Following loss of a critical 275kV circuit, the voltage step resulting from switching additional capacitor banks could result in voltage fluctuations in excess of that allowed by the voltage quality provisions of the National Electricity Code.
Installation of a Static VAr Compensator at Mudgeeraba (item of substation equipment which can dynamically address voltage stability and control requirements)	Installation of a Static VAr Compensator (SVC) at Mudgeeraba is able to address the immediate voltage control requirements[32], but was rejected because: ♦ It would not address the overloading of 110kV circuits between Beenleigh and Molendinar for loss of either Swanbank to Mudgeeraba 275kV circuit. ♦ It is therefore only a partial solution and would have to be implemented in conjunction with other action. These other projects can address the network requirements without an SVC, making any combination option more expensive than options without an SVC. An SVC to address the short-term supply requirements was therefore not considered further[33].

4.5.2. Feasible Augmentation Options

Feasible network options included transmission line augmentation at either 110kV or 275kV. An overview is provided below, with further details provided in section 6.0.

Feasible Queensland Network Augmentations	
110kV Beenleigh to Molendinar	This option involves augmentation of the 110kV network between Beenleigh and Molendinar and installation of a second 110kV 50MVAr capacitor bank at Molendinar by late 2005. Augmentation at 110kV would also require substantial reconstruction of the Molendinar 110kV substation.
275kV Greenbank to Maudsland	This option involves establishment by late 2005 of a 275kV switchyard at Greenbank, including a 120MVAr 275kV capacitor bank and the construction of an additional double circuit 275kV line from Greenbank to Maudsland. The new circuit would be connected to the recently completed Maudsland to Molendinar 275kV circuit, providing a third 275kV circuit to the Gold Coast/Tweed zone.

[32] Reactive power needs
[33] It is anticipated that a Static Var Compensator may be required on the Gold Coast in the longer term – refer 5.1(e).

Feasible Queensland Network Augmentations	
"Double tee" Maudsland to Molendinar, followed by 275kV Greenbank to Maudsland	The third feasible network augmentation involves the establishment by late 2005 of a second Maudsland 275kV tee using the second circuit of the existing Maudsland to Molendinar double circuit line. This would provide only a small increase in capacity and further augmentation would be necessary by late 2006. This could be achieved by establishment of a 275kV switchyard at Greenbank, including a 120MVAr 275kV capacitor bank and the construction of an additional double circuit line from Greenbank to Maudsland. The new circuit would be connected to the Maudsland to Molendinar 275kV circuit, providing a third 275kV circuit to the Gold Coast/Tweed zone.

It should be noted that the options described above deliver different increments in supply capacity to the Gold Coast/Tweed zone. These differences are taken into account in the economic comparison of options by considering future anticipated/modelled projects that are expected to be required under each option during the planning horizon.

Conclusions on Augmentations of the Queensland Electricity Network

With respect to possible augmentations of the Queensland electricity network, Powerlink and ENERGEX:

- Considered multiple network options, some of which were found to be infeasible;
- Identified three alternative augmentations of the Queensland transmission and distribution network that would address the future supply requirements in the Gold Coast/Tweed zone; and
- These options are considered further in section 6, in combination with network support via DirectLink, anticipated/modelled augmentations to address future supply requirements in Queensland, and anticipated/modelled projects to increase supply capability to the Far North Coast of New South Wales.

5. ANTICIPATED/MODELLED PROJECTS

In accordance with the ACCC Regulatory Test, the economic analysis of options includes future anticipated/modelled projects that may be required within the planning horizon. All options are expected to require a series of augmentations during the fifteen year period analysed to meet the high demand growth forecast for the Gold Coast/Tweed zone. Works required beyond 2006 are not recommended for approval in this Final Report, but are included to ensure the proposed augmentations are compared on an equivalent basis. The sensitivity of the analysis to these assumptions is tested through the use of market development scenarios.

Anticipated/modelled projects are considered to address the future supply requirements in the Far North Coast area of New South Wales. Other works are also anticipated to be required to meet ongoing load growth in the Gold Coast/Tweed zone beyond 2006. These anticipated/modelled projects are discussed below:

5.1. Anticipated/Modelled Projects - Gold Coast/Tweed Zone

Anticipated/modelled projects expected to be required to meet supply requirements in the Gold Coast/Tweed zone beyond 2006 have been included in the analysis in accordance with requirements of the ACCC Regulatory Test. These anticipated/modelled projects are common to all of the options considered[34], with the scope of works and timing varying depending on what works are undertaken in the earlier years.

The variation in timing and scope occurs because some proposed augmentations only address the forecast supply requirements in the short term, and will require further augmentation in the medium term to provide for continuing load growth in the area. Other proposed augmentations provide a large increment in network capability, and therefore provide for forecast load growth further into the future before further action would be required. An overview of each anticipated/modelled project is provided below.

It should be noted some of the anticipated/modelled projects listed below form part of the proposed augmentations in different options (ie – they will be necessary in 2005 or 2006 rather than at a later time).

(a) Molendinar Substation Reconstruction

The Molendinar substation was established in the 1960s. Reconstruction of the 33kV switchyard is expected to be necessary in the future to address switchgear fault ratings and to provide for additional ENERGEX 110kV connections to accommodate additional load growth. Reconstruction of the 110kV busbar[35] is expected to be necessary due to thermal capacity limitations.

(b) 275kV Line Capacity to the Gold Coast

The two existing 275kV transmission lines from Swanbank to Mudgeeraba will approach thermal limits in the event of an outage of the other 275kV circuit in the next few years. The timing for anticipated/modelled projects to address this issue is dependent on the amount of power required to be transferred across these lines to satisfy Gold Coast demand growth. On current forecasts, it will be necessary to provide additional 275kV line capacity to the Gold Coast to address this requirement by 2007 to 2009. It will also be necessary to provide a second 275/110kV transformer at Molendinar to allow independent operation of the 275kV line circuits in around 2008.

[34] Meaning that, by the end of the 15 year period of analysis, the transmission and distribution network configuration would be similar for all options.
[35] Item of substation equipment that makes a common connection between several circuits.

(c) Augmentation of the 110kV Network Between Beenleigh and Molendinar

To accommodate the forecast load growth in the area between Beenleigh and the Gold Coast, it is expected to be necessary to upgrade the 110 and 33kV distribution networks in that area. The modelled works include construction of a new 110/33kV substation at Coomera and associated distribution works. They also include rebuilding the existing Beenleigh-Cades County line as a double circuit 110kV line and converting the Cades County-Molendinar 110kV line to double circuit 110kV operation. This section of the network is designed for 110kV operation but one circuit is presently operating at 33kV.

(d) Terranora – Mudgeeraba Double Circuit 110kV Line

Electricity demand in the Tweed zone will eventually grow so that it exceeds the firm capability of the lines which supply Terranora from Mudgeeraba in Queensland. It is anticipated that, depending on the loading on these lines, an additional circuit may be required between these two substations to avoid thermal overloads during contingency conditions beyond 2008.

(e) Ongoing Voltage Support

The forecast load growth in the Gold Coast/Tweed zone may require an ongoing program of voltage support. Compensation of customer load reactive demand will be achieved at the distribution level by ENERGEX and Country Energy. In the longer term, it may also be necessary to install shunt capacitor banks or Static Var Compensators at the 110 or 275kV level to compensate for reactive losses in those systems as the power transfers increase with load growth. However, the requirement for ongoing voltage support is expected to be common to all options in this Final Report, and has therefore not been included in the analysis[36].

(f) Installation of 275kV Switchgear at Molendinar Substation

By about 2015, there is a forecast need to install a third 275/110kV transformer at Molendinar to provide for the expected long-term load growth in the Gold Coast/Tweed zone. This will require the installation of 275kV switchgear[37] to allow independent switching of the incoming lines and transformers at the substation.

5.2. Anticipated/Modelled Projects – Far North Coast NSW

As outlined in section 2.3, TransGrid and Country Energy have identified that action will be required to address approaching supply requirements in the Far North Coast area of NSW.

When evaluating options to address the Gold Coast/Tweed zone requirements, the impacts of each option on these forecast NSW requirements was considered. Joint planning studies by Powerlink, ENERGEX, TransGrid and Country Energy also considered anticipated and modelled projects to address the New South Wales limitations and considered the impact of these on the Queensland network.

TransGrid advised of two alternative network augmentations that could address the forecast requirement in the northern NSW network, namely:
(a) A 330kV connection between Dumaresq and Lismore.
(b) A 330kV connection between Armidale and Lismore. Due to the longer distance, this would be a higher cost augmentation than a Dumaresq-Lismore line.

[36] Common works have no impact on the ranking outcome of net present value analysis.
[37] Ie - a 275kV busbar

The DirectLink interconnector could provide network support to New South Wales as described in section 4.4. In addition, TransGrid and Country Energy also advised of the possibility that local generation of up to 60MW may complement supply to the far north coast area. It is assumed that such generation would be embedded within the northern NSW distribution network.

For the purposes of the joint planning studies, two potential options to meet northern NSW supply requirements were modelled to assess the impacts on supply to the Gold Coast/Tweed zone:

A. Network support from either DirectLink or local generation from 2006 onwards.
B. Dumaresq – Lismore 330kV Line in 2006.

Further details are provided below. Together with the feasible Queensland augmentations discussed in section 4.4 and 4.5, consideration of these modelled projects in NSW resulted in eight potential options to address the future supply requirements in the Gold Coast/Tweed zone. These eight options are discussed in more detail in section 6 and in Appendix 2.

5.2.1. Network Support for the Far North Coast of NSW

An arrangement has been included in the analysis in this Final Report where it is assumed that the northern NSW requirements are addressed through network support from either DirectLink or local embedded generation.

The level of network support required depends on load growth in the Far North Coast area and the location and operating pattern of the network support providers. For the purposes of this Final Report, it is assumed that sufficient support would be available to address northern NSW requirements for approximately six years from 2006 (in the order of 10MW initially growing to possibly 100MW may be required over this period). From 2012, it is assumed that 330kV network augmentation in New South Wales would be necessary.

The costs included in the financial analysis for this arrangement for network support are based on the offer of network support provided by the owners of DirectLink to Powerlink in relation to meeting the Gold Coast/Tweed zone supply requirements. It is recognised that the future northern New South Wales requirements are of a different quantum and nature, and that an offer of network support by the owners of DirectLink or (as yet uncommitted) local generation may vary considerably from the Queensland offer. However, this is considered to be the best estimate of network support costs available for northern NSW at this point in time.

The primary interrelationships between anticipated/modelled network support arrangements for northern New South Wales and the Queensland supply system are as follows:

- It is expected that any embedded generation output would be consumed locally in northern NSW, and would have minimal impact on the Gold Coast/Tweed zone where load is growing by 25-40MW per year. Limitations on northerly transfer across DirectLink as discussed in section 4.4 would also be likely to restrict the utilisation of any new generation in NSW to assist Queensland network requirements.

- The option being considered of network support via DirectLink to the Gold Coast/Tweed zone followed by 275kV augmentation should not prevent network support being utilised to address the northern NSW requirements from mid 2006 onwards. When DirectLink is flowing northward to support Queensland, it is not able to simultaneously be used to transfer power southward to northern New South Wales. However, the Queensland network support requirements are anticipated to occur primarily during the peak summer period, from October 2005 to March 2006. DirectLink is therefore able to provide network support to Queensland in 2005/06, and still be a viable option for consideration to meet the NSW requirements from 2006 onwards.

- The capacity of the Queensland electricity system to support southerly flow on DirectLink for the provision of network support to New South Wales needs to be considered. When DirectLink is flowing in a southerly direction, it places a corresponding additional demand on the transmission network between Queensland power stations and the Gold Coast area. The Queensland network is presently unable to supply this additional demand from DirectLink during peak summer periods, as all capability is required to maintain a reliable power supply to the Gold Coast/Tweed zone. DirectLink is therefore currently restricted from flowing southwards during periods of Gold Coast/Tweed zone peak demand. If DirectLink is to be a viable solution to the New South Wales supply requirements beyond 2006, it is essential that augmentation works are undertaken in Queensland to provide sufficient capacity above the Gold Coast/Tweed zone requirements to transfer power south to NSW[38]. In the longer term, as the Gold Coast/Tweed zone electricity demand continues to grow, the capacity for additional southward transfer may require additional works. However, no change in timing of longer-term projects is being assumed in this Final Report.

5.2.2. Dumaresq – Lismore 330kV Transmission Line

An alternative arrangement to address northern NSW requirements involving the completion of a 330kV line from Dumaresq to Lismore was also included in the analysis. A new 330kV supply to Lismore would substantially increase the capability to transfer electricity to the Far North Coast Area of NSW, and would therefore address the identified future supply requirements in the area. Further investigations are required to refine the scope of this modelled project. For the purposes of this Final Report, it was assumed this modelled project would be achieved by construction of a 330kV line from Dumaresq substation to Tenterfield and rebuilding of the Tenterfield-Lismore 132kV line to 330kV design at an estimated cost of approximately $100 Million.

There are no significant interrelationships between the anticipated/modelled 330kV augmentation in northern New South Wales and the Queensland supply requirements. Such an augmentation would alleviate some of the restrictions on northward flow on DirectLink during contingencies in the northern New South Wales network, but would have no other impact on the capability to supply customers in the Gold Coast/Tweed zone within the timeframe being considered.

[38] Southerly transfer on DirectLink may also require installation of duplicate emergency tripping schemes on the Queensland network elements supplying DirectLink.

6. FEASIBLE OPTIONS

This section provides an overview of the feasible proposed augmentation options identified, with full details of the financial analysis contained in Appendix 2.

The eight options are based on four potential alternatives to address the Gold Coast/Tweed zone requirements, with two variations on each alternative based on different modelled projects to address the requirements in northern New South Wales.

The proposed augmentations to address the Gold Coast/Tweed zone include:

Option 1	110kV Augmentation Beenleigh – Molendinar in late 2005
Option 2	275kV Augmentation Greenbank - Maudsland in late 2005
Option 3	Network support from DirectLink for the summer of 2005/06, followed by 275kV Augmentation Greenbank - Maudsland in late 2006
Option 4	"Double tee" connection Maudsland – Molendinar in late 2005, followed by 275kV Augmentation Greenbank - Maudsland in late 2006

For each option, a variation to examine the impact of modelled projects to address northern NSW requirements was considered as follows:

1A to 4A Network support from 2006 onwards, OR;
1B to 4B Construction of Dumaresq – Lismore 330kV Line in 2006.

Other anticipated/modelled projects are also included in each option when they are anticipated to be required to maintain ongoing reliability of supply to the Gold Coast/Tweed zone and the Far North Coast of NSW.

6.1. Proposed Augmentation Option 1A

Proposed Option 1A – 110kV Augmentation Beenleigh to Molendinar (Late 2005)		
Date Reqd	**Proposed Augmentation**	**Capital Cost ($M)**
Late 2005	Augmentation of the 110kV network between Beenleigh and Molendinar.	$25.5
Late 2005	Reconstruction of the Molendinar substation.	$22.0

Proposed Option 1A involves an initial network augmentation in Queensland at 110kV in late 2005. Under this option, a new 110kV connection would be constructed between Beenleigh and Molendinar. The proposal involves rebuilding the 110kV single circuit line between Beenleigh and Cades County to a double circuit line and converting the Cades County to Molendinar feeder to a double circuit 110kV line (presently one circuit is operating at 33kV and one circuit at 110kV). Option 1A also includes the installation of a 50MVAr capacitor bank at Molendinar substation and related works in the ENERGEX 33kV network.

This would overcome the potential thermal overloads on the existing Beenleigh to Molendinar circuits during a 275kV network contingency by providing extra 110kV network capacity to the Gold Coast/Tweed zone. The additional lines would also provide an additional power path to the area

from power stations in Queensland. This would address the identified voltage stability limit in the existing network by reducing reactive power losses.

Under Option 1A, additional electricity would be transferred to the Gold Coast/Tweed zone via the 110kV network to Molendinar. Under this option, it will therefore be necessary to substantially reconstruct Molendinar substation to cater for the additional power transfer through this substation.

Anticipated/Modelled Projects – Not Recommended in this Final Report

Date Reqd	Anticipated Future Projects : Queensland	Capital Cost ($M)
Late 2007	Establishment of a 275kV switchyard at Greenbank, including a 120MVAr 275kV capacitor bank. Construction of an additional double circuit line from Greenbank to Maudsland.	$48.9
Late 2008	Second Molendinar 275/110kV transformer	$6.2
Late 2008	Construction of new Mudgeeraba-Terranora 110kV line	$8.0
Late 2015	Installation of 275kV switchgear & third 275/110kV transformer at Molendinar substation	$15.7
	Anticipated Future Projects : NSW	
Mid 2006	Network support for northern NSW for six years to 2012	$18.0[39]
Late 2012	Construction of a new Dumaresq-Tenterfield 330kV line, rebuilding of the existing Tenterfield-Lismore 132kV line for 330kV operation and associated substation works at Dumaresq and Lismore.	$100

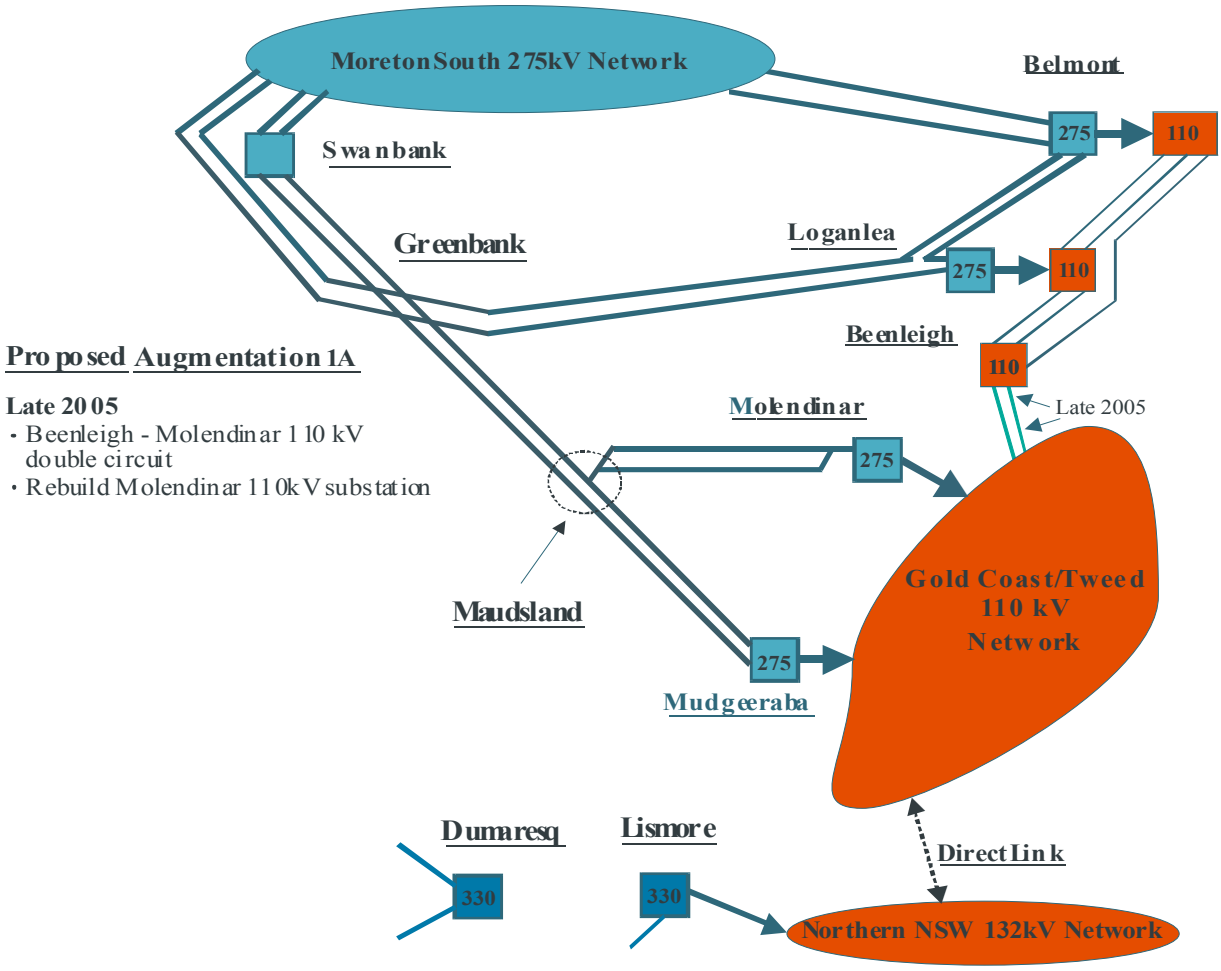
The proposed 110kV augmentation in Option 1A provides a modest increment in supply capacity to the Gold Coast/Tweed zone. It is a short-term solution, as it can only address the identified future supply requirements in the area for two years before further augmentation will be necessary. At this time, it is assumed that a 275kV augmentation between Greenbank and Maudsland will be required to address forecast thermal overloads in the existing 275kV network.

Other anticipated/modelled projects are also expected to be required in Queensland, as described in section 5.1. The timings for these augmentations under Option 1A are shown in the table above, and have been determined through planning studies which examined how long the proposed and anticipated works will address the future supply requirements before further action is required.

Option 1A assumes that northern NSW supply requirements are addressed through a modelled arrangement for network support from either DirectLink or embedded generation from mid 2006 onwards. It is assumed that this is capable of addressing the Far North Coast of NSW supply requirements for six years, with network augmentation being required in NSW by 2012.

[39] Refer section 5.2.1

Figure 3 – Proposed Option 1A
110kV Network Augmentation in late 2005



6.2. Proposed Augmentation Option 1B

Proposed augmentation 1B is the same as Option 1A except that it is assumed the modelled project to address the future supply requirements in northern New South Wales involves the construction of a 330kV transmission line from Dumaresq to Lismore by mid 2006 as described in section 5.1.2.

6.3. Proposed Augmentation Option 2A

Proposed Option 2A – Greenbank– Maudsland 275kV Transmission Line (Late 2005)		
Date Reqd	**Proposed Augmentation**	**Capital Cost ($M)**
Late 2005	Establishment of a 275kV switchyard at Greenbank, including a 120MVAr 275kV capacitor bank and the construction of an additional double circuit line from Greenbank to Maudsland.	$48.9

Proposed Option 2A involves transmission network augmentation in Queensland at 275kV.

The works in proposed Option 2A, shown in Figure 4, involve establishment of a new 275kV switchyard at Greenbank in the Logan area. This would improve voltage stability in the network supplying the Gold Coast/Tweed zone by providing a switching point closer to the Gold Coast/Tweed zone. The proposed works would also include the installation of a 120MVAr capacitor bank at the new Greenbank switchyard to provide additional voltage support.

Option 2A also includes construction of a 43km section of new transmission line between Greenbank and Maudsland, 12km inland from Molendinar, by late 2005. The new circuit would be connected to the existing Maudsland to Molendinar 275kV circuit. It would initially operate as a single circuit, providing additional 275kV line capacity to the Gold Coast/Tweed zone. This proposed new line addresses both the potential voltage collapse (by reducing the loading on remaining lines during a 275kV contingency and therefore reducing reactive power losses) and the potential 110kV line overloads (by redistribution of network power flows away from the 110kV lines to the 275kV lines).

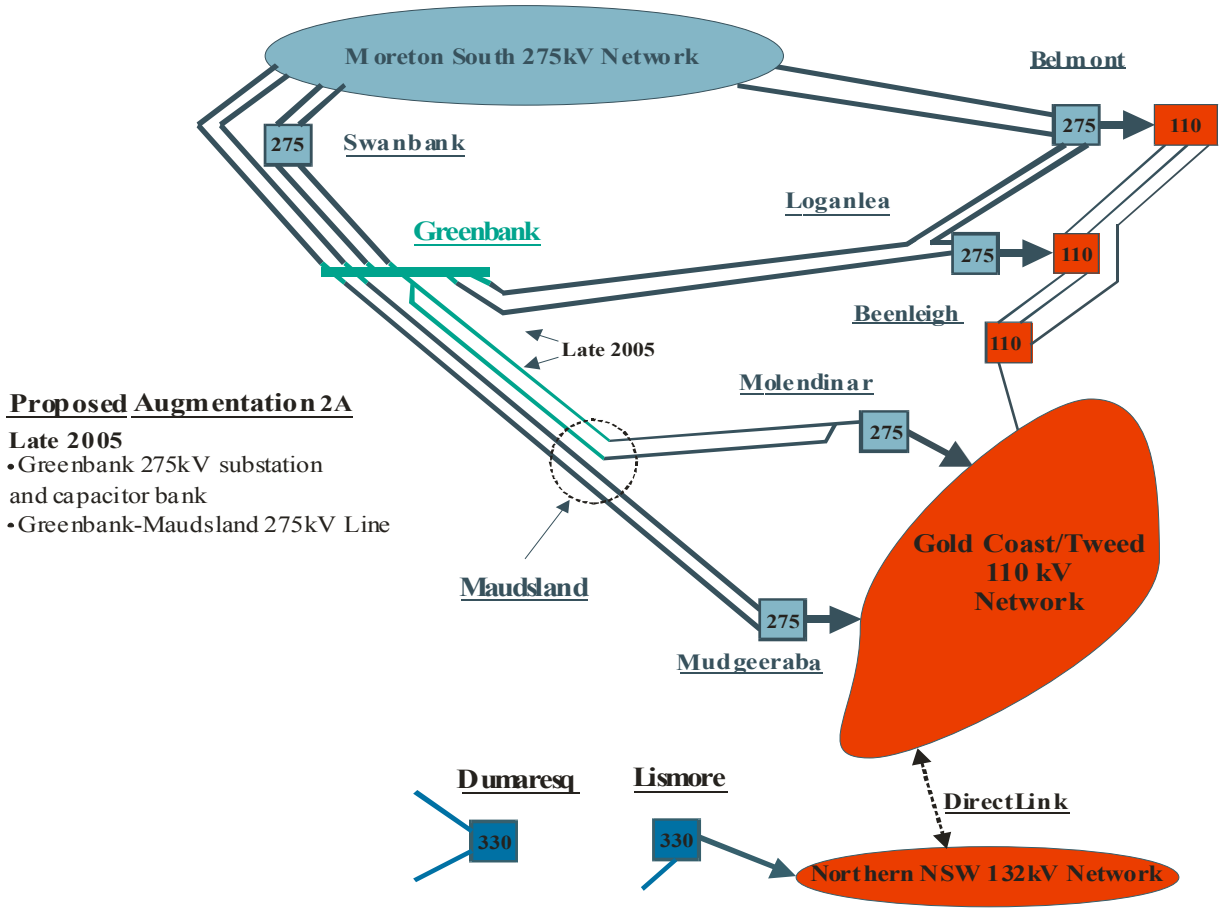
Anticipated/Modelled Projects – Not Recommended in this Final Report		
Date Reqd	**Anticipated Future Projects : Queensland**	**Capital Cost ($M)**
Late 2007	Molendinar 110kV Substation Reconstruction	$22.0
Late 2008	Second Molendinar 275/110kV transformer	$6.2
Late 2008	Construction of new Mudgeeraba-Terranora 110kV line	$8.0
Late 2009	Augmentation of 110kV Network Beenleigh - Molendinar	$25.5
Late 2015	Installation of 275kV switchgear & third 275/110kV transformer at Molendinar substation	$15.7
	Anticipated Future Projects : NSW	
Mid 2006	Network support for northern NSW for six years to 2012	$18.0[40]
Mid 2012	Construction of a new Dumaresq-Tenterfield 330kV line, rebuilding of existing Tenterfield-Lismore 132kV line for 330kV operation and substation works at Dumaresq and Lismore.	$100

[40] Refer section 5.2.1

Option 2A assumes anticipated/modelled projects will be required in Queensland, as described in section 5.1. The timings for these augmentations under Option 2A are shown in the table above, and have been determined through planning studies which examined how long the proposed and anticipated works will address the future supply requirements before further action is required.

Option 2A also assumes that northern NSW supply requirements are addressed through a modelled arrangement for network support from mid 2006 onwards. It is assumed that this is capable of addressing the Far North Coast of NSW supply requirements for six years, with network augmentation being required in NSW by 2012.

Figure 4 – Proposed Option 2A
275kV Network Augmentation in late 2005



6.4. Proposed Augmentation Option 2B

Proposed Option 2B is the same as Option 2A, except the modelled project to address the future supply requirements in northern New South Wales involves the construction of a 330kV transmission line from Dumaresq to Lismore instead of network support from DirectLink or embedded generation.

6.5. Proposed Augmentation Option 3A

Proposed Option 3A – DirectLink network support for 2005/06 summer followed by 275kV Greenbank – Maudsland Transmission Line by late 2006		
Date Reqd	**Proposed Augmentation**	**Capital Cost ($M)**
Late 2005	DirectLink network support of up to160MW for 2005/06 summer	$2.7[41]
Late 2006	Establishment of a 275kV switchyard at Greenbank, including a 120MVAr 275kV capacitor bank and the construction of an additional double circuit line from Greenbank to Maudsland.	$48.9

Proposed Option 3A involves DirectLink network support for the Gold Coast/Tweed zone for the 2005/06 summer period. The network support via DirectLink reduces the amount of power that has to be transferred across the Powerlink and ENERGEX networks to the Gold Coast during critical contingencies. It therefore overcomes the forecast voltage issues and thermal overloads in the existing transmission and distribution network and defers the need for other action.

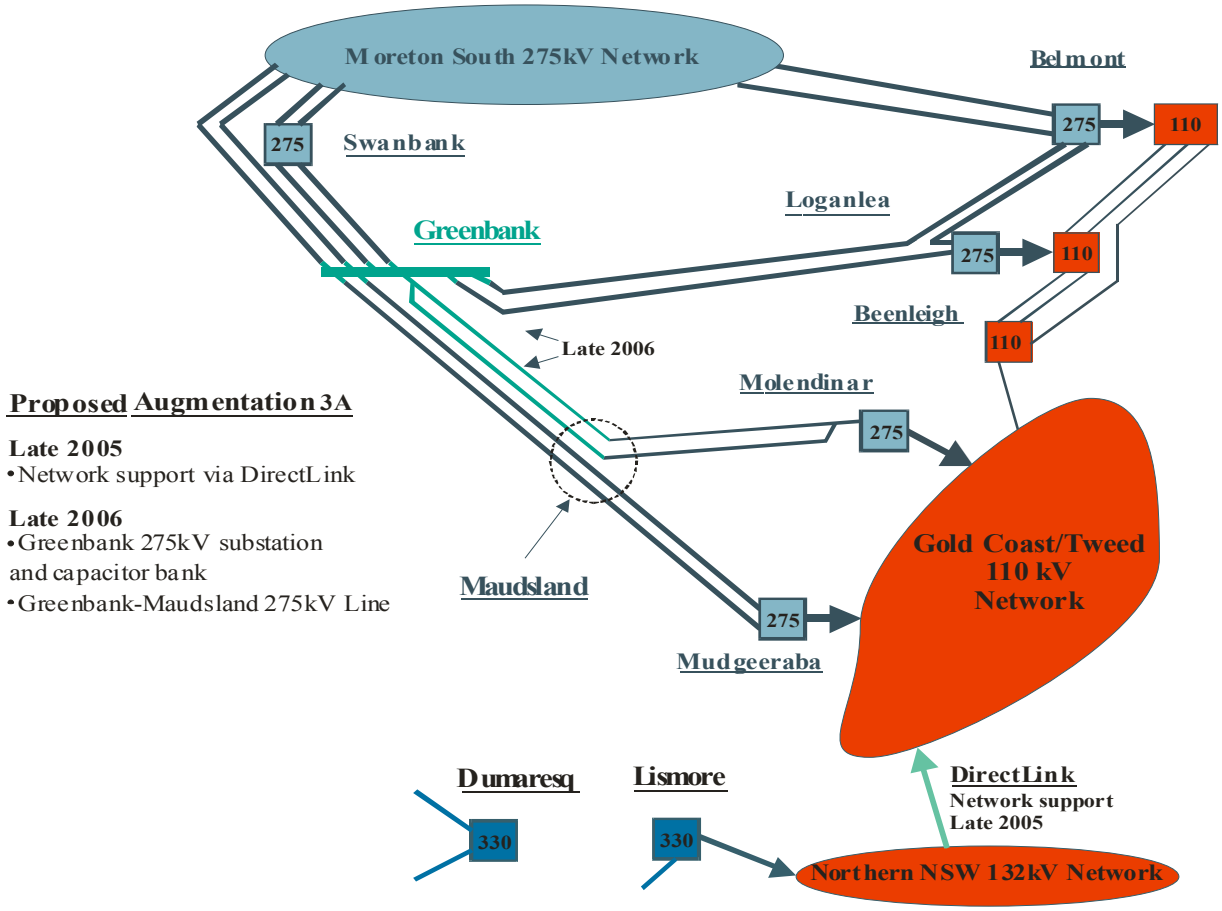
As discussed in section 4.4, there are restrictions on the ability of DirectLink to provide network support to the Gold Coast/Tweed zone for a longer period than one year. Other action is therefore required to meet supply requirements from late 2006 onwards. Option 3A proposes the establishment of a new 275kV switchyard at Greenbank in the Logan area, and construction of a 43km section of new transmission line between Greenbank and Maudsland, by late 2006. This involves the same works as described in option 2A, but deferred by one year due to the proposed network support arrangement with DirectLink.

Anticipated/Modelled Projects – Not Recommended in this Final Report		
Date Reqd	**Anticipated Future Projects : Queensland**	**Capital Cost ($M)**
Late 2007	Molendinar 110kV Substation Reconstruction	$22.0
Late 2008	Second Molendinar 275/110kV transformer	$6.2
Late 2008	Construction of new Mudgeeraba-Terranora 110kV line	$8.0
Late 2009	Augmentation of 110kV Network Beenleigh - Molendinar	$25.5
Late 2015	Installation of 275kV switchgear & third 275/110kV transformer at Molendinar substation	$15.7
	Anticipated Future Projects : NSW	
Mid 2006	Network support for northern NSW for six years to 2012	$18.0[42]
Late 2012	Construction of a new Dumaresq-Tenterfield 330kV line, rebuild of the existing Tenterfield-Lismore 132kV line for 330kV operation and associated substation works at Dumaresq and Lismore.	$100

[41] Refer section 8.4

It should be noted that no deferral of anticipated/modelled projects beyond 2006 is achieved through the proposed provision of network support by DirectLink in 2005/06 in Option 3A[43]. The anticipated/modelled projects for Option 3A are therefore the same as Option 2A.

Figure 5: Proposed Option 3A
DirectLink Network Support 2005/06
275kV Network Augmentation Late 2006



6.6. Proposed Augmentation Option 3B

Proposed Option 3B is the same as Option 3A, except the modelled project to address the future supply requirements in northern New South Wales involves the construction of a 330kV transmission line from Dumaresq to Lismore instead of network support from DirectLink or embedded generation.

[42] Refer section 5.2.1
[43] When DirectLink is not providing network support, the total supply capacity to the Gold Coast/Tweed zone is determined by the capacity of the existing transmission and distribution network.

6.7. Proposed Augmentation Option 4A

Proposed Option 4A – Double tee Maudsland – Molendinar by late 2005 followed by 275kV Greenbank – Maudsland Transmission Line by late 2006		
Date Reqd	**Proposed Augmentation**	**Capital Cost ($M)**
Late 2005	Second Maudsland – Molendinar 275kV tee connection	$3.6[44]
Late 2006	Establish a 275kV switchyard at Greenbank, including a 120MVAr 275kV capacitor bank. Construct an additional double circuit line Greenbank -Maudsland.	$48.9

The existing Maudsland-Molendinar 275kV tee connection has been constructed as a double circuit line, but operates as a single circuit connected to only one transformer at Molendinar substation. Proposed Option 4A involves the establishment by late 2005 of a second Maudsland 275kV tee using the second circuit of the existing Maudsland to Molendinar double circuit line.

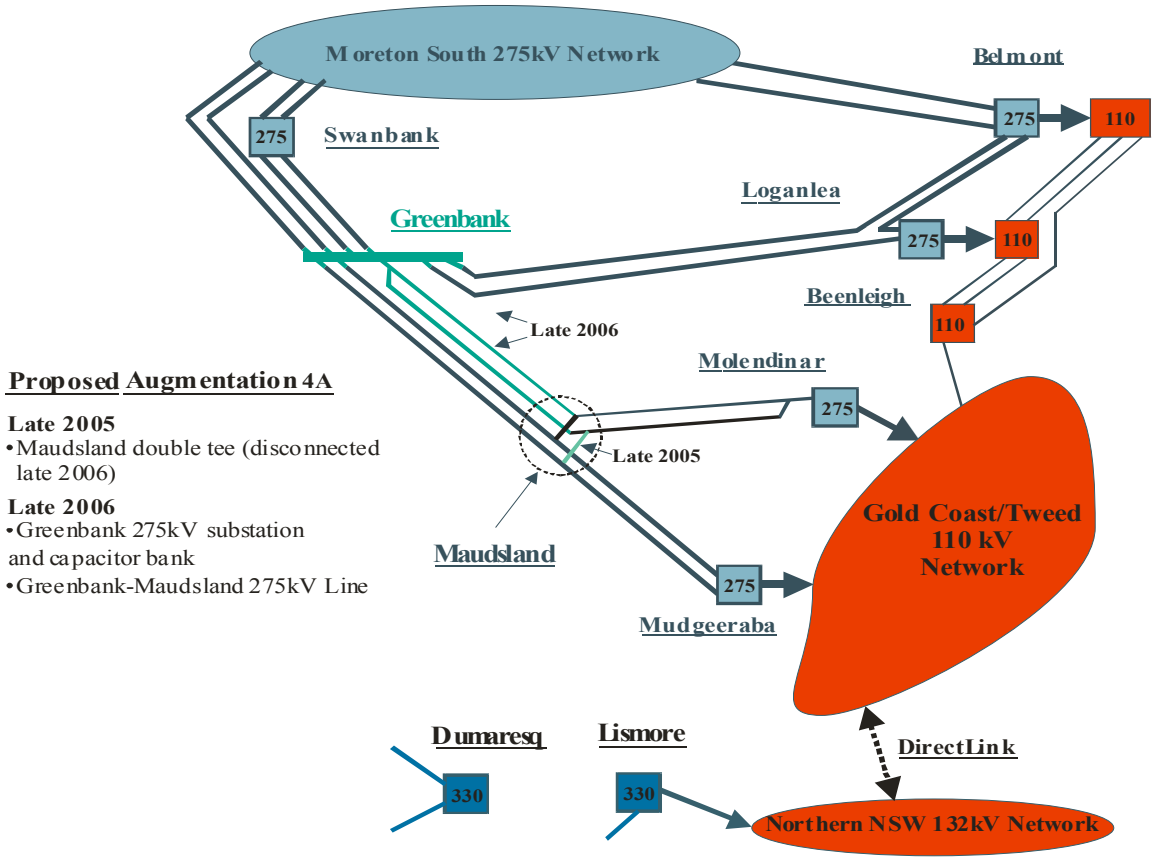
At present, an outage of the existing Maudsland – Molendinar tee connection is the worst credible single contingency as no electricity can be injected into Molendinar at 275kV during an outage of this circuit. Establishment of a second tee connection would reduce the impact of an outage of the existing tee connection, providing a marginal increase in transfer capacity to the Gold Coast/Tweed zone.

Further augmentation would be necessary the following year to meet the Gold Coast/Tweed zone supply requirements. Option 4A proposes the establishment of Greenbank switchyard and the construction of a 43km section of new 275kV transmission line between Greenbank and Maudsland, by late 2006. This involves the same works as described in option 2A, but deferred by one year due to establishment of the double tee.

Anticipated/Modelled Projects – Not Recommended in this Final Report		
Date Reqd	**Anticipated Future Projects : Queensland**	**Capital Cost ($M)**
Late 2007	Molendinar 110kV Substation Reconstruction	$22.0
Late 2008	Second Molendinar 275/110kV transformer	$6.2
Late 2008	Construction of new Mudgeeraba-Terranora 110kV line	$8.0
Late 2009	Augmentation of 110kV Network Beenleigh - Molendinar	$25.5
Late 2015	Installation of 275kV switchgear & third transformer at Molendinar	$15.7
	Anticipated Future Projects : NSW	
Mid 2006	Network support for northern NSW for six years to 2012	$18.0[45]
Late 2012	Construction of a new Dumaresq-Tenterfield 330kV line, rebuild of the existing Tenterfield-Lismore 132kV line for 330kV operation and substation works at Dumaresq and Lismore.	$100

[44] Comprises $1.46M operating expenditure and $2.17M capital expenditure

Figure 6 – Proposed Option 4A
"Double Tee" Late 2005
275kV Network Augmentation Late 2006



6.8. Proposed Augmentation Option 4B

Proposed Option 4B is the same as Option 4A, except the modelled project to address the future supply requirements in northern New South Wales involves the construction of a 330kV transmission line from Dumaresq to Lismore instead of network support from DirectLink or embedded generation.

[45] Refer section 4.2.1

7. MARKET DEVELOPMENT SCENARIOS

7.1. Context for Evaluation of Options

All feasible solutions to the identified supply requirements must be viewed in the context of wider developments in the National Electricity Market:

- The Queensland Government is proceeding with the implementation of its policy requirement for Queensland energy retailers to source 13% of their energy from gas-fired generation from 1 January 2005. The 13% Gas Scheme is designed to deliver on the government policy objectives of diversifying the State's energy mix towards a greater use of gas and encouraging new gas infrastructure in Queensland, while reducing the growth in greenhouse gas emissions;

- Commonwealth legislation has been in effect since 1 January 2001 to encourage increased generation from renewable energy sources. Powerlink has incorporated independent forecasts of additional renewable energy generation into the forecasts of demand and energy used in assessing future supply requirements;

- NEMMCO's Statement of Opportunities (SOO) issued in July 2003 contained information on existing and committed generation developments in Queensland. There is currently a considerable margin between supply capacity and demand, with several large new generating units commissioned in Queensland in the past two years.

- The large margin between supply capacity and demand for Queensland as a whole does not apply to the Gold Coast/Tweed zone. As outlined in section 2.2, electricity demand in the Gold Coast zone (which must be transmitted from power stations outside the zone) is growing at an average of 3.6% per year over the next 10 years and at about 6% per year over the next three years. This is equivalent to between 25 and 40MW per year. Apart from small amounts of generation embedded in the distribution systems (which is already accounted for in the ENERGEX and Country Energy load forecasts) there has been no net increase in power generation installed in the Gold Coast/Tweed zone to match this demand growth.

- Historical market data shows that generation dispatch during the past twelve months has resulted in southward flows on the Queensland-New South Wales interconnector (QNI) and on the DirectLink market network service provider (ie – from Queensland to New South Wales) for the majority of the time. This trend is anticipated to continue in the short term. However, as DirectLink operation and flows across QNI depend on market bidding behaviour, new generation investment etc, the direction that power will flow across these interconnectors in the future cannot be presumed.

7.2. Assumed Market Development Scenarios

The ACCC Regulatory Test requires that options to address network requirements be assessed against a number of plausible market development scenarios. These scenarios need to take account of:

- the existing system;
- future network developments;
- variations in load growth;
- committed generation and demand side developments;
- potential generation and demand side developments.

The purpose of utilising this approach is to test the Net Present Value costs of the solutions being evaluated under a range of plausible scenarios.

7.2.1. Existing Network and Future Transmission Developments:

No market development scenarios have been developed related to new network developments proposed by Powerlink, ENERGEX, Country Energy or TransGrid outside the Gold Coast/Tweed area. These are independent of the future supply requirements that are the subject of this report, and are considered to be common to all options analysed. Future network developments, in both NSW and Queensland, which are relevant to the Gold Coast/Tweed area have been included as anticipated/modelled projects in the analysis.

7.2.2. Variations in Load Growth

Four market development scenarios have been developed to consider sensitivity to variations in customer electricity demand:

Scenario	Forecast Electricity Demand Level
Scenario A	Medium (medium economic growth and typical weather conditions)
Scenario B	High (higher economic growth and typical weather conditions)
Scenario C	Low (lower economic growth and typical weather conditions)
Scenario D	Embedded Generation (medium economic growth and typical weather conditions with 2005/06 demand reduced by 30MW)

These scenarios are based on typical weather (50% probability of exceedance) forecast for electricity usage, with varying levels of economic growth[46]. The forecasts include all known information about existing and planned demand side initiatives, and also include independent forecasts of local embedded generation developments. The forecasts do not consider extreme temperature conditions.

The Gold Coast area has to date been one of the highest load growth areas in Australia. Demand is forecast to increase at more than 3% per year over the next ten years, with higher than average growth over the next 2-3 years. Scenarios A, B and C have been developed based on different levels of demand growth (from 2.2%p.a to 3.9%p.a over a ten year period). Scenario D has been developed to assess the sensitivity of the analysis to an outcome where electricity demand on the transmission system is lower than anticipated over the next few years, but then continues at a medium growth rate thereafter. This could occur through the installation of additional small generation embedded within the distribution network and/or a reduction in the recent high levels of development in the Gold Coast/Tweed zone. As noted in section 4.3.2, there are no indications that embedded generation could occur by the required timeframe, but Scenario D has been developed to assess sensitivity of the analysis results to this scenario.

7.2.3. Existing and Committed Generators:

As noted in section 4.2, there are no major power stations in the Gold Coast/Tweed area and no recently committed generators proposing to establish in the Gold Coast/Tweed zone prior to 2005. For this reason, no scenarios have been developed in which the output of existing and/or committed generators is increased.

[46] Refer 2003 Annual Planning Report and 'Request for Information' document published in August 2003.

However, due to the inclusion of DirectLink network support as an option, it is necessary to assess how the operation of existing generators in the National Electricity Market as a whole may influence the dispatch of the DirectLink market network service provider. Powerlink Queensland has sought advice from ROAM Consulting on the impacts of market dispatch and wholesale market pricing on the cost of network support from DirectLink. ROAM Consulting carried out market simulations to examine potential generation patterns and resulting regional price differentials. For the purposes of this Final Report, the cost of network support in all scenarios has been based on the average price differential between the NSW and Queensland market regions based on the market simulations by ROAM Consulting. Sensitivity analysis has been carried out to test the sensitivity of the analysis results to changes in this assumption (refer sections 8.4 and 9.2).

7.2.4. Potential New Generation:

NEMMCO's 2003 Statement of Opportunities indicated that additional investment in major generation may be required in the medium term. However, any such investment is considered unlikely to occur in the Gold Coast/Tweed zone. No new stand-alone generation was proposed in response to the Request for Information document, and is considered unlikely because of a lack of economic fuel sources and the high density of residential and commercial development within the area. Hence no market development scenarios have been developed to consider the establishment of major new stand-alone generators in the Gold Coast/Tweed zone.

Smaller generation or demand side developments may occur in the Gold Coast/Tweed area. The impact of potential embedded generation developments has been considered through the development of Scenario D, where demand on the electricity network supplying the Gold Coast/Tweed zone is forecast to be reduced by 30MW in 2005/06[47].

[47] This scenario assumes 30MW demand reduction at the high load centres of Southport, Surfers Paradise and Broadbeach. The actual impact of embedded generation would depend on its location, distance from load centres etc.

8. FORMAT AND INPUTS TO ANALYSIS

8.1. Regulatory Test Requirements

The requirements for the comparison of options to address an identified network limitation are contained in the Regulatory Test prescribed by the Australian Competition and Consumer Commission (ACCC)[48].

The Regulatory Test requires that the recommended option be the option that "maximises the net present value of the market benefit having regard to a number of alternative projects, timings and market development scenarios". To satisfy the Test, a proposed augmentation must achieve a greater market benefit in most, *but not necessarily all*, credible scenarios.

The Regulatory Test contains guidelines for the methodology to be used to calculate the net present value (NPV) of the market benefit. For example, where an augmentation is required to satisfy minimum network performance requirements (ie – a reliability augmentation), the methodology published by the ACCC defines "cost" as the total cost of the augmentation to all those who produce, distribute and consume electricity in the National Electricity Market. That is, the option with the lowest net present value cost maximises the market benefit.

Information to be considered includes the 'efficient operating costs of competitively supplying energy to meet forecast demand' and the cost of complying with existing and anticipated laws. However, the Regulatory Test specifically excludes indirect costs, and costs that cannot be measured as a cost in terms of financial transactions in the electricity market.

8.2. Inputs to Analysis

A solution to address future supply needs in the Gold Coast/Tweed zone as outlined in this document is required to satisfy reliability requirements linked to Schedule 5.1 of the National Electricity Code, the requirements of the Queensland Electricity Act, Powerlink's Transmission Authority and the connection agreement between Powerlink and ENERGEX[49].

According to the ACCC Regulatory Test, this means that the costs of all options must be compared, and the least cost solution in most (although not all) credible scenarios is considered to satisfy the Regulatory Test. The results of this evaluation, carried out using a cash flow model to determine the Net Present Value (NPV) of the various options, are shown in section 9.0.

Cost inputs to the NPV analysis are described below.

8.3. Cost of Network Augmentations:

The cost of the Queensland and New South Wales network augmentations and anticipated/modelled projects outlined in the options in section 6.0 have been estimated by Powerlink, ENERGEX, Country Energy and TransGrid[50]. Sensitivity studies have been carried out using variations in the capital cost estimates of plus or minus 15% (see section 9.2).

The financial analysis considers all cost impacts of the proposed network augmentations to market participants as defined by regulatory processes. The estimated saving in the cost of network losses for each option has been included based on the assumption of typical load factor and an

[48] Powerlink is required to evaluate options for new transmission developments under the Regulatory Test in accordance with clause 5.6 of the National Electricity Code.
[49] Refer section 2.0.
[50] Each network service provider estimated the costs of proposed augmentations in their own networks.

average cost of losses of $25/MWh[51]. Sensitivity studies have also been carried out on the assumed cost of losses (see section 9.2).

8.4. Cost of Network Support:

As noted earlier in this document, the cost of network support for the Gold Coast/Tweed zone from DirectLink has been negotiated between the owners of DirectLink and Powerlink. The estimated total cost of $2.7M has been incorporated into the financial analysis of options. Sensitivity analysis has been carried out to assess the sensitivity of the analysis to a higher or lower cost of network support.

The commercial arrangements for the provision of network support by DirectLink are confidential. However, the following background information on the process to estimate the cost of network support required for the Gold Coast/Tweed zone is provided for the information of market participants and other interested parties:

- The capability of the existing transmission and distribution network to transfer electricity to the Gold Coast/Tweed zone was determined using the voltage stability constraint equation as implemented in NEMMCO's market dispatch systems.

- The amount of network support required from DirectLink in 2005/06 was estimated based on the network capability and the load duration curves from the past four summer periods.

- This analysis estimated the amount of peak summer demand that would be unable to be supplied from the existing network without network support from DirectLink, and the estimated periods of time that network support would be required. It was estimated that up to 160MW[52] would be required from DirectLink in 2005/06 to maintain a reliable electricity supply to the Gold Coast/Tweed zone. The total number of market trading intervals in which DirectLink could be required to flow in a northerly direction to support the Gold Coast/Tweed zone was estimated at 200 (ie – up to 100 hours over the 2005/06 summer). Due to the uncertainty associated with future predictions of variables including electricity demand and generation pattern, the estimated requirement for network support will vary depending on actual customer demand, actual generation dispatch etc.

- The cost of network support from DirectLink is related to both the MW/MVAr requirement and the wholesale market price differential between the regions of NSW and Queensland. DirectLink is a market network service provider, meaning that its normal operation depends on market bidding patterns and market price differentials between Queensland and New South Wales. The negotiated agreement for network support provides for DirectLink to flow in a northerly direction whenever necessary to meet customer electricity demand in the Gold Coast/Tweed zone. This may result in counter-price flows, for which the owners of DirectLink would be compensated under the network support agreement.

- Powerlink asked ROAM Consulting Pty Ltd[53] to prepare a market forecast to evaluate the impacts on network support costs of pool price differentials between the Queensland and NSW regions of the NEM. Estimated costs of network support in this Final Report are based on the average regional price differential identified during the market simulations conducted by ROAM Consulting. Sensitivity analysis was carried out on the full set of results from the ROAM study to consider the impact of a change in the assumed regional price differential.

[51] Network losses are a function of the length and capacity of individual network elements, and the power being transferred through them. In heavily loaded systems, additional network elements reduce the amount of power that must be forced through the existing network, and therefore reduce total losses.
[52] The MW requirement can be reduced if reactive support is available from DirectLink.
[53] ROAM Consulting Pty Ltd has considerable experience in electricity market simulations.

- The estimated cost of grid support also includes the installation of appropriate emergency control systems by the owners of DirectLink to allow northerly transfers to the required level.

It must be emphasised that the total network support costs are an estimate only, based on the forecast energy that may be unable to be supplied by the Powerlink and ENERGEX networks and estimated regional price differentials. Actual costs of network support will vary. Should a network support option be adopted, DirectLink has indicated its willingness for the full commercial details to be disclosed on a confidential basis to the ACCC for regulatory review purposes.

Interested parties should also note that the owners of DirectLink have applied for conversion of DirectLink from a market network service provider to a regulated interconnector. Should DirectLink be operating as a regulated service prior to the summer of 2005/06, the option of obtaining network support from DirectLink for the Gold Coast/Tweed zone would still be feasible. The network support arrangement agreed between Powerlink and the owners of DirectLink provides for network support to be provided to the Gold Coast/Tweed zone in 2005/06 at no charge should the interconnector become regulated prior to that time. In such circumstances, the owners of DirectLink would obtain regulated revenue and no network support payments would be required.

8.5. Other Inputs to Analysis:

While a solution must be adopted by late 2005 to overcome the future supply requirements, the NPV analysis contains anticipated projects required to address longer-term supply reliability requirements, excepting some future developments common to all options which have been excluded. The sensitivity of the timing of these anticipated projects to load growth and generation development scenarios (and therefore the incidence of the capital expenditure) has been taken into account in the financial analysis.

Capital and operating costs for some items which are common to all options were not included in the analysis. These common costs include the capital and operating costs of other future transmission 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. Where the timing of common works is affected by the proposed options, the cost of the other works proposed has been included in the NPV analysis.

9. FINANCIAL ANALYSIS

The economic analysis undertaken considered the net present value (NPV) of net market benefits of alternative options over the fifteen year period from 2003/04 to 2017/18. Full details of this analysis are contained in Appendix 2.

9.1. Net Present Value Analysis

Financial analysis was carried out to calculate and compare the Net Present Value (NPV) of the costs to market participants of each option under the range of assumed market development scenarios.

A fifteen year analysis period was selected, as an appropriate period for financial analysis. A discount rate of 10% was selected as a relevant commercial discount rate, and sensitivity analysis was conducted to test this assumption.

Under the Regulatory Test, it is the ranking of the options which is important, rather than the actual net present value results. This is because the Regulatory Test requires the recommended option to have the lowest net present value cost compared with alternative projects.

The following table is a summary of the economic analysis contained in Appendix 2. It shows the net present value of each alternative, and identifies the best ranked option, for the range of scenarios considered.

Discount rate 10%	**Scenario A** Medium load growth		**Scenario B** High load growth		**Scenario C** Low load growth		**Scenario D** 30MW of embedded generation	
Option 1A 110kV Augmentation in Qld (Modelled Projects include Network Support to NSW)	NPV ($M)	$91.15	NPV ($M)	$98.96	NPV ($M)	$78.29	NPV ($M)	$81.57
	Rank	4	Rank	4	Rank	4	Rank	4
Option 1B 110kV Augmentation in Qld (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)	NPV ($M)	$112.05	NPV ($M)	$117.37	NPV ($M)	$99.67	NPV ($M)	$100.62
	Rank	8	Rank	8	Rank	8	Rank	8
Option 2A 275kV Augmentation in Qld (Modelled Projects include Network Support to NSW)	NPV ($M)	$87.87	NPV ($M)	$95.49	NPV ($M)	$74.09	NPV ($M)	$78.82
	Rank	3	Rank	3	Rank	3	Rank	3
Option 2B 275kV Augmentation in Qld (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)	NPV ($M)	$108.77	NPV ($M)	$113.89	NPV ($M)	$95.46	NPV ($M)	$97.86
	Rank	7	Rank	7	Rank	7	Rank	7
Option 3A DirectLink Network Support North followed by 275kV Augmentation in Qld (Modelled Projects include Network Support to NSW)	NPV ($M)	$86.68	NPV ($M)	$94.32	NPV ($M)	$71.84	NPV ($M)	$76.49
	Rank	1	Rank	1	Rank	2	Rank	2
Option 3B DirectLink Network Support North followed by 275kV augmentation in Qld (modelled projects include Dumaresq - Lismore 330kV line in NSW)	NPV ($M)	$107.58	NPV ($M)	$112.73	NPV ($M)	$93.21	NPV ($M)	$95.54
	Rank	5	Rank	5	Rank	6	Rank	6
Option 4A Maudsland Double Tee followed by 275kV augmentation in Qld (Modelled Projects include Network Support to NSW)	NPV ($M)	$86.93	NPV ($M)	$94.58	NPV ($M)	$70.10	NPV ($M)	$74.73
	Rank	2	Rank	2	Rank	1	Rank	1
Option 4B Maudsland Double Tee followed by 275kV Augmentation in Qld (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)	NPV ($M)	$107.84	NPV ($M)	$112.99	NPV ($M)	$91.47	NPV ($M)	$93.78
	Rank	6	Rank	6	Rank	5	Rank	5

As can be seen in the table above, Directlink network support in 2005 and 275kV augmentation in 2006 (option 3A) is the lowest cost option in Scenarios A and B.

In Scenarios C & D, both DirectLink network support and the Maudsland double tee are able to address the Gold Coast/Tweed zone supply requirements for two years due to the lower levels of electricity demand assumed in these scenarios. The DirectLink network support option (option 3A) is a higher cost option than the Maudsland double tee (option 4A) in these scenarios primarily because the fixed component of the network support charge would be paid for two years.

An option must be the lowest cost option in most (although not all) scenarios for it to satisfy the ACCC Regulatory Test. As shown in the table above, Option 3A and Option 4A are the lowest cost options in an equal number of scenarios. However, Scenario A (medium growth scenario) is the scenario considered most likely to occur. Powerlink and ENERGEX therefore consider that Option 3A satisfies the Regulatory Test. In addition, DirectLink is an existing facility and therefore avoids implementation issues associated with Option 4A such as the need to temporarily take existing lines out of service to allow the double tee arrangement to be connected.

9.2. Sensitivity Analysis

In addition to examining the impact of market development scenarios, the sensitivity of the option ranking to other critical parameters was also examined.

The effect of varying these parameters over their credible range was investigated using standard Monte Carlo techniques[54]. The following table shows the parameters that were investigated in the sensitivity analysis, the distribution that was assumed for each parameter and the range of values.

Parameter	Distribution
Capital Cost of Transmission Augmentations	The capital cost of the proposed augmentations and anticipated/modelled projects was tested for sensitivity to variations of plus or minus 15% from the expected value. The variation in each cost was modelled as a triangular distribution with the assumption that the costs are statistically independent. This means that the cost of each network component is allowed to vary within plus and minus 15% independently of the over or underspend of the other components.
Cost of losses	The sensitivity to the average cost of losses was tested by allowing this parameter to vary randomly between $20/MWh and $30/MWh using a triangular distribution with a mode of $25/MWh.
Cost of Network Support	The cost of network support was tested for sensitivity to wholesale market regional price differentials. ROAM Consulting provided a forecast of these differentials (see section 8.4). The average was used for the base economic analysis. The sensitivity analysis used the complete distribution of results from the ROAM study.

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 (in this case, 1,000 times) to cover a large number of combinations of parameters. The analysis identifies which option is the best ranked option (the option that has the lowest cost on an NPV basis for the largest number of samples) and gives the frequency for which this option 'wins'.

In addition to the above sensitivities, the sensitivity of the ranking of options to the discount rate assumption was also investigated by repeating the above analysis with a discount rate of 8%, 10% and 12%. The following table shows the 'winning option' and the frequency for which it 'wins' for each scenario and discount rate across the range of parameters assessed.

[54] Using the @Risk add-in for Microsoft Excel.

	Discount Rate		
	8%	10%	12%
Scenario A - Medium Load Growth	3A(100%)	3A(99%)	3A(88%)
Scenario B - High Load Growth	3A(100%)	3A(99%)	3A(88%)
Scenario C - Low Load Growth	4A(100%)	4A(100%)	4A(100%)
Scenario D – 30 MW of embedded generation	4A(100%)	4A(100%)	4A(100%)

As can be seen in this table, the results of the sensitivity analysis are consistent with the base case economic analysis, and the outcome is robust in terms of the variations in parameters assessed.

On the basis of the financial analysis and the sensitivity studies, Option 3A is the option that satisfies the ACCC Regulatory Test. Technical details and the construction timetable for Option 3A are provided in Appendix 1.

9.3. Inter-Network Impact

Powerlink is required under the National Electricity Code to assess whether a proposed new large network asset is reasonably likely to have a material inter-network impact. Powerlink and TransGrid have determined that the proposed new large network asset (Option 3A) will not impose power transfer constraints or adversely impact on the quality of supply within the New South Wales network.

10. CONCLUSIONS

The following conclusions have been drawn from the analysis presented in this report:

- Powerlink and ENERGEX must take action now to ensure a continued reliable electricity supply to the Gold Coast/Tweed zone in 2005 and 2006, and to position the area for future growth.

- Such action is necessary to comply with electricity reliability standards which Powerlink and ENERGEX must meet, as the local Transmission Network Service Provider and Distribution Network Service Provider respectively. Interruptions to power supply during single network contingencies are not consistent with these reliability standards. Augmentations proposed in this document will prevent such interruptions during a critical contingency in the 275kV network supplying the Gold Coast/Tweed zone. They are therefore 'reliability augmentations' as defined in the National Electricity Code.

- Future supply requirements are also expected to arise in northern New South Wales by mid 2006 during the most critical single contingency. Anticipated/modelled projects to address this future need were considered in the analysis of options to address the Gold Coast/Tweed zone requirements.

- Powerlink and ENERGEX carried out a consultation process in August 2003 in order to identify any non-network solutions to address the Gold Coast supply requirements. Joint planning studies were carried out between Powerlink and ENERGEX and their counterparts in New South Wales, TransGrid and Country Energy to evaluate potential options to address the future supply requirements in the Gold Coast/Tweed zone. Following the consultation and joint planning process, Powerlink and ENERGEX concluded that network support for the summer of 2005/06 via DirectLink is the only viable alternative to network augmentation. Three network augmentations and a combined option involving DirectLink network support for 2005/06 were evaluated in detail.

- Economic analysis carried out in accordance with the Regulatory Test has identified that proposed augmentation Option 3A - *"Network Support from DirectLink for the 2005/06 summer, followed by 275kV Augmentation Greenbank-Maudsland in 2006* - is the least-cost solution over the fifteen year period of analysis in two of the four scenarios considered, assuming a modelled project for DirectLink to provide network support to NSW from 2006. Sensitivity analysis showed that the analysis is robust to variation in capital cost and other assumptions. The scenarios in which option 3A is not the least cost option are considered to have a lower probability of occurring, as they are low growth and reduced demand scenarios. As Option 3A is the lowest cost option in the most likely scenario, Option 3A is considered to satisfy the ACCC Regulatory Test.

- In addition to maximisation of benefit, the ACCC Regulatory Test requires that a transmission network service provider optimise the timing of any proposed network augmentation that is justified under the Regulatory Test. It is evident from the analysis that action is required prior to late 2005, in order to maintain a reliable power supply to customers in the Gold Coast/Tweed zone. Any deferral of timing beyond this date will result in unacceptable network reliability.

- No construction work is necessary for the provision of network support from DirectLink. Construction of the subsequent network augmentation as per Option 3A will commence in late 2004 to ensure completion by late 2006.

11. FINAL RECOMMENDATION

Powerlink and ENERGEX received one submission to the Application Notice from the DirectLink Joint Venture. The option raised in that submission is considered neither technically nor commercially feasible. It is therefore recommended that the draft recommendation for a 'new large network asset' be adopted without change. That is, it is recommended that the following action be implemented to address the future supply requirements in the Gold Coast and Tweed Area:

- Powerlink and the owners of DirectLink to enter into a commercial agreement for the provision of network support via import into Queensland from New South Wales over the DirectLink interconnector for the 2005/06 summer period. This arrangement has an estimated total cost of $2.7M. A satisfactory commercial agreement has been finalised between Powerlink and the owners of DirectLink.

- Powerlink to establish a 275kV switchyard at Greenbank and construct a double circuit 275kV transmission line between Greenbank and Maudsland for commissioning by late 2006. This proposed augmentation has an estimated total cost of $48.9M.

The network support agreement will be valid over the summer period of 2005/06. The proposed construction timetable for the subsequent network augmentation provides for award of construction and equipment contracts in Quarter 4, 2004 and Quarter 1, 2005, commencement of on-site construction in Quarter 2, 2005 and commissioning by late 2006.

Following publication of this report, Powerlink and ENERGEX intend to take immediate steps to implement the above final recommendation.

APPENDIX 1:

TECHNICAL DETAILS OF PROPOSED NEW LARGE NETWORK ASSET

Option 3A

Option 3A includes the following works:

Late 2005

- Powerlink and the owners of DirectLink to enter into a commercial agreement for the provision of network support via import into Queensland from New South Wales over the DirectLink interconnector for the summer period of 2005/06.

Late 2006

- 43km of 275kV double circuit twin "phosphorus" conductor transmission line from Greenbank to Maudsland, including OPGW. Connection of new line to existing Maudsland – Molendinar 275kV line, including disconnection of existing tee at Maudsland.

- A 275kV switchyard at Greenbank with the following:

    - 3 x 3 circuit breaker diameters and associated equipment
    - 3 x 2 circuit breaker diameters and associated equipment
    - 1 x 275kV 120MVAr capacitor bank and 1 bay with associated equipment
    - protection and control systems

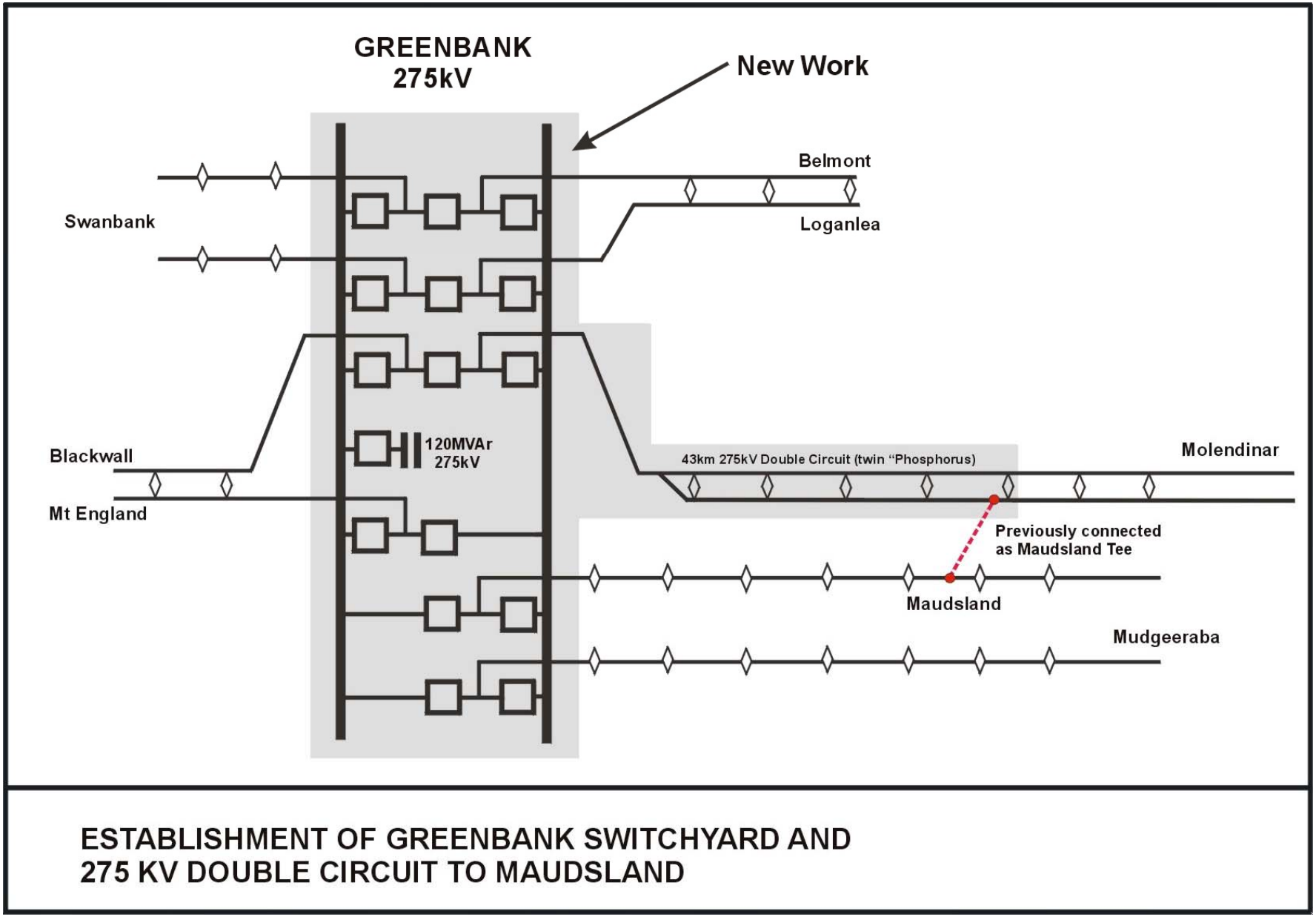
- connection of existing 275kV lines between Blackwall/Mt England - Belmont/ Loganlea and Swanbank-Mudgeeraba into Greenbank switchyard. Necessary deviation works around Greenbank switchyard site of existing Swanbank-Mudgeeraba lines to facilitate construction of switchyard and new line

- Protection and control system modifications at 8 substation sites – Molendinar, Mudgeeraba, Mt England, Blackwall, Swanbank B, Swanbank E, Belmont and Loganlea

- Establishment of dual telecommunications paths using existing and new OPGW between Greenbank switchyard and other substations connected to Greenbank.

The proposed construction timetable for these works provides for award of construction and equipment contracts in Quarter 4, 2004 and Quarter 1, 2005, commencement of on-site construction in Quarter 2, 2005 and commissioning by late 2006.

New works are highlighted in the following network configuration diagram:



ESTABLISHMENT OF GREENBANK SWITCHYARD AND 275 KV DOUBLE CIRCUIT TO MAUDSLAND

APPENDIX 2 - FINANCIAL ANALYSIS

Summary

Discount rate 10%	**Option 1A** **110kV Augmentation in Queensland** (Modelled Projects include Network Support to NSW)		**Option 1B** **110kV Augmentation in Queensland** (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)		**Option 2A** **275kV Augmentation in Queensland** (Modelled Projects include Network Support to NSW)		**Option 2B** **275kV Augmentation in Queensland** (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)		**Option 3A** **DirectLInk Network Support North followed by 275kV Augmentation in Qld** (Modelled Projects include Network Support to NSW)		**Option 3B** **DirectLInk Network Support North followed by 275kV Augmentation in Qld** (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)		**Option 4A** **Maudsland Double Tee followed by 275kV Augmentation in Qld** (Modelled Projects include Network Support to NSW)		**Option 4B** **Maudsland Double Tee followed by 275kV Augmentation in Qld** (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)	
Scenario A Medium load growth	NPV ($M)	$91.15	NPV ($M)	$112.05	NPV ($M)	$87.87	NPV ($M)	$108.77	NPV ($M)	$86.68	NPV ($M)	$107.58	NPV ($M)	$86.93	NPV ($M)	$107.84
	Rank	4	Rank	8	Rank	3	Rank	7	Rank	1	Rank	5	Rank	2	Rank	6
Scenario B High load growth	NPV ($M)	$98.96	NPV ($M)	$117.37	NPV ($M)	$95.49	NPV ($M)	$113.89	NPV ($M)	$94.32	NPV ($M)	$112.73	NPV ($M)	$94.58	NPV ($M)	$112.99
	Rank	4	Rank	8	Rank	3	Rank	7	Rank	1	Rank	5	Rank	2	Rank	6
Scenario C Low load growth	NPV ($M)	$78.29	NPV ($M)	$99.67	NPV ($M)	$74.09	NPV ($M)	$95.46	NPV ($M)	$71.84	NPV ($M)	$93.21	NPV ($M)	$70.10	NPV ($M)	$91.47
	Rank	4	Rank	8	Rank	3	Rank	7	Rank	2	Rank	6	Rank	1	Rank	5
Scenario D 30MW of embedded generation	NPV ($M)	$81.57	NPV ($M)	$100.62	NPV ($M)	$78.82	NPV ($M)	$97.86	NPV ($M)	$76.49	NPV ($M)	$95.54	NPV ($M)	$74.73	NPV ($M)	$93.78
	Rank	4	Rank	8	Rank	3	Rank	7	Rank	2	Rank	6	Rank	1	Rank	5

Development Options	FY	Capex $M	FY	Capex $M	FY	Capex $M	FY	Capex $M	FY	Capex $M	FY	Capex $M
	Scenario A		Scenario B		Scenario C		Scenario D		Scenario E		Scenario F	
Option 1A - 110kV Augmentation in Qld (Modelled Projects include Network Support to NSW)												
Augment Beenleigh - Molendinar line	05/06	25.48	05/06	25.48	05/06	25.48	05/06	25.48		25.48		25.48
Rebuild Molendinar substation	05/06	21.98	05/06	21.98	05/06	21.98	05/06	21.98		21.98		21.98
Proposed and modelled projects												
NSW network support	06/07		06/07		07/08		07/08					
Greenbank & Greenbank - Maudsland	07/08	48.90	06/07	48.90	08/09	48.90	08/09	48.90		48.90		48.90
Second Molendinar Transformer	08/09	6.20	07/08	6.20	09/10	6.20	10/11	6.20		6.20		6.20
110kV Mudgeeraba - Terranora	08/09	8.00	08/09	8.00	10/11	8.00	09/10	8.00		8.00		8.00
330 kV Dumaresq - Lismore	12/13	100.00	11/12	100.00	14/15	100.00	13/14	100.00		100.00		100.00
Molendinar 275 kV bus	15/16	9.50	12/13	9.50	18/19	9.50	16/17	9.50		9.50		9.50
Third Molendinar transformer	15/16	6.20	12/13	6.20	18/19	6.20	16/17	6.20		6.20		6.20
Option 1B - 110kV Augmentation in Qld (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)												
Augment Beenleigh - Molendinar line	05/06	25.48	05/06	25.48	05/06	25.48	05/06	25.48		25.48		25.48
Rebuild Molendinar substation	05/06	21.98	05/06	21.98	05/06	21.98	05/06	21.98		21.98		21.98
Proposed and modelled projects												
330 kV Dumaresq - Lismore	06/07	100.00	06/07	100.00	07/08	100.00	07/08	100.00		100.00		100.00
Greenbank & Greenbank - Maudsland	07/08	48.90	06/07	48.90	08/09	48.90	08/09	48.90		48.90		48.90
Second Molendinar Transformer	08/09	6.20	07/08	6.20	09/10	6.20	10/11	6.20		6.20		6.20
110kV Mudgeeraba - Terranora	08/09	8.00	08/09	8.00	10/11	8.00	09/10	8.00		8.00		8.00
Molendinar 275 kV bus	15/16	9.50	12/13	9.50	18/19	9.50	16/17	9.50		9.50		9.50
Third Molendinar transformer	15/16	6.20	12/13	6.20	18/19	6.20	16/17	6.20		6.20		6.20
Option 2A - 275kV Augmentation in Qld (Modelled Projects include Network Support to NSW)												
Greenbank & Greenbank - Maudsland	05/06	48.90	05/06	48.90	05/06	48.90	05/06	48.90		48.90		48.90
Proposed and modelled projects												
NSW network support	06/07		06/07		07/08		07/08					
Rebuild Molendinar substation	07/08	21.98	06/07	21.98	08/09	21.98	08/09	21.98		21.98		21.98
Second Molendinar Transformer	08/09	6.20	07/08	6.20	09/10	6.20	09/10	6.20		6.20		6.20
110kV Mudgeeraba - Terranora	08/09	8.00	08/09	8.00	10/11	8.00	09/10	8.00		8.00		8.00
Augment Beenleigh - Molendinar line	09/10	25.48	08/09	25.48	11/12	25.48	10/11	25.48		25.48		25.48
330 kV Dumaresq - Lismore	12/13	100.00	11/12	100.00	14/15	100.00	13/14	100.00		100.00		100.00
Molendinar 275 kV bus	15/16	9.50	12/13	9.50	18/19	9.50	16/17	9.50		9.50		9.50
Third Molendinar transformer	15/16	6.20	12/13	6.20	18/19	6.20	16/17	6.20		6.20		6.20
Option 2B - 275kV Augmentation in Qld (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)												
Greenbank & Greenbank - Maudsland	05/06	48.90	05/06	48.90	05/06	48.90	05/06	48.90		48.90		48.90
Proposed and modelled projects												
330 kV Dumaresq - Lismore	06/07	100.00	06/07	100.00	07/08	100.00	07/08	100.00		100.00		100.00
Rebuild Molendinar substation	07/08	21.98	06/07	21.98	08/09	21.98	08/09	21.98		21.98		21.98
Second Molendinar Transformer	08/09	6.20	07/08	6.20	09/10	6.20	09/10	6.20		6.20		6.20
110kV Mudgeeraba - Terranora	08/09	8.00	08/09	8.00	10/11	8.00	09/10	8.00		8.00		8.00
Augment Beenleigh - Molendinar line	09/10	25.48	08/09	25.48	11/12	25.48	10/11	25.48		25.48		25.48
Molendinar 275 kV bus	15/16	9.50	12/13	9.50	18/19	9.50	16/17	9.50		9.50		9.50
Third Molendinar transformer	15/16	6.20	12/13	6.20	18/19	6.20	16/17	6.20		6.20		6.20
Option 3A - DirectLink Network Support North followed by 275kV Augmentation in Qld (Modelled Projects include Network Support to NSW)												
Queensland network support	05/06		05/06		05/06		05/06					
Greenbank & Greenbank - Maudsland	06/07	48.90	06/07	48.90	07/08	48.90	07/08	48.90		48.90		48.90
Proposed and modelled projects												
NSW network support	06/07		06/07		07/08		07/08					
Rebuild Molendinar substation	07/08	21.98	06/07	21.98	08/09	21.98	08/09	21.98		21.98		21.98
Second Molendinar Transformer	08/09	6.20	07/08	6.20	09/10	6.20	09/10	6.20		6.20		6.20
110kV Mudgeeraba - Terranora	08/09	8.00	08/09	8.00	10/11	8.00	09/10	8.00		8.00		8.00
Augment Beenleigh - Molendinar line	09/10	25.48	08/09	25.48	11/12	25.48	10/11	25.48		25.48		25.48
330 kV Dumaresq - Lismore	12/13	100.00	11/12	100.00	14/15	100.00	13/14	100.00		100.00		100.00
Molendinar 275 kV bus	15/16	9.50	12/13	9.50	18/19	9.50	16/17	9.50		9.50		9.50
Third Molendinar transformer	15/16	6.20	12/13	6.20	18/19	6.20	16/17	6.20		6.20		6.20
Option 3B - DirectLink Network Support North followed by 275kV augmentation in Qld (modelled projects include Dumaresq - Lismore 330kV line in NSW)												
Queensland network support	05/06		05/06		05/06		05/06					
Greenbank & Greenbank - Maudsland	06/07	48.90	06/07	48.90	07/08	48.90	07/08	48.90		48.90		48.90
Proposed and modelled projects												
330 kV Dumaresq - Lismore	06/07	100.00	06/07	100.00	07/08	100.00	07/08	100.00		100.00		100.00
Rebuild Molendinar substation	07/08	21.98	06/07	21.98	08/09	21.98	08/09	21.98		21.98		21.98
Second Molendinar Transformer	08/09	6.20	07/08	6.20	09/10	6.20	09/10	6.20		6.20		6.20
110kV Mudgeeraba - Terranora	08/09	8.00	08/09	8.00	10/11	8.00	09/10	8.00		8.00		8.00
Augment Beenleigh - Molendinar line	09/10	25.48	08/09	25.48	11/12	25.48	10/11	25.48		25.48		25.48
Molendinar 275 kV bus	15/16	9.50	12/13	9.50	18/19	9.50	16/17	9.50		9.50		9.50
Third Molendinar transformer	15/16	6.20	12/13	6.20	18/19	6.20	16/17	6.20		6.20		6.20

Development Options	FY	Capex $M	FY	Capex $M	FY	Capex $M	FY	Capex $M	FY	Capex $M	FY	Capex $M
	Scenario A		Scenario B		Scenario C		Scenario D		Scenario E		Scenario F	
Option 4A - Maudsland Double Tee followed by 275kV augmentation in Qld (Modelled Projects include Network Support to NSW)												
Double tee opex	05/06	1.46	05/06	1.46	05/06	1.46	05/06	1.46		1.46		1.46
Double tee capex	05/06	2.17	05/06	2.17	05/06	2.17	05/06	2.17		2.17		2.17
Greenbank & Greenbank - Maudsland	06/07	48.90	06/07	48.90	07/08	48.90	07/08	48.90		48.90		48.90
Proposed and modelled projects												
NSW network support	06/07		06/07		07/08		07/08					
Rebuild Molendinar substation	07/08	21.98	06/07	21.98	08/09	21.98	08/09	21.98		21.98		21.98
Second Molendinar Transformer	08/09	6.20	07/08	6.20	09/10	6.20	09/10	6.20		6.20		6.20
110kV Mudgeeraba - Terranora	08/09	8.00	08/09	8.00	10/11	8.00	09/10	8.00		8.00		8.00
Augment Beenleigh - Molendinar line	09/10	25.48	08/09	25.48	11/12	25.48	10/11	25.48		25.48		25.48
330 kV Dumaresq - Lismore	12/13	100.00	11/12	100.00	14/15	100.00	13/14	100.00		100.00		100.00
Molendinar 275 kV bus	15/16	9.50	12/13	9.50	18/19	9.50	16/17	9.50		9.50		9.50
Third Molendinar transformer	15/16	6.20	12/13	6.20	18/19	6.20	16/17	6.20		6.20		6.20
Option 4B - Maudsland Double Tee followed by 275kV Augmentation in Qld (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)												
Double tee opex	05/06	1.46	05/06	1.46	05/06	1.46	05/06	1.46		1.46		1.46
Double tee capex	05/06	2.17	05/06	2.17	05/06	2.17	05/06	2.17		2.17		2.17
Greenbank & Greenbank - Maudsland	06/07	48.90	06/07	48.90	07/08	48.90	07/08	48.90		48.90		48.90
Proposed and modelled projects												
330 kV Dumaresq - Lismore	06/07	100.00	06/07	100.00	07/08	100.00	07/08	100.00		100.00		100.00
Rebuild Molendinar substation	07/08	21.98	06/07	21.98	08/09	21.98	08/09	21.98		21.98		21.98
Second Molendinar Transformer	08/09	6.20	07/08	6.20	09/10	6.20	09/10	6.20		6.20		6.20
110kV Mudgeeraba - Terranora	08/09	8.00	08/09	8.00	10/11	8.00	09/10	8.00		8.00		8.00
Augment Beenleigh - Molendinar line	09/10	25.48	08/09	25.48	11/12	25.48	10/11	25.48		25.48		25.48
Molendinar 275 kV bus	15/16	9.50	12/13	9.50	18/19	9.50	16/17	9.50		9.50		9.50
Third Molendinar transformer	15/16	6.20	12/13	6.20	18/19	6.20	16/17	6.20		6.20		6.20

Scenario A			*Medium load growth*														
			1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
			04/05	**05/06**	**06/07**	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**	**17/18**	**18/19**
Option 1A			**110kV Augmentation in Qld (Modelled Projects include Network Support to NSW)**														
Augment Beenleigh - Molendinar line		25.48															
=> DUOS			0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547	2.510	2.473	2.435	2.398	2.360
==> NPV of DUOS	$15.46																
Rebuild Molendinar substation		21.98															
=> TUOS/DUOS			0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133	2.100	2.068	2.036
==> NPV of TUOS/DUOS	$13.34																
Proposed and modelled projects																	
NSW network support																	
* MWhrs			0	0	1560	2520	3840	6000	9000	11200	0	0	0	0	0	0	0
=> TUOS			0.000	0.000	3.003	3.005	3.008	3.012	3.018	3.022	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$10.84																
Greenbank & Greenbank - Maudsland		48.90															
=> TUOS			0.000	0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672
==> NPV of TUOS	$22.62																
Second Molendinar Transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611	0.602
==> NPV of TUOS	2.48																
110kV Mudgeeraba - Terranora		8.00															
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788	0.776
==> NPV of TUOS/DUOS	3.20																
330 kV Dumaresq - Lismore		100.00															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290
==> NPV of TUOS	$19.76																
Molendinar 275 kV bus		9.50															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033	1.019
==> NPV of TUOS	$0.82																
Third Molendinar transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665
==> NPV of TUOS	$0.53																
Relative Losses																	
* Relative Losses GWhs			0.0	10.2	26.5	16.8	20.6	18.8	20.4	22.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.256	0.662	0.420	0.515	0.470	0.510	0.560	0.000	0.000	0.000	0.000	0.000	0.000	0.0
=> NPV of Losses	$2.10																
Total for Option 1A	**$91.15**																

Option 1B			**110kV Augmentation in Qld (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)**												
Augment Beenleigh - Molendinar line		25.48													
=> DUOS			0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547	2.510	2.473	2.435	2.398	2.360
==> NPV of DUOS	$15.46																
Rebuild Molendinar substation		21.98													
=> TUOS/DUOS			0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133	2.100	2.068	2.036
==> NPV of TUOS/DUOS	$13.34																
Proposed and modelled projects															
330 kV Dumaresq - Lismore		100.00													
=> TUOS			0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290	10.143	9.996	9.849	9.702	9.555	9.408
==> NPV of TUOS	$53.14																
Greenbank & Greenbank - Maudsland		48.90													
=> TUOS			0.000	0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672
==> NPV of TUOS	22.62																
Second Molendinar Transformer		6.20													
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611	0.602
==> NPV of TUOS	2.48																
110kV Mudgeeraba - Terranora		8.00													
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788	0.776
==> NPV of TUOS/DUOS	$3.20																
Molendinar 275 kV bus		9.50													
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033	1.019
==> NPV of TUOS	$0.82																
Third Molendinar transformer		6.20													
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665
==> NPV of TUOS	$0.53																
Relative Losses															
* Relative Losses GWhs			0.0	10.2	11.3	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.256	0.282	0.000	0.065	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.46																
Total for Option 1B	**$112.05**																

Option 2A			**275kV Augmentation in Qld (Modelled Projects include Network Support to NSW)**													
Greenbank & Greenbank - Maudsland		48.90														
=> TUOS			0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672	4.601	4.529
==> NPV of TUOS	$29.67															
Proposed and modelled projects																
NSW network support																
* MWhrs				0	1560	2520	3840	6000	9000	11200	0	0	0	0	0	0	0
=> TUOS			0.000	0.000	3.003	3.005	3.008	3.012	3.018	3.022	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$10.84															
Rebuild Molendinar substation		21.98														
=> TUOS			0.000	0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133	2.100
==> NPV of TUOS	$10.17															
Second Molendinar Transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611	0.602
==> NPV of TUOS	$2.48															
110kV Mudgeeraba - Terranora		8.00														
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788	0.776
==> NPV of TUOS/DUOS	$3.20															
Augment Beenleigh - Molendinar line		25.48														
=> DUOS			0.000	0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547	2.510
==> NPV of DUOS	$8.72															
330 kV Dumaresq - Lismore		100.00														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290
==> NPV of TUOS	$19.76															
Molendinar 275 kV bus		9.50														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033	1.019
==> NPV of TUOS	$0.82															
Third Molendinar transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665
==> NPV of TUOS	$0.53															
Relative Losses																
*** Relative Losses GWhs**			0.0	0.0	15.2	19.3	18.0	18.8	20.4	22.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.000	0.380	0.482	0.450	0.470	0.510	0.560	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$1.68															
Total for Option 2A	**$87.87**															

Option 2B			**275kV Augmentation in Qld (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)**												
Greenbank & Greenbank - Maudsland		48.90													
=> TUOS			0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672	4.601	4.529
==> NPV of TUOS	$29.67																
Proposed and modelled projects																	
330 kV Dumaresq - Lismore		100.00															
=> TUOS			0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290	10.143	9.996	9.849	9.702	9.555	9.408
==> NPV of TUOS	$53.14																
Rebuild Molendinar substation		21.98															
=> TUOS			0.000	0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133	2.100
==> NPV of TUOS	$10.17																
Second Molendinar Transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611	0.602
==> NPV of TUOS	$2.48																
110kV Mudgeeraba - Terranora		8.00															
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788	0.776
==> NPV of TUOS/DUOS	$3.20																
Augment Beenleigh - Molendinar line		25.48															
=> DUOS			0.000	0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547	2.510
==> NPV of DUOS	$8.72																
Molendinar 275 kV bus		9.50															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033	1.019
==> NPV of TUOS	$0.82																
Third Molendinar transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665
==> NPV of TUOS	$0.53																
Relative Losses																	
*** Relative Losses GWhs**			0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.000	0.000	0.062	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.04																
Total for Option 2B	**$108.77**																

Option 3A			DirectLink Network Support North followed by 275kV Augmentation in Qld (Modelled Projects include Network Support to NSW)													
Queensland network support		0.00														
* MWhrs			0	4000	0	0	0	0	0	0	0	0	0	0	0	0
=> TUOS			0.000	2.717	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$2.25															
Greenbank & Greenbank - Maudsland		48.90														
=> TUOS			0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672	4.601
==> NPV of TUOS	$25.98															
Proposed and modelled projects																
NSW network support		0.00														
* MWhrs			0	0	1560	2520	3840	6000	9000	11200	0	0	0	0	0	0	0
=> TUOS			0.000	0.000	3.003	3.005	3.008	3.012	3.018	3.022	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$10.84															
Rebuild Molendinar substation		21.98														
=> TUOS			0.000	0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133	2.100
==> NPV of TUOS	$10.17															
Second Molendinar Transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611	0.602
==> NPV of TUOS	2.48															
110kV Mudgeeraba - Terranora		8.00														
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788	0.776
==> NPV of TUOS/DUOS	3.20															
Augment Beenleigh - Molendinar line		25.48														
=> DUOS			0.000	0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547	2.510
==> NPV of DUOS	$8.72															
330 kV Dumaresq - Lismore		100.00														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290
==> NPV of TUOS	$19.76															
Molendinar 275 kV bus		9.50														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033	1.019
==> NPV of TUOS	$0.82															
Third Molendinar transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665
==> NPV of TUOS	$0.53															
Relative Losses																
* Relative Losses GWhs			0.0	12.0	15.2	19.3	18.0	18.8	20.4	22.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.301	0.380	0.482	0.450	0.470	0.510	0.560	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$1.93															
Total for Option 3A	**$86.68**															

Option 3B			**DirectLink Network Support North followed by 275kV augmentation in Qld (modelled projects include Dumaresq - Lismore 330kV line in NSW)**														
Queensland network support		0.00															
* MWhrs			0	4000	0	0	0	0	0	0	0	0	0	0	0	0	0
=> TUOS			0.000	2.717	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$2.25																
Greenbank & Greenbank - Maudsland		48.90															
=> TUOS			0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672	4.601
==> NPV of TUOS	$25.98																
Proposed and modelled projects																	
330 kV Dumaresq - Lismore		100.00															
=> TUOS			0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290	10.143	9.996	9.849	9.702	9.555	9.408
==> NPV of TUOS	$53.14																
Rebuild Molendinar substation		21.98															
=> TUOS			0.000	0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133	2.100
==> NPV of TUOS	$10.17																
Second Molendinar Transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611	0.602
==> NPV of TUOS	2.48																
110kV Mudgeeraba - Terranora		8.00															
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788	0.776
==> NPV of TUOS/DUOS	3.20																
Augment Beenleigh - Molendinar line		25.48															
=> DUOS			0.000	0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547	2.510
==> NPV of DUOS	$8.72																
Molendinar 275 kV bus		9.50															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033	1.019
==> NPV of TUOS	$0.82																
Third Molendinar transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665
==> NPV of TUOS	$0.53																
Relative Losses																	
* Relative Losses GWhs			0.0	12.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.301	0.000	0.062	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.29																
Total for Option 3B	**$107.58**																

Option 4A			**Maudsland Double Tee followed by 275kV augmentation in Qld (Modelled Projects include Network Support to NSW)**													
Double tee opex		1.46														
=> TUOS			0.000	0.973	0.487	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$1.17															
Double tee capex		2.17														
=> TUOS			0.000	0.000	0.239	0.236	0.233	0.230	0.227	0.223	0.220	0.217	0.214	0.211	0.208	0.204	0.201
==> NPV of TUOS	$1.32															
Greenbank & Greenbank - Maudsland		48.90														
=> TUOS			0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672	4.601
==> NPV of TUOS	$25.98															
Proposed and modelled projects																
NSW network support		0.00														
* MWhrs			0	0	1560	2520	3840	6000	9000	11200	0	0	0	0	0	0	0
=> TUOS			0.000	0.000	3.003	3.005	3.008	3.012	3.018	3.022	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$10.84															
Rebuild Molendinar substation		21.98														
=> TUOS			0.000	0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133	2.100
==> NPV of TUOS	$10.17															
Second Molendinar Transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611	0.602
==> NPV of TUOS	2.48															
110kV Mudgeeraba - Terranora		8.00														
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788	0.776
==> NPV of TUOS/DUOS	3.20															
Augment Beenleigh - Molendinar line		25.48														
=> DUOS			0.000	0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547	2.510
==> NPV of DUOS	$8.72															
330 kV Dumaresq - Lismore		100.00														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290
==> NPV of TUOS	$19.76															
Molendinar 275 kV bus		9.50														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033	1.019
==> NPV of TUOS	$0.82															
Third Molendinar transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665
==> NPV of TUOS	$0.53															
Relative Losses																
* Relative Losses GWhs			0.0	12.7	15.2	19.3	18.0	18.8	20.4	22.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.318	0.380	0.482	0.450	0.470	0.510	0.560	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$1.95															
Total for Option 4A	**$86.93**															

Option 4B			Maudsland Double Tee followed by 275kV Augmentation in Qld (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)													
Double tee opex		1.46														
=> TUOS			0.000	0.973	0.487	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$1.17															
Double tee capex		2.17														
=> TUOS			0.000	0.000	0.239	0.236	0.233	0.230	0.227	0.223	0.220	0.217	0.214	0.211	0.208	0.204	0.201
==> NPV of TUOS	$1.32															
Greenbank & Greenbank - Maudsland		48.90														
=> TUOS			0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672	4.601
==> NPV of TUOS	$25.98															
Proposed and modelled projects																
330 kV Dumaresq - Lismore		100.00														
=> TUOS			0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290	10.143	9.996	9.849	9.702	9.555	9.408
==> NPV of TUOS	$53.14															
Rebuild Molendinar substation		21.98														
=> TUOS			0.000	0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133	2.100
==> NPV of TUOS	$10.17															
Second Molendinar Transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611	0.602
==> NPV of TUOS	2.48															
110kV Mudgeeraba - Terranora		8.00														
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788	0.776
==> NPV of TUOS/DUOS	3.20															
Augment Beenleigh - Molendinar line		25.48														
=> DUOS			0.000	0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547	2.510
==> NPV of DUOS	$8.72															
Molendinar 275 kV bus		9.50														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033	1.019
==> NPV of TUOS	$0.82															
Third Molendinar transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665
==> NPV of TUOS	$0.53															
Relative Losses																
* Relative Losses GWhs			0.0	12.7	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.318	0.000	0.062	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.31															
Total for Option 4B	**$107.84**															

Scenario B			*High load growth*														
			1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
			04/05	**05/06**	**06/07**	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**	**17/18**	**18/19**
Option 1A			**110kV Augmentation in Qld (Modelled Projects include Network Support to NSW)**														
Augment Beenleigh - Molendinar line		25.48															
=> DUOS			0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547	2.510	2.473	2.435	2.398	2.360
==> NPV of DUOS	$15.46																
Rebuild Molendinar substation		21.98															
=> TUOS/DUOS			0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133	2.100	2.068	2.036
==> NPV of TUOS/DUOS	$13.34																
Proposed and modelled projects																	
NSW network support																	
* MWhrs			0	0	1716	2800	4352	6800	10300	0	0	0	0	0	0	0	0
=> TUOS			0.000	0.000	3.003	3.006	3.009	3.014	3.021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$9.43																
Greenbank & Greenbank - Maudsland		48.90															
=> TUOS			0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672	4.601
==> NPV of TUOS	$25.98																
Second Molendinar Transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611	0.602	0.592
==> NPV of TUOS	2.87																
110kV Mudgeeraba - Terranora		8.00															
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788	0.776
==> NPV of TUOS/DUOS	3.20																
330 kV Dumaresq - Lismore		100.00															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290	10.143
==> NPV of TUOS	$24.16																
Molendinar 275 kV bus		9.50															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033	1.019	1.005	0.992	0.978
==> NPV of TUOS	$1.88																
Third Molendinar transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638
==> NPV of TUOS	$1.23																
Relative Losses																	
* Relative Losses GWhs			0.0	11.3	15.6	19.6	18.4	19.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.282	0.390	0.490	0.460	0.480	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$1.42																
Total for Option 1A	**$98.96**																

Option 1B			**110kV Augmentation in Qld (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)**												
Augment Beenleigh - Molendinar line		25.48													
=> DUOS			0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547	2.510	2.473	2.435	2.398	2.360
==> NPV of DUOS	$15.46																
Rebuild Molendinar substation		21.98													
=> TUOS/DUOS			0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133	2.100	2.068	2.036
==> NPV of TUOS/DUOS	$13.34																
Proposed and modelled projects															
330 kV Dumaresq - Lismore		100.00													
=> TUOS			0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290	10.143	9.996	9.849	9.702	9.555	9.408
==> NPV of TUOS	$53.14																
Greenbank & Greenbank - Maudsland		48.90													
=> TUOS			0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672	4.601
==> NPV of TUOS	25.98																
Second Molendinar Transformer		6.20													
=> TUOS			0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611	0.602	0.592
==> NPV of TUOS	2.87																
110kV Mudgeeraba - Terranora		8.00													
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788	0.776
==> NPV of TUOS/DUOS	$3.20																
Molendinar 275 kV bus		9.50													
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033	1.019	1.005	0.992	0.978
==> NPV of TUOS	$1.88																
Third Molendinar transformer		6.20													
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638
==> NPV of TUOS	$1.23																
Relative Losses															
* Relative Losses GWhs			0.0	11.3	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.282	0.000	0.070	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.28																
Total for Option 1B	**$117.37**																

Option 2A			**275kV Augmentation in Qld (Modelled Projects include Network Support to NSW)**													
Greenbank & Greenbank - Maudsland		48.90														
=> TUOS			0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672	4.601	4.529
==> NPV of TUOS	$29.67															
Proposed and modelled projects																
NSW network support																
* MWhrs				0	1716	2800	4352	6800	10300	0	0	0	0	0	0	0	0
=> TUOS			0.000	0.000	3.003	3.006	3.009	3.014	3.021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$9.43															
Rebuild Molendinar substation		21.98														
=> TUOS			0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133	2.100	2.068
==> NPV of TUOS	$11.68															
Second Molendinar Transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611	0.602	0.592
==> NPV of TUOS	$2.87															
110kV Mudgeeraba - Terranora		8.00														
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788	0.776
==> NPV of TUOS/DUOS	$3.20															
Augment Beenleigh - Molendinar line		25.48														
=> DUOS			0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547	2.510	2.473
==> NPV of DUOS	$10.19															
330 kV Dumaresq - Lismore		100.00														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290	10.143
==> NPV of TUOS	$24.16															
Molendinar 275 kV bus		9.50														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033	1.019	1.005	0.992	0.978
==> NPV of TUOS	$1.88															
Third Molendinar transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638
==> NPV of TUOS	$1.23															
Relative Losses																
*** Relative Losses GWhs**			0.0	0.0	18.5	16.8	18.4	19.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.000	0.462	0.420	0.460	0.480	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$1.19															
Total for Option 2A	**$95.49**															

Option 2B			**275kV Augmentation in Qld (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)**													
Greenbank & Greenbank - Maudsland		48.90														
=> TUOS			0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672	4.601	4.529
==> NPV of TUOS	$29.67															
Proposed and modelled projects																
330 kV Dumaresq - Lismore		100.00														
=> TUOS			0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290	10.143	9.996	9.849	9.702	9.555	9.408
==> NPV of TUOS	$53.14															
Rebuild Molendinar substation		21.98														
=> TUOS			0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133	2.100	2.068
==> NPV of TUOS	$11.68															
Second Molendinar Transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611	0.602	0.592
==> NPV of TUOS	$2.87															
110kV Mudgeeraba - Terranora		8.00														
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788	0.776
==> NPV of TUOS/DUOS	$3.20															
Augment Beenleigh - Molendinar line		25.48														
=> DUOS			0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547	2.510	2.473
==> NPV of DUOS	$10.19															
Molendinar 275 kV bus		9.50														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033	1.019	1.005	0.992	0.978
==> NPV of TUOS	$1.88															
Third Molendinar transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638
==> NPV of TUOS	$1.23															
Relative Losses																
*** Relative Losses GWhs**			0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.000	0.072	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.05															
Total for Option 2B	**$113.89**															

Option 3A			**DirectLink Network Support North followed by 275kV Augmentation in Qld (Modelled Projects include Network Support to NSW)**													
Queensland network support		0.00														
* MWhrs			0	4800	0	0	0	0	0	0	0	0	0	0	0	0
=> TUOS			0.000	2.720	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$2.25															
Greenbank & Greenbank - Maudsland		48.90														
=> TUOS			0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672	4.601
==> NPV of TUOS	$25.98															
Proposed and modelled projects																
NSW network support		0.00														
* MWhrs			0	0	1716	2800	4352	6800	10300	0	0	0	0	0	0	0	0
=> TUOS			0.000	0.000	3.003	3.006	3.009	3.014	3.021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$9.43															
Rebuild Molendinar substation		21.98														
=> TUOS			0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133	2.100	2.068
==> NPV of TUOS	$11.68															
Second Molendinar Transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611	0.602	0.592
==> NPV of TUOS	2.87															
110kV Mudgeeraba - Terranora		8.00														
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788	0.776
==> NPV of TUOS/DUOS	3.20															
Augment Beenleigh - Molendinar line		25.48														
=> DUOS			0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547	2.510	2.473
==> NPV of DUOS	$10.19															
330 kV Dumaresq - Lismore		100.00														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290	10.143
==> NPV of TUOS	$24.16															
Molendinar 275 kV bus		9.50														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033	1.019	1.005	0.992	0.978
==> NPV of TUOS	$1.88															
Third Molendinar transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638
==> NPV of TUOS	$1.23															
Relative Losses																
* Relative Losses GWhs			0.0	13.2	18.5	16.8	18.4	19.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.331	0.462	0.420	0.460	0.480	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$1.46															
Total for Option 3A	**$94.32**															

Option 3B			**DirectLink Network Support North followed by 275kV augmentation in Qld (modelled projects include Dumaresq - Lismore 330kV line in NSW)**														
Queensland network support		0.00															
* MWhrs			0	4800	0	0	0	0	0	0	0	0	0	0	0	0	0
=> TUOS			0.000	2.720	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$2.25																
Greenbank & Greenbank - Maudsland		48.90															
=> TUOS			0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672	4.601
==> NPV of TUOS	$25.98																
Proposed and modelled projects																	
330 kV Dumaresq - Lismore		100.00															
=> TUOS			0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290	10.143	9.996	9.849	9.702	9.555	9.408
==> NPV of TUOS	$53.14																
Rebuild Molendinar substation		21.98															
=> TUOS			0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133	2.100	2.068
==> NPV of TUOS	$11.68																
Second Molendinar Transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611	0.602	0.592
==> NPV of TUOS	2.87																
110kV Mudgeeraba - Terranora		8.00															
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788	0.776
==> NPV of TUOS/DUOS	3.20																
Augment Beenleigh - Molendinar line		25.48															
=> DUOS			0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547	2.510	2.473
==> NPV of DUOS	$10.19																
Molendinar 275 kV bus		9.50															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033	1.019	1.005	0.992	0.978
==> NPV of TUOS	$1.88																
Third Molendinar transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638
==> NPV of TUOS	$1.23																
Relative Losses																	
* Relative Losses GWhs			0.0	13.2	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.331	0.072	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.33																
Total for Option 3B	**$112.73**																

Option 4A			Maudsland Double Tee followed by 275kV augmentation in Qld (Modelled Projects include Network Support to NSW)													
Double tee opex		1.46														
=> TUOS			0.000	0.973	0.487	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$1.17															
Double tee capex		2.17														
=> TUOS			0.000	0.000	0.239	0.236	0.233	0.230	0.227	0.223	0.220	0.217	0.214	0.211	0.208	0.204	0.201
==> NPV of TUOS	$1.32															
Greenbank & Greenbank - Maudsland		48.90														
=> TUOS			0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672	4.601
==> NPV of TUOS	$25.98															
Proposed and modelled projects																
NSW network support		0.00														
* MWhrs			0	0	1716	2800	4352	6800	10300	0	0	0	0	0	0	0	0
=> TUOS			0.000	0.000	3.003	3.006	3.009	3.014	3.021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$9.43															
Rebuild Molendinar substation		21.98														
=> TUOS			0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133	2.100	2.068
==> NPV of TUOS	$11.68															
Second Molendinar Transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611	0.602	0.592
==> NPV of TUOS	2.87															
110kV Mudgeeraba - Terranora		8.00														
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788	0.776
==> NPV of TUOS/DUOS	3.20															
Augment Beenleigh - Molendinar line		25.48														
=> DUOS			0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547	2.510	2.473
==> NPV of DUOS	$10.19															
330 kV Dumaresq - Lismore		100.00														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290	10.143
==> NPV of TUOS	$24.16															
Molendinar 275 kV bus		9.50														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033	1.019	1.005	0.992	0.978
==> NPV of TUOS	$1.88															
Third Molendinar transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638
==> NPV of TUOS	$1.23															
Relative Losses																
* Relative Losses GWhs			0.0	14.0	18.5	16.8	18.4	19.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.350	0.462	0.420	0.460	0.480	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$1.48															
Total for Option 4A	**$94.58**															

Option 4B			Maudsland Double Tee followed by 275kV Augmentation in Qld (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)													
Double tee opex		1.46														
=> TUOS			0.000	0.973	0.487	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$1.17															
Double tee capex		2.17														
=> TUOS			0.000	0.000	0.239	0.236	0.233	0.230	0.227	0.223	0.220	0.217	0.214	0.211	0.208	0.204	0.201
==> NPV of TUOS	$1.32															
Greenbank & Greenbank - Maudsland		48.90														
=> TUOS			0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672	4.601
==> NPV of TUOS	$25.98															
Proposed and modelled projects																
330 kV Dumaresq - Lismore		100.00														
=> TUOS			0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290	10.143	9.996	9.849	9.702	9.555	9.408
==> NPV of TUOS	$53.14															
Rebuild Molendinar substation		21.98														
=> TUOS			0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133	2.100	2.068
==> NPV of TUOS	$11.68															
Second Molendinar Transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611	0.602	0.592
==> NPV of TUOS	2.87															
110kV Mudgeeraba - Terranora		8.00														
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788	0.776
==> NPV of TUOS/DUOS	3.20															
Augment Beenleigh - Molendinar line		25.48														
=> DUOS			0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547	2.510	2.473
==> NPV of DUOS	$10.19															
Molendinar 275 kV bus		9.50														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033	1.019	1.005	0.992	0.978
==> NPV of TUOS	$1.88															
Third Molendinar transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638
==> NPV of TUOS	$1.23															
Relative Losses																
* Relative Losses GWhs			0.0	14.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.350	0.072	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.34															
Total for Option 4B	**$112.99**															

Scenario C			*Low load growth*														
			1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
			04/05	**05/06**	**06/07**	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**	**17/18**	**18/19**
Option 1A			**110kV Augmentation in Qld (Modelled Projects include Network Support to NSW)**														
Augment Beenleigh - Molendinar line		25.48															
=> DUOS			0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547	2.510	2.473	2.435	2.398	2.360
==> NPV of DUOS	$15.46																
Rebuild Molendinar substation		21.98															
=> TUOS/DUOS			0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133	2.100	2.068	2.036
==> NPV of TUOS/DUOS	$13.34																
Proposed and modelled projects																	
NSW network support																	
* MWhrs			0	0	0	1100	1824	3000	4464	6600	8500	10416	0	0	0	0	0
=> TUOS			0.000	0.000	0.000	3.002	3.004	3.006	3.009	3.013	3.017	3.021	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$11.01																
Greenbank & Greenbank - Maudsland		48.90															
=> TUOS			0.000	0.000	0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744
==> NPV of TUOS	$19.55																
Second Molendinar Transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611
==> NPV of TUOS	2.12																
110kV Mudgeeraba - Terranora		8.00															
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800
==> NPV of TUOS/DUOS	2.32																
330 kV Dumaresq - Lismore		100.00															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584
==> NPV of TUOS	$12.02																
Molendinar 275 kV bus		9.50															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.00																
Third Molendinar transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.00																
Relative Losses																	
* Relative Losses GWhs			0.0	10.0	25.8	28.6	17.6	18.4	20.0	21.6	24.4	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.251	0.646	0.714	0.440	0.460	0.500	0.540	0.610	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$2.48																
Total for Option 1A	**$78.29**																

Option 1B			**110kV Augmentation in Qld (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)**												
Augment Beenleigh - Molendinar line		25.48													
=> DUOS			0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547	2.510	2.473	2.435	2.398	2.360
==> NPV of DUOS	$15.46																
Rebuild Molendinar substation		21.98													
=> TUOS/DUOS			0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133	2.100	2.068	2.036
==> NPV of TUOS/DUOS	$13.34																
Proposed and modelled projects															
330 kV Dumaresq - Lismore		100.00													
=> TUOS			0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290	10.143	9.996	9.849	9.702	9.555
==> NPV of TUOS	$46.26																
Greenbank & Greenbank - Maudsland		48.90													
=> TUOS			0.000	0.000	0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744
==> NPV of TUOS	19.55																
Second Molendinar Transformer		6.20													
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611
==> NPV of TUOS	2.12																
110kV Mudgeeraba - Terranora		8.00													
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800
==> NPV of TUOS/DUOS	$2.32																
Molendinar 275 kV bus		9.50													
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.00																
Third Molendinar transformer		6.20													
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.00																
Relative Losses															
* Relative Losses GWhs			0.0	10.0	11.0	12.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.251	0.276	0.304	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.62																
Total for Option 1B	**$99.67**																

Option 2A			**275kV Augmentation in Qld (Modelled Projects include Network Support to NSW)**													
Greenbank & Greenbank - Maudsland		48.90														
=> TUOS			0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672	4.601	4.529
==> NPV of TUOS	$29.67																
Proposed and modelled projects																	
NSW network support																	
* MWhrs				0	0	1100	1824	3000	4464	6600	8500	10416	0	0	0	0	0
=> TUOS			0.000	0.000	0.000	3.002	3.004	3.006	3.009	3.013	3.017	3.021	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$11.01																
Rebuild Molendinar substation		21.98															
=> TUOS			0.000	0.000	0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133
==> NPV of TUOS	$8.79																
Second Molendinar Transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611
==> NPV of TUOS	$2.12																
110kV Mudgeeraba - Terranora		8.00															
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800
==> NPV of TUOS/DUOS	$2.32																
Augment Beenleigh - Molendinar line		25.48															
=> DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585
==> NPV of DUOS	$6.16																
330 kV Dumaresq - Lismore		100.00															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584
==> NPV of TUOS	$12.02																
Molendinar 275 kV bus		9.50															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.00																
Third Molendinar transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.00																
Relative Losses																	
*** Relative Losses GWhs**			0.0	0.0	14.8	16.4	20.8	22.0	24.0	21.6	24.4	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.000	0.370	0.410	0.520	0.550	0.601	0.540	0.610	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$2.01																
Total for Option 2A	**$74.09**																

Option 2B			**275kV Augmentation in Qld (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)**													
Greenbank & Greenbank - Maudsland		48.90														
=> TUOS			0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672	4.601	4.529
==> NPV of TUOS	$29.67															
Proposed and modelled projects																
330 kV Dumaresq - Lismore		100.00														
=> TUOS			0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290	10.143	9.996	9.849	9.702	9.555
==> NPV of TUOS	$46.26															
Rebuild Molendinar substation		21.98														
=> TUOS			0.000	0.000	0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133
==> NPV of TUOS	$8.79															
Second Molendinar Transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611
==> NPV of TUOS	$2.12															
110kV Mudgeeraba - Terranora		8.00														
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800
==> NPV of TUOS/DUOS	$2.32															
Augment Beenleigh - Molendinar line		25.48														
=> DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585
==> NPV of DUOS	$6.16															
Molendinar 275 kV bus		9.50														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.00															
Third Molendinar transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.00															
Relative Losses																
*** Relative Losses GWhs**			0.0	0.0	0.0	0.0	3.2	3.6	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.000	0.000	0.000	0.080	0.090	0.101	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.15															
Total for Option 2B	**$95.46**															

Option 3A			**DirectLink Network Support North followed by 275kV Augmentation in Qld (Modelled Projects include Network Support to NSW)**														
Queensland network support		0.00															
* MWhrs			0	4000	9000	0	0	0	0	0	0	0	0	0	0	0	0
=> TUOS			0.000	2.717	2.738	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$4.30																
Greenbank & Greenbank - Maudsland		48.90															
=> TUOS			0.000	0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672
==> NPV of TUOS	$22.62																
Proposed and modelled projects																	
NSW network support		0.00															
* MWhrs			0	0	0	1100	1824	3000	4464	6600	8500	10416	0	0	0	0	0
=> TUOS			0.000	0.000	0.000	3.002	3.004	3.006	3.009	3.013	3.017	3.021	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$11.01																
Rebuild Molendinar substation		21.98															
=> TUOS			0.000	0.000	0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133
==> NPV of TUOS	$8.79																
Second Molendinar Transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611
==> NPV of TUOS	2.12																
110kV Mudgeeraba - Terranora		8.00															
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800
==> NPV of TUOS/DUOS	2.32																
Augment Beenleigh - Molendinar line		25.48															
=> DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585
==> NPV of DUOS	$6.16																
330 kV Dumaresq - Lismore		100.00															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584
==> NPV of TUOS	$12.02																
Molendinar 275 kV bus		9.50															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.00																
Third Molendinar transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.00																
Relative Losses																	
* Loss saving MW			0.0	11.8	27.8	16.4	20.8	22.0	24.0	21.6	24.4	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.295	0.695	0.410	0.520	0.550	0.601	0.540	0.610	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$2.50																
Total for Option 3A	**$71.84**																

Option 3B			**DirectLink Network Support North followed by 275kV augmentation in Qld (modelled projects include Dumaresq - Lismore 330kV line in NSW)**													
Queensland network support		0.00														
* MWhrs			0	4000	9000	0	0	0	0	0	0	0	0	0	0	0
=> TUOS			0.000	2.717	2.738	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$4.30															
Greenbank & Greenbank - Maudsland		48.90														
=> TUOS			0.000	0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672
==> NPV of TUOS	$22.62															
Proposed and modelled projects																
330 kV Dumaresq - Lismore		100.00														
=> TUOS			0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290	10.143	9.996	9.849	9.702	9.555
==> NPV of TUOS	$46.26															
Rebuild Molendinar substation		21.98														
=> TUOS			0.000	0.000	0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133
==> NPV of TUOS	$8.79															
Second Molendinar Transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611
==> NPV of TUOS	2.12															
110kV Mudgeeraba - Terranora		8.00														
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800
==> NPV of TUOS/DUOS	2.32															
Augment Beenleigh - Molendinar line		25.48														
=> DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585
==> NPV of DUOS	$6.16															
Molendinar 275 kV bus		9.50														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.00															
Third Molendinar transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.00															
Relative Losses																
* Relative Losses GWhs			0.0	11.8	13.0	0.0	3.2	3.6	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.295	0.325	0.000	0.080	0.090	0.101	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.64															
Total for Option 3B	**$93.21**															

Option 4A			Maudsland Double Tee followed by 275kV augmentation in Qld (Modelled Projects include Network Support to NSW)														
Double tee opex		1.46															
=> TUOS			0.000	0.973	0.487	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$1.17																
Double tee capex		2.17															
=> TUOS			0.000	0.000	0.239	0.236	0.233	0.230	0.227	0.223	0.220	0.217	0.214	0.211	0.208	0.204	0.201
==> NPV of TUOS	$1.32																
Greenbank & Greenbank - Maudsland		48.90															
=> TUOS			0.000	0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672
==> NPV of TUOS	$22.62																
Proposed and modelled projects																	
NSW network support		0.00															
* MWhrs			0	0	0	1100	1824	3000	4464	6600	8500	10416	0	0	0	0	0
=> TUOS			0.000	0.000	0.000	3.002	3.004	3.006	3.009	3.013	3.017	3.021	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$11.01																
Rebuild Molendinar substation		21.98															
=> TUOS			0.000	0.000	0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133
==> NPV of TUOS	$8.79																
Second Molendinar Transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611
==> NPV of TUOS	2.12																
110kV Mudgeeraba - Terranora		8.00															
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800
==> NPV of TUOS/DUOS	2.32																
Augment Beenleigh - Molendinar line		25.48															
=> DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585
==> NPV of DUOS	$6.16																
330 kV Dumaresq - Lismore		100.00															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584
==> NPV of TUOS	$12.02																
Molendinar 275 kV bus		9.50															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.00																
Third Molendinar transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.00																
Relative Losses																	
* Relative Losses GWhs			0.0	13.7	29.9	16.4	20.8	22.0	24.0	21.6	24.4	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.343	0.747	0.410	0.520	0.550	0.601	0.540	0.610	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$2.58																
Total for Option 4A	**$70.10**																

Option 4B			Maudsland Double Tee followed by 275kV Augmentation in Qld (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)													
Double tee opex		1.46														
=> TUOS			0.000	0.973	0.487	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$1.17															
Double tee capex		2.17														
=> TUOS			0.000	0.000	0.239	0.236	0.233	0.230	0.227	0.223	0.220	0.217	0.214	0.211	0.208	0.204	0.201
==> NPV of TUOS	$1.32															
Greenbank & Greenbank - Maudsland		48.90														
=> TUOS			0.000	0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672
==> NPV of TUOS	$22.62															
Proposed and modelled projects																
330 kV Dumaresq - Lismore		100.00														
=> TUOS			0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290	10.143	9.996	9.849	9.702	9.555
==> NPV of TUOS	$46.26															
Rebuild Molendinar substation		21.98														
=> TUOS			0.000	0.000	0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133
==> NPV of TUOS	$8.79															
Second Molendinar Transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611
==> NPV of TUOS	2.12															
110kV Mudgeeraba - Terranora		8.00														
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800
==> NPV of TUOS/DUOS	2.32															
Augment Beenleigh - Molendinar line		25.48														
=> DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585
==> NPV of DUOS	$6.16															
Molendinar 275 kV bus		9.50														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.00															
Third Molendinar transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$0.00															
Relative Losses																
* Relative Losses GWhs			0.0	13.7	15.1	0.0	3.2	3.6	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.343	0.377	0.000	0.080	0.090	0.101	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.72															
Total for Option 4B	**$91.47**															

Scenario D			*30MW of embedded generation*														
			1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
			04/05	**05/06**	**06/07**	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**	**17/18**	**18/19**
Option 1A			**110kV Augmentation in Qld (Modelled Projects include Network Support to NSW)**														
Augment Beenleigh - Molendinar line		25.48															
=> DUOS			0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547	2.510	2.473	2.435	2.398	2.360
==> NPV of DUOS	$15.46																
Rebuild Molendinar substation		21.98															
=> TUOS/DUOS			0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133	2.100	2.068	2.036
==> NPV of TUOS/DUOS	$13.34																
Proposed and modelled projects																	
NSW network support																	
* MWhrs			0	0	0	1560	2520	3840	6000	9000	11200	0	0	0	0	0	0
=> TUOS			0.000	0.000	0.000	3.003	3.005	3.008	3.012	3.018	3.022	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$9.85																
Greenbank & Greenbank - Maudsland		48.90															
=> TUOS			0.000	0.000	0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744
==> NPV of TUOS	$19.55																
Second Molendinar Transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620
==> NPV of TUOS	1.80																
110kV Mudgeeraba - Terranora		8.00															
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788
==> NPV of TUOS/DUOS	2.74																
330 kV Dumaresq - Lismore		100.00															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437
==> NPV of TUOS	$15.72																
Molendinar 275 kV bus		9.50															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033
==> NPV of TUOS	$0.52																
Third Molendinar transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674
==> NPV of TUOS	$0.34																
Relative Losses																	
* Relative Losses GWhs			0.0	9.3	25.4	28.1	18.0	21.4	20.4	22.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.232	0.636	0.702	0.450	0.535	0.510	0.560	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$2.25																
Total for Option 1A	**$81.57**																

Option 1B			**110kV Augmentation in Qld (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)**												
Augment Beenleigh - Molendinar line		25.48													
=> DUOS			0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547	2.510	2.473	2.435	2.398	2.360
==> NPV of DUOS	$15.46																
Rebuild Molendinar substation		21.98															
=> TUOS/DUOS			0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133	2.100	2.068	2.036
==> NPV of TUOS/DUOS	$13.34																
Proposed and modelled projects																	
330 kV Dumaresq - Lismore		100.00															
=> TUOS			0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290	10.143	9.996	9.849	9.702	9.555
==> NPV of TUOS	$46.26																
Greenbank & Greenbank - Maudsland		48.90															
=> TUOS			0.000	0.000	0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744
==> NPV of TUOS	19.55																
Second Molendinar Transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620
==> NPV of TUOS	1.80																
110kV Mudgeeraba - Terranora		8.00															
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788
==> NPV of TUOS/DUOS	$2.74																
Molendinar 275 kV bus		9.50															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033
==> NPV of TUOS	$0.52																
Third Molendinar transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674
==> NPV of TUOS	$0.34																
Relative Losses																	
* Relative Losses GWhs			0.0	9.3	10.2	11.3	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.232	0.256	0.282	0.000	0.065	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.61																
Total for Option 1B	**$100.62**																

Option 2A			**275kV Augmentation in Qld (Modelled Projects include Network Support to NSW)**													
Greenbank & Greenbank - Maudsland		48.90														
=> TUOS			0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672	4.601	4.529
==> NPV of TUOS	$29.67																
Proposed and modelled projects																	
NSW network support																	
* MWhrs				0	0	1560	2520	3840	6000	9000	11200	0	0	0	0	0	0
=> TUOS			0.000	0.000	0.000	3.003	3.005	3.008	3.012	3.018	3.022	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$9.85																
Rebuild Molendinar substation		21.98															
=> TUOS			0.000	0.000	0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133
==> NPV of TUOS	$8.79																
Second Molendinar Transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611
==> NPV of TUOS	$2.12																
110kV Mudgeeraba - Terranora		8.00															
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788
==> NPV of TUOS/DUOS	$2.74																
Augment Beenleigh - Molendinar line		25.48															
=> DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547
==> NPV of DUOS	$7.38																
330 kV Dumaresq - Lismore		100.00															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437
==> NPV of TUOS	$15.72																
Molendinar 275 kV bus		9.50															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033
==> NPV of TUOS	$0.52																
Third Molendinar transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674
==> NPV of TUOS	$0.34																
Relative Losses																	
* Relative Losses GWhs			0.0	0.0	15.2	16.8	20.5	18.8	20.4	22.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.000	0.380	0.420	0.512	0.470	0.510	0.560	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$1.68																
Total for Option 2A	**$78.82**																

Option 2B			**275kV Augmentation in Qld (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)**													
Greenbank & Greenbank - Maudsland		48.90														
=> TUOS			0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672	4.601	4.529
==> NPV of TUOS	$29.67																
Proposed and modelled projects																	
330 kV Dumaresq - Lismore		100.00															
=> TUOS			0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290	10.143	9.996	9.849	9.702	9.555
==> NPV of TUOS	$46.26																
Rebuild Molendinar substation		21.98															
=> TUOS			0.000	0.000	0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133
==> NPV of TUOS	$8.79																
Second Molendinar Transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611
==> NPV of TUOS	$2.12																
110kV Mudgeeraba - Terranora		8.00															
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788
==> NPV of TUOS/DUOS	$2.74																
Augment Beenleigh - Molendinar line		25.48															
=> DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547
==> NPV of DUOS	$7.38																
Molendinar 275 kV bus		9.50															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033
==> NPV of TUOS	$0.52																
Third Molendinar transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674
==> NPV of TUOS	$0.34																
Relative Losses																	
*** Relative Losses GWhs**			0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.000	0.000	0.000	0.062	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.04																
Total for Option 2B	**$97.86**																

Option 3A			**DirectLink Network Support North followed by 275kV Augmentation in Qld (Modelled Projects include Network Support to NSW)**													
Queensland network support		0.00														
* MWhrs			0	600	2640	0	0	0	0	0	0	0	0	0	0	0
=> TUOS			0.000	2.703	2.711	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$4.27															
Greenbank & Greenbank - Maudsland		48.90														
=> TUOS			0.000	0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672
==> NPV of TUOS	$22.62															
Proposed and modelled projects																
NSW network support		0.00														
* MWhrs			0	0	0	1560	2520	3840	6000	9000	11200	0	0	0	0	0	0
=> TUOS			0.000	0.000	0.000	3.003	3.005	3.008	3.012	3.018	3.022	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$9.85															
Rebuild Molendinar substation		21.98														
=> TUOS			0.000	0.000	0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133
==> NPV of TUOS	$8.79															
Second Molendinar Transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611
==> NPV of TUOS	2.12															
110kV Mudgeeraba - Terranora		8.00														
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788
==> NPV of TUOS/DUOS	2.74															
Augment Beenleigh - Molendinar line		25.48														
=> DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547
==> NPV of DUOS	$7.38															
330 kV Dumaresq - Lismore		100.00														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437
==> NPV of TUOS	$15.72															
Molendinar 275 kV bus		9.50														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033
==> NPV of TUOS	$0.52															
Third Molendinar transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674
==> NPV of TUOS	$0.34															
Relative Losses																
* Relative Losses GWhs			0.0	10.9	27.2	16.8	20.5	18.8	20.4	22.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.273	0.681	0.420	0.512	0.470	0.510	0.560	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$2.13															
Total for Option 3A	**$76.49**															

Option 3B			**DirectLink Network Support North followed by 275kV augmentation in Qld (modelled projects include Dumaresq - Lismore 330kV line in NSW)**														
Queensland network support		0.00															
* MWhrs			0	600	2640	0	0	0	0	0	0	0	0	0	0	0	0
=> TUOS			0.000	2.703	2.711	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$4.27																
Greenbank & Greenbank - Maudsland		48.90															
=> TUOS			0.000	0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672
==> NPV of TUOS	$22.62																
Proposed and modelled projects																	
330 kV Dumaresq - Lismore		100.00															
=> TUOS			0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290	10.143	9.996	9.849	9.702	9.555
==> NPV of TUOS	$46.26																
Rebuild Molendinar substation		21.98															
=> TUOS			0.000	0.000	0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133
==> NPV of TUOS	$8.79																
Second Molendinar Transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611
==> NPV of TUOS	2.12																
110kV Mudgeeraba - Terranora		8.00															
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788
==> NPV of TUOS/DUOS	2.74																
Augment Beenleigh - Molendinar line		25.48															
=> DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547
==> NPV of DUOS	$7.38																
Molendinar 275 kV bus		9.50															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033
==> NPV of TUOS	$0.52																
Third Molendinar transformer		6.20															
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674
==> NPV of TUOS	$0.34																
Relative Losses																	
* Relative Losses GWhs			0.0	10.9	12.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.273	0.301	0.000	0.062	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.49																
Total for Option 3B	**$95.54**																

Option 4A			Maudsland Double Tee followed by 275kV augmentation in Qld (Modelled Projects include Network Support to NSW)													
Double tee opex		1.46														
=> TUOS			0.000	0.973	0.487	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$1.17															
Double tee capex		2.17														
=> TUOS			0.000	0.000	0.239	0.236	0.233	0.230	0.227	0.223	0.220	0.217	0.214	0.211	0.208	0.204	0.201
==> NPV of TUOS	$1.32															
Greenbank & Greenbank - Maudsland		48.90														
=> TUOS			0.000	0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672
==> NPV of TUOS	$22.62															
Proposed and modelled projects																
NSW network support		0.00														
* MWhrs			0	0	0	1560	2520	3840	6000	9000	11200	0	0	0	0	0	0
=> TUOS			0.000	0.000	0.000	3.003	3.005	3.008	3.012	3.018	3.022	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$9.85															
Rebuild Molendinar substation		21.98														
=> TUOS			0.000	0.000	0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133
==> NPV of TUOS	$8.79															
Second Molendinar Transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611
==> NPV of TUOS	2.12															
110kV Mudgeeraba - Terranora		8.00														
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788
==> NPV of TUOS/DUOS	2.74															
Augment Beenleigh - Molendinar line		25.48														
=> DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547
==> NPV of DUOS	$7.38															
330 kV Dumaresq - Lismore		100.00														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437
==> NPV of TUOS	$15.72															
Molendinar 275 kV bus		9.50														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033
==> NPV of TUOS	$0.52															
Third Molendinar transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674
==> NPV of TUOS	$0.34															
Relative Losses																
* Relative Losses GWhs			0.0	11.6	27.9	16.8	20.5	18.8	20.4	22.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.289	0.698	0.420	0.512	0.470	0.510	0.560	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$2.16															
Total for Option 4A	**$74.73**															

Option 4B			Maudsland Double Tee followed by 275kV Augmentation in Qld (Modelled Projects include Dumaresq - Lismore 330kV line in NSW)													
Double tee opex		1.46														
=> TUOS			0.000	0.973	0.487	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
==> NPV of TUOS	$1.17															
Double tee capex		2.17														
=> TUOS			0.000	0.000	0.239	0.236	0.233	0.230	0.227	0.223	0.220	0.217	0.214	0.211	0.208	0.204	0.201
==> NPV of TUOS	$1.32															
Greenbank & Greenbank - Maudsland		48.90														
=> TUOS			0.000	0.000	0.000	0.000	5.391	5.319	5.247	5.176	5.104	5.032	4.960	4.888	4.816	4.744	4.672
==> NPV of TUOS	$22.62															
Proposed and modelled projects																
330 kV Dumaresq - Lismore		100.00														
=> TUOS			0.000	0.000	0.000	0.000	11.025	10.878	10.731	10.584	10.437	10.290	10.143	9.996	9.849	9.702	9.555
==> NPV of TUOS	$46.26															
Rebuild Molendinar substation		21.98														
=> TUOS			0.000	0.000	0.000	0.000	0.000	2.423	2.391	2.359	2.327	2.294	2.262	2.230	2.197	2.165	2.133
==> NPV of TUOS	$8.79															
Second Molendinar Transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674	0.665	0.656	0.647	0.638	0.629	0.620	0.611
==> NPV of TUOS	2.12															
110kV Mudgeeraba - Terranora		8.00														
=> TUOS/DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.882	0.870	0.858	0.847	0.835	0.823	0.811	0.800	0.788
==> NPV of TUOS/DUOS	2.74															
Augment Beenleigh - Molendinar line		25.48														
=> DUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.810	2.772	2.735	2.697	2.660	2.622	2.585	2.547
==> NPV of DUOS	$7.38															
Molendinar 275 kV bus		9.50														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.047	1.033
==> NPV of TUOS	$0.52															
Third Molendinar transformer		6.20														
=> TUOS			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.684	0.674
==> NPV of TUOS	$0.34															
Relative Losses																
* Relative Losses GWhs			0.0	11.6	12.7	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
* Losses $			0.000	0.289	0.318	0.000	0.062	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
=> NPV of Losses	$0.52															
Total for Option 4B	**$93.78**															

APPENDIX 3 – SUMMARY OF SUBMISSIONS

Only one submission was received in response to the Application Notice and is summarised below:

Submission Author: DirectLink Joint Venture Issues:	
1	The DirectLink Joint Venture considers that another option, "Option 3C" has the capability to meet the reliability needs of the Gold Coast/Tweed zone at a lower cost.
2	Option 3C includes: - network support from DirectLink with pre-contingent support for the 05/06 summer - network support from DirectLink with post-contingent support for the summers of 2006/07 through 2009/10 - 150MVAr 110kV switched shunt capacitors by Powerlink and/or Energex in late 2006 - 275kV Greenbank-Maudsland augmentation in late 2010.
3	The DirectLink Joint Venture previously discussed DirectLink post-contingent support with Powerlink, but is now in a position to provide sufficient detail to allow an assessment of this option. Technology supplier ABB has confirmed an upgrade to allow post-contingent support is technically feasible and able to be commissioned by 2006/07. It would have an estimated cost of $4.5M.
4	In option 3A, DirectLink is only able to provide network support in one direction because of its inability to respond quickly and automatically to network outages. With constraints potentially arising in both NSW and Qld regions around the same time, this creates a conflict in the scheduling of DirectLink as it could not provide support to the NSW and Qld networks at the same time.
5	By comparison, in Option 3C, DirectLink with post-contingent support could provide network support to both regions at the same time. DirectLink would do this by detecting the critical contingency and responding to adjust its flows to provide network support into the affected area. A high speed secure communication scheme would be required to provide the DirectLink control systems with the necessary information.
6	The lifting of the conflict associated with scheduling Directlink with constraints in both areas enables Option 3C to defer reliability augmentations in both NSW and QLD.
7	Burns and Roe Worley (BRW) advise the DirectLink Joint Venture that Option 3C would enable: - the 275kV Greenbank-Maudsland augmentation (first single circuit line with potential to be upgraded to double circuit in the future) to be deferred until 2010 - a second Molendinar 275/110kV transformer to be deferred until 2010 - the second Greenbank-Maudsland line to be deferred until 2018 - 275kV switchgear and third 275/110kV transformer at Molendinar substation in late 2018 Like Option 3A, Option 3C would also defer a new/rebuilt Dumaresq to Lismore 330kV line from 2006 until 2012. BRW advises DirectLink's network support would also defer the next tranche of reliability augmentations in the far north coast of NSW.
8	The cost reductions associated with Option 3C deferring expenditure have been assessed using a discounted cash flow analysis. Based on Powerlink's cost and timing estimates where available, it is estimated that Option 3C would cost $13.2M less than Option 3A.
9	Network support payments or changes to transmission charges have not been included as costs because the ACCC's Regulatory Test recognises these as wealth transfers between those who transport and consume electricity.
10	A more detailed discounted cash flow analysis has been undertaken – which takes account of interest during construction, contingency, easements and life-cycle operating and maintenance costs using mostly BRW's cost and timing estimates for project components. Using this more detailed analysis, it is estimated that Option 3C would cost $33.1M less than Option 3A.
11	In summary, the analysis indicates that Option 3C would provide greater economic benefits than Option 3A or 3B and for this reason Option 3C would satisfy the Regulatory Test. The DirectLink Joint Venturers therefore request that Powerlink and ENERGEX consider it in their final evaluation of options.
12	The Directlink Joint Venturers have recently submitted an application to the ACCC for it to determine that DirectLink may convert to a regulated interconnector. The estimated benefits of Option 3C are independent of the regulatory status of DirectLink, as DirectLink's post-contingent support could be made available through a network support agreement or included in DirectLink's prescribed service. However, the DirectLink Joint Venturers wish to highlight that Option 3C is only commercially feasible for them if DirectLink is converted to regulated status with a regulatory asset value that fairly recognises DirectLink's economic value to the National Electricity Market.

13	The next steps for the DirectLink Joint Venturers in the implementation of Option 3C are to: - confirm with ABB each step in a design and implementation timetable - conduct dynamic and digital simulation studies - engage ABB to develop a detailed technical specification for DirectLink's post-contingent support. The DirectLink Joint Venturers believe it is essential that this work and subsequent implementation be conducted in close cooperation with Powerlink, TransGrid and NEMMCO.
14	The submission contained an attachment on High Level Post Contingent Support Control Capability (information available on request). In brief, this attachment stated that: - DirectLink would use its active power flow capability in the event of a network contingency to provide voltage support (to supplement the fast reactive power response) with response times from 0—60 seconds and to reduce network overloads with response times from 0-10 minutes. - DirectLink would use its reactive power output capability to provide steady state voltage control (required about a pre-determined set point and ±0.5% tolerance) and to provide fast voltage support in the event of voltage disturbance (such that the reactive output of DirectLink at each end of the link would be capable of changing output from –75MVAr to +75MVAr within 40 milliseconds). The active power output of DirectLink would have priority over the reactive power output to ensure DirectLink does not operate outside of its rating. The capability of DirectLink would be limited to the capability of the surrounding network. Information on lines that may limit DirectLink's capability would need to be available for the post-contingent support control system. A high speed communication link and duplicated control and communications systems with fail-over provisions would be required to implement the post-contingent support scheme and provide sufficient security to satisfy NEMMCO requirements.
15	The submission contained an attachment on Calculation of the Relative Benefits of Option 3C (information available on request). In brief, this attachment stated: - to calculate the benefits of Option 3C compared to Options 3A and 3B, the following costs and estimates were used - Powerlink and ENERGEX's cost and project timing estimates for components of options 3A and 3B in their Application Notice. We understand these cost estimates are exclusive of interest during construction, contingency, easement and operating and maintenance costs and the timing estimates are based on medium economic growth - Cost and timing estimates for components of Options 3A and 3B which are breakdowns of estimates prepared by BRW included in the DirectLink Joint Venture application to the ACCC (not repeated here as complete cost and timing information prepared by BRW is available in their report from **www.accc.gov.au**) - Three cases considered (A) April 2004 dollars, 10% discount rate, medium growth, mostly Powerlink and ENERGEX's estimates – consistent with Application Notice (B) BRW's cost and timing estimates, April 2004 dollars, 10% discount rate and medium growth and (C) BRW's cost and timing estimates, January 2005 dollars, 9% discount rate and medium growth – consistent with base case in DirectLink's Application to the ACCC. - Differences between BRW's and Powerlink/ENERGEX cost estimates are due to data obtained and estimates made by BRW. BRW also believes that a second Greenbank to Maudsland circuit would not need to be built with the new 275kV switchyard at Greenbank and the first Greenbank-Maudsland circuit. - Results of cash flow analysis for each case over 40 years: - Case A: Option C costs $13.2M less than Option 3A and $52.8M less than Option 3B - Case B: Option C costs $33.1M less than Option 3A and $121.8M less than Option 3B - Case A: Option C costs $32.1M less than Option 3A and $114.2M less than Option 3B

APPENDIX 4 – RESPONSE TO ISSUES RAISED IN SUBMISSION FROM DIRECTLINK JOINT VENTURE

This appendix expands on the overview that was provided in section 3.2. This more detailed discussion of issues raised in the submission received from the DirectLink Joint Venture in response to the Application Notice is organised as follows:

- Comments on the planning criteria for supply to the Gold Coast/Tweed zone
- Discussion of post-contingent support from DirectLink
- Conclusions reached regarding the feasibility of DirectLink's Option 3C
- A review of the assumptions in the economic evaluation of alternative options to address the Gold Coast/Tweed zone future supply requirements
- Implications for the outcomes of the Regulatory Test assessment.

1. Reliability Planning Criteria

The option put forward in the DirectLink Joint Venture submission delivers a lower level of reliability to Gold Coast/Tweed zone customers than required under Powerlink's statutory obligations.

This is acknowledged in the Application for Conversion to a Prescribed Service submitted by the DirectLink owners to the ACCC. The Burns and Roe Worley Report states that it is not necessary for options for future supply to the Gold Coast/Tweed zone to meet 'N-1' levels of reliability, based on the BRW assessment that the existing networks are presently operating above N-1 capability[55].

Powerlink rejects this statement entirely. Powerlink disputes BRW's assessment of the performance of the existing transmission network. In addition, the logic in BRW's statement is flawed. Even if there is a shortfall in the existing performance levels (which Powerlink refutes), this cannot be used as justification to allow Powerlink to knowingly plan to deliver below the required reliability levels. Powerlink has an explicit statutory obligation to meet N-1 criteria. The Electricity Act 1994 requires Powerlink to comply with its transmission licence. Powerlink's transmission licence requires it to meet 'N-1' criteria, unless agreed otherwise by affected parties, as follows:

6.2 Subject to clause 6.3, the transmission entity must plan and develop its transmission grid in accordance with good electricity industry practice such that …. (c) the power transfer available through the power system will be adequate to supply the forecast peak demand during the most critical single network element outage.

6.3 The obligations imposed on the transmission entity by clause 6.2 will apply unless otherwise varied by a connection or other agreement made by the transmission entity with a person who receives or wishes to receive transmission services.

The relevant parties who receive transmission services are the local distribution network service providers, ENERGEX and Country Energy. Both ENERGEX and Country Energy have confirmed that they require future transmission supply to the Gold Coast/Tweed zone to meet the 'N-1' planning standard of reliability.

[55] "In BRW's opinion, it is not equitable to assess the DirectLink Application for conversion on an N-1 approach given the assets in far north east New South Wales and Gold Coast networks are presently operating above N-1" - refer p43 BRW Report.

All of the options compared in the Application Notice were designed to be able to meet N-1 criteria for reliability of supply to the Gold Coast/Tweed zone for the entire 15-year period of analysis. Any alternative option to be evaluated must also meet the N – 1 standard of reliability. Solutions to future supply requirements that do not meet the 'N-1' standard for reliability are not feasible solutions for consideration under the Regulatory Test, as they do not comply with Powerlink's statutory obligations for supply reliability.

Whilst this criterion alone is sufficient to rule out the proposed option, Powerlink has identified other shortcomings which are discussed below.

2. Post-Contingent Operation of DirectLink

DirectLink's submission to the Powerlink/ENERGEX Application Notice advised that a scheme could be put in place for a cost of $4.5M that would allow DirectLink operation to be ramped up, or the direction of power flow changed, immediately following a network contingency.

This is new information that was not available at the time of preparing the Application Notice. Powerlink specifically requested technical details of how grid support could potentially be provided to the Queensland and New South Wales regions simultaneously, during discussions with representatives of the DirectLink Joint Venture in October and November 2003[56]. No such detail was provided. High level discussions were held regarding what might conceptually be required in terms of control and communication requirements for a post-contingent response mechanism. Following these discussions, the owners of DirectLink indicated that they were not offering post-contingent support as a non-network solution.

The DirectLink owners did not advise Powerlink during any of the extensive subsequent discussions over recent months associated with negotiation of a network support contract for the pre-contingent use of DirectLink during the 2005/06 summer, that a post contingent response scheme was now being actively considered.

Powerlink has several serious concerns regarding the post-contingent scheme. We do not consider these concerns are resolvable in the timeframe necessary to address the supply requirements in the Gold Coast/Tweed zone, if they can be resolved at all.

3. Commercial Feasibility – Powerlink's position

Powerlink does not consider the suggested post-contingent scheme is commercially acceptable, given Powerlink's potential liability exposures associated with reliability of supply.

As identified in the Application Notice, the existing transmission network will be unable to reliably meet customer requirements from the summer of 2005/06 onwards. Powerlink and ENERGEX have recommended action to address the future supply requirements to the Gold Coast/Tweed zone. If augmentation were to be deferred through the use of post-contingent support from DirectLink, the reliability of supply in the Gold Coast/Tweed zone during peak periods would depend on the operation of DirectLink.

If the post-contingent scheme failed to operate correctly after a contingency and failed to arrest a voltage collapse of the transmission system, there is a high likelihood that there would be a total and immediate interruption to electricity supplies to the entire Gold Coast/Tweed area. This sudden loss of up to 700MW of load would cause a power swing in the Queensland network that could result in instability of the Queensland-New South Wales interconnection (QNI) or other parts of the Queensland power system. This is more likely to occur under high southerly power flows on

[56] In response to the September 2003 TransEnergie submission to the Powerlink/ENERGEX Request for Information which stated that "DirectLink can provide support to either region in isolation and can potentially provide support simultaneously to both regions".

QNI (a frequent occurrence). Disconnection (separation) of QNI under these conditions could lead to severe market impacts and load shedding in both Queensland and southern states.

If it were known in advance that DirectLink was unable to provide the required post-contingent support:

- power transfers through the network would have to be maintained at 2005/06 levels (ie – within the existing transfer capacity of the network);
- this would require Powerlink to interrupt supply to a growing proportion[57] of customers in the Gold Coast/Tweed zone prior to a contingency on a rotational loadshedding basis throughout the peak summer period;
- this would continue until either the post-contingent scheme operated as designed, or was replaced by a network augmentation that could take up to two years to implement;
- Operating above the network transfer capacity would not be acceptable as it would result in uncontrollable voltage collapse and total loss of supply following a contingency.

The DirectLink post-contingent scheme is a new implementation that has not been undertaken elsewhere in Australia. Its technical feasibility is unproven. Powerlink considers the scheme is not acceptable to meet our obligations for reliable supply to the Gold Coast/Tweed zone, particularly when the consequences of failure could be total loss of supply to this major load centre and international tourist destination, with potential liability to Powerlink. Other consequences could include potentially severe market impacts and wider loadshedding due to power system instability.

Powerlink emphasises that the recommendation in the Application Notice provided for the utilisation of *pre-contingent* grid support from DirectLink in the 2005/06 summer, where there is no reliance on a fast-response scheme and where it would be clear that DirectLink is already operating at a defined level.

4. Commercial Feasibility - Potential Lack of a Proponent

The second issue is that Option 3C does not have an identifiable proponent at this point in time. There is a lack of certainty that the DirectLink Joint Venture is a proponent for the suggested post-contingent scheme. The DirectLink submission to Powerlink and ENERGEX stated that:

> *"The DirectLink Joint Venturers have recently submitted an application to the ACCC for it to determine that Directlink may convert to a regulated interconnector. Our estimation of the relative benefits that Option 3C may provide is independent of the regulatory status of Directlink. The provision of Directlink's post-contingent support could be made available through a network support agreement or included in Directlink's prescribed service.*
>
> *However, **we wish to highlight that the Directlink Joint Venturers believe that Option 3C is only commercially feasible for them if Directlink is converted to regulated status with a regulatory asset value that fairly recognises Directlink's economic value to the National Electricity Market**.[58]"*

In their submission to the ACCC, the DirectLink owners advised of their "preference for implementing post-contingent support as part of the regulatory conversion[59]".

There is no suggestion that the DirectLink owners are offering the post-contingent scheme on a non-regulated basis. The Joint Venture's willingness to be a proponent for the scheme therefore

[57] Equivalent to the growth in electricity demand each year from 2006/07 onwards. It is assumed that pre-contingent support from DirectLink would be able to meet the incremental load requirements in the summer of 2005/06.
[58] Directlink Joint Venture Submission to Powerlink and ENERGEX, p4.
[59] p58 BRW Report, Appendix D, DirectLink Application for Conversion to a Prescribed Service

appears to be dependent on the outcome of its application to the ACCC for conversion of the DirectLink interconnector to regulated status, including the magnitude of any regulatory asset value assigned by the ACCC. This outcome may not be known for a considerable period of time. Further, there is no way of knowing whether the asset value ultimately determined by the ACCC will be large enough to make the offered service 'commercially feasible' to the DirectLink owners. The only previous conversion application for a market network service provider underwent evaluation by the ACCC for almost a full year[60] before a determination was made, and the regulatory asset value was substantially lower than that sought.

Powerlink considers that an option without a proponent is not a feasible solution to a reliability of supply requirement. This is supported by the ACCC Draft Decision on the review of the Regulatory Test which states that the ACCC is of the view that the statutory obligations imposed on TNSPs require that reliability augmentations be constructed within a specified timeframe and that therefore there is a greater emphasis on having an identifiable proponent. To clarify the issue, the ACCC proposes to amend the Regulatory Test to require that all options to address reliability requirements must have an identifiable proponent[61].

The uncertainty surrounding the willingness of the DirectLink Joint Venture to be a proponent for Option 3C must be considered when determining whether it is a viable option to address the future supply requirements in the Gold Coast/Tweed zone.

5. Technical Issues

Since receiving the submission from the DirectLink Joint Venture, Powerlink has carried out preliminary technical studies to examine the impacts of a post-contingent scheme such as that now being suggested. Powerlink's conclusion is that the envisaged post-contingent scheme is not a technically feasible option to address the future supply requirements in the Gold Coast/Tweed zone.

The technical issues can be categorised into three areas:
- proving the post-contingent scheme will reliably operate as required;
- risks of using external detection schemes to initiate the post-contingent scheme; and
- whether the post-contingent scheme would arrest transient voltage collapse in the Gold Coast/Tweed zone.

[60] The Murraylink application for conversion to regulated status was made on 18 October 2002, and a decision was made on 1 October 2003.
[61] ACCC Draft Decision – Review of the Regulatory Test p29-30

These issues are discussed in turn:

1. *Proving Reliable Operation of Post-Contingent Scheme*

The concept of a post-contingent scheme is that power flow on the Queensland network would be allowed to exceed the network's firm transfer limit[62]. The aim would be to allow future demand on the Gold Coast to be met while also allowing DirectLink to export power to NSW[63]. The assumption is that, if a contingency occurs on the Queensland network, DirectLink would immediately 'turn-around'[64] and provide support to Queensland so that power flows on the Queensland transmission network are reduced to within the pre-contingent network transfer capability.

The requirement would be for a fast-response scheme where power flows on DirectLink would be rapidly adjusted to provide sufficient real power[65] (in less than half a second) to the Queensland network from which it may previously have been drawing power. This type of scheme has not been implemented before in Australia. In fact, Powerlink is not aware of anywhere in the world where such a mechanism on a DC link using Voltage Source Controllers is relied upon to prevent voltage collapse.

Action to "arrest transient voltage collapse" (ie – quickly halt any decline in voltage before voltage collapse occurs) is usually achieved through the installation of specialist voltage control equipment, Static Var Compensators (SVCs) or sometimes rapidly switched[66] capacitor banks. This equipment assists in maintaining voltages at acceptable levels, therefore reducing the tendency of motor loads (air-conditioners, pumps, industrial motors etc) to stall. Voltage (reactive) support by generators or a controllable link such as DirectLink can also assist to control and recover voltage levels. The required level of reactive support, and how quickly it must be able to respond depends on the severity of the voltage depression after the network contingency. This in turn depends on the actual conditions (generation support, voltage levels, system load, etc) existing at the time of the contingency. Response times of this voltage control equipment must be very fast. Motors that begin to stall draw increasing reactive current, reducing voltages further on other nearby motors. If this is allowed to continue, additional motors will stall in cascade fashion, resulting in widespread voltage collapse.

There is considerable technical complexity involved in fast-response mechanisms, as demonstrated by proven technology in the form of Static Var Compensators. Powerlink's experience with SVCs is that significant modelling is required to ensure the detailed technical specifications are developed correctly, significant testing is needed to ensure the equipment operates correctly, and rectification of issues detected during commissioning is a common requirement.

[62] That is, the limit of transfer capacity where voltage instability would occur following the critical single network contingency

[63] At present, DirectLink is prevented from operating in a southerly direction, if this operation would otherwise cause the network supplying the Gold Coast/Tweed zone to reach its firm transfer limit. Already DirectLink is restricted from exporting power to NSW from Queensland during peak demand periods due to capacity limits in the Queensland electricity supply network. The periods of time where export will be restricted will grow over time as load growth continues.

[64] Or commence operation if at zero MW output, or increase its level of northerly flow as required.

[65] Electrical power comprises 'real' and 'reactive' components – both would be required as part of the DirectLink support arrangements

[66] Thyristor switched

None of this type of detailed modelling has been carried out for the DirectLink post-contingent scheme. The DirectLink Joint Venture is yet to begin work on design of the scheme in conjunction with the manufacturer of the relevant equipment. The feasibility of Directlink responding in the timeframe required to address transient voltage collapse in a reliable manner (ie – each and every time it is required) is therefore unproven. Powerlink considers that relying on an unproven, unique post-contingent scheme when the consequence of failure could be almost total loss of supply to customers in the Gold Coast/Tweed zone would not be prudent. Planning on the basis of implementing such a scheme to meet short-term reliability requirements, when no dynamic simulation studies have been carried out and work on detailed technical specifications has not begun, would be contrary to all precepts of good electricity industry practice.

2. *Risks Associated with External Detection Schemes*

Unlike an SVC, which detects and responds directly to low source voltages, operation of the post-contingent scheme suggested by DirectLink would be initiated by signals from locations remote from Directlink that a network contingency had occurred. Equipment capable of detecting contingencies at a series of locations across south-east Queensland and in northern NSW, and sending relevant high-speed signals to the DirectLink control equipment, would need to be installed.

Duplicate[67] high-speed communications links would be required between each location and the DirectLink control systems. There are currently no such duplicated high-speed communication links available, as acknowledged in the DirectLink Joint Venture submission. However, the submission is silent on requirements for external detection of a contingency other than stating that information on lines that may limit DirectLink's capability (in addition to lines on which a critical contingency may occur) would need to be available for the post-contingent support system.

Powerlink is not confident that a technically feasible detection scheme could be developed which could detect the relevant contingencies and provide reliable signals to DirectLink within the necessary 'super-fast' timeframe.

We note that the response timeframes stated in the DirectLink submission[68] only include the response of the DirectLink interconnector itself. They do not include the time for detection of the relevant contingency (which would be at least 100 milliseconds[69]), or the sending of remote high-speed signals to the DirectLink control equipment. It is also not apparent whether the timeframes include 'decision time' for the relevant control equipment.

Existing fast-response voltage support schemes in use by Powerlink are controlled from local input signals. That is, control signals are derived for system conditions which are measured at the local substation. Signals are hard wired locally and hence do not require external detection, logic or signal transfer systems. The DirectLink post-contingent scheme, on the other hand, would rely on detection of a critical system response by detecting initiating faults from a range of remote or external locations, both in Queensland and New South Wales. In addition to detection, these systems would need to sort critical from non-critical system events

[67] To meet National Electricity Market requirements for system security. "Where security limits are dependent on automatic post contingent control action, NEMMCO would expect that similar levels of robustness and redundancy be provided as those associated with primary protection systems" (letter from NEMMCO to Powerlink dated 4 December 2003).

[68] The DirectLink submission stated that the reactive output of DirectLink at each end of the link would be capable of changing output from –75MVAr to +75MVAr within 40 milliseconds.

[69] It is essential that the equipment determine whether the fault is 'real', as there could be significant reliability consequences if a false signal is sent to DirectLink.

as well as effectively and securely transmit appropriate control signals to the DirectLink control systems. As no standard systems of this type exist, a precursor to implementation of a robust and reliable high speed remote detection system for this application would require feasibility studies, concept design followed by detailed design and due diligence. Until such detailed work is undertaken, such a scheme must be at best considered as uncertain.

3. Arresting Voltage Collapse

The other unknown regarding the technical capability of the post-contingent scheme is, even if all elements operate correctly, whether the post-contingent response would arrest transient voltage collapse in the Gold Coast/Tweed zone.

Powerlink has carried out preliminary modelling studies to examine the capability of post-contingent support from DirectLink to maintain voltage stability. It is emphasised that no detailed technical specifications for the post-contingent scheme are available to allow more complete analysis.

As already outlined, the aim of the Directlink post-contingent scheme is to allow pre-contingent power transfers into the Gold Coast/Tweed zone to exceed the network's firm transfer capacity. The consequence of this is that the immediate post contingent voltages (prior to the activation of the DirectLink scheme) in the Gold Coast/Tweed zone will be significantly lower than if the network was operated within its firm capacity. These lower voltages will remain until the post-contingent scheme has successfully activated. The time delay to this occurring is one critical factor in determining whether or not voltage collapse can be avoided.

The impact of operating the transmission system well above its firm capacity also needs to be considered in combination with the normal high summer loading on the Energex distribution network in the Gold Coast area. Very heavily loaded/utilised networks such as those in the Gold Coast/Tweed zone are vulnerable to transient voltage instability.

The timeframe of voltage collapse can be very fast (0 to 10 seconds). Failure occurs as a result of severe voltage dips that can occur after a network contingency. Under these conditions, the slip of induction motors increase in an attempt to continue to meet the required load torque. This has the effect of increasing the reactive power drawn by the motors. This increase in current compounds the voltage depression (ie - as current increases, voltage decreases). Under these conditions, induction motors may have difficulty re-accelerating, and can stall in a cascade fashion leading to widespread voltage collapse.

Dynamic modelling of the network and system loads was undertaken to simulate the 'time domain' response following the critical contingency. The load response was investigated by considering a physical based model of the load including static and dynamic (induction motor) components. The recovery of the dynamic component of the Gold Coast/Tweed zone loads following the critical contingency was investigated in the time frame to 10 seconds, the time period under which transient voltage instability is possible. The dynamic modelling performed to simulate the actual response of the network and system loads following the critical contingency considered:

- The application of the critical credible contingency (as defined in Schedule 5.1.2.1 of NEC);
- Followed by the sustained outage of the critical faulted transmission circuit; and
- The operation of the Directlink post-contingent response scheme (Directlink was assumed to operate in its pre-contingency mode for at least 100 milliseconds until detection equipment could signal that a fault had occurred and a change in operation was required).

The dynamic studies for this scenario for the 2006/07 summer show that, even with the Directlink post-contingent response scheme, it may not be possible to arrest a transient voltage collapse under all conditions.

6. Conclusions Regarding Feasibility of DirectLink "Option 3C"

In summary, Powerlink considers that Option 3C, as put forward in the submission by the DirectLink Joint Venture, is neither technically nor commercially feasible for the following reasons:

- Option 3C has not been designed to be capable of meeting the N-1 reliability standard for supply to the Gold Coast/Tweed zone. Powerlink has an explicit statutory requirement to meet N-1 criteria. The Electricity Act 1994 requires Powerlink to comply with its transmission licence. Powerlink's transmission licence states that it must be able to supply peak demand with one network element out of service (N-1). Any options that do not meet this requirement are not feasible solutions to the future supply requirements in the Gold Coast/Tweed zone.

- Powerlink does not consider it acceptable to rely on the post-contingent scheme to maintain reliability of supply to the Gold Coast/Tweed zone. The scheme has yet to be designed, and the implementation of a post-contingent response by DirectLink is new and unproven. Powerlink is not aware of any evidence of such a scheme being successfully used anywhere in the world on a DC link using Voltage Source Controllers to arrest voltage collapse by rapidly changing real power throughput. Powerlink has onerous liability exposure for loss of supply events, and adopting such an unproven, untested scheme is not commercially acceptable.

- The suggested post-contingent response scheme would be technically complex, and its feasibility is doubtful. No design or development of detailed specifications for the post-contingent scheme has begun at this stage. Powerlink is not confident that a technically feasible external detection scheme can be developed to detect a network fault and initiate post-contingent support from DirectLink in the required 'super-fast' timeframe. In addition, even if this scheme could be successfully implemented, technical studies of the dynamics of transient voltage instability in the Gold Coast/Tweed zone indicate the post-contingent scheme cannot be demonstrated to reliably arrest voltage collapse under all system conditions. Powerlink's transmission authority requires it to plan and develop its transmission grid in accordance with good electricity industry practice. Planning on the basis of such a unique scheme being found to be feasible, reliable and able to be fully operational by late 2006 to maintain reliability of supply to the Gold Coast/Tweed zone would be contrary to all precepts of good electricity industry practice.

- Finally, there is uncertainty whether there will be a proponent for Option 3C. The DirectLink Joint Venture has indicated that its willingness to be a proponent is dependent on the outcome of the application to the ACCC for conversion to regulated status. This may not be determined for some time and an option without a proponent is not a feasible solution to a reliability limitation.

7. Economic Evaluation

As outlined above, the option proposed by the DirectLink Joint Venture is neither a technically nor commercially feasible solution to address the future supply requirements in the Gold Coast/Tweed zone.

However, Powerlink considers it important to provide further information regarding its approach to the Regulatory Test economic analysis in the Application Notice in response to other matters raised in the submission from the DirectLink Joint Venture[70].

[70] It should be noted that this response is based on both the information contained in the submission to the Application Notice and in the Application for Conversion to a Prescribed Service submitted to the ACCC. Additional detail

1. Discount Rate

In the Application Notice for the Gold Coast/Tweed zone, Powerlink and ENERGEX conducted sensitivity analysis for discount rates of 8%, 10% and 12%. The outcome of the Regulatory Test was robust for these variations in discount rate. Therefore, the use of discount rates of 9% and 10% in the cashflow analysis in the DirectLink submission has no impact on the outcomes of the Regulatory Test analysis.

2. Expression of Costs

Powerlink's approach is to express costs in the financial year in which the Regulatory Test is carried out (ie – 2003/04 dollars for the Gold Coast/Tweed zone analysis).

Two of the cases examined by DirectLink used costs expressed in 2004 dollars. In the third case, Case C, costs were expressed in January 2005 dollars consistent with the base case in DirectLink's application to the ACCC.

It is assumed that Case C was only included in the DirectLink submission to the Application Notice to clarify minor differences between Option 3C as put forward in the submission and the information provided to the ACCC in the "Application for Conversion to a Prescribed Service". Provided all costs are expressed in the same terms to allow equivalent comparison, this assumption should not affect the ranking of alternative options under the Regulatory Test. This issue has therefore not been addressed further.

3. Capital Cost Estimates

The cost estimates included in the Powerlink/ENERGEX Application Notice differ considerably from the estimates of the cost of similar project elements in alternative options in the DirectLink Joint Venture submission[71].

The DirectLink estimates were prepared by BRW, and are significantly higher than the Powerlink/ENERGEX estimates. This is primarily due to inclusion of an estimated easement cost, interest during construction (IDC), operation and maintenance (O&M), and a contingency allowance.

If the easement cost, IDC, O&M and contingency allowance are removed, BRW's capital cost estimates are approximately 6% higher than the equivalent Powerlink/ENERGEX estimates. This is not considered significant, as the Regulatory Test economic evaluation published in the Application Notice was robust to sensitivity analysis that included a variation in capital cost estimates of ±15%.

Further information regarding Powerlink's approach to the inclusion of easement costs, IDC, O&M and contingences is provided below:

<u>Easement Costs</u>

The cost estimates in the Application Notice did not include easement related costs associated with the construction of the recommended 275kV augmentation between Greenbank and Maudsland. Powerlink's predecessor, the Queensland Electricity Commission, obtained the

regarding the DirectLink Joint Venture assumptions is provided in the latter document, and referenced in the submission to the Application Notice.

[71] Powerlink has not analysed the cost and feasibility of project elements that are unique to DirectLink's Option 3C (eg – capacitor banks and communication links) as this option is not considered feasible.

easement between Greenbank and Molendinar in the mid 1980s. Relevant easement costs have already been expended, and therefore cannot be avoided or deferred by implementing any alternative option. It is therefore Powerlink's view that inclusion of easement costs are not relevant in the Regulatory Test analysis for the Gold Coast/Tweed zone.

Interest During Construction & Operation and Maintenance

Powerlink agrees with BRW that interest during construction (IDC) and operating and maintenance (O&M) costs need to be considered in any economic analysis of alternative options. These costs are included in the Regulatory Test analysis in the Powerlink/ENERGEX Application Notice.

In the body of the Application Notice, Powerlink provided the capital cost of proposed projects, excluding IDC and O&M, for the information of interested parties. However, the economic analysis in the Application Notice is based on a cashflow of annualised transmission charges that would be associated with proposed augmentations. This includes IDC and an annual O&M allowance. The analysis approach therefore meets the Regulatory Test requirement that costs included should be "the total cost of the augmentation to all those who produce, distribute or consume electricity in the National Electricity Market".

Inclusion of a Contingency

The BRW estimates in the DirectLink Joint Venture submission include a percentage contingency amount on top of the cost estimates for all project cost components in the economic analysis.

Powerlink's capital cost estimates used in the Regulatory Test analysis include normal construction contingencies but do not include percentage contingency allowances for changes of scope and other unexpected events. The reasons Powerlink does not add a percentage contingency are:

- sensitivity analysis is carried out to random variations in capital cost estimates of between zero and plus or minus 15%. Powerlink considers this more appropriately takes into account the impact on ranking of options of potential variations in project costs than inclusion of a positive percentage contingency amount applied to all project components.
- Inclusion of percentage contingencies can bias the results of the economic analysis where the evaluation is sensitive to the deferral of significant future capital expenditure. The approach assumes that all components of a series of augmentations are 'overspent' by a contingency amount. For example, the BRW cost estimates include varying contingencies of between +10.8% and +14.1% for different augmentation components. Powerlink notes that differing levels of contingency may be valid depending on the initial basis of the estimates, but that this may also affect the outcomes of the economic analysis.
- The aim of the Regulatory Test is to compare the expected actual cost of augmentation options. The purpose of a contingency is to deal with unexpected events – it is not intended that a contingency will actually be spent.

4. Scope of Greenbank-Maudsland Augmentation

The proposed scope of the augmentation between Greenbank and Maudsland recommended as part of Option 3A in the Application Notice comprises the construction of a 275kV double circuit line (stringing both sides) to be operated initially as a single circuit. It is proposed to reconfigure the Maudsland-Molendinar tee connection off the existing Swanbank-Mudgeeraba lines to connect to the new 275kV line.

However, in Option 3C, BRW proposes retaining the tee between Maudsland and Molendinar and building a new single circuit line between Greenbank and Maudsland. BRW say they have "costed a single circuit transmission line with the potential to be upgraded to double circuit in the future". It is unclear exactly what this means. One option could be that BRW is proposing only initially stringing one side of the towers between Greenbank and Maudsland, and later stringing the other side.

However, Powerlink considers the cost reduction identified by BRW of $14M is excessive if this is the case. Powerlink does not consider that a single circuit line could be constructed with a second circuit added at a later time for the same total cost as constructing the line as double circuit in the first place. Additional mobilisation costs would be incurred. Powerlink considers a premium would also need to be paid for stringing the second circuit with the first circuit energised. This would be necessary to avoid outages and the impact on supply reliability and the market associated with those outages.

The capacity difference between the two variations in scope is minimal, as they both initially result in three circuits between Swanbank and the Gold Coast (the two existing circuits plus the new one). The key differences are cost, transmission line losses and environmental impact. In all three of these areas, the option where both circuits are strung at the same time has advantages:

- Stringing both circuits results in greater transmission loss savings than an option where only a single circuit is strung initially, as power flows are shared between the two circuits.

- It is more cost-effective to string both circuits of the new line at the same time, given the short timeframe (two years) between when the first and second circuits are required and the cost premium that would be incurred if stringing the second side separately. Powerlink estimates a project cost reduction of $3.4M if stringing only one side initially, and a cost of $4.5M (including remobilisation etc) to string the second circuit at a later time. The financial comparison is shown in the table below.

Discount rate 10%		Scenario A *2nd side 1 yr later*		Scenario B *2nd side 2 yr later*		Scenario C *2nd side 3 yr later*		Scenario D *2nd side 4 yr later*	
		NPV ($M)	**Rank**	**NPV ($M)**	**Rank**	**NPV ($M)**	**Rank**	**NPV ($M)**	**Rank**
Option 1	Both sides strung together	$25.98	1	$25.98	1	$25.98	1	$25.98	2
Option 2	Sides strung separately	$26.37	2	$26.19	2	$26.04	2	$25.90	1

- The environmental impact of stringing both circuits at the same time is lower. Firstly, disruption to the physical environment and nearby residents is lower with a single construction period. Secondly, assuming the phases are arranged appropriately, electric and magnetic fields (EMF) are lower for a line that has both circuits strung than for a single circuit line, due to phase interaction. That is, the fields from each circuit tend to offset each other at the ground level. Powerlink's Environmental Impact Assessment for the easement between Greenbank and Molendinar was carried out on the basis of constructing a line with both circuits strung (reversed-phase double circuit construction). Specific reference was made to design features to minimise EMF levels (eg – phase cancellation, compaction and centreline positioning). Powerlink considers there is uncertainty as to whether a single circuit option could legitimately be constructed on the existing easement. Potential environmental issues associated with higher electric and magnetic field characteristics of a single circuit line (single phase construction) were not evaluated in the Environmental Impact Assessment process.

The EMF requirements in the section of easement between Maudsland and Molendinar require that the current on both circuits must be the same magnitude and direction[72] to maximise phase cancellation and thereby minimise EMF levels. The configuration proposed by BRW, which retains the tee connection for one circuit and establishes the second circuit from Greenbank to Molendinar via Maudsland, will not result in equal currents in the two circuits and is therefore not acceptable.

5. Inclusion of Network Support Payments and Changes in TUOS Charges

[72] During intact system operation

The Application Notice for the Proposed New Large Network Asset in the Gold Coast/Tweed zone recommended that $2.7M be paid to the owners of DirectLink under a network support contract for the summer of 2005/06. This network support payment was included in the economic analysis comparing network support with other options, in particular the low cost alternative of deferring further network augmentation through implementation of a double tee arrangement between Maudsland and Molendinar. The Regulatory Test analysis in the Application Notice also included transmission charges arising from proposed augmentations to the Powerlink transmission network.

In its submission to the Application Notice, the DirectLink Joint Venture stated that they "have not included network support payments or changes to transmission charges as costs in their calculations because the Australian Competition and Consumer Commission's Regulatory Test recognises these as wealth transfers between those who transport and consume electricity".

This statement is not correct. No reference is made in the Regulatory Test to wealth transfers or network support payments when describing the costs to be included in the net present value calculations. The section of the Regulatory Test regarding relevant costs states that "cost means the total cost of the augmentation to all those who produce, distribute or consume electricity in the National Electricity Market". Only costs that cannot be measured in terms of financial transactions in the National Electricity Market can be excluded, as stated in Note (4)[73].

There has, however, been considerable discussion of wealth transfers by various parties during processes to review the existing Regulatory Test. The ACCC has provided some clarification of the references in the Regulatory Test to determining the 'total increase in consumers and producers surplus' and carrying out 'partial equilibrium analysis'. The ACCC has stated on numerous occasions that "a key feature of the Regulatory Test is the calculation of net benefits of the various options with reference to the underlying economic cost savings and not with reference to pool price outcomes which may be distorted by market participants exercising market power"[74] This has been further explained through references indicating wealth transfers between producers and consumers should not be included in the analysis because the transfer of income between generators and consumers is different from increases in economic efficiency[75].

Powerlink has sought advice from KPMG on the issue of whether costs associated with network support payments and changes to transmission charges are eligible costs to be included in evaluation under the ACCC Regulatory Test. KPMG has advised that, where a network support payment does represent an eligible cost (ie – there is a reasonable expectation that a service may be provided for the payment) and where the network support payment is new to the market (ie – it is additional to current network support payments), then KPMG consider it should be incorporated as an eligible cost in any Regulatory Test evaluation.

This advice is consistent with Powerlink's interpretation. It is Powerlink's view that the $2.7M in network support payment which the Application Notice recommends DirectLink be paid for the 2005/06 summer is not being paid by the producers, distributors or consumers of electricity at present. These payments would be new costs to participants in the electricity market, and therefore any suggestion that there is no underlying economic cost associated with these charges does not appear valid.

In a practical sense, Powerlink also considers that comparing network support payments with transmission charges arising from a network augmentation is the only realistic way to compare network and non-network alternatives. Network support payments are funded from regulated revenue, and Powerlink considers it essential that it be able to demonstrate that such expenditure is efficient (ie – less than the cost of augmenting the transmission network to achieve the same

[73] ACCC Regulatory Test, December 1999.
[74] P10 ACCC Draft Decision ,Review of the Regulatory Test for network Augmentations, 10 March 2004
[75] Refer discussion of the differences between income transfers and increases in efficiency on p50 of the ACCC Draft Decision: Review of the Regulatory Test for Network Augmentations, March 2004.

outcome). Conversely, if a network augmentation is to be justified as an alternative to implementing a network support arrangement, Powerlink considers that it must be able to demonstrate that the network augmentation has a lower cost than the non-network alternative and therefore satisfies the Regulatory Test. The only practical way to determine which option delivers the highest level of economic efficiency is to include the cost of network support arrangements in the Regulatory Test analysis.

It also does not appear to make sense to exclude transfers of income between transporters and consumers of electricity from the Regulatory Test. The Regulatory Test is designed to compare the costs and benefits of network augmentations and non-network alternatives. Transmission charges are the mechanism by which the capital investment in network augmentations is recovered from producers and consumers of electricity. Excluding such charges would mean that there would be no valid costs able to be included in a Regulatory Test assessment of transmission augmentations.

However, Powerlink is uncertain regarding how, or if, transmission charges arising from conversion of an unregulated interconnector to a prescribed service should be reflected in the Regulatory Test. For this reason, Powerlink also sought advice from KPMG regarding the treatment in the Regulatory Test financial analysis for the Gold Coast/Tweed zone of any regulated revenue which it is determined the DirectLink Joint Venture should receive. KPMG has advised that the incremental cost to the National Electricity Market of DirectLink converting to a regulated network asset should be included. Powerlink has not conducted financial analysis on this basis. The result of including the incremental cost to the market of a DirectLink conversion is likely to be a higher cost than the best ranked option being recommended.

8. Recommendation to Meet Gold Coast/Tweed Zone Future Requirements

As described in the previous sections of this response, the alternative option put forward by the DirectLink Joint Venture, Option 3C, is not considered a feasible solution to the future supply requirements in the Gold Coast/Tweed zone.

Therefore, the option which satisfies the Regulatory Test remains Option 3A, as recommended in the Application Notice. This draft recommendation has therefore been adopted as the final recommendation as follows:

- Provision of network support to the Gold Coast/Tweed zone by DirectLink for the summer of 2005/06 at an estimated total cost of $2.7M
- Establishment of a 275kV switchyard at Greenbank, and construction of a 275kV transmission line between Greenbank and Maudsland by late 2006. Construction of this proposed augmentation, estimated to cost $48.9M, to begin in late 2004, for commissioning by late 2006.

As explained in section 8.4, if the application by the DirectLink Joint Venture for regulated status is successful, network support from DirectLink in 2005/06 would still be feasible. The network support arrangement agreed between Powerlink and the owners of DirectLink provides for network support to be provided to the Gold Coast/Tweed zone in the summer of 2005/06 should the interconnector become regulated prior to that time.

Immediate steps will now be taken to implement this final recommendation to ensure that reliability of supply to customers in the Gold Coast/Tweed zone can be maintained.