OUTCOMES OF JOINT PLANNING INVESTIGATION

BENEFITS OF UPGRADING THE CAPACITY OF THE QUEENSLAND – NEW SOUTH WALES INTERCONNECTOR (QNI)

A PRELIMINARY ASSESSMENT

19 March 2004

1. Overview

Powerlink and TransGrid are the owners and operators of the Queensland and New South Wales electricity transmission grids respectively, and are the designated jurisdictional transmission network planning bodies appointed by the respective State Governments of Queensland and New South Wales.

The two organisations planned and constructed the Queensland-New South Wales Interconnector (QNI) and proceeded to commission it in late 2000. Since that time, Powerlink and TransGrid have worked as part of a multi-state team, comprising transmission network service providers and NEMMCO, to test the interconnector and progressively release its transfer capability for use in the National Electricity Market (NEM).

Powerlink and TransGrid have observed sustained periods exceeding 500 hours over the past twelve months where the Queensland-New South Wales Interconnector (QNI) has operated at the limit of its capacity. Ongoing high levels of constrained operation of this transmission link between the Queensland and New South Wales regions of the NEM are forecast in the future.

Powerlink and TransGrid are well aware of the importance to some National Electricity Market participants of unconstrained trading between market regions. It is therefore important to understand the extent to which upgrades to QNI capacity that would alleviate these constraints can be economically justified. For this reason, Powerlink and TransGrid have published this report, which contains the results of joint planning investigations by the two organisations into various potential increases in the power transfer capability between Queensland and New South Wales.

Any upgrade of the capacity of a regulated interconnector such as QNI must be justified in accordance with regulations governing transmission network augmentations set out in the National Electricity Code. The aim of this joint planning investigation was to carry out sufficient preliminary work to determine whether a full application of the relevant economic evaluation methodology - the Regulatory Test promulgated by the Australian Competition and Consumer Commission (ACCC) - should be carried out.

The first conclusion of these joint planning investigations is that a relatively small intra-regional augmentation, costing approximately $15-20 million, to alleviate future thermal limitations in northern NSW may be justifiable. Further work will need to be carried out by TransGrid to determine whether increasing QNI transfer capability in this way would be justifiable under a full application of the ACCC Regulatory Test. These preliminary studies show that the margin between the cost of alleviating this constraint on operation of QNI in a southerly direction and the benefits allowable under the ACCC Regulatory Test, whilst positive, is not large.

The second conclusion of these joint planning investigations is that no other, more significant, upgrade of QNI power transfer capability is likely to be judged economically viable under the current regulatory framework. The costs of a major upgrade of QNI transfer capacity are likely to be higher than the net market benefits presently allowable under the ACCC Regulatory Test.

These conclusions are based on assumed generation and load scenarios. It is acknowledged that commitment to a major power station in northern NSW or southern Queensland may alter these conclusions.

It is also acknowledged that reviews of the regulations governing new electricity network augmentations are currently underway, and in particular, a review of the Regulatory Test by the ACCC, including the definition of allowable market benefits. Other benefits of upgrading QNI may be allowable under future regulatory arrangements. Both the recent COAG Review (Parer) and the Ministerial Council on Energy (December 2003) have cited the desirability for the Regulatory Test to include ‘full competition benefits’. Recognising this, Powerlink and TransGrid have also estimated the gross market benefits (one possible method for evaluation of competition benefits) for various potential QNI upgrades. By way of illustration, whilst a 200MW upgrade of QNI, costing between $120 million and $160 million would be unlikely to pass the current version of the Regulatory Test, such an upgrade would deliver estimated gross market benefits of in excess of $500M.

Should there be a material change in the ACCC Regulatory Test or an emerging generation pattern significantly different to those assumed in these joint planning studies, Powerlink and TransGrid will work together to carry out a revised assessment of the benefits of upgrading the transfer capability of QNI.

"The clear conclusion is that no major upgrade of QNI transfer capability can be justified under the current regulatory framework"

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2. Background – QNI Historical Operation and Benefits

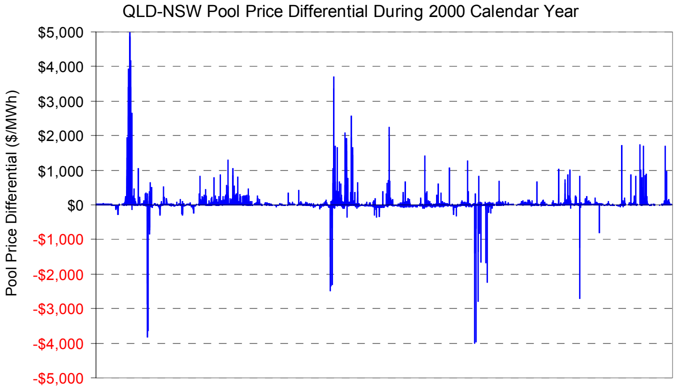
The Queensland – New South Wales interconnector (QNI) is an electricity transmission line linking the Queensland and New South Wales regions of the National Electricity Market (NEM) between Dumaresq in northern New South Wales and Bulli Creek in southern Queensland[1].

QNI is a free-flowing regulated transmission link. Flow across QNI occurs, within the physical limits of the interconnector, solely in response to the bidding patterns of generators in the NEM. In the early phases of its operation, power flow across QNI was predominantly in a northerly direction during peak demand periods. Following changes in generation capacity and market bidding patterns, flow on QNI is presently in a southerly direction for more than 90% of the time.

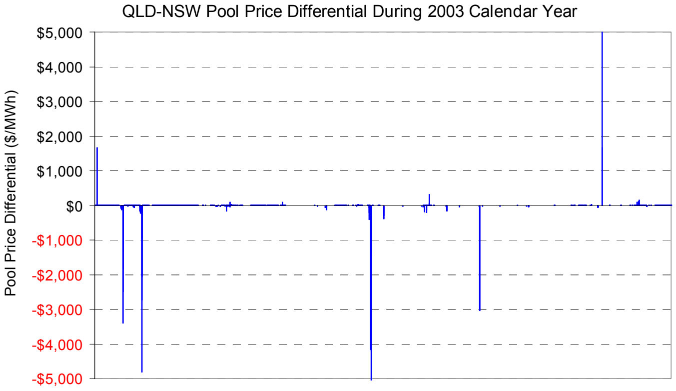
Since it commenced commercial operation in February 2001, the interconnector has been widely recognised as a valuable infrastructure investment. The transfer capacity of QNI is well utilised. In fact, the interconnector operated at the limits of its capacity for more than 500 hours during 2003. It has also delivered significant benefits well in excess of its cost. Following commissioning of QNI, there was an immediate and sustained decrease in ancillary services costs in the NEM of approximately $2.5 M per week. This benefit alone is much higher than the transmission use of system charges (TUOS) for QNI ($0.8M per week), leaving a net benefit in ancillary services costs alone of $1.7M per week, or about $80M per annum.

In addition, since QNI was installed, there has been a marked reduction in wholesale pool price volatility in the NEM (which ultimately manifests as lower contract/hedging costs) and a reduction in the pool price in both Queensland and New South Wales. The implementation of QNI is also attributed with facilitating the establishment of new low cost power generators (for example, Millmerran Power Station) and subsequent increased competition in the NEM.

Pre QNI



Post QNI



"Benefits of QNI have included reduced pool price volatility and sustained ancillary service cost savings of approx $2.5 Million per week"

Appendix A contains further information regarding the operation of QNI, including network configuration diagrams, transfer duration curves, and historical incidence of binding constraints.

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[1] DirectLink, an entrepreneurial link in the Tweed area of NSW that links the north coast NSW transmission system to that of south east Queensland, operates essentially in parallel with QNI.

3. Future Outlook for QNI

QNI commenced commercial operation in early 2001 with an initial maximum transfer capacity of 300-350MW. This has been progressively increased, following extensive testing, to the present maximum transfer capacity of up to 700MW north and up to 950MW south[2]. Further work is currently underway to increase the maximum southerly transfer capacity to at least 1000MW.

The operation of the existing interconnector is limited by numerous factors including transient stability, oscillatory stability and thermal and voltage limitations within the Queensland and New South Wales networks to which QNI is connected. The limiting factor at any point in time is dependent on generation patterns and other system conditions at that time. When physical transfer limits are reached, the operation of QNI is referred to as 'constrained'. The physical limits on transfer capacity are implemented in NEMMCO's market dispatch systems according to a series of constraint equations[3].

The factors most likely to limit QNI transfer capacity in a northerly direction in the next ten years are:

(1) oscillatory stability limits related to the capabilities of generator control systems to withstand disturbances on the system;

(2) limits imposed to maintain transient stability and voltage stability following a trip of the largest generator in Queensland or an outage of a line in northern NSW or in the Queensland network between Tarong and Braemar; and

(3) thermal limits on the network within northern NSW.

In a southerly direction, constrained operation in the next ten years is most likely to be due to:

(1) limits imposed to maintain transient stability of the electricity system following an interruption to potline operation at Boyne Island Aluminium Smelter in Queensland;

(2) oscillatory stability limits related to the capabilities of generator control systems to withstand disturbances on the system, and;

(3) the thermal capacity of the NSW transmission system between Armidale and Liddell. Market participants are advised that the recent upgrade work completed by TransGrid on the 132kV Armidale – Kempsey line (feeder 965) almost completely alleviated thermal constraints on southerly QNI flow caused by feeder 965 during the summer of 2003/04. However, it is possible that binding constraints on transfer across QNI due to thermal limits in the network south of Armidale will begin to reappear at times of high NSW load from the summer of 2004/05 as the load in the mid north coast of New South Wales continues to increase.

> ***"Forecasts of up to 2000+ hours of constrained operation per year have created a market expectation that an upgrade to QNI may be economic."***

The utilisation of QNI is expected to continue at very high levels in the future. Studies carried out by the Inter-Regional Planning Committee (IPRC) for the 2003 Annual Interconnector Review[4] (AIR) forecast that significant levels of constrained operation of QNI were likely to occur over the next decade under some scenarios. Constrained operation for up to 2500 hours p.a.(approximately 25-30% of the time) is possible within the next ten years (refer table of forecast hours of constrained operation in NEMMCO 2003 Statement of Opportunities). This outlook has created an expectation among some market participants and commentators that there may be economic justification for an upgrade of QNI transfer capability.

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[2] Under favourable loading and generation dispatch conditions.

[3] Equations can be downloaded from the NEMMCO Infoserver.

[4] Published as part of the NEMMCO '2003 Statement of Opportunities'.

4. Background – Regulatory Environment

Because QNI is a regulated interconnector, any future upgrade is required to pass the ACCC Regulatory Test. Current Code obligations[5] require proponents of new interconnector investments to undertake a cost-benefit analysis of a range of feasible augmentation options having regard to alternative timings and market development scenarios. The augmentation which passes the Regulatory Test is the one which "maximises the net present value of the market benefit". The limb of the Regulatory Test applicable to interconnectors defines the market benefit as "the total net benefits of the proposed augmentation to all those who produce, distribute and consume electricity in the National Electricity Market. That is, the increase in consumers' and producers' surplus or another measure that can be demonstrated to produce equivalent ranking of options in most (although not all) credible scenarios".

> ***"Interconnection upgrades must now satisfy the ACCC Regulatory Test, which did not exist when QNI was approved"***

In its 2003 Discussion Paper on the Review of the Regulatory Test, the ACCC provided some guidance on the type of market benefits that should form part of such an assessment process. Precedents for the interpretation of costs and benefits have also been established through past applications of the Regulatory Test.

The objective of the joint planning investigations carried out by Powerlink and TransGrid was to reach a preliminary view as to the extent to which a QNI upgrade was likely to be able to be economically justified under the ACCC Regulatory Test. These preliminary studies therefore focused on the following net market benefits[6] generally accepted as being allowable within the existing Regulatory Test.

Allowable Market Benefits	Description of Benefit
Production Efficiency Benefits	Reduction in fuel consumption of higher-priced sources Reduction in transmission losses Reduction in ancillary services
Capital Efficiency Benefits	Deferral of generation plant that would be required to maintain reliability reserve margins Deferral of generation plant that could be expected to enter the market in response to sustained high pool prices Reduction in capital costs Reduction in O&M costs Deferral of other transmission investments
Consumer Efficiency Benefits	Reduction in voluntary Demand Side Participation Reduction in involuntary load shedding

There are other types of benefits which are either not clearly defined or which are presently specifically excluded from the ACCC Regulatory Test (refer Appendix B). For example, the existing Regulatory Test does not recognise competition benefits that may arise from a transmission augmentation. It specifically excludes 'wealth transfers' between generators and customers (ie – underlying pool price outcomes) from the benefits assessment. Some discussion of benefits that are not allowed under the existing ACCC Regulatory Test is provided in section 8 for comparison purposes.

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[5] Refer clause 5.6.6 of the National Electricity Code and the Regulatory Test promulgated by the ACCC.

[6] Further details of benefits assessed are contained in Appendix C.

5. Overview of Joint Planning Investigations

TransGrid and Powerlink have worked together to carry out preliminary studies into the extent to which an upgrade to QNI was likely to be able to be justified under the current ACCC Regulatory Test.

Close cooperation between the two organisations resulted in the joint planning analysis. Significant exchange of technical expertise and cross-checking of simulation results occurred during the analysis process.

The methodology used for quantifying the potential economic benefits associated with an increase in QNI transfer capability was consistent with the methodology established and used by the Inter-regional Planning Committee (IRPC) and market consultants in the evaluation of other interconnector proposals (eg - SNI and SNOVIC), and builds on the work carried out for the 2003 AIR.

> ***"Close co-operation occurred between TransGrid and Powerlink to carry out the joint planning investigations"***

Information regarding assumptions used in the joint planning investigations is described in Appendices C and D. In brief, the joint planning investigation used a market simulation dataset based on the AIR 2003 database. The Supply-Demand Calculator (SDC) jointly developed by NEMMCO and ROAM Consulting Pty Ltd to forecast reserve margins across the NEM for a range of generation capabilities, demand growths, network capabilities and demand side participation was also used. Both of these analytical tools were modified slightly to incorporate available updated information (eg - from the 2003 Statement of Opportunities). Additional bidding scenarios were modelled to provide a more robust assessment of the range of possible benefits associated with each QNI upgrade option. TransGrid and Powerlink engaged ROAM Consulting Pty Ltd to develop a range of generation investment scenarios for use within the joint planning study. ROAM was also commissioned to provide generic outage rates for the different types of plant.

These joint planning investigations by TransGrid and Powerlink were designed to provide a high level indication of potential benefits for various scales of QNI capacity increases.

Consistent with this approach, some of the benefits of interconnection were examined in less detail than would be required for a full application of the ACCC Regulatory Test (refer Appendix C for further details). The extent of analysis and computation for each type of market benefit corresponded to the accepted benefits in the ACCC Regulatory Test as established through precedents, and the expected degree to which each benefit would contribute to the total benefit. For example, a high level of evaluation was carried out to examine changes in generation dispatch and deferral of capital investment in reliability plant (which has a major impact on the analysis), while no analysis was carried out into the benefits arising from a stimulation of consumer demand due to decreased pool prices. Experience from the evaluation of the South Australia-New South Wales Interconnector (SNI) indicates that the latter benefits do not significantly impact investment outcomes due to the relatively inelastic nature of electricity demand.

6. Options & Scenarios

Powerlink and TransGrid are not aware of any proposals to establish any additional entrepreneurial interconnectors between the Queensland and New South Wales transmission networks. The options considered in the joint planning analysis therefore comprise regulated network upgrades.

The options were developed by Powerlink and TransGrid based on their in-depth understanding of the transmission networks in both states and of the present and future limits on the transfer capacity of QNI. The organisations continually monitor the ongoing performance of the existing interconnector and jointly carry out ongoing analysis of the performance of constraint equations, and their impact on the capability of QNI. In addition, planning studies carried out by TransGrid for recent reliability augmentations on the Mid North Coast of NSW have provided additional data regarding how the wider NSW transmission network behaves under conditions of northern and southern QNI transfers.

Three QNI capacity upgrade option concepts were developed for the 2003 AIR. These upgrades covered a wide range of capacity increase (nominally 200MW, 800MW and 2000MW). These same upgrade concepts have been included in this market benefit study as Options D, E and F. It should be noted that Options D, E and F also include intra-regional network upgrades to ensure the region to region capacities can be achieved.

In addition to these significant options, a range of incremental capacity concepts has been developed to assess the benefits of marginally improving QNI transfer capability in a southerly direction. Option A removes the thermal constraints which are anticipated to, at times, limit the assumed stability limit. Options B and C address the oscillatory and transient stability of the interconnected network to achieve a 50MW and 100MW increase in southerly transfer capability respectively.

In all, six upgrade concepts which could alleviate forecast constraints on QNI operation were examined, as summarised in the table overleaf.

Option	Capacity Increase	Description	Estimated Cost[7]
Option A	Various -southerly direction[8]	Works to alleviate future thermal limitations in northern NSW network[9]	$15-20M
Option B	Nominal 50MW - southerly direction*	Option A works + transient/oscillatory stability enhancements[10]	$35-45M
Option C	Nominal 100MW - southerly direction*	Option A & B works + further transient/oscillatory stability enhancements	$50-60M
Option D	Nominal 200MW in both directions*	Option A, B & C works + further transient/oscillatory stability enhancements. A 200MW upgrade will have wider impacts on connected systems, and will therefore require related intra-regional augmentations[11]	$120-160M
Option E	Nominal 800MW in both directions*	An additional Queensland – New South Wales HVAC interconnection	$600-800M
Option F	Nominal 2000MW in both directions*	An additional Queensland – New South Wales HVDC connection	$1400-1800M

* in addition to the capacity increases achieved by Option A

For the purposes of the joint planning investigations, the market benefit of the six options was evaluated under a range of market development scenarios, generator bidding patterns and demand conditions as listed in the table overleaf. Powerlink and TransGrid recognise that other scenarios may be plausible, but consider that the scenarios examined are sufficiently comprehensive to indicate the possible extent of net market benefits of an upgrade to QNI transfer capability.

An independent expert market consultant, ROAM Consulting Pty Ltd, was engaged to develop the generation investment scenarios used in the study. Pricing premium and minimum reserve levels were the main triggers for new plant entry. However, scenario 'themes' were used to influence the location and type of plant entry, so as to ensure a broad range of potential market developments were examined. Further details regarding the scenario assumptions and study methodology are included in Appendices C and D.

It should be noted that the scenarios involving development of major coal-fired generation assumed that the power station/s would be located within the Queensland system relatively close to major existing transmission lines. Should major coal-fired generation develop in alternative locations (eg – in NSW remote from the route of QNI), the assumptions regarding the extent and cost of transmission augmentations to alleviate transfer constraints would need to be re-evaluated.

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[7] Costs are pre-feasibility level estimates only. The focus of this preliminary study was on determining the extent of capacity upgrade that could potentially be justified under a full application of the ACCC Regulatory Test, rather than on detailed scoping of potential projects.

[8] Dependent on system conditions eg- customer load on relevant NSW transmission elements.

[9] Option A would involve only substation works and minor line works as new transmission line works are clearly not feasible for such a low capital cost. Option A would be in addition to recent upgrade work on the Armidale-Kempsey 132kV line (feeder 965), and does not include potential augmentations of the 132kV network to maintain supply reliability to the NSW Mid North Coast (refer TransGrid 2003 Annual Planning Report).

[10] Transient/oscillatory stability enhancement works include the installation of power system equipment such as series compensation on relevant lines, Static Var Compensators, high speed switching facilities etc.

[11] to address transformer capacity and thermal and voltage limitations in the NSW & QLD networks.

Scenario	Description
New Entry Scenario 1	Major coal fired development within the Queensland Surat Basin
New Entry Scenario 2	Major gas fired development within the Victorian and South Australian regions
New Entry Scenario 3	Energy policy favouring gas development throughout the NEM
New Entry Scenario 4	Major industrial load development within Queensland
New Entry Scenario 5	Major industrial load development within New South Wales
New Entry Scenario 6	Major industrial load development concurrently within Queensland and NSW
New Entry Scenario 7	Major coal fired development within south-west and central Queensland
Transmission Scenario 1	Transmission network database used for AIR 2003 market simulations[12]
Transmission Scenario 2	Includes proposed upgrade between Snowy and Victoria regions (NEWVIC)
Bidding Scenario 1	Short-run marginal costs (SRMC) as provided by ACIL Tasman for AIR 2003
Bidding Scenario 2	Short-run marginal costs (SRMC) used in the SNI evaluation (Garlick Associates)
Bidding Scenario 3	Historical (simplified representation based on 2001/02 bidding behaviour)
Bidding Scenario 4	Long-run marginal cost (LRMC) used in the SNI evaluation
Bidding Scenario 5	Shadow (ie – Bertrand bidding) where highest band corresponds to marginal cost of next competitor within merit order bidding
50% POE Forecast	50% Probability of Exceedance demand forecast (average weather conditions)
10% POE Forecast	10% Probability of Exceedance demand forecast (1 Year in 10 weather conditions)

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[12] The impact of SNI was excluded as this proposed project is being re-evaluated

7. Results – Allowable Benefits Under ACCC Regulatory Test

Key Outcomes of the Joint Planning Investigations

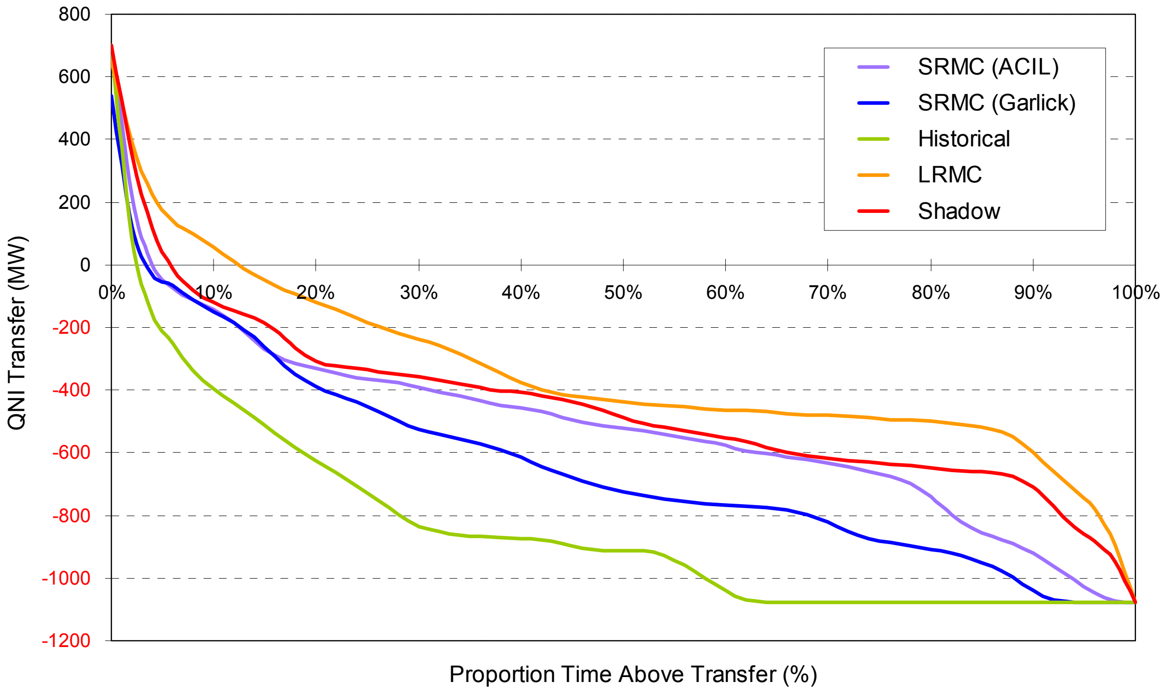
The key outcomes of the preliminary joint planning studies carried out in accordance with the existing ACCC Regulatory Test to determine the extent of economic benefits that could be achieved with an upgrade of QNI transfer capacity[13] are:

1. The forecast level of constrained future operation of QNI in a southerly direction (no upgrade) is high for bidding strategies based on historical trends. Lower levels of constrained operation are evident for other bidding patterns.

2. The forecast level of constrained future operation of QNI (no upgrade) is higher for market development scenarios where there is a higher level of new entry generation in Queensland.

The following graphs show the percentage of time that interconnector transfer is expected to be above a certain level for various bidding scenarios and generation patterns.

Figure 7.1 - Cumulative QNI Transfer Distribution 2012/13 (No QNI Upgrade)
Various Generator Bidding Strategies; New Entry Scenario 1



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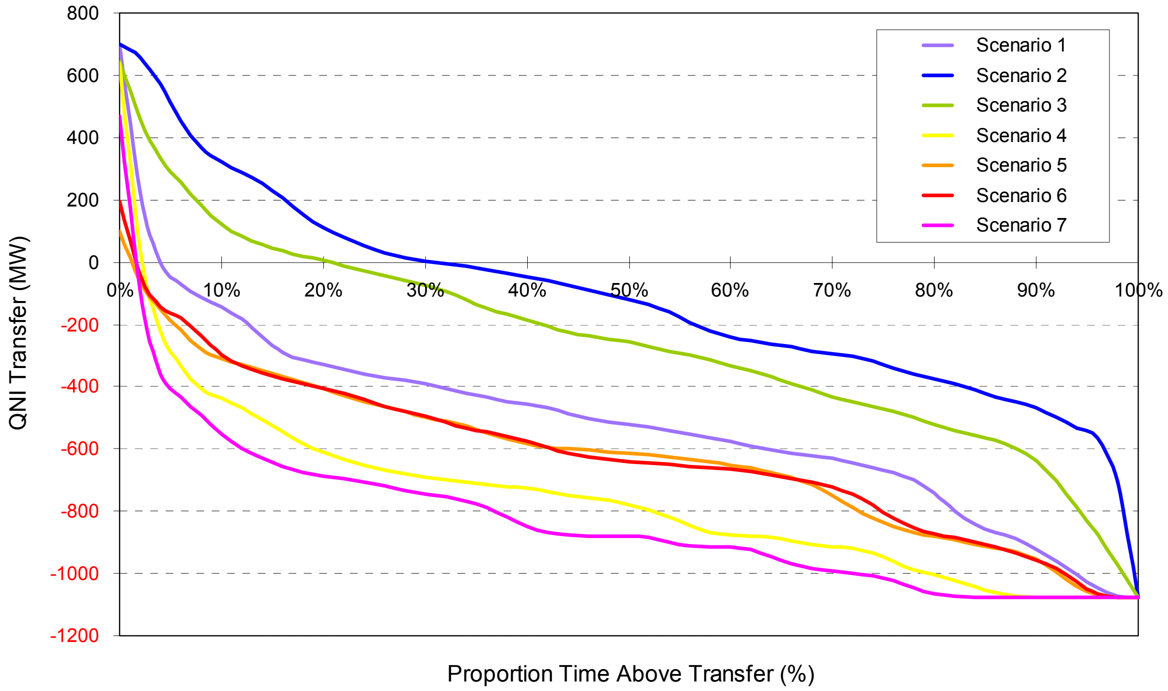
[13] Refer Appendix E for further detail. Note that all graphs in this report assume 50% Probability of Exceedance demand forecast and the completion of the possible NEWVIC Stage 2 interconnector upgrade between NSW and Victoria, unless otherwise stated.

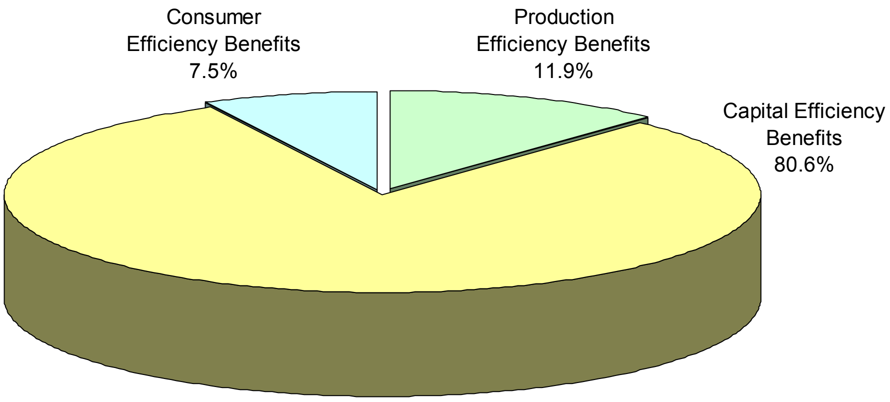
Figure 7.2 – 2012/13 Cumulative QNI Transfer Distribution (No QNI Upgrade) Various New Entry Scenarios; SRMC (ACIL) Bidding



3. The source of the allowable benefits under the existing ACCC Regulatory Test varies between options and scenarios. The majority of benefits are due to the benefits that a QNI upgrade would deliver in terms of deferral of capital investment in new reliability plant (ie – generation required to ensure reserve margins are maintained and to meet customer demand[14]).

4. The benefits associated with a reduction in production costs (eg - dispatch of lower cost generation and associated fuel cost savings through alleviation of transmission constraints) and consumer efficiency (eg – reduction in involuntary load-shedding) are relatively minor proportion of the total benefits, as shown in the following pie-chart.

Source of Market Benefits
Average of New Entry Scenarios and Average of Bidding Strategies[15]



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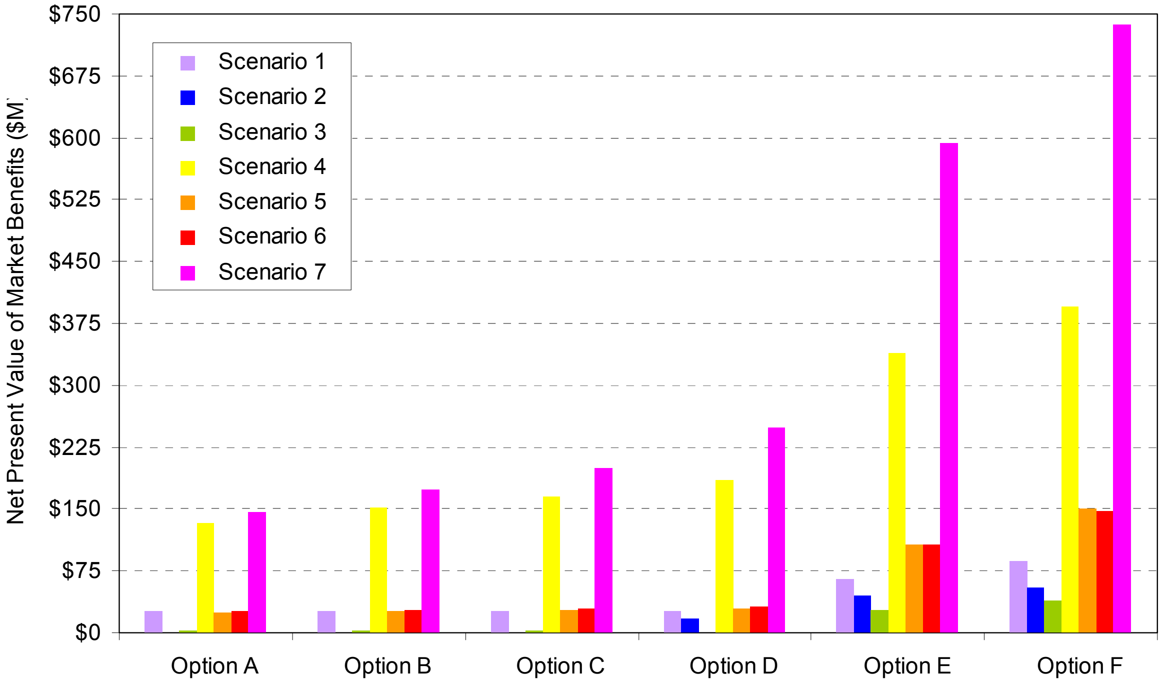
[14] The study did not investigate net market benefits associated with deferral of market entry plant. Based on the studies carried out for SNI, it is considered that the capital deferral of reliability plant captures the majority of the capital efficiency benefits of an interconnector upgrade. It is therefore considered that benefits associated with deferral of market entry plant due to a QNI upgrade are likely to be relatively small.

[15] Graph based on results for Option A

5. The results are sensitive to the assumed market development scenario. Benefits of upgrading QNI transfer capacity are higher in scenarios where there are higher levels of generation capacity in Queensland (Scenarios 4 and 7), because forecast constraints are higher under these scenarios;

Figure 7.3 - Total Market Benefits for the Various New Entry Generation Scenarios (Note that No Costs are Included in this Graph).



6. Only Option A appears to deliver positive net market benefits under the majority of scenarios considered, as shown in Figure 7.4 below.

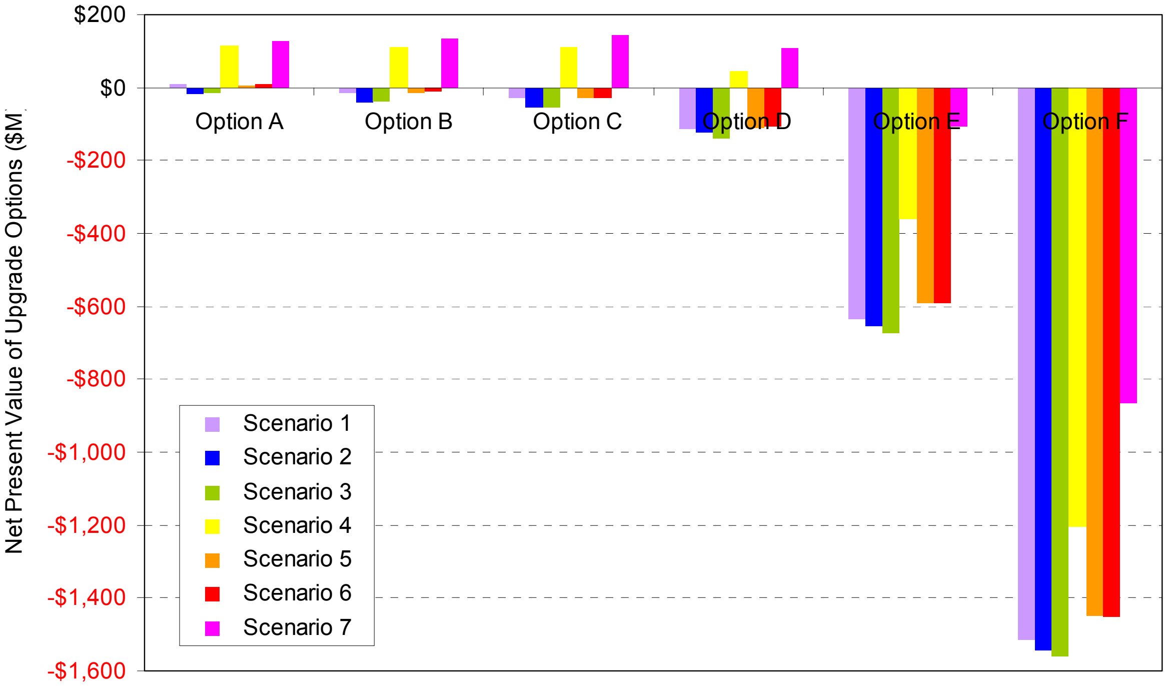
7. Options B & C show relatively small negative net benefits in the majority of scenarios. The three highest cost options to upgrade QNI transfer capacity (Options D, E and F) have a significant unfavourable gap between the costs of augmentation and the benefits that are allowable under the ACCC Regulatory Test.

8. However, Options A, B, C and D exhibit strong positive net benefits for the scenarios (4 and 7) which involve higher levels of generation in Queensland.

Table 7.1 - Net Present Value ($M) of Each QNI Upgrade Option Across the Various Generation Development Scenarios

Scenario	Option A	Option B	Option C	Option D	Option E	Option F
1	$8	-$14	-$29	-$114	-$635	-$1,513
2	-$17	-$40	-$55	-$123	-$655	-$1,545
3	-$15	-$38	-$53	-$140	-$673	-$1,561
4	$116	$111	$110	$45	-$361	-$1,205
5	$7	-$14	-$28	-$111	-$592	-$1,450
6	$8	-$13	-$26	-$108	-$592	-$1,452
7	$128	$133	$145	$109	-$107	-$864

Figure 7.4 - Net Present Value of Each QNI Upgrade Option Across the Various Generation Development Scenarios [16]



<u>Discussion of Results – Options B - F</u>

The Regulatory Test requires a proponent of a proposed augmentation to demonstrate that a recommended option maximises the net market benefit in the majority of scenarios considered.

As demonstrated in the graph and table above, Options E and F, the options where an additional HVAC or HVDC interconnector is constructed, are clearly not economically viable under the existing regulatory framework. The costs are expected to significantly outweigh the allowable net market benefits. This outcome is not considered sensitive to changes in assumptions regarding load growth, bidding behaviour or generation dispatch.

Options B, C and D, where relatively large augmentations costing $35-$160 million are carried out to alleviate constraints on the existing interconnector, are also not expected to be justifiable under the ACCC Regulatory Test. These options have negative net benefits in the majority of scenarios considered.

Positive net market benefits are evident for these options under market development scenarios 4 and 7 (ie - where generation in Queensland exceeds local requirements by high to very high amounts). This is primarily due to the capital efficiency benefits of a QNI upgrade – that is, the excess capacity in Queensland can be used in conjunction with an augmentation of QNI transfer capability to defer capital investment in reliability plant in other states. However, in the other scenarios, these benefits are not as significant, particularly in Scenarios 2 & 3 where a large proportion of new entry generation occurs in southern states.

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[16] The net present values for the QNI options in the graph and table above represent the average total net market benefit across the bidding strategies for the seven new entry scenarios. They have been calculated by subtracting the project costs from the sum of the production, capital efficiency and consumer efficiency benefits as outlined in section 4. The project costs used were the average of the estimated cost range, incurred in 2006/07.

On the basis of these results, Options B – F are unlikely to be able to pass the Regulatory Test, and thus a full Regulatory Test evaluation is not warranted.

Discussion of Results – Option A

These joint planning studies indicated that only Option A has the potential to deliver positive net market benefits in the majority of scenarios considered. Option A involves expenditure of between $15 and $20 million on substation and minor transmission line works in NSW to alleviate future constrained operation of QNI due to thermal limitations in the transmission network in the Mid North Coast area of NSW[17]. Based on this preliminary result, further detailed analysis and project scoping is considered to be necessary to determine whether Option A can pass the ACCC Regulatory Test.

The benefits and costs of Option A are much closer than in other options considered in this joint planning analysis. The preliminary work has identified that, because there is only a small margin between the benefits and costs of Option A, the results are more sensitive to changes in the assumptions made in the planning analysis. This sensitivity is shown in Figure 7.5.

It is important to highlight that the analysis carried out for these joint planning investigations indicated that uncommitted network developments which may be required to maintain a reliable electricity supply to the Mid North Coast area of NSW[18] could reduce the benefits of implementing Option A (refer Figure 7.5). The reliability augmentations will strengthen the 132kV network which operates in parallel with the Armidale to Liddell 330kV lines. Such augmentations will therefore alleviate thermal limits in northern NSW, and could have small coincidental beneficial impacts on the existing QNI transfer capability.

The case for the economic justification of Option A under the existing regulatory framework will therefore need to be clarified through more detailed work. Of particular interest will be the dependence of the benefits on the works of the NEWVIC Stage 2 project. TransGrid will continue further assessment of potential actions to address thermal limits on southerly transfer on QNI. Work is already underway to refine the scope of several reliability augmentation proposals in northern NSW[19] which will allow the impact of these proposed augmentations on QNI transfer to be clarified.

Other work is expected to be initiated shortly, as part of the 2004 Annual National Transmission Statement (ANTS), to carry out further analysis of the future operation of QNI and other interconnectors in the NEM. This will allow further detailed evaluation of Option A works to be carried out using the most up-to-date information.

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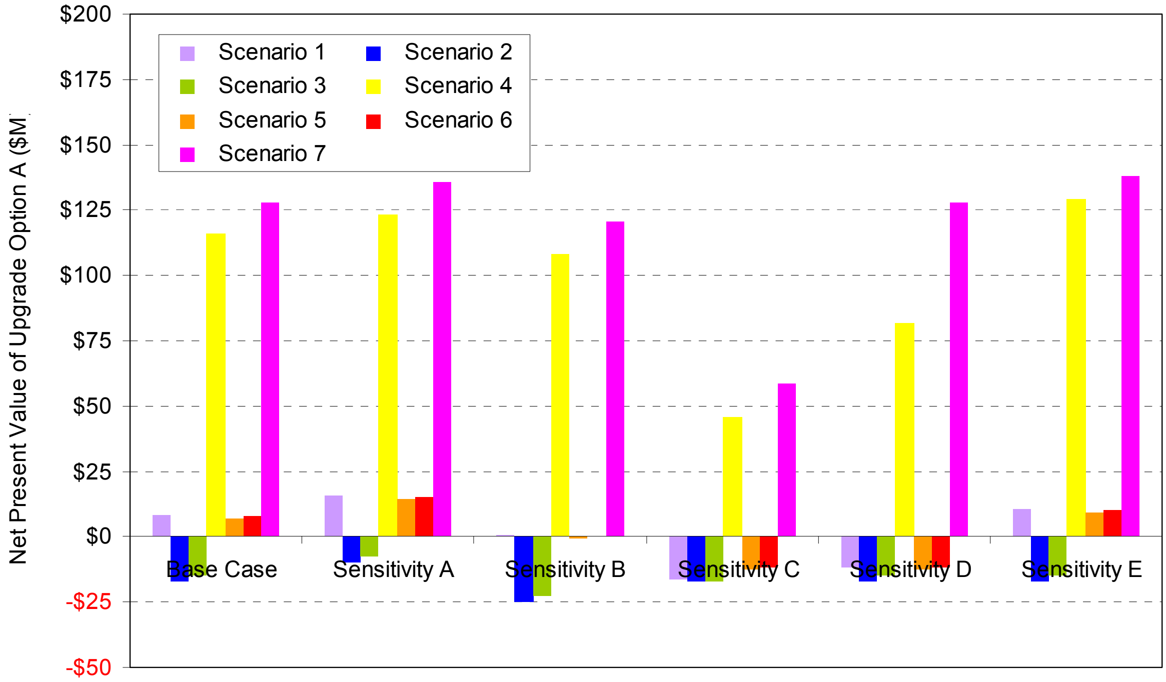
[17] These limitations have been addressed in the short-term through upgrade work recently completed by TransGrid, but are expected to re-emerge from summer 2004/05 as load in the NSW Mid North Coast Area increases.

[18] For example, it is anticipated that reliability augmentations may be required in the next five years to address supply in this area, including a potential upgrade of the Coffs Harbour-Nambucca-Kempsey 132kV line to operate both circuits at 132kV, and a proposed new Kempsey-Port Macquarie 330kV line initially operating at 132kV. Refer TransGrid 2003 Annual Planning Report for further details.

[19] to allow assessment under the ACCC Regulatory Test.

Figure 7.5 - Sensitivity of the Net Present Value of Option A to Various Assumptions and Factors



Schedule of Sensitivities:

Base Case	Project cost $17.5M; project timing 06/07, includes NEWVIC Stage 2
A	Reduced project cost ($10M)
B	Increased project cost ($25M)
C	Includes uncommitted reliability augmentations within northern NSW
D	Excludes NEWVIC upgrade stage 2
E	Project timing 2007/08

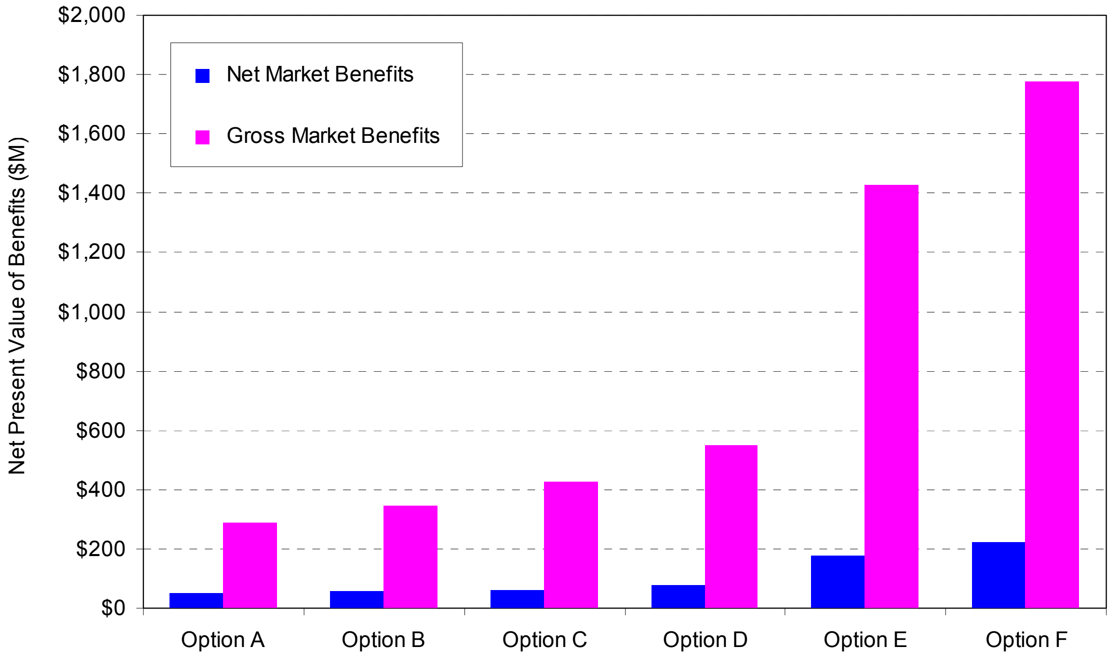
8. Discussion of Other Potential Benefits

The purpose of these joint planning investigations by TransGrid and Powerlink was to carry out a preliminary study to determine whether a full Regulatory Test evaluation into upgrading QNI was justifiable. Powerlink and TransGrid therefore did not seek to carry out studies into benefits that are not allowable under the ACCC Regulatory Test, such as competition benefits or other benefits associated with the pool price impacts of increased interconnector capacity. However, there has been considerable market focus (Parer, MCE) on the methodology for measuring the benefits of transmission upgrades, and regulatory reviews into the assessment process for new network augmentations are presently underway. Some discussion of alternative approaches to evaluating the benefits of a QNI upgrade is provided in this section for comparison purposes.

Gross Market Benefits

A by-product of the market simulation studies to define net market benefits in accordance with the ACCC Regulatory Test was the generation of data to allow calculation of the gross market benefits of the various interconnector upgrade options. The gross benefits represent the average change in customer payments across each new entry scenario and generator bidding strategy, and include assumptions relating to ongoing benefits beyond the ten year analysis period. Gross market benefits can arise due to lower pool prices through increased competition, changes in generator dispatch, changes in new generation investment etc. Pool price outcomes are specifically excluded from the existing ACCC Regulatory Test as the costs and benefits of an augmentation exclude "wealth transfers" between generators and customers. Gross market benefits are one possible way of measuring "full competition benefits".

These joint planning investigations identified estimated average gross market benefits between $300M and almost $1800M for the upgrades to QNI transfer capability considered. These figures are the average across all the scenarios and bidding strategies. In each case, the gross market benefits exceeded the cost of the relevant interconnector upgrade option. For example, Option D which would deliver an increase in interconnector capacity of 200MW for an estimated cost of $120-160 million exhibited average gross market benefits of more than $500 million. Option E which would deliver a 800MW capacity increase exhibits approximately $1400 million in gross market benefits compared with an estimated cost of $600-800 million.



Parer Report

The Parer Report, instigated by the Council of Australian Governments (COAG), postulated that significant competition benefits would ensue from interconnector upgrades which would not be captured through the restrictive definition of "net market benefits" under the current Regulatory Test. When examining weaknesses in the rules and approval processes applying to investment in new regulated interconnectors, the report states "at the heart of these concerns is the problematic regulatory benefits test".

The Parer Panel considered that the key problem with the Test is that it does not fully recognise the commercial benefits associated with alleviating network constraints between regions, and that the Regulatory Test "…does not attempt to assess or include the benefits that would arise through increased competition or the spillover effects that could potentially be captured by a coalition of investors. The result can be to undervalue interconnector augmentation."

The Parer Report identified substantial competition benefits which would be expected to arise following upgrade of interconnections within the NEM. The Report stated that upgrading the capacity of all interconnectors in the NEM by 20% would result in benefits of $1.1 billion for the five year period (2005 to 2010), but did not provide any breakdown by interconnector.

A 20% increase in the capacity of QNI is equivalent to Option D, a 200MW increase in transfer capability in both directions. One simple method of approximating the proportion of the benefits identified in the Parer Report which could be attributable to upgrading QNI is to use the proportion of inter-regional settlement residue arising across QNI[20]. The average of the forecast settlement residue for QNI in proportion to the total forecast settlements revenue across the NEM in the AIR 2002 and 2003 is 13.2%. On this high level basis, a 20% capacity upgrade of QNI could be expected to deliver 13.2% of the total Parer benefits to customers, or $146M over 5 years. Assuming the benefits continue at the same rate for a substantial proportion of the interconnector asset life, the projected net present value of the benefits identified by Parer of upgrading QNI capacity by 20% would be $383M. This is of the same order of magnitude as the gross market benefits identified in these forward looking market simulations carried out as part of the joint planning investigation by Powerlink and TransGrid.

Ministerial Council on Energy (MCE) December 2003

At its meeting in December 2003, the MCE made a number of recommendations in relation to the COAG Review (Parer Report) which it believed constituted a 'substantial response' to the COAG Review. A specific MCE recommendation was:

- a new regulatory test for transmission to include the full economic benefits of increased competition, to be implemented in July 2004.

Powerlink and TransGrid intend to review the analysis described in this report when details of this new Regulatory Test are published.

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[20] Settlement residues are considered an indicator of the benefits being denied to the market as residues comprise the product of pool price separation times the energy volume constrained for each interconnector.

9. Conclusions

The conclusions of these joint planning investigations carried out by TransGrid and Powerlink to provide a preliminary assessment of the extent to which an upgrade of the transfer capability of the Queensland-New South Wales interconnector can be economically justified under the existing Regulatory Test are as follows:

- The majority of the market benefits of a QNI upgrade, as calculated in accordance with the existing ACCC Regulatory Test, are associated with deferral of capital investment in new generation.

- Options B, C, D, E and F do not deliver a positive net market benefit under a majority of the market development scenarios considered. On this basis, these QNI upgrade options are unlikely to be able to pass the existing ACCC Regulatory Test.

- This conclusion is based on comprehensive market simulations and scenario assessment carried out in accordance with the ACCC Regulatory Test requirements.

- Powerlink and TransGrid are confident that the substantial analytical work carried out in the preliminary assessment clearly shows that significantly upgrading QNI transfer capability is not economically viable under the existing regulatory framework. On the basis of the preliminary joint planning studies, it is therefore not proposed to carry out a full Regulatory Test evaluation to seek to justify a major QNI upgrade in the short-term.

- The only upgrade option that could potentially deliver positive net market benefits under a majority of market development scenarios is Option A. This relatively low cost option involving substation and minor line works in NSW would alleviate future constrained operation of QNI in a southerly direction due to future thermal limitations in the northern NSW network. It would be in addition to anticipated reliability augmentations in the Mid North Coast Area of NSW.

- Powerlink and TransGrid consider that Option A is the only QNI upgrade option which may be able to pass the existing ACCC Regulatory Test, although the outcome is by no means clear-cut. Based on this preliminary analysis, TransGrid will undertake further work to assess the costs and sensitivity of benefits of this option in more detail.

- Preliminary investigations carried out by Powerlink and TransGrid indicate that gross market benefits are significant. These benefits are not allowable in the current Regulatory Test, and could be as high as $1400 million for an 800MW capacity increase that could be delivered for a cost of $600-800 million.

- Powerlink and TransGrid will continue to work together to carry out new studies should there be a material change in the existing Regulatory Test or an emerging generation pattern significantly different to the ones assumed in this study.

10. Comments & Feedback

Powerlink and TransGrid welcome feedback and comments regarding this joint planning investigation and the analysis outcomes. Please contact:

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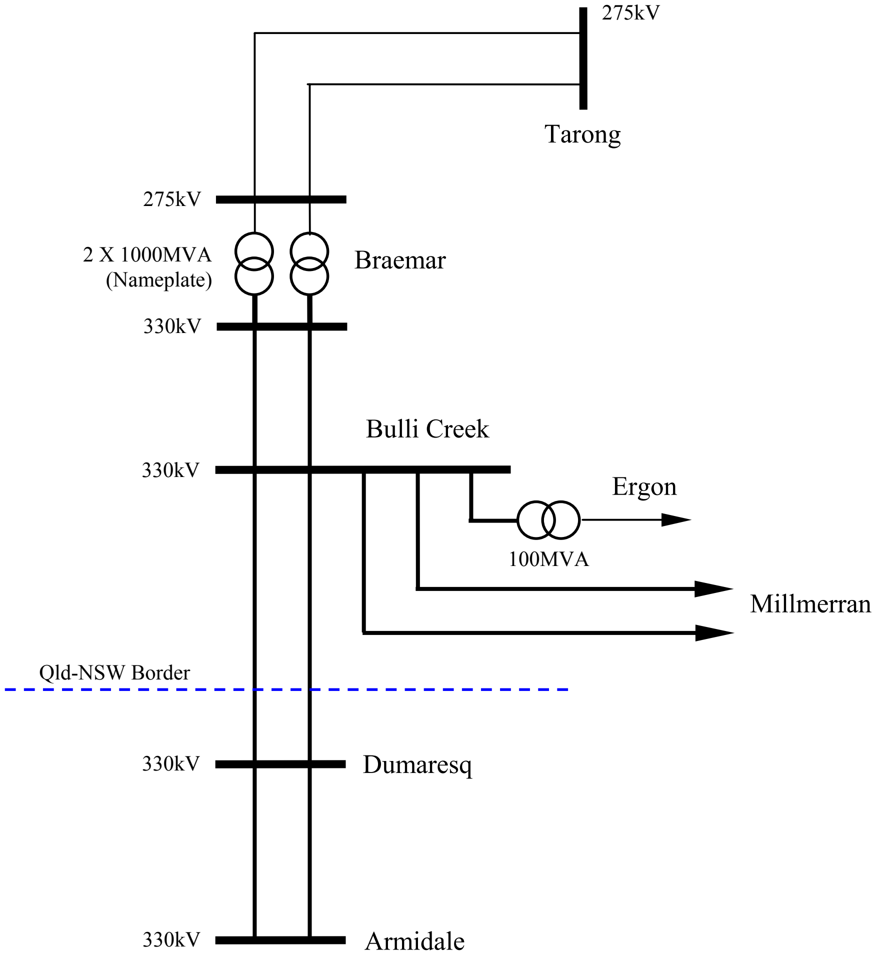
APPENDICES

Appendix A – QNI Background and Historical Performance

Existing Queensland to NSW Interconnection Connectivity

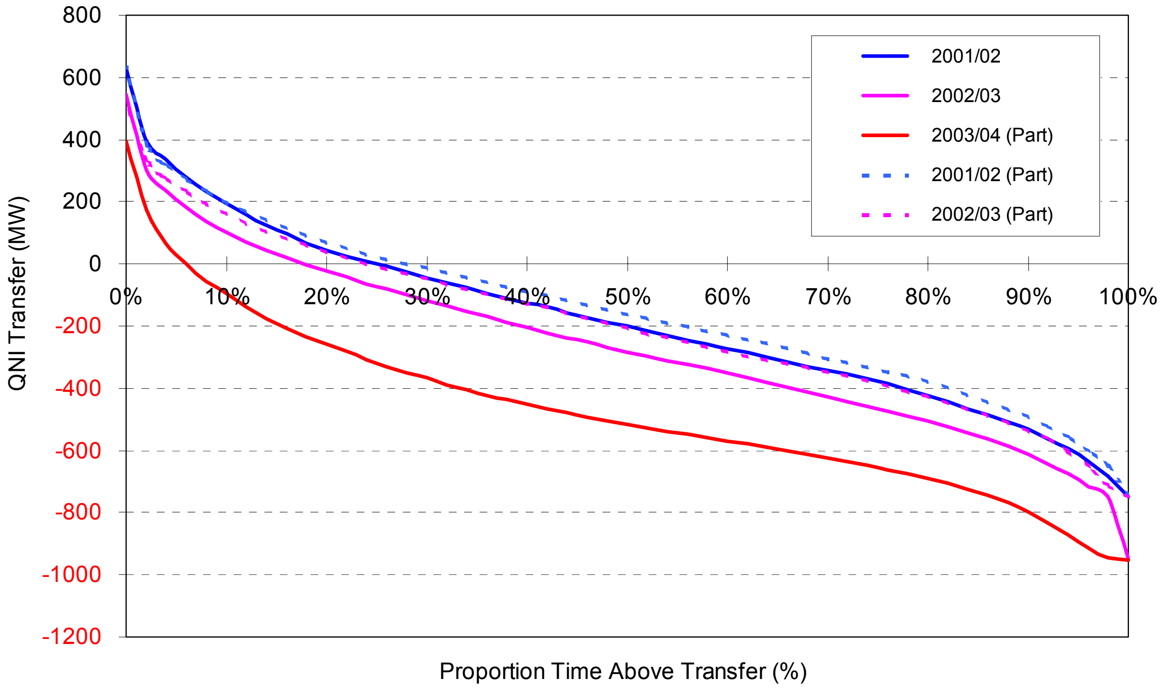
The existing Queensland to NSW interconnector connectivity is detailed below. Switching and reactive control equipment (ie. circuit breakers, isolators, shunt reactors, SVCs, etc) have not been included for simplicity.

Figure A.1 - Existing Queensland to NSW Connectivity



The level of southward flow has been increasing since the commencement of QNI, with a pronounced increase during the last year following establishment of new coal-fired and combined cycle gas turbine plant (ie. Callide Power Plant, Millmerran, Tarong North and Swanbank E) within Queensland. Figure A.2 demonstrates the shift in higher levels of southerly transfer over the past year.

Figure A.2 - Historical Cumulative QNI Transfer Distribution Curves



1. The 2003/04 curve corresponds to part of the financial year from 1st July 2003 to 31st January 2004.
2. The dashed 2001/02 and 2002/03 curves correspond to the same parts of the financial year as the 2003/04 curve (ie. 1st July to 31st January) in order to allow comparisons across these time slices.

The changing pattern of QNI operation is also evident in the historical data for actual interconnector flows, mode of operation and constraint times shown in Table A1.

Table A.1 - Historical QNI Performance (January 2002 to December 2003)

Average Transfer (MW) [1]													
Period		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
2002		72	72	-198	-227	-380	-381	-206	-163	-267	-170	-245	-151	-191
2003		-147	-223	-418	-279	-536	-351	-551	-572	-609	-575	-498	-227	-418
Mode of Operation (% of time)														
Period/Direction		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
2002	North	64%	58%	18%	21%	4%	6%	25%	29%	17%	20%	14%	35%	25%
	South	36%	42%	82%	79%	96%	94%	75%	71%	83%	80%	86%	65%	75%
2003	North	35%	19%	8%	12%	1%	5%	1%	1%	0%	1%	5%	25%	9%
	South	65%	81%	92%	88%	99%	95%	99%	99%	100%	99%	95%	75%	91%
Constraint Times (hours per month)														
Period/Direction		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
2002	North	65.0	72.8	8.1	0.0	10.1	3.3	18.3	9.8	11.6	14.1	30.8	91.7	335.5
	South	6.8	4.7	26.6	21.1	57.3	37.7	24.6	20.3	83.3	24.6	4.5	11.8	323.1
	Total	71.8	77.5	34.7	21.1	67.3	40.9	42.9	30.1	94.9	38.7	35.3	103.4	658.6
2003	North	17.0	4.3	52.4	19.8	0.0	0.0	0.0	0.0	0.7	0.0	2.4	6.4	103.0
	South	40.9	5.8	105.4	16.5	32.8	3.0	15.8	41.6	109.2	111.1	40.8	6.0	528.9
	Total	57.9	10.1	157.8	36.3	32.8	3.0	15.8	41.6	109.8	111.1	43.2	12.4	631.9

1. QNI transfer as per NEM convention (ie. positive transfer denotes northerly flow).

Appendix B – Regulatory Environment

Table B.1 - Potential Benefits Associated with an Interconnector Upgrade (Shaded Area Denotes Benefits Considered Recognisable and Allowable under the Existing ACCC Regulatory Test)

Benefit	Description of Benefit	Notes	Mechanism
Production Efficiency Benefits	More efficient (optimal) generation dispatch	▪ Reduction in transmission constraints (interconnector upgrades) ▪ Establishment of power sharing mechanisms (new interconnections)	Decreased variable costs (fuel and O&M)
	Reduction transmission losses		
	Reduction ancillary services		
Capital Efficiency Benefits	Deferral or avoidance of reliability plant		Decreased fixed (capital) and variable costs (fuel and O&M)
	Deferral or avoidance of market entry plant		
Consumer Efficiency Benefits	Reduction voluntary demand side participation (DSP)		Increased consumption benefits through lower pool prices[1]
	Reduction involuntary load shedding (unserved energy)		
	Stimulated consumer demand	▪ Demand elasticity mechanism	
Competition Benefits[2]	Reduction in market power resulting in more efficient generation production	▪ Elimination of opportunity for strategic capacity withdrawal ▪ Reduction in predatory pricing strategies	Decreased variable costs (fuel and O&M) Pool price outcomes
	Productivity gains as a result of greater competition	▪ More efficient machine utilisation or work methods ▪ More efficient material handling or waste control ▪ Technical enhancement or innovations	

1. Increase in consumption benefits (consumer surplus) outweighs increase in production costs (ie. additional energy production) resulting in a net social surplus increase.
2. Competition benefits currently not explicitly recognised or prescribed within the Regulatory Test.

Appendix C – Methodology and Assumptions

The following methodologies and assumptions for calculating the different types of market benefits were used:

Production Efficiency Benefits

- Production efficiency benefits were calculated by evaluating the change in short run marginal production costs across the NEM associated with each interconnector upgrade option. Note that the change in production cost captures both dispatch optimisation and changes associated with interconnector transmission losses.
- The production efficiency benefits were evaluated through the use of forward looking market simulations. The market simulations were performed using specialist software designed to replicate the operation of the NEM dispatch engine.
- The market simulation dataset was based on that developed for the Annual Interconnector Review (AIR) 2003. Some modifications and enhancements were made to the database as detailed within Table C.1.
- Additional generator bidding strategies and new entry development scenarios were modeled to provide a more robust assessment of the range of potential benefits (refer Appendix D).
- Short run marginal cost data derived by ACIL Tasman and P M Garlick and Associates were used in the calculation of production efficiency benefits. The production costs of new entry was based on average costs of existing similar technology plant.
- ROAM Consulting was commissioned to provide equivalent annualised planned outage rates for the different type of plant technologies.

Table C.1 - Forward Looking Market Simulation Dataset

Parameter	Property	Dataset Source
Generators	Capacity	Updated to correspond with SOO 2003[21]
	Planned Outages	Based on ROAM data
	Forced Outages	AIR 2003
	Bidding	AIR 2003 plus additional bidding strategies
	MLFs	AIR 2003
	Hydros	AIR 2003 plus enhancements
	New Entry	ROAM Consulting
Demand	Load Traces	Modified to align with SOO 2003 forecasts
	DSP	AIR 2003
Transmission	Constraint Equations	AIR 2003 plus additional scenarios and options
	dMLFs	AIR 2003 plus additional upgrade options

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[21] The AIR simulations were conducted prior to some of the information published within the SOO 2003 being finalised and available.

- The effects of transmission forced outages were not modeled within the simulations. However, it is acknowledged that some of the upgrade options incorporating parallel transmission corridors (ie. options E and F) would have advantages in maintaining higher levels of transfer capacity under contingency conditions.

- Some modifications to the AIR 2003 constraint equations were made, mainly associated with excluding the impacts of SNI[22]. The constraint equations representing northern NSW network limitations act as a combined limit on both QNI and DirectLink.

- The increase in transfer capacity associated with Option A was modelled by removing constraint equations which represented the northern NSW network limitations. The increase in capacity for the other options was modelled by increasing the constant term of the constraint equations (ie. right hand side) by the respective nominal increase in capacity.

- It was assumed that Options A to D would not significantly impact on the notional transmission losses between Queensland and NSW[23]. However, it was assumed that the notional losses would decrease by a factor of two for Option E and by a factor of three for Option F. The resultant impacts on the inter-regional loss equations and marginal loss factor equation are as follows:

  <u>Options A - D</u>[24]

  Loss equation = (-0.0057 - 3.9115e-06 * Nd + 1.1155e-05 * Qd) * NQt + 1.3118e-04 * NQt^2

  dMLF = 0.9943 + 2.6235e-04 * NQt - 3.9115e-06 * Nd + 1.1155e-05 * Qd

  <u>Option E</u>

  Loss equation = (-0.0028 - 1.9558e-06 * Nd + 5.5775e-06 * Qd) * NQt + 6.5590e-05 * NQt^2

  dMLF = 0.9972 + 1.3118e-04 * NQt - 1.9558e-06 * Nd + 5.5775e-06 * Qd

  <u>Option F</u>

  Loss equation = (-0.0019 - 1.3038e-06 * Nd + 3.7183e-06 * Qd) * NQt + 4.3725e-05 * NQt^2

  dMLF = 0.9981 + 8.7450e-05 * NQt - 1.3038e-06 * Nd + 3.7183e-06 * Qd

  Nd = NSW Sent-out Demand

  Qd = QLD Sent-out Demand

  NQt = Transfer from NSW to Queensland.

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[22] Note that the AIR 2003 equations were used relatively unchanged to maintain consistency with the AIR process. The AIR 2003 constraint equations assume an increase in the southern oscillatory stability limit from 950MW to 1080MW within the base case. They also assume some level of uncommitted reliability upgrade works within NSW.

[23] Upgrading of transmission or series compensation could impact on losses, but were assumed not to have an appreciable effect for the purposes of this study.

[24] The loss equations used within the AIR 2003 were based on those published by NEMMCO for the 2002/03 financial year.

Capital Efficiency Benefits

- Capital efficiency benefits were calculated by the reduction in reliability plant required to meet minimum reserve margins associated with each upgrade option.
- The SOO 2003 Supply Demand Calculator produced and updated by ROAM Consulting and NEMMCO was used to evaluate the changes in reliability plant requirements[25].
- Some minor modifications to the SOO 2003 constraint equations were made to reflect updated information relating to the committed Middle Ridge to Millmerran reinforcement. The oscillatory stability limit in the southerly direction was also assumed to be increased to 1080MW. The recent upgrade works on the Armidale to Kempsey 132kV line (feeder 965) have been incorporated in an approximate manner (pending development of detailed power transfer limit equations) within the Supply Demand constraint equations. However, uncommitted reliability upgrade works within northern NSW have not been included.
- The increase in transfer capability associated with each interconnector upgrade option was represented by changes to the constraint equations in the same manner as described for the production efficiency benefits.
- Reserve trader entry was assumed to be met by open cycle gas turbine plant, since this generation type represents the lowest capital cost option to meet reserve levels. The capital cost of the OCGT plant was assumed to be $500/kW, corresponding to an annualised rate of $45.5/kW based on a discount rate of 10%.
- It was assumed that the intervention reserve trigger level will continue to be set by the size of the largest generator within each region (in accordance with the current requirements of the NECA Reliability Panel) across the ten year time frame. Hence, the minimum reserve margin for Queensland was increased from 450MW (existing level) following the advent of larger sized coal-fired plant (eg. Kogan Creek).

Consumer Efficiency Benefits

- Consumer efficiency benefits were assessed by calculating the net change in consumer and producer surplus associated with reduction in demand side responses and unserved energy.
- The consumer benefit associated with reductions in demand side participation was valued at $3000/MWh. The consumer benefit associated with reductions in unserved energy was costed at $29,600/MWh. The cost of production was assumed to be $20/MWh, roughly corresponding to the average of coal-fired and CCGT short run marginal costs.

Financial Analysis

- A discount rate of 10% was used within the NPV calculations. It was assumed that benefits were incurred at the end of the financial year, whereas expenditure for augmentations occurred at the start of the financial year.

Residuals

- It was assumed that upgrade benefits continue for the economic life of the asset (ie. typically 50 years) at a constant rate equal to the average across the final three years of the analysis period. Sensitivities to different residual calculation methodologies were assessed (refer Appendix E).

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[25] The Supply Demand calculator is a spreadsheet designed by NEMMCO and ROAM for the purposes of forecasting reserve margins across the NEM for a range of generation capabilities, demand growths, network capabilities and demand side participation. The calculator uses linear programming optimisation to minimise reserve deficits by sharing available resources subject to dynamic transmission constraints.

Appendix D – Market Development Scenarios

The ACCC Regulatory Test requires that options be assessed in the context of market development scenarios associated with variations in load growth, network development, generation dispatch (bidding strategies), and new generation development.

Generator Bidding Strategies

Five different bidding strategies were modeled within the forward looking market simulations as described within Table D.1.

Table D.1 - Description and Characteristics of Bidding Strategies

Strategy	Characteristics
SRMC (ACIL)	▪ Self dispatch levels as per the AIR 2003. ▪ Short run marginal costs as provided by ACIL Tasman for the IRPC and NEMMCO for use within the AIR 2003 ▪ Higher order bands not incorporated.
SRMC (Garlick)	▪ Self dispatch levels as per the AIR 2003 assumptions. ▪ Short run marginal costs compiled by P M Garlick and Associates for use within the SNI evaluation. ▪ Higher order bands not incorporated.
Historical	▪ Simplified three band representation based on historical 2001/02 financial year bidding behaviour. ▪ Minor adjustments made such that simulation outcomes matched historical behaviour.
LRMC (SNI)	▪ Long-run marginal cost bidding as used within the SNI evaluation. ▪ Based on costs compiled by P M Garlick and Associates for use within the SNI evaluation.
Shadow	▪ Highest band corresponds to marginal cost of next competitor within merit order (ie. Bertrand bidding). ▪ Dynamically takes into account merit order variations associated with generator planned and forced outages.

Demand Forecasts

Two demand growth scenarios were modelled within the market simulations incorporating 50% and 10% probability of exceedance (POE) medium economic growth forecasts.

Network Development

Two transmission development scenarios representing the commissioning of the possible Stage 2 upgrade of the Snowy to Victoria Interconnector (NEWVIC) were modelled. The upgrade alleviates the limitations on the transfer of power from NSW/Snowy to Victoria, and may increase the benefits associated with an upgrade of the Queensland to NSW interconnection. This project is not a committed development and it will be important to adequately reflect this in future detailed work.

New Generation Entry

ROAM Consulting were commissioned to develop range of generation investment scenarios for use within the upgrade study. The process used by ROAM involved the use of scenario themes. Although pricing premium and minimum reserve levels were the main triggers for new plant entry, the scenario themes were used to bias or weight the location and type of merchant entry. This approach reduced the dependency of market price outcomes as the sole mechanism for type and location of new generation investment.

The market development scenarios provided by ROAM are detailed within Table D.2. Assumptions of major new loads within each of the region are detailed within Table D.3. Schedules of generator sizes, timings and costs are provided within Tables D.4-10. Scenario 7 represents a heavily biased generation investment program within Queensland, which could occur with the expectation of new interconnection, collapse of major new load development, and/or abrupt economic (and demand growth) downturn.

Table D.2 – Description of ROAM Consulting Market Development Scenarios

Scenario	Description
1	Major coal fired development within the Queensland Surat Basin
2	Major gas fired development within the Victorian and South Australian regions
3	Energy policy favouring gas development throughout the NEM
4	Major industrial load development within Queensland
5	Major industrial load development within NSW
6	Major industrial load development concurrently within Queensland and NSW
7	Major coal fired development within central and south-west Queensland

Table D.3 - Schedule of Major New Loads within the ROAM Consulting Scenarios[1]

Scenario	Industrial Load
1	No additional load
2	No additional load
3	No additional load
4	1000MW within Queensland commissioned during 2006/07[2]
5	1000MW within NSW commissioned during 2006/07[2]
6	1000MW within each of the Queensland and NSW regions commissioned concurrently during 2006/07[2]
7	No additional load

Notes:

1. Major new industrial loads are in addition to the SOO 2003 medium economic growth forecasts.
2. Commissioning date 1/12/2006.

Table D.4 - New Entry Program for Scenario 1 - Major Coal-Fired Plant within the Queensland Surat Basin

Year	Queensland			NSW			Victoria			South Australia		
	Type	Size	Plant	Type	Size	Plant	Type	Size	Plant	Type	Size	Plant
2003/04												
2004/05												
2005/06	Renewable	50	Q_Renewables#1									
2006/07	Coal	750	Kogan Creek #1	Coal	700	NN Coal #1				Renewable	50	S_Renewables#1
				OCGT	350	NSW OCGT #1				OCGT	350	SA OCGT #1
2007/08				Coal	700	NN Coal #2				CCGT	350	SA CCGT #1
				OCGT	350	NSW OCGT #2						
				OCGT	350	NSW OCGT #3						
2008/09				OCGT	350	NSW OCGT #4	OCGT	350	VIC OCGT #1			
				Renewable	50	N_Renewables#1						
				OCGT	350	NSW OCGT #5						
				OCGT	350	NSW OCGT #6						
2009/10	Coal	450	Millmerran #3	Coal	700	NN Coal #3	OCGT	350	VIC OCGT #2			
	Coal	450	Millmerran #4									
2010/11	Coal	450	CQ Coal #1	OCGT	350	NSW OCGT #7	OCGT	350	VIC OCGT #3	OCGT	350	SA OCGT #2
	Coal	450	CQ Coal #2									
2011/12	CCGT	350	Swanbank E #2	Coal	700	NN Coal #4	CCGT	350	VIC CCGT #1			
				OCGT	350	NSW OCGT #8						
2012/13	Coal	750	Kogan Creek #2				CCGT	350	VIC CCGT #2			

Notes:

▨ Denotes reliability plant to meet minimum reserve levels

Table D.5 - New Entry Program for Scenario 2 - Major Gas-Fired Development within Victoria and South Australia

Year	Queensland			NSW			Victoria			South Australia		
	Type	Size	Plant	Type	Size	Plant	Type	Size	Plant	Type	Size	Plant
2003/04												
2004/05												
2005/06	Renewable	50	Q_Renewables#1							CCGT	350	SA CCGT #1
2006/07				OCGT OCGT	350 350	NSW OCGT #1 NSW OCGT #2				Renewable	50	S_Renewables#1
2007/08				CCGT CCGT OCGT	350 350 350	NSW CCGT #1 NSW CCGT #2 NSW OCGT #3	CCGT	350	VIC CCGT #1			
2008/09	Coal	750	Kogan Creek #1	CCGT Renewable	350 50	NSW CCGT #3 N_Renewables#1	CCGT	350	VIC CCGT #2	CCGT	350	SA CCGT #2
2009/10				Coal	700	NN Coal #1	CCGT	350	VIC CCGT #3			
2010/11	CCGT	350	Swanbank E #2				CCGT Renewable	350 50	VIC CCGT #4 V_Renewables#1			
2011/12	Coal	450	Tarong North #2	Coal Renewable	700 50	SN Coal #1 N_Renewables#2				CCGT	350	SA CCGT #3
2012/13				Coal	700	NN Coal #2	CCGT Renewable	350 50	VIC CCGT #5 V_Renewables#2			

Notes:

▨ Denotes reliability plant to meet minimum reserve levels

Table D.6 - New Entry Program for Scenario 3 - Energy Policy Favouring Gas Development

Year	Queensland			NSW			Victoria			South Australia		
	Type	Size	Plant	Type	Size	Plant	Type	Size	Plant	Type	Size	Plant
2003/04												
2004/05												
2005/06	Renewable	50	Q_Renewables#1							CCGT	350	SA CCGT #1
2006/07				OCGT OCGT	350 350	NSW OCGT #1 NSW OCGT #2	Renewable	50	V_Renewables#1	Renewable	50	S_Renewables#1
2007/08	CCGT Renewable	350 50	Swanbank E #2 Q_Renewables#2	Renewable OCGT	50 350	N_Renewables#1 NSW OCGT #3	CCGT	350	VIC CCGT #1			
2008/09	CCGT	350	QLD CCGT #1	CCGT CCGT Renewable	350 350 50	NSW CCGT #1 NSW CCGT #2 N_Renewables#2				CCGT	350	SA CCGT #2
2009/10	CCGT	350	QLD CCGT #2	Renewable	50	N_Renewables#3	CCGT Renewable	350 50	VIC CCGT #2 V_Renewables#2	Renewable	50	S_Renewables#2
2010/11	CCGT	350	QLD CCGT #3	CCGT Renewable Renewable	350 50 50	NSW CCGT #3 N_Renewables#4 N_Renewables#5	CCGT	350	VIC CCGT #3			
2011/12	CCGT CCGT	350 350	QLD CCGT #4 QLD CCGT #5	CCGT CCGT	350 350	NSW CCGT #4 NSW CCGT #5	Renewable	50	V_Renewables#3	Renewable	50	S_Renewables#3
2012/13	Coal	750	Kogan Creek #1	CCGT	350	NSW CCGT #6	CCGT	350	VIC CCGT #4			

Notes:

▨ Denotes reliability plant to meet minimum reserve levels

Table D.7 - New Entry Program for Scenario 4 - Major Industrial Load Development within Queensland

Year	Queensland			NSW			Victoria			South Australia		
	Type	Size	Plant	Type	Size	Plant	Type	Size	Plant	Type	Size	Plant
2003/04												
2004/05												
2005/06	Renewable	50	Q_Renewables#1									
2006/07	Coal Coal Coal CCGT	750 450 450 350	Kogan Creek #1 CQ Coal #1 CQ Coal #2 Swanbank E #2	OCGT	350	NSW OCGT #1				Renewable OCGT	50 350	S_Renewables#1 SA OCGT #1
2007/08	Coal	450	Tarong North #2	OCGT OCGT	350 350	NSW OCGT #2 NSW OCGT #3				CCGT	350	SA CCGT #1
2008/09	Coal Coal	450 450	Millmerran #3 Millmerran #4	OCGT Renewable OCGT OCGT	350 50 350 350	NSW OCGT #4 N_Renewables#1 NSW OCGT #5 NSW OCGT #6	OCGT	350	VIC OCGT #1			
2009/10	Coal Coal	450 450	CQ Coal #3 CQ Coal #4	Coal	700	NN Coal #1	OCGT	350	VIC OCGT #2			
2010/11				Coal CCGT	700 350	NN Coal #2 NSW CCGT #1	OCGT	350	VIC OCGT #3	OCGT	350	SA OCGT #2
2011/12	Coal	450	Tarong North #3	CCGT	350	NSW CCGT #2	CCGT	350	VIC CCGT #1			
2012/13	Coal	750	Kogan Creek #2				CCGT	350	VIC CCGT #2			

Notes:

▨ Denotes reliability plant to meet minimum reserve levels

Table D.8 - New Entry Program for Scenario 5 - Major Industrial Load Development within NSW

Year	Queensland			NSW			Victoria			South Australia		
	Type	Size	Plant	Type	Size	Plant	Type	Size	Plant	Type	Size	Plant
2003/04												
2004/05												
2005/06	Renewable	50	Q_Renewables#1	OCGT OCGT	350 350	NSW OCGT #1 NSW OCGT #2						
2006/07	Coal	750	Kogan Creek #1	CCGT OCGT	350 350	NSW CCGT #1 NSW OCGT #3				Renewable OCGT	50 350	S_Renewables#1 SA OCGT #1
2007/08	CCGT	350	Swanbank E #2	Coal	700	NN Coal #1				CCGT	350	SA CCGT #1
2008/09				Coal Renewable	700 50	NN Coal #2 N_Renewables#1	OCGT	350	VIC OCGT #1			
2009/10				CCGT	350	NSW CCGT #2	CCGT	350	VIC CCGT #1			
2010/11	Coal Coal	450 450	Tarong North #2 CQ Coal #1	CCGT	350	NSW CCGT #3	OCGT	350	VIC OCGT #2			
2011/12	Coal	450	CQ Coal #2	Coal	700	SN Coal #1	CCGT	350	VIC CCGT #2	CCGT	350	SA CCGT #2
2012/13	Coal Coal	450 450	Millmerran #3 Millmerran #4				CCGT	350	VIC CCGT #3			

Notes:

▨ Denotes reliability plant to meet minimum reserve levels

Table D.9 - New Entry Program for Scenario 6 - Major Industrial Load Development within Queensland and NSW

Year	Queensland			NSW			Victoria			South Australia		
	Type	Size	Plant	Type	Size	Plant	Type	Size	Plant	Type	Size	Plant
2003/04												
2004/05												
2005/06	Renewable	50	Q_Renewables#1	OCGT OCGT	350 350	NSW OCGT #1 NSW OCGT #2						
2006/07	Coal Coal Coal	750 450 450	Kogan Creek #1 CQ Coal #1 CQ Coal #2	CCGT OCGT	350 350	NSW CCGT #1 NSW OCGT #3				Renewable OCGT	50 350	S_Renewables#1 SA OCGT #1
2007/08	Coal CCGT	450 350	Tarong North #2 Swanbank E #2	Coal	700	NN Coal #1				CCGT	350	SA CCGT #1
2008/09	Coal Coal	450 450	Millmerran #3 Millmerran #4	Coal Renewable	700 50	NN Coal #2 N_Renewables#1	OCGT	350	VIC OCGT #1			
2009/10	Coal Coal	450 450	CQ Coal #3 CQ Coal #4	CCGT	350	NSW CCGT #2	OCGT	350	VIC OCGT #2			
2010/11				CCGT	350	NSW CCGT #3	OCGT	350	VIC OCGT #3			
2011/12				Coal	700	SN Coal #1	CCGT	350	VIC CCGT #1	CCGT	350	SA CCGT #2
2012/13							CCGT	350	VIC CCGT #2			

Notes:

▨ Denotes reliability plant to meet minimum reserve levels

Table D.10 - New Entry Program for Scenario 7 - Major Coal-Fired Plant within Central and South-West Queensland

Year	Queensland			NSW			Victoria			South Australia		
	Type	Size	Plant	Type	Size	Plant	Type	Size	Plant	Type	Size	Plant
2003/04												
2004/05												
2005/06	Renewable	50	Q_Renewables#1									
2006/07	Coal	750	Kogan Creek #1	OCGT	350	NSW OCGT #1				Renewable	50	S_Renewables#1
	Coal	450	Tarong North #2							OCGT	350	SA OCGT #1
2007/08	Coal	450	CQ Coal #1	OCGT	350	NSW OCGT #2				CCGT	350	SA CCGT #1
	Coal	450	CQ Coal #2	OCGT	350	NSW OCGT #3						
2008/09				OCGT	350	NSW OCGT #4	OCGT	350	VIC OCGT #1			
				Renewable	50	N_Renewables#1						
				OCGT	350	NSW OCGT #5						
				OCGT	350	NSW OCGT #6						
2009/10	Coal	450	Millmerran #3	Coal	700	NN Coal #1	OCGT	350	VIC OCGT #2			
	Coal	450	Millmerran #4									
2010/11	Coal	450	CQ Coal #3	OCGT	350	NSW OCGT #7	OCGT	350	VIC OCGT #3	OCGT	350	SA OCGT #2
	Coal	450	CQ Coal #4									
2011/12	CCGT	350	Swanbank E #2	Coal	700	NN Coal #2	CCGT	350	VIC CCGT #1			
				OCGT	350	NSW OCGT #8						
2012/13	Coal	750	Kogan Creek #2				CCGT	350	VIC CCGT #2			

Notes:

▨ Denotes reliability plant to meet minimum reserve levels

Appendix E – Analysis Results

Production Efficiency Benefits

The production efficiency benefits were calculated through the use of forward looking market simulations. The forecast behaviour of QNI across different generator bidding strategies and new entry assumptions can be examined through the use of cumulative distribution transfer curves.

Cumulative distribution curves for QNI transfer comparing the effects of differing generator bidding strategies and new entry scenarios are shown within Figures E.1 to E.4. Distribution curves comparing the effects of upgrade options are shown within Figures E.5 to E.6. Comparisons of the average production efficiency benefits for different probability of exceedance demand forecasts are illustrated within Figure E.7.

It is evident that the historical bidding scenario provides the closest correlation to recent QNI behaviour, whereas the LRMC bidding has the highest level of discontinuity. New entry scenarios 4 to 7 result in the highest levels of southerly transfers, whereas scenarios 2 and 3 result in the lowest levels.

The production efficiency benefits were assessed by calculating the change in net production costs across the NEM associated with the upgrade option. An interconnector upgrade may increase transmission losses if alleviation of constraint occurrences results in higher inter-regional power transfers. However, this is outweighed by an overall reduction in the cost of production across the NEM resulting from more efficient dispatch resulting from alleviation of the constraint.

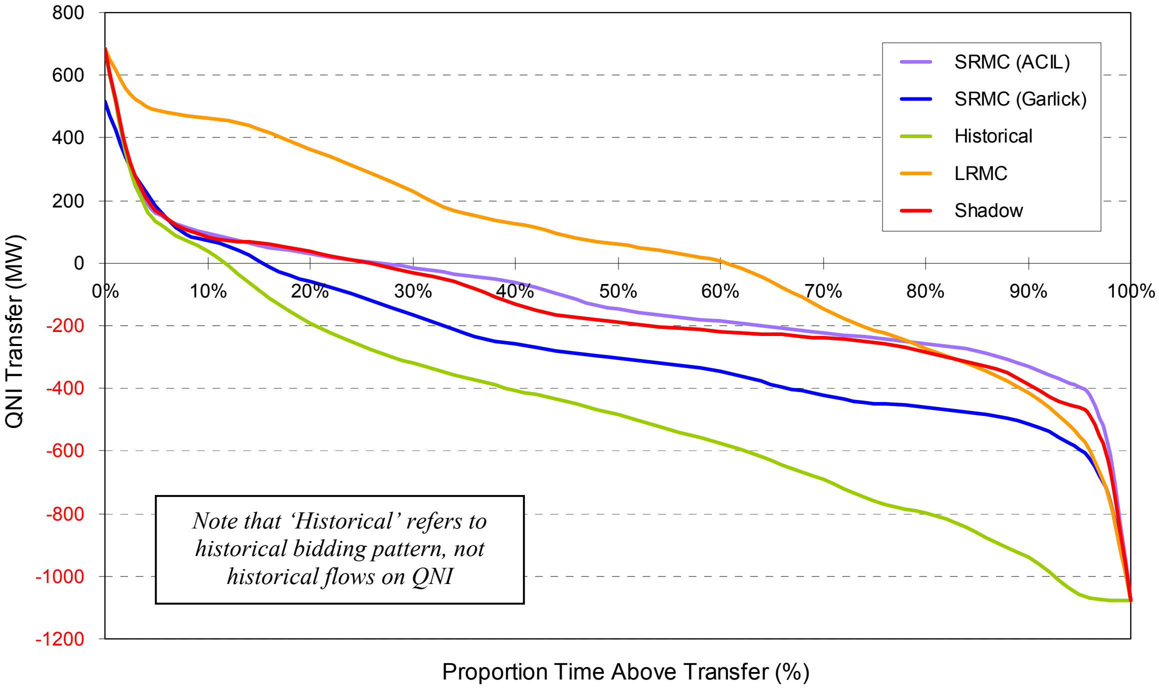
Changes to the dynamic marginal loss factor equation across QNI for upgrade options E and F leads to lower price differentials between the Queensland and NSW regions, resulting in higher levels of power transfers across the entire spectrum of QNI operation. The increase in power transfers for the other options are confined to areas associated with alleviation of constraints.

Capital Efficiency Benefits

The net present value of the capital efficiency benefits associated with deferral of reliability plant are illustrated within Figures E.8 to E.9. The net present values include assumptions of on-going benefits beyond the ten year analysis time frame (ie. includes residual benefits).

The possible NEWVIC Stage 2 project improves the capital deferral benefits, since it allows excess generation capacity within Queensland to be accessed through the QNI upgrades to address potential reserve margin deficits within Victoria or South Australia. Figure 7.5 illustrated the sensitivity of the NPV of Option A to the presence of this project and Figure E.9 shows the effect of the NEWVIC project on the Capital Deferral Benefits for each option.

Figure E.1 - Cumulative QNI Transfer Distribution Curve 2003/04 (No QNI Upgrade) Various Generator Bidding Strategies



Note that 'Historical' refers to historical bidding pattern, not historical flows on QNI

Figure E.2 - Cumulative QNI Transfer Distribution Curve 2006/07 (No QNI Upgrade) Various Generator Bidding Strategies; New Entry Scenario 1

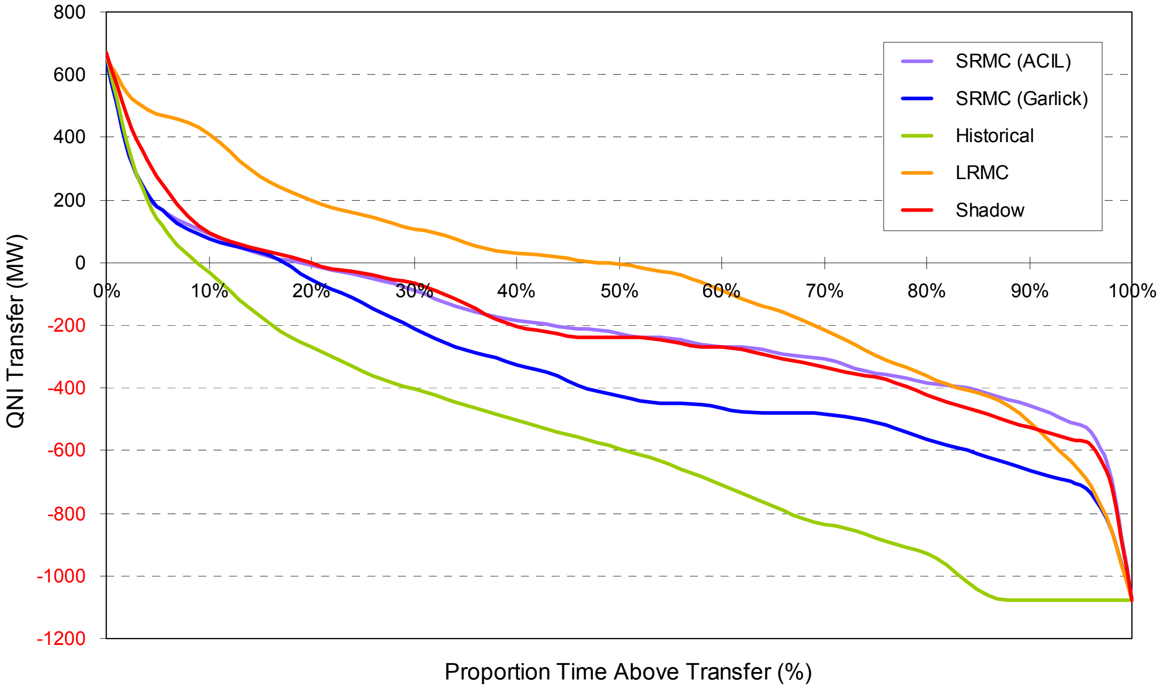


Figure E.3 - Cumulative QNI Transfer Distribution Curve 2012/13 (No QNI Upgrade) Various Generator Bidding Strategies; New Entry Scenario 1

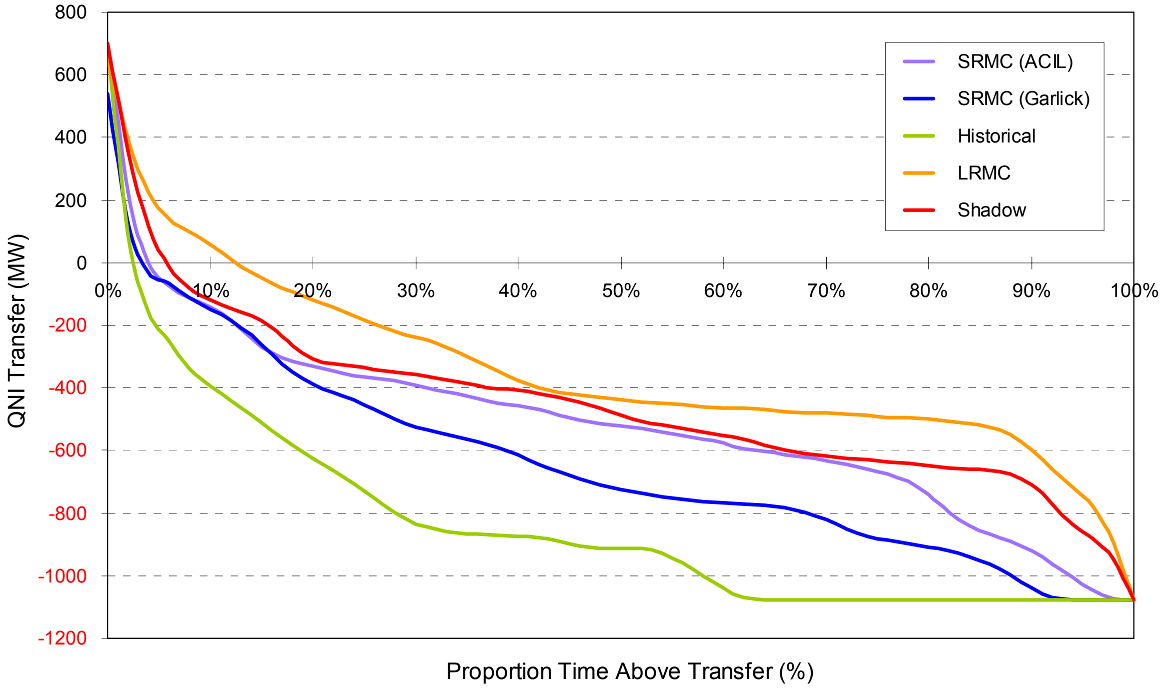


Figure E.4 - Cumulative QNI Transfer Distribution Curve 2012/13 (No QNI Upgrade) SRMC (ACIL) Bidding Strategy; Various New Entry Scenarios;

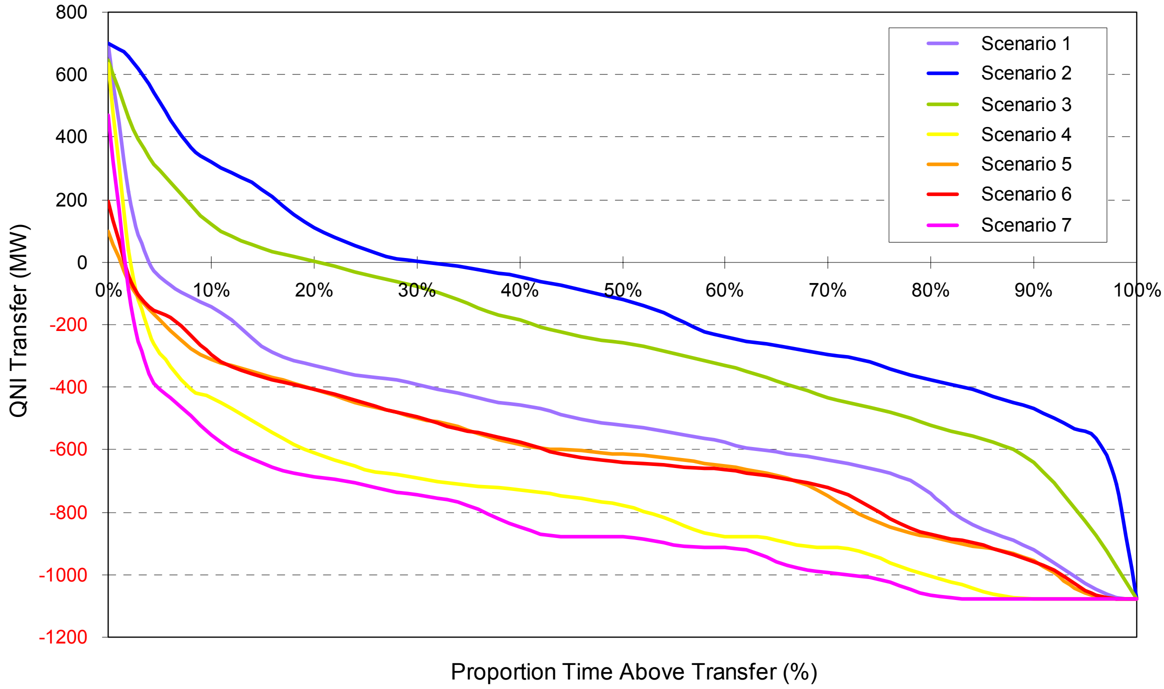


Figure E.5 - Cumulative QNI Transfer Distribution Curve 2006/07
SRMC (ACIL) Bidding Strategy; New Entry Scenario 1

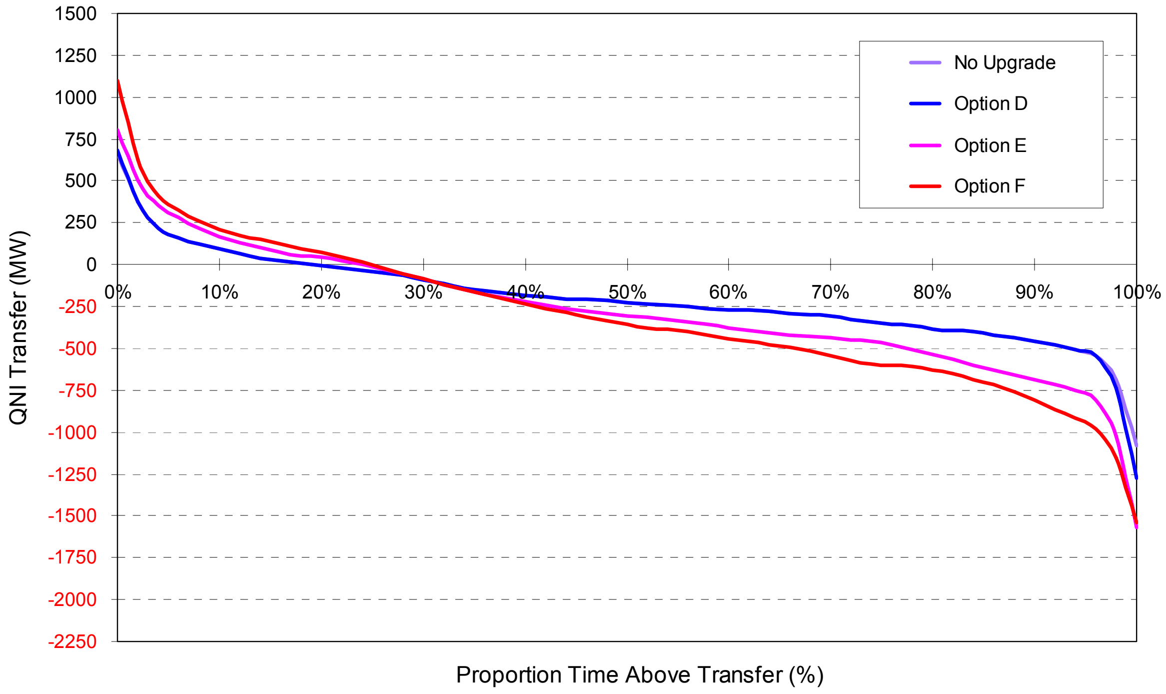


Figure E.6 - Cumulative QNI Transfer Distribution Curve 2006/07
Historical (ACIL) Bidding Strategy; New Entry Scenario 1

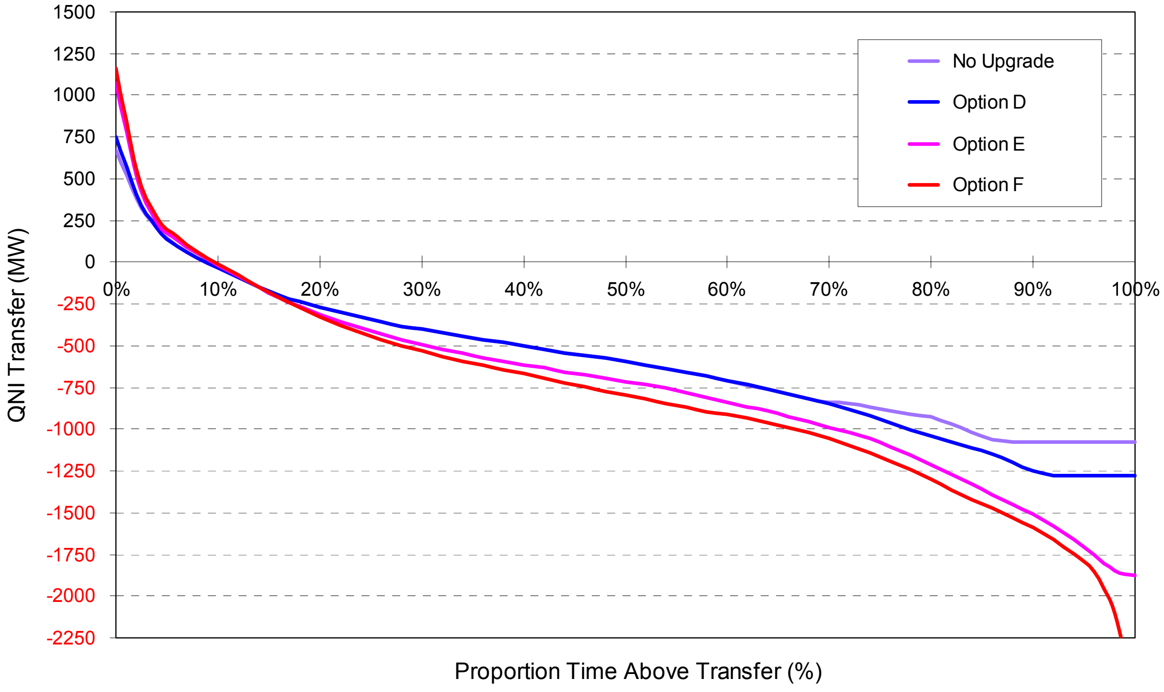


Figure E.7 - Effects of Demand Forecasts on Production Efficiency Benefits Average Across Generator Bidding; Average Across New Entry Scenarios

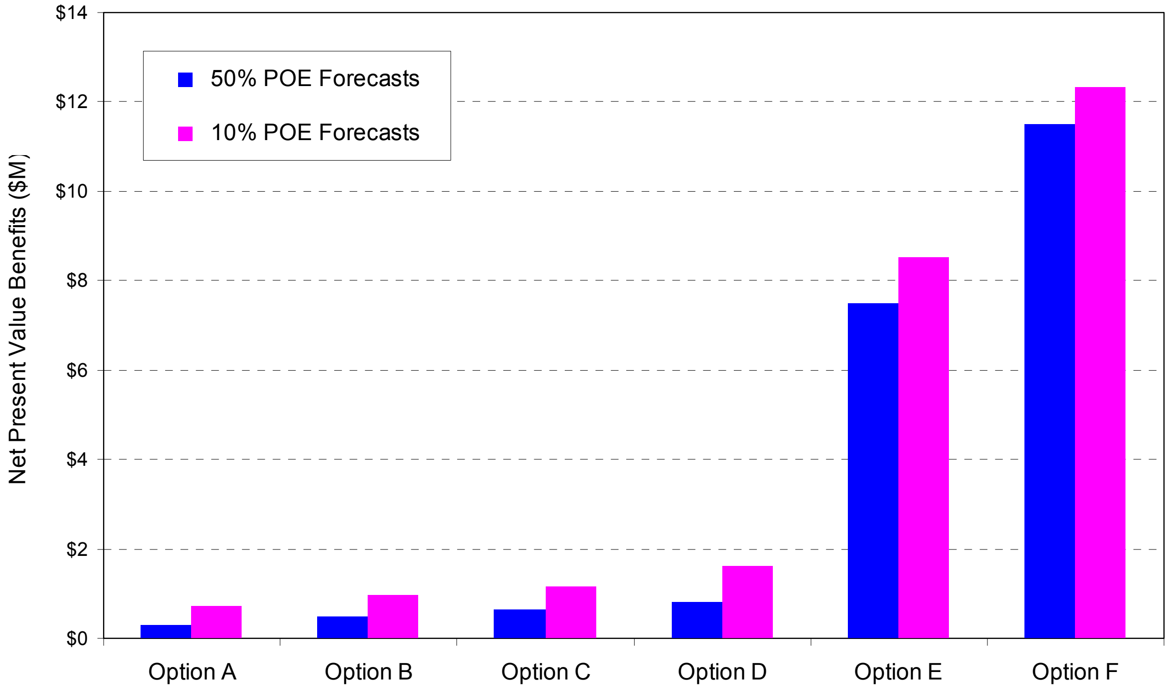


Figure E.8 - Capital Deferral Benefits Across the New Entry Generation Scenarios

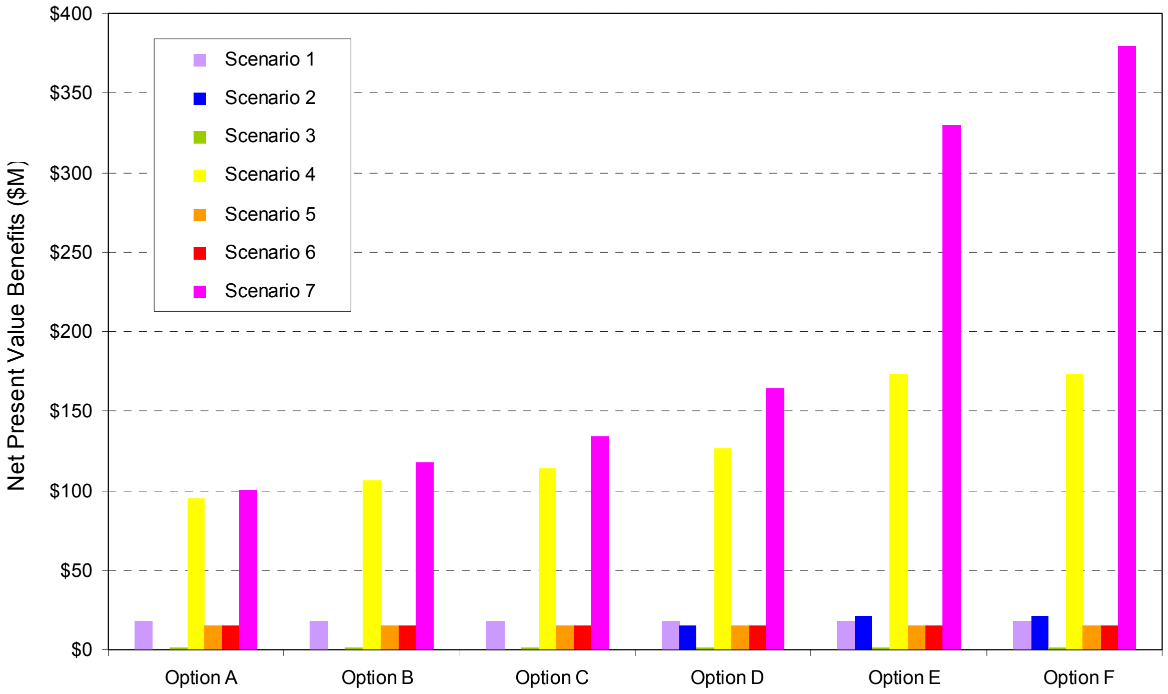
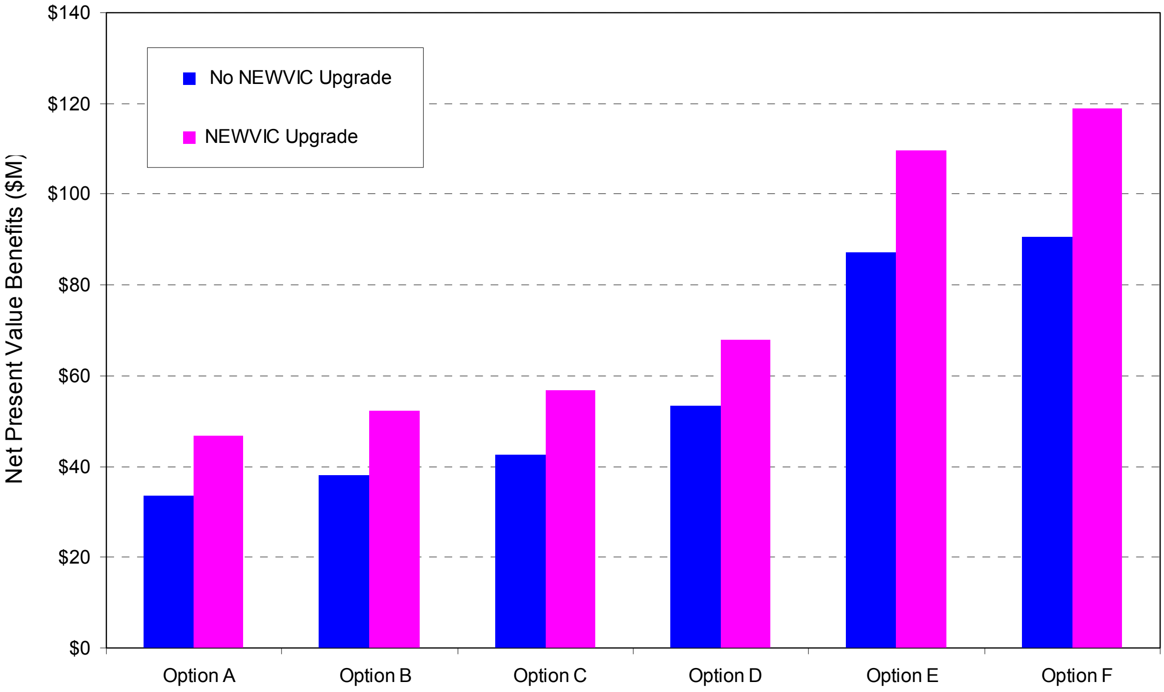


Figure E.9 - Effects of NEWVIC Stage 2 Upgrade on the Capital Deferral Benefits Average Across New Entry Scenarios



Assessment of Benefits

The net present values for each of the QNI upgrade options (ie. incorporating the capital costs of the project) across the range of generation development scenarios are shown within Figures E.10 to E.11. The capacity upgrade costs are the averages of the values detailed within Section 5, and assumed to be expended during the 2006/07 financial year.

The capital expenditure year was assumed to be the same for all options for comparison purposes only. It is acknowledged that the lead times for the various capacity upgrades can vary significantly, and that the 2006/07 commissioning time is not practical for some of the larger upgrade options (ie Options E and F).

The market benefits across the ten year analysis time frame and residual period for each category of benefit are shown within Table E.1. These values represent the average benefit across the various new entry scenarios and generator bidding strategies.

Figure E.10 - Net Present Value of Each QNI Upgrade Option Across the Various Generation Development Scenarios

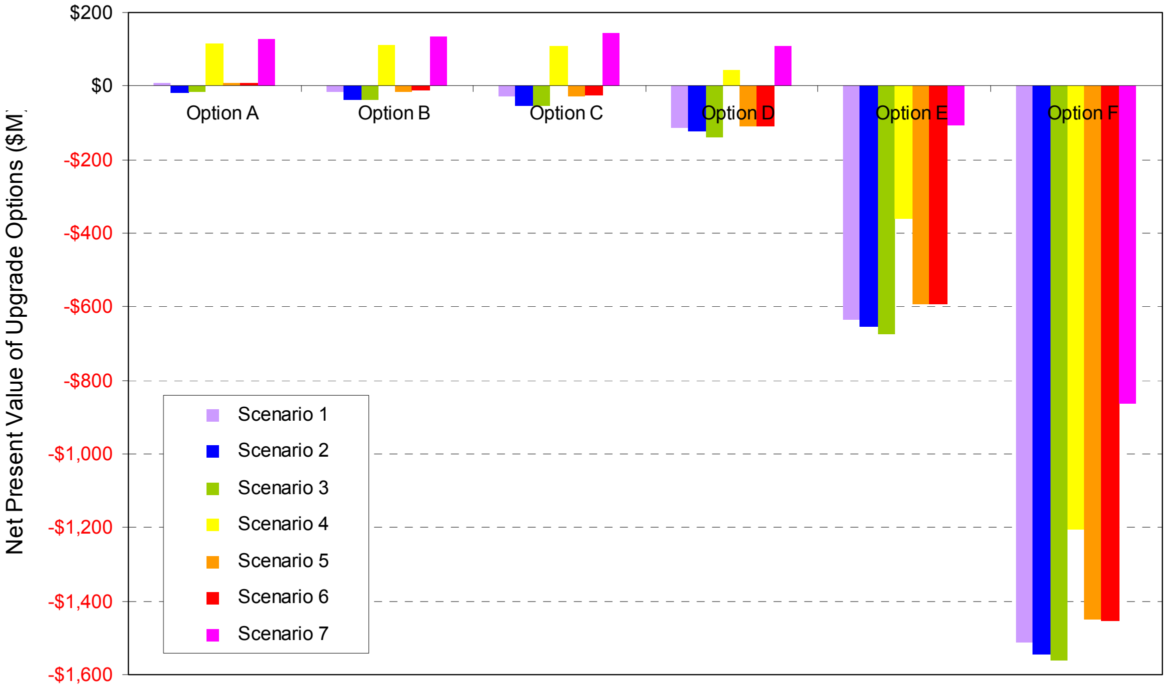
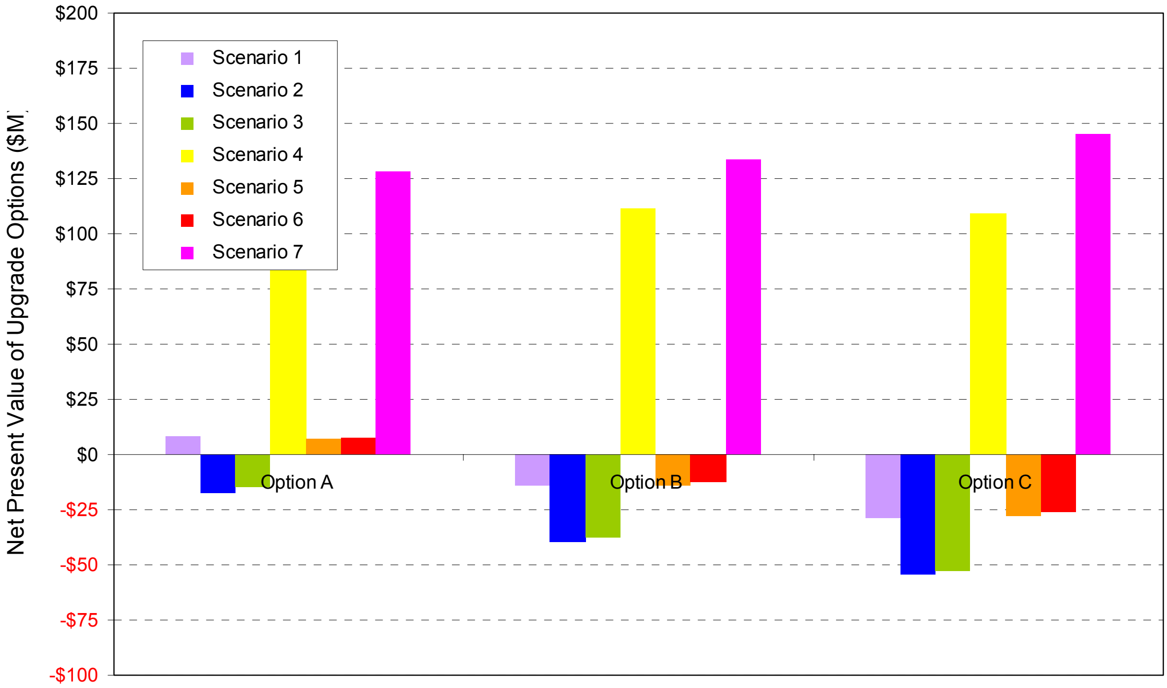


Figure E.11 - Net Present Values for QNI Upgrade Options A to C Across the Various Generation Development Scenarios[26]



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[26] This graph provides an enlargement of Figure E.10.

Table E.1 - Summary of Average Net Market Benefits Associated with QNI Upgrades
Average Across Generator Bidding; Average Across New Entry Scenarios

Option	Benefit[27]	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	Residual	NPV[28]
A	Production	$0.0	$0.1	$0.1	$0.1	$0.2	$0.2	$0.2	$0.3	$0.3	$0.3	$3.3	$2.6
	Capital	$0.0	$0.0	$0.0	$0.6	$2.0	$2.7	$3.3	$3.8	$4.7	$9.7	$65.2	$46.8
	Consumer	$0.0	$0.0	$0.1	$0.1	$0.1	$0.1	$0.1	$0.2	$0.2	$0.2	$2.1	$1.6
	Total	$0.0	$0.1	$0.1	$0.8	$2.2	$3.0	$3.7	$4.2	$5.2	$10.2	$70.6	$51.0
B	Production	$0.0	$0.1	$0.1	$0.1	$0.2	$0.3	$0.3	$0.4	$0.5	$0.6	$5.2	$3.9
	Capital	$0.0	$0.0	$0.0	$1.0	$2.6	$3.3	$4.0	$4.1	$5.3	$10.3	$71.1	$52.2
	Consumer	$0.0	$0.0	$0.1	$0.1	$0.1	$0.2	$0.2	$0.2	$0.2	$0.3	$2.6	$2.0
	Total	$0.0	$0.1	$0.2	$1.2	$2.9	$3.7	$4.5	$4.7	$6.0	$11.1	$78.8	$58.2
C	Production	$0.0	$0.1	$0.1	$0.2	$0.2	$0.3	$0.4	$0.5	$0.6	$0.7	$6.9	$5.1
	Capital	$0.0	$0.0	$0.0	$1.2	$2.9	$4.0	$4.6	$4.4	$5.8	$11.0	$76.2	$56.8
	Consumer	$0.0	$0.0	$0.1	$0.1	$0.1	$0.2	$0.2	$0.2	$0.3	$0.3	$3.0	$2.4
	Total	$0.0	$0.1	$0.2	$1.5	$3.2	$4.5	$5.3	$5.2	$6.7	$12.0	$86.1	$64.3
D	Production	$0.0	$0.0	$0.0	$0.1	$0.1	$0.3	$0.5	$0.6	$0.8	$1.0	$8.9	$6.2
	Capital	$0.0	$0.0	$0.0	$1.2	$3.5	$5.3	$5.9	$5.1	$6.4	$13.6	$90.3	$67.9
	Consumer	$0.0	$0.1	$0.1	$0.1	$0.2	$0.2	$0.3	$0.3	$0.3	$0.4	$3.6	$2.9
	Total	$0.0	$0.0	$0.1	$1.4	$3.8	$5.8	$6.7	$6.0	$7.6	$14.9	$102.8	$76.9
E	Production	$2.0	$2.4	$2.7	$3.1	$3.4	$4.4	$5.5	$6.5	$7.5	$8.5	$81.1	$63.1
	Capital	$0.0	$0.0	$0.0	$1.2	$6.7	$10.0	$11.3	$9.0	$10.1	$20.1	$141.4	$109.5
	Consumer	$0.0	$0.2	$0.3	$0.5	$0.6	$0.8	$1.0	$1.1	$1.3	$1.4	$13.7	$10.8
	Total	$2.1	$2.6	$3.1	$4.8	$10.8	$15.3	$17.8	$16.5	$18.9	$30.1	$236.3	$183.4
F	Production	$3.1	$3.6	$4.1	$4.7	$5.2	$6.8	$8.4	$9.9	$11.5	$13.1	$124.4	$96.8
	Capital	$0.0	$0.0	$0.0	$1.2	$6.7	$10.0	$11.3	$10.4	$10.1	$23.0	$156.7	$119.0
	Consumer	$0.0	$0.2	$0.4	$0.7	$0.9	$1.1	$1.3	$1.5	$1.7	$1.9	$18.3	$14.4
	Total	$3.1	$3.9	$4.6	$6.5	$12.8	$17.9	$21.0	$21.8	$23.3	$37.9	$299.5	$230.1

Start Accumulation of Benefits

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[27] Benefits shown are non-discounted values assumed to accumulate at the end of nominated financial year.

[28] NPV assumes 10% discount rate and upgrade timing of 2006/07 (ie. benefits accumulate from 2006/07 onwards).

Effects of Residuals

Assumptions relating to the calculation of residuals (ie continuation of benefits beyond the analysis time frame) can make significant differences to the net present value of market benefits. There is no clear direction within the ACCC Regulatory Test relating to the calculation of residual benefits. However, there is a general view that continuation of benefits in accordance with patterns and trends demonstrated within the initial ten to fifteen year time period is a reasonable and valid approach.

Within this study, it has been assumed that market benefits continue at a constant rate equal to the average of the benefits across the final three years of the analysis period. Other methods involve escalating on-going benefits either at a linear or exponential increasing rate.

The effects of different residual calculation methodologies (refer Table E.2) on net market benefits are shown within Figure E.12. The net benefits have been reported across the average of new entry scenarios and generator bidding strategies. The results indicate that net market benefits can be sensitive to assumptions relating to on-going benefits.

Table E.2 - Different Methodologies for Calculation of Residual Benefits

Method	Description of Methodology
1	Residuals assumed to continue for the life of the asset (ie. total 50 years) at a constant rate equal to the average across the final three years of the analysis period (methodology used within this study).
2	Residual benefits not included within the analysis.
3	Residuals assumed to continue for an additional five years (ie. total 15 year time frame) at a constant rate equal to the average across the final three years.
4	Residuals assumed to continue for an additional ten years (ie. total 20 year time frame) at a constant rate equal to the average across the final three years.
5	Residuals assumed to continue for the life of the asset at a constant rate equal to the final year of the analysis period.
6	Residuals assumed to continue to increase for the life of the asset at a linear rate for production and consumer efficiency benefits, and at a constant rate equal to the final three years of the analysis period for the capital efficiency benefits.
7	Residuals assumed to continue to increase for the life of the asset at a linear rate for production, consumer and capital efficiency benefits.

Figure E.12 - Effects of Residual Calculation Methodologies on Upgrade Net Present Values Average Across Generator Bidding; Average Across New Entry Scenarios