PB ASSOCIATES

POWERLINK QUEENSLAND

Review of Capital Expenditure Requirements

CONFIDENTIAL

Prepared for

AUSTRALIAN COMPETITION AND CONSUMER COMMISSION

***PB Associates** Quality System:*

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EXECUTIVE SUMMARY

This report presents the results of a review of Powerlink's regulatory revenue cap application in respect of capital expenditure. PB Associates undertook the review for the Australian Competition and Consumer Commission.

The main conclusions and recommendations of the review are as follows:

- The processes used by Powerlink for developing the load growth forecasts is in accordance with industry best practice.

- Due to significant uncertainty in the future connection of new generation to the Powerlink network, the use of traditional planning methodologies for forecasting non-current augmentation capital expenditure requirements was considered inappropriate. The probabilistic planning process developed by Powerlink is a rigorous and detailed approach, which involved the modelling of 72 possible development scenarios. We consider the approach to be an appropriate methodology for forecasting augmentation capital expenditure requirements in the face of high levels of uncertainty.

  Due to the number of scenarios that required study, some simplifications have been made, for example in flow modelling and project economic assessment. However, on the basis of the level of detail we have been able to examine during this review, we would not consider these simplifications to significantly change the capital expenditure forecast from that produced if more detailed analysis were performed.

- The analysis of the different development scenarios and their associated probabilities has shown that the main driver for the level of capital expenditure is load growth. The various generation development scenarios have a secondary impact on top of this.

- Asset replacement capital expenditure accounts for 14.5% of the total capital expenditure forecast by Powerlink in their Regulatory Application. Where possible Powerlink attempts to integrate asset replacement with necessary augmentation projects. While the replacement programme and current network augmentation projects have not been examined in detail, we have found no evidence of double counting of replacement assets due to both age and condition and augmentation replacement. Further, we have found no evidence of inefficient augmentation plans.

- During the course of the review we examined the five major projects most likely to be required during the upcoming regulatory period. The total value of these projects was $266m. Based on the information provided by Powerlink, we do not consider the requirement for, or timing of, these projects to be unreasonable.

- The asset management processes used by Powerlink are in accordance with Code requirements. Compliance with these processes should lead to only necessary and efficient capital expenditure occurring.

- Given the greater level of uncertainty in Powerlink's capital expenditure requirements for the final three years of the regulatory period, a mid term reset of the augmentation related capital expenditure forecast is appropriate. At this point it should be possible to forecast the capital expenditure requirement with greater certainty and the revenue cap can then be adjusted accordingly.

- Powerlink has claimed $40.5m in efficiency gains on the construction of the Queensland – New South Wales Interconnector. These efficiency gains have been measured against the independently estimated construction cost of the project, which was used in the cost benefit analysis on which the decision to proceed with the project was based.

  In assessing the merits of this claim, the Commission should be mindful of the need to be even handed in its approach to regulation and also of the fact that the roll-in of new assets at actual construction cost can penalise efficient construction.

- The proposed opening asset base at the commencement of the regulatory period includes a total of $40.5m added back into the asset base to allow for the claimed efficiency gains arising from QNI.

  The adding back of efficiency gains is inconsistent with the Commission's normal practice of requiring new assets to be added in to the asset base at actual cost. A more consistent approach would be to value the asset at actual construction cost, and to treat any allowed efficiency gains as a separate line item.

- Of the $40.5m claimed as QNI efficiency gains, we recommend all but $6.5m be allowed. The $6.5 m related to the hedging of aluminium construction should not be allowed due to the speculative nature of the gain.

1. INTRODUCTION

The Australian Consumer and Competition Commission (the Commission) is currently conducting an inquiry into the appropriate revenue cap to be applied to the non-contestable elements of the transmission services provided by the Powerlink transmission network. The revenue cap determined as a result of this inquiry will apply for a $5^1/_2$-year regulatory period commencing 1 January 2002.

In respect of this inquiry, Powerlink has submitted to the Commission an application for a transmission network revenue cap for the period commencing January 2002[1]. This document outlines Powerlink's views on the appropriate revenue cap to be applied by the Commission.

PB Associates has been engaged to review the Powerlink application in respect of the following areas that are pertinent to establishing an appropriate revenue cap:

- The value of the assets used by Powerlink to supply non contestable transmission services;
- Powerlink's capital expenditure (CAPEX) requirement over the regulatory period;
- Powerlink's operational expenditure (OPEX) requirement over the regulatory period;
- The appropriate standard of service that Powerlink should reasonably be expected to achieve over the regulatory period.

This report covers PB Associates' review of the Powerlink application in respect of the forecast CAPEX requirements. The Terms of Reference for this CAPEX review were to undertake a review which analyses and comments on the assumptions, methodology and findings on capital expenditure contained in the Powerlink application.

In undertaking this review PB Associates was required to address the following matters:

- The assumed level of materiality;
- The methodology for determining the adequacy of Powerlink's system for present and future duty;
- Findings in relation to the security and reliability of the system *vis a vis* the criteria set out in the Code;
- The effectiveness of Powerlink's asset management system in ensuring that only necessary (and efficient) capital expenditure occurs;
- The effectiveness of Powerlink's capital works assessment criteria and process in identifying and evaluating alternatives to proposed expenditure (including generation, embedded generation, cogeneration, demand side responses and other non-build options); and
- Findings in relation to the appropriateness of the major proposed capital works and the anticipated costs of these works.

PB Associates was further asked to assess and comment on the appropriateness of Powerlink's use of a probabilistic methodology to forecast capital expenditure scenarios and budgets. This was to include an assessment of:

[1] *Application - Transmission Network Revenue Cap Commencing January 2002*, Powerlink Queensland, February 2001.

- The methods Powerlink uses to check the reasonableness of the forecasts and related expenditure;
- The allocation of individual capital expenditure projects to each scenario; and
- The identification of cost-effective alternatives to the proposed expenditure.

Major transmission reinforcement projects can have very high (>$50 million) CAPEX requirements that may require procurement of assets over a very short (1 or 2 year) time frame. For this reason, a transmission company's capital expenditure requirements, from year to year, can be very lumpy. This can make benchmarking a transmission company's capital expenditure over a short time frame unreliable if due consideration of this effect is not taken into account.

The general approach undertaken for this study has been to review the inputs, assumptions and processes adopted by Powerlink in forecasting its capital expenditure requirement for the revenue cap. The reasonableness of these is then assessed in terms of NEC compliance and industry 'best practise'.

Powerlink have proposed a probabilistic approach to the forecasting of capital expenditure in their application to the Commission. The general philosophy of this approach has already been described in a public discussion paper produced by Powerlink.

2. PB ASSOCIATES REVIEW PROCESS

A series of meetings was held with Powerlink staff, which took the form of presentations by Powerlink, discussions, and question and answer sessions. These meetings addressed the following issues:

- a general overview of Powerlink's transmission system including the main load centres and existing generation plant, committed generation commissioning/decommissioning, possible uncommitted generation, existing network constraints and the impact of generation size, location and despatch on these constraints, and general uncertainty in level of augmentation required in future;

- an overview of the internal review procedures and public consultation process adopted by Powerlink when considering a major augmentation. The Cairns transmission line augmentation project was used as an example;

- the load forecasting methodology used by Powerlink including the rationalisation of distributor supplied forecasts, and independent NIEIR forecasts;

- an overview of joint planning process undertaken with Distributors to identify economic distribution solutions;

- the generation scenarios used by Powerlink in the development of their capital expenditure forecast and the methodology and inputs used to generate these scenarios and the associated probabilities; and

- the process used by Powerlink to produce transmission network project scopes and generator grid support requirements and the associated capital and operational (grid support) expenditure forecasts for each of the scenarios.

During the course of this review Powerlink provided a number of documents. A summary of the main documents provided follows:

Document	Comments
Process to Determine the Capital Expenditure Forecast	This document details the methodology applied by Powerlink in producing a capital plan for each generation/load scenario. The appendices detail the inputs and outputs of the process and include: the assumed generation additions/subtractions and bidding orders for each scenario; network power flows and assumed network grid developments for each scenario; and summaries of individual project scopes.
National Electricity Market Forecasting: Identification of Asset Development Scenarios	An independent consultant's report commissioned by Powerlink to determine a range of future generation development scenarios and to assign a probability to each scenario. This report resulted in a set of 72 generation/demand scenarios and associated probabilities.
Powerlink Annual Planning Statement 2000	A public document produced in accordance with NEC 5.6.2 (b). This summarises demand / energy / generation forecasts, network capability, and committed network developments.
Capital Re-investment and Operational Refurbishment Plan	This document lists Powerlink's current and projected capital re-investment (replacement) and operation refurbishment projects until 2009/10.

Queensland Energy Policy	A public state government report that outlines Queensland's energy policy. Relevant sections relate to generation developments due to renewable energy, greenhouse initiatives and gas developments.
Asset Management Plan 2001	A document that provides a formal method of disseminating information to stakeholders on the manner in which Powerlink manages its assets. It defines how the asset management process is structured and managed within Powerlink, and provides an overview of future grid developments and replacements forecast to occur in the next 10 year period.
Grid Support Forecasting	A brief discussion of the methodology Powerlink has adopted to estimate grid support operational expenditure where this defers the requirement for capital expenditure.

3. POWERLINK'S CAPITAL EXPENDITURE FORECASTING METHODOLOGY

3.1 DEMAND / GENERATION RELATED FORECASTS

3.1.1 Overview

The *traditional* method for forecasting transmission capital expenditure would begin with forecasts of both network power demand, and generation (including merit order) connected to the network. These forecasts would be analysed with respect to network planning criteria to establish violations of the criteria or constrained generation. Further analysis would then be performed to ascertain economic solutions to these violations or constraints. The individual projects should then be rationalised with the other projects and asset replacement projects, and an aggregate capital expenditure forecast developed.

The above capital forecasting process has proved effective where the inputs to the process (e.g. demand forecasts, generation forecasts, material and service costs) can be predicted with a reasonable level of certainty. However, in a de-regulated environment many of the inputs, particularly generation and interconnection development, are subject to many factors outside the control of the TNSP and cannot be predicted with a high level of confidence.

To date, most regulated TNSPs have addressed this problem by using a *most likely* forecast of demand and generation despatch and pricing to produce a single *most likely* forecast of capital expenditure[2]. This *most likely* forecast may be adjusted slightly to apportion the asymmetrical risk due to the uncertainties to an appropriate level between the TNSP and its customers.

Powerlink consider that there is a very high level of uncertainty as to the future generation pattern in their region, and the level of network augmentation required is particularly sensitive to the amount and location of both new and displaced generation. Therefore Powerlink have developed and used a new probabilistic methodology for preparing a capital expenditure forecast for its regulatory revenue cap application.

The methodology used by Powerlink is to define a number of credible demand and generation scenarios and then to assign a probability to each scenario. A capital expenditure requirement is calculated for each scenario. The actual capital expenditure forecast used by Powerlink in its regulatory application is the *expected* value, which is the probability weighted average of all the individual scenario capital expenditure forecasts.

The inputs and processes/methodologies employed by Powerlink in developing the capital expenditure forecast in their Application are summarised and commented upon in the sections below.

3.1.2 Load Forecasts

The requirement for network augmentation, and hence capital expenditure, is strongly dependent upon the level and pattern of demand on the network. Therefore, it is important to adopt a reasonably robust method of forecasting the load growth that is to be used to produce the capital expenditure forecast.

[2] Mathematically, due to the non-linear mapping between the input forecasts and the output capital expenditure and the probability of other inputs, the output capital expenditure may not actually be the *most probable*.

The load forecasts used by Powerlink in the development of the capital expenditure forecast are based on two sources:

- The distributors and other customers connected to Powerlink's transmission network have supplied 10-year forecasts of demand at each transmission connection point pursuant to clause 5.6.1 of the NEC.

- Powerlink commissioned an independent assessment of the energy and demand forecasts for the Queensland region. This forecast was produced by the NIEIR. The NIEIR forecasts also include high and low economic growth forecasts, and peak demand forecasts based upon 10 %, 50 % and 90 % probability of exceedance due to temperature. These high, moderate and low growth scenarios correspond to those provided by NIEIR to NEMMCO for the production of the Statement of Opportunities.

Powerlink stated that the two forecasts compared reasonably well with only minor differences in a few geographic areas. These differences were resolved after discussion with the Distributors with respect to their forecasting methodology and assumptions.

The forecast diversity of the peak demand between connection points has been estimated based upon historic records. The 10-year forecast used in the development of the capital plans was based upon the distributors' forecasts with the 'shaping' from the NIEIR forecast in the long terms.

The load forecast adopted in their capital plan allows for predicted growth in embedded and renewable generation forecast by NIEIR. Powerlink have stated that the level used is significantly higher than the level of currently committed development incorporated in the Distributors' forecasts.

PB Associates consider that the process employed by Powerlink in developing the load growth forecasts is in accordance with accepted industry best practices.

3.1.3 Generation Forecasts

Powerlink consider a large increase in generation capacity in next 5-10 years is likely to occur, which could lead to a large surplus of capacity in Queensland. However the size and location of the generator additions (and retirements) and the effect that this will have on the national electricity market, and despatch of generation in the Powerlink system is a significant uncertainty. As with demand growth, generation and market developments can have a significant impact on network augmentation requirements, particularly in terms of the economic removal of constrained on or off generation via network augmentations.

The uncertainty in the future generation pattern and the impact this may have on the Powerlink capital expenditure requirement has mainly lead to the adoption of the probabilistic forecasting methodology used by Powerlink. Powerlink considered it appropriate to engage the services of an independent electricity market-forecasting specialist to assist in the development of possible generation development scenarios. This is similar to the commissioning of NIEIR to produce independent load forecasts.

The main aims of the independent study were as follows:

- to identify a range of realistic generation asset development scenarios;

- to provide and justify a probability of each scenario proceeding; and

- to provide probabilities for all prospective generation developments in the Queensland region.

In this study, 72 possible generation and demand scenarios were proposed and the probability of each scenario occurring was estimated. The following is a brief overview of the methodology used to develop the scenarios and estimate the probabilities.

To generate the scenarios four "themes" were defined. These themes are described in Table 7.1 of Powerlink's regulatory application. Each theme comprises a set of mutually exclusive outcomes of which it is assumed one must occur. The probability of an outcome in one theme is considered independent of an outcome in another theme. Based upon this assumption, the first pass scenario probability is just the product of the theme outcome probabilities.

To allow for the fact that the assumption of independence of themes is inherently flawed, the probability of any particular scenario has been *moderated* to account for generation development probabilities and known market indicators. For example, there is a reduced probability of the low load growth theme outcome and a high generation capacity outcome occurring together since it is less likely high levels of generation capacity will be added if low load growth is occurring.

The first moderation applied to the theme outcome probabilities was based upon the probabilities of the individual generation developments occurring. For example, if a set of theme outcomes required a low probability set of generation developments, then this scenario probability would be reduced.

Additionally, two market indicator moderators have been used to adjust the scenario probabilities further. One is based upon historical patterns of reserve plant margin, and the other is based upon historical patterns of annual system capacity factor. These moderators essentially adjust the probabilities of each scenario based upon the assumed likelihood of the market indicators occurring. For example, if a scenario's generation developments would result in a low probability system capacity factor, the scenario's probability would be adjusted down.

The resulting fully moderated probability for each scenario was used by Powerlink to calculate the probability weighted average capital expenditure proposed in their regulatory application. As can be seen in Fig 7.3 of the Powerlink application[3], the highest scenario probability is around 8%, indicating that no one outcome has significantly greater probability than other outcomes.

PB Associates has reviewed the consultant's report detailing the generation scenario development. We do not consider the generation developments, nor the methodology applied or probabilities assumed to be unreasonable.

3.1.4 Powerlink Network Capability

The requirement for future network augmentation is a function not only of the load and generation forecasts but also the existing network capability. The network capability can be viewed as the maximum power transfer on network circuits or equipment for which the system remains compliant with the NEC and statutory requirements[4]. It should be noted that network capability can be dependent on the load and generation pattern, and as such, the capability of a circuit (or group of circuits) may not be constant for all scenarios. Further the capability of a circuit may not be reversible in that the maximum acceptable power flow in one direction may be different from the maximum power flow in the reverse direction.

Powerlink use internationally benchmarked, power system analysis software to model their system and assess the existing and future network capability. The models are validated by comparing modelled results with monitored actual system operation. The

[3] Page 72. The hard copy version of the Application issued by Powerlink incorrectly refers to this Figure as Fig 7.1.
[4] NEC 5.6 and schedule 5.1 and Electricity Act 1994, S34.2

network capability is contained in the Powerlink Annual Planning Statement, which is a public document and published annually pursuant to Clause 5.6.1 of the NEC.

Powerlink has calculated the network capabilities for the existing network including future committed augmentations. Additional studies were performed to reassess the network capability when further augmentations were developed during the course of the plan.

PB Associates consider the system and processes used by Powerlink to be satisfactory in assessing network capability, and the limiting factors defining the capabilities appear to be in line with the NEC network planning and operational requirements.

3.1.5 Estimation of Future Network Power Flows

Due to the large number of power flow studies that were required to analyse the 72 scenarios, Powerlink developed a simplified steady state network model. This is a model of the main network power transfers and generation and load buses. This model is spreadsheet based, but still performs a power flow analysis on the simplified network model. Powerlink have stated that this model has been validated against the full system model, and the network power flows are accurate to within 5 %.

For each scenario power flow studies are performed for summer and winter peaks, summer medium (80 % peak) and winter light (50 % peak) demand condition for each year in the ten-year planning period. Powerlink have used the 50 % probability of exceedance forecasts in the power flow studies.

It should be noted that this simplified power flow model is used to produce the overall 10-year capital expenditure forecast. Powerlink have stated that when planning actual augmentation of the network the full network model, using the internationally benchmarked software, is used.

PB Associates would agree with Powerlink that it would be unrealistic to perform the full range of studies for all scenarios using the full network model, and consider a simplified model acceptable for overall capital planning/forecasting purposes provided the model is suitably detailed and the power flow suitably accurate. Although we have not studied the model and the underlying formulation in detail, a range of outputs of the model has been supplied to PB Associates during the course of this review. We would consider the detail of this simplified model and the load conditions studied to be acceptable for the production of the capital expenditure forecast for the regulatory application.

3.1.6 Establishment of Project Plans

Where the power flow analysis showed network capabilities to be violated, specific projects were developed by Powerlink's planning engineers. The solution adopted to alleviate the violation and the timing of any network augmentation were generally subjective decisions by the planning engineers, based upon their knowledge and experience.

Solutions to network violation proposed by Powerlink included, where appropriate, non-transmission network augmentations, such as distribution solutions, demand side response and generation support. It is also important to note that the load forecasts used by Powerlink inherently included independently forecast levels of embedded generation (see Section 3.1.2). Powerlink also analysed the marginal costs of constrained on or off generation and considered the cost of generation support to defer network augmentation. In situation where this was considered to be economic generation support was built into the project plans. The costs of generation support are incorporated in the operational expenditure forecasts and the methodology used to calculate the cost of generation support is not discussed here.

PB Associates has discussed with Powerlink the extent of distribution augmentations in its capital plans.

Powerlink has stated the following: "*Regarding distribution project solutions, it is worthwhile distinguishing two types: (i) the joint planning projects … and (ii) those that would support the main grid and defer (or eliminate) the need for main transmission reinforcement. Type (ii) can be considered a "competing" distribution solution.*

In the earlier years of the CAPEX review period, the proposed timing of some projects (where appropriate) has been determined in consultation with distribution planners, and an agreed "understanding" reached on published planning information. Examples of these would be the Woolooga 275/132kV transformer reinforcement, the Palmwoods 275/132kV transformer reinforcement, Greenbank establishment, and the second Tarong to Murphy's Creek 275kV single circuit line – distribution options are considered in this process.

Overall, there is little scope for Distribution projects relieving a main grid limitation with the exception of the Greater Brisbane area. In Powerlink's view, subtransmission reinforcement options (110kV) in the Greater Brisbane area are very limited, due to the great difficulty of obtaining new easements in residential and highly developed areas. In many cases, such reinforcement would have to include large portions of underground cable, costing around 10-15 times that of overhead lines. The strategic planning of the Greater Brisbane area has allowed for support of the existing 110kV system by new 275kV injection points, for which 275kV overhead line easements and new substation sites have been strategically acquired. Notwithstanding, Energex have commenced a project to build a cable that has deferred the requirement for reinforcement of Belmont by about 12 months. This has been incorporated in the CAPEX forecast."

It would be impossible in the time available for this review to assess the possibility of further efficient distribution solutions in addition to those provided for in the Powerlink capital expenditure forecast. However, if these do exist, we would not consider them to impact the majority of Powerlink projects, and therefore, they would have a minor affect on the Powerlink forecast.

PB Associates have also discussed the method of determining the timing of the project service date to establish whether the timing is determined purely by the occurrence of the network violations, or whether some projects have been deferred to account for risk management initiatives.

Powerlink have stated the following: "*In Powerlink's view, due to the requirements of the National Electricity Code, there is very little scope for risk management unless consultation with customers leads to agreement that such risk strategies are acceptable. At the present time there are a few such arrangements in place with DNSPs and a major industrial customer. However, it has been observed that DNSPs are now more reluctant to consider such arrangements due to their perceived threat of substantial legal claims from customers arising from supply failures. An emerging trend that sees electricity as a commodity, and TNSPs, DNSPs responsible for the reliability and quality of that commodity, suggests that the widespread use of risk arrangements in the future is unlikely. In this CAPEX review, such risk management arrangements have not been assumed except where they are already in place."*

We would consider that to estimate the optimal timing of a transmission project, some risk assessment must be performed to ensure that only necessary augmentations occur. This analysis may indicate that the *expected* reliability of supply warrants a deferment or advancement of an augmentation. We would consider that the Code does allow scope for this based upon the economic evaluation of the projects. However, a risk analysis involves a number of factors, such as probable load profile, expected equipment reliability and fault dependence, economic worth of load at risk. If these are not known accurately, then load may be at a much higher risk than anticipated. At present, there is some debate within the industry as to the merits of this probabilistic planning. It is noted that

Vencorp, the Victorian transmission shared network planner, is initiating a discussion on whether it should continue using probabilistic planning methods or adhere to strict deterministic security levels.

PB Associates consider that it is reasonable for Powerlink not to assume the possible deferment of projects passed N-1 levels in their capital expenditure forecast for the following reasons: the flat load profile in Queensland, the use of only the 50 % POE peak demand forecast, the industry uncertainty in the use of probabilistic planning methods, and the uncertainty in determining the appropriate parameters to use in such analysis

Full economic evaluation of the individual major projects has not been performed in order to find the optimum solution and timing. However for aggregate capital forecasting, particularly when are large number of scenarios is being considered, this would be cumbersome and unnecessary, provided a reasonably unbiased view of possible solutions and timing is considered. Although it has not been within the scope of our work to perform a detailed review of all projects, based upon our discussion with Powerlink planning engineers, the information provided, and a more detailed review of individual proposed projects, we do not consider the subjective methodology for projects and timing to be unreasonable. We have not found evidence of unnecessary or inefficient network projects or an obvious bias in favour of an early implementation.

Powerlink have applied some empirical analysis to account for the amount of new reactive plant (shunt capacitor banks) required on their network. This is based on historical levels of capacitors bank capacity per MW network loading. In the circumstances, this approach is appropriate.

Further, Powerlink have stated that they are intending to lower the utilisation of their transformers, and therefore have included in their forecast transformer capacity over and above that required to meet demand following advice from external consultants Ewbank Preece on their asset management and risk. This has lead to Powerlink proposing to increase the level of transformer reserve capacity as a risk mitigation exercise. It has not been within the scope of our work to undertake a detailed assessment of the requirement for this additional transformer capacity but, on the surface, the argument does seem reasonable. The expenditure for this additional transformer capacity is about 1.5% of the total capital expenditure, and therefore, we would not consider this provision to materially affect the capital expenditure review.

3.1.7 Project CAPEX Estimates

Powerlink have stated that they have "*compiled and maintained a comprehensive database of transmission costs*". This database includes a range of transmission line costs and modular elements of substations. The majority of these costs are based upon recent tendering outcomes. The costs "*also take into account such influences as inflation rate, exchange rate movements, international metal prices, and other market factors such as demand for particular contract services*". Overheads are also allowed for in the cost database.

Powerlink state that they only capitalise planning and engineering costs related to projects that are capitalised. These costs include planning, project management, design, procurement, testing and commissioning. These are costed at standard labour rates and, hence, include overheads but do not include a profit margin.

The methodology used by Powerlink for the allocation of overheads is discussed in some detail in PB Associates' report titled "Powerlink Queensland. Review of Operating and Maintenance Expenditure". In this report it was concluded that the allocation methodology was effective and should provide a fair allocation of overheads between the various expenditure categories. Powerlink state that overheads included in the cost database are in line with the actual overhead allocation to completed capital projects using their cost allocation methodology. On this basis, estimated capital expenditure costs would not incorporate an excessive overhead margin.

For all the main projects defined, Powerlink have produced a high-level project scope that summarises the project works. From this project works scope the build up of the capital expenditure requirement has been produced using the Powerlink cost database. Powerlink have stated that they increase the estimated cost by 10 % to cover project items that are not included for in the project build up using the Powerlink database. Powerlink consider that the resulting estimate, after applying the 10% factor to be the actual build cost , with equal risk of under or over expenditure.

It should be noted that for capital expenditure forecasting for the revenue cap the project cost build up should be based upon *expected* costs, and any project escalation included in the estimate should be only sufficient to give an *expected* total cost for the project[5]. This cost may differ from a cost that may be used for an actual planned project cost, where this cost may be the cost that the project is reasonably expected to come below (e.g. a 90 % confidence). PB Associates have discussed this issue with Powerlink. Powerlink have stated that the project costs used for their CAPEX forecast should reflect expected cost (e.g. equal possibility of under or over expenditure). Powerlink have also provided historical planning cost estimates and actual project costs that indicate the 10 % factor to be reasonably unbiased.

Any inaccuracies in estimating costs and methodologies should, however, be evaluated in the context of the unavoidable high level of uncertainty in the generation / load related capital expenditure forecasting process. Apart from the uncertainties related to generation development, project scopes have been developed on the basis of high-level project plans. No high level investigation has been undertaken to identify potential problems that could escalate project costs. Errors in the cost estimating process are therefore likely to be well below the margin of error created by uncertainties elsewhere in the forecasting process.

3.1.8 Comments on Overall Approach

Powerlink has adopted what appears to be rigorous and detailed process for the forecasting of generation / load related capital expenditure, given the high level of uncertainty in regard to future network development needs. The basic methodology for analysing individual scenarios follows expected transmission planning processes. Due to the number of scenarios that required study, some simplifications have been made, for example in power flow modelling and project economic assessment. However, on the basis of the level of detail we have been able to examine during this review, we would not consider these simplifications to significantly change the total capital expenditure forecast from that produced if more detailed analysis were performed.

3.2 REPLACEMENT

The Powerlink Asset Management Plan states that "*Powerlink makes extensive use of condition monitoring and life extension techniques … Decisions to commit to this capital expenditure are based on a sound review of the economics and the system requirements"*.

Powerlink maintain a register of all assets due for replacement due to age or condition in the next ten years. This has been supplied to PB Associates during the course of this review. This document is broken down into transmission lines and substations. For each transmission line section or substation due for replacement, the document gives an overview of the assets age, condition, environment, estimated replacement cost, replacement comments etc.

The document also notes the assets that require replacement, but where the replacement is being performed as part of a network augmentation project. Powerlink have stated that the preferred solution to network violations takes account of upcoming asset

[5] The cost may be adjusted from the *expected* value to suitably apportion risk.

replacements. Although it has not been possible to examine the replacement programme and network augmentation projects in detail, we have found no evidence of double counting of replacement assets due to age/condition and augmentation, or inefficient replacement and augmentation plans.

Asset replacement capital expenditure accounts for $ 132.3 millions (nominal not including financing) or 14.5 % of the total capital expenditure forecast by Powerlink in their revenue cap Application.

3.3 REFURBISHMENT

The breakdown of Powerlink's network into individual assets in the SAP asset database is maintained at a high level. Transmission lines are not broken down below "built sections" and primary equipment in substations is not broken down below switchyard bays.

Maintenance programs that do not increase the capacity of an individual asset, as identified in the asset database, or that are not expected to extend the overall asset's life beyond the expected life used for depreciation purposes, are considered refurbishment and expensed as operational expenditure. Powerlink has issued formal guidelines on the classification of different projects as capital or operation expenditure

One result of the high-level asset breakdown is that many relatively large maintenance projects, such as circuit breaker replacements, which might be capitalised by some TNSPs, are expensed as operation expenditure by Powerlink.

Asset refurbishment costs are reviewed in PB Associates report "Powerlink Queensland. Review of Operating and Maintenance Expenditure".

4. APPROPRIATENESS OF MAJOR PROJECTS

Powerlink have supplied details of the individual network projects that build up the generation / demand related capital expenditure forecast. These project details summarise the network violations initiating the requirement for the project, a high-level project scope, and the scenario drivers influencing the need and timing of the project.

Table 1 is a summary of the major unapproved projects (> $ 30 million)[6] contained within the scenario project list. The cost estimate is the expected capital expenditure requirement in 00/01 dollars. The range of service dates indicates the possible service date for all studied scenarios. The probable service date is the most likely service date from an examination of the highest probability scenarios (scenario probability > 2.5 %). These high probability scenarios account for 50 % of the total probability.

Table 1 Summary of major projects

ID	Project	Cost estimate $'million	Range of service dates	Probable service date
1	Greenbank 275 kV establishment	91	2003-2004	03/04
2	Greenbank-Molendinar 275 kV DCST	45	2003-2006	04/05
3	2nd Tarong-Murphy Creek 275 kV SCST	36	2003-…	04/05
4	Murphy Creek-Blackwall 275 kV	55	2004-2008	05/06
5	Yabulu N-Tully 275/132 kV DCST	39	2005	05/06
6	2nd Breamar-Tarong 275 kV DCST	54	2005-…	07/08
7	2nd Stanwell-Broadsound SCST	34	2006-…	08/09
8	Nebo-Strathmore 275 kV SCST	44	2007-…	08/09
9	Strathmore-Ross 275 kV SCST	41	2008-…	09/10
10	Establish Halys sub 275 kV	32	2006-…	09/10
11	Halys-Gbank 500 kV DCST op. 275 kV	138	2006-…	09/10
12	2nd Bulli Creek-Breamer 330 kV DCST	56	2006-…	
13	Stanwell-Broadsound 275 kV DCST	56	2006-…	
14	Bullimba-Nudgee 275 kV SCC cable op 110 kV	54	2007-…	
15	Uprate 275 kV Halys-Gbank to 500 kV	53	2008-…	

From an examination of these major projects and how they fit into the individual scenarios, the following has been ascertained:

- The first five projects (1-5) have a very high probability of occurring on the probable service date and are required in all scenarios. They account for $ 266 million, which is nearly half of the total scenario driven CAPEX.

- The next six projects (6-11) are most likely to be required under the higher load growth scenarios. Powerlink gave this a probability of 40 %. There are variations to these requirements dependent on the generation developments assumed. As can be seen from the probable service date, it is likely that most of these projects will not be required during the regulatory period.

[6] This is not the Powerlink and NEC definition of major (large) and minor (small) projects, where major projects are those greater than $ 10 million.

- The remaining 4 projects (12-15) were low probability projects. The main driver for these projects being required was a high load growth scenario.

PB Associates has reviewed the 5 major projects that are most likely to be required during the coming revenue cap period. The following is an overview of each project.

Greenbank 275 kV establishment - $91 million.

This project is required due to a number of network capacity limitations developing in the South East Brisbane and Gold Coast areas. These may result in circuit overloading and low voltages under single contingency conditions, and the loss of large amount of load following the total loss of a double circuit line. The requirement for this project is very much driven by the loading in this region. The Powerlink scenarios place the most likely commissioning of this project in the 2003/04 year.

Powerlink have performed a major planning study to identify a programme of network augmentations that will address these capacity limitations[7]. The first phase of this project was the establishment of the Loganlea 275 kV substation, which has already received approval. Consultation for the first stage was carried out in 1999 under the Code requirements of the day. This consultation process included an examination of options, consultation with affected parties, co-ordination with distribution options, and notification of possible interested parties via the Annual Planning Statement.

The Greenbank 275 kV establishment is the second phase of this network augmentation and includes the construction of a 500 kV single circuit line (operating initially at 275 kV); establishment of the Greenbank 275 kV substation; construction of a 275 kV double circuit line; and the installation of a 275 kV capacitor bank at Greenbank.

Greenbank-Molendinar 275 kV DCST - $45 million

This project forms the third stage in the South East Queensland reinforcement, of which the Greenbank 275 kV establishment (discussed above) was the second stage. The timing of this stage is mainly dependent on the loading in the region, but also the operation of Directlink and possible new generation. The Powerlink scenarios place the most likely commissioning of this project in the 2004/05 year.

This phase of network augmentation includes construction of a 275 kV double circuit line; extension of the Greenbank 275 kV substation to connect the Molendinar circuit; further development of the Molendinar 110 kV substation; and installation of 300 MVA 275/110 kV transformer.

Murphy Creek-Blackwall 275 kV - $ 55 million

There are network limitations on the amount of power that can be transferred from the North of Tarong to the South East Queensland region. For various scenarios this network limitation may constrain generation in the Queensland system. Powerlink consider that there may be a net market benefit in removing this constraint by augmenting the network. The requirement and timing of this project are related to the generation developments and the loading; however the main driver appears to be the loading. The Powerlink scenarios place the most likely commissioning of this project to remove the constraint in the 2005/06 year.

The work assumed for this project includes the construction of a 275 kV double circuit line; establishment of a 275 kV switching station, and addition of a further bay to the Blackwall 275 kV substation.

2nd Tarong-Murphy Creek 275 kV SCST - $ 36 million

[7] The Powerlink detailed planning study has not been reviewed as part of this review.

The South West Queensland network is prone to voltage depressions under single circuit contingencies of the lines supplying this area. Powerlink and the distributor have plans to add reactive support in the form of capacitor banks in order to support the voltage. However, Powerlink consider that these measures will only defer the requirement for the proposed network augmentation. The requirement for this project is driven by the loading in South West Queensland region. The Powerlink scenarios place the most likely commissioning of this project in the 2004/05 year.

The work assumed for this project includes the acquisition of an easement, construction of a 275 kV single circuit line; and modifications to substation arrangements.

Yabulu North - Tully 275/132 kV DCST - $ 39 million

Powerlink consider that these lines will need to be replaced due to their condition. The replacement date is considered to be 2006. Powerlink do not consider the timing of this project to be related to the load or generation forecasts, but instead it will be driven by the cost of maintaining the line and the risk of leaving the line in service.

The work assumed for this project includes the acquisition of a 275 kV double circuit easement, and construction of a 275 kV double circuit line (operating at 132 kV); and establishment of a 132 kV substation.

It has not been within the scope of our work to review the requirement for each project, the cost of each project, and the efficiency of each proposed project in detail. PB Associates has not viewed any detailed technical or economic analysis of these projects during the course of this review. However, based upon the information provided by Powerlink we do not consider the requirement for and timing of these projects to be unreasonable. PB Associates points out that the CAPEX allowance provided by the Commission in Powerlink's revenue cap does not constitute an approval for Powerlink to proceed with the new network projects. Under the Code, Powerlink is required to follow specific procedures, including the Regulatory Test, for each project at the time it wishes to advance that particular project.

5. PROBABLISTIC CAPEX FORECAST

The capital expenditure forecast in the Powerlink Application is built up from a number of components. These components are:

- current (approved) projects;
- asset replacement;
- non-network assets; and
- non-current augmentations.

It is assumed that the cost of current projects, asset replacement and non-network assets has been forecasted with a high level of certainty. However, forecast costs for non-current augmentations are scenario driven and therefore uncertain. The possible range of non-current augmentation CAPEX revenue requirements, and the impact of this range on Powerlink's total request CAPEX over the period 2001/2 to 2006/7 is shown in Table 2.

Note that Table 2 shows capital expenditure in real (00/01) dollars. The "Total average" CAPEX is Table 2 is equivalent to the Total Forecast CAPEX in the Table on P74 of Powerlink's Regulatory Application except that the numbers in the Application are expressed in nominal (rather than real) dollars.

Table 2 shows that the probability weighted average non-current augmentation capital expenditure accounts for approximately 67 % of the total requested capital expenditure.

Table 2 Summary of Powerlink Capital Expenditure Application

REAL (00/01 PRICE LEVELS) $M		01/02	02/03	03/04	04/05	05/06	06/07
Network Capex							
Current Projects		61.4	25.7	3.5	0.0	0.0	0.0
Asset Replacement		35.8	32.2	11.7	14.3	9.7	19.4
Non-Current Augmentations	minimum	18.8	34.4	55.1	84.8	64.2	46.9
	average	**24.1**	**72.4**	**139.2**	**143.1**	**105.1**	**77.8**
	maximum	40.0	140.4	250.0	260.5	307.2	242.3
Non-network capex		11.8	8.8	8.9	12.3	8.9	11.6
TOTAL	minimum	127.7	101.1	79.3	111.4	82.7	77.9
	average	**133.1**	**139.1**	**163.3**	**169.7**	**123.7**	**108.7**
	maximum	148.9	207.1	274.2	287.1	325.7	273.3

The discussion of the capital expenditure in this Section, and Figures 1-14 in Appendix 2, relate only to the non-current augmentation capital expenditure. All expenditure costs discussed below are real 00/01 costs. The results and figures discussed below have been generated from scenario capital expenditure and probability information supplied to PB Associates by Powerlink during the course of this review.

The following key will be used in the discussions of the Powerlink probabilistic analysis that follow. The theme descriptions relate to those given in Table 7.1 of the Powerlink Application.

Key	Theme and possible outcome
Queensland Energy Policy	
EP 1	Outcomes lower than expected
EP 2	Outcomes equal expectations
EP 3	Outcomes exceed expectation
Load Growth	
LP 1	Low load growth
LP 2	Medium load growth
LP 3	Medium load growth with added new loads
LP 4	High load growth
Kyoto Targets	
Q 1	Outcomes lower than expected
Q 2	Outcomes equal expectations
Q 3	Outcomes exceed expectations
Impact of Committed New Coal-Based Generation	
C 1	Low impact
C 2	High impact

Figure 1 to Figure 4 (see Appendix 2) each show the capital expenditure profile for all 72 scenarios with each figure focusing on a different theme. Scenarios with the same colour have similar theme outcomes. The following points can be ascertained from an analysis of these figures:

- Scenarios representing similar levels of load growth show a more consistent pattern than scenarios grouped by other themes. This shows that load growth is the theme that most influences the level of capital expenditure required. In particular load growth is the dominant driver in the first three years of the regulatory period when the generation developments have a higher level of certainty.

- The impact of new coal generation theme has some influence, secondary to the load growth. This tends to indicate that the level that the new committed coal wins market share is directly related to the level of network augmentation that may be economic. This matches with what would be intuitively expected.

- The Kyoto Target theme has a significant influence for the high load growth outcome around 04/05. Kyoto targets exceeding expectations for a high load growth outcome reduces significantly the level of network augmentation required in the 04/05 year. It should be noted that the group of scenarios relating to this outcome is low (approx. 2.5 %).

Although Figure 1 to Figure 4 show the capital expenditure profiles for each theme outcome they do not indicate the relative probability of the different theme outcomes occurring. To give a better indication of the probability of total capital expenditure outcomes, probability distribution of the total capital expenditure over differing ranges of years have been produced.

Figure 5 to Figure 8 (see Appendix 2) show the probability distributions for the various levels of total non-current augmentation capital expenditure over the period 01/02 to 09/10. Each plot is grouped by theme outcomes. The following points can be ascertained from an analysis of these figures:

- The potential total non-current augmentation capital expenditure is split into three distinct ranges defined by the load growth. These ranges correspond to low, medium and high load growth outcomes.

- The total non-current augmentation capital expenditure outcome that is related to the medium load growth outcome is by far the most probable. The total capital expenditure spread for the medium load growth scenario is about $ 610 million to $ 980 million. This indicates there is still a large level of uncertainty in the total capital expenditure.

- The three generation development themes do not independently have a significant impact on the total level of capital expenditure.

- The impact of new coal generation theme and the Kyoto Target for a high load growth outcome discussed above can also be seen on these Figures.

Figure 1 to Figure 4 showed that there is an increasing uncertainty in later years. Therefore, it would be useful to consider the probability distribution for the total non-current augmentation capital expenditure during the regulatory period only, years 01/02 to 06/07. Figure 9 to Figure 12 (see Appendix 2) show these probability distributions, grouped into the four themes. The following points can be ascertained from an analysis of these figures:

- The total non-current augmentation capital expenditure is split into three ranges defined by the load growth. These ranges correspond to low, medium and high load growth outcomes.

- The total non-current augmentation capital expenditure outcome that is related to the medium load growth outcome is by far the most probable. The total capital expenditure spread for the medium load growth scenario is about $480 million to $ 620 million. However, there is about 68 % certainty that the total capital expenditure during the review period is between $ 500 million and $ 540 million.

- The highest probability total non-current augmentation capital expenditure is about $ 520 – 540 million range, which has a probability of about 45 %. The average total capital expenditure is $561 million. The increase in the average from the highest probability is due to the skewness of the probability distribution.

- The three generation development themes do not independently have a significant impact on the total level of capital expenditure.

- The impact of the New Coal Generation theme and the Kyoto Target theme for a high load growth outcome as discuss above can also be seen on these Figures.

Due to the increasing uncertainty in later years, Powerlink has requested a mid term reset of the capital expenditure forecast. Figure 13 and Figure 14 (see Appendix 2) show the probability distribution of the total non-current augmentation capital expenditure for years 01/02 to 03/04 and 04/05 to 06/07 respectively.

These graphs indicate that there is a very high certainty in the total level of non-current augmentation capital expenditure in the first three years. The graphs indicate about 85% certainty that total capital expenditure is between $ 220 – 260 million. There is less certainty in the total level of non-current augmentation capital expenditure required in the final three years, due mainly to the greater uncertainty in generation developments in the medium/long term. However, the graphs still indicate about 80% certainty that total capital expenditure is between $ 260 – 340 million.

Given the greater level of uncertainty in Powerlink's capital expenditure requirements for the final three years of the regulatory period, a mid term reset of the augmentation related capital expenditure forecast is appropriate. At this point it should be possible to forecast the capital expenditure requirement with greater certainty and the revenue cap can then be adjusted accordingly.

This analysis has shown that the main driver for the level of capital expenditure is the load growth. The generation developments have a secondary effect on top of this. The individual theme outcomes have little independence in the level of capital expenditure. The main generation driver is the combination of themes and the resulting generation developments. We do not consider it within the time constraints of this work to analyse in detail the actual generation developments (or patterns of development) that impact most on the level of capital expenditure.

Important Cautionary Note on Analysis The probabilistic approach adopted by Powerlink assumed a discrete probability distribution for each theme and generation development. This is appropriate for project developments, where there can be a probability that a development will occur or will not occur. However, the themes, particularly the load growth theme, would more approximate a continuous distribution. This would have a tendency to reduce and spread the bars in the probability distribution charts. Therefore, it would be expected that the range of capital expenditure for a particular certainty would be greater than that indicated by the above analysis of the Powerlink scenario results. It would be expected that this increase in spread would be related to the variance in the load growth forecast. However it is unlikely that a more detailed and accurate analysis would materially change either the forecast or the conclusions.

6. POWERLINK ASSET MANAGEMENT FOR CAPITAL WORKS

As part of the review of the capital expenditure forecast in the Powerlink Application, PB Associates have also conducted a brief review of the Powerlink asset management system. The aim of this review is to assess the effectiveness of the Powerlink asset management system in ensuring that only necessary and efficient capital expenditure occurs.

Powerlink have stated that their present strategy is to perform small incremental network augmentations, where possible, in order to minimise risk of asset stranding due to future changes in generation size, location and despatch.

Powerlink have provided PB Associates with a summary of the joint planning process Powerlink undertake with the distributors in their region. They have also provided details of the planning and consultation process undertaken by Powerlink for major and minor network augmentation proposals.

PB Associates would consider the process defined by Powerlink to be in line with Code requirements, and should lead to only necessary and efficient capital expenditure occurring.

It should be noted that this review did not include an audit to assess actual compliance with the stated processes.

7. ASSET ADDITIONS

7.1 ASSET ROLL INS

The actual and forecast additions to the asset base following the 1 July 1999 valuation by the Arthur Anderson, GHD Worley consortium is given in Table 3 below

Table 3 – Summary of Capital Expenditure Roll-Ins

Capitalisation Summary

Capex Category	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07
		ESTIMATED COST AT 00/01 COST LEVELS $'000						
			First Regulatory Period					
Lines	60,946	125,724	27,637	23,097	77,364	95,686	90,198	11,119
Substations	114,671	123,595	82,343	97,022	62,974	70,184	55,234	46,444
Communications	8,419	9,711	8,858	15,210	6,595	8,462	3,081	2,561
Control Centre	14,323	9,826	630	950	500	1,000	1,250	250
Easements	20,147	7,733	4,819	8,082	0	0	0	0
Non-network Capex	16,602	8,590	11,797	8,787	8,897	12,297	8,897	11,597
Interest During Construction		19,927	8,914	10,067	10,808	12,795	11,139	4,431
TOTAL CAPEX	**235,108**	**305,106**	**144,998**	**163,215**	**167,137**	**200,425**	**169,800**	**76,401**
Additional FDC		14,372	6,456	7,409	7,670	9,118	7,799	3,141
TOTAL CAPEX (incl addit FDC)		**319,478**	**151,454**	**170,624**	**174,807**	**209,543**	**177,599**	**79,542**

The capitalisation summary in the above table provides a summary of actual and forecast capital expenditure in real 2000/01 dollars.

In interpreting Table 3 above the following should be noted.

- The table include the roll in of new assets only and does not include write-offs.
- The 99/00 column corresponds to the Asset Acquisitions column in the table on P61 of the Powerlink Regulatory Application. It includes provision for finance during construction.
- The total capitalisation of $319.478m in 00/01 corresponds to the total of New Acquisitions and Interconnector Acquisitions in the table on P 62 of the Regulatory Application.
- The “TOTAL CAPEX” for the period 01/02 to 06/07 in the above table corresponds to the “Asset Roll In” in Table 7.2 on P76 of the regulatory application, indexed back to real 00/01 dollars.
- The additional FDC is a factor added in by Powerlink to allow for the fact that the Commission bases the allowed revenue in any year on the opening asset base. The FDC is a provision for a return on assets commissioned during the year and is based on the assumption that assets will be commissioned mid way through the year on average.
- The above table includes a total provision of $255.4m for the Queensland – New South Wales Interconnector. (QNI). $50.2m was rolled in 1999/2000 for the 275 kV Tarong-Braemar section. $205.2m was included in the projected asset value to be rolled in during the current year ending 30 June 2001.

7.2 QUEENSLAND - NEW SOUTH WALES INTERCONNECTOR

7.2.1 Background

In response to an application made jointly by the Queensland and New South Wales Governments, the Commission authorised changes to the Code to allow the Queensland – New South Wales Interconnector (QNI) to be accepted as a regulated interconnector. The project has recently been commissioned and will therefore be added to the asset base during the first quarter of 2001.

The decision to proceed with QNI was made on the basis of a cost – benefit analysis based on a Sinclair Knight Merz (SKM) cost estimate prepared in December 1996. The estimate for the Queensland component of QNI is shown in Table 4 below:

Table 4 QNI Cost Estimate

	Cost	Comment
Transmission Lines	$142m	
Substations	$100m	
FDC	$16m	
Total	**$258m**	December 1996 cost levels
Escalated costs	**$270m**	June 200 cost levels

In the event Powerlink expects to complete the project for a total cost, including finance during construction, of $205m.

Powerlink considers that the cost savings on the original budget were due to innovative and efficient project management on their part. If this is accepted, then Powerlink considers it will be disadvantaged if the Commission applies its normal practice of adding in new assets to the asset base at actual cost.

There is merit to this argument. Once an asset is added into the asset base, the TNSP is allowed to earn a return calculated by multiplying the value of the asset by the WACC. If the asset is added valued at replacement cost, rather than at an agreed standard cost, then an asset built using less efficient project management and construction techniques will have a higher opening value and will therefore earn a higher return, (when measured in absolute rather than percentage terms). Thus inefficient construction is rewarded, which is contrary to the intent of the regulatory regime.

7.2.2 Regulatory Overview

While this is the first time the Commission has undertaken a regulatory review of Powerlink, its revenue is currently constrained by a regulatory determination issued in June 2000 by the Queensland Electricity Reform Unit. This determination does not specifically show the provision made for QNI in the capital expenditure forecast.

In relation to capital expenditure the Commission states in its Draft Statement:

"The Commission notes that forward estimates of capital expenditure are often subject to greater uncertainty than estimates of operations and maintenance expenditures and is

wary of encouraging overestimates of forward capital expenditures, which, if not undertaken, the regulated business may try to claim as efficiency gains in the future.

"For this reason the Commission considers it most appropriate to treat any cost reductions resulting from deferred capital expenditures as windfall gains and, as such, subject them to a P_0 adjustment mechanism at the beginning of the next regulatory period. However the regulated TNSP is invited to demonstrate at each regulatory review that any capital expenditure below forecast levels has arisen because of management induced efficiency gains. Where it is clearly demonstrated by the TNSP that capital expenditure shortfalls have resulted because of management efficiencies or innovation, the capital expenditure may be subject to a glide path, similar to the operations and maintenance expenditure."[8]

In its Application[P63] Powerlink quotes the final section of the above extract from the Commissionsion's Draft Statement and submits that it should be entitled to benefit from efficiency gains in relation to the construction cost of QNI[9].

The extract from the Draft Statement quoted above indicates that efficiencies should be measured against the capital expenditure forecast used by the regulator when setting the revenue cap for the current regulatory period. However, the ERU Determination that currently applies to Powerlink, does not specify the capital expenditure provision allowed for the in construction of QNI.

Powerlink's efficiency claim is based on savings made against the estimated cost of the project that was used as the basis for the cost-benefit analysis on which the decision to proceed with the project is based.

We agree that, if management efficiencies can be established, then the Commission should give serious consideration to the application of a glide path. The Commission needs to be even handed in its approach to regulation and also to be aware of the danger that its practice of rolling in new assets at their actual cost could penalise efficient construction.

7.2.3 Efficiency Claim

Powerlink has claimed efficiency savings of $40.5m in the construction cost of QNI, broken down as shown in Table 5 below:

Table 5 – Summary of QNI Cost Efficiencies Claimed by Powerlink

Efficiency	Saving
Reduced transmission line length	$18.5m
Selection of transmission line contractor	$6m
Hedging of aluminium prices	$6.5m
Use of imported structural steel	$2.6m
Innovative project management	$6.9m
Total	**$40.5m**

[8] Section 7.2.2, P 95.
[9] See P64 of Powerlink's Application.

These claimed efficiency gains are discussed in the paragraphs below.

7.2.3.1 Reduced Transmission Line Length

The route on which the decision to proceed with QNI was based followed a westerly alignment and was chosen after the Queensland government, following community opposition, rejected an earlier proposal for a shorter more easterly route. The SKM cost estimate was based on this original route.

Subsequent to the decision by the Queensland and NSW governments to proceed, Powerlink was able to negotiate a new, shorter alignment that avoided a "dog-leg", in the north-western corner of the approved route. This new route was more difficult in that it traversed cultivated areas, passed though areas of significant aboriginal cultural heritage and passed close to the township of Warra.

The new route increased route acquisition costs and required more expensive construction. However the overall route length was reduced by 42 km and permitted a more favourable location for the northern terminal station, which in turn avoided two line reactors. Overall construction costs were reduced by a net $18.5m through the use of the alternative route.

7.2.3.2 Selection of Contractor

Powerlink selected the lowest priced construction contractor for this project even though it had no previous experience with this contractor. The contractor's previous experience in Australia, on this type of work, had been on much smaller projects outside of Queensland.

Powerlink believes that it took a risk using this contractor, with which it had no previous experience, on such a large project with a high profile. However selection of this contractor resulted in a savings of $6m.

We accept that this contractor's previous experience in Australia indicated that it did not have a proven track record on projects of this size and complexity. However, in making its Contractor selection, we believe Powerlink would have been reassured by the fact that the contractor was the Australian subsidiary of a well-known international company with significant experience in the construction of large transmission line projects outside Australia.

7.2.3.3 Hedging of Aluminium Prices

The price of aluminium line conductor is dependent on the commodity price of aluminium. At the time the project was approved the aluminium price was $3,000 per tonne but early in the project the price dropped to $2,400 per tonne before rising again to $3,000. Powerlink took out a forward hedge for 7,500 tonnes of aluminium when its price was at the bottom of its cycle. As a result of this hedge it was able to procure the required aluminium for $18m, a saving of $6.5m on the estimated $24.5m it would have had to pay for aluminium had the hedge not been in place.

7.2.3.4 Use of Imported Steel

Australian steel is considered to be of a better quality than imported steel and traditionally has been used for all tower footings and for the above ground portions of tension towers, which are more highly stressed. This approach results in a mix of 25% Australian steel and 75% imported steel on large projects.

At the time of construction of QNI, the price of Australian steel was $3,200 per tonne while imported steel was $2,400 per tonne. On QNI, Powerlink used 100% imported steel giving a savings of $2.6m.

7.2.3.5 Project Management

In undertaking this project Powerlink introduced new and innovative project management procedures. These included:

- Increased liaison with overseas suppliers to ensure that plant was compliant before dispatch;

- Installation of project and inspection officers on site. This avoided problems in areas that have been a traditional cause of contract price overruns such as the installation of tower footings;

- Improved procedures for agreeing work methodology and conditions of site access with Aboriginal traditional owners. It is estimated that the direct costs involved in negotiating with Aboriginal owners were over $1m less than Powerlink's previous project of a similar length.

Powerlink's project managers have estimated that these project management initiatives saved $6.4m wand that an additional $0.5m was saved through reducing the duration of field supervision.

7.2.4 Conclusion

The efficiencies claimed can be separated into four distinct categories, each of which needs to be considered separately from a regulatory perspective. These four categories are discussed below.

7.2.4.1 Asset Avoidance

The first category is the efficiency created by avoiding the need to build an asset that was planned and thought to be required. The savings due to a reduction in the route length fall into this category.

QNI was approved based on a route that was politically acceptable to the government of the day and the project budget reflected that route. In the event, due to proactive management by Powerlink, some 42 km of the planned line was not required. In these circumstances, we believe that it is fully consistent with the intent of the incentive regime that Powerlink be given credit for the savings made. It is noted that this saving is a one-off efficiency gain specific to QNI and it cannot be assumed that similar efficiencies will be available for future projects.

It is inappropriate to recognise this efficiency by adding back the savings into the value of the asset. This would, in effect, capitalise an asset that does not exist. The glide path, as discussed in Section 7.2.2 of the Commission's Draft Statement is an appropriate mechanism for rewarding this efficiency. The Commission may wish to separately identify this saving in its Decision, given that it does not relate directly to the value of an existing asset.

7.2.4.2 Speculative Gain

The second category is the speculative gain, characterised by the savings made through the hedging of aluminium prices. These savings are speculative in that the savings made could, in different circumstances, have been a loss. In determining the appropriate treatment of such transactions, the Commission needs to consider the issue of symmetry.

From a regulatory perspective it would be inappropriate for gains from the trading of hedge contracts to be subject to a glide path unless losses are also subjected to a similar glide path.

In its Draft Statement the Commission makes no provision for a glide path where capital expenditure exceeds that forecast. In this case, while the Company may carry the loss for the remainder of the regulatory period, after a reset the losses are assumed by the customers, since the allowed revenue will increase to support the higher value of the asset base. On this basis we do not recommend that gains made from commodity hedge contract be subject to a glide path.

7.2.4.3 Contractor Selection Gains

Powerlink believes that its QNI contractor priced the work very competitively in order to gain a foothold in the Queensland market. To the extent that this is correct, this is a one-off gain. Nevertheless, if more contractors remain active in the market, it may be more competitive and the construction costs of future projects can be expected to decrease as a result.

7.2.4.4 Construction Efficiencies

The fourth category incorporates savings made by the introduction of construction efficiencies, including the use of 100% imported steel and project management gains. These efficiencies are not project specific and are measures that the Company might equally apply other new projects. The fact that these efficiencies were available to QNI indicates that there may be ongoing opportunities for Powerlink to reduce the cost of new project construction and, in a competitive environment, there would be strong incentives for it to do so.

For this regulatory reset, it is understood that the Commission is likely to determine a revenue cap based on an asset valuation using replacement costs, based on existing project management and construction practices that do not take into account additional efficiencies that may be available. However, the ODRC methodology does *not* predicate that existing construction and project management methodologies should form the basis for the assessment of replacement costs. Construction efficiencies should therefore be reflected in the asset replacement costs used as the basis for future asset valuations.

7.2.4.5 Conclusion

The Commission’s current practice is to require new assets to be rolled into the asset base at actual installation cost which, for most projects, would be based on project management practices in accordance with current industry norms. On this basis we consider the above construction efficiencies, except for the speculative gain made through the hedging of aluminium prices, should be allowed. Failure to take this approach would mean that efficient construction is penalised, which is not consistent with the intent of the regulatory regime.

However increased market competitiveness and more efficient project management may provide scope for a reduction in the construction cost of future projects, particularly larger ones.

The Commission’s Draft Regulatory Principles indicate that allowed efficiency gains, similar to those Powerlink has claimed on QNI, would normally be subject to a glide path. This would mean that the return would be ramped down to zero at a linear rate over the next regulatory period, in accordance with Section 7.2.2 of the Commission’s Draft Principles.

However, as indicated in Section 2.1, Powerlink has added the requested savings of $40.5m back into the value of the asset base. This would have the effect of maintaining a full return on the savings, without any ramp down, until the next asset valuation.

The adding back of efficiency gains is inconsistent with the Commission's normal practice of requiring new assets to be added in to the asset base at actual cost. A more consistent approach would be to value the asset at actual construction cost, in accordance with the Commission's normal requirements, and to treat any allowed efficiency gains as a separate line item.

APPENDIX A
Glossary of Terms

Glossary of Terms

ACCC	Australian Competition and Consumer Commission
Code	National Electricity Code
Commission	Australian Competition and Consumer Commission
CAPEX	Capital Expenditure
DCST	Double Circuit Steel Tower
DNSP	Distribution Network Service Provider
Draft Statement	*Statement of Principles for the Regulation of Transmission Revenues* – Draft; ACCC, 27 May 1999
ERU	Queensland Electricity Reform Unit
FDC	Finance During Construction
GHD	Gutteridge Haskins & Davey Pty Ltd
MEA	Modern Equivalent Asset
NEC	National Electricity Code
NEM	National Electricity Market
NEMMCO	National Electricity Market Management Company
NIEIR	National Institute of Economic and Industrial Research
NSW	New South Wales
ODRC	Optimised Depreciated Replacement Cost
OPEX	Operations and Maintenance Expenditure
QNI	Queensland – New South Wales Interconnector
SCST	Single Circuit Steel Tower
SKM	Sinclair Knight Merz
TNSP	Transmission Network Service Provider

APPENDIX B
PB Associates Review Figures

Figure 1 CAPEX profile - Load growth split: LG 1 – red, LG 2 – green, LG 3 – blue, and LG – 4 yellow.

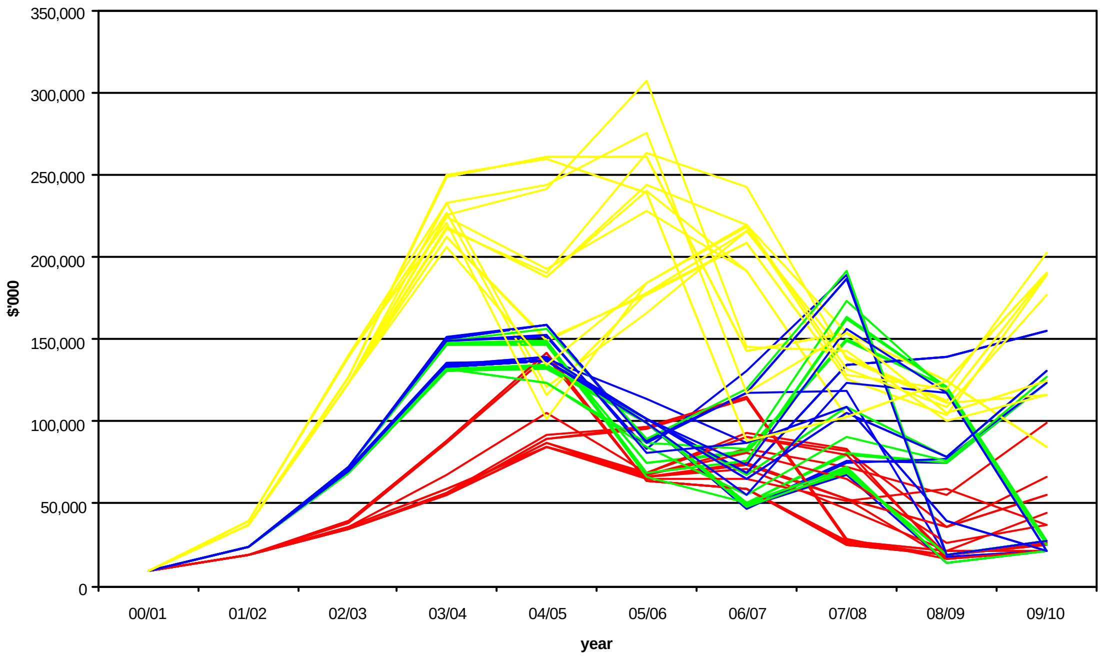

Figure 2 CAPEX profile – Energy Policy split: EP 1 – red, EP 2 – green, and EP 3 – blue.

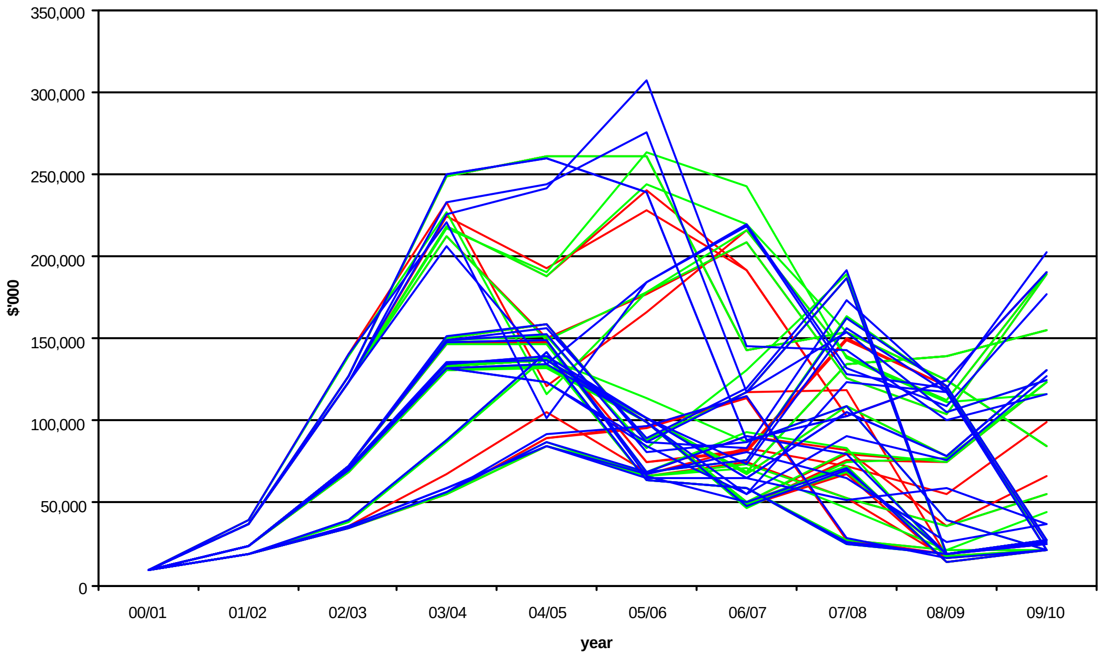

Figure 3 CAPEX profile – Kyoto Target split: Q 1 – red, Q 2 – green, and Q 3 – blue

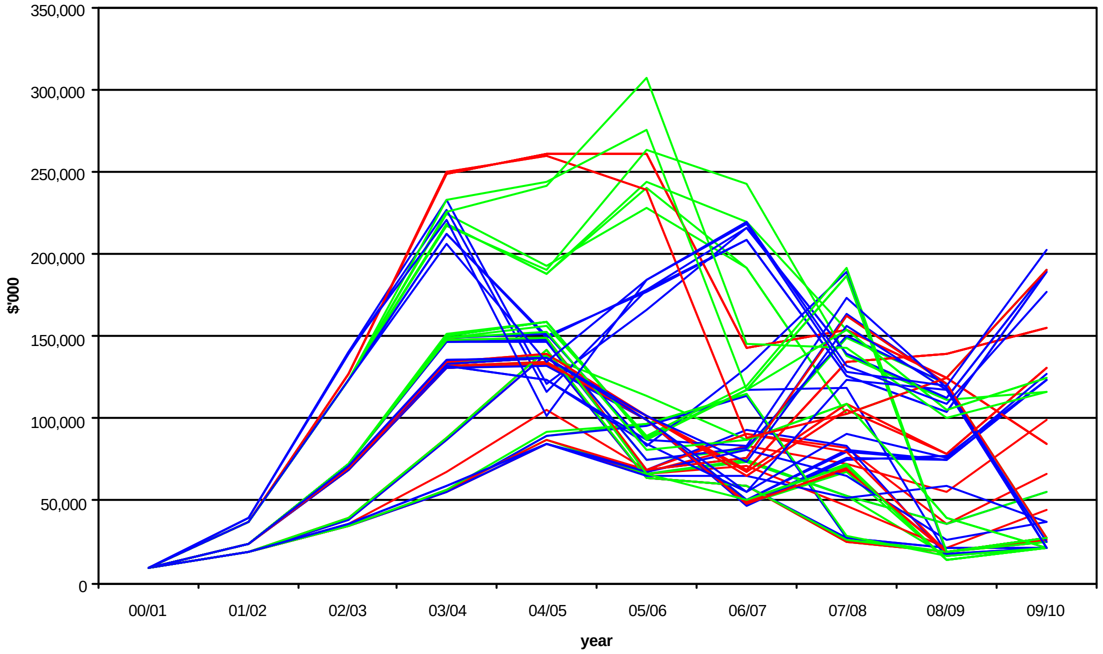

Figure 4 CAPEX profile – Impact of Coal split: C 1 – red, and C 2 – green

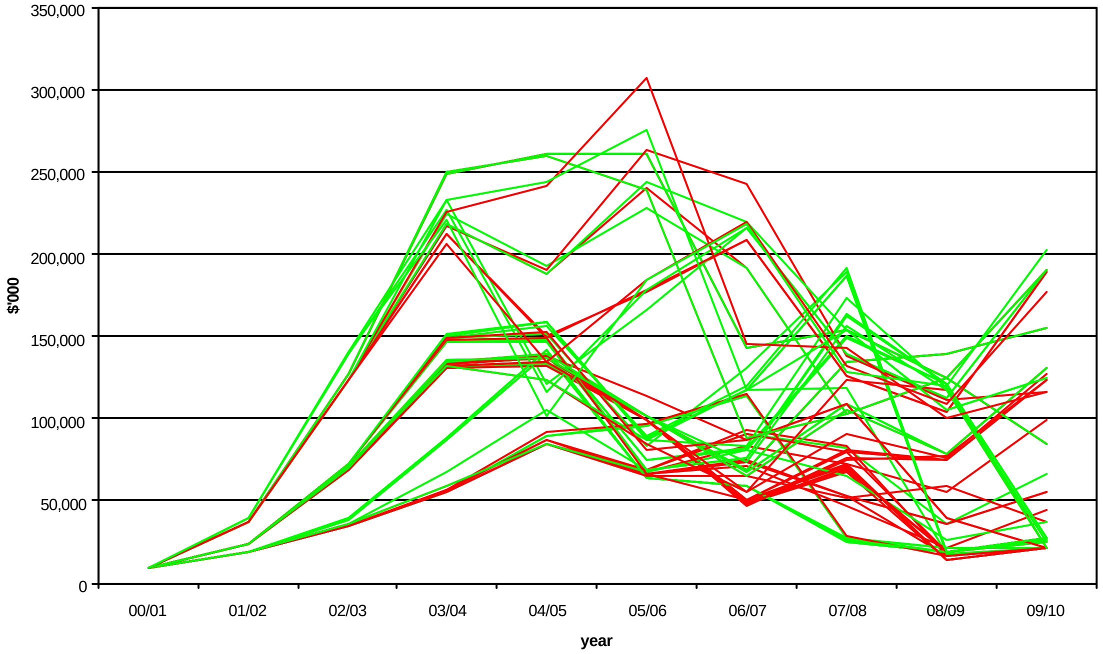

Figure 5 Probability distribution – Load Growth split – to 09/10

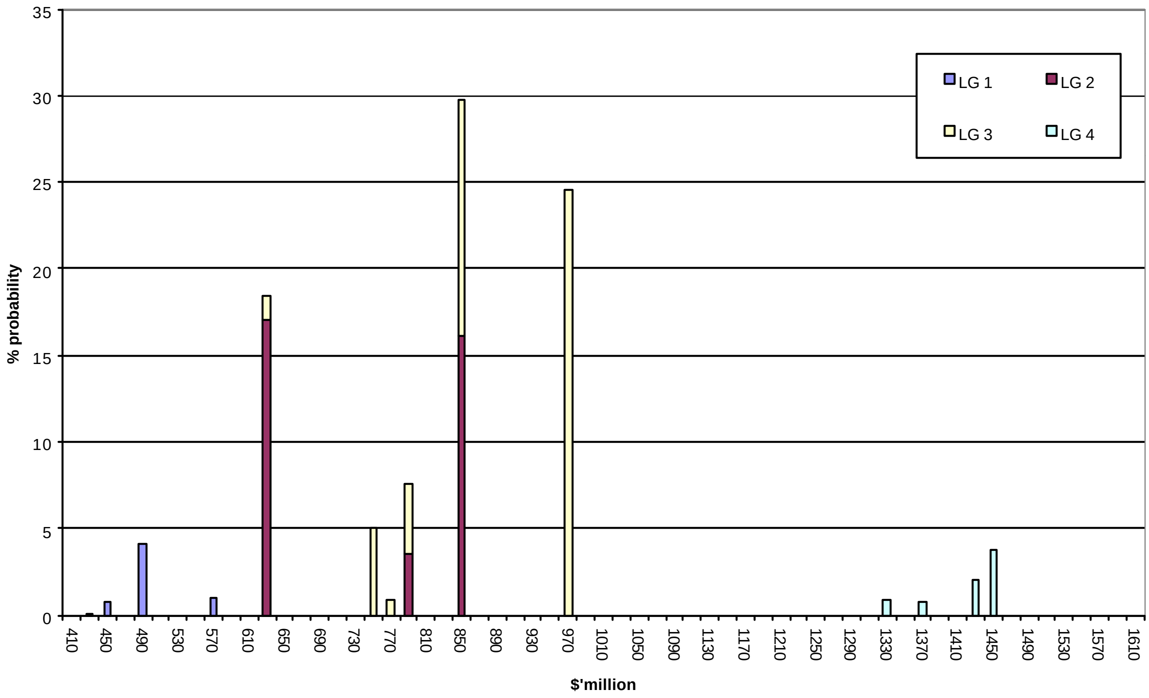

Figure 4 Probability distribution – Energy Policy split – to 09/10

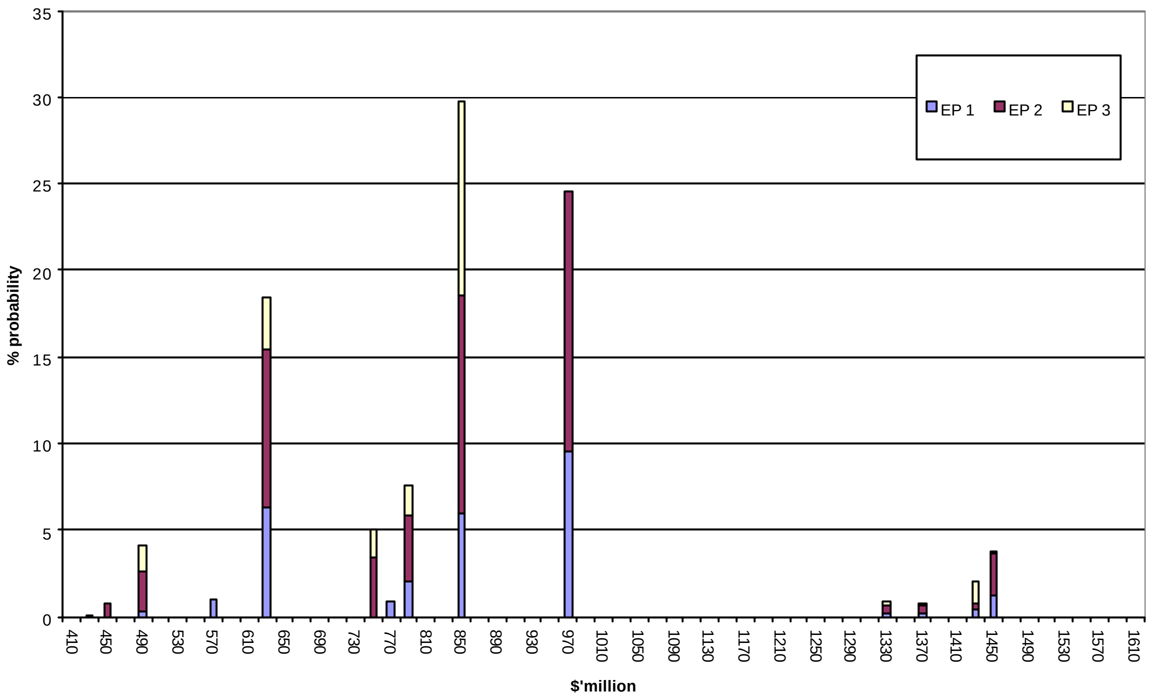

Figure 5 Probability distribution – Kyoto Target split – to 09/10

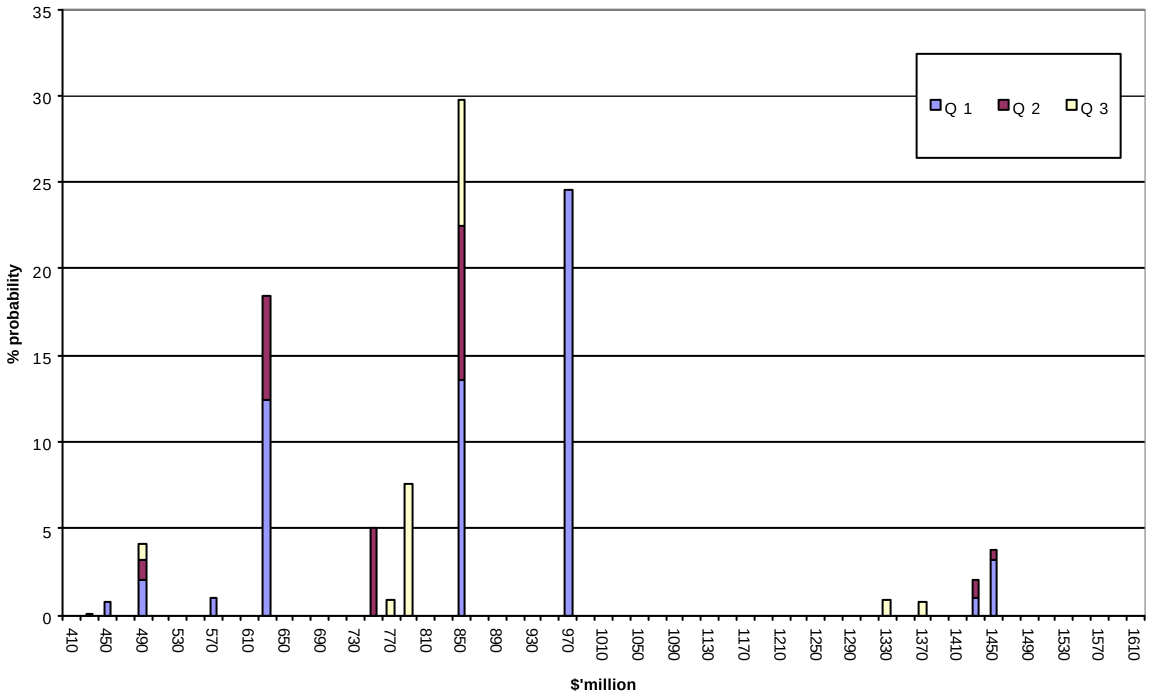

Figure 8 Probability distribution – Impact of Coal split – to 09/10

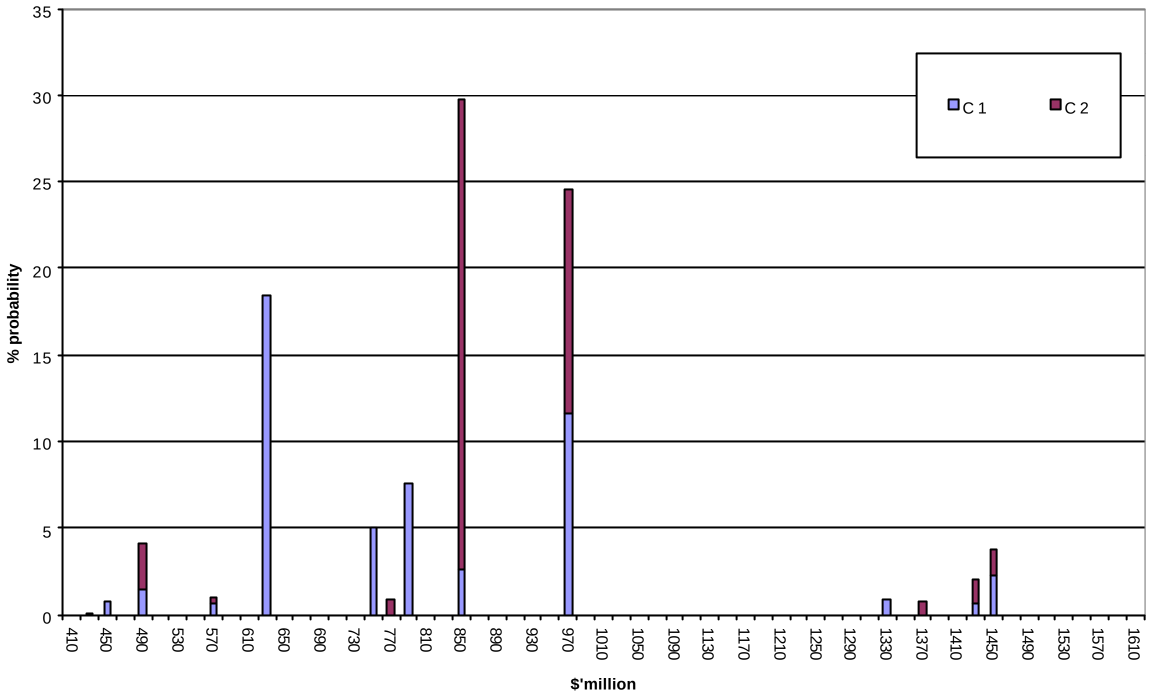

Figure 9 Probability distribution – Load Growth split – to 06/07

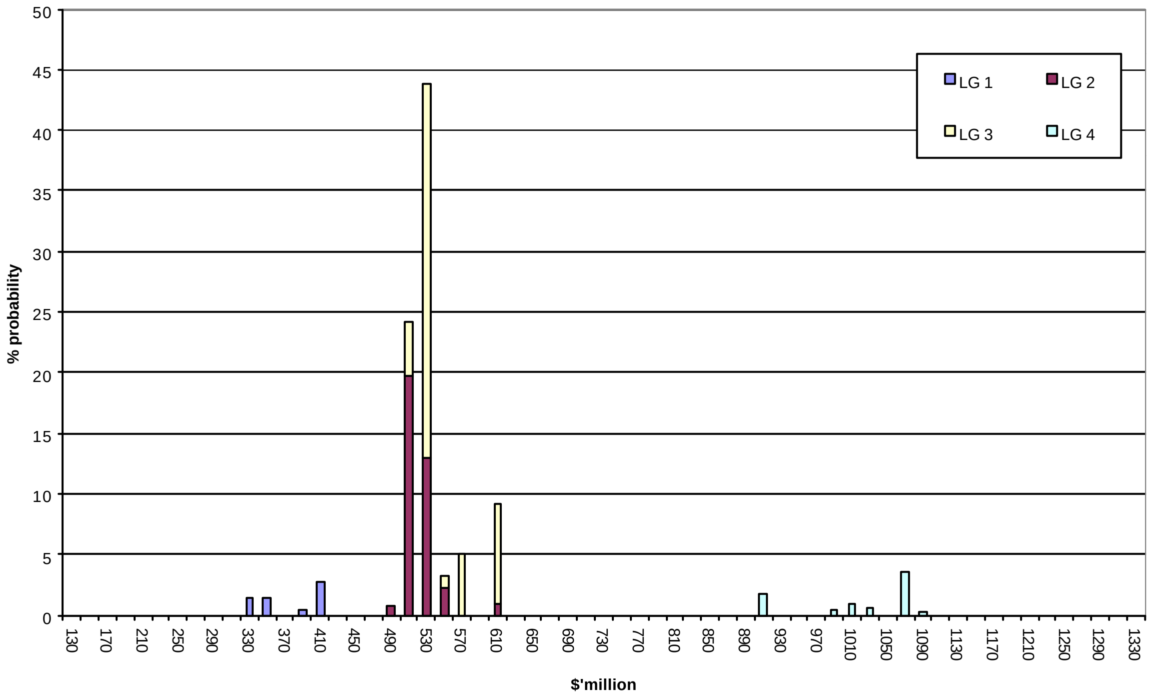

Figure 6 Probability distribution – Energy Policy split – to 06/07

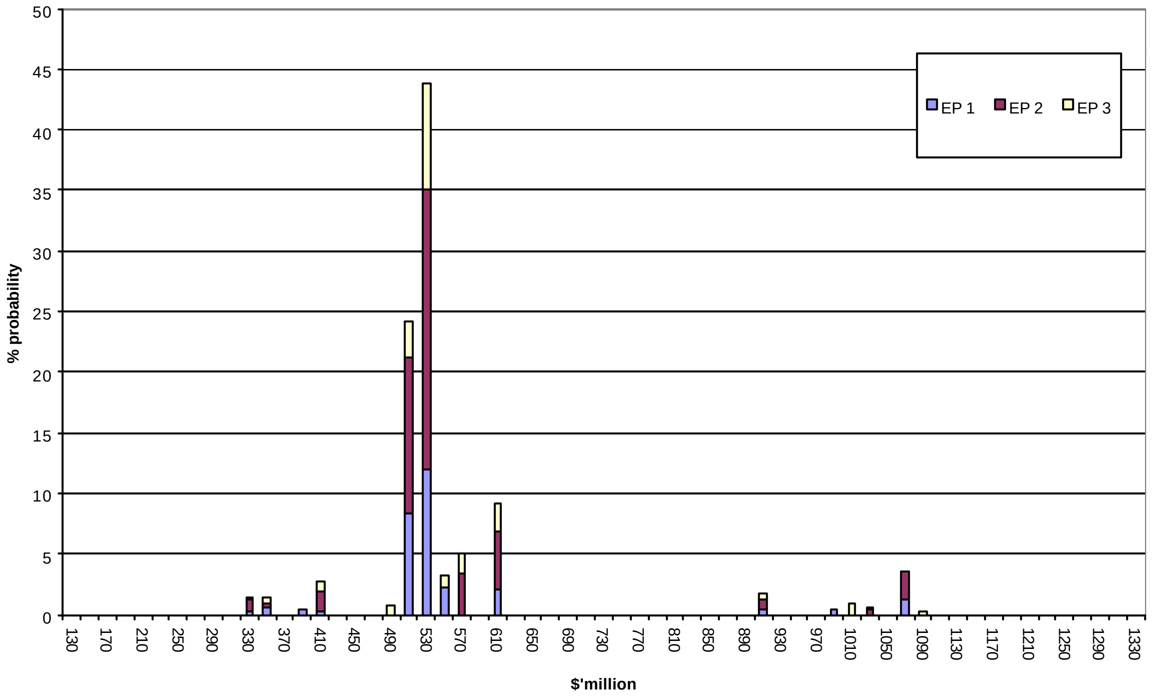

Figure 7 Probability distribution – Kyoto Target split – to 06/07

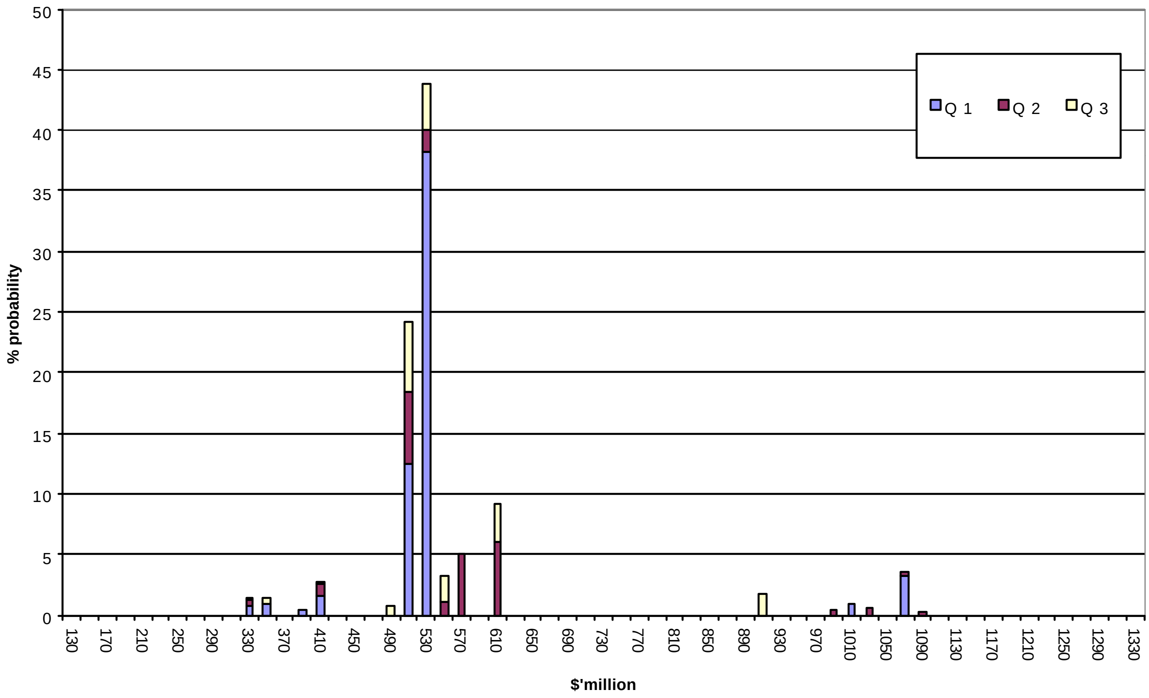

Figure 12 Probability distribution – Impact of Coal split – to 06/07

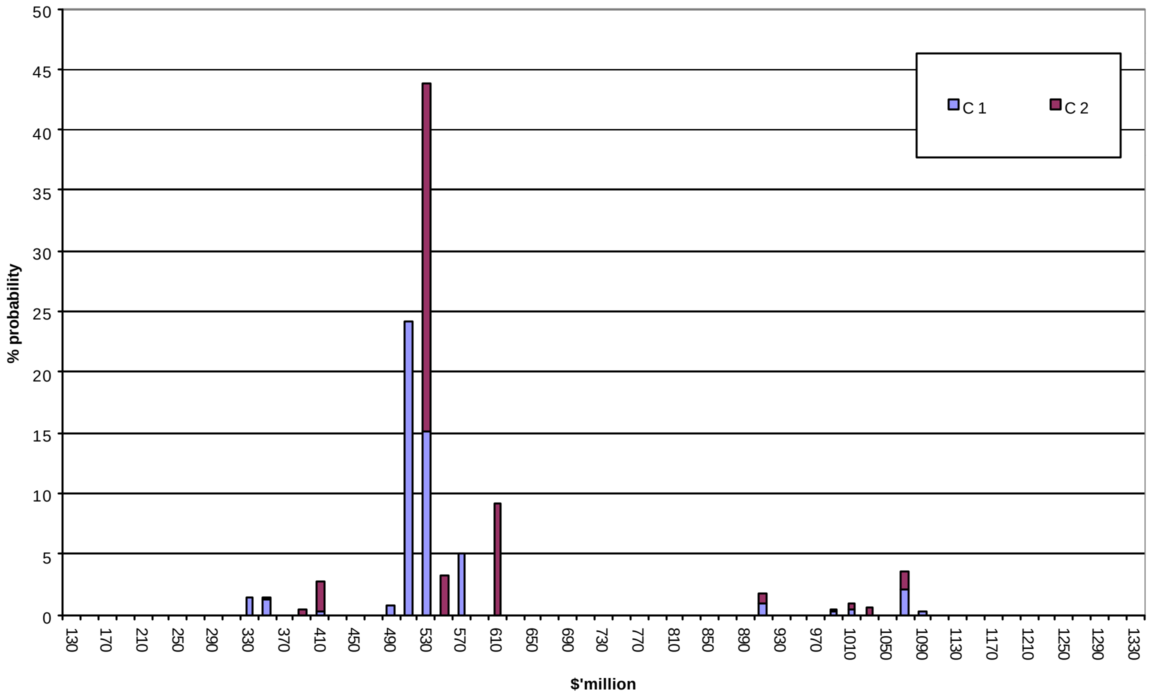

Figure 13 Probability distribution – Load Growth split – to 03/04

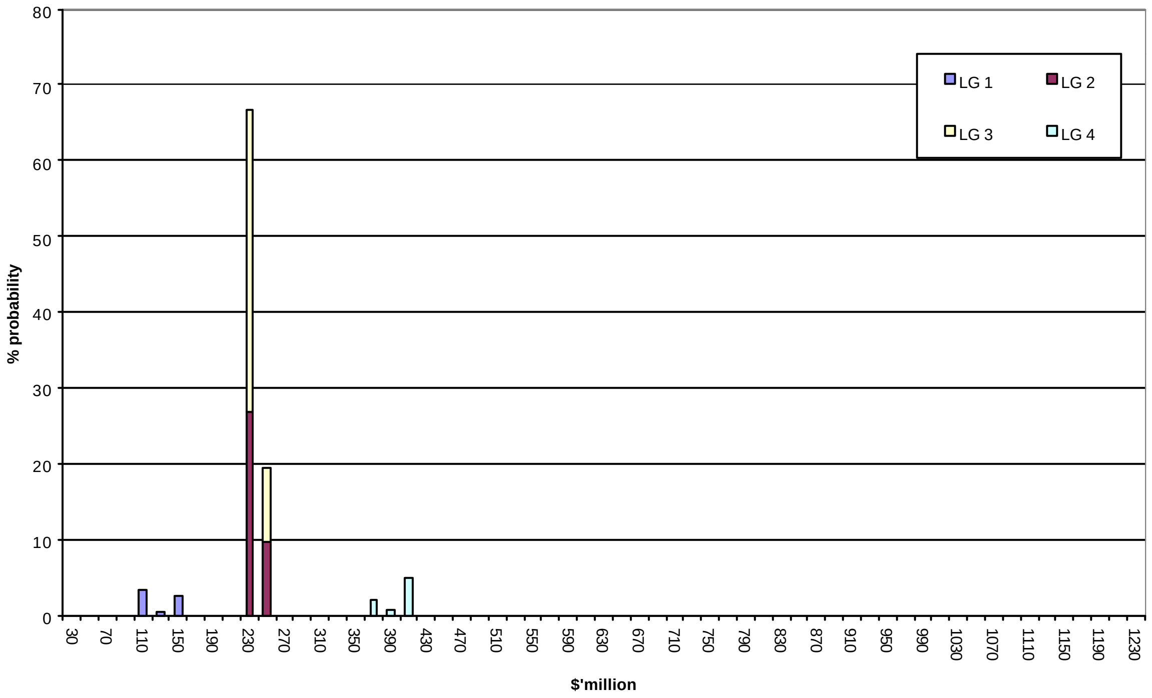

Figure Probability distribution – Load Growth split – 04/05 to 06/07