grid australia
BACKBONE OF THE NEM

22 August 2012

Mr Phillip Weickhardt
Presiding Commissioner
Electricity Network Inquiry
Productivity Commission
GPO Box 1428
Canberra City ACT 2601

Via email: electricity@pc.gov.au

Dear Phillip

Electricity Network Regulation - Supplementary Submission to Issues Paper

Grid Australia welcomes the opportunity to provide this supplementary submission to the Productivity Commission Inquiry on Electricity Network Regulation - Issues Paper, which was foreshadowed in an earlier submission made on 8 June 2012.

This submission responds to issues and comments raised in two recent submissions from the Australian Energy Market Operator (AEMO) to the Productivity Commission's Issues Paper for its Electricity Network Regulation Inquiry. These comprise a primary submission from AEMO,[1] and then a subsequent letter from AEMO[2] accompanied by a report from Nuttall Consulting.[3] The purpose of this submission is to respond to both the quantitative and policy statements that have been put forward in each of these documents.

The AEMO submission contends that the Victorian approach to transmission investment decision making – namely where a not-for-profit entity plans the transmission system and procures transmission assets when augmentation is required – is superior and should be extended across the National Electricity Market (NEM).

Grid Australia has commissioned expert advice from Evans & Peck test the evidence presented by AEMO.

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1 Australian Energy Market Operator, *Electricity Network Regulation – Response to the Productivity Commission Issues Paper*, May 2012.

2 Australian Energy Market Operator, *Electricity Network Regulation – Nuttall Consulting Report: Victoria Over capacity review, Letter to the Productivity Commission*, August 2012.

3 Nuttall Consulting, *Victoria over capacity review: Is over-capacity the reason for low augmentation levels in Victoria? A report to the AEMO*, July 2012.

A report from Evans & Peck accompanies this submission. While a request was made for the data AEMO used for its analysis on 4 July 2012, this data has not yet been received. While the absence of this data does not affect the overall conclusions reached in this submission and Evans & Peck's accompanying paper, it does mean it has been more difficult to draw direct comparisons with AEMO's analysis.

We trust that this submission will be useful to the Commission and look forward to further constructive engagement with the Commission and staff on these important matters for the electricity sector.

Yours sincerely

Rainer Korte
Chairman
Grid Australia Regulatory Managers Group

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BACKBONE OF THE NEM

Electricity Network Regulation

Supplementary Submission in Response to the Productivity Commission Issues Paper

August 2012

Powerlink Queensland · TransGrid · ElectraNet electricity transmission · Transend · SP AusNet A member of Singapore Power Group

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1. Introduction and summary

This submission responds to issues and comments raised in two recent submissions from the Australian Energy Market Operator (AEMO) to the Productivity Commission's (Commission) Issues Paper for its Electricity Network Regulation Inquiry (the Inquiry). These comprise a primary submission from AEMO,[1] and then a subsequent letter from AEMO[2] accompanied by a report from Nuttall Consulting.[3] The purpose of this submission is to respond to both the quantitative and policy statements that have been put forward in each of these documents.

1.1 Overview of AEMO's submissions and our response

The AEMO submission contends that the Victorian approach to transmission investment decision making – namely where a not-for-profit entity plans the transmission system and procures transmission assets when augmentation is required – is superior and should be extended across the National Electricity Market (NEM). AEMO presents both quantitative and qualitative evidence in support of this position.

Grid Australia has commissioned expert advice from Evans & Peck to test the evidence presented by AEMO. A report from Evans & Peck accompanies this submission. While a request was made for the data AEMO used for its analysis on 4 July 2012, this data has not yet been received.[4] While, the absence of this data does not affect the overall conclusions reached in this submission and Evans & Peck's accompanying paper, it does mean it has been more difficult to draw direct comparisons with AEMO's analysis.

The table below sets out AEMO's key propositions and Grid Australia's high level response. Grid Australia's response is based in part on the Evans & Peck analysis.

1 Australian Energy Market Operator, *Electricity Network Regulation – Response to the Productivity*

2 Australian Energy Market Operator, *Electricity Network Regulation – Nuttall Consulting Report: Victoria Over capacity review, Letter to the Productivity Commission*, August 2012.

3 Nuttall Consulting, *Victoria over capacity review: Is over-capacity the reason for low augmentation levels in Victoria? A report to the AEMO*, July 2012.

4 A request was also made to AEMO by a Grid Australia member before this time via email on 29 May 2012.

Table 1.1: Summary of AEMO's Key Propositions and Grid Australia's Response

AEMO Proposition	Grid Australia Response
Transmission planning performance has been superior in Victoria compared to other states, the evidence for which is: • superior asset utilisation in Victoria[5] • a lower level of recent capital expenditure than other jurisdictions (contributing to a lower growth in the RAB and transmission prices), and • superior service outcomes to other jurisdictions.	Apart from the obvious potential fallacy of correlation implying causation, Evans & Peck's analysis reveals that there is no compelling reason to suggest that the outcomes attributable to AEMO's planning in Victoria have been superior to those observed in other jurisdictions. In particular: • the available information does not suggest that asset utilisation in Victoria has been superior (average utilisation – the metric proposed by AEMO – is a particularly poor indicator) • service performance has not been superior when alternative measures are considered, and • a myriad other factors outside of AEMO's control in Victoria also affect overall levels of capital expenditure, growth in the RAB and transmission prices.
Applying probabilistic planning to each investment, as applied in Victoria, delivers more efficient outcomes than the setting of "deterministic" or "hybrid" planning standards, as applied elsewhere.	An economic approach to planning standards is important for facilitating efficient transmission investment. However, the "probabilistic" techniques currently applied by AEMO do not properly reflect an economic approach, in part because they undervalue the cost of high impact, low probability events. A deterministic expression of economically-derived standards is also necessary to maintain an objective and transparent regime. In any event the planning technique adopted is largely independent of the primary issue of who does the investment planning and decision making; i.e. this issue is independent of any arguments to increase AEMO's role in transmission investment planning.

5 AEMO used measures of network utilisation for two purposes (i) as a direct measure of planning performance, and (ii) as an indicator of whether the lower level of capital expenditure in Victoria may be the result of legacy excess capacity.

AEMO Proposition	Grid Australia Response
The regulatory regime (when applied to “for profit” entities) provides an incentive for “gold plating”, which is best addressed by a not-for-profit entity making investment decisions. Investment decision making by a “not for profit” entity also permits competition in the provision of new network assets. In addition, a single, not-for-profit planning and investment decision making entity is essential for efficient planning from a national point of view.	Conferring investment and operational decisions on for-profit entities allows financial incentives to be used to drive efficient outcomes. AEMO’s contentions ignore the difficulties of motivating performance in “not-for-profit” entities given the inability to use financial incentives as a tool to motivate behaviour. It also downplays the costs that are created when responsibility for intrinsically related functions are split. Significantly, AEMO’s assessment of this matter is directly at odds with the assessment of the AEMC and its expert advisers who have concluded that the incentive properties of the current regime do not provide an incentive to over-invest.

1.2 Quantitative evidence on the efficiency of planning

At the outset, it needs to be emphasised that attempting to test whether planning outcomes in one state have been superior to those in another is an extremely complex task.

In the first instance, the part of the Victorian shared network for which AEMO has planning responsibility is very different to the transmission networks in other states. The assets it is responsible for are much larger (220 kV and above) and do not play as significant a role in matching regional generation to regional loads. This means AEMO’s benchmarking analysis is not comparing like with like.

In addition to the concern regarding vastly different networks, the present day performance and cost of transmission is materially affected by a variety of other factors. These include the size, density and growth rate of demand, topography and extent of urban development, asset condition (itself a product of environmental factors and historical decisions), the price of inputs, historical network expenditure and asset valuations, and decisions about the rate at which new capital expenditure should be recovered in the future (depreciation). These complications mean correlation in a statistical sense is not a satisfactory basis for drawing conclusions about the cause of an outcome.

1.2.1 Measures of relative utilisation

The difficulties associated with comparing outcomes across transmission networks means that caution is required when comparing the relative performance of transmission networks. That said, there are a number of shortcomings with the measure of relative utilisation that has been used to test the pressure for augmentation and efficiency of transmission planning across the states.

- First, the use of asset utilisation at an aggregate level is misleading and inappropriate. The driver of augmentation expenditure is the utilisation of individual assets. The Evans & Peck's analysis demonstrates that, on an individual asset basis, jurisdictions outside of Victoria have higher utilisation than indicated by AEMO's analysis.

- Secondly, the measure of utilisation used by AEMO and Nuttall is only a partial measure of the pressure for augmentation, for three reasons:

  - The utilisation of individual assets ("N" utilisation) has less relevance for predicting augmentation expenditure than asset utilisation measured with one asset assumed to be out of service ("N-1" utilisation).6 While calculating "N-1" utilisation is a complex task, the more meshed nature of the Victorian 220kV and above network means that a higher "N" measure of utilisation would be expected in this network before augmentation is required.

  - Measuring utilisation as a proportion of the thermal capacity of assets (as AEMO has done) will understate the effective utilisation of assets where power flows are constrained first by voltage or stability limits. Properly adjusting for this fact is very difficult. However, voltage and stability limits are less likely to bind in highly meshed networks like in Victoria than in more 'stringy' networks like in Queensland, South Australia, and in large parts of New South Wales.

  - Measuring utilisation when there is system-wide maximum demand, will understate the utilisation of assets whose maximum use occurs at other times (for example, in Tasmania where generation and load are often matched in the north and south, but where the lines between centres are heavily used under different operating conditions).

- More generally, observed utilisation of network assets says little about the efficiency of network investment.

  - The lumpiness of efficient transmission investment means that utilisation will generally drop following a network upgrade. As such, variations in utilisation over time can arise as a consequence of the economies of scale in transmission.

[6] This reflects the fact that planning decisions – including under probabilistic planning – inevitably come down to deciding upon the level of redundancy that is appropriate to cope with the outage of network assets. Thus, where "N-1" utilisation approaches 100 per cent, it becomes more likely that an asset outage may lead to a loss of supply, and augmentation would be considered. However, how N-1 utilisation translates into N utilisation depends upon the number of assets that operate in parallel (i.e., with two parallel assets, 100 per cent N-1 utilisation translates into 50 per cent N utilisation, whereas with 9 assets in parallel, 100 per cent N-1 utilisation translates into 89 per cent N utilisation.

- Planning decisions are made – and can only be made – on the basis of forecasts of demand, and network investment is not easily reversed beyond a certain point – e.g. once contracts have been established and work is underway.

- Where demand growth occurs within a region has a significant impact over performance outcomes and investment needs. In Victoria most of its demand growth has occurred where major transmission corridors already exist.

Indeed, our analysis suggests that the historical capacity in Victoria has continued to substantially shield Victoria from the need to augment compared with other states, and measured utilisation does not suggest that planning in Victoria has been superior. That said, we emphasise again that it is difficult to draw definitive conclusions from this indicator.

1.2.2 Relative service performance

Our analysis suggests that Victoria has not been a superior performer in terms of service performance. By way of example, that part Victorian network planned by AEMO has suffered more loss of supply events due to transmission outages over the 10 years to 2011 than the comparable network in Queensland. This is despite the much more dense nature of the Victorian network, with its inherently lower risk of unplanned line outages due to the relatively shorter distances involved.

1.2.3 Comparisons of capital expenditure, regulatory asset bases and prices

The relationship between transmission planning performance and the indicators of observed capital expenditure, changes to the RAB and prices, is uncertain. Accordingly, it is difficult to use these indicators to draw inferences about the relative planning performance of AEMO and the “for-profit” TNSPs.

- First, as discussed above, numerous factors that are external to a TNSP – including historical investment decisions and the location of demand growth – have a profound effect on current-day capital expenditure needs.

- Secondly, comparisons between TNSPs on publically available data are not a “like for like” comparison because they include transmission connection point augmentation and renewal expenditure, which in Victoria are planned by the distributors and SP AusNet respectively.

- Thirdly, the effect of capital expenditure on the RAB and price changes also depends upon past valuation decisions, past rates of depreciation and the rate of depreciation for future investment for regulatory purposes.

1.2.4 Conclusion on quantitative matters

The quantitative information that AEMO has provided does not permit a definitive conclusion that planning has been more efficient in Victoria. The key success indicators (capital expenditure and prices) capture many factors that are beyond AEMO's control. It appears that the lower level of augmentation observed in Victoria remains a product of past investment decisions.

An important implication of history and circumstance in Victoria is that its framework has not yet been seriously tested. Indeed, Nuttall has identified that while some conscious decisions have been made to accept a risk of unserved energy in Victoria, more recent low expenditure / high utilisation may be the product of a failure of project delivery rather than any conscious decision by AEMO to defer projects.

1.3 Response to qualitative statements

1.3.1 Planning standards

The debate about the approach to setting planning standards has become unnecessarily polarised, and at times oversimplifying what is a complex and, sometimes, imprecise activity.

Grid Australia accepts that there are imperfections in the current approach to setting planning standards, and that customer value should be paramount in testing the need for augmentation. For this reason, Grid Australia supports the AEMC's recommendations for a nationally consistent approach to planning standards. Grid Australia's preferred approach to transmission planning has the following elements:

- The planning standards should be economically derived, that is, to weigh the cost of transmission projects against estimates of customer benefit (utility improvement). However, implementing this objective in practice requires further consideration of the incorporation of factors such as the value risk averse customers place on insuring against high impact, low probability events and the overall imprecision of an economic test.

- The standards should be expressed deterministically in order to facilitate transparency and accountability, noting, however, that the flexibility exists to set a standard that would accommodate any timing of investment and is not limited to the choices of an N, N-1 or N-2, etc.[7]

[7] As explained more fully in the text, for a given augmentation project, the planning decision comes down to the timing of the project and, as a direct consequence, the level of unserved energy that is accepted if there is one or more equipment outages. The main effect of a probabilistic assessment is to revise the timing of a project and, as a consequence, the accepted level of unserved energy. It follows that a deterministic standard could generate the timing that is derived from a probabilistic assessment by, for example, specifying the maximum level of unserved energy that is allowed in the case of an equipment outage (e.g., N-1 with no more than Z MWh of unserved energy).

- A mechanism should exist to accommodate material changes in factors that would have caused a change to the deterministic standard. The important factors would be obvious from the original standard setting process, but would include material changes to project cost, including because a subsequent more detailed study showed that a materially different project should be undertaken.[8]

Lastly, we note for completeness that the question of *how* planning should be undertaken is largely independent of the question of *who* plans.

1.3.2 "For profit" vs. "not-for-profit", the effectiveness of financial incentives in economic regulation and other considerations

A key element of AEMO's argument that a not-for-profit entity should make transmission planning and investment decisions is that the current approach to economic regulation has substantial deficiencies and encourages "gold plating" by for profit entities. We disagree with this conclusion:

- AEMO's general conclusion that "gold plating" is encouraged seems to be based upon a misunderstanding of the financial incentives that are provided by the "building blocks plus incentives" model of regulation. In this regard, AEMO's views contrast with those of the AEMC and its expert economic advisors on this matter.

- AEMO also argues that the transmission framework needs fundamental change to become "output focused" rather than based around "assets". Again, this appears to reflect a misunderstanding of the financial incentives under the current regime, as well as an underweighting of the importance of efficient "cost" in price/revenue regulation and investment decisions more generally. In particular:

  - the "for profit" TNSPs face incentives related to service performance, and Grid Australia supports extending such incentives where practicable (for example, to matters such as network capability and other service outcomes)

  - alongside incentives for efficiency, it is a prerequisite for maintaining the incentive and capacity for investment that investors have the opportunity to recover efficient cost – this principle applies to monopoly and competitive activities alike.

In contrast, conferring significant planning and investment powers on AEMO across the National Electricity Market (NEM) would preclude the use of incentive regulation

8 Changes in demand would not automatically require a change to a deterministic standard – changes to demand would change the time at which a deterministic standard is projected to be breached, thus automatically flowing through into the date a project would be undertaken.

as a tool for encouraging efficiency. It would also cause a split across responsibilities where trade-offs would otherwise be possible and create other new transaction costs.

1.3.3 The approach to national planning

Grid Australia disagrees with AEMO's view that the current planning framework leads to inefficient outcomes when considered from a national perspective.

The current planning framework provides for short to medium term regional planning by entities with the local knowledge and accountability for delivery, subject to a strategic national perspective being delivered through AEMO's National Transmission Planner role. This framework provides for AEMO, and other parties, to challenge development plans. AEMO already has the capacity to raise any concerns it may have with the TNSPs planning decisions (such as the application of the Regulatory Investment Test for Transmission (RIT-T)), as well as mechanisms to formally dispute these decisions.

In relation to AEMO's more specific concerns on the approach to national planning Grid Australia has the following comments:

- The information benefits from combining transmission planning and system operation purported by AEMO are unlikely to exist. This information is either held by TNSPs or is already made publically available. To suggest that additional information exists to facilitate decision making implies AEMO is presently withholding information that would be useful for the market.

- Given AEMO's role in applying the RIT-T (consistent with other TNSPs), Grid Australia is particularly concerned at its claims that this regulatory tool is not effective at properly selecting the more efficient option.

- AEMO's claim that competition in the ownership of networks would advance the interests of customers ignores the very real costs associated with the model, including transaction costs, costs incurred due to a split in responsibilities, and the long term impact of reduced accountability and transparency on cost and service performance.

- Grid Australia notes that there is no evidence that a competitive market exists across the NEM, or can be developed, for the ownership of shared network services to deliver the benefits purported by AEMO. This contrasts with the supply and erection of capital investment in the transmission network which is already almost universally procured competitively by transmission businesses.

2. Overarching comments

Before addressing AEMO's specific comments, Grid Australia wishes to provide some overarching observations that are relevant to the matters addressed in this submission. This section addresses both the issue of recent price rises in electricity and the important role that financial incentives play in modern economic regulation, and how the effectiveness of this regulatory tool differs between for-profit and not-for-profit entities.

2.1 Drivers of recent price increases

Grid Australia recognises that there is public and political concern about rising electricity prices. Network price rises, however, have been a consequence of required investment that has been undertaken in the interests of providing electricity customers with continuity of secure and reliable service. Grid Australia disputes any suggestions that the recent price rises are a result of fundamental shortcomings in the transmission regulatory regime.

There is no rationale to automatically conclude that an increase in prices is due to a failure of the regulatory framework. Indeed in the case of transmission, an increase in network prices may be necessary in order to deliver a reduction in congestion, and therefore, a relatively larger reduction in wholesale electricity prices. Further to this, recent prices rises in transmission have all followed a detailed review and approval process by the Australian Energy Regulator (AER). At the time of making determinations the AER noted that considerable investment was necessary in response to the pressures on transmission businesses to meet future load growth and to reinforce existing networks.[9] Grid Australia notes that the AEMC Economic Regulation of Network Service Providers Rule change process is examining whether the regulatory revenue setting process can be improved.

The AEMO analysis, however, highlights the recent increases in *overall* electricity prices as evidence for the need to change the transmission regulatory framework. Such an appeal to overall electricity prices does not allow for an accurate appreciation of the facts. Transmission accounts for around 8% of the forecast rise in overall prices between 2010/11 and 2012/13[10]. This reflects the relative contribution of transmission costs to the overall electricity price. Therefore, it is inappropriate for AEMO to rely on claims about overall price increases to support its case in this

9 While acknowledging the AER has recently made statements to the contrary it is proposed Economic Regulation of Network Service Providers Rule change, there are numerous examples of the AER positively supporting the need for increased investment at the time of making various transmission determinations. Examples of these comments can be found in Grid Australia's 1st Round Submission to the AEMC on the AER's economic regulation Rule changes. This submission can be accessed here: http://aemc.gov.au/Electricity/Rule-changes/Open/economic-regulation-of-network-service-providers-.html

10 Possible Future Retail Electricity Price Movements: 1 July 2011 to 30 June 2014, AEMC, November 2011, p6.

instance. Indeed, on a more general level, the AEMO submission frequently mixes transmission and distribution issues in its analysis without clear distinction.

Further to this, there is considerable evidence to suggest that the significant reforms in transmission regulation over recent years are delivering outcomes consistent with the National Electricity Objective (NEO). These outcomes include:

- Considerable investment in the shared network to meet forecast load growth and to accommodate the entry of new generation. This has effectively maintained an appropriate level of reliability in the transmission network.
- Improved co-ordination of planning and investment decisions nationally as a result of recent developments such as AEMO's publication of the National Transmission Network Development Plan and the introduction of the Regulatory Investment Test for Transmission.
- Minimal separation in the wholesale electricity price between regions and a cost of congestion that appears to be very small.

2.2 Incentives for efficient decision making

AEMO's submission states that it is preferable for the planning and procurement of a transmission network to be conducted by a single, national body which is independent and not-for-profit. Grid Australia notes at the outset that the AEMC in its most recent report for the Transmission Frameworks Review considers that a single NEM-wide transmission planner and procurer is unlikely to be efficiency enhancing:[11]

> *On balance, the Commission considers that a single NEM-wide transmission planner and procurer is unlikely to be efficiency enhancing. There are two key reasons for this.*
>
> *First, the Commission considers that financial incentives are likely to provide the most robust and transparent driver for efficient decision-making. This is discussed in Box 5.3 below. Consequently, a not-for-profit decision maker is not our preferred option.*
>
> *Second, and consistent with the use of financial incentives, the Commission supports arrangements whereby the owner and operator of a network is also responsible for planning and investment decisions. A single entity is better placed to trade off the relative costs and benefits of operational and investment decisions. This is likely to result in more efficient outcomes than where these functions are separated, such as in a "planner and procurer" model, where operational and investment decisions are made in isolation.*

Grid Australia agrees with the AEMC's statements on this matter. In particular, that financial incentives will deliver superior outcomes that are consistent with the NEO.

[11] AEMC, Transmission Frameworks Review, Second Interim Report, 15 August 2012, pp.78-79.

2.2.1 Financial incentives best deliver outcomes in the public interest

Grid Australia considers that conferring investment and operational decisions on for-profit organisations allows financial incentives to be applied so that investment is undertaken with regard to the public good. Where it is identified that outcomes can be improved, the correct response is to refine the incentives faced by the business. In contrast, no mechanism exists to harness the incentives of not-for-profit organisations towards the public good.

It is accepted that it is the profit motives of network businesses in combination with their market power in their core services that creates the public policy justification for economic regulation.[12] However, once regulated, harnessing this profit motive – by establishing a regulatory framework that provides financial rewards for efficiency – is a regulator's most powerful tool for driving efficiency improvements.

As a not-for-profit entity like AEMO is not financially motivated, such a tool cannot be applied. Indeed, the assumption behind the creation of AEMO appears to be that its not-for-profit nature naturally will lead to it acting to pursue the public interest. Considering whether this assumption is correct – or what other objectives such an entity may be expected to pursue – is important when evaluating whether a not-for-profit monopoly should have responsibility for making what are typically commercial decisions.

Grid Australia notes that the AEMC also considers that financial incentives are likely to deliver superior outcomes compared to a not-for-profit approach. In Box 3.8 of the AEMC's Second Interim Report on the Transmission Frameworks Review, referred to in the AEMC quote above, it articulates what it considers to be the advantages of for profit TNSPs:[13]

> *The Commission considers that financial incentives are likely to provide the most robust and transparent driver for efficient decision-making. Efficient outcomes can best be promoted by aligning the commercial incentives on businesses with the interests of consumers. This view that financial incentives are likely to lead to more efficient outcomes is widely held (and practised) by regulators internationally as well as in Australia. All entities are subject to incentives: financial incentives provide an understandable and transparent approach to influencing behaviour.*
>
> *While there may be some inefficiencies present in the existing regulatory framework, this is not an indication that financial incentives do not work; rather, the existing frameworks can be improved to better align TNSP incentives with the interests of consumers. This is being pursued through the Economic Regulation of Network Service Providers rule change process.*

12 Absent regulation, monopolies would be able to charge prices well in excess of costs and diminish service performance.

13 AEMC, Transmission Frameworks Review, Second Interim Report, 15 August 2012, p. 78.

> *The Commission further considers that there are likely to be drivers for financial incentives to play an increasing role in the economic regulation of TNSPs, for instance, the availability incentive scheme under the OFA model set out in chapter 3. While this scheme would, initially at least, focus on TNSPs making assets available in operational timeframes, this is inextricably linked to earlier investment decisions in terms of the specification and configuration of assets.*

Grid Australia agrees with the AEMC's statements on this matter.

2.2.2 Incentives and motivation for not-for-profit entities

As identified by the AEMC in the quote above, all entities are subject to incentives, even not-for-profit entities. Public choice theory explores the incentives for not-for-profit organisations to deliver desirable societal objectives[14]. This theory extends the mainstream economic model that economic agents are self-interested. Its general proposition is that not-for-profit economic agents are typically self-interested, eschewing the traditional notion that they are motivated by selfless interest in the public good. William A. Niskanen was a prominent figure in the field of public choice theory. His work was important in identifying that agents of not-for-profit organisations may not act in the public good as might be expected:

> *"Most of the literature on bureaucracy*[15] *has represented the bureaucrat either as an automaton or as maximizing some concept of general welfare, the latter usually considered to be identical with the objectives of the state. For a positive theory of bureaucracy, the beginning of wisdom is the recognition that bureaucrats are people who are, at least, not entirely motivated by the general welfare or the interests of the state."*[16]

Niskanen considers that *budget* maximisation replaces the profit motive for not-for-profit organisations. Niskanen's budget maximisation model suggests that the management of not-for-profit organisations, motivated at least in part by self interest, will maximise their utility by increasing the budgets of their organisation. The expectation is that this will result in an increase in remuneration, prestige, career prospects and other benefits. These points are made by Niskanen when comparing the incentives of the management of a profit motivated firm to a not-for-profit organisation:

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14 The theory became prominent in the 1950s and 1960s and continues to be influential and well respected. A number of leaders in the field have been awarded the Nobel Memorial Prize in Economic Sciences: George J. Stigler (1982), James M. Buchanan Jr. (1986) and Gary S. Becker (1992).

15 Niskanen defines a bureaucracy as a non-profit organisation which is financed, at least in part, by a periodic appropriation or grant. The important characteristic of a bureaucracy is not, therefore, that the organisation is publicly owned (although many publicly owned organisations do meet this definition). For the purpose of this discussion, NSPs (whether private or publicly owned) are not defined as bureaucracies, as they are demonstrably profit motivated and do not receive a periodic appropriation or grant to finance their functions.

16 Niskanen, W.A, Bureaucracy and Representative Government (1971), p36.

> *"The central motivating assumption of this theory is that a businessman maximizes the profits (more precisely, the present value) of this firm."*[17]

In contrast:

> *"Among the several variables that may enter the bureaucrat's utility function are the following: salary, prerequisites of the office, public reputation, power, patronage, output of the bureau, ease of making changes and ease of managing the bureau. All of these variables except the last two, I contend, are a positive monotonic function of the total budget of the bureau during the bureaucrat's tender in office."*[18]

There is no reason to expect that an entity with the objective function posited by this Nobel prize winning literature – budget maximisation in order to maximise salary, prerequisites of the office, public reputation, power, patronage, output of the bureau, while preserving an easy existence – need necessarily coincide with the long term interests of customers.

Rather, it is more likely that the entity would be focused upon expanding its operations irrespective of its efficiency. While it is accepted that attempts are made to make not-for-profit entities accountable, this is in fact particularly difficult to achieve in practice. Therefore, over the longer term, the organisation would concentrate on its own long-term preservation, which could be expected to materialise itself through a highly conservative organisation that seeks to avoid being placed under detailed scrutiny, in turn ultimately leading to inefficiently higher prices for network users.

In short, replacing incentive regulated, for-profit entities with an unregulated not-for-profit entity could be expected to be substantially adverse to the long term interests of customers.

2.3 Important context for Victoria

As indicated above, much of the AEMO submission and Nuttall's work are centred on the premise that the observed outcomes in Victoria justify a fundamental reform to the transmission planning and investment framework in the NEM. It is a fact that there has been less expenditure on transmission augmentation in Victoria than in other states over the last decade, although care is required to ensure that appropriate comparisons are drawn. However, in this regard Grid Australia is somewhat perplexed that AEMO summarised the conclusions of the Nuttall Report in its August letter as follows:[19]

17 Ibid., p37.

18 Ibid., p38.

19 AEMO, *Electricity Network Regulation – Nuttall Consulting Report: Victoria Over capacity review, Letter to the Productivity Commission*, August 2012.

> *On the basis of market operations and other data, Nuttall Consulting concluded that since 2006, the Victorian transmission network has been the most efficiently planned and operated network of the three assessed.*

This is not a fair summary of the Nuttall Report, and indeed Nuttall was not asked to comment on the efficiency of planning.[20] A key question is whether the historical excess capacity in Victoria explains the difference in recent capital expenditure, or whether this may be due to other factors (one of which is the efficiency of planning).

The overriding factor that makes Victoria different to other jurisdictions is that it undertook considerable network investment before the period of energy market reform. The Victorian 500kV transmission line system, developed over a twenty year period from the 1970s was built with considerable excess capacity. Indeed, at the time of this investment many commentators were critical of a 500kV system being built for Victoria when numerous studies and consultants demonstrated that a 330kV system was more economically efficient.[21]

The other significant factor is that the network in Victoria that AEMO has responsibility for is very different to that of TNSPs in other jurisdictions. This is a point emphasised in the Evans & Peck report, which states:[22]

> *It is also important to note that this comparison is based on very different networks. In Victoria, AEMO is responsible for the planning of the "shared" network. This network is made up exclusively of 220kV, 330kV and 500kV lines, whereas the "shared" network in other NEM jurisdictions includes equipment at voltages of 132kV, 110kV and 66kV. In addition to this voltage differentiation, the Victorian shared assets have significantly higher ratings than those in the other states. This is demonstrated graphically in Figure 2.1.*
>
> *[figure omitted]*
>
> *The average "AEMO" substation is approximately 1500MW, 44% larger than that of TransGrid, twice the size of Powerlink and six times the size of ElectraNet. Similar ratios exist in relation to lines, with the average Transend line being less than one sixth the capacity of the average shared network line in Victoria.*

Grid Australia notes that the proposition that Victoria has historically had excess capacity is not contentious. Indeed, this is a point that is accepted in the Nuttall Report. The Nuttall Report suggests that this situation has changed since 2006 and historical expenditure on network augmentation in Victoria no longer explains the

20 Nuttall noted that "[i]t is important to stress that this review has not been concerned with the structural arrangements, planning approaches, or reliability standards in each region" (Nuttall, Op. Cit., pp.52-53).

21 Booth, R.R., 'Warring Tribes – The Story of Power Development in Australia', 2000.

22 Evans & Peck, *Response to AEMO Position Paper – Collation of Statistics on Reliability, Utilisation and Capital Expenditure in Transmission Networks,* August 2012, pp. 7-8.

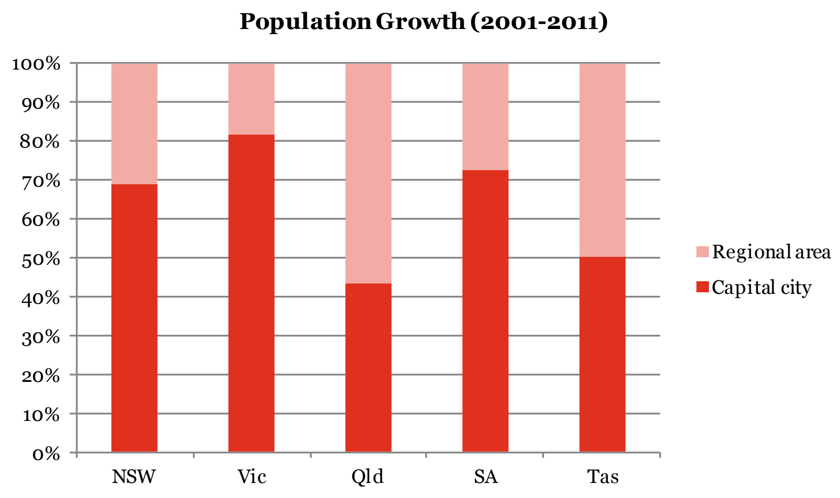
difference in augmentation needs between Victoria and other jurisdictions.[23] However, Grid Australia's analysis, informed by the advice of Evans and Peck, suggests that there continues to be substantially less pressure for augmentation in Victoria compared to other states (as described in the following section).

2.3.1 Other factors impacting on outcomes in Victoria

In addition to the previous capacity building that occurred in Victoria there are other factors about the State and its customers that mean planning and operating a network in that jurisdiction is different to other jurisdictions.

- Victoria has the highest proportion of population in its capital city (74%). This means it also has the highest customer density for its network of all NEM states. Other states have considerably more customers outside of their capital cities. Tasmania has the largest with 58 per cent outside of Hobart, while 45 per cent of Queenslanders live outside of Brisbane and 37 per cent of people in NSW live outside of Sydney.

- Growth in population has also been focused predominately in the capital city in Victoria, and more specifically within the corridor of its existing 500kV network[24], while network businesses in other jurisdictions have had to accommodate far more population growth in regional areas, in particular Queensland, as demonstrated in the figure below.



- All states aside from Tasmania cover a much larger geographic area than Victoria. This means that network businesses outside of Victoria have to build many more kilometres of line compared to Victoria in order to deliver electricity

[23] Nuttall Consulting, *Victoria over capacity review: Is over-capacity the reason for low augmentation levels in Victoria? A report to the AEMO*, July 2012, p.8.

[24] Evans & Peck, *Response to AEMO Position Paper – Collation of Statistics on Reliability, Utilisation and Capital Expenditure in Transmission Networks,* August 2012, p.36.

from its source to customers. Line length is a key determinant of network expenditure.

- Victoria has a very concentrated energy source with virtually all its power being generated in the Latrobe Valley about 150km east of Melbourne. Other NEM jurisdictions, however, have considerably more dispersed and distant generation sources. This means it is far simpler to plan the network in Victoria and also means that the needs of load can be met largely through a single core corridor of transmission line.
- The assets AEMO has responsibility for are considerably larger and more homogenous than the assets that exist across other transmission networks. This means that it is very difficult to make any meaningful comparisons between networks.

On the basis of the information presented above, Grid Australia considers that the evidence continues to support the proposition that the outcomes to date in Victoria are more likely to be a result of history and circumstance rather than any action by AEMO or a superior planning framework.

In addition, the evidence suggests that the Victorian framework has not yet been fully tested. It is noted in this respect that the Nuttall Report has drawn attention to a number of areas where conscious decisions have been made to accept the risk of unserved energy in Victoria. However, Nuttall also observes that more recent low expenditure / high utilisation may be the product of a failure of project delivery in Victoria rather than a conscious decision by AEMO to defer projects.[25]

3. Analysis of AEMO's quantitative statements

The data and analysis presented by AEMO to support the proposition that the Victorian framework is more efficient than the framework that prevails in other jurisdictions is not sufficient for such robust conclusions to be reached. This is because the analysis does not consider or take into account the many factors that can impact on service performance and expenditure outcomes.

Importantly, AEMO's analysis is largely based on the assumption that correlation equates to causation. AEMO's essential argument is that because the apparent outcomes in improved utilisation and service outcomes occur in a region with a different transmission planning regime, then the different planning regime is the reason for the better outcome. As noted below, there are other much more plausible explanations for apparent differences in utilisation and service outcomes, including incorrect measurement.

25 Nuttall Consulting, *Victoria over capacity review: Is over-capacity the reason for low augmentation levels in Victoria? A report to the AEMO*, July 2012, pp.5-6.

To assist in understanding the issues with AEMO's analysis Grid Australia has commissioned expert advice from Evans & Peck. The purpose of the Evans & Peck work is to test whether the facts support AEMO's case for change. Given the Nuttall Report applies much of the same analysis that is contained in the AEMO submission, the Evans & Peck analysis is also useful in drawing inferences on the findings in this report. The overarching finding from the Evans & Peck analysis is that there is no compelling reason to suggest that outcomes in Victoria are better than for other jurisdictions.

This submission comments on the following matters from AEMO's submission (and where appropriate the Nuttall Report):

- The benchmarking of network utilisation and RAB values
- The claims supporting probabilistic planning over deterministic standards
- AEMO statements regarding the South Australian and Victorian interconnector, and
- AEMO's source of evidence regarding the number of Automatic Control Systems in each jurisdiction.

Grid Australia notes that a significant limitation in responding to AEMO's analysis has been the inability to access the data it used. A request for this data was put to AEMO on 4 July 2012. However, as of the time of lodging this submission this data has not yet been received by Grid Australia.

3.1 Is AEMO's benchmarking appropriate?

AEMO's submission seeks to apply benchmarking analysis in order to support a case that network investment in Victoria is more efficient than for other transmission networks across the NEM. The Nuttall Report also applies benchmarking analysis in its comparison of outcomes in Victoria to those of New South Wales and Queensland. However, the analysis of AEMO and Nuttall does not give proper regard to much of the complexity of the drivers of expenditure, network utilisation and the value of a regulated asset base.

The one outcome that is clear from the benchmarking analysis is that the results from such analysis are rarely, if ever, unambiguous. This is because in order to present data in a useful way some pieces of information that might affect results need to be ignored or assumed.

Benchmarking in the context of the electricity industry is particularly complex. Outcomes are materially affected by the size, density and growth rate of demand, topography and extent of urban development, the price of inputs and decisions about the rate at which new capital expenditure should be recovered in the future (depreciation). Present day costs are also heavily dependent upon history. This includes historical choices about network architecture, historical expenditure levels, and historical decisions about asset valuations and the past rate of recovery of costs.

Given the considerable difficulties in benchmarking electricity network businesses, in general, and transmission networks in particular (due to the lumpy nature of transmission investment), it is Grid Australia's position that benchmarking data is best used as a source of information for further analysis and not a tool for making definitive conclusions.

As with AEMO's analysis, the analysis presented here, and in the attached Evans & Peck paper, is unlikely to provide a complete picture of the state of play. It is always possible for data to be presented in a different way and tell a different story. However, what it does do definitively is to reveal that the analysis provided to the Commission by AEMO cannot be relied upon as an accurate or logical basis for supporting the claims made.

3.1.1 Network utilisation

Much of the focus of AEMO's evidence, and the Nuttall Report, has been on the current utilisation of assets as an indicator for when augmentation is required. AEMO claims that network utilisation data provides evidence that Victoria is the most efficient jurisdiction with respect to expenditure on the network. It also claims that this data is evidence of the effectiveness of the planning standard it applies.

The link between average utilisation and efficient transmission service provision is not clearly made by AEMO. Utilisation levels of themselves do not imply that one system or another is at higher risk of service failure. At best they are but one imperfect indicator. Furthermore, the measures of relative utilisation and service performance applied by AEMO have a number of limitations that make it difficult to draw any firm conclusions. Some of the more obvious limitations of the AEMO analysis of network utilisation are:

- It presents only a snapshot of assets that have a 40 year asset life and does not consider the outcomes over the full life-cycle of the assets. Indeed, where new assets are installed and augmentations undertaken it would be highly concerning if the assets had high utilisation rates. This would mean that the NSP had not initially invested in sufficient capacity to accommodate future demand, thereby losing scale economy benefits and requiring additional network investment in the near future.

- The AEMO and Nuttall analysis relies upon system wide averages. However, network investment is triggered by the conditions and utilisation of individual assets. Therefore, system wide averages do not provide any meaningful information about how a network is being run and whether additional network investment is required. This point is further illustrated in Box 3.1 below.

- The AEMO and Nuttall analysis are each focused on the utilisation of assets measured with all assets in service ("N" utilisation). However, planning decisions inevitably come down to the level of redundancy in the network, including under probabilistic planning. This means a potentially more relevant measure of utilisation is to assume that one asset is out of service ("N-1" utilisation). Assessing utilisation on an "N-1" basis reveals that when utilisation approaches 100 per cent, it becomes more likely that an asset outage may lead to the loss of supply, and augmentation would be considered.[26]

  – The relationship between the N-1 and N utilisation depends on the number of parallel assets – if there are two parallel assets, 100 per cent N-1 utilisation translates into an N utilisation of 50 per cent, whereas if there are 10 parallel assets then 100 per cent N-1 utilisation translates into a much higher N utilisation of 90 per cent. In the area of AEMO's planning responsibility, there are a much greater number of parallel assets on average (again, the product of history and the density and topography of Victoria), which implies that a higher N utilisation would be expected prior to augmentation being required.

- Measures of utilisation that are based on the thermal capacity of lines will understate utilisation where capacity is constrained first by voltage or stability limits. While it is particularly difficult to adjust for these factors, it is noted that voltage or stability limits might be expected to bind much less on meshed networks such as Victoria's compared to long and stringy networks such as in Queensland, South Australia, and much of NSW.

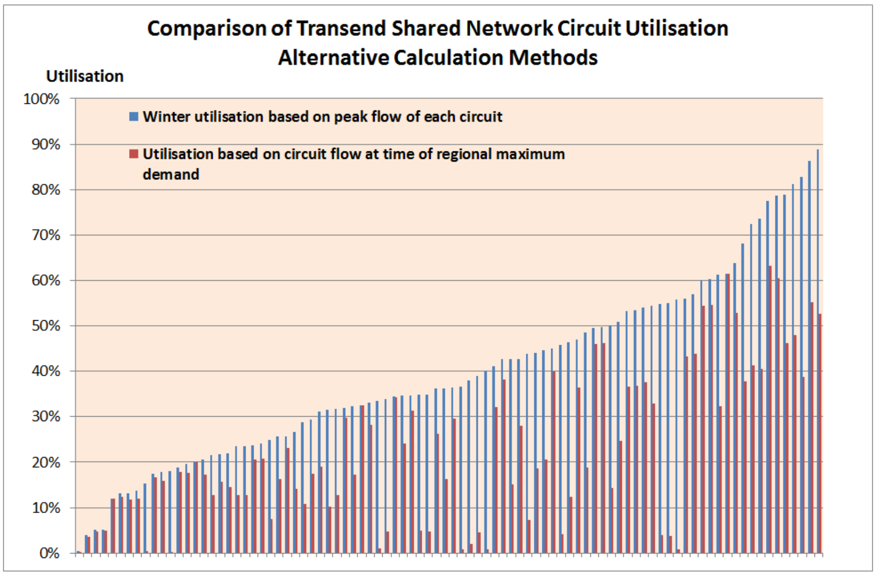
- In Victoria and South Australia, demand is much peakier than in other states. This means the utilisation of assets (before augmentation) should be higher. This fact, as discussed further in section 3.2, also means that the expected loss from an outage is much lower in Victoria than in most other states.

Box 3.1: Limitations of Average Utilisation Data

Key limitations of using average utilisation data to measure asset or planning performance are revealed in two charts contained in the Evans & Peck report. The first chart shows the difference in outcomes that follow from observing the utilisation of all assets at the time of the annual peak demand compared to measuring utilisation as the maximum loading on each asset at any time during the year. The key point being that it cannot be assumed that peak loading occurs (or is intended to occur) on all equipment at the time of annual system peak.

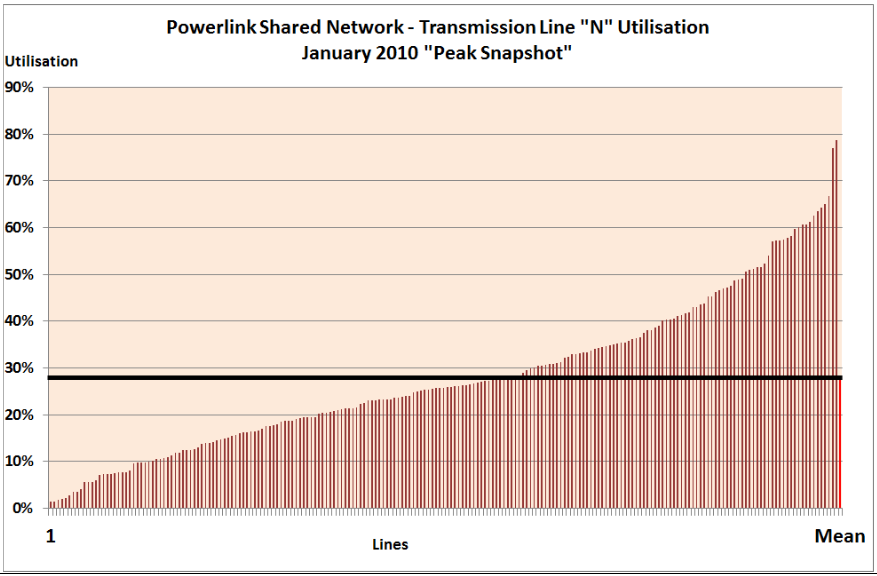
26 It is a particularly complex task to undertake a proper assessment of "N-1" utilisation as it involves system modelling. Therefore, undertaking this assessment has not been possible in the time available.

Figure 3.1: "Non-diversified" vs. "Snapshot" Demand Utilisation in Tasmania



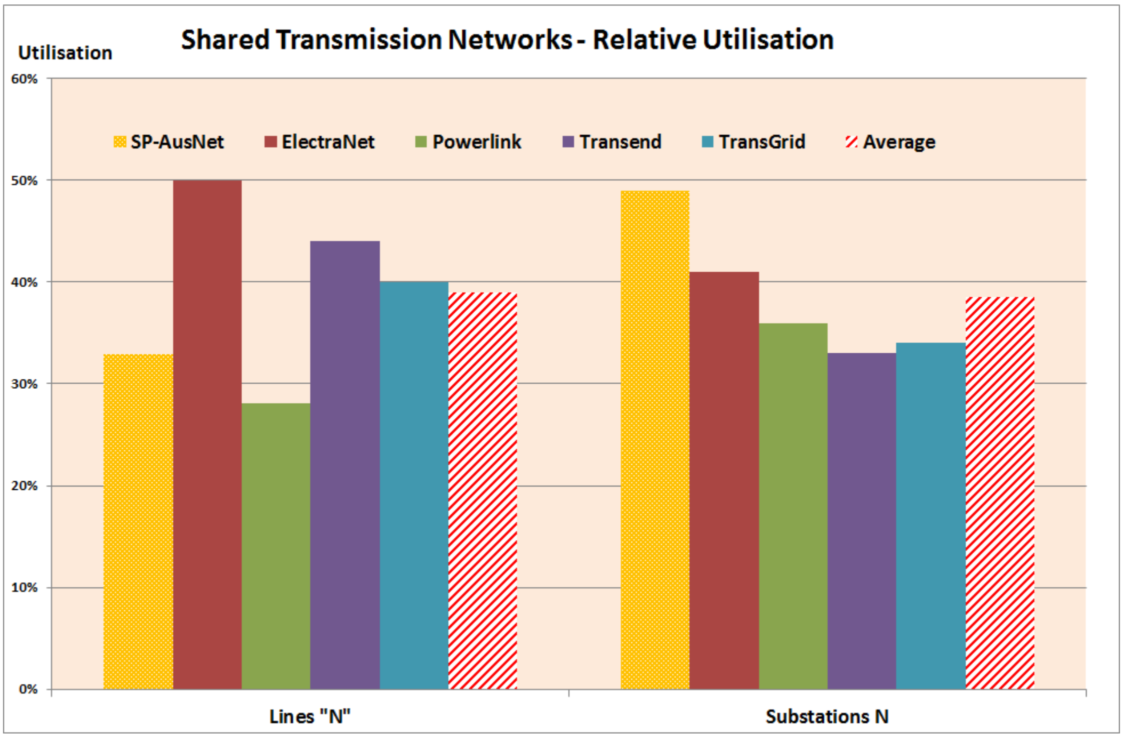
The second figure shows the "peak snapshot' utilisation of individual lines in Powerlink's network. What this figure demonstrates is that, on an individual line level, there can be very wide range of utilisation outcomes, which shows the imprecision involved when only network-wide utilisation levels are considered.

Figure 3.2: Transmission Line "N" Utilisation in Queensland January 2010



While noting the considerable limitations with providing data on an average basis, the analysis undertaken by Evans & Peck reveals that, even on this basis, there is nothing to suggest AEMO is achieving outcomes that are obviously superior to other jurisdictions. Instead, the analysis demonstrates that while substantial anytime "N" utilisation is highest in Victoria, this is not the case for transmission line "N" utilisation. Grid Australia also notes that, given the issues identified above, the outcomes may change even further if it were possible to undertake a proper "N-1" analysis within the timeframe.

Figure 3.3: Relative Utilisation of Shared Transmission Network



When the utilisation of individual assets is scrutinised it reveals an entirely different story to that put forward by AEMO and Nuttall. Evans & Peck's analysis provides "N" utilisation on individual lines and substations. This analysis reveals that on an "N" utilisation basis that all jurisdictions have a number of lines approaching 100 per cent utilisation.[27] Evans & Peck also demonstrate that while AEMO achieves a higher substation "N" utilisation, this outcome reflects the atypical nature of its network rather than being a meaningful indicator of planning outcomes.[28]

27 Grid Australia notes that it may be efficient in some circumstances for N-1 utilisation to exceed 100 per cent. This where the loss of utility to customers from the risk of loss of supply is less than the cost of the augmentation.

28 Evans & Peck, *Response to AEMO Position Paper – Collation of Statistics on Reliability, Utilisation and Capital Expenditure in Transmission Networks,* August 2012, pp. 22-23.

3.1.2 Demand forecasting

AEMO and Nuttall both observe that recent demand forecasts have been revised down from historical levels. AEMO suggests that this outcome is evidence that past investment was inefficient and should not have proceeded.

Planning and infrastructure investment decisions are made on an ex-ante basis. At a certain point in its delivery infrastructure investment is largely irreversible and it is therefore the only way such decisions can be made. It means, however, that investment decisions rely on a forecast of expected outcomes, including for demand. It also means that indicators of realised demand provide little, if any, information about whether a decision to invest was efficient or not.

It is relevant to note that, to the extent it has been possible, TNSPs have been successful in adjusting their plans in the face of substantial changes in out-turn demand.[29] This has meant that where a project is not yet a committed project, TNSPs have been able to defer projects until a time that the demand conditions warrant them proceeding. For example, in New South Wales TransGrid's Far North Coast Supply project was originally expected to be needed in 2010/11. However, changes in demand conditions meant that forecast limitations are delayed until at least winter 2016.

Grid Australia does not agree with AEMO's implicit suggestion that past TNSP forecasts have been consciously overstated. These forecasts have been subject to extensive checks and testing. This includes AER review at the time of the revenue reset or contingent projects assessment. In addition, demand forecasts that TNSPs apply are based on the connection point forecasts that are undertaken by distributors.

Indeed, AEMO (and NEMMCO before it) has relied on similar forecasts to inform the market of future possible generation capacity shortfalls in successive Statements of Opportunity over many years.

Whether a forecast of demand is made on the basis of reliable information and is sufficiently robust is important for considering whether an ex-ante investment decision is efficient. This is also important to provide market participants and customers with confidence that investment decisions are being made on the basis of solid demand forecasts. Grid Australia considers that confidence in demand forecasts can be supported through independent oversight of the forecasts.

[29] Importantly, the Nuttall Report compares demand forecasts at the time of revenue determinations against realised demand some years after the determinations. This does not reflect TNSPs' investment decision making practices, which undergo an annual planning review based on the most recent demand forecasts. The outcomes of these reviews are transparent and published in Annual Planning Reports.

3.1.3 Reliability of supply

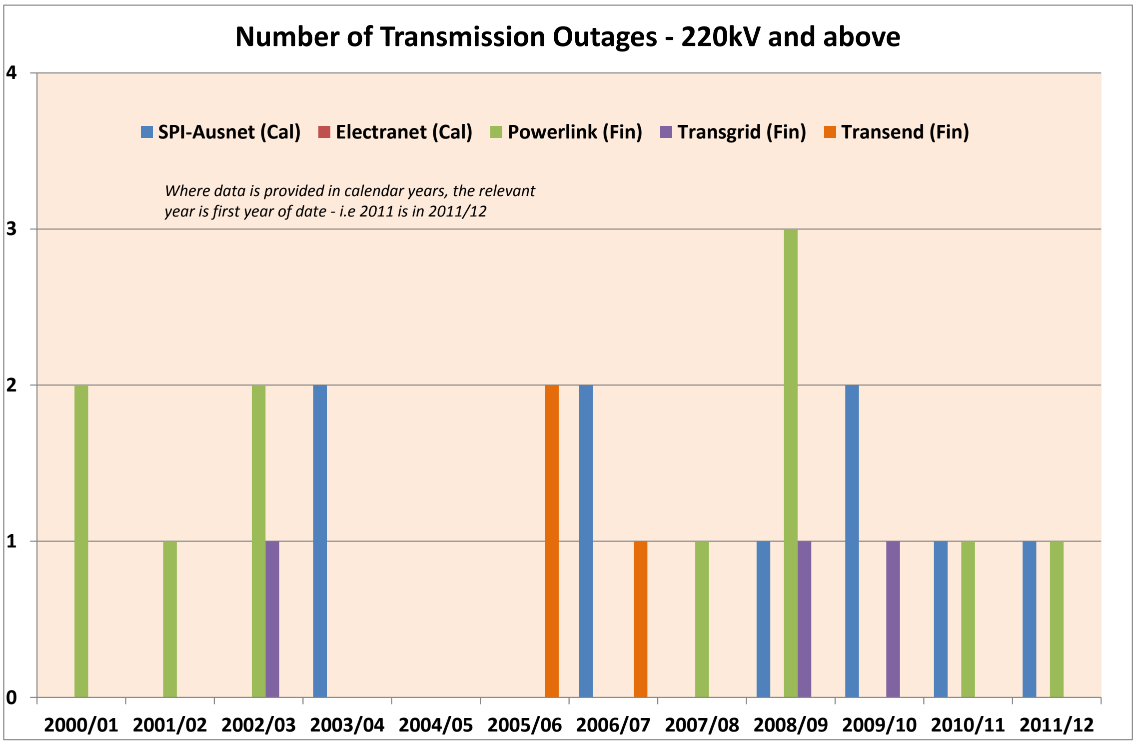
AEMO's analysis stresses that higher network utilisation outcomes in Victoria have not come at the cost of network reliability. AEMO cites circuit availability outcome to support this contention. Circuit availability, however, is not a good indicator of reliability. Indeed it may be said that this indicator predominantly identifies which jurisdictions are doing more scheduled maintenance and capital works. In addition, where there are numerous parallel circuits in place, the unavailability of one of these circuits will have little, or no, impact on customer supply. Instead, from the perspective of customers, the number of outages resulting in loss of supply, and system minutes lost[30], provide a more robust indication of continuity of supply to customers.

It is important to note when considering outage data that there are many reasons why an outage might occur. Indeed, a reliable network in the short term may not reflect prudent management of the network to sustain reliability in the long term. In addition, highly meshed networks, such as Victoria's, might be expected to have higher levels of reliability than long and stringy networks, such as Queensland's. Even with these caveats in mind, the analysis of system outages and system minutes lost reveals that AEMO's performance in Victoria is not superior to other jurisdictions.

To properly compare AEMO's performance to other jurisdictions Evans & Peck compared data on assets consistent with AEMO's planning responsibility (namely, assets that have a voltage of 220kV and above). While there have been relatively few outages on the higher voltage network over a ten year period, it is noteworthy that the Victorian network has not performed better than other jurisdictions. Indeed, over this period Victoria experienced more outages than for any other network.

[30] System minutes lost is a normalised measure that takes into account the number, length and size of outages.

Figure 3.4: Number of Transmission Outages – 220 kV and Above 2000/01 - 2011/12

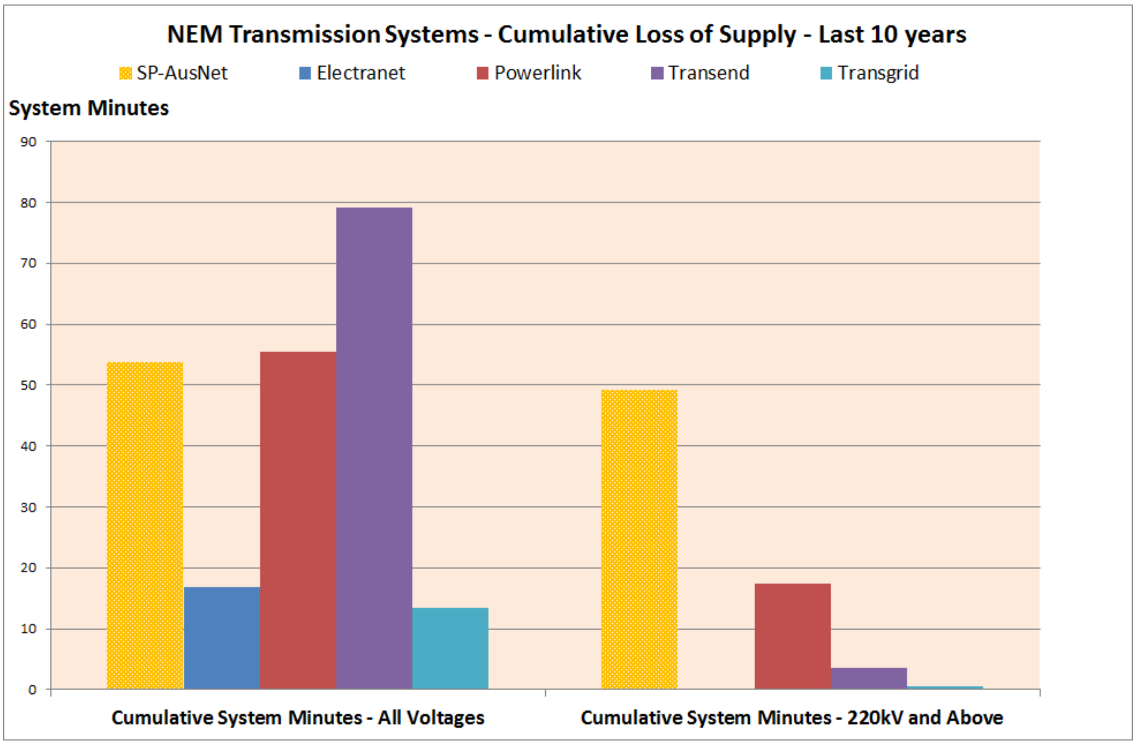


A similar story exists when system minutes lost is considered. The figure below sets out the cumulative loss of supply outcome across each jurisdiction over a 10 year period. Again, while recognising there are many factors that can impact on this outcome, the evidence indicates that Victoria is not superior to other jurisdictions. Grid Australia understands, however, that the high result for Victoria is dominated by a serious event that occurred in 2009-2010.[31]

The event that occurred in Victoria is an example of the low probability events that are an inherent characteristic of major transmission networks. As noted by Evans & Peck, what this reveals is that it is unwise for AEMO, or any other TNSP, to draw strong linkages between planning proficiency and historical reliability.

[31] The event was the failure of a 500kV voltage transformer at South Morang in 2009.

Figure 3.5: Cumulative Loss of Supply 2000/01 - 2011/12



3.1.4 Comparison of Regulatory Asset Bases

AEMO's submission presents data that it purports demonstrates that RAB values in Victoria have grown at a slower rate than for other jurisdictions. It then draws the implication that this reflects significantly lower capital expenditure on augmentations in Victoria compared to other jurisdictions, which it concludes reflects superior planning decisions by AEMO compared to other TNSPs. However, this comparison of the growth rate of RABs across jurisdictions is a poor indicator of the relative quality of AEMO's planning decisions, for the reasons that are set out below.

First, as discussed already above, given the capability building that occurred from the 1970s in Victoria, the analysis of its network utilisation on an individual asset basis and the location of demand growth, lower augmentation in Victoria should be expected. Considerable augmentation capital expenditure in the circumstance of Victoria would be a clear indication of inefficiency. Secondly, the regulatory model that applies in Victoria means that a comparison of capital expenditures across TNSPs will not isolate the areas of AEMO's responsibility. This is because the regulatory model that applies in Victoria splits the responsibility for investment decisions between a number of parties. In particular AEMO is not responsible for decisions on transmission connection point augmentation or the renewal of shared network assets, these being the responsibility of the distributors and SP AusNet respectively.

Evans & Peck's analysis also shows that a large proportion of the increase in capital expenditure in other jurisdictions relative to Victoria has been due to the need to replace aging assets and other matters, rather than only for augmentations as asserted by AEMO.

Lastly, AEMO's control over the change in the RAB over time in Victoria compared to other jurisdictions is a step further removed from its control over total capital expenditure. The value of a regulated asset base – and therefore the growth rate in the RAB that is caused by a particular capital expenditure program (and the consequent effect on prices) – will also be highly dependent on historical expenditure levels, historical decisions about asset valuations, and the past rate of recovery of capital for regulatory purposes.

Thus, if a higher regulatory asset base had been determined in the past then, all else constant, the same current day capital expenditure would be less likely to cause an increase in prices. Similarly, a higher historical recovery of costs, in the form of depreciation, would make it more likely that the same current day capital expenditure would cause an increase in prices.

Lastly, the AEMO analysis also ignores the central proposition of probabilistic planning that there is a trade-off between network expenditure and unserved energy (a proposition which Grid Australia strongly supports). That is, the efficiency gain when a decision is made to defer a project is not merely the reduction in expenditure. Instead, consideration needs to also be given to what customers lose through that reduction in expenditure.

3.2 Comparison of outcomes under probabilistic and deterministic standards

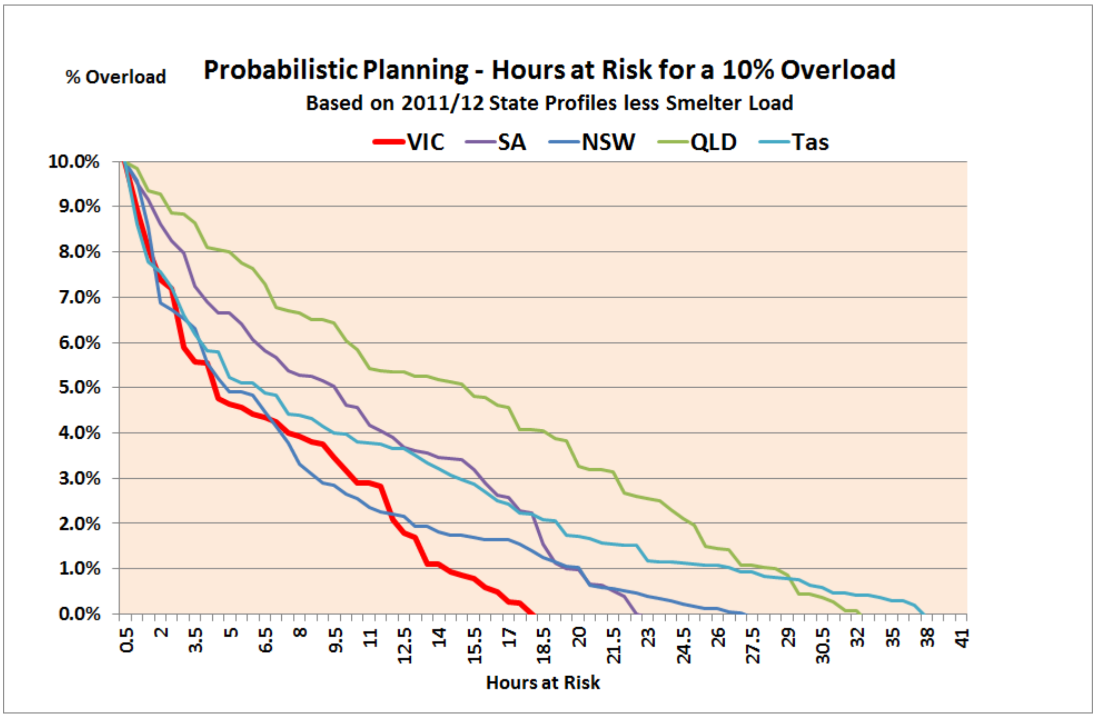
To support its case for a shift to NEM-wide probabilistic planning standards AEMO argues that its planning approach would deliver even larger benefits in states like Queensland, which have flatter load duration curves than for peakier states such as Victoria and South Australia.[32] However, it is incorrect to suggest that probabilistic planning can deliver greater benefits in jurisdictions with flatter load profiles by materially deferring projects. The flatter load profile in jurisdictions such as Queensland implies that under a probabilistic assessment, infrastructure investments would be triggered earlier than for peakier states such as Victoria. Grid Australia is surprised that AEMO would reach the conclusion it has on this matter given its experience in this area.

One of the main factors that is considered when undertaking a probabilistic assessment is the hours that energy is at risk. That is, if there was an overload of the

32 AEMO also makes a number of broader policy assertions regarding probabilistic and deterministic planning, these are addressed in section 4.1 below.

system, for how long might the network be exposed to not being able to supply electricity to customers. Where a region has a flatter load profile a system overload leads to more hours at risk than for a peakier load profile. When a value is attributed to this loss of supply, it also means that the cost of this exposure to energy at risk is higher for flatter load profiles. Given this higher cost, an investment will be triggered earlier for a flatter load profile than for a peakier profile. The difference between the hours at risk for each jurisdiction under a 10 per cent overload is identified in the following chart.

Figure 3.6: Hours at Risk Following a 10% Network Overload



3.3 Automatic Control Systems

AEMO's submission includes a table of the total number of Automatic Control Systems (ACS) in each jurisdiction as evidence that Victoria is more innovative and has better network management. Grid Australia notes, however, that the number of ACS in a jurisdiction is not, in any event, an indicator of efficiency. The need for ACS will depend on the individual circumstances of the network, their cost to install, and the impact that their increasing number might have on the complexity of managing the network.

Further, these numbers are misleading. AEMO's analysis ignores the fact that Victoria's network is actually relatively larger than networks in South Australia and Tasmania. When network size is taken into consideration both South Australia

(1 ACS/159km of transmission line) and Tasmania (1 ACS/158km of transmission line) have more ACS than Victoria (1 ACS/168km of transmission line).

4. Analysis of AEMO's qualitative statements

While the previous section focused on the quantitative statements put forward by AEMO, the purpose of this section is to focus on the qualitative statements it has made to support a policy change. This section addresses the following matters:

- Planning standards
- The effectiveness of financial incentives and economic regulation, and
- The approach to national planning.

4.1 Planning standards – certainty, probability, and possibility

One of the key arguments in AEMO's submission is that its approach to network planning – a "probabilistic" approach – should be the preferred approach to determining transmission investment, and should be preferred over any other approach, such as where a deterministic standard is set (even where that standard was itself set on the basis of a "probabilistic" assessment). In recent years, it is clear that the debate over transmission planning methods has become unnecessarily and artificially polarised, and some of this debate has portrayed the issues as more black and white than exists in reality. Prior to addressing the question of the appropriate approach to planning, a few overarching observations are relevant.

First, notwithstanding the tendency for the issues to be conflated, the question of *how* planning should be undertaken is independent of *who* should undertake planning and make investment decisions. In addition, Grid Australia members are already well equipped to undertake probabilistic planning in relation to all projects should this be decided by policy makers.[33]

Secondly, there are more similarities between probabilistic and deterministic planning than there are differences. All transmission planning by its nature involves making assessments about the appropriate extent of redundancy in capacity that should be built in order to maintain supply (or minimise the loss of supply) in the event of the inevitable but random outage of a piece of equipment. Likewise, the choices and outcomes to the planner are identical – for a given augmentation project, the key

[33] It is noted that if probabilistic planning were to be implemented generally, there would be a need for a substantial effort to standardise approaches and assumptions in order to provide an acceptable level of transparency, although the level of transparency of even a standardised probabilistic approach would not reach the level of a deterministic standard.

choice is the timing of that project, with the consequence of that choice being the extent of risk of unserved energy that is accepted.

Thirdly, transmission planning is by its nature a difficult task. Transmission networks are complex systems, where seemingly unlikely events nonetheless do occur and have dramatic effects.[34] Customers clearly place considerable value on a secure and reliable supply. Transmission investment decisions generally need to be made some years in advance of the need. Analytical approaches for judging the "worth" of transmission investments are at best a considerable simplification of reality.

It is not contentious to suggest that improvements can be made to the approach to the framework under which planning standards are determined – and consequently to those planning standards – compared to what currently exists in most jurisdictions in the NEM. This is a matter that has been the subject of a comprehensive review by the AEMC and its Reliability Panel. The key finding of that review, which is supported by Grid Australia, is that planning standards should be set economically with the capability of being expressed deterministically.[35]

The recommendations made by the AEMC and its Reliability Panel were made a number of years ago and are yet to be fully acted on. Since this time, Grid Australia's members have given greater consideration to how the AEMC's recommended approach should be implemented.

4.1.1 Preferred approach to planning standards

Grid Australia's further thinking on the approach to planning standards is set out below, which also responds to some of the comments of AEMO. Grid Australia's preferred method for implementing the AEMC and Reliability Panel's recommendations has the following features:

- Economically derived standards, based on both "probabilistic" valuations and with criteria allowing for consideration of high impact, low probability events. Further consideration is required with respect to whether the probabilistic approach as currently implemented correctly captures the value that customers place on supply reliability (especially in relation to modest projects to avoid high impact, low probability risks).

- The transparent and objective expression of standards (deterministically expressed), noting that substantial flexibility exists over how standards are defined, and

[34] An example of the dramatic effects of such events is described in Appendix A.

[35] http://aemc.gov.au/Market-Reviews/Completed/transmission-reliability-standards-review.html

- A mechanism to accommodate material changes in circumstances over time, although this mechanism does need to be so wide as to detract from the benefits from setting out the planning standards in deterministic form.

These are addressed in turn below.

Economically derived standards

Grid Australia agrees with the AEMC (and with AEMO) that it is important to ensure when planning a transmission network there is a recognition of the trade-off between the cost and benefits of action with the costs and benefits of inaction. This is inherently an economic test, where the cost of *action* is the societal cost of a transmission project,[36] and a key cost of inaction is the loss of customer value (utility) from the increased risk of a power outage if the transmission project does not proceed.[37]

Grid Australia also considers that a probabilistic assessment as AEMO advocates should be a central part of that analysis. Having said that, probabilistic assessments have a number of shortcomings that need to be taken into account when deciding upon whether transmission projects should proceed.

In general, undertaking a complete probabilistic assessment would be an extremely complex and most likely impossible task. In principle, this would require the modelling of the effects of a large number of combinations of network outages and the assigning of probabilities to each of these combinations, and for this analysis to cover the life of the asset, including the effect of other new transmission and generation development. In practice, all that can be done is to take account of a limited number of possible outage conditions – which is AEMO's practice. This means that a probabilistic analysis is likely at best to provide a distant approximation of reality, and is also likely to result in high impact, low probability events being excluded from the analysis.

In addition to the inherent complexity of the "probabilistic" modelling task, estimates of the benefits to customers from a given reliability improvement are measured with substantial imprecision. Moreover, AEMO's method for estimating the benefit to customers is likely to systematically understate this benefit, including by ignoring the preference for "risk averse" customers to place a value upon being insured against high impact, low probability events. These matters are discussed more fully in Appendix A.

In light of these matters, it is important not to attribute a false precision to probabilistic assessments of the need for transmission investment. In addition, further work is

36 The term transmission project is used for brevity, but includes non-network options where these are the most efficient.

37 A number of other possible costs of inaction (benefits of action) exist, including (i) the potential to reduce losses and (ii) the potential to relieve network constraints and thus permit lower cost generation to be used. Both of these benefits are (appropriately) required to be counted under the RIT-T.

required on an appropriate method to "economically derive" planning standards, noting that a prima facie case exists that a further criterion may be required to ensure that customers' preferences are fully captured with respect to high impact, low probability events. In this regard, direct input from customers may be particularly useful for understanding their views more generally as to how much "insurance" against large power outages they may be prepared to pay for.

Transparent and objective expression of standards

Grid Australia considers it is important for an economically derived planning standard to be set in an objective and transparent manner. This means a deterministic expression of the standard. However, this need not be a simplistic n-k value. Instead, a deterministic standard can be far more sophisticated and include elements such as energy at risk, and thus provide a trigger for investment that matches the forecast date that the project would most efficiently proceed. Including more sophisticated deterministic measures such as energy risk means that deterministic expression of economically derived standards it is not the blunt tool claimed by some detractors of the approach.

The deterministic expression of standards provides for enhanced accountability on TNSPs by making it transparent as to whether a TNSP is undertaking the level of investment desired by customers. A deterministic standard facilitates a robust assessment of forecast expenditure by the regulator and other interested parties, such as customers, by providing greater clarity as to the expectations of the TNSP. Such a well-informed review would not be possible if planning was undertaken purely on a probabilistic basis. It is also worth noting that deterministic planning is also consistent with the deterministic approach to system operation that is undertaken by AEMO in the NEM.

Further, a deterministically set standard is supported by international practice. Grid Australia is not aware of a major economy with an advanced electricity regulation framework that does not in the main apply deterministic planning standards for their transmission system.[38] That is, where probabilistic methods are used as part of a

[38] In its 2008 report for the Reliability Panel, KEMA found that each of the six international power systems it reviewed adopted deterministic planning standards. The power systems were:

- Germany;
- Great Britain (GB);
- Nordel (Norway, Sweden, Finland, and Denmark);
- Alberta (AESO);
- PJM in North America; and
- California Independent System Operator (CAISO).

KEMA subsequently commented on the international adoption of probabilistic planning standards in an updated version of its report. KEMA noted that probabilistic methods are being used "to at least some extent" in British Columbia (Canada), California, New Zealand, and Victoria (Australia). However, KEMA also explained that international electric systems that use probabilistic methods limit their scope or use in at framework, they are not applied in their pure form. Rather their scope and use are appropriately limited within the broader planning framework.

Accommodate changes over time

AEMO has identified that a deterministically set standard (even if economically derived) can become out-of-date and may lead to uneconomic investments being triggered.

It is true that even an economically derived deterministic planning standard may become out-of-date and therefore direct investment could occur earlier or later than would be most efficient. This can occur where circumstances such as the costs of major inputs, or the Value of Customer Reliability (VCR), changes significantly over time.

As Grid Australia has identified previously, this outcome might support the inclusion of some flexibility in the application of planning standards, with the ability or requirement for TNSPs to apply an economic test to reconsider the efficiency of investment decisions in certain circumstances; e.g. where there has been a material change in input prices over time.[39]

It is important to note that a probabilistic standard can also become out-of-date. As identified previously, the VCR is an important input into a probabilistic assessment and it is derived through survey analysis. The method for deriving the VCR means that it can also become out of date and therefore not properly reflect the value customers place on reliability. Applying an out-of-date VCR could then also lead to investments being triggered sooner or later than is otherwise efficient. The assumptions made for other important inputs, such as the failure rates on assets, are also susceptible to change over time and changed values for these might lead to distortions from efficient outcomes under a probabilistic approach.

4.2 Effectiveness of financial incentives and economic regulation

AEMO argues that the current building blocks approach should be replaced with a framework that rewards transmission businesses based on service outcomes. It argues this because it contends that the building blocks framework closely resembles

least some important ways. KEMA commented that 'pure' probabilistic approaches are highly complex, data intensive and less transparent than deterministic planning methods.

39 It is noted that deterministic standards would be robust to many potential changes in forecasts or assumptions. For example, the investment requirement under a deterministic standard would react automatically with changes in demand, as this would flow through directly into the time at which the standard was forecast to be breached.

rate-of-return regulation, and hence rewards the building of assets as opposed to the provision of services, an effect known as gold-plating[40]:

> *"One of the main criticisms of the building block approach is that it closely resembles rate-of-return regulation. While there are incentives designed to improve operational behaviour, the power of the incentive is low compared with the incentive of the business to over-invest in its asset base or drive down the unit cost of investment. This is known as gold plating or the Averch-Johnson effect."*[41]

Grid Australia has two principal concerns with this view:

- First, it does not represent the common understanding of how incentive regulation works.
- Second, its proposed solution, if implemented as expressed by AEMO, would expose network businesses to considerable investment risk and in doing so threaten the capacity for network businesses to raise debt and equity finance to fund necessary investment.

Each of these matters are addressed in turn below.

4.2.1 Rate of return regulation versus building blocks plus incentives

AEMO has asserted that the building block approach of the current regime closely resembles rate-of-return regulation and therefore provides an incentive to over-invest in the current regime. Grid Australia does not consider that this is an accurate representation of the building block approach and of how incentive regulation is applied in the NEM.

The building block approach is a term to describe the summing of relevant annual costs to calculate an estimated total annual cost of service provision. The fact that the building block approach is applied in a regime does not mean strong inferences can be drawn about the incentive properties of a regime. This is because the building block approach can be equally applied to a number of different regulatory regimes, including those with relatively weak efficiency incentives such as rate-of-return regulation. While the building block approach is applied in the NEM, classic rate-of-return regulation, upon which the stated gold-plating theories are based, is not. Instead, the approach to regulation in the NEM is best described as incentive regulation.

Rate-of-return regulation and incentive regulation, as it applies in the NEM, are described below to provide clarity about the distinction between the two approaches.

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[40] This asserted effect is also known as the Averch-Johnson effect.

[41] AEMO, Electricity *Network Regulation – AEMO's response to the Productivity Commission Issues Paper*, p 21.

Rate of return regulation

Rate-of-return regulation sets prices according to an operator's actual costs. Its focus is primarily on ensuring that regulated entities are provided with a fair return on their investments. A key objective of this form of regulation is to ensure that future investment is not dissuaded. Rate-of-return regulation allows prices to be reset when costs rise above the regulated allowance.[42] The ability to reset prices when costs increase means there is little incentive to minimise costs. As such, the 'gold-plating' incentive referred to by AEMO is likely to exist for this form of regulation.

Incentive regulation

The approach to incentive regulation that applies in the NEM requires costs to be decoupled from prices for a period of time; typically five years. This decoupling of costs and prices provides network businesses with financial incentives to *minimise* their expenditure within the period. This is because if a business spends more than its forecast allowance it will be exposed to the costs of financing any capital expenditure or any actual operating expenditure incurred. Conversely, expenditure less than forecast allows a business to benefit to the extent of the difference between its allowed revenue and its actual costs.

AEMO states in its submission that the AEMC and its advisors consider there is a deficiency in the Rules that may provide incentives for capital expenditure beyond allowances.[43] However, these statements are not made by the AEMC and its advisors and in fact they make statements to the opposite effect. The statement below identifies that the conclusion that incentive regulation provides incentives to minimise expenditure is in fact *supported* by the AEMC:[44]

> *"Putting the cost of capital issue to one side, the current mechanism provides that a NSP will have to bear the costs of any overspend during a regulatory control period until the start of the next regulatory control period... ...**There appears to be no other incentive in the NER on a NSP to overspend. The Commission is of the view that the capex incentives in the NER do not create an incentive for a NSP to spend more than its allowance in its regulatory determination."***

In addition, Professor Yarrow, an advisor to the AEMC, argues in his paper that the problem is actually one of under-investment, not over-investment. Further to this, Professor Yarrow states that regulated entities have an incentive to keep all costs (including capital costs) to a minimum.[45]

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42 A regulator may also trigger a rate review where it perceives that the allowed return is greater than cost.

43 AEMO, Electricity Network Regulation – AEMO's response to the Productivity Commission Issues Paper, p 22.

44 AEMC, Directions Paper: *National Electricity Amendment (Economic Regulation of Network Service Providers) Rule 2012; National Gas Amendment (Price and Revenue Regulation of Gas Services) Rule 2012, 2 March 2012*, p. 40 – 41, emphasis added by Grid Australia.

45 G. Yarrow, *Preliminary views from the AEMC*, p 2, p13.

Grid Australia acknowledges, as does the AEMC and Professor Yarrow, that the incentive to minimise expenditure is strongest at the start of the regulatory period and then declines until the final year of the period. Importantly, this is an issue regarding the timing of investment, not whether there is an incentive to spend more than the regulatory allowance. In submissions to the AEMC's Economic Regulation of Network Service Providers Rule change request the application of an efficiency benefits sharing scheme to capital expenditure has been advocated. Such a scheme would address this issue by providing an equal and consistent incentive in each year of a regulatory period.

4.2.2 Outcomes focus versus cost based regulation

AEMO's submission advocates that in place of the building blocks framework, revenue should be based on outputs and service outcomes.[46]

Transmission businesses in the NEM already operate in an 'output' focused environment, that is, an environment based on service standard incentives and requirements. The intention of the outcomes and service performance based incentives is to encourage network businesses to identify low cost service improvements that benefit customers. Indeed, it is service obligations and incentives that counterbalance the incentives to minimise expenditure described above.

Grid Australia supports a framework that focuses strongly on outcomes and service performance. In previous submissions to the AEMC's Transmission Frameworks Review it has advocated the consideration of stronger incentives on matters such as improved network capability. In addition, transmission businesses advocated for the timely introduction of the new Market Impact Component (MIC) of the Service Target Performance Incentive Scheme (STPIS).

A focus on outputs and service performance should not, however, dilute the importance of ensuring that efficient costs will be recovered. Sustainable cost recovery is a fundamental requirement for all businesses in the economy, not just regulated network businesses. An expectation of efficient cost recovery is essential in order to maintain incentives for future investment in services for customers. The importance of this principle is reflected in the requirement in the National Electricity Law (NEL) that network businesses at least be able to recover their efficient costs.[47]

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[46] AEMO, *Electricity Network Regulation – AEMO's response to the Productivity Commission Issues Paper*, p21

[47] We note also that it forms a central tenant of regulatory regimes in other jurisdictions and industries In the UK water sector, one of Ofwat's primary duties is to ensure that the companies can finance their functions (ensure that the companies can finance their functions (http://www.ofwat.gov.uk/aboutofwat/whatwedo/duties). In the UK energy sector, the Gas and Electricity Markets Authority must have regard to the need to secure that licence holders are able to finance the activities which are the subject of obligations on them (http://www.ofgem.gov.uk/About%20us/Authority/Pages/TheAuthority.aspx#fn3).

There is also a practical problem with rejecting cost-based regulation in favour of a strict outcomes-based approach. That is that factors outside the control of network businesses can have a considerable impact on the 'outcomes' businesses are assessed against. Such factors include changing customer demographics, climate and general economic conditions. A strict outputs focused regime may, therefore, lead to considerable revenue and profit volatility, and in turn put at risk efficient cost recovery. This additional risk could be expected to jeopardise the capacity for network business to efficiently raise debt finance for necessary investment. Given the factors that create the risks in this instance are largely outside of the control of network businesses there is no efficiency basis for asking network businesses to manage them.

The United Kingdom's outcomes focused regime

The framework in the United Kingdom for the economic regulation of electricity networks is often touted as a particularly 'outcomes' focused regime.[48] The UK regulator, Ofgem, refers to its approach as RIIO (Revenue = Incentives + Innovation + Outputs)[49]. The intention of the RIIO framework is to place an increased focus on incentives to encourage innovation and desirable service standards. Crucially, however, the RIIO model remains centred on the recovery of *efficient costs.* Like in the NEM, Ofgem still applies the building block approach on an *ex ante* basis. Also like in the NEM, the base revenue requirement is subsequently *adjusted ex post* to reflect the delivery of outputs and innovation.

Ofgem describes its approach to setting prices within the RIIO framework as follows:[50]

> *"The price control will be set using a 'building block' approach, incorporating incentives to encourage network companies to deliver outputs and value for money over the long term.*
>
> *Under the RIIO model the price control will include details of the primary outputs network companies are expected to deliver and will set revenue for efficient delivery of these outputs. This revenue commitment will comprise three elements:*
>
> – ***base revenue*** *to cover expected efficient costs (including financing costs) of delivering outputs and long-term value for money, including allowances for maintenance of, and investment in, capital assets and taxation;*
>
> – ***adjustments to reflect company performance*** *in delivering outputs efficiently and innovating to expose efficiencies during the control period; and*
>
> – ***adjustments made during the control period for specified uncertainties*** *that are considered to be outside the company's control but will have a*

48 Grid Australia notes, however, this is most often by the regulator itself.

49 *RIIO: A new way to regulate energy networks (Final Decision),* Ofgem, October 2010

50 *Handbook for implementing the RIIO model,* Ofgem, October 2010, p28-29

> *significant impact on costs of delivery (e.g. compensation for changes in general price inflation in the economy) and changes to financial parameters that are updated during the period (e.g. annual adjustment to the cost of debt, pension adjustments)."*

What the UK example demonstrates is that even in those frameworks that profess to have a very strong focus on outputs and outcomes, efficient cost recovery remains at their core. This is a principle that is strongly supported by Grid Australia. Furthermore this type of framework is only possible where the service provider operates on a for-profit basis.

4.3 Approach to national planning

This section addresses the following issues raised by AEMO:

- Coordinated national planning
- Coordination with system operation, and
- Competition for network ownership.

4.3.1 Coordinated national planning

AEMO claims that a state-by-state approach to network planning has resulted in obvious inefficiencies. It considers that the difficulties of coordinating five transmission businesses and the lack of alignment in revenue resets is limiting projects such as its NEMLink proposal proceeding. AEMO also states in its submission that a national planner is better able to integrate government energy policies into network investment plans.

Effective coordination of national and regional network plans

Grid Australia considers that AEMO's comments regarding the effectiveness of strategic national planning are out-dated and reflect a period prior to significant reforms being introduced in the NEM. These reforms include: creating the National Transmission Planner, introduction of the new Regulatory Investment Test for Transmission (RIT-T) and vesting the Last Resort Planning Power (LRPP) with the AEMC. Instead, recent evidence suggests that the revised NEM framework is in fact delivering on its intended outcomes.

Best practice planning requires the incorporation of a strategic view of the national grid into short-to-medium term transmission plans of profit motivated network businesses. Indeed, following extensive reviews by Parer, the Energy Reform Implementation Group (ERIG), and the AEMC, this is the framework that has been implemented for the NEM. AEMO has responsibility for strategic national plans that can then be incorporated into the more detailed plans of regional transmission businesses. While this framework is still in its infancy, the evidence suggests that it is successful in delivering coordinated planning across jurisdictions and revealing efficient network investments for customers needs. This view is supported by the AEMC in its most recent publication for the Transmission Frameworks Review:[51]

> *The Commission considers on the basis of evidence provided to date that there is no indication of a lack of inter-regional capacity being built. The Last Resort Planning Power investigations conducted by the Commission in both 2010 and 2011 found that TNSPs were planning to undertake RIT-T assessments of projects to augment inter-regional transmission capacity where appropriate. Further, AEMO's initial analysis of a project to significantly expand interconnector capacity, NEMLink, suggests that substantial increases in capacity are unlikely to be economic.*

The current planning framework also allows for AEMO, including through its role as the National Transmission Planner, to make an important contribution at various stages of the planning process. This allows AEMO to put forward its view of whether certain projects should or should not proceed. AEMO is able to ensure that transmission businesses give proper regard to the national perspective via the following avenues:

- The publication of a long-term network development plan (NTNDP)
- Joint planning with transmission network businesses
- The capacity to review and comment on the application of the Regulatory Investment Test for Transmission (RIT-T)
- The capacity to dispute a TNSP’s final assessment under the RIT-T, and
- Providing advice to the AEMC in its application of LRPP.

While there are clearly many opportunities for AEMO to raise any concerns it may have about the efficiency of network planning, Grid Australia notes that AEMO has not raised disputes or formally questioned any projects put forward by network businesses. If it truly believes that TNSPs are not planning efficiently AEMO should pursue the many opportunities available to it to work cooperatively with regional TNSPs.

Delivery of strategic national projects

Grid Australia does not agree with AEMO that the current framework is incapable of delivering national projects such as NEMLink. There are numerous examples of coordination between TNSPs to identify efficient projects at a national level.

51 AEMC, *Transmission Frameworks Review, Second Interim Report,* 15 August 2012, p. 59.

Examples underway at the moment include:

- the South Australia to Victoria (Heywood) Interconnector Upgrade, for which a RIT-T process is well advanced by ElectraNet and AEMO (in its role as the Victorian TNSP);

- a joint working group established between AEMO (in its role as the Victorian TNSP), and ElectraNet to investigate the most cost efficient solutions for meeting reliability in the Riverland of South Australia; and

- The potential increase in capacity of the Queensland to New South Wales Interconnector (QNI) to realise net market benefits, for which a RIT-T is jointly underway by Powerlink and TransGrid.

While the economic merits of the cited NEMLink project are at present questionable, Grid Australia nevertheless considers that AEMO's assessment of this project in the NTNDP provides evidence that the current framework for strategic national planning is working. Through the NTNDP, AEMO published its assessment of the merits of the NEMLink project and also other near term projects, such as the proposed extension of the Sydney 500 kV network. This demonstrates that the current NEM framework for national planning is working.

It is important to note that contrary to the suggestion of AEMO, there is no need for the alignment of revenue determinations to facilitate a project such as NEMLink. Instead, NEMLink or similar projects, would most likely be treated as a contingent project within the current framework. Under this framework revenue is provided only when the project proceeds and not at the start of a regulatory period. The trigger for a revenue allowance for NEMLink under the contingent projects framework would be a favourable assessment under the RIT-T. Grid Australia notes, in any event, that there is already a high degree of alignment in the timing of revenue determinations across jurisdictions.

The key reason that NEMLink is not proceeding at this time is that the economic case does not yet stack up. AEMO's analysis in the NTNDP identifies that the NEMLink project only approaches breakeven around 2020-2021. Importantly, even this outcome is only under an optimistic set of assumptions.[52] Grid Australia considers that this outcome points more to the success of the current framework rather than any failing. That is, a framework including robust economic tests and transparent consultation has been successful in preventing inefficient investment proceeding. Indeed, it would be concerning if a different regulatory framework allowed the current NEMLink project to proceed given the lack of an economic case supporting it.

[52] See Grid Australia, *Transmission Frameworks Review, Supplementary Submission in response to AEMC First Interim Report,* May 2012, AEMO, *2011 NTNDP for the National Electricity Market,* 2011, p.6-1, and AEMO, *2010 NTNDP for the National Electricity Market*, 2010, p.135.

Alignment between network planning and government policy

Grid Australia is concerned with AEMO's statements that a national planner would be better able to integrate government policy into network plans than regional TNSPs. It is acknowledged that it is important to have regard to the NEO and government policy. Transmission businesses currently act to facilitate the implementation and application of government policies where it is relevant to do so. AEMO, however, has not provided any practical reason for why it is better placed to integrate government policy into network plans relative to TNSPs. Indeed, making such a claim without any justification only serves to support the case that a not-for-profit planner is more likely to be swayed, inappropriately, by political outcomes rather than those that are in the long-term interests of consumers as set out in the NEO.

4.3.2 Coordination with system operation

AEMO claims in its submission that there are benefits from combining national system operation and planning, including:

- A national planner and system operator would be better able to plan the NEM by taking into account utilisation of intra-regional network and national flow paths
- A system operator is better able to monitor the system's behaviour, for example, oscillatory characteristics, and
- The information provided to AEMO as the system operator on TNSP outage schedules would allow it to suggest changes to schedules so to provide more efficient market outcomes.

Grid Australia notes the United Kingdom has a framework with a combined system operator and network planner and procurer. However, the important difference between the UK approach and that proposed by AEMO is that in the UK there is a strong reliance on having a profit-motivated entity responding to financial incentives. Conversely, if AEMO's proposed approach was implemented there would be no opportunity to impose financial incentives on the many matters that are important for driving efficiency in the context of network planning and system operation.

Should a single system operator and transmission planner and procurer be implemented in the NEM it would be a fundamental change from the existing framework. As such, it could be expected to impose substantial implementation costs. In particular, the entity would need to be made a 'for profit' business to enable the effective use of commercial incentives to capture any synergies that might exist. Given that there is no material deficiency in the existing framework with respect to the coordination of system operation and network planning it is likely that the costs of implementation would far outweigh the benefits.

Importantly, the information required to make the operational decisions referred to by AEMO is held by the party responsible for maintaining the assets, namely the regional transmission network owners and not the system operator. Given all the information in AEMO's possession is made public, it is not clear that that a combined system operator and national planner would have access to superior information and make better decisions. Indeed, the fact that operational decisions, which are most relevant in this instance, would need to remain with the network owner suggests that outcomes could only be worse under AEMO's proposed approach.

4.3.3 Competition for network ownership

AEMO states that the RIT-T is not an appropriate substitute for competitive procurement by an independent planner. Specifically, AEMO states that the RIT-T is a consultative mechanism only and is unlikely to prevent inefficient investment. It considers that competition for ownership of the shared network focuses on a need rather than assets and in doing so encourages innovative solutions and a greater response from non-network solutions. Further to this, AEMO claims that contestable ownership of shared network assets is preferred to economic regulation through the AER due to the information asymmetry problem.

Contrary to AEMO's view, Grid Australia considers that concerns about efficiency are likely to be exacerbated if its competition for network ownership approach is implemented across the NEM. Grid Australia's main concerns with competition for network ownership are:

- It presumes a competitive market for network ownership of the shared transmission network exists across the NEM. However, there is limited evidence that there would be sufficient competition for infrastructure companies to tender for network ownership. Indeed, the experience in Victoria suggests that competition to own network assets has not been strong.[53]
  - Grid Australia considers that the significant transaction costs associated with responding to a tender are also likely to be a barrier to alternative providers. In particular, these transaction costs would likely dissuade non-network options such as demand-side response from participating in tenders.
- Accountability is diluted. Under the Victorian model accountability for meeting performance standards across the NEM are dispersed. Network augmentation, renewal and operation and maintenance expenditure are all substitutes for delivering improved service performance. However, in Victoria responsibility for delivering on each of these aspects resides with different parties. This means

53 It is important to recognise that the conclusion on competition for ownership of the shared network does not hold for extensions to the network to facilitate connections. In the case of network extensions there is a natural alternative owner available in the form of generators and loads.

that no single party is accountable for the overall performance of the network and these decisions may not, in practice, be optimised.

- Significant costs can be imposed on customers with little or no scrutiny of their efficiency. Implementing AEMO's model means that the entity could tender for major augmentations without any 3rd party oversight. This is at odds with the rest of the NEM and indeed how governments operate. Arguably, AEMO's actions impose costs on a broader tax base than the government with significantly less, or no scrutiny. The lack of oversight by a body such as the AER on an overall revenue allowance also reduces the opportunities for customers and other stakeholders to assess and comment on investment proposals in Victoria.

It is also not correct to suggest that a contestable approach to network ownership will drive more cost efficiency, innovation or non-network solutions than the process presently applied by TNSPs. The planning approach employed by TNSPs works to facilitate the identification of alternative proposals to meet a network need. The focus of the RIT-T is on a network need rather than a network augmentation. In addition, TNSPs are required to undertake consultation in order to identify alternative means of addressing a network need. The evidence to date demonstrates that TNSPs have indeed been successful in identifying solutions other than network investment or in conjunction with smaller network investments to meet network needs.

Efficiency and innovation in the process is further facilitated through the construction of network assets, and often project design, being subject to competitive tender by TNSPs. This means that the benefits of competition are captured while ensuring that responsibility and accountability rests with a single profit motivated party. This approach is also common across non-regulated sectors.

Grid Australia is also concerned to learn that AEMO considers the RIT-T is not effective in the planning framework. The RIT-T provisions include specific arrangements for consultation between TNSPs and AEMO. In addition, the AEMC has proposed in its most recent report for the Transmission Frameworks Review to place a more formal requirement on AEMO to review Annual Planning Reports and the application of the RIT-T.[54] Grid Australia would be highly concerned if AEMO maintains that, even with its direct involvement, the RIT-T framework does not encourage a proper assessment of the costs and benefits of alternative projects.

It is also important to note that the role of the RIT-T, in any event, is secondary to the financial incentives faced by transmission businesses. It is these incentives that drive network businesses to undertake only efficient projects. To that extent, AEMO is correct to suggest that the RIT-T is primarily a consultative mechanism. Its purpose is to provide confidence to the market that network businesses are in fact undertaking the proper economic assessments of projects.

[54] AEMC, *Transmission Frameworks Review, Second Interim Report,* 15 August 2012, p. 60.

Economic characteristics of network services

Grid Australia notes that AEMO has attempted to undertake an analysis of the economic characteristics of various services provided by TNSPs. It is not clear, however, what AEMO has drawn upon to reach its conclusions. As a consequence, the conclusions appear rudimentary and lacking any actual evidence.

Grid Australia recently engaged PwC to undertake an analysis of the economic characteristics of the various services provided by TNSPs. The purpose of this analysis was to focus on how connection related services should be regulated, however, it is also relevant in this instance. PwC's findings were as follows:

- The case for regulating 'standard' transmission services, known in the Rules as prescribed transmission services, is clear. These services are characterised by strong economies of scale and scope meaning that competition from an alternative provider is neither desirable, nor likely. In addition, these services are for the benefit of millions of customers, meaning negotiation is infeasible. As such, direct price setting is necessary in order to counterbalance the market power afforded to service providers.

- Regulation is justified for connection related works within the boundary of the substation as well as augmentations to the shared network beyond standard requirements – referred to in the Rules as negotiated transmission services. However, the ability for a transmission business to exercise market power is limited by the countervailing market power of sophisticated and well resourced customers for the service. This fact, combined with the administrative feasibility of negotiation with individual or small numbers of customers, means that a negotiating framework, with binding dispute resolution, an appropriate form of regulation in this instance.

- There is no case for regulating services outside the boundary of the present network. These services are characterised by low barriers to entry and as such have proven to be able to be provided by different parties with little cost disadvantage compared to the relevant transmission business.

5. Appendix A: Issues for probabilistically derived planning standards

The purpose of this Appendix is to provide some additional detail on a number of the issues associated with the application of probabilistic planning techniques as applied by AEMO. This material is an extension of the discussion contained in section 4.1.1 of the main submission. An illustration is first provided of the imprecision with which the value that customer's place upon reliability is estimated. The basis is then provided for the concern expressed in the submission that AEMO's technique may understate the benefit to customers from reliability improvement, particularly in the case of low probability, high consequence events. This stems from three factors, which are that:

- the use of a survey technique for residential customers that does not fully capture the costs of power outages in terms of customer disutility
- AEMO applies a constant value of customer reliability (in $/MWh terms) irrespective of the severity of the outcome, whereas standard economic principles would suggest that the value of an additional unit of reliability would be higher where reliability is low, and
- most importantly, AEMO's probabilistic technique does not factor in customer risk aversion, which recognises that people value the quality of certainty itself (and hence are prepared to pay an "insurance premium").

The Value of Customer Reliability is highly uncertain

The Value of Customer Reliability (VCR) is a highly significant input into the application of AEMO's probabilistic approach to planning. This number effectively represents how customers trade-off a loss of supply with the cost of improving reliability. However, the approach to its estimation in Victoria ignores a number of important sources of potential uncertainty. This in turn calls into question the level of precision that can be attributed to the cost-benefit assessments undertaken in Victoria.

In the first instance it is important to recognise that the VCR cannot be observed directly. Instead, surveys are used to estimate VCR through a series of questions regarding customers' response to an outage. This also means that there is a high degree of uncertainty associated with the value. However, there are also a number of detailed issues with the approach undertaken in Victoria that add to this uncertainty:

- The VCR applied in Victoria is a composite (or weighted average) measure of customer interruption costs for a wide range of customers. However, values can vary widely between different types of customers (in Victoria $13.25/kWh for domestic customers and up to $111.06/kWh for agricultural customers). Accordingly, the accuracy of the VCR estimate for any outage would be sensitive to the composition of affected customers.

- The 2007 survey undertaken for AEMO made no attempt to sample transmission-connected customers even though these loads represent a significant portion of total regional load.

- The complexity and length of the survey underpinning AEMO's VCR estimate led to a poor response rate for some categories of customers (such as industrial customers, where the AEMO VCR estimate is based upon only 4 responses.

It is noted that AEMO itself has identified that an error band of +/-50% is applied to VCR estimates in New Zealand,[55] which is indicative of the potential precision of the Australian estimates.

The VCR does not take proper account of the full costs of power outages

One of the main limitations of the VCR is that it asks customers for the cost of the measures they would take to ameliorate the inconvenience of a supply interruption. This purports to reflect the amount that customers would be willing to pay to avoid a supply interruption, in turn reflecting the disutility experienced during that period. In this regard, Oakley Greenwood states:[56]

> *"[The VCR] is essentially seeking to quantify the opportunity cost of unserved energy (USE); that is, the electricity that the customer does not receive due to a supply interruption, and is measured in dollars per kWh ($/kWh) of electricity not supplied. This is a somewhat different question to what the customer would be willing to pay for a different level of reliability, but the assumption can be made that a rational customer would be willing to pay a price for increased reliability that is no more (and presumably somewhat less than) the cost they would incur in the event of an interruption to their electricity supply."*

However, this approach erroneously assumes that customers are able to reveal their full willingness to pay to avoid power interruptions purely via the incurring of cost on substitutes, particularly as close substitutes for electricity, and devices that rely on it, are not readily available. In this regard, it is noted that customers who responded that they would "put up with having no electricity" were assumed to place no value upon it. It is likely that rational customers would be willing to pay a price that is above the costs they incur in the event of a supply interruption, meaning that the estimate of the VCR would be understated.

In addition, the most recent estimate of the VCR for AEMO adopted very low estimates for some key categories of costs and ignored others, in particular:

- the loss suffered from the shut down for the health service for a 24 hour period was assumed to be equal only to its operational budget for that period, and

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[55] AEMO, National Value of Customer Reliability, 19 January 2012, p.5.

[56] Oakley Greenwood, *NSW Value of Customer Reliability,* 30 May 2012, p.2

- while some of the social costs of a widespread outage were considered, non-tangible costs (such as impacts on leisure and study time and interruptions to schools, public administration and public transportation) and flow-on costs (such as trauma related to injuries, fear, panic and the increased incidence of crime) were ignored.

AEMO's approach to VCR implicitly assumes a constant value of reliability irrespective of the level of reliability

By using a point aggregated estimate of VCR, AEMO's approach implicitly assumes that customers place the same benefit on a marginal increase in reliability, irrespective of the level of reliability.

Economic principles suggest that customers are more likely to place a higher value upon marginal reliability improvements as reliability falls, reflecting the standard assumption that the "demand curve" for a good or service (reliability in this case) should be downward-sloping. This suggests that AEMO's use of the VCR estimate is likely to understate the value to customers of reliability for poor reliability outcomes.

The VCR does not factor in the fact that customers are risk-averse

The probabilistic approach as applied by AEMO ascribes probability weights to various outcomes in arriving at its measure for customer benefits. In doing so, it implicitly assumes that a customer would be indifferent between a) the certain outcome of a given reliability level and b) a probabilistic expectation of this same outcome occurring but with some chance of variation above and below this level.

However, such an approach effectively ignores that people are risk-averse, in that we value the quality of certainty itself. That is, even if the expected outcome is the same between two states of the world, it is a fundamental tenet of economics that the certain utility of such an outcome is greater than its ex ante expected utility, due to the fact that people prefer certain outcomes to uncertain ones. AEMO's estimate of customer benefits would therefore understate the true value to customers of greater assurance over a given level of reliability.

Moreover, according to established economic literature – Prospect Theory, which has positive rather than normative underpinnings – people tend to overweight small probability events, meaning that AEMO's estimate of customer benefits would tend to understate customer's perceptions in relation to high impact, low probability events, of which blackouts are an example. As stated by the founders of Prospect Theory:

> *[p]eople prefer a small loss, which can be viewed as the payment of an insurance premium, over a small probability of a large loss.*[57]

[57] http://www.econ.brown.edu/fac/Kfir_Eliaz/ProspectTheory.pdf

Indeed, this describes much of the wide-spread prevalence of insurance for all manner of things where the probability of something going wrong might be low but the cost very high. This phenomenon would add further to what customers may be prepared to pay for insurance against high impact, low probability events.

Accordingly, standard economic principles should suggest that a proper application of an economically set standard should take account of the value that customers receive from 'insurance' against high impact, low probability, events. This would require a modification or enhancement to the form of probabilistic planning that is applied by AEMO.

It is important to recognise that the high impact, low probability events for which there should be insurance do occur in practice in electricity systems. An example of such an event was in the power outage that occurred throughout parts of the Northeastern and Midwestern United States and Ontario, Canada in August 2003, which affected an estimated 10 million people in Ontario and 45 million people across eight U.S. states. As well as the direct effects from loss of electricity, water supply was affected in some areas, as were cellular services and there were significant disruptions to passenger rail services (including a cancellation of all trains running into and out of New York City) and many airports were unable to operate. In the same year, a power outage affected all of Italy and parts of Switzerland, affecting approximately 56 million people.

Grid Australia

Response to AEMO Position Paper – Collation of Statistics on Reliability, Utilisation and Capital Expenditure in Transmission Networks

August 2012

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1 Executive Summary

On 11 May 2012 the Australian Energy Market Operator (AEMO) made a submission to the Productivity Commission titled *"Electricity Network Regulation – AEMO's Response to the Productivity Commission Issues Paper"*. AEMO's submission focused on five themes:

- Meet reliability economically
- Reward the services provided not the assets constructed
- Promote inter-regional trade
- Plan nationally
- Independence delivers optimal results.

Central to these points is the assertion that AEMO, as the planning body responsible for the shared network in Victoria, has achieved superior outcomes to transmission planners in other jurisdictions. This argument is underpinned by four claims. Grid Australia has engaged Evans & Peck to assist in the analysis of these claims:

- Average utilisation of assets in Victoria is higher, therefore highlighting superior efficiency in infrastructure provision
- This has not been at the cost of reliability
- For similar rates of growth in maximum demand, the Regulated Asset Base (RAB) in Victoria has not grown to the same extent as RAB's in other states
- Probabilistic (rather than deterministic) planning has assisted in delivering these outcomes in Victoria, and would deliver even better results in other jurisdictions.

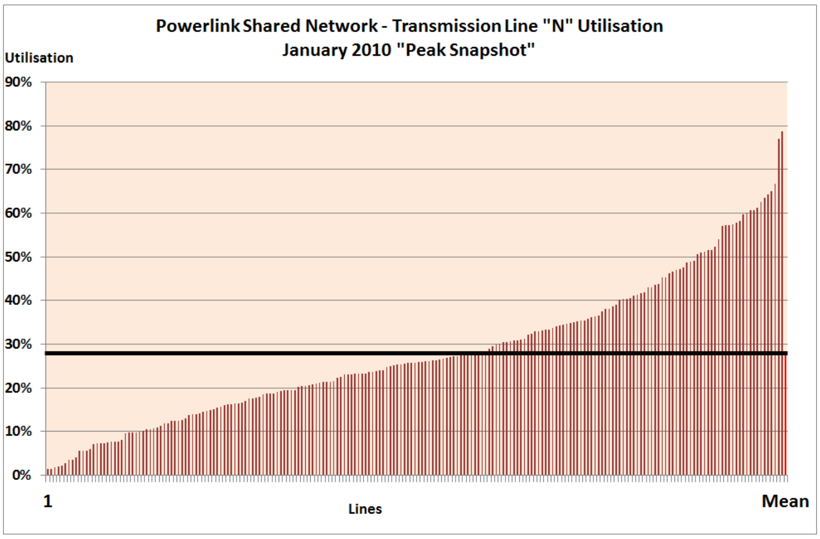
The Victorian shared network, for which AEMO has planning responsibility, is very different to the transmission networks in other states. It is made up of a highly interconnected 500kV / 220kV system with only eight substations. Seven of these substations have a highest voltage of 500kV. TransGrid and Powerlink have almost four times this number of substations categorised as part of the "shared" network. The average size of the relevant substations in Victoria is between 50% and 600% larger than the substations in other jurisdictions with which comparisons have been drawn by AEMO. Similarly, average line capacities are between 65% and 677% greater than those in other jurisdictions. Put simply, the Victorian shared network provides a "super highway" for the transport of bulk power around Victoria, whereas the networks in other jurisdictions have a more sophisticated role in matching regional generation to regional loads.

AEMO's utilisation analysis is based on comparing average "N" utilisation (i.e. utilisation when all components are in service) of lines and transformers during a summer peak "snapshot". We have three primary concerns with such a measure.

Firstly, AEMO's utilisation analysis does not account for the underlying historical configuration of the network. By way of example, a substation with only two transformers in it would be expected to have an "N" utilisation approaching 50% (i.e. 100% with one transformer out of service), whereas a substation with four transformers would be expected to have an "N" utilisation of 75% (again 100% with 1 transformer out of service), and so an increasing number of network elements may result in a higher utilisation. A similar principle applies to transmission line utilisation. The corridor between Yallourn and Rowville boasts six parallel

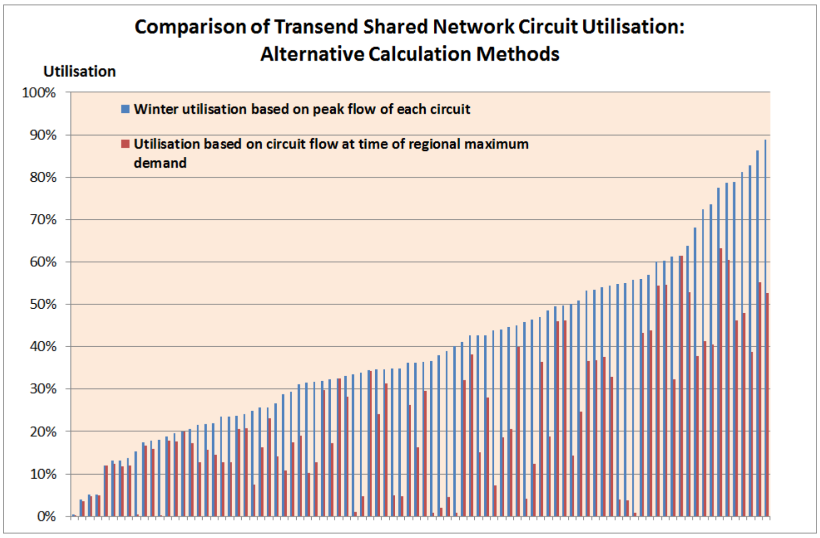
220kV lines,[1] supplemented by four 500kV / 220kV in-feeds. Comparison of the utilisation of these assets, as implied by averaging, with a relatively small system that has few interconnections and less redundancy is simply misleading and not appropriate.

We are also concerned with the appropriateness of AEMO's comparison of utilisations across TNSPs at system peak, without analysis of the situation. Average utilisation is a statistical outcome from the planning of individual situations; it is not a planning objective in its own right. To determine prudency in planning, analysis of each situation needs to be considered. The following figure shows the range of individual transmission line utilisation outcomes for a TNSP such as Powerlink. The wide range of individual line utilisations measured at system peak and lack of correlation demonstrates the futility of comparing average utilisations between jurisdictions in the absence of a detailed analysis of each situation.



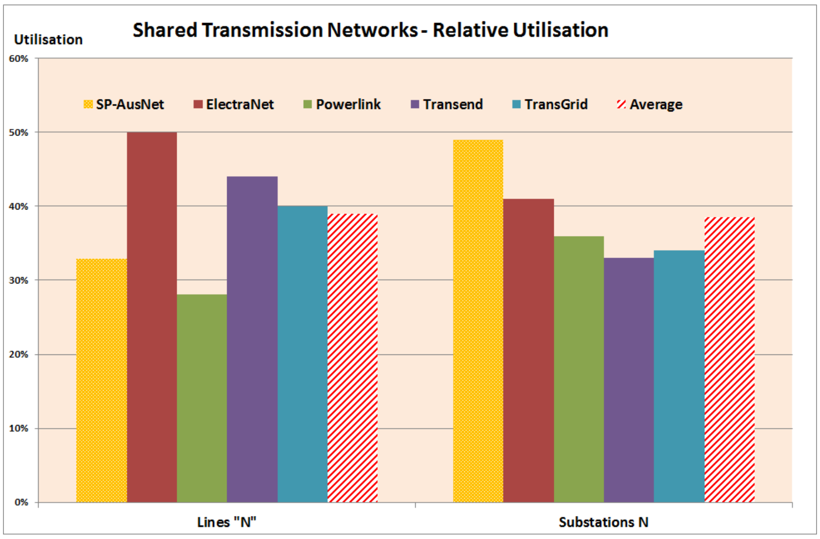
In the larger states of NSW and Queensland, almost 30% of lines have an utilisation below 20%. In some instances, this is attributable the "block" nature of line sizes, in other instances due to issues such as voltage constraints, or it may simply be attributable to generation dispatch patterns. This leads us to our third concern with the AEMO analysis - the use of a demand "snapshot" at the time of summer system peak to draw fundamental conclusions regarding planning effectiveness. Transend has compared line loadings at the time of system peak with maximum loadings that occurred on each line during the entire winter. This is shown below.

[1] The term "line" often refers to a physical structure that may include a number of circuits. Throughout this document, a line is taken to mean a single circuit



The differences between utilisation calculated during the entire winter and utilisation calculated at the winter maximum demand "snapshot" are extraordinary in the Tasmanian network. These differences are driven by dispatch patterns from generators (outside Transend's control). Under ideal generation / load matching in the north and south of the state, the main north-south transmission backbone may have virtually zero power flow. However, at other times this backbone is relied upon for the efficient transfer of power. Such effects may be less in Victoria, with relatively stable base load generation in the Latrobe Valley. However the effects are likely to be more pronounced in New South Wales and Queensland, which both have relatively more dispersed load and generation. It is far from logical to conclude the lines with low utilisation at the time of the peak "snapshot" have no purpose, as implied by AEMO's "average" measure. For this reason, three of the TNSPs have provided the "anytime" demand in response to our request for utilisation data.

For completeness, we have presented the comparative utilisation statistics derived as part of this engagement below, acknowledging that there is a mixture of summer peak "snapshot" utilisation, and non-diversified peak load used to calculate individual line / substation utilisation. The degree of variance between these two methodologies differs between states depending on variability in load and generation, and serves to highlight the dangers in using a simplistic benchmark such as "average" utilisation in supporting arguments on planning effectiveness.

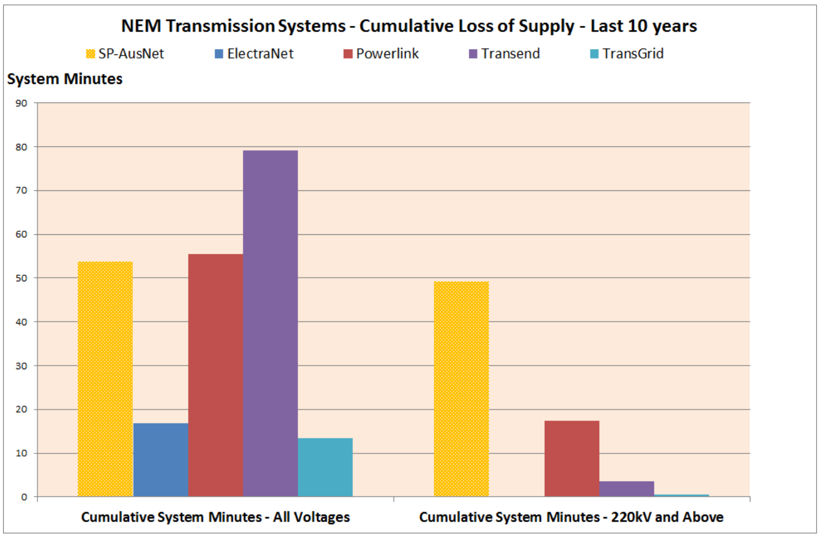


Subject to the above caveat, this chart demonstrates that while substation anytime "N" utilisation is highest in Victoria, this is not case for transmission line "N" utilisation. It is impossible to conclude from this analysis that asset utilisation in any one jurisdiction is superior to others.

The second plank of AEMO's argument is that efficiency in infrastructure provision has not come at the cost of reliability. AEMO has cited three measures:

- Circuit unavailability
- Number of Outages
- Average Outage duration.

In Evans & Peck's view, circuit unavailability is not a reliability measure – it is a redundancy measure. In networks planned to "N-1" or "N-2", a circuit outage does not generally result in a loss of supply. The number of outages and average outage duration are more appropriate measures, but these still do not adequately capture the "size" of the outage in terms of its impact on customers. A measure that integrates the number of outages, their duration, the size of the outage in terms of MW lost and normalises this against the size of each transmission system is System Minutes Lost, presented graphically in the following figure at all transmission voltages, and at 220kV and above.



On this measure, when all voltages are considered, Victorian performance is relatively consistent with its peers. Statistically, the Victorian shared network performance is dominated by one outage event at South Morang in 2009. A 500kV capacitive voltage transformer failed, resulting in a large loss of supply. Such low likelihood, high impact events are an inherent characteristic of major transmission networks. Under these circumstances, Evans & Peck concludes it is unwise for any TNSP to draw a strong linkage between planning proficiency and historical reliability, as AEMO has done.

AEMO has strongly argued for the application of probabilistic planning across the NEM. Evans & Peck has no philosophical disagreement with this, and has actively participated in policy development allowing its application in a number of states. Evans & Peck recognises that there is a place for both probabilistic and deterministic planning standards and that both have their strengths and weaknesses. However, we challenge AEMO's assertion that probabilistic planning will work more effectively in states with flatter load profiles. We believe this to be an error of fact. Section 5 of this report quantitatively demonstrates that, from a theoretical point of view, probabilistic planning in fact works most effectively in peakier states – Victoria and South Australia and less well in the other states.

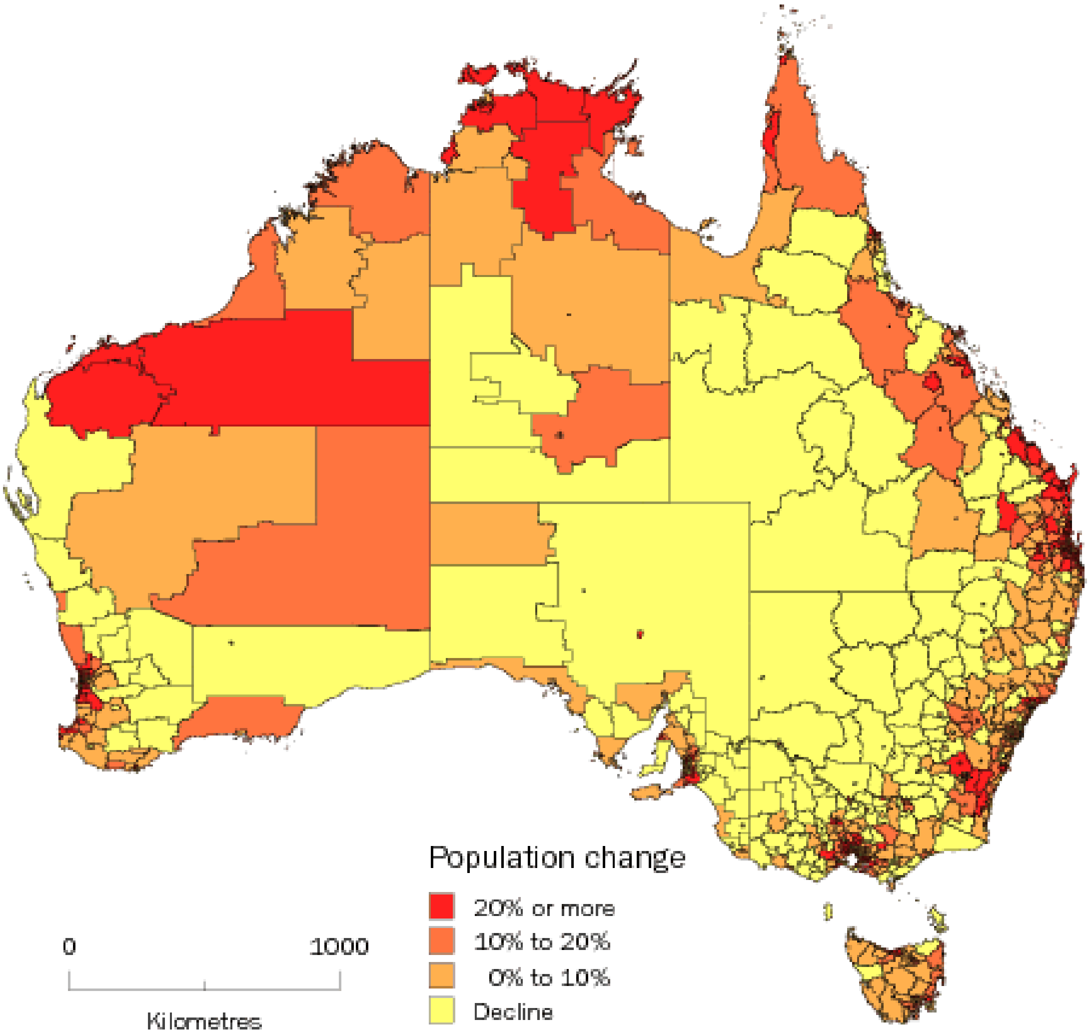
AEMO has linked a lower rate of growth in the Victorian Regulated Asset Base (RAB) to growth in maximum demand as an indicator of greater efficiency in planning than has occurred in other states – notably Queensland and South Australia. Due to the different regulatory model for the delivery of transmission augmentation projects in Victoria, there is a lack of transparency in the impact of augmentation on the RAB. Putting this administrative issue to one side, we are of the view that such simplistic comparisons are fraught with danger. Changes in the RAB are driven by many factors including replacement needs. Augmentation capital is just one of many drivers. This, in turn, is driven not only by growth, but also where the growth occurs and the starting capacity of the network to cope with demand increases.

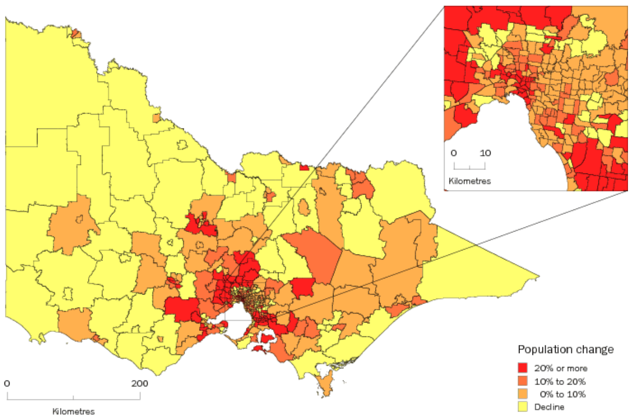
Comparison of the ABS[2] 2011 Census with the 2001 Census shows that whereas only 13% of population growth in Victoria occurred outside the major cities, in Queensland's case 32% was outside the major cities. In South Australia, 22% was outside the major cities. Inspection of the following graphic, extracted directly from the ABS analysis, provides insight into differing drivers of augmentation in each of the states over the last decade.

A key factor in Victoria is the correlation between the growth corridors, and the backbone 220kV/500kV network. Inspection of AEMO's 2012 Victorian Annual Planning Report shows it currently has eight or nine transmission line projects in the process of "regulatory review" or "priority assessment". The average length of line involved is less than 30km, with most being well under 20km. Implicitly, AEMO's RAB based analysis treats such projects on the same basis as remote projects such as Powerlink's North Queensland augmentation. Whilst it may be argued that establishment of the 500kV backbone around Melbourne nearly 50 years ago was good planning, it is difficult to attribute this to AEMO as the current planner. Consistent with AEMO's general approach throughout its submission, the superficial presentation of RAB data does not differentiate between correlation and causality, and more exhaustive analysis is required before leaping to any conclusion on planning efficiency.

Our focus in this report is not to discredit AEMO's achievements, or those of its predecessor, VENCorp. However, Evans & Peck is strongly of the view that there are fundamental flaws in the analysis AEMO has presented to the Productivity Commission in support of its claims as the pre-eminent planner of transmission systems in the NEM.

[2] Australian Bureau of Statistics Cat 3218.0 – Regional Population Growth, Australia, 2011.


Population change
20% or more
10% to 20%
0% to 10%
Decline
0
1000
Kilometres


0
10
Kilometres
Population change
20% or more
10% to 20%
0% to 10%
Decline
0
200
Kilometres

2 Background

On 11 May 2012, the Australian Energy Market Operator (AEMO) provided a submission to the Productivity Commission's Public Inquiry on Electricity Network Regulation – Issues Paper. A central theme in AEMO's submission[3] is that the Victorian model, whereby AEMO plans, but does not own, the "shared" transmission network, provides superior outcomes in terms of utilisation, reliability and capital expenditure when compared to those states where planning is performed by the asset owner. AEMO's logic subsequently extended to the rationale that planning should be done centrally by an "independent" agency such as AEMO.

In July 2012 Grid Australia, as the peak body for Transmission Network Service Providers (TNSPs), including[4] ElectraNet (South Australia), SP AusNet (Victoria), Powerlink (Queensland), Transend (Tasmania) and TransGrid (NSW), engaged Evans & Peck to co-ordinate the development of a number benchmarks that independently examined whether or not AEMO had achieved industry leadership from a planning perspective. This report primarily focuses on two key areas:

- Transmission system asset utilisation
- Transmission system outage data.

In addition, the report examines related issues in the areas of capital expenditure and probabilistic planning. Evans & Peck's report is intended to provide supplementary input to a detailed submission to the Productivity Commission being prepared by Grid Australia. In preparing this report, Evans & Peck has sought and obtained a range of data from:

- ElectraNet
- Powerlink
- SP AusNet
- Transend
- TransGrid.

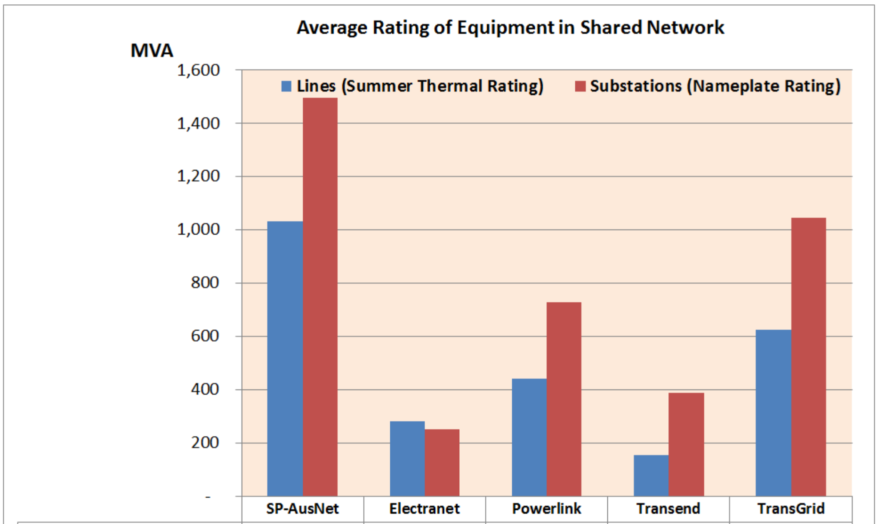
In addition, a significant amount of data has been obtained from Chapter 3 of the 2012 Victorian Annual Planning Report[5] prepared by AEMO. In arriving at its conclusions, AEMO has drawn heavily on a supporting report by Nuttall Consulting.

At the outset, Evans & Peck must highlight that a project such as this presents a number of data challenges. There are differences in the ways individual TNSPs record and manage data, and in the context of the time available to complete the interrogation of data bases, a pragmatic approach has been necessary so as to acquire as much relevant data as possible to permit meaningful analysis to be conducted. Whilst acknowledging these shortcomings, Evans & Peck does not believe that they erode our ability to draw generalised conclusions from the analysis undertaken.

It is also important to note that this comparison is based on very different networks. In Victoria, AEMO is responsible for the planning of the "shared" network. This network is made up

[3] Electricity Network Regulation – AEMO's Response to the Productivity Commission Issues Paper – Version 2 – 21 May 2012
[4] GridAustralia has a number of other members
[5] http://www.aemo.com.au/en/Gas/Planning/~/media/Files/Other/planning/2012_Victorian_Annual_Planning_Report.ashx

exclusively of 220kV, 330kV and 500kV lines, whereas the "shared" network in other NEM jurisdictions includes equipment at voltages of 132kV, 110kV and 66kV. In addition to this voltage differentiation, the Victorian shared assets have significantly higher ratings than those in the other states. This is demonstrated graphically in Figure 2.1.



	SP-AusNet	Electranet	Powerlink	Transend	TransGrid
Lines (Summer Thermal Rating)	1,030	280	442	152	624
Substations (Nameplate Rating)	1,496	250	727	388	1,045

Figure 2.1 – Relative Size of Key Components – Shared Transmission Networks

The average "AEMO" substation[6] is approximately 1500MW, 44% larger than that of TransGrid, twice the size of Powerlink and six times the size of ElectraNet. Similar ratios exist in relation to lines, with the average Transend line being less than one sixth the capacity of the average shared network line in Victoria.

In addition to this size difference, there are differences in the number of parallel paths serving some major load centres. For example, the corridor from the Latrobe Valley to Rowville, a major substation feeding Melbourne, consists of 6 x 220kV transmission circuits and 3 x 500kV circuits, a total of 9 circuits. There are a total of 15 x 220kV and 3 x 500kV circuits into or out of this station. Comparisons based on averages that include the utilisation of this network with averages comprised of significantly less meshed networks are fraught with danger and bring into question the validity of AEMO's fundamental assertions – that average utilisation is a leading indicator of superior planning. The following sections further test these assertions.

[6] AEMO does not actually own network assets. It plans the Victorian "shared" network owned and maintained by SP-AusNet. This network consists of backbone 220/330/500kV lines and a small number of step up / step down substations. The interface between this network and the distributors is a series of 220kV / 66kV Terminal Stations that are categorised as Connection Assets. Planning responsibility for these sits with the DNSP's, even though they are owned by SP-AusNet.

3 Utilisation

Utilisation of assets can be measured in a number of ways. Most commonly, it is a measure of the annual peak load on an asset as a percentage of its rating, i.e.:

$$\frac{peak\ load}{rating}\ x\ 100$$

"N" utilisation usually refers to the utilisation with all equipment in service. "N-1" refers to the situation where multiple elements perform the same function (such as transformers servicing the same load) and refers to the utilisation with one element (such as a transformer) out of service. In determining utilisation there are variants in how both the load (the numerator) and the rating (the denominator) are measured. For example, in the case of the denominator, the rating may be the so called "nameplate" rating of a transformer. However, a transformer can have many ratings, as technical rating is dependent on such factors as:

- The peakiness of the load
- The ambient temperature
- The temperature history throughout the preceding day
- The history of loading of the transformer.

The "thermal" rating of an overhead line can be impacted by:

- The design clearances of the line
- Wind speed and direction
- Ambient temperature
- Solar radiation
- The condition of the conductor surface.

The allocation of a rating to a transmission line[7] (or substation) is a complex issue. From a **planning** perspective, the rating should be based on the conditions that can, with a degree of statistical rigour, be assumed to apply *ex-ante* under peak loading conditions. Thus it is common practice to allocate at least a summer and winter rating. From an **operational** perspective however, the rating can be dynamically set according to the conditions prevailing in real time. If the temperature is lower or the wind speed higher than used in the planning design, the rating will increase significantly. Depending on information available (such as temperature and wind speed) this can be readily applied to short lines, but becomes more challenging on long lines subject to weather variance. Notwithstanding, as a general principle, dynamic ratings will be higher than the planning rating which, by necessity, is conservative.

In addition, as well as "thermal" ratings, line ratings can be constrained by factors such as voltage drop and the impact on system stability. Short lines (say 80km) can be loaded at or close to their thermal rating. Longer lines can be limited by voltage stability and dynamic stability. Reactive power control for long lines adds to the cost of long distance electricity transmission. Simple "averages" provide no insight into these factors.

It is also possible to interchange impacts between the numerator and the denominator. For example, should the impact of allowing a higher load due to "dynamic rating" result in an

[7] A line often refers to a physical structure, which may have one or two individual circuits on it. For the purposes of this report, we use the term line to refer to a single circuit.

increase in utilisation against the "base rating", or result in a lower utilisation because of the allocation of a higher rating. Given the capital cost of assets is primarily driven by the base rating, and planning takes place on the basis of base rating, Evans & Peck is of the view that adoption of policies such as dynamic rating for operational purposes should reflect increased utilisation to the benefit of the TNSP (and therefore appear in the numerator). Whilst possible to take advantage of dynamic ratings in an operational sense, this may not always be achievable because "optimal" conditions are not guaranteed under extreme weather conditions.

Utilisation is also influenced by factors such as equipment standardisation and the point in history that equipment is in with respect to its design life. TNSPs have standardised on particular items of equipment as a matter of economic and operational prudence. For example, a TNSP may have settled on the use of 320MVA and 500MVA transformers at a particular voltage range. If a particular application requires a 350MVA transformer, it may be advantageous to install the standard 500MVA transformer at a relatively small incremental cost instead of purchasing a one-off 350 MVA unit: the use of a non-standard transformer would require a unique spares inventory, a non-standard maintenance regime, increased design costs, etc., which could cumulatively outweigh any capital cost savings from the use of a smaller transformer. The decision to install the standard (larger-than-needed) transformer may be easily economically justifiable, but such a transformer would have a lower utilisation than one selected purely on the basis of optimal rating. Similarly, new assets in a high growth environment would generally be expected to have spare capacity for future growth whereas mature assets in a low growth environment would be more likely to be reaching full load.

There is also ambiguity in how the load (numerator) is measured. Peak loading of a particular piece of equipment may occur in summer or winter, and is often heavily impacted by generation dispatch. It does not automatically follow that peak loading occurs on all equipment at the time of the annual system peak. Networks are planned around the utilisation of individual assets. Whilst cross optimisation between assets serving similar load transfers is possible, this is usually not the case. This impact is demonstrated in Figure 3.1.

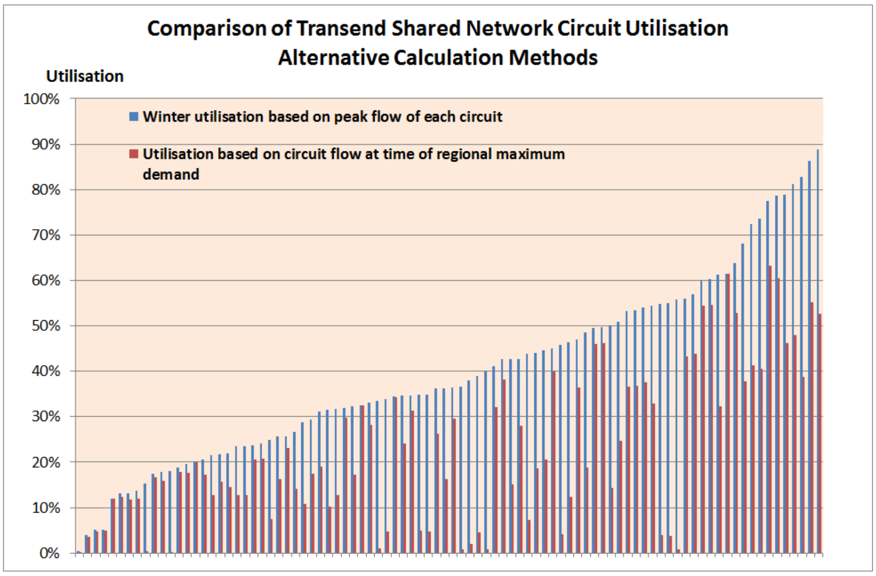


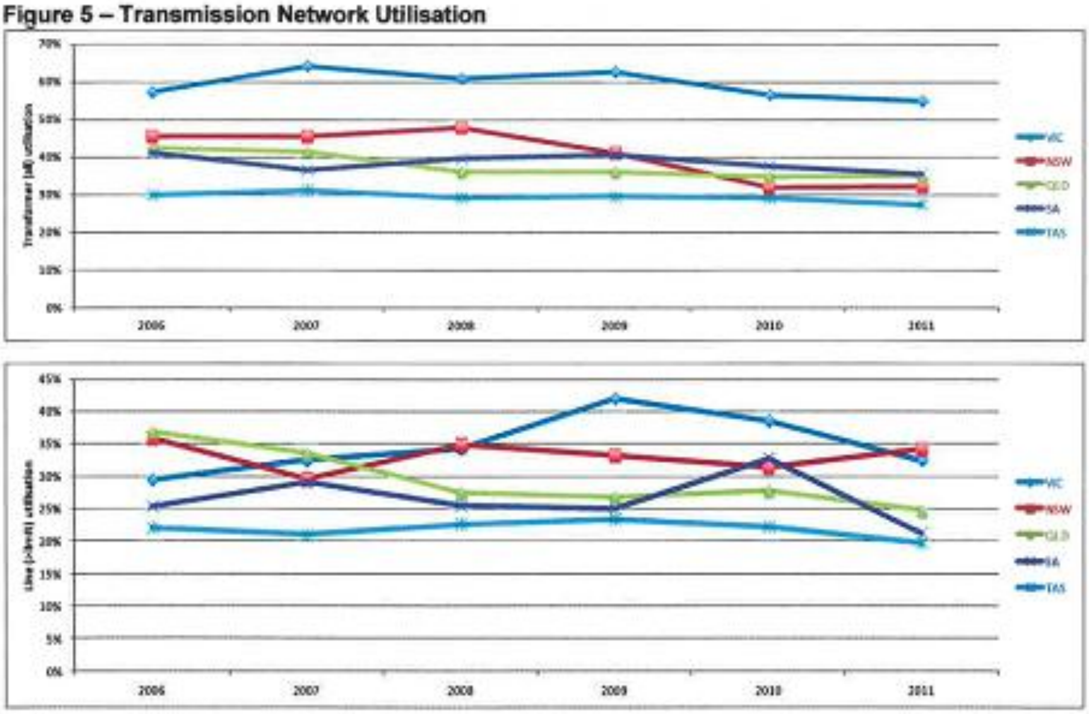
Figure 3.1 – "Non-Diversified" vs. "Snapshot" Demand Utilisation - Transend

Transend has compared the utilisation of its shared transmission circuits under both a peak (state) load snapshot and at the time of the individual winter peak on each circuit. The differences between utilisation calculated at individual circuit level during winter and that calculated at the winter maximum demand "snapshot" are extraordinary in this state, driven by dispatch patterns from generators (outside Transend's control). Under ideal generation / load matching in the north and south of the state, the main north-south transmission backbone may have virtually zero power flow. However, at other times this backbone is relied upon for the efficient transfer of power. Such effects may be less in Victoria, with relatively stable base load generation in the Latrobe Valley. However they are likely to be more pronounced in New South Wales and Queensland, which both have relatively more dispersed load and generation. It is far from logical to conclude the lines with low utilisation at the time of the peak "snapshot" have no purpose, as implied by AEMO's "average" measure.

As a consequence, "average" utilisation of a portfolio of assets is, in effect, a statistical outcome that arises from planning individual assets. By and large, it is a meaningless statistic. Notwithstanding, AEMO has chosen this statistic to justify its claim that:

"Figure 5 clearly indicates that Victoria has the greatest utilisation of their networks and efficiency in infrastructure provision" [8]

Figure 5 – Transmission Network Utilisation



Source: AEMO

Figure 3.2 – Extract from AEMO's Submission to the Productivity Commission

Evans & Peck has been engaged by Grid Australia to examine the validity of AEMO's analysis and its assertions in relation to superior planning outcomes. Our focus has been on the so called "shared network", the part of the network that AEMO is responsible for planning in Victoria.

[8] AEMO p14,15

Consistent with the approach outlined above, we have focussed on the utilisation of individual assets, recognising that the "average" value is simply a statistical derivation.

3.1 Shared Network Transmission Lines – "N" Utilisation

The primary source of information relating to utilisation of the Victorian shared network has been the *2012 Victorian Annual Planning Report – Electricity and Gas Transmission Planning for Victoria*[9] – Figures 2.3 to 2.7 inclusive. Figure 3.3 shows, in ascending order of utilisation, the utilisation of all 220kV and 500kV lines under a "summer snapshot". The high degree of variability in individual asset utilisation is readily observed, with an overall (unweighted) average of 33%.

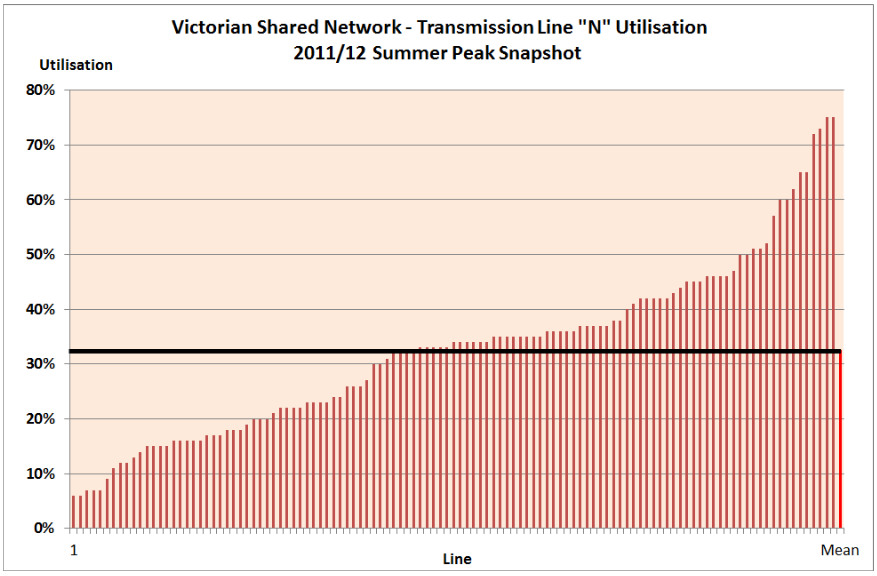


Figure 3.3 – Victorian Shared Network – Transmission Line "N" Utilisation

The three highest utilisation lines run between Yallourn (Latrobe Valley) and Rowville (Melbourne), a combination of corridors which includes:

- 4 x 220kV lines directly from Yallourn
- 2 additional 220kV lines from Hazelwood
- 2 additional 500 kV lines from Hazelwood, one of which is via Cranbourne
- An additional 500kV interconnection to South Morang, which in turn has two 500kV links to Hazelwood.

As a general principle, it is to be expected that corridors with a high number of parallel lines will have better "N" utilisation than those with low numbers of parallel lines. In the simplest "N-1" redundant design with two lines, the "N" utilisation should tend towards 50%, with three towards 66.7%, with four to 75% and so on. Thus the high end performance of the Yallourn – Rowville lines is not unexpected, but it does give rise to the need for caution in correlating "average" utilisation with planning prowess.

[9] http://www.aemo.com.au/en/Gas/Planning/~/media/Files/Other/planning/2012_Victorian_Annual_Planning_Report.ashx

This need for caution is further highlighted when AEMO's reported 2012 utilisations are compared with those reported for 2011. For 109 lines where direct comparisons can be made, the average utilisation only changed from 32.9% to 32.8%. Figure 3.4, however, shows the significant change in reported utilisation on individual lines. Given the geographical diversity in the changes in individual line utilisation, it is difficult to conclude anything other than the fact that the average utilisation has stayed virtually constant is a matter of luck rather than design.

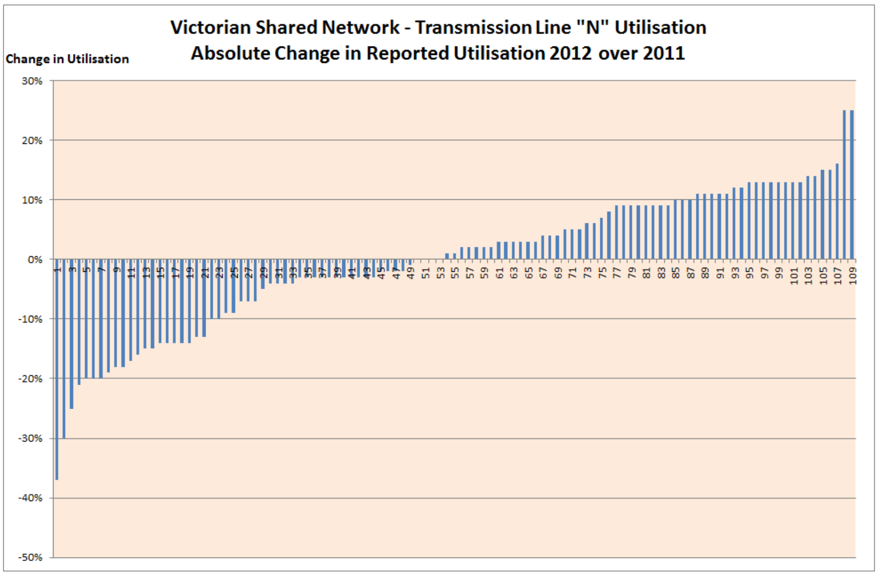


Figure 3.4 – Victorian Shared Network – Change in Line "N" Utilisation 2011 to 2012

As part of this review, ElectraNet has provided data on individual transmission lines considered part of the South Australian shared network. In this case, utilisation is based on the peak demand on individual lines over the summer of 2011/12 as a percentage of thermal rating, and is shown in Figure 3.5.

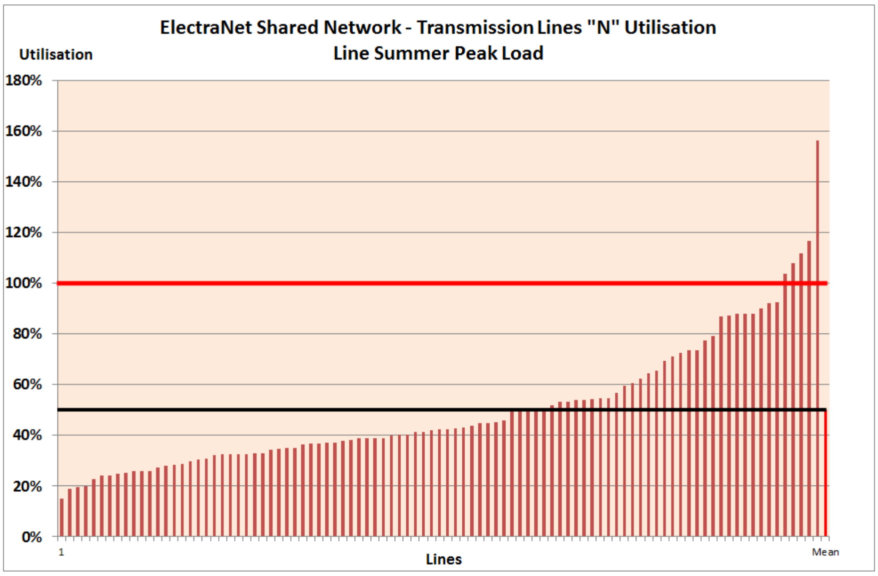


Figure 3.5 – South Australian Shared Network – Transmission Line "N" Utilisation Summer 2011/12

ElectraNet has applied non – diversified peak demand on individual circuits (rather than on a peak demand "snapshot"). Notwithstanding, Figure 3.5 has three differentiating characteristics:

- A much higher average utilisation than in the Victorian case (50% vs. 33%)
- An average well above that shown for South Australia in the AEMO extract shown in Figure 3.2. This is probably due to the use of individual circuit peaks, rather than the state peak snapshot.
- Individual lines having utilisations above 80% and even 100%. Operationally, these lines may be being managed through the use of dynamic ratings or automated control schemes, rather than from a planning perspective.

Queensland data is shown in Figure 3.6. In common with the Victorian approach, this is 2009/10 summer "snapshot" data. Again, the utilisation of individual lines shows a wide range – from virtually zero to approaching 80%. The overall average is slightly above 28%, consistent with but above the value reported by AEMO in Figure 3.2. Highlighting the deficiencies of the "snapshot" approach to the determination of utilisation (on which AEMO's argument is based), Powerlink's non-diversified average utilisation (calculated separately) is 57%, consistent with the variance observed by Transend.

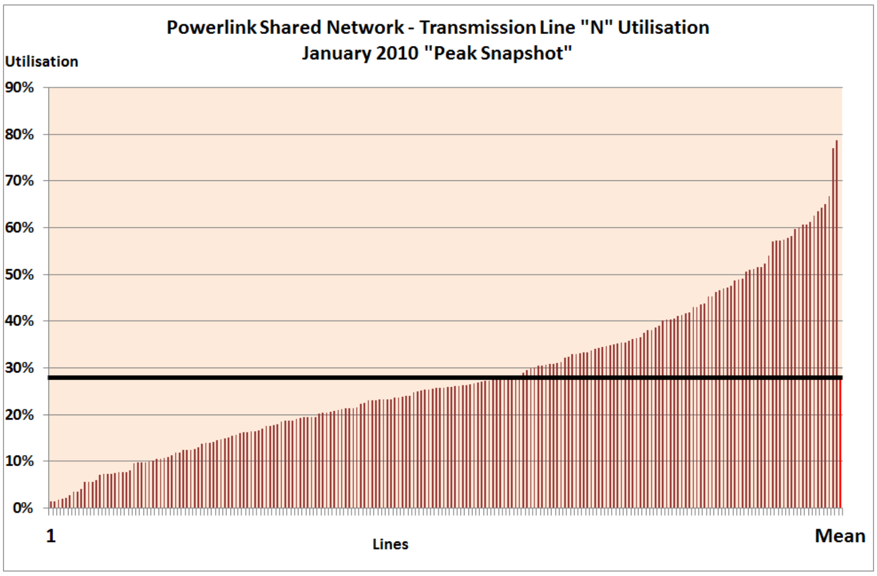


Figure 3.6 – Queensland Shared Network – Transmission Line "N" Utilisation – January 2010

A strong driver of Powerlink's lower overall utilisation is the high number of lines with very low utilisation. 35% of lines have utilisations of 20% or less; the average utilisation of these lines being 12%. The equivalent in Victoria is 27% with an average of 14%. Whilst beyond the scope of this study, the drivers of such low utilisation (such as generator dispatch patterns, geography, remote loads, historical factors and the like) need to be more fully understood before leaping to any conclusions regarding planning prowess.

Figure 3.7 shows the NSW Shared System Transmission "N" Utilisation. TransGrid has provided data on a "P10 temperature normalised[10]" basis using non-diversified peak line loadings. In addition to the wide range of individual line utilisations, this data shows an average utilisation of 40%, and a number of individual lines approaching 100%. It is expected that the P10 normalisation would increase loads by approximately 6%, and therefore add around 2.4% to the overall average utilisation when compared to the Victorian approach. With this adjustment, the average utilisation is consistent with the values shown in the AEMO extract in Figure 3.1. Over 29% of TranGrid's lines have an utilisation below 20%, averaging only 11%. At the other end of the spectrum, over 10% of lines have an "N" utilisation above 80%, with an average of 89%.

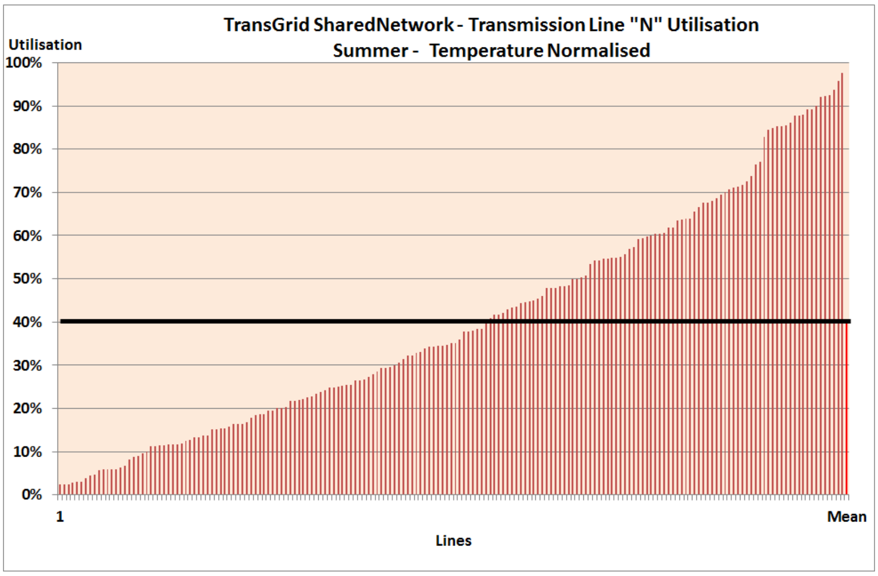


Figure 3.7 – NSW Shared Network – Transmission Line "N" Utilisation

Figure 3.8 shows shared network line utilisation in Tasmania based on non-diversified peak summer loads. Whilst Tasmania is a winter peaking system, line ratings are such than the overall average utilisation is higher in summer. This may not be true of every line, again highlighting the issues associated with average statistics. Average utilisation is 44%, well above the value shown in the AEMO extract in Figure 3.2, presumably due to the use of individual line peaks with a significant number of lines both below 20% and above 80% utilisation. Utilisations above 100% are possible due to the use of dynamic line ratings in Tasmania.

[10] For planning purposes, TransGrid check "N" utilisation by normalising actual loads to ""P10" summer conditions. Data has been provided on this basis. "P10" means the conditions, on average, will be equalled or exceeded 1 year in 10

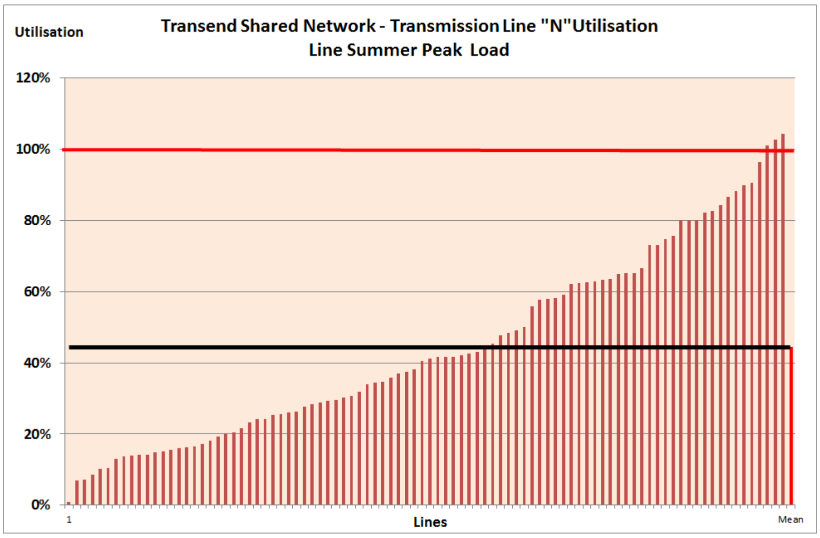


Figure 3.8 – Tasmanian Shared Network – Transmission Line "N" Utilisation

Based on this analysis, and despite the highly meshed nature of the Victorian shared 220kV / 500kV network, it is difficult to unambiguously conclude that AEMO demonstrates superior "planning" outcomes. Whilst differences exist in measurement methodologies, and if one accepts "average" utilisation as a meaningful measure (which we don't) a number of TNSPs appear to achieve significantly higher "N" utilisations in more challenging circumstances.

3.2 Shared Network Transmission Line – "N-1" Utilisation

Calculation of "N-1" utilisation in a meshed network is complex, necessitating extensive modelling in network simulation packages. Lines (and other equipment) are systematically taken out of service, and the load on remaining in service elements calculated. Whilst this is part of a normal ongoing planning process for all TNSPs, in the time available for this assignment we have not been able to collect a consolidated set of data for each of the states. However, such information is available in the AEMO Victorian Annual Planning Report.

Figure 3.9 graphically presents the reported[11] "N-1" utilisation for the Victorian Shared Transmission Lines.

[11] AEMO Victorian Annual Planning Report

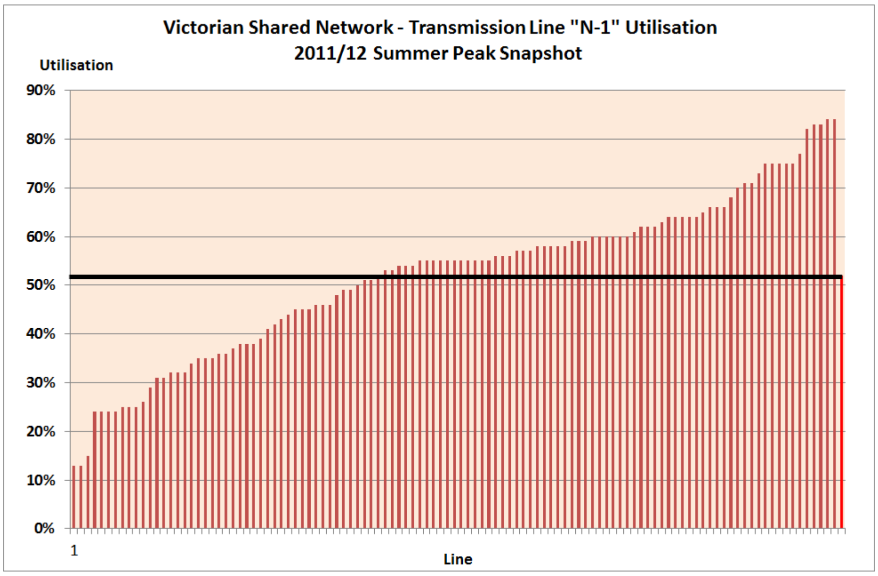


Figure 3.9 – Victorian Shared Network – Transmission Line "N-1" Utilisation

Inspection of Figure 3.9 shows that "N-1" utilisations currently peak at approximately 83%. On the basis that neither the "N" utilisation, nor the "N-1" utilisation of lines is exceeding, or even approaching 100%, Evans & Peck would notionally expect the need for lines augmentation in Victoria to be minimal.

Notwithstanding, we have reviewed the AEMO 2012 Victorian Annual Planning Report and tabulated lines projects that either have a current Regulatory Investment Test – Transmission (RIT-T) process underway or are listed as having a "Priority Assessment" in place. These projects are listed in Table 2.1 below.

Line	**2011/12 Reported Utilisation**		**2012/13 Projected Utilisation**		**Length (km)**	**Status**
	"N"	**"N-1"**	**"N"**	**"N-1"**		
East Rowville – Rowville	20%	51%	38%	109%	1.9	Current RIT-T
Ballarat - Bendigo	31%	60%	65%	142%	96	Current RIT-T
Ballarat - Moorabool	43%	66%	89%	162%	64	Current RIT-T
Geelong - Moorabool	32%	62%	N/A	N/A	7.1	Priority Assessment
Rowville - Springvale	42%	70%	63%	106%	15.5	Priority Assessment
Springvale - Heatherton	34%	63%	54%	96%		
Rowville - Malvern	32%	55%	59%	102%	14.6	Priority Assessment
Ringwood – Thomastown	23%	59%	38%	99%	24.5	Current RIT - T
Ringwood - Rowville	47%	55%	69%	99%	13.1	
South Morang - Thomastown	44%	55%	N/A	N/A	7.8	Priority Assessment
Average	**35%**	**60%**			**27.2**	

Our immediate observations are:

- The 2011/12 "N" utilisation for projects in the above categories is 35%, only 2% above the average for all lines
- The 2011/12 "N-1" utilisation for projects in the above categories is 60%, compared to the group average of 52%
- The average length of augmentation required is 27.2km
- The majority of projects are in the near vicinity of Rowville.

Evans & Peck is not in a position to dispute the need for any of these projects. On the contrary, work Evans & Peck has done on population change between the 2001 and 2011 ABS Census data indicates that some of the highest population increases in Victoria (up to 43%) occurred in local government areas within a 10km radius of Rowville – Cranbourne, and many of the above projects appear to be consistent with this development.

However, we make the following points:

- The above data confirms that historical "N" utilisation, and even "N-1" utilisation, is a poor indicator of the need for augmentation – it needs to be forward looking to address emerging demand hotspots. Yet AEMO has incorrectly used average utilisation as a prime indicator of planning and operational effectiveness.
- Given that all lines are reported in 2011/12 with an "N-1" utilisation well below 100%, the data does not provide empirical evidence supporting the argument that there has been widespread adoption of probabilistic planning in shared transmission lines in Victoria. Some operation above "N-1" values of 100% would confirm adoption of this approach.

3.3 Shared Network Substations – "N" Utilisation

As a prelude to this analysis, it is important to highlight that the shared substations in Victoria generally perform a different role to that of most "shared" substations in other jurisdictions. In Victoria, the majority of shared substations for which AEMO has planning responsibility either transform voltages from 220kV to 500kV, or from 500kV to 220kV. They are then paired with a 500kV line to perform a line function similar to that of a 220kV line – albeit at a higher voltage and power transfer capability. Substations in other jurisdictions are more akin to performing the role of a "Terminal Substation", transforming from the transmission line voltage to a sub-transmission voltage. The Victorian arrangement is shown in Figure 3.10. At the outset, this brings into question the validity of benchmarking substation utilisation as a determinant of planning effectiveness.

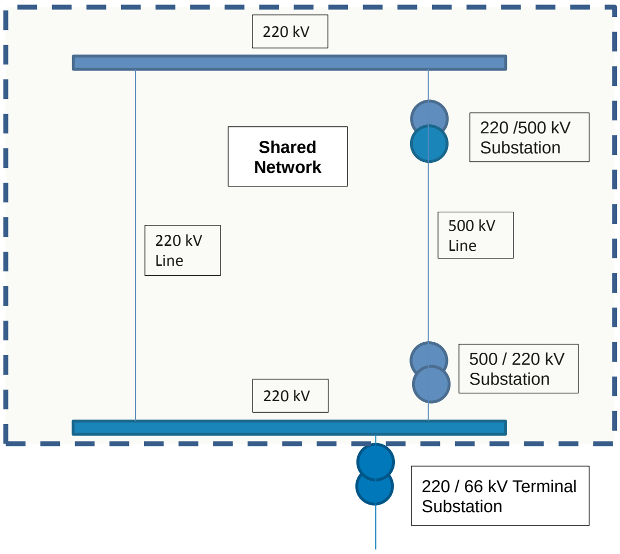


Figure 3.10 – Role of Victorian Shared Substations

Notwithstanding the above caveat, Evans & Peck has sought to compare substation transformer utilisation. The historical design of substations in relation to the number of transformer at the substation does have an impact on optimal "N" utilisation. In the absence of interconnection[12], and with a general "N-1" philosophy in place, a two transformer substation is expected to have an optimal utilisation of around 50% or above if cyclic rating is taken into account. For three transformers, this increases to 66.7% and so on, as shown graphically in Figure 3.11.

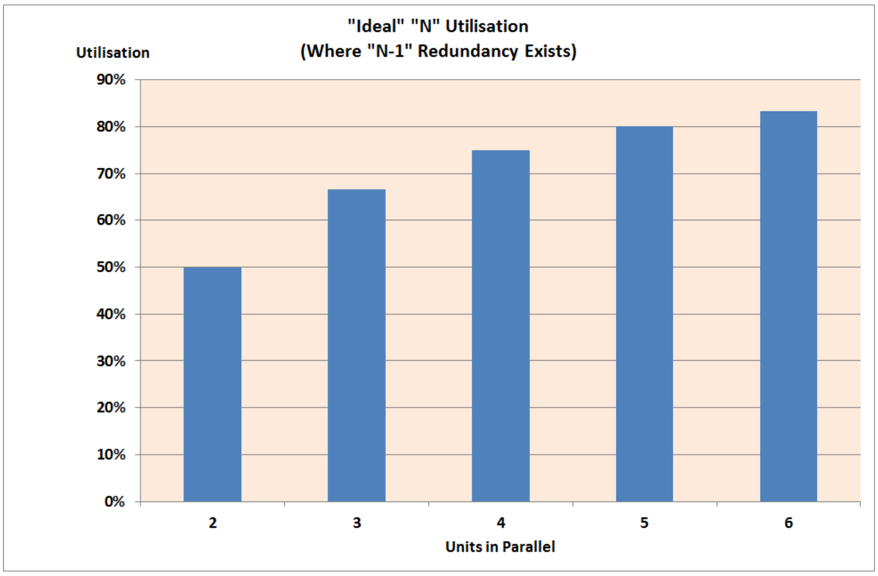


Figure 3.11 Nominal Optimal "N" utilisation

Evans & Peck reviewed the expected "optimal" "N" utilisation for each state in the context of the number of transformers in its fleet of shared substations. The results are shown in Figure 3.12.

[12] That is, a line connection to a neighbouring substation at the outgoing voltage. For example, a two transformer substation stepping down from 275kV to 132kV, if interconnected, would be able to draw on capacity from another substation if an interconnecting line was in place.

Two transformer designs predominate in South Australia, resulting in the lowest expected "N" utilisation at 50%. Victoria, on the other hand, has the highest proportion of three and four transformer designs, resulting in a notional target "N" utilisation of just under 60%. The other states fall between these two extremes. These target levels would increase if there is significant interconnection with other substations on the load side of the transformers. This effect has not been analysed.

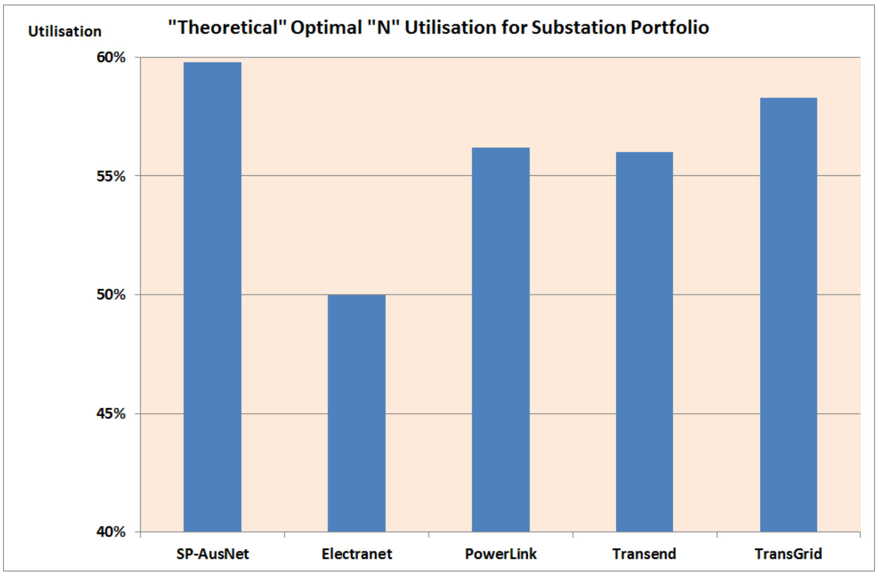


Figure 3.12 Substations –Optimal "N" transformer utilisation

Consistent with the approach taken for lines, we have sought to compare the "N" utilisations of the transformers in shared substations in each of the five jurisdictions. Victorian results are shown in Figure 3.13.

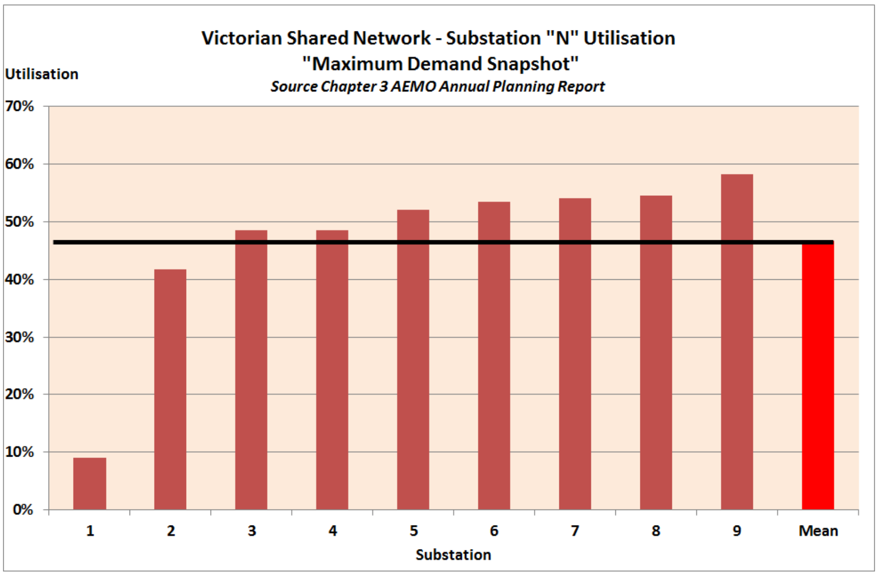


Figure 3.13 Victorian Shared Network – Substation "N" Utilisation

Figure 3.13 shows an average substation utilisation, under "Summer Peak Demand" snapshot conditions of 47%. This is lower than the 50% calculated if transformer utilisation alone is considered, and significantly lower than the circa 55% shown in Figure 3.1 for Victoria for 2011. These differences are largely attributable to the impact that the transformers associated with the highly meshed Hazelwood – Rowville system have. It is also of interest to note, with one exception, the relative uniformity in utilisation. This exception relates to a single 500/330kV transformer at South Morang. This substation also includes two 330/220kV transformers which we have treated separately.

ElectraNet's average utilisation, as shown in Figure 3.14, is 41%. In common with the data provided on lines, this data is based on non-diversified summer peak demands. Given the lower expected utilisation based on the number of transformers in substations, the utilisation in South Australia is superior to that in Victoria. There is also a more diverse range of outcomes.

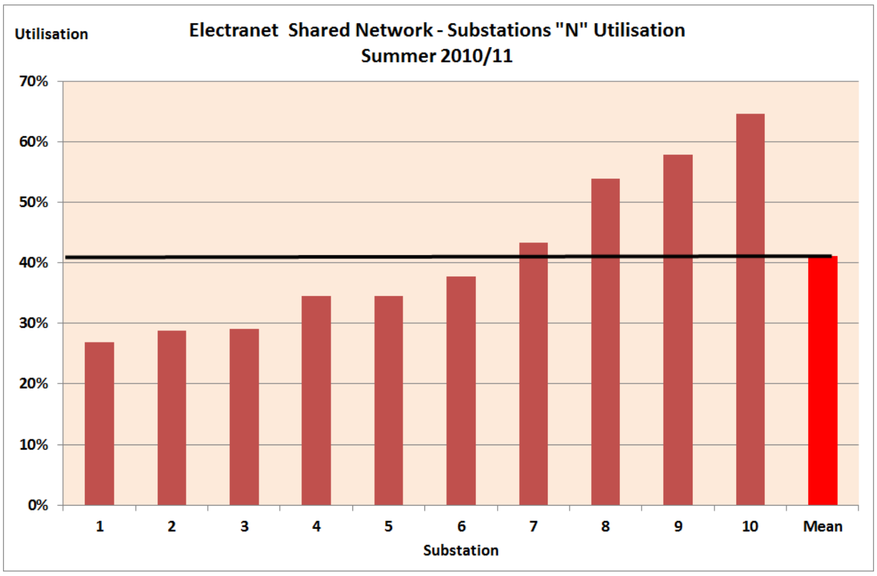


Figure 3.14 – South Australia Shared Network – Substation "N" Utilisation

This diversification of utilisation increases significantly in Powerlink's case. Figure 3.15 shows that, in addition to having nearly 4 times the number of "shared" substations[13], close to 30% of Powerlink's substations have an "N" utilisation under snapshot conditions of less than 20%. This results in an overall average of 36%, nearly 50% above the individual transformer value reported by AEMO in Figure 3.2. In the absence of a complete set of comparative data used by AEMO, we have not yet reconciled this difference.

[13] This is not all of Powerlink's substations – those having a connection function have not been included.

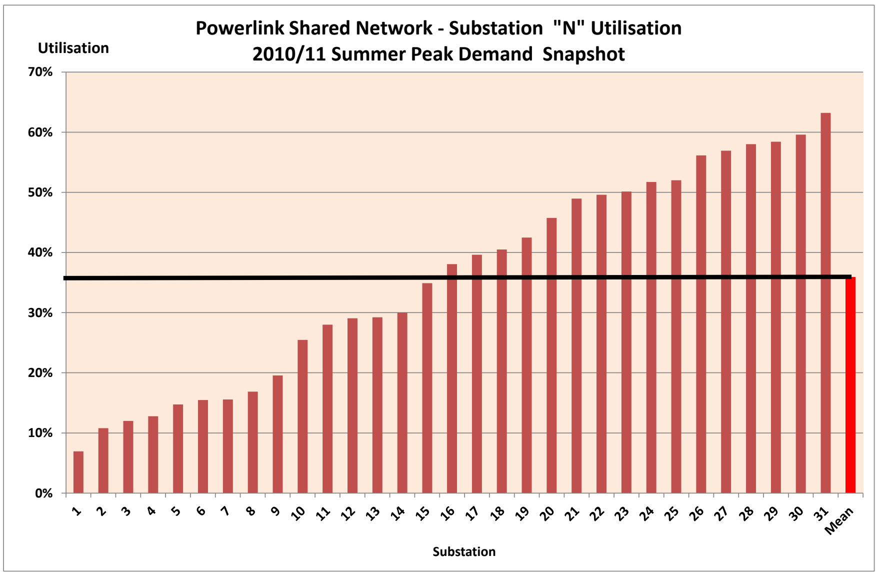


Figure 3.15 – Queensland Shared Network – Substation "N" Utilisation (Summer Snapshot)

This diversity of outcomes again highlights the danger of comparing average statistics in fundamentally different systems. In drawing conclusions on planning effectiveness, each situation needs to be considered individually. At the heart of this issue is the fact that not all networks are as meshed or compact as the Victorian network, with highly consistent generation flows from a single region.

Based on nameplate rating, and non-diversified peak demands, Transend's summer data (Figure 3.16) shows a substation "N" utilisation of 33%. This increases to 39% in winter. Both are significantly above the circa 26% reported at a transformer level by AEMO in Figure 3.2, presumably due to the use of non-diversified demand as a measure.

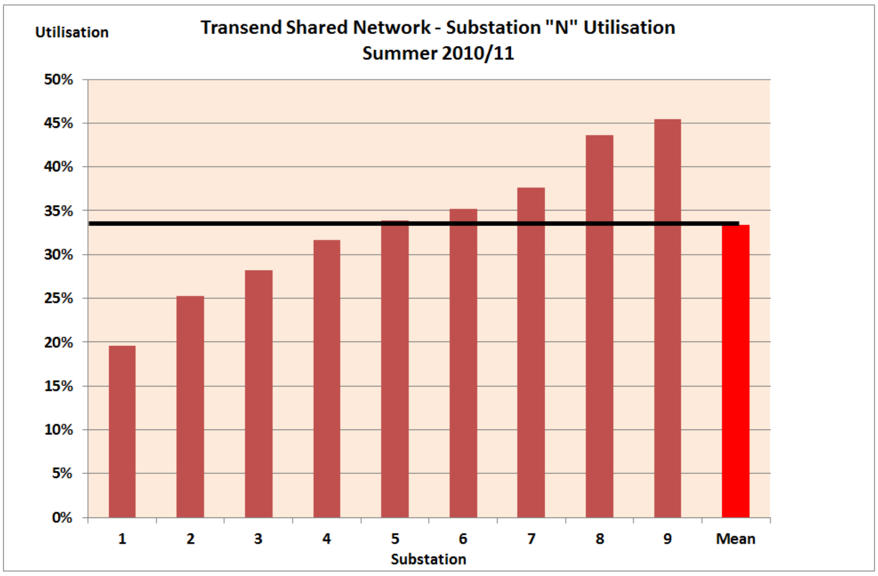


Figure 3.16 – Tasmania Shared Network – Substation "N" Utilisation – Summer

The diversity in individual substation outcomes is again highlighted in TransGrid's data shown in Figure 3.17.

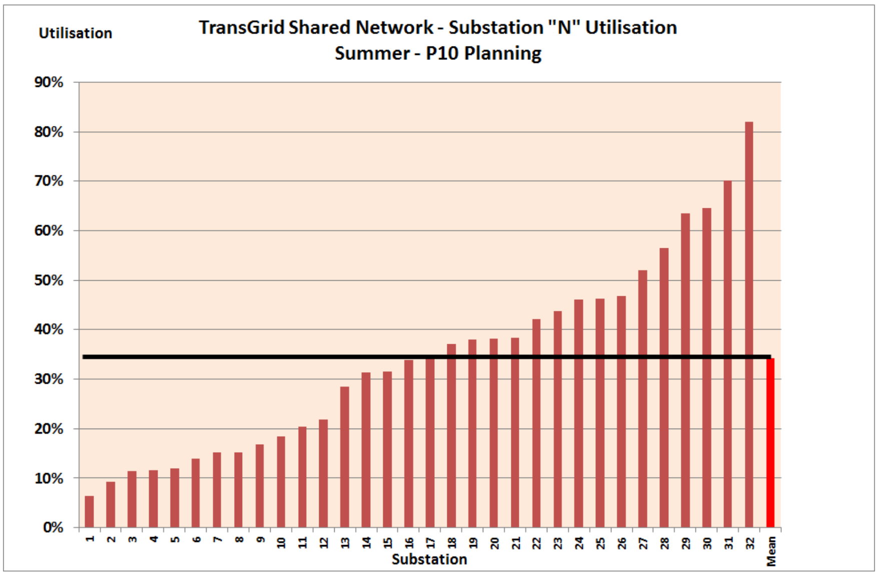


Figure 3.17 – New South Wales Shared Network – Substation "N" Utilisation

In common with Powerlink, TransGrid has nearly four times the number of "shared" substations as the Victorian shared network, and around 30% of substations have an utilisation of 20% or less, resulting in an average summer planning utilisation of 34%. This is consistent with the transformer value shown by AEMO in Figure 3.2.

Implicit in the use of average utilisation as a measure is the assumption that TNSPs can transfer capacity between highly utilised substations and those that are under-utilised. As a general rule, this is impractical. That said, whilst again subject to data and measurement differences, AEMO achieves a higher substation "N" utilisation than its peers. However, the Victorian shared network is atypical compared to the other major networks in that:

- Substation size is very large, with an average of 1,500 MVA, 50% larger than TransGrid, twice Powerlink and six times that of ElectraNet.
- It only consists of only eight or nine substations (depending on whether South Morang is treated as one or two).
- The primary voltage at seven of the substations is 500kV. The primary purpose of the substations is to transfer load into or out of the 500kV network running in parallel with the 220kV network. They essentially perform a transmission line function which is very different from the function performed by shared network substations in the other NEM jurisdictions.

In the context of these differences, the conclusion that average utilisation (as claimed by AEMO) is a meaningful indicator of planning superiority seems, in Evans & Peck's opinion, a rather large leap of faith.

3.4 Shared Substations – "N-1" Utilisation

In a radial system, comparison of substation utilisation on an N-1 basis is a relatively simple matter. With little or no meshing on the output side of the substation, the numerator (load) remains the same as in the "N" case, and the denominator (rating) reduces to the extent of one transformer. Where extensive meshing occurs it is again necessary to use network modelling software to determine the worst case utilisation with one transformer out of service. AEMO has completed this analysis for the Victorian shared network "summer snapshot" in the 2012 Victorian Annual Planning Report. The results are shown in Figure 3.18

Average N-1 utilisation is shown at 57%, with a range from 20% to 86%. The 20% value again relates to the South Morang 500/330 kV substation where there is a mixture of transformer voltages. All other substations exceed 45%. The fact that average "N" utilisation only increases from 47% to 57% under "N-1" conditions is indicative of a highly meshed network. In essence, when a transformer is out of service, the load is shared not only between the remaining transformers but also the parallel 220kV network. A further refinement made by AEMO is to allocate an "emergency" rating to some transformers under "N-1" conditions. Discussions with SP AusNet have indicated that this rating is typically 5 – 10% higher than the "nameplate" rating used for "N" calculations. Thus, on a nameplate basis, AEMO's average utilisation is likely to be of the order of 61%, again highlighting the complexity of what may appear to be a relatively simple average comparison.

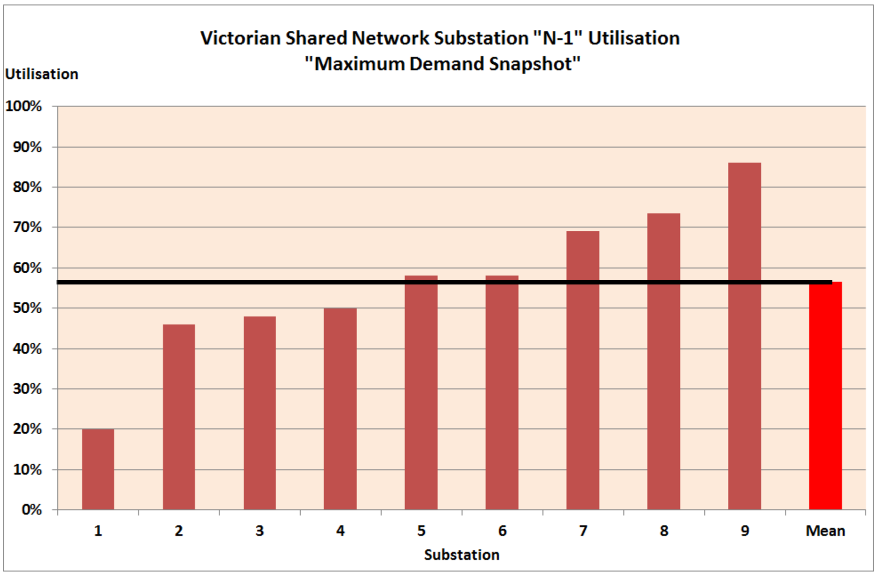


Figure 3.18– Victorian Shared Network – Substation Integrated "N-1" Utilisation

In the time available, we have not been able to collate similar results for all TNSPs - such analysis forms part of an annual planning process upon which individual asset investment decisions are made. What is not immediately evident from Figure 3.18 however, is the impact probabilistic planning currently has in the Victorian shared network. AEMO has progressed the requirement for additional transformer capacity at Cranbourne to RIT-T status, yet only shows an "N-1" utilisation of 50% on the existing transformer in the Annual Planning Report. Evans & Peck does not dispute this need, but again highlights the disjoint between utilisation, average utilisation in particular, and planning efficiency.

3.5 Conclusions – Utilisation

Throughout this analysis, we have encountered a number of issues that highlight how different the Victorian shared network is from that of the other states, particularly in relation to the functionality of the substations under AEMO's planning responsibility. In essence, the 500kV substation / 500kV line combination provides a backbone to the 220kV grid. It serves loads indirectly.

Investment decisions generally focus on four measures;

- Line "N" utilisation
- Line "N-1" utilisation
- Substation "N" utilisation
- Substation "N-1" utilisation.

Calculation of "N-1" utilisation necessitates extensive system modelling which has not been completed as part of this assignment. This limits our ability to compare substations on an "N-1" basis. However, what is clear to us, in networks with such different functionalities, is that the use of simple average utilisation is not a reliable basis of determination of planning effectiveness.

AEMO's comparisons, and by necessity our own, largely rely on comparisons of "N" utilisation. This will always favour a network where there are large numbers of parallel connections. Planning is not about managing averages, it is about managing all lines and installations. The average is a statistical outcome.

Notwithstanding all of these caveats, and acknowledging differences in the basis of data collection between the TNSPs, our analysis suggests that it is not as clear cut as AEMO may suggest that the Victorian shared network is best in group performer in relation to utilisation. This is demonstrated in Figure 3.19.

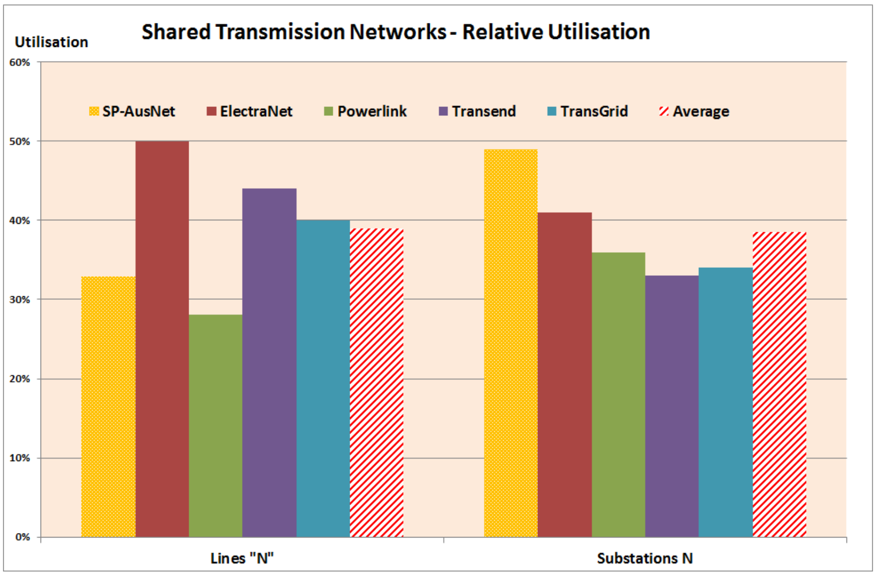


Figure 3.19– Comparative "N" Utilisation – Shared Networks

All factors taken into account, we have concluded that AEMO's assertion that:

> *"Figure 5 clearly indicates that Victoria has the greatest utilisation of their networks and efficiency in infrastructure provision"* [14]

is an extraordinary and unjustified leap in logic.

[14] AEMO p14,15

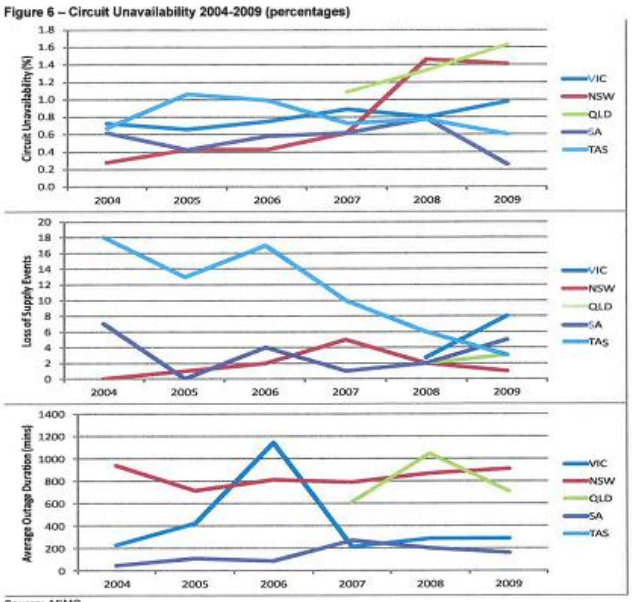
4 Reliability – Loss of Load Events

Supporting claims relating to higher utilisation, AEMO has made the statement:

> *"The higher network utilisation has not come at the cost of network reliability as demonstrated in Figure 6 [*Figure 4.1*] below"*

As shown in Figure 4.1, AEMO has chosen 3 measures on which to base this claim:

- Circuit Availability
- Loss of Supply events
- Average Outage Duration



Source: AEMO

Figure 4.1– Extract from AEMO Submission – Basis of Claim for Reliability Performance

In addition to a concern that the data is incomplete, Evans & Peck challenges these parameters as a meaningful measure of reliability. Circuit un-availability usually does not result in an outage to customers, particularly where parallel supplies exist. Use of circuit availability as a measure, can impede decisions to take lines out of service for maintenance and become dysfunctional. The "loss of supply event" measure is more customer focused, but provides no information on the extent of such events. AEMO has only provided two years of data for Victoria and Queensland. Similarly, average outage duration is a more customer focussed measure, but provides little insight as to the number and scale of customers impacted by the outage.

In Evans & Peck's view and from a customer perspective, an integrated set of measures should take into account:

- The number of outages (included above – in part)

- The customer impact of outages, integrating the number, length and size of outages in terms of load lost, normalised to reflect the relative electrical size of the network. The common measure is System Minutes Lost[15].

4.1 Number of Outages

The five TNSPs have provided data on the number of outages (resulting in supply loss) over a ten year period. There is a slight mismatch between Calendar Year data, and Financial Year Data, but this does not materially impact the analysis. Figure 4.2 graphically demonstrates the number of outages for all voltages in each "shared" network over the period 2002/3 to 2011/12 or 2002 to 2011.

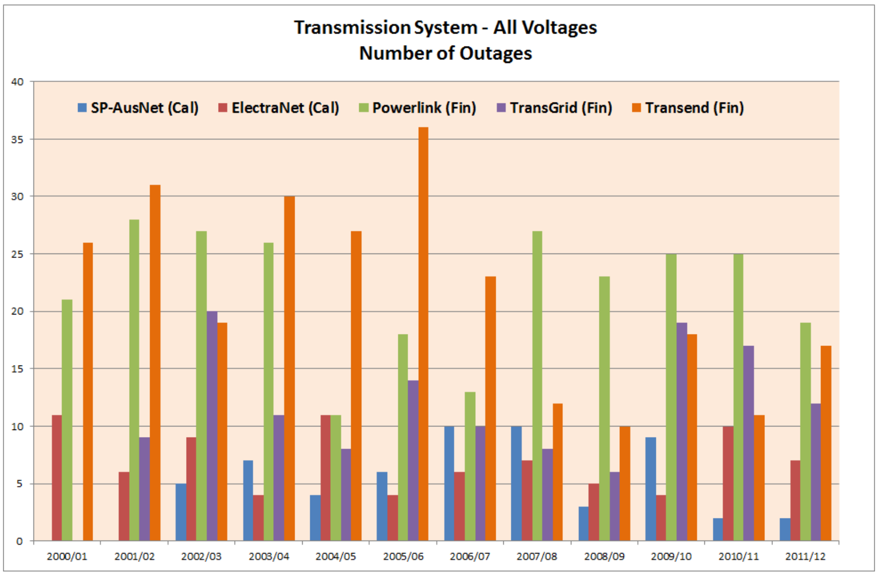


Figure 4.2– Number of Outages over Last 10 Years – All Transmission Voltages

Based on this measure alone, the Victorian network performs significantly better than the Queensland and Tasmanian networks in particular. However, throughout this report we have highlighted that the networks are very different. This difference is brought into focus if the same measure is calculated only for the 220kV and above network (for which AEMO has planning responsibility in Victoria). This is shown in Figure 4.3.

[15] If all a TNSP's load was lost for 1 minute, the System Minutes Lost would be 1. If 10% of the load was lost for 10 minutes, this would also be 1 System Minute.

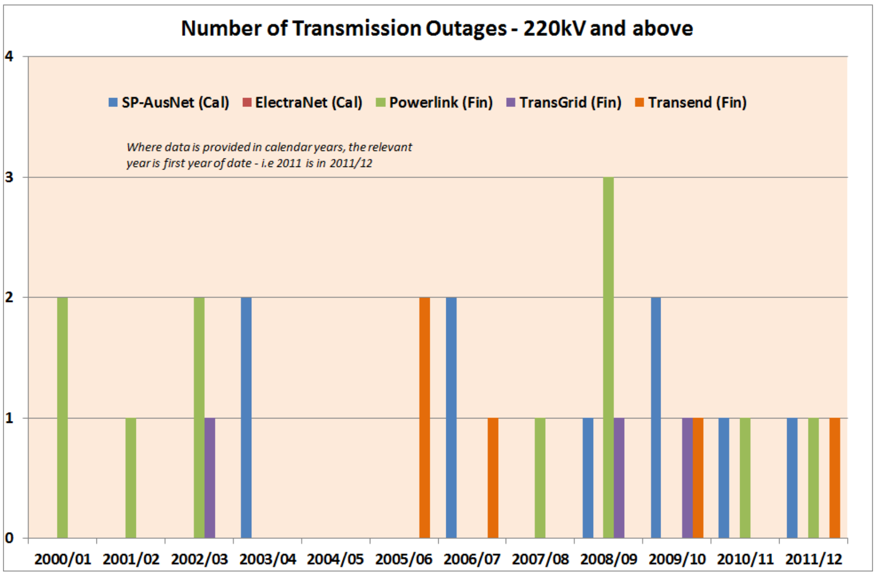


Figure 4.3– Number of Outages over Last 10 Years – 220kV and Above

Figure 4.3 highlights how few outages there are on the higher voltage networks, even over a ten year period. Across five TNSPs, there have been twenty-five outages – meaning an average of one outage in each TNSP every two years. What is less clear from Figure 4.3 is whether or not the Victorian system has performed better than that of the other states. Table 4.1 shows the cumulative total of outages over the 10 year period for "All Voltages" and "Voltages Above 220kV" for each TNSP.

State	Cumulative Outages All Voltages	Cumulative Outages 220kV and Above
Victoria	58	9
South Australia	67	0
Queensland	214	8
Tasmania	203	3
New South Wales	125	5

Table 4.1 – Cumulative Number of Loss of Supply Events – Last 10 Years

Table 4.1 highlights how few events occur in the higher voltage parts of the network. There are only twenty-five events across five TNSPs over a ten year period – on average one event in each TNSP every two years.

4.2 System Minutes Lost

Our second measure is System Minutes Lost. This is a normalised measure taking into account number, length and size of outages. Figure 4.4 shows the resultant values for each of the systems.

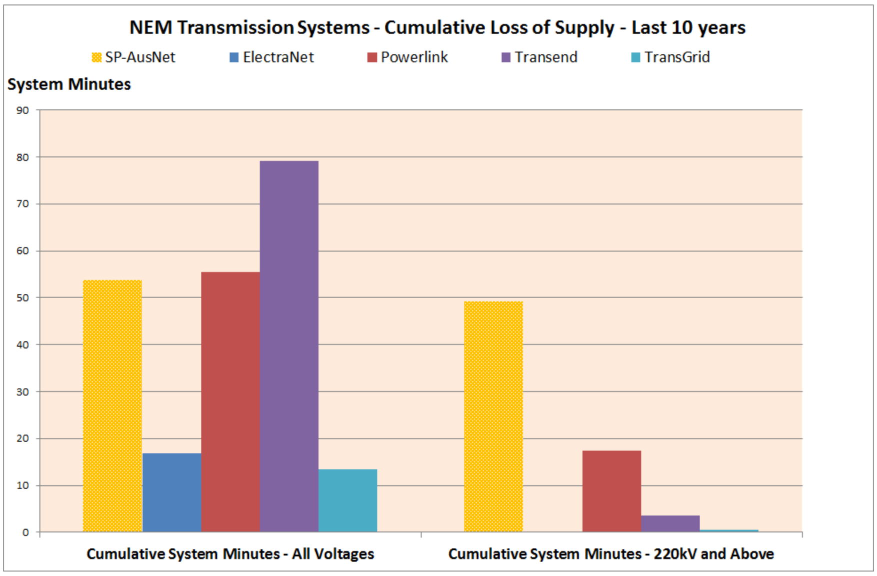


Figure 4.4– Cumulative System Minutes Lost – Last 10 Years

Normalisation based on system minutes does not account for the many other factors that impact reliability. These include factors such as line design, levels of redundancy, topography, weather, line length, lightning and other environmental activities. In addition to the impact on outage frequency, these factors can also impact response time and thereby System Minutes Lost.

4.3 Overall Conclusion – Reliability

The most balanced measure of reliability is System Minutes Lost. When all voltages are considered, Victorian performance is relatively consistent with its peers.

Our focus has been on AEMO's claim that:

> *"The higher network utilisation has not come at the cost of network reliability as demonstrated in Figure 6 (*Figure 4.1*) below"*

Statistically, the Victorian shared network performance is dominated by one outage event at South Morang in 2009. A 500kV capacitive voltage transformer failed, resulting in a large loss of supply. Such low likelihood-, high impact events are an inherent characteristic of major transmission networks. Under these circumstances, Evans & Peck concludes it is unwise for any TNSP to draw a strong linkage between planning proficiency and historical reliability, as AEMO has done.

5 Probabilistic Planning

In its submission to the Productivity Commission, AEMO has made the following assertion[16]:

> Probabilistic planning can be rolled out across the NEM and arguably deliver more benefits in states like Queensland, which have flatter load duration curves, than in states such as Victoria and South Australia which have shorter peaks.

Grid Australia has sought Evans & Peck's views on the validity of this argument. There are two assertions inherent in this statement:

- States like Queensland have flatter load duration curves
- Probabilistic planning can arguably deliver more benefits in states that have flatter load profiles.

Evans and Peck concur with the first assertion. Figure 5.1 shows the load duration curve for each jurisdiction for Calendar year 2011/12. In preparing this curve we have removed the effect of the Aluminium smelter loads in order to provide a representation of the "native" load where probabilistic planning is of relevance.

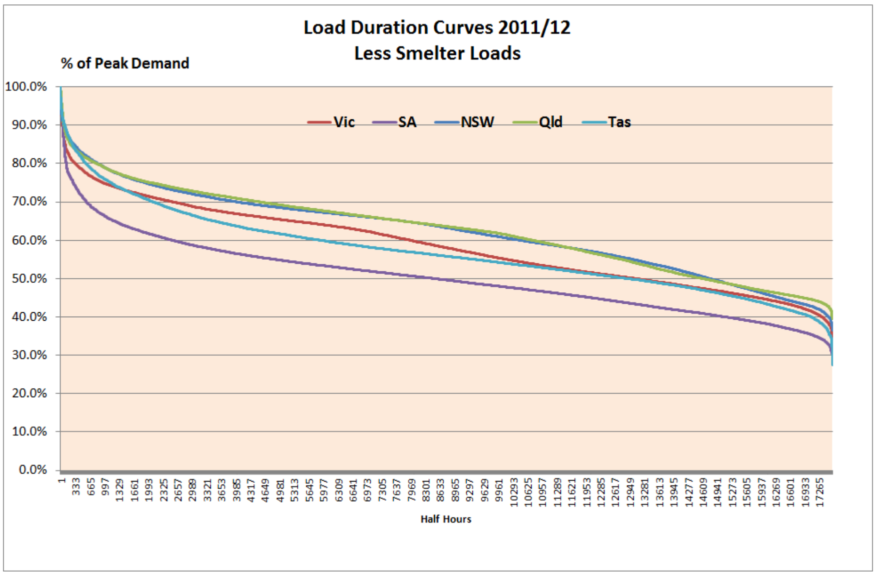


Figure 5.1 – Load Duration Curve – NEM Jurisdictions 2011/12

We do not agree with the second assertion – that probabilistic planning can arguably deliver more benefits in states that have flatter load profiles. Figure 5.2 amplifies the load duration curves at high loads. We have shown the loads above 90.9% (i.e. 1 /1.1) and expressed this as an "overload" between 0 and 10%. In reality, few loads will have exactly the same load duration curve as the state as a whole. Some will be peakier, some will be flatter. Planning is

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done at a load specific level. Notwithstanding, we have used the state profiles to illustrate our points regarding load shape.

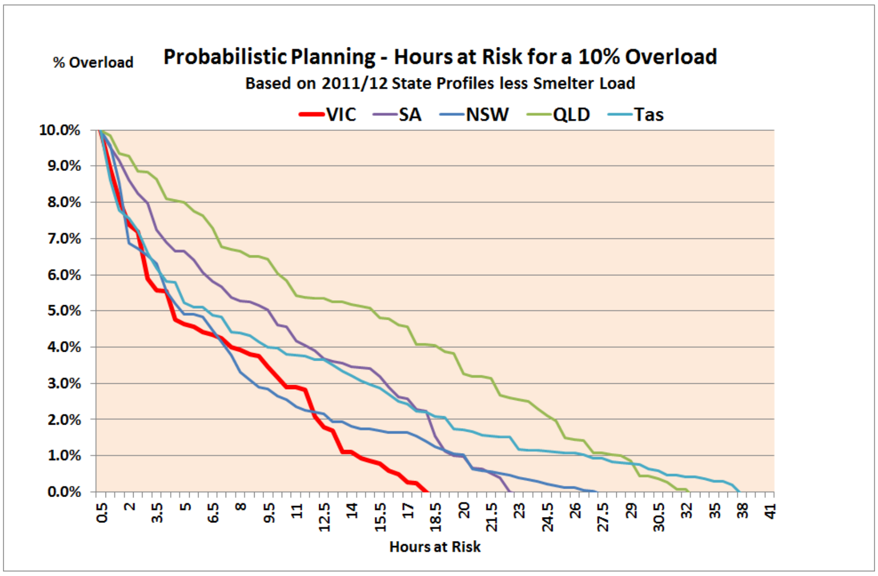

Figure 5.2 – Load Duration Curve Top 10% of Load – NEM Jurisdictions 2011/12

With a 10% overload, load would be at risk in each state as follows:

- Victoria 18 hours
- South Australia 22.5 hours
- NSW 27 hours
- Queensland 32 hours
- Tasmania 37 hours.

The energy lost during an outage at this level of overload is shown in Figure 5.3.

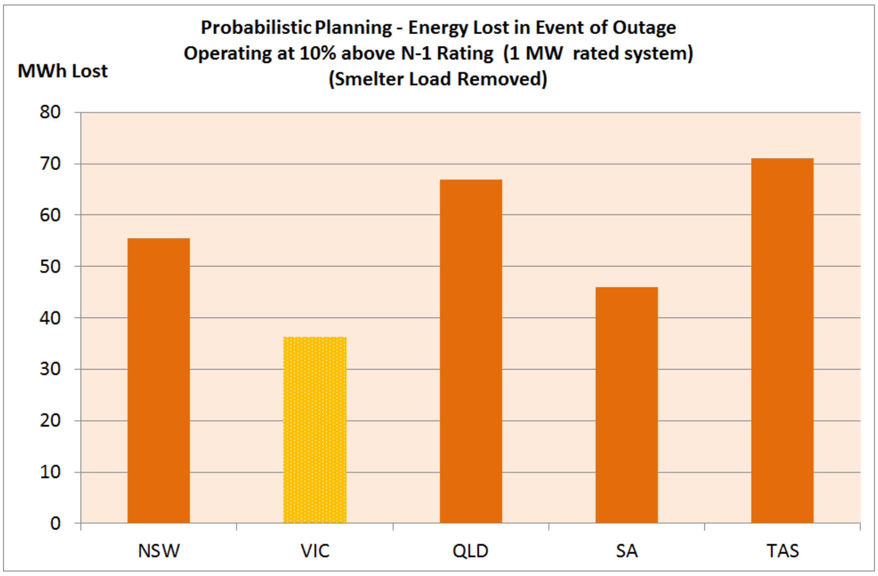

Figure 5.3 – Unserved Energy – Loss of Load Where 10% Overload Applies

For the same level of overload, Victorian customers would suffer the least unserved energy, then South Australia, New South Wales, Queensland and Tasmania. Put simply, the methodology works best in Victoria.

Evans & Peck is not arguing against the adoption of probabilistic planning principles in certain situations - in fact we were the technical advisors to the ENCAP review cited by AEMO[17] that recognised the need for greater application of the methodology in Queensland. There is a place for both probabilistic and deterministic planning. However, we are strongly of the view that AEMO has an error of fact in the second of the above assertions.

[17] AEMO Submission Page 17

6 Linkage between RAB and Maximum Demand Growth

AEMO has drawn conclusions on planning efficiency from the link between growth in the Regulatory Asset Base (RAB) and the growth in Annual Maximum Demand. AEMO has presented a number of graphs such as that shown in Figure 6.1 (AEMO Figures 3 and 11).

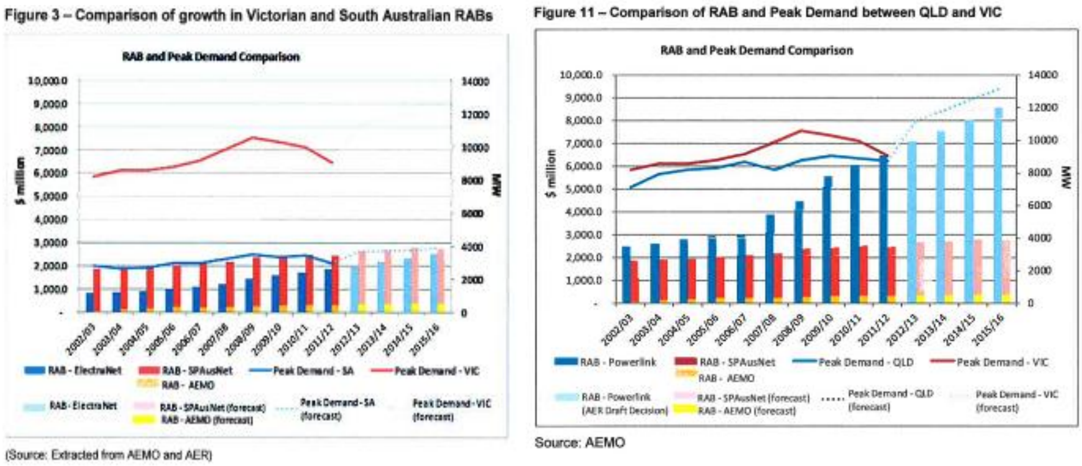

Figure 6.1 – AEMO's Linkage between RAB Changes and Peak Demand

Under the Victorian model, AEMO procures the ownership of augmentation projects competitively sourced. Projects are issued to the market, and the winning bid is selected on the basis of the annual cost stream offered to AEMO. Most, but not all, of these projects have been awarded to SP AusNet. They subsequently appear in AEMO's accounts as an annual cost stream, rather than a capital item. Two cost items appear in AEMO's accounts:

- Committed Augmentation Charges
- Planned Augmentation Charges

However, the capital associated with these projects does not formally appear in the winning bidder's RAB – they are un-regulated assets once awarded.

Examination of the AER's *Final Decision – Victorian Networks Corporation (VENCorp) transmission determination 2008-09 to 2013-14 (April 2008)* identifies the following[18]:

- Planned Augmentation Charges of $47.45 million (nominal) over the 6 year period
- Committed augmentation charges of $125.16 million over the 6 year period.

The planned charges appear to correspond to an augmentation capital of $200.78 million[19] for the period. Overall, the Planned Augmentation and Committed Augmentation Charges reach $36.25 million nominal by 2013/14. In round terms, this is likely to underpin an augmentation capital expenditure of around $350 million since the initial ACCC VENCorp determination at the

[18] Table 1, page 8
[19] Final Decision - Page 6

commencement of 2003. It is not clear whether these augmentation projects were delivered as forecast, or if this is the AEMO "RAB" that has been charted in Figure 6.1.

Notwithstanding these uncertainties, Evans & Peck accepts that augmentation capital has been relatively low in Victoria. The leap in logic is that this is due to AEMO's planning prowess.

At the highest level, it must be recognised that augmentation, and augmentation of the shared network in particular, is not the only cause of changes in the RAB. Capital expenditure, a major input to the RAB change, occurs for many reasons. Figures 6.2 (Powerlink) and 6.3 (ElectraNet) show half of Powerlink's expenditure and 56% of ElectraNet's expenditure over the past 5 years has been on non-augmentation related projects and programs. In addition, not all augmentation is associated with the shared network. It is unlikely that AEMO would have sufficient granularity in its information on all TNSPs to be able to complete a like for like comparison solely on shared network augmentation. Certainly Evans & Peck is not in a position to do so.

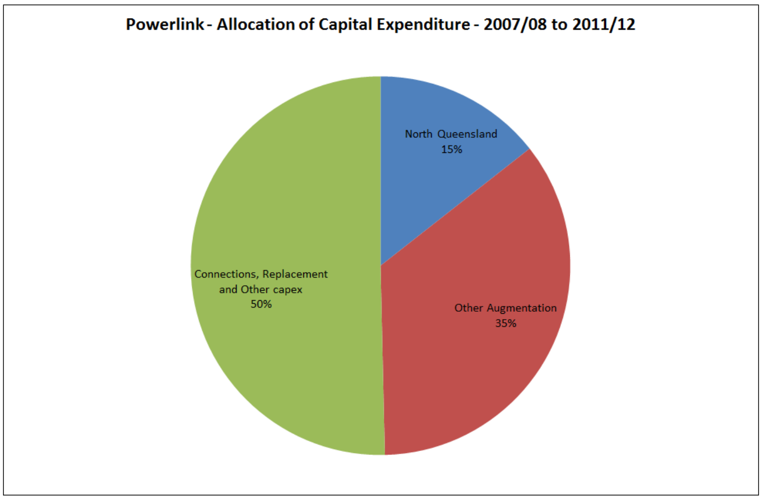

Figure 6.2– Allocation of CAPEX – Powerlink 2007/08 to 2011/12

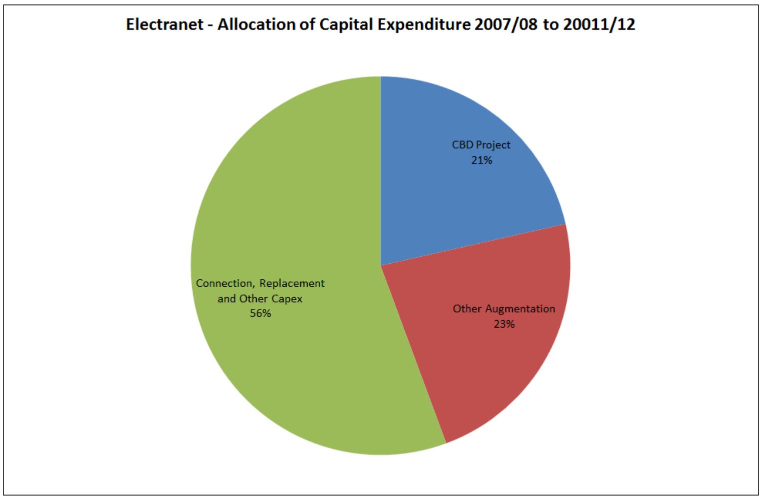

Figure 6.3– Allocation of CAPEX – ElectraNet 2007/08 to 2011/12

When considering the augmentation spend, it is critical to understand where growth has occurred in each state. Figure 6.4, extracted directly from the ABS[20] comparison of 2011 Census data with the equivalent 2001 Census data, provides insight into differing drivers of augmentation in each of the states over the last decade.

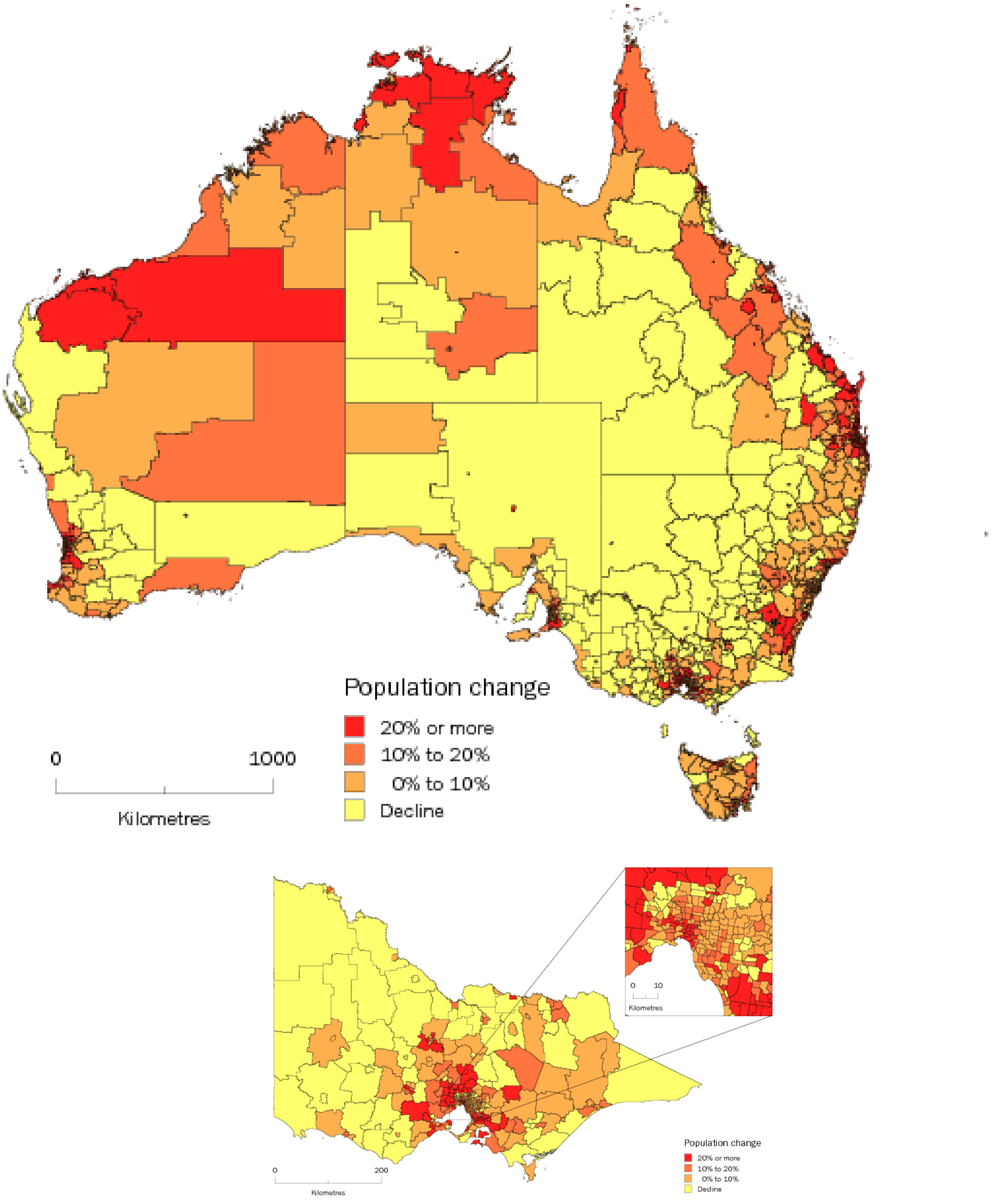

Figure 6.4– Population Growth Patterns Australia – 2001 to 2011 (Source ABS)

Whereas only 13% of population growth in Victoria occurred outside of the major cities, in Queensland's case 32% of growth occurred outside the major cities. The graphic also highlights growth around Melbourne. The relationship between electrical infrastructure and this growth is highlighted in Figure 6.5 which overlays the major transmission corridors.

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[20] Australian Bureau of Statistics Cat 3218.0 – Regional Population Growth, Australia, 2011.

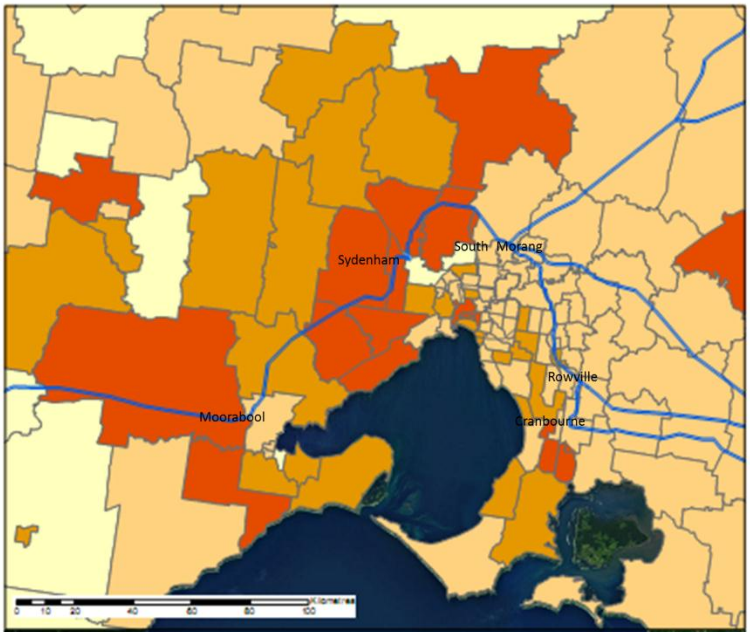

Figure 6.5– Population Growth and Transmission Infrastructure - Port Phillip

One "major" augmentation in the Victorian Shared network was the establishment of a 500kV / 220kV substation at Cranbourne. This 1000 MVA augmentation of 220kV transmission line capacity required little or no line work, and came at a reported cost of under $40 million. This is contrasted with Powerlink's more modest augmentation of capacity into North Queensland (some 700km from major generation sources) that in its own right accounted for around ten times the Cranbourne project cost.

Figure 6.5 highlights how well Victoria's growth corridor is served by a 500kV network that was built with significant over capacity some 50 years ago. That network may well be running out of capacity. In the meantime, it has allowed significant load growth at low cost.

These factors, the failure to recognise expenditure other than augmentation, and the failure to look at growth in the context of existing infrastructure, highlight deficiencies in AEMO's analysis. In addition, such a snapshot does not take into account the state of the network at the beginning or end of the period. The need for prudent spare capacity to cope with growth and weather extremes, issues such as equipment condition and fault level adequacy also need to be considered.

A full consideration of these factors may or may not change the accuracy of AEMO's assertions, but in Evans & Peck's view to conclude that the lower comparative RAB growth in Victoria and maximum demand growth presented to date is solely attributable to AEMO's superior planning is again a significant leap in faith.