VENCorp

CONSULTATION PAPER

OPTIMISING THE LATROBE VALLEY TO MELBOURNE ELECTRICITY TRANSMISSION CAPACITY

February 2002

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EXECUTIVE SUMMARY

This report is published in accordance with clause 5.6.2 of the National Electricity Code (NEC) for development of networks within a region. Clause 5.6.2 (f) of the NEC states that;

> 'the *Network Service Provider* must consult with affected *Code Participants* and *interested parties* on the possible options, including but not limited to demand side options, *generation* options and market network services provider options to address the projected limitations of the *relevant transmission system* or *distribution system* except that a *Network Service Provider* does not need to consult on a *network* option which would be a *new small network asset*.'

Since 1995 VENCorp has identified in its A*nnual Planning Review*[1] that transmission constraints exist between the Latrobe Valley and Melbourne 500 kV transmission network. VENCorp has now undertaken detailed planning studies in accordance with the ACCC's regulatory test, as promulgated by the ACCC in December 1999, to consider the options and timing for optimising the Latrobe Valley to Melbourne 500 kV network. Conversion of the fourth[2] 500 kV line from the Latrobe Valley to Melbourne from 220 kV operation to 500 kV by December 2003 has been shown to be the optimum network solution. The lead-time for this project is about two years from the date of starting the public consultation.

The ACCC's regulatory test states that "an augmentation option satisfies this test if it maximises the net present value of the market benefit having regard to a number of alternative projects, timings and market development scenarios". The detailed planning studies undertaken by VENCorp include four transmission augmentation alternatives, sensitivity to timings and 45 market development scenarios. Demand Side Management and generation options have been included as market development scenarios.

The estimated capital costs, estimated range of net benefits, number of scenarios that maximises the benefits and number of scenarios with lower costs than benefits for each of the four alternative transmission projects identified to remove the constraint are summarised in the following table. Net benefit is net present value (NPV) of benefits minus NPV of costs over the ten year study period (2002/03 to 2011/2012).

[1] VENCorp Annual Planning Review is available from the VENCorp web site http://www.vencorp.com.au.

[2] The fourth 500 kV line was established between the Latrobe Valley and Melbourne in the late 1980s to increase the level of transfer capability between Victoria's major generation and load centres. The line has been operated at 220 kV since that time to optimise the use of the existing assets, and to defer the need for additional 500/220 kV transformation.

Transmission Alternative	Median capital cost estimate ($M)	Estimated range of net benefits ($M)	Number of scenarios that maximises the benefits	Number of scenarios with lower costs than benefits
Line termination upgrade	2.6	0.5 to 12.4	3	45
The 4th 500 kV line with a Rowville transformer	23.8	0.0 to 21.9	38	44
The 4th 500 kV line with a Cranbourne transformer	35.9	-5.6 to 18.3	4	38
5th 500 kV line from Latrobe Valley to Melbourne	71	-32.4 to –6.0	0	0

Range of net benefits with alternative transmission projects

The cost estimates for Cranbourne and Rowville are +/- 12.5% so the final costs could come in at $26.8M for Rowville versus $ 31.4M for Cranbourne, if the costs were at the extreme of the tolerances. There is also the issue that the establishment cost for Cranbourne will depend on whether or not it becomes a connection point to the transmission system at or about the same time ie a 220/66 kV transformation station is established. This would reduce the cost of making the 500 kV connection at Cranbourne as about $9M of the works is common to both projects. The benefits that are shown in the above table assume the full costs are against the 500 kV development. This represents a worst case outcome for the Cranbourne option. The best outcome for Cranbourne would result in benefits close to those shown for the Rowville option. It is therefore not possible at this time to say that one option is preferred over the other.

According to the ACCC's regulatory test;

(a) a proposed augmentation maximises the market benefit if it achieves a greater market benefit in most (although not all) credible scenarios; and

(b) an augmentation minimises the cost if it achieves a lower cost in most (although not all) credible scenarios.

As shown above the 4th 500 line with a Rowville transformer or a Cranbourne transformer (depending on costs) best satisfies the ACCC's regulatory test by maximising market benefits for most scenarios and by lower costs for 44 scenarios out of 45 credible market scenarios. In effect the total net benefit to all those that produce, distribute and consume electricity in the National Electricity Market is increasing with this project.

Details of the planning studies undertaken by VENCorp are presented in the two related documents;

1. "*Technical Report on optimising the Latrobe Valley to Melbourne electricity transmission capacity*" which describes the existing system issues, proposed development plan and transmission alternatives and constraint equations to be used for the economic evaluation; and

2. "*Economic Evaluation on optimising the Latrobe Valley to Melbourne electricity transmission capacity"* which describes the methodology, market scenarios, simulation data, results and recommendations.

This consultation paper provides a summary of the key issues with further detail available from the above documents. VENCorp welcomes written comments on the issues raised in this Consultation Paper. At the same time, interested parties are encouraged to provide written comments on any other issues, which they consider relevant.

VENCorp will publish its response to the key matters raised in submissions. It then proposes to review its proposal on optimising the Latrobe Valley to Melbourne electricity transmission capacity in light of those submissions.

Key steps of the process leading to optimising the Latrobe Valley to Melbourne electricity transmission capacity are:

- VENCorp publish the Consultation Paper and detailed planning reports on 27th February 2002.
- Public consultation close on 28th March 2002.
- Review the proposal and recommendations following receipt of comments from affected parties and VENCorp Board makes decision on optimising the Latrobe Valley to Melbourne electricity transmission capacity by late April 2002. VENCorp publishes a report.
- If the VENCorp Board approves a network augmentation, a tender process would be followed to build, own and operate any network deemed contestable. Provision of the of the 500 kV switching and the 500/220 kV transformer would be contestable as they are major works which could reasonably be provided separately from the existing facilities.
- SPI PowerNet would be contracted to construct the non-contestable part of the network services in parallel with the contestable network services. Non-contestable works includes line termination, extension to existing terminal stations and interface with contestable works.

OPTIMISING THE LATROBE VALLEY TO MELBOURNE ELECTRICITY TRANSMISSION CAPACITY

1 Purpose Of This Consultation Paper

Under the Electricity Industry Act and its transmission licence, VENCorp is responsible for planning and developing the shared transmission network[3] to provide, in an economic manner, a reliable and cost-effective means of transferring energy from generators to customers. In accordance with this responsibility and clause 5.6.2 of the National Electricity Code, VENCorp has assessed options for optimising the Latrobe Valley to Melbourne electricity transmission capacity based on higher economic benefits to customers.

Detailed planning studies undertaken by VENCorp confirm that conversion of the present 220 kV line to 500 kV, with associated works including a new 500/220 kV transformer at Rowville (or possibly Cranbourne) is economically justified based on benefits gained in terms of:

- reduced power and reactive transmission losses;
- reduced dispatch costs under certain transmission outage conditions; and
- increased supply reliability under certain transmission outage conditions.

The purpose of this Consultation paper is to;

- provide details of the planning studies undertaken by VENCorp in its consideration on converting the fourth 500 kV line for 500 kV operation as the best network solution;
- provide stakeholders with an opportunity to comment on specific issues arising in relation to converting the fourth 500 kV line for 500 kV operation; and to
- seek other solutions for optimising the Latrobe Valley to Melbourne electricity transmission capacity.

VENCorp will examine all responses to this Consultation Paper, and then review this proposal and recommendations, to ensure that VENCorp's decisions continue to satisfy the two basic goals of:

- reflecting the overall needs and expectations of all stakeholders as a whole; and
- fostering an efficient level of investment in the shared network, in accordance with the requirements of the ACCC's regulatory test.

VENCorp welcomes written comments on the issues raised in this Consultation Paper. At the same time, interested parties are encouraged to provide written comments on any other issues, which they consider relevant.

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[3] The "shared transmission network" is the Victorian transmission system, excluding the transmission facilities that connect the distribution networks and the generators to the high voltage network. The distribution companies and the generators, respectively, are responsible for planning and development of the relevant transmission connection facilities. These arrangements are set out in detail in Chapter 3 of VENCorp's 2001 *Electricity Annual Planning Review,* and in transmission and distribution licences issued by the Office of the Regulator-General.

All written comments will be made public, and where possible, will be available on VENCorp's website at: **www.vencorp.com.au**

Written comments should be received by VENCorp by no later than 28 March 2002.

Responses should be addressed to:

Company Secretary
c-/ Consultation Returning Officer
PO Box 413
World Trade Centre Vic 8005

Submissions may be made via e-mail to: vencorp@vencorp.vic.gov.au (Word 6.0/97 format)

Alternatively, hard copy submissions may also be made but should include an electronic copy.

Unless advised, VENCorp will treat submissions as public documents and may post these on the VENCorp website for further consideration.

By no later than 26 April 2002, VENCorp will publish on its web site, its responses to the matters raised in submissions. At that time, VENCorp will also announce its intentions in relation to any possible modification of the present proposal for the 4^{th} 500 kV line project, in light of the submissions received.

2 Processes and Time Frames

Under the terms of VENCorp's Transmission Licence, VENCorp is required to undertake a tender process to select the party to build, own and operate any network augmentation which is deemed contestable. Part of the network solution works involved in optimising the Latrobe Valley to Melbourne electricity transmission capacity is contestable as it involves major transmission plant items including a new 500/220 kV 1000 MVA transformer and station works, which can be provided separately from the existing facilities.

SPI PowerNet would undertake part of the development work as it involves modification and extension works to the existing SPI PowerNet assets.

The steps leading for optimising the Latrobe Valley to Melbourne electricity transmission capacity are as follows;

1. VENCorp prepares the detailed technical report on optimising the Latrobe Valley to Melbourne electricity transmission capacity describing existing system issues, proposed transmission alternatives and constraint equations to be used for the economic evaluation by end February 2002.
2. VENCorp prepares economic evaluation report on optimising the Latrobe Valley to Melbourne electricity transmission capacity describing methodology, simulation data and recommendations by end February 2002.
3. VENCorp Board approves public consultation process on optimising the Latrobe Valley to Melbourne electricity transmission capacity by end February 2002.
4. VENCorp publish the public consultation documents by placing on VENCorp's web site and seek input from interested parties and review the proposal and recommendations following receipt of comments from affected parties.

5. VENCorp Board makes a decision on optimising the Latrobe Valley to Melbourne electricity transmission capacity.

6. VENCorp publishes a report.

7. If a network solution is approved VENCorp issues a detailed tender for the contestable works including;
   - full information on the interface with the existing network assets;
   - detailed technical requirements;
   - commercial provisions;
   - performance requirements including cost penalties.

8. Potential network service providers respond.

9. VENCorp evaluates tenders and makes recommendation to VENCorp Board to award tenders. Following Board approval, VENCorp awards contract on a build own and operate basis.

10. VENCorp negotiates and enters into a Network Agreement with SPI PowerNet for the interface and non-contestable works to be carried out in parallel with contestable works.

The following time table is proposed:

Date	**Component of work**
27 February 2002	Start public consultation process.
28 March 2002	Close public consultation process.
Late April 2002	VENCorp Board approves the preferred solution for optimising the Latrobe Valley to Melbourne electricity transmission capacity following publication of responses to submissions.
Early May 2002	Issue expression of interest documents.
Early June 2002	Issue detailed ITT documents.
Mid July 2002	Tender close.
End August 2002	Tender evaluation complete.
Late September 2002	Tender recommendation to VENCorp Board.
Mid October 2002	Award Contracts.
1 December 2003	Project completion – Services provided.

Table 2.1: Proposed time table

3 VENCorp PLANNING ROLE

VENCorp is the monopoly provider of shared electricity transmission network services in Victoria, and has responsibilities under various legal and regulatory instruments to plan and direct the augmentation of the shared network within Victoria.

The electricity transmission planning responsibilities and obligations of VENCorp[4] are set out in the Electricity Industry Act, the Officer of the Regulator General Act, the National Electricity Code and other instruments.

VENCorp executes its planning role in an independent manner, with the objective of undertaking effective planning and development of the shared transmission network within Victoria so as to maximise net benefits to electricity industry participants (including end consumers) as a whole.

The scope of VENCorp's planning role includes:

- commissioning of extensions and modifications of the Victorian network:
  - to accommodate general load growth; or
  - to integrate new generators and major loads into the system; or
  - to reduce the costs associated with constraints or losses in the existing network;
- the pursuit of least cost outcomes that minimise the cost of delivered electricity in Victoria; and
- pursuing the optimal balance between the costs of transmission constraints to market participants as a whole, versus the cost of new investment.

VENCorp will implement a transmission augmentation if, when compared to all other options, it can be shown to be reasonably expected to maximise net benefits directly associated with the production and consumption of electricity to electricity industry participants (including end consumers) as a whole.

A probabilistic approach is used to determine the expected benefits for a range of transmission alternatives. The appropriate augmentation, in this case is a network solution on optimising the Latrobe Valley to Melbourne electricity transmission capacity, is then selected to maximise the net benefit. With the exception of quality of supply standards that are mandated by the National Electricity Code, VENCorp does not plan to meet a particular reliability criterion, such as N-1, or to support a load level. With higher demands or for conditions where there is plant out of service, the network may limit the supportable demand.

VENCorp reviewed the planning criteria recently and documents on this review including the Consultation Paper, copies of the submissions, VENCorp's responses and conclusions of the consultation process are available from VENCorp's web site at: www.vencorp.com.au

Details of the evaluation process for transmission augmentation investments are also contained in the VENCorp Annual Planning Review 2001.

4 LATROBE VALLEY TO MELBOURNE 500 kV TRANSMISSION CAPACITY

Four 500 kV transmission lines were constructed between the Latrobe Valley and Melbourne, two in 1970s and two in 1980s, to provide a strong transmission link between base load brown coal generation and the Victorian load centre. One of these lines has been operated at 220 kV

4 Further details of VENCorp's planning role are contained in the VENCorp Annual Planning Review 2001, which is available from the VENCorp web site http://www.vencorp.com.au Electricity Annual Planning Review.

since that time to optimise the use of assets, and to defer the need for additional 500/220 kV transformation as shown in Figure 4.1.

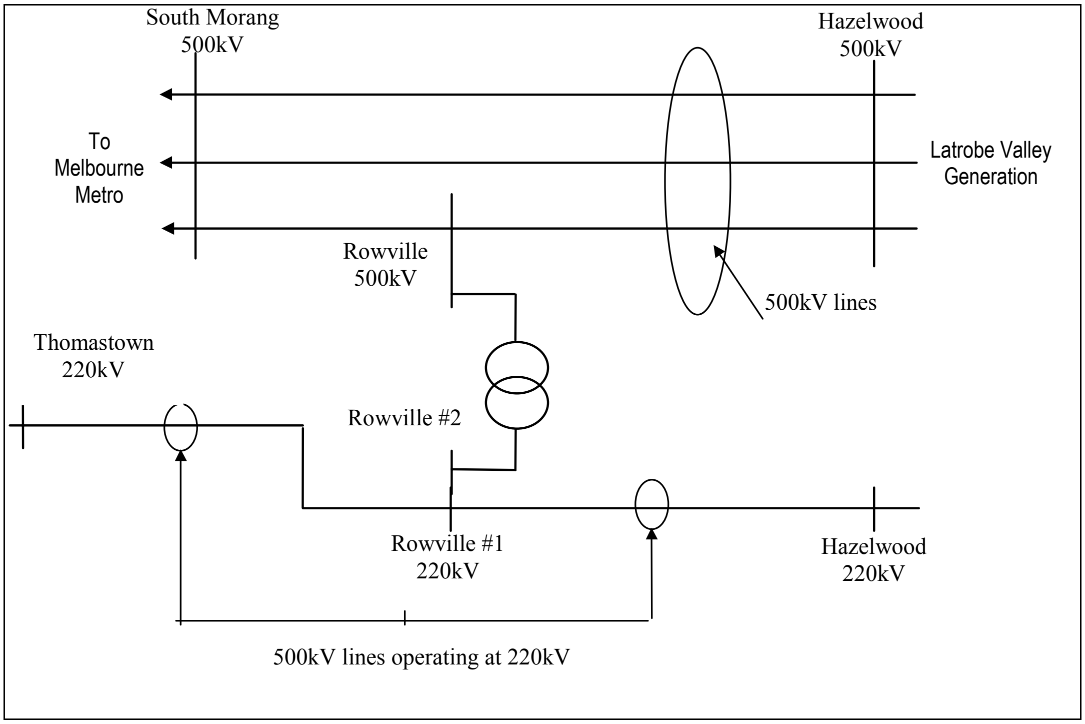

Figure 4.1: Latrobe Valley to Melbourne 500 kV transmission system

The Victorian load has grown significantly since the 500 kV transmission lines construction. An upgrade in the capacity of the 500 kV network between the Latrobe Valley and Melbourne has become necessary due to both growth in the Victorian load and an increase in the amount of generation installed in the Latrobe Valley.

4.1 Existing system issues

The Victorian power system is heavily dependent on the 500 kV transmission network from the Latrobe Valley to the Melbourne area to connect about 5600 MW of generation to the Victorian load centre. An outage of one of the 500 kV transmission lines between Latrobe Valley and Melbourne may constrain the amount of Latrobe Valley generation that can be transmitted because of voltage collapse, thermal or transient stability limitations.

Capacity of the transmission network is sufficient to transport existing and proposed generation capacity, including the proposed interconnection to Tasmania, Basslink, with all 500 kV transmission lines in service. With one 500 kV line out of service up to 1550 MW of generation may need to be reduced from the existing level and up to 2150 MW with the proposed generation additions and interconnection, as shown in Appendix 2. If this event were to occur then the Latrobe Valley generation would need to be replaced by high cost generation and if insufficient then by load shedding.

Transmission losses (both active and reactive) on the 220 kV network from Latrobe Valley to Melbourne area is comparatively high compared with the 500 kV network. The 4th 500 kV line, which is operating at 220 kV, is under-utilised in terms of its design capacity of 3400 MVA. In addition, this arrangement increases transmission losses and reduces voltage collapse and system stability limits.

These issues are described in Section 2 of the accompanying technical report on optimising the Latrobe Valley to Melbourne electricity transmission capacity.

4.2 Transmission alternatives

Benefits of strengthening the 500 kV transmission network between the Latrobe Valley and the Melbourne metropolitan area are:

1. reduction in the amount of generation re-scheduling due to the Latrobe Valley to Melbourne thermal capability limit;
2. reduction in the amount of load shedding due to the Latrobe Valley to Melbourne thermal capability limit;
3. reduction in reactive losses during the summer peak demand; and
4. reduction in Latrobe Valley to Melbourne transmission losses.

Transmission projects between Latrobe Valley and Melbourne that are available to provide a part or all these benefits have been identified as transmission alternatives. Eastern metropolitan area transmission developments proposed by TXU and United Energy have also been considered in developing the following transmission alternatives.

4.2.1 The 4th 500 kV line with a Rowville transformer "Rowville Option"

- This development would involve the conversion of the HWPS to ROTS No.3 220 kV line to 500 kV operation and installation of a second 1000 MVA 500/220 kV transformer at Rowville. Transmission works included in this option are; Remove Hazelwood Power Station (HWPS) to Rowville Terminal Station (ROTS) No 3 220 kV line from service and use the Hazelwood Terminal Station (HWTS) to ROTS section which has been constructed for operation at the 500 kV level as a 500 kV line between HWTS to ROTS.
- The HWTS end of this 500 kV line will be connected to HWTS.
- The ROTS end of this 500 kV line will be connected to ROTS 500 kV switch yard with two additional 500 kV circuit breakers.
- Install the second 500/220 kV 1000 MVA transformer at ROTS.
- The 220kV side of the new transformer will be connected to ROTS at the connection used by former HWPS-ROTS No.3 220 kV line. Four East Rowville line circuit breakers at ROTS to be replaced to increase fault current clearance capability of the switchyard.
- Rearrange the HWPS bus and replace three HWPS circuit breakers to increase fault current clearance capability of the switchyard.

4.2.2 The 4th 500 kV line with a Cranbourne transformer "Cranbourne Option"

This would involve the conversion of the HWPS to ROTS No.3 220 kV line to 500 kV operation and the establishment of a new 500/220 kV transformation station at Cranbourne. Further details of this work are described in Section 5.2 of the Technical Report. The scope of works for this alternative is;

1. Remove the existing HWPS to ROTS No 3 220 kV line from service and use the HWTS to ROTS section which has been constructed for operation at the 500 kV level as a 500 kV line between HWTS to ROTS.
2. The HWTS end of this 500 kV line will be connected to HWTS.
3. The ROTS end of this 500 kV line will be connected to ROTS 500 kV switch yard with one additional 500 kV circuit breaker.
4. Establish Cranbourne 500 kV and 220 kV switching stations with one 500/220 kV transformer. The 500 kV side of the Cranbourne to be connected the HWTS-ROTS No3 500 kV line. The East Rowville to Tyabb 220 kV lines to be switched into the 220 kV side of the Cranbourne switching station.
5. Rearrange the HWPS bus and replace three HWPS circuit breakers to increase fault current clearance capability of the switchyard.

4.2.3 Termination upgrade

Increase rating of the existing 500 kV lines by upgrading the termination equipment. This project would involve replacement of 500 kV circuit breakers at Hazelwood terminal station and line traps at each end of the 500 kV lines. Further details of this work are described in Section 5.1 of the Technical Report.

4.2.4 The 5th 500 kV line

This would involve building a 5th 500 kV line from the Latrobe Valley to the Melbourne metropolitan area. The 5th 500 kV line would be built in the existing northern easement from HWTS to Templestowe through Coldstream. This line would be switched to the existing ROTS-South Morang 500 kV line at Templestowe. Further details of this work are described in Section 5.3 of the Technical Report.

4.3 Other Alternatives

Other non-network alternatives can be considered by reviewing the areas of benefit achieved with the network solution:

> Expected Unserved Energy (EUE) – DSM and peaking plant to the west of the Latrobe Valley to Melbourne corridor would achieve the same benefit.
>
> Generation rescheduling – DSM would be uncompetitive at $ 300/MWh and the only other alternative is to locate a base load generator west of the Latrobe Valley to Melbourne corridor with short run marginal costs lower than the existing brown coal generation which is impractical and would be uneconomic from a capital cost viewpoint.

Reactive – DSM and peaking plant to the west of the Latrobe Valley to Melbourne corridor would achieve the same benefit

Losses - locate a base load generator west of the Latrobe Valley to Melbourne corridor with short run marginal costs lower than the existing brown coal generation which is likely to be impractical and uneconomic from a capital cost viewpoint.

The above analysis concludes that there are no real competitors for the network solution however certain market development scenarios may affect the benefits seen for the network solution. Therefore generation and DSM alternatives are not considered for this project but they are considered in terms of market development scenarios.

4.3.1 Demand side management

Demand side management (DSM) could be used to reduce the amount of energy at risk of shedding due to the transmission constraint and reduce the amount of reactive support required to support the peak demand. It is not expected to be a cost effective alternative to generation re-scheduling that is required due to the transmission constraint. The impact of DSM has been investigated as a market development scenario in the economic evaluation.

4.3.2 Generation alternatives

The market scenarios considered that may impact on the benefits from the transmission alternatives are;

1. Development of the SNOVIC 800 MW option with medium demand growth. This represents a 400 MW generation increase on the Melbourne side of the line.
2. Retirement of 500MW of Latrobe Valley brown coal generation with medium demand growth. Retired generation has been replaced by gas fired generation in Victoria of which 50% considered to be connected to Melbourne metropolitan area and the rest to Latrobe Valley.
3. Changed bidding strategy from a Short Run Marginal Cost (SRMC) to a Long Run Marginal Cost (LRMC) bidding strategy with medium demand growth. This bidding strategy increases import from Snowy to Victoria to the maximum limit and offset Latrobe Valley base load generation considerably reducing flow on the 500 kV lines from Latrobe Valley to Melbourne. This is equivalent to a 1900 MW base load generator being connected to Melbourne area and offsetting Latrobe Valley generation.

4.4 Summary

Table 4.1 shows a comparison of benefits that could be provided by the alternatives in sections 4.2 and 4.3 to optimise the Latrobe Valley to Melbourne electricity transmission capacity. Costs of the transmission alternatives are shown in Section 6.2.4.

Alternative	Reduce EUE	Reduce generation rescheduling	Reduce reactive losses	Reduction in transmission losses
Rowville option	Yes	Yes	Yes	Yes
Termination upgrade	Yes	Yes	No	No
Cranbourne option	Yes	Yes	Yes	Yes
5th 500 kV line	Yes	Yes	Yes	Yes
DSM	Yes	No uncompetitive at $ 300/MWh	Yes	No
Additional generation	Yes	Yes uncompetitive as SRMC costs higher than brown coal	Yes	Yes Reduce as generators close to the load centre

Table 4.1: Comparison of benefits provided by alternative projects

5 ECONOMIC EVALUATION METHODOLOGY

5.1 Overview

The project principally involves the connection of the line to the 500 kV network at Hazelwood and in the metropolitan area and the installation of new 500/220 kV transformation in the eastern metropolitan area of Melbourne. The total capital cost of the project is estimated to be about $24 million.

The magnitude of the benefits provided by the project depends on a number of factors. One of these factors is the level of generation sent out of the Latrobe Valley to Melbourne. It is expected however, that over a wide range of plausible scenarios relating to Latrobe Valley to Melbourne transfers, there would be significant reductions in losses and energy constraints as a result of the project. This is illustrated in the diagram below.

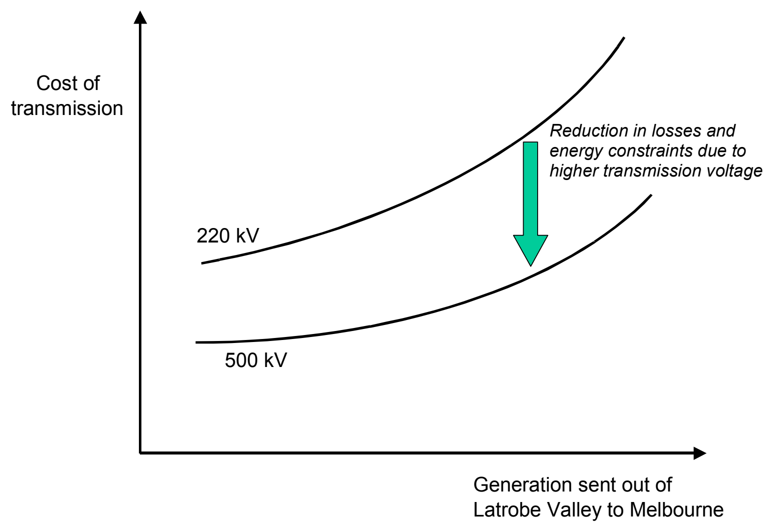

Figure 5.1: Transmission costs and generation sent out

Note: Cost of transmission includes transmission loss and transmission constraint related costs.

Other factors that may influence the economics of the project include:

- the timing and sequence of entry of new generation and/or MNSP capacity into the Victorian region;
- the availability and cost of alternative projects that deliver reductions in transmission losses and constraints.

5.2 Regulatory test requirements

The ACCC's regulatory test states:

> "An *augmentation* satisfies this test if –
>
> (a) in the event the *augmentation* is proposed in order to meet an objectively measurable service standard linked to the technical requirements of schedule 5.1 of the Code – the *augmentation* minimises the net present value of the *cost* of meeting those standards; or
>
> (b) in all other cases – the augmentation maximises the net present value of the *market benefit*".

Market benefit is defined as:

> "the total net benefits of the proposed augmentation to all those who produce, distribute and consume electricity in the National Electricity Market. That is, the increase in consumers' and producers' surplus or another measure that can be demonstrated to produce equivalent ranking of options in most (although not all) credible scenarios".

5.3 Objective of the economic evaluation

The objective of the economic evaluation is to identify the most economic means of increasing the level of energy efficiency within the Victorian power system, in accordance with the requirements of paragraph (b) of the regulatory test. In other words:

- the evaluation would not be conducted as a cost-effectiveness study against a pre-determined target level of transmission losses and energy constraint level;
- the project would have to generate a positive net present value (NPV); and
- across a range of scenarios, the project would have to maximise the NPV of the market benefit, having regard to the alternative projects that would be available to increase the level of energy efficiency within the Victorian power system.

5.4 Formulation and methodology

A number of representative "market development scenarios" (alternative generation and transmission expansion sequences over the study horizon) are defined, for given demand forecasts. These scenarios would include feasible transmission development alternatives to the fourth 500 kV line, as sources of increased energy efficiency within the power system.

The NPV incremental cost of meeting the forecast demand for electricity over the (10 year) study horizon is determined for each scenario, with and without the proposed project and with the timing of the proposed project varied in different scenarios. Market modelling software developed by VENCorp (the VISION[5] model) and Power Technology Incorporated (PTI) power system modelling software have been used to estimate:

1. Reduction in transmission losses between Latrobe Valley to Melbourne area;
2. Reduction in reactive losses in Victoria;
3. Reduction in Expected Unserved Energy; and
4. Reduction in generation re-scheduling costs.

The NPV incremental costs of each scenario are compared, and the scenario that produces the lowest NPV incremental cost would be identified as the option that best satisfies the regulatory test. This decision signal would be tested against variations in the following key parameters:

- discount rate;
- generator bidding strategies (that is "SRMC" versus "LRMC"); and

[5] VISION is a multi-region generation bidding model, designed for use in studying the NEM in South-Eastern Australia by VANCorp.

- entry of new generation determined outside of the market, in accordance with the minimum reserve requirements set down by the NECA Reliability Panel.

5.5 Inter-regional impacts

It is expected that any inter-regional impacts of the project are beneficial to the market as a whole, however these impacts are not material. Inter-regional impacts are therefore excluded from the economic evaluation of net benefits.

5.6 Externalities

5.6.1 Worst case exposure

The maximum amount of Victorian load exposed for load shedding following an outage of one 500 kV lines from the Latrobe Valley to Melbourne area, during the peak demand period on a hot summer day, is about 1050 MW. This is with the current level of Latrobe Valley generation assuming minimum reserve level maintained. This includes 300 MW from Valley Power and 80MW from Bairnsdale. The maximum amount of load exposed for shedding increases to 1650 MW with the proposed Basslink assuming minimum reserve level maintained.

This exposure in terms of unserved energy, assuming $10,000 per MWhr (VoLL price) over a possible five hour peak demand period, is $55M with the current level of Latrobe Valley generation, and $82M with an additional 600 MW of supply side development in the Latrobe Valley assuming minimum reserve level maintained. This exposure could be eliminated by the converting the 4^{th} line to 500 kV operation and installing a 500/220kV transformer in eastern Melbourne.

5.6.2 Bush fires

Of the three 500 kV transmission lines between the Latrobe Valley and Melbourne, two lines are in the northern easement. Although the loss of both circuits from a single event is extremely unlikely, a bush fire in the vicinity of a transmission line may force the transmission line to be switched off for safety reasons. The recent 2001/02 bushfires in NSW caused a number of parallel single circuits to fault within seconds of each other so that it is possible. A bush fire on the northern transmission easement could lead to both 500 kV transmission lines being switch off and even automatically tripped out within a few minutes or seconds of each other. There is a considerable chance for bush fire events to coincide with summer hot periods that lead to peak Victorian demands and outage of a line at this time would be most critical.

Transmission capacity between the Latrobe Valley and the Melbourne area reduces to about 2250MW with two 500 kV lines switched off. Victorian peak forecast demand would need to be reduced by up to 3700 MW. This level of load shedding is about six to seven times than the level of supply interruption (600 MW) that occurred on 3 February 2000. The Rowville option would reduce the level of load shedding to about 300 MW at peak demand times.

Options that increase the capacity of the transmission between the Latrobe Valley and Melbourne are;

Option	Demand would need to be reduced during a bush fire in the vicinity of 500 kV lines
Rowville option	300 MW
Line termination upgrade	3700 MW
Cranbourne option	300 MW
5th 500 kV line from Latrobe Valley to Melbourne (along the northern easement)	3700 MW

Table 5.1: Demand would need to be reduced during a bush fire in the vicinity of 500 kV lines

5.6.3 Line maintenance window

Line maintenance on the 500 kV transmission network between the Latrobe Valley and the Melbourne area is planned during light load periods. It is unlikely for gas fired peak generator plant in the Latrobe Valley to run during this period. The Latrobe Valley brown coal generators that are connected to the 500 kV network need to be constrained by about 750 MW during the line maintenance outage periods, prior to Basslink. This will be reduced to about 350 MW with Basslink assuming the flow on Basslink during this period is toward Tasmania.

5.6.4 Greenhouse gas reduction

In May 1999, the Commonwealth Government committed an additional $400 million over four years, through the Greenhouse Gas Abatement Program (GGAP) to further assist Australia in meeting its commitments under the Kyoto Protocol. The objective of the program is to reduce Australia's net greenhouse gas emissions by supporting activities that are likely to result in substantial emission reductions.

One factor that is not incorporated fully into the economic decision signal provided by the regulatory test is the benefit delivered by the project in terms of greenhouse gas reduction. The project is expected to reduce transmission losses by around 90 GWh per year (10 MW average at 100% capacity factor) in the year 2004, and increases to around 150 GWh per year by the year 2012. This equates to a reduction in $C0_2$ emissions of roughly 90,000 and 150,000 tonnes per year for the years 2004 and 2012 respectively.

The potential value of carbon credits in an emission trading market has been estimated to be in the range of $10 to $50 per tonne.[6] Taking the lower bound of this range, the intangible value of the greenhouse gas emission reductions that would be delivered by the project is $1 million per year.

Projects that have received funding under the Commonwealth Government's Greenhouse Gas Abatement Program provide a more tangible measure of the value of emission reductions. Successful projects include the following:

6 Refer to the document Questions and answers: Carbon trading - Emissions trading and carbon credits at the website of the Australian Greenhouse Office on the following address: http://www.greenhouse.gov.au/emissionstrading/qanda.html

Applicant	Project	Grant	Emission reduction	Implied value of $C0_2$ reductions
Macquarie Generation	Replacement of ageing low pressure turbines at Liddell power station	$5 million towards total cost of $52 million	1.5 MT over 5 years	$3.30 per tonne
Queensland Alumina Limited	Replacement of natural gas fired kilns, with energy efficient stationary calciners	$11 million towards total cost of $175 million	1.5 MT over 5 years	$7.30 per tonne
Nabalco Pty Ltd	Conversion of fuel from oil to natural gas	$7 million towards total cost of $48 million	1.2 MT over 5 years	$5.80 per tonne
Origin Energy and the Australian Ecogeneration Association	Development of cogeneration plants	$26 million	More than 3 MT over 5 years	Not more than $8.70 per tonne

Table 5.2: Projects that have received funding under the Commonwealth Government's Greenhouse Gas Abatement Program

It is noteworthy that the Greenhouse Gas Abatement Program (GGAP) has contributed funding to green-house friendly power generation projects proposed by private and State-owned generation companies. These projects are described by the Australian Greenhouse Office as "innovative", and in the case of Macquarie Generation, the project is described as "beyond commercial best practice". This suggests that the GGAP funding has been provided only to the extent required to move a project from being marginally uneconomic to economic. It may therefore be possible for VENCorp to seek funding for the project.

5.6.5 Greenhouse gas emission reduction with the Cranbourne terminal station development

The transmission loss saving is higher for the Cranbourne development alternative compared with the Rowville option. This is due to the shorter transmission distance from the Latrobe Valley to Cranbourne compared with Rowville. The amount of transmission loss saving for the Cranbourne option is about 100GWh per year in 2003/04, compared to 90 GWh for the Rowville option, and increases to about 160GWh per year in 2011/12. The amount of CO2 emission reduction is about 100,000 Tons for year 2003/04 and about 160,000 tons for year 2011/2012. This increase has been factored in the economic evaluation.

5.7 Other considerations

The project will have an impact on marginal loss factors, and transmission use of system charges. However, these financial impacts are not explicitly included in the ACCC Regulatory Test.

6 Net benefit Test

6.1 Methodology

The methodology, which has been applied to the evaluation of the upgrade of the 4th 500kV line, is based on the ACCC regulatory Test.

Four types of possible benefits have been identified with the Latrobe Valley to the Melbourne area transmission network.

6.1.1 Benefit assessment

The VISION pool simulation model has been used to determine the hourly generation dispatch and loads for a large number of scenarios to capture the range of variation. These generation and load information have been then used to estimate impact of the transmission augmentations between the Latrobe Valley to the Melbourne area as follows;

- Transmission line loading are determined on an hour by hour basis and compared with the line ratings. This allows the load or generation associated with the transmission overloading to be identified. Generation re-scheduling required has been valued by the price difference of the generators involved in re-scheduling. Any load shedding has been valued at Value Of Loss Load (VoLL) price.
- Estimate hourly transmission losses by using PSS/E[7] power transmission network simulation software by solving a load flow case for every hour for each of the transmission alternatives considered. These load flow cases have been optimised to maintain a consistent voltage profile across all transmission alternatives considered. Transmission losses have been valued using System Marginal Price (SMP) on hourly basis.

As the amount of reactive support required for the Victorian system depends on strength of the transmission network between the Latrobe Valley to the Melbourne area, there is a change to the amount of reactive support required with the 4th 500 kV line project. The amount of reactive support required for each transmission alternative has been estimated using the 10% forecast summer peak demand in Victoria.

6.1.2 Project costs

Project costs have been obtained from SPI PowerNet with +25% tolerance except for shunt capacitors. Shunt capacitor costs are based on excess reactive charging. Costs obtained from SPI PowerNet are scaled up to obtain costs with ±12.5% tolerance.

6.2 Data and Assumptions

The simulation data used in the analysis, including generator, load, and network data are provided in the two attached reports; Technical Report and Economic Evaluation of optimising the Latrobe Valley to Melbourne capacity.

Assumptions related to generation, load and transmission network are consistent with the VENCorp 2001 Annual Planning Review and the NEMMCO 2001 Statement of Opportunities.

[7] PSS/E is transmission network analysis software by Power Technology Inc., USA

Key market simulation assumptions are shown in Appendix 3.

6.2.1 Transmission development alternatives

Under the regulatory test, it is necessary to compare the net present value of the market benefit of a number of alternative projects with different timings and under a variety of market development scenarios. The alternative projects, which have been considered as part of this assessment, are:

1. No transmission augmentations;
2. The Rowville option includes the 4th 500 kV line with an additional 1000MVA 500kV/220kV transformer at ROTS.
3. The Cranbourne option includes the 4th 500kV line with establishment of a new Cranbourne terminal station and additional 1000MVA 500kV/220kV transformer at Cranbourne.
4. Upgrade of terminations on the existing three Latrobe Valley to Melbourne lines operating at 500kV.
5. Construction of 5th 500kV line from Latrobe Valley to Melbourne

6.2.2 Market scenarios

The expected net market benefits of the alternative transmission projects depend on the behaviour that is assumed for market participants. As the behaviour of market participants cannot be predicted with certainty and depends on bidding strategies, a number of market development scenarios need to be considered. The market development scenarios, which have been considered in this evaluation, are as follows:

1. Base case, medium economic growth scenario.
2. Base case, low economic growth scenario.
3. Base case, high economic growth scenario.
4. Development of Basslink in November 2003, medium growth.
5. Development of SNOVIC 800 MW option in November 2004, medium growth.
6. Without the 400 MW SNOVIC project, medium growth.
7. Retirement of 500MW of generation in Latrobe Valley, medium growth.
8. Base case with LRMC bidding strategies, medium growth.
9. Demand side management in Victoria, medium growth.

The base case relates to the most likely market development scenario over the period of the study. This includes the development of the SNOVIC Upgrade of 400MW by December 2002 and the development of SNI by 2004. Under the base case, the development of Basslink is not considered. Rather, Basslink is considered under market development scenario number 4 above.

The base case is considered for the medium, low and high economic growth scenarios. These scenarios describe the conditions for alternative growth levels in annual energy consumption and peak summer and winter demand.

Each of these scenarios has been considered with SRMC bidding strategy except the scenario 8, which uses LRMC bidding. In market development scenario number 9, demand side management levels of 500MW are considered in the Victorian region (Melbourne metropolitan area). Further detail on the base case and the other scenarios is contained in Appendix 3 and in the Economic Evaluation report.

As stated above, generation development schedules have been developed for each of these scenarios. For each scenario, additional generation developments in the form of open-cycle gas turbine plant, it assumed to be added to the system to ensure that the minimum reserve levels are maintained over the course of the study. These minimum reserve levels are currently 500MW in Victoria and 260MW in South Australia and are with reference to the 10 percentile peak (summer) demand in each region.

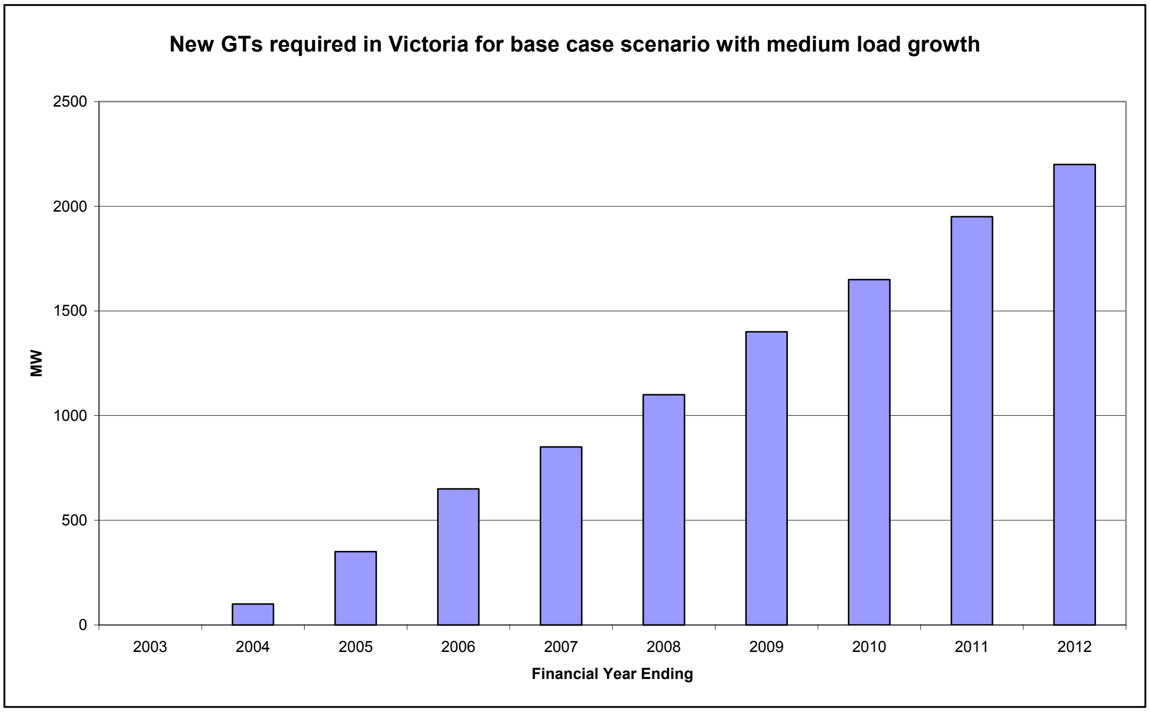

Figure 6.1: Additional generation required in Victoria to satisfy the reliability criteria

The four alternate projects listed in Section 6.2.1 have been examined under each scenario.

6.2.3 Sensitivity studies

An additional series of sensitivity studies has been carried out to test the robustness of the Rowville option to variations in the assumptions. The sensitivity studies are summarised below;

1. Increase VoLL value to $20,000 per MWh.
2. Double the forced outage rates for the transmission elements.
3. Introduction of carbon tax/emission trading with a value of $10 per MWh.
4. Discount rate varied between 6% and 10%.

5. Project costs increased by 12.5%.
6. Project costs reduced by 12.5%.
7. Optimised commissioning dates.
8. Cranbourne capital works of $9M allocated to Cranbourne 220/66 kV development.

6.2.4 Transmission costs

Capital, operation and maintenance costs of alternative transmission projects are shown in Table 6.1. Operating and maintenance costs are based on assumption of 20% of the capital works involving additional transmission developments. There is no maintenance and operating cost for plant upgrade or replacement.

	Rowville option	Cranbourne option	Termination upgrade	5th 500 kV line
Capital cost $M	23.8	35.8	2.6	71
Operation and maintenance $M	4.0	6.7	0.0	14

Table 6.1: Costs of alternative transmission projects

Costs of shunt capacitors are valued as excess reactive charging rates of $2250 per MVAr per year.

6.3 Market benefit analysis

For a transmission alternative to pass the regulatory test (see Appendix 1), it must be shown to maximise “the net present value of the market benefit having regard to a number of alternative projects, timings and market development scenarios”.

For the purpose of this project VENCorp has evaluated market benefits of plausible alternative transmission project in great detail over a 10 year period.

Costs of each transmission alternative have been obtained from the best possible source in providing cost estimates, on a common basis for alternative project comparison.

A cost benefit assessment has been carried out consisting the costs and benefits for each component in each year of the ten year study period. These studies are shown in the attached report Economic Evaluation on optimising the Latrobe Valley to Melbourne electricity transmission capacity.

6.3.1 Generation re-scheduling

This benefit arises from reducing transmission constraint between the Latrobe Valley and the Melbourne area, as low cost brown coal generators in Latrobe Valley would not be able to supply loads.

Alternative generating sources to replace Latrobe Valley generators available are: gas fired generators, Victorian hydro generators or generators from other states.

Benefit for generation re-scheduling has been included in each of the ten years of the study.

6.3.2 Expected unserved energy (EUE)

This benefit arises from reducing transmission constraint between the Latrobe Valley and the Melbourne area, when the generation re-scheduling options described in Section 6.3.1 has been completed.

Load shed in Victoria is valued at the price of VoLL.

Benefit for EUE has been included in each of the ten years of the study.

6.3.3 Transmission losses

This benefit arises from the reduced transmission losses as a result of the different power flow distribution and voltage levels of alternative transmission projects. The transmission loss change due to the transmission augmentation is valued as fuel cost of the marginal unit. This value reflects combined benefits to the market participants (generators and consumers) as a result of reduced transmission losses. Transmission loss savings have been included for each of the ten years of the study.

6.3.4 Reactive support

Additional shunt capacitors are being installed annually in Victoria to support the summer peak demand. It is possible to avoid installation of part of these capacitors by augmenting the transmission network. Benefits of these avoided capacitors have been included for each of the ten years of the study.

6.3.5 Transmission costs

Annual costs of capital works and associated operating and maintenance costs have been included.

6.3.6 Benefits of Other Options

The discussion above has focused on the cost and benefits of the four transmission network alternative projects. The 500kV line upgrade projects contribute benefits in term of expected unserved energy, generation re-scheduling, transmission losses and reduction in reactive support. The non-network alternatives, which were identified in Section 4.3 above, are also examined for their benefits and costs.

Demand side management developments in the Melbourne metropolitan area will tend to reduce the energy at risk from load shedding and the need for additional reactive support. However, DSM will not significantly impact on the rescheduling costs in the event of an outage on one of the 500kV lines. In the economic assessment, DSM has been valued at a level above the most expensive generation in the system (but below VoLL). As DSM is also available for brief periods at high price, it will not have any impact on the transmission losses associated with the project.

As discussed in Section 4.3, the other non-network alternative is a different generation development schedule. The impact of different generation allocation will mainly be on the transmission losses. If generation developments occur outside of the Latrobe Valley, the transmission losses on the Latrobe Valley to Melbourne corridor will be reduced. This reduction in losses will only be significant (ie approach that of the benefit afforded by the 4th 500kV line) if the generation has a capacity factor approaching 100%. This change in generation would need to be of the order of at least 300MW to produce the reduction in losses of 10MW which is observed with the 4th 500kV line upgrade. The costs associated with such an alternative would depend on both the capital and operating costs of such an option.

The analysis of the costs and benefits of these alternatives are discussed in Section 6.5.

6.4 Results

Summary of results of the net benefit test is shown in Tables 6.2 to 6.8. The values shown in these tables are NPV of benefits minus NPV of costs. A higher number indicates higher benefits to the National Electricity Market.

It should be noted that the establishment cost for Cranbourne will depend on whether or not it becomes a connection point to the transmission system at or about the same time ie a 220/66 kV transformation station is established. This would reduce the cost of making the 500 kV connection at Cranbourne as about $9M of the works is common to both projects. The benefits that are shown in Table 6.10 to Table 6.12 and in Tables 6.8 and 6.9 have been assessed assuming the full costs are against the 500 kV development. This represents a worst case outcome for the Cranbourne option. Tables 6.5 to 6.8 indicate how the benefits of the Cranbourne option improve as the cost of establishing the 500 kV connection is reduced. Section 6.6 further discusses the Cranbourne option and the additional benefits it provides compared to the Rowville option.

Market scenario	Base case Growth	Base case-Growth	Base case-Growth	Basslink	SNOVIC 800	NO SNOVIC	Retire LV 500 MW	LRMC	DM in Victoria
load growth	Medium	Low	High	Medium	Medium	Medium	Medium	Medium	Medium
Termination upgrade	4.6	3.5	7.4	4.2	4.5	7.0	0.9	1.9	4.2
Rowville option	**7.5**	**4.6**	**16.5**	**6.9**	**7.5**	**10.2**	**2.9**	**14.7**	**7.1**
Cranbourne option	2.9	1.0	11.8	2.2	2.8	5.5	-1.8	10.0	2.5
5th 500 kV line	-20.1	-26.0	-13.4	-22.9	-22.9	-20.3	-27.7	-15.3	-23.3

Table 6.2: Net Benefits of alternative transmission projects with 8% discount rate

Market scenario	Base case Growth	Base case-Growth	Base case-Growth	Basslink	SNOVIC 800	NO SNOVIC	Retire LV 500 MW	LRMC	DM in Victoria
load growth	Medium	Low	High	Medium	Medium	Medium	Medium	Medium	Medium
Termination upgrade	3.8	**2.9**	6.2	3.4	3.8	5.9	**0.5**	1.4	3.4
Rowville option	**4.1**	1.5	**11.8**	**3.5**	**4.1**	**6.4**	-0.05	**10.5**	**3.7**
Cranbourne option	1.1	-3.0	6.2	-2.1	-1.5	0.8	-5.6	4.9	-1.8
5th 500 kV line	-26.1	-30.7	-19.9	-28.9	-28.0	-25.7	-32.4	-21.3	-28.4

Table 6.3: Net Benefits of alternative transmission projects with 10% discount rate

Market scenario	Base case Growth	Base case-Growth	Base case-Growth	Basslink	SNOVIC 800	NO SNOVIC	Retire LV 500 MW	LRMC	DM in Victoria
load growth	Medium	Low	High	Medium	Medium	Medium	Medium	Medium	Medium
Termination upgrade	5.5	4.2	8.8	5.1	5.4	8.2	1.4	2.6	5.0
Rowville option	**11.5**	**8.1**	**21.9**	**10.8**	**11.5**	**14.5**	**6.3**	**19.6**	**11.0**
Cranbourne option	6.2	5.7	18.3	7.1	7.8	10.9	2.7	16.0	7.4
5th 500 kV line	-13.2	-20.5	-6.0	-18.0	-17.0	-14.0	-22.4	-8.3	-17.5

Table 6.4: Net Benefits of alternative transmission projects with 6% discount rate

Other Sensitivity studies

Tables 6.5 to 6.7 shows results of the sensitivity studies that were carried out.

Scenario	VoLL chang to $20K	Project cost increase by 12.5%	Project cost reduce by 12.5%	Double FOR	Carbon tax	ROTS increase by 12.5% & CBTS reduce by 12.5%
load growth	Medium	Medium	Medium	Medium	Medium	Medium
Termination upgrade	6.8	4.4	4.8	10.7	4.6	4.6
Rowville option	11.1	**5.9**	**9.1**	**13.9**	**12.0**	5.9
Cranbourne option	**12.1**	3.1	5.3	11.9	7.3	**5.3**
5th 500 kV line	-16.3	-25.0	-15.3	-13.7	-14.8	-20.1

Table 6.5: Net Benefits of alternative transmission projects with 8% discount rate

Scenario	VoLL chang to $20K	Project cost increase by 12.5%	Project cost reduce by 12.5%	Double FOR	Carbon tax	ROTS increase by 12.5% & CBTS reduce by 12.5%
load growth	Medium	Medium	Medium	Medium	Medium	Medium
Termination upgrade	5.8	**3.6**	4.0	9.3	3.8	3.8
Rowville option	7.7	2.3	**5.8**	**9.7**	**8.1**	**2.3**
Cranbourne option	**8.2**	-1.3	1.1	7.0	2.6	1.1
5th 500 kV line	-23.2	-31.3	-20.9	-20.5	-21.3	-26.1

Table 6.6: Net Benefits of alternative transmission projects with 10% discount rate

Scenario	VoLL chang to $20K	Project cost increase by 12.5%	Project cost reduce by 12.5%	Double FOR	Carbon tax	ROTS increase by 12.5% & CBTS reduce by 12.5%
load growth	Medium	Medium	Medium	Medium	Medium	Medium
Termination upgrade	8.0	5.3	5.7	12.4	5.5	5.5
Rowville option	15.1	**10.1**	**13.0**	**18.8**	**16.5**	10.1
Cranbourne option	**16.7**	8.1	10.1	17.5	12.9	**10.1**
5th 500 kV line	-8.7	-17.6	-8.8	-6.0	-7.3	-13.2

Table 6.7: Net Benefits of alternative transmission projects with 6% discount rate

6.5 Analysis of results

Benefits for the transmission alternative “the Rowville option” is shown in Figure 6.2 with base case market scenario.

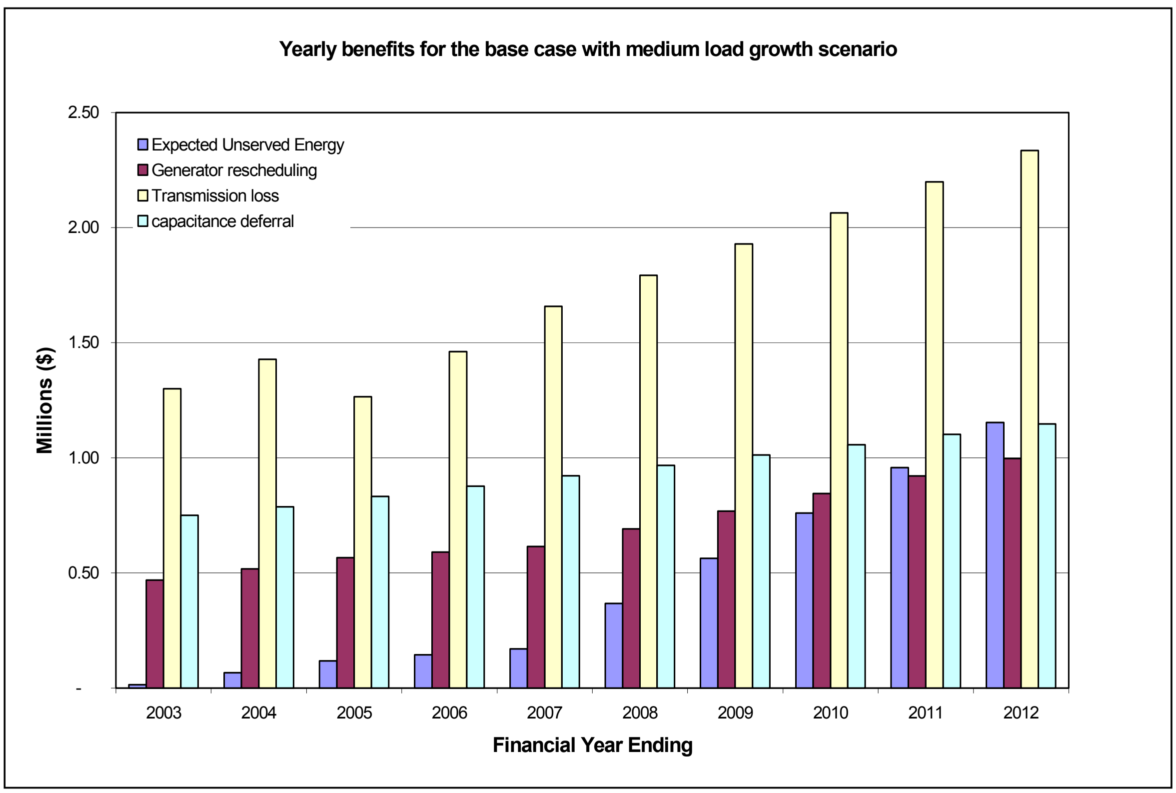

Figure 6.2: Components of Benefits for the Rowville option base case scenario

All four benefits are identified on an annual basis. The total NPV benefit for this base case is $7.5M, as identified in Table 6.2 for a discount rate of 8%. The total present value of these benefits for this base case is $21.8M for a discount rate of 8%. The cost associated with the Rowville Option has a NPV of $14.3M, leading to the net benefit for this option and market development scenario of $7.5M, as shown in Table 6.2.

As can been seen from these results, the annual transmission loss benefit of the project is initially $1.3M in 2002/03, and increasing in step with the growth in load demand over the period of the study to $2.3M in 2011/12. (The slight dip in the transmission loss benefit in 2004/05 is due to one year advancement of the next eastern metropolitan area 500/220 kV transformer without the 500 kV line conversion works.)

The value of the expected unserved energy in 2002/03 is only $0.1M in 2002/03, but this increase to over $1M by 2011/12. This is due to the continuing growth in the peak summer demand over the course of the study and consequent increased load, which is exposed to shedding in the event of an outage on one of the 500kV lines.

The value of the rescheduled generation benefit is initially about $0.5M in 2002/03 and this gradually increases to $1.0M by 2011/12. The increase in this benefit is reasonably moderate over the period of the study, in contrast with the rapid increase in the unserved energy.

The final component in the benefit assessment is the reduction in the reactive support requirement as a result of the project. The 4th 500kV line will initially mean that the additional reactive support required in 2002/03 will be reduce by 335 MVAr. This translates to an annualised benefit of $0.75M in 2002/03. This annual benefit increases to $1.15M by 2011/12, in line with the increasing demand over the period.

The details of the benefits for each of the market development scenarios are presented in the Economic Evaluation report.

The Net benefit test states that:

> "A proposed augmentation maximises the market benefit if it achieves a greater market benefit in most (although not all) credible scenarios."

The number of times that each transmission augmentation maximises the market benefits out of the 45 market scenarios considered is shown in Table 6.8

Scenario	Number of scenarios that maximises the market benefits
Termination upgrade	3
Rowville option	38
Cranbourne option	4
5th 500 kV line	0

Table 6.8: Number of Scenarios that maximises the market benefits

The Rowville option maximises the market benefits in 38 scenarios out of the 45 market scenarios considered and satisfies this criterion of the net benefit test.

In addition, the Net benefit test states that:

> "An augmentation minimises the cost if it achieves a lower cost in most (although not all) credible scenarios."

Scenario	Number of scenarios with lower costs than benefits
Termination upgrade	45
Rowville option	44
Cranbourne option	38
5th 500 kV line	0

Table 6.9: Number of Scenarios that maximises the market benefits

The Rowville option has a lower cost than benefits in 44 scenarios out of the 45 scenarios considered and satisfies this criterion of the net benefit test. The scenario with 500 MW of brown coal generator retires from Latrobe Valley has marginally less ($–0.05M) benefits than costs.

6.6 Establishment of a new Cranbourne terminal station

The long term electricity supply plan is to establish a 500/220 kV transformation station at Cranbourne to supply demand around South Gippsland and the Mornington Peninsula areas. The two southern easement 500 kV lines from the Latrobe Valley to Melbourne (including the line operating at 220 kV) pass through the site reserved for the future Cranbourne terminal station.

One option for connection of the 500 kV line into the Melbourne area after it is converted from 220 kV operation is to establish the 500/220 kV transformation at Cranbourne. The cost of transformation, 500 kV and 220 kV switching to connect into the existing ERTS to TBTS 220 kV lines results in this option being about $12M more expensive than the Rowville option. However, TXU/UE are contemplating development of a 220/66 kV transformation station at Cranbourne around the same time. The timing of this development is sensitive to other alternatives such as DSM and new generation with about 40 MW of DSM or additional generation giving about a one year deferment in timing.

The 220/66 kV station will also include the development of a 220 kV switchyard to switch the ERTS to TBTS 220 kV lines. Much of this work is common to both developments and therefore it is more appropriate to consider only part of the cost against the 500/220 kV development. The sensitivity of the overall cost of 500/220 kV development to the timing of the 220/66 kV development is shown in Table 6.10 to Table 6.12.

Scenario	Avoided cost of CBTS by $9M in 2003/4	Avoided cost of CBTS by $9M in 2004/5	Avoided cost of CBTS by $9M in 2005/6
load growth	Medium	Medium	Medium
Termination upgrade	4.6	4.6	4.6
Rowville option	**7.5**	**7.5**	**7.5**
Cranbourne option	**7.5**	6.8	6.2
5th 500 kV line	-20.1	-20.1	-20.1

Table 6.10: Net Benefits of projects with Cranbourne 220/66 kV transmission with 8% discount rate

Scenario	Avoided cost of CBTS by $9M in 2003/4	Avoided cost of CBTS by $9M in 2004/5	Avoided cost of CBTS by $9M in 2005/6
load growth	Medium	Medium	Medium
Termination upgrade	3.8	3.8	3.8
Rowville option	**4.1**	**4.1**	**4.1**
Cranbourne option	3.5	2.7	2.0
5th 500 kV line	-26.1	-26.1	-26.1

Table 6.11: Net Benefits of projects with Cranbourne 220/66 kV transmission with 10% discount rate

Scenario	Avoided cost of CBTS by $9M in 2003/4	Avoided cost of CBTS by $9M in 2004/5	Avoided cost of CBTS by $9M in 2005/6
load growth	Medium	Medium	Medium
Termination upgrade	5.5	5.5	5.5
Rowville option	11.5	**11.5**	**11.5**
Cranbourne option	**12.1**	**11.5**	11.0
5th 500 kV line	-13.2	-13.2	-13.2

Table 6.12: Net Benefits of projects with Cranbourne 220/66 kV transmission with 6% discount rate

The Cranbourne sites would also involve uncertainties and potential delays resulting from the public approval process which should not be an issue at the already established Rowville site.

There are a number of benefits from establishing the Cranbourne terminal station compared to Rowville option as follows:

- East Rowville and Tyabb loads are presently radially connected from Rowville. By establishing a 220 kV point of connection at Cranbourne the reliability and security of loads supplied from the East Rowville, Tyabb terminal stations and BHP Westernport are increased. The estimated benefit is about $0.34M for the financial year 2003/04 and this increases to $0.70M in the financial year 2011/12. These benefits have been estimated assuming no DSM and local generation.
- The transmission losses are reduced by about 8,100 GWh per year more than the ROTS option with a fuel saving of $0.13M per year.
- The more remote connection from Rowville reduces the fault current level increase at the Rowville 220 kV terminal station and avoids replacement of four 220 kV circuit breakers at Rowville.
- Diversity of 220 kV supply to the Melbourne metropolitan area. Presently around 35% of the total Metropolitan load is supplied from the 220 kV at Rowville. Of this 55% is supplied radially to ERTS/TBTS/BHP WesternPort, SVTS/HTS and MTS making these stations completely dependent on Rowville for supply. Establishing a new connection point at Cranbourne would significantly reduce this dependence on Rowville and provide an alternate supply directly to ERTS/TBTS and BHP WesternPort and in the case of a catastrophic event at Rowville also provide an opportunity for an alternate source into Rowville. This is difficult to cost and no specific allowance has been made for this in the analysis.

The value of these benefits have been included in the assessment, however with the tolerances of the cost estimates and the possibility of 220/66 kV development, it is not possible to clearly say that the Rowville option is better than the Cranbourne option at this time. Details of Cranbourne and Rowville development options are shown in Appendix 2 of the accompanying Technical Report.

Economic comparison of the Cranbourne development option with the ROTS option is shown in accompanying Economic Evaluation report.

6.7 Analysis of Non-network Alternatives

In Section 4.3, non-network alternatives were identified for comparison with the network options being considered. As is clear from Table 6.2, the DSM option of 500MW in Victoria has a net benefit which is less than the base case by $0.4M for the termination upgrade and for the 4th line upgrade. DSM does not affect the transmission loss benefits of the upgrade options. Its main impact is on the generation re-scheduling costs and on the reactive support requirement. From the results presented, the DSM option results in lower benefits, because the cost of supplying the reactive support by means of this option is more expensive than providing it with the line upgrade.

In Table 6.2, the impact of an alternative generation development schedule can also be seen. For the market development scenario, which involves the retirement of a 500MW generator in the Latrobe Valley, the net benefit for the Rowville Option is only $2.9M, compared to the base case benefit of $7.5M. This difference is largely due to the lower transmission and generation rescheduling benefits which arise from this option, compared to the base case.

A more detailed assessment of both the network and non-network alternatives is presented in the Economic Assessment report. However, this assessment presented here for the base case shows that whilst DSM and alternative generation developments do deliver some of the four benefits identified in this study, they do not maximise the net benefits

6.8 Project Timing

Additional sensitivity to those reported in Section 6.4 was conducted to assess the timing of the Rowville option. Base case studies have assumed commissioning of the project by financial year 2003/04. Table 6.13 shows NPV values of the Rowville option for different commissioning times.

Commissioning year	NPV ($M) of the Rowville option		
	6% discount rate	8% discount rate	10% discount rate
2002/03	**12.02**	**7.60**	3.71
2003/04	11.54	7.54	4.09
2004/05	10.84	7.25	4.21
2005/06	10.2	7.00	**4.33**
2006/07	9.36	6.56	4.24

Table 6.13: Net benefits of the Rowville option with commissioning date

Based on this assessment NPV of the project is highest in financial year 2002/03 for the discount rates 8% and 6%. Timing for the discount rate 10% is financial year 2005/06. Lead time for the project implementation is around 24 months including consultation, tenders process, detailed design and construction. The project is timed for 31st January 2004 based on highest benefits for most options by early commissioning date and marginal reduction in benefits in the financial year 2004/05 compared with the financial year 2005/06 for the 10% discount rate. In addition, this timing takes higher benefits of the project during summer period into consideration. A similar timing would apply to the Cranbourne option.

6.9 Summary of results

The Capital costs and estimated range of net benefits for each of the four alternative transmission projects identified to remove the constraint are summarised in Table 6.12.

Transmission Alternative	**Median capital cost (estimate $M)**	**Estimated range of net benefits ($M)**	**Number of scenarios that maximises the benefits**	**Number of scenarios with lower costs than benefits**
Termination upgrade	2.6	0.5 to 12.4	3	45
Rowville option	23.8	0.0 to 21.9	38	44
Cranbourne option	35.9	-5.6 to 18.3	4	38
5th 500 kV line	71	-32.4 to –6.0	0	0

Table 6.14: Range of net benefit test with alternative transmission projects

According to the ACCC's regulatory test;

(c) a proposed augmentation maximises the market benefit if it achieves a greater market benefit in most (although not all) credible scenarios; and

(d) an augmentation minimises the cost if it achieves a lower cost in most (although not all) credible scenarios.

As shown above the Rowville option satisfies the ACCC's regulatory test by maximising market benefits for 38 scenarios and by lower costs for 44 scenarios out of 45 credible market scenarios. In effect the total net benefit to all those that produce, distribute and consume electricity in the National Electricity Market is increasing with the project. VENCorp proposes the Rowville option to be commissioned by 1 December 2003 based on higher net benefits to market participants.

7 VENCorp's Conclusion

The analysis shows that the network solution to optimising the Latrobe Valley to Melbourne electricity transmission capacity satisfies the ACCC's regulatory test.

Out of the four network solutions considered "Rowville Option " is the lowest cost alternative with higher benefits for most credible scenarios. Optimum timing for this project is 31st January 2004 based on higher net benefits to market participants. It is proposed to tender for both Cranbourne and Rowville options.

This project reduces CO2 emissions by about 100,000 CO2 tons per year and an approval will be made to the GGAP to register this project for a greenhouse gas grant.

APPENDIX 1

ACCC REGULATORY TEST

On 15 December 1999, the ACCC published the "Regulatory Test for New Interconnectors and Network Augmentations" pursuant to section 5.6.5(q)(1) of the National Electricity Code. The regulatory test is to be applied to transmission augmentation proposals in accordance with clause 5.6.2 of the National Electricity Code.

The test states that "A new interconnector or an augmentation option satisfies this test if it maximises the net present value of the market benefit having regard to a number of alternative projects, timings and market development scenarios".

For the purposes of the test:

(a) market benefit means the total net benefits of the proposed augmentation to all those who produce, distribute and consume electricity in the National Electricity Market. That is, the increase in consumers' and producers' surplus or another measure that can be demonstrated to produce equivalent ranking of options in most (although not all) credible scenarios. The benefits associated with augmentation of the transmission network are the avoided costs of providing the additional network capability. These costs include ;

  - the value of any load that must be curtailed to ensure that the transmission system does not operate beyond its rated capability;
  - changes in the cost of providing ancillary services;
  - the additional cost of generating plant (both fixed and variable costs); and
  - reductions in the cost of losses.

(b) cost means the total cost of the augmentation to all those who produce, distribute or consume electricity in the National Electricity Market;

(c) the net present value calculations should use a discount rate appropriate for the analysis of a private enterprise investment in the electricity sector;

(d) the calculation of the market benefit or cost should encompass sensitivity analysis with respect to the key input variables, including capital and operating costs, the discount rate and the commissioning date, in order to demonstrate the robustness of the analysis;

(e) a proposed augmentation maximises the market benefit if it achieves a greater market benefit in most (although not all) credible scenarios; and

(f) an augmentation minimises the cost if it achieves a lower cost in most (although not all) credible scenarios.

APPENDIX 2

Latrobe Valley to Melbourne 500 kV transmission capacity and generation during summer peak demand periods.

Network condition	**Capacity (MW)**
Transmission capacity with all lines available	5860
Transmission capacity with one 500 kV line out of service	3430

Generator/Interconnector	Existing MW	With Proposed additions (MW)
LYPS A	2000	2000
LYPS B	1300	1300
HWPS	1600	1600
JLPS	432	432
MPS	170	170
Bairnsdale	80	80
YWPS unit 1 (Transferred to 220 kV side)		
Basslink		600
Total injection to the 500 kV system	5582	6182
Loads	606	606
Available for transfer to Melbourne area	4976	5576
Generation constrained (MW)		
With all transmission lines in service	0	0
With one 500 kV line to Melbourne out of service	1546	2146

APPENDIX 3

KEY MARKET SIMULATION ASSUMPTIONS APPLIED IN THE STUDY

Regions	The regions modelled are: Queensland, NSW, Snowy, Victoria, South Australia and Tasmania.
Time period of study, and treatment of the residual value of new capital expenditure	The study period is 10 years, from fiscal 2002/03 to 2011/12. Incremental generation capital costs are incorporated as annuities, to ensure that results obtained for this shortened study horizon are not distorted by cash flow effects associated with long-lived capital expenditures. Interconnector augmentation costs are incorporated as annuities, but the amortisation period applied is set to be equal to the period over which surplus generating capacity is expected to be available for import to Victoria. In effect, this results in the entire capital cost of the various interconnection augmentation options being included as cash-flow costs within the 10 year study period.
Number of Simulations	Number of simulations generated for forecast demand levels. • 100 simmulations with 10% demand • 100 simmulations with 50% demand • 100 simmulations with 90% demand
Demand forecasts	Demand traces used in VENCorp's 2001 Annual Planning Review (APR), modified for coincident 10% reference years in Victoria and South Australia, are available. These traces have been updated to reflect the maximum demand and energy forecasts to be supplied to NEMMCO for the 2001 Statement of Opportunities (SOO). Demand and generation data is expressed on "at generator terminals" basis. Assumed energy growth reflects the Medium energy growth forecast. Maximum demand forecasts having probabilities of exceedance of 10%, 50% and 90% have been used. Separate simulation runs are made for each demand trace. Post-processing is used to obtain composite reliability outputs use the same weightings as those used in the Reliability Panel reserve requirement studies.
Losses	The latest NEMMCO dynamic loss factor equations and static loss factors are used. Details are available at: http://www.nemmco.com.au/operating/transmission/
Existing Generation	Capability of existing generation plant is consistent with that stated in the 2001 NEMMCO SOO, with updated committed plant (if any). Generation capability is on "at generator terminals" basis.
New Generation	The study assumes that all new generating capacity required to maintain the minimum level of reserve determined by the NECA Reliability Panel will be open cycle gas turbines. Out of the new generators in Victorian 50% is assumed to be in Latrobe Valley and the rest in Melbourne metropolitan area.
Bids	Short run marginal cost (SRMC) bidding is assumed for all except for one sensitivity study that used Long run marginal costs (LRMC), in accordance with

	the latest SNOVIC Stage 1 report. This approach enables reasonable estimates to be made of the total resource cost of energy dispatch for each scenario. This approach is consistent with the requirements of the ACCC regulatory test.
Generator Reliability	Generator forced outage rates and outage times are consistent with those stated in the latest SNOVIC Stage 1 report.
Generator Maintenance	Notional periodic maintenance assumptions are consistent with those used in VENCorp's 2001 Annual Planning Review studies.
Snowy	Snowy is modelled as generation in the Snowy region with an annual energy target of 4800 GWh. The monthly profile used is consistent with that applied in the SNOVIC Stage 1 report.
Southern Hydro	Southern Hydro is modelled as generation in the Victorian region with a total annual energy target of 970 GWh. The monthly profile reflects typical inflow and/or irrigation releases.
Transmission	Base transmission is as planned as at 1 December 2001, including DirectLink, MurrayLink, SNOVIC and SNI. Transmission capabilities for QNI are 500 MW North and 1000 MW South. Basslink and SNOVIC 800 are included as transmission variation scenarios.
Basslink	Victorian import capability of 600 MW and Victorian export capability of 400 MW are assumed.
Incremental operations & maintenance	It is assumed that there are no material differences between the incremental operations and maintenance costs for each scenario. On the basis of this assumption, these costs have not been included in the economic evaluation of incremental cost differences between the scenarios.
Discount rate	A discount rate of 6%, 8% and 10% real has been applied.
VoLL	To reflect the ACCC determination of December 2000, expected unserved energy (involuntary load shedding due to insufficient capacity) is valued at the VoLL wholesale market price cap ($5,000/MWh for fiscal 2001/02, and $10,000/MWh thereafter).