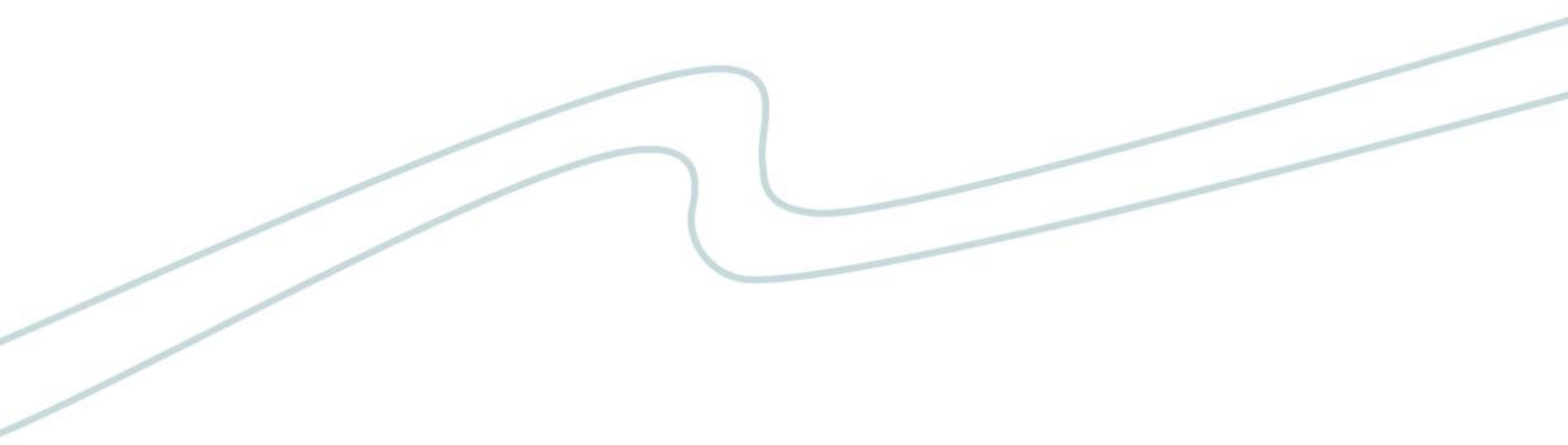


Transpower's North Island Grid Upgrade Proposal

**Analysis of the Electricity Commission's
Reasons for Decision set out in its Notice
of Intention to Approve**

Report to MEUG

30 March 2007



Preface



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1. Purpose

On 20 October 2006, Transpower New Zealand Limited (Transpower) lodged with the Electricity Commission (the Commission) an amended proposal for the North Island Grid Upgrade Project.¹ This replaces Transpower's original proposal (the North Island 400 kV Upgrade Project) as part of the Grid Upgrade Plan (GUP) submitted to the Commission in September 2005.

The Major Electricity Users' Group (MEUG) previously commissioned NZIER and Strata Energy Consulting Limited (Strata Energy) to review Transpower's amended proposal and report on any aspects of the proposal that were unclear and any issues that warranted particular attention and scrutiny by the Commission in the course of reaching its draft decision.²

On 31 January 2007, the Commission announced its intention to approve the investment described in Transpower's amended proposal.³ The Commission has invited interested parties to provide written submissions, by 30 March 2007, to assist it in making its final decision. MEUG has commissioned NZIER and Strata Energy to review the Commission's explanation and reasoning for its draft decision.

2. Transpower's proposal

The main components of Transpower's amended proposal are:

- construction of a new double-circuit overhead transmission line of approximately 190 km from a new substation near Whakamaru in the central North Island to a new transition station on the southern urban edge of Auckland. This new line will be capable of operation at 220 kV and conversion in the future to 400 kV operation
- construction of two underground cables from the new transition station to the Pakuranga substation in Auckland that are capable of 220 kV operation
- construction of the necessary substation and transition station facilities near the present Whakamaru station, at the transition station site on the urban edge of Auckland and at Pakuranga

¹ Transpower (2006) *North Island Grid Upgrade Project, Amended Proposal, Application for Approval*, www.electricitycommission.govt.nz/consultation/transpoweramendedproposal/view

² NZIER and Strata Energy Consulting (2006) *Transpower's Amended North Island Grid Upgrade Proposal*, report to MEUG.

³ Electricity Commission (2007a) *Reasons for Decision set out in Notice of Intention to Approve Transpower's North Island Grid Upgrade Proposal*, www.electricitycommission.govt.nz/pdfs/opdev/transmis/Feb07-decision/Reasons-for-Decision-23Feb07-v15.pdf

- works necessary to convert and connect the existing 110 kV Otahuhu-Pakuranga line to 220 kV operation, for which it is already designed and consented
- dismantling of the existing 110 kV Arapuni to Pakuranga transmission line and
- planning the works, including the acquisition of designations, consents and easements, to allow for future upgrade to 400 kV operation.

The intended commissioning date for construction and dismantling components is 2011 “to prudently allow for potential delays due to delivery, designation, consenting and easement risks.”⁴

Transpower is seeking approval of estimated costs of \$824 million in 2011 dollars. This comprises \$614 million for assets, \$105 million in contingency provision, \$25 million for exchange rate movements and \$80 million in interest payments during construction. If the Commission approves an investment proposal, Transpower is able to recover the approved costs from designated transmission customers in accordance with the transmission pricing methodology determined according to part F, section IV, of the Electricity Governance Rules 2003 (the Rules).

3. Rule requirements

Transpower’s amended proposal is a reliability investment. These are defined in Part A of the Rules as:

investments by Transpower in the grid, or alternative arrangements by Transpower, the primary effect of which is, or would be, to reduce expected unserved energy

Under part F, section III, of the Rules, reliability investments are required to:

- reflect good electricity industry practice in meeting the grid reliability standards set out in the Rules (rule 13.4.1.1)
- comply with the processes set out in the Rules (rule 13.4.1.2) and
- meet the requirements of the grid investment test (rule 13.4.1.3).

3.1 Grid reliability standards

Under the Rules, schedule F3, rule 4, the grid reliability standards require that:

4.1. the power system is reasonably expected to achieve a level of reliability at or above the level that would be achieved if all economic reliability investments were to be implemented; and

⁴ Transpower (2006), p.6.

4.2 with all assets that are reasonably expected to be in service, the power system would remain in a satisfactory state during and following any single credible contingency event occurring on the core grid.

Rule 6 provides that, for the purpose of rules 4.1 and 4.2, above:

the expected level of reliability, and state, of the power system must be assessed using the range of relevant operating conditions that could reasonably be expected, having regard to the possible future scenarios set out in the statement of opportunities.

3.2 Processes

The Commission considers that the processes required by part F, section III of the Rules in relation to Transpower's amended proposal include:

- submitting a GUP to the Commission within three months of receiving a written request from the Commission, or such other date as the Commission agrees (rule 12.2)
- providing such content in the GUP as prescribed in writing by the Commission (as relevant to the proposed investment under consideration) (rule 12.3.4)
- complying with the timetable for consultation and approval of the investment under consideration as agreed by the Commission and Transpower or stipulated by the Commission (rule 13.2) and
- answering the Commission's questions and carrying out investigations and evaluations as required by the Commission under rule 13.3.3.

3.3 Grid investment test

Under the Rules Part F, section III, schedule F4, rule 4, the grid investment test requires that:

4.1. for a proposed investment that is necessary to meet the reliability standard set out in clause 4.2 of the grid reliability standards:

4.1.1. the proposed investment maximises the expected net market benefit or minimises the expected net market cost compared with a number of alternative projects; and

4.1.2. if sensitivity analysis is conducted, a conclusion that a proposed investment satisfies clause 4.1.1 is sufficiently robust having regard to the results of that sensitivity analysis; or

4.2. for any other proposed investment:

4.2.1. the proposed investment maximises the expected net market benefit compared with a number of alternative projects;

4.2.2. the expected net market benefit of the proposed investment is greater than zero; and

4.2.3. if sensitivity analysis is conducted, a conclusion that a proposed investment satisfies clauses 4.2.1 and 4.2.2 is sufficiently robust having regard to the results of that sensitivity analysis.

4. Commission's assessment

4.1 Rule requirements

In its assessment, the Commission is satisfied that Transpower's amended proposal meets the grid reliability standards and Transpower has complied with the relevant processes set out in the Rules.

On the third component of the Rules requirements, the grid investment test, however, the Commissioners are divided. Three Commissioners conclude that the amended proposal meets the requirements of the grid investment test. One Commissioner considers that it does not, on grounds that there is an alternative option that meets the reliability standards at a lower net market cost. The Commission's decision that the amended proposal complies with the grid investment test, and consequently with all Rule requirements, is therefore by majority rather than unanimous.

4.2 Net present value calculations

Transpower considered eight options for upgrading the North Island grid, including a mix of 400 kV, 220 kV and duplexing options from Whakamaru to Pakuranga and Otahuhu. Transpower's analysis of technical feasibility, diversity and capital cost reduced the options for further consideration to just two:

- option 2, the amended proposal, as outlined above, and
- option 1, the main component of which is construction of a 220 kV transmission line.

The Commission has reviewed the methodology, models, inputs and assumptions used by Transpower to calculate net present values for options 1 and 2. The Commission finds Transpower's approach appropriate, but, in its own calculations, differs in the analysis parameters it adopts in four respects (five year lead time, transformer rationalisation benefit, cable adjustments and revised market development scenarios).

As noted above, the Commission is not unanimous in finding option 2 to be the lower cost option. The alternative calculations of Commissioner Pinnell are presented below. The majority of the Commission finds option 2 to have a net present value cost of \$689.5 million in 2006 dollars, whilst option 1 has a net

present value cost of \$700.4 million.⁵ Thus, under these calculations, option 2 is the lower cost option by only \$11.0 million, just 1.6 per cent. The difference between these and Transpower's calculations (following correction of an error by the Commission in loss modelling, Transpower estimates option 2 to be the lower cost option by \$11.9 million⁶) is not material; the conclusion is the same – that option 2 is the lower cost option, and remains so throughout most of the sensitivity analysis, but by only a narrow margin.

4.3 Alternative calculations

Commissioner Pinnell presents alternative net present value calculations.⁷ These calculations are predicated on the assumptions that options 1 and 2 are very similar in electrical performance and have identical future development options, given that option 2's 400 kV line would operate at 220 kV until, if ever, energised at 400 kV when demand growth necessitates greater capacity. We consider the validity of these assumptions below.

The main difference between the two options, up to the point of full utilisation of the capacity of these lines at 220 kV, is option 2's need for larger towers, in terms of height, base width and steel size, which incur significantly higher capital, operating and maintenance costs.⁸ Up to 220 kV capacity, therefore, option 1 costs less than option 2. This capacity is forecast to be sufficient until around 2050.

Beyond 2050, when demand growth necessitates greater capacity, option 2 could be upgraded to 400 kV with the installation of transformers at the South Auckland and Whakamaru substations. Commissioner Pinnell contends that such an upgrade is not reasonably likely, however, without also constructing a second 400 kV-capable line, due to the significant risk and consequences of double circuit failure on a single line of such capacity when heavily loaded and serving a large portion of the upper North Island load.

Together, these two 400 kV lines operating at 220 kV would provide sufficient capacity for about a century before any need to energise one at 400 kV. This future development option of adding a further line exists equally under option 1. Indeed, until one of the 400 kV lines operating at 220 kV were energised at 400 kV, a further 220 kV line would be able to provide just as great a capacity at a lower cost than a second 400 kV line, as for the initial investment, above.

⁵ Electricity Commission (2007a), p.73.

⁶ Electricity Commission (2007b) *Economic Analysis of the Revised North Island Grid Upgrade Project*, <http://www.electricitycommission.govt.nz/pdfs/opdev/transmis/feb07-decision/Economic-Report-23-Feb07-v3.pdf>

⁷ Electricity Commission (2007a), pp.78-92.

⁸ Electricity Commission (2007a), p.77.

Thus, option 2 represents the higher cost option up to 220 kV capacity around 2050, without offering any cost advantage in future development options beyond 2050. Commissioner Pinnell estimates option 1 to have an economic advantage over option 2 in incurring between \$39 million and \$45 million less in net present value costs. This comprises savings of \$40 million in capital costs and \$7 million in operating and maintenance costs, offset by \$1 million more in losses and between \$1 million and \$7 million additional expenditure on a modelled project to equate the capacities of the two options.

4.4 Additional benefits

Transpower identifies a number of additional benefits of option 2 in terms of competition, business confidence, strategic interaction between investments, regional environment, and facilitation of renewables.

The Commission acknowledges that there may be competition benefits in terms of a reduction in opportunities for the exercise of market power, due to the perception of increased future certainty of capacity or the ability to release additional capacity at short notice. Given the analytical difficulty of separately identifying and calculating these competition benefits, however, they have not been included in the Commission's application of the grid investment test. The Commission considers the alleged "perception of certain capacity" benefits, including business confidence, not to be material. It considers the strategic, regional environmental and renewables facilitation benefits to have already been taken into account in the base calculations or sensitivity analysis.

5. Our analysis

5.1 Our previous review of the amended proposal

5.1.1 Our recommendations

In our previous review of Transpower's amended proposal,⁹ we recommended that the Commission:

- consider whether Transpower has:
 - established that there will be sufficient surplus generation to require the proposed amount of additional transmission capacity between Whakamaru and Auckland
 - adopted appropriate load growth scenarios given the evidence available on demand growth and the context in which its estimates will be used

⁹ NZIER and Strata Energy Consulting (2006) *Transpower's Amended North Island Grid Upgrade Proposal*, report to MEUG.

- adopted an approach to extending the period of analysis that is consistent with the grid investment test and, if so, consider whether the approach is appropriate in the light of the uncertainties about future technology and asset prices
- proposed efficient costs and the Commission should look for ways to ensure Transpower will seek out cost savings in planning and construction
- included only capital expenditure items in the \$27 million of investigations for which it is seeking approval
- review Transpower’s capacity figures for the Otahuhu to Whakamaru A and B circuits and any impact this error may have had on the analysis
- seek answers regarding the variations in cost between apparently similar tasks in the Costing Report and be satisfied that the significant additional property costs for the duplexing options are reasonable and realistic
- consider the opportunity benefits through the adoption of future new technology that some options create and include this value in comparative analysis of the options
- seek clarification from Transpower on whether:
 - if a reasonable allowance for demand-side management was included in the non-transmission alternatives, this would have a material impact on the analysis and preferred option
 - the expected impact of the proposed transmission price methodology has been considered in the use of load growth scenarios and, if not, why not
- seek assurances on the technical and operational issues regarding the series compensation and decommissioning of the 110 kV Arapuni to Pakuranga line
- consider the appropriate allocation of the costs of cabling when completing comparisons of the options
- before being influenced to favour the lower end of the discount rate spectrum by the supporting attachment to Transpower’s amended proposal, obtain a thorough review of the use of discount rates in regulatory tests like the grid investment test
- review the values of unserved energy it prescribes for use in the grid investment test and take a cautious view of Transpower’s argument that the value of unserved energy in Auckland is \$41,000/MWh
- disregard the argument that gold plated transmission investment into Auckland will fool controllers of foreign direct investment and result in a sharp rise in New Zealand’s economic welfare and
- seek a very high standard of transparency in all the detailed material it obtains from Transpower and others.

5.1.2 Commission's assessment

We note that in its assessment of Transpower's amended proposal, the Commission has addressed a number of the concerns we raised in our previous paper. Specifically, the Commission has:

- rejected Transpower's use of the higher growth scenario demand-side forecasts alone as the basis of its analysis; the Commission has used the demand forecasts from the 2005 initial statement of opportunities (SOO)¹⁰ and included the lower demand forecasts from the draft 2007 SOO in sensitivity analysis; the Commission's explanation for not adopting the demand scenarios from the draft 2007 SOO is that Transpower first submitted its proposal under the earlier SOO and the draft 2007 SOO has not yet been finalised; given the legal nature of the role of the Commission, we consider it appropriate for the Commission to adopt this course of action, despite a lower demand scenario than predicted in the 2005 SOO now being more likely
- included a Monte Carlo procedure in the net present value analysis to capture the uncertainty in demand growth rates and generation locating in the Auckland region, as a means to assess the real option value of flexible investment timing
- used an extended variant of the "low demand" market development scenario outlined in the 2005 initial SOS instead of some combination of a variety of alternatives; it has justified its decision to focus on this scenario by referring to a number of recently released government policy documents:
 - the Government Policy Statement
 - the draft New Zealand Energy Strategy and
 - a letter to generators from the Minister indicating that the Government is considering means to restrain carbon emissions
- engaged Parson Brinckerhoff Associates (PBA) to scrutinise Transpower's capital cost estimates; PBA's and Transpower's capital cost estimates were found to be largely consistent and the Commission decided to use Transpower's estimates in its base calculations and PBA's estimates in sensitivity analysis; furthermore, the Commission has indicated its intention to approve the amount sought by Transpower or the actual costs incurred, whichever is the lower; this would cause Transpower to bear the risk of costs being higher than estimated, although, given the size of the contingencies included, this risk is unlikely to materialise
- modelled an analysis period of 20 years, plus terminal benefits
- applied a discount rate of seven per cent, ranging between four per cent and 10 per cent in sensitivity analysis
- adopted a value of unserved energy of \$20,000/MWh, ranging between \$10,000/MWh and \$30,000/MWh in sensitivity analysis

¹⁰ Electricity Commission (2005) *Initial Statement of Opportunities*, July 2005, www.electricitycommission.govt.nz/pdfs/opdev/transmis/soo/pdfssoo/Initial-SOO-final.pdf

- disregarded the suggested business confidence benefits of effects on foreign direct investment and economic growth.

There are, however, a number of other matters we raised in our earlier paper that we do not think have been adequately addressed. These are:

- whether there will be sufficient surplus generation to require the proposed amount of additional transmission capacity between Whakamaru and Auckland
- whether Transpower has included any operating expenditure in the \$27 million of investigation costs for which it is seeking approval
- review Transpower's capacity figures for the Otahuhu to Whakamaru A and B circuits and any impact this error may have had on the analysis; we understand that the Commission has found this to be an error in the drawings and that Transpower's calculations do not contain this error
- consider the opportunity benefits through the adoption of future new technology that some options create and include this value in comparative analysis of the options
- seek clarification from Transpower on whether including a reasonable allowance for demand-side management in the non-transmission alternatives would have a material impact on the analysis and preferred option
- seek assurances on the technical and operational issues regarding the series compensation and decommissioning of the 110 kV Arapuni to Pakuranga line.

5.2 220 kV alternative option

Given that option 2's 400 kV line would operate at 220 kV until, if ever, energised at 400 kV when demand growth necessitates greater capacity, Commissioner Pinnell's alternative net present value calculations are predicated on options 1 and 2 being very similar in electrical performance and having identical future development options.

From a technical perspective, options 1 and 2 are very similar until 2031 when the second 220 kV line would be built. Up to this point, system losses are the same¹¹ under both options. Energy transfer capability for both options is above the high upper North Island load scenario until at least 2040.¹² Beyond 2031, option 1 provides an earlier increase in transfer capacity than does option 2. Dynamic requirements for both options are also comparable up to building of the second 220 kV line under option 1 or the change to 400 kV under option 2.

It is therefore reasonable to conclude that both options 1 and 2 provide technically sound solutions until the step changes are made post-2031. After 2031, option 1 provides an earlier increase in transfer capacity than does option 2.

¹¹ Transpower (2006), Attachment A, Figure 6-10.

¹² Transpower (2006), Attachment A, Figure 6-1.

Commissioner Pinnell has, however, highlighted a key technical issue for option 2 in terms of the vulnerability of the 400 kV line to infrequent but significant events. For the 400 kV line to be economically worth building and operating at 400 kV, it must take a significant proportion of the Auckland load. This raises questions about the implications of an outage on the 400 kV circuits.

It has been suggested that special protection schemes (SPS) or automatic under frequency load shedding (AUFLS) would be used to provide n-1 security levels. It is interesting to note that in the past Transpower has resisted the use of such schemes and has only used them as temporary measures.¹³ We consider that the proposed use of SPS is not technically sound for the management of security of the Auckland load and is unlikely to meet the requirements of good electricity industry practice. The Commission should also be certain that the mean time between failure (MTBF) figures provided by Transpower are independently verified. We would expect the people of Auckland to be surprised to learn that an outage of the 400 kV line (that they have paid dearly for) is proposed to be managed by power cuts.

We agree with Commissioner Pinnell's conclusion that, due to the above issue, it is highly likely that Transpower would seek approval for the construction of a second 400 kV line before stepping up the voltage on the first line to 400 kV. A second 400 kV line would provide a massive capacity increase far ahead of the requirements of Auckland demand.

The Commission should give serious consideration to Transpower's proposed management of the good electricity industry practice concern raised by Commissioner Pinnell. Transpower's current proposal to use SPS appears to be technically unsound and the Commission should seek further technical advice on the likely timing of the need for a second 400 kV line in order to meet grid reliability standard requirements. As it stands currently, option 2 does not provide an adequately full solution and should be revised to include amendments that address the security management issue that arises when voltage is stepped up to 400 kV.

Option 1 delivers a diversified system of supply by spreading load across existing and two new line routes. The capacity increase would be sufficient to meet Auckland's forecast demand into the second half of the century. This option is technically sound, meets good electricity industry practice and does not raise questions of technical risk and uncertainty.

5.3 Duplexing alternative option

The Commission gives no further consideration to Transpower's option 3, duplexing existing line routes. This option still, however, appears to provide a

¹³ Management of Manapouri second tailrace connection and Bay of Plenty inter-trip prior to thermal upgrades of circuits.

technically sound solution that defers the need for major line construction. It is interesting to note that Transpower appears to be satisfied that duplexing existing line routes is an appropriate and technically sound approach to take in the South Island. Greater certainty over Transpower's ability to undertake such upgrades has been provided through the recent Fernwood Dairies Environment Court decision. Yet Transpower appears to be set against using such an approach for Auckland transmission.

Our understanding is that, by duplexing the Otahuhu to Whakamaru A and B lines, there will be sufficient additional capacity to defer the construction of new line routes for several years. In addition, the decommissioning of the 110 kV Arapuni to Pakuranga lines could be postponed, eliminating the risks associated with this aspect of the 400 kV option.

In light of the greater certainty over Transpower's rights to undertake existing line upgrades, we consider that it would be appropriate for the Commission to undertake a further review of the duplexing option, including the optimisation of conductor selection.

5.4 Commencement date

The Commission's draft decision on Transpower's original proposal (the North Island 400 kV Upgrade Project) suggested that new lines would not need to be constructed until 2017. Transpower's amended proposal provides for new line construction in 2013. The Commission has not made it clear why it is accepting the earlier date.

5.5 Additional costs considered in the Resource Management Act approval process

The role of the Commission is to approve or not to approve the proposed investment under the Rules. Should Transpower's amended proposal be approved by the Commission in this respect, it is required to be submitted for approval under the Resource Management Act 1991 also. The latter requires the additional consideration of environmental costs.

Even without Commissioner Pinnell's alternative calculations, the calculations of the majority of the Commission still raise serious doubts that option 2 would remain the lower cost option with consideration of not only economic costs and benefits but also environmental costs. Option 2 would require larger towers, in terms of both height and base width, than option 1.¹⁴ Option 2 would therefore incur significantly higher environmental costs.

Under the Commission's majority calculations, option 2 has net economic costs of only \$11.0 million less than the 220 kV alternative option. Should, as seems to us

¹⁴ Electricity Commission (2007a), p.77.

to be very likely, the environmental costs be assessed by the Environment Court to be more than \$11.0 million higher for option 2, the total net costs would tip in favour of option 1. \$11.0 million is only 1.6 per cent of its net economic cost.

To tip the balance back in favour of option 2, Transpower would have to convince the Environment Court to overturn the decisions the Commission has made on economic grounds or to include in the analysis the additional benefits that the Commission has not ruled out but has not quantified – the competition benefits.

We consider it unlikely that the Environment Court would readily overturn the Commission's judgement on the economic matters relating to transmission which the Commission was established to make.

Transpower's only real hope to receive approval for option 2 would, therefore, be to convince the Environment Court to value the competition benefits that the Commission has found itself unable to value and for the Environment Court to find these values to be large enough to offset the significant relative environmental detriment. We believe this approach also unlikely to succeed.. We are sceptical about the relevance of the alleged competition benefits that the Commission has omitted but not dismissed and we believe that the Environment Court would struggle to identify and accept their materiality, never mind quantify them.

6. Conclusions

Commissioner Pinnell's alternative net present value calculations show Transpower's amended proposal, to be the higher cost option up to 220 kV capacity around 2050, without offering any cost advantage in future development options beyond 2050. He estimates the difference in net present value costs to be in the range of \$39 million to \$45 million.

This difference in net costs is material, even without considering the option value of allowing for technological developments providing new lower cost future development options within the considerable time period until full utilisation of the capacity of the line at 220 kV.

Additionally, the technical questions raised regarding the management of outages on the proposed 400 kV line should give the Commission serious cause for concern. If the Commission approves Transpower's amended proposal, it seems highly likely that, before any benefits of such a decision are realised, the Commission will be faced with an application for a further 400 kV line. On the other hand, if Transpower's amended proposal is judged as it stands currently, it may not meet good electricity industry practice, in which case the Commission should not approve it.

Even under the Commission's majority calculations, the small economic advantage but likely significantly higher environmental costs of option 2 raise

serious doubts that this would remain the lower cost option with consideration of not only economic costs and benefits but also environmental costs. If option 2 did not receive Resource Management Act approval, the Commission would have to reconsider, and re-consult on, options for upgrading the North Island grid. This could add up to two years more to the approvals process.

The Commission's role does not involve it in the Resource Management Act approval process, but the Commission does need to consider the implications of the delay resulting from an option that it has approved not receiving Resource Management Act approval.

The Commission's role is to approve or reject Transpower's proposal. It cannot make its own proposal and then accept it as it has no right to direct Transpower to undertake investments. In view of this, we suggest that to ensure smooth decision making the Commission must reject Transpower's current proposal. Given the narrow economic benefit of its proposal over an alternative, even if the calculations of the majority are accepted, Transpower's proposal will almost certainly fail under the Resource Management Act process.

It would be preferable for Transpower to be given the opportunity now to put up even if only as an option a proposal that is likely to succeed in the Environment Court. The alternative is to go all the way through a lengthy decision making process involving the Commission and the Court only to have to effectively start again.

The Commission has addressed many of the issues we raised in our earlier paper on Transpower's current proposal, but some appear to us to be still outstanding. We have noted these above. We believe the Commission should address these outstanding points, or require Transpower to do so. Moreover, why the Commission has accepted a line construction date of 2013 when in its draft decision to reject Transpower's previous 400 kV upgrade proposal it found that construction was not necessary until 2017 should be fully explained by the Commission. The later start date was such a key matter in the Commission's earlier decision that the change in its view cannot be left unexplained.