Reasons for Decision set out in Notice of Intention to Approve Transpower's HVDC Grid Upgrade Proposal

Prepared by Electricity Commission

29 July 2008
Executive summary

Proposal

1. On 2 May 2008, the Commission received from Transpower New Zealand Limited a proposal to upgrade the HVDC inter-island link (the Proposal). The Proposal comprises Part V of Transpower’s 2007 grid upgrade plan (2007 GUP), which is submitted in accordance with rule 12 of section III of Part F of the Electricity Governance Rules 2003 (rules).

2. The Proposal was submitted as an “economic investment”, as defined in Part A of the rules.

Rule requirements

3. The rules are promulgated under the Electricity Act 1992. Section III of part F of the rules includes rules dealing with upgrades to, and investments in, the national electricity transmission grid owned by Transpower.

4. In particular, rule 14.4 provides that, subject to rule 15, the Commission may approve an economic investment if the Commission is satisfied that Transpower has:

   (a) applied the grid investment test (GIT) reasonably; and

   (b) followed any agreed consultation process.

5. Rule 15 requires the Commission to publish a notice of its intention to approve some or all of the investment proposals in a GUP. Under rule 15.2 certain parties are able to request a public conference. The purpose of a public conference is to provide a final opportunity for comment.

6. If a public conference is requested, the Commission must consider whether it wishes to agree to that request. If the Commission does not agree to hold a public conference, the Commission’s decision, as set out in the notice of intention, is final.

Has Transpower applied the GIT reasonably?

7. The Commission is satisfied that Transpower has applied the GIT reasonably.

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1 Unless otherwise stated, all references to rules in this paper are to rules in section III of part F of the Electricity Governance Rules, references to schedules are to schedules in section III of part F, and references to clauses are to clauses in schedule F4 (Grid Investment Test).

2 Rule 15.3.
Has Transpower followed any agreed consultation process?
8. The Commission is satisfied that Transpower has followed the agreed consultation process.

Intention to approve the Proposal
9. The Commission concludes that the Proposal satisfies the requirements of rule 14.4. On 31 July 2008, the Commission issued a notice of its intention to approve the Proposal.
10. If a public conference is not requested, or if the Commission does not agree to hold a conference, the Commission’s decision set out in the notice of intention will be final.
11. The purpose of this document is to:
   (a) present the Commission’s analysis as to whether the Proposal meets the requirements of rule 14.4; and
   (b) explain the reasons supporting the Commission’s decision, as set out in this document, to approve the Proposal.
## Glossary of abbreviations and terms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>2005 GUP</td>
<td>The grid upgrade plan submitted by Transpower on 30 September 2005</td>
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<tr>
<td>2005 SOO</td>
<td>The statement of opportunities published by the Commission in July 2005</td>
</tr>
<tr>
<td>2007 GUP</td>
<td>The grid upgrade plan submitted by Transpower on 21 September 2007</td>
</tr>
<tr>
<td>GIT</td>
<td>The grid investment test, which is set out in schedule F4 of section III of part F of the rules</td>
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<tr>
<td>MDS</td>
<td>Market Development Scenarios</td>
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<td>NPV</td>
<td>Net Present Value</td>
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<td>NZES</td>
<td>New Zealand Energy Strategy</td>
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<tr>
<td>O&amp;M</td>
<td>Operation and Maintenance</td>
</tr>
<tr>
<td>PBA</td>
<td>Parsons Brinckerhoff &amp; Associates</td>
</tr>
<tr>
<td>Proposal</td>
<td>Transpower’s proposal to upgrade the HVDC inter-island link, submitted to the Commission on 2 May 2008</td>
</tr>
<tr>
<td>rules</td>
<td>Electricity Governance Rules 2003</td>
</tr>
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1. The proposal

1.1 Background to the Proposal

1.1.1 On 30 September 2005, Transpower New Zealand Limited submitted its 2005 grid upgrade plan (2005 GUP) to the Commission in accordance with rule 12 of section III of Part F of the Electricity Governance Rules 2003. Volume 3 of the 2005 GUP included a proposal to upgrade the HVDC inter-island link. This proposal was submitted as a “reliability investment”, as defined in Part A of the rules.

1.1.2 On 21 October 2005, the Commission wrote to Transpower to state its view that this proposal should be considered as an economic investment, rather than a reliability investment. This was because the primary effect of the investment is not to reduce expected unserved energy. On 8 December 2005, Transpower agreed that it was appropriate to analyse the proposal as an economic investment.

1.1.3 In the interim, at a meeting held on 29/30 November 2005, the Commission approved (under rule 16) $6.3 million of interim grid expenditure to enable Transpower to carry out an investigation of the performance requirements for the new link.

1.1.4 In June 2006, the Commission agreed to a request from Transpower that consideration of the investment proposal relating to the HVDC link contained in the 2005 GUP be suspended.

1.1.5 Transpower undertook work on a revised proposal to upgrade the HVDC inter-island link as an economic investment and consulted with substantially affected parties on its application of the GIT during March and April 2008.

1.1.6 On 2 May 2008, Transpower submitted to the Commission a revised proposal (the Proposal) to upgrade the HVDC inter-island link as Part V of Transpower’s 2007 GUP. The Proposal was submitted as an “economic investment”, as defined in Part A of the rules.

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3 Unless otherwise stated, all references to rules in this paper are to rules in section III of part F of the Electricity Governance Rules, references to schedules are to schedules in section III of part F, and references to clauses are to clauses in schedule F4 (Grid Investment Test).

4 A copy of the Proposal and additional supporting information provided by Transpower is available on the Commission’s website: http://www.electricitycommission.govt.nz/pdfs/opdev/transmis/HVDC/May08-proposal/proposal.pdf
1.1.7 At the same time, Transpower withdrew the previous proposal contained in Volume 3 of the 2005 GUP.

1.1.8 On 18 July 2008, Transpower wrote to the Commission to reduce the amount for which approval is sought, from $728 million to $672 million.

1.2 The purpose of the Proposal

1.2.1 Transpower describes the purpose of the Proposal as being to obtain the Commission’s approval to recover the full costs (up to $672 million) associated with procuring, constructing and commissioning a new thyristor-based 700 MW pole and associated equipment (including converters, condensers, new control systems, transformers) at Haywards and Benmore by 2012.\(^5\)

1.2.2 The new pole will replace the existing Pole 1 of the HVDC inter-island link, and, together with Pole 2, will provide 1000 MW link capacity from 2012. The Proposal does not include replacement of the existing lines or augmentation of the existing cables of the HVDC inter-island link comprising 571 km of bipolar transmission line and 40 km of submarine cables.

1.2.3 Transpower states that Pole 1 uses equipment and technology that are no longer supported by manufacturers. Transpower has already decommissioned half of Pole 1, although Transpower has made the remaining half pole available for limited operation during peak demand periods for 2008, with the use of Pole 1 for subsequent years to be determined on an annual basis. Without Pole 1, the capacity of the inter-island link with Pole 2 operating is presently 700 MW. With Pole 1 operating on a half pole basis, the total capacity of the link is 970 MW.

1.2.4 In the Proposal, Transpower describes the measures for which approval is sought as follows:\(^6\)

   **Stage 1:**

   - Procuring, constructing and commissioning new HVDC converter station facilities including control systems at Haywards and Benmore that:
     - have nominal continuous ratings of around 700 MW at 350 kV; and
     - have AC filters suitable for bipole operation of around 1200 MW.

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\(^5\) Ibid, executive overview.

\(^6\) Ibid, page 4.
• Procuring and constructing seismic strengthening works for existing and new switchyards at Haywards and Benmore.

• Procuring, constructing and commissioning extended and new 220 kV switchyards to facilitate the connection of the new HVDC converter station facilities and (in preparation for Stage 2) new dynamic reactive power compensation facilities at Haywards.

• Procuring, constructing and commissioning extended 220 kV switchyards to facilitate the connection of the new HVDC converter station facilities at Benmore.

• Decommissioning and removal of existing HVDC control system facilities at Haywards and Benmore including:
  • Pole 2 control systems and valve base electronics; and
  • bipole control systems.

• Procuring, constructing and commissioning new HVDC control system facilities at Haywards and Benmore including:
  • Pole 2 control systems and valve base electronics;
  • bipole control systems; and
  • SCADA interfaces at the converter stations.

• Procuring, constructing and commissioning communication facilities to enable efficient operation of the bipole link.

• Procuring, constructing and commissioning new unit connection transformers for the existing C7, C8, C9 and C10 synchronous condensers at Haywards.

• HVDC transmission line works and activities required to facilitate the above.

Stage 2:

• Procuring, constructing and commissioning new dynamic reactive power compensation facilities at Haywards to enable bipole operation of at least 1200 MW.

Common to Stage 1 and Stage 2:

• Obtaining approvals under the Resource Management Act (including designations and consents) and easements and property purchases for the above.
• Any additional minor works and activities required to facilitate the above.

1.2.5 Transpower confirmed that the elements of Stage 1 comprising procuring, constructing and commissioning new HVDC control system facilities at Haywards and Benmore, and additional minor works and activities required to facilitate such works include works to replace the existing submarine cable electrical protection equipment located at Fighting Bay and Oteranga Bay.

1.2.6 In a technical specification provided in May 2008, Transpower advised that it will consider including in the works a number of frequency and power control features that could benefit the wholesale electricity market. The Commission encourages Transpower to fully explore the opportunities for including those features in the works. The Commission considers that those features are important as they will support the development of a national reserves market and better integration of wind generation into the electricity system. Those possible benefits are discussed further in section 5.3 of this document.

1.3 Proposal submitted as an economic investment

1.3.1 The Proposal was submitted by Transpower as an economic investment. The term "economic investments" is defined in part A of the rules as follows:

"economic investments" means investments in the grid that can be justified on the basis of the grid investment test under section III of part F and are not reliability investments;

1.3.2 Reliability investments are defined in part A of the rules as follows:

"reliability investments" means 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;

1.3.3 Expected unserved energy is defined in part A of the rules as follows:

"expected unserved energy" means a forecast of the aggregate amount by which the demand for electricity exceeds the supply of electricity at each grid exit point as a result of likely planned or unplanned outages of primary transmission equipment;

1.3.4 As set out in paragraph 1.2, the Proposal is directed at constructing and commissioning a new thyristor-based 700 MW pole and associated equipment (including converters, condensers, new control systems, transformers) at Haywards and Benmore. Transpower states that the purpose of the Proposal is

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7 Paragraph 2.2.5
therefore not relevant to reducing a demand and supply imbalance of the type described in the definition of expected unserved energy.

1.3.5 The Commission agrees that the Proposal is appropriately categorised as an economic investment.

1.4 **Overview of estimated costs**

1.4.1 Transpower is seeking approval to recover the lesser of actual costs or the estimated 90% of project costs (P90 cost).

1.4.2 On 18 July 2008 Transpower amended the amount for which approval is sought, reducing it from $728 million to $672 million. The table below breaks down the original amount for which approval was sought and the revised amount:

<table>
<thead>
<tr>
<th>Table 1: Estimate of project costs</th>
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</thead>
<tbody>
<tr>
<td>Original approval amount</td>
</tr>
<tr>
<td>-------------------------------</td>
</tr>
<tr>
<td>Estimated capital cost (in $2007)</td>
</tr>
<tr>
<td>Scope contingency (in $2007)</td>
</tr>
<tr>
<td>Expected cost (in $2007)</td>
</tr>
<tr>
<td>Price contingency (in $2007)</td>
</tr>
<tr>
<td>Exchange rate variation (in $2007)</td>
</tr>
<tr>
<td>Interest during construction (in $2007)</td>
</tr>
<tr>
<td>Inflation</td>
</tr>
<tr>
<td>Estimated P90 cost</td>
</tr>
</tbody>
</table>
### Revised approval amount

<table>
<thead>
<tr>
<th>Revised approval amount</th>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Total</th>
<th>Diff</th>
</tr>
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<tbody>
<tr>
<td>Estimated capital cost (in $2007)</td>
<td>371</td>
<td>42</td>
<td>413</td>
<td>1</td>
</tr>
<tr>
<td>Scope contingency (in $2007)</td>
<td>25</td>
<td>3</td>
<td>28</td>
<td>-30</td>
</tr>
<tr>
<td>Expected cost (in $2007)</td>
<td>396</td>
<td>45</td>
<td>441</td>
<td>-29</td>
</tr>
<tr>
<td>Price contingency (in $2007)</td>
<td>48</td>
<td>4</td>
<td>52</td>
<td>-16</td>
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<tr>
<td>Exchange rate variation (in $2007)</td>
<td>43</td>
<td>5</td>
<td>48</td>
<td>-3</td>
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<tr>
<td>Interest during construction (in $2007)</td>
<td>44</td>
<td>5</td>
<td>49</td>
<td>-6</td>
</tr>
<tr>
<td>Inflation</td>
<td>95</td>
<td>16</td>
<td>111</td>
<td>-9</td>
</tr>
<tr>
<td>Estimated P90 cost</td>
<td>600</td>
<td>72</td>
<td>672</td>
<td>-56</td>
</tr>
</tbody>
</table>

1.4.3 The difference column shows the difference between the original amount and the revised amount. Negative numbers show a reduction from the original estimate. However, the changes to the individual components are not cumulative, because the uncertainties associated with the changes between the original amounts and the revised amounts are independent.

1.4.4 The difference is attributable primarily to a reduction in the scope contingencies and a reduction in the converter cost estimates.  

1.4.5 The cost for which approval is sought is expected to be an amount that the project is most likely to be completed within. In statistical terms, it is expected with 90% confidence that the project costs will be less than the approved amount. Such costs are also referred to as “P90” costs, and represent a cap which is expected to be reached only one occasion out of 10.

1.4.6 The Commission uses the expected cost in order to apply the GIT, rather than the P90 cost, because it is not expected that the cost at the top of the P90 range will be the actual cost for the project.

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8 Those matters are discussed further in paragraphs 5.2 and 7.2 of this paper respectively.
1.4.7 A meaningful comparison between the Proposal and alternatives is therefore best achieved by using expected costs in all cases.

1.4.8 The Commission expects that the approved costs will provide an adequate contingency amount to enable Transpower to manage many foreseeable risks that arise during a large construction project without having to come back to the Commission to seek additional funds (as provided for in rule 17). However, approving a maximum amount that is too high could lead to poor project management, cost management, and contractor management, as well as extensions to the scope of the project.

1.4.9 Confidence as to the reasonableness of both the expected costs, and the amount for which approval is sought is therefore important in considering an investment proposal.

1.4.10 If the costs for which approval is sought are not reasonable, this may call into question the reasonableness of the expected costs used in applying the GIT.

1.4.11 Even if it can be established (as in this case) that the expected costs used in applying the GIT to the Proposal are reasonable, the Commission is of the view that it must be satisfied that the amount for which approval is sought is reasonable. If that amount is not reasonable, then the Commission should not approve the Proposal.

1.4.12 Given that Transpower has a number of major projects projected to be commissioned in or about 2012 (and a number of other smaller projects), the Commission expressed some concern to Transpower about the likelihood of the Proposal being delivered within the proposed timeframe and for the expected costs. The Commission expects that Transpower will take into account issues such as design and construction resources, contractor performance, Transpower’s staff resource, system operator resources, material provision and industrial relations when managing the implementation of the Proposal, in order to facilitate the delivery of the Proposal for the expected costs.

1.4.13 Transpower has confirmed to the Commission that it will use efficient project management techniques to manage project costs and risks to the Proposal.

1.4.14 The Commission is satisfied that the revised amount for which approval is sought is reasonable.

1.4.15 The Commission’s approval is intended to accurately define the maximum amount that can be recovered from designated transmission customers.

1.4.16 For this reason the Commission intends to approve actual costs up to $672 million. This effectively establishes the maximum “book value” for the regulated asset base.
1.4.17 Under rule 17.1, Transpower may recover approved costs in accordance with the Transmission pricing methodology. The approved costs of a grid investment may not be revoked or amended except with the consent of Transpower (rule 17.2). If unforeseen circumstances arise, or if a number of significant risks associated with implementing a proposal of the size and complexity anticipated by the Proposal arise, the Commission will consider a request from Transpower to increase the maximum approved amount.

1.4.18 However, Transpower has some room to move within the contingency amount provided for, and the Commission expects that Transpower will be able to manage within that amount a number of contingency events without having to seek an increase in the approved amount.

1.5 **Timing of Proposal**

1.5.1 In relation to the timing of the Proposal, Transpower states:

> “Transpower will work towards commissioning Stage 1 of the Proposal in 2012 and Stage 2 in 2014”

1.5.2 The Commission’s review of the base case (discussed in paragraph 4.4) and alternatives (discussed in paragraph 4.8) suggests that there may be some flexibility in the timing of the Proposal.

1.5.3 Specifically, Transpower may be able to co-ordinate the commissioning of the new Pole 1 converter equipment with the decommissioning of the existing Pole 1 equipment. Transpower may be able to use this flexibility in a manner which minimises the cost of the proposed project and the costs faced by designated transmission customers who are required to pay for the Proposal. For example, Transpower could choose to accept delay in project delivery rather than imposing onerous liquidated damages provisions or seeking to accelerate work to meet the original timeframe.

1.5.4 Deferring expenditure on the project would mean that designated transmission customers would not be required to pay for the investment until a later date. In addition, if the existing Pole 1 equipment could be maintained for longer, it is possible that grid users would be able to rely on an adequate level of performance for a longer period before facing the costs of replacement.

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9 Application for approval, page 5.
2. Analysis and information assisting Commission deliberations

2.1 Reports

2.1.1 The Commission was assisted in its decision-making by analysis of the information provided by Transpower undertaken by its staff and a number of advisors.

2.1.2 Reports by the Commission’s advisors include the following, which are available on the Commission’s website:

(a) Report for Electricity Commission. Foreign Exchange Risk Assessment. Bancorp Treasury Services Limited (June 2008);

(b) Report to the Electricity Commission. Exchange Rate Contingencies for the HVDC and NAaN Projects. Castalia Limited (June 2008);

(c) HVDC Grid Upgrade Investment Project: Review of the Capital Cost Estimates for the AC Augmentation as per Proposal of May 2008. Parsons Brinckerhoff Associates (PBA) (July 2008); and

(d) Technical note on Transpower’s HVDC upgrade. System Studies Group (July 2008).

2.2 Correspondence

2.2.1 After receiving the Proposal, the Commission sought further information from Transpower. Key correspondence (excluding correspondence containing confidential or commercially sensitive information) is available on the Commission’s website.

2.3 Directions under rule 14.3.2

2.3.1 Under rule 14.3.2 the Commission may direct Transpower to consider modifying all or part of its application of the GIT and/or to investigate and apply the GIT to alternative economic investments. The Commission has not exercised that power in respect of the Proposal.
3. **Rule requirements**

3.1 **The rules**

3.1.1 The Commission is required to consider and assess the Proposal in accordance with the rules.

3.1.2 As set out above, Transpower submitted the Proposal as an economic investment.

3.1.3 The Commission agrees that the Proposal is an economic investment because the primary effect of the Proposal is not to reduce expected unserved energy.

3.1.4 Therefore, rule 14 applies to the Proposal.

3.1.5 Rule 14.4 provides that, subject to rule 15, the Commission may approve an economic investment if the Commission is satisfied that:

   (a) Transpower has applied the GIT reasonably; and
   (b) Transpower has followed any agreed consultation process.

3.1.6 Rule 15 requires the Commission to publish notice of its intention to approve some or all of the investment proposals in a GUP. Rule 15.2 provides that certain parties may request a public conference. The purpose of a public conference is to provide a final opportunity for comment.\(^{10}\)

3.1.7 If the Commission is satisfied that the requirements of rules 14.4 and 15 are met, it may approve the investment proposal. If the Commission approves an investment proposal, Transpower is able to recover the approved costs of that investment from designated transmission customers in accordance with the transmission pricing methodology set out in section IV of part F of the rules.\(^{11}\)

3.1.8 This section sets out how the Commission has interpreted and applied the criteria for approval.

3.2 **The GIT**

3.2.1 The essence of the GIT is in clause 4, which states:

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\(^{10}\) Rule 15.3.

\(^{11}\) Rule 17.1. Under section 57MA of the Commerce Act 1986, the Commerce Commission must “take into account” a decision under the Rules that relates to or affects the quality standards or pricing methodologies applicable to Transpower before exercising any of its powers under Part 4A of the Commerce Act (which relates to the regulation of Transpower’s revenue requirements).
A proposed investment satisfies the grid investment test if the Board is reasonably satisfied that:

4. 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. 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."

3.2.2 Clause 4.1 applies to a proposed investment necessary to meet the N-1 standard (set out in clause 4.2 of the grid reliability standards). Clause 4.2 applies to proposed investments that are not necessary to meet the N-1 standard.

3.2.3 The Commission considers that the proposed investment is not needed to meet the N-1 standard. The Proposal does not relate to ensuring that the power system remains “whole” if a single credible contingency event occurs on the core grid and the HVDC link is not part of the core grid. Therefore clause 4.2 of the GIT applies.

3.2.4 The rigour and comprehensiveness of the analysis undertaken in applying the GIT must be commensurate with the estimated capital expenditure required for the proposed investment.12

12 Clause 12.
3.2.5 Transpower engaged experts, carried out modelling and analysis, and consulted with substantially affected persons. The Commission is satisfied that the level of analysis has been commensurate with estimated capital expenditure of the Proposal.

3.3 **Determining whether Transpower has applied the GIT reasonably**

3.3.1 The Commission must be satisfied that Transpower has applied the GIT “reasonably”. In a decision-making context, the Courts have considered what it means to act reasonably.

3.3.2 Specifically, in administrative law, a decision-maker must act in a reasonable fashion and the decision must rely on some reasonable basis. To invalidate the ultimate decision as unreasonable, the decision must be so perverse, absurd, or outrageous in its defiance of logic that the law-maker could not have contemplated such a decision being made.\(^{13}\)

3.3.3 The Commission’s task, as the decision-maker required to assess the reasonableness of Transpower’s conduct, is not to substitute its own view for the views of Transpower. However, it is open to the Commission, in assessing the reasonableness of Transpower’s application of the GIT to use its own modelling and analysis.

3.3.4 Therefore, this document, and the related economic report\(^ {14}\), explain the Commission’s analysis in assessing whether Transpower has applied the GIT reasonably.

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\(^{13}\) This principle is often referred to as “Wednesbury unreasonableness”, after the leading case *Associated Provincial Picture Houses Limited v Wednesbury Corporation* [1948]1 KB 223.

\(^{14}\) The Commission Economic Report is available from the Commission’s website.
4. **Analysis parameters**

4.1 **Introduction to GIT analysis parameters**

4.1.1 Within the GIT methodology, a number of analysis parameters must be determined for the purpose of applying the GIT to the Proposal. This section sets out the analysis parameters for the GIT adopted by Transpower, and provides the Commission’s views regarding those parameters.

4.2 **Analysis period (clauses 23 and 27)**

4.2.1 Clause 23 (definition of “cost”) and clause 27 (definition of “market benefit”) require that the Commission calculate the present value of costs and benefits of a proposed investment or alternative project:

> “…over a period of 20 years from the commissioning date (unless significant market benefits or costs are expected to arise from the proposed investment or alternative project after that time, in which case the then-present value of any future benefits may also be included in the market benefit of the proposed investment or alternative project)”.

4.2.2 Clauses 23 and 27 mean that the Commission:

(a) must take into account the present value of costs and benefits of the Proposal and each alternative project that arise over the period of 20 years that commences with the commissioning of the Proposal or alternative project; and

(b) may, if significant market benefits or costs are expected to arise after that time, include those market benefits or costs in the NPV analysis by calculating the “then present value” of those future costs and benefits. The Commission has termed such costs and benefits “terminal benefits” and “terminal costs” respectively, and calculates them using a “terminal benefit calculation”.

4.2.3 Transpower states that the HVDC converters have an expected life of 30 years, and that it is expected that there will be significant benefits arising from any replacement of Pole 1 during the period between 20 years and the end of its expected life.\(^{(15)}\)

4.2.4 While Transpower states that it has used a 30 year analysis period, the GIT results are presented as the expected net benefit after 20 years, with future costs and benefits after 20 years being reported as a terminal value (benefit).

4.2.5 The Proposal includes a terminal benefit of $4,620m. These are the costs and benefits (primarily generation fixed and variable costs) forecast to arise after 20 years from commissioning of the replacement Pole 1, to the end of the 30 year expected life of the replacement.\(^{16}\)

4.3 **Market development scenarios (clauses 5, 6 and 28)**

4.3.1 As the manner in which new generation will enter the New Zealand electricity market is uncertain, the GIT requires the costs of a proposed investment and its alternative projects to be estimated for a number of MDSs (i.e. reasonable future states of the electricity industry).

4.3.2 MDSs include estimated future demand growth, generation investments and transmission investments.

4.3.3 The MDSs used in applying the GIT must be those scenarios the Commission outlined in the relevant *Statement of Opportunities (SOO)* unless the Commission has determined that others are more appropriate.\(^{17}\)

4.3.4 In July 2005, the Commission prepared and published the 2005 SOO (*2005 SOO*) which remains current. The 2005 SOO includes five equally weighted scenarios.

4.3.5 Since the 2005 SOO was published\(^{18}\) additional information has become available, and the New Zealand Energy Strategy (*NZES*) has been released. Therefore, in preparing the Proposal, Transpower discussed with the Commission the market development scenarios and weightings to be used in applying the GIT to the Proposal.

4.3.6 Clause 6.2 of the GIT states that the probability of occurrence of a market development scenario must be as set out in a SOO in respect of the relevant possible future scenario. If scenarios other than those set out in the SOO are used, then this clause does not apply.

4.3.7 Transpower used the following MDSs and weightings in applying the GIT to the Proposal and the alternative projects:

(a) High gas discovery (MDS 1) 20%

(b) Mixed technologies (MDS 2) 10%

\(^{16}\) Application for approval, Attachment A, page 20.

\(^{17}\) Clause 6.1.

\(^{18}\) Since the Proposal was submitted, the Commission has released a new draft SOO for consultation. The 2008 draft SOO is available from the Commission’s website.
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4.3.8 A more detailed description of the market development scenarios used in Transpower’s GIT analysis and the weightings is provided in table 5-1 of the Application for approval.

4.3.9 In accordance with clause 6.1 of the GIT, the Commission agrees that the scenarios proposed by Transpower as listed above are more appropriate than those in the 2005 SOO.

4.4 Base case (clauses 5, 8 and 20)

4.4.1 The GIT requires the market benefits and costs of a proposed investment or alternative project to be determined for each MDS for the future with that proposed investment or alternative project, by comparing that MDS with the corresponding MDS developed for the base case.19

4.4.2 Clause 20 of the GIT defines the base case as follows:

“Base case” means the market development scenarios developed for the reasonable future state of the electricity industry without the proposed investment or any alternative project.

4.4.3 The market development scenarios discussed in sections 4.3 above each assume that the replacement of Pole 1 occurs. It was therefore necessary for Transpower to develop a new base case. Transpower’s base case, and the Commission’s comments on the base case, are discussed further below.

Transpower’s Base Case – No Pole 1 replacement

4.4.4 Transpower adopted a base case which anticipated that Pole 1 would not be replaced. Transpower’s development plan for this option involves:20

Stage 1
(a) electrode and HVDC transmission line works for continuous mono-polar operation, and replacement of cable terminal bushings
(b) refurbishment and unit connection of three Haywards Synchronous condensers

19 Clause 5.
20 Application for approval, paragraph 4.3.1, page 16
(c) low order harmonic filter at Haywards
(d) seismic strengthening at Haywards and Benmore sites

Stage 2
(e) Pole 2 valve base electronics and control system replacement

Commission comments

4.4.5 In order to test the robustness of Transpower’s GIT analysis and in particular Transpower’s assumptions regarding the existing Pole 1 assets, the Commission modelled a base case that included the continued operation of Pole 1 until 2016.

4.4.6 Transpower is already committed to ensuring that some of the existing Pole 1 assets are made available to 2012, and the Commission expects that the base case put forward by Transpower would allow for that. In the Commission’s analysis, the Commission has assumed that the mitigation steps required to ensure that the existing assets can operate until 2012 are sufficient to allow the assets to continue to operate to 2016. This means that the Commission has not included further costs to cover the modelled extended operation of the assets.

4.4.7 The modelling shows that, if Pole 1 was included in the base case until 2016, the Proposal would still satisfy the GIT, because it would maximise the expected net market benefits compared with the base case and the alternatives.21

4.4.8 The Commission considers that, on the basis of the information provided to it, it is reasonable to adopt a base case that does not include the extension of the life of the existing Pole 1 assets beyond 2012.

4.5 Net present value or real options analysis (clause 13)

4.5.1 Clause 13 requires that either standard net present value (NPV) analysis or real options analysis be applied in assessing the expected net market benefit of a proposed investment or alternative project.

4.5.2 Traditional NPV analysis calculates the NPV of a proposed investment based on the benefits less the costs. Real options analysis attempts to value the flexibility that is inherent in many investment projects, which allows investment plans to be changed or abandoned as new information becomes available. By responding appropriately to such new information, decision-makers are able to take advantage of new opportunities.

21 The possibility of extending the life of the existing Pole 1 assets gave rise to a new potential alternative of a delayed version of the Proposal. This matter is discussed in paragraph 4.8.
4.5.3 Transpower states that a textbook treatment of real options is not tractable for transmission investment analysis. The Commission’s economic models for grid investment test analysis incorporate a Monte Carlo NPV analysis to approximate the value of any real options. By calculating the expected net market benefit of the short listed options over the expected range of uncertainties which surround the economics of investment in transmission, the values of any real options are effectively incorporated into the analysis.

4.5.4 Transpower states that it is not possible to consider the use of the Commission’s Monte Carlo approach in the Proposal, as generation expansion plans would need to be derived for each of the 10,000 Monte Carlo demand paths, which is impractical.

4.5.5 Accordingly, Transpower used standard NPV analysis to assess the expected net market benefit of alternative projects.  

4.5.6 The Commission agrees that a real options analysis is not practicable for analysing the Proposal, and that Transpower’s approach in this regard (using a standard NPV analysis) is reasonable.

4.6 **Discount rate (clause 14)**

4.6.1 The GIT requires the discount rate to be used in all NPV calculations to be:

(a) a discount rate determined by the Commission; or

(b) if the Commission has not determined a rate, equivalent to a pre-tax real rate of 7%.

4.6.2 The Commission has not determined a discount rate. Transpower has applied a pre-tax real rate of 7% in the Proposal.

4.6.3 Transpower has adopted as sensitivities discount rates of 4% and 10%. This is consistent with the Commission’s approach to analysing previous investment proposals. The Commission agrees that those values are reasonable.

4.7 **Alternative projects**

4.7.1 In order to assess whether the Proposal satisfies the GIT, the Proposal must be compared with a number of alternative projects.

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22 Application for approval, Attachment B, page 15
23 Application for approval, page 14
24 Application for approval, Attachment B, page 28
25 Clause 4.2.1.
4.7.2 Clause 19 specifies the criteria for the selection of alternative projects as follows:

“19. **Alternative projects** means any alternative transmission augmentation projects and **transmission alternatives** to the **proposed investment**, including any variant of the **proposed investment** that involves a non-negligible change in the timing of that **proposed investment**, that are:

19.1 technically feasible;

19.2 reasonably practicable having regard to the matters set out in clauses 8.1 to 8.4;

19.3 reasonably likely to proceed if neither the **proposed investment** nor any other **alternative project** proceeds and unlikely to proceed if the **proposed investment** does proceed;

19.4 reasonably expected to provide similar benefits, in type but not necessarily in magnitude, to relevant nodes, as the **proposed investment**; and

19.5 reasonably expected to enable the deferment of investment of the type contemplated by the **proposed investment** for a period of 12 months or more.”

4.7.3 Clause 11 requires that the alternative projects used in applying the GIT are limited to those appropriate in number and technology given the cost magnitude of the proposed investment, the complexity of the required modelling and the urgency of the proposed investment.

**Consideration of alternatives**

4.7.4 From 83 original candidate alternatives (including transmission and non-transmission options) that were technically possible, Transpower narrowed the options to a short list of four options, being the base case, a 500MW option (“Option 1”), the Proposal (“Option 2”), and a 1000MW option (“Option 3”).

4.7.5 The base case and the Proposal are discussed earlier in this document. Option 1 and Option 3 are summarised below.
500 MW pole at BEN-HAY – referred to in the Proposal as Option 1

4.7.6 Transpower’s development plan for this option involves:26

Stage 1
(a) new 500 MW, 350 kV, converter pole terminating at Benmore and Haywards including new Pole 1 and bipole control system
(b) Pole 2 valve base electronics and control system replacement
(c) harmonic filters at Benmore and Haywards suitable for bipole operation of around 1200 MW
(d) seismic strengthening and AC switchyard development for 500 MW option at Benmore and Haywards
(e) electrode and HVDC Transmission line works for 500/700 MW operation, and replacement of cable terminal bushings
(f) refurbishment and unit connection of Haywards Synchronous condenser C7 to C10

Stage 2
(g) New condenser C11 or equivalent dynamic reactive power compensation facilities at Haywards 60 MVAr

1000 MW pole at BEN-HAY – referred to in the Proposal as Option 3

4.7.7 Transpower’s development plan for this option involves:27

Stage 1
(a) new 1000 MW, 350 kV, converter pole terminating at Benmore and Haywards including pole and bipole control systems
(b) Pole 2 valve base electronics and control system replacement
(c) harmonic filters at Benmore and Haywards suitable for bipole operation of around 1200 MW
(d) seismic strengthening and AC switchyard development for 1000 MW option at Benmore and Haywards
(e) electrode refurbishment for 1000/700 MW operation

26 Application for approval, paragraph 4.3.2, page 16
27 Application for approval, paragraph 4.3.4, page 17
(f) HVDC transmission line works for 700/700 MW operation, and replacement of cable terminal bushings

(g) refurbishment and unit connection of Haywards Synchronous condenser C7 to C10

**Stage 2**

(h) new synchronous condenser C11 or equivalent dynamic reactive power compensation facilities at Haywards 120 MVA

**Stage 3**

(i) additional filters suitable for 1400/1700 MW operation

(j) add one new HVDC submarine cable rated, 350 kV, 500 MW

**Stage 4**

(k) new synchronous condenser C12 or equivalent dynamic reactive power compensation facilities at Haywards 120 MVA

(l) HVDC Transmission Line works for BEN-HAY 1000/700 MW bipole operation

**Commission comments on alternatives**

4.7.8 As discussed in paragraph 4.3, Transpower’s base case assumes that the existing Pole 1 assets do not operate past 2012. This drives the need date for the Proposal.

4.7.9 In modelling a revised base case with the continued operation of the existing Pole 1 assets (discussed in paragraph 4.4 above), the Commission identified that the need date for the works anticipated by the Proposal could be delayed if the Pole 1 assets were assumed to operate until 2016.

4.7.10 Clause 19 of the GIT defines alternative projects as “including any variant of the proposed investment that involves a non-negligible change in timing of the proposed investment”.

4.7.11 Preliminary modelling by the Commission estimates that delaying the investment anticipated by the Proposal by up to four years (to 2016) could lead to an increase in the expected net market benefit of the Proposal of $12 million.\(^\text{28}\)

4.7.12 The Commission emphasises that it agrees with Transpower that the works anticipated by the Proposal are reasonable. The issue considered by the Commission relates only to the possible timing of the Proposal.

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\(^{28}\) Refer to section 3 of the Commission Economic Report, which is available from the Commission’s website.
4.7.13 In this context, the Commission is concerned that, while there is some flexibility as to timing, it would not be reasonable to delay construction of the Proposal significantly. This is because, in the Commission’s view, it is reasonable to expect to replace the existing Pole 1 assets at some stage, in the short to medium term, and it is necessary to identify a specific date so that Transpower can prudently plan to replace the assets. In addition, the Commission’s modelling shows that delay of the Proposal does not materially change the net market benefits arising from it. The Commission does not consider that the 2012 date is unreasonable.

4.7.14 Further, the Commission does not conclude that to apply the GIT without an alternative project comprising the Proposal delayed by four years is unreasonable.

4.7.15 Therefore, in summary, the Commission does not consider that it is necessary for Transpower to have adopted an alternative comprising the delay of the Proposal.

4.7.16 The Commission concludes that the alternatives put forward by Transpower (which comprise Option 1 and Option 3 in the Application for approval) are reasonable.
5. Test 1 – Has Transpower applied the GIT reasonably? (rule 14.4)

5.1 Introduction

5.1.1 This section summarises key aspects of Transpower’s application of the GIT to the Proposal and the alternatives.

5.1.2 Applying the GIT involves quantifying, to the extent practicable, the costs and benefits associated with the Proposal and the alternatives. The following sets out Transpower’s conclusions in respect of the costs and benefits and the Commission’s comments (as applicable) on those costs and benefits.

5.2 Costs

5.2.1 Clause 23 defines “costs” as “the present value of the costs of a proposed investment or alternative project to those persons who produce, distribute, retail and consume electricity in New Zealand over a period of 20 years from the commissioning date...” including:

“(a) capital costs incurred prior to the commissioning of the proposed investment or alternative project (as the case may be), including interest during construction” (clause 23.1 – capital costs);

“(b) operating, maintenance and dismantling costs over the operating life of the proposed investment or alternative project (as the case may be)” (clause 23.2 – O&M costs);

“(c) costs to participants associated with testing of the proposed investment or alternative project (as the case may be)” (clause 23.3 – testing costs);

“(d) any additional amount, approved by the Board, that could reasonably be considered to be a cost related to the commissioning of a proposed investment or alternative project (as the case may be)” (clause 23.4 – commissioning costs); and

“(e) costs of complying with or arising pursuant to all applicable existing and anticipated laws, regulations and administrative determinations” (clause 23.5 – statutory compliance costs).
Capital costs

5.2.2 Estimating the costs of proposed investment projects at an early stage of planning such projects can be very difficult. It is necessary to strike a balance between developing a realistic view as to what the likely costs will be, and recognising the risk that additional costs could arise which have not been anticipated. Typically, appropriate investigation and design work means that key cost and performance risks can be more accurately understood and evaluated.

5.2.3 The interim grid expenditure approved by the Commission in November 2005 enabled Transpower to prepare a 10-page mini-specification, which was used by Transpower to elicit initial estimates of costs from overseas equipment providers. The cost of converter equipment is the key capital cost for the Proposal and both of the alternatives.

5.2.4 Transpower explains the capital costs of the Proposal in paragraph 4.2.4 of attachment B (Databook) of the GIT consultation document included in volume 2 of the Proposal.

5.2.5 The new HVDC converters and control systems are a major component of the costs of the Proposal. The application for approval contains high level cost information rather than detailed cost estimates. However, Transpower provided the Commission with more detailed cost estimates in order to enable the Commission to verify Transpower’s costs, including the estimates of costs provided by the overseas vendors in response to the mini-specification.29 The Commission requested and was provided with confirmation from Transpower’s consultant Teshmont that Transpower’s approach to obtaining those estimates was appropriate.30

5.2.6 The Commission and Transpower discussed the methodology that Transpower adopted to estimate the expected costs of the Proposal. The Commission expressed some concern about the scope contingencies included in the original expected costs figure of $470 million.

5.2.7 Scope contingencies have two aspects. First, such contingency may provide some margin for works that have not been explicitly detailed in the project plan (in this case, in particular, the mini-specification). Second, scope contingencies may cover the uncertainties associated with estimating the works required for a project, and reflect an expectation that some works could be more or less extensive than originally estimated.

29 Those cost estimates were provided on a confidential basis. The information is highly commercially sensitive and release of the detailed cost estimates would be likely unreasonably to prejudice Transpower’s commercial position: Transpower is yet to seek formal tenders from suppliers.

30 The Teshmont report is available from the Commission’s website.
5.2.8 It was unclear initially whether the scope contingencies put forward by Transpower should be treated as a contingency with an expected cost of zero and a probability distribution around that, or if it was reasonable to treat at least a portion of the scope contingencies as being expected to occur (and, therefore, included in the expected costs).

5.2.9 The Commission accepts that it is reasonable to consider some level of scope contingency as being expected across the project. However, the Commission does not consider that it is likely that all contingency will be realised as actual costs.

5.2.10 The Commission therefore suggested to Transpower that it would be appropriate to include a standard 10 percent contingency for most cost items rather than the higher values put forward by Transpower for electrical works, but has relied on Transpower’s proposed values for the civil works (ground clearance works, site preparations, seismic strengthening and so on). The contingencies for civil works are accepted as reasonable by the Commission as this work has a comparatively low value.

5.2.11 As explained further in paragraph 7.2, the scope contingency for converter costs and Pole 2 refurbishment costs have been treated as having an expected cost of zero.

5.2.12 The total impact of all corrections and scope contingency adjustments was to reduce the expected cost of the project by approximately $29 million.

5.2.13 However, the GIT analysis for the Proposal was carried out using the original $470 million expected cost figure. Using a lower expected cost figure (as a result of the adjustments to the costs and the scope allowance treatment explained above) would increase the expected net market benefit of the Proposal and, therefore, these adjustments do not impact on the reasonableness of Transpower’s application of the GIT.

5.2.14 The Commission also engaged PBA to review the capital cost estimates of other aspects the Proposal and the alternatives. That report is available on the Commission’s website. PBA were engaged to review the capital cost estimates of the AC switchyard, AC harmonic filters, synchronous condensers, and seismic strengthening.

5.2.15 In summary, PBA confirmed that Transpower’s costs for those items were reasonable. However, as discussed above, the Commission suggested that Transpower adopt the approach suggested by PBA of a fixed 10% scope allowance for electrical works, rather than the larger allowances assumed by Transpower. This approach may still result in overestimated costs, as the additional scope components would still be unlikely to all occur.
5.2.16 PBA used more recent exchange rate assumptions than those used by Transpower. Given that Transpower’s costs were established in April 2007, this may explain some of the relatively small differences that exist between Transpower’s cost estimates and PBA’s cost estimates.

5.2.17 The Commission considers that Transpower may have overestimated the expected cost of the convertor equipment. However, if the expected costs were reduced, this would only increase the amount by which the Proposal would maximise the expected net market benefits compared with the alternatives.

5.2.18 The Commission has addressed this issue with Transpower in the course of discussing the amount for which approval is sought. The revised amount for which approval is sought also reflects a lower estimate of expected costs for convertor equipment and related control systems.

5.2.19 The Commission did not review Transpower’s costs in respect of the work required to the HVDC transmission line and has relied on Transpower’s estimate of those costs.

**O&M costs (clause 23.2)**

5.2.20 Different transmission investments may lead to different operation and maintenance (O&M) costs.

5.2.21 O&M costs were included in Transpower’s GIT analysis. The Commission agrees the O&M costs are reasonable.

**Testing costs (clause 23.3) and commissioning costs (clause 23.4)**

5.2.22 Clauses 23.3 and 23.4 include the costs associated with testing and commissioning of a proposed investment or alternative project in the definition of “costs”.

5.2.23 The testing and commissioning costs of the Proposal, the base case, and the alternatives has been included in Transpower’s GIT analysis. The Commission considers that those costs are reasonable.

**Statutory compliance costs (clause 23.5)**

5.2.24 Clause 23.5 refers to costs associated with complying with existing or anticipated legislation.
5.2.25 Transpower has not separately included any statutory compliance costs in its GIT analysis.\textsuperscript{31} Costs such as consenting costs are incorporated in the capital costs and/or the GEM modelling.

5.2.26 The Commission agrees that this is reasonable.

\textbf{5.3 Market benefits}

5.3.1 Clause 27 defines “market benefits” as “the present value of the benefits to those persons who produce, distribute, retail and consume electricity in New Zealand from a \textbf{proposed investment or alternative project} over a period of 20 years from the commissioning date…\textsuperscript{32} including:

\begin{itemize}
  \item \textbf{(a)} changes in fuel cost of \textit{existing assets, committed projects} and \textit{modelled projects} (clause 27.1 – fuel cost benefits);
  \item \textbf{(b)} changes in the value of involuntary \textbf{demand curtailment} (clause 27.2 – \textit{reliability benefits});
  \item \textbf{(c)} changes in the costs of \textit{demand-side} management (clause 27.3 – \textit{demand side management cost change benefits});
  \item \textbf{(d)} changes in costs resulting from the deferral of capital expenditure on \textit{modelled projects} (clause 27.4 – \textit{deferral benefits});
  \item \textbf{(e)} changes in costs resulting from differences in the amount of capital expenditure on \textit{modelled projects} (clause 27.5 – \textit{capital cost benefits});
  \item \textbf{(f)} changes in costs resulting from differences in operations and maintenance expenditure on \textit{existing assets, committed projects} and \textit{modelled projects} (clause 27.6 – \textit{O&M benefits});
  \item \textbf{(g)} changes in costs for ancillary services (clause 27.7 – \textit{ancillary services benefits});
  \item \textbf{(h)} changes in losses, including local losses (clause 27.8 – \textit{loss benefits});
  \item \textbf{(i)} subsidies or other benefits provided under or arising pursuant to all applicable laws, regulations and administrative determinations (clause 27.9 – \textit{statutory compliance benefits});
\end{itemize}

\textsuperscript{31} Anticipated carbon charges are incorporated in the MDSs.

\textsuperscript{32} If significant market benefits or costs are expected to arise from the proposed investment or alternative project after that time, a terminal benefit calculation may be carried out to quantify these benefits or costs.
5.3.2 The Commission considers that there are four main drivers of value for the Proposal, as described below.

5.3.3 In recent years, additional baseload generation has been built in the North Island. However the Commission anticipates a growing need for peaking type plant in the North Island. South Island hydro plant is well suited to this task, and there is excess peak capacity in that Island.

5.3.4 Investment in inter-island transmission capacity enables more existing South Island hydro plant to contribute to load following and peak demand in the North Island, deferring the need for specific new peaking plant to be constructed in the North Island.

5.3.5 Increased HVDC link capacity also permits greater flexibility in the scheduling of generation in both islands to manage dry year risk. This ultimately results in less spill, or less thermal fuel burn, greater dry year security, or some combination of all three, depending upon the operating policy adopted by the generation sector.

5.3.6 Further, continued investment in North Island wind generation will ultimately lead to a requirement for various types of short term "firming" capacity to compensate for the intermittent nature of wind generation. The HVDC link will enable South Island hydro plant to contribute to the firming of North Island wind generation. Although there may not be specific market arrangements to enable this type of firming to occur at the moment, it may well be facilitated by current market processes, and the Commission considers this to be a valid value driver for the project given the long lifetime of the assets.

5.3.7 By increasing the HVDC transfer voltage (pole to pole), the Proposal will reduce transmission losses over the HVDC link. In comparison with the base case where the existing Pole 1 equipment is assumed to be fully decommissioned, transmission voltage is effectively doubled.

5.3.8 The above benefits may not be sufficient to enable the construction of a new "greenfields" HVDC link. However, in this case the project does not involve the construction of new transmission lines. It is a project to derive more benefit from existing assets, by means of investment within existing substations.

5.3.9 Those and other benefits are calculated in an integrated fashion in the generation expansion and operation models used by Transpower to calculate net market benefits. It is not possible to readily itemise and quantify these benefits.
separately from such a model. The Commission has undertaken some analysis separate from the GIT application to better understand the significance of the four main benefits listed above, and is of the opinion that their magnitude or significance could be ranked in the order in which they are addressed above, with the most significant first (substitution for North Island peaking plant).

**Fuel cost benefits (clause 27.1)**

5.3.10 Fuel cost benefits arise when a proposed transmission investment relieves a constraint in the transmission system and so enables generation plant(s) with lower fuel costs to be dispatched, i.e. the proposed investment reduces possible out-of-merit-order dispatch.

5.3.11 The Commission agrees that the Proposal (and the alternatives) would potentially reduce possible interisland transmission constraints and so enable generation plant with lower fuel costs to be dispatched.

5.3.12 Transpower states that there are possible benefits from differences and savings in fuel costs and reductions in transmission losses (which reduces the amount of fuel consumed) as between the Proposal, the base case and the alternatives. Those differences have been included in the GIT analysis and the Commission agrees that Transpower’s approach is reasonable.

**Demand-side management cost change benefits (clause 27.3)**

5.3.13 Demand-side management cost change benefits were not included by Transpower in its GIT analysis.

5.3.14 However, the Commission observes that if the Proposal is constructed, it may reduce wholesale electricity prices in the North Island, which would mean that there would be less need for demand-side responses. However, the Commission agrees that it is not material to the assessment of the Proposal and therefore considers that Transpower’s approach is reasonable.

**Deferral benefits (clause 27.4)**

5.3.15 If modelled generation or grid investments or the proposal can be delayed by using other, less costly, means to ensure that the power system continues to meet the GRS, “deferral benefits” can result.

5.3.16 As discussed in section 4.8, the Commission considered the impact of a delay on the timing of the Proposal. However, the Commission decided not to adopt an alternative that comprised a delayed version of the Proposal.
5.3.17 With the exception of the stage 3 development of the HVDC link modelled by Transpower in its GIT analysis, the Commission did not identify any further modelled transmission projects that could be deferred due to the Proposal or the alternatives considered. The benefits of deferring investment in generation are incorporated in the GEM model and so have been included in the GIT analysis.

**Capital cost benefits (clause 27.5)**

5.3.18 Option 1 has a lower expected capital cost and Option 3 has higher expected capital costs. Those different costs (benefits) have been included in the GIT analysis.

**O&M benefits (clause 27.6)**

5.3.19 Transpower has included O&M benefits in its GIT analysis. The Commission considers that those benefits are reasonable.

**Ancillary services benefits (clause 27.7)**

5.3.20 Ancillary services benefits occur if any of the costs of providing ancillary services are reduced when a transmission investment project is implemented.

5.3.21 Transpower states that there are possible benefits from reducing the overall need for ancillary services, in particular, instantaneous reserves and frequency keeping. Transpower's analysis incorporates the benefits of the Proposal in terms of reducing the need for generation to provide instantaneous reserve in the North Island. There is also a potential source of benefit in facilitating the development of a national frequency keeping market and instantaneous reserves market. In general, the national ancillary market benefits would favour the Proposal.

5.3.22 The Commission agrees and notes that ancillary services benefits would favour the Proposal or either of the alternatives by a similar amount compared with the base case as each could be expected to have power and frequency control functions similar to those identified as possible by Transpower. The Commission agrees that Transpower's approach is reasonable, given that such benefits are not likely to distinguish between the Proposal and the alternatives.

**Competition benefits (clause 27.8)**

5.3.23 Clause 10 of the GIT states that competition benefits may be included if the Board reasonably considers it appropriate, provided that the benefits can be separately identified and calculated.
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5.3.24 Transpower provided some preliminary analysis relating to competition benefits, but has not quantified any competition benefits and so these have not been included in the GIT.

5.3.25 While intuitively it could be expected that the Proposal would lead to greater competition, Transpower's analysis suggests that in the base case a larger amount of thermal generation would be built in the North Island, which may result in greater overall competition which could be a benefit to the base case (and relative cost to the Proposal).

**Loss benefits (clause 27.8)**

5.3.26 In applying the GIT to the Proposal, loss benefits have been considered, but they largely comprise fuel cost benefits as a result of reduced losses. Those benefits are discussed above.

**Statutory compliance benefits (clause 27.9)**

5.3.27 The most likely statutory compliance benefit is that of reducing an emissions charge such as a carbon tax. This has been taken account of as it is reflected in the carbon charge component of generation costs in the MDSs.

**Real option benefits (clause 27.10)**

5.3.28 Transpower has not taken into account any real options benefits. The Commission agrees that this approach is reasonable.

**Terminal Benefits and Terminal Costs (clauses 23 and 27)**

5.3.29 The expected economic life of the Proposal is 30 years. Therefore Transpower carried out a terminal benefit calculation after the end of the 20 year analysis period.

**Non-quantifiable material market costs and benefits**

5.3.30 Clause 9 of the GIT states:

"where a material benefit or cost cannot be quantified, the direction of the market benefit or cost and likely magnitude of the market benefit or cost must be identified."

5.3.31 Transpower has not identified any non-quantifiable material market costs or benefits.
5.4 **Sensitivity Analysis**

5.4.1 Clause 16 requires a sensitivity analysis to be applied in assessing the expected net market benefit and costs. Clause 17 lists a number of specific sensitivities that must be applied to test the robustness of results to changes in the underlying model assumptions, unless to do so is either not reasonably practicable or not reasonably necessary.

5.4.2 The sensitivity analysis carried out by Transpower is summarised in Table 2.

<table>
<thead>
<tr>
<th>Variable and clause in Schedule F4</th>
<th>Comment</th>
</tr>
</thead>
</table>
| 17.1—forecast demand | Medium demand and 90% renewables only  
Medium demand, option 2 (Proposal) only |
| 17.2—the size, timing, location and operating and maintenance costs of the proposed investment or alternative project; and existing assets, committed projects and modelled projects | Variable O&M costs of 0.2% and 1% |
| 17.3—the capital cost of the proposed investment or alternative project | Capital costs of 80% of estimate and 120% of estimate |
| 17.4—the timing of decommissioning, removing or de-rating decommissioned assets | Not reasonably necessary |
| 17.5—the value of unserved energy | $10,000/MWh and $30,000/MWh |
| 17.6 and 17.7—the discount rate used | 4% and 10% |
| 17.8—hydrological inflow sequences as defined in the statement of opportunities | Not reasonably necessary |
| 17.9—generator and demand-side bidding strategies | Not reasonably necessary |
| 17.10—key input variables in the calculation of competition benefits | Not reasonably necessary |
| 17.11—carbon charge | The anticipated carbon charge is reflected in the individual MDS results |
| 17.12—the probability of occurrence of an MDS | Medium demand and 90% renewables only |

*Additional sensitivities*
<table>
<thead>
<tr>
<th>Variable and clause in Schedule F4</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 year average exchange rate</td>
<td></td>
</tr>
<tr>
<td>N-2 capacity constraint</td>
<td></td>
</tr>
<tr>
<td>General capital</td>
<td></td>
</tr>
<tr>
<td>No HVDC charge</td>
<td></td>
</tr>
<tr>
<td>Roxburgh termination</td>
<td></td>
</tr>
<tr>
<td>Bunnythorpe termination</td>
<td></td>
</tr>
</tbody>
</table>
5.5 GIT Results

NPV analysis

5.5.1 Transpower’s GIT analysis results are presented in Table 3 below. The expected net market benefits of the Proposal and the alternatives are each greater than zero, compared with the base case. The Proposal maximises the expected net market benefits compared with the alternatives.

Table 3: Overall results of application of the Grid Investment Test

<table>
<thead>
<tr>
<th>Item</th>
<th>Base Case</th>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Present Value 2007$M</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generation fixed costs (A)</td>
<td>8,083</td>
<td>7,907</td>
<td>7,809</td>
<td>7,853</td>
</tr>
<tr>
<td>Generation variable costs (B)</td>
<td>9,499</td>
<td>9,392</td>
<td>9,356</td>
<td>9,291</td>
</tr>
<tr>
<td>HVDC costs (C)</td>
<td>59</td>
<td>325</td>
<td>436</td>
<td>554</td>
</tr>
<tr>
<td>AC augmentation costs (D)</td>
<td>45</td>
<td>47</td>
<td>48</td>
<td>49</td>
</tr>
<tr>
<td>Terminal benefit (E)</td>
<td>4,775</td>
<td>4,652</td>
<td>4,620</td>
<td>4,607</td>
</tr>
<tr>
<td>Total cost (A+B+C+D+E)</td>
<td>22,461</td>
<td>22,323</td>
<td>22,269</td>
<td>22,355</td>
</tr>
<tr>
<td>Expected Net Market Benefit</td>
<td>-</td>
<td>138</td>
<td>191</td>
<td>106</td>
</tr>
</tbody>
</table>

Sensitivity analysis

5.5.2 The sensitivity analysis results are expressed as mean NPVs for the Proposal and the Alternatives.

33 This table was provided by Transpower to the Commission by letter of 22 May 2008.
### Table 4: Sensitivity analysis

<table>
<thead>
<tr>
<th>$2007 million</th>
<th>Base Case No Pole 1 replacement</th>
<th>Option 1 500 MW Pole 1</th>
<th>Option 2 700 MW Pole 1</th>
<th>Option 3 1000 MW Pole 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base results</td>
<td>-</td>
<td>138</td>
<td>191</td>
<td>106</td>
</tr>
<tr>
<td><strong>Sensitivity:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discount rate, 4%</td>
<td></td>
<td>446</td>
<td>600</td>
<td>514</td>
</tr>
<tr>
<td>Discount rate, 10%</td>
<td></td>
<td>-</td>
<td>-7</td>
<td>4</td>
</tr>
<tr>
<td>HVDC capital 80%</td>
<td></td>
<td>-</td>
<td>191</td>
<td>267</td>
</tr>
<tr>
<td>HVDC capital 120%</td>
<td></td>
<td>-</td>
<td>84</td>
<td>115</td>
</tr>
<tr>
<td>10 yr average x-rate</td>
<td></td>
<td>-</td>
<td>135</td>
<td>174</td>
</tr>
<tr>
<td>HVDC O&amp;M 0.2%</td>
<td></td>
<td>-</td>
<td>143</td>
<td>199</td>
</tr>
<tr>
<td>HVDC O&amp;M 1.0%</td>
<td></td>
<td>-</td>
<td>122</td>
<td>168</td>
</tr>
<tr>
<td>Base – med demand, 90% renewables only</td>
<td></td>
<td>-</td>
<td>300</td>
<td>395</td>
</tr>
<tr>
<td>N-2 cap constraint</td>
<td></td>
<td>-</td>
<td>531</td>
<td>672</td>
</tr>
<tr>
<td>Generation capital</td>
<td></td>
<td>-</td>
<td>312</td>
<td>375</td>
</tr>
<tr>
<td>No HVDC charge</td>
<td></td>
<td>-</td>
<td>305</td>
<td>352</td>
</tr>
<tr>
<td>Base – med demand, Option 2 only</td>
<td></td>
<td>-</td>
<td>-</td>
<td>221</td>
</tr>
<tr>
<td>ROX termination</td>
<td></td>
<td>-</td>
<td>-</td>
<td>211</td>
</tr>
</tbody>
</table>
Conclusion on GIT results

5.5.3 As set out in section 3, a proposed investment satisfies clause 4.2 of the GIT if the Commission is reasonably satisfied that the proposed investment:

(a) minimises expected net market cost compared with possible alternative projects; and

(b) the expected net market benefit is greater than zero; and

(c) the conclusion in (a) above is sufficiently robust having regard to the results of the sensitivity analysis.

5.5.4 The Commission is satisfied that the Proposal:

(a) minimises expected net market cost compared with possible alternative projects; and

(b) the expected net market benefit is greater than zero; and

(c) the conclusion in (a) above is sufficiently robust having regard to the results of the sensitivity analysis.

5.5.5 Therefore, the Commission is satisfied that the proposal satisfies clause 4.2 of the GIT.

5.5.6 The Commission agrees that Transpower has applied the GIT reasonably.
6. **Test 2 – Did Transpower follow the agreed consultation processes? (rule 14.4)**

6.1 **Compliance with rule processes**

6.1.1 Rule 14.4 requires that Transpower has “followed any agreed consultation process”.

6.1.2 The rules do not require a consultation process to be agreed. However, two clauses in rule 14.2 relate to consultation-related processes that Transpower and the Commission could agree to:

(a) clause 14.2.1 requires the Board and Transpower to agree to a timetable (not a process) for consultation and approval of economic investments; and

(b) clause 14.2.3 requires the Board and Transpower to consult (but not agree) on a process for consultation with persons that the Board thinks are representative of the interests of persons likely to be substantially affected by economic investments and the content of draft grid upgrade plans.

6.1.3 The Commission considers that rule 14.4 refers to any agreement, between Transpower and the Commission, arising out of either clause 14.2.1 or clause 14.2.3.

**Agreed consultation processes**

6.1.4 On 11 October 2007 Transpower and the Commission agreed on a process and timetable for consultation regarding the Proposal.


6.1.6 The timetable was amended on 13 June 2008 as the Commission sought further information from Transpower to ascertain the reasonableness of the costs used in applying the GI to the Proposal.

6.1.7 The timetable was further amended in early and mid July 2008 to provide time for the Commission and Transpower to discuss the appropriate amount for which approval would be sought.
6.2 Summary

6.2.1 The Commission is satisfied that Transpower has complied with the agreed consultation process in terms of rule 14.4.
7. Decision

7.1 Rule criteria

7.1.1 Rule 14.4 provides that, in order to be able to approve an economic investment, the Commission must be satisfied that:

(a) Transpower has applied the GIT reasonably; and

(b) Transpower has followed any agreed consultation process.

7.1.2 On the basis of the information provided, the Commission considers that the Proposal satisfies the GIT.

7.1.3 The Commission considers that this conclusion is robust having regard to the sensitivity analysis carried out. Accordingly, the Commission considers that Transpower has applied the GIT reasonably.

7.1.4 The Commission is satisfied that Transpower has followed the agreed consultation process and therefore the Proposal meets the requirements of rule 14.4.

7.1.5 This means that, under rule 14.4, the Commission has the discretion to approve the Proposal.

7.2 Amount for which approval is sought

7.2.1 As discussed in section 2 of this document, Transpower initially sought approval of $728 million. The Commission expressed concerns to Transpower regarding the difference between the expected costs used in applying the GIT (which the Commission considers are reasonable and robust for that purpose), and the amount for which approval was sought.

7.2.2 As noted above, adjustments were made to the expected HVDC upgrade cost used for the application of the GIT. The combined impact of the changes in the estimated capital costs and the revised application of scope allowances was a reduction of $29 million in total expected costs. Two further adjustments to the methodology used by Transpower were also necessary to calculate appropriate expected costs and then additional components to define the maximum approval amounts.

7.2.3 The first adjustment relates to the application of exchange rate uncertainty by Transpower. The P50 cost in Transpower's proposal converts the expected project costs to nominal dollars, and incorporates interest during construction costs. Transpower also included an exchange rate adjustment in the calculated P50 cost, based on moving from the twenty-day spot rate used for the calculation
of the expected costs, to a rate equivalent to the average exchange rate over the past ten years.

7.2.4 The Commission sought independent advice on exchange rate risk from BANCORP and Castalia. Both supported using the current spot exchange rate as a base for assessing exchange rate risk, estimating likely future movement boundaries using historical movement information. Discussions with Transpower resulted in the base used for calculating the P50 value being adjusted to a recent twenty-day rate (15 July 2008) rather than the historical ten-year average.

7.2.5 In establishing the amount for which approval was sought, Transpower sought to define an exchange rate contingency by calculating exchange rate uncertainty through sampling from the past 10 years’ rates. Based on the above exchange rate advice, the Commission’s view is that it is more appropriate to sample from a distribution using the current spot rate as a mean, with variation being based on historical variation over six-month periods in the past. The choice of six months is based on the expected time required for Transpower to resubmit an application for additional funding in the event of a significant change in exchange rates resulting in the total project costs exceeding the existing approval amounts.

7.2.6 Exchange rate risk can be mitigated through hedging. At this stage the Commission has not reached a view on the appropriateness of hedging and the potential recovery by Transpower of hedging costs from participants. Indicative figures suggest that total hedging costs may be in the order of $30 million for the HVDC project.

7.2.7 The second adjustment relates to the application of price uncertainty for the converter equipment. The approach used by Transpower to estimate price contingencies for the converter equipment did not recognise the independence of the various uncertainties in the project costs.

7.2.8 The combined impact of the adjustments to the expected costs and the handling of exchange rate and price contingencies has resulted in a total reduction of $56 million in the total approval amount, down to $672 million.

7.2.9 In light of the adjustments described above, the Commission considers that the amount for which approval is sought is reasonable.

7.3 Decision

7.3.1 The Commission is satisfied that the proposal meets the criteria for consent set out in rule 14.4. The decision of the Commission is to approve the proposal, with the maximum amount which may be recovered by Transpower being $672 million.
Final

Reasons for Decision set out in Notice of Intention to Approve Transpower's HVDC Grid Upgrade Proposal