**IMPORTANT**

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<td>1st February 2013</td>
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# Table of Contents

1. **Executive Summary** ........................................................................................................... 6
2. **Glossary** ........................................................................................................................... 7
3. **Introduction** ....................................................................................................................... 7
   3.1 **Invitation to Comment** ................................................................................................. 8
4. **Background** ....................................................................................................................... 8
   4.1 **Assessment Context and Interpretation** ......................................................................... 8
   4.2 **Other System Operator Security of Supply Functions** .................................................. 9
   4.3 **Previous Security Assessments** .................................................................................. 9
5. **Input Assumptions** ........................................................................................................... 9
   5.1 **Framework** .................................................................................................................. 9
   5.2 **Baseline Assumptions** ............................................................................................... 10
      5.2.1 Monitoring Input Assumptions .................................................................................... 10
      5.2.2 Existing Generation Assumptions .............................................................................. 10
      5.2.3 Future Generation Assumptions ............................................................................... 11
      5.2.4 Thermal Fuel Assumptions ....................................................................................... 12
      5.2.5 Demand Forecast Assumptions .................................................................................. 12
      5.2.6 Inter-island Transmission Assumptions ..................................................................... 13
   5.3 **Scenarios** .................................................................................................................... 14
6. **Energy Margin Assessment** ............................................................................................. 17
   6.1 **Methodology** ............................................................................................................. 17
   6.2 **Energy Margin Results** ............................................................................................. 18
7. **Capacity Margin Assessment** ......................................................................................... 24
   7.1 **Methodology** ............................................................................................................. 24
   7.2 **Capacity Margin Results** .......................................................................................... 25
8. **Conclusions** .................................................................................................................... 29
   8.1 **Energy Margin Security** ............................................................................................ 29
   8.2 **Capacity Margin Security** ........................................................................................ 29
   8.3 **Margin Interpretation Against the Standards** ............................................................. 30
9. **Appendix 1: Detailed Supply Assumptions in the Baseline Scenario** ......................... 31
   9.1 **Introduction** .............................................................................................................. 31
   9.2 **Existing Supply** ....................................................................................................... 31
   9.3 **New Supply** ............................................................................................................. 32
   9.4 **Other Key Assumptions for Generation** .................................................................... 33
      9.4.1 Outage Modelling and De-ratings ............................................................................ 33
      9.4.2 Thermal Fuel Assumptions ...................................................................................... 34
      9.4.3 Wind Capacity Contribution .................................................................................... 34
      9.4.4 Start Storage ............................................................................................................ 34
      9.4.5 Huntly Units Long-term Storage ............................................................................. 34
   9.5 **Transmission** ............................................................................................................ 34
      9.5.1 HVDC: Southwards Flow ......................................................................................... 34
      9.5.2 HVDC: Northwards Flow ....................................................................................... 35
      9.5.3 AC Transmission Assumptions ................................................................................ 36
10. **Appendix 2: Detailed Demand Forecast Assumptions in the Baseline Scenario** ........ 37
   10.1 **Introduction** ............................................................................................................ 37
   10.2 **Treatment of Generation** ........................................................................................ 37
   10.3 **Specific Demand Assumptions** ................................................................................. 37
      10.3.1 Estimating Winter Demand .................................................................................... 37
      10.3.2 Demand Response .................................................................................................. 38
      10.3.3 Transmission Losses .............................................................................................. 38
   10.4 **Demand Data** ......................................................................................................... 38
11. **Appendix 4: Secondary Scenarios** .............................................................................. 40
   11.1 **Scenarios** ............................................................................................................... 40
   11.2 **Secondary Scenario Results** ................................................................................... 41
**Tables**

Table i: Committed Generation Projects .......................................................... 11
Table ii: Assumed Huntly Long-term Storage Plans ........................................... 11
Table iii: Main sensitivity scenarios ................................................................. 15
Table iv: Summarising the NZ-WEM components .............................................. 17
Table v: Summarising the SI-WEM components ................................................ 17
Table vi: Summarising the North Island Winter Capacity Margin (WCM) Components ... 24
Table vii: Existing North Island Supply ............................................................ 31
Table viii: Existing South Island supply ............................................................ 32
Table ix: New Generation Aggregated by Year .................................................. 32
Table x: New Generation Aggregated by Type ................................................... 32
Table xi: New Generation Aggregated by Probability ......................................... 33
Table xii: New Generation Aggregated by Island .............................................. 33
Table xiii: Base case forecast of annual energy demand .................................... 38
Table xiv: Base case forecast of annual H100 demand ...................................... 38

**Figures**

Figure 1: New generation assumptions (all projects).......................................... 12
Figure 2: Expected demand – both Peak and Energy (net GXP + transmission losses) .. 13
Figure 3: Base case projections of New Zealand Winter Energy Margins ............... 19
Figure 4: Base case projections of South Island Winter Energy Margins ............... 19
Figure 5: Sensitivity projections for both WEM’s – Case: HIGH DEMAND ............ 20
Figure 6: Sensitivity projections for both WEM’s – Case: LOW DEMAND ............. 20
Figure 7: Sensitivity projections for both WEM’s – Case: DELAYED BUILDS ........... 21
Figure 8: Sensitivity projections for both WEM’s – Case: LOW INFLOWS ............. 21
Figure 9: Sensitivity projections for both WEM’s – Case: LOW THERMAL GENERATION (No new thermal) ................................................................. 22
Figure 10: Sensitivity projections for both WEM’s – Case: LOW THERMAL GENERATION (No new thermal and decommissioning of one CCGT) .................... 22
Figure 11: Sensitivity projections for both WEM’s – Case: NO POLE 3 FOR WINTER 2013 (only affects 2013 data) ................................................................. 23
Figure 12: Sensitivity projections for both WEM’s – Case: LIMITED SI TRANSFER (only affects 2013/2014 data) ................................................................. 23
Figure 13: Sensitivity projections for both WEM’s – Case: TIWAI SHUTDOWN ........... 23
Figure 14: Base case projections of Winter Capacity Margins ............................... 26
Figure 15: Sensitivity projections of WCM – Case: HIGH DEMAND (left) and LOW DEMAND (right) ................................................................. 26
Figure 16: Sensitivity projections of WCM – Case: DELAYED BUILDS (left) and LIMITED WIND CONTRIBUTION TO CAPACITY (right) ......................... 27
Figure 17: Sensitivity projections of WCM – Case: LOW THERMAL GENERATION (No new thermal only – left) and LOW THERMAL GENERATION (No new thermal and removal of one CCGT – right) ......................................... 27
Figure 18: Sensitivity projections of WCM – Case: REDUCED RELIABILITY (existing thermal plant only – left) and REDUCED RELIABILITY (reduced reliability of all plant older than 10 years – right) ............................................... 28
Figure 19: Sensitivity projections of WCM – Case: NO POLE 3 FOR 2013 (left) and TIWAI SHUTDOWN (right) ................................................................. 28
Figure 20: Curves used to convert South Island surplus to North Island capacity contribution (indicative) ................................................................. 35
Figure 21: Sensitivity projections for NI-WCM and SI-WEM – Case: NO HVDC ....... 41
Figure 22: Sensitivity projections for NI-WCM – Case: 0% WIND CAPACITY CONTRIBUTION ................................................................. 41
Figure 23: Sensitivity projects for NZ-WEM and SI-WEM - Case: PUKAKI CONTINGENT STORAGE ................................................................. 42
1. **EXECUTIVE SUMMARY**

The 2013 Annual Security of Supply Assessment (ASA) has been completed by the System Operator in accordance with the requirements set out in the Security of Supply Forecasting and Information Policy (SoSFIP), and provides an assessment of the power system’s ability to meet prudent winter energy and peak requirements over the period 2013 to 2020.

The assessment forecasts Winter Capacity Margin and Winter Energy Margin in accordance with the SoSFIP, and compares them with the Electricity Authorities’ recently updated security of supply standards, set out in clause 7.3(2) (a) and (b) of the Code:

- a Winter Energy Margin (WEM) of 14-16% for New Zealand and 25.5-30% for the South Island; and
- a Winter Capacity Margin (WCM) of 630-780 MW for the North Island

This assessment follows a similar methodology to that used in the 2012 assessment. The only major points of difference are the aforementioned security standard changes and a slight modification to the supply side modelling of generation (due to different demand assumptions – see section 5.2 for details).

The key conclusions of this report are as follows:

- **Winter Energy Margin (New Zealand and South Island)**
  - Under base case assumptions, even with just existing and committed generation investments, it is projected that Winter Energy Margin for New Zealand and South Island will meet or exceed the standards for the foreseeable future
  - However, under certain scenarios (such as high demand or low thermal generation) it is possible Winter Energy Margins could fall below the standards in the later years of this analysis (2017+)
  - With additional investment “high” and “medium” likelihood generation, it is projected the New Zealand and South Island WEM standards will be met or exceeded until 2020 even in the most negative outlook scenarios

- **Winter Capacity Margin**
  - Winter Capacity Margin is projected to exceed the capacity security standard in 2013-2015 in all scenarios with only committed generation projects
  - Under base case assumptions, investment in “high” probability generation will be sufficient to meet or exceed the WCM standard until 2020
  - In all but one scenario the addition of “medium” probability generation is sufficient to meet or exceed the WCM standard until 2020
  - In the low thermal generation scenario (where no new thermal generation is built and a CCGT is removed) it is projected that the WCM will fall below the standard in 2016 even with “low” likelihood generation investment. This recovers the following year and all subsequent years. In this scenario there remains a large amount of generation project depth that electricity market participants can bring forward if necessary.

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1. [http://www.systemoperator.co.nz/sosfip](http://www.systemoperator.co.nz/sosfip)
Overall the results of the 2013 ASA present higher security margins over the 2012 ASA. This is a largely a result of an increase in generation projects that have been approved (i.e. become “committed”) as well as the inclusion of a number of low to medium probability projects that were not included in 2012. The changes to assumptions and methodology described above have had only a minor impact on the results.

2. **GLOSSARY**

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Code</td>
<td>Electricity Industry Participation Code 2010</td>
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<tr>
<td>EA</td>
<td>Electricity Authority</td>
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<td>ASA</td>
<td>Annual Security of Supply Assessment</td>
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<tr>
<td>WEM</td>
<td>Winter Energy Margin</td>
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<td>WEM – NZ</td>
<td>New Zealand Winter Energy Margin</td>
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<tr>
<td>WEM – SI</td>
<td>South Island Winter Energy Margin</td>
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<tr>
<td>WCM</td>
<td>Winter Capacity Margin</td>
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<tr>
<td>WCM – NI</td>
<td>North Island Winter Capacity Margin</td>
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<tr>
<td>Energy Security Standard</td>
<td>A WEM of 14-17% for New Zealand and 25.5-30% for the South Island</td>
</tr>
<tr>
<td>Capacity Security Standard</td>
<td>A WCM of 630-780 MW for the North Island</td>
</tr>
<tr>
<td>SoSFIP</td>
<td>The Security of Supply Information Policy</td>
</tr>
<tr>
<td>GXP</td>
<td>Grid Exit Point – where electricity exits the Transpower grid and enters the distribution networks</td>
</tr>
<tr>
<td>GIP</td>
<td>Grid Injection Point – where electricity enters the Transpower grid from grid connect generation</td>
</tr>
<tr>
<td>CCGT</td>
<td>Combined cycle gas turbine</td>
</tr>
<tr>
<td>Nameplate Capacity</td>
<td>This is the maximum capacity of individual generation equipment; this data is typically supplied by the generation companies and does not account any de-rating effects such as outages or operating constraints</td>
</tr>
<tr>
<td>Embedded Generation</td>
<td>Generation plant that is connected directly to the distribution network in which it is located; this type of plant is not modelled in the ASA</td>
</tr>
<tr>
<td>Grid Connected Generation</td>
<td>Generation plant that is connected directly to the high voltage grid</td>
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3. **INTRODUCTION**

The annual publication of medium to long-term security assessment required by the Code and the SoSFIP is part of the System Operator’s security of supply role. A security
assessment was last published by the System Operator in 2012. This document fulfils the obligations set out in clause 7.3(2) (a) and (b) of the Code.

This assessment is intended to provide information that enables participants to assess risk and assist potential investment decision making; as well as present industry stakeholders with a metric in which to gauge security of supply in the medium to long term.

This report presents a new security assessment from the 2012 ASA. It assesses Winter Energy Margin and Winter Capacity Margin, terms defined in the SoSFIP, for the period 2013 to 2020.

### 3.1 Invitation to Comment

The System Operator welcomes feedback on this report, including any additional information for analysis that may lead to this report being updated. Comment and additional information, which if marked accordingly may be given in confidence, should be:

Emailed to the attention of:

Bennet Tucker at SecurityofSupply@transpower.co.nz

Or hard copy may be sent to the attention of:

Bennet Tucker
Transpower
PO Box 1021
Wellington 6140

### 4. Background

#### 4.1 Assessment Context and Interpretation

As set out in the System Operator's SoSFIP, the System Operator must prepare and publish a security of supply assessment that enables interested parties to compare projected winter energy and capacity margins over the next 5 or more years with the security standards derived and published by the Electricity Authority, summarised below:

- 14-16% winter energy margin in New Zealand
- 25.5-30% winter energy margin in the South Island, and
- 630-780MW winter capacity margin in the North Island

The Electricity Authority updated these standards in 2012, and therefore they differ from those used in the 2012 ASA.

The Electricity Authority derived the above standards using a probabilistic analysis\(^2\). The analysis sought to determine:

- the efficient level of North Island peaking capacity – defined as the level that minimises the sum of the expected societal cost of capacity shortage plus the cost of providing peaking generation capacity;

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the efficient level of national winter energy supply – defined as the level that minimises the sum of the expected societal cost of energy shortage plus the cost of providing thermal firming capacity; and

equivalently, the efficient level of South Island winter energy supply.

The Authority has suggested that the capacity security of supply standard should be interpreted as follows:

a) WCM below the lower standard of 630 MW indicates an inefficiently low level of capacity. That is, the cost of adding more capacity would be more than justified by the reduction in shortage costs at times of insufficient capacity;

b) WCM between 630 and 780 MW indicates a roughly efficient level of capacity; and

c) WCM above the upper standard of 780 MW indicates a capacity level that is inefficiently high in terms of the trade-off between supply costs and the cost of shortage at times of insufficient capacity (but may still be efficient for other reasons).

The energy security of supply standards should be interpreted in a similar fashion.

In this report not only are security margins derived but conclusions based the Authority’s interpretation performed. See section 8.3 for details.

4.2 Other System Operator Security of Supply Functions

The System Operator performs other security of supply related functions that are covered in the SoSFIP and the Emergency Management Policy (EMP). These include:

- shorter-term monitoring and information provision such as the weekly reporting of hydro levels relative to the Hydro Risk Curves\(^3\); and
- where necessary, implementing emergency measures

4.3 Previous Security Assessments

For the Electricity Commission’s similar assessments up until 2010, refer http://www.ea.govt.nz/industry/ec-archive/security-of-supply/asa/

For the assessments undertaken by the system operator from 2011, refer http://www.systemoperator.co.nz/sos-reporting

5. Input Assumptions

5.1 Framework

The input assumptions of the assessment are:

- generation (existing and proposed new projects);
- electricity demand (including demand response); and
- inter-island transmission capability.

\(^3\) http://www.systemoperator.co.nz/latest-sos-update
This assessment includes a baseline scenario and a range of sensitivity scenarios designed to test the effect of a variety of credible but less probable alternatives from the base case. The baseline assumptions are set out in Section 5.2, and the alternate assumptions used in the sensitivity scenarios are set out in Section 5.3.

New generation development options under consideration by investors may or may not proceed for a number of reasons. Accordingly, new generation projects have been allocated to four categories – committed, “high” probability, “medium” probability, and “low” probability. Each scenario includes four cases, with:

- existing and committed generation only;
- existing, committed and “high” probability generation;
- existing, committed, “high” and “medium” probability generation; and
- existing, committed, “high”, “medium” and “low” probability generation.

All scenarios cover the period from 2013 to 2020.

The methodology for the calculation of WEM and WCM is covered in Sections 6.1 and 7.1.

5.2 Baseline Assumptions

The basis for the ASA methodology, including assumptions used in modelling, is the Electricity Authority’s Security Standards Assumptions Document (SSAD). The SSAD outlines the high level assumptions and formulas in which the ASA calculations are based upon. This section describes many of these and other non-prescribed assumptions that are drawn from other sources; however for a complete and detailed set of assumptions please refer to the appendices (Sections 9 and 10).

Assumptions about generation are largely based on information received from Generators on a confidential basis. The System Operator thanks all contributors including, Genesis Energy, Meridian Energy, Contact Energy, Mighty River Power, TrustPower and Todd Energy for the information provided. Some publicly available information is also used.

Demand assumptions are based on a P50 view of Transpower's Long Term Electricity Demand Forecast (LEDFM)

5.2.1 Monitoring Input Assumptions

It is possible that projected WCM and WEM in this assessment may change during the year as a result of changing conditions. All assumptions that inform this assessment will be reviewed and if necessary adjusted as part of the next annual assessment process, due in early 2014.

5.2.2 Existing Generation Assumptions

Based on information flagged in the Planned Outage Coordination Protocol, this assessment has assumed one 245 MW Huntly coal unit will be put into long-term storage before winter 2013, with a further 245 MW unit placed into long-term storage prior to winter 2015. This assumption affects WEM and WCM and has been reflected in this assessment as a base case input. Note that this removal of Huntly units applies to all

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5 [http://pocp.redspider.co.nz/](http://pocp.redspider.co.nz/)
scenarios including the base case; and the removals are assumed to be committed in terms of likelihood.

All other existing generation is expected to remain operationally available throughout the assessment period (2013 – 2020), subject to normal limitations (e.g. the variability of intermittent generation, the dependence of hydro on inflows, the outage rates of thermal and hydro plants).

See Section 9 for further detail on baseline assumptions about existing generation.

### 5.2.3 Future Generation Assumptions

Information provided by generators has been aggregated for publication in order to preserve confidentiality. However, as the committed generation information is publically available our assumptions around those projects can be freely disclosed. Table 1 below shows the data on the committed generation projects, with table 2 showing the assumptions around Huntly Unit storage. Figure 1 shows the new generation data in aggregated form (from left to right the categories are year, generation type and probability – it includes committed project data).

Note on interpretation: the aggregations are independent, that is the Geothermal bar includes all geothermal generation from 2013-2020 (and likewise across all probabilities).

#### Table i: Committed Generation Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>Type</th>
<th>MW</th>
<th>Assumed Contribution to Energy Margin's (potential GWh over April - Sep)</th>
<th>Assumed Contribution to Capacity Margins (MW)</th>
<th>Commissioning Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>McKee</td>
<td>Thermal</td>
<td>100</td>
<td>414</td>
<td>97</td>
<td>2012</td>
</tr>
<tr>
<td>Te Mihi</td>
<td>Geothermal</td>
<td>114*</td>
<td>459</td>
<td>107</td>
<td>2013</td>
</tr>
<tr>
<td>Ngatamariki</td>
<td>Geothermal</td>
<td>82</td>
<td>341</td>
<td>78</td>
<td>2013</td>
</tr>
<tr>
<td>Mill Creek</td>
<td>Wind</td>
<td>59.8</td>
<td>119</td>
<td>12</td>
<td>2014</td>
</tr>
</tbody>
</table>

* This is the assumed net gain of MW to the system; the Te Mihi plant is actually larger than this, however there is a subsequent reduction in Wairaki output.

#### Table ii: Assumed Huntly Long-term Storage Plans

<table>
<thead>
<tr>
<th>Project</th>
<th>Type</th>
<th>MW</th>
<th>Assumed Contribution to Energy Margin’s (potential GWh over April - Sep)</th>
<th>Assumed Contribution to Capacity Margins (MW)</th>
<th>Last year of winter generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 3 storage</td>
<td>Thermal</td>
<td>245</td>
<td>-993</td>
<td>-236</td>
<td>2012</td>
</tr>
<tr>
<td>Unit 2 storage</td>
<td>Thermal</td>
<td>245</td>
<td>-993</td>
<td>-236</td>
<td>2014</td>
</tr>
</tbody>
</table>
Figure 1: New generation assumptions (all projects)

Note that the island aggregation is not shown above; North Island new generation projects make up approximately 85-90% of all new generation projects.

5.2.4 Thermal Fuel Assumptions

All thermal generation is assumed to be fully fuelled. This means that thermal ability to contribute to the WEM and WCM metrics is in no way constrained by fuel availability.

5.2.5 Demand Forecast Assumptions

This assessment uses the P50 Transpower Electricity Demand Forecast for its base case scenario, produced using the 2012 Long-term Electricity Demand Forecast Model (LEDFM).

Once again the new forecast is lower than previous demand forecasts, mostly due to actuals for 2011 being lower than expected; the slope of the demand outlook (i.e. demand growth) is not materially different from last year’s growth.

The use of a forecast derived from the LEDFM is consistent with both the National Winter Group Assessment (NWG) and the System Security Forecast (SSF), and fulfils the Electricity Authority’s requirements around demand in the ASA (section 4 of the SSAD).
The demand forecast is net of all embedded generation; that is demand is net demand at the GXP and converted to GIP via loss assumptions; note that this treatment is slightly different when compared to the 2012 ASA as it does not include any embedded generation; unlike the 2012 ASA which attempted to model some specific embedded generation. Figure 2 below shows the expected demand profiles out to 2020 (inclusive of losses):

The average growth rate in the base case is approximately 1.4% p.a. for the period between 2013 and 2020; as described in table i below the growth rates for the low and high scenarios are 0.5% and 2.5% respectively.

See Section 10 for more detailed assumptions about the electricity demand forecast used in the baseline scenario.

This assessment also explores the impact of demand being significantly higher or lower than the baseline forecast. See Section 5.3 for the relevant sensitivity cases.

5.2.6 Inter-island Transmission Assumptions

The assessment of WEM and WCM does not incorporate detailed modelling of transmission. However, it does make assumptions about the amount of:

- energy that can be transferred from the North Island to the South Island during winter (which affects the South Island Winter Energy Margin); and
- power that can be transferred from the South Island to the North Island during periods of peak demand (which affects the Winter Capacity Margin).

It is assumed in the base case that HVDC Pole 3 will be available for the entire period of analysis (i.e. starting winter of 2013). The new Pole will increase the amount of power that can be transferred northwards at peak times (to the extent there is surplus South Island capacity). Reduced DC losses and increased ability for the HVDC to cover its own reserve risk will contribute to the increased power transfer.

See Section 9 for detailed assumptions about inter-island transmission.
5.3 **Scenarios**

The ASA examines the sensitivity of WCM and WEM to a number of scenarios. Table i below describes the sensitivity scenarios that are included in this assessment.

Note that, in reality, the outcomes described are not mutually exclusive – for instance, it is unlikely but possible that demand will be high and new generation will be delayed and inflows will be low. However in terms of analysis the scope of this study has been limited to assessing the scenarios on a case by case basis.

Additionally a number of secondary scenarios have been carried out to assess some more extreme or specifically requested scenarios. The details of these scenarios and their results can be found in Appendix 3.
### Table iii: Main sensitivity scenarios

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Affects Energy</th>
<th>Affects Capacity</th>
<th>Rationale</th>
<th>Assumptions Made</th>
</tr>
</thead>
<tbody>
<tr>
<td>High demand</td>
<td>Y</td>
<td>Y</td>
<td>Demand may exceed the base case forecast.</td>
<td>2.5% annual demand growth.</td>
</tr>
<tr>
<td>Low demand</td>
<td>Y</td>
<td>Y</td>
<td>Demand may fall below the base case forecast.</td>
<td>0.5% or lower annual demand growth.</td>
</tr>
<tr>
<td>Delayed Builds</td>
<td>Y</td>
<td>Y</td>
<td>Based on the previous ASA and general analysis of the power system it is known that the system currently has comfortable security margins for one reason or another. This is likely to result in lower investment in new generation in the near to medium term, and thus delay the time frame in which projects are built.</td>
<td>Projects, other than committed, are uniformly delayed by 1 year if they are assumed to be built prior to 2016, and delayed by 2 years for those projects expected to be built after, or including, 2016.</td>
</tr>
<tr>
<td>Low inflows</td>
<td>Y</td>
<td>N</td>
<td>It has been theorised(^6) that, due to climate factors, New Zealand is currently in an extended period of lower-than-average inflows. The System Operator seeks to explore this scenario (without entering into a debate about climate change).</td>
<td>In the calculation of energy margins, inflows and initial hydro storage are reduced by 5%.</td>
</tr>
<tr>
<td>Limited wind contribution to capacity</td>
<td>N</td>
<td>Y</td>
<td>Parties have historically expressed concern about the effects of increased wind penetration on the ability of the power system to meet peak demand. The baseline assumption is that wind has a 20% capacity factor (contributes 20% of its nameplate capacity to meet peak). 7 This scenario explores the impact of assuming that wind has a substantially lower capacity factor.</td>
<td>Wind makes only a 10% contribution to the WCM calculation.</td>
</tr>
<tr>
<td>Low thermal generation</td>
<td>Y</td>
<td>Y</td>
<td>It is possible that, for a number of reasons, thermal generation viability may drop significantly. This could result in reduced output of existing thermal plant or the decreased likelihood that any new thermal generation equipment will be built.</td>
<td>Two scenarios are looked at: no new base load thermal generation, and no new base load thermal generation and the removal of one existing CCGT.</td>
</tr>
</tbody>
</table>

---


\(^7\) The baseline assumption of a 20% capacity factor for wind was based on stochastic modelling, and was part of the work done in the development of the capacity standard. It accounted for hourly distributions of wind output across sites. The conclusion of the analysis was that a 100 MW wind farm provides peaking capacity equal in value to a 20 MW fast-start peaking plant.
## Scenario

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Affects Energy</th>
<th>Affects Capacity</th>
<th>Rationale</th>
<th>Assumptions Made</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced generation plant reliability</td>
<td>N</td>
<td>Y</td>
<td>The reliability of some major thermal plants may be lower than assumed in the assessment. It is also possible that all types of generation equipment suffer a drop in reliability as they age. This scenario looks at two possible futures; one where thermal reliability is decreased, the second where all generation equipment that is older than 10 years has its reliability decreased.</td>
<td>For the first scenario forced outage factor for existing thermal plant is raised by 2% (typically from 3% to 5%). For the second scenario this increase in forced outage increase applies to all existing thermal plant plus all generation equipment older than 10 years.</td>
</tr>
<tr>
<td>Limited south transfer</td>
<td>Y</td>
<td>N</td>
<td>The baseline assumption is that southward transfer can rise to an average of over 480 MW – but, as noted in the Winter Review[^8], various factors can combine to prevent this. During June-August 2008, the average net southward transfer over the HVDC link was approximately 300 MW.</td>
<td>In the calculation of energy margins for 2013 and 2014, inter-island transfer is limited to 1,314 GWh over April-September (equivalent to an average of 300 MW).</td>
</tr>
<tr>
<td>No Pole 3 for winter 2013</td>
<td>Y</td>
<td>Y</td>
<td>It is possible that Pole 3 may not be commissioned in time for the Winter of 2013.</td>
<td>Pole 3 is unavailable to contribute during Winter 2013, in addition there is limited SI transfer for this year as in previous scenario.</td>
</tr>
<tr>
<td>Tiwai shutdown</td>
<td>Y</td>
<td>Y</td>
<td>It is possible that due to poor economic conditions, specifically in the Aluminium industry, that the Tiwai aluminium smelter may shut down permanently.</td>
<td>Both the South Island peak demand and energy demand are reduced by the equivalent of the smelter demand. This is done in a staged fashion, over a number of years beginning 2014.</td>
</tr>
</tbody>
</table>

6. **Energy Margin Assessment**

6.1 **Methodology**

The assessment of Energy Margins follows the methodology set out in the SSAD. There are two key metrics:

- The New Zealand Winter Energy Margin (NZ-WEM), defined as:
  \[
  \frac{\text{expected NZ winter supply capability}}{\text{expected NZ winter demand}} - 1 \times 100\% \text{; and}
  \]

- The South Island Winter Energy Margin (SI-WEM), defined as:
  \[
  \frac{\text{expected SI winter supply capacity + southward DC transfers}}{\text{expected SI winter demand}} - 1 \times 100\%.
  \]

Components to these equations are described in Tables iv & v, below.

<table>
<thead>
<tr>
<th>Component</th>
<th>Comprises</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected Supply Capability</td>
<td>Thermal GWh</td>
<td>Maximum expected thermal generation available to meet winter (1 April to 30 September) energy demand allowing for forced and scheduled outages, available fuel supply and transmission constraints.</td>
</tr>
<tr>
<td></td>
<td>+ Wind GWh</td>
<td>Expected winter (1 April to 30 September) wind generation based on long-run average supply.</td>
</tr>
<tr>
<td></td>
<td>+ Base-load GWh</td>
<td>Expected winter (1 April to 30 September) base-load generation available from geothermal and cogeneration plants based on long-run average supply.</td>
</tr>
<tr>
<td></td>
<td>+ Mean Hydro GWh</td>
<td>Expected winter (1 April to 30 September) hydro generation based on mean inflows and including expected 1 April start storage of 2,750 GWh.</td>
</tr>
<tr>
<td>Expected Demand (GWh)</td>
<td>N/a</td>
<td>Expected winter demand, allowing for the normal demand response to periods of high spot prices (excluding any response due to savings campaigns or forced rationing).</td>
</tr>
</tbody>
</table>

**Table v: Summarising the SI-WEM components**

<table>
<thead>
<tr>
<th>Component</th>
<th>Comprises</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected Supply Capability</td>
<td>HVDC GWh</td>
<td>Expected winter (1 April to 30 September) HVDC transfers received in the South Island.</td>
</tr>
<tr>
<td></td>
<td>+ Wind GWh</td>
<td>Expected winter (1 April to 30 September) wind generation based on long-run average supply.</td>
</tr>
<tr>
<td></td>
<td>+ Mean Hydro GWh</td>
<td>Expected winter (1 April to 30 September) hydro generation based on mean inflows and including expected 1 April start storage of 2,400 GWh.</td>
</tr>
<tr>
<td>Expected Demand (GWh)</td>
<td>N/a</td>
<td>Expected winter demand, allowing for the normal demand response to periods of high spot prices (excluding any response due to savings campaigns or forced rationing).</td>
</tr>
</tbody>
</table>
6.2 Energy Margin Results

This section summarises projected WEM, based on input assumptions summarised in Section 5 and described in more detail in Appendix 1 and Appendix 2 (section 9 and 10 of this document).

Projections of NZ-WEM and SI-WEM under the baseline scenario are shown in figures 3 and 4.

Sensitivity results are presented following the base case results.

In all cases the yellow bar indicates the relevant security of supply standard range.

Under the base case:

- With committed generation only, the SI-WEM is projected to exceed the upper range of the security standard for the entire length of analysis, likewise the NZ-WEM also sits above the security standard until 2018;
  - That is no new generation other than what is currently committed is required to keep the the SI-WEM above 30% out as far as 2020
  - However the NZ-WEM sits within the security standard range in 2019 and falls below it in 2020
- Additional, non-committed (high, medium, low), generation equipment built during this time will have the result of moving the energy margins further above the relevant security of supply standards

Key sensitivity results are that:

- In all scenarios committed generation will see both the NZ-WEM and SI-WEM stay within or above the prescribed standards until 2017
- Past this point the only scenarios in which the margins fall below the standard prior to 2017 are the high demand and low thermal generation (including removal of a CCGT) scenarios
  - This is not surprising as there is a significant amount of energy supplied by a single CCGT, and, likewise, a similar significant amount of additional energy is consumed in the high demand scenario
- If “medium liklihood” or “low liklihood” generation equipment is built then at all times both the NZ-WEM and SI-WEM will exceed the security standard range for all scenarios
Figure 3: Base case projections of New Zealand Winter Energy Margins

Figure 4: Base case projections of South Island Winter Energy Margins
Figure 5: Sensitivity projections for both WEM’s – Case: HIGH DEMAND

Figure 6: Sensitivity projections for both WEM’s – Case: LOW DEMAND
Figure 7: Sensitivity projections for both WEM’s – Case: DELAYED BUILDS

Figure 8: Sensitivity projections for both WEM’s – Case: LOW INFLOWS
Figure 9: Sensitivity projections for both WEM’s – Case: LOW THERMAL GENERATION (No new thermal)

Figure 10: Sensitivity projections for both WEM’s – Case: LOW THERMAL GENERATION (No new thermal and decommissioning of one CCGT)
Figure 11: Sensitivity projections for both WEM’s – Case: NO POLE 3 FOR WINTER 2013 (only affects 2013 data)

Figure 12: Sensitivity projections for both WEM’s – Case: LIMITED SI TRANSFER (only affects 2013/2014 data)

Figure 13: Sensitivity projections for both WEM’s – Case: TIWAI SHUTDOWN


### 7. Capacity Margin Assessment

#### 7.1 Methodology

The assessment of Winter Capacity Margin follows the methodology set out in the SSAD. There is a single key metric: the North Island Winter Capacity Margin (WCM), defined as:

\[
WCM = \text{North Island expected available capacity} - \text{North Island expected demand for capacity} + \text{South Island Capacity Contribution (function of SI capacity – SI demand)}
\]

The input factors that comprise the WCM calculation are summarised in Table vi, below:

*Table vi: Summarising the North Island Winter Capacity Margin (WCM) Components*

<table>
<thead>
<tr>
<th>Component</th>
<th>Comprises</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected NI Supply Capacity (MW)</td>
<td>+ NI Thermal MW</td>
<td>Installed capacity of North Island thermal generation sources allowing for forced and scheduled outages.</td>
</tr>
<tr>
<td></td>
<td>+ NI Wind MW</td>
<td>20% of North Island wind capacity.</td>
</tr>
<tr>
<td></td>
<td>+ NI Base-load MW</td>
<td>Expected winter daytime (1 April – 31 October between 7am and 10pm) generation available from geothermal, cogeneration, and uncontrolled hydro scheme generation.</td>
</tr>
<tr>
<td></td>
<td>+ NI Demand Response and Interruptible Load MW</td>
<td>Expected demand response and interruptible load over the highest 200 half hours of demand in winter (1 April – 31 October between 7am and 10pm).</td>
</tr>
<tr>
<td></td>
<td>+ NI Hydro MW</td>
<td>Installed capacity of North Island controllable hydro schemes allowing for forced and scheduled outages and de-rated to account for energy and other constraints which affect output during peak times.</td>
</tr>
<tr>
<td>Less Expected NI H100 Demand (MW)</td>
<td>N/a</td>
<td>Expected average of the highest 200 half hours (or 100 hours) of demand in winter, plus losses. This is referred to as H100 NI demand</td>
</tr>
<tr>
<td>SI Capacity Contribution</td>
<td>+ South Island MW</td>
<td>The net amount of MW the South Island can provide the North Island during peak periods. This is essentially the same calculation above (supply capacity minus H100 NI demand) for the South Island and then modified based on the attributes of the HVDC</td>
</tr>
</tbody>
</table>
7.2 **Capacity Margin Results**

This section summarises the projected WCM, based on the input assumptions that are summarised in Section 5 and described in more detail in Appendix 1 and Appendix 2. (Section 9 and 10 of this document)

Projections of WCM under the baseline scenario are shown in figure 14.

Sensitivity results are presented following the base case results.

In all cases the yellow bar indicates the relevant security standard.

Under the base case:

- With committed generation only, the WCM is projected to fall within or exceed the security of supply standard over 2013-2017;
- “High” probability or equivalent generation will result in the margin remaining above or within the security standard until 2020; if only committed generation is built the margin will fall below the security of supply standard range from 2018 onwards;
- All other generation built (medium, low) will result in the security margin increasing further above the security standard.

Key sensitivity results are that:

- With committed generation only, the WCM is projected to exceed, or stay within, the capacity security standard range until 2015 in all sensitivity scenarios.
- From 2016 onwards all of the scenarios that see either a decrease in generation or increase in demand will fall below the security standard with committed generation only; medium and high generation futures in most scenarios see the margins above the security of supply standard; the below points detail some notable exceptions:
  - The **low thermal generation (including removal of a CCGT)** scenario falls below the security standard in 2016 in all build futures except low likelihood where it remains within the security standard, (this is primarily due to the timing of the removal of the CCGT, which occurs in 2016 in the modelling – see Section 8 for a more detailed discussion on this)
  - The unfavourable build conditions, lower wind contribution to capacity, reduced generation plant reliability, low thermal generation (no new thermal generation only) and high demand scenarios all have their margins fall below the standards later in the second half of the decade when only committed or high probability generation is built.
Figure 14: Base case projections of Winter Capacity Margins

Figure 15: Sensitivity projections of WCM – Case: HIGH DEMAND (left) and LOW DEMAND (right)
Figure 16: Sensitivity projections of WCM – Case: DELAYED BUILDS (left) and LIMITED WIND CONTRIBUTION TO CAPACITY (right)

Figure 17: Sensitivity projections of WCM – Case: LOW THERMAL GENERATION (No new thermal only – left) and LOW THERMAL GENERATION (No new thermal and removal of one CCGT – right)
Figure 18: Sensitivity projections of WCM – Case: REDUCED RELIABILITY (existing thermal plant only – left) and REDUCED RELIABILITY (reduced reliability of all plant older than 10 years – right)

Figure 19: Sensitivity projections of WCM – Case: NO POLE 3 FOR 2013 (left) and TIWAI SHUTDOWN (right)
8. CONCLUSIONS

8.1 ENERGY MARGIN SECURITY

NZ-WEM and SI-WEM are expected to remain within or above the energy security standards for the foreseeable future (2013-2020), even without any additional generation investment over that which is currently committed (basecase scenario).

This implies that the New Zealand electricity system, generally, has a high degree of energy security.

However from 2017 there are several possible situations which could lead to reduced energy security. These include:

- high demand growth;
- low viability of thermal generation equipment.

This is not an unexpected outcome, as both situations present a very significant change from the assessment’s baseline assumptions. However the scenarios in themselves do not present a significant supply risk. In the case of a sustained high demand scenario, demand growth would most likely be gradual, allowing time for participants to respond to its effects. Similarly, the planned removal of a CCGT is likely to be signalled in advance, thus giving the generators time to respond to the situation. In other words, generation projects that have low or medium probability currently would probably increase in probability in a high demand/low thermal generation scenario.

Low energy margin scenarios could cause concern if medium or low probability build profiles did not have sufficient depth to meet the shortfall in energy balance. However, currently, this is not the case as there is significant depth of resource in the energy sense, especially from wind generation.

When compared to the 2012 ASA the 2013 energy margin results are significantly higher. The difference between the 2012 and 2013 Energy Margin results is between 5-10% (in absolute terms – the 2012 ASA and 2013 ASA WEM – NZ results for 2015 were 20% and 25% respectively) depending on the year selected for the committed and high probability futures; for the medium and low probability futures the 2012 energy margins were actually higher in the near term (but roughly equivalent in the longer term). This increase is a result of two main things: Firstly the demand forecast has been revised down once again due to continued flat demand growth; secondly a number of specific generation plants appear to have been deemed more likely to go ahead.

8.2 CAPACITY MARGIN SECURITY

WCM is projected to meet the capacity security standard over the period from 2013-2015 for all scenarios.

Under the base case scenario, investment in high probability generation will result in the NI-WCM to meet or exceed the capacity security standard in until 2019.

This implies that, while the capacity margin is not as high as the energy margin, it will remain within or above the security standard with only small amounts of additional generation investment.

If the system is faced with conditions that deviate from expected (in a way with negatively impacts capacity margins such as higher than expected demand) it is possible that the WCM could fall below the capacity security standard. However, in all but one
scenario this is unlikely to be cause for alarm. This is because there is sufficient
generation resource in the medium and low probability build profiles that is more than
capable of filling any potential shortfall should the need arise.

There is one scenario where none of the build profiles are able to meet the capacity
standard: the scenario where no new thermal generation is built and a CCGT is
decommissioned. This occurs because the CCGT is removed in 2016 and there is
insufficient generation built before that time. This date, however, was chosen for
illustrative purposes and is only a best guess estimate. The reality of the situation is a
CCGT will only be decommissioned when the viability of thermal generation is severely
reduced – this viability is likely to be obvious to industry participants and therefore
signalled to the market in good time. This combined with the relative depth of alternative
generation resources means the sudden disappearance of a CCGT with no replacement
generation is unlikely. However it is an important sensitivity to take note of as the
impact of removing one CCGT is very large.

When compared to the 2012 results the WCM – NI is, like the energy margins,
significantly higher in the 2013 results. The difference between 2012 and 2013 margins
ranges between 300-600 MW. This difference arises because of the presence of a slightly
larger number of thermal generation options in the future scenarios; this is in addition to
the reasons listed previously in the energy margin conclusions.

8.3 Margin Interpretation Against the Standards

This ASA demonstrates that WCM-NI, WEM-NZ and WEM-SI all generally fall above the
efficient level indicted by the Electricity Authority’s analysis, and are expected to remain
above for in the near term at the least; with many generation options available that
could potentially keep the standard at this level until 2020. This is consistent with the
view, widely held, that the New Zealand generation sector is currently in a state of
oversupply, and some recent announcements on generation investment decisions⁹.

With the current generation capability above the efficient level indicated by the
Authority’s analysis, it might be tempting to comment that, in hindsight, some recent
new generation investment decisions were economically inefficient. However, it is
important to note that generation investment decisions are made with a multi-year time
lag, on the basis of the relevant participant’s commercial position, and with reasonable
expectations of future supply and demand. For example many of the existing and
committed generation projects in the 2013 ASA were likely based on forecasts of
demand growth that were significantly higher than actual demand growth observed in
recent years. Therefore it would be incorrect, and unfair on market participants, to use
the ASA standards as a yardstick in which to measure recent investment decisions
relative efficiency.

---

⁹ such as the long term storage of 2 Huntly units, and a number of generation projects recently
being delayed
9. **APPENDIX 1: DETAILED SUPPLY ASSUMPTIONS IN THE BASELINE SCENARIO**

9.1 **INTRODUCTION**

This Appendix sets out key supply assumptions used in the energy and capacity margin assessments. Many of the assumptions discussed are based on the Security Standards Assumptions Document (SSAD) published by the Electricity Authority.

The focus is on grid-connected generation. As set out in Appendix 2, embedded generation is netted off the demand forecasts used for this assessment, and should not be modelled on the supply side.

9.2 **EXISTING SUPPLY**

Below is a summary of the existing supply that is used in the model; note that this supply is based on the assumptions in section 9.4 below.

<table>
<thead>
<tr>
<th>Scheme</th>
<th>Type</th>
<th>MW</th>
<th>Assumed Contribution to Energy Margin’s (potential GWh over April-Sep)</th>
<th>Assumed Contribution to Capacity Margins (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Otahuhu B</td>
<td>Thermal</td>
<td>400</td>
<td>1657</td>
<td>388</td>
</tr>
<tr>
<td>TCC</td>
<td>Thermal</td>
<td>377</td>
<td>1562</td>
<td>366</td>
</tr>
<tr>
<td>Huntly 1,2 &amp; 4</td>
<td>Thermal</td>
<td>729</td>
<td>2979</td>
<td>707</td>
</tr>
<tr>
<td>Whirinaki</td>
<td>Thermal</td>
<td>155</td>
<td>642</td>
<td>150</td>
</tr>
<tr>
<td>Huntly U5</td>
<td>Thermal</td>
<td>385</td>
<td>1595</td>
<td>373</td>
</tr>
<tr>
<td>Huntly U6</td>
<td>Thermal</td>
<td>48</td>
<td>199</td>
<td>47</td>
</tr>
<tr>
<td>Southdown</td>
<td>Thermal</td>
<td>175</td>
<td>725</td>
<td>170</td>
</tr>
<tr>
<td>Stratford Peaker</td>
<td>Thermal</td>
<td>200</td>
<td>829</td>
<td>194</td>
</tr>
<tr>
<td>Mokai</td>
<td>Geothermal</td>
<td>112</td>
<td>444</td>
<td>370 for combined geothermal sites</td>
</tr>
<tr>
<td>Ohaaki</td>
<td>Geothermal</td>
<td>40</td>
<td>131</td>
<td></td>
</tr>
<tr>
<td>Poihipi</td>
<td>Geothermal</td>
<td>55</td>
<td>177</td>
<td></td>
</tr>
<tr>
<td>Wairakei incl. binary</td>
<td>Geothermal</td>
<td>172</td>
<td>722</td>
<td>135</td>
</tr>
<tr>
<td>Nga Awa Purua</td>
<td>Geothermal</td>
<td>138</td>
<td>582</td>
<td></td>
</tr>
<tr>
<td>Kawerau</td>
<td>Geothermal</td>
<td>100</td>
<td>386</td>
<td>98</td>
</tr>
<tr>
<td>Te Huka</td>
<td>Geothermal</td>
<td>23</td>
<td>91</td>
<td>22</td>
</tr>
<tr>
<td>Waikato</td>
<td>Hydro</td>
<td>1038</td>
<td>2311 + April storage</td>
<td>957</td>
</tr>
<tr>
<td>Waikaremoana</td>
<td>Hydro</td>
<td>138</td>
<td>306 + April Storage</td>
<td>135</td>
</tr>
<tr>
<td>Matahina</td>
<td>Hydro</td>
<td>80</td>
<td>135</td>
<td>65</td>
</tr>
<tr>
<td>Tokaanu/Rangipo</td>
<td>Hydro</td>
<td>360</td>
<td>700 + April Storage</td>
<td>328 for these combined sites</td>
</tr>
<tr>
<td>Mangahao</td>
<td>Hydro</td>
<td>28</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>Patea</td>
<td>Hydro</td>
<td>32</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Wheao</td>
<td>Hydro</td>
<td>26</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>Tararua 3</td>
<td>Wind</td>
<td>93</td>
<td>152</td>
<td>19</td>
</tr>
<tr>
<td>Te Apiti</td>
<td>Wind</td>
<td>88</td>
<td>145</td>
<td>18</td>
</tr>
</tbody>
</table>
9.3 **New Supply**

The tables below list the aggregated quantities of new generation that is added to the system; this is the supporting data for Figure 1.

**Table ix: New Generation Aggregated by Year**

<table>
<thead>
<tr>
<th>Year</th>
<th>Nameplate MW</th>
<th>Assumed Contribution to Energy Margin’s(potential GWh over April - Sep)</th>
<th>Assumed Contribution to Capacity Margins (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>296</td>
<td>1215</td>
<td>282</td>
</tr>
<tr>
<td>2014</td>
<td>216</td>
<td>401</td>
<td>43</td>
</tr>
<tr>
<td>2015</td>
<td>466</td>
<td>948</td>
<td>170</td>
</tr>
<tr>
<td>2016</td>
<td>1493</td>
<td>4321</td>
<td>856</td>
</tr>
<tr>
<td>2017</td>
<td>1004</td>
<td>3009</td>
<td>617</td>
</tr>
<tr>
<td>2018</td>
<td>1282</td>
<td>2534</td>
<td>410</td>
</tr>
<tr>
<td>2019</td>
<td>76</td>
<td>132</td>
<td>15</td>
</tr>
<tr>
<td>2020</td>
<td>180</td>
<td>738</td>
<td>170</td>
</tr>
</tbody>
</table>

**Table x: New Generation Aggregated by Type**

<table>
<thead>
<tr>
<th>Type</th>
<th>Nameplate MW</th>
<th>Assumed Contribution to Energy Margin’s(potential GWh over April - Sep)</th>
<th>Assumed Contribution to Capacity Margins (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geothermal</td>
<td>751</td>
<td>3047</td>
<td>708</td>
</tr>
<tr>
<td>Thermal</td>
<td>1155</td>
<td>4786</td>
<td>1120</td>
</tr>
<tr>
<td>Hydro</td>
<td>147</td>
<td>357</td>
<td>144</td>
</tr>
<tr>
<td>Wind</td>
<td>2960</td>
<td>5109</td>
<td>592</td>
</tr>
</tbody>
</table>
### Table xi: New Generation Aggregated by Probability

<table>
<thead>
<tr>
<th>Probability</th>
<th>Nameplate MW</th>
<th>Assumed Contribution to Energy Margin’s (potential GWh over April - Sep)</th>
<th>Assumed Contribution to Capacity Margins (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Committed</td>
<td>356</td>
<td>1334</td>
<td>294</td>
</tr>
<tr>
<td>High</td>
<td>250</td>
<td>1007</td>
<td>235</td>
</tr>
<tr>
<td>Medium</td>
<td>2635</td>
<td>4808</td>
<td>629</td>
</tr>
<tr>
<td>Low</td>
<td>1772</td>
<td>6150</td>
<td>1406</td>
</tr>
</tbody>
</table>

### Table xii: New Generation Aggregated by Island

<table>
<thead>
<tr>
<th>By Island</th>
<th>Nameplate MW</th>
<th>Assumed Contribution to energy Margin’s (potential GWh over April - Sep)</th>
<th>Assumed Contribution to Capacity Margins (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NI</td>
<td>4166</td>
<td>11838</td>
<td>2280</td>
</tr>
<tr>
<td>SI</td>
<td>847</td>
<td>1460</td>
<td>284</td>
</tr>
</tbody>
</table>

### 9.4 Other Key Assumptions for Generation

#### 9.4.1 Outage Modelling and De-ratings

In order to allow for forced and scheduled outages the following assumptions are made in the calculation of the WEM-NZ, WEM-SI and WCM:

- For thermal generation, other than the coal fired Huntly units, a de-rating of 5.4% is applied to the nameplate capacity when calculating the WEM-NZ and WEM-SI
- For the coal-fired Huntly units a de-rating of 6.7% is applied to the nameplate capacity when calculating the WEM-NZ and WEM-SI
- In addition to the de-rating above, the Huntly units are also further de-rated by 303 GWh in the calculation of the WEM-NZ and WEM-SI to reflect spinning reserve and frequency keeping requirements
- For all thermal generation (excluding cogeneration) a de-rating of 3% is applied to the nameplate capacity when calculating the WCM
- For all controllable hydro generation a de-rating of 2% is applied to the nameplate capacity when calculating the WCM
- In addition to this 2% de-rating the following further de-ratings are applied to certain hydro generation in order to account for limited short term storage ability (Matahina, Patea and Tokaanu) and chronological flow constraints on peaking ability (Waikato):
  - Matahina de-rated by 13 MW for the WCM
  - Patea de-rated by 5 MW for the WCM
  - Tokaanu de-rated by 20 MW for the WCM
  - The Waikato hydro scheme de-rated by 60 MW for the WCM
- Rangipo, Wheao (Flaxy Scheme), Mangahao and Branch River Hydro schemes are all treated as run of river and subsequently assumed to only contribute 55% of their nameplate capacity to the WCM calculation
9.4.2 Thermal Fuel Assumptions

It is assumed that all thermal stations have sufficient fuel in which to provide both the energy and capacity contributions as stated in the assumptions above (i.e. their ability to contribute to the WEM and WCM are not restricted by fuel supply).

9.4.3 Wind Capacity Contribution

In the calculation of the WCM it was recommended by the Electricity Authority that the wind capacity contribution be in the range of 20-25%.

Due to the conservative nature of the ASA and the relative unknowns of how wind capacity contribution will evolve as more wind is added to the New Zealand system this assessment uses a wind capacity contribution of 20%.

9.4.4 Start Storage

In the calculation of the WEM’s an amount of freely usable energy (GWh) is prescribed; this is to account for the start storage levels in the hydro catchments. The assumptions around these start storage amounts are:

- For the calculation of the NZ-WEM the start storage level is 2750 GWh
- For the calculation of the SI-WEM the start storage level is 2400 GWh

9.4.5 Huntly Units Long-term Storage

It is assumed that the second Huntly unit will be placed into long-term storage as scheduled in December of 2014. This means that Huntly winter capacity and energy drop to 471 MW and 1683 GWh respectively (from 707 MW and 2676 GWh – it removed more than one third of the GWh due to the de-rating of 303 GWh described above).

9.5 Transmission

Inter-island transmission assumptions are required for the assessments of Energy and Capacity Margins. The calculation of the WEM-SI needs to account for the extent to which North Island supply could potentially to the South Island supply and, likewise, the calculation of the WCM-NI needs to account for the extent to which South Island supply can contribute to North Island peaks.

The baseline assumption of this assessment is that the HVDC capability will be the combined capability of Pole 2 and Pole 3. We have completed a minor sensitivity in order to allow for Pole 3 commissioning to be delayed (i.e. only Pole 2 is available for winter 2013), thus we have also supplied assumptions around HVDC operation in the case where only Pole 2 is available.

In addition to the modelling of the HVDC; the ASA also makes some assumptions around AC losses in order to convert GXP demand into GIP demand (i.e. net demand for grid-connected generation).

9.5.1 HVDC: Southwards Flow

It is assumed that during winter the NI has potential to supply the SI with energy. This is only used in the calculation of the SI-WEM.

It is assumed that the North Island will be able to supply the South Island with 2102 GWh (480 MW average transfer) of energy during the winter period. Note that this energy transfer is dependent on the North Island having the required surplus energy
available; to allow for this restriction the lesser value of 2102 GWh or the net NI energy surplus (which is calculated in the same way the SI-WEM is calculated) is used.

It should be noted that actual southward transfer during June-August 2008 dry year was rather less than that assumed above. The Winter Review\(^\text{10}\) canvasses some of the reasons for this. This assessment includes a scenario with considerably less southward transfer (300 MW cf. 480 MW).

### 9.5.2 HVDC: Northwards Flow

It is assumed that during winter the South Island has the potential to supply the North Island with capacity. This is only used in the calculation of the NI-WCM.

Firstly the surplus capacity available in the South Island is estimated (same way in which the WCM-NI is calculated) and then, using a function, calculate the effective contribution of South Island capacity to meeting North Island demand. The function used in this process was derived using simulation analysis, taking account of:

- HVDC capacity;
- transmission losses;
- North Island instantaneous reserve requirements; and
- the (low) probability of forced outages on the HVDC link.

It is expected that HVDC Pole 3 will be available for winter 2013. Accordingly, in the base case of this assessment, it is assumed that both Pole 2 and Pole 3 are available at all times, and in all scenarios (with the exception of the scenario that specifically considers a pole 3 delay).

The capacity contribution function used is shown in Figure 20. Note that because there is a scenario where we need to assess the WCM with only Pole 2 in operation (for winter 2013) then the monopole HVDC performance is also shown.

Also note that the function is offset by 120 MW (this is the South Island surplus on the chart is the calculated South Island Surplus minus 120MW).

![Figure 20: Curves used to convert South Island surplus to North Island capacity contribution (indicative)](image)

9.5.3 AC Transmission Assumptions

This assessment does not explicitly model AC transmission constraints. The implicit assumption is that AC constraints will not systematically reduce inter-island transfers below the limits specified above. Future assessments will likely need to include a more detailed treatment of AC constraints.

However in order to convert GXP demand into demand for generation at the node we need to allow for AC losses. These losses are detailed in the following section (section 10.3.3).
10. **APPENDIX 2: DETAILED DEMAND FORECAST ASSUMPTIONS IN THE BASELINE SCENARIO**

10.1 **INTRODUCTION**

This assessment bases its demand forecast on the Transpower Long-term Electricity Demand Forecast Model September 2011 (LEDFM)\(^{11}\); however it should be noted that a new version of the LEDFM has been used for the 2013 ASA and thus the methodology and results will not be exactly the same as described in the above link – the current version of the LEDFM has not been publically released. This Appendix sets out key demand assumptions used in the energy and capacity margin assessments.

Note that for peak demand forecasting instead of the single highest half hour period that occurs in each year, the forecast uses an H100 number to describe system peak requirements. This number is the highest 200 peak periods that occur during the winter months.

10.2 **TREATMENT OF GENERATION**

The LEDFM forecast predicts demand at GXP level, with *all* embedded generation netted off. This approach was employed as it is how the LEDFM treats demand without modification, so all assumptions that are made in the LEDFM can be carried over to the ASA. Secondly it was used as it avoids any confusion with embedded generation.

This approach is slightly different to that used in the 2012 ASA: the 2012 ASA attempted to model some embedded generation plant. However this may have resulted in double counting some generation (as it was modelled on the supply side but netted off on the demand side). Therefore to improve clarity, avoid any chance of double counting and to align with the LEDFM assumptions it was chosen to not include any modelling of embedded generation.

10.3 **SPECIFIC DEMAND ASSUMPTIONS**

For the energy margin calculations, this forecast is adjusted by:

- allowing for transmission losses;
- allowing for demand response; and
- scaling annual forecasts to produce winter demand forecasts

Similarly for capacity margin calculations the forecast is adjusted by:

- allowing for transmission losses; and
- allowing for demand response

10.3.1 **Estimating Winter Demand**

In the assessment:

- New Zealand winter demand (April to September) is assumed to be 52% of annual New Zealand demand; and
- South Island winter demand is assumed to be 51.5% of annual demand.

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10.3.2 Demand Response

Energy demand forecasts have been reduced by 2% to allow for voluntary demand response.

This includes voluntary demand response resulting from high spot prices or retailer pricing initiatives, but excludes reductions in demand as a result of savings campaigns or calls for conservation.

Additionally peak demand projections in the North Island have been reduced by 176 MW to account for demand response at peak times.

10.3.3 Transmission Losses

Energy demand forecasts are adjusted to allow for average AC transmission losses of 3.5% (New Zealand) or 4.5% (South Island).

Peak demand forecasts are adjusted to allow for AC transmission losses of 2.88% (North Island) or 4.88% (South Island) for peak forecasting.

DC losses are incorporated in the assumptions about HVDC transfers

10.4 Demand Data

The base case energy demand shown in Table viii, below.

<table>
<thead>
<tr>
<th>Calendar Year</th>
<th>New Zealand Demand (GWh)</th>
<th>North Island Demand (GWh)</th>
<th>South Island Demand (GWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>38,287</td>
<td>24,320</td>
<td>13,966</td>
</tr>
<tr>
<td>2010</td>
<td>39,366</td>
<td>24,209</td>
<td>15,158</td>
</tr>
<tr>
<td>2011</td>
<td>38,774</td>
<td>24,195</td>
<td>14,579</td>
</tr>
<tr>
<td>2012</td>
<td>40,355</td>
<td>25,295</td>
<td>15,060</td>
</tr>
<tr>
<td>2013</td>
<td>40,852</td>
<td>25,601</td>
<td>15,251</td>
</tr>
<tr>
<td>2014</td>
<td>41,357</td>
<td>25,881</td>
<td>15,475</td>
</tr>
<tr>
<td>2015</td>
<td>41,936</td>
<td>26,203</td>
<td>15,733</td>
</tr>
<tr>
<td>2016</td>
<td>42,571</td>
<td>26,600</td>
<td>15,971</td>
</tr>
<tr>
<td>2017</td>
<td>43,210</td>
<td>26,988</td>
<td>16,223</td>
</tr>
<tr>
<td>2018</td>
<td>43,864</td>
<td>27,393</td>
<td>16,471</td>
</tr>
<tr>
<td>2019</td>
<td>44,588</td>
<td>27,841</td>
<td>16,747</td>
</tr>
<tr>
<td>2020</td>
<td>45,182</td>
<td>28,212</td>
<td>16,970</td>
</tr>
</tbody>
</table>

The base case annual H100 demand forecast is shown in Table xiv below.

<table>
<thead>
<tr>
<th>Calendar Year</th>
<th>North Island Demand (MW)</th>
<th>South Island Demand (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>4,272</td>
<td>2,050</td>
</tr>
<tr>
<td>2010</td>
<td>4,123</td>
<td>2,147</td>
</tr>
<tr>
<td>2011</td>
<td>4,195</td>
<td>2,151</td>
</tr>
<tr>
<td>2012</td>
<td>4,369</td>
<td>2,189</td>
</tr>
<tr>
<td>2013</td>
<td>4,430</td>
<td>2,216</td>
</tr>
<tr>
<td>2014</td>
<td>4,504</td>
<td>2,249</td>
</tr>
</tbody>
</table>
Note: These tables are inclusive of losses but do not include the demand side or winter scaling adjustments.
## 11. Appendix 4: Secondary Scenarios

### 11.1 Scenarios

The table below outlines the secondary scenarios that have been carried out. These scenarios are specifically requested scenarios that test some more extreme situations. It should be noted that these scenarios are generally very unlikely.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Affects Energy</th>
<th>Affects Capacity</th>
<th>Rationale</th>
<th>Assumptions Made</th>
</tr>
</thead>
<tbody>
<tr>
<td>No HVDC (extreme contingent event)</td>
<td>Y</td>
<td>Y</td>
<td>It was suggested that in extreme situations the HVDC may not be present for the entire length of a winter period. To observe the results of an event like this we have shown results for a number of years that reflect this scenario.</td>
<td>For years 2013 – 2017 the interisland contributions (NI contribution to SI-WEM and SI contribution to NI-WEM) were set to zero. Note: in this scenario the NZ-WEM loses meaning due to the inability to aggregate the separate islands thus only NI-WCM and SI-WEM results are shown.</td>
</tr>
<tr>
<td>0% Wind Contribution to Capacity</td>
<td>N</td>
<td>Y</td>
<td>It has been suggested that it is possible that total wind generation could potentially drop to zero during peak periods. Hence there was interest in a scenario that assumed a 0% wind capacity contribution.</td>
<td>Wind capacity contribution was set to 0% for the WCM calculation. This only impacts the WCM calculation thus only NI-WCM results are shown.</td>
</tr>
<tr>
<td>Pukaki Contingent Storage</td>
<td>Y</td>
<td>N</td>
<td>Recently Meridian Energy were given consent to take an additional 550 GWh from lake Pukaki in specific shortage situations.</td>
<td>An additional 550 GWh was added to hydro generation from the Waitaki chain each winter. This only impacts the NZ-WEM and SI-WEM calculations thus only those results are shown.</td>
</tr>
</tbody>
</table>

---

11.2 **Secondary Scenario Results**

- **Winter Capacity Margin - NI**
- **Winter Energy Margin - SI**

*Figure 21: Sensitivity projections for NI-WCM and SI-WEM – Case: NO HVDC*

*Figure 22: Sensitivity projections for NI-WCM – Case: 0% WIND CAPACITY CONTRIBUTION*
Figure 23: Sensitivity projects for NZ-WEM and SI-WEM - Case: PUKAKI CONTINGENT STORAGE