5 Generation assumptions

5.1 Introduction

This chapter sets out the planning assumptions used to forecast future electricity generation at each grid injection point.

Transpower undertakes grid planning to ensure that:

- electricity demand is met reliably
- the grid provides for efficient generation investment and as such supports a competitive wholesale energy market
- the generation investment market is efficient for all market participants, and
- the energy market is competitive for all consumers.

Consideration of the National Grid's future adequacy requires a view of not only future electricity demand – a requirement of both the Annual Planning Report (APR) and the Grid Reliability Report (GRR) – but also future electricity generation at each grid injection point.

The uncertainty surrounding future generation requires the consideration of possible generation futures and we have considered five scenarios.

5.2 Generation capacity assumptions

Generation capacity assumptions include:

- **existing grid connected generation** assumed to be available at its existing capacity
- **committed new generation** available from its publicly notified commissioning date, at its publicly notified capacity, for the duration of the planning period
- **committed decommissioned generation** from its publicly notified decommissioning date for the remainder of the planning period, and
- **modelled generation (de)commissioning** (un)available as determined to by GEM to be the least cost way to meet the load forecast given our input assumptions

5.2.1 Existing grid connected generation

Table 5-1 lists the operating capacities of existing grid-connected generation. Installed capacities may differ in some cases.

Table 5-1: Existing grid-connected generation

Generation plant	Region	Type	Operating capacity in MW	Grid injection point
Glenbrook[1]	Auckland	Cogen	74	Glenbrook
Otahuhu B	Auckland	Gas - CCGT	380	Otahuhu
Southdown	Auckland	Cogen	170	Southdown
Kawerau	Bay of Plenty	Geothermal	105	Kawerau
Kawerau Norske Skog	Bay of Plenty	Geothermal	25	Kawerau

Generation plant	Region	Type	Operating capacity in MW	Grid injection point
Kinleith	Bay of Plenty	Cogen	28	Kinleith
Matahina	Bay of Plenty	Hydro	72	Matahina
Wheao/Flaxy	Bay of Plenty	Hydro	24	Rotorua
Aratiatia	Central North Island	Hydro	78	Aratiatia
Mangahao	Central North Island	Hydro	37	Mangahao
Ohaaki	Central North Island	Geothermal	46	Ohaaki
Poihipi	Central North Island	Geothermal	51	Poihipi
Rangipo	Central North Island	Hydro	120	Rangipo
Tararua III[2]	Central North Island	Wind	93	Bunnythorpe
Te Apiti	Central North Island	Wind	90	Woodville
Tokaanu	Central North Island	Hydro	240	Tokaanu
Te Mihi	Central North Island	Geothermal	166	Te Mihi
Wairakei	Central North Island	Geothermal	161	Wairakei
Nga Awa Purua	Central North Island	Geothermal	140	Nga Awa Purua
Ngatamariki	Central North Island	Geothermal	82	Nga Awa Purua
Kaitawa	Hawke's Bay	Hydro	36	Tuai
Piripaua	Hawke's Bay	Hydro	42	Tuai
Tuai	Hawke's Bay	Hydro	60	Tuai
Whirinaki	Hawke's Bay	Diesel	155	Whirinaki
Kapuni	Taranaki	Cogen	25	Kapuni
Kiwi Dairy	Taranaki	Cogen	70	Hawera
McKee Peaker	Taranaki	Gas - OCGT	100	Motunui Deviation
Patea	Taranaki	Hydro	31	Hawera
Taranaki CC	Taranaki	Gas - CCGT	385	Stratford
Stratford Peaker	Taranaki	Gas - OCGT	200	Stratford
Arapuni	Waikato	Hydro	197	Arapuni
Atiamuri	Waikato	Hydro	84	Atiamuri
Huntly	Waikato	Coal	1000	Huntly
Huntly e3P	Waikato	Gas - CCGT	385	Huntly
Huntly P40	Waikato	Gas - OCGT	50	Huntly
Karapiro	Waikato	Hydro	90	Karapiro
Maraetai	Waikato	Hydro	360	Maraetai
Mokai	Waikato	Geothermal	112	Whakamaru
Ohakuri	Waikato	Hydro	112	Ohakuri
Waipapa	Waikato	Hydro	51	Maraetai
Whakamaru	Waikato	Hydro	100	Whakamaru
West Wind	Wellington	Wind	143	West Wind
Argyle/Wairau	Nelson/Marlborough	Hydro	11	Argyle
Cobb	Nelson/Marlborough	Hydro	32	Cobb
Coleridge	Canterbury	Hydro	45	Coleridge
Aviemore	South Canterbury	Hydro	220	Aviemore
Benmore	South Canterbury	Hydro	540	Benmore
Ohau A	South Canterbury	Hydro	264	Ohau A

Generation plant	Region	Type	Operating capacity in MW	Grid injection point
Ohau B	South Canterbury	Hydro	212	Ohau B
Ohau C	South Canterbury	Hydro	212	Ohau C
Tekapo A	South Canterbury	Hydro	25	Tekapo A
Tekapo B	South Canterbury	Hydro	160	Tekapo B
Waitaki	South Canterbury	Hydro	105	Waitaki
Clyde	Otago/Southland	Hydro	432	Clyde
Manapouri	Otago/Southland	Hydro	840	Manapouri
Roxburgh	Otago/Southland	Hydro	320	Roxburgh
Waipori[3]	Otago/Southland	Hydro	84	Halfway Bush

1. This value includes an embedded generating unit with a nominal rating of 38 MW that is operating at a continuous output of 25 MW.
2. Tararua stages I and II are both embedded generation.
3. Partly embedded.

5.2.2 Committed new generation

Committed projects are those which are reasonably likely to proceed and where the following are satisfied:

- all necessary resource and construction consents have been obtained
- construction has commenced, or a firm date set
- arrangements for securing the required land are in place
- supply and construction contracts have been executed, and
- financing arrangements are in place.

Table 5-2 lists committed grid-connected generation projects.

Table 5-2: Committed new generation

Generation plant	Region	Type	Operating capacity in MW	Grid injection point
There are currently no committed new grid connected generation projects.				

5.2.3 Decommissioned generation

Generation forecasts must also account for decommissioned generation. In late 2013, Genesis Energy placed one unit of Huntly (250 MW) into long-term storage, and decommissioned the unit that was currently in long-term storage. This reduced the capacity of the coal-fired steam turbines at Huntly to 500 MW. Technically, units placed into long-term storage could be recertified and brought back into operation within 90 days. However, for modelling purposes we treat storage as equivalent to decommissioning.

New generation forecasts

This year's APR uses a new set of scenarios, which are an updated version of the scenarios in the Electricity Commission's 2010 Statement of Opportunities (SoO).

What are generation scenarios?

Generation scenarios represent possible future generation outcomes, resulting from making specific assumptions about future fuel availability and environmental policy. They enable the assessment of transmission needs.

Transpower's scenarios are based on the five generation scenarios in the 2010 SoO:

- Scenario 1: Sustainable Path
- Scenario 2: South Island Renewables
- Scenario 3: Medium Renewables
- Scenario 4: Coal
- Scenario 5: High Gas Discovery

Scenario 1 – Sustainable Path

New Zealand embarks on a path of sustainable electricity development and sectoral emissions reduction. Major development of renewable generation takes place, particularly in the North Island – mainly hydro, geothermal, and wind, but tidal and wave energy, solar power and biomass cogeneration also feature. Renewable energy production exceeds 90% of total generation from 2020 onwards. Baseload thermal generation is largely phased out, but new thermal peakers are required. The demand side also has an important role to play in balancing intermittent generation and meeting peak demand.

Scenario 2 – South Island Renewables

There is extensive wind and hydro generation development, with a focus on the South Island. Geothermal resources in the central North Island are developed more slowly than in the Sustainable Path scenario. As with the previous scenario, renewable energy production exceeds 90% of total generation (on average) from 2020 onwards. Baseload thermal generation is reduced and the need for thermal peakers is moderated by the availability of South Island hydro peaking plant from the 2020s.

Scenario 3 – Medium Renewables

A 'middle-of-the-road' scenario. The NZAS aluminium smelter is progressively phased out between 2022 and 2027 – reducing generation expansion overall. There is moderate geothermal and wind development, mainly in the North Island, but little new hydro generation. Baseload thermal generation is considerably reduced, but new thermal peakers are required. The demand side contributes less than in the other scenarios.

Scenario 4 – Coal

This is the scenario with the lowest carbon prices, which makes investment in new coal-fired power stations economic. The remaining Huntly coal units are replaced by efficient new coal-fired power stations commissioned in 2019 and 2020. Most existing baseload thermal generation remains online. There is also some renewable development, with significant growth in geothermal capacity but little investment in new hydro or wind. Baseload generation is supported by thermal peaking generation and demand-side response.

Scenario 5 – High Gas Discovery

Major new gas discoveries keep gas prices low over the entire time horizon. Many existing thermal plants are replaced with new and efficient gas-fired plant. New gas-fired peakers are also constructed to support new gas-fired baseload generation. There is some growth in geothermal capacity but little hydro or wind development.

Scenario development approach

The Electricity Commission's scenarios from the 2010 SoO were produced using the Generation Expansion Model (GEM), which creates a least-cost schedule of new generation capacity required to meet forecast demand. More information about GEM is available on the GEM project site.[13]

The new scenarios described in this document are based on the 2010 SoO scenarios and have been produced using a similar version of GEM with many of the same input assumptions (including capital and maintenance costs, fuel costs and carbon prices).

Transpower has revised some assumptions to bring the scenarios up to date with current information, and to reflect our views about plausible generation and demand-side development. Key changes include:

- updating the lists of existing, committed and potential generation
- using the 2014 APR demand forecast as described in Chapter 4
- relaxing the GEM security constraints as the original constraints tended to produce scenarios with an implausibly high amount of North Island peaking capacity
- setting exchange rates to what we would regard as a plausible long-term average
- reviewing the range of possible Huntly decommissioning schedules.

GEM data files and code are available on request.

The scenarios produced by GEM were manually edited so as to increase the diversity of outcomes in some regions. This is important for assessing the range of possible transmission flows.

We have attempted to incorporate the most up to date information about future generation projects. Since the release of the 2010 Statement of Opportunities, there has been little load growth. Several large generation projects, particularly in the South Island, have subsequently been put on hold due to flat demand expectations and protracted consent process. These projects include Meridian Energy's Mokinui and North Bank Tunnel hydro schemes and the Hayes wind-farm, Mighty River Power's Wairau River, and Contact Energy's Clutha hydro developments. These are now included only in MDS2 – South Island Renewables and only post-2025. While less likely given the announcement of the last few years, this timing is still feasible.

5.3 Use of the generation capacity assumptions

5.3.1 Use of generation scenarios in the APR

The generation scenarios are used to assess the effect of generation on the National Grid backbone. The generation output is varied to test the transmission capability. Issues that have already been noted are considered again to determine what effect, if any, the forecast generation will have.

5.3.2 Grid Injection Point injection forecast assumptions

Grid Injection Point injection forecasts, required for the GRR, are based on each generator's operating capacity. For the purposes of assessing local grid injection point adequacy, we base our assessment on ensuring there is adequate transmission capacity to fully dispatch each generator rather than making assumptions about how much each generator may actually generate in the future.

[13] http://code.google.com/p/gem/