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 Transmission Planning Report (TPR) 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 existing capacity
- **committed new generation** available from publicly notified commissioning dates, at its publicly notified capacity, for the duration of the planning period
- **committed decommissioned generation** from publicly notified decommissioning dates 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	140	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	Hawkes Bay	Hydro	36	Tuai
Piripaua	Hawkes Bay	Hydro	42	Tuai
Tuai	Hawkes Bay	Hydro	60	Tuai
Whirinaki	Hawkes 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	500	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.

We are not aware of any new grid-connected generation that meets the criteria above.

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.

Mighty River Power announced in March 2015 that they plan to retire the remaining 140 MW of generation at Southdown in December 2015. We have assumed that Southdown is retired at the end of 2015 in all scenarios.

5.2.4 New generation forecasts

This year generation scenarios included in the TPR are based on the Ministry of Business, Innovation and Employment's (MBIE's) draft Electricity Demand and Generation Scenarios[13] (EDGS) and work done by the New Zealand Smart Grid Forum[14] on disruptive technologies. MBIE released the draft EDGS for consultation in

[13] www.med.govt.nz/sectors-industries/energy/energy-modelling/modelling/electricity-demand-and-generation-scenarios

[14] www.med.govt.nz/sectors-industries/energy/electricity/new-zealand-smart-grid-forum

April 2015. The EDGS will replace the 2010 Statement of Opportunities previously used as a basis for Transpower's scenario analysis when they are finalised.

Due to the limited lead time since the release of the draft EDGS, for this year's TPR we have not explicitly considered MBIE's draft EDGS scenarios 5-8. They are similar to MBIE's mixed renewables scenario except they have different demand assumptions, such as about the future levels of demand from Tiwai and future demand growth rates.

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. Appendix A gives details on the timing, type, location and size of new generators assumed in each of the generation scenarios.

Transpower's scenarios are based on the five generation scenarios:

- Scenario 1: Mixed Renewable
- Scenario 2: High geothermal access
- Scenario 3: Low-cost fossil fuels
- Scenario 4: Global low carbon
- Scenario 5: Disruptive Technologies

Scenario 1 – Mixed Renewables

Scenario 1 is based on MBIE's draft mixed renewables scenario. It is a "balanced" renewables scenario, reflecting the current views of relative technology costs and expected fuel costs. Uptake of potentially disruptive technologies – such as energy storage and solar photovoltaics – is relatively muted.

Scenario 2 – High geothermal access

Scenario 2 is based on MBIE's draft high geothermal access scenario. In this scenario we allow more geothermal generation to be constructed sooner. All other assumptions are as in scenario 1.

Scenario 3 – Low-cost fossil fuels

Scenario 3 is based on MBIE's draft low-cost fossil fuels scenario. It assumes there are sizeable discoveries in Taranaki which increase the supply of gas available for electricity generation, resulting in increased baseload gas generation. The carbon cost also remains low throughout the modelling horizon, reducing the incentive to build low-carbon generation.

Scenario 4 – Global low carbon

Scenario 4 is based on MBIE's draft global low carbon scenario. In this scenario carbon prices increase early in the modelling horizon and wind generation costs reduce. Solar photovoltaic installations increase more rapidly and there is a higher uptake of electric vehicles. The amount of geothermal resource available is reduced from the mixed renewables scenario.

Scenario 5 – Disruptive Technologies

The disruptive technologies scenario is based on that developed by the New Zealand Smart Grid Forum and assumes that uptake of residential solar photovoltaics and electric vehicle increases more rapidly. From the early 2020s, energy storage becomes standard for residential solar installations, and by 2030 every new light passenger vehicle purchased is electric. All other assumptions are the same as in the mixed renewables scenario.

Scenario development approach

All scenarios 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.[15]

The scenarios have been produced using the same input assumptions (including capital and maintenance costs, fuel costs and carbon prices) as those used by MBIE and the New Zealand Smart Grid Forum.

GEM data files and code are available on request.

5.3 Use of the generation capacity assumptions

5.3.1 Use of generation scenarios in the TPR

Generation development scenarios (see Section 5.2.4) are not explicitly used, other than to note where significant issues may arise if the future generation is in particular regions.

System conditions that we have considered in assessing the grid backbone are broad and encompass significant regional differences in demand, such as could occur if Tiwai was to close. The system conditions also cover the possible impact of the generation scenarios in section 5.2.4.   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

In addition to load forecasts for each Grid Exit Point, the GRR requires Grid Injection Point (GIP) injection forecasts to assess the adequacy of the local grid to receive generation.

GIP injection forecasts are based on the total operating capacity of generators connected to the GIP. The assessment of local grid injection point adequacy is based on ensuring there is adequate transmission capacity to fully dispatch all local generators rather than making assumptions about how much each generator will contribute at the time of maximum injection.

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