

3 Existing National Grid

3.1	Introduction
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3.1 Introduction

This chapter provides an overview of New Zealand's existing National Grid as at 30 June 2015 with respect to load and generation. New Zealand's National Grid consists of the:

- HVAC transmission network, and
- an inter-island HVDC link.

3.1.1 The AC transmission network

New Zealand's HVAC transmission network supplies most of the major load centres, and consists of a grid backbone of 220 kV transmission lines stretching nearly the full length of each island.

There is also a network of 110 kV lines that run roughly parallel to the 220 kV system. The 110 kV system was the original grid backbone, largely superseded by the introduction of the 220 kV grid from the 1950s onwards. The 110 kV system is now primarily used for transmission to some regions that do not have 220 kV, or for sub-transmission to substations within a region.

Figure 3-1 and Figure 3-2 show maps of the transmission network for both the North and South Islands.

Figure 3-1: New Zealand's North Island transmission network



Figure 3-2: New Zealand's South Island transmission network



3.1.2 The HVDC Link

The HVDC link connects the North and South Island transmission networks.

This bi-directional link runs from Benmore, in the South Island, where there is an AC/DC converter station. There is a 534 km transmission line between Benmore and Fighting Bay (Marlborough), a 40 km submarine cable between Fighting Bay and Oteranga Bay across the Cook Strait, and a further 37 km transmission line into Haywards substation north of Wellington. At Haywards substation, there is another AC/DC converter station.

HVDC power flow is predominantly from the South Island to the North Island. Power flow is from north to south when it is necessary to conserve South Island hydro resources as part of an efficient generation process, or to supply South Island demand during dry South Island periods.

Table 3-1 lists the existing pole capacities for converting power from AC to DC and from DC to AC for both poles. Total pole capacity equates to the total capacity of the link.

Table 3-1: Converter ratings and pole capacities

Pole	Commissioned	Converter type	Transmission capacity
Pole 2	1991	Thyristor valves	700 MW
Pole 3	2013	Thyristor valves	700 MW
Total possible HVDC transmission capacity			1200 MW

3.1.3 Transmission network asset profile

Table 3-2 provides a summary of the transmission network's assets.

Table 3-2: Transmission network assets

Asset description	Detail
Length of HVAC and HVDC transmission line	11,646 route km
Number of substations (including HVDC)	169
HVAC transmission line voltages	220, 110, 66, 50 kV
HVDC transmission line voltage	350 kV
HVDC link capacity	1200 MW
Capacitor banks and filters	87
Transformers (banks)	346
Synchronous condensers	8
Static Var Compensators/STATCOMS	8
Shunt reactor	3
Series reactor	2

Over the last few years we have been actively pursuing opportunities to rationalise our network assets including transfer of lightly loaded, low voltage and spur line assets to the relevant local lines company. In this TPR year the following transfers have been completed:

- Upper Takaka, Cobb and Motueka substations together with the Motupipi–Upper Takaka–A, Cobb–Upper Takaka–A and B and Stoke–Upper Takaka–A and B lines.

3.1.4 Recently completed transmission upgrade projects

Table 3-3 lists the transmission upgrade projects completed since the last Transmission Planning Report (31 March 2014).

Table 3-3: Projects completed since the 2014 Transmission Planning Report

Project name
Additional bus coupler circuit breaker at Islington
Replace Stratford supply transformer with two 40 MVA units
Replace Redclyffe supply transformers with two 120 MVA units
Replace the existing three Timaru 110/11 kV supply transformers with three 47 MVA units
Replacement 220 kV Wairakei–Whakamaru–C line
Resolve Balclutha protection and branch component limit
Paraparaumu 220 kV connection
Replace Hamilton 220/33 kV supply transformer
Replace Huirangi supply transformer with two 60 MVA units
Replace National Park supply transformer
Replace Ohakune supply transformer
Replace Tarukenga interconnecting transformer
Replace Rotorua 110/11 kV supply transformers with two 35 MVA units.
Resolve South Dunedin supply transformer metering constraint

Table 3-4 lists the committed transmission upgrade projects.

Table 3-4: Committed projects

Project name	Expected completion date
Lower South Island Reliability projects (including 220/110 kV connection at Gore)	2012-TBC
Clutha–Upper Waitaki Lines Project	2013-TBC
Timaru 110 kV bus rationalisation	2017-2018
A third Wilton 110 kV bus section	2017
Hawera bus rebuild	2015-2017
New 110 kV Hangatiki–Te Awamutu circuit (see note 1)	2016
Install SPS to automatically increase generation and/or reduce load post-contingency at Redclyffe	2015-2016
Install one additional cable per phase to increase incomer capacity at EDN	2015

1. This line will be built and owned by Waipa Networks

3.2 Load and generation

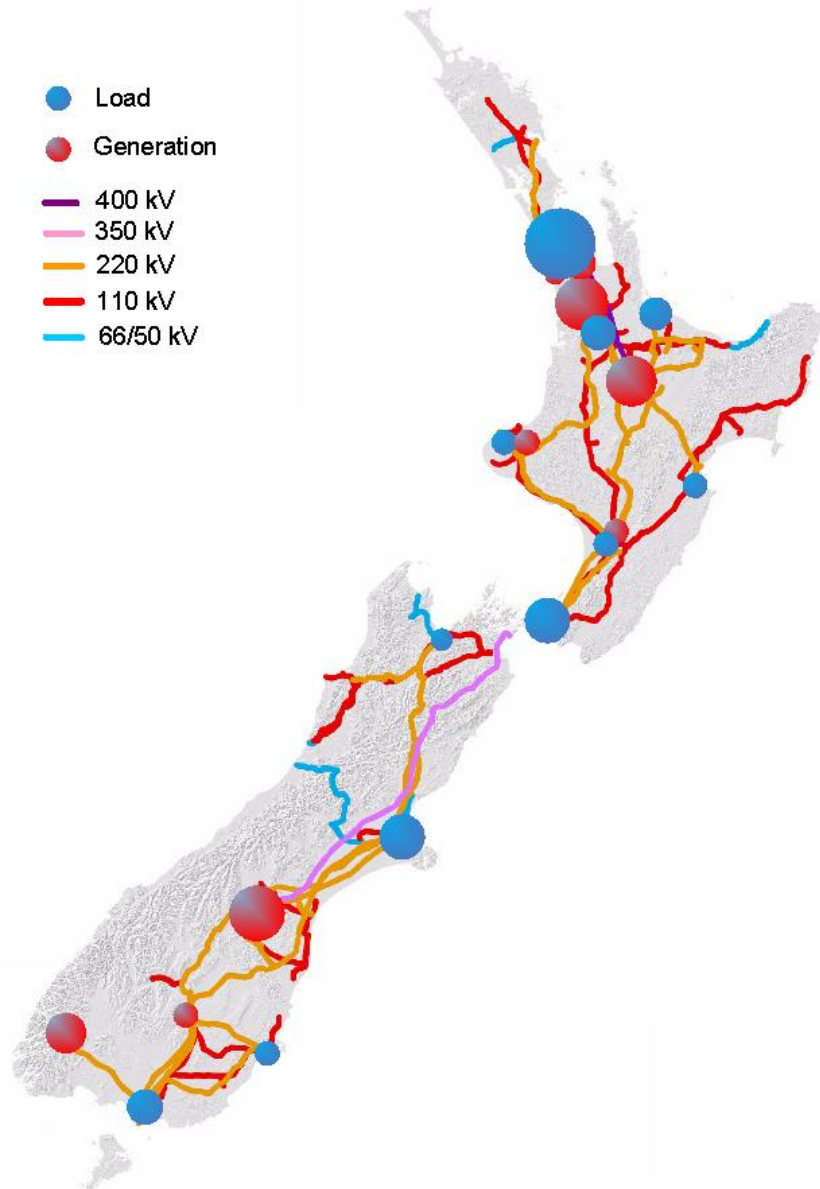
New Zealand's transmission network is regarded as narrow and longitudinal, with areas of demand (load) commonly some distance from the areas of significant generation. Consequently, the transmission network is essential in complementing generation to bring the power to where it is needed.

A particular feature of the National Grid, and a key benefit for a sustainable New Zealand, is its ability to provide New Zealanders with access to renewable generation. Typically, the remote areas of generation connected by the National Grid

are renewable (e.g. hydro in the Waitaki Valley, wind in the Tararuas, and hydro and geothermal in the Central North Island).

Figure 3-3 shows a simplified map of load, generation, and the transmission network's grid backbone. For more information see Chapter 4 for the demand assumptions, Chapter 5 for the generation assumptions and Chapter 6 for the transmission backbone.

Figure 3-3: Load, Generation and the Grid Backbone

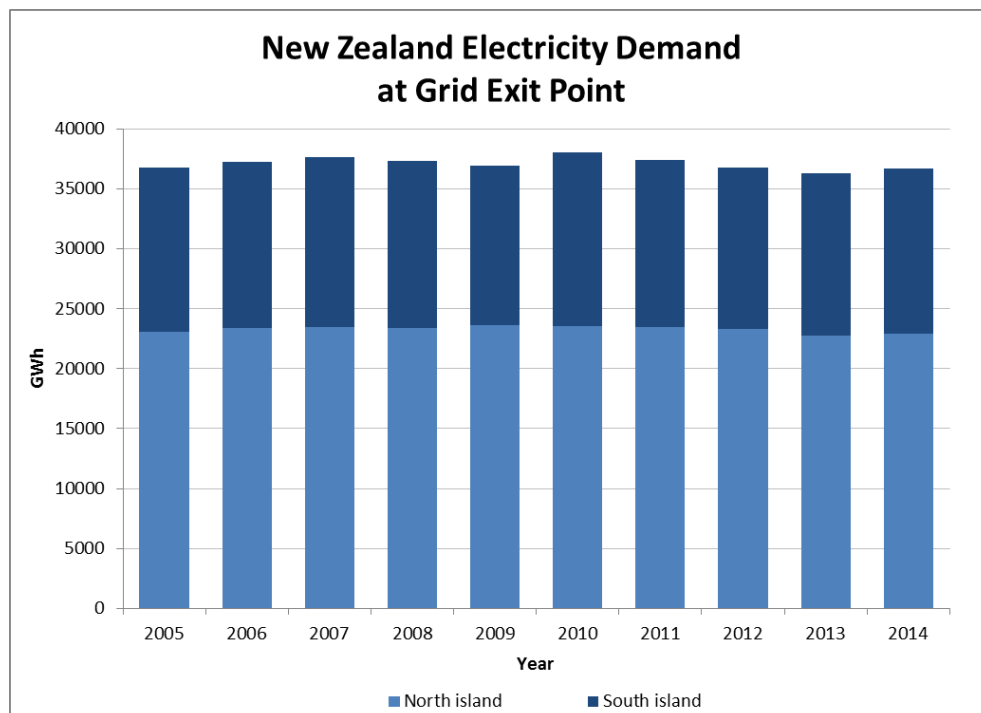


Many of New Zealand's larger population centres are located in the North Island, while a significant amount of hydro generation is located in the South Island.

Power flow tends to be from south to north during normal rainfall years, delivering power from the hydro generation in the South Island to the North Island through the HVDC link, which also balances demand between the islands. North to south transfers have been occurring for longer periods in recent years. They occur more frequently during dry years where hydro generators in the South Island try to conserve water.

Figure 3-4 shows New Zealand's electricity energy demand at grid exit points (i.e. this includes distribution network losses but not demand supplied by generation embedded within these networks).

Figure 3-4: New Zealand Grid energy demand



Energy demand (GWh) has been relatively flat over the last decade compared to the strong growth seen in earlier decades. In recent years energy demand has been affected by the:

- global recession, reduced industrial demand (e.g. Tiwai Aluminium Smelter and Norske Skog Tasman mill),
- the Christchurch earthquakes
- increased uptake of energy efficiency lighting and appliances
- increases in generation embedded within distribution networks which reduce the demand observed at grid exit points.