3 Investment Uncertainties

3.1 Demand

Peak demand, at grid exit points or for regions or Islands, is a key input to the planning that underlies the TPR. An important part of our demand forecasting approach is understanding and quantifying uncertainty in future demand. This understanding allows us to identify a prudent level of future peak demand growth for use in our planning studies. Our forecasting approach is described below. Note that for the TPR, our focus is on peak rather than energy demands.

We incorporate a wide range of viewpoints and uncertainties regarding demand growth. However there have been a number of recent instances of industrial and large commercial companies announcing their intention to significantly reduce or increase their demand at relatively short notice. We expect that this will continue, necessitating regular review of our demand forecasts and investment plans.

3.1.1 New Zealand peak Grid demand

Figure 3-1 shows New Zealand’s peak grid demand\(^1\) since 1997. In the period to 2007, peak demand grew at an average 1.5 per cent per annum, but since then it has

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\(^1\) NZ Grid demand is defined as the sum of demand across all Grid Exit Points (GXP). The Peak Demand is the maximum grid demand seen in any half-hour within each calendar year.
plateaued. The exception is 2011, when a new national peak demand record was set in mid-August during an unusual polar weather event that affected the whole country. Considerable year to year variability is also evident.

Figure 3-1: New Zealand peak grid demand (MW)

The relatively flat peak demand seen in recent years is the aggregate result of many factors across all sectors of demand. The growth that we would have expected to see as a result of recent strong growth in both population and GDP has been offset by a combination of factors including:

- an increased uptake of energy efficient lighting and appliances
- an increase in the efficiency of new homes
- milder winters
- an increase in generation embedded within distribution networks, which reduces grid supplied demand
- the global recession in 2008, with associated reductions in industrial demand at some notable sites including the Norske Skog Tasman mill, Pacific Steel at Mangere, the Stockton coal mine and the Tiwai aluminium smelter
- the Christchurch earthquakes, which triggered an immediate reduction in local demand of about 10 per cent. The subsequent rebuild has so far only stimulated a partial return towards historical levels
- the current Transmission Pricing Methodology (TPM) has encouraged load management aimed at reducing regional coincident peak demand, in order to defer or avoid new investment in transmission.

While the figure above shows national annual peak demand we also forecast Island and regional peak demand, by season. In some of our drier regions there has been

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2 This impact is more on total energy (GWh) than on peak demand (MW).
strong demand growth from irrigation schemes and dairy production expansion, leading to strong growth in summer peak demand. South Canterbury is a summer peaking region that has seen these effects. The West Coast is also a summer peaking region, where dairying and tourism have contributed to recent summer peak demand growth.

3.1.2 Peak demand forecasting

Our approach to demand forecasting includes both top-down modelling of national, Island and regional peak and energy demand, and bottom-up modelling of grid exit point (GXP) peak demand.

Our top down approach considers demand at national, Island and regional levels. We use an ensemble of models\(^3\) (trend, econometric, etc.) to produce forecasts, and define a plausible range for future demand growth. Our bottom-up approach to grid exit point forecasting uses simpler techniques and draws on information from local distribution companies.\(^4\)

This year we have enhanced the approach we take to incorporating the uncertainty resulting from distributed generation. Data supplied by the electricity market Reconciliation Manager on existing distributed generation enables us to forecast gross demand supplied by the grid and by distributed generation. From this we derive grid demand forecasts by making suitable assumptions about the generation output we would expect from existing distributed generation at times of regional and Island peaks.\(^5\)

We use prudent peak demand forecasts in planning studies. The prudent forecast has a 10 per cent probability of exceedance for the first seven years of the forecast period (until 2023).\(^6\) Post-2023 we assume an expected (or mean) rate of growth. We consider this an appropriate basis on which to conduct our planning studies as it ensures timely identification of grid issues with sufficient time for these to be resolved appropriately.

3.1.3 Island and regional peak demand forecasts

Figure 3-2 shows our latest national peak demand forecast compared to previous forecasts.

The grey region shows our current view as to the plausible range of demand, given identified uncertainties (but excluding uncertainties associated with structural changes such as the uptake of battery storage, discussed in section 3.5).

Continuing flatness in demand growth has lead us to further revise down our 2017 forecast. The first year of our prudent forecast is now below that of the 2011 historical peak and not dissimilar to demands seen over the 2006 to 2010 period. However, there is some chance demand could recover with the grey region extending up towards the 2015 and 2016 TPR prudent forecast levels.

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\(^3\) Use of an ensemble approach recognises that there is no perfect approach to forecasting.


\(^5\) Future distributed generation development is discussed within our generation section.

\(^6\) This is equivalent to a P90 forecast, in which peak demand has a 90 per cent chance of being less than the prudent forecast. Put another way, we expect actual peak demand to exceed the forecast in just one year in ten.
3.1.4 Grid exit point forecasts

At a grid exit point level we employ simpler regression techniques based on historical gross grid exit point demand, and feedback from local distribution companies.

Local information about new demand (for example, a new factory opening) is incorporated into the forecast. Additional demands are usually expected in the 1–5 year horizon, while on occasion there are reductions in demand over the same period relating to announced plant closures.

Some of the major step increases in demand identified in the 2017 grid exit point forecasts include:

- Auckland CBD growth ~ 16 MW at Penrose 110 kV grid exit point by 2020
- Auckland combined residential and commercial growth ~ 22 MW at Penrose 33 kV grid exit point by 2019
- Christchurch CBD re-build ~ 16 MW at Islington 66 kV GXP by 2019
- Hunter Downs irrigation and associated on-farm demand growth ~ 40 MW in the South Canterbury region between 2020 and 2030.

For more information about specific step changes in load in a region, see the relevant regional chapter (Chapters 7-19).

A particular challenge in this space is new information. We work closely with distribution companies and industrial customers to understand the scope and timing of what are often short notice demand changes at grid exit points. For example, in September 2012, Norske Skog announced\(^7\) plans, to halve production at its Kawerau

paper mill and subsequently reduced its typical grid demand by 50 MW just four months later. It is not possible for us to predict these changes so instead we try to respond to changes quickly and regularly review our forecasts and the impact of forecast changes on our plans.

3.1.5 GXP contribution to Island and regional peak forecasts

By combining our top down and grid exit point forecasts, we can calculate the expected contribution of each grid exit point to regional and Island peak demands. These contributions are inputs to regional planning studies. The regional and Island peaks will not necessarily occur at the same time as the grid exit point demand peaks and thus the grid exit point contributions are typically less than the grid exit point peak demand forecast.

3.2 Generation

A period of strong growth in new generation plant occurred over the period from 2009-14, with more than 1,200 MW of new capacity installed. It is likely that much of this investment was premised on continuing strong growth in demand, as seen in the period to 2007 (refer to Figure 3-1), which did not eventuate.

Since 2015 we have seen the closure or announced closure of a significant amount of thermal generation in the upper North Island. Otahuhu B (380 MW) and Southdown (140 MW) have been decommissioned and in August 2015, Genesis Energy announced its intention to decommission the remaining 500 MW of coal-fired generation at Huntly in 2018, although this was later amended to 2022.

Such plant retirements can drastically alter power flows on the grid, and in future, retirements may be a primary driver of grid investments.

The existing grid connected generation plant is listed in Chapter 2.

3.2.1 Generation development

New Zealand has abundant resources for development of new generation. However, investment in new generation is currently commercially challenging due to flat demand, and uncertainties surrounding uptake of solar photovoltaic panels and batteries, and the future of the Tiwai smelter.

We expect new generation will be developed but it is more likely to be small and ‘just in time’. This may present a significant challenge to developing transmission investment plans as it unclear where, when and how much new generation may appear.

3.3 Emerging technologies

There is a growing awareness in New Zealand of the potential for new technology to significantly impact future grid demand. Technologies include the increased electrification of heating and cooling (in the residential, commercial and industrial sectors), electric vehicles, roof-top solar photovoltaic panels and battery storage. Uncertainty regarding whether (and when) these technologies will have a significant impact on grid demand presents a challenge to developing medium to long term network plans.
3.3.1 Overseas experience

Other countries have pursued renewable sources of energy as they have worked to address energy security, sustainability and climate change issues. This has led to significant investment in solar photovoltaics and electric vehicles, and as a result, the costs of solar photovoltaics and battery technologies for domestic (and commercial/industrial) use are reducing quickly.

- The cost of solar photovoltaics panels have decreased at an average rate of 10 per cent per year since 1980. It is now possible to install a domestic 1.5kW system in New Zealand for $5,000 with module costs expected to continue to drop.
- The cost of batteries is also reducing rapidly, with many forecasters predicting that electric vehicles will be cost competitive with internal combustion vehicles in less than 10 years.

As costs fall, we expect that many New Zealand consumers will find such technologies attractive, and uptake of the technologies will increase significantly over time.

3.3.2 New Zealand experience

Distribution companies are now actively evaluating the use of these emerging technologies. Some of the technologies provide significant opportunities for distribution companies to improve their own asset management, provide new services to connected customers and pursue commercial growth opportunities.

It is expected that some distribution companies will need to become distributed system operators, managing two way energy flows over their own networks. How these distributed system operators and our own System Operations group will interface will need to be established over time, to ensure security of supply is maintained to consumers.

The New Zealand government has indicated that the uptake of electric vehicles and the further electrification of industry, (i.e. substituting electric technologies for coal and gas) are important elements in New Zealand meeting its Paris climate change commitment.

3.3.3 Emerging technology influences on demand

The changing technology environment creates considerable uncertainty about the future demand for electricity supplied from the grid. Whilst we expect population growth, a strong economy and industrial electrification to drive electricity demand growth in the short to medium term, advances in energy efficiency and uptake of emerging technologies will lead to a decrease in the longer term.

Overall, we have a view that peak electricity demand from the grid will go through a wax and wane sometime in the next 40 years i.e. peak demand will grow in the short

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to medium term, but then flatten out and eventually start to reduce. The timing and trajectory of this effect is highly uncertain.

3.4 Decarbonisation and Electrification

We are aware of increasing interest and discussion regarding the potential for the electricity industry to assist in meeting New Zealand’s climate change targets. Much of the discussion to date has surrounded the potential for energy use change across multiple industries, where increasing the use of New Zealand’s renewable electricity generation can reduce the country’s carbon emissions.

The ability for industries and consumers to transition to electricity as a low carbon fuel source will require both access to the grid through adequate transmission services and additional renewable generation to meet the increased load. We are beginning to explore these aspects of electrification and their impact on the transmission grid and will provide more information in future TPR updates.

3.5 Uncertainty and investment planning

The presence of demand, generation and new technology uncertainty makes developing a medium to long-term investment plan challenging. While we forecast the key drivers of investment, and analyse grid issues based on these, we also know that our plans are likely to change as the environment changes and new information comes to light.

3.5.1 Demand

The grid problems and opportunities presented in the TPR are identified through analysis that compares our demand forecast expectations, generation assumptions and current grid capability. Assessment of Grid Needs through the Decision Framework is where we seek to test the impact of demand forecast variation on the investment Need, the preferred option chosen and timing of commissioning.

Where the investment need or timing is highly uncertain due to demand uncertainty, we may need to change our investment plans at short notice. This is preferable to remaining committed to an investment plan that is no longer fit for purpose.

3.5.2 Generation

In this TPR we have considered the uncertainty associated with generation primarily as it relates to investment in the grid backbone, although the impact of any committed generation is also considered at a regional level.

Testing the limits of the grid backbone capability is done by identifying the boundaries of the grid to handle new or changed generation dispatch profiles. We particularly focus on regions where the Ministry of Business, Innovation and Employment’s Electricity Demand and Generation Scenarios indicate significant generation resources. In addition we seek to test the practical limitations of the grid, helping identify where generation uncertainty may influence grid investment needs.

However, while we do investigate potential grid problems and opportunities, we cannot predict with any certainty that these issues will arise, as generation investment

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may evolve differently than anticipated. This uncertainty requires us to apply some judgement in the way we construct our investment plans.

3.5.3 Emerging technologies

In this TPR we have not taken a view on the uptake of emerging technology (PV and batteries). This is reflected in the demand forecasting approach outlined above. As this TPR focuses on identifying short to medium term grid issues and the uptake of the identified new technologies is more likely in the medium to long term, we consider this approach is reasonable in terms of identifying grid issues and potential solutions.

Nevertheless this is an active area of investigation and we intend to do more work in incorporating a view of these drivers into our planning processes. We are currently developing a monitoring framework to map New Zealand’s progress against the transition identified in our Transmission Tomorrow12 publication. As we develop our approach and strategies to dealing with this uncertainty we are likely to put a higher value on incremental investment, consider shorter life assets and increase our use of transmission alternatives.

3.5.4 Electrification

Transitioning fuel use from fossil fuels to renewable electricity for uses such as industrial process heat, vehicle fleets and heating, is unlikely to be experienced as a step change in load due to the long term nature of asset investments. However due to the long life of transmission assets we need to be mindful of the potential future change in the energy landscape when considering investments in the medium term.

12 https://www.transpower.co.nz/resources/transmission-tomorrow-2016-0