



ELECTRICITY IN NEW ZEALAND

FOREWORD

The Electricity Authority is an independent Crown entity and the regulator of the electricity industry. We were established in November 2010.

We are tasked with governing the electricity market under the Electricity Industry Act 2010 (Act). The Act authorises the making of regulations and the Electricity Industry Participation Code 2010 (Code). The Code sets out the rules for the electricity sector. The Electricity Authority promotes a competitive, reliable and efficient electricity industry for the long-term benefit of consumers and New Zealand.

Electricity in New Zealand outlines the structure and achievements of the electricity industry. It combines Electricity Authority data with official information from other government sources. It tells you about the retail companies, distribution companies, transmission network or 'national grid', generation companies and marketplaces where electricity is traded.

It also shows you how these parts of the sector interact with each other to make sure your home stays warm in winter and your television and computer keep working. It's a really handy tool to have by your side when you're learning about the electricity industry or the electricity market.



CONTENTS

About the Electricity Authority	2
Electricity Authority Strategic Framework	3
We focus on issues that matter to consumers	4
Consumers	5
Retail	16
Distribution	22
Transmission	25
Generation	28
Operating the market	36
The wholesale market	40
Who else is involved in the electricity industry?	46
Definitions	47
Contact us	48



Look out for this
symbol if you want
to know more.

ABOUT THE ELECTRICITY AUTHORITY

Our vision is to be a world-class electricity regulator, delivering long-term benefits for consumers and contributing to the New Zealand economy.

OUR FOCUS

We want to ensure:

- consumers continue to have choice
- there are no inefficient barriers to adopting new technologies
- as far as practicable, that decision-makers and consumers face efficient prices
- robust incentives are in place to encourage efficient levels of security of supply.

OUR WORK PROGRAMME

Before we develop our plans, we consult with stakeholders on our appropriations and work priorities for the coming financial year. We also carry out consumer and stakeholder surveys that feed into our planning and reporting.

Our statutory accountability documents address the requirements of the Public Finance Act 1989, Crown Entities Act 2004, Electricity Industry Act 2010 and government directions and guidelines.

OUR KEY DOCUMENTS

Statement of Intent: our strategy for the next four years.

Statement of Performance Expectations: what we are planning to do over the coming year.

Annual Report: our key achievements in the past year, including information about our financial and non-financial performance.

For more information visit: www.ea.govt.nz/about-us



ELECTRICITY MARKET INFORMATION (EMI) WEBSITE

The Authority's electricity market information website (EMI) is where we publish data, insights, market performance metrics and analytical tools to support decision-making within the electricity sector. For more insights or information visit: www.emi.ea.govt.nz.

ELECTRICITY AUTHORITY STRATEGIC FRAMEWORK

THE OUTCOMES WE SEEK

A competitive, reliable and efficient electricity industry
for the long-term benefit of consumers and New Zealand

OUR MARKET DEVELOPMENT STRATEGIES

Reduce
barriers

Improve
consumer
participation

Improve
price
signals

Increase
flexibility and
resilience

OUR FUNCTIONS - THE THINGS WE DO

1 Promote
market
development

2 Monitor,
inform and
educate

3 Operate the
electricity system
and markets

4 Enforce
compliance

OUR VISION

To be a world-class electricity regulator, delivering long-term benefits
to consumers and contributing to the New Zealand economy

ORGANISATIONAL CAPABILITY STRATEGIES

Effective stakeholder
engagement and
communication

Empowered and
engaged people

Processes that achieve
improved efficiency,
productivity and quality

WE FOCUS ON ISSUES THAT MATTER TO CONSUMERS



WILL THE LIGHTS STAY ON?

Do the market arrangements ensure continued electricity supply even in dry years or during foreseeable emergencies?



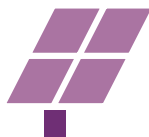
DO CONSUMERS HAVE CHOICE?

Are there options out there for consumers and can they access them easily?



ARE PRICES REASONABLE?

Do the prices consumers pay reflect the efficient costs of supplying their electricity?



IS INNOVATION HAPPENING?

Are suppliers developing new services and pricing plans to deliver greater value to consumers?



WHAT ARE MY RIGHTS AS AN ELECTRICITY CONSUMER?

Go to the Electricity Authority
website: [www.ea.govt.nz/
consumers/what-are-my-
rights-as-an-electricity-
consumer](http://www.ea.govt.nz/consumers/what-are-my-rights-as-an-electricity-consumer)

CONSUMERS

THERE ARE RESIDENTIAL, COMMERCIAL AND INDUSTRIAL ELECTRICITY CONSUMERS IN NEW ZEALAND.

Demand for electricity is largely driven by factors such as GDP, pricing, wealth and population size. For example, generally we would expect a growing economy to lead to growing demand for electricity, and vice versa.

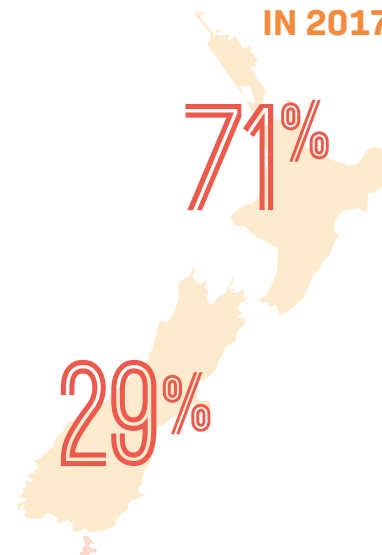
New Zealand consumed about 38,800 gigawatt hours (GWh) of electricity in 2017.

In 2017 residential customers consumed 32 percent of electricity produced. Household consumption depends on many factors, including the number of occupants, size, age and construction materials of the house, heating choices and environmental factors.

Most residential electricity use is for refrigeration, water heating and space heating. Although there has been an increase in the types of technology that need electricity, appliances are generally becoming more efficient.

The electricity sector is constantly changing, and New Zealanders have embraced evolving technologies, including electric vehicles, small-scale solar generation and residential-scale batteries. Technology is also changing the way electricity providers can engage with businesses and households.

RESIDENTIAL ELECTRICITY CONSUMPTION IN 2017



Source: Electricity Authority
www.emi.ea.govt.nz/r/phiik



> **EXPAND YOUR KNOWLEDGE**

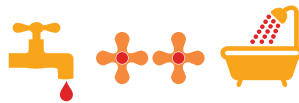
WHAT IS ELECTRICITY?

Electricity is created when electrons flow through a conducting material, such as the copper or aluminium used in power lines. Voltage is the electrical force that 'pushes' electrons, and the number of electrons that flow in a wire is the current. Electrons are subatomic particles that are part of all matter and hundreds of millions of times smaller than the wires they move through.

TYPICAL HOUSEHOLD

ELECTRICITY USAGE

WATER HEATING 27%



ELECTRONICS AND OTHER ELECTRICAL 20%



REFRIGERATION 17%



SPACE HEATING 15%



LIGHTING 13%



COOKING 5%



CLOTHES DRYING 3%



Source: Energy End Use Database, EECA 2018



WANT TO KNOW HOW MUCH IT COSTS TO RUN APPLIANCES?

Look at the Energy Efficiency and Conservation Authority (EECA) website: www.energywise.govt.nz/tools/running-costs-calculator

BY THE NUMBERS

AROUND
38,800 GWh
OF ELECTRICITY WAS CONSUMED IN 2017

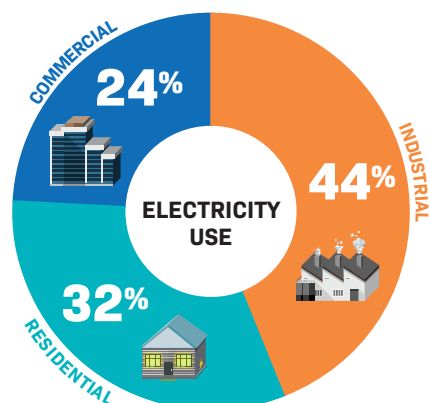
RESIDENTIAL CONSUMERS
1,720,000



COMMERCIAL CONSUMERS
175,000



INDUSTRIAL CONSUMERS
123,000

Source: Ministry of Business Innovation and Employment as at 25 May 2018

EXPAND YOUR KNOWLEDGE

WHAT'S A WATT?

Electrical power is measured in watts (W), kilowatts (kW), megawatts (MW) or gigawatts (GW).

1,000 W = 1 kW
1,000,000 W = 1 MW
1,000,000,000 W = 1 GW

An electric jug uses about 2 kW (2,000 W), while a LED lightbulb uses about 7 W and an electric oven and cooktop can use 10 kW or even more.

Kilowatt hours (kWh) are used to measure how much electrical energy or electricity a household uses over time. They're often called 'units' on your electricity bill. Larger electricity users such as factories measure their consumption in megawatt hours (MWh) or gigawatt hours (GWh).

For example, an electric jug (2 kW) switched on for one hour uses 2 kWh of energy and for the three minutes it normally takes to boil it would use 1/10th (0.1) kWh. A 7 W LED lightbulb would need to be switched on for 143 hours to use 1 kWh of electricity.

> EXPAND YOUR KNOWLEDGE

DID YOU KNOW?

A house on average uses about 7,000 kWh of electricity, but the amount used depends where in New Zealand you're living and how your house and hot water are heated.

In 2017 average residential consumption varied from about 5,870 kWh on the West Coast to 8,550 kWh in Canterbury. The reason for the low average on the West Coast is because most houses are heated using fires, and the exact opposite is true in Canterbury where most houses are heated by electricity.

Source: www.ea.govt.nz/consumers/my-electricity-bill

ELECTRICITY CONSUMPTION

As at the end of 2017, electricity was supplied to around 1.7 million residential consumers. They account for about 85 percent of all customers but consume only about 32 percent of the country's electricity. Usage varies from season to season.

Commercial consumers (such as shops, factories and other businesses) represent about nine percent of customers. They use about 24 percent of the electricity consumed.

Although there are only 123,000 industrial consumers in New Zealand (six percent of customers), they use 44 percent of total electricity consumption. This includes about seven percent used in the agriculture, forestry and fishing sectors.

The single largest consumer is New Zealand Aluminium Smelters Limited, at Tiwai Point in Southland, which is included in the industrial sector. It consumed about 5,000 GWh, which was about 13 percent of New Zealand's total electricity demand in 2017.

ELECTRICITY DEMAND

Because demand for electricity varies from moment to moment, supply needs to change to match it. There are daily and seasonal patterns, with electricity consumption usually highest on cold winter evenings when people want to heat their houses and are also cooking.

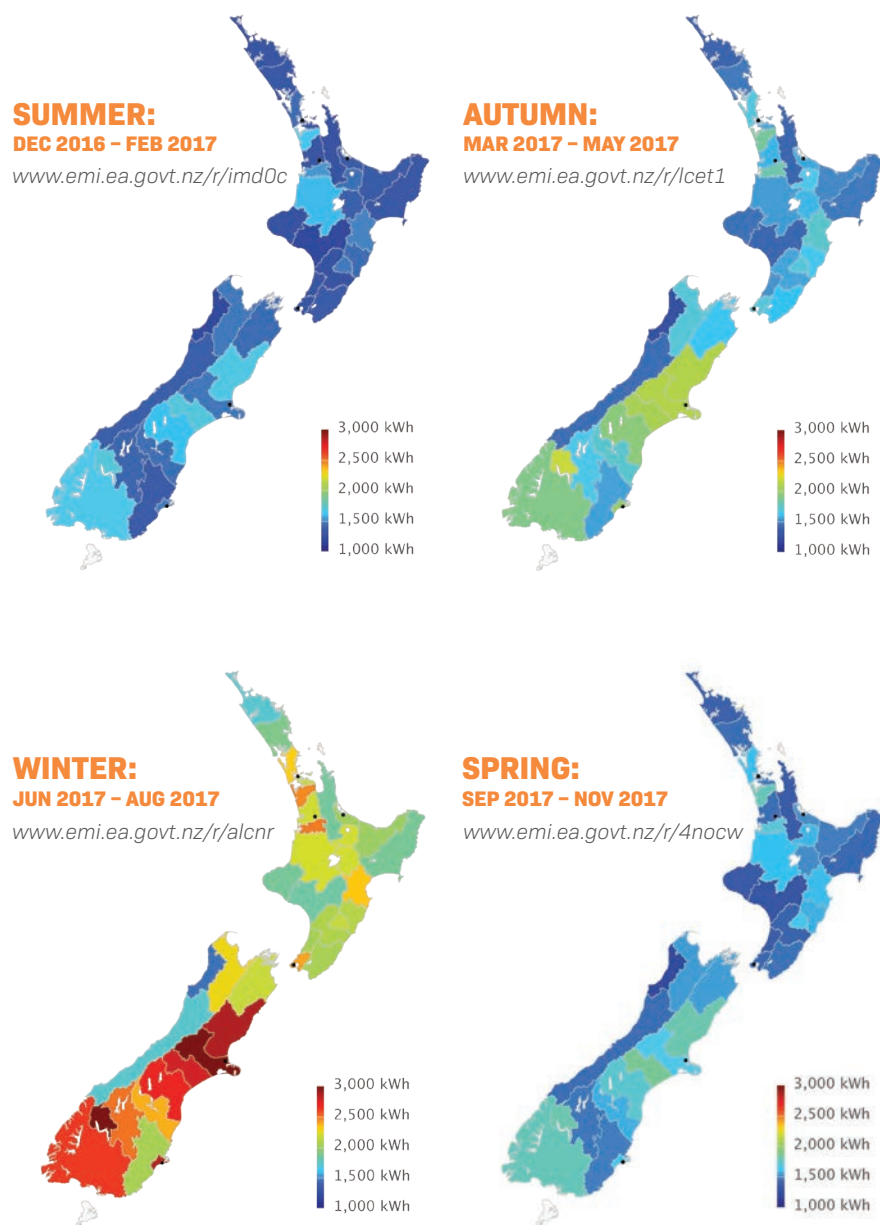
While most people would expect electricity use to peak in the winter, some regions may have a higher demand during summer. This can happen, for example, when farmers use large irrigation pumps or people want to turn on air-conditioning.

Residential demand (or use) peaks in the morning and in the evening.

Demand peaks in the morning as people get up and start their day and in the evening when they return home to cook dinner and watch TV. Electricity distribution networks have to be capable of supplying enough electricity during those daily peak times when demand is highest.

The maps on the following page show how residential consumption levels changed during 2017. The red and orange shades indicate high demand for electricity; the green and blue shades indicate low demand.

Figure 1: Residential consumption by season

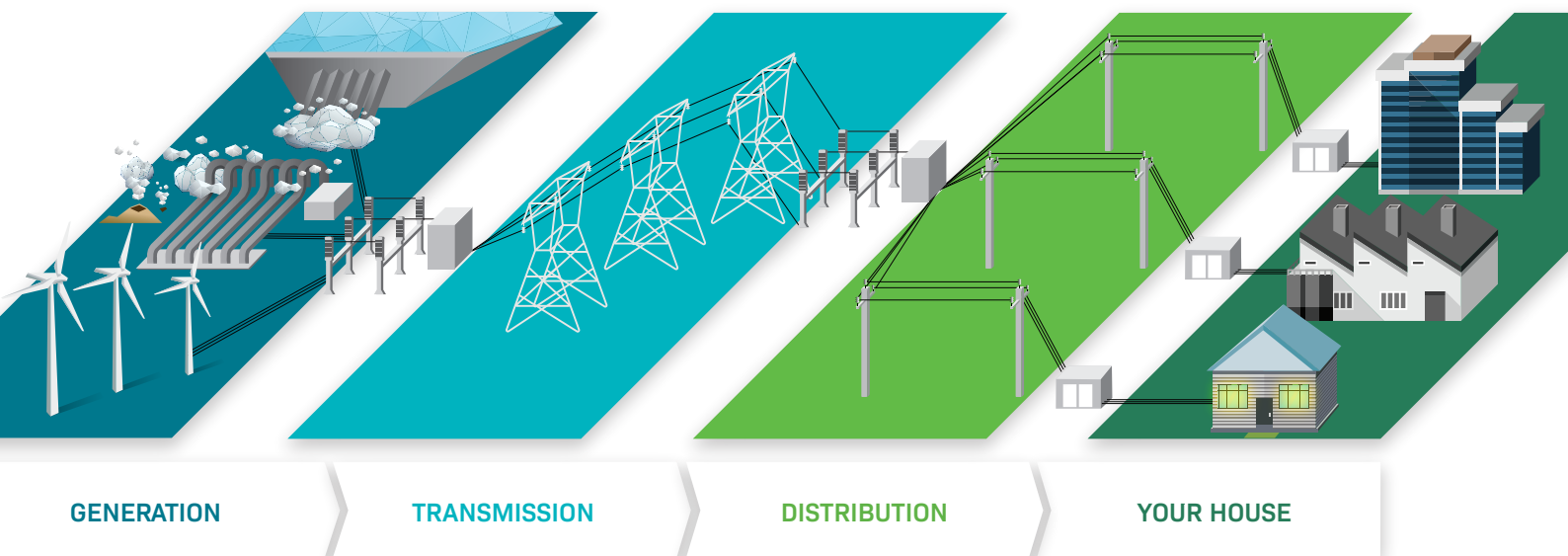


HOW DOES ELECTRICITY GET TO YOUR HOUSE?

THE TRADITIONAL MODEL

In most cases the supply of electricity to New Zealand homes follows a traditional model where electricity is sold to customers by a retailer (power companies).

In the traditional model, generators make electricity from primary energy sources by harnessing water, wind, sun, geothermal energy, coal and gas, which then flows into the transmission and distribution networks. The retailers pay for the electricity from the generators (at spot and contract wholesale prices) and pay for distribution or transmission services from the lines companies. They manage the risk of varying wholesale prices. These costs are passed on to consumers along with a small amount for metering, GST and the Electricity Authority levy. The power companies also send you the bill.



WHOLESALE MARKET
Electricity is sold and purchased
on the wholesale market



RETAIL MARKET
Retailers (power companies)
sell electricity to consumers

Image: the traditional electricity pipeline in New Zealand

NEW WAYS OF GETTING ELECTRICITY TO YOUR HOUSE ARE EMERGING

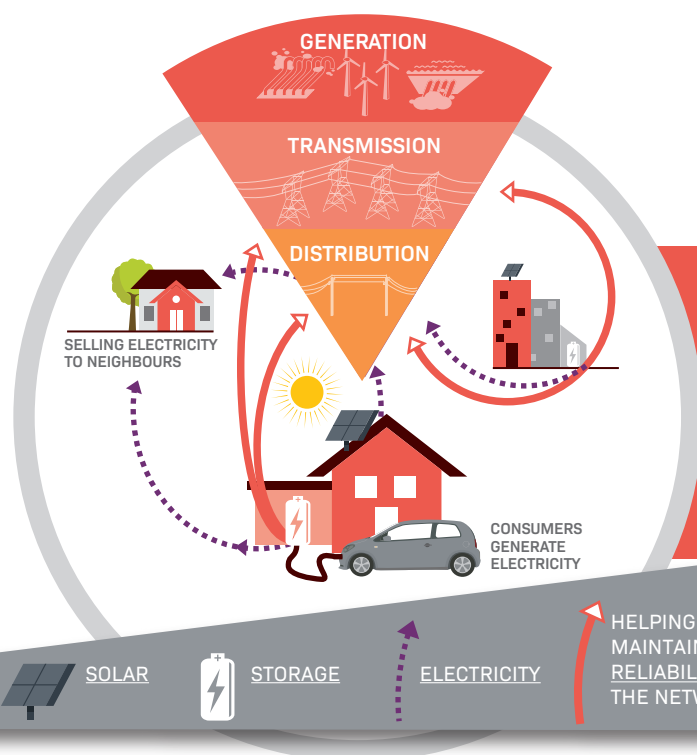
Today's electricity supply market is becoming more complex.

The Electricity Authority focuses on creating a level playing field, so new players can enter the market to innovate, compete to supply products and services, and deliver the benefits of innovation to consumers.

Electricity market dynamics are changing as new technologies and business models give consumers more choices about where they get their electricity from, how they use it and how closely they interact with the electricity market itself.

Consumers today can generate their own electricity by solar or other means and sell the excess back to their retailer or to the wholesale market. They can continue to buy electricity from a retailer when they can't generate enough to meet their own needs.

Even though there are more options available, most consumers still follow the traditional model and access electricity from an electricity retailer. However, in future, it is anticipated more consumers will interact in new ways with the electricity market.



CONSUMERS TODAY CAN GENERATE THEIR OWN ELECTRICITY BY SOLAR OR OTHER MEANS AND SELL THE EXCESS BACK TO THEIR RETAILER OR TO THE WHOLESALE MARKET. THEY CAN ALSO BUY ELECTRICITY FROM A RETAILER WHEN THEY CAN'T GENERATE ENOUGH TO MEET THEIR OWN NEEDS.

Image: emerging technology and the new electricity supply model

WHAT ARE YOU PAYING FOR?

Every time you receive your electricity bill, you'll notice some parts – for generation, transmission and distribution – cover the costs of supplying electricity to your house. The total costs of electricity transmission, and some distribution, are affected by regulation. The Commerce Commission regulates the total amount some lines companies are charging to limit the profit these companies can make from their services.

Prices can also vary depending on where you live in the country, as different areas pay different charges to cover the cost of transporting electricity to where it is used. Geography and population size will play a part in determining the price you pay, as some parts of the country are more difficult to get electricity to than others. The price consumers pay will be different in densely populated urban areas to that of scarcely populated rural areas.

The revenue of community owned lines companies isn't restricted, but profits are monitored by the Commerce Commission.

The Commerce Commission also monitors how many outages the lines companies each have.

WHOLESALE PRICES

Electricity wholesale prices are based on the efficient costs of providing the services. This means they reflect what it costs to produce the electricity and then supply it to end users.

How much it costs to generate electricity is affected by weather conditions and forecasts, the time of day and consumer demand. Producing electricity usually becomes more costly as demand increases and less costly as demand falls. This is because the lowest cost generation is dispatched first, so as demand increases, higher cost generation is needed. This means the wholesale prices for electricity are usually higher in the morning, evening and in winter.

High prices can occur at any time due to other factors, such as how full the hydro-lakes are, weather (rain) forecasts, equipment failure or other surprises. Prices can also be higher in the autumn if the lakes are lower than normal, as power generators need to conserve water which will be needed for winter hydroelectric generation.

Some types of generation have low operating costs but are expensive to build; others cost more to operate but are needed to provide back-up supply when demand 'spikes' or rises sharply.

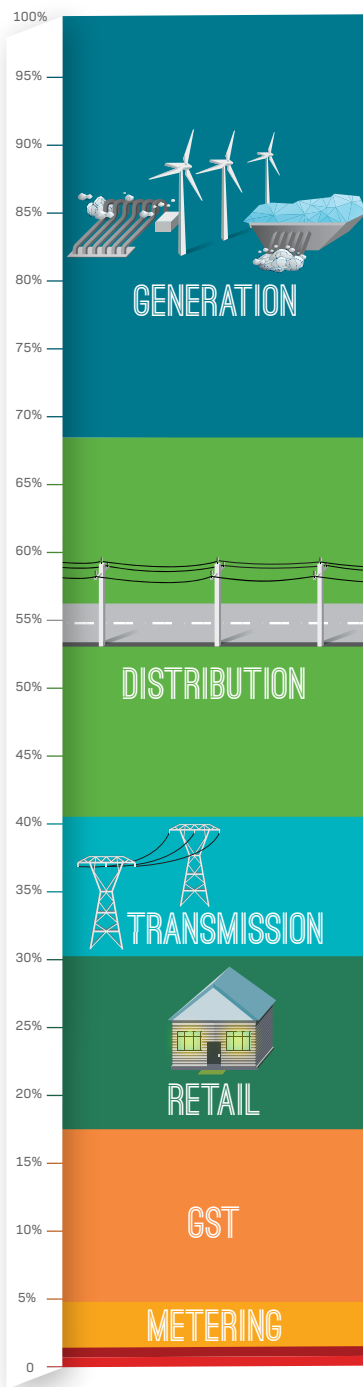
Electricity producers should have enough capacity so demand can be met at any time. They manage supply so there is enough generation available when needed.

PRICING ARRANGEMENTS

Pricing arrangements in the electricity sector may change over time to ensure the benefits of new technologies are shared. This involves reviewing the pricing arrangements for the use of electricity transmission systems and networks, as the current arrangements may not allow the full benefit of these evolving technologies to be realised.

The Electricity Authority want to see decision makers and consumers face efficient prices. It is important pricing arrangements give consumers the right signals about investment in these technologies and how to operate them in a way that provides best value.

WHAT DOES YOUR POWER BILL PAY FOR?



32% GENERATION

This money goes towards the cost of generating the electricity you used.

27% DISTRIBUTION

This money helps pay for building and maintaining the power lines that transport electricity from the national grid to your house.

10.5% TRANSMISSION

This portion goes towards the cost of building and maintaining the national grid.

13% RETAIL

This money goes towards paying for the operating costs borne by the retailer you buy your electricity from.

13% GST*

This money goes towards the Goods and Services Tax we all pay.

3.5% METERING

This money goes towards the cost of reading and maintaining your electricity meter.

0.5% MARKET GOVERNANCE

This money goes towards energy efficiency programmes and the costs of running the organisations that regulate the electricity industry, including the Electricity Authority.

0.5% MARKET SERVICES

This money goes towards the operating costs of the organisations that manage the day-to-day running of the electricity market.

NB: This is based on an average bill. These proportions may vary from year to year.

**GST is 15% of the pre-GST cost and therefore 13% of the GST-inclusive amount.*

www.ea.govt.nz/consumers/my-electricity-bill

Source: Electricity Authority

HOW MUCH COULD YOU SAVE?

THE ELECTRICITY AUTHORITY RUNS THE *WHAT'S MY NUMBER* INFORMATION CAMPAIGN IN PARTNERSHIP WITH CONSUMER NZ.

What's My Number helps to educate consumers about the benefits of comparing and switching retailers. The campaign aims to inform consumers of the choices available to them to make decisions about whether to change their electricity provider.

If more consumers compare and switch providers to save money on their electricity bills or find products and services that better suit their needs, there is more pressure on providers to offer competitive pricing plans and innovative services.

A calculator on the *What's My Number* website shows consumers how much they could save by switching to another electricity provider.

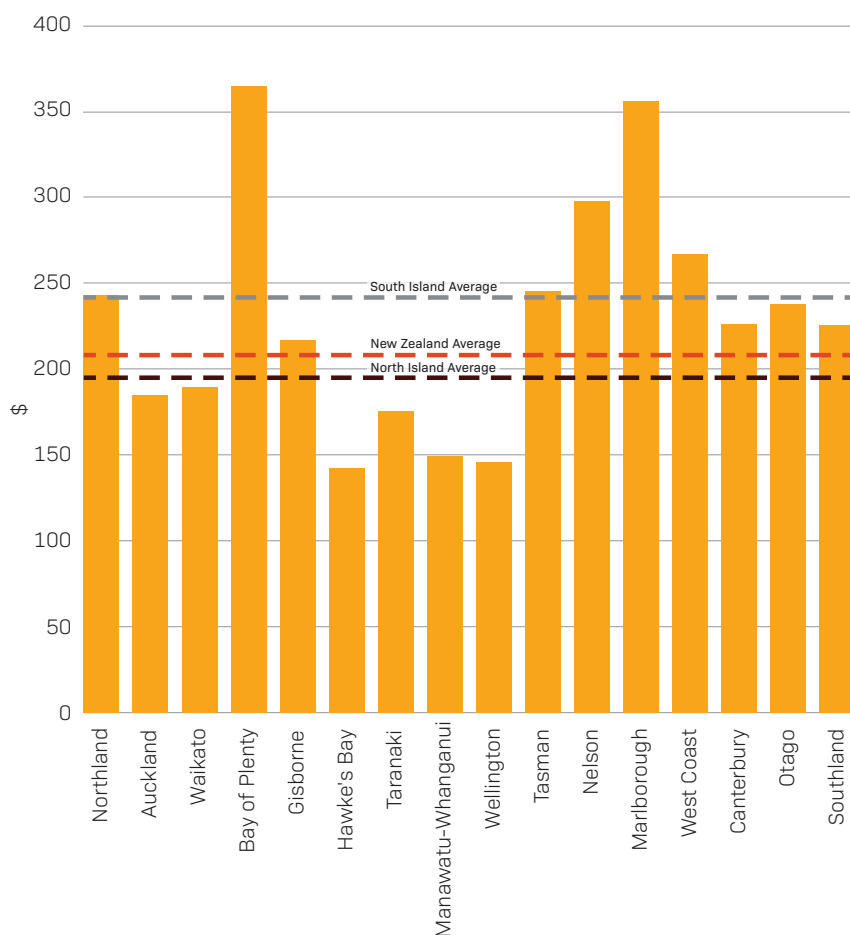
Consumers can click through to Consumer NZ's Powerswitch website (www.powerswitch.org.nz) to compare offers and decide whether to switch or ask their current provider for a better deal.

Retail offers in the market can change frequently as new retailers enter the market, strategies change, and others respond to competitive pressure. There is a wide range of deals and plans available to suit households and consumers' needs. *What's My Number* encourages all consumers to regularly check their options.

In 2017, about 440,000 consumers switched retailers. The estimated average savings available to residential consumers was \$207.50. This is an average saving, so half the households in New Zealand could save more than this if they had switched.



Electricity Authority:
[www.ea.govt.nz/
consumers/how-
do-i-switch-electricity-
companies](http://www.ea.govt.nz/consumers/how-do-i-switch-electricity-companies)

Figure 2: Average annual residential savings, 2017

Source: www.emi.ea.govt.nz/r/tcww0

ENERGY EFFICIENCY

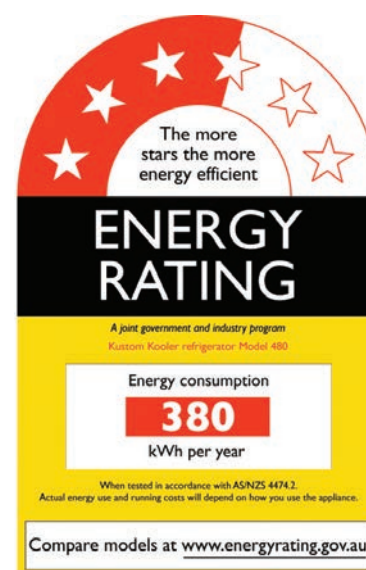
The Energy Efficiency and Conservation Authority (EECA) runs programmes and provides information on how people can have a more energy efficient home.

Choosing energy efficient products is key to saving money on electricity. The Energy Rating Label, which shows stars on the label, lets people compare the energy efficiency of similar appliances. The more stars, the more efficient a model is.

You can also avoid power hungry appliances by using EECA's Rightware tool to find the most efficient products. For example, depending on the model you choose, the running cost of a new fridge/freezer over a 10 year period could vary from \$600 to \$2,000.

Swapping incandescent lights for LEDs makes a big difference in energy efficiency in homes, particularly in high-use rooms.

To find out more about energy essentials for a healthy home visit: www.energywise.govt.nz/at-home/3-essentials



Source: EECA 2018

RETAIL

RETAILERS (POWER COMPANIES) SELL ELECTRICITY TO CONSUMERS.

All New Zealand electricity consumers have choice, with a range of retailers and brands to choose from. Retailers are often known as 'power companies' or electricity providers and retailers sometimes sell electricity under several different brands.

Most consumers buy their electricity from one of about 48 different retail brands, which are spread across the country. In most places there are more than 25 brands to choose from.

Retail costs account for about 13 percent, on average, of residential consumers' electricity costs. While the five largest retailers have the biggest share of the market, the proportion of the market taken up by small and medium-sized retailers is steadily increasing.

During 2017, nine new retail companies with 12 new retail brands were launched. At the same time, two retail companies exited the market.

The new market entrants indicate there is space for retailers to innovate and develop new products to offer consumers.

The table on the following page shows how many retail brands were available in New Zealand at the end of 2017.



Figure 3: Availability of retail brands in New Zealand (2017)

RANK	REGIONS	2017 MEASURE	INCREASE*
1	Auckland	37	▲ 9
2	Waikato	36	▲ 9
3	Bay of Plenty	33	▲ 8
4=	Manawatu-Whanganui	31	▲ 5
4=	Wellington	31	▲ 6
6=	Hawke's Bay	30	▲ 6
6=	Canterbury	30	▲ 6
8	Northland	28	▲ 8
9	Gisborne	27	▲ 5
10=	Taranaki	26	▲ 5
10=	Otago	26	▲ 4
12	Marlborough	25	▲ 7
13=	Tasman	24	▲ 5
13=	Nelson	24	▲ 5
15	Southland	19	▲ 4
16	West Coast	17	▲ 7
	North Island	45	▲ 11
	South Island	33	▲ 5
	New Zealand	48	▲ 12

Note: the consumer choice measure is a count of brands operating on any network operating within regional council boundaries. These retailers may not be operating on all networks in the regional council area.

* Increase between the end of 2016 and the end of 2017.

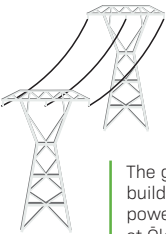
Source: www.emi.ea.govt.nz/r/arkob



A BRIEF HISTORY OF INNOVATION IN NEW ZEALAND'S ELECTRICITY SECTOR

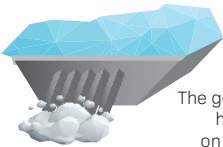
1st

Six-kilometre high-voltage electricity transmission line built at Bullendale in Central Otago. This is the first industrial use of hydro power in the Southern Hemisphere.



The government builds its first power station at Ōkere Falls, Rotorua.

Coleridge, the first major state hydro scheme, begins generating electricity. Coleridge is a world leading design and the blueprint for many power stations around the world.



The government initiates hydro development on the Waikato River, starting with the giant (for the time) Arapuni power station.



Lloyd Mandeno invents the Single Wire Earth Return (SWER) distribution system, which is cheap enough to bring power to New Zealand's most remote areas. SWER is used around the world to bring power to rural communities.

100%

New Zealand briefly achieves 100% hydroelectric supply, but demand grows quickly.

The government decides it needs a coal-fired power station to end power rationing. Meremere is New Zealand's first state built thermal station.



Wairakei power station, the world's second geothermal generating plant is commissioned. It is the first in the world to run on the more common 'wet' steam.

The onshore Kapuni gas field is discovered.

The massive underground power station Manapouri is completed with no change to the natural levels of the lake. The nationwide environmental movement had culminated in a 265,000 signature petition against raising the lake.



Struggle to build power stations quickly enough, and need to fill the large Lake Pukaki, power restrictions are again in place until 1978.

1886

1888

1897

1907

1914

1919

1920

1923

1924

1925

1934

1939

1958

1959

1960

1965

1969

1971

1975

1987



Reefton becomes the first town in the Southern Hemisphere to have a public electricity supply.

Waipori hydro station commissioned. This is the oldest power station still in operation. The government commits to building only hydro power stations.

The government brings in the Power Board Act. Separate public authorities are now responsible for building distribution lines and selling electricity to consumers. Private collectives and councils had done this previously.

New Zealander Lloyd Mandeno invents the on-demand storage hot water cylinder and probably the first all-electric house in the world is built in Tauranga.



With the construction of Mangahao power station New Zealand builds the first 110 kV lines in the Southern Hemisphere.

Demand has increased exponentially, and WW2 interrupts the supply of generating equipment. Power rationing is needed for many years.

One of the first nationwide environmental campaigns in the world is inspired by the proposal to raise Lake Manapouri by 14 m.



North and South Islands linked by seafloor electricity cables across Cook Strait. The cables are part of a HVDC link from the middle of the South Island (Benmore) to Wellington (Haywards). This is the largest, most advanced HVDC project in the world. Benmore power station is built at the same time and is still New Zealand's largest construction project.

The huge offshore Maui gas field is discovered. It is one of the six largest fields in the world at the time. The exploration uses the most advanced offshore drilling platform in the world. The discovery of Maui eliminates the need for a nuclear power station on the Kaipara Harbour, which had been seriously considered. The first grid scale gas turbine power station in the Southern Hemisphere is built at Ōtāhūhū.

Corporatisation – the New Zealand Electricity Department becomes Electricorp. A corporatisation and privatisation programme is started for Power Boards.

Power restrictions and cuts due to a winter electricity supply shortage and blackouts are narrowly avoided. A ministerial inquiry recommends that ECNZ changes its security policies and should signal high prices earlier in a developing hydro crisis. The last large hydroelectric dam built in New Zealand (Clyde) is completed.



The Electricity Corporation of New Zealand (ECNZ)'s transmission business is split off as Transpower. Trading of electricity between buyers and sellers begins.

Contact Energy is formed by splitting from ECNZ. A competitive wholesale electricity market begins, the third of its kind in the world; but the first to use nodal pricing. The first phase of New Zealand's first wind farm (Hau Nui) is built, generating 3.65 MW



A dry autumn and winter leads to very high prices. New Zealand's largest ever electricity retailer (On Energy) is driven to sell its customers. A government led savings campaign is introduced.

100yrs

After over 100 years of constant growth electricity demand 'flattens' out.



Another dry year leads to the highest sustained electricity prices seen in the New Zealand wholesale market. The industry initiates a savings campaign.

A customer compensation scheme is introduced to encourage industry participants to manage electricity supply to avoid the need for conservation campaigns. What's My Number customer switching campaign begins.

Record dry spell, but no savings campaign is needed. Stress testing regime begins to encourage industry participants to better manage electricity supply.



About 85 percent of electricity generation is achieved from renewable sources.



Another dry winter and low hydro-lake inflows, but no savings campaign is needed.

1992

1993

1994

1996

1999

2001

2003

2005

2007

2008

2009

2010

2011

2012

2013

2014

2016

2017

2018



First wind turbine is built in Brooklyn, Wellington generating 0.2 MW.

Contact Energy is privatised and the remainder of ECNZ split. Major assets are divided between Mighty River Power, Genesis and Meridian Energy and minor assets sold off. Full retail competition begins. Consumer switching begins, taking up to 200 days for a customer to change suppliers. The old Power Board businesses are also split. The new lines companies are not allowed to sell electricity to customers and must either sell their customer bases or their lines businesses. The privatisation programme is halted, and the remaining consumer trust owned lines businesses are allowed to remain.

A dry year and lack of coal lead to another period of high prices. Another government led savings campaign is introduced. The Electricity Commission is established to regulate and manage operation of the electricity market.



Meridian Energy introduce the first Smart Meter in Central Hawke's Bay, with over 1,000 households participating.



With support from the Electricity Commission and major generators the New Zealand electricity futures exchange is set up on the ASX. This helps small retailers manage risk and gives a public forecast of electricity prices looking forward.



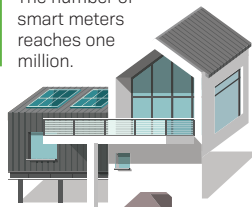
ELECTRICITY AUTHORITY
TE MANA HIKO



The Electricity Authority replaces the Electricity Commission.

Record dry spell, but no savings campaign is needed. 49 percent of Mighty River Power and Meridian Energy are sold via public share offer.

49 percent of Genesis Energy is sold via public share offer. The number of smart meters reaches one million.



52 different brands are offered, with a diverse choice of plans and packages. 25 generators sell into the wholesale market and close to 50 traders purchase from it. New Zealand leads the world for customer switching rates, taking three to four days on average.

Now

INNOVATION

THE ELECTRICITY AUTHORITY FOCUSES ON CREATING A LEVEL PLAYING FIELD SO NEW PLAYERS CAN ENTER THE MARKET AND PROVIDE GREATER INNOVATIONS FOR CONSUMERS.

Changes to how the market operates have made it easier for retailers to enter and exit the market, creating stronger competition for customers.

Electricity retailers have to be innovative in the way they engage with and provide information to consumers. This is good for consumers as it gives them more choice of products and services and the opportunity to reduce their electricity costs.

New retailers can help raise consumer awareness about available options. They can encourage existing retailers to offer competitive prices and improve their service, or risk losing customers.

Innovations in technology such as home batteries to store electricity and electric vehicles are also changing our electricity landscape.

New retail pricing plans include time-of-use tariffs that let consumers and tools monitor their own consumption online. They can then make savings by shifting their electricity use to off-peak times, or take advantage of low night rates to charge their electric vehicles.

In 2018 there were about 8,000 light electric vehicles throughout New Zealand and they're becoming increasingly popular. So far they're not affecting local lines companies' ability to meet demand. One of the challenges of additional electric vehicles will be to find ways to minimise the need for extra network investment in case the electric vehicles are all charging at the same time.



METERING

An electricity meter keeps track of what power is being used at your house. Metering is essential in the electricity market, as meters provide the basis for sellers (retailers/power companies) and buyers (consumers) to agree on the quantity of electricity that has been supplied and consumed.

Traditionally, houses had a standard (non-smart) meter. A meter reader came to read the meter at your house, to find out how much electricity you had used since it was last read. Today, most households have a smart meter. Smart meters measure electricity usage at half-hourly intervals and regularly transmit the data back to your retailer. Smart meters either use mobile data or their own radio networks to communicate back. If you have a smart meter, a meter reader doesn't need to come to your property.



Analogue meter



Smart meter

Smart meters are beneficial because your retailer will only charge you for the power you have actually used. Previously, if retailers didn't read meters every month, or if the meter readers couldn't get to the meter, your electricity usage would be estimated. Smart meters also allow retailers to offer more innovative pricing plans and allow customers to reduce their overall power bill by reducing their consumption at peak times.

Smart meters record how much electricity you use every half-hour. Some retailers have online tools to help track power consumption as you use it. Retailers can also customise their products and services to work out the consumption data recorded by smart meters and offer new, cheaper payment options to consumers.

EXPAND YOUR KNOWLEDGE <

DID YOU KNOW?

About 80 percent of all installation control points (ICPs) in New Zealand have a smart meter?

> EXPAND YOUR KNOWLEDGE

DID YOU KNOW?

There are several network types?

Local networks are directly connected to the grid. These are the networks most of us connect to.

While all local networks are connected to the national grid, there are numerous secondary, or embedded, networks. Airports, apartment buildings and large retail complexes, for example, often have embedded networks. These connect to local distribution networks to supply clusters of consumers at one place or to provide onsite supply.

Types of secondary networks: **Customer networks**, where the customer has no ICP identifier and has no choice of retailer.

Embedded networks, where the customer has an ICP identifier issued by the embedded network owner and has a choice of retailer.

Islanded networks are not connected to the grid – directly or indirectly. The customer may not have a choice of retailer. Examples of islanded networks are Haast and Stewart Island.

DISTRIBUTION

DISTRIBUTION COMPANIES TRANSPORT ELECTRICITY ON LOCAL LINES FROM THE NATIONAL GRID.

They provide and maintain the power lines that carry electricity from the national transmission grid to homes and businesses across New Zealand. On average, distribution accounts for 27 percent of residential consumers' total electricity costs.

The distribution companies ensure their customers receive their electricity at a particular level of quality (specified by Energy Safety) and reliability (specified by the Commerce Commission for some companies). This includes keeping a certain amount of additional capacity available on the networks for each customer to use.

Electricity is transported by overhead wires and underground cables to consumers within 39 networks. Most networks are owned by the 29 distribution companies. The largest distribution company, Vector, is listed on the stock exchange, but most are owned by trusts or local councils.

The Commerce Commission applies information disclosure requirements to Transpower and all distributors. It also regulates the overall level of charges levied and the quality of service of 17 of the 29 distribution companies and by Transpower. The other 12 distributors are exempt because they meet the definition of community ownership.

Installation control points (ICPs) are the points of connection to the electricity supply. Distribution companies nominate these as the points where a retail company takes responsibility for supplying electricity to consumers. Each residence in your street has its own unique ICP number. ICPs can provide information about the number of individual homes or businesses there are in a given area.

WHAT'S THE DIFFERENCE BETWEEN DISTRIBUTION AND TRANSMISSION?

You could compare 'distribution' to the roads in a neighbourhood and 'transmission' to a highway connecting two cities.

Distribution refers to the power poles and power lines that you often see on the street.

Distributors transport electricity to your house or the place where it's consumed. Distributors reduce the voltage from the transmission system to a voltage that's safe to use at home.

Transmission refers to the big pylons and power lines you often see in the countryside (the national grid). Transmission takes the electricity from the big generation stations to the distributors. Transmission is much higher voltage because the distances are longer. These power lines have to be thick because they're used to transport large amounts of electricity across large distances. The pylons have to be taller, and stronger, than the average power pole, because it's too dangerous to have the high-voltage power lines close to the ground.

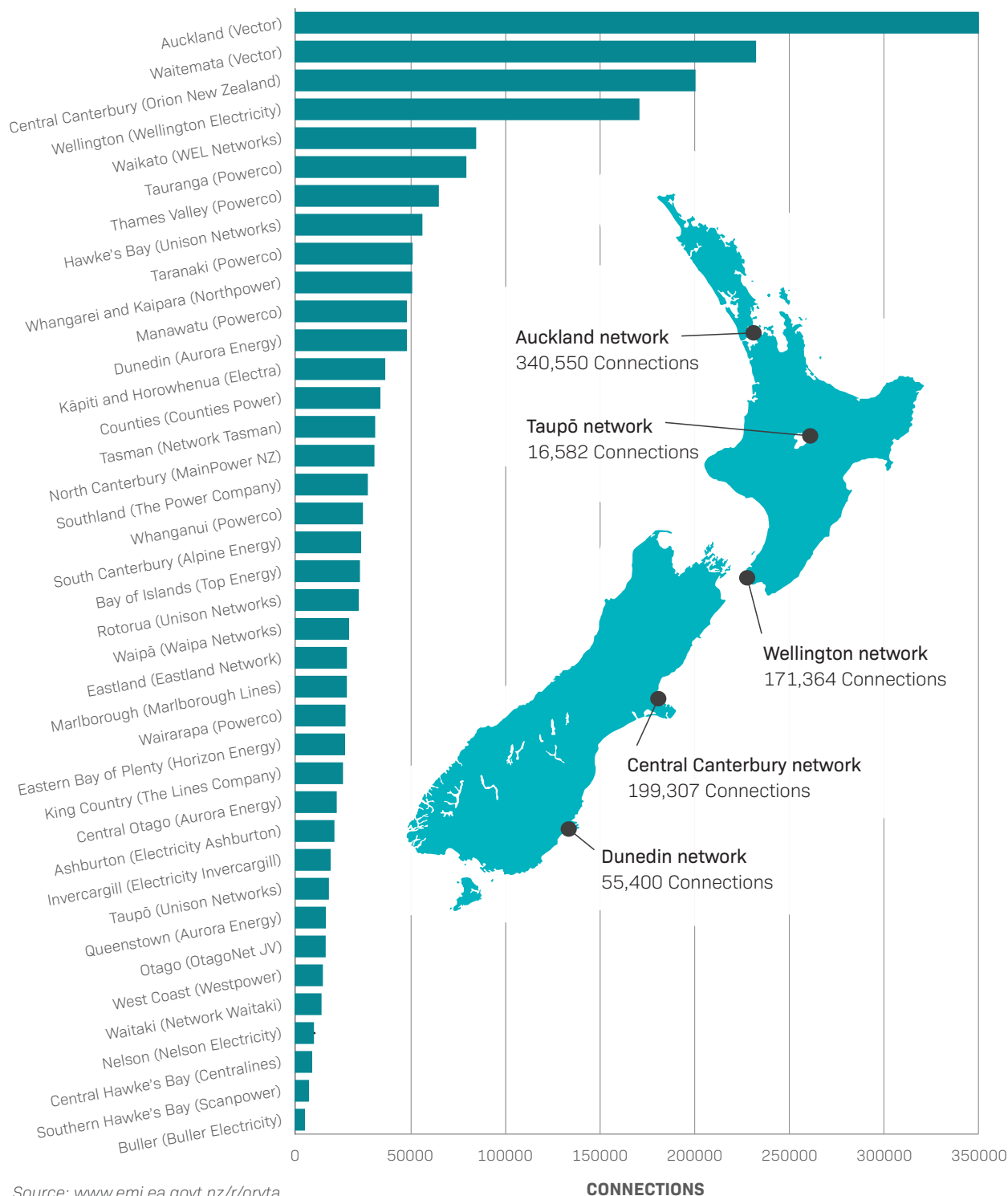
New Zealand's geography and the nature of the electricity industry mean that Transpower (the only transmission business) and distribution businesses are natural monopolies, so the Commerce Commission regulates them.

A monopoly is where a single business has all, or nearly all, of the market for a certain product or service. A natural monopoly is where, as in the case of electricity transmission

and distribution, it makes sense to have monopolies as it would be very expensive to invest in two (or more) alternative sets of power lines that run side by side.

The map below provides a snapshot of electricity connections as at 31 December 2017. This includes the number of residential, commercial and industrial connections (ICPs) in each region and the distribution company that transports electricity to each region.

Figure 4: Electricity connections by region (December 2017)



FINDING THE RIGHT BALANCE BETWEEN COST AND RELIABILITY

The Electricity Authority helps the electricity system achieve the right balance between cost and reliability by providing incentives and information and by developing the market rule book (the Code).

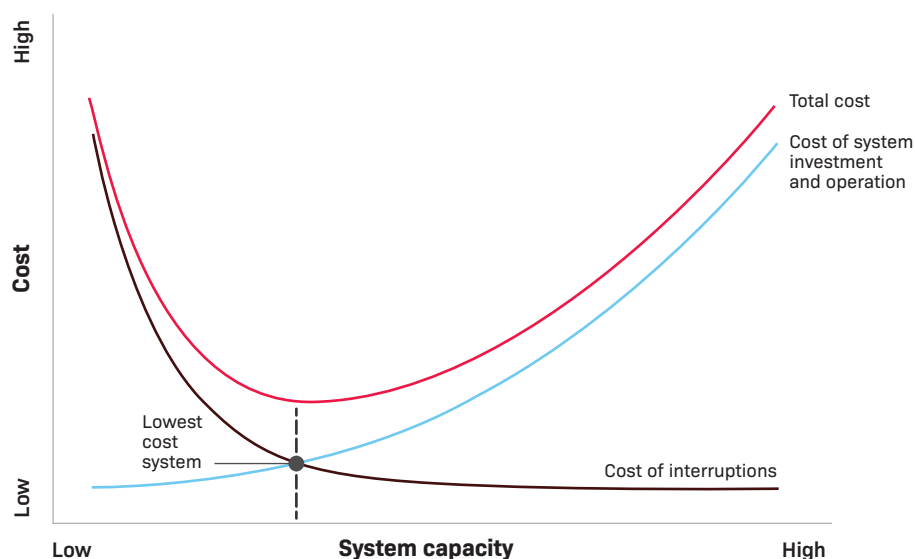
Any system can suffer occasional interruptions, no matter how good it is. For electricity systems, interruptions may include weather-related events, accidental damage, age-related damage to assets, or shutdowns for maintenance work. 'Reliability' is a measure for the frequency and severity of interruptions to systems.

Electricity systems are usually built and operated in ways that minimise the chances of interruptions or reduce their impact, but reliability can be costly. Money spent on building and using equipment and systems to ensure greater reliability could be spent on activities, or services, that are worthwhile in other ways.

The graph below compares the cost of building and maintaining a highly reliable electricity system with that of a cheaper system with a higher level of supply interruptions. The brown line shows the cost of interruptions. Systems with greater capacity and redundancy (duplication) are usually more reliable, but as the level of system capacity increases the costs of providing it also rise (the blue line).

The red line shows the total system cost for any level of reliability. The ideal system balances cost and reliability ('Optimal system' at the lowest total cost, shown by the dotted line). Systems at either side of this line will be more expensive because they have either too many interruptions, or too much costly infrastructure.

Figure 5: Balancing the costs of investment against the costs of interruptions to supply



Note: This is based on an average bill. These proportions may vary from year to year.

Source: Electricity Authority

TRANSMISSION

The national grid spreads across most of the country and is used to transport electricity from generators, which are often located in remote areas. It takes the electricity to the distribution networks and to large industries that are connected directly to the transmission network.

New Zealand's national transmission grid is owned and operated by Transpower, a state-owned enterprise. Transpower is responsible for new grid investments and is responsible for all transmission development processes. These include obtaining resource consents, arranging access and undertaking construction (subject to the Commerce Commission's approval). On average, transmission costs for residential consumers account for about 10.5 percent of their total electricity charges.

THERE ARE
11,349
KILOMETRES OF
HIGH-VOLTAGE
TRANSMISSION LINES
IN NEW ZEALAND



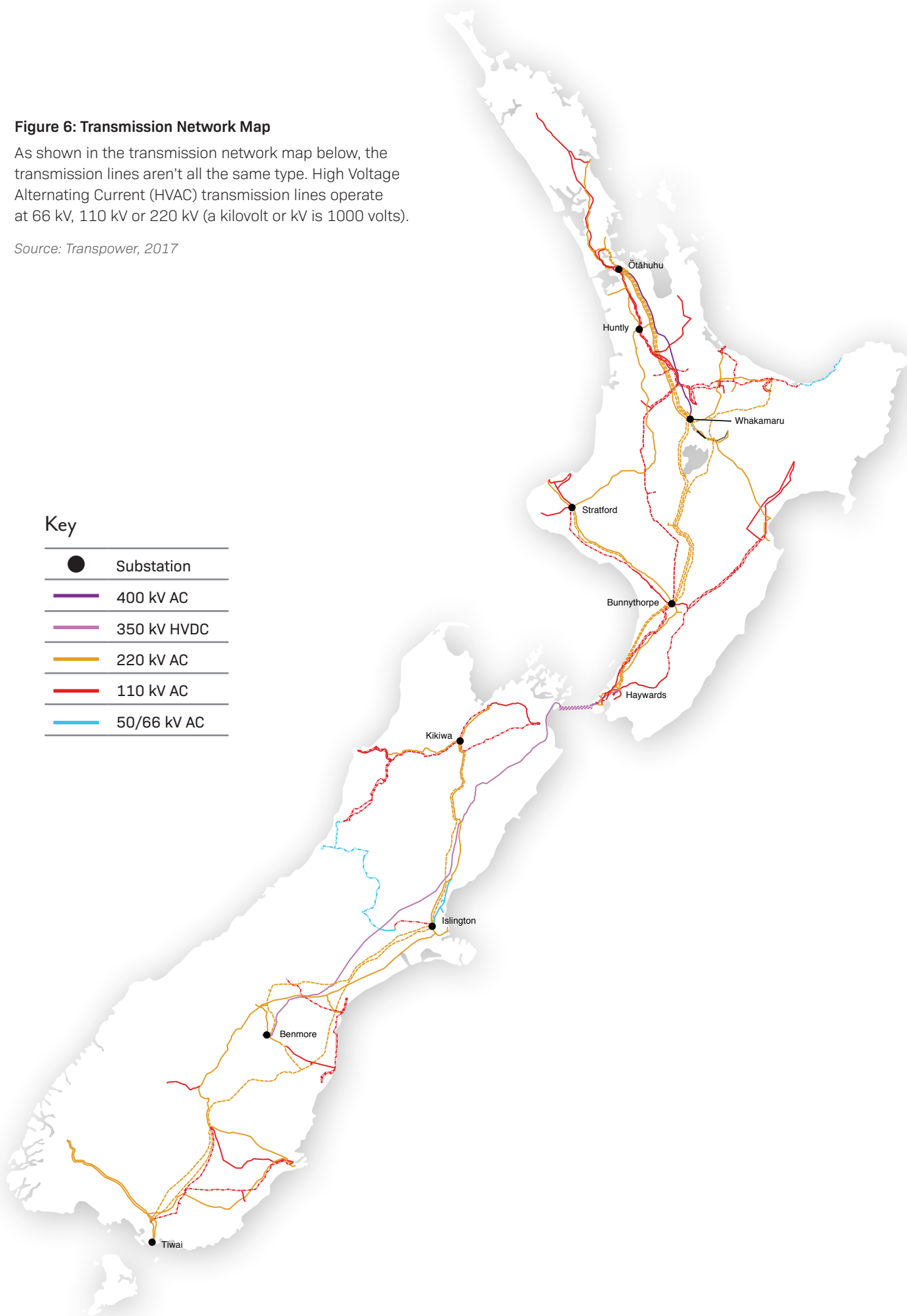
Figure 6: Transmission Network Map

As shown in the transmission network map below, the transmission lines aren't all the same type. High Voltage Alternating Current (HVAC) transmission lines operate at 66 kV, 110 kV or 220 kV (a kilovolt or kV is 1000 volts).

Source: Transpower, 2017

Key

●	Substation
—	400 kV AC
—	350 kV HVDC
—	220 kV AC
—	110 kV AC
—	50/66 kV AC



THE COOK STRAIT CABLE

The power line that connects the North Island to the South Island is commonly known by three names: the Cook Strait Cable (although the Cook Strait cables are only part of the link), the Inter-Island Link or the High Voltage Direct Current (HVDC).

The HVDC carries electricity in both directions at 350 kV, but is mostly used to transport electricity from major hydroelectric generators in the South Island to the North Island. However, in periods of sustained low inflows into southern hydro catchments, this is often reversed, and power from North Island generators supplies consumers in the South Island.

The HVDC starts as an overhead line at Benmore in South Canterbury and finishes at Haywards in Wellington (a total distance of 611 km), with submarine cables crossing the 30 km across Cook Strait. It only runs between Benmore and Haywards and doesn't connect with any other wires or generators. The HVDC is the purple line in the transmission network map.

EXPAND YOUR KNOWLEDGE <

DID YOU KNOW?

In the five years to 31 December 2017, between six percent (2,502 GWh) and nine percent (3,776 GWh) of total annual generation travelled between the North and South Islands via the HVDC.

HOW BIG IS THE HVDC?



ONE AA BATTERY
GENERATES ABOUT
1.5 VOLTS



THE AVERAGE CAR BATTERY
GENERATES ABOUT
12.6 VOLTS



AN ELECTRIC FENCE CARRIES BETWEEN
**2,000 AND
10,000 VOLTS**



THE HVDC CABLE CARRIES
**350,000
VOLTS (350 KV)**

GENERATION

GENERATION COMPANIES USE RESOURCES SUCH AS WATER, WIND, GAS, GEOTHERMAL, STEAM OR COAL TO GENERATE ELECTRICITY.

There are more than 219 electricity generation stations in New Zealand. Five large generation companies produce the majority of our electricity.

Generation accounts for about 32 percent of residential consumers' total electricity costs.

The five major companies (Contact Energy, Trustpower, Genesis Energy, Meridian Energy and Mercury NZ) are all listed on the stock exchange. Between them, they own 98 power stations. They also operate approximately 81 power stations on behalf of other owners. The government has a major shareholding in three of the big five generators.

Other hydro, cogeneration, geothermal and wind generation companies operate a further 40 plants. Cogenerators produce both heat and electricity for industrial use. Their excess electricity is often exported into distribution networks or the national grid.

In addition, many smaller businesses or consumers supply electricity to their network from small scale generation such as solar power.

ENERGY BY GENERATION TYPE (GWH)

New Zealand's five largest power stations

SITE CAPACITY	STATION NAME	GENERATION TYPE	LOCATION	OWNER
953 MW	Huntly ¹	Thermal (Gas and Coal)	Waikato	Genesis Energy
800 MW	Manapouri	Hydro	Otago/Southland	Meridian Energy
577 MW	Stratford ²	Thermal (Gas)	Taranaki	Contact Energy
540 MW	Benmore	Hydro	South Canterbury	Meridian Energy
464 MW	Clyde	Hydro	Otago/Southland	Contact Energy

Source: Electricity Authority

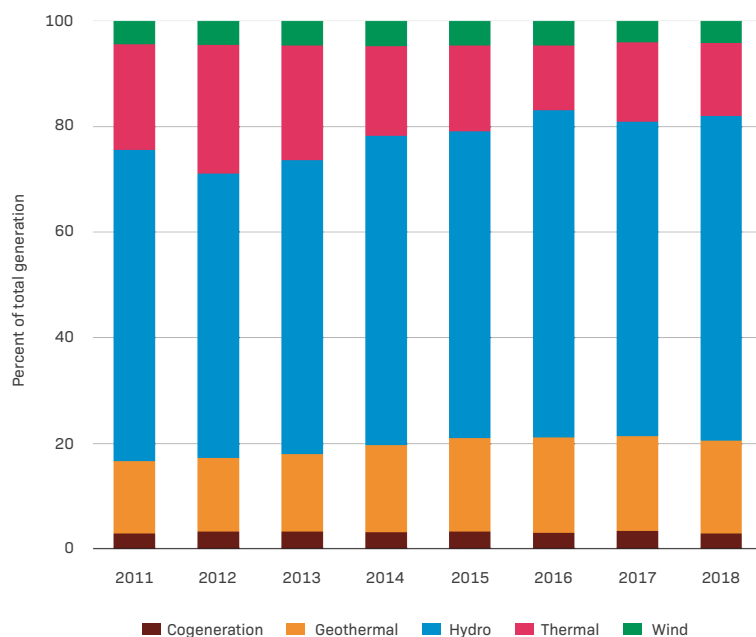
1 Includes both coal/gas fired units, the Combined Cycle Gas Turbine (Unit 5), and the smaller gas peaker (Unit 6).
2 Includes both the Combined Cycle Gas Turbine (TCC) and the two gas turbine peaking units.



To find out how electricity is generated in New Zealand, have a look at the Electricity Authority website: www.ea.govt.nz/consumers/what-is-electricity

The graph below shows annual generation according to fuel type/technology. It has changed somewhat during the past five years. Hydro remains the dominant technology used to generate electricity in New Zealand.

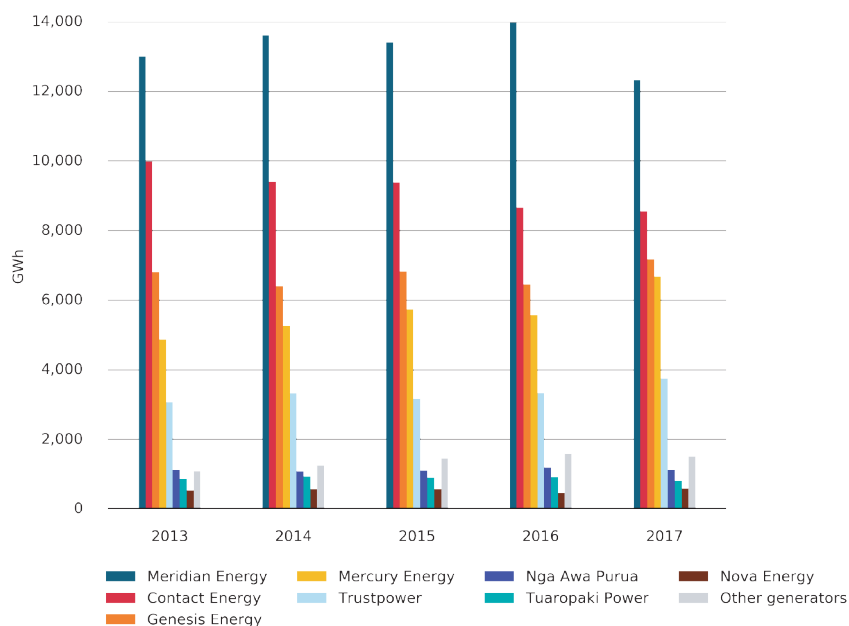
Figure 7: Energy by technology type (percentage)



Source: Electricity Authority

The market share of the various generation companies changes constantly, as is evident in the table below.

Figure 8: Generation by generation company (GWh)



Source: Electricity Authority

AVERAGE PERCENTAGE OF GENERATION BY FUEL TYPE 2013-2017

HYDRO	COGENERATION
59%	3%
THERMAL	WIND
16%	5%
GEOTHERMAL	
17%	

AVERAGE PERCENTAGE OF GENERATION BY COMPANY 2013-2017

MERIDIAN	NGA AWA PURUA
31%	3%
CONTACT	TUAROPAKI POWER
21%	2%
GENESIS	NOVA ENERGY
16%	1%
MERCURY	OTHER GENERATORS
13%	6%
TRUSTPOWER	
8%	



Solar generation accounted for 72 GWh in 2017; this was 0.2 percent of total generation.

Source: www.mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/statistics/documents-image-library/electricity.xlsx

DIFFERENT GENERATION TYPES

Each type of electricity generation has different characteristics. Most of New Zealand's generation sources are sensitive to weather conditions, so a mix of generation types is needed to balance our demand with resource availability. This means we aren't relying on one fuel source, location or technology.

HYDRO-GENERATION

Most of our electricity is generated from hydro, averaging 59 percent of supply over the last five years³. However, hydro-generation depends on the level of rainfall and snowmelt received, which can be quite variable. Managing times of low inflows to ensure there is always a secure supply is an important issue for New Zealand, especially as we move towards an increasingly renewable electricity system.

OTHER GENERATION TYPES

Geothermal

Geothermal power provides about 17 percent of our renewable electricity. Together the geothermal power stations produce about 7,100 GWh of electricity each year. There are currently six fields used for geothermal electricity generation. These are principally located in the Taupō Volcanic Zone, with one field at Ngāwhā in Northland.

There are many advantages to geothermal energy. It is a renewable energy source. In modern geothermal plants the water (and sometimes the steam) used can be pumped back (reinjecting) into the ground in the geothermal field. Reinjection helps the fields regenerate and stabilises the ground. Because there are greenhouse gases (GHG) dissolved in the geothermal fluids, geothermal power stations do emit some GHG, but usually far less than gas or coal plants. Importantly, geothermal power provides a reliable supply of energy for conversion to electricity.

Wind

Wind generates a growing proportion of the country's electricity. At the moment, there is about 700 MW of large-scale wind generation available in New Zealand, supplying around five percent of the country's electricity needs.

Solar

Solar power is a growing generation type. Most solar generation is produced by solar panels (photovoltaic) on private homes. The installation cost of solar panel systems in New Zealand fell 75 percent in the 10 years to 2018.

³ www.mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/statistics/electricity average taken from 2013 – 2017 calendar years.



By 31 March 2018, New Zealand had about 18,000 residential connections with installed solar generation. The installed capacity is about 62 MW and accounted for about 83 percent of the country's total installed solar capacity. Some retailers offer to buy back excess solar electricity, generated by consumers, that is exported back into the local network⁴.

Both solar and wind generation are intermittent as neither energy source can be controlled. When the sun isn't shining, or the wind isn't blowing, electricity needs to be provided by other sources, such as hydro or thermal.

Thermal

Other types of fuel for generating electricity are coal, diesel and gas. These are known as 'thermal generators'. Thermal fuel can be stored and is not dependent on weather conditions. Thermal plants often generate when other supply sources are scarce.

Some industrial sites produce heat and electricity for industrial purposes, in a process known as cogeneration. Excess cogenerated electricity is often exported into distribution networks or to the national grid.

Wave power

Tidal and wave power are examples of emerging technologies that may become viable forms of electricity generation for New Zealand in the future.

Batteries

Batteries may increasingly become a viable option to store electricity when price or demand is low and release that electricity later when price or demand is high. Importantly, batteries do not generate any new electricity but can be used to reduce the need for new generation by reducing the peak demand.

MOVING TOWARDS A RENEWABLE FUTURE

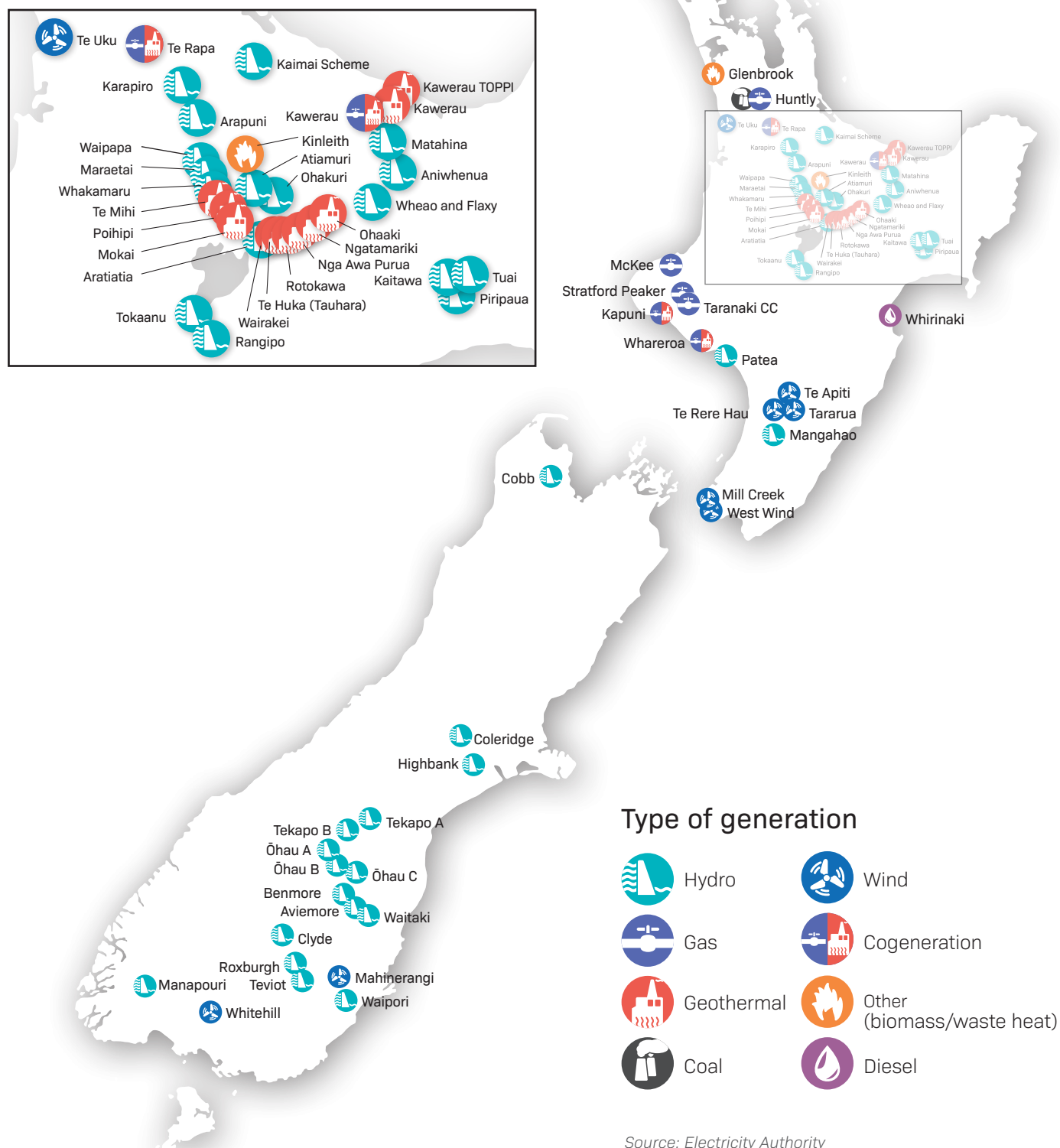
Renewable energy comes from resources that are naturally replenished, such as water, wind, solar and geothermal heat. About 85 percent of New Zealand's electricity generation output comes from renewable sources. This amount is steadily increasing.

The government has a strategy to lift renewable energy output to 100 percent (in years with normal hydro inflows) by 2035. 100 percent renewable doesn't mean zero carbon. At the moment geothermal power emits GHG, but in relatively small amounts and geothermal is a reliable power source. Technology to reinject all the geothermal extractions, including GHG, is being developed, but is currently still infeasible in most applications.

⁴ EMI Retail electricity market insights, March 2018.



Figure 9: Location of electricity generators in New Zealand
(10 MW or greater)



Source: Electricity Authority

KEEPING THE LIGHTS ON

THE BALANCE OF ELECTRICITY SUPPLY AND DEMAND OVER TIME IS OFTEN REFERRED TO AS 'SECURITY OF SUPPLY'.

In New Zealand, hydro-generation is the predominant way of producing electricity. However, rainfall varies hugely across New Zealand's hydro catchments, so water stored in reservoirs for future generation is important. During periods of sustained low inflows, this storage can be depleted and the ability to supply future demand can change quickly. Managing these scenarios is called managing security of supply.

In winter, there tends to be more snow than rain, which reduces inflows into the South Island hydro-lakes (particularly the largest storage lake – Pukaki) when electricity demand is at its highest. The snow then melts in late spring, filling the lakes over summer when demand is usually lower. This natural cycle means lake inflows tend not to align with demand. Generators need to manage lake levels in autumn to ensure there is enough stored water for the winter. Any change to the natural cycle, such as low snowfall which affects storage for the following winter, needs to be carefully managed to ensure we don't run out of hydro storage.

The ability to store water to meet generation needs is limited by the consented operating levels of our lakes. Hydro generators cannot use all the water out of a lake. The operating levels are the upper and lower level of the lake that the hydro generator must operate within. For example, Lake Taupō is New Zealand's largest lake and is very deep, but its level may only be varied by 1.4 m for hydro-generation.

When inflows are low for a sustained period other forms of generation need to increase their output where possible. Alternatives such as coal, which is easily storable, can act as a substitute.

Electricity market arrangements are designed to ensure there is continued supply even in dry years or for emergencies. The Electricity Authority contracts the system operator (the system operator is a division of Transpower) to forecast security of supply levels in New Zealand.

The system operator forecasts the ability for the electricity system to meet demand

The system operator compares actual stored water against hydro risk curves to show how likely an energy shortage is, and to make plans to deal with it, in the rare chance one occurs.

As lake levels fall, the amount of actual hydro storage available falls. If the amount of stored water falls into one of three zones, watch, alert or emergency, the security of supply level changes to reflect the increased risk that energy shortages may occur. Appropriate action is then taken to maintain supply.

When the amount of stored water is in the red or emergency zone, a public conservation campaign may be triggered.

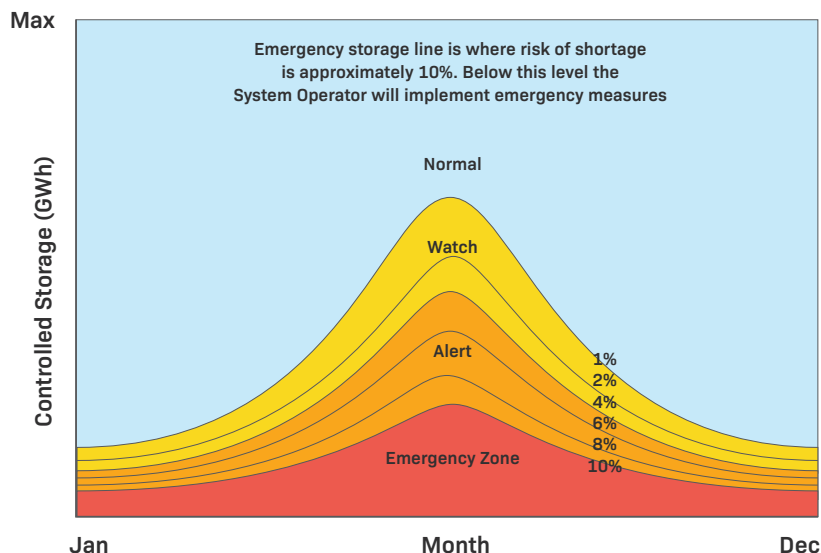
> EXPAND YOUR KNOWLEDGE

DID YOU KNOW?

Did you know that if an Official Conservation Campaign (OCC) is called, your retailer will need to compensate you?

Read more at: www.ea.govt.nz/consumers/what-are-my-rights-as-an-electricity-consumer/what-happens-if-the-hydro-lakes-are-low

Figure 10: Monitoring hydro risk



THE ELECTRICITY MARKET HELPS SECURITY OF SUPPLY

The wholesale electricity market balances supply and demand in response to generators' ability to supply demand today and in the future. Typically, when hydro storage reduces, the wholesale price rises in response as higher cost (usually coal and gas) generation is brought on and hydro storage is conserved. By conserving water early in the process, the electricity system has more options to get through the winter comfortably and there is lower risk of needing to ask consumers to reduce their electricity use. Figure 11 shows the link between hydro storage in the South Island and the average spot price of generation.

Figure 11: Hydro storage and average spot price for 2017



Source: Electricity Authority

THE ELECTRICITY MARKET HELPS SECURITY OF SUPPLY (CONTINUED)

Most consumers are not usually affected by short-term changes in the wholesale market, unless they are on a 'spot pricing' plan. Aside from consumers on this type of plan, or those living near the hydro-lakes, most people are unlikely to be aware of the regular changes in lake levels. That's because New Zealand has a comprehensive set of arrangements to ensure resources are managed so the lights can stay on, even when supply looks tight.

MANAGING A DRY WINTER

Two initiatives were introduced by the Electricity Authority to help manage dry winter situations.

The initiatives are:

- the customer compensation scheme (CCS), which requires retailers to make payments to their customers should savings be officially called for
- a stress testing regime to ensure major electricity users and retailers are aware of the risk they face.

The CCS was introduced in 2011. It motivates retailers to arrange for backup supply or ration hydro-generation in plenty of time to limit price rises and conserve the hydro-lakes during a dry spell. If their efforts don't succeed and an electricity conservation campaign is needed, the retailers have to compensate their customers⁵.

Although conservation campaigns have not been needed for some time, there have been instances when a campaign has been necessary. For example, the public was asked to conserve

electricity in 1992, 2001, 2003 and 2008, when hydro-lakes had sustained periods of low inflows. In 1992, the dry year necessitated some areas in the South Island having mandatory water heating cuts leaving many people with cold water. The South Island was worse affected than the North Island as a result of limitations in transmission of power from the North Island across the HVDC. No conservation campaigns have been required since 2008, despite dry periods in 2012, 2013 and 2017.

The stress testing regime was introduced in 2012. It requires retailers and large industrial companies to disclose what they would lose if wholesale market prices rose to high levels. This encourages them to have "insurance" (through buying hedge contracts) against high prices. A hedge contract transfers the risk of high prices from the buyer to the seller. As the sellers of hedge contracts, generators then have an extra incentive to try to keep prices lower, which means carefully managing their hydro storage and other fuel supply contracts.

Energy efficiency may also have helped as demand has been lower than predicted since 2007.

⁵ Customers do not qualify if they are on a wholesale price plan or they do not have an ICP (they are part of a Customer network – see page 20).

OPERATING THE MARKET

TO OPERATE EFFICIENTLY, THE ELECTRICITY MARKET DEPENDS ON MANY KEY ACTIVITIES.

The electricity market may appear to be complex, but it has common features that are found in many other marketplaces, including:

- a central body in charge of managing the market – the Electricity Authority
- service providers to support efficient trading in the market and ensure the market can still operate in adverse conditions
- a set of rules for market participants to follow – the Electricity Industry Participation Code 2010 (Code)
- a set of policies and standards to manage supply into the market
- a set of processes to minimise barriers to entry into the market
- a central list of market participants called the participants' register
- a central list of consumers and the name of the company responsible for supplying them, called the Registry
- a clearing manager and reconciliation processes to calculate and prove what was bought and sold.



MARKET ADMINISTRATION

The Electricity Authority contracts out most of the services required to operate the retail and wholesale electricity markets. However, we have a range of functions that support the market's efficient operation.

Rather than actively processing market data or providing real-time market services, we have an oversight role. For example, we check various classes of industry participants to ensure they have systems and processes that meet Code requirements. We also oversee the contracted service providers' performance and agree on backup procedures for any failure in the market systems.

Our contracted service providers include the system operator, the registry manager, the reconciliation manager, the wholesale information and trading system (WITS) manager, the pricing manager, the clearing manager, the financial transmission rights (FTRs) manager and any other role identified in regulations as a market operations service provider role.

SYSTEM OPERATOR

Under the Electricity Industry Act (2010), and in accordance with Part 7 and Part 8 of the Code, Transpower is contracted to act as system operator and to coordinate supply and demand resources in real-time to make sure the lights stay on at the lowest possible cost.

Ensuring real-time security requires the system operator to manage the power system so that there is a continuous balance between electricity supply and demand.

The system operator is also responsible for investigating and planning activity over periods ranging from minutes to years ahead of real-time. This work includes assessing security of supply, helping to coordinate generation and transmission outages, ensuring new generators meet Code requirements for system reliability, and finalising contracts with generators, retailers and distributors for essential ancillary services.

SECURITY OF SUPPLY

It is important to consider the balances of supply and demand, both in the short and the longer term. The Electricity Authority and the system operator are involved in establishing security of supply policy. The system operator assesses and monitors the security of supply over the next decade and evaluates factors such as planned generation and transmission, forecast growth in demand and fuel stockpiles. The system operator also monitors short-term security (up to 18 months ahead) and provides stakeholders and consumers with information on risks to hydro-lake storage and changes in electricity consumption patterns.

In the worst possible case, if power cuts are required due to insufficient generation being available, then the system operator and distributors have agreed plans for rolling outages, to ensure emergency services are maintained and other consumers are treated fairly.

Under the Act, the system operator has operational responsibility for emergency management.



To find out more
about security of supply,
visit: [www.ea.govt.nz/
operations/wholesale/
security-of-supply](http://www.ea.govt.nz/operations/wholesale/security-of-supply)

> **EXPAND YOUR KNOWLEDGE**

DID YOU KNOW?

There is publicly available information in a registry about your property, visit: www.ea.govt.nz/consumers/your-power-data-in-your-hands/my-meter

To find out more about the registry, visit: www.ea.govt.nz/operations/retail/the-registry

REGISTRY

The registry is a national database that has information about all of the connection points where electricity is supplied to a site (such as a home or business). These points are called installation control points (ICPs). Each ICP has a unique identifier which is used to identify information relating to the site that the retailer supplies. The registry records the name of the retailer responsible for each ICP and facilitates the switching process between retailers.

The registry manager is responsible for the national database.

The registry only contains relevant technical information about the connection and does not contain any information about the connected consumer.

RECONCILIATION

The amount of electricity that is consumed, as measured by the meters at every consumer site, needs to be reconciled against the amount that is injected into the local network. This is the reconciliation manager's responsibility. Reconciliation makes sure everyone is allocated the correct share of the electricity they generate or consume.

To ensure this happens efficiently and accurately, retailers collect data from millions of meters, aggregate it and send it to the reconciliation manager. The reconciliation manager processes the data and ensures each retailer is allocated the correct amount of electricity to pay for, and each generator is paid for the electricity they produce.

Reconciliation information is used in the electricity market settlement function performed by the clearing manager.

OTHER MANAGERS

Other managers include the pricing, clearing and wholesale information and trading system managers. They look after different aspects of the wholesale market and are discussed in the following section.



To find out more about reconciliation, visit: www.ea.govt.nz/operations/retail/reconciliation

ANCILLARY SERVICES

Managing an electricity system requires more than just scheduling generation.

Additional support (ancillary) services ensure the New Zealand electricity system is stable and reliable.

There are five types of ancillary services.

1. Frequency keeping: in New Zealand we operate a 50 Hz system. Managing the frequency is a technical way of measuring how well supply and demand is matched. Increasing and decreasing supply to keep frequency within a prescribed band keeps supply matched to changing demand.
2. Instantaneous reserve: to provide immediate backup electricity supply in the event of supply failure (eg, a generator fails or the HVDC stops working). This reserve is supplied by spare generation capacity and can also be supplied by interruptible load, which reduces demand if frequency falls unexpectedly.
3. Over-frequency reserve: to stop an unplanned rise in system frequency by reducing generation. This can be needed if a large load unexpectedly disconnects from the system, especially the HVDC if it is transferring a lot of power.
4. Voltage support: to inject power into the system to boost voltage.
5. Black start: to restore operation in the event of a major power outage.

AUFLS AND EXTENDED RESERVE

Despite all the careful operation and management of the power system it is still possible to have a very large fault affect many power stations or transmission lines. In this rare emergency event, distribution companies and those large consumers that are directly connected to the grid are required to automatically disconnect a portion of their load. This system is referred to as automatic under frequency load shedding, or AUFLS.

Extended reserve is any type of reserve that is needed as a 'final backstop' against large-scale emergencies.



To find out more
about the system
operator, visit:
www.transpower.co.nz

THE WHOLESALE MARKET

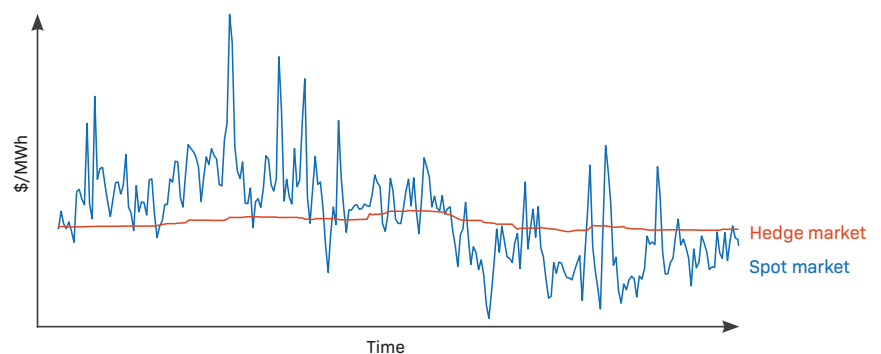
ELECTRICITY IS PURCHASED AND SOLD ON THE WHOLESALE MARKET

The spot and hedge markets are the major components of the wholesale electricity market.

Prices on the spot market are calculated every half-hour and vary depending on supply and demand, and the location on the national grid. In addition to buying electricity directly from the spot market, retailers and large industrial users can also enter into financial contracts, often called hedges or hedge contracts, which smooth out some or all of the volatility in spot prices. For retailers and large industrial users, a hedge is a form of insurance against the financial harm of high electricity prices. Equally, some generators can sell their output via hedge contracts, insulating them against the risk of low spot prices.

THE WHOLESALE MARKET

Figure 12: The hedge and spot market



www.emi.ea.govt.nz/r/ocqkx

Prices in the spot market rise and fall, as shown by the jagged line in the graph. The red line shows how prices in the hedge market are less volatile, but can change in response to people's views about what future spot prices are likely to be.



THE SPOT MARKET

The spot or 'wholesale' market is a marketplace to buy and sell electricity.

All of a grid-connected generator's electricity is supplied to the national grid. Most of a retailer's electricity comes from the national grid. This is often thought of as a 'power pool' where generation flows into the pool and a retailer's wholesale consumption flows out of it.

A complicating factor is that when transmitting electricity, some electricity is lost in transportation. In addition, the transmission system can get congested, just like a motorway can, and power must be 'rerouted'. Losses and congestion must be accounted for when calculating the prices for electricity.

The spot market works out how to supply every grid exit point without congesting the transmission network, using the lowest cost combination of generation and losses. The spot market then calculates prices at each grid exit point, based on the transmission network (losses and congestion) and the cost of generation.

It is known as a 'spot' market because purchases and sales are done on the spot, at a particular time at a particular place.

The spot market includes four main components.

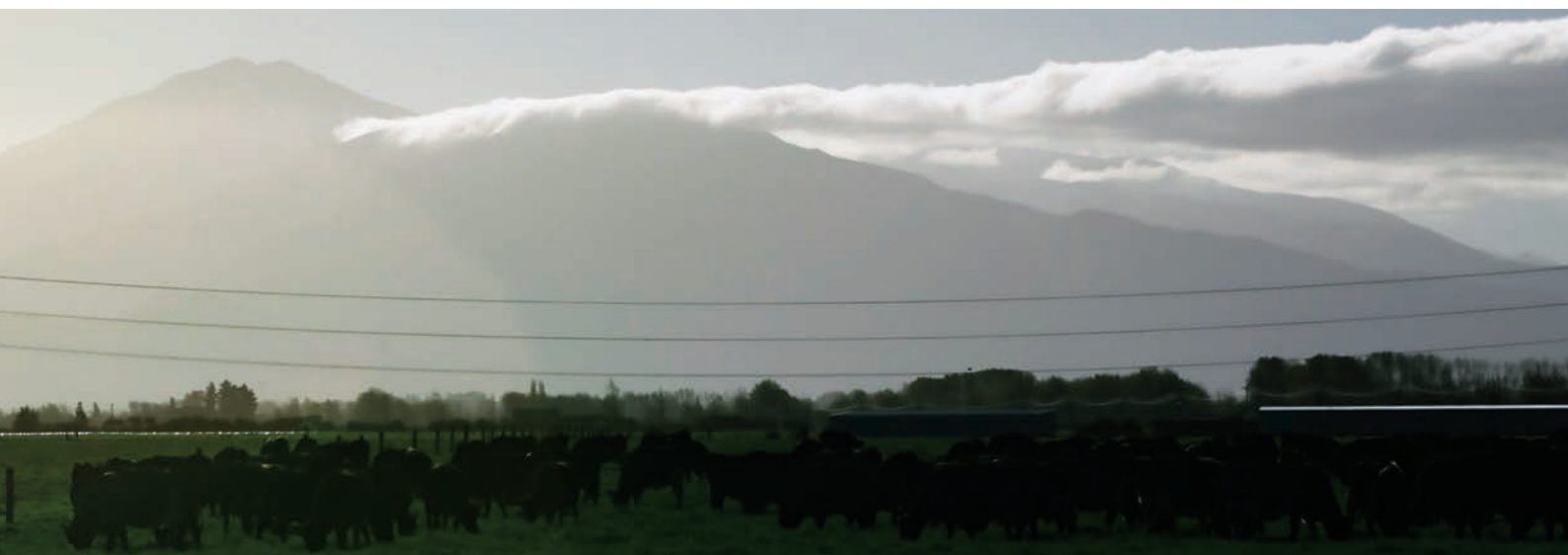
1. The wholesale information and trading system: electricity market participants (purchasers and sellers) upload their bids and offers into the wholesale information and trading system (WITS).
2. Scheduling and dispatch: the system operator decides which offers to accept, determining which generators will generate and how much.
3. Spot pricing: the pricing manager is responsible for calculating and publishing the spot prices that market transactions are settled at.
4. Clearing: the clearing manager uses the electricity quantities calculated by the reconciliation manager and the prices calculated by the pricing manager to ensure that wholesale market participants are paid for the electricity they generate, or pay the correct amount for the electricity they consumed.

EXPAND YOUR KNOWLEDGE <

DID YOU KNOW?

Grid exit point:
the large substations where the local distributor or industrial customers take electricity from the national grid.

Grid injection point:
a physical location where electricity enters the national grid.



HOW THE SPOT MARKET WORKS

The spot market is where electricity is traded amongst market participants. Generators that are bigger than 10 MW, or are connected to the national grid, compete in the spot market for the right to generate electricity to satisfy demand. This is subject to constraints, such as the available transmission capacity.

Each 'offer' covers a half-hour period in the future (called a trading period) and is an offer to generate a specified quantity (MW) at that time, for a nominated price. The system operator ranks offers in order of price and then selects the lowest-cost combination of resources to satisfy demand and ensure a reliable supply. In doing so, the system operator also considers the cost of losses across the transmission system. This means a generator with a low offer price may not be dispatched if that generator is a long way from load.

Generators make offers to supply electricity from power stations at 52 grid injection points. Retailers and major users make bids to buy electricity at 196 grid exit points.

With spot price contracts, **there is a risk prices will spike at certain times and under certain conditions, and 'spot-price' consumers (both residential and commercial) need to accept this risk.** Being on a spot price arrangement can mean low prices at times and higher prices when supply is tight (for example, when lake levels are low). Consumers who are on spot price contracts are advised this can happen but, in the same way as choosing a floating over a fixed mortgage rate, these consumers have chosen to take on this risk.

WHOLESALE INFORMATION AND TRADING SYSTEM

Electricity market participants upload their bids and offers into the wholesale information and trading system (WITS), which is operated by the WITS manager. WITS also delivers pricing, scheduling and other market data to participants and other parties. WITS offers a free to the public service providing price, demand and hydrology information.

SPOT PRICING

As demand and supply change over the course of a day, spot prices are different in each trading period. Prices also vary by location, because of the costs of getting electricity from generators to consumers. Generally, prices are higher in locations that are further away from the main power stations.

The pricing manager calculates and publishes the spot prices at which market transactions settle for each half-hour trading period. These are called 'final prices'. Scheduling, pricing and dispatch software is used to compare bids and offers in the market and order them by price (this is the same software used by the system operator for scheduling and dispatch). The pricing manager calculates about 12,000 final prices every day (one price for each trading period at each node), which are then published through WITS.

Figure 13: The wholesale market

CLEARING

The clearing manager makes sure wholesale market participants are paid for the electricity they generate, or pay the correct amount for the electricity they consume. The clearing manager does this each month by combining information provided by the reconciliation manager with the half-hourly pricing information from the pricing manager. The clearing manager plays an important part in maintaining market confidence under the Code, and administers prudential requirements to make sure payment obligations are met.

The prudential arrangements require 'participants', buyers of electricity, to lodge security with the clearing manager for those purchases. They can use various methods to lodge this security, such as letters of credit from a bank, cash deposits or evidence of hedge arrangements.

THE HEDGE MARKET

To manage the risk of price movements in the spot market, generators and buyers can enter into financial hedge contracts with other participants. If a party purchases a contract that reduces their financial risk, this is called hedging. If a party sells a contract that increases their financial risk, this is known as speculating. For example, betting on a good outcome but risking a worse one.

There are three key markets in the New Zealand hedge market: the over-the-counter (OTC) market, the Futures and Options Exchange (currently ASX only) and the financial transmission rights (FTRs) market. Participants can trade OTC contracts, or exchange-traded contracts, but FTRs are bought through an auction process that is managed by the FTR manager.

OTC MARKET

OTCs are where buyers negotiate directly with sellers to agree on a price. These contracts can be customised and provide flexibility for both parties.



ASX FUTURES

An alternative to OTC contracts, buyers and sellers can buy and sell futures contracts on the Australian Securities Exchange (ASX) futures market. The ASX provides a market in which participants can buy or sell 0.1 MW contracts, referenced to the New Zealand market, and covering quarterly or annual periods (0.1 MW is the amount of electricity required to continuously supply 100 1kW heaters).

A futures contract is a special type of contract, which has a built in way of managing the risk if a party can't pay their obligations. This makes the futures market accessible to small players in the market.

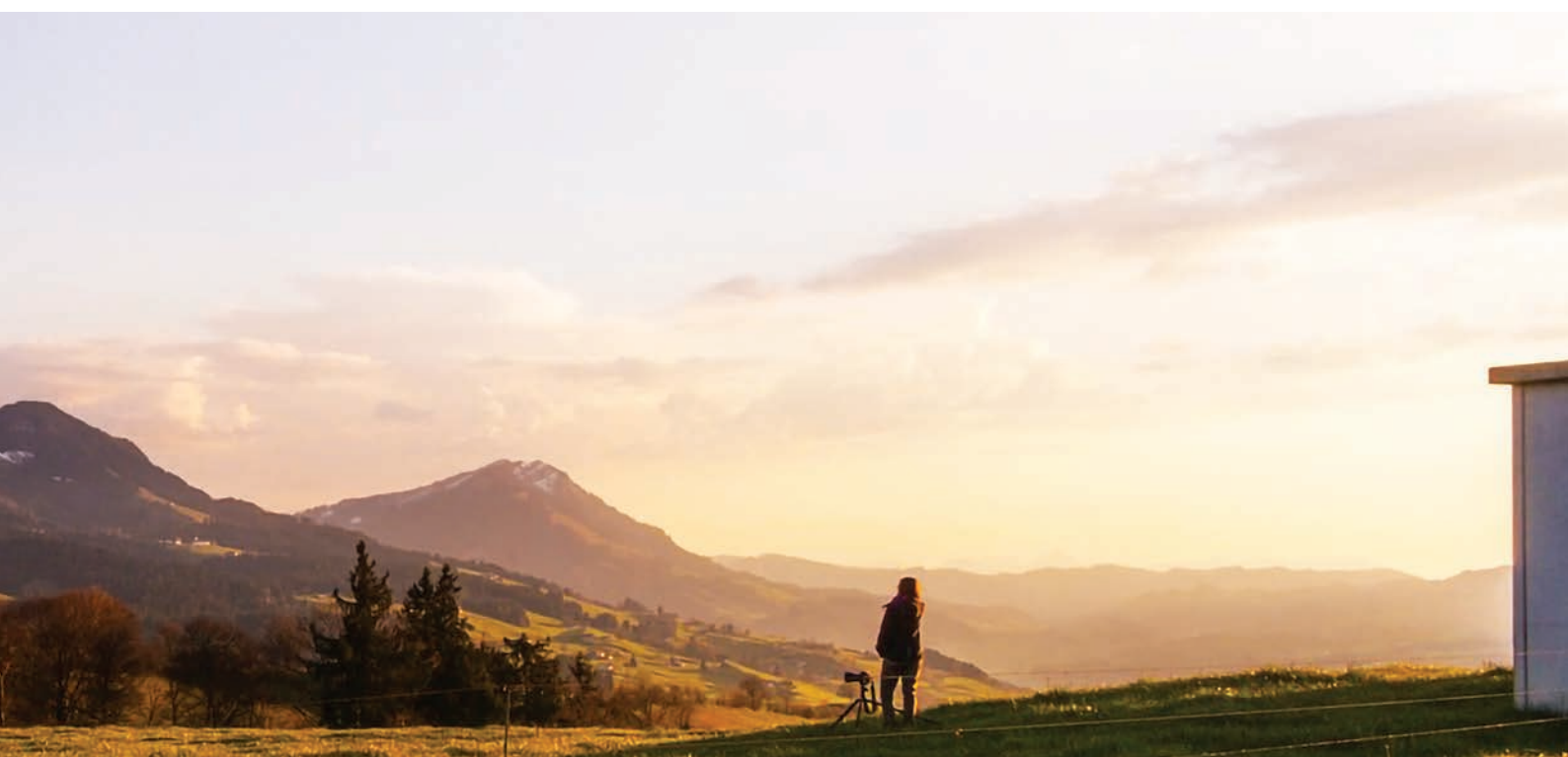
A key advantage of futures trading is that it allows all market participants to easily observe the forward price of electricity – which represents the market's expectation of future spot price levels. Forward prices for long-term contracts provide valuable information to generation and demand-side investors. Likewise, prices for short-term contracts assist with short-term generation and demand decisions.

To encourage more trading in the hedge market, the size of futures and options contracts was lowered from 1 MW to 0.1 MW in late 2015.

FINANCIAL TRANSMISSION RIGHTS

Financial transmission rights (FTRs) are a type of hedge contract allowing parties to cover their price risk between two locations, or nodes, on the national grid. FTRs protect wholesale market participants from variations in spot market prices between the two locations.

The FTR market enhances competition in the retail and hedge markets by allowing generator-retailers to compete for customers on a national basis, rather than just in regions near where they own generation assets. It also allows other retailers to compete in areas away from where they purchase the hedges.



WHO ELSE IS INVOLVED IN THE INDUSTRY?



COMMERCE COMMISSION

Email: contact@comcom.govt.nz

Phone: 0800 943 600 or 04 924 3808 (note: this number is not toll free)

The Commerce Commission evaluates and approves capital expenditure proposals prepared by Transpower for investing in the national grid and for overseeing the efficiency, quality and revenue of electricity lines services (the distribution sector).



UTILITIES DISPUTES

Email: info@utilitiesdisputes.co.nz

Phone: 0800 22 33 40 or 04 914 4630

Utilities Disputes is a free service to resolve consumer disputes with electricity suppliers, such as complaints about billing, disconnection, damaged property and problems with access to property.



ENERGY EFFICIENCY AND CONSERVATION AUTHORITY

Email: info@eeeca.govt.nz

The Energy Efficiency and Conservation Authority (EECA) promotes and supports energy efficiency and conservation and the use of renewable energy sources. EECA runs programmes and initiatives aimed at supporting and encouraging energy efficiency in residential and business communities.



MINISTRY OF BUSINESS, INNOVATION AND EMPLOYMENT

Email: info@mbie.govt.nz

Phone: 04 901 1499

The Ministry of Business, Innovation and Employment (MBIE) provides policy advice to the government on energy issues, including supply and demand, efficiency and conservation, and renewable energy. Its Consumer Protection division (www.consumerprotection.govt.nz) provides information and advice for consumers and businesses.



FIND OUT HOW TO STAY SAFE WITH ELECTRICITY

WorkSafe consumer information (www.worksafe.govt.nz)

Phone: 0800 030 040



GET HELP WITH YOUR ELECTRICITY BILL OR SUPPLIER

Consumer NZ (www.consumer.org.nz)

Email: info@consumer.org.nz

Phone: 0800 CONSUMER (0800 266 786) or 04 384 7963



GENERAL INFORMATION

Citizen's Advice Bureau (www.cab.org.nz)

DEFINITIONS

The Electricity Industry Act 2010: this allows the Electricity Authority to amend the Code and sets out the process we must follow.

The Code: Electricity Industry Participation Code 2010 sets out industry participant responsibilities, including our own duties and responsibilities.

Customer compensation scheme: this scheme has been established to encourage industry participants to manage electricity supply, to avoid the need for conservation campaigns.

RETAIL

What's My Number: is a marketing campaign that aims to provide information about the ability to switch power companies, the ease of switching and the potential savings that can be made.

DISTRIBUTION

ICP: an installation control point is the point where electricity is supplied to a consumer.

TRANSMISSION

HVDC cable: the high voltage direct current cable that connects the North Island to the South Island.

The national grid: the system of cables and wires that are used to transport electricity across New Zealand.

GENERATION

Cogeneration: using heat from industrial processes to generate electricity.

Geothermal: using heat from the earth to generate electricity.

Hydro: using the movement of water to generate electricity.

Thermal: using the heat from the combustion of coal, diesel or gas to generate electricity.

Wind: using the movement of wind to generate electricity.

COMBINED CYCLE

A combined cycle plant is a gas plant that uses the waste exhaust heat from the main gas turbine to power a secondary steam turbine.

PEAKER PLANT

Peaker plants are designed to run for short periods to supply electricity when demand is high.

OPERATING THE MARKET

AUFLS: automatic under-frequency load shedding is a system that is used to manage under frequency events, such as the unexpected outage of multiple generating units.

SPD: scheduling pricing and dispatch software compares bids and offers and orders them.

WITS: the wholesale information and trading system.

THE WHOLESALE MARKET:

FTRs: Financial transmission rights are a type of hedge contract initially allowing parties to cover their price risk between nodes on the national grid.

Hedge contracts: used to smooth out some or all of the volatility in spot prices.

Node: a point on the national grid where electricity enters or exits the grid

OTC: (over-the-counter) where buyers negotiate directly with sellers to agree on a price. These contracts can be customised and provide flexibility.

Spot price: the half-hour price of wholesale market electricity.

Local networks: networks that are directly connected to the grid.

Secondary networks: networks that are indirectly connected to the grid.

Customer networks: networks where the customer has no ICP identifier and has no choice of retailer.

Network extensions: networks where the customer has an ICP identifier issued by the parent network owner and has choice of retailer.

Embedded networks: networks where the customer has an ICP identifier issued by the embedded network owner and has choice of retailer.

Islanded networks: networks that are not directly or indirectly connected to the grid – the customer may not have choice of retailer.

Stress testing: the financial stress testing regime was implemented to encourage retailers to manage reserve capacity and security of supply.



CONTACT US

If you need further information, you can find it on our website: www.ea.govt.nz or

Phone: 04 460 8860

Email: info@ea.govt.nz

SOCIAL

www.twitter.com/electricityauth

www.linkedin.com/company/electricity-authority-of-new-zealand

www.youtube.com/user/ElectricityNZ

POSTAL ADDRESS

Electricity Authority
Level 7 Harbour Tower,
2 Hunter Street
PO Box 10041
Wellington 6140
New Zealand





ISBN: 978-0-473-45219-3
© Electricity Authority 2018

All data correct as at June 2018.
Originally published September 2018.