TRANSPOWER

Whakamana i Te Mauri Hiko

Monitoring Report

March 2022

The Whakamana i Te Mauri Hiko Monitoring Report indicates how New Zealand is tracking against our energy futures

This report

In 2018 Transpower launched Te Mauri Hiko to start a discussion on New Zealand's Energy Future. Taking a scenario-based approach we considered what the future may look like in the year 2050, as a mechanism to understand the opportunities and discussions stakeholders need to focus on.

Since the first Te Mauri Hiko, we have further refined our understanding and released Whakamana i Te Mauri Hiko (WiTMH) in 2020, and the Electrification Roadmap in 2021.

We also have more refined scenarios. Nearly four years have passed since the original Te Mauri Hiko and the pace of social, political, scientific and environmental concern around climate change has continued to accelerate. At the same time, the rate of development and price reductions across a range of renewable energy technologies has continued to increase.

It is critical we continue to monitor the signs and drivers that underpin our scenarios. This active intelligence gathering will provide insight to help us identify both likely to be realised future scenarios, as well as new and divergent alternative scenarios.

This report is designed to identify, within the key drivers of Te Mauri Hiko, those factors that are consistent—or vary—from the expected course of our scenarios. We aim for this to be a discussion and an industry resource like Te Mauri Hiko, so we welcome feedback and suggestions on how to improve our monitoring.

If you have comments please send them to: communications@transpower.co.nz

For all our reports in the Te Mauri Hiko series, visit https://www.transpower.co.nz/about-us/transmission-tomorrow

This edition

This March 2022 edition is the third in the series since we reinvigorated the monitoring report to align with our latest Whakamana i Te Mauri Hiko scenarios. You can see our September 2021 report here.

What you might notice is that some of the data may not be refreshed every edition. This is because some data sources are only published annually. In several instances, we've chosen to show you alternative indicators that help tell New Zealand's story.

Also, a lot of annual data from 2021 has only just been released, therefore some of our commentary will reach back further than the past six months.

Our Whakamana i Te Mauri Hiko scenarios

The base case:
Accelerated Electrification

A realistic yet aspirational future, that anticipates large-scale transformation of energy in New Zealand

Tiwai Exit:
Electric Tiwai Exit

A variation of *Accelerated Electrification* where the Tiwai Aluminium smelter exits around 2025

Higher demand:
Mobilise to Decarbonise

Higher demand for electricity is driven by significant and rapid efforts to mitigate climate change after years of 'sitting on our hands'

Slower case:
Measured Action

A variation of *Accelerated Electrification* where transport electrification is slowed by factors such as policy or technology

Lower case:
Business as usual

Significant electrification fails to eventuate and other climate change mechanisms such as forestry abatement are prioritised

At a glance: New Zealand stays on course for the *Accelerated Electrification* scenario, supported by positive signs of electrification growth

Summary

In our last update, we reported that New Zealand is taking steps towards a net zero carbon economy. We are continuing to observe encouraging policies and incentives that are supporting process heat and transport electrification. Since the last report, we've seen our pipeline of enquiries starting to convert into committed projects both in the supply and the demand side. We expect this trend to continue as investors and developers continue to invest in decarbonisation.

However, security of supply and reliability, COVID-19 setbacks, as well as global energy and political instability and high sustained energy prices are at the forefront of industry conversations. These issues have prevailed and remain as headwinds in our indicators.

The upcoming release of the Emissions Reduction Plan, the ongoing uncertainty of Tiwai Point and the ongoing effects of COVID-19 are three uncertainties that could materially shift the future of energy in New Zealand. However, it now seems less likely we will trend towards the 'Electric Tiwai Exit' scenario, due to recent developments indicating a pathway for Tiwai to extend operations beyond the end of 2024. There is an increasing likelihood that new demand in Southland will materialise from process heat, data centres and green hydrogen, complementing or replacing Tiwai's load.

Together, these signs confirm that we are in the early stages of a push towards a more renewable electricity system and a new period of electrification growth. For this reason, New Zealand could remain on the base case 'Accelerated Electrification' trajectory.

How our indicators are tracking against our forecasts

Utility scale generation interest is high in anticipation of growing electrification demand	▲ Consistent	**Electric vehicle numbers** have been boosted by recent transport policy and funding, and are expected to continue rising	▲ Consistent
Climate change continues to be a concern for New Zealand and the rest of the world, but overall carbon emissions remain constant	■ Inconsistent	**Electric passenger vehicles** are becoming more attractive due to the new Clean Car Discount and lower running costs	▲ Consistent
Electricity demand has remained constant over the past decade, with signs of increasing residential demand	■ Consistent	**Battery technology and flexible demand** providing solutions to meet peak and energy demand and support system reliability	▲ Consistent
Drivers of base demand have been slow caused by the COVID-19 pandemic but future population growth is uncertain	■ Uncertain	**Distributed solar installations** continue to grow in number and capacity, driven by falling costs	▲ Consistent
Overall energy efficiency and energy intensity continues to improve, offset by recent increase in residential demand growth	▼ Consistent	**Capability to meet energy demand and peak demand** is generally sufficient today but recent events highlight potential future issues	■ Uncertain
Industrial energy users are still relying on fossil fuels, rising costs are causing issues but new entrants are also on the way	■ Uncertain	**Electricity affordability** and electricity contribution **to wider energy system** is uncertain and **renewability** affected by dry period	■ Uncertain
Process heat decarbonisation building momentum through support of the Government Investment in Decarbonising Industry fund	▲ Consistent	**Progress against the ten Whakamana i Te Mauri Hiko industry themes is ongoing** and may shift with future energy policy	▲ Consistent

Utility scale generation interest is high in anticipation of growing electrification demand

The number of new grid connected demand and renewable energy generation enquiries has increased

As the Grid Owner, Transpower receives enquiries from potential grid scale generators and load developers about connecting to the grid. While not all enquiries eventuate in built projects, the volume of enquiries is a good indicator of developer appetite.

Transpower has experienced a significant increase in the volume of enquiries from potential developers of new generation. The chart below shows the number of enquiries Transpower has received historically and how we are tracking in the current financial year. It is clear that developer interest has ramped up significantly.

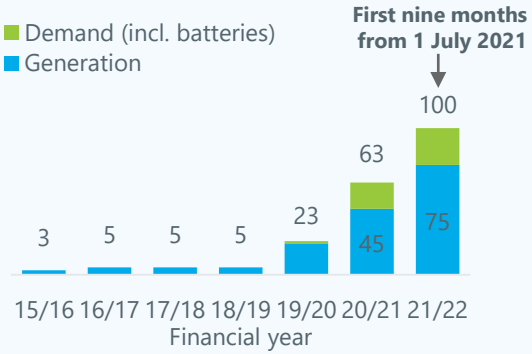
The number of enquiries in this financial year has reached 100 in total, and is expected to more than double compared to the previous year. Of the 75 generation enquiries this financial year, most are for either wind (24%) or utility scale solar PV generation (65%). There are several key factors at play:

- Solar plants and batteries are faster to build than traditional thermal plants
- Global cost declines and improvements in technology for utility scale solar and wind
- Solar PV is perceived as easier to consent than other forms of generation
- Increased number of new entrants primarily international based solar farm developers
- Policies encouraging increased electrification of demand and energy system renewability

In total there is approximately ~20GW of interest for new generation projects in NZ. However not all of this project interest will be converted into built generation and commentary out of Europe suggests only 1/3 of grid scale solar projects actually get built.

Generation and demand customer enquiries to Transpower

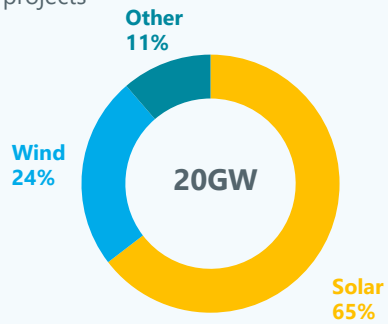
Count, excludes GXP enquiries from EDBs



Source: Transpower. Last updated March 2022.

Breakdown of enquiries by generation type

% of MW, excludes commissioned and in delivery projects



Source: Transpower. Last updated March 2022.

Popularity of power purchase agreements emerging in NZ to provide offtake for renewable generation projects

Power purchase agreements (PPAs) are used when one party agrees to purchase electricity from a generator for a set price for a set period of time, defining the revenue and credit quality for that generation project.

PPAs are becoming popular globally to underwrite the investment case for renewable energy projects and large corporations such as Amazon, Microsoft and Meta, look to secure low carbon electricity to meet their corporate sustainability commitments.

In New Zealand, public announcements from PPAs over the last six months include:

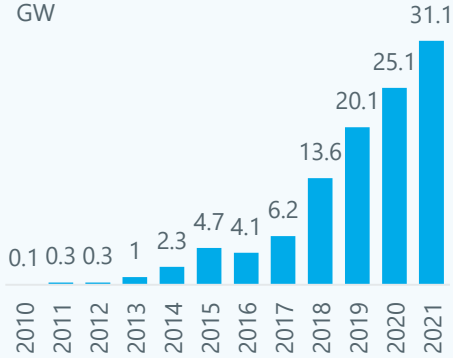
- In October 2021, Contact Energy announced the signing of PPAs with several customers under 10-year deals, including Pan Pac Forest Products (10 MW), Oji Fibre Solutions (15MW).
- Genesis has signed PPAs which play a part in its Future-gen strategy to displace 2,650 GWh of baseload thermal generation by 2030. This includes 455 GWh/year from Mercury Energy's Waipipi wind farm, 230 GWh/year from Kaiwaikawe wind farm and ~500 GWh/year from Contact's Tauhara geothermal plant.
- Meridian Energy has signed 157 GWh in provisional 'MoU' load and contracted 14 GWh in its process heat supply strategy which has a target of 600 GWh.

Approximately 300 MW of utility scale generation was commissioned in 2021 and another 20GW is early and mid stage development interest. Further data releases will indicate how much PPA plays a role in supporting renewable electricity generation.

In March 2022, Transpower released a consultation paper on the concept of Renewable Energy Zones (REZ) and a potential pilot in Northland.

Global corporate PPA volumes

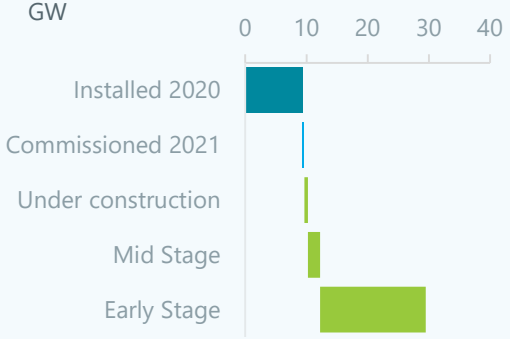
GW



Source: BloombergNEF. Last updated March 2022.

Forecast utility scale generation pipeline

GW



Source: MBIE, Transpower analysis, March 2022.

Climate change continues to be a concern for New Zealand and the rest of the world, but overall carbon emissions remain constant

Inconsistent

Global concern is high with gap between commitments and action

Countries and companies around the world are increasingly recognising the need for climate action, so that the globe avoids the catastrophic consequences of inaction.

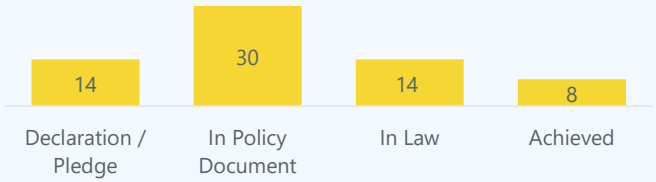
The IPCC Summary for Policymakers report released in February 2022 reinforced the importance of infrastructure resilience and reliable power systems in the energy system transition. The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (August 2021) warns that we will not be able to limit global warming to even 2°C unless there are immediate, rapid and large-scale reductions in greenhouse gas emissions.

Since March 2021, an additional 22 countries have included net zero carbon targets as part of their policy, with a further 14 including targets in law. Currently, approximately 90% of the world's emissions are covered by net zero carbon targets.

According to the Climate Action Tracker, if all the announced net zero targets were actioned, the globe would warm by 1.8°C by 2100. However, there are still gaps in policy for delivering on these targets. As a result, Climate Action Tracker estimates the globe is on track for 2.4°C.

Countries with policies committed to net zero carbon by 2060 or earlier

Number of countries



Source: Climate Action Tracker. Excludes countries with targets under discussion. Some European countries will be rolled up in EU target and not have a separate country target. Last updated March 2022.

Uncertain

New Zealand government to announce emissions reduction plan

New Zealand's emission reduction goals:

- **Domestic net zero target:** NZ legislation outlines a domestic target to reduce emissions to net zero by 2050 (other than biogenic methane). In addition to these targets there will be five-yearly interim targets in the form of emissions budgets.
- **International target under Paris Agreement:** NZ has also revised its target under the Paris Agreement from 30% to 50% of net emissions below our gross 2005 level by 2030. This target can be met through both domestic action and offshore mitigation.

Policy continues to be strengthened

- The Government is set to announce its first **Emissions Reduction Plan (ERP),** which will set out policies and strategies for meeting emissions budgets. The first three emission budgets covering 2022-2035 are due to be set by the Government in May 2022. A National Energy Strategy is expected to kick off following the release of the ERP. In advance of this, the Aotearoa Circle has released a Low Carbon Aotearoa, Energy Roadmap to 2030.
- The **Emissions Trading Scheme (ETS)** continues to be updated ahead of a new ETS framework coming into effect 1 January 2023.
- In February 2022, the Government passed the Land Transport (Clean Vehicles) Amendment Bill to allow for the expansion of the existing **Clean Car Discount (CCD)** and introduction of the **Clean Car Standard (CCS)**. From 1 April 2022 the CCD will impose charges on high-emitting vehicles, and rebates for low-emitting ones. The CCS will encourage supply of low and zero emission vehicles to NZ by placing CO2e reduction targets for vehicle importers from 2023.

Sourced from various media updates. Last updated March 2022.

Inconsistent

Greenhouse gas emissions have remained constant

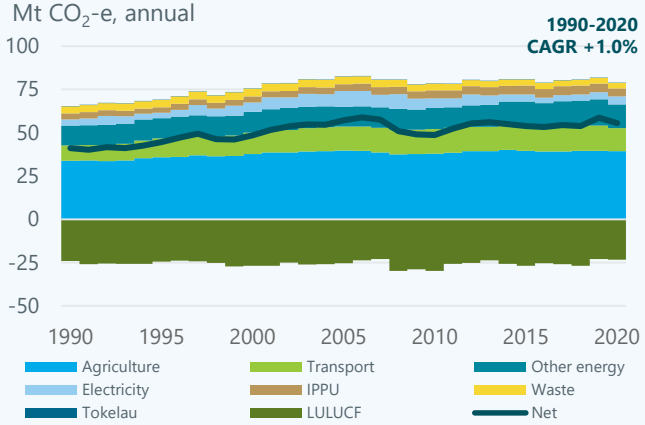
Since 1990, New Zealand's net greenhouse gas emissions have grown an average of 1.0% per year, a total increase of 26% due to the underlying increase in gross emissions. In the latest Greenhouse Gas Inventory, total gross emissions decreased 3% between 2019 and 2020, and net emissions decreased by 5%.

Emissions from the energy sector (includes transport) in 2020 were 32% higher than in 1990.

Between 2019 and 2020, emissions from the energy sector decreased by 7%, however this decrease was primarily due to impacts from COVID-19 which were felt across the sector. This saw decreases in emissions from road transport, domestic aviation and manufacturing. Emissions from electricity and heat production increased, likely driven by increased coal and gas use for electricity production during 2020.

New Zealand's greenhouse gas inventory

Mt CO_2-e, annual



Source: Statistics New Zealand, Annual GHG Inventory data sourced from Ministry for the Environment. Last updated April 2022.

Electricity demand has remained constant over the past decade, with signs of increasing residential demand

Consistent

Stable annual electricity demand trend continues in 2021

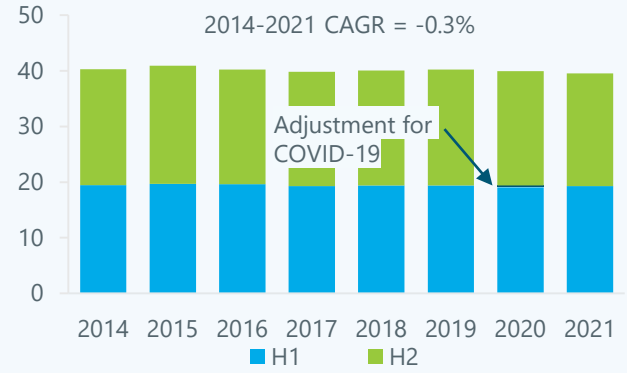
When we refer to demand we are referring to the volume of energy required to meet consumer and system requirements and ensure reliability. In the chart below, electricity demand is met from both generation that is grid connected and embedded, such as rooftop.

Electricity demand has been relatively stable in recent years, decreasing at an average of 0.3% per annum from 2015 to 2021. In 2020, we added a 'normalising' factor to explore what demand could have been if April demand wasn't dampened by the Alert Level 4 lockdowns. As shown in the chart below by the dark blue band, the impact is small.

Electricity demand in 2021 is broadly consistent with previous years. Whakamana i Te Mauri Hiko estimates a 68% increase in electricity demand by 2050 in the 'Accelerated Electrification' scenario.

Annual electricity demand

TWh, annual



Source: MBIE. Last updated March 2022.

Consistent

COVID-19 effect evident in monthly electricity demand

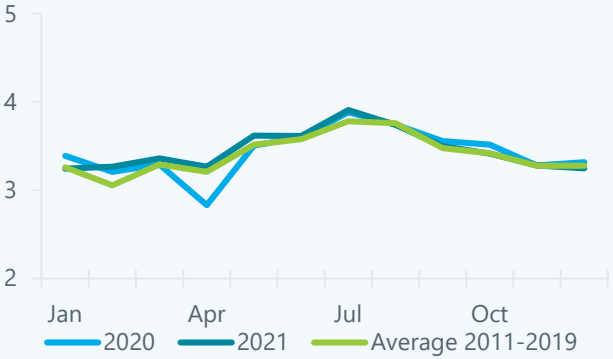
Electricity demand typically follows a seasonal pattern, with consumption being higher in the winter period, as New Zealanders use more power to light and heat their homes.

In the first half of 2021, total monthly demand trended slightly above average. The increase during the winter period is likely due to more frequent cold weather events and increased demand for heating. Due to COVID-19, electricity demand in the second half of 2021 was lower than the prior year; electricity demand was consistent with the long term average.

Future data releases will show the ongoing impact of the Omicron variant and COVID-19 protection framework on electricity consumption. This framework is impacting on businesses and supply chains, future energy use behaviour and is a key driver for the number of people working from home.

Monthly electricity demand

GWh, monthly



Source: Electricity Authority. Note truncated y-axis. Last updated December 2021.

Consistent

Residential electricity demand had material increase in last two years

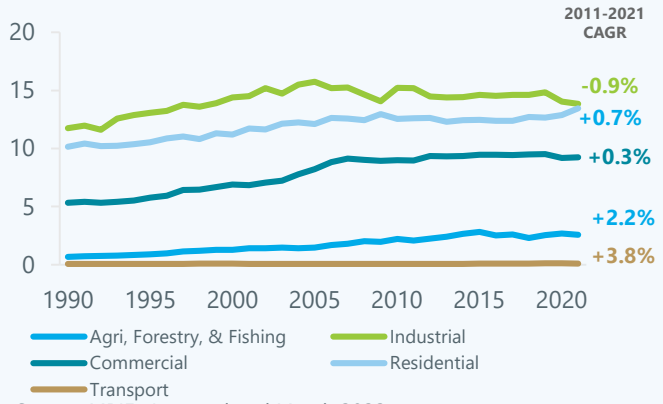
Electricity demand across the different sectors has been stable over the past ten years, in line with the country's total demand.

In 2021, the industrial sector saw a decline in demand, largely due to closure of plant, curtailed operations due to higher electricity prices and the effect of COVID-19 restrictions. The wood, pulp and paper sector was the single largest contributor to the decline. However, there are indications of likely step changes in industrial load in the future from switching to electricity and/or dual fuel such as biomass.

Electricity demand grew in the residential sector by 6.4% in 2021 compared to pre-COVID levels. The increase in demand is due to higher number of ICP connections from a boom in residential building consents and higher electricity consumption per ICP, partly due to increased working from home.

Electricity demand by sector

GWh, annual



Source: MBIE. Last updated March 2022.

Drivers of base demand have been slow due to the COVID-19 pandemic but future population growth is uncertain

Inconsistent

Population continues to grow at a slower rate due to COVID-19

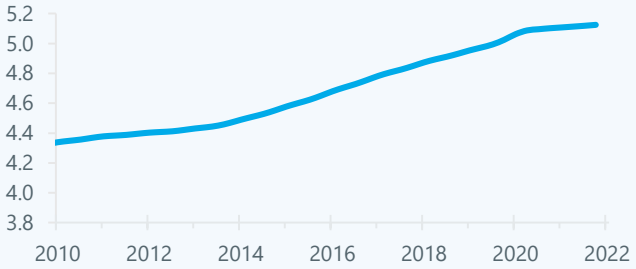
Because each New Zealander consumes electricity in their day to day life, population is an important driver of base demand. When excluding the impacts of increasing energy efficiency, we can expect base demand to increase with population growth.

Prior to COVID-19, the New Zealand population was growing at 2.8% per annum since 2010. According to Stats NZ, for the year ended 2021, the population grew by just 0.5%. This was also the first year since 2012 when NZ had a net migration loss. Historically, net migration losses from NZ were driven by NZ citizens heading overseas, but the COVID-19 border and travel restrictions have seen a reversal, and the net migration losses are driven by non-New Zealand citizens heading overseas.

The Government has released its COVID-19 five-step plan to reopen the border to New Zealand. In November, the Productivity Commission released a preliminary paper with recommendations on immigration policy and issues. Future population may be impacted by international labour market attractiveness and immigration settings for migrants to NZ

Estimated resident population of New Zealand

Millions of people, annual



Source: Stats NZ. Note truncated y-axis. Last updated March 2022.

Inconsistent

The road to recovery is bumpy, but growth expected in coming years

Economic activity is also a driver of base electricity demand as businesses use energy to deliver their goods and services.

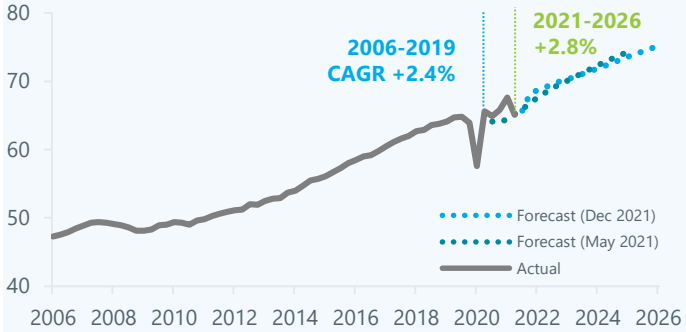
When excluding the impacts of increasing energy efficiency we can expect base demand to increase with economic growth. The changing composition of the economy (e.g. increasing share of services) will also have an impact on base demand as some industries are more energy intense than others.

At the highest level, gross domestic product (GDP) is used as a measure for the size of the economy.

Prior to COVID-19, GDP had been growing at an average of 2.4% per annum. For the September quarter 2021 GDP fell by 3.7%, the second largest quarterly fall since 1986. Treasury's December 2021 forecast suggests there will be continued downward pressure on GDP in early 2022 due to the Omicron outbreak, and it will rebound to grow at 2.8% per annum following the recovery.

Historical and forecast real production GDP

NZD billions, 2009/10 prices, quarterly



Source: Treasury. Last updated December 2021.

Consistent

Growth in ICP volume steady over 2021

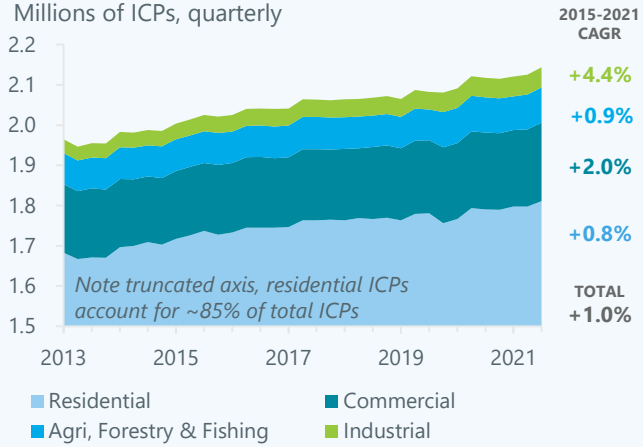
Installation Control Points (ICPs) are the physical points of connection on a local network. When new ICPs are added, for example when new houses are built, it is likely that there is an increase in electricity demand.

As with population and GDP growth, any growth in base demand will not be directly proportionate to ICP number growth due to energy efficiency and the specific consumer behaviours associated with those new ICPs.

During 2021, the total number of ICPs did not change significantly. The largest change on the prior year occurred in the residential sector, which increased ICP numbers by 20,734 (+1.2%), its largest annual increase since 2015. The agriculture, forestry and fishing sector fell by 400 (-0.5%); industrial increased by 1,540 (+3.1%); and commercial increased by 4,480 (+2.3%).

Number of ICPs

Millions of ICPs, quarterly



Source: MBIE. Last updated March 2022.

Overall energy efficiency and energy intensity continues to improve, offset by recent increase in residential demand growth

Consistent

Energy intensity decreasing at a national level

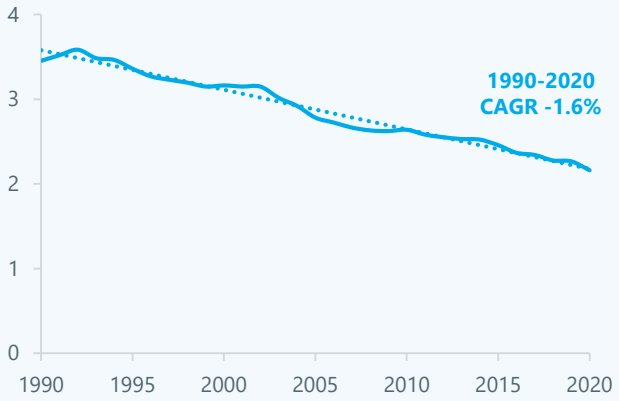
Energy intensity is a measure of the energy inefficiency of an economy. It is calculated as energy use divided by gross domestic product (GDP), and tells us the amount of energy required to produce goods and services. High energy intensity means more energy is required per dollar of GDP.

According to MBIE's Energy in New Zealand, energy intensity improved in 2020, with the national average energy intensity indicator falling 4.6% in 2020. Up to 2020, the national average energy intensity had been improving (falling) on an average of 1.6% per annum since 1990.

This decrease has been driven by continued economic growth in the commercial sector which, being service-based, is relatively less energy intensive than other parts of the economy.

Energy intensity across New Zealand

MJ/$ GDP in real 2009/2010 prices, annual



Source: MBIE. Last updated September 2021.

Consistent

Industrial sector continues to have highest intensity but improving

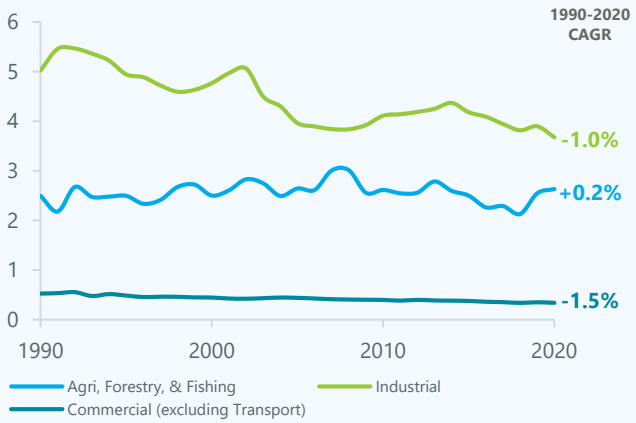
Energy intensity differs across sectors, and tends to be higher in capital intensive industries and lower for more service based industries.

Therefore, the industrial sector has consistently had a higher energy intensity since 1990, but has been falling at a rate of 1.0% per annum. Technology enabling even more efficient conversion of electricity to energy will only increase, and we should expect to see the industrial energy intensity decline further.

Agriculture, forestry and fishing follows next, with little change over the past thirty years. The commercial sector, being largely service-based, has the lowest energy intensity and has been declining at an average rate of 1.5% per year.

Energy intensity by sector

MJ/$ GDP in real 2009/2010 prices, annual



Source: MBIE. Last updated September 2021.

Inconsistent

Residential electricity consumption per ICP increased in last two years

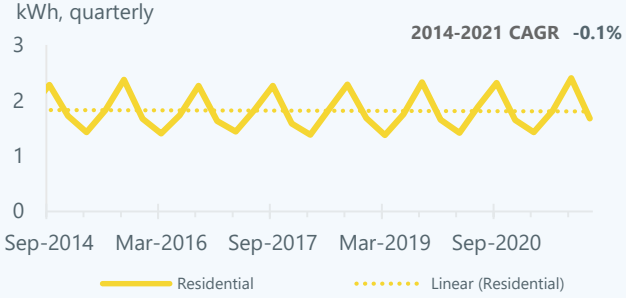
The average electricity consumed at a residential ICP can be an indicator for improvements in energy efficiency in New Zealand homes. From 2014-2021, the average consumption fell by an average of 0.1% per year. However, in 2021 average consumption increased by 3.3% compared to 2020 and 4.4% compared to pre COVID-19 levels. 2021 was the highest annual average consumption per ICP since 2012.

Under COVID-19 alert levels in May/April 2020, 4 in 10 employed New Zealanders worked from home. Previous analysis from Transpower showed that residential consumption during level 4 lockdown in 2020 increased by about 13 percent, with people working and studying from home. It is expected this dynamic continued in the second half of 2021 with similar percentages of people working from home according to data from Statistics New Zealand.

It is difficult to measure the short-term impacts of working from home on residential consumption per ICP. Longer term trends such as increased energy efficiency or uptake of private electric vehicle charging in the home will have future impact. Future data releases may highlight these drivers.

Average residential consumption per ICP

kWh, quarterly



Source: MBIE. Last updated March 2022.

Industrial energy users are still relying on fossil fuels, rising costs are causing issues but new entrants are also on the way

Consistent

Soft demand, but fossil fuels continue to power industrial sector

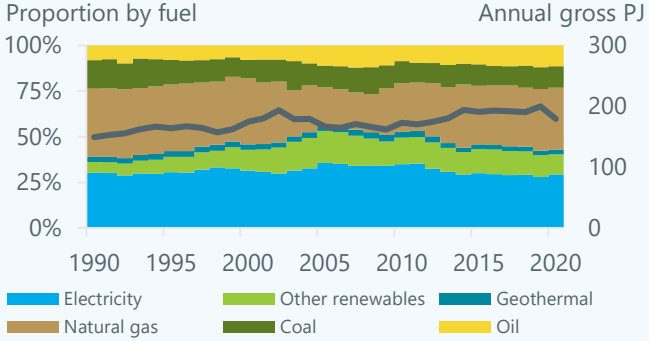
New Zealand's industrial sector relies on both fossil fuels and renewable energy sources. In our commentary we have estimated some data points not yet released by MBIE.

Due to COVID-19 restrictions and supply issues, we estimate that industrial sector energy consumption fell by 10% to 20% in 2021 compared to pre-COVID levels. Although there was a fall in total consumption, the relative share of renewable and non-renewable fuels remained the same. In 2021, we estimate that fossil fuels accounted for 55% of industrial energy consumption.

Due to gas supply issues in 2021, natural gas consumption for industrial use decreased 13% compared with 2020, its lowest level since 2006. The wood, pulp, paper and printing and chemicals sectors were the largest contributors to the decrease.

In the future, the push for electrification should see some fossil fuel demand displaced by electricity. Hydrogen, biofuels and other low carbon fuels are being investigated, particularly in areas that are difficult to electrify.

Industrial energy consumption by fuel



Source: MBIE. Last updated September 2021, Gas and Coal updated March 2022.

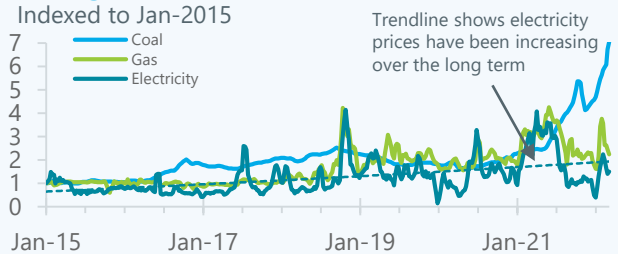
Uncertain

Cost of carbon and fossil based fuels have risen in the past year

Fuel costs were significantly higher during 2021 with several large energy users having to curtail activity. We are observing continued pressure on prices in early 2022, however these are partly being absorbed by higher commodity market prices.

- **Increasing carbon prices:** The NZU spot price has more than doubled in the past year, from around $35 in late 2020 to over $80 in February 2022. This will increase the cost of higher carbon fuels such as gas for electricity generation.
- **Coal:** Internationally, coal prices have surged in recent months due to international supply and demand factors, such as the halt in exports from Indonesia, the energy crunch in Europe and geopolitical tensions from the war in Ukraine.
- **Gas:** Tight supply from the Pohokura gas field last year drove higher NZ gas spot prices. The scarcity of supply has eased since 2021, but a tight gas supply outlook may continue to put upward pressure on prices and volatility.
- **Electricity**: During early 2021, prices were higher, linked to low hydro storage, limited renewable generation and constrained gas supply. Heading into 2022, there is continued pressure on current and forward electricity prices.

Change in fuel prices, carbon inclusive



Source: Coal – Trading Economics; Gas – emsTradepoint; Electricity – EA; NZUs - CarbonNews. Last updated March 2022.

Uncertain

Large energy users continue to adapt amidst high energy prices

Large energy user reviews

Tiwai Aluminium smelter – Rio Tinto has signalled that the planned closure date in 2024, when its current electricity contracts ends, is not final. Recent reports suggest high aluminium prices may lead to the smelter remaining open longer, possibly to 2034, which could play a role in dry-year cover.

Refining NZ (Channel Infrastructure) – Converting to an import-only terminal from April 2022. Exploring several options: solar installation, hydrogen production; manufacturing sustainable aviation fuel and import/export of biofuels. In December 2021 it signed an MOU with Fortescue Future Industries to study feasibility of producing hydrogen at the Marsden site.

Whakatane Mill – Planning to expand paperboard production in 2023 by 40% and reduce natural gas use through use of more efficient drying processes using steam.

Methanex - Temporarily shut Motunui during periods of low hydro in 2021 to provide gas supply for electricity generation. Expects production to increase +10% in 2022 on the prior year.

Potential large energy user entrants

In January 2022, DataGrid announced it purchased 43-hectare site near Invercargill and applied for resource consent to build a 150 MW data centre. DCI Data Centres is planning to build a 10 MW in 2023 and a 40 MW data centre in Auckland in 2024. Over the last few years Microsoft and Amazon Web Services have unveiled plans to build data centres in NZ.

Meridian Energy and Contact Energy announced a shortlist of four potential partners for their Southern Green Hydrogen project. It expects to announce project partners by mid-2022.

Sourced from various media updates. Last updated March 2022.

Process heat decarbonisation building momentum through support of the Government Investment in Decarbonising Industry fund

Consistent

Policy and investment is enabling process heat decarbonisation

Decarbonising process heat is a large opportunity for New Zealand as it contributes 10% of gross emissions and 17% of those covered under the domestic net zero target.

Since 2021, there have been several developments for decarbonising process heat:

- In April 2021, the **Energy Efficiency and Conservation Authority (EECA)** launched the Government Investment in Decarbonising Industry (GIDI) fund. The fund is a partnership between Government and business to accelerate emission reductions from process heat used in industry by supporting energy efficiency and fuel switching projects. In total the fund has provided $56.5m in co-funding across 39 approved projects. Collectively, this represents lifetime emissions cuts of 6.6 million tonnes at an average marginal abatement cost to Government of $12-18 per tonne of CO_2-e. EECA has closed Round 3, and successful projects are expected to be announced in April 2022.
- In April and May 2021, the **Ministry for the Environment** consulted publicly on their *Phasing out fossil fuels in process heat* paper.
- In April 2021, the Government announced that it would ban new low- and medium-temperature coal boilers used in manufacturing and production effective from 31 December 2021.
- In December 2021, **Standards New Zealand** published a Publicly Available Specification (PAS) standard design to provide information on process heat technology which present alternatives to using coal.

Sourced from various media updates. Last updated March 2022.

Consistent

Electrification of process heat is being boosted by the GIDI fund

Across the first two rounds of GIDI funding, 19 electricity projects were awarded a total of $27.2m in GIDI co-funding, equating to an expected 2.4m tCO_2-e in emissions reductions.

GIDI round	# of projects	GIDI co-funding	Lifetime emissions reductions (tCO2-e)
1	7	$11,907,075	945,480
2	12	$15,321,382	1,433,927
Total	**19**	**$27,228,457**	**2,379,407**

DETA Consulting, EECA and **Transpower** continue to explore opportunities to decarbonise coal boilers via low carbon fuels and energy efficiency. Full results of the South Island study findings are expected to be released shortly, which previously suggested there was up to 1.5 GW of non-renewable boiler capacity. The study has started data collection on North Island sites. The study is ongoing and outputs include the recently published Regional Heat Demand Database.

EECA, together with Transpower, local electricity distribution business and other regional stakeholders are piloting a Regional Energy Transition Accelerator Pilot in Southland to identify opportunities for process heat decarbonisation. The aim is to develop a well-informed and coordinated approach for regional decarbonisation.

In March 2021, **Meridian Energy** launched its Process Heat Electrification Programme, which aims to provide process heat users with long-term electricity supply contracts at competitive prices. Meridian Energy is targeting 600 GWh in its process heat supply strategy.

Sourced from various media updates. Last updated March 2022.

Consistent

Other fuels are also playing a part in decarbonising process heat

Other fuels outside of electricity are also playing their part in decarbonising process heat including use of biogas, biomass, geothermal or energy efficiency.

Across the first two rounds of GIDI funding, 20 projects that achieved emissions reductions via use of biogas, biomass, geothermal or energy efficiency were awarded a total of $29.3m in GIDI co-funding, equating to an expected 4.2m tCO_2-e in emissions reductions.

Type	GIDI round	# of projects	GIDI co-funding	Lifetime emissions reductions (tCO2-e)
Biogas	1	1	$406,083	34,600
Biomass	1	5	$10,296,750	2,048,890
	2	5	$6,363,500	705,100
Energy efficiency	1	3	$5,183,050	779,375
	2	5	$5,404,887	535,700
Geothermal	2	1	$1,650,000	136,610
	Total	**20**	**$29,304,270**	**4,240,275**

In Round 2, projects include:

- **Pioneer Energy, Hautapu Pine Products, AFFCO, Talley's and Golden Bay Cement** displacing fossil fuel boilers with biomass.
- **Asaleo Care** switching from natural gas to geothermal steam.

Based on conversations with industry experts, we are aware that the dual fuel use of biomass and electricity may become a preferred option for fuel security and cost benefits. For example, pairing the use of electrode boilers and woody biomass for process heat requirements at certain sites.

Sourced from various media updates. Last updated March 2022.

Electric vehicle numbers have been boosted by recent transport policy and funding, and are expected to continue rising

Consistent

Passenger EV uptake climbs with introduction of Clean Car Discount

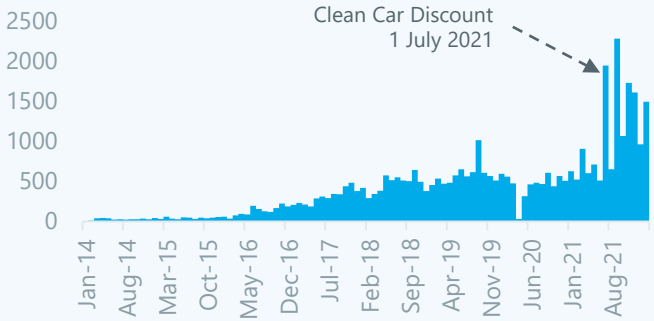
The electrification of the light vehicle passenger fleet is the single largest decarbonisation opportunity, as cars and two-wheelers combined contribute to 58% of transport emissions.

Prior to July 2021, the growth of EVs had been approximately linear with ~500 EVs being added to the fleet every month. Since the introduction of the Clean Car Discount (CCD) at 1 July 2021, which provides buyers of imported EVs up to $8,625 as a rebate, the average growth of EVs has increased three-fold to approximately ~1500 EVs per month.

It is yet to be seen whether the increased EV sales volumes will persist in the medium and long term. At the start of 2022, passenger EVs represent 1% of the total current light vehicle fleet. Current high petrol prices are enlivening interest in fuel efficient vehicles, with a 72% increase in the number of people adding EVs to their watchlist on Trademe. A global shortage of semi-conductors and computer chips is putting pressure on manufacturers of both EV and ICE new vehicles, which may cause supply issues.

Monthly electric vehicle registrations

Number of vehicles



Source: Ministry of Transport. Last updated March 2022.

Consistent

Small but consistent increase in numbers of electric trucks

Heavy vehicles are also starting to electrify, but at a slower pace than light passenger vehicles, due to the technology being in earlier stages.

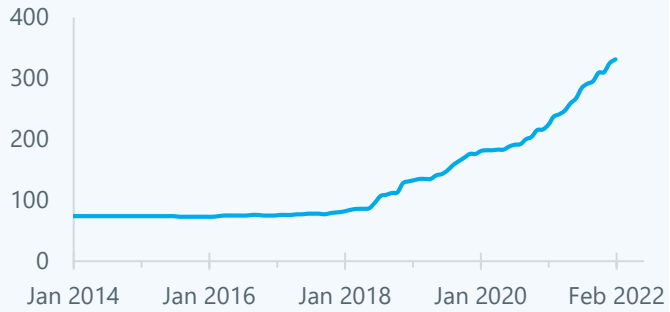
Since the start of 2021, there have been 116 new electric trucks added to the fleet, averaging eight per month. This is an acceleration in pace from the growth between January 2018 to December 2020, where the electric truck fleet was growing by approximately four per month.

In the latest round of EECA's Low Emission Transport Fund, there are five low emission truck projects, including: two battery swap heavy duty trucks, an electric milk tanker with battery swap technology, an electric concrete truck and two conversions of diesel to hydrogen dual fuel hybrid vehicles. Compared to previous truck projects, the weight class and range capacity of battery trucks is improving significantly.

Fonterra will operate NZ's first electric 46T milk tanker, and they currently have around ~480 diesel fuelled milk tankers.

Electric trucks in New Zealand

Number of vehicles



Source: Ministry of Transport. Last updated March 2022.

Consistent

Road transport decarbonisation supported by Government policy

Policy and enablers

- EECA has announced the rounds 1 and 2 of the Low Emissions Transport Fund. The two rounds focused on demonstration of vehicles and technology and public charging infrastructure projects. A total of $6.4m co-funding was provided for 26 projects.
- In January 2022, the Ministry of Transport released a consultation document considering changes to Road User Charges (RUC) to support uptake of low carbon fuels.
- In February 2022, the Government announced the expansion of the Clean Car Discount and introduction of the Clean Car Standard (discussed above). This will:
  - expand the existing rebate scheme for low emission vehicles, while also imposing fees on high emitting vehicles,
  - apply targets to encourage importers to import more zero- and low-emissions vehicles from 2023, and
  - provide vehicle labelling for consumers on emissions and rebates receivable or charges payable for different vehicles.
- In November 2021, EECA released an interactive public EV charger map, and consultation on developing a roadmap on the future of public EV charging infrastructure investment.

Charging infrastructure

- **Z Energy** has begun plans to scale up its investment in EV charging infrastructure in NZ. It will install 12 ultrafast chargers, supported by funding from EECA. Z Energy has recently been acquired by Ampol, who has similar plans to rollout EV charging in Australia.
- **Zenobe Australia have received Government co-funding to** trial second-life batteries for grid-constrained areas to provide network support for EV charging.
- **Chargenet** is currently NZ's largest EV infrastructure company with over 260 charge points on the network.

Sourced from various media updates. Last updated March 2022.

Electric passenger vehicles are becoming more attractive due to new Clean Car Discount and lower running costs

Consistent

EV purchase price parity still higher than ICE but is narrowing

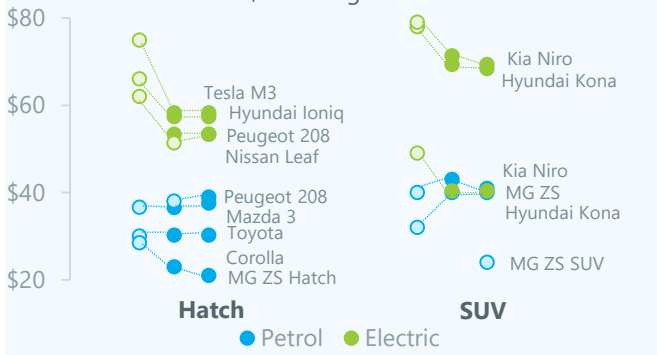
Upfront purchase price is a key barrier to adoption of electric vehicles. EV purchases will start to grow significantly once the purchase price of EVs is on par with internal combustion engine (ICE) vehicles. Research by Bloomberg suggests global price parity with petrol and diesel equivalents between 2026-2030.

The Clean Car Discount rebate has helped to drive a significant increase in EV purchases since July 2021. The upfront cost of an EV, however, is still higher than the petrol/diesel equivalent, as shown below. This gap should close further in 2022, when buyers of new imported higher emitting petrol/diesel vehicles will be required to pay a fee. The Tesla Model 3 is still one of the most popular new EVs and the ZS Excite EV is currently the cheapest electric vehicle in NZ. Hybrids as low-emission vehicles are also becoming popular, as the CCD expands to include new and used imported hybrid vehicles.

The chart shows how prices have changed over the last three half year periods since March 2021.

Sticker price of petrol and electric models

Thousands of dollars, including GST



Source: EECA and Optifleet TCO tool. Last updated March 2022.

Consistent

EV running costs significantly lower than petrol and diesel equivalents

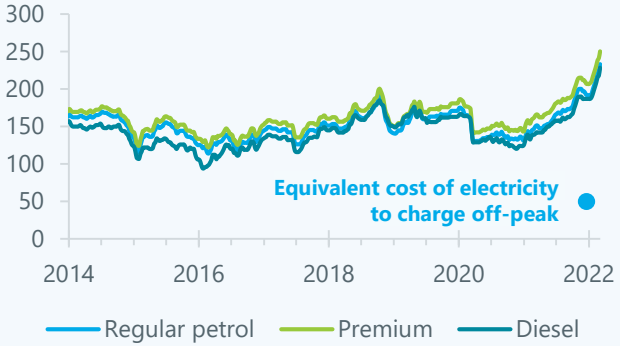
The total cost of ownership (TCO) is a more accurate cost comparison, and factors in both purchase price and operating expense over the lifetime. Electric vehicles have lower running costs than their petrol and diesel equivalents and therefore, in some cases, lower total cost of ownership.

Fuel is a large component of a vehicle's running costs. Petrol prices fell as the pandemic hit in 2020, but have now risen higher than pre-COVID-19 levels. Fuel prices have continued to increase during 2021 from a weaker NZD-USD exchange rate, higher import costs, and supply chain issues due to COVID-19. They continue to rise amid volatility from higher oil prices and geopolitical instability from the Russia-Ukraine war.

Higher petrol costs make charging an EV more attractive and the gap is widening with petrol over 7x times more expensive than (off-peak) electricity on a per litre equivalent basis. In March 2022, the Government announced a 25 c/litre reduction of the petrol fuel excise duty for 3 months.

Vehicle fuel prices

Cents per litre (petrol excise duty removed for comparability)



Source: MBIE. Last updated March 2022.

Consistent

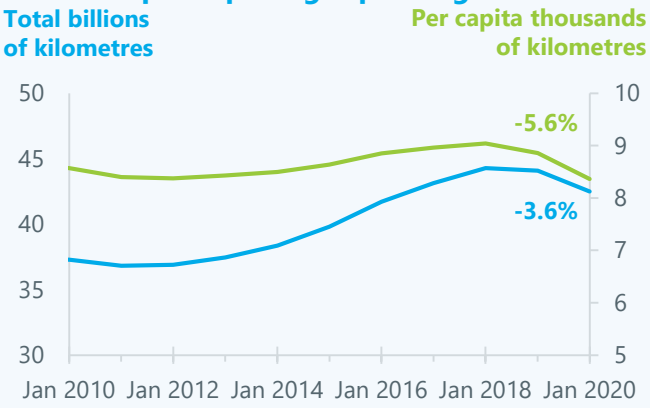
Total and per capita travel has decreased due to COVID

According to Ministry of Transport's Annual Fleet Statistics, prior to 2019 both total and per capita vehicle kilometres travelled (VKTs) were increasing. However in 2020, total annual light VKT decreased 3.6% and 5.6% on a per capita basis compared to the prior comparable year. This is the second year of decreases in succession due to COVID-19 restrictions impacting on movement of people for periods of time.

Despite the push to lower our carbon emissions, New Zealand's total light vehicle fleet has been increasing since 2012. It is not known whether the trend toward reduced travel will continue after the COVID-19 pandemic.

This strong reliance on private vehicles highlights the crucial role electrification will play in reducing our transport emissions. It also emphasises the need for alternative modes of transport, such as walking, cycling, micro mobility and public transport, as well as reducing the need for travel in general.

Total and per capita light passenger travel



Source: Ministry of Transport. Last updated December 2021.

Battery technology and flexible demand providing solutions to meet peak and energy demand and support system reliability

Consistent

Grid-scale battery projects are emerging in New Zealand

Overseas, batteries are proving that they can access multiple value streams through energy markets, network deferral and providing ancillary services.

Recent announcements across New Zealand's electricity industry suggest that both micro-grid and large grid-scale batteries could soon play a bigger role in NZ's power system.

- **WEL Networks** through Infratec to build a 35MW battery energy storage system in Waikato. It will provide electricity reserves into the market and is expected to be commissioned by December 2022.
- **Meridian Energy** announced that it is planning to build a renewable energy park near Marsden Point by mid-2023. It includes utility scale solar and a 100 MW capacity grid-connected battery.
- **Contact Energy** are investigating the economics of a 100 MW battery energy storage system, with an investment decision expected by mid-2022.
- **Vector** issued a ROI for non-wires alternatives in the wider Warkworth region. Non-wires alternatives includes solutions such as distributed generation, energy storage, demand-side management and demand response.
- **Transpower** has issued a RFP for non-transmission solutions to provide voltage support, following an RFI in 2021.

These are not the only battery projects in New Zealand and it is expected that further large scale projects will occur by 2030. According to the IEA, installations of utility-scale batteries have jumped by 50% worldwide last year, driven by the global uptake toward renewables and the fall in battery costs.

Sourced from various media updates. Last updated March 2022.

Consistent

Flexible demand an option for supporting energy security

Flexible demand (such as demand response) provides another layer in supporting energy security as it allows for electricity consumption to flex (either up or down) in line with available supply. This dynamic ability is particularly useful at times when energy supply is tight. Flexible demand can be deployed to help avoid outages in the electricity system by preventing demand from exceeding supply line limits.

Recently, large energy use projects have been announced that actively consider the role of flexing demand to support energy security:

- **Contact Energy** intends to supply 10 MW of flexible electricity to a **data centre near the Clyde Dam**. The data centre will have demand flexibility technology built in to allow demand to be curtailed by up to 95% during a dry year.
- **Meridian and Contact's joint Southern Green Hydrogen project** sets out to evaluate the potential for hydrogen production in Southland. Part of the study will look at a dry year response where hydrogen production can be ramped down in times of low hydro storage.
- **MBIE's NZ Battery Project** which is investigating energy storage options, including pumped hydro and a range of other dry year storage solutions.

There are already several forms of flexible demand in New Zealand's electricity system:

- **Ripple control** has been in place since the 1950s and allows distribution businesses to turn off consumers' hot water systems at times of peak demand.
- **Tiwai's demand response agreement with Meridian**, which can be triggered to assist with managing low hydro periods.

Sourced from various media updates. Last updated March 2022.

Consistent

Distributed energy resources also gaining traction

Distributed energy resources (DER) are growing in large volumes globally as consumers seek to benefit from their own controllable systems, and networks take advantage of wider energy system benefits.

A number of announcements have emerged since our last update, including:

- The **Electricity Authority and Ara Ake** are undertaking a multiple trading relationship pilot (MTR). This will unbundle electricity services to allow for a greater range of choices and suppliers available to consumers, supporting the uptake of distributed energy resources, such as rooftop solar PV. The pilot is expected to run until mid-2023 and Ara Ake announced that at least 24 companies have signed up so far.
- **WEL Networks** launched a three-year EV charging and DER trial across 10 EV owners in Raglan. The trial will use smart EV chargers and integrate with WEL's distributed energy resources management system (DERMS).
- **Kāinga Ora** released a Request for Information (RFI) on energy sharing trials. It is seeking potential partners to understand how to share the benefits of DER between homes on multiple sites across New Zealand.
- **Transpower** released new DER connection guidelines for connecting large scale DER resources.

Solar and battery systems are not the only DER available. Others include smart appliances and EV charging. Recent analysis undertaken by the Market Development and Advisory Group (MDAG) noted the importance of demand-side flexibility (such as batteries) to play an importance role in short term balancing of the power system under a highly renewable future.

Sourced from various media updates. Last updated March 2022.

Distributed solar installations continue to grow in number and capacity, driven by falling costs

Consistent

Residential solar installations continue to grow

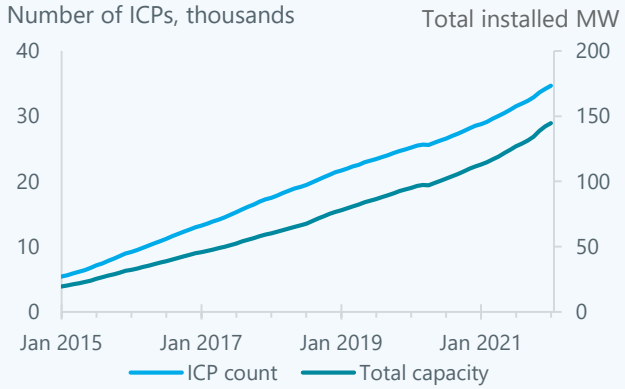
More New Zealand households are installing solar PV systems on their rooftops to take advantage of lower electricity costs.

Since the start of 2015, the total number of solar installations have grown by an average of 31% per year, from 5,160 ICPs to 34,200 ICPs in 2022. The average capacity of new installations grew from 3.5 kW at the beginning of 2015 to around 5.2 kW in 2021. The number of residential solar installations is ~34,200 at the end of 2021, this is approximately 1.9% of households.

A record 30 MW of residential solar was installed in 2021, up 72% on the prior 12 month period. According to Forsyth Barr, growth in solar installations will continue and it is expected ~55 MW of rooftop solar will be installed in 2022.

According to the SEIA and Wood MacKenzie, there are emerging trends that co-location of battery storage and solar generation is growing around the world, however there is no data in NZ to support this trend yet.

Residential solar installations



Source: Electricity Authority. Last updated January 2022.

Consistent

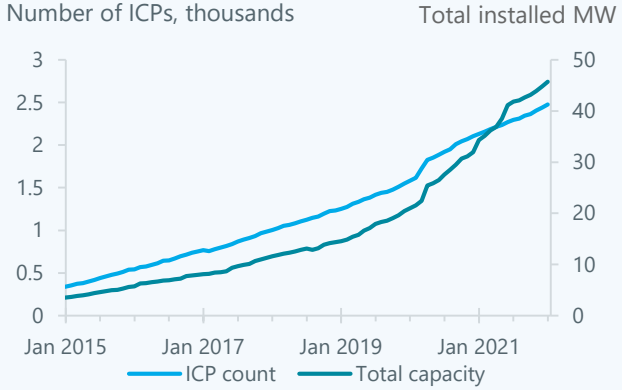
Commercial solar installations continue to grow

As with residential sites, commercial and industrial solar installations have also been increasing. These installations are embedded and do not include any grid connected solar installations.

Since the start of 2015, the total number of solar installations have grown by an average of 33% per year, from 330 ICPs to 2,440 ICPs by the end of 2021. The average capacity of new installations is becoming larger, and averaged approximately 38 kW in 2021. Emerging technology improvements such as light weight solar panels, has the ability to increase capacity of existing commercial roofs being economically available for solar PV.

The New Zealand Green Investment Fund has provided $40m in funding for the financing of commercial-scale solar installations in partnership with SolarZero. This includes the funding of solar panels on schools (~ 200 MW estimated capacity) across New Zealand using PPAs.

Commercial solar installations



Source: Electricity Authority. Last updated January 2022.

Consistent

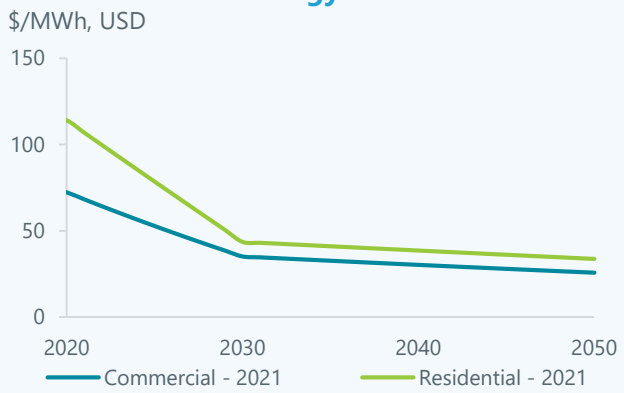
Distributed solar costs forecast to continue on sharp decline

The National Renewable Energy Laboratory (NREL) releases industry updates on forecast solar PV levelised cost of energy (LCOE). The cost of solar is expected to fall significantly out to 2030.

According to NREL, the global PV module price increased 23% in 2021 compared to 2020. This is largely driven by the higher cost of polysilicon, a key feedstock to most PV modules. Component price increase, material shortages and supply-chain disruptions caused by the global pandemic are expected to soften solar growth in 2022.

Despite supply chain shortages and component price increases, reported solar PV system installed prices remained relatively flat between 2020 and 2021, as costs include both soft costs (e.g labour) and module costs. NREL estimates that 171 GW of PV were installed globally in 2021, and analysts project 209 GW of PV will be installed in 2022 and 231 GW will be installed in 2023.

Levelised cost of energy for distributed solar



Source: NREL. Last updated September 2021.

Capability to meet energy demand and peak demand is generally sufficient today but recent events highlight potential future issues

Uncertain

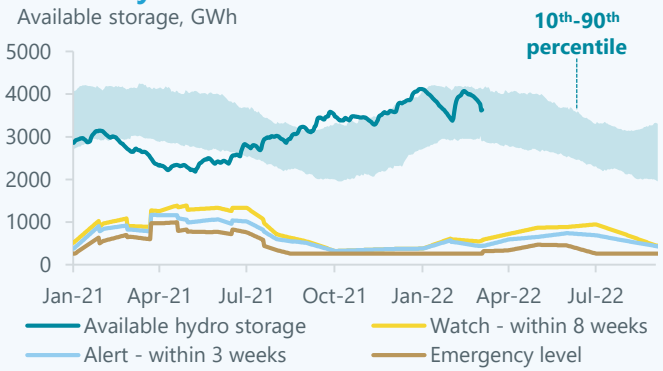
Security of supply situation continues reliance on coal

The industry needs to ensure there is enough electricity to meet energy demand, particularly during dry years when low rainfall impacts hydro generation. Transpower regularly assesses New Zealand's security of supply to help the industry with decision making to avoid shortages. It is currently seeking feedback on its proposed reference case and sensitivities for the 2022 Supply Annual Assessment (SOSAA).

Last year in 2021, New Zealand had to manage a La Niña climate event which caused low hydro inflows and, at the same time, a tight gas market that reduced gas supply available for electricity. Compared to 2021, the security of supply outlook overall assessment notes key drivers for 2022 including current hydro storage levels, snowpack in the Waitaki catchment, gas supply, coal stockpile for winter thermal generation and the commissioning of 900 GWh annum of wind generation.

In the long term, large scale storage and flexible demand could have a role to play in the future of security of supply.

Electricity risk status curve



Source: Transpower's Security of Supply. Last updated March 2022.

Uncertain

Generation capacity exists to meet peaks but some slow start concerns

To move towards a low carbon economy, traditional slow start[1] baseload thermal power stations, which have backed up our hydro-dominated system, are progressively being phased out and need to be replaced with fast start peaking capacity. No new fast start generation projects are at financial close or under construction.

Plant, comm. date and capacity	Announced developments
Huntly Rankines (U1,2,& 4) 1982, 750 MW Coal/Gas	• Commitment to no coal after 2025 in normal year and zero coal by 2030 • Biomass trial 4,000 tonnes for use in one of the 250 MW units (Q2 2022) • Three units available until end of 2023
Huntly U5 2007, 403 MW Gas	• No announced plans
Huntly U6 2004, 51 MW Gas	• No announced plans
Taranaki Combined Cycle 1998, 385 MW Gas	• No announcement from Contact Energy on strategic review of thermal generation assets • "ThermalCo" proposal in which all fossil-fuel generation is owned by a single entity.
Stratford Peaker 2011, 200 MW Gas	
Whirinaki Peaker 2004, 155 MW Diesel	
McKee Peaker 2013, 100 MW Gas	• No announced plans
Junction Rd Peaker 2020, 100 MW Gas	• No announced plans • Commissioned May 2020

Sourced from various media updates. Last updated March 2022.
1 Slow start thermals require at least 6 hours to warm up before they can start producing energy. In certain circumstances this can mean that slow start thermals are not available to provide peaking capacity

Uncertain

Peak demand is growing, with some COVID-19 anomalies

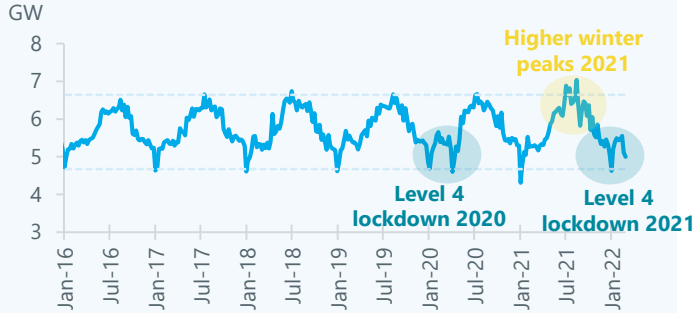
The power system is built to ensure the highest demand at any one point in time can be met. As with overall demand, peak demand follows a seasonal pattern, with higher levels during winter, specifically in the mornings and evenings as people light and warm their homes.

Peak demand has seen little variation of the five years to 2020. However, recent peak electricity demand has raised concerns for security of supply. In 2021, peak demand increased significantly. Despite having the second warmest winter on record last year, New Zealand broke two peak demand records (refer to our September 2021 report), both during a cold snap.

Peak demand is expected to grow as electrification ramps up. Looking forward, because the power system is built to ensure the highest demand at one point in time can be met, increasing peak demand can be a concern if it grows faster than the system capacity.

Typically, investment in grid infrastructure has catered for growing peak demand, however, demand side management is recognised as an important and economically efficient solution.

Weekly peak demand



Source: Electricity Authority. Last updated March 2022.

Electricity affordability and electricity contribution to wider energy system is uncertain and **renewability** affected by dry period

Uncertain | Inconsistent | Consistent

Residential electricity bill increase due to price and consumption

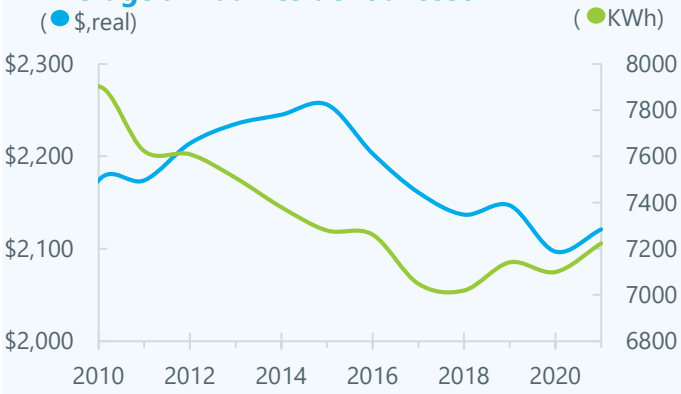
Energy affordability is a core pillar of the energy trilemma. Electrification is only likely to occur if electricity is affordable and competitive against other forms of energy.

At a household level, the average cost of electricity hasn't changed much, at 29-30 cents per kWh, over the past five years.

In the five years leading up to March 2020, the total household bill has been decreasing. However, for the most recent 12-month period ending December 2021, the nominal total annual household bill increased by 2.7%, largely a reflection of the high wholesale energy prices during 2021 and increased residential consumption. From April 1 2022, the Government announced the phase out of the low user fixed charge tariff.

Changes in consumption and costs trends will become evident in future data releases.

Average annual residential cost



Source: MBIE, Quarterly Survey of Domestic Electricity Prices. Last updated December 2021.

Renewable electricity continued dependence on hydro

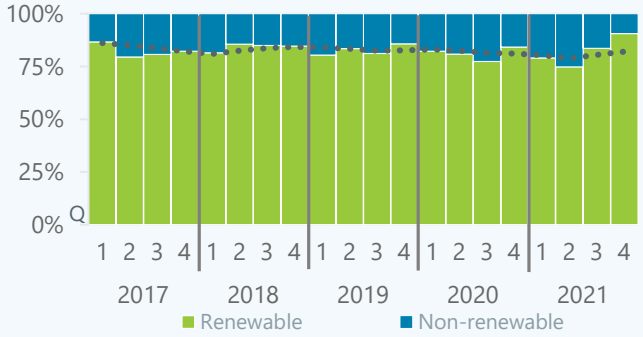
For the most part of the past decade, New Zealand's electricity system has consistently been around 80% renewable.

The past year has seen records for renewable electricity generation. In the June quarter of 2021, renewability of the electricity system fell to 74.9%, the lowest level since the June quarter of 2013. However, by the December quarter, renewability of the electricity system was 90.7%, the highest quarter in 26 years. The June quarter fall was due to the dry hydro conditions and the need to ramp up coal generation to maintain security of supply. The December quarter rise was due to a sizeable increase in hydro inflows and wind generation.

Several actions helped to manage the low hydro storage period in the first half of 2021 and prevent severe outcomes. For example, Genesis signed a deal with Methanex to free up gas supply and coal fired generation had to ramp up significantly. Our reliance on hydro (approx. 55% of net generation annually) for renewability is expected to reduce by 2035, supported by a more diverse renewable mix and the phase out of coal.

Renewability of electricity generation

Percentage by quarter year



Source: MBIE. Last updated March 2022.

Electricity contributes a quarter of energy needs

Historically, electricity has provided approximately a quarter of consumer energy needs. However, due to COVID-19 impacts on energy use, trends in electricity and renewable energy were disrupted. Overall, energy consumption fell by almost 10% in 2020 and renewable energy made up 28% of the total energy consumption.

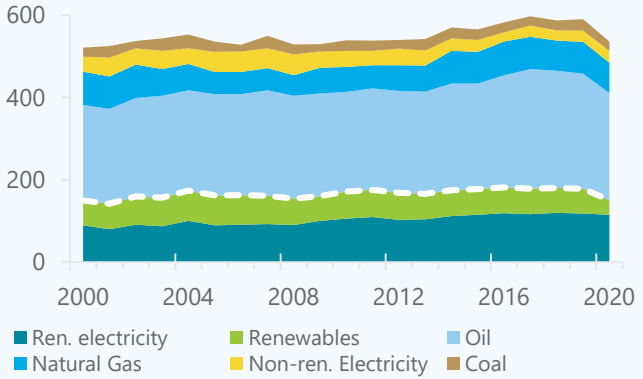
Through electrification and efficiency improvements, we estimated in WiTMH that electricity's contribution to New Zealand's energy demand would grow 68% by 2050.

Other fuel switching possibilities such as coal to gas, gas to hydrogen, and the use of biomass/ biofuel will also have a role to play in the displacement of fossil fuels out to 2050.

Future data releases will indicate the change in proportion of consumer energy demand balances across fuel types for 2021.

Energy consumption by supply source

Annual, petajoules



Source: MBIE. Last updated September 2021.

Progress against the ten Whakamana i Te Mauri Hiko industry themes is ongoing and may shift further with future energy policy

1 Streamlining our connections process

- Transpower is continuing on its programme to streamline its connections process.
- We have improved our education and information provision with the release of EnVision.
- We have released a consultation on how Renewable Energy Zones could apply to New Zealand.

2 Integrated system planning

- Transpower is continuing with its Net Zero Grid Pathways (NZGP) project, which aims to ensure New Zealand can take an integrated view of future investment needs.
- As part of Phase One, the NZGP team is preparing to consult on a short list of options for investment into the central North Island, Wairekei ring and the HVDC.

3 Getting the incentives right for electrification and renewables

- EECA-managed funding and support available to transport and process heat electrification.
- Introduction of new policy; e.g. new coal boiler ban, Clean Car Discount, Clean Car Standard.
- Schemes such as Meridian's Electrification Programme.

4 Removing barriers to low carbon infrastructure

- National and Built Environment Act legislation, as part of the Resource Management Act Reform is underway.
- MBIE's Building for Climate Change programme to reduce emissions from constructing and operating buildings.
- Commerce Commission review on the impact of decarbonisation on electricity lines services, in relation to Part 4 of the Commerce Act

5 Demand-side management of peaks

- EECA and EEA are leading a project across New Zealand's electricity supply industry to trial OpenADR standard for EV smart charger communications.
- EA and Ara Ake are piloting multiple trading relationships.
- Distribution businesses conducting various projects: South Island DSO, Orion's LV monitoring, Vector's smart charging trial, Wellington Electricity's EV Connect consultation, Aurora's non-network alternatives project.

6 Ensuring generation meets peaks

- Increased pipeline of generation projects.
- Interest in grid-scale and flexible energy is rising
- MDAG's work on wholesale market settings under a 100% renewable electricity supply, and proposal to use 'green peakers' run on biomass or green hydrogen.

7 Managing dry year risk

- MBIE's NZ Battery project is underway; Phase 1: Investigation into solutions due to finish May 2022.
- Genesis energy trialling biomass to displace coal.
- Flexible demand projects are being investigated to assist with dry year management, e.g.: Clyde Data Centre, Southern Green Hydrogen project, Tiwai and Methanex flexibility.

8 Protecting system stability

- Transpower continues to monitor risks to system stability.
- Transpower is working with the Electricity Authority on understanding the future security and resilience of the electricity system. Transpower has published its draft roadmap and intends to run workshops in April 2022.

9 Access to skilled workforce

- Transpower sponsorship of the Engineering New Zealand Power Challenge has been piloted with the goal of implementing in Q3 of 2022.
- Transpower has assessed its engineering capability requirements and will target further investment in capability development.
- EEA "Re-energise" work creating pathways for the future energy workforce.

10 Collaboration

- The Aotearoa Circle and partners have released a Low Carbon Energy Roadmap .
- Transpower is currently working with EECA and electricity distribution businesses on a Regional Energy Transition Accelerator Pilot.
- Transpower is consulting on the concept of a Renewable Energy Zone and pilot in Northland with EDBs.