TRANSPOWER

Te Mauri Hiko Monitoring
FY2019 Q4 Review

June 2019

Introduction

- 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.

- Significant geo-political and technological change are likely to increase future uncertainty, so it is critical we 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 quarterly report is designed to identify, within 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: TeMauriHiko@transpower.co.nz

Te Mauri Hiko monitoring dashboard

View of our drivers and signs

Key: Consistent | Possible variation | Probable variation

↑ Direction of variation (up indicates more demand or more supply)

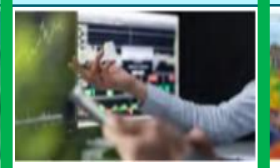
	Driver	Sign 1	Sign 2	Sign 3
Demand ↑	• Climate Response	Climate change concern	Warming still likely	NZ committed to reduction
	• NZ economic performance	Economic growth	Energy efficiency	Sectoral balance
	• Residential demand	Population growth	Transport sharing	Residential demand
	• Electrification	Light EV adoption	Heavy EV adoption	Process Heat electrification
Supply ↓	• Distributed solar & storage	Residential solar adoption ↓	Commercial solar adoption ↓	Economics of distributed energy
	• Utility generation	Economics favour solar and wind	Renewable generation consented	New generation is renewable ↓
	• Demand management	Battery capacity	Battery technology	Load control tools
	• Dry winter risk	Fossil fuel plant closure ↓	Inter-seasonal demand	Dry year coverage ↓
	• New technology	Unexpected new tech +/- 10%		

ICCC outlined peaker role continues near-term

Emergent Scenarios

Demand Scenario


Vibrant Haven


NZ Inc


Struggling alone


Mobilise

Supply Scenario


Clean NZ


Peakers permitted


Roaring 40s


Mass Solar


Big South

Key areas to monitor

- New Zealand population growth and economic performance still may be consistently higher leading to vibrant haven
- Distributed solar uptake continues to track lower suggesting Roaring 40s
- Energy efficiency effects continuing to be significant
- NZ approach to fossil fuel plant closure could be relaxed to focus on broader decarbonisation goals

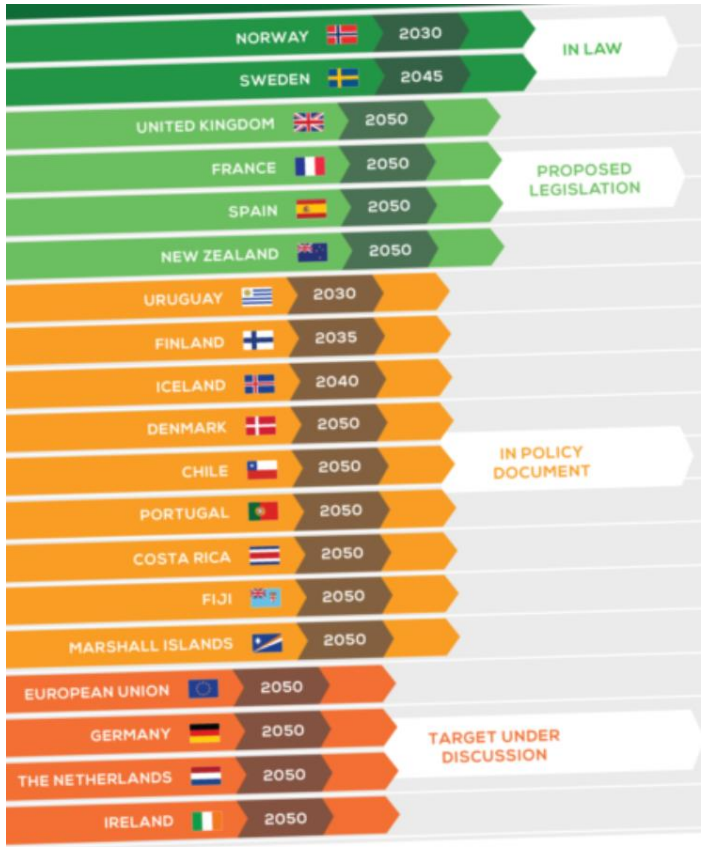
Demand Driver: Climate response driving emission reduction targets

Overall Status: Consistent

Global concern remains high

Countries committed to, or exploring Net Zero Target by 2050:

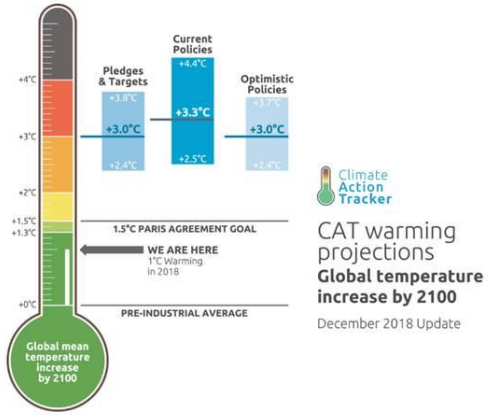
NZ and UK recently proposed legislation



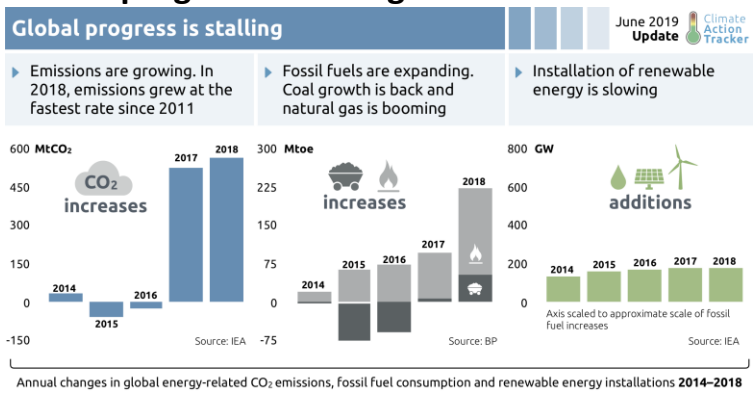
Source: Energy and Climate Intelligence Unit

Climate projections continue to show warming

Forecasts show global temperature increases



Global progress is stalling



Source: CAT

NZ committed to emissions reduction

Proposed Targets:

- 30% reduction by 2030 (vs 2005)
  (All greenhouse gases)
- All greenhouse gases Net Zero by 2050
  (except biogenic methane)

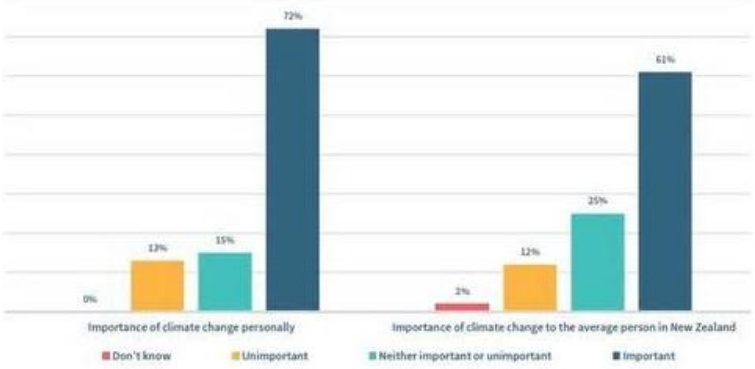
Emission Budgets:

- CCC to establish 5 yr budgets from 2021

Legal Status:

- Select Committee considering Zero Carbon Bill. Passing into law late 2019.

NZ public view on importance of climate change



Source: MfE, IAG/Ipsos poll

Demand Driver: NZ economy continues to become more efficient but underpins sustained demand growth

Overall Status: Consistent

Continued long-term economic growth

Long-term NZ GDP forecast: GDP forecast will behave in line with Treasury estimates (2.3% p.a by 2023) with no major structural obstacle observed

Budget Economic and Fiscal Update 2019

June years	2018 Actual	2019 Estimate	2020 Forecast	2021 Forecast	2022 Forecast	2023 Forecast
Economic						
Real production GDP (annual average % change)	3.2	2.4	3.0	2.8	2.4	2.4
Real GDP per capita (annual average % change)	1.1	0.7	1.5	1.5	1.3	1.2
Unemployment rate (June quarter)	4.4	4.1	4.0	4.1	4.2	4.3
CPI inflation (annual % change, June quarter)	1.5	1.8	2.0	2.1	2.0	2.0
Current account balance (% of GDP)	-3.4	-3.4	-3.4	-3.4	-3.3	-3.3

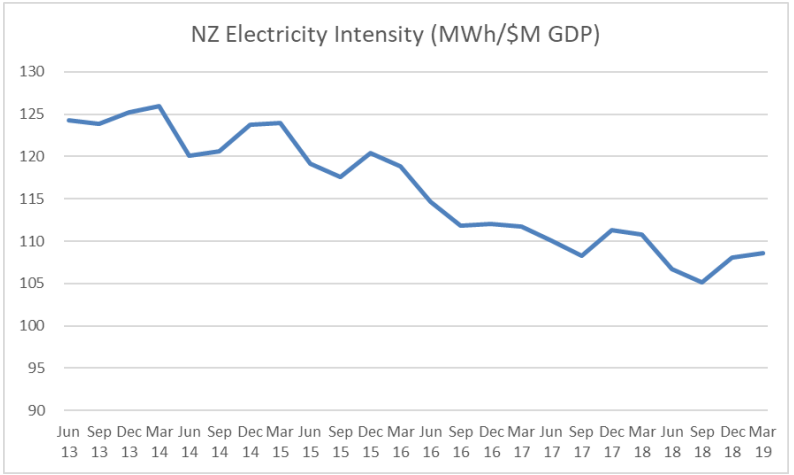
Economic activity, as measured by gross domestic product (GDP), was up 0.6 percent in the March 2019 quarter, the same growth seen in the December 2018 quarter. GDP grew 2.7 percent over the year ended March 2019.

Source: Stats NZ Gross Domestic Product: March 2019 quarter data release

Continuing energy efficiency supports the economy's electricity intensity reducing

Electricity intensity: Electricity intensity will decrease (-1.5% p.a.), driven by buildings and other efficiencies (excluding electrification).

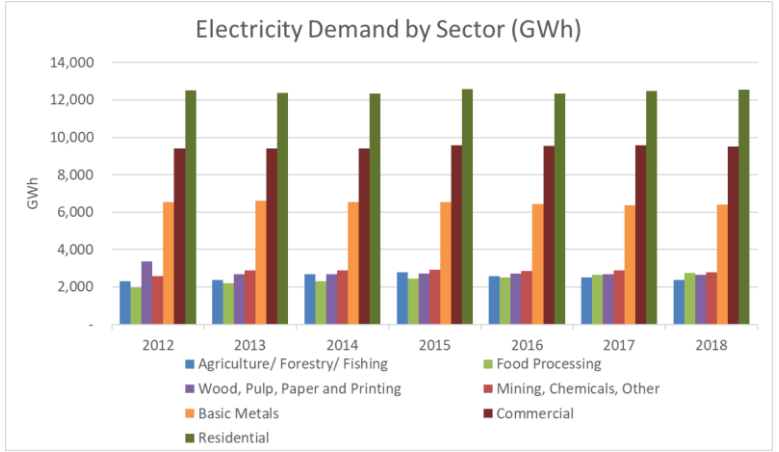
March 2019 quarter saw a 2.8% improvement from a year ago.



Source: Stats NZ, MBIE

The sectoral outlook shows continuing electricity demand growth

Primary sector outlook: Primary mobile motive power electrifies strongly towards 2050, Increased robotics & work automation & crop farming increases



Continued strong growth in electricity demand from the Food Processing sector but little observable change elsewhere.

Source: MBIE

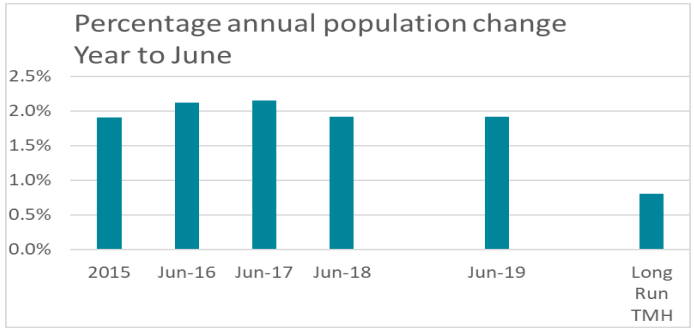
Demand Driver: Residential demand underpinned by population growth

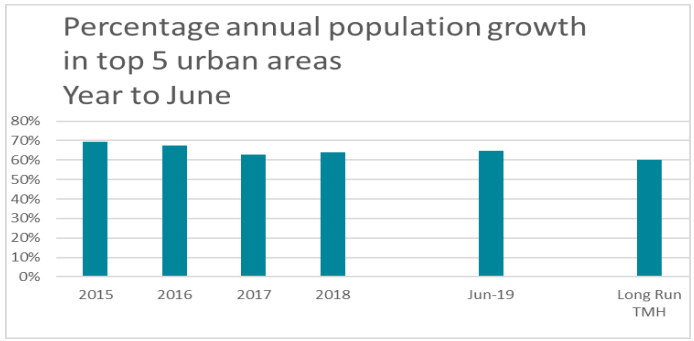
Overall Status: Consistent

Continuing population growth

Population growth and location:

Population growth rates will remain constant, focused on urban centres.





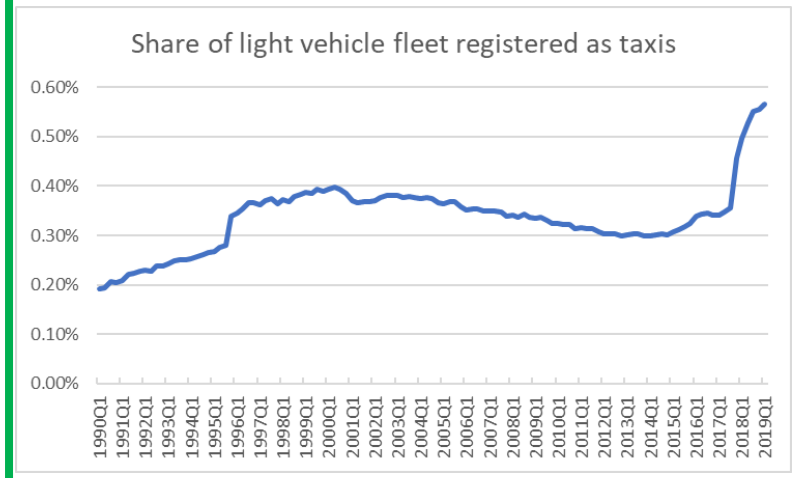
Annual net migration gain remains high at 55,800 for the 12 months to April 2019 up from 50,200 a year earlier.

Source: MBIE, Stats NZ

Shared versus private vehicle ownership

Shared versus private vehicle ownership:

Increasing transport as a service to 50% by 2035 with increased vehicle occupancy



Since ridesharing platforms entered the market, there has been a material increase in the number of vehicles on the road registered as taxis.

The increase is continuing albeit at a slower pace by March Quarter 2019.

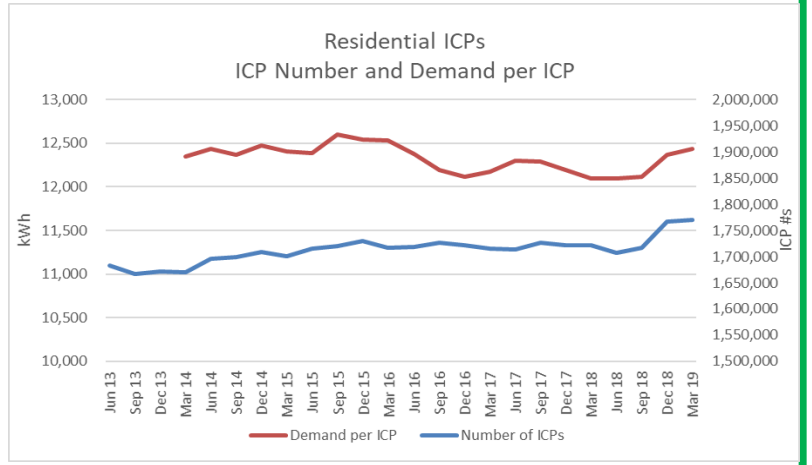
Source: Stats NZ Infoshare

Overall residential demand

Homes become more energy efficient (incl. PV/EV):

In the year ended April 2019, the actual number of new dwellings consented was 34,392, up 7.4 percent from the April 2018 year.

Total NZ residential ICP numbers grew strongly up 2.8% in the 12 months to March 2019 with virtually all of the growth occurring in the last 6 months.



Somewhat against trend demand per ICP has also grown at 1.8%. In combination overall residential electricity consumption is up 2.7% to March 2019 and is expected to continue to rise in the next quarter.

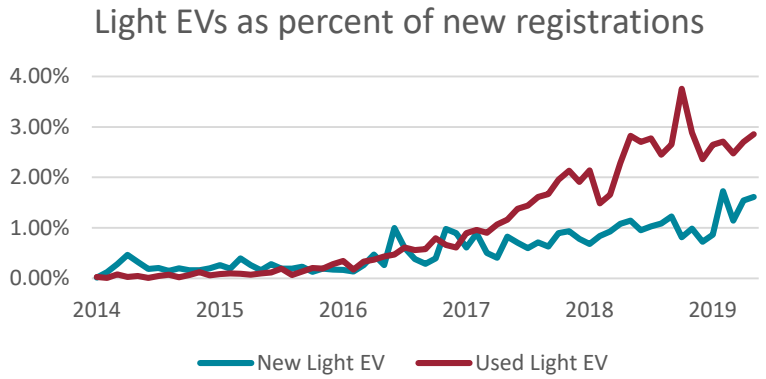
Source: MBIE, Stats NZ

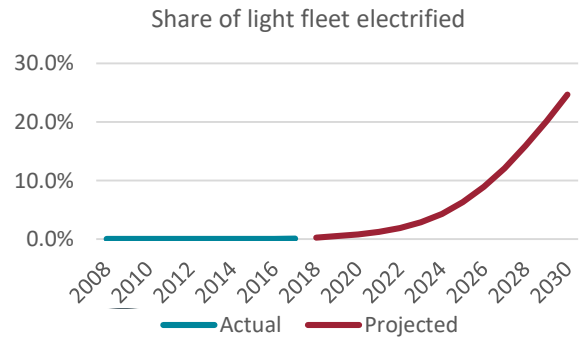
Demand Driver: Significant electrification, driven by transport and process heat

Overall Status: Consistent

Light vehicle fleet is electrified

Percent of light vehicle fleet electrified: EV fleet approaches 2 million cars by 2030
Cost parity of EVs vs ICE reached 2020-2025

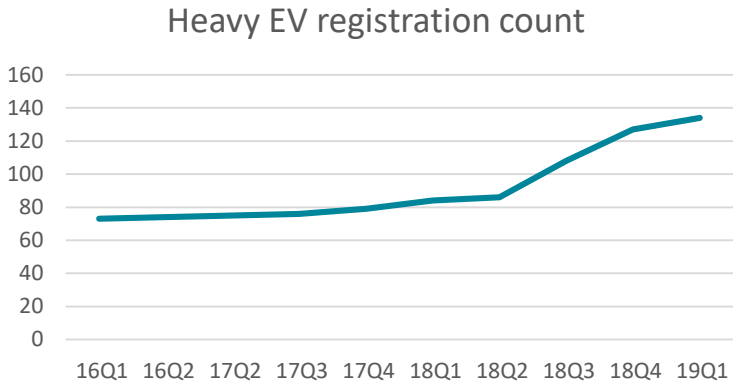


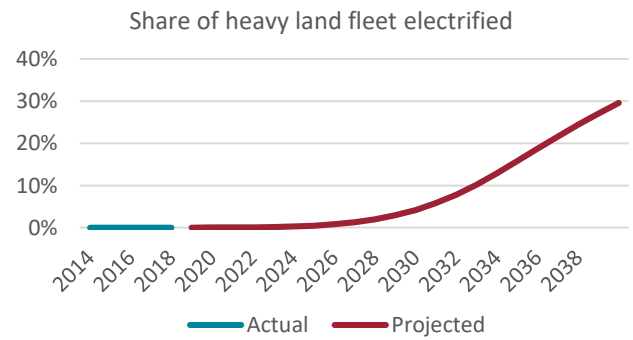


Source: transport.govt.nz

Heavy vehicle fleet electrified more slowly

Percent of medium and heavy vehicle fleet electrified: 30% of heavy land transport electrifies by 2040



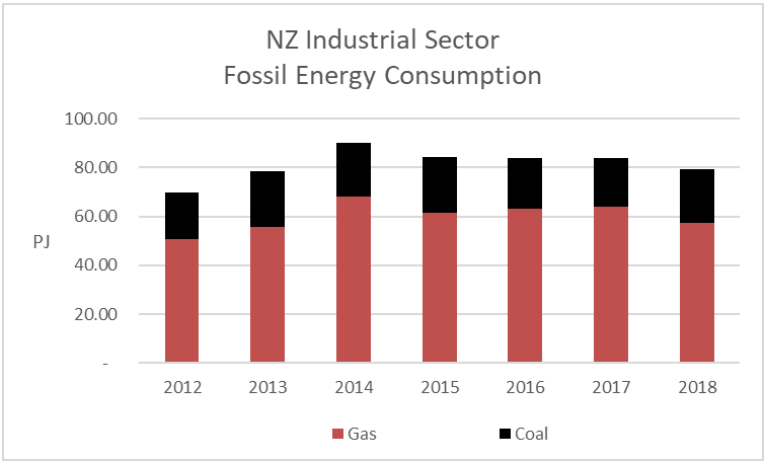


Source: transport.govt.nz

Process Heat Electrification

Percent of major industrials with plans to electrify heat:

- 100% of coal used for process heat is electrified 2050
- 50% of oil used for process heat is electrified 2050
- 40% of gas used for process heat is electrified by 2050



Industrial sector gas demand declined by 5.5% in 2018 however coal demand grew by 10.7%. There was an overall decline in industrial sector fossil fuel use of 5.5%.

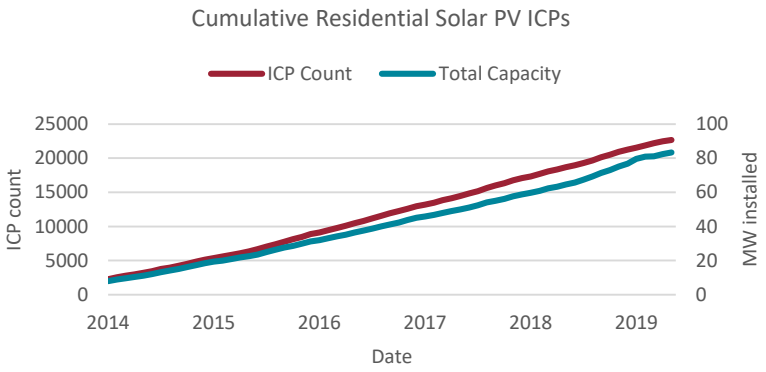
Source: MBIE

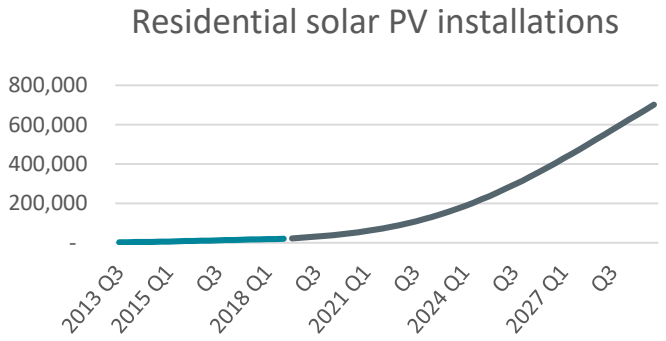
Supply Driver: Residential and commercial solar and storage grows substantially

Overall Status: Possible variation ↓

↓ Amount of residential solar growth

Amount of residential solar: 650 thousand houses with solar PV by 2030

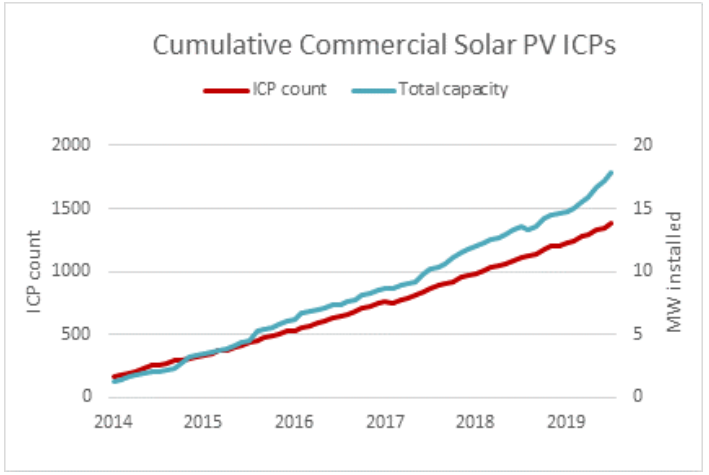


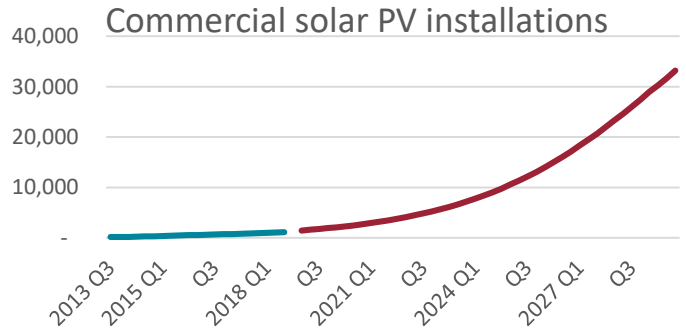


Source: emi.ea.govt.nz

↓ Amount of commercial solar growth

Amount of commercial solar: 30,000 businesses with solar PV by 2030 All NZ, solar>10kW : 307 ICPs

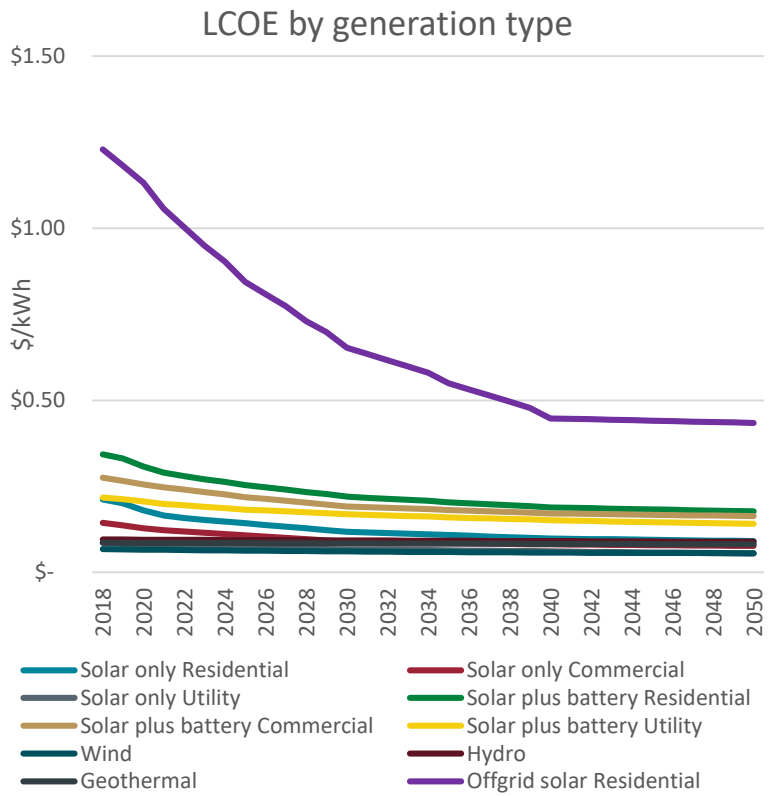




Source: emi.ea.govt.nz

Solar economics support uptake to complement grid

Long run price forecasts of solar/battery versus electricity price



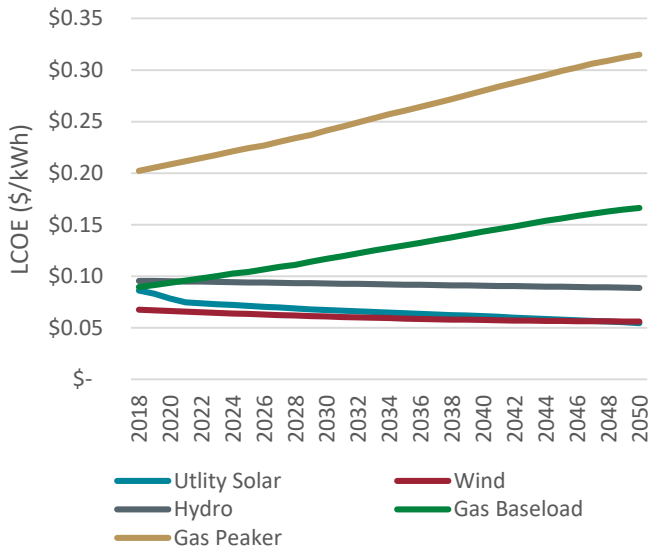
Source: NREL

Supply Driver: Utility energy growth mostly through solar and wind

Overall Status: Consistent

Solar and Wind becoming lowest cost utility additions

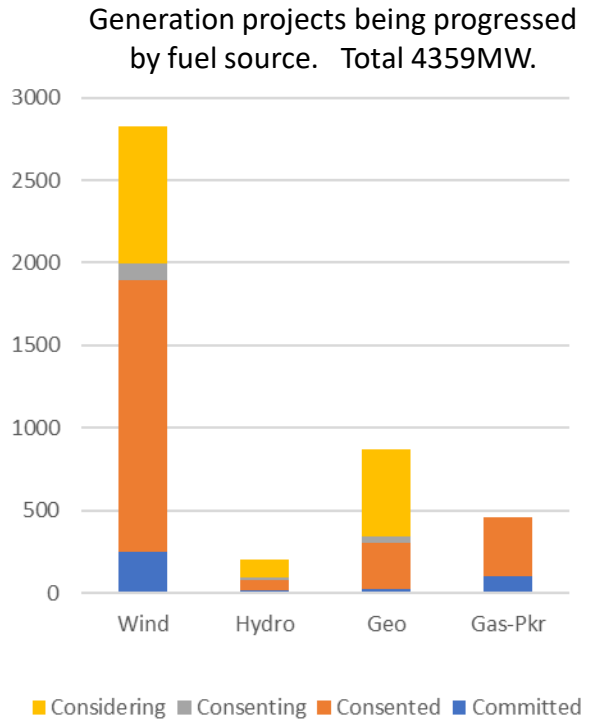
Long run LCOE forecasts by generation type: Solar and wind keep falling to become the preferred option



Source: NREL

New renewable generation schemes can be progressed

New generation being progressed is 90% renewable.



Source: Transpower research

New generation is renewable

New generation which are committed to are renewable (committed to means that full construction has commenced)

Project	Type	Capacity	Status
Junction Rd	Gas (non-renewable)	100MW	Construction
Ngawha 3	Geothermal	28MW	Construction
Turitea	Wind	119MW	Committed
Waverly	Wind	~130MW	Investment Decision Pending

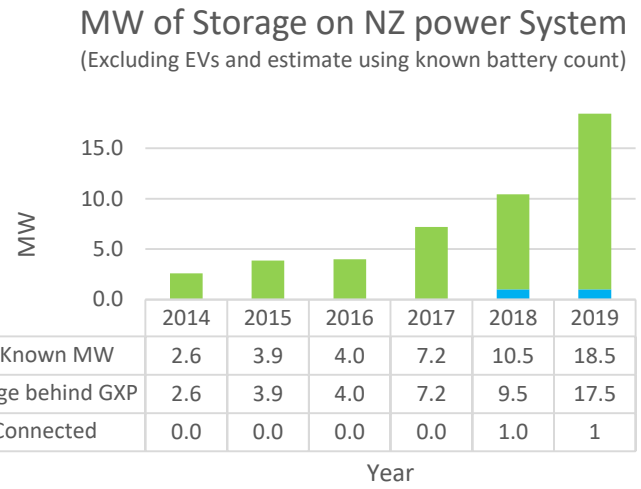
Source: Transpower research

Supply Driver: Batteries and DER will play a large role in meeting the daily winter peak

Overall Status: Consistent

Sufficient battery capacity is added

Combined residential/commercial/utility batteries



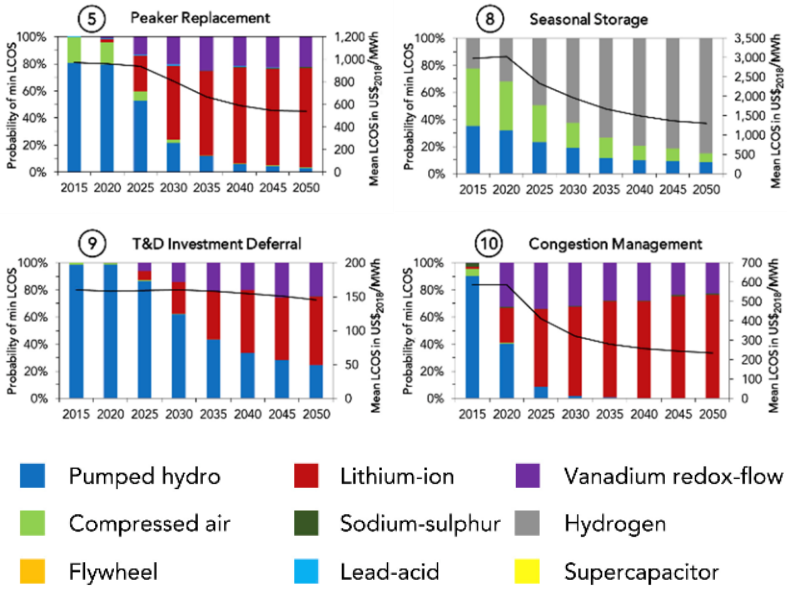
	2014	2015	2016	2017	2018	2019
Total Known MW	2.6	3.9	4.0	7.2	10.5	18.5
Storage behind GXP	2.6	3.9	4.0	7.2	9.5	17.5
Grid Connected	0.0	0.0	0.0	0.0	1.0	1

- Vector committed to install further 8 MW post 2018
- Te Mauri Hiko base case – 700MW in 2030

Source: Commerce Commission

Known storage technologies continue to be preferred

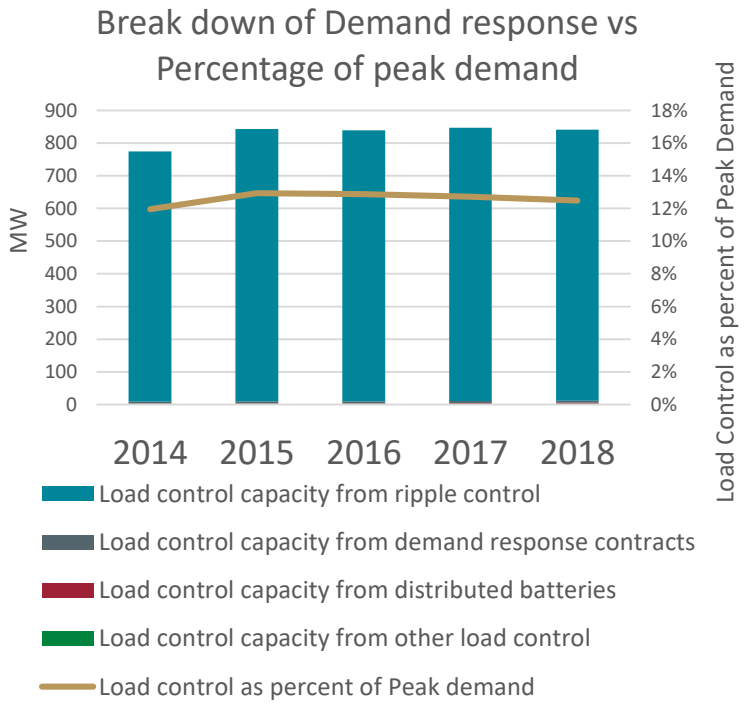
Adoption of storage technologies: Li-ion remains the preferred choice.
Some key technologies applications are shown below.



Source: https://www.sciencedirect.com/science/article/pii/S254243511830583X?via%3Dihub

Load control / response grows to play a bigger role

Demand response as a percentage of peak:



Source: Commerce Commission

Supply Driver: Winter and peak supply needs are met, even in a dry year

Overall Status: Possible variation ↓

Closure of fossil fuel plants as modelled

NZ strategy / policy for dry winter risk: Closure of all fossil fuel peakers between now and 2040

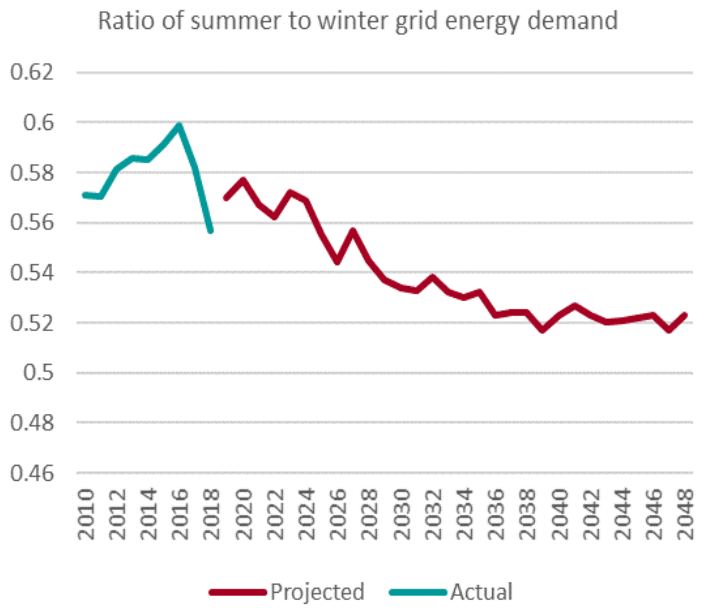
Plant	Comm-ission	Capacity (MW)	Time horizon
Huntly Rankines	1982	750* Coal/ Gas	Commitment to no coal after 2025 in normal year or at all from 2030
Huntly U5	2007	400 Gas	Major upgrade to continue beyond ~2022 Discussion of shift in use
Huntly U6	2004	48 Gas	No announced plans
Stratford TCC	1998	385 Gas	TCC gas secured until 2024 and future is dependent on reliable, affordable gas after this
Stratford Peaker	2011	200 Gas	No announced plans
Whirinaki	2004	155 Diesel	No announced plans
McKee Peaker	2013	100 Gas	No announced plans

* One 250MW unit already permanently closed
NB: Also gas co-gen at Glenbrook, Hawera, Te Rapa, Kawerau, Kinleith, Kapuni

Source: Press, Annual reports and presentations

Inter-seasonal demand gap is manageable

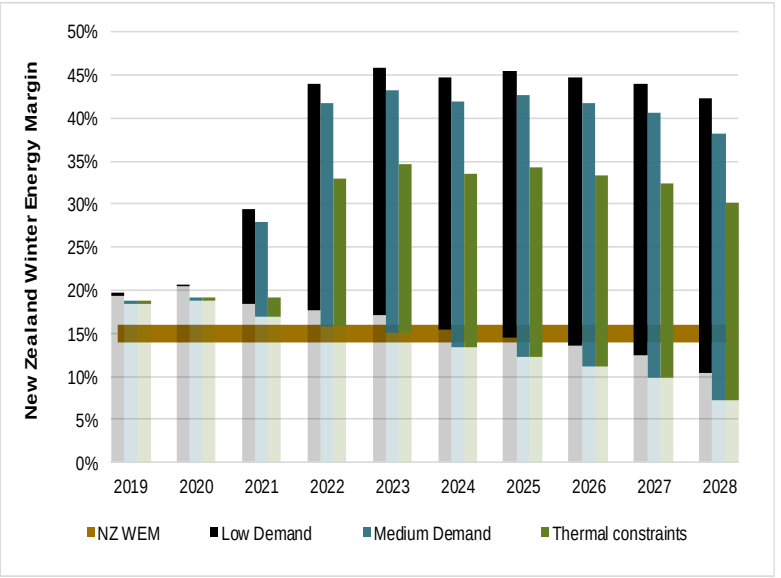
Supply and demand changes don't unduly accentuate inter-seasonal gap and can be managed



Source: Transpower demand data

Dry year coverage is available

Security of supply even in a 1 in 10 dry year



Source: Transpower Security of Supply Assessment 2019

Driver: Other technology significantly different from Te Mauri Hiko

Overall Status: Consistent

New Technology	Description of change	Potential impact	Likelihood
Low cost long storage batteries	• New battery technology could enable super-low cost, long term storage that is very reliable	• Potential to provide security of supply so less need for overbuild for domestic consumption • Ability to shift energy between seasons flattening demand	• Possible
Widespread use of hydrogen for energy storage	• Hydrogen energy storage could enable heavy transport and create new export market • Economics appear to be challenging	• Export of hydrogen increases demand • Heavy transport based on hydrogen moves or increases demand	• Possible
Acceleration of energy efficiency	• Step change in energy efficiency improvements from big changes in homes, heating and lighting	• Existing demand reduces as energy efficiency more than offsets population and economic growth. • EV and process heat still to be layered in	• Possible

* Also monitoring Blockchain, offshore wind, international grid and carbon sequestration but seen as low likelihood of unexpected disruption at this time