



TRANSPOWER

# 2025 Generation Stack - a snapshot



 **Beca**

 **concept**  
consulting

Transpower's Te Kanapu initiative is developing a future grid blueprint to guide investments in the national electricity grid and the way they manage the electricity system. The grid blueprint will also support industry and those in the energy sector with their long-term planning.

At its core, Te Kanapu is about ensuring the transmission network supports Aotearoa New Zealand to thrive and grow as it electrifies.

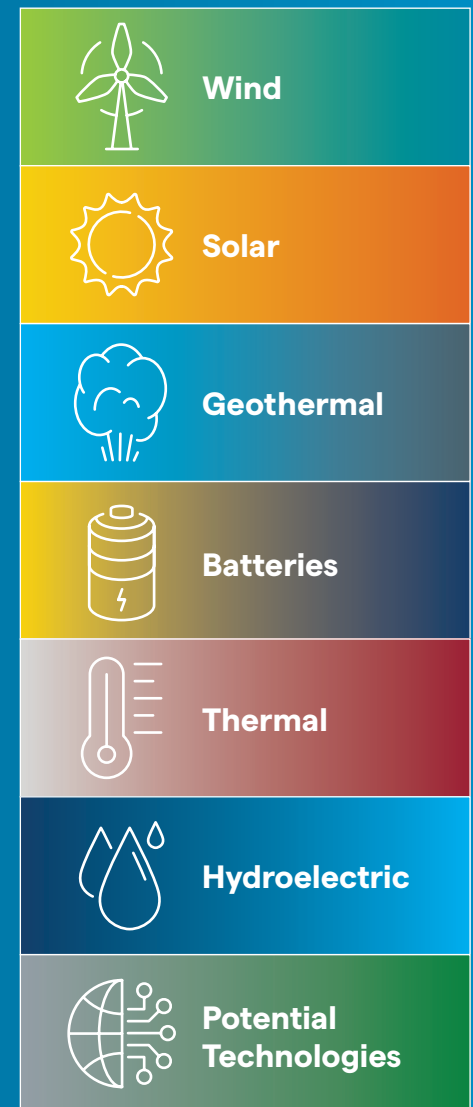
To develop the future grid blueprint, there are several important factors to understand:

1. What the future might look like, to understand what kind of energy infrastructure Aotearoa will need.
2. The current and future costs of different technologies (*for example solar power*) known as a 'generation stack'.

The following is a snapshot of the 2025 generation stack, produced by Beca Ltd. and Concept Consulting Group Ltd. for Te Kanapu, outlining current costs of different technologies in Aotearoa and what these costs might be in the future.

It is important to note these are capital costs for projects only - there are other factors that also should be considered when looking at the overall cost effectiveness of a technology.

Read more about Te Kanapu and tell us what you think at [transpower.co.nz/our-work/te-kanapu](https://transpower.co.nz/our-work/te-kanapu).





# Wind

Onshore wind is a proven technology in Aotearoa and will be one of the main technologies used to meet demand in the future.

## New Onshore Wind

Potential and new wind farm projects.

### Current cost estimate

We looked at costs for recent and potential projects. Turbine costs make up the majority of project costs for a wind farm. Other costs include site access and grid connection, which can be highly dependent on site location.

**\$3,400/kW**

The 2025 cost estimate for new wind farms.

### Cost trajectory

Over the coming decades, the cost of onshore wind projects is expected to decrease. This is primarily driven by improvements in technology such as larger wind turbines.

**\$2,300/kW**

The 2060 projected costs for onshore wind projects.

These are the average costs to develop the capacity needed to produce a kilowatt of power.

**\$3,400/kW**

The 2025 cost estimate for repowered wind farms.

**\$1,840/kW**

2060 projected costs for repowering onshore wind projects.

## Repowering Onshore Wind

Replacing older, generally smaller, wind turbines with newer and more efficient designs.

### Current cost estimate

There are two examples of wind farms that have been repowered in Aotearoa - Te Rere Hau and Tararua wind farms. A comparison with recent and potential wind farms shows the costs to repower a wind farm are similar. However, developing on an existing site reduces risks because the wind resource is well understood.

### Cost trajectory

While repowering older wind farms is a similar cost to building a new one from scratch, that changes slightly when repowering modern wind farms. With a modern wind farm, any increase in turbine size will be less, and more assets can be reused. We assume that non-turbine costs are reduced by a third when repowering a modern wind farm.

## Specific project costs



Consenting	Labour	Site accessibility	Operating and maintenance
	Land	Connection	Turbine costs

**kW** - Kilowatt, a unit of power

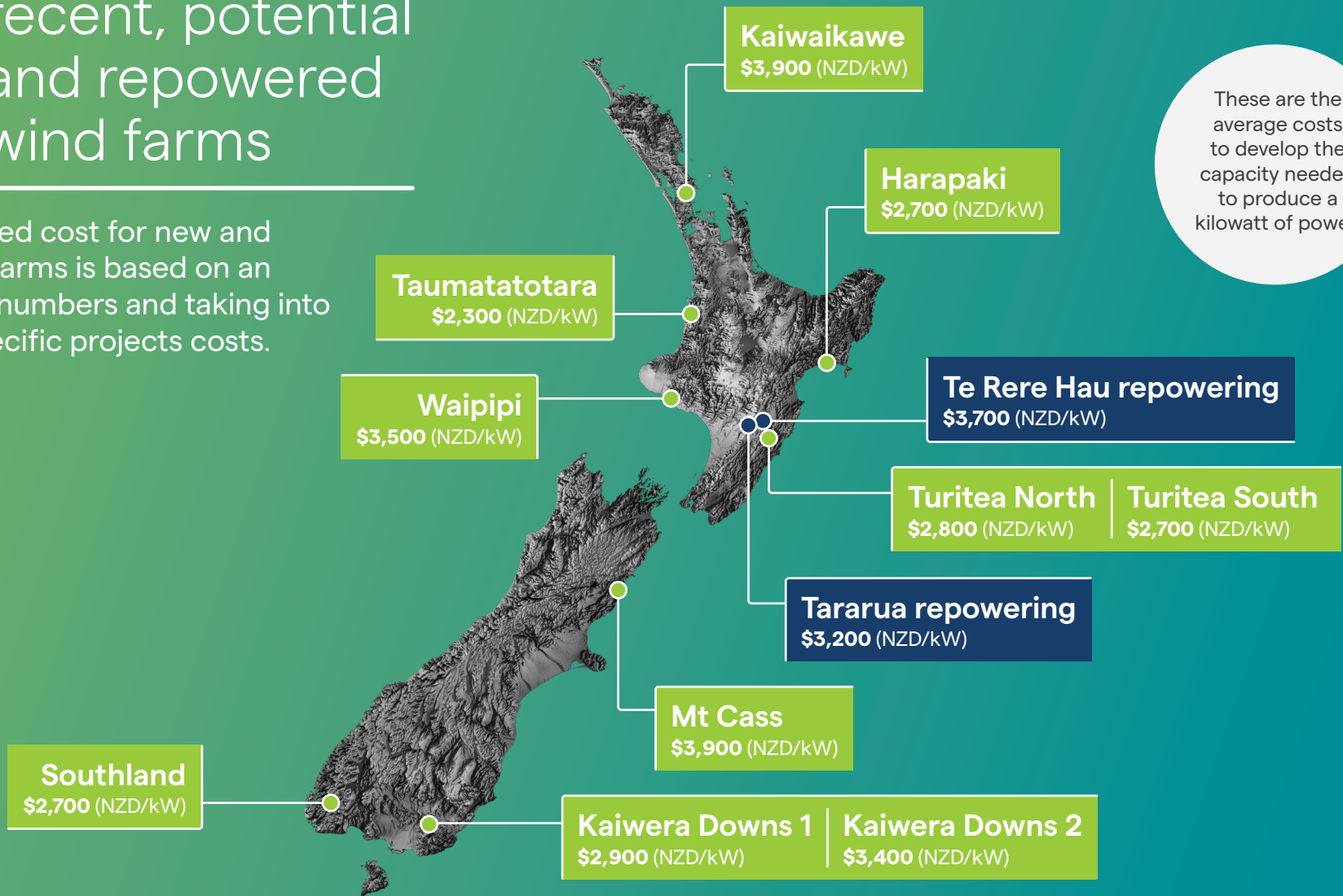


# The cost of recent, potential and repowered wind farms

The 2025 estimated cost for new and repowered wind farms is based on an average of these numbers and taking into consideration specific projects costs.

**kW** - Kilowatt, a unit of power

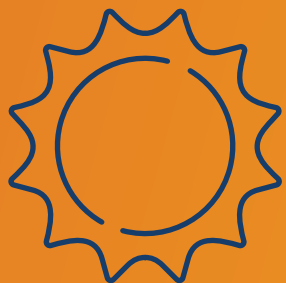
These are the average costs to develop the capacity needed to produce a kilowatt of power.



- Project capital costs for recent and potential wind farms
- Costs for repowered wind farm projects

**Capacity factors in the range: 33%-45%.** Capacity factor is the ratio of actual energy generated to the theoretical maximum energy generated over a year. This depends on the resource quality at a given location (i.e. how windy it is).





# Solar

Photovoltaic solar is a proven technology growing in scale in Aotearoa. There are around eight large scale solar farms in operation and more than 50 solar farm projects in the pipeline.

## Utility Scale

Utility scale refers to large solar farms designed to generate significant amounts of electricity and feed it directly into the national electricity grid.

### Current cost estimate

The current cost estimate for utility scale solar farm projects has been developed using the average cost of recent and potential solar farms.

### Cost trajectory

Over the coming decades, the projected cost of utility scale solar farm projects is expected to decrease. This is primarily driven by improvements in solar technology and an increase in the amount of solar power we are able to produce.

## Specific project costs



Solar panels and inverters



Operation and maintenance



Connection



Labour



Land



Consenting

**\$1,900  
/kWAC**

The 2025 cost estimate for utility scale solar projects.

**\$900  
/kWAC**

The 2060 projected cost for utility scale solar projects.

**kWAC** - Kilowatt Alternating Current, a measurement of electrical power output

These are the average costs to develop the capacity needed to produce a kilowatt of power.

## Residential Rooftop Solar

Solar power systems installed on the roof of a house.

### Current cost estimate

The current cost estimate for residential rooftop solar has been developed by considering the average cost of publicly advertised prices.

**\$2,100  
/kWAC**

The 2025 cost estimate for rooftop solar.

**\$1,300  
/kWAC**

The 2060 projected cost for rooftop solar.

### Cost trajectory

As with utility scale solar farms, the cost of rooftop residential solar is expected to decrease in the coming decades due to improvements in solar technology.

## Specific project costs



Solar panels and inverters



Labour

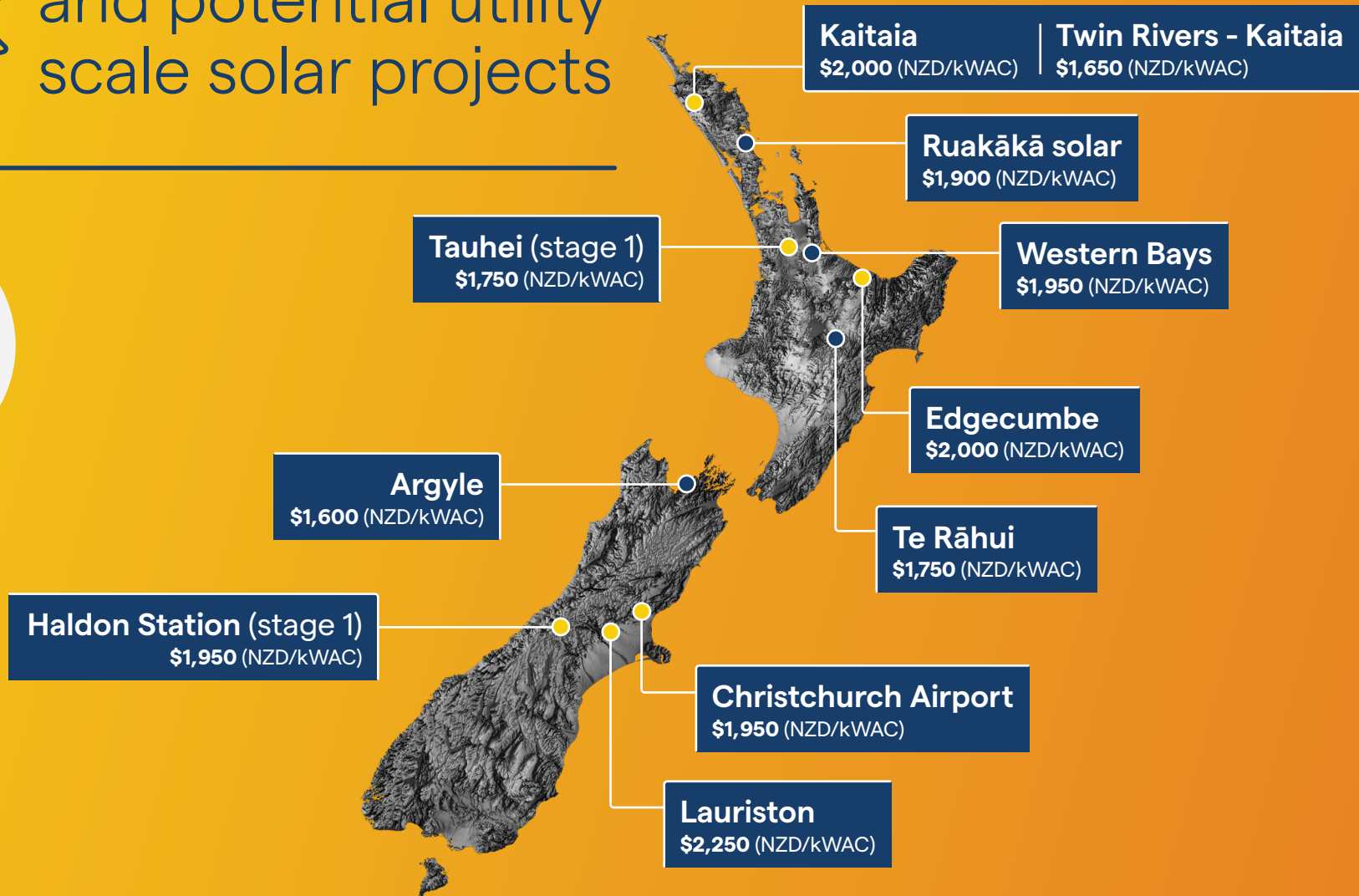




# Costs for recent and potential utility scale solar projects

**kWAC** - Kilowatt Alternating Current, a measurement of electrical power output

These are the average costs to develop the capacity needed to produce a kilowatt of power.



**Capacity factors in the range: 12%-20%.** Capacity factor is the ratio of actual energy generated to the theoretical maximum energy generated over a year. This depends on the resource quality at a given location (i.e. how sunny it is).



# Geothermal

**kW** - Kilowatt, a unit of power

Steam from underground water stores is used to spin turbines, which drive generators to produce electricity. Aotearoa is a global leader in geothermal energy due to our abundant resources and long history of development.

There are two main geothermal types - flash and binary. Binary plants are a two part system, they use geothermal fluid (*a mixture of underground hot water and steam*) to heat a secondary fluid (*typically an organic compound with a low boiling point, such as isobutane or isopentane*), turning it into vapor. This vapor then spins a turbine. In a flash plant, geothermal fluid is used to turn turbines directly. Costs have been developed for both these plant types.

## Current cost estimates

The current cost estimate for both binary and flash geothermal in 2025 is based on average costs of geothermal projects across Aotearoa.

Binary plants can reinject or minimize emissions, which reduces operating costs. So, their higher capital costs (*relative to flash*) may be offset by lower operational costs.

**\$5,600/kW**

The 2025 cost estimate for flash geothermal.

**\$6,700/kW**

The 2025 cost estimate for binary geothermal.

## Cost trajectory

The cost of geothermal is expected to decline by 2060. This is due to improvements in technology and an increased uptake of geothermal energy globally.

**\$4,400/kW**

The 2060 cost estimate for flash geothermal.

**\$5,200/kW**

The 2060 cost estimate for binary geothermal.



## Specific project costs



Infrastructure costs



Operation and maintenance



Connection



Consenting



Labour



Location



Land

These are the average costs to develop the capacity needed to produce a kilowatt of power.



# Geothermal costs

The 2025 estimated geothermal cost is based on the average of these numbers and taking into consideration specific project costs.

All known geothermal resources in Aotearoa are located in the Taupō volcanic zone, with Ngawha in Northland being the only exception.

## Various locations

18 kilometres north-east of Rotorua and 2 kilometres north-east of Okere Village above the Taheke geothermal field  
**\$6,100 (NZD/kW)**

**Te Mihi**  
**\$6,000 (NZD/kW)**

**Ngawha (OEC4)**  
**\$8,200 (NZD/kW)**

**Nga Awa Purua**  
**\$4,200 (NZD/kW)**

**Kawerau**  
**\$4,100 (NZD/kW)**

**Te Ahi O Maui**  
**\$6,800 (NZD/kW)**

**Nga Tamariki** | **Nga Tamariki upgrade**  
**\$7,600 (NZD/kW)** | **\$5,000 (NZD/kW)**

**Te Huka** | **Te Huka (Unit 3)**  
**\$6,300 (NZD/kW)** | **\$6,500 (NZD/kW)**

**Tauhara**  
**\$5,600 (NZD/kW)**

**Te Mihi (stage 2)**  
**\$7,500 (NZD/kW)**

**kW** - Kilowatt, a unit of power

These are the average costs to develop the capacity needed to produce a kilowatt of power.

- Flash geothermal projects
- Binary geothermal projects

**Capacity factors in the range: 90%-95%.** Capacity factor is the ratio of actual energy generated to the theoretical maximum energy generated over a year. This depends on the resource quality at a given location.





# Batteries

Prices for both utility scale and residential batteries are rapidly declining making them more cost effective for both national energy suppliers and individuals.

## Utility scale batteries

Utility scale refers to large batteries that store significant amounts of power and feed it directly into the national electricity grid.

### Current cost estimate

The current cost estimate for utility scale batteries is based on 2-hour battery cost data (*the cost to store two hours worth of power*) at large 100 MW battery developments owned by Genesis, Contact and Meridian.

**\$1,700/kW**

The 2025 2-hour cost estimate for utility scale batteries.

### Cost trajectory

With improvements to battery technology, the projected costs for utility scale batteries is expected to decrease in the coming decades.

**\$950/kW**

The 2060 2-hour cost estimate for utility scale batteries.



## Specific project costs



Battery cost



Operation and maintenance



Connection



Consenting



Land

**kW** -  
Kilowatt,  
a unit of  
power

These are the average costs to develop the capacity needed to produce a kilowatt of power.

## Residential batteries

Smaller batteries that store electricity for later use in individual households.

### Current cost estimate

The current cost estimate for residential batteries is based on a value of \$13,500 Australian Dollars (AUD) for a 5kW/10kWh battery from 2024, adjusted to New Zealand dollars (NZD).

**\$3,700/kW**

The 2025 2-hour cost estimate for residential batteries.

### Cost trajectory

The cost of residential batteries is expected to decline over time due to improvements in battery technology, making them more efficient, affordable and sustainable.

**\$2,900/kW**

The 2060 2-hour cost estimate for residential batteries.

## Specific project costs



Labour

Battery cost



# Thermal

Aotearoa has a relatively small number of thermal generators and limited recent experience with new operations. Cost information has been provided for four different types of thermal generation.

These are the average costs to develop the capacity needed to produce a kilowatt of power.

## Combined Cycle Gas Turbine (CCGT)

Uses a gas turbine to generate electricity. Hot exhaust gases produced during this process are sent to a heat recovery steam generator which is used to power a second steam turbine for even more electricity.

### Current cost estimate

The current cost for CCGT has been determined using cost information from existing CCGT projects in Australia and overseas.

**\$2,400/kW**

The 2025 cost estimate for CCGT.

### Cost trajectory

The future cost estimate for CCGT is expected to decline in the coming decades due to improvements in technology.

**\$1,950/kW**

The 2060 cost estimate for CCGT.

## Open Cycle Gas Turbine (OCGT)

Generates electricity by producing hot gases that expand through a turbine.

### Current cost estimate

The cost for OCGT is the same as CCGT in 2025 because there is more demand than supply, driving up costs. However, this is expected to decrease by 2030.

**\$2,400/kW**

The 2025 cost estimate for OCGT.

### Cost trajectory

Similar to CCGT, the future cost estimate for OCGT is expected to decline in the coming decades due to improvements in technology.

**\$1,500/kW**

The 2060 cost estimate for OCGT.

**kW** - Kilowatt, a unit of energy



# Thermal

These are the average costs to develop the capacity needed to produce a kilowatt of power.

## Rankine Cycle Plant

A closed-loop system where fluid repeatedly circulates through a pump, a boiler, a turbine, and a condenser to convert waste heat into electrical power.

The current and future costs for a Rankine Cycle plant are expected to remain the same. This is because it is a mature technology with limited scope for improvements. In addition, there is unlikely to be much more research and development around plants that use coal because of its carbon footprint.

**\$6,300/kW**

The 2025 cost estimate for a Rankine Cycle Plant.

**\$6,300/kW**

The 2060 cost estimate for a Rankine Cycle Plant.

## Reciprocating Engine Plant

A type of heat engine that uses a piston inside a cylinder to convert high-temperature, high-pressure energy into rotating motion, like a car engine or a steam engine.

**\$1,700/kW**

The 2025 cost estimate for a Reciprocating Engine Plant.

### Current cost estimate

This generation type has been determined using information from existing projects in Australia and overseas.








**\$1,800/kW**

The 2025 cost estimate for a Reciprocating Engine Plant.

### Cost trajectory

Limited technological gains are expected as decarbonization efforts focus on other technologies, with a gradual increase in cost over time.

## Specific project costs

 Thermal generator	 Operation and maintenance	 Connection	 Land
 Labour	 Location	 Consenting	

kW - Kilowatt, a unit of power





# Hydroelectric

Hydroelectricity is a renewable energy source created from moving water which turns turbines connected to generators to produce electricity. It is well established in Aotearoa and internationally, however, no significant new projects have been built in Aotearoa for several decades.

**kW** - Kilowatt,  
a unit of power

These are the average costs to develop the capacity needed to produce a kilowatt of power.

## Current cost estimate

The current cost estimate for hydroelectric projects in Aotearoa is based off international and Australian estimates. It is difficult to determine an exact cost because costs for hydroelectric projects are site dependent and can vary significantly.

**\$9,200/kW**

The 2025 cost estimate for hydroelectric.

## Cost trajectory

As with the current cost estimate, the future cost estimate for hydroelectric projects in Aotearoa is based off international and Australian estimates.

This is a well developed technology, and while there is a reduction in cost over time, we don't expect a significant decrease.

**\$8,100/kW**

The 2060 cost estimate for hydroelectric.

## Specific project costs



Infrastructure



Operation and  
maintenance



Land



Consenting



Connection



Labour



Location





# Potential Technologies

These energy generation types are well established overseas but there are no examples in Aotearoa.

## Offshore wind

Offshore wind is similar to onshore wind but located out at sea. Offshore wind turbines are typically fixed to the ocean floor.

### Current cost estimate

There are several examples of offshore wind projects that are being considered in Aotearoa, although none have been developed yet. The current cost estimate is therefore a combination of overseas estimates and these potential Aotearoa projects.

**\$6,000/kW**

The 2030 cost estimate for offshore wind projects.

### Cost trajectory

As with the current cost estimate, the future cost estimate of offshore wind is based off potential Aotearoa projects and overseas estimates. Costs are expected to decrease over time due to continued research and development leading to improvements in turbine technology.

**\$4,400/kW**

The 2060 cost estimate for offshore wind projects.

These are the average costs to develop the capacity needed to produce a kilowatt of power.



## Specific project costs



Infrastructure and turbine costs



Operation and maintenance



Connection



Consenting

**kW** - Kilowatt, a unit of power



# Potential Technologies

These energy generation types are well established overseas but there are no examples in Aotearoa.

## Concentrated Solar Power

This technology uses mirrors to reflect sunlight and heat a fluid (*typically molten salts, specialized thermal oils, or even air*). This fluid is then used to turn a turbine and generate electricity.

### Current cost estimate

A significant number of CSP plants have been constructed overseas making this a well developed technology despite not being used in Aotearoa.

**\$9,500/kW**

The 2025 cost estimate for CSP.

### Cost trajectory

The cost of CSP is expected to decline over the coming decades due to continued research and development leading to improvements in solar technology.

**\$5,200/kW**

The 2060 cost estimate for CSP.



## Specific project costs



Infrastructure and technology costs



Operation and maintenance



Consenting



Connection



Land

These are the average costs to develop the capacity needed to produce a kilowatt of power.

**kW** - Kilowatt, a unit of power



# Potential Technologies

These energy generation types are well established overseas but there are no examples in Aotearoa.

## Nuclear Small Modular Reactor

Small nuclear power plants that can produce a significant amount of power. They are built in factories and then transported to their final location.

### Current cost estimate

The current cost estimate for SMRs is based on overseas examples. It is unlikely this technology would be used in Aotearoa due to difficulties obtaining a consent.

**\$25,600/kW**

The 2025 cost estimate for SMRs.

### Cost trajectory

The cost of SMRs is expected to decrease over the coming decades due to continued research and development leading to improvements in technology.

**\$15,800/kW**

The 2060 cost estimate for SMRs.

## Specific project costs



Infrastructure costs



Operation and maintenance



Regulatory changes



Land



Consenting

These are the average costs to develop the capacity needed to produce a kilowatt of power.

**kW** - Kilowatt, a unit of power



# Potential Technologies

These energy generation types are well established overseas but there are no examples in Aotearoa.

## Pumped Hydroelectric Storage

During times of low electricity demand, when there's excess power (like from solar or wind), a pumped hydro system uses that power to pump water from a lower water store up to a higher water store. When demand for electricity increases, the water is released back down through turbines, spinning them to generate electricity.

### Current cost estimate

The current cost estimate for pumped hydroelectric projects in Aotearoa is based off international and Australian estimates. Costs are site dependent and can vary significantly.

**\$9,400/kW**

The 2025 cost estimate for pumped hydroelectric storage.

### Cost trajectory

Based off Australian estimates, the cost for pumped hydroelectric storage is expected to decrease slightly towards 2030 and then rise again. This is because the sites that are currently being developed are well suited to this type of technology whereas projects in the future are likely to be in sites that are more difficult to develop.








**\$9,400/kW**

The 2060 cost estimate for pumped hydroelectric storage.

These are the average costs to develop the capacity needed to produce a kilowatt of power.

**kW** - Kilowatt, a unit of power

## Specific project costs

 Infrastructure costs	 Operation and maintenance	 Consenting	 Land
 Connection	 Labour	 Location	





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## Te Kanapu

This snapshot of the 2025 generation stack was produced by Beca Ltd and Concept Consulting Group Ltd for Te Kanapu.

To learn more about Te Kanapu, or to provide Transpower with feedback on the initiative, visit:

***[transpower.co.nz/our-work/te-kanapu](https://transpower.co.nz/our-work/te-kanapu)***

