

# New Zealand Energy Scenarios TIMES-NZ 2.0

EECA and BEC Lunchtime Webinar

Electricity Generation



# NZ Energy Scenarios TIMES-NZ 2.0



Our work at EECA included creating the data structure, data inputs, modelling, and analysis of the results.



# NZ Energy Scenarios TIMES-NZ 2.0

## Kea

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Kea represents a scenario where climate change is prioritised as the most pressing issue and New Zealand deliberately pursues cohesive ways to achieve a low-emissions economy.

## Tūī

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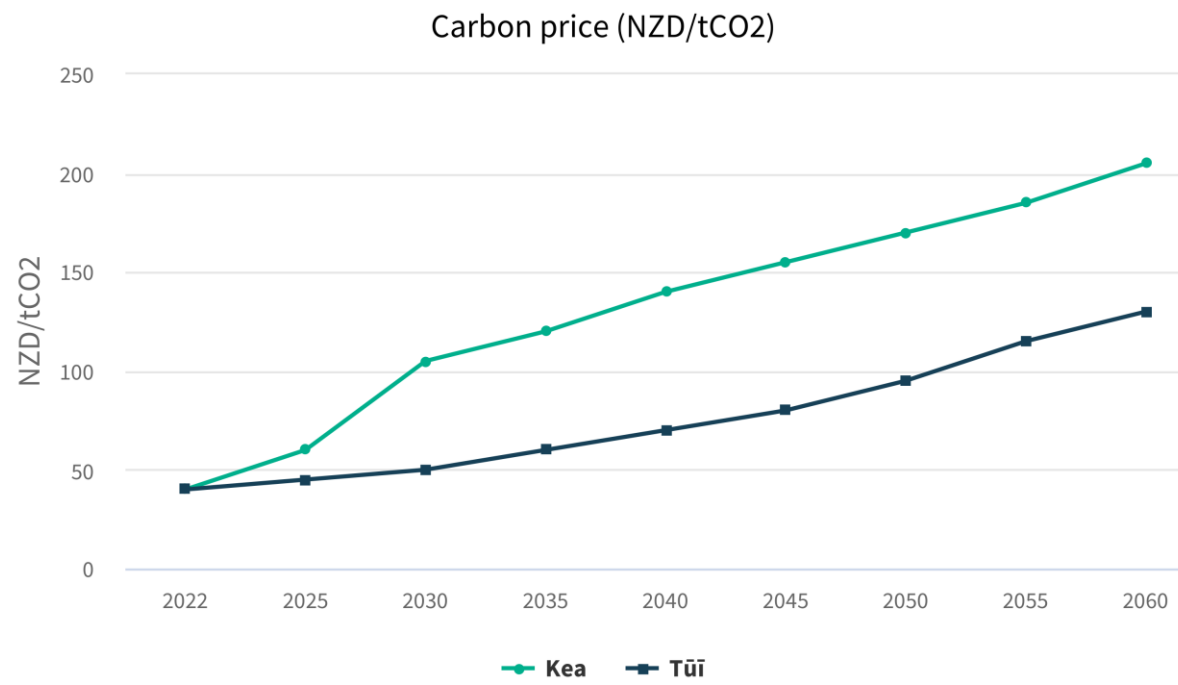
Tūī represents a scenario where climate change is an important issue to be addressed as one of many priorities, with most decisions being left up to individuals and market mechanisms.



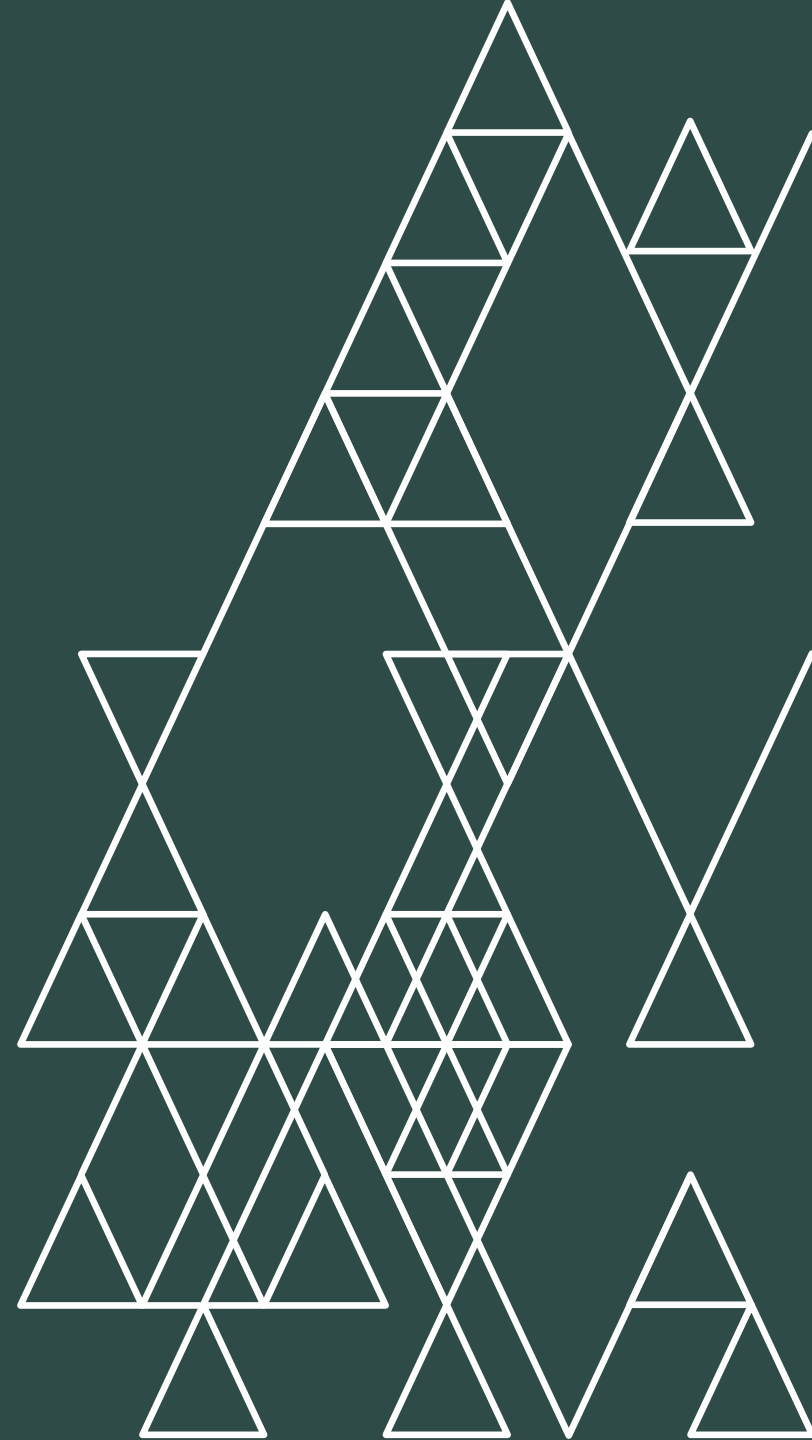
# Scenario Parameters

The key model input differences between Kea and Tūi are:

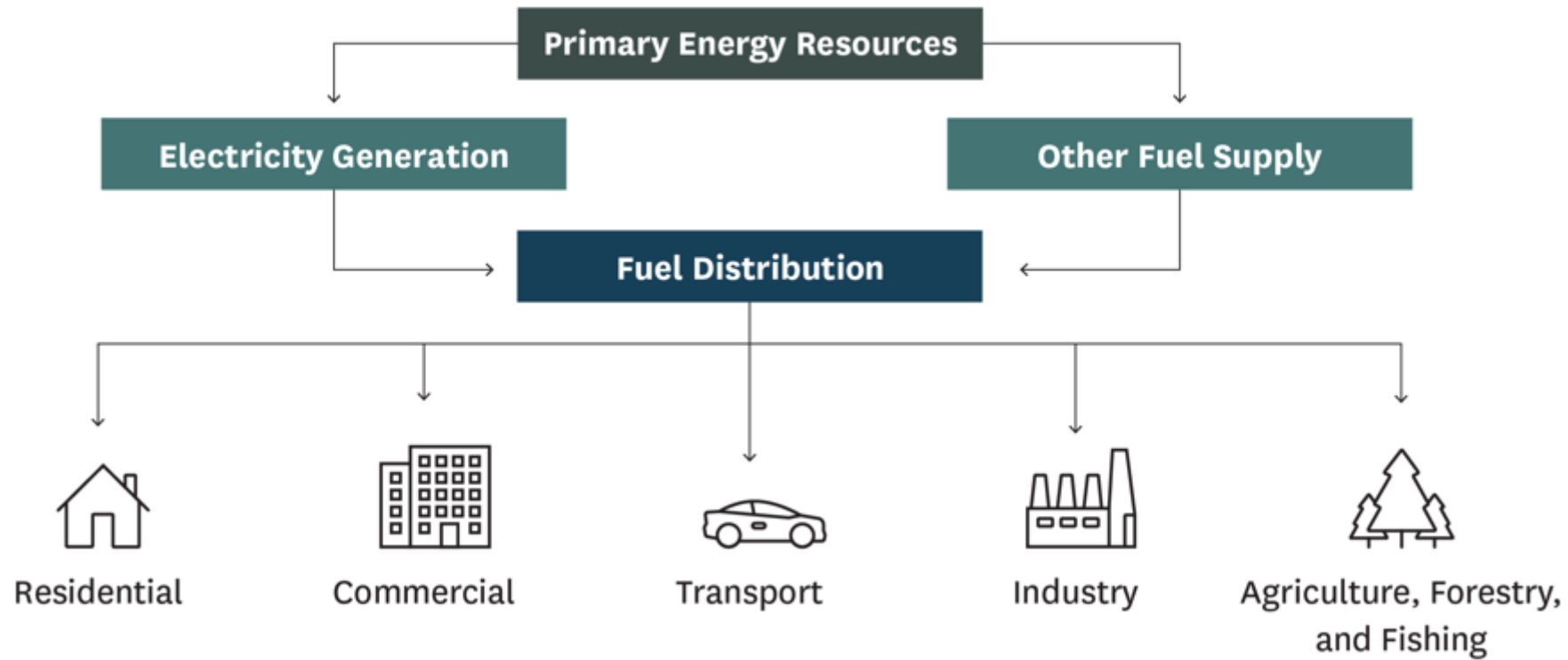
- **Composite GDP**
- **Carbon price**
- **Discount rates**
- **Technology cost curves**



# TIMES-NZ Overview



# TIMES-NZ 2.0 Model Structure



# TIMES-NZ 2.0 Model Structure



## Residential

- Detached Dwellings
- Joined Dwellings



## Commercial

- Education
- Healthcare
- Office blocks
- Warehouses Supermarkets and Retail (WSR)
- Other



## Transport

- Light road
- Heavy road
- Aviation
- Shipping
- Rail



## Industry

- Aluminium
- Construction
- Dairy Product Manufacturing
- Food Processing
- Iron/Steel Manufacturing
- Meat Processing
- Metal Product Manufacturing
- Methanol Production
- Mineral Production
- Mining
- Petroleum/Chemicals
- Refining of petroleum products
- Urea Production
- Wood Product Manufacturing
- Wood Pulp and Paper Processing



## Agriculture, Forestry, and Fishing

- Dairy Farming
- Livestock Farming
- Outdoor Horticulture & Arable Farming
- Indoor Cropping
- Forestry
- Fishing

**EECA's Energy End Use Database (EEUD) provides a greatly improved input dataset for describing demand sectors.**



# TIMES-NZ 2.0 Model Structure

## Regions and Time Representation



Time horizon: 2018 - 2060

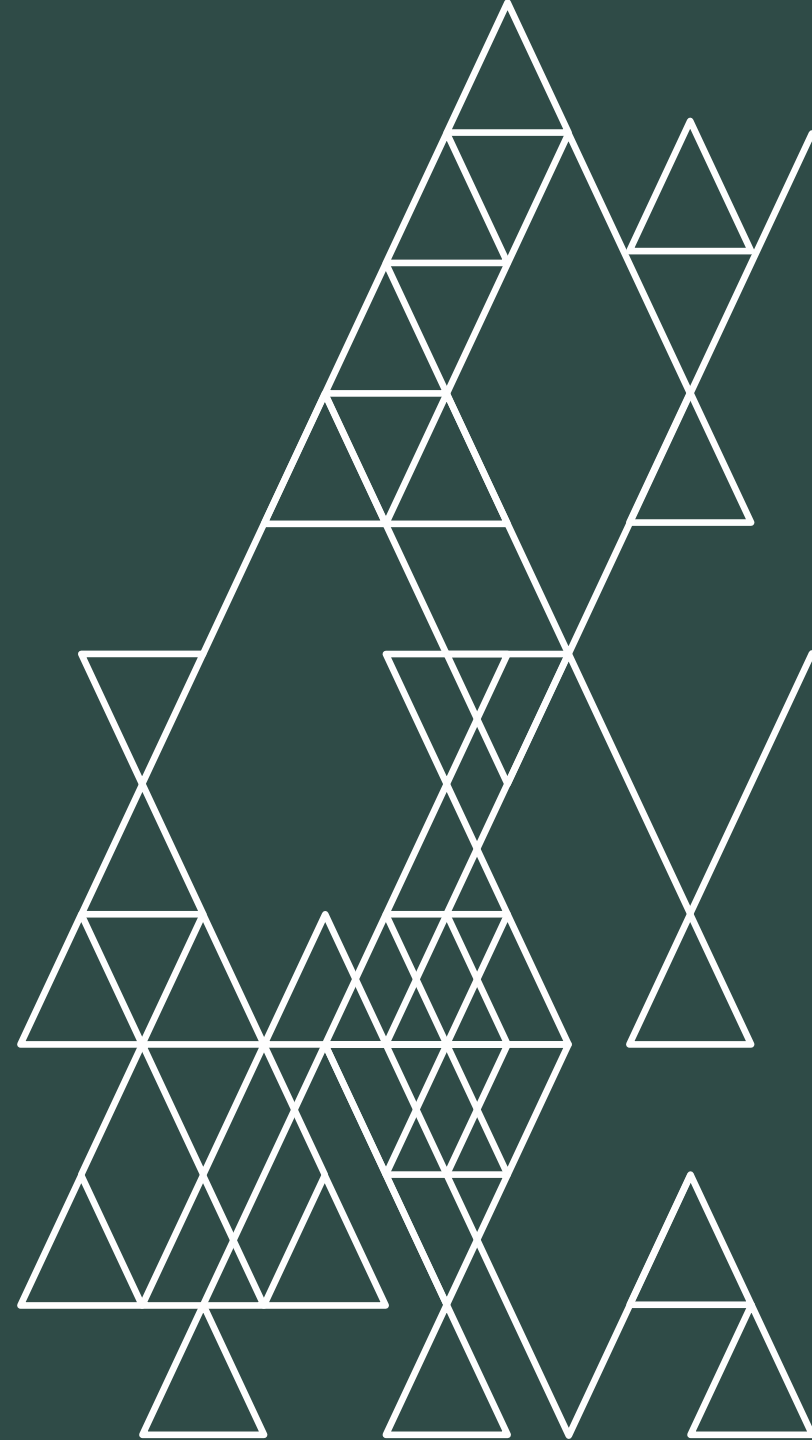
Category	Values	Number of
Season	Summer Autumn Winter Spring	4
Weekday type	Weekday Weekend	2
Time of day	Day Time Peak Time Night Time	3

$4 \times 2 \times 3 = 24$  time slices per year





# Assumptions



# Electricity Generation

## Technology Options

- **Wind**
  - Consented
  - High Capacity Factor
  - Low Capacity Factor
  - Distributed
  - Offshore (fixed)
  - Offshore (floating)
- **Solar**
  - Residential
  - Commercial
  - Distributed
  - Utility (fixed)
  - Utility (tracking)
- **Geothermal**
  - Consented Binary
  - Consented Flash
  - Other Flash
  - Other Binary
- **Hydro**
  - Dams
  - Run of river (small)
  - Run of river (large)



# Electricity Generation

## Technology Options (cont)

- **Thermal**
  - **Gas (Combined Cycle) with or without CCS**
  - **Gas (Open Cycle) with or without CCS**
  - **Coal with CCS**
  - **Oil plants**
  - **Biomass plants**
  - **Biogas plants**
- **Storage**
  - **Batteries (Li-Ion)**
  - **Batteries (Flow)**
  - **Pumped hydro storage (large)**
  - **Pumped hydro storage (small)**
- **Other**
  - **Tidal**



# Electricity Generation

## Plant Flexibility

- Solar – Resource maps
- Wind – Existing generation
- Geothermal – Existing generation
- Hydro (Run of river) – Existing generation trends
- Hydro (Dams) – Fully flexible within estimated water availability
- Thermals – Fully flexible



# Electricity Generation

## Available Capacities

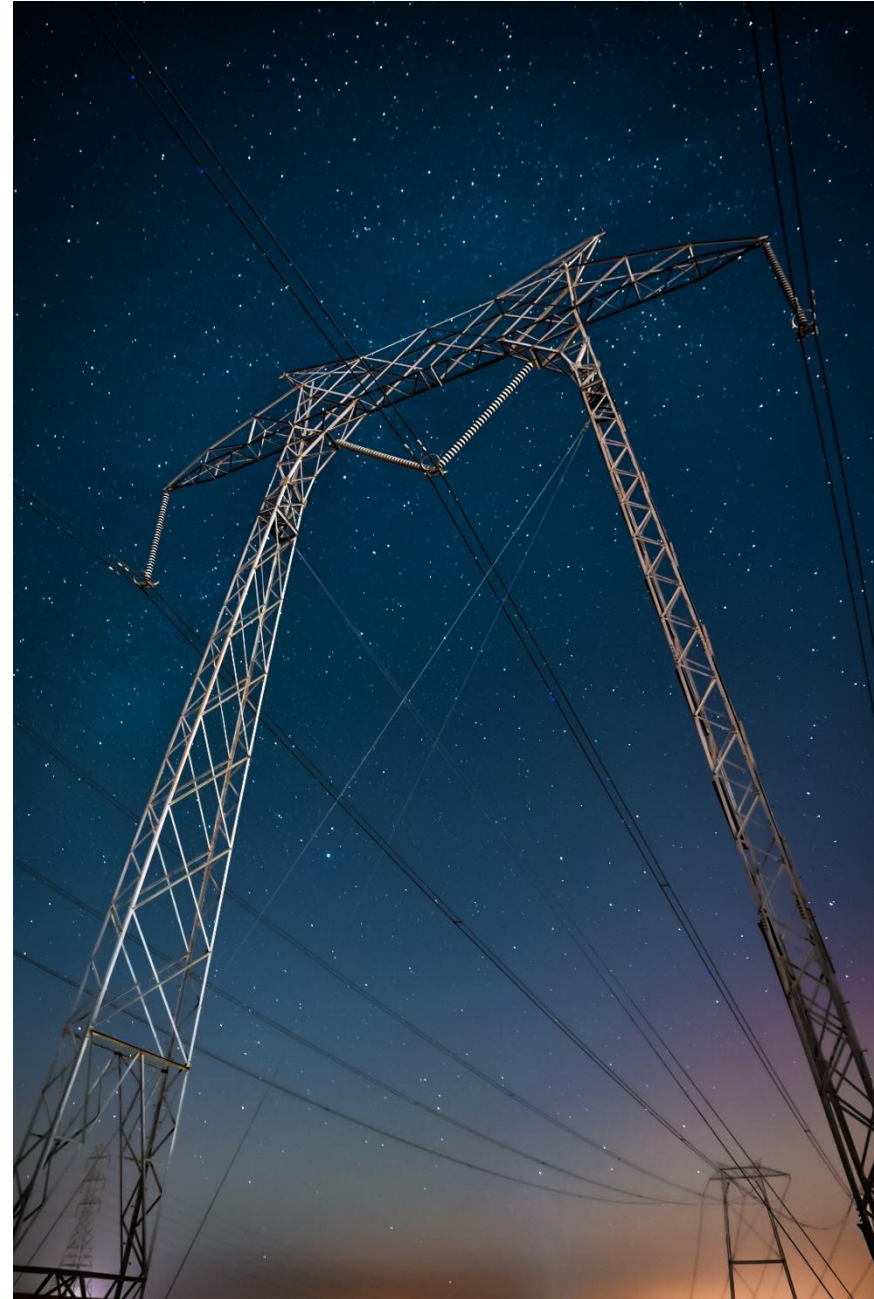
Resource (GW)	2030	2040	2050	2060
Solar	15	20	24	24
Onshore Wind	11	11	11	11
Geothermal	0.6	1.0	1.0	1.0
Hydro	1.9	1.9	1.9	1.9
Pumped Hydro	2.2	2.2	2.2	2.2



# Electricity Generation

## Winter Capacity and Energy Margins

- Provides security of supply
  - Applies to Autumn and Winter
- Capacity Margins
  - 30% for the South Island
  - 15% for the whole of New Zealand



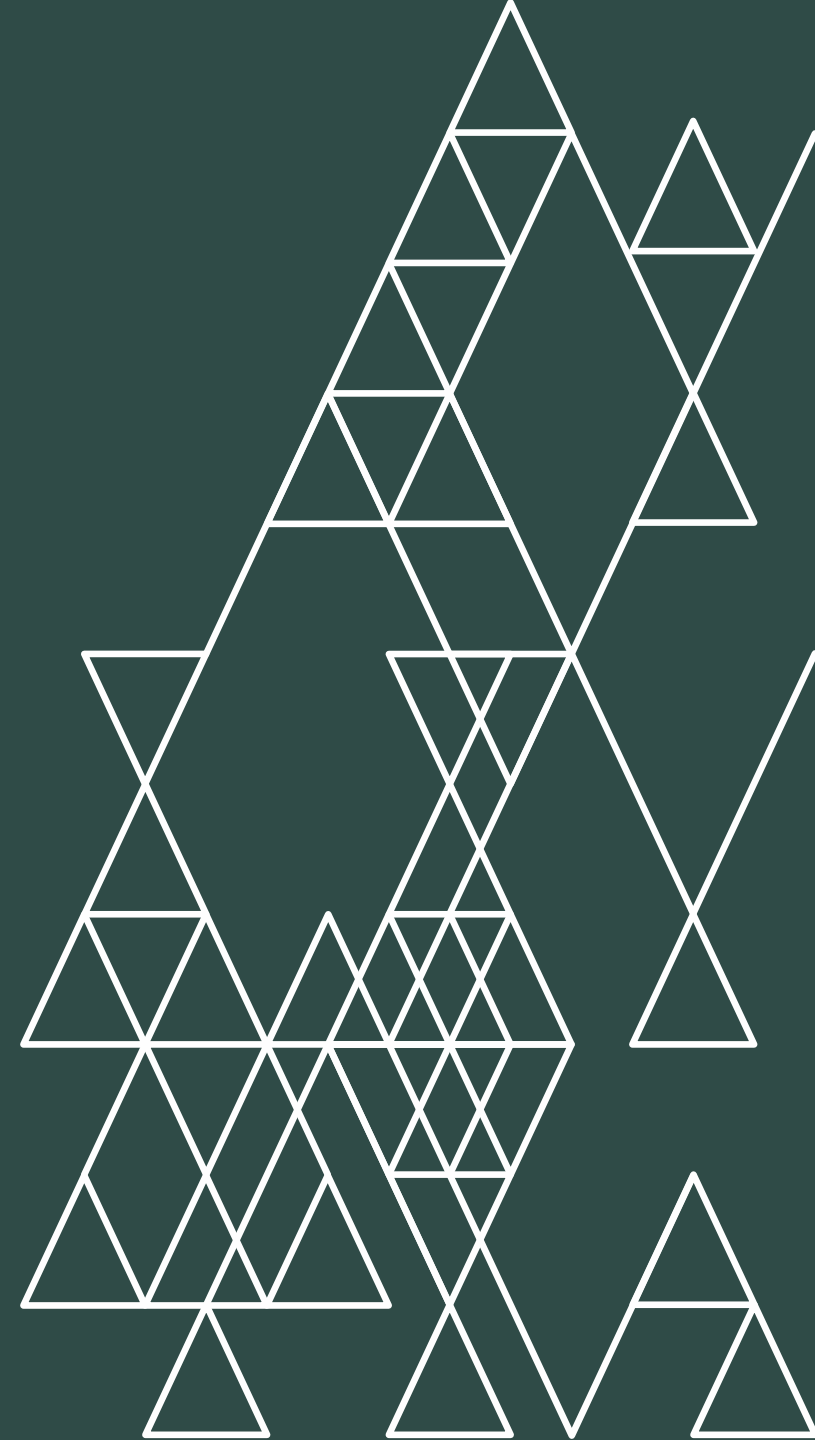
# Electricity Generation

## Demand Sector Assumptions

- **Explicit assumptions we made:**
  - Tiwai Exit (only in Kea scenario in 2027)
  - EV Charging
    - Tui assumes current charging trends are maintained
    - Kea assumes a flat charging profile
- **Total electricity demand**
  - Determined by the model in technology choice for each sector



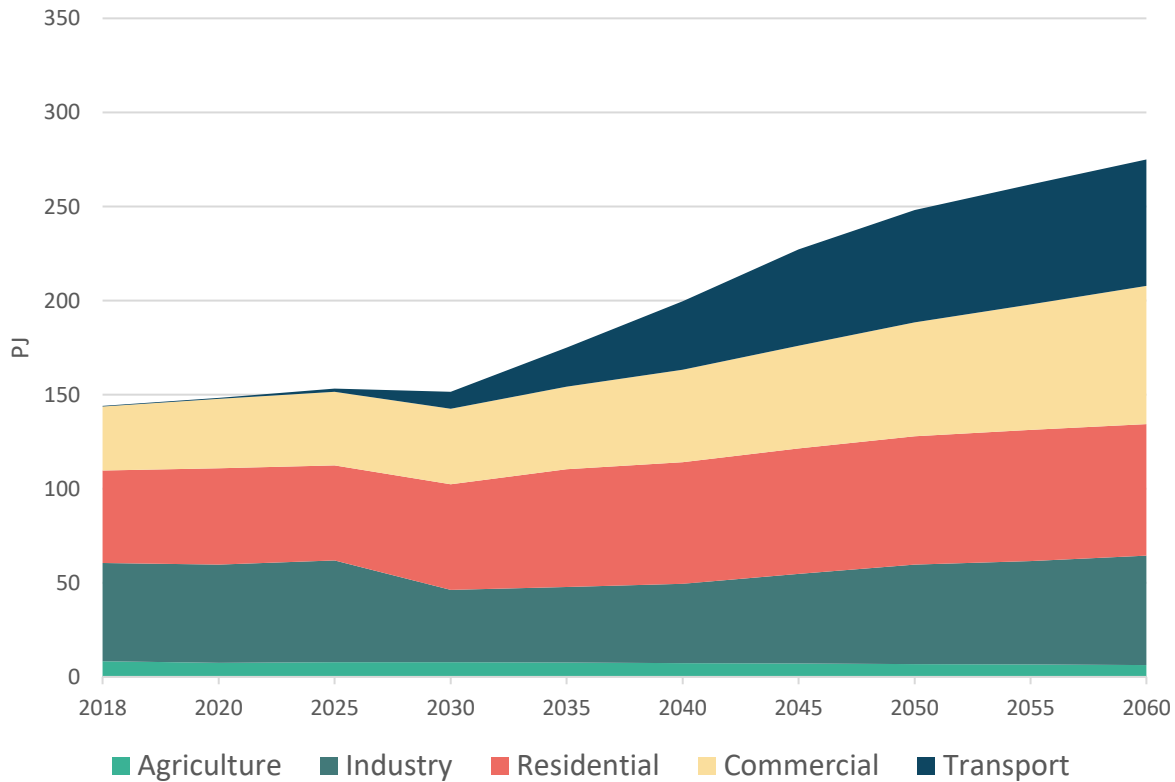
# Results



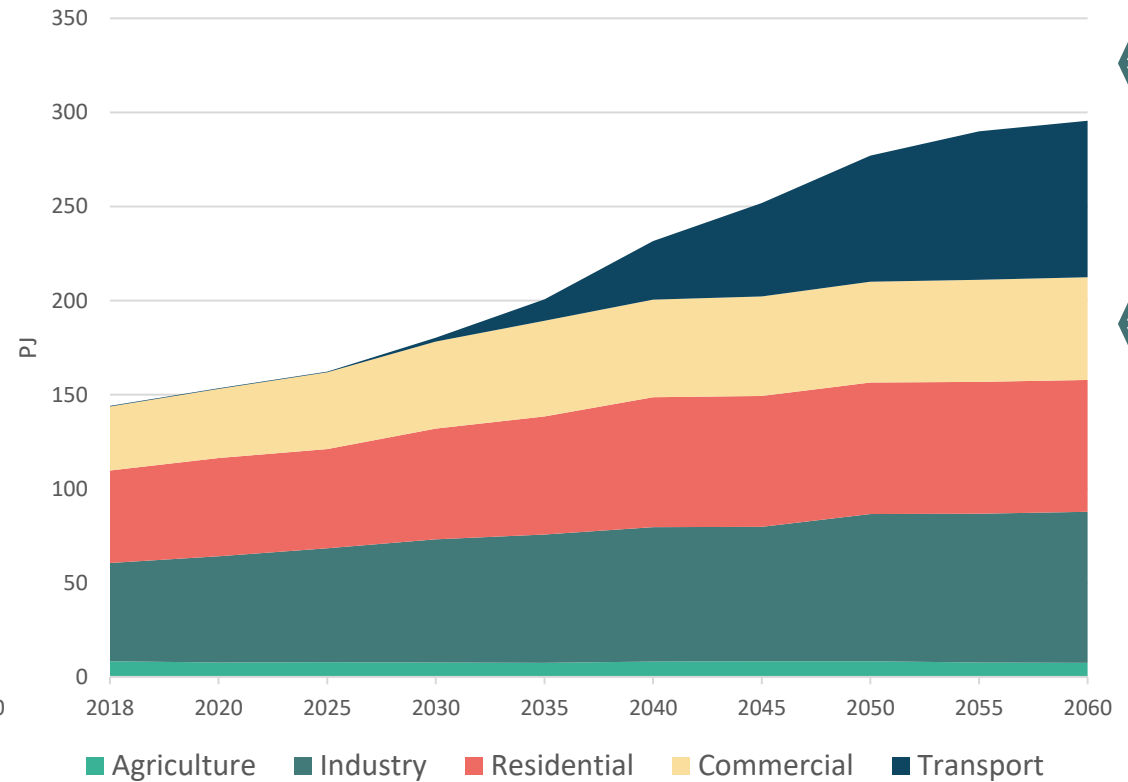


# Electricity Demand

## Kea Electricity Demand



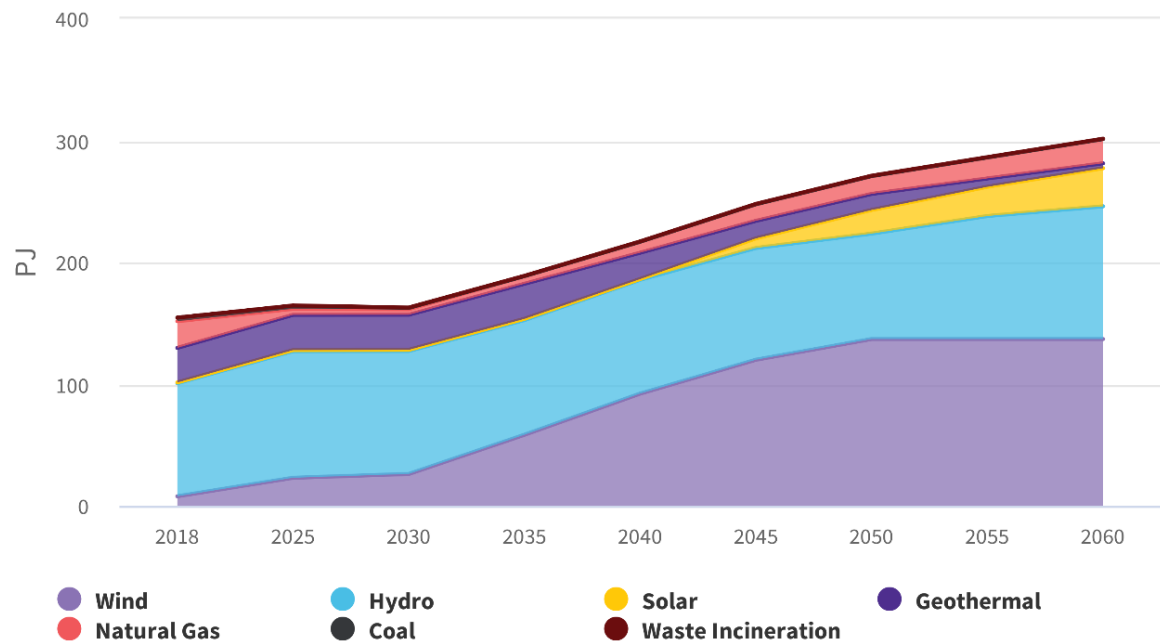
## Tui Electricity Demand



# Electricity Generation

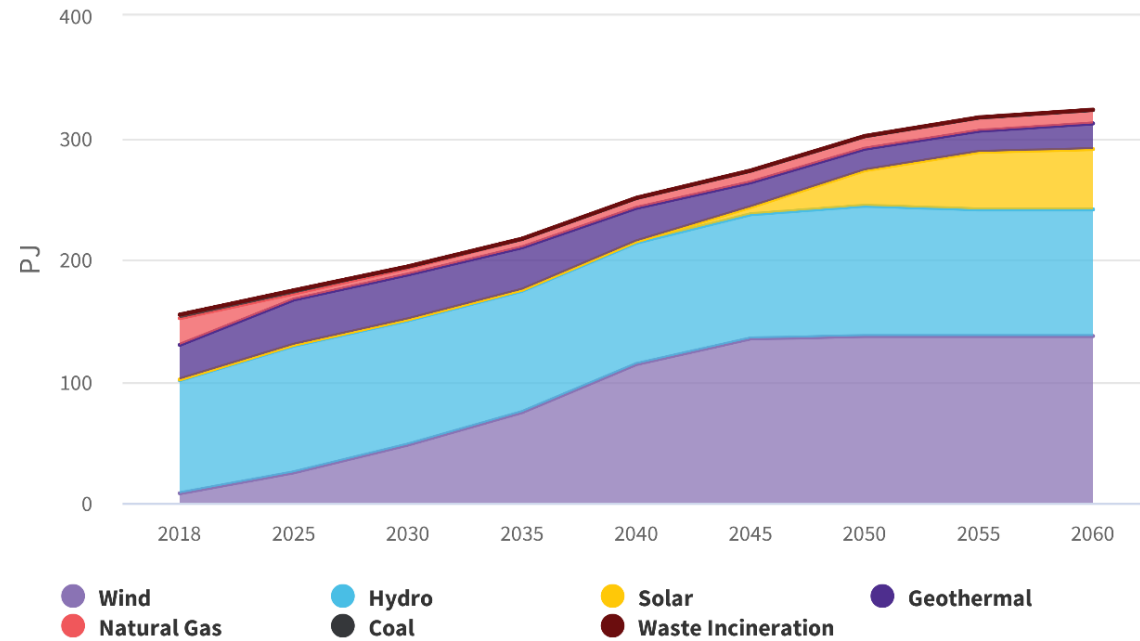
## Where might the electricity come from?

### Kea Electricity Generation Mix



TIMES-NZ 2.0, Scenario: Kea

### Tui Electricity Generation Mix



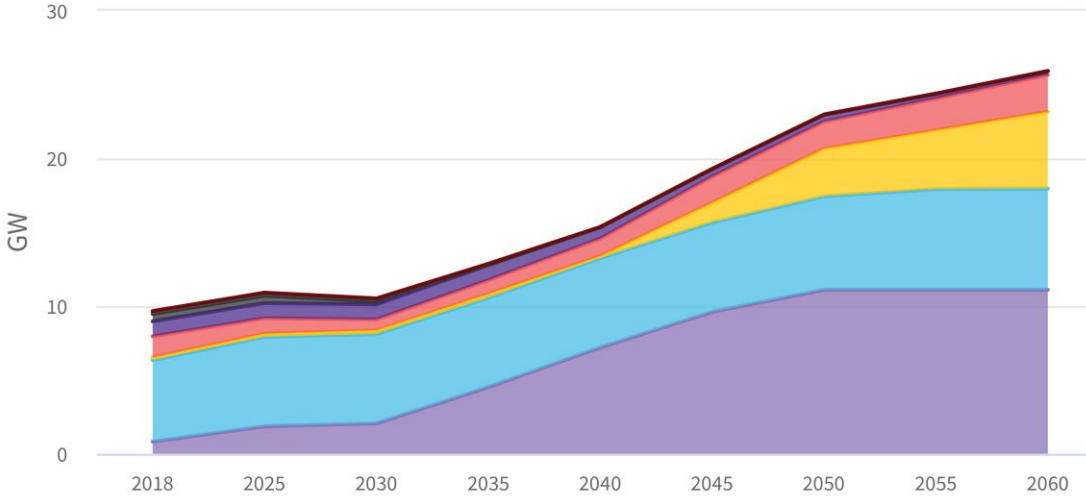
TIMES-NZ 2.0, Scenario: Tui



# Electricity Generation Capacity

## Capacity

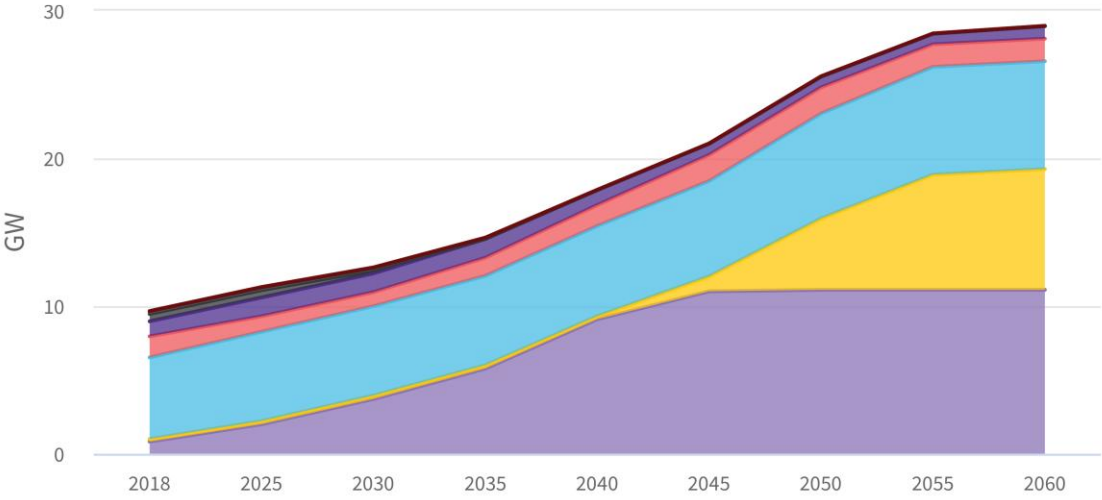
### Kea Electricity Generation Capacity



- Wind
- Hydro
- Solar
- Natural Gas
- Geothermal
- Coal
- Diesel
- Biogas
- Waste Incineration

TIMES-NZ 2.0, Scenario: Kea

### Tui Electricity Generation Capacity



- Wind
- Hydro
- Solar
- Natural Gas
- Geothermal
- Coal
- Diesel
- Biogas
- Waste Incineration

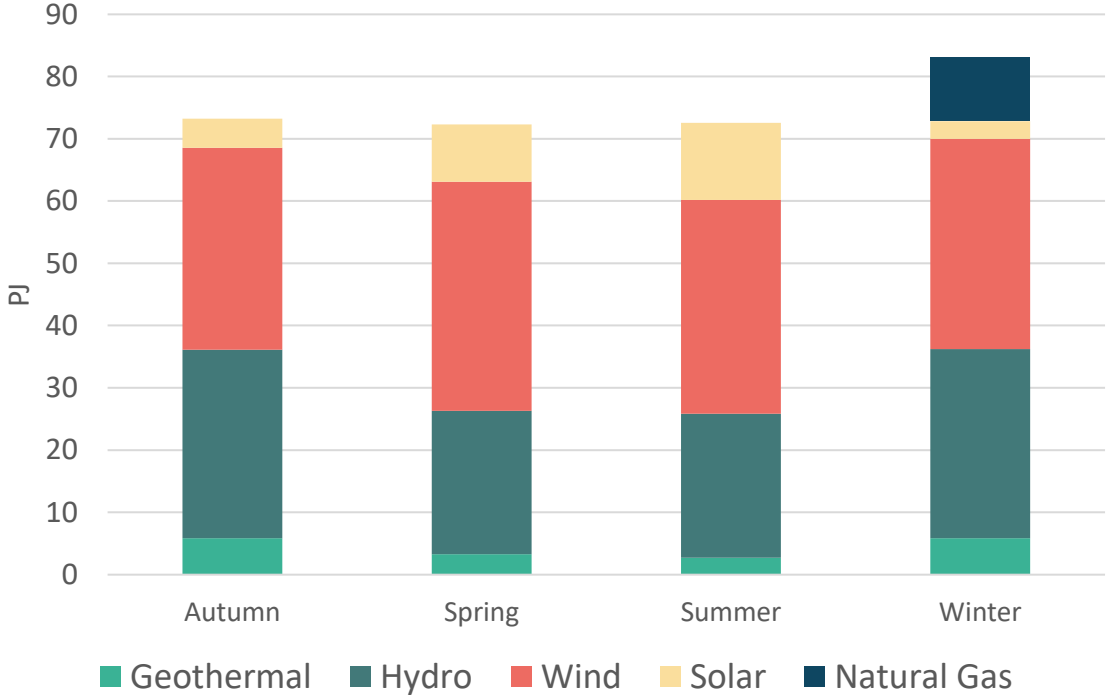
TIMES-NZ 2.0, Scenario: Tui



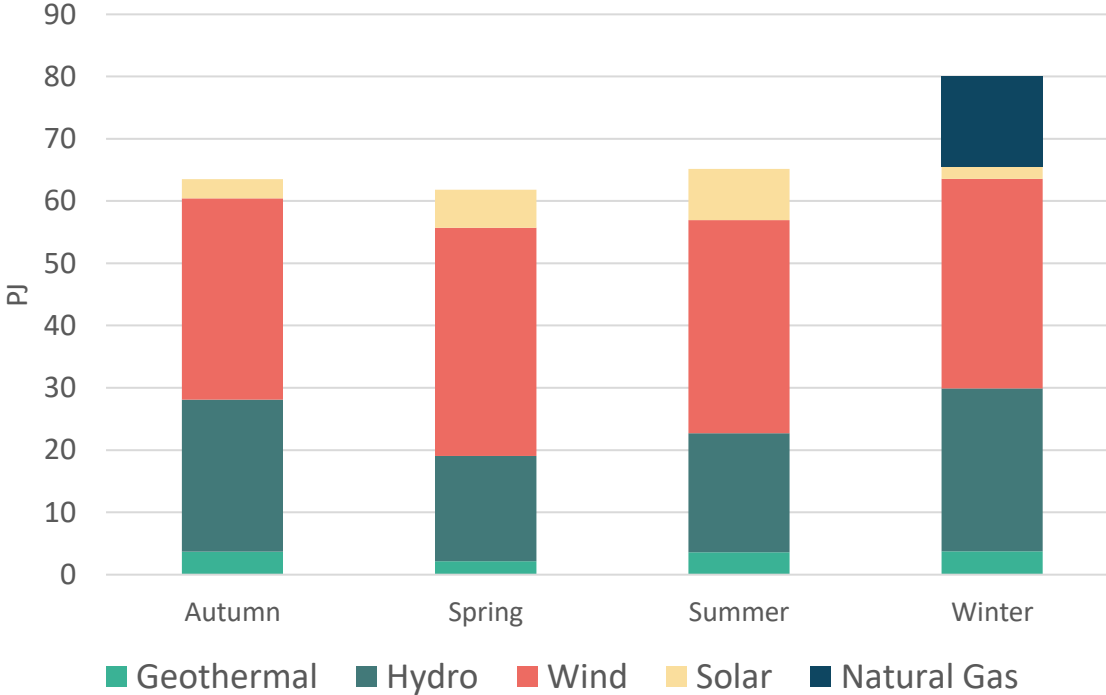
# Electricity Generation

## Seasonal Generation Mix in 2050

### Tui Generation

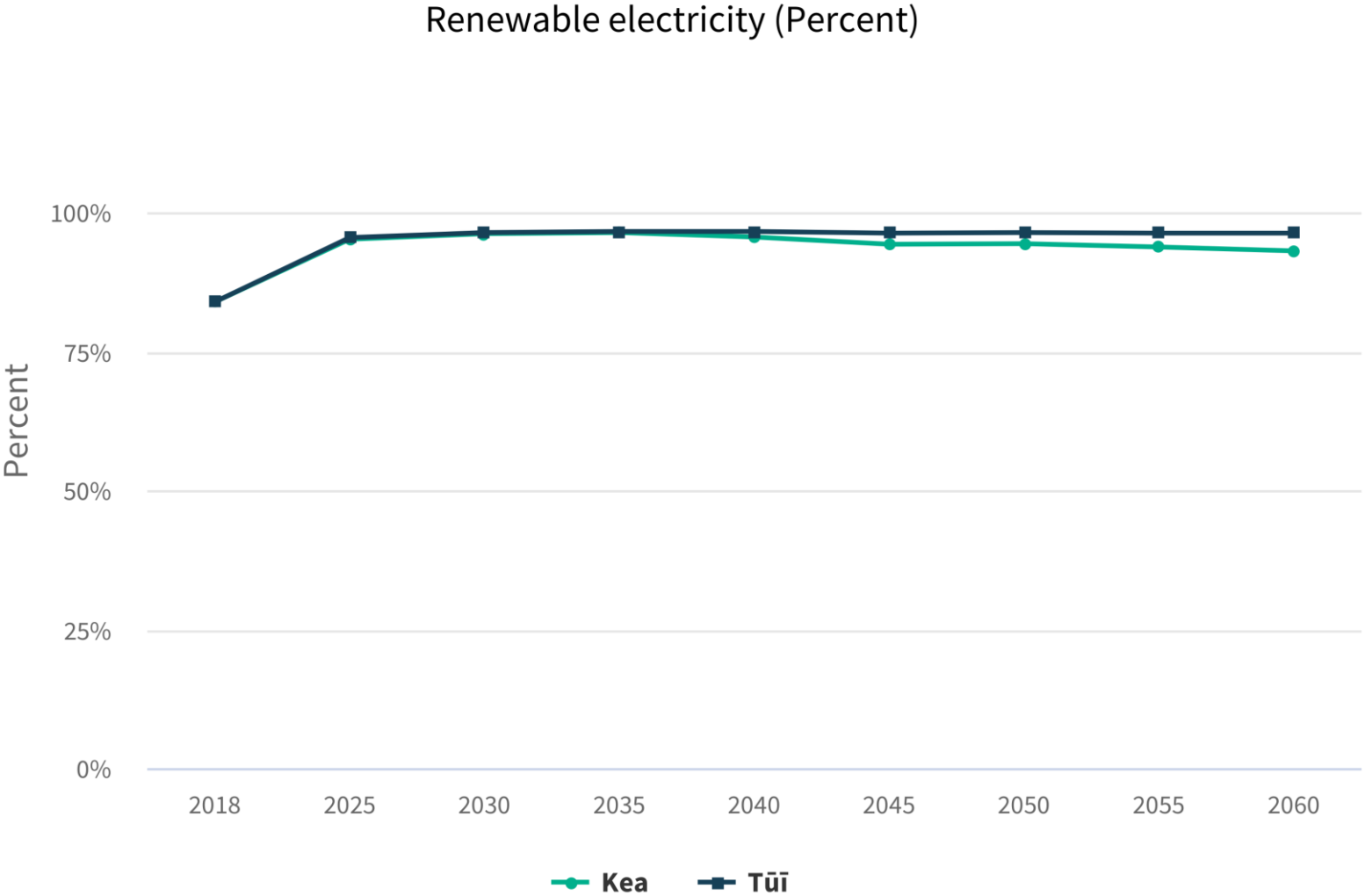


### Kea Generation



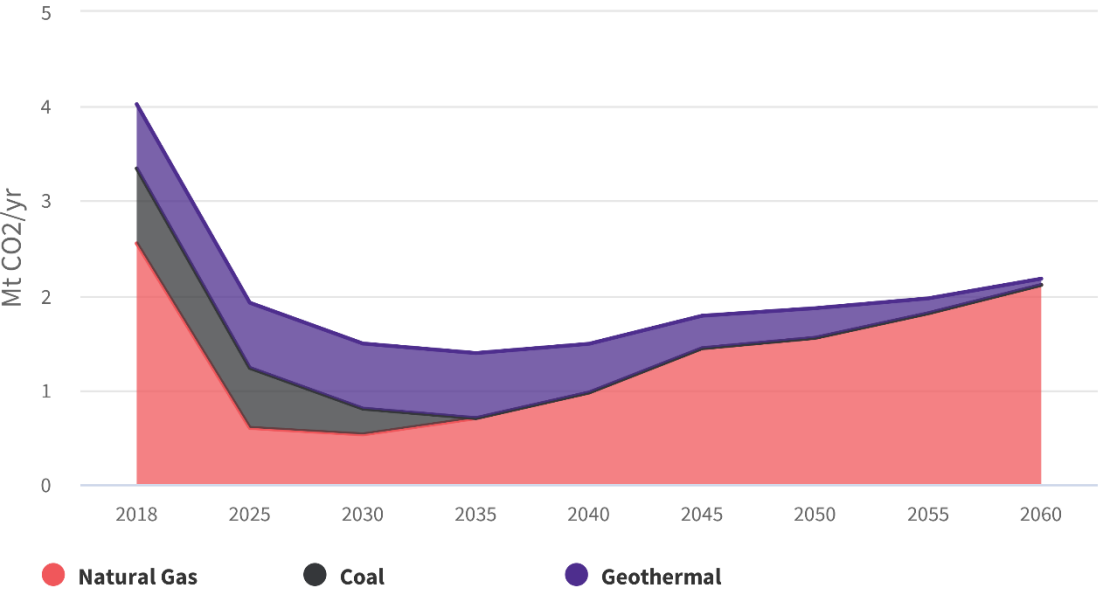
# Electricity Generation

## Renewables Percentage



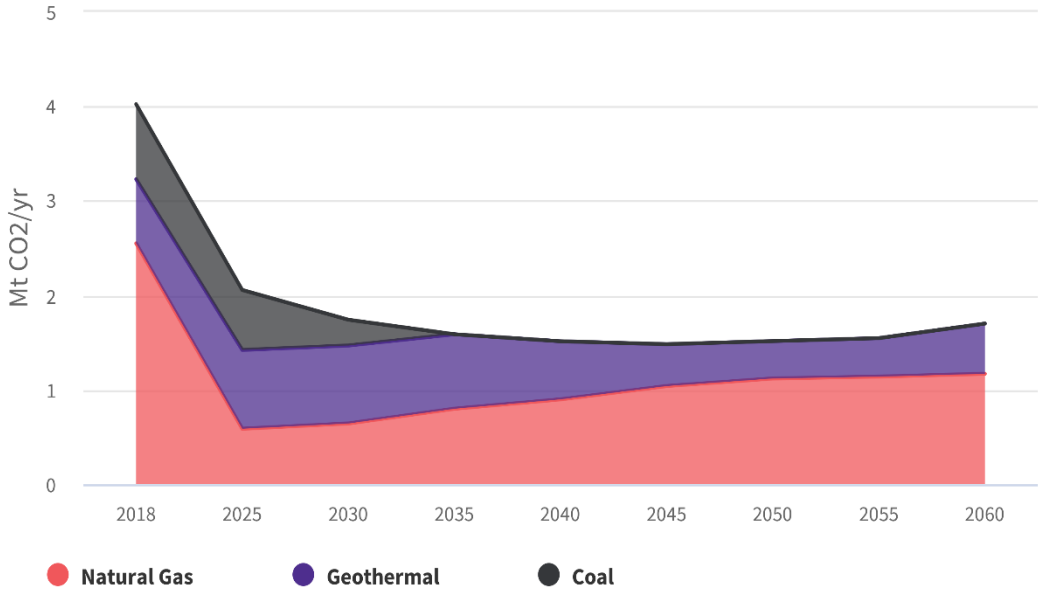
# Electricity Generation Emissions

### Kea Electricity Emissions



TIMES-NZ 2.0, Scenario: Kea

### Tui Electricity Emissions



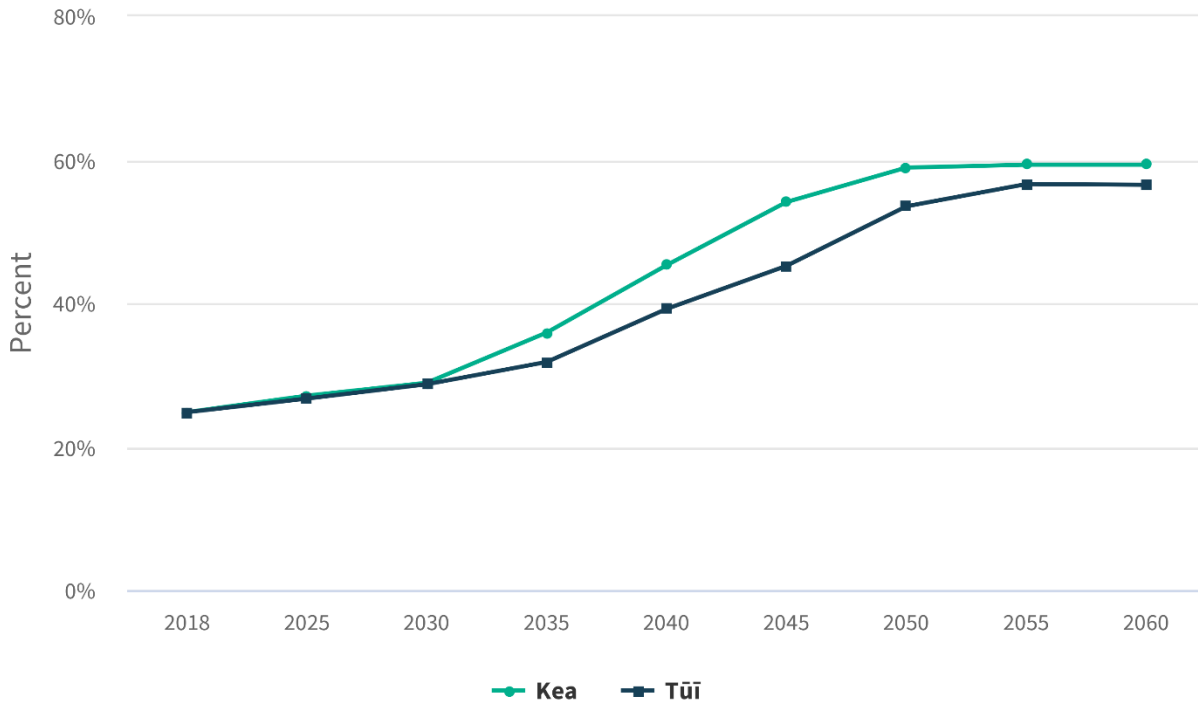
TIMES-NZ 2.0, Scenario: Tui



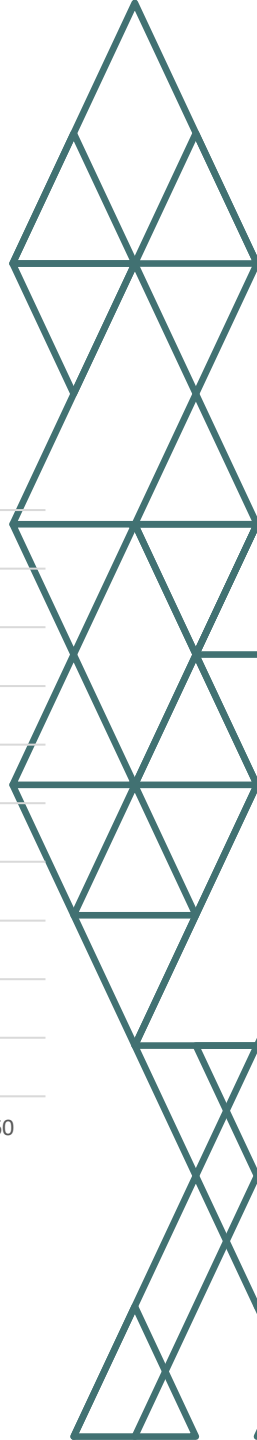
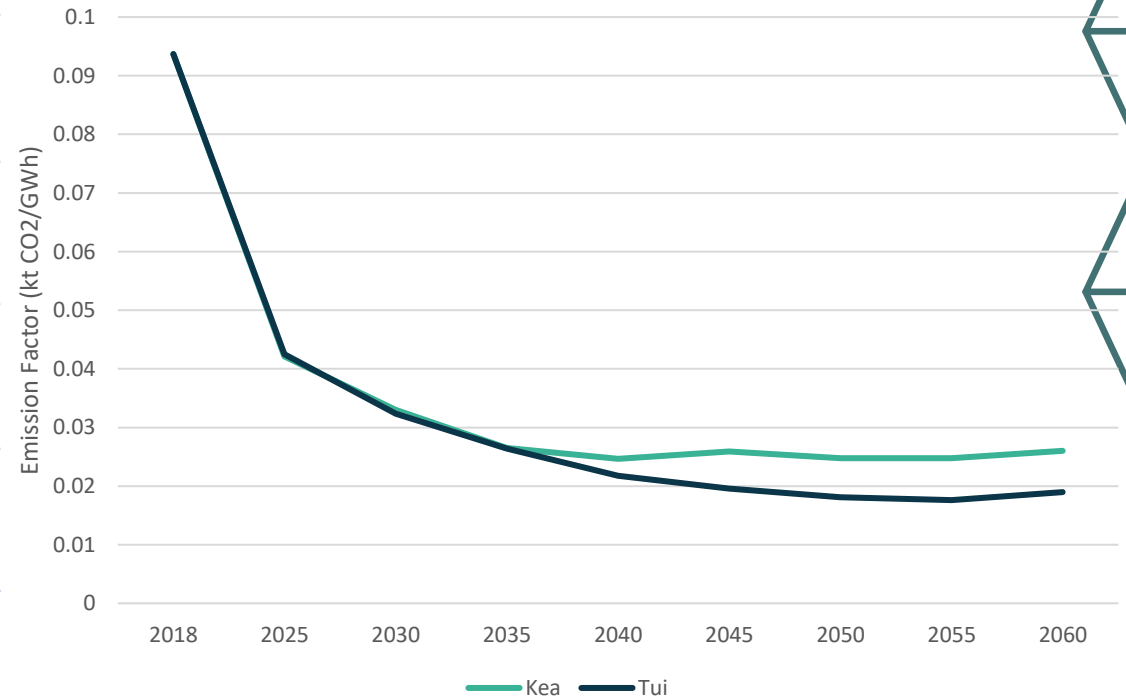
# Electricity Generation

## Electrification and Emission Factors

Electrification (Percent)

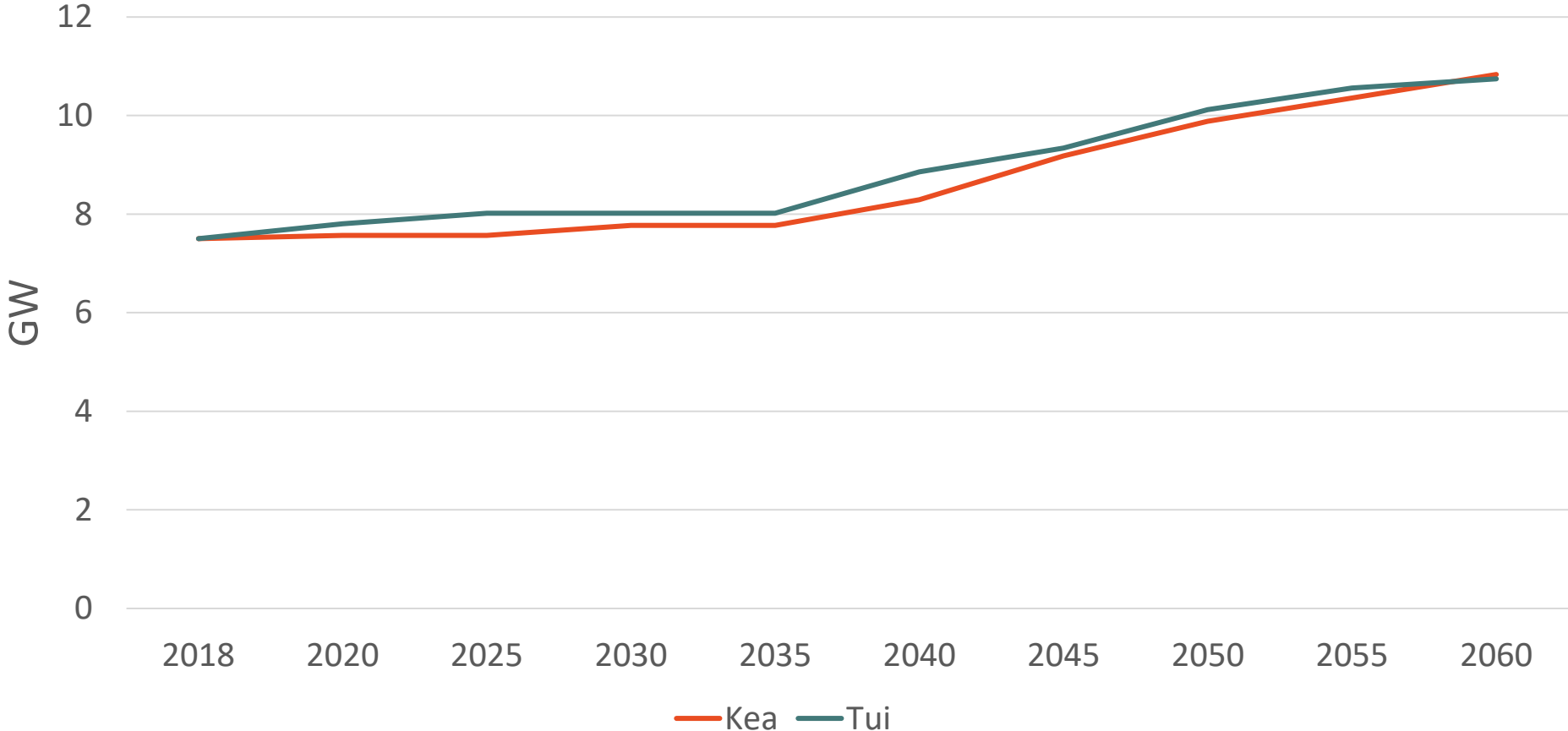


Electricity Emission Factors



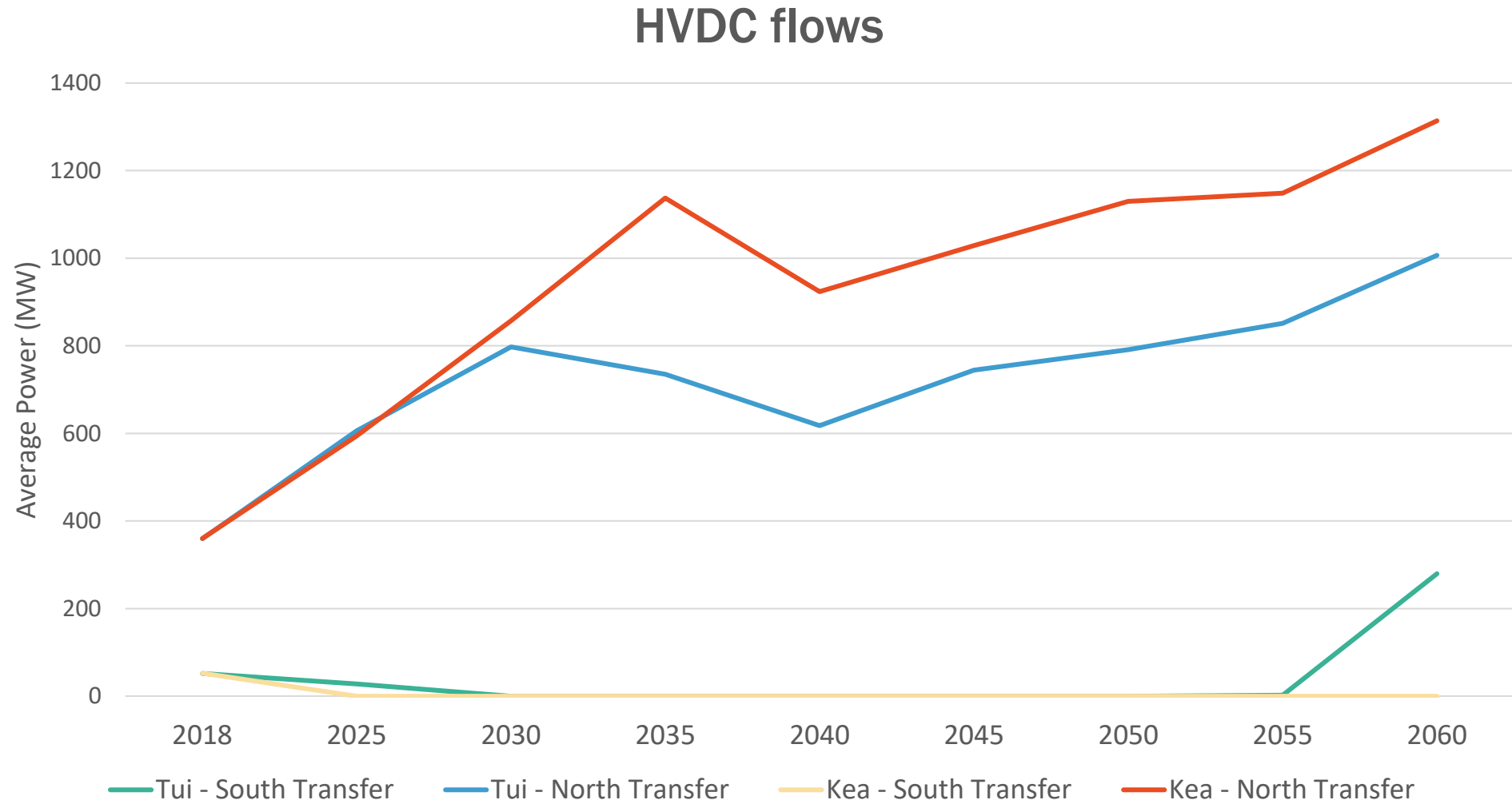
# Transmission

## High Voltage Transmission Capacity



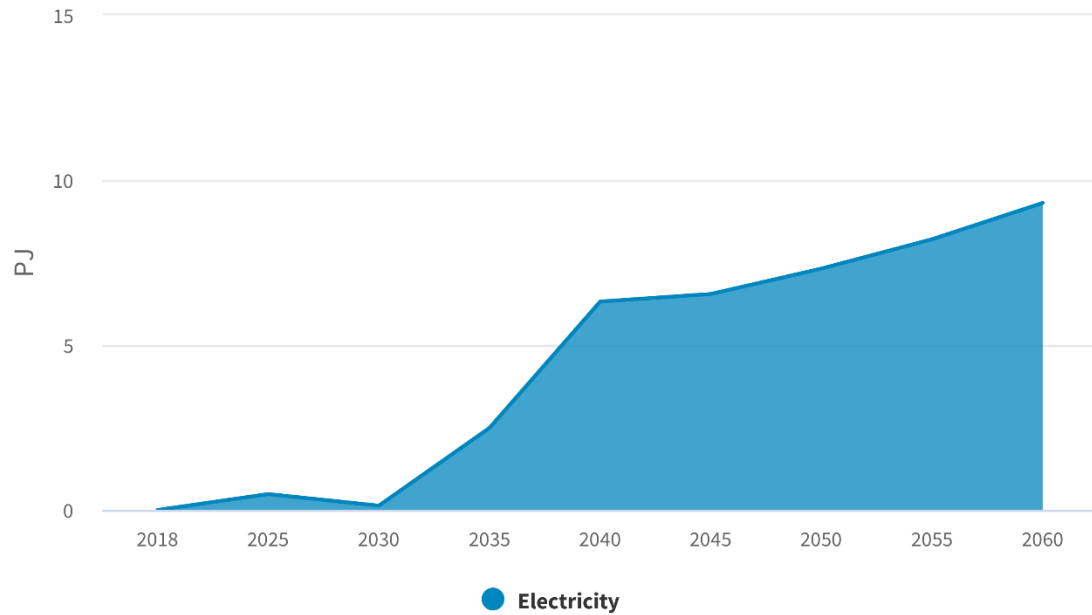


# Transmission



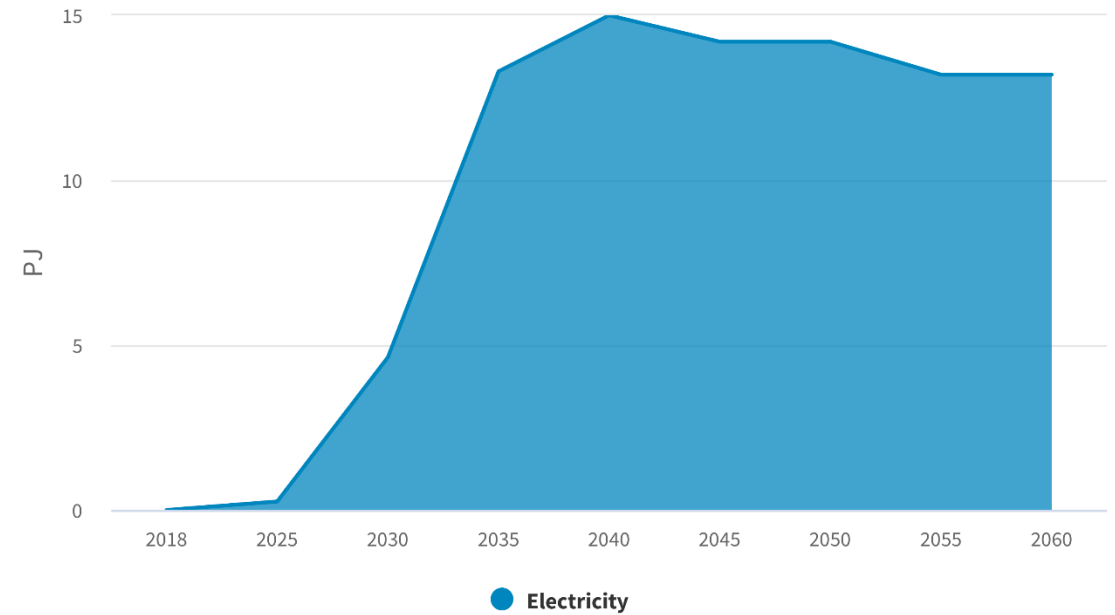
# Storage Batteries

## Kea Battery Uptake



TIMES-NZ 2.0, Scenario: Kea

## Tui Battery Uptake



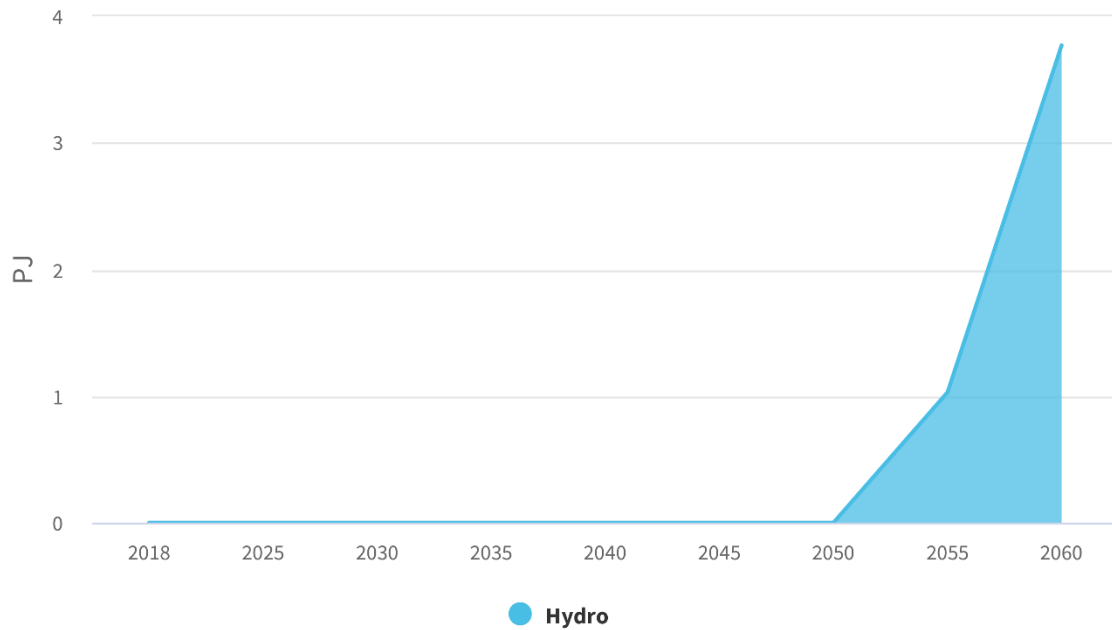
TIMES-NZ 2.0, Scenario: Tūi



# Storage

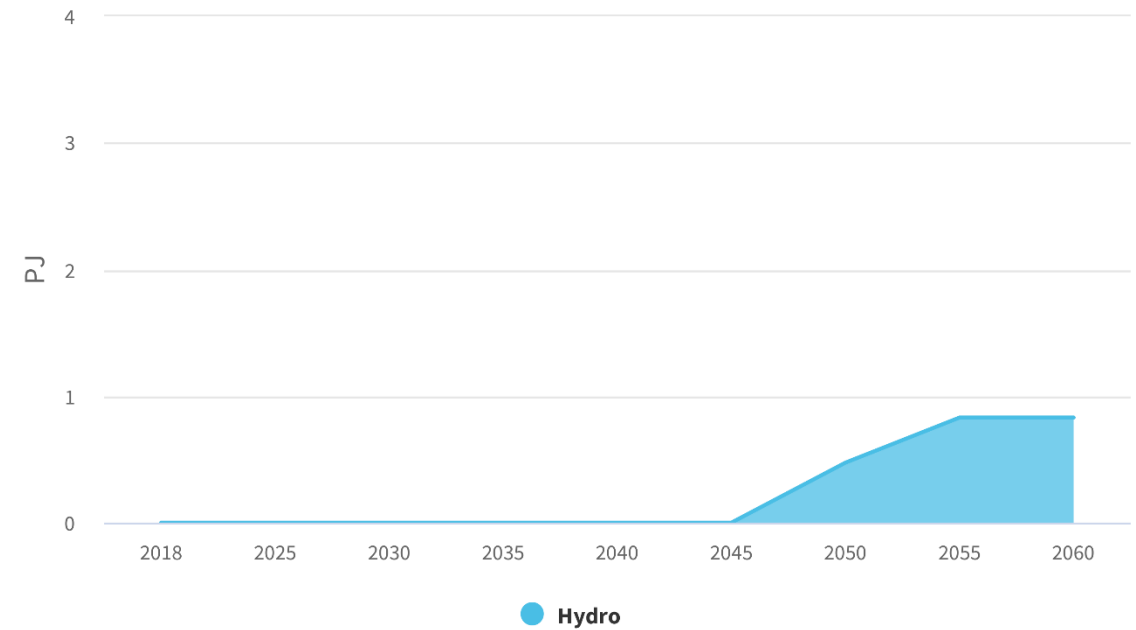
## Pumped Hydro

### Kea Pumped Hydro Uptake



TIMES-NZ 2.0, Scenario: Kea

### Tui Pumped Hydro Uptake

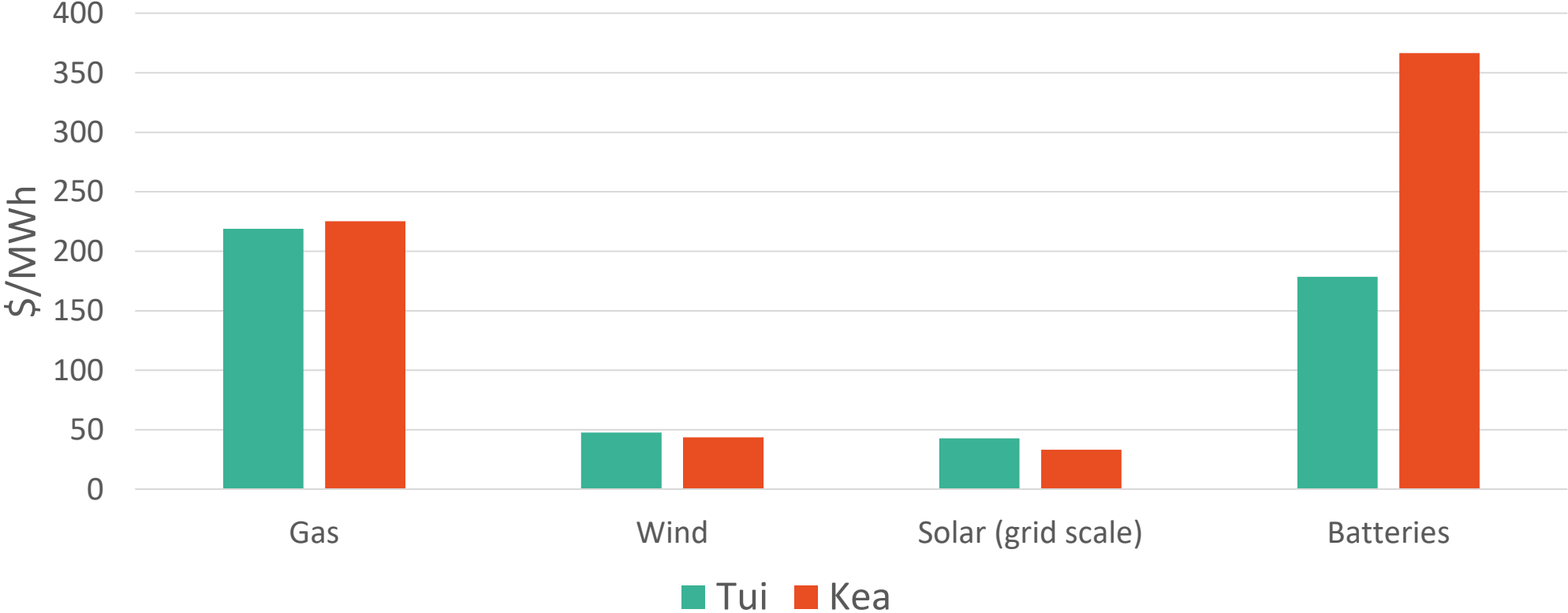


TIMES-NZ 2.0, Scenario: Tui

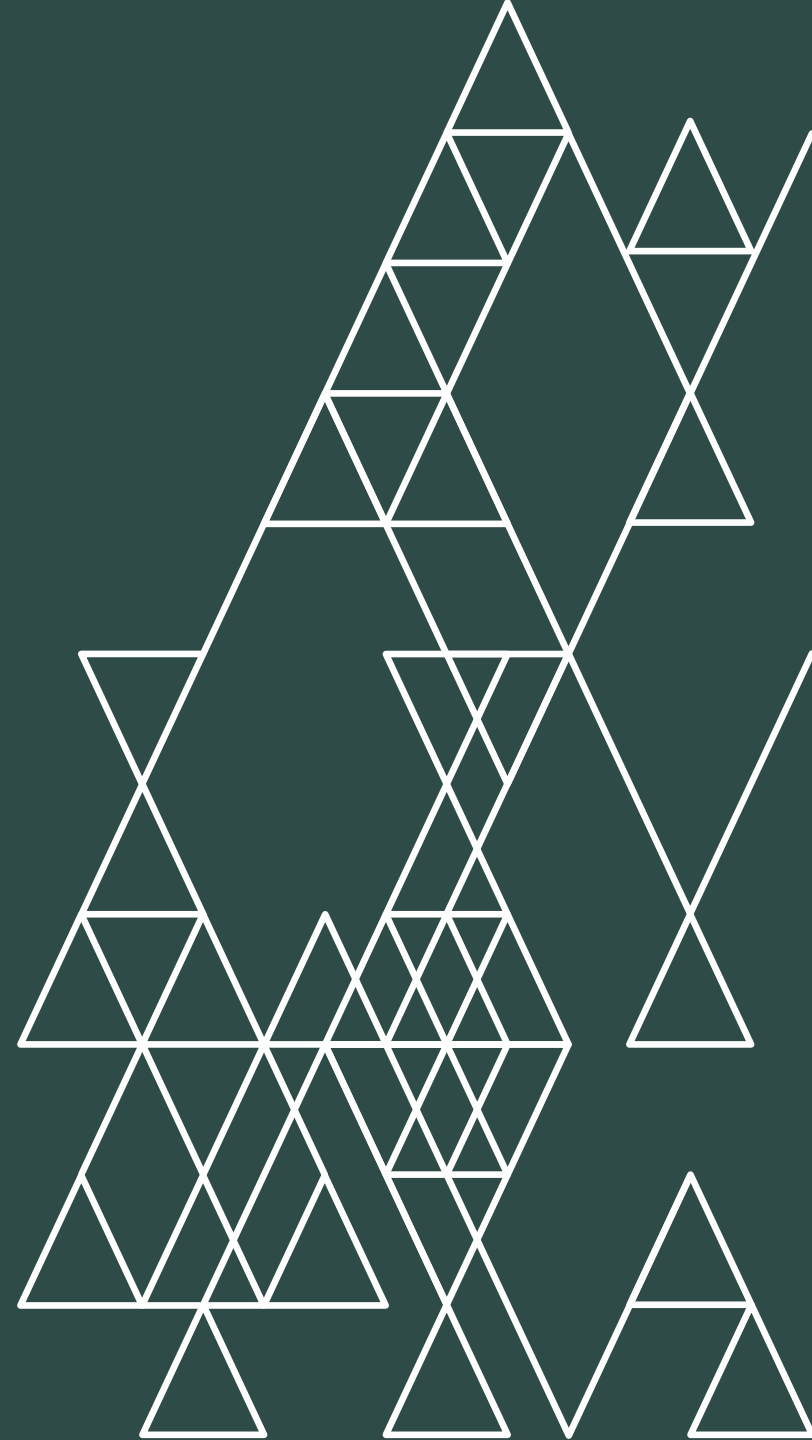
# Electricity Generation

## Levelised Cost of Electricity Generation

Levelised costs in 2040



# Summary



# Summary

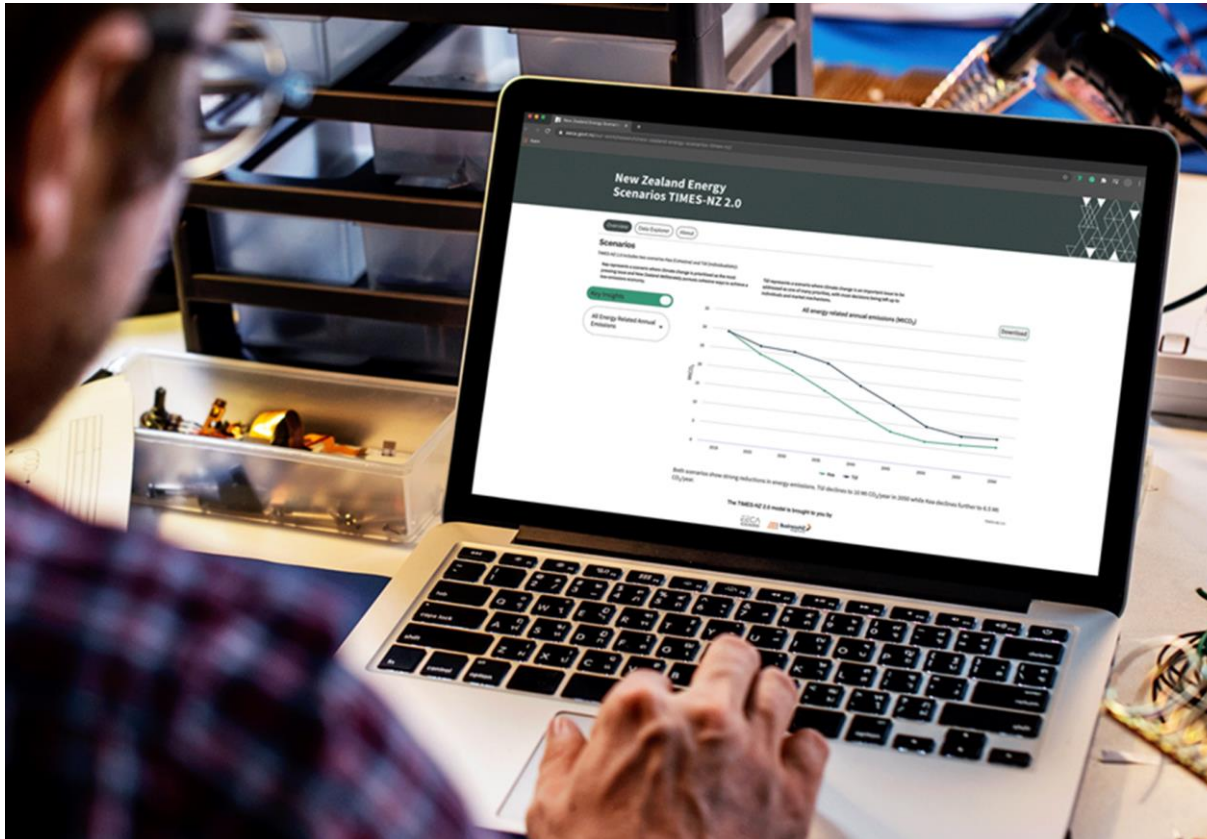
- **Wind generation grows significantly from 2025 onwards**
- **Solar generation grows rapidly from 2040 onwards**
- **Storage of electricity plays a key role**
- **Difficulties in meeting winter demand with a low emissions alternative**



# NZ Energy System Scenarios TIMES-NZ 2.0

## Innovative communication

To ensure results are accessible to the community, and clearly communicated, TIMES-NZ 2.0 data have been released as an interactive visualisation app: <http://www.eeca.govt.nz/times-nz>



# NZ Energy Scenarios TIMES-NZ 2.0

<https://times.bec.org.nz/>



The screenshot shows the homepage of the NZ Energy Scenarios TIMES-NZ 2.0 website. The page features a blue and orange color scheme. At the top left, there are logos for the World Energy Council and BusinessNZ Energy Council. A navigation menu at the top right includes links for HOME, INSIGHTS, SECTORS, TOOL, DOWNLOADS, ABOUT, MEDIA, and CONTACT. The main content area has a background illustration of snow-capped mountains and a forest. The title "NEW ZEALAND ENERGY SCENARIOS" is displayed in large blue letters, with "TIMES-NZ 2.0" in orange below it. A paragraph of text explains that the ECA, BusinessNZ Energy Council, businesses, academia, and government have prepared two potential scenarios for New Zealand's energy future to 2060. Two orange buttons labeled "INSIGHTS" and "TOOL" are positioned below the text. The page is decorated with illustrations of a colorful parrot on the left and a blue bird on the right. A small yellow double arrow icon is located at the bottom center of the page.

WORLD ENERGY COUNCIL | BusinessNZ Energy Council

HOME | INSIGHTS | SECTORS | TOOL | DOWNLOADS | ABOUT | MEDIA | CONTACT

## NEW ZEALAND ENERGY SCENARIOS

### TIMES-NZ 2.0

ECA, BusinessNZ Energy Council, businesses, academia and government have prepared two potential scenarios of New Zealand's energy future to 2060.

INSIGHTS | TOOL

