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

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.

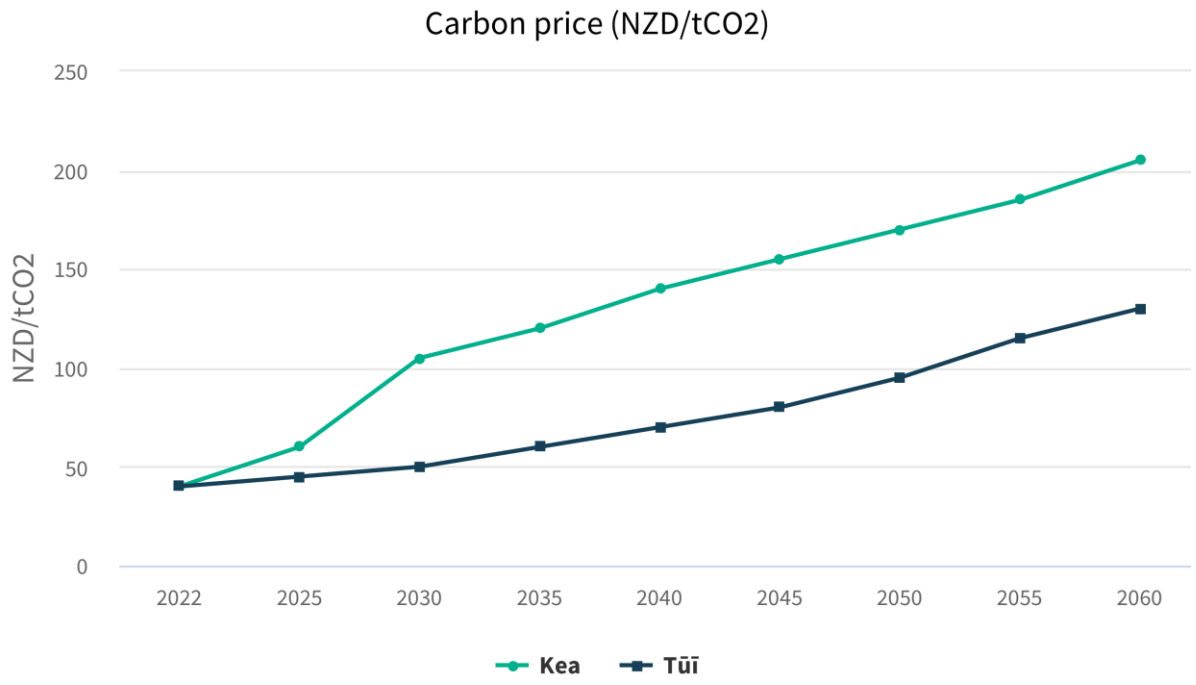
Tūī

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.

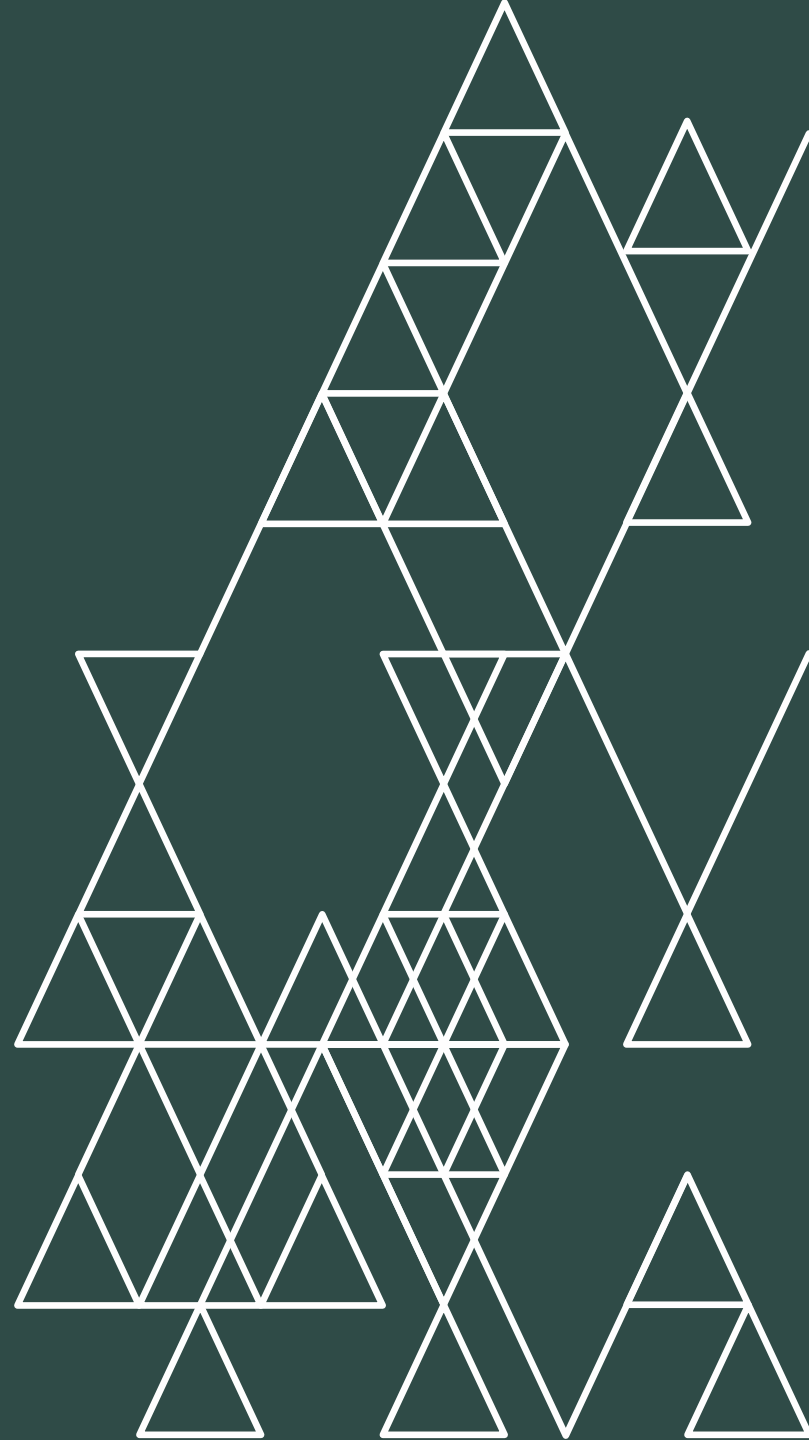
Scenario Parameters

The key model input differences between Kea and Tūī are:

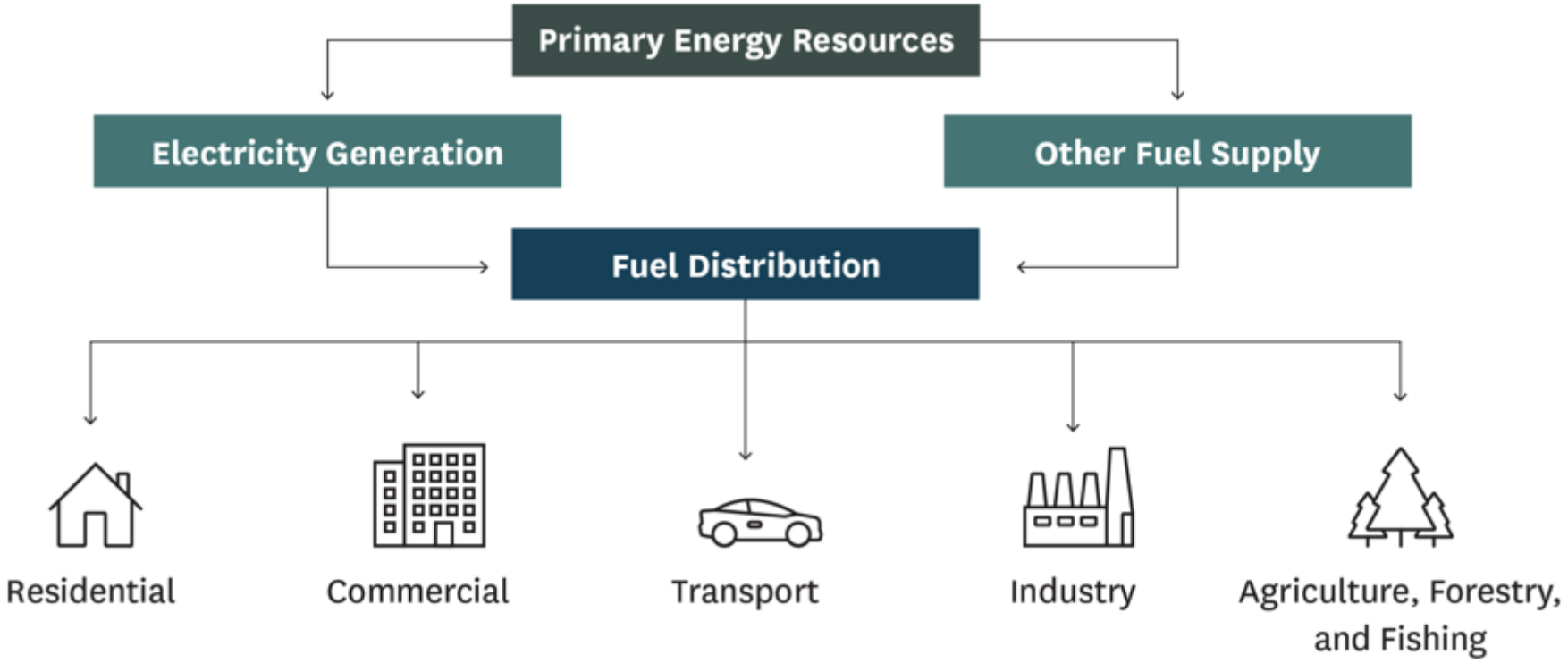
- **Composite GDP**
- **Carbon price**
- **Discount rates**
- **Technology cost curves**



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 x 2 x 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

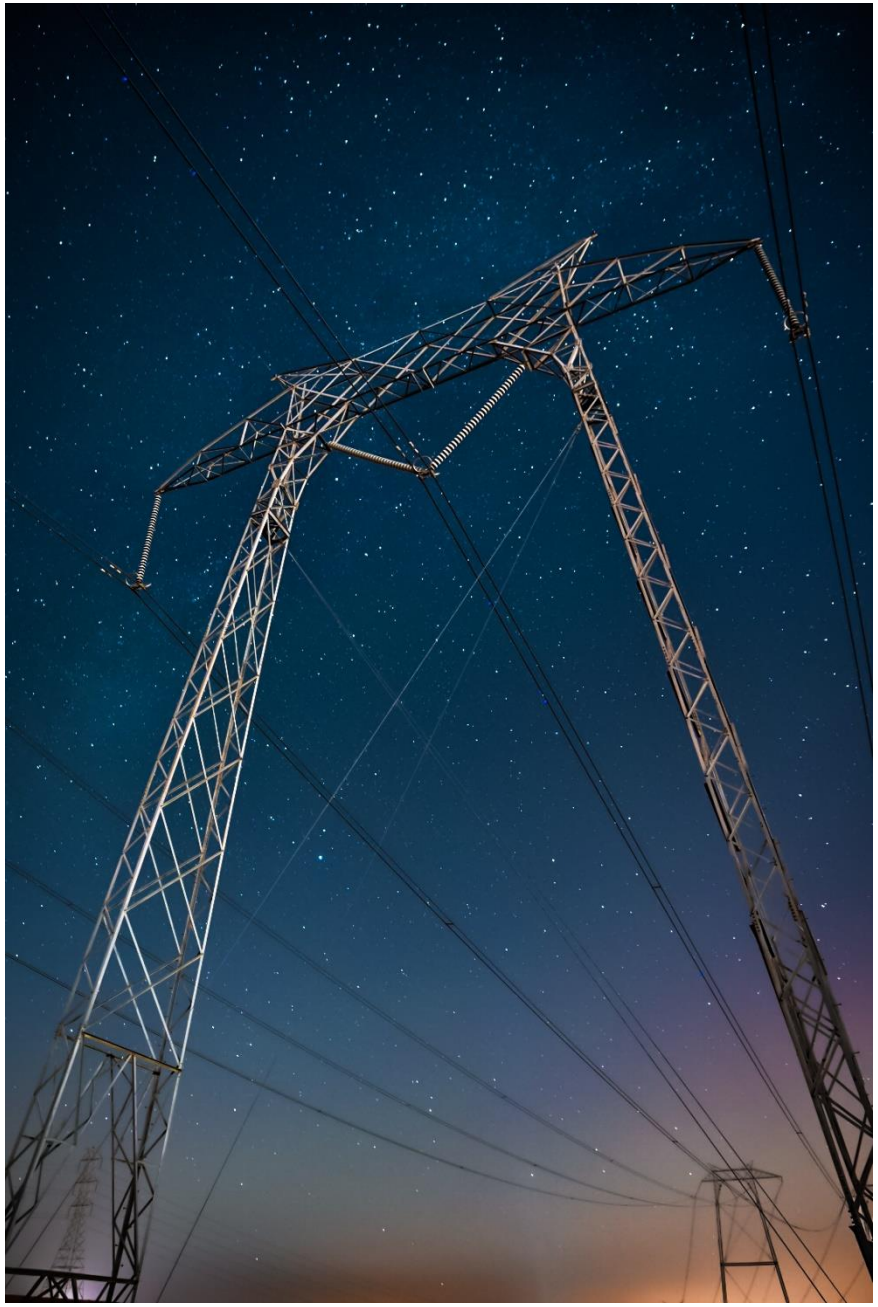
Resource (GW)	2030	2040	2050	2060
Solar	15	20	24	24
Onshore Wind	11	11	11	11
Geothermal	0.6	1.0	1.0	1.0
Hydro	1.9	1.9	1.9	1.9
Pumped Hydro	2.2	2.2	2.2	2.2

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

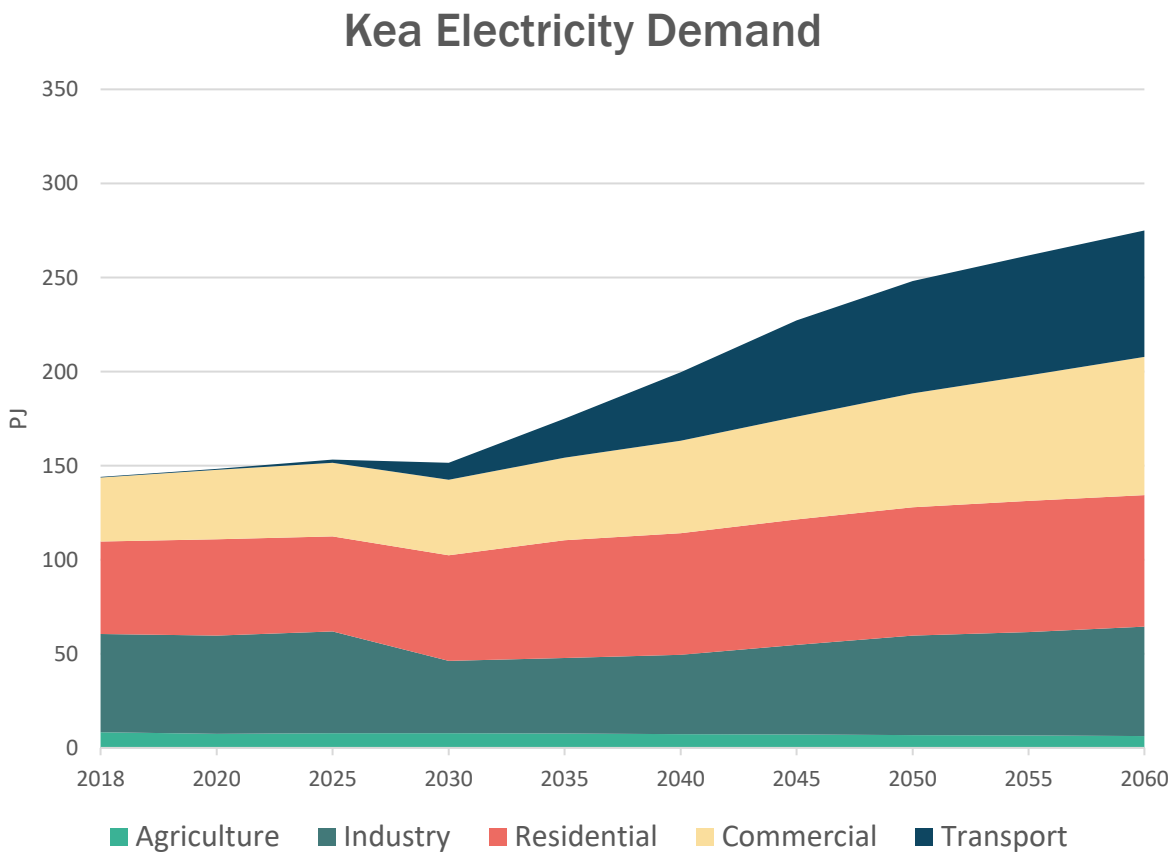
Demand Sector Assumptions

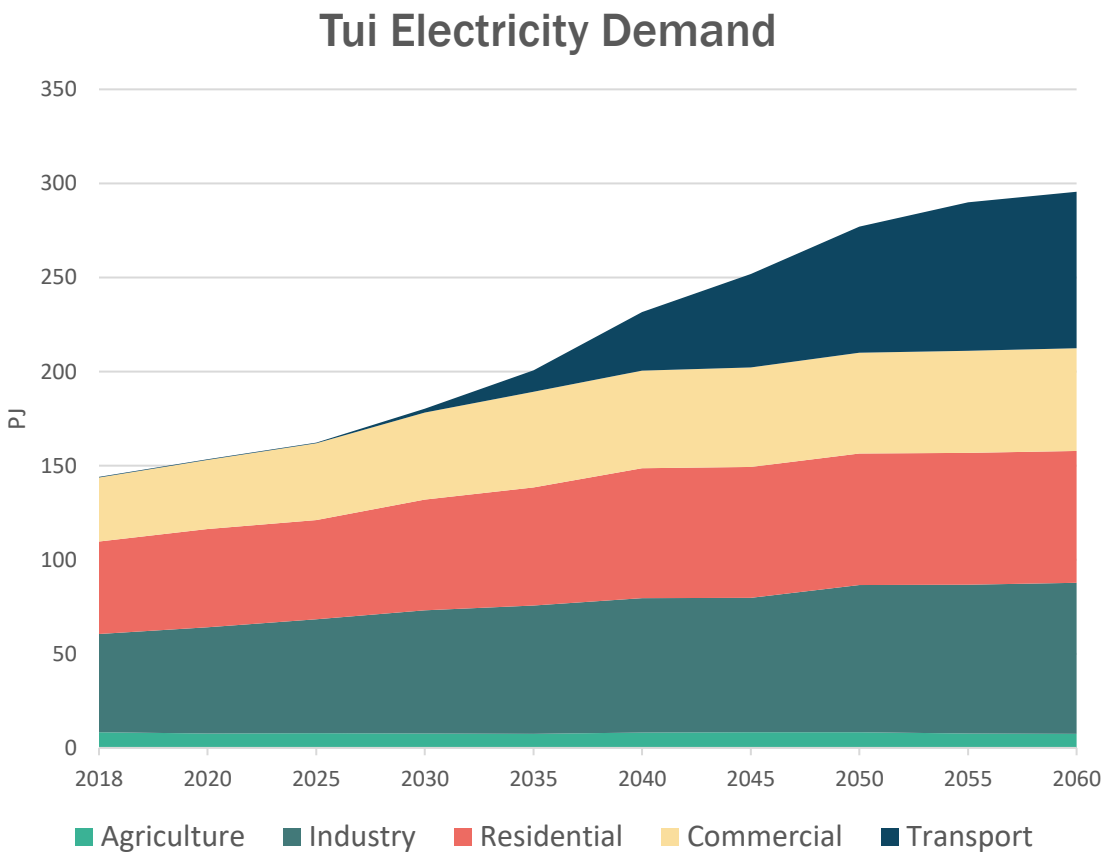
- Explicit assumptions we made:
  - Tiwai Exit (only in Kea scenario in 2027)
  - EV Charging
    - Tui assumes current charging trends are maintained
    - Kea assumes a flat charging profile

- Total electricity demand
  - Determined by the model in technology choice for each sector

Results

Electricity Demand

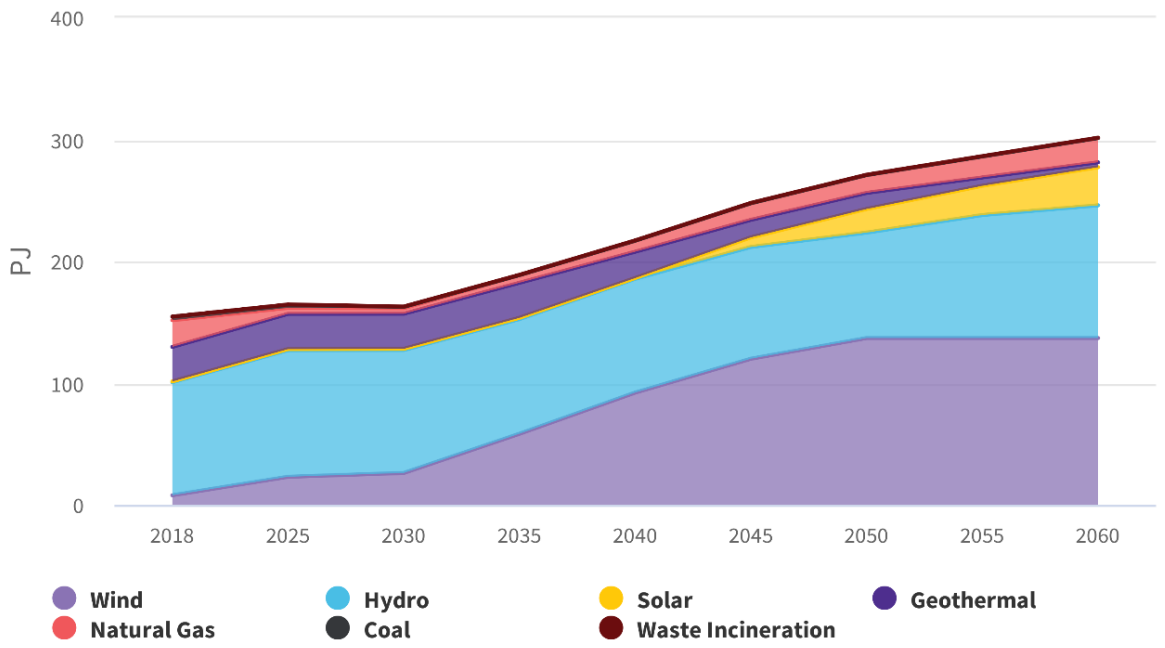




Electricity Generation

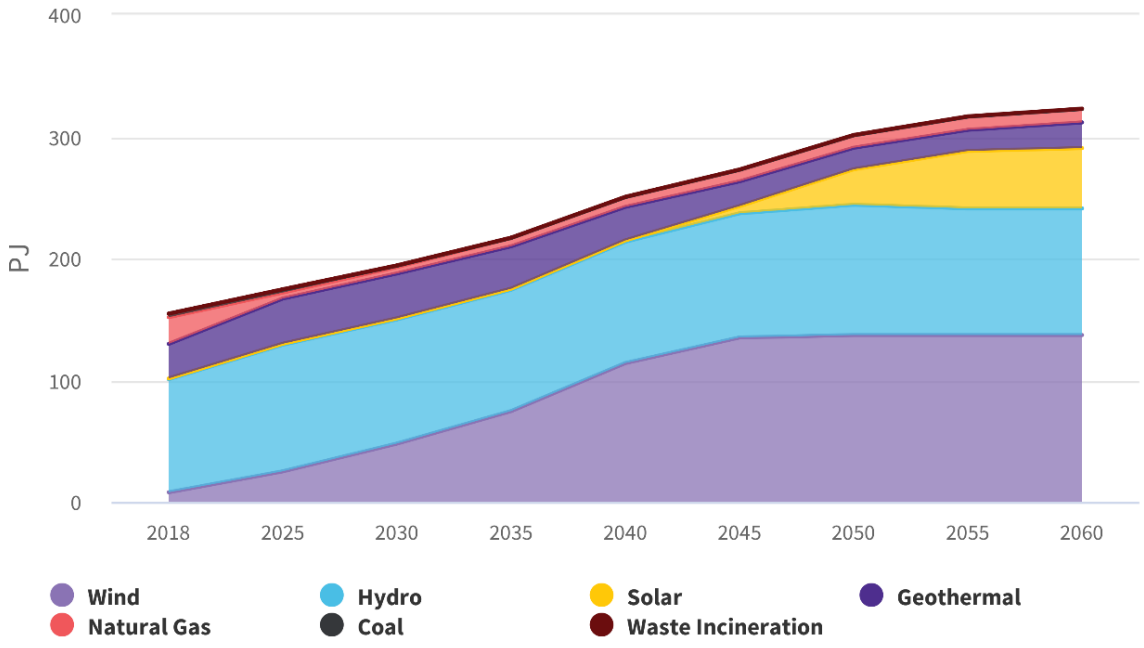
Where might the electricity come from?

Kea Electricity Generation Mix



TIMES-NZ 2.0, Scenario: Kea

Tui Electricity Generation Mix

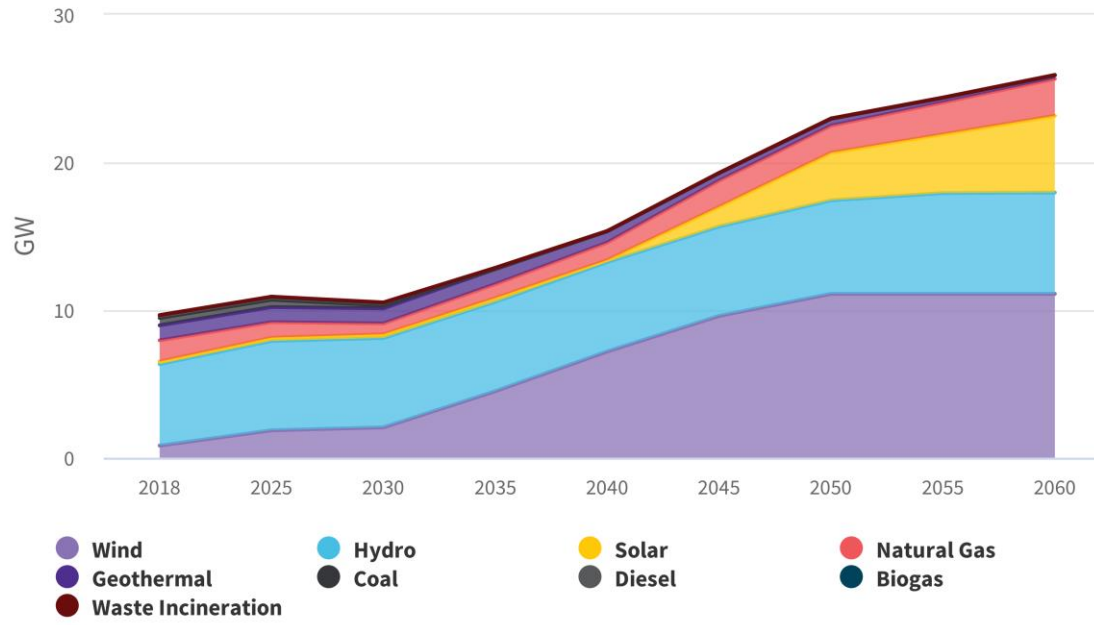


TIMES-NZ 2.0, Scenario: Tūī

Electricity Generation

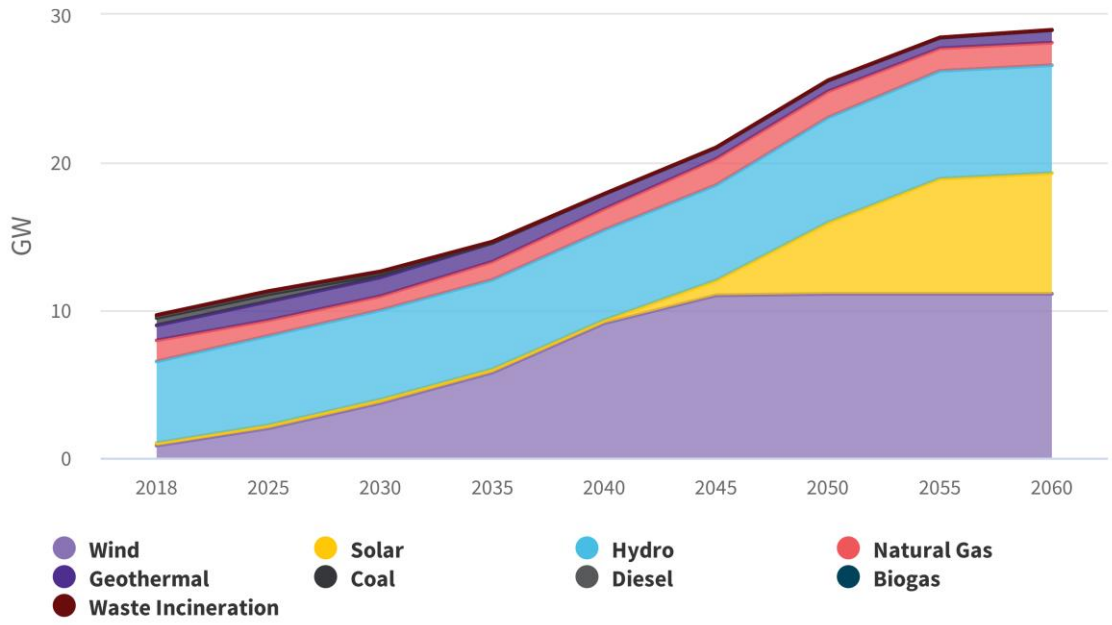
Capacity

Kea Electricity Generation Capacity



TIMES-NZ 2.0, Scenario: Kea

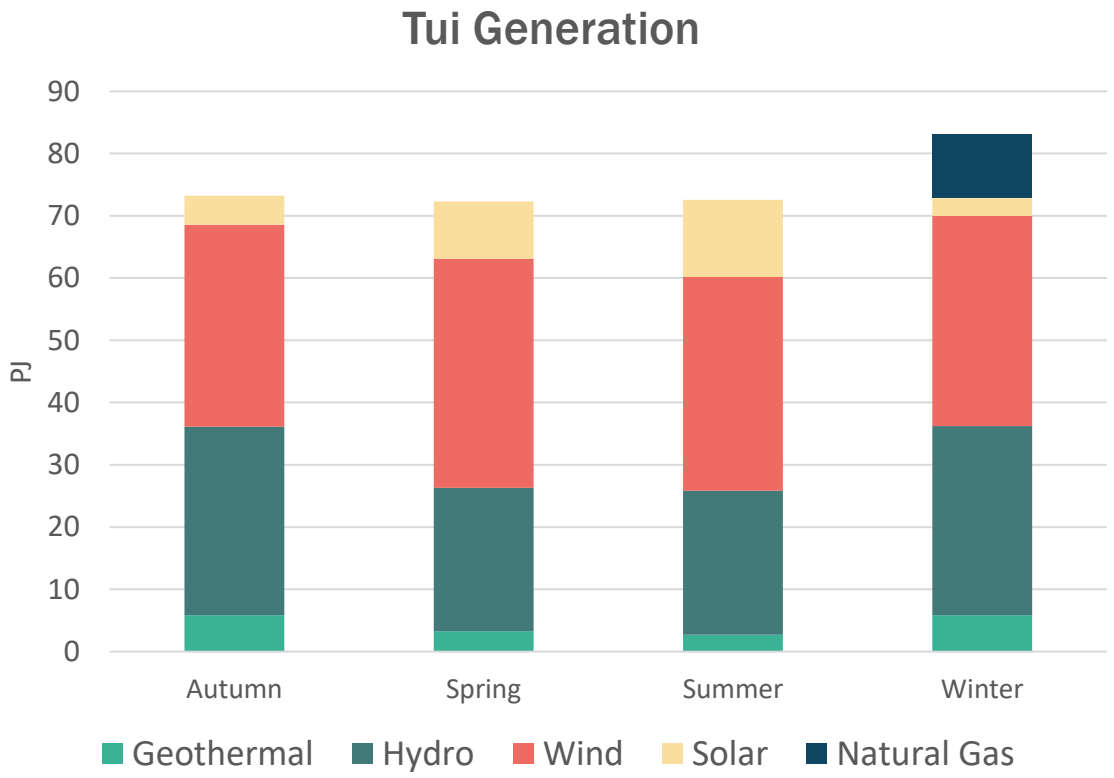
Tui Electricity Generation Capacity

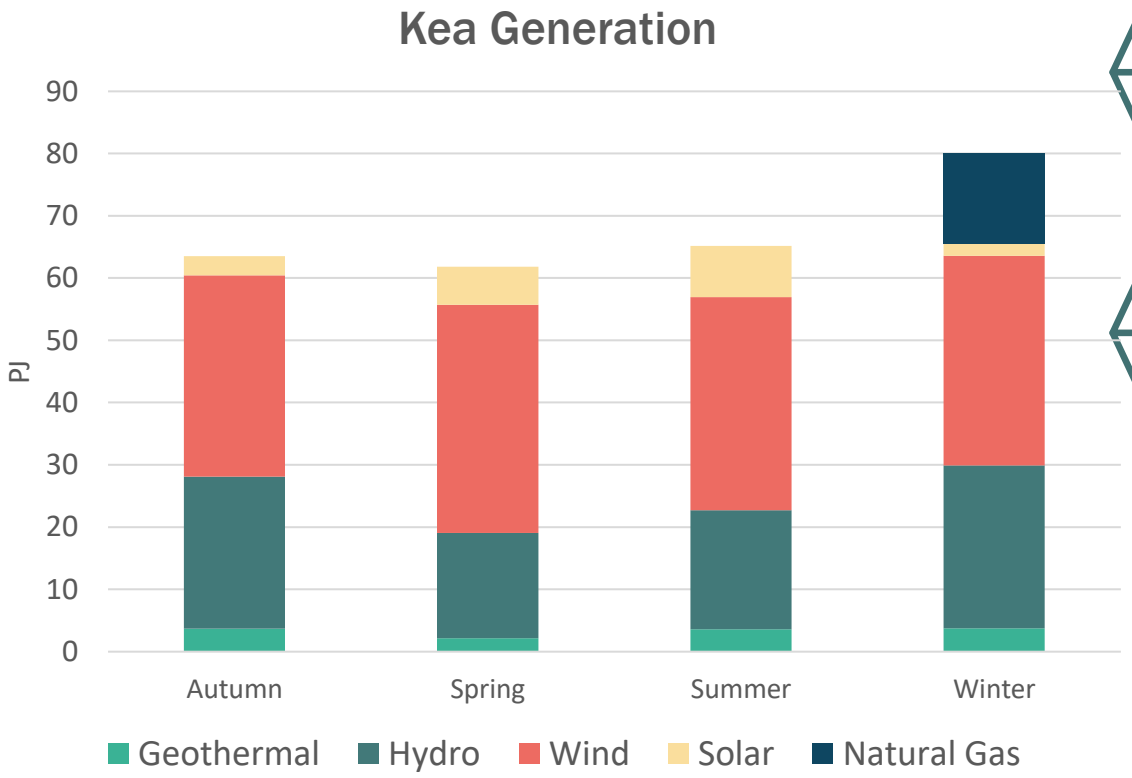


TIMES-NZ 2.0, Scenario: Tūī

Electricity Generation

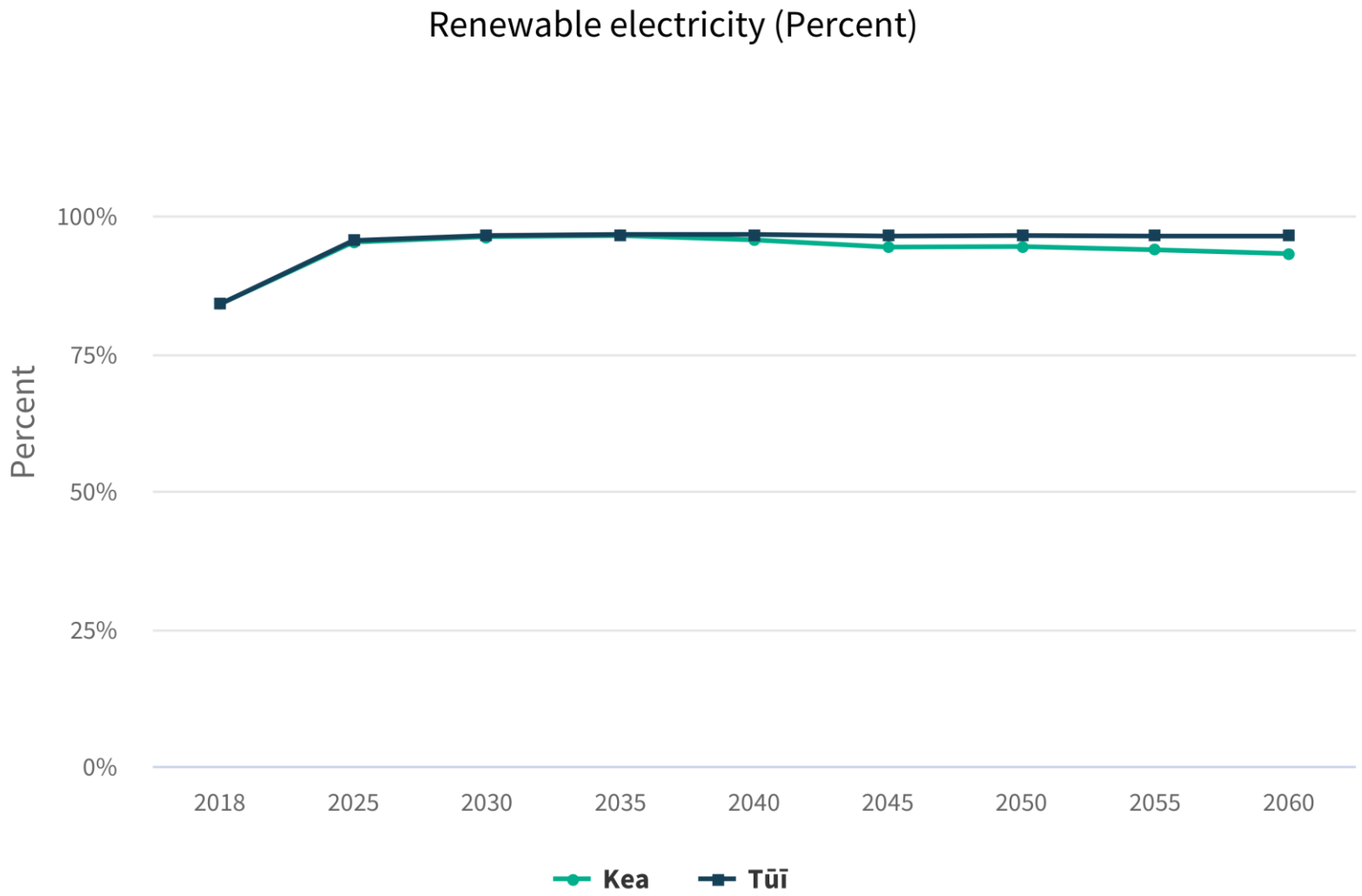
Seasonal Generation Mix in 2050





Electricity Generation

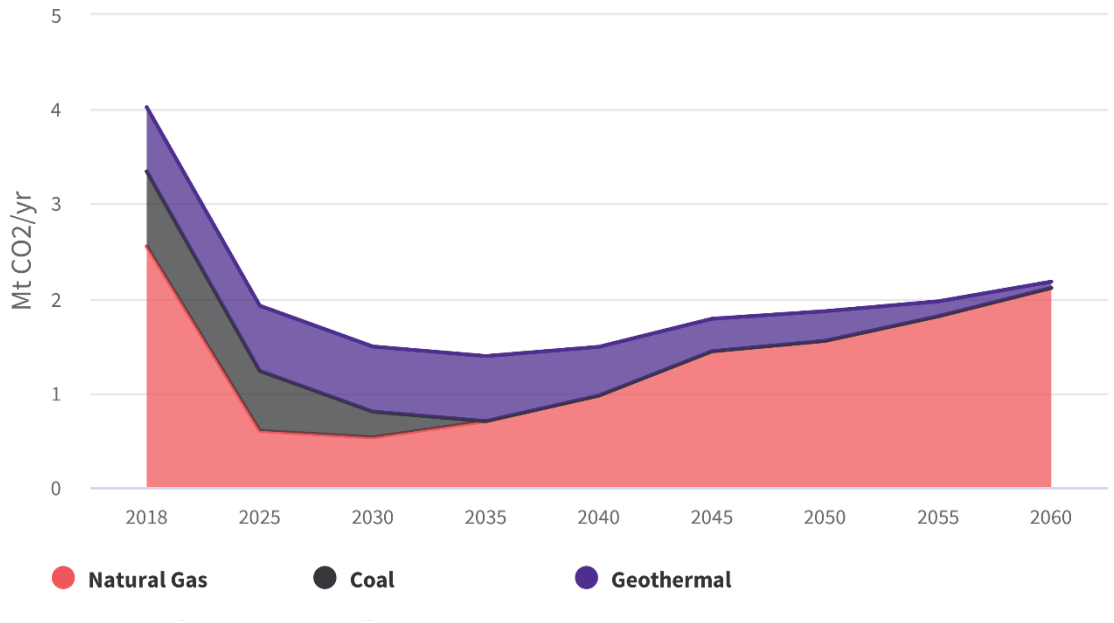
Renewables Percentage



Electricity Generation

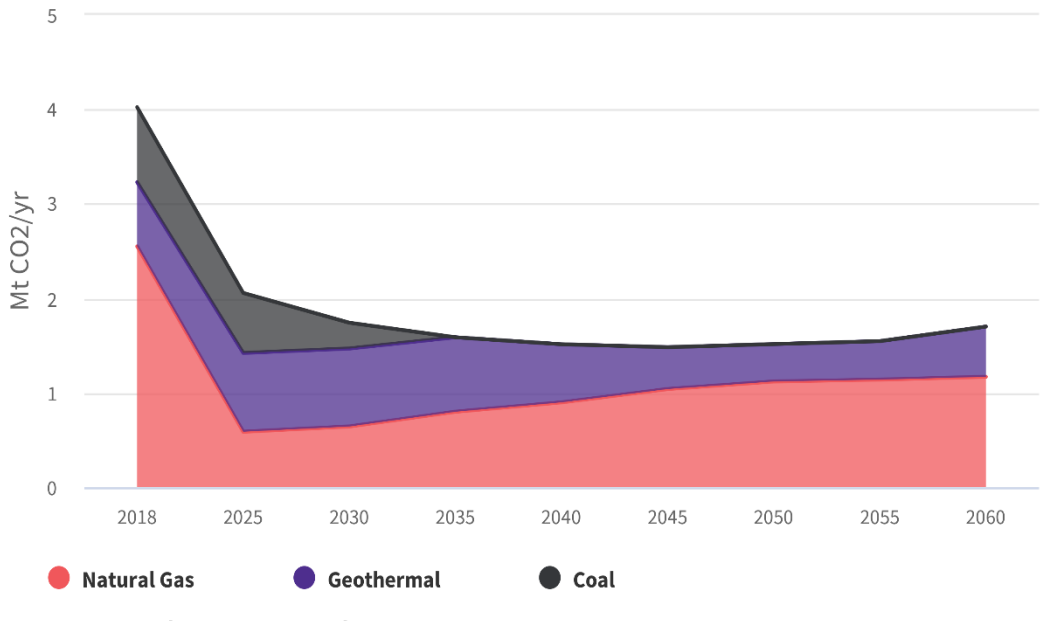
Emissions

Kea Electricity Emissions



TIMES-NZ 2.0, Scenario: Kea

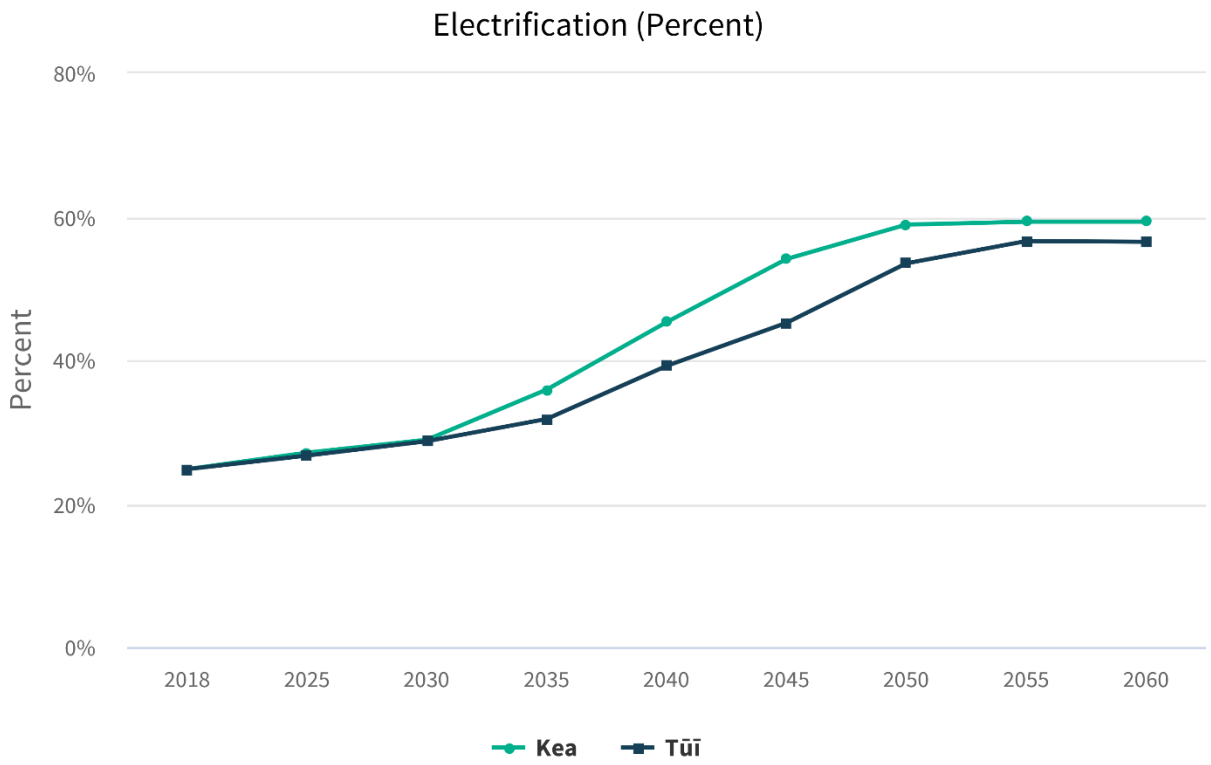
Tui Electricity Emissions

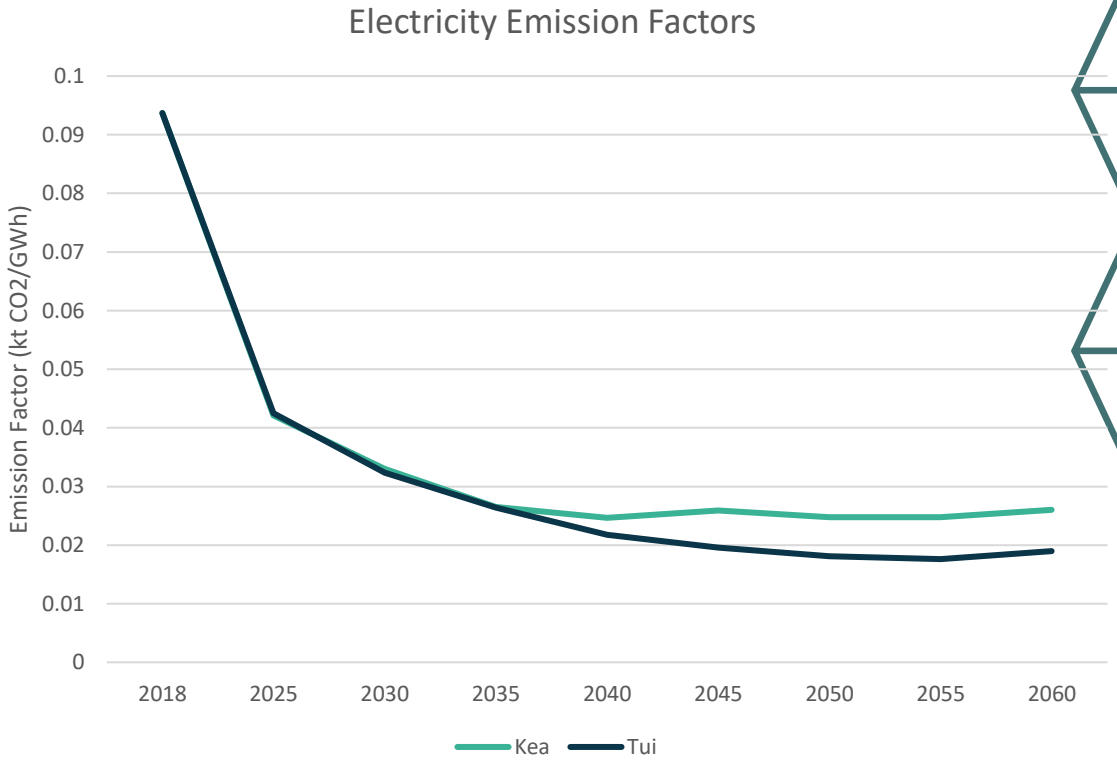


TIMES-NZ 2.0, Scenario: Tūī

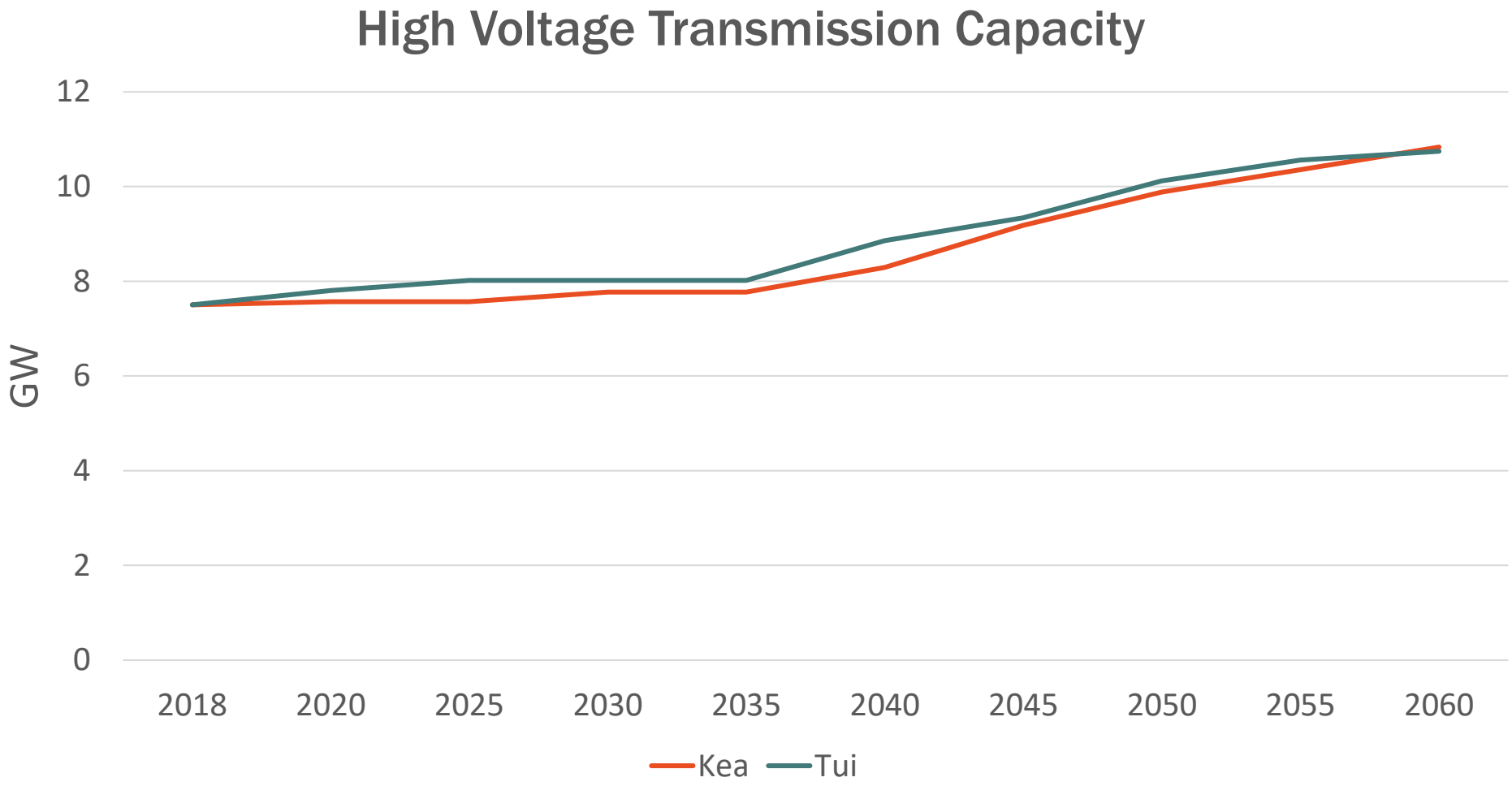
Electricity Generation

Electrification and Emission Factors

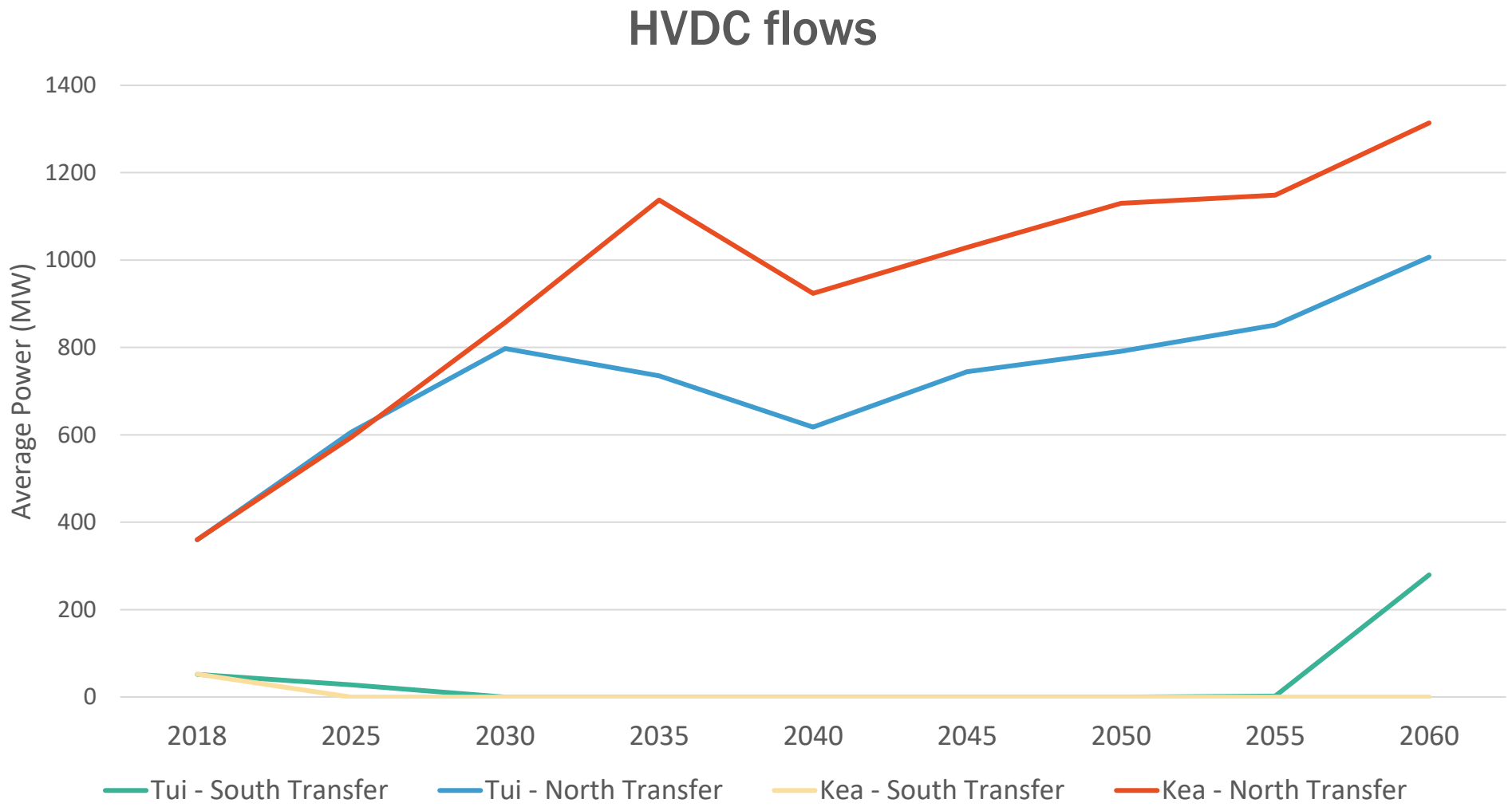




Transmission



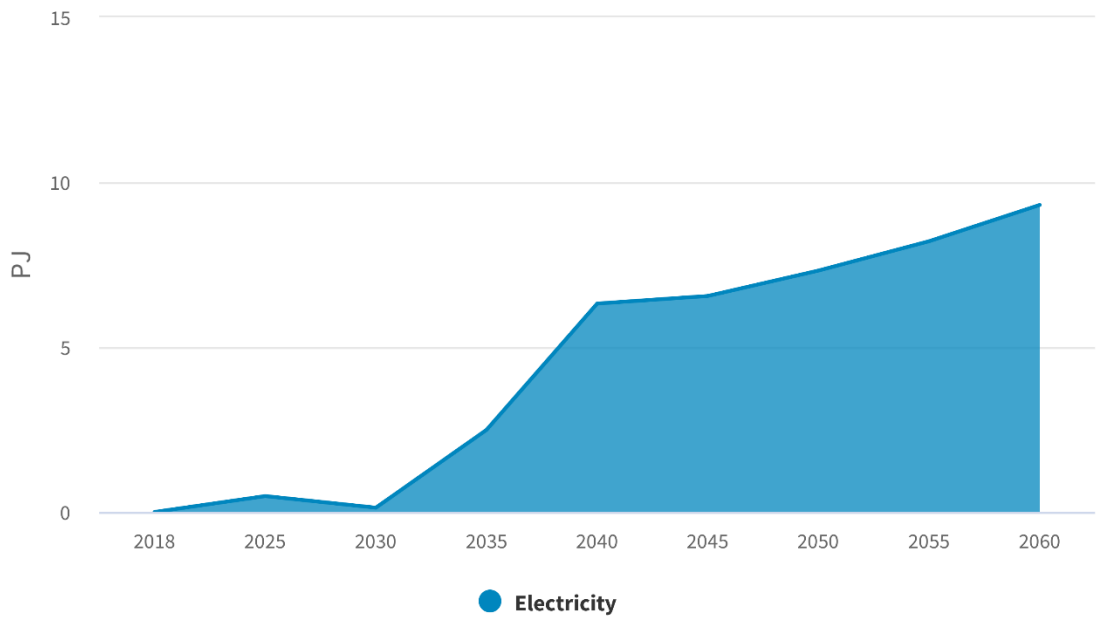
Transmission



Storage

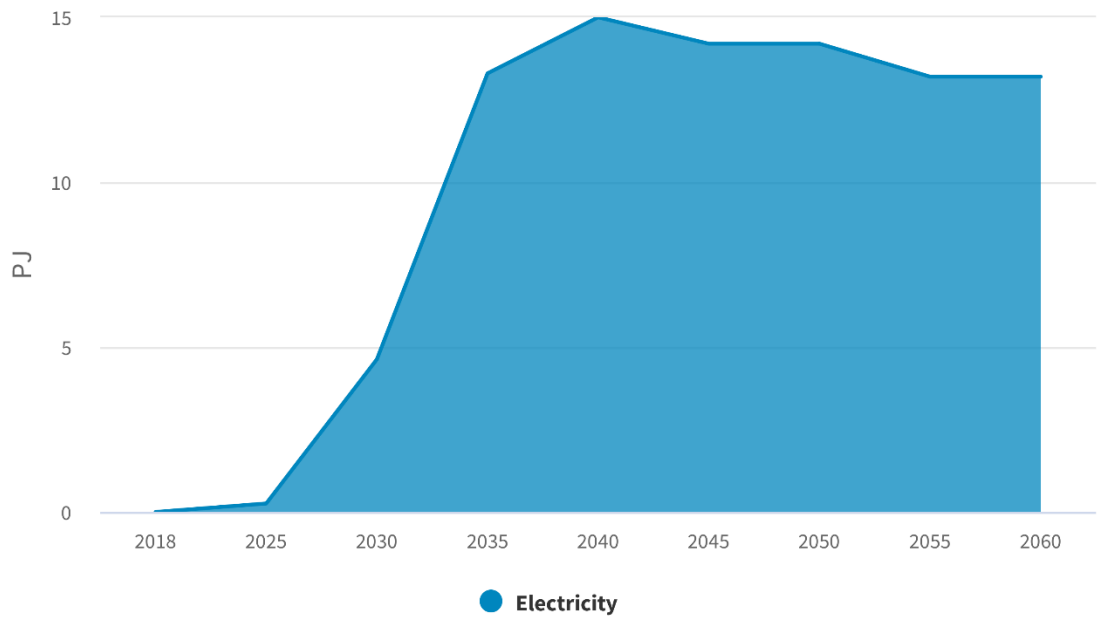
Batteries

Kea Battery Uptake



TIMES-NZ 2.0, Scenario: Kea

Tui Battery Uptake

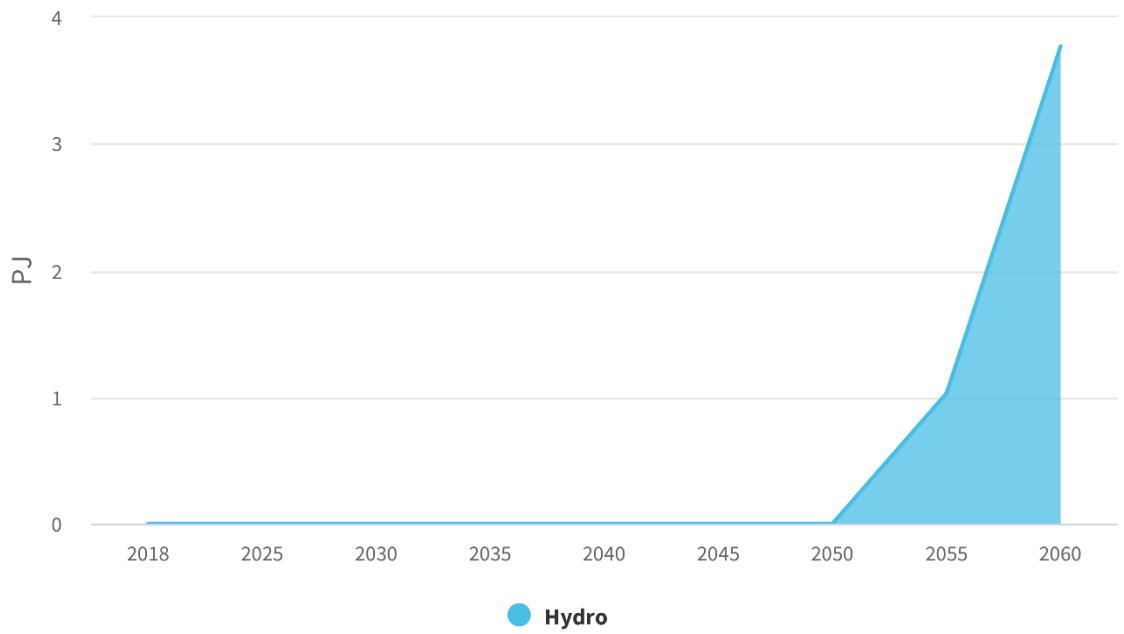


TIMES-NZ 2.0, Scenario: Tūī

Storage

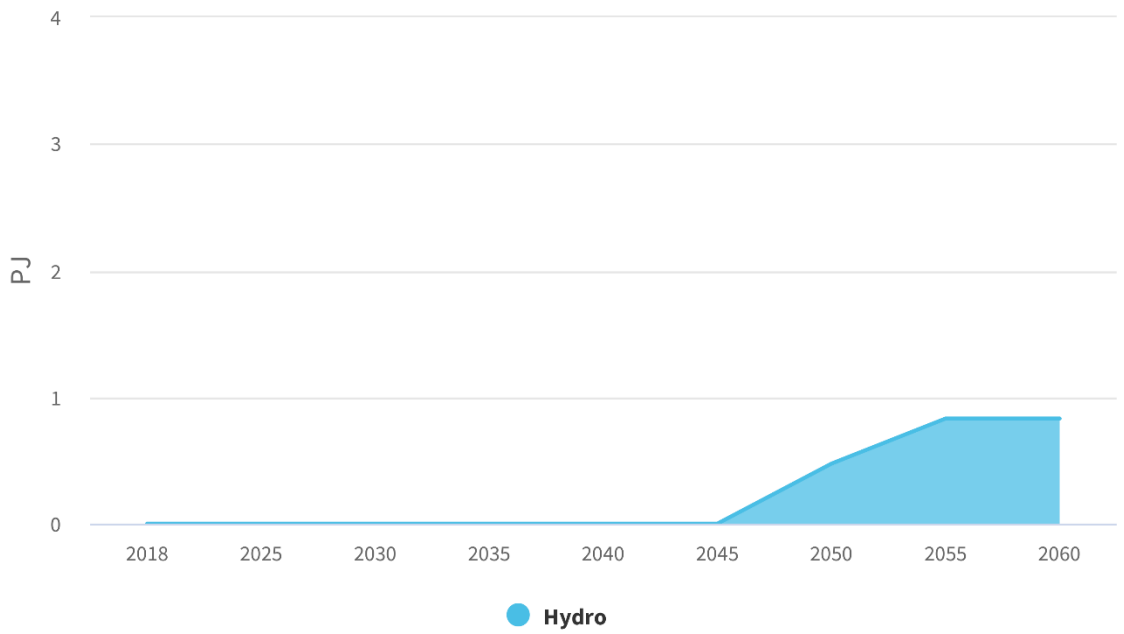
Pumped Hydro

Kea Pumped Hydro Uptake



TIMES-NZ 2.0, Scenario: Kea

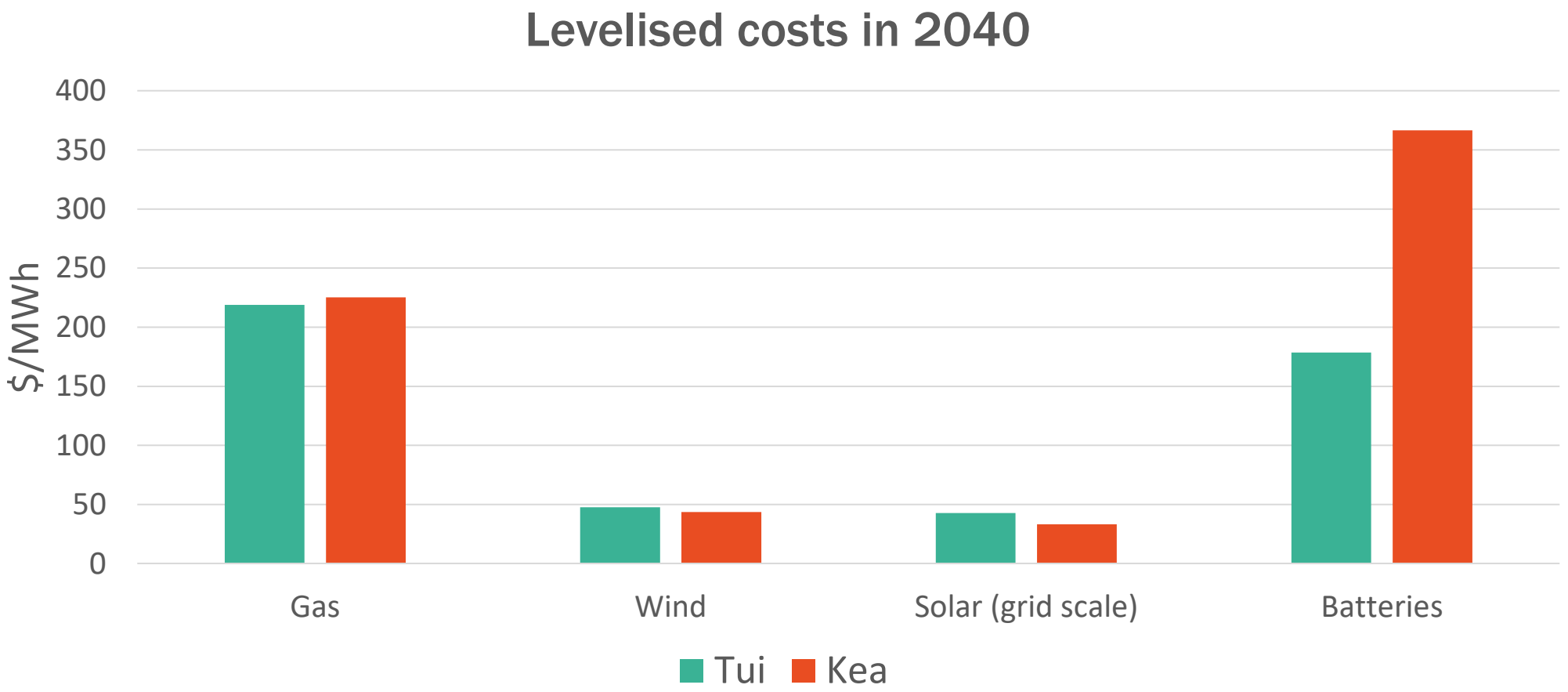
Tui Pumped Hydro Uptake



TIMES-NZ 2.0, Scenario: Tūī

Electricity Generation

Levelised Cost of Electricity Generation



Summary

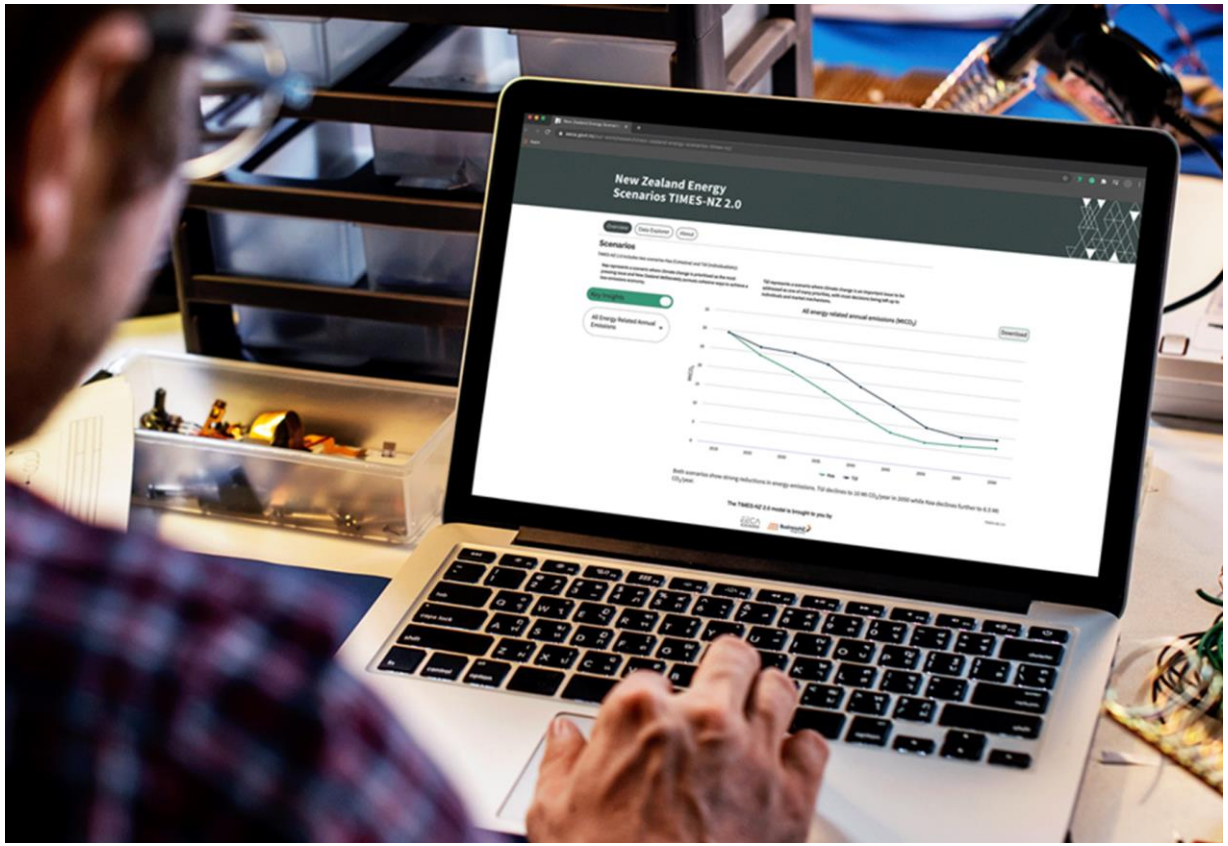
Summary

- 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/