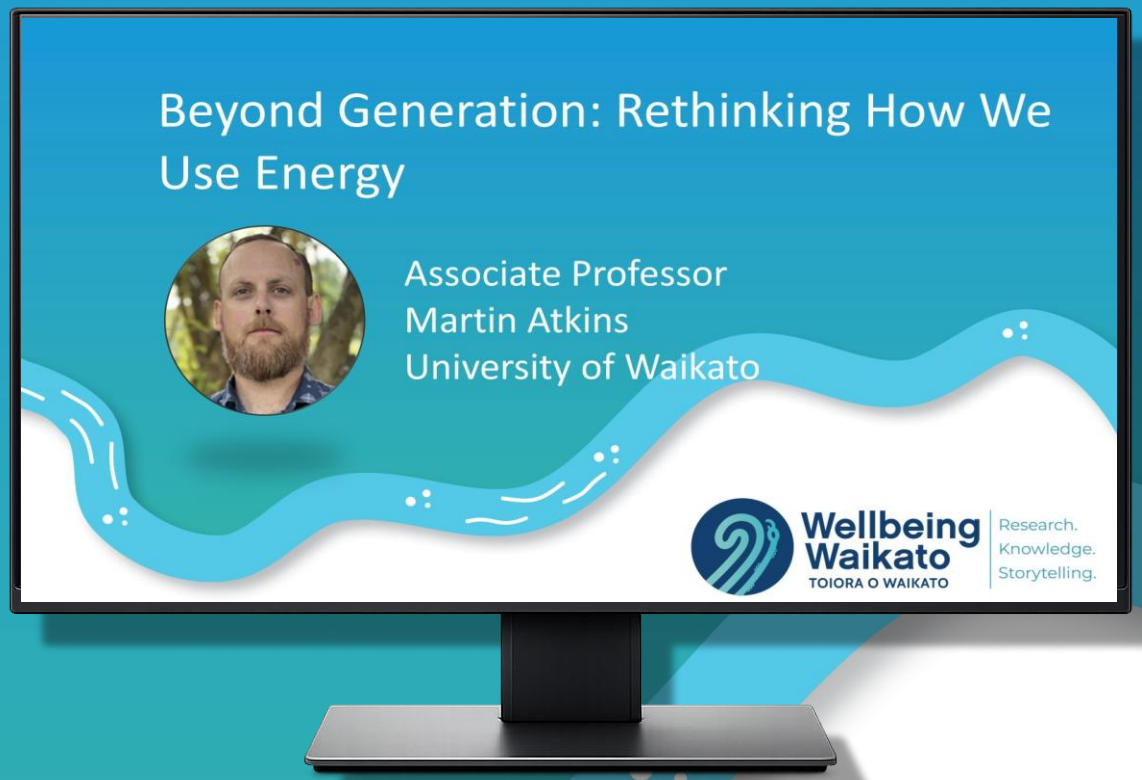
Waikato Affordable Energy Webinar Series

June-November 2026

Wellbeing Waikato
TOIORA O WAIKATO

Research.
Knowledge.
Storytelling.

To View This Webinar On Line, Click on the Image Below



Wellbeing Waikato
TOIORA O WAIKATO
Research.
Knowledge.
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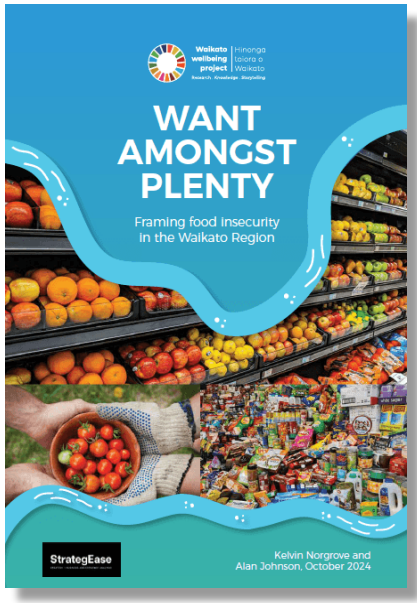
Wellbeing Waikato

Wellbeing Waikato
TOIORA O WAIKATO
Research. Knowledge. Storytelling.

Independent Charitable Trust focused on:

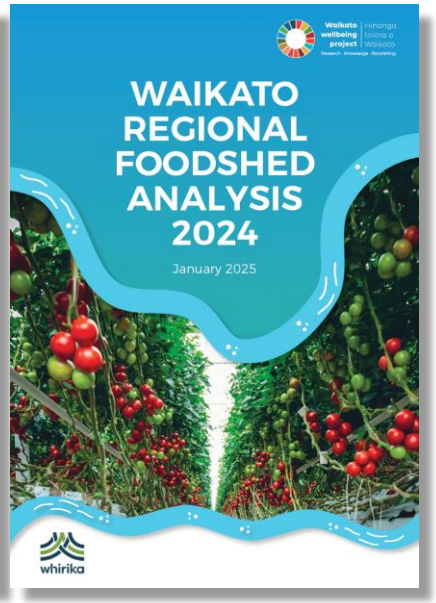
- Regional intelligence about what's most important to households and whanau
- Identifying emerging opportunuities and risks early
- Surfacing underlying drivers, not just symptoms
- Convening government, iwi, councils, community organisations and the private sector around decision-useful insights.

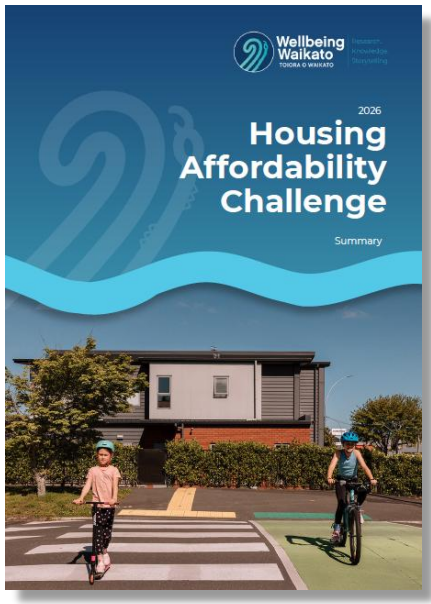






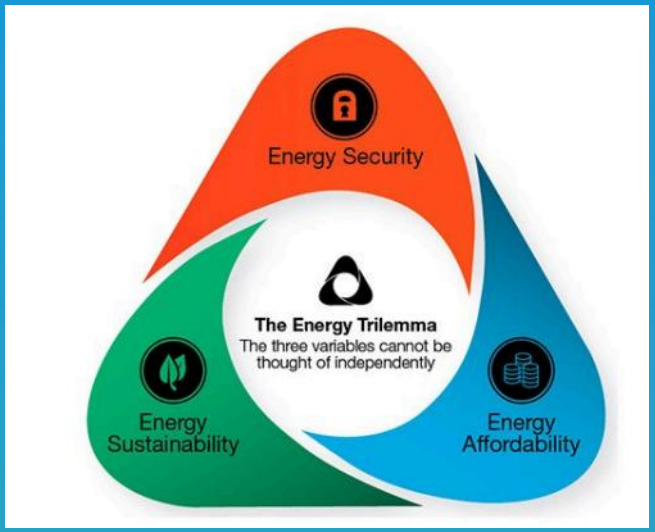






Energy systems need to be:

- Affordable
- Reliable
- Sustainable



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4 Big Questions

1. How does the electricity system actually work—and why is it designed this way?
2. What drives power prices, and how could they be made more affordable?
3. How does energy affordability affect household and community wellbeing?
4. What would a better system look like—and how do we get there?

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Beyond Generation: Rethinking How We Use Energy



Associate Professor
Martin Atkins
University of Waikato

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CENTRE FOR SMART ENERGY SYSTEMS

The Ahuora Project: Accelerating Industrial Decarbonisation with Digital Twin and Heat Pump Technology

Associate Professor Martin Atkins

School of Engineering, University of Waikato

Outline

- Introduction
- NZ Wholesale Market Research
- Industrial Process Heat – Ahuora Project

THE UNIVERSITY OF WAIKATO

Te Whare Wānanga o Waikato

SCHOOL OF ENGINEERING

~1100 Students

- 25 Years (2027)

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CENTRE FOR SMART ENERGY SYSTEMS

Advanced Energy Technology Platform funding

- $12.5 Million / 7 years
- Started Oct 2020



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NZ Wholesale Market Research

Jack O'Leary – PhD Candidate



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PhD Work – Jack O'Leary

- Energy and electricity systems undergoing enormous changes
- Increasing variable renewables
- Decreasing fossil fuelled dispatchable sources









https://businessdesk.co.nz/article/energy/genesis-looks-at-expansion-of-huntly-power-station
https://www.bbc.com/news/business-65321487

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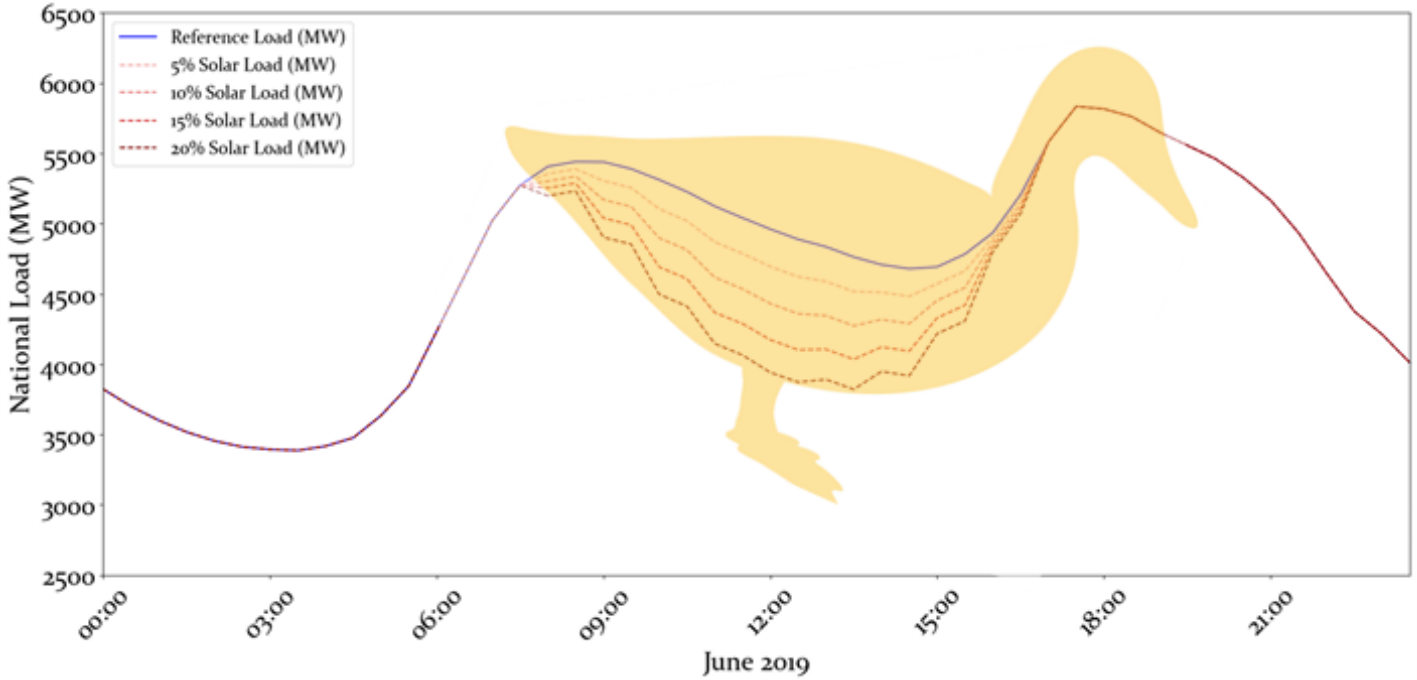
https://www.nzherald.co.nz/nz/politics/another-blow-for-industry-methanex-proposes-idling-one-plant-indefinitely-job-cuts/FZS76HTRDJAEVN3RS4YAWXJXFQ/
https://www.ea.govt.nz/news/eye-on-electricity/changing-winds-how-wind-energy-interacts-with-the-new-zealand-power-system/

Changing electricity systems

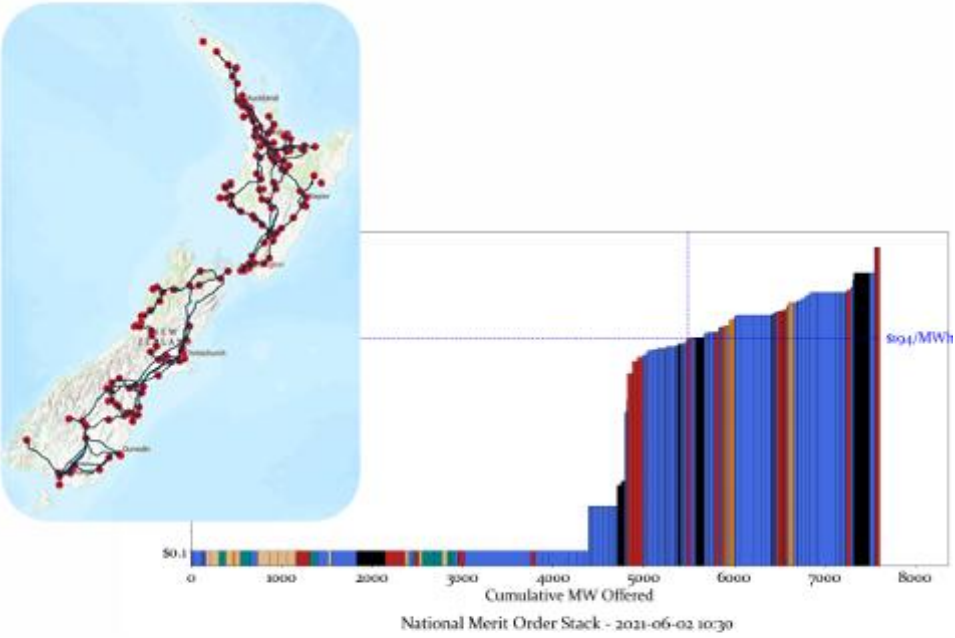
- Generation to come from **Wind, Solar, Geothermal**
- Solar has low CAPEX, but is only available during the day
- Increasing solar capacity can exacerbate issues
- Potential to increase **variability** in the market

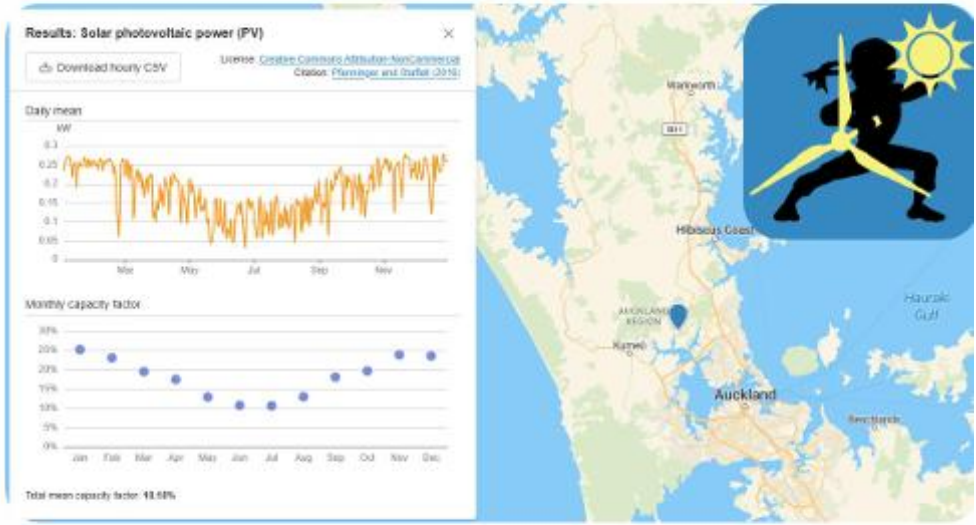


Understanding how generator behaviour will adapt to NZ's changing electricity system

How

- Using **vSPD** – Publicly available verified replica of system operator's market clearing engine
- **High granularity PV** data
- **Historical operational and environmental data** to inform offer emulator framework
- **Scenario-based behavioural models** applied to operator pricing strategies
- Scenario-based models of **future demand and generation** landscapes





Transpower, SPD 101, (2025) https://static.transpower.co.nz/public/bulk-upload/documents/SPD101.pdf?VersionId=jKntNdYQZFm9t_bbtbd5V4GypKuVl8aj

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Transpower, SPD 101, (2025) https://static.transpower.co.nz/public/bulk-upload/documents/SPD101.pdf?VersionId=jKntNdYQ

vSPD

- **Scheduling, Pricing, and Dispatch (SPD):**
- The SPD model is the **market clearing engine** used by the **system operator**
- The NZ power system is modelled as a series of **nodes** (GXPs) connected by **branches** (Transmission lines)
- **vSPD – Publicly available verified replica** of SPD



Transpower, SPD 101, (2025) https://static.transpower.co.nz/public/bulk-upload/documents/SPD101.pdf?VersionId=jKntNdYQZFm9t_bbtbd5V4GypKuVI8aj

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Transpower, SPD 101, (2025) https://static.transpower.co.nz/public/bulk-upload/documents/SPD101.pdf?VersionId=jKntNdYQ

vSPD

Inputs:

- Energy offers
- Demand bids
- Demand forecast
- Dispatchable demand
- Power reserve Requirement
- Network data
- Security constraints



Outputs:

- Dispatch schedules
- Locational energy prices
- Co-optimised reserves and energy schedule

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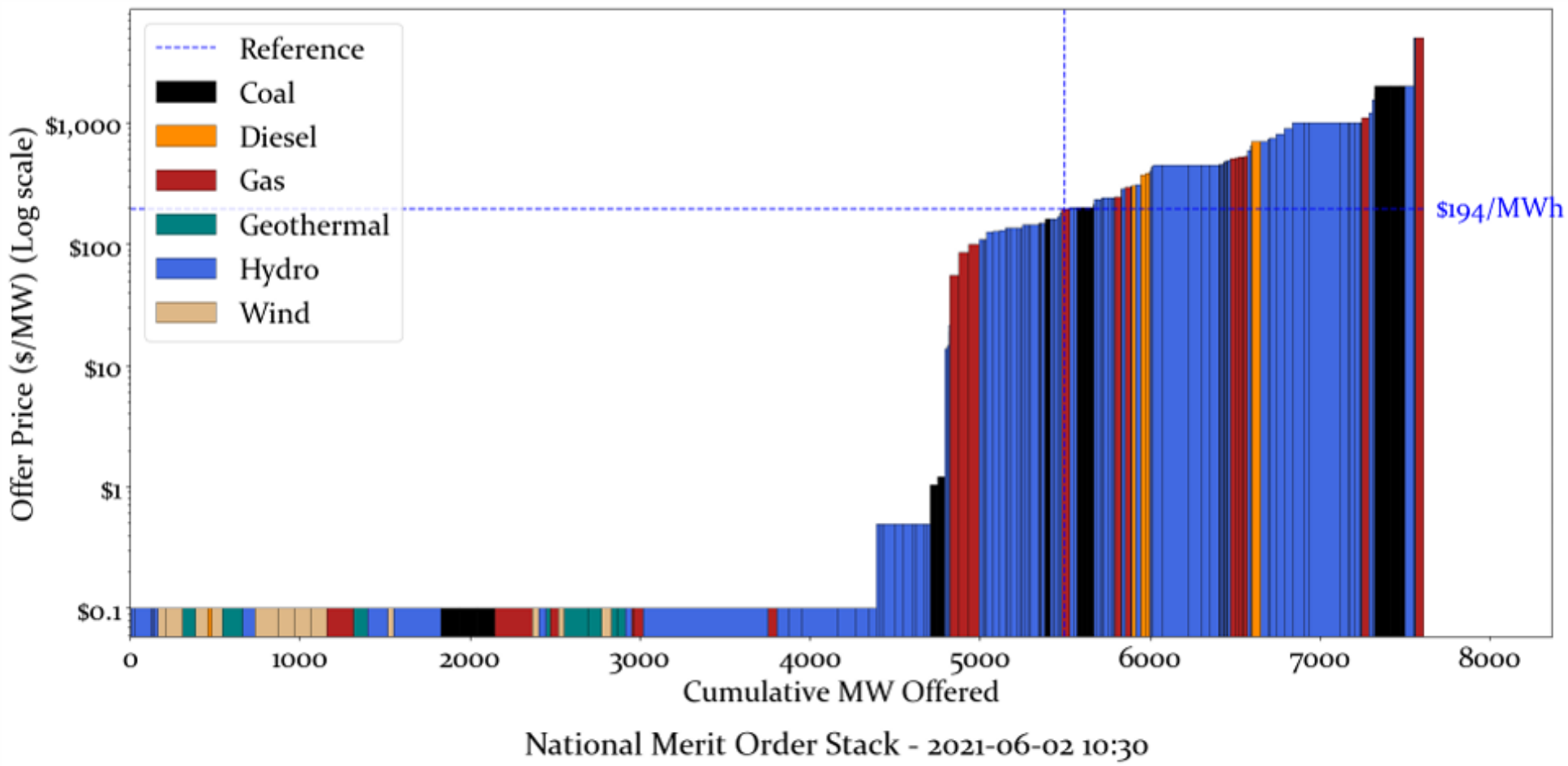
Transpower, SPD 101, (2025)
https://static.transpower.co.nz/public/bulk-upload/documents/SPD101.pdf?VersionId=jKntNdYQ

Merit Order Stack

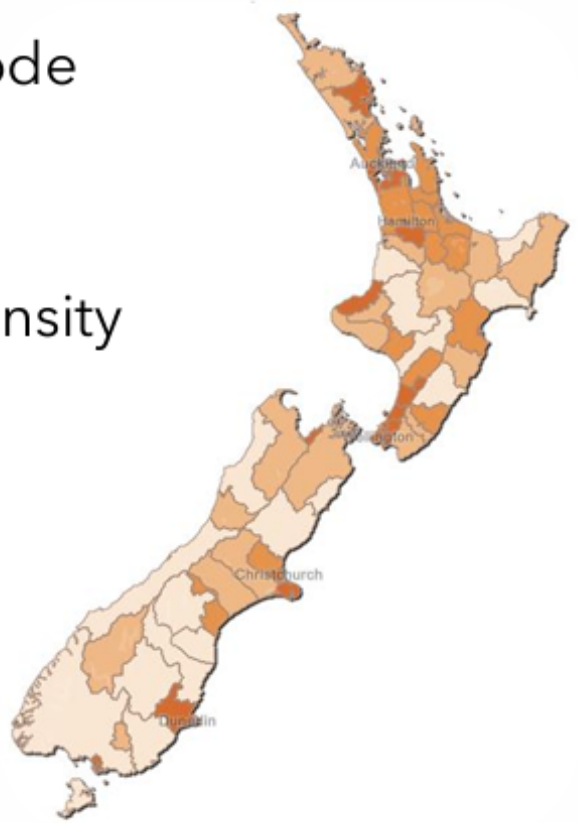


Solar generation modelling

- Generation was assumed to be a demand reduction at the node
- Utility PV – same merit order effect
- System size – 6 kW – average installed size in NZ
- Generation distributed nationally according to population density

Residential Uptake (%)	Total Installed (GW)
5	0.62
10	1.23
15	1.85
20	2.47

- Total generation capacity is 11 GW across all sources



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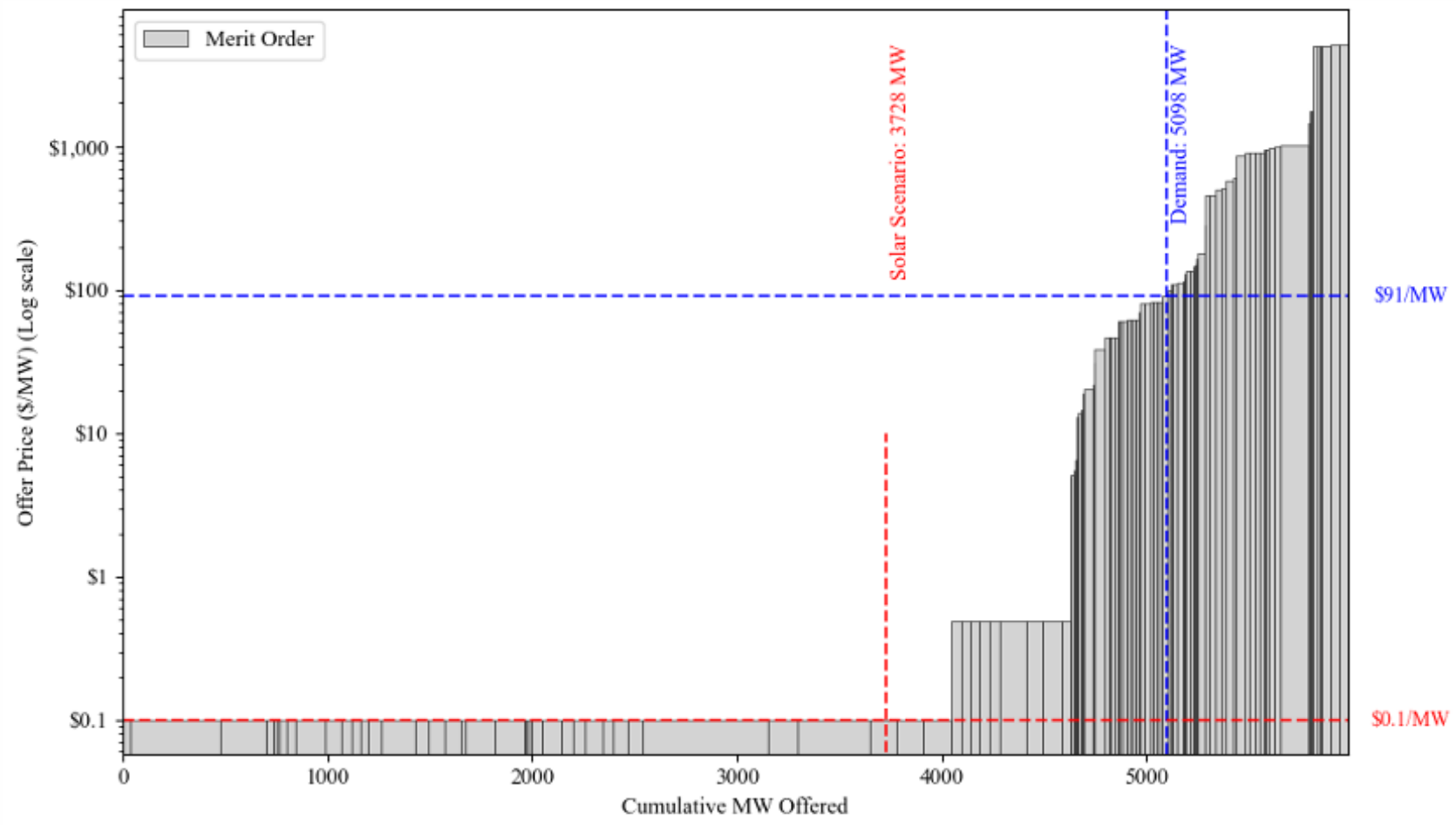
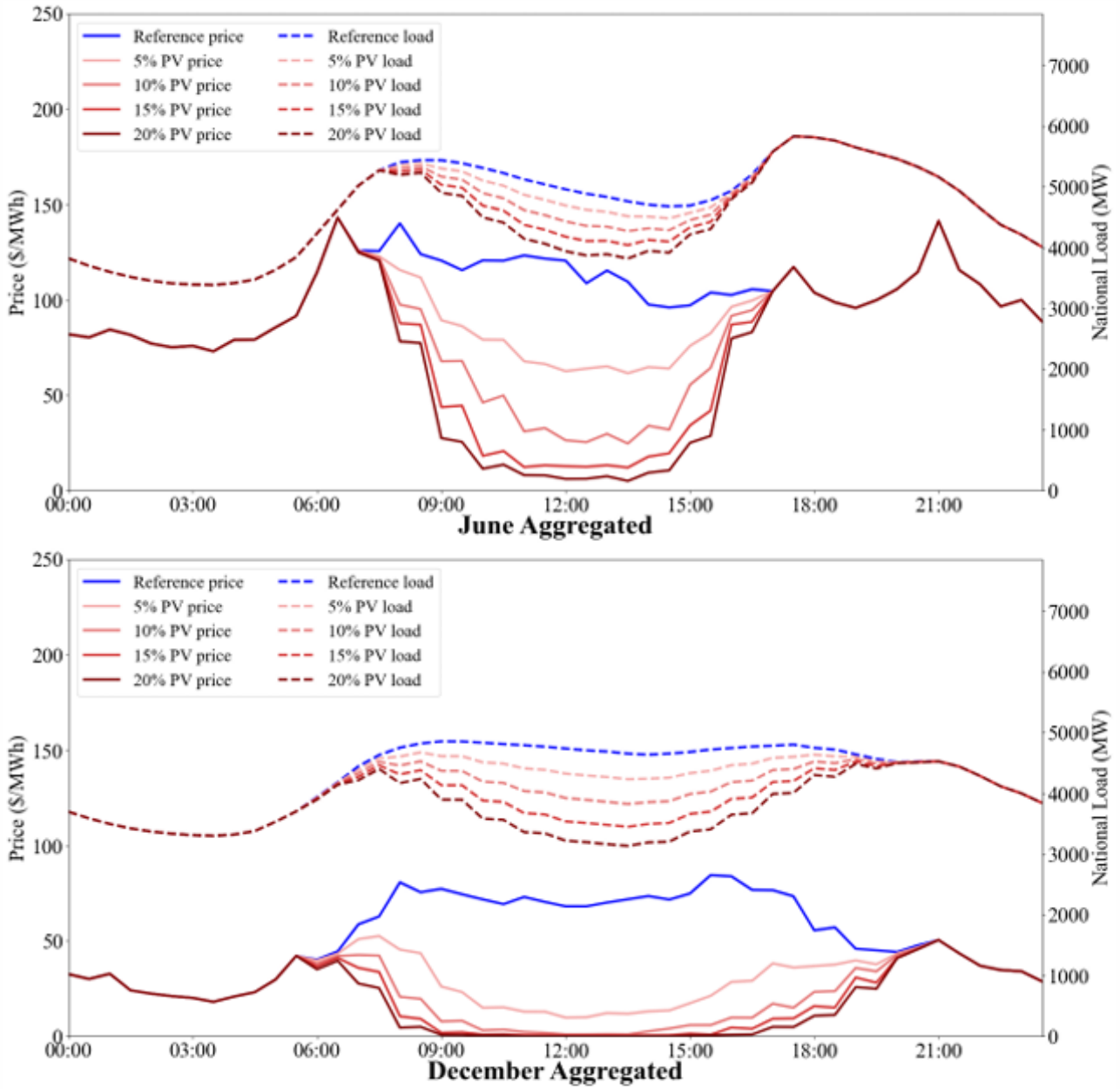
| *Stats NZ*. (2025). Govt.nz. https://www.stats.govt.nz/tools/stats-maps/

Merit Order Stack(Please refer to video for animation)



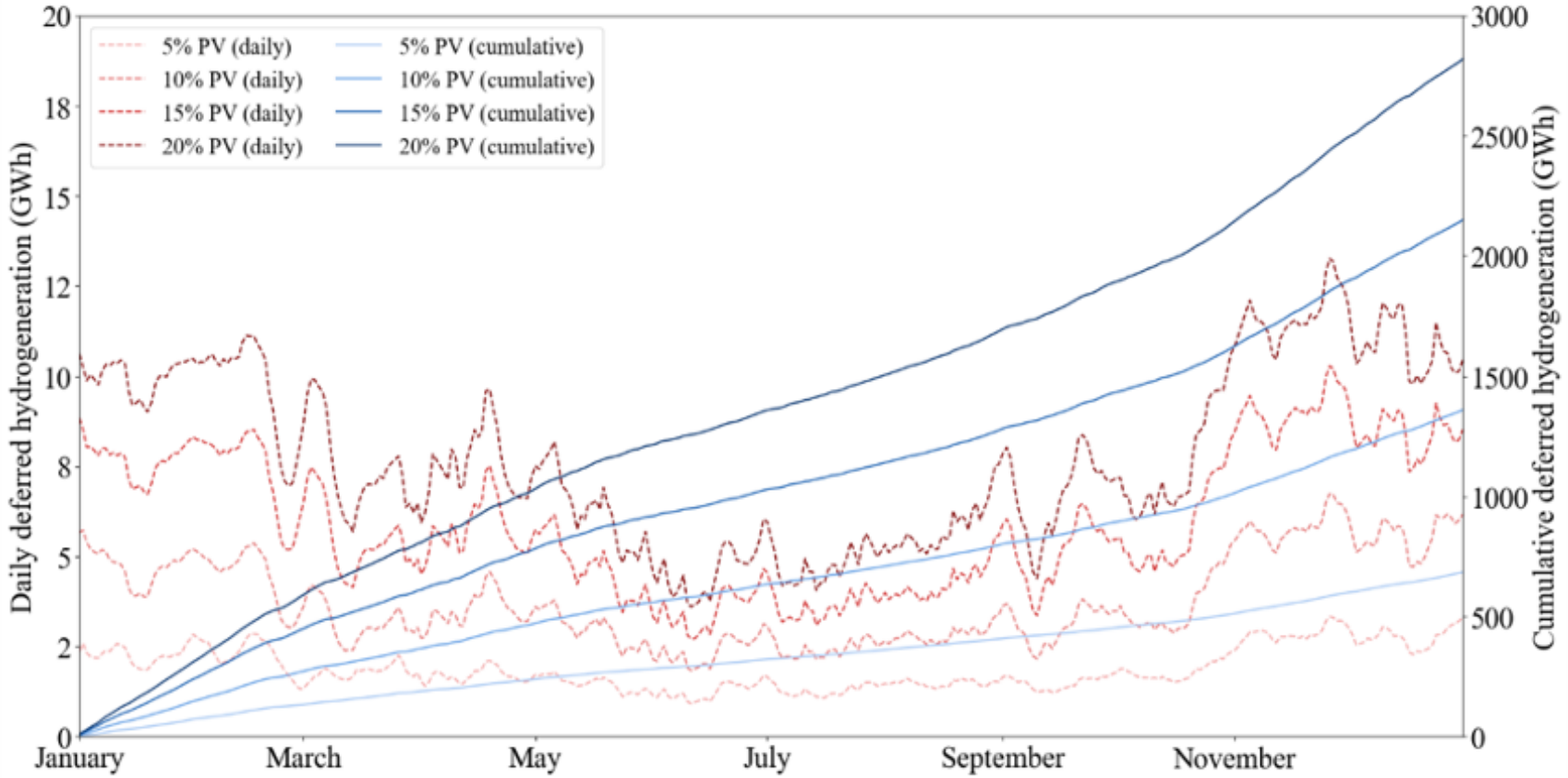
Results - Prices

- Modest residential PV uptake causes substantial price reductions during daylight hours
- December (bottom) impact is stronger than June (top) due to higher irradiance
- Reserve prices also fall with lower grid demand



Deferred hydro generation

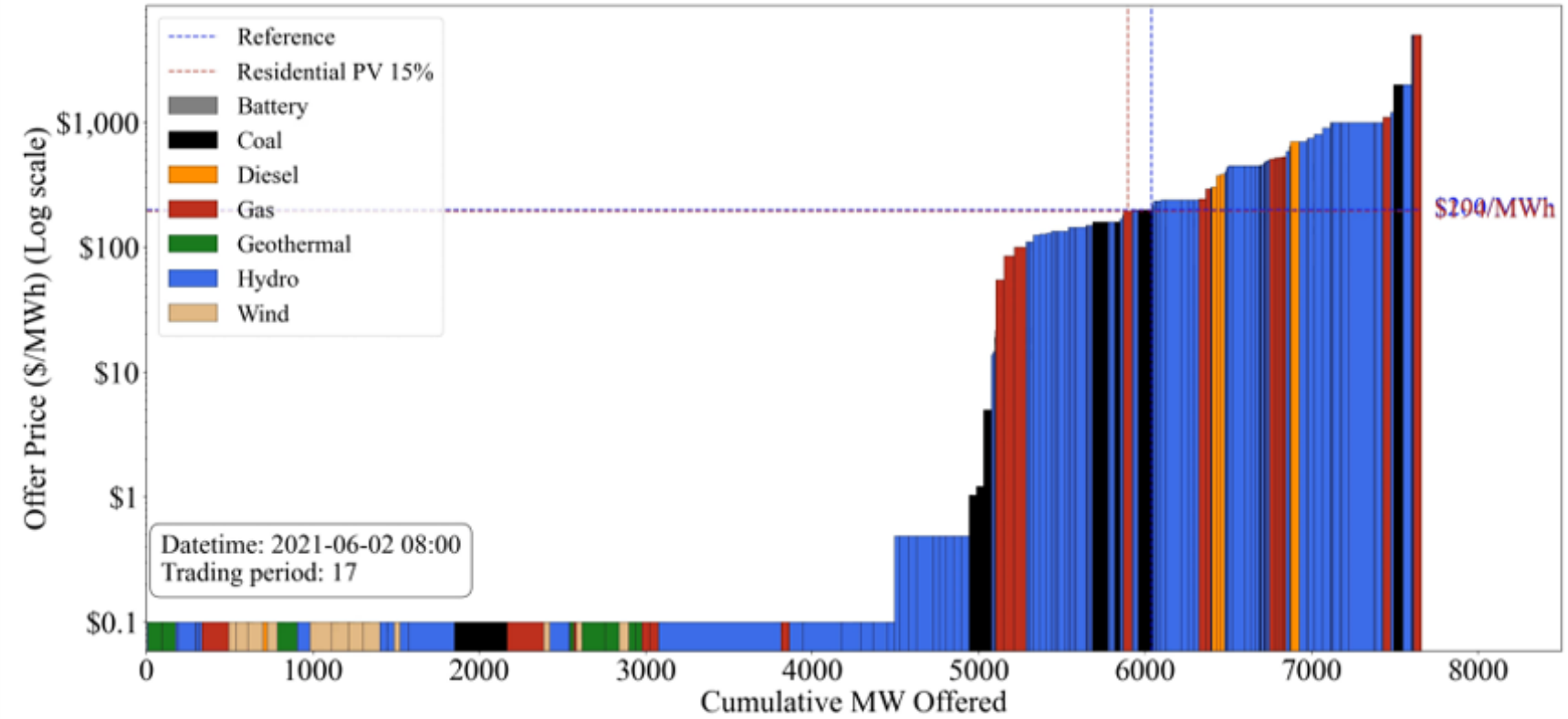
- Under these modest PV uptake levels, significant portions of hydrogeneration are deferred.
- Deferral of 700 – 2,800 GWh in 2019



Key question is – What happens to this water

Markets are dynamic

- Offer prices typically rise sharply near the anticipated point of demand



Energy 360 (2026) 141862

Contents lists available at ScienceDirect

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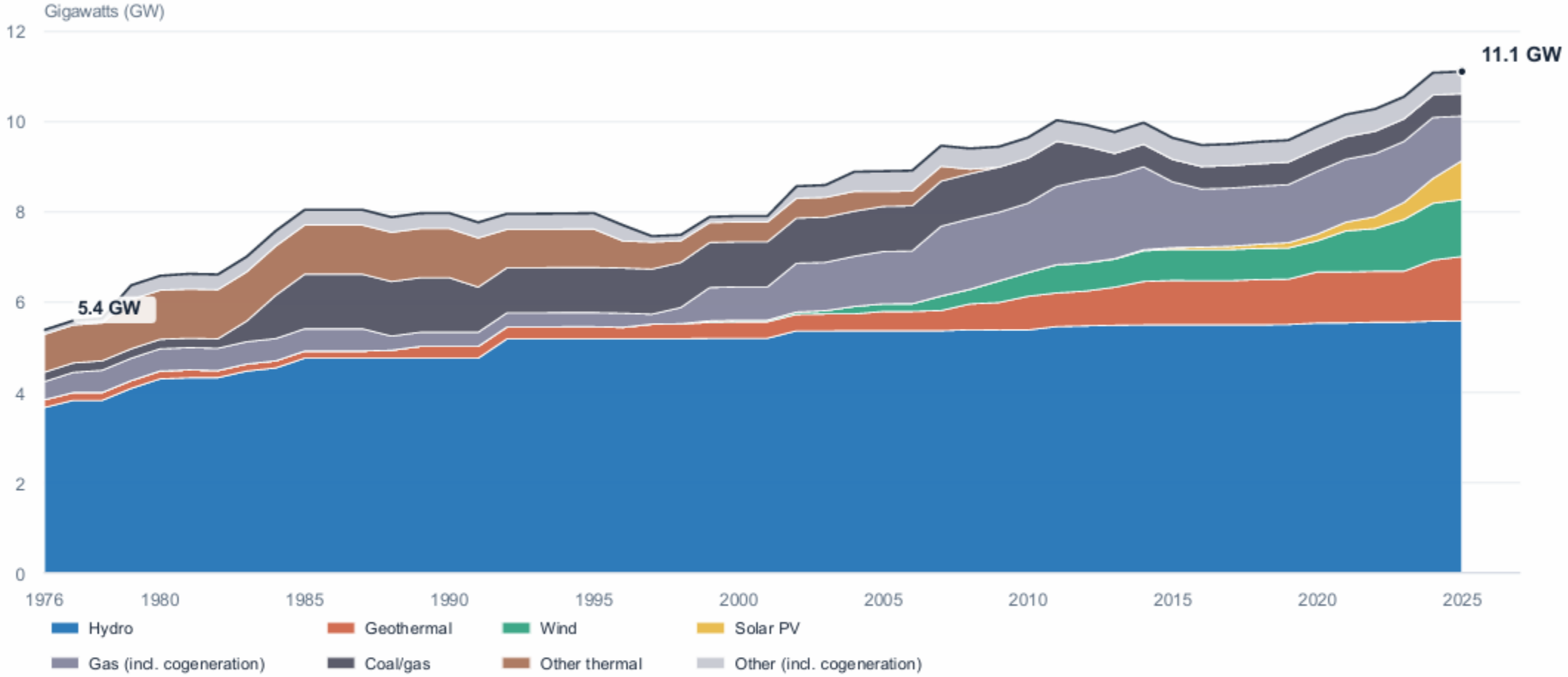
Operational and market impacts of residential solar photovoltaics using a system operator-derived dispatch framework

Jack O'Leary *, Martin Atkins, Isaac Severinsen

Ahuora – Centre for Smart Energy Systems, School of Engineering, University of Waikato, Hamilton, 3210, New Zealand

New Zealand's installed electricity generation capacity

Year-end installed capacity by plant type · 1976–2025



Notes: Gas includes gas cogeneration. "Other" combines biogas, diesel and other cogeneration.
Source: MBIE, Electricity data tables (June 2026), "7 - Plant type (MW)". Installed capacity is net of decommissioning.

Why haven't we built much generation?

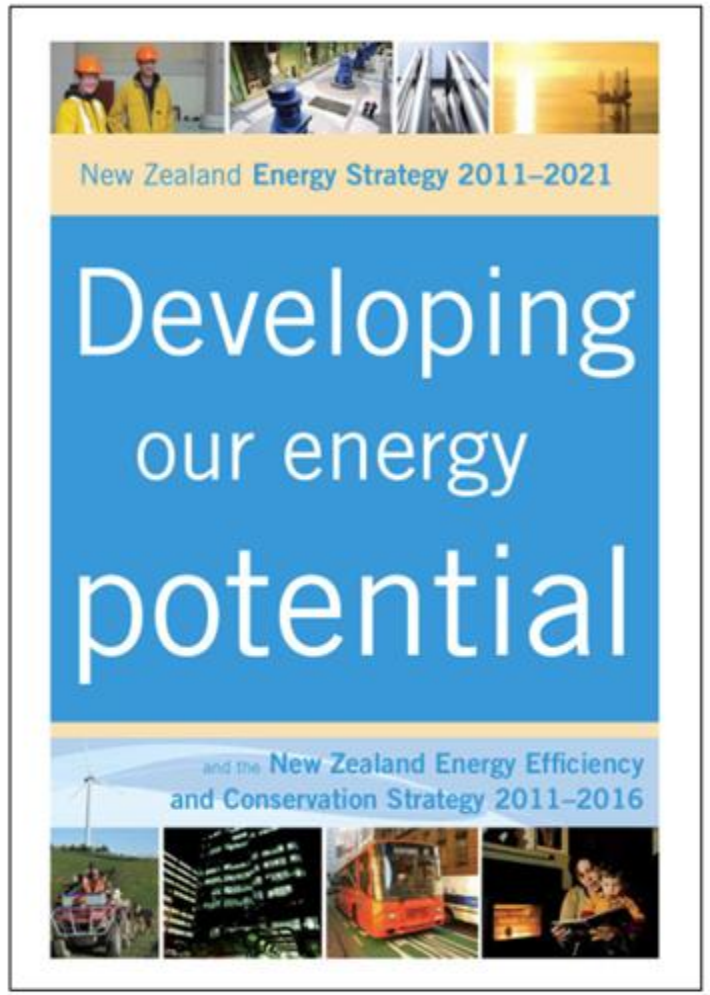
Uncertainty

- Policy Uncertainty – e.g. Lake Onslow, NZ Energy Strategy
- Demand Uncertainty / Poor Demand Growth
- Decline in Natural Gas Production



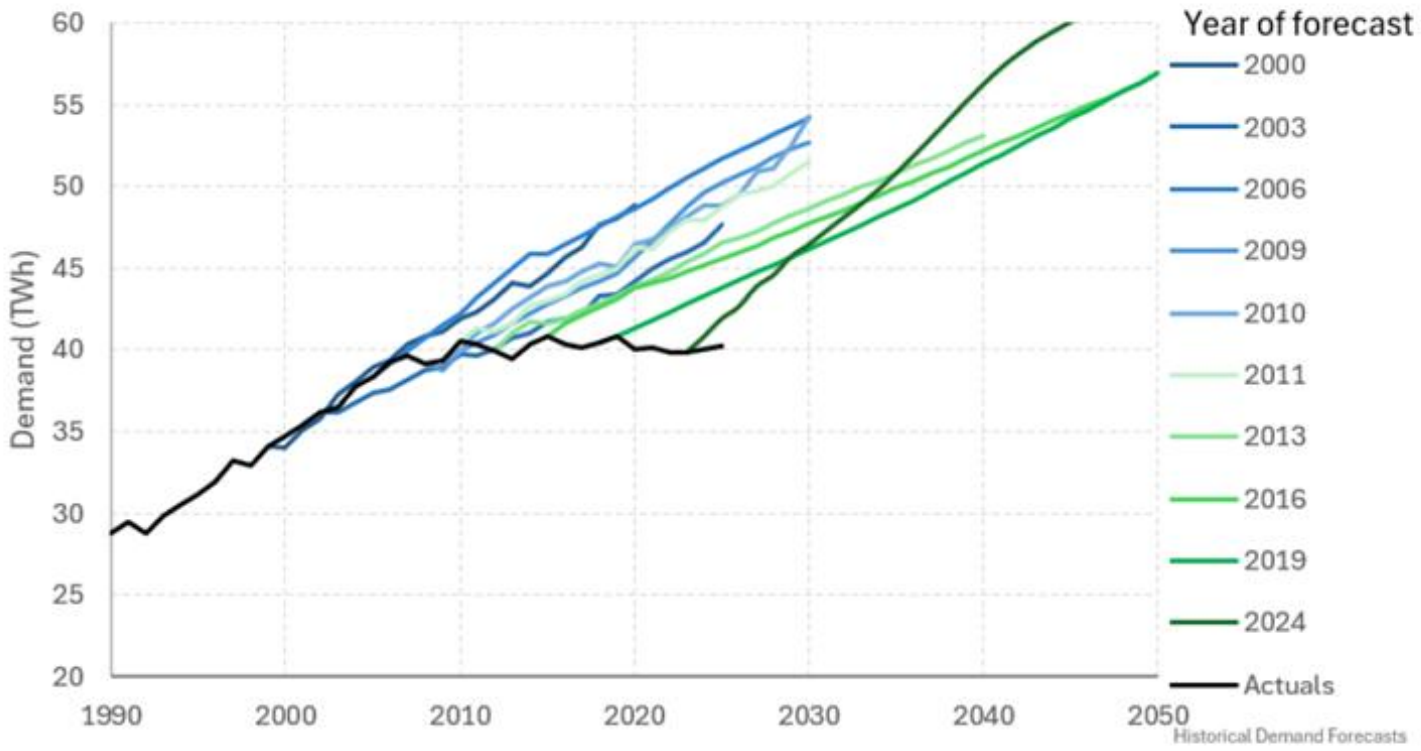
Policy Uncertainty

- No NZ Energy Strategy
  - Last one released 2011
- No cross-party agreement re energy issues
- Endless ETS uncertainty
- NZ Battery Project / Lake Onslow



Demand Uncertainty

Figure 6 - Official demand forecasts

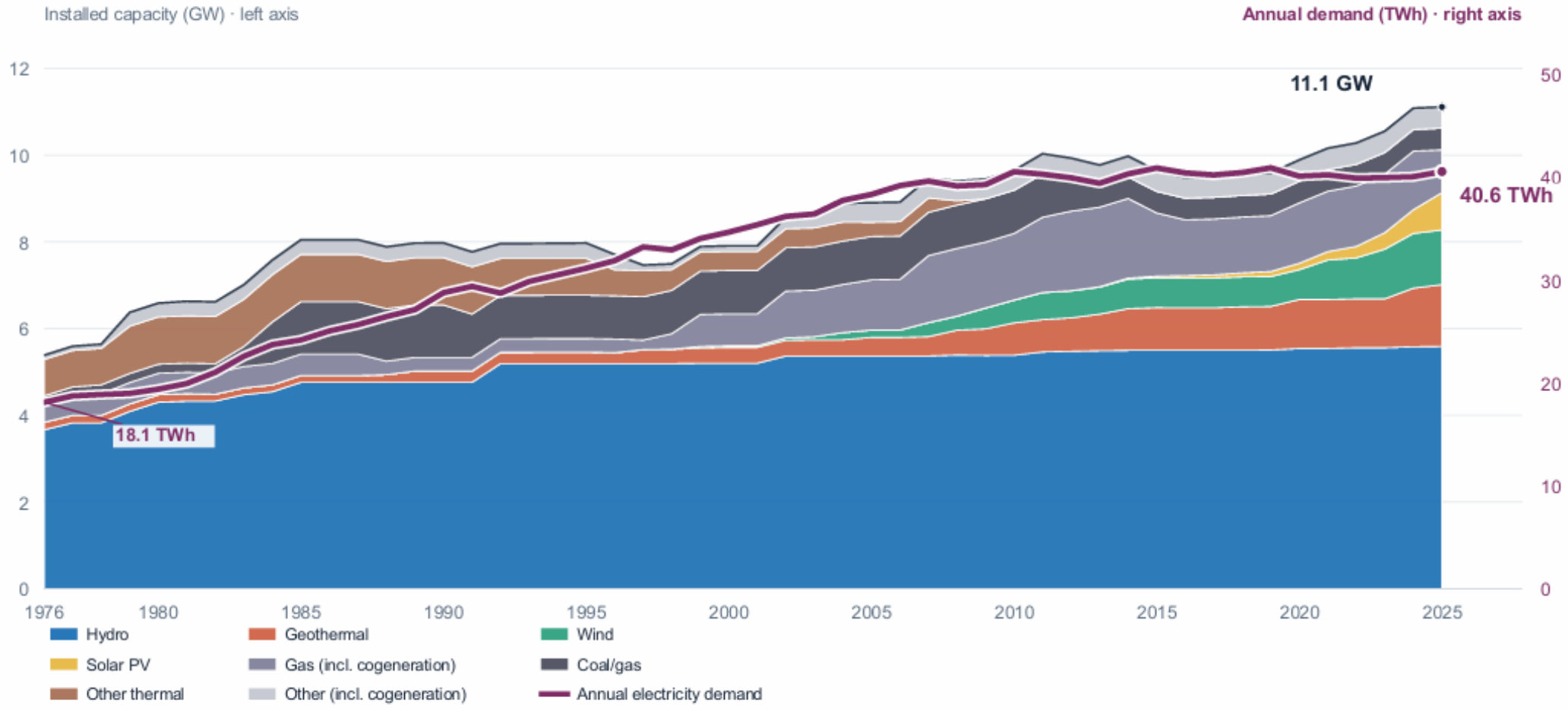


Tiwai - NZAS Uncertainty on future until Dec 2024

https://www.concept.co.nz/uploads/1/2/8/3/128396759/concept_winter_2024_review.pdf

New Zealand's electricity generation capacity and demand

Installed generation capacity by plant type, with annual electricity consumption · 1976–2025



Demand = annual electricity consumption from MBIE estimated-sales series; not peak power demand. Axes use different units.
Source: MBIE, Electricity data tables (June 2026), "7 - Plant type (MW)" and "2 - Annual GWh".

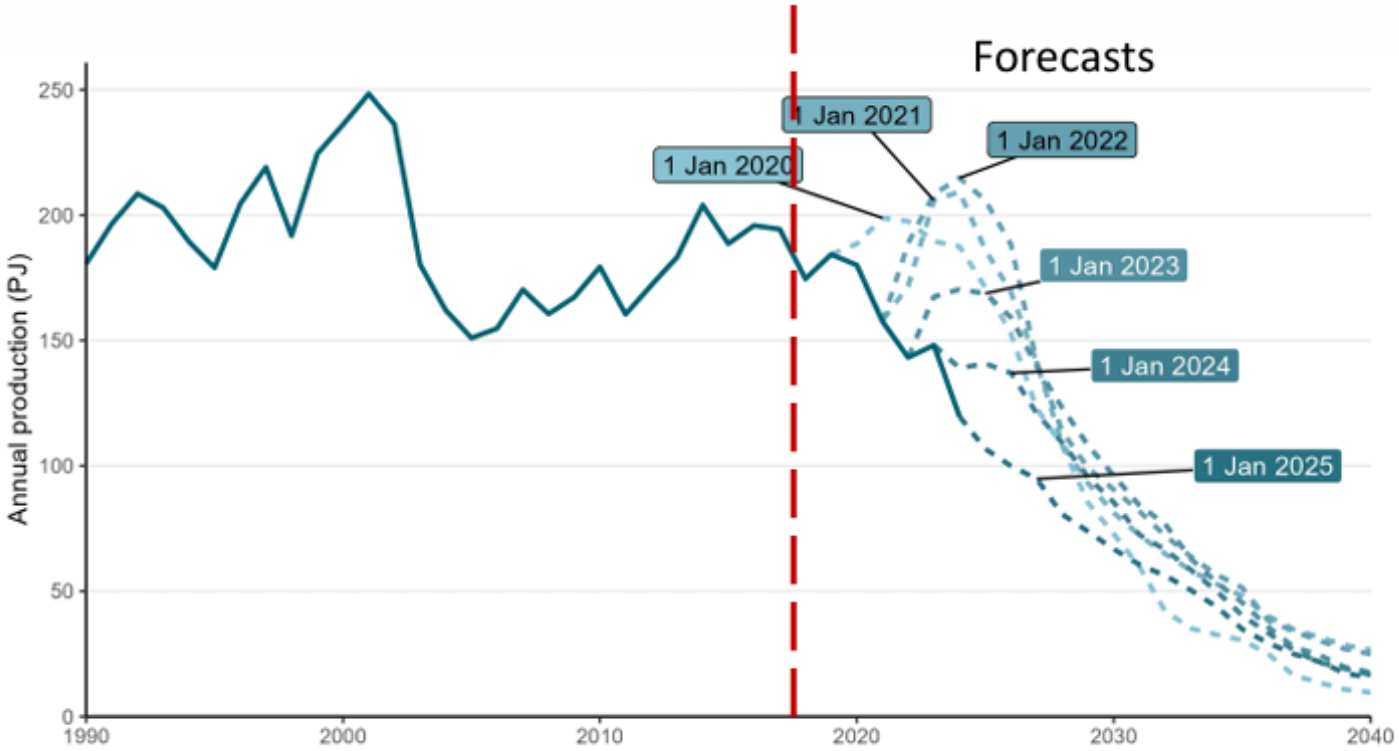
Natural Gas Decline

NEW ZEALAND

Prime Minister Jacinda Ardern bans new offshore oil and gas exploration in New Zealand

12 Apr, 2018 5:00am 5 minutes to read





Source: MBIE

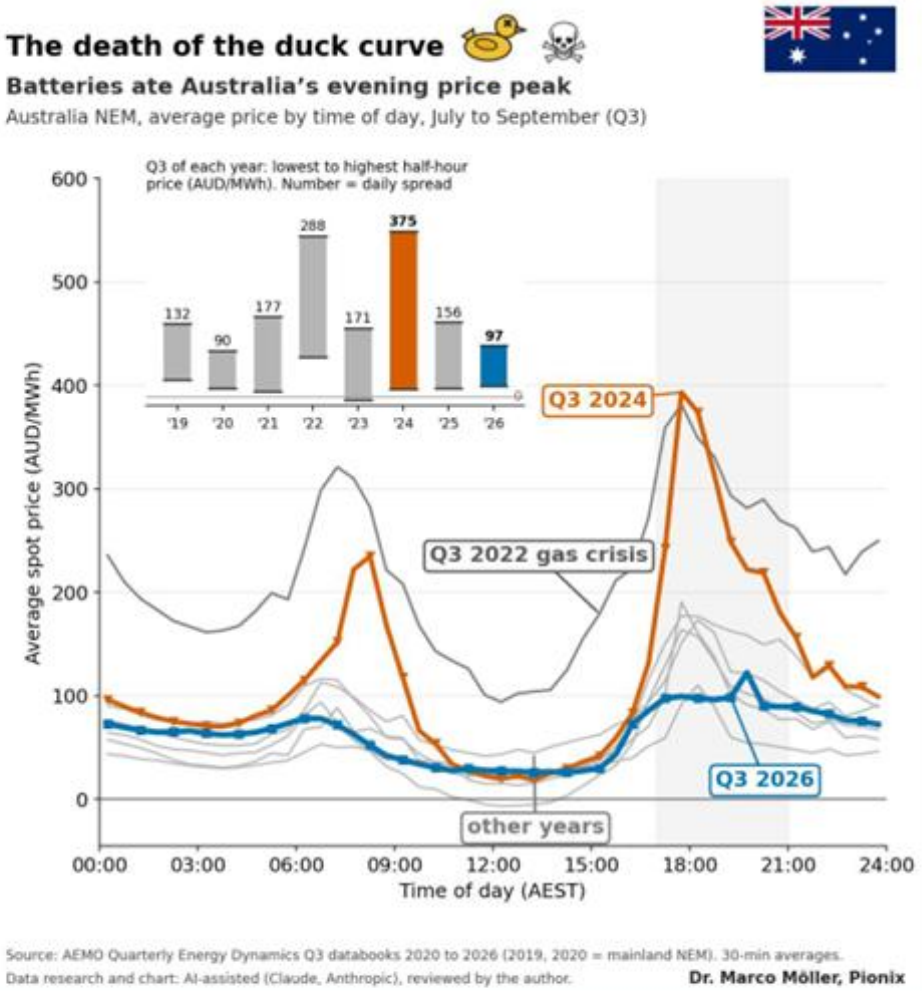
NZ Wholesale Market Design

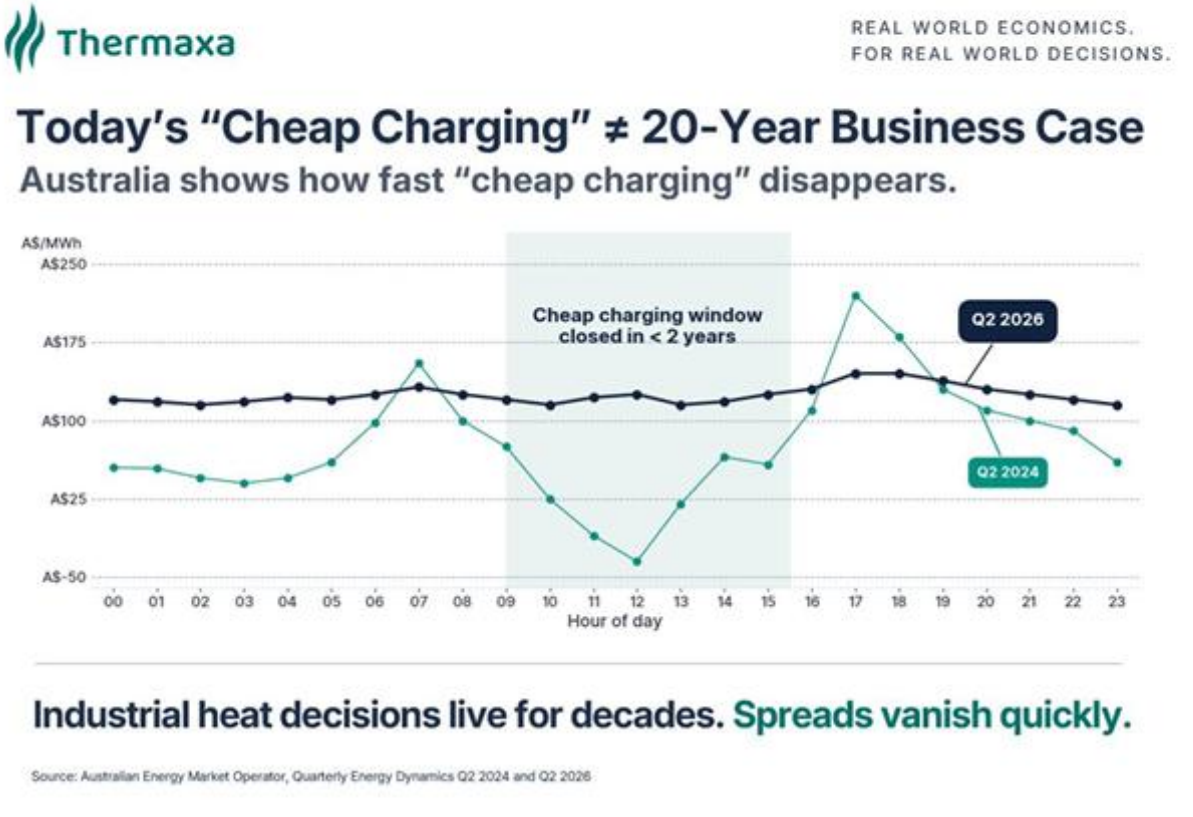
- Solar and Wind
  - Cheap when unfirmed
  - Need to also consider firming costs

- Increased non-dispatchable renewables increases price variability

- Marginal Pricing (NZ Market) more important for high degree of non-dispatchable renewables in the system
  - Sends clear price signal (especially when firming is needed)

Impact of Batteries





The Ahuora Project

- Advanced Energy Technology Platform funding
- $12.5 Million / 7 years
- 2020 – 2027

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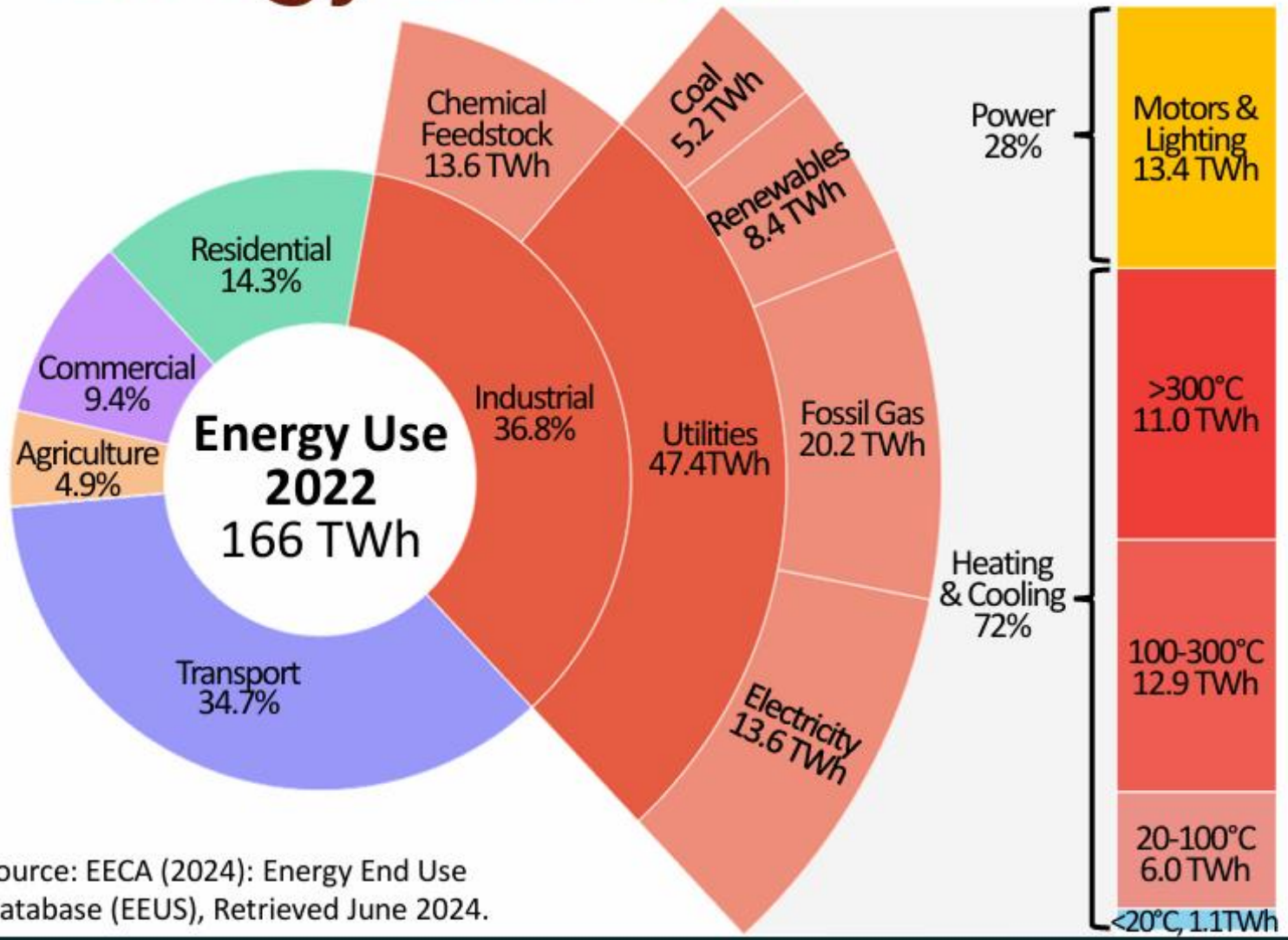
CENTRE FOR SMART ENERGY SYSTEMS

Re-engineer the way we **use**, **convert**, and **provision** energy for **process heat** using a smart systems approach

Energy End-Use



Source: EECA (2024): Energy End Use Database (EEUS), Retrieved June 2024.



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Industrial Process Heat

- Heat is larger energy demand than work (power)
  - 70 – 80% heat / 20 – 30% work
- Temperature heat is delivered at is also important
  - 80°C hot water easier than 250° hot air
- Heat is typically delivered via combustion of fossil fuels or bioenergy



Ahuora Process Heat Decarbonisation Research Programme

Plant efficiency

Boilers & Heat pumps

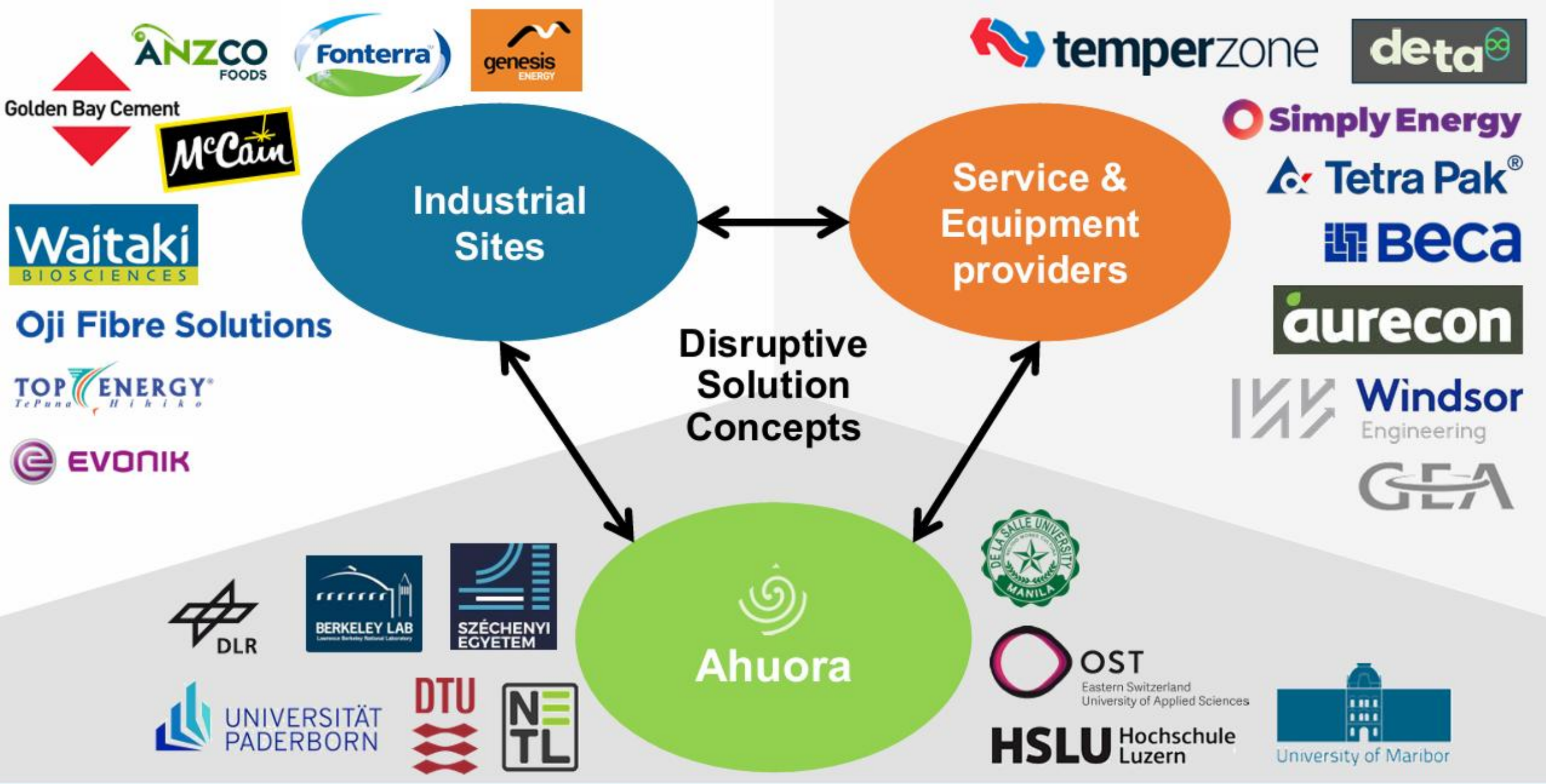
Renewable energy

- Re-engineer the way we **use**, **convert**, and **provision** energy for process heat using a smart systems approach

- Produce open-access software tools for NZ industry

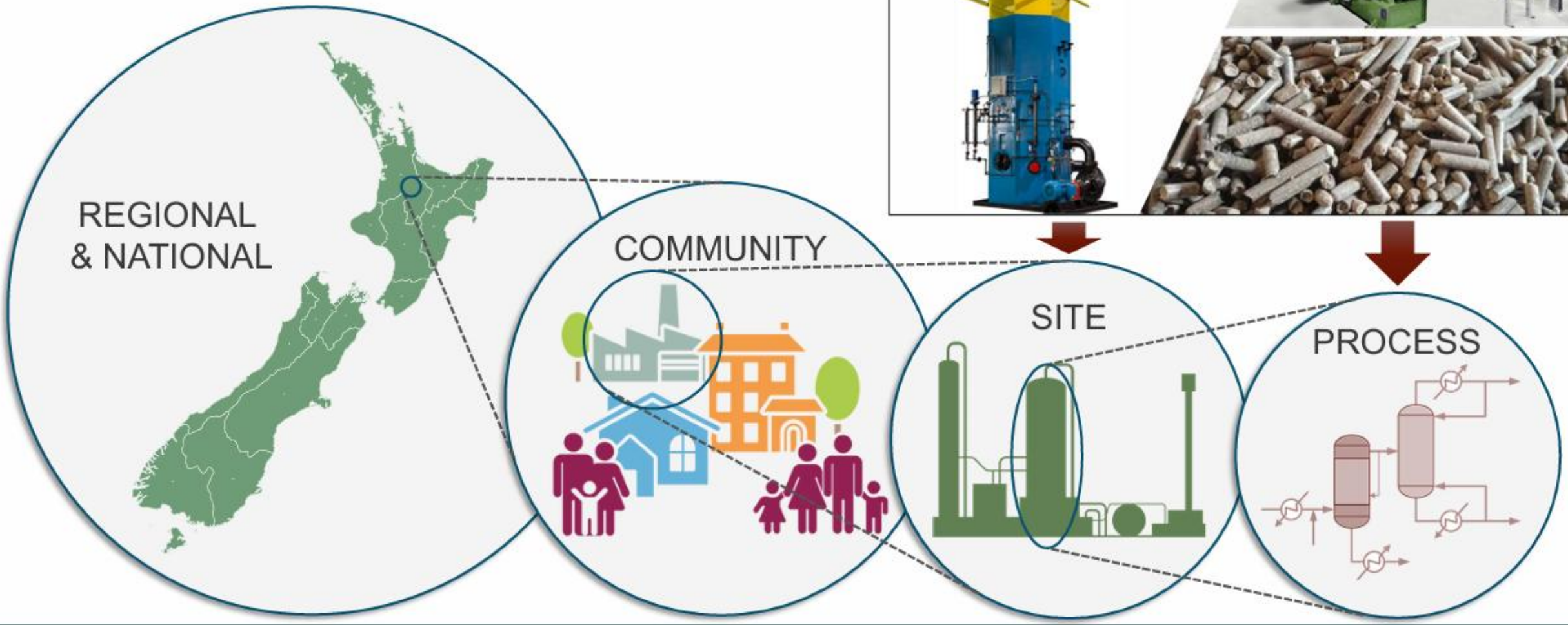
- Develop the next generation of **Digital Twin** technology called **Adaptive Digital Twin**

Smart design and operation


Industrial Sites
Service & Equipment providers
Disruptive Solution Concepts
Ahuora
ANZCO FOODS
Fonterra
genesis ENERGY
Golden Bay Cement
McCain
Waitaki BIOSCIENCES
Oji Fibre Solutions
TOP ENERGY
EVONIK
temperzone
deta
Simply Energy
Tetra Pak
Beca
aurecon
Windsor Engineering
GEA
DLR
BERKELEY LAB
SZÉCHENYI EGYETEM
UNIVERSITÄT PADERBORN
DTU
NTL
DE LA SALLE UNIVERSITY MANILA
OST Eastern Switzerland University of Applied Sciences
HSLU Hochschule Luzern
University of Maribor

Industrial Sector: Process Heat Decarbonisation



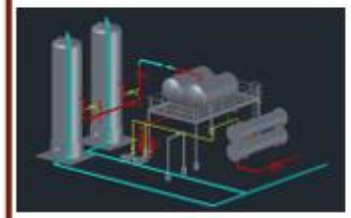


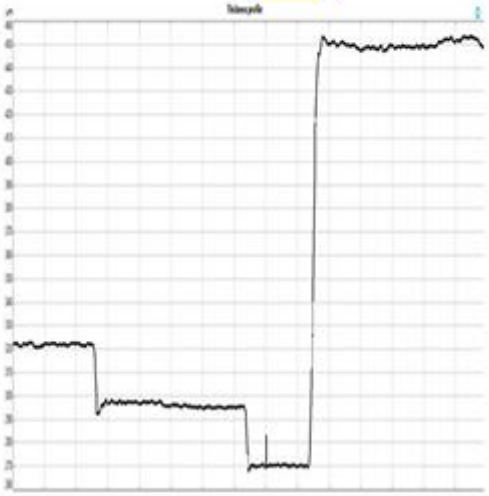
Industry Tools













Research Tools

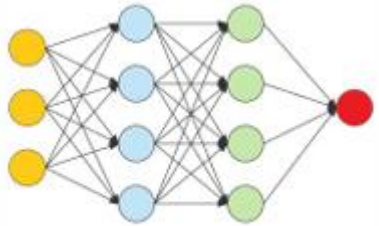




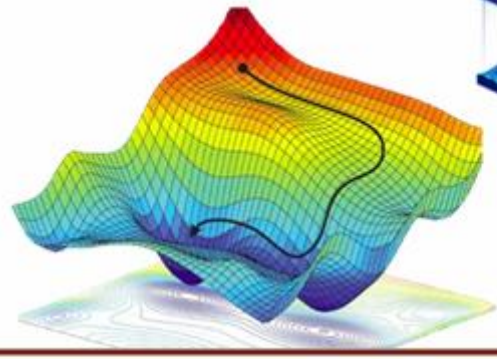




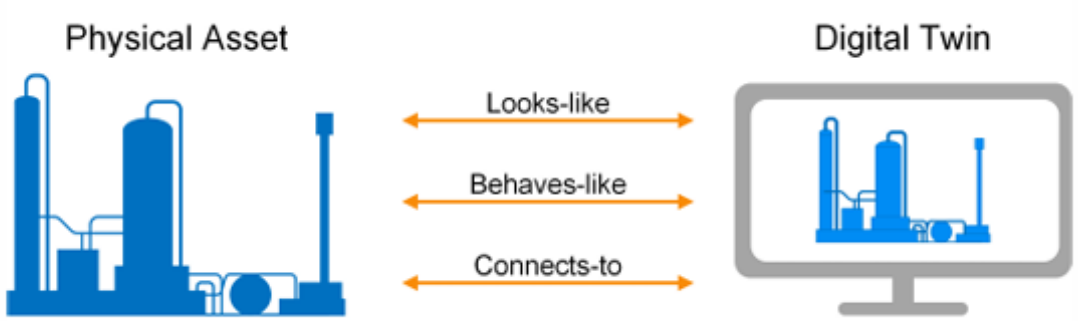


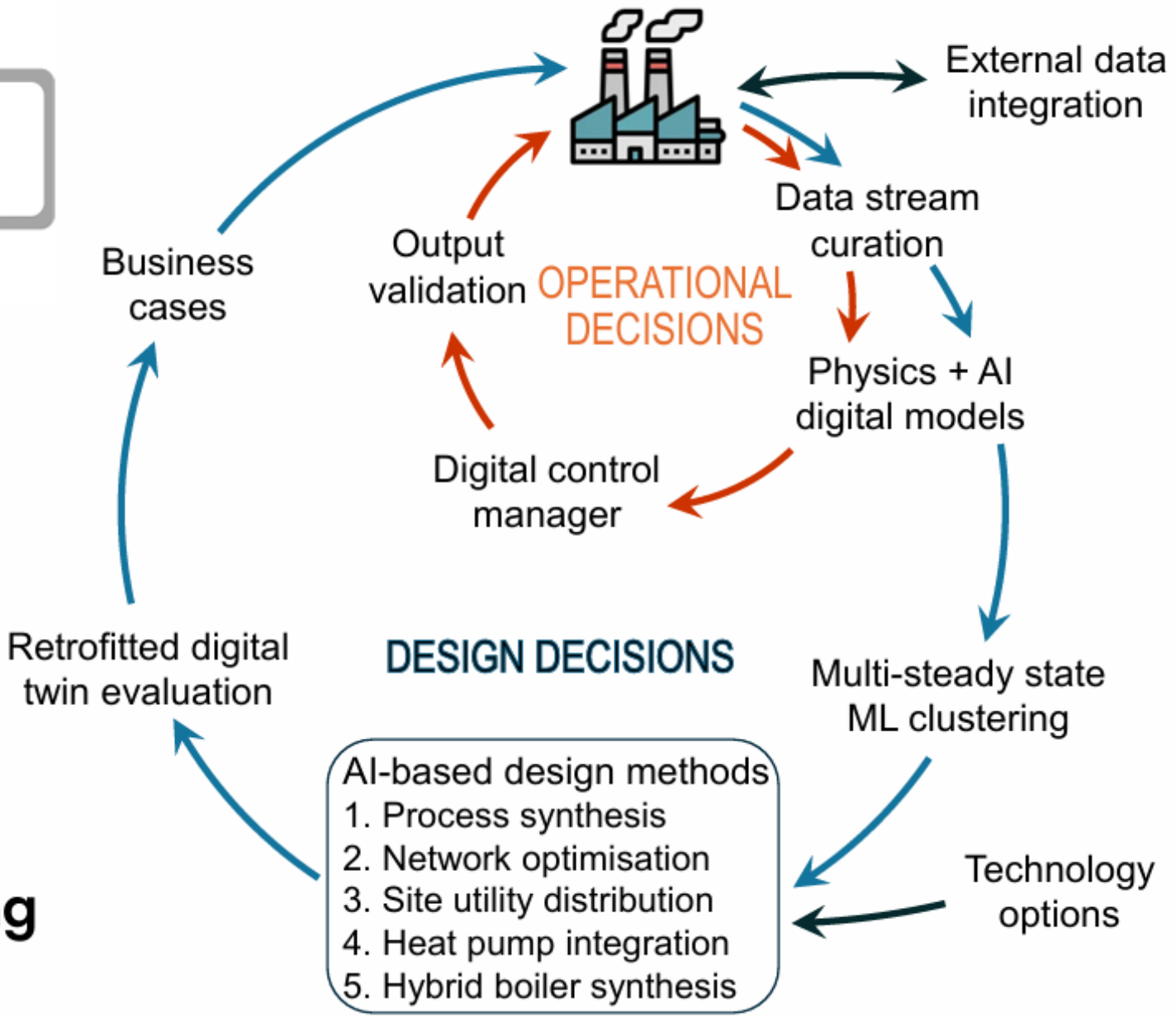












Better Design & Operation Decisions: Digital Twins & AI

Goal: improve decision-making across all "time horizons"

Future Utility Systems

Electricity vs Biomass

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1. Why electricity will replace coal in dairy plants

By Gavin Evans | 07.41am 9 July 2018



Electricity could power the boilers used to dry milk in future, rather than coal or gas. Photo by Lynn

Wednesday, **25 August 2021**

Danone showing way with biomass

50 7

Rural life > Other News



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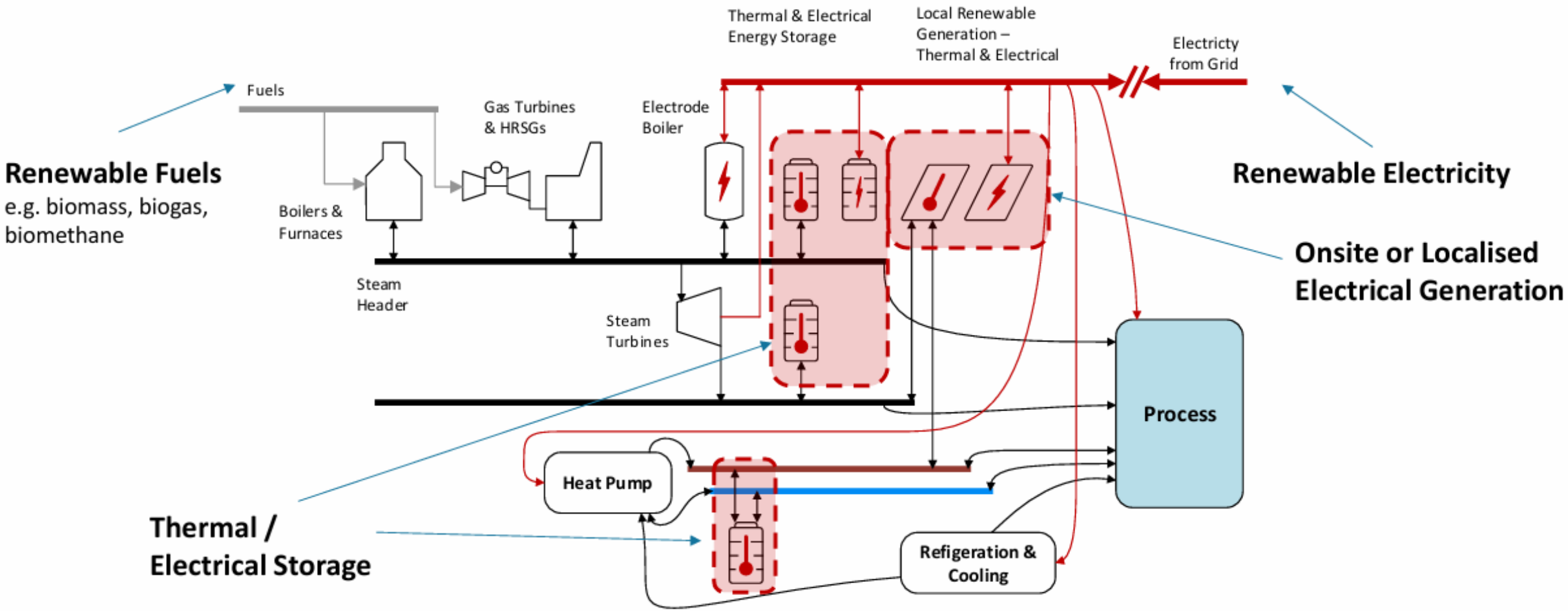
Renewable Energy Utility Systems



Example – Food Processing Site

We developed ETA roadmap for a food processor in the South Island for New Zealand



New Technology Project
10% reduction

Efficiency Projects
35% reduction
Heat Recovery
Process Optimisation

Remaining 5% emissions are from electricity grid

Fuel Switching
50% reduction
Biomass or Electrode Boilers

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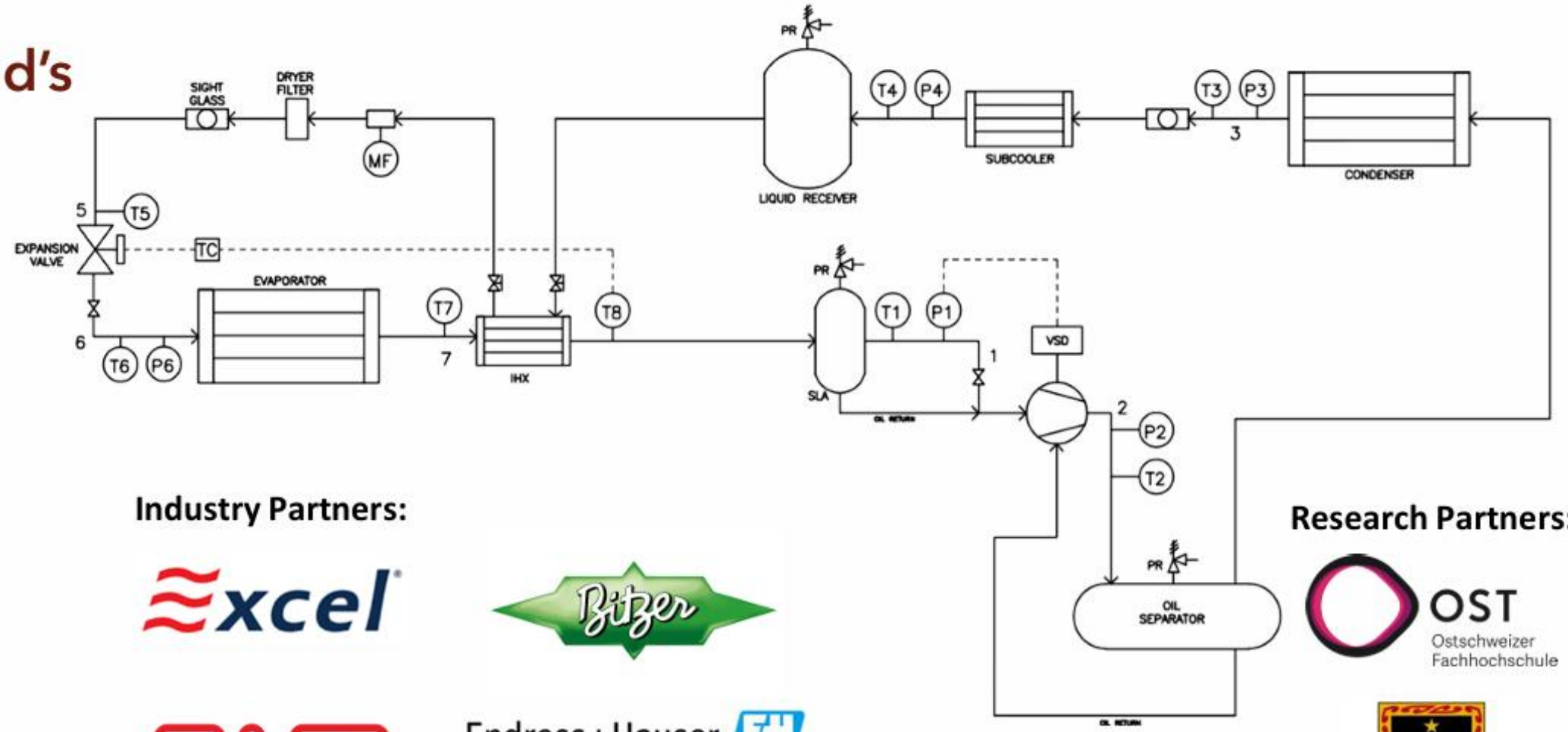
New Zealand's First Steam Generating Heat Pump (50 kW)



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climate innovations

Liquid Dynamics

Research Partners:

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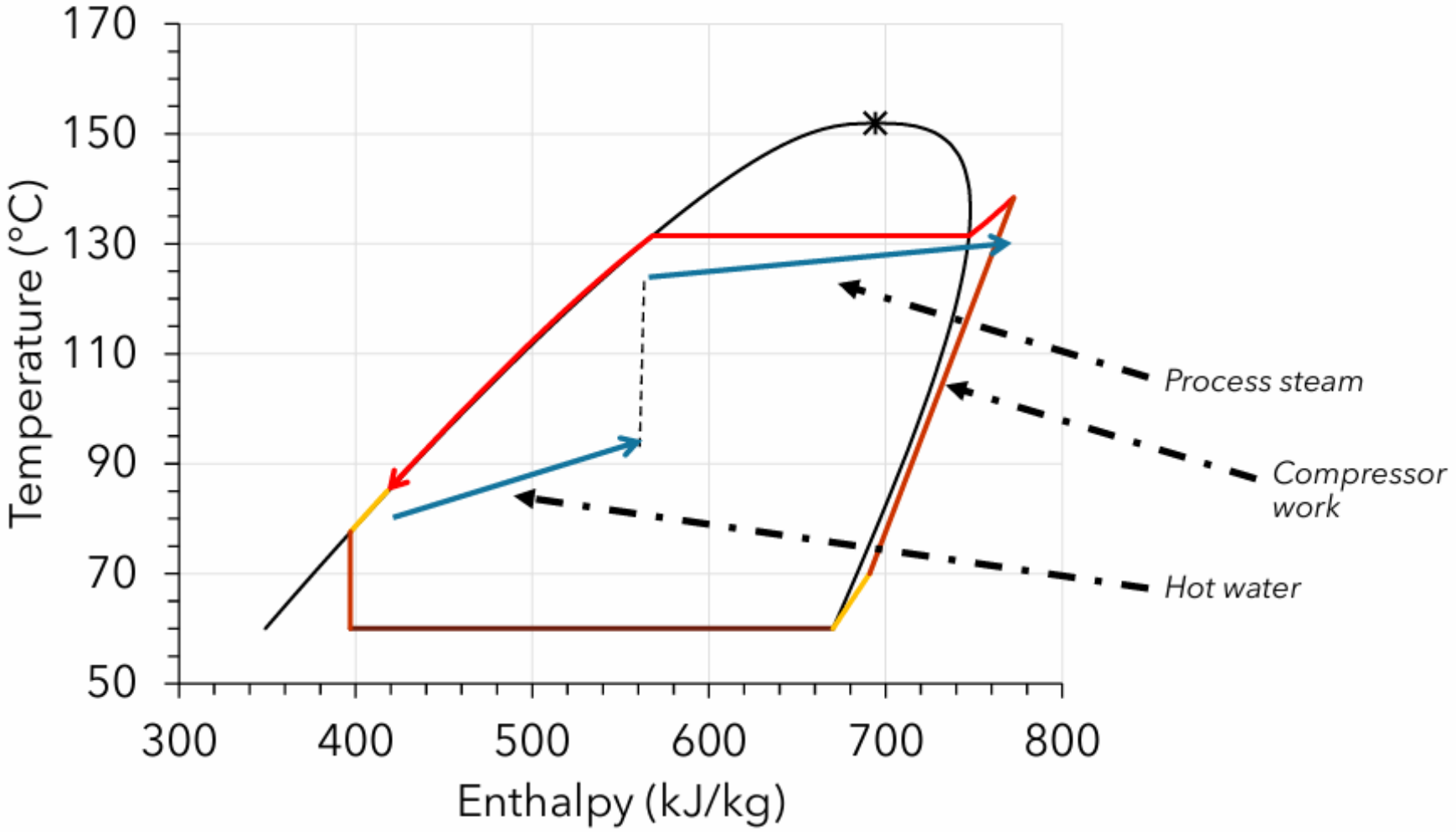
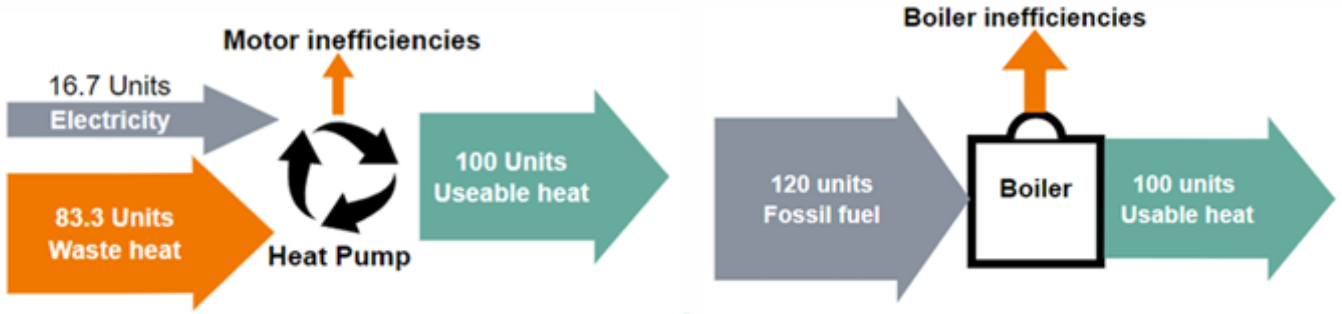
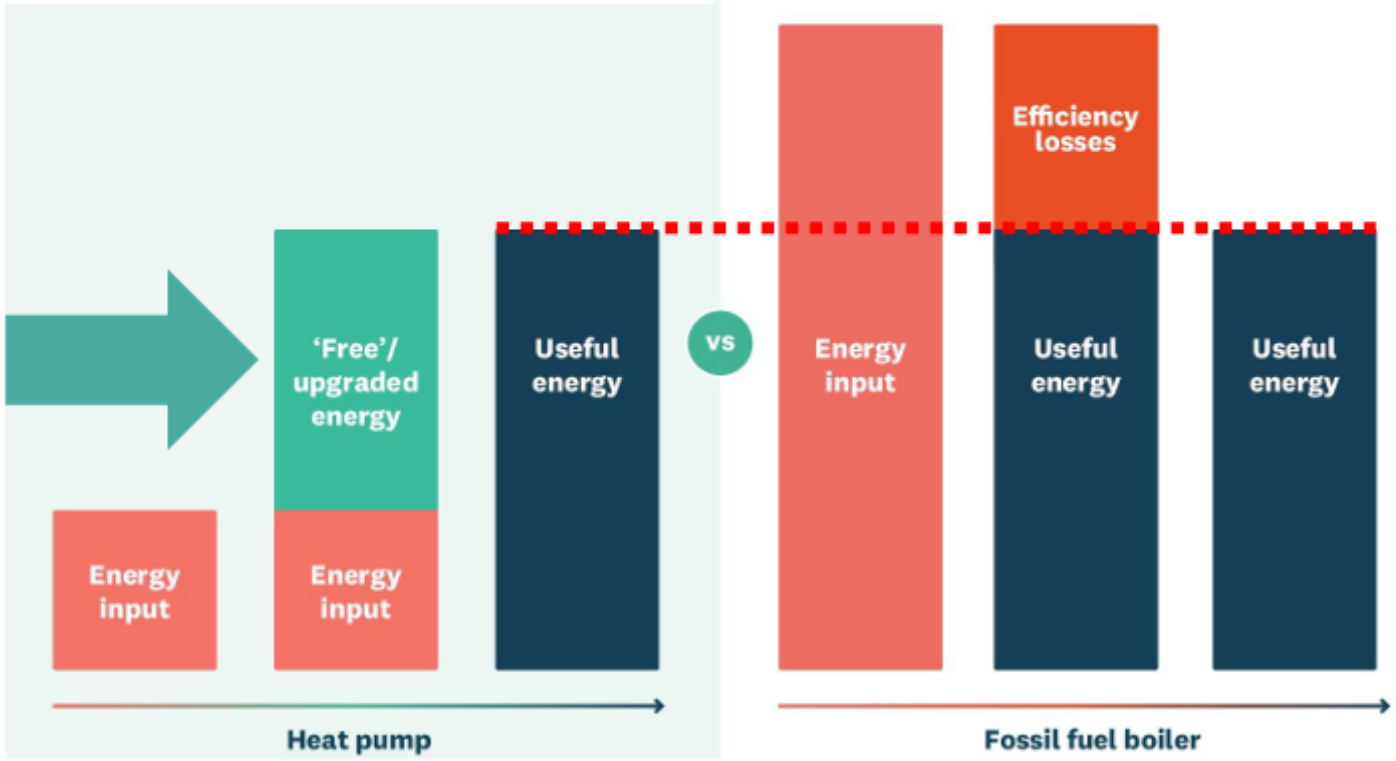
Heat Pump Technology

- Refrigerant – Butane, R600
- Target cogeneration:
  - Steam: 115 – 125 ° C
  - Hot water: 80 – 95 °C
- Source
  - Temperature: 50 – 60 ° C
  - Industrial waste heat or bottom cycle heat pump (e.g., propane, ammonia)



Heat pump vs Boiler





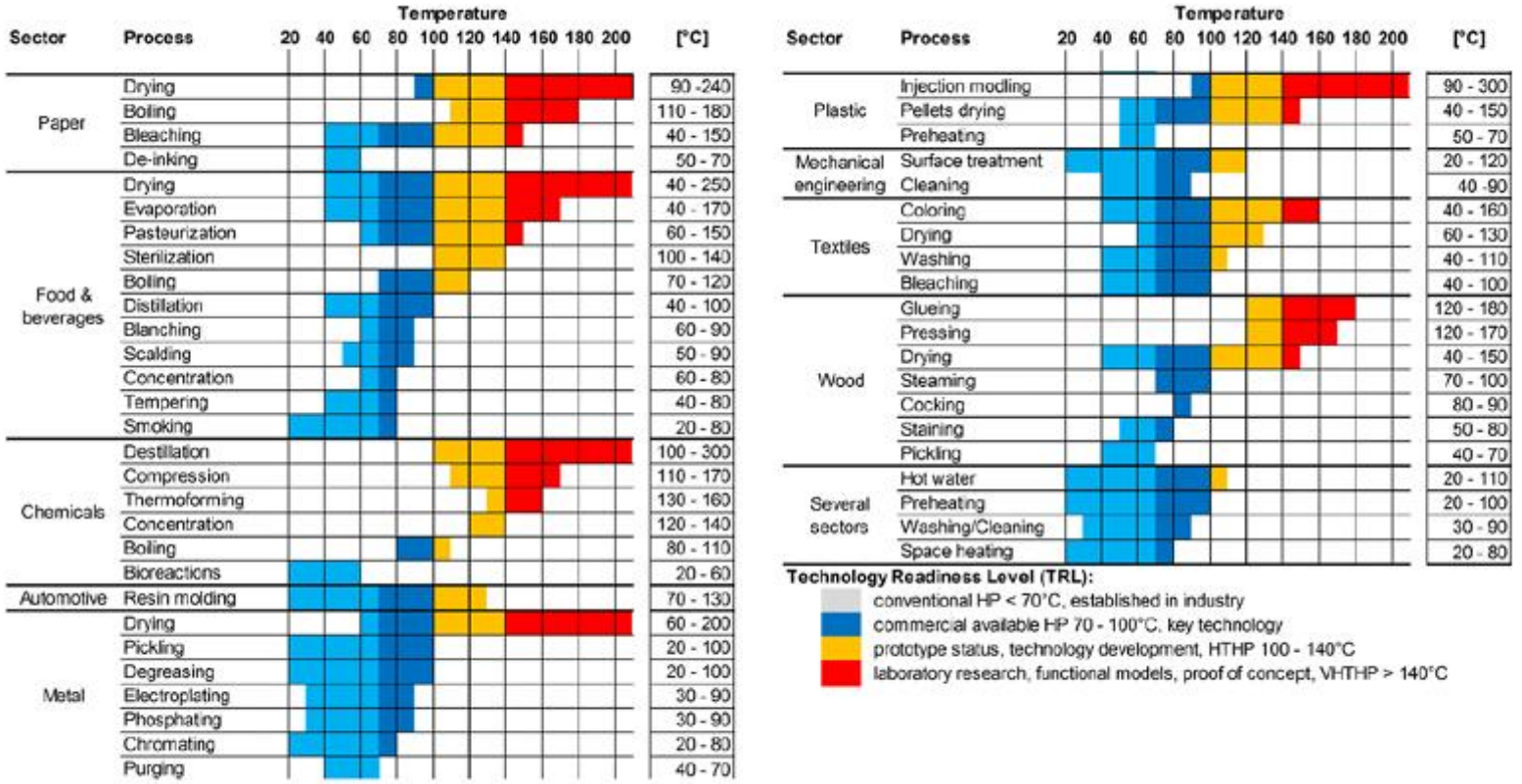
However…

The larger the difference between cold and hot, the lower the efficiency

$$COP_{Heating} = \frac{T_{HOT}}{T_{HOT} - T_{COLD}}$$

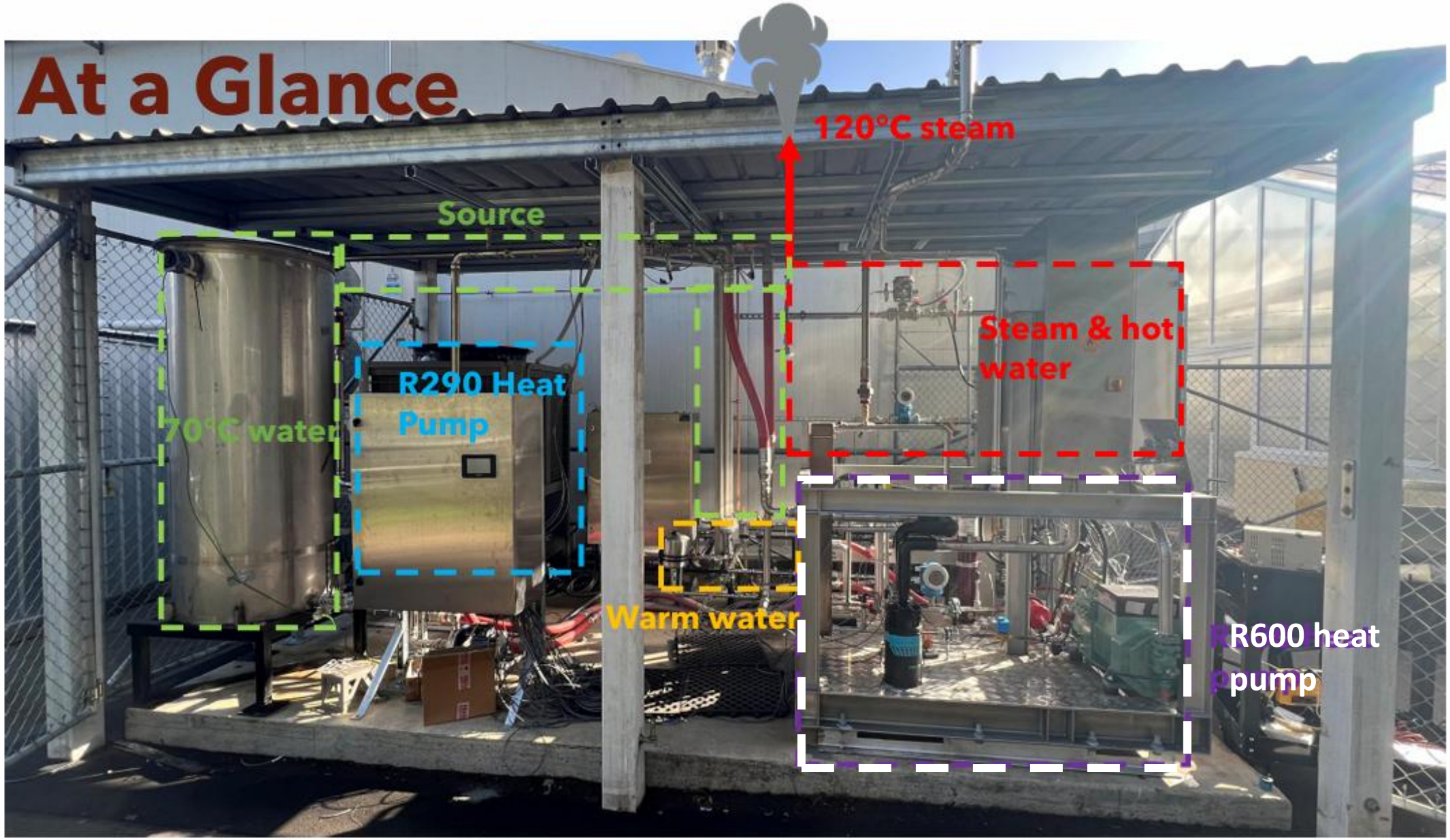
	80-100°C	100-120°C	120-140°C	140-160°C	160-180°C	180-200°C
Scalding						
Blanching						
Distilling						
Boiling						
Sterilizing						
Pasteurizing						
Evaporating						
Drying						

Where Heat Pumps Fit



Data sources: *Brunner et al. (2007), Hartl et al. (2015), IEA (2014), Kalogirou (2003), Lambauer et al. (2012), Lauterbach et al. (2012), Noack (2016), Ochsner (2015), Rieberer et al. (2015), Watanabe (2013), Weiss (2007, 2005), Wolf et al. (2014)*

Arpagaus 2017


At a Glance
120°C steam
Source
70°C water
R290 Heat Pump
Steam & hot water
Warm water
R600 heat pump

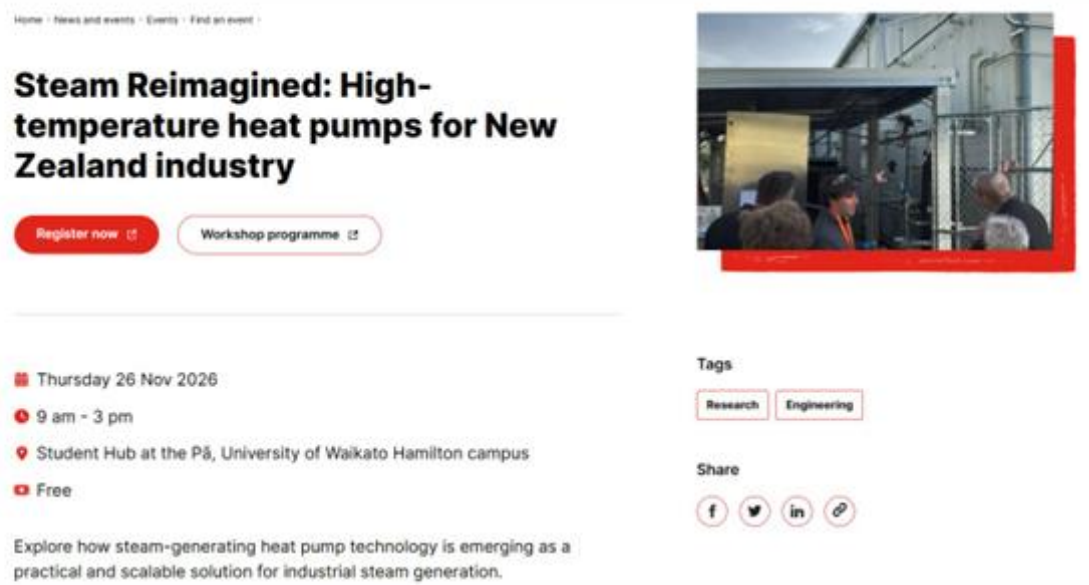


See video for recordings



Summary

- Energy Systems are complex
- Non-dispatchable renewables + batteries
  - Big impact on market
  - Unclear exactly how
- Industrial process heat
  - Heat pumps important for NZ industry



Thank you for listening.

For more information, visit our website or email martin.atkins@waikato.ac.nz

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The Affordable Energy Webinar Series June-November 2026: Final Speaker



Blair Dickie
Waikato Regional Council
2 December, 10:30am

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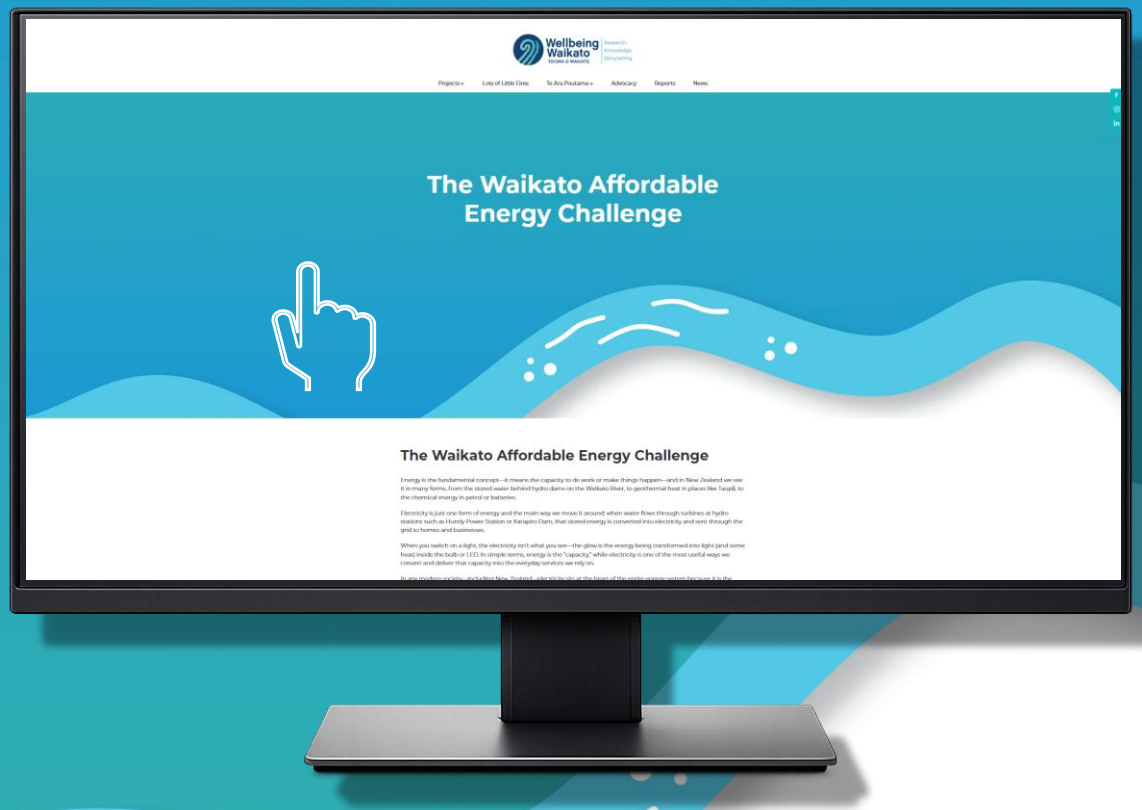

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Thank you!

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