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CENTRE FOR SMART ENERGY SYSTEMS

Decarbonising Industrial Process Heat in New Zealand: The Role of High-Temperature Heat Pumps

Martin Atkins, Daniel Chong, Michael Walmsley, Tim Walmsley, Cordin Arpagaus

SDEWES 2025

New Zealand

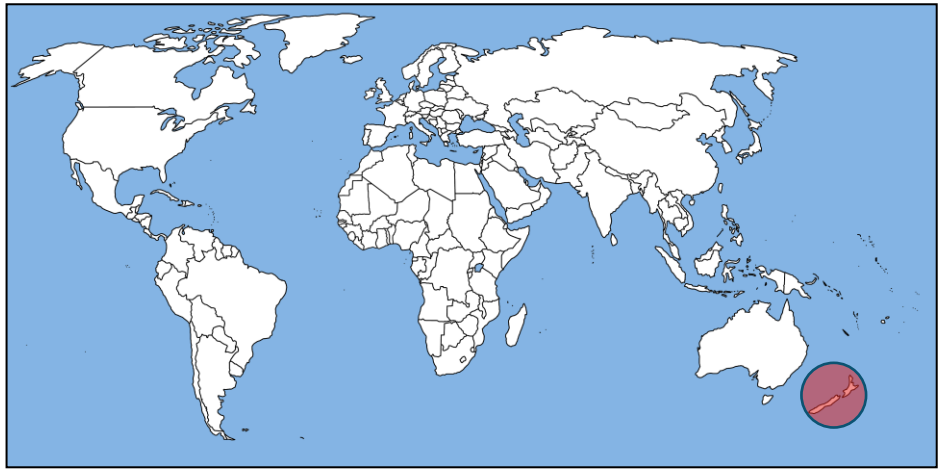
Population - 5.3 million

Key Sectors of Economy

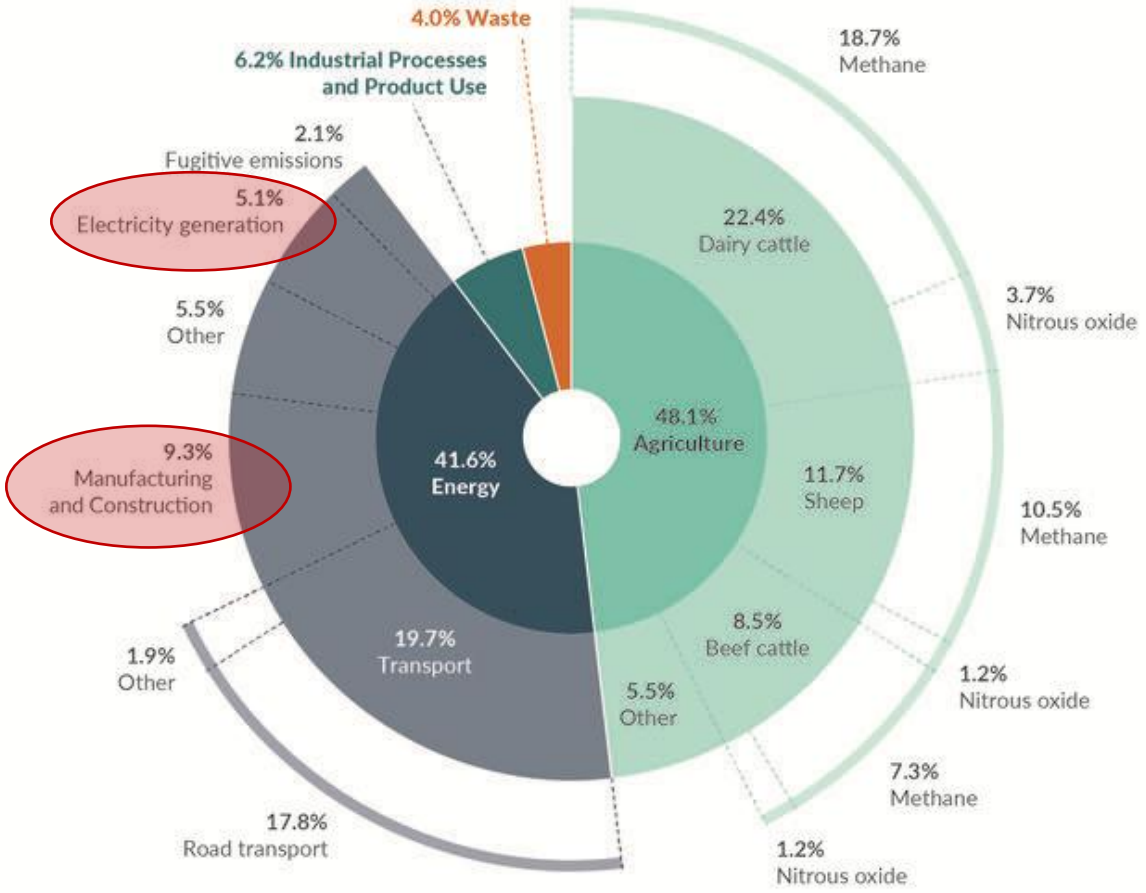
Dairy, Food, Forestry/Wood Products, Tourism

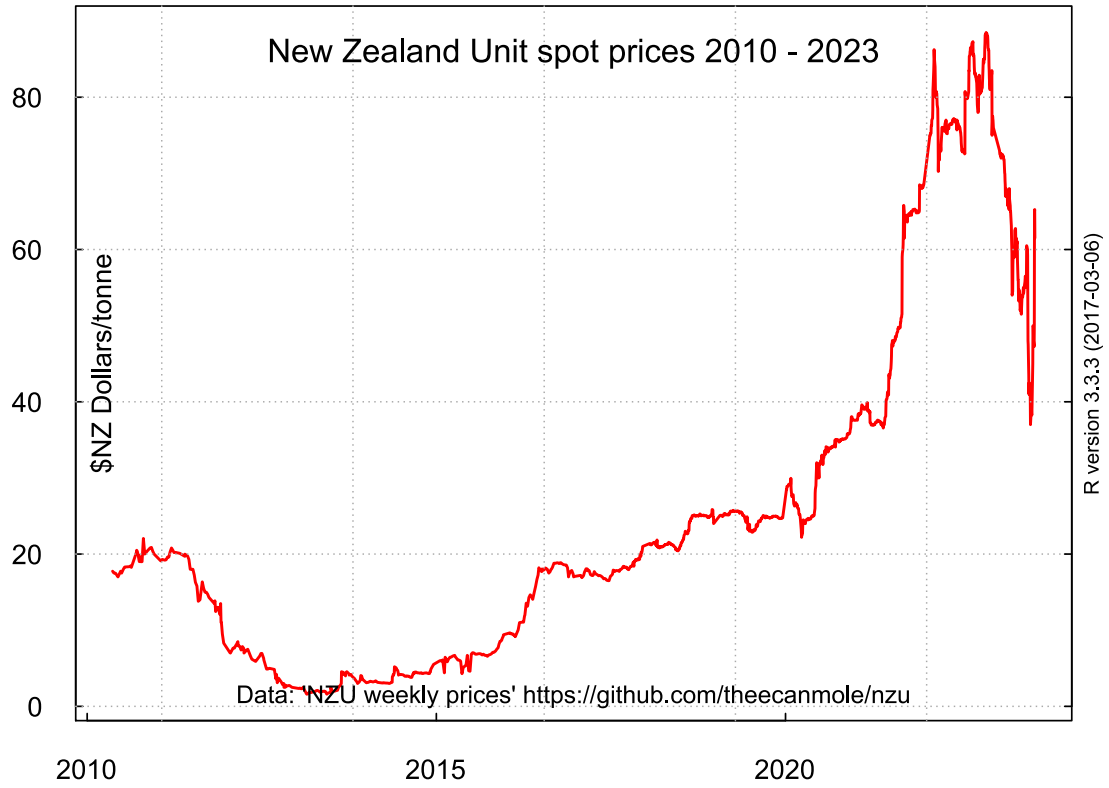
Renewable Electricity ~85%

Hydro, Geothermal, Wind



NZ Emissions





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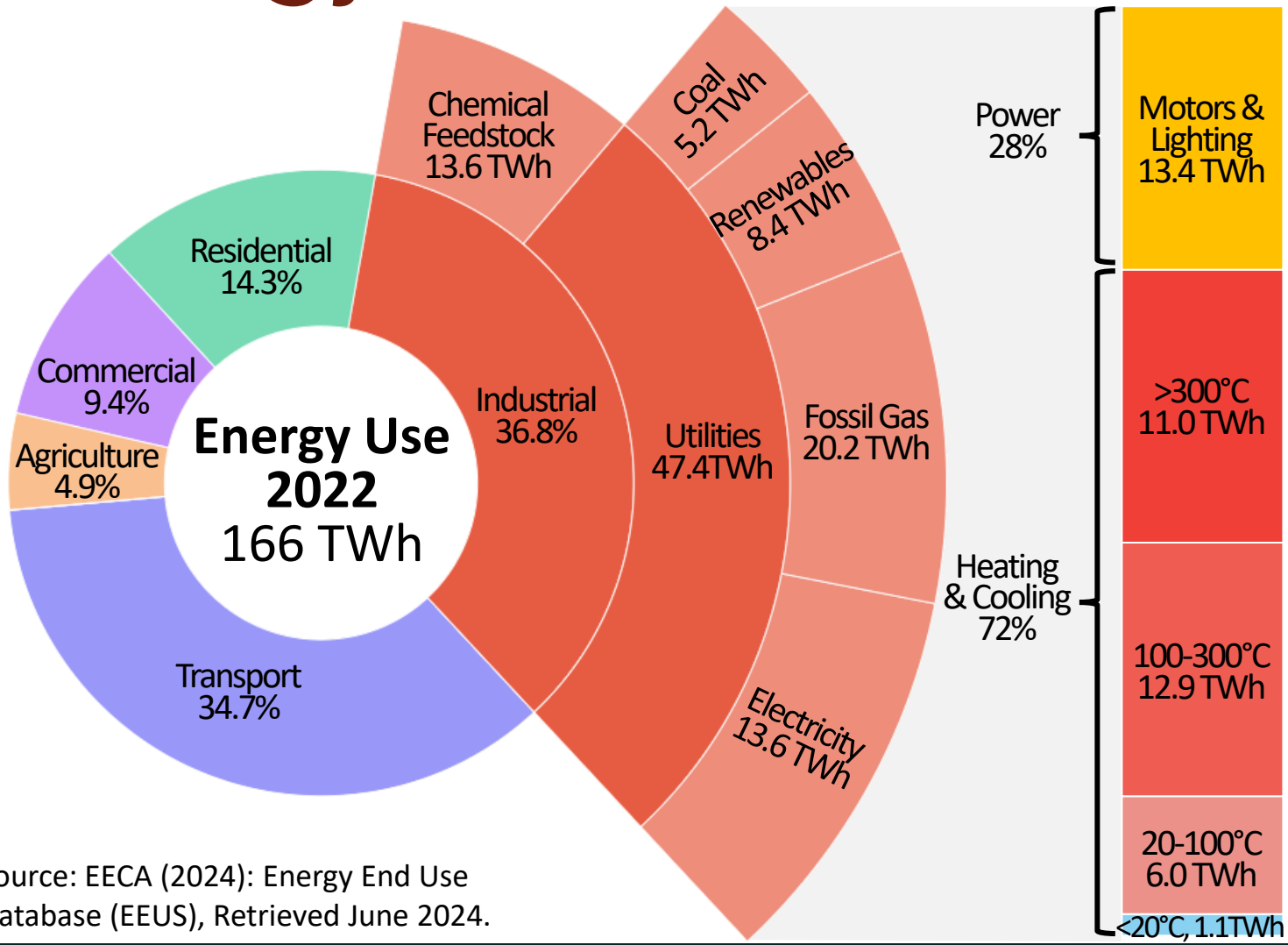
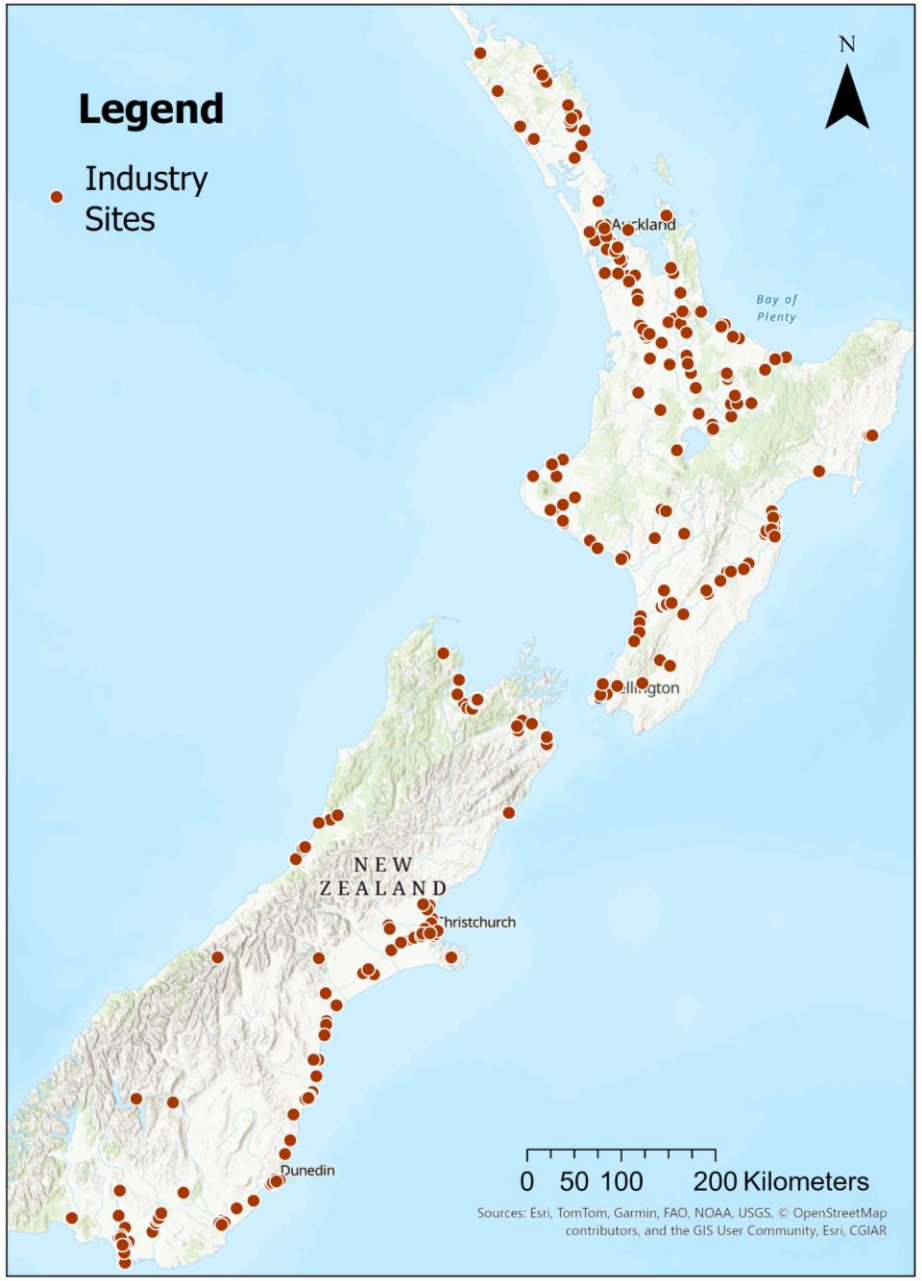
Energy End-Use



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



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By Gavin Evans | 07:41am 9 July 2018

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Wednesday, **25 August 2021**

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50 7

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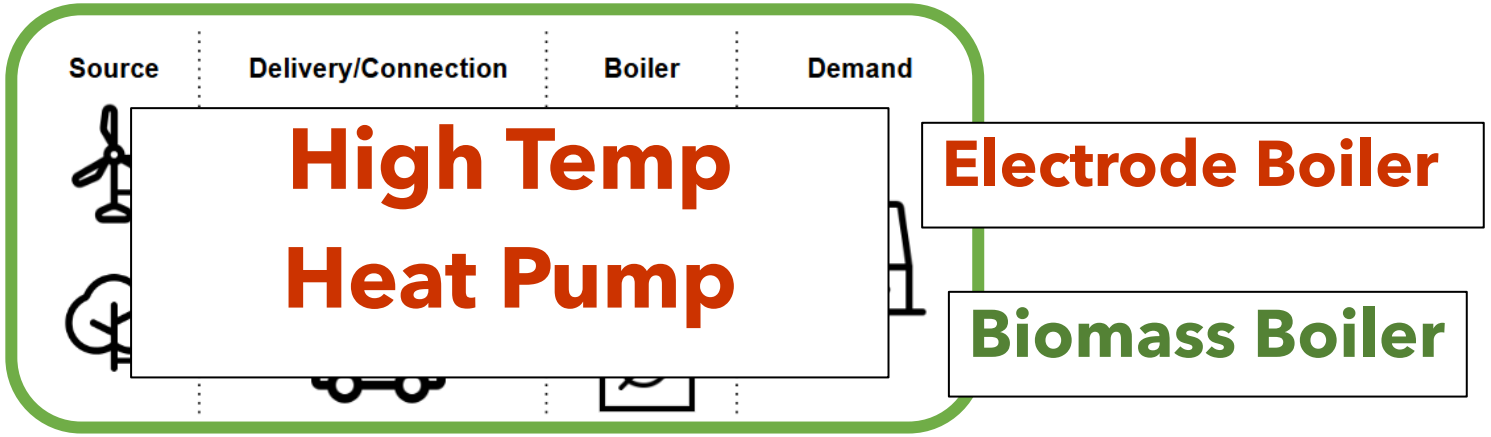
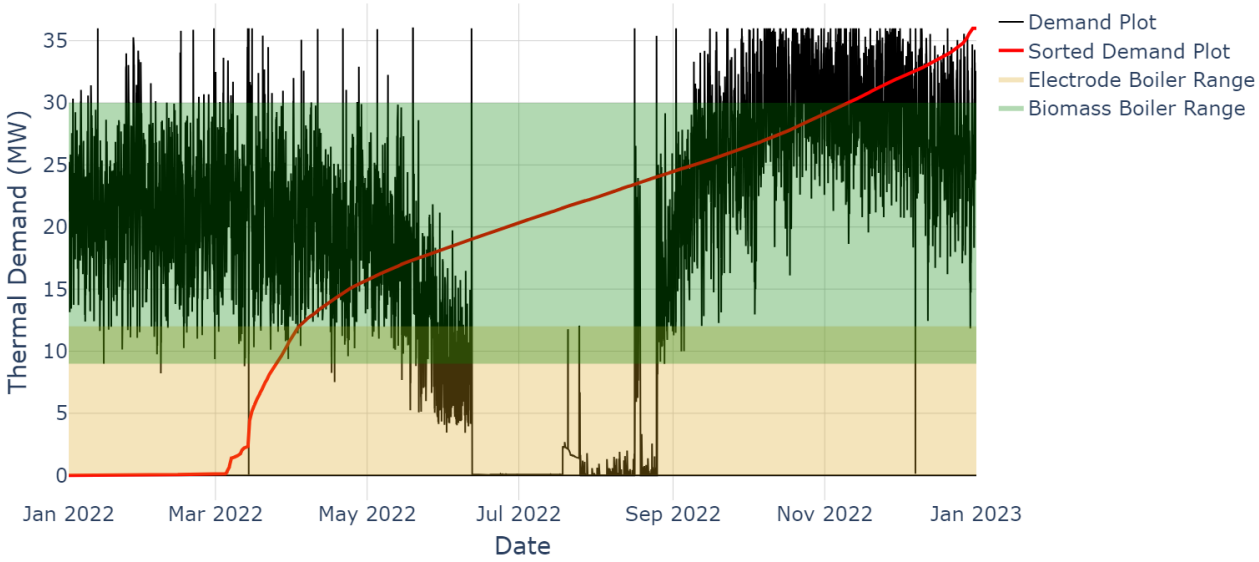
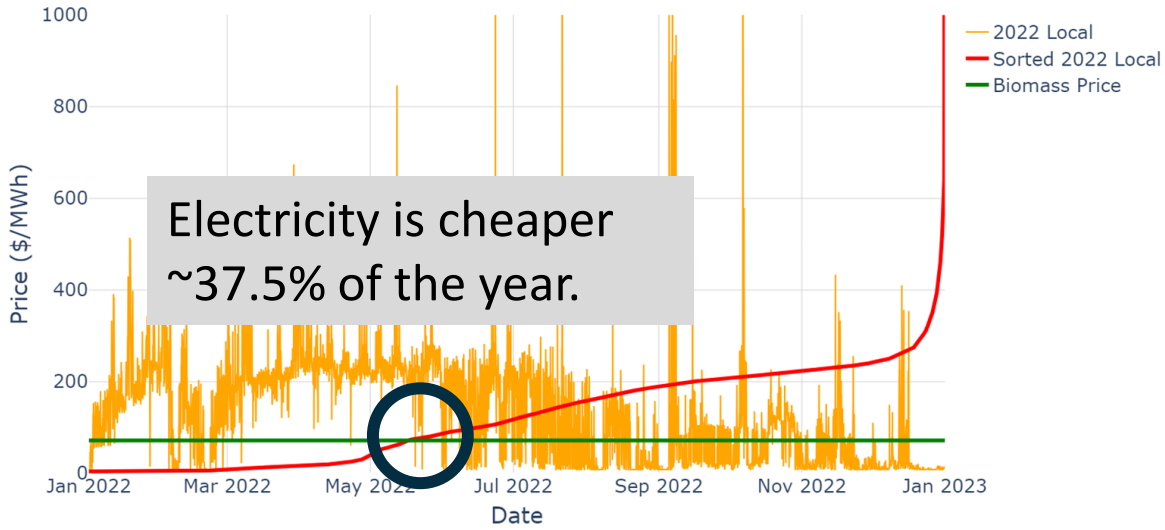
Hybrid Boiler System



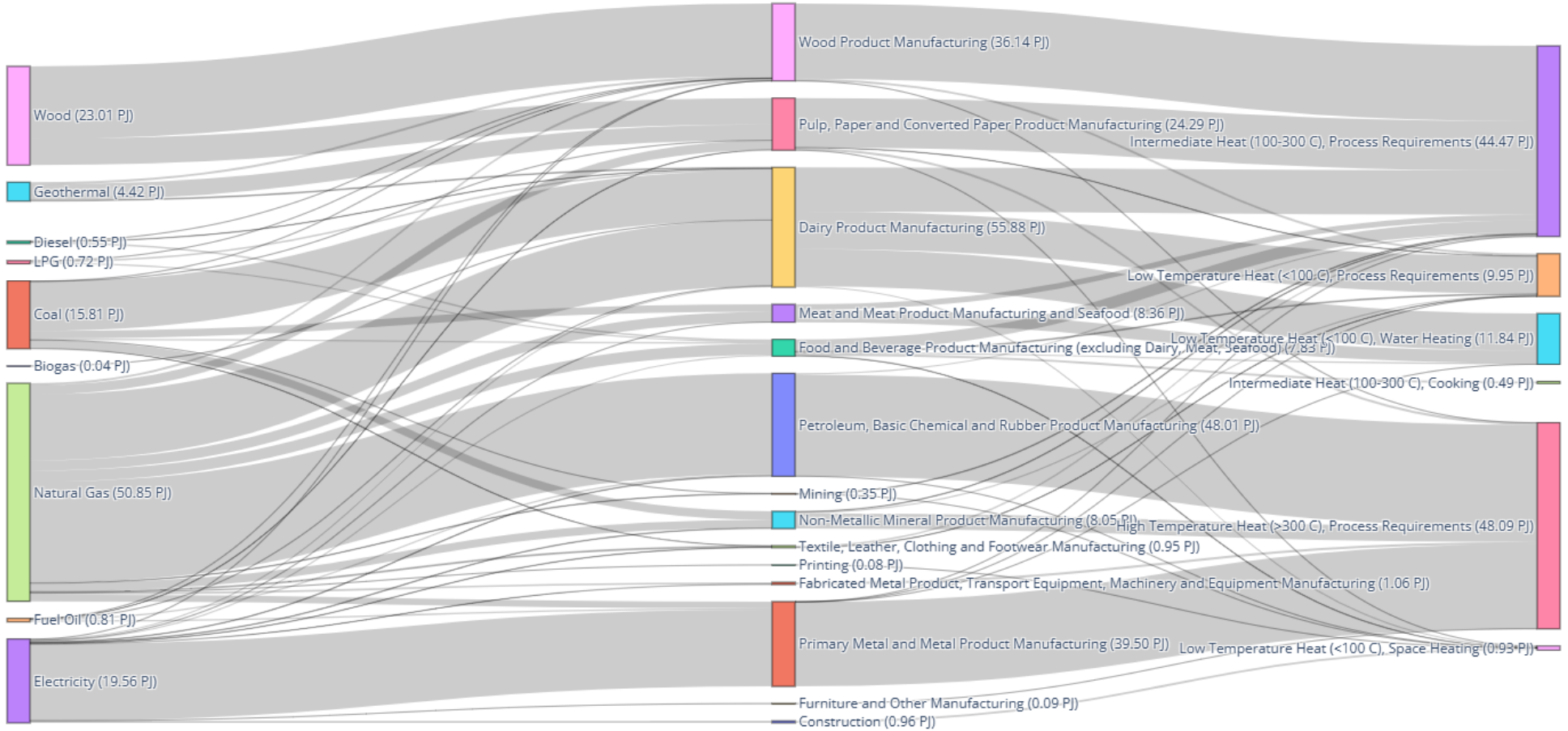
Case Study Demand Profile



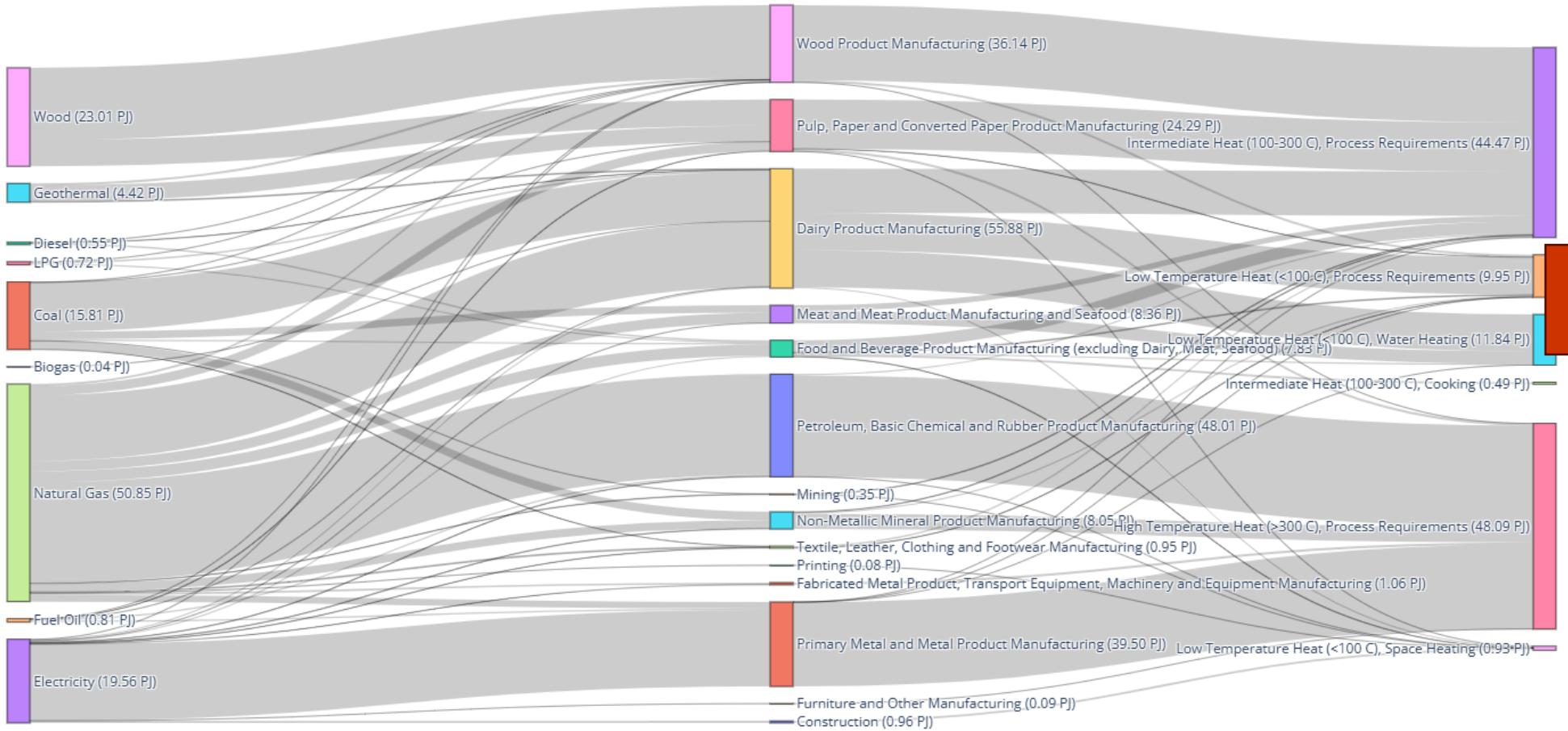
Fuel Pricing



Industrial Process Heat Flows 2023



Industrial Process Heat Flows 2023



16.4 PJ
(NG, LPG, Coal, Diesel)

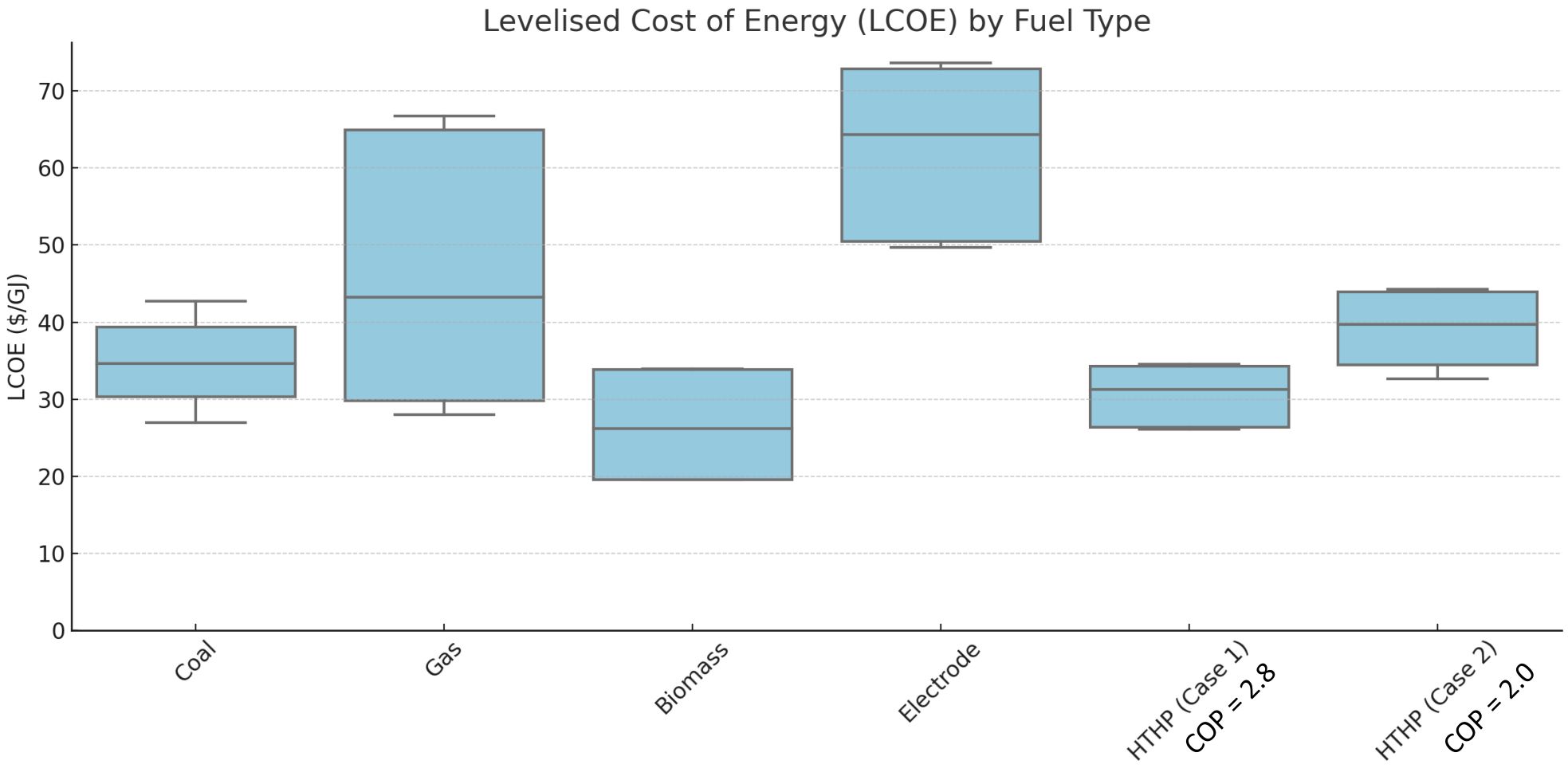
100 °C – 300 °C
44.7 PJ

6.6 PJ
(Heat Pump Potential)

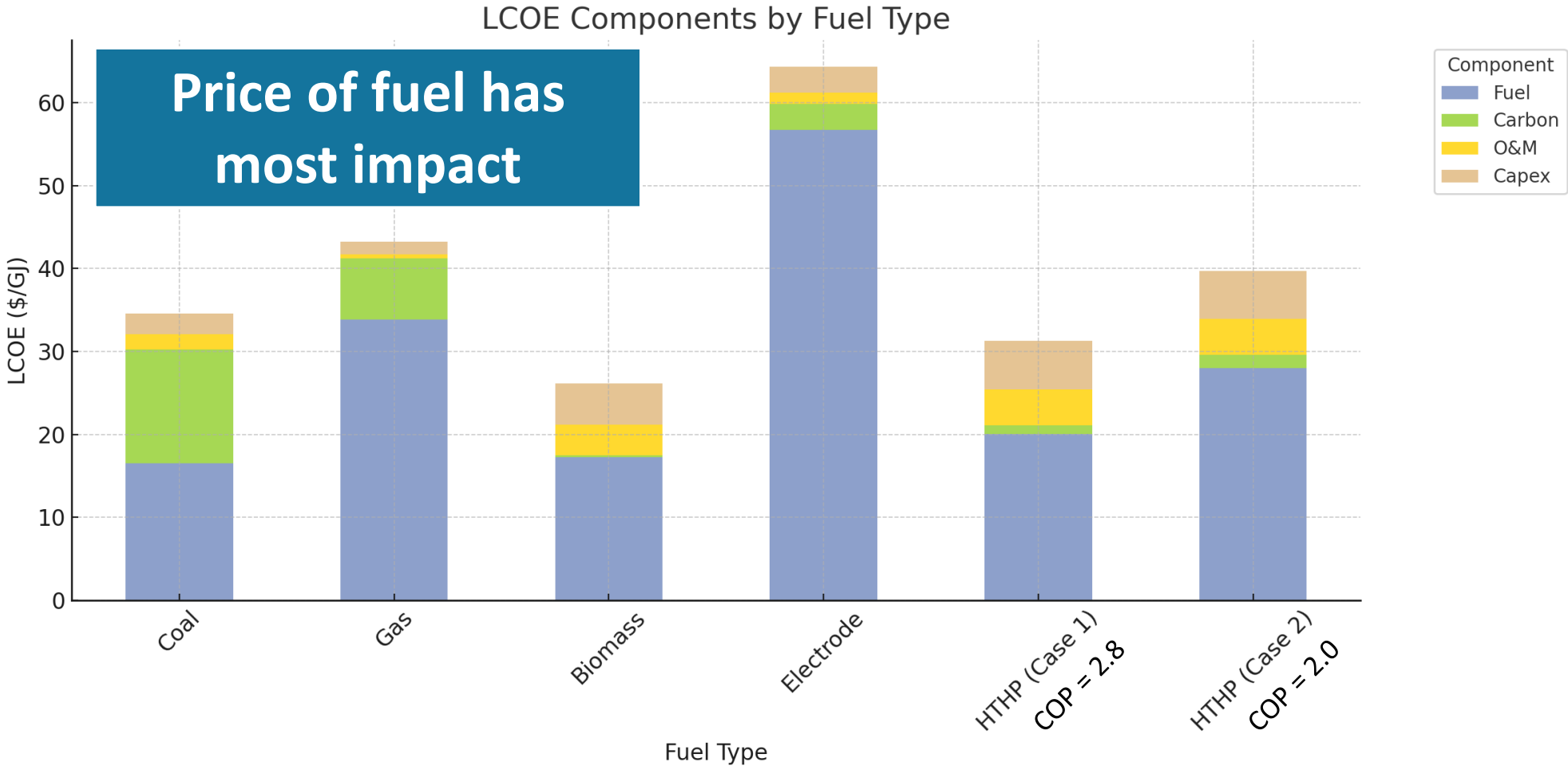
High Temperature Heat Pumps

- Looked at two generic situations
  - Case 1: 50 °C ➡ 120 °C (2 bar steam)
  - Case 2: 40 °C ➡ 144 °C (4 bar steam)

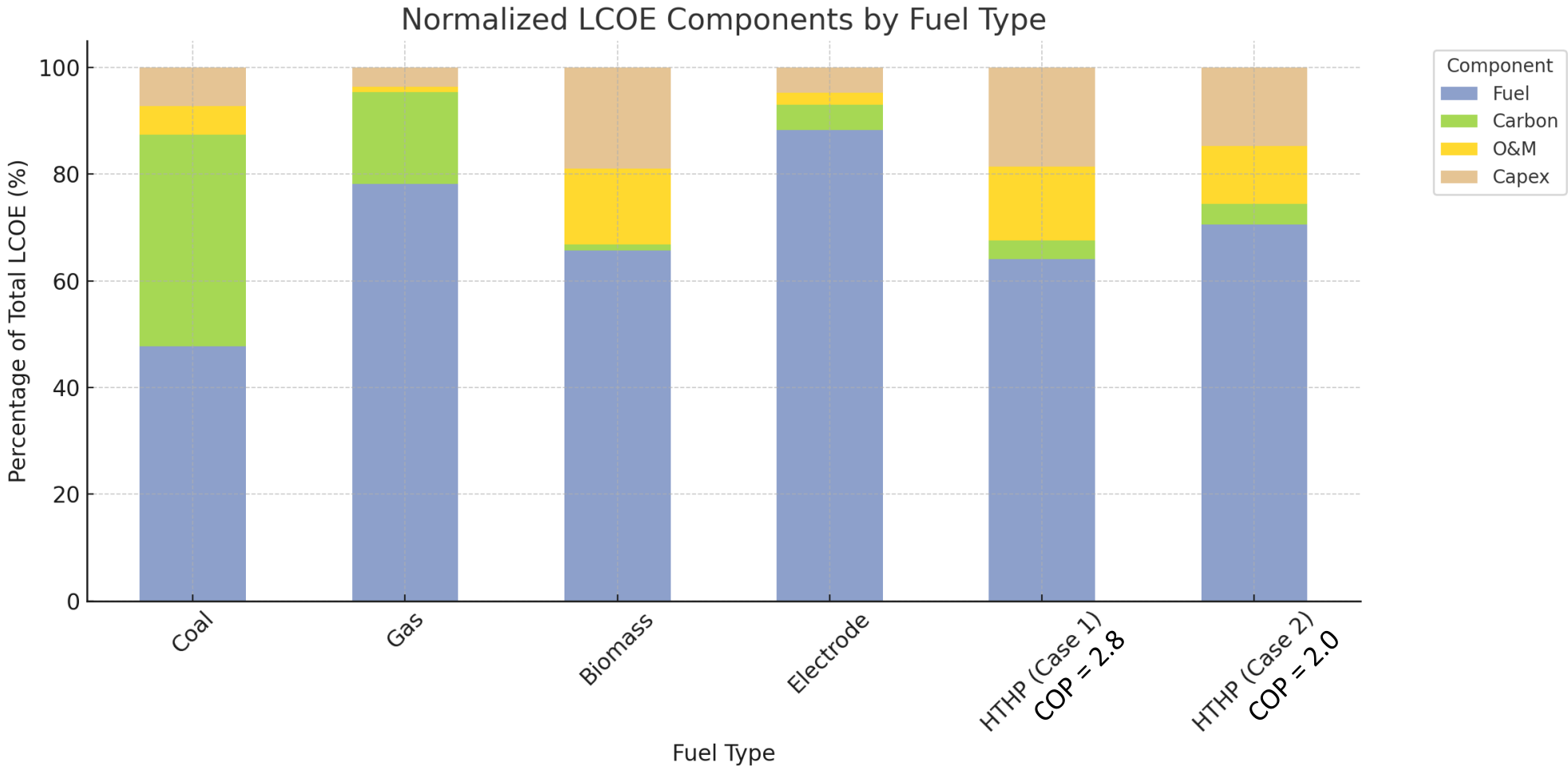
Levelised Cost of Energy by Fuel Type



LCOE Components



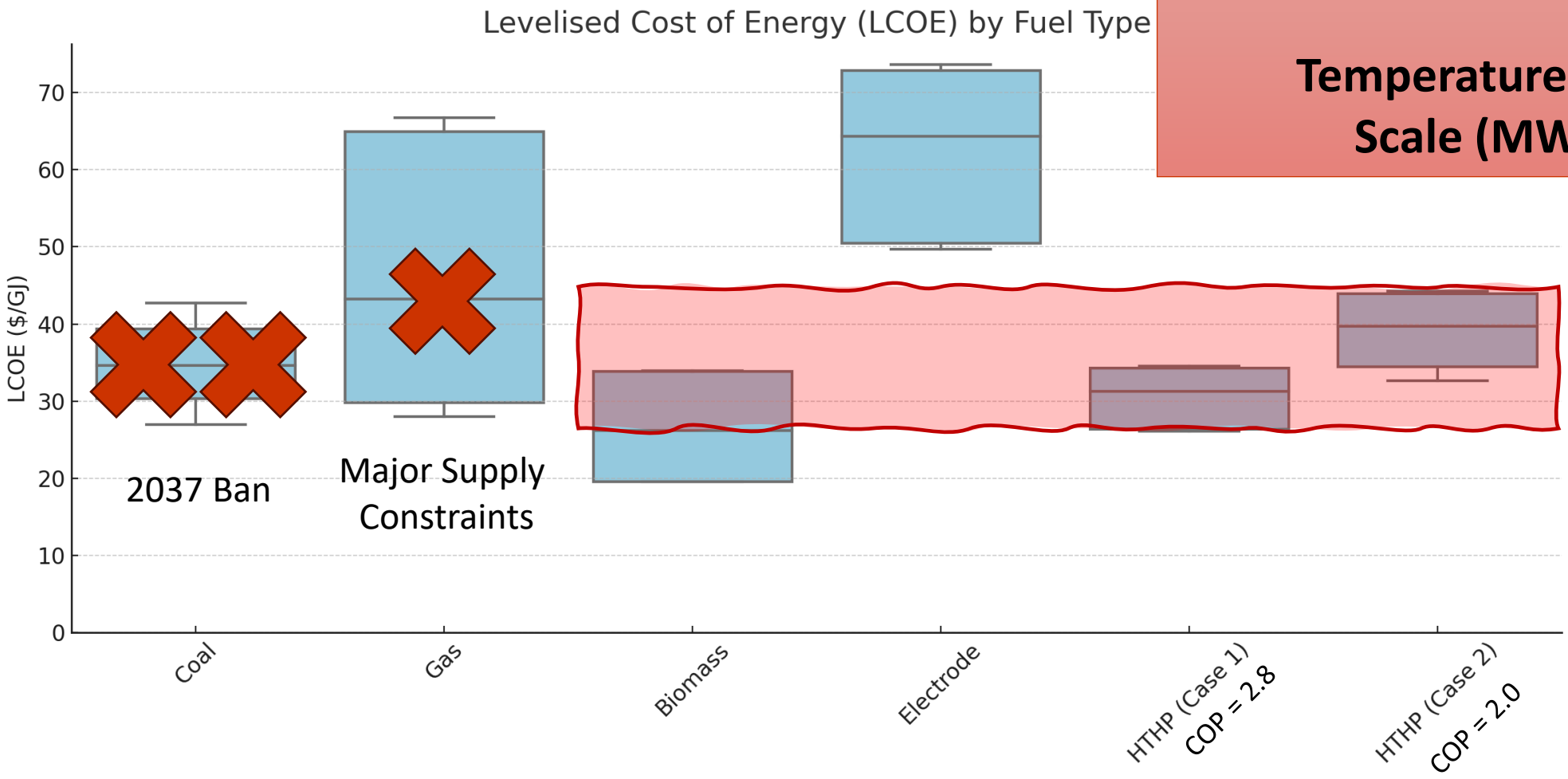
LCOE Components



Levelised Cost of Energy by F

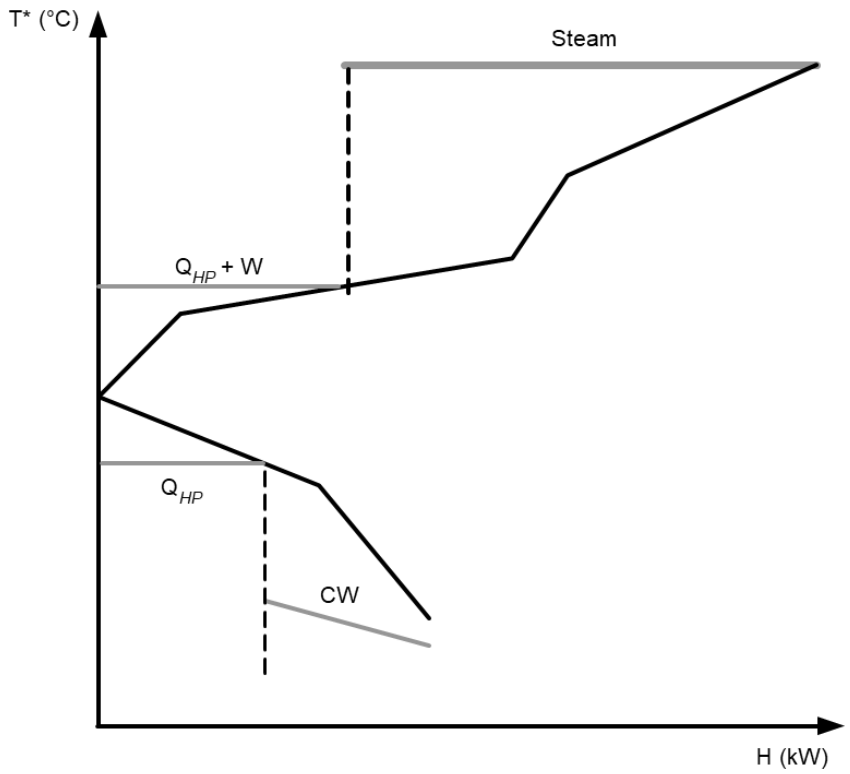
Waste Heat / Heat Source Availability

Temperature (°C)
Scale (MW)



What is the Potential for HTHP?

- LCOE shows HTHP have potential to be part of the mix
- Need to be integrated correctly
- Available waste heat / heat source at the right temperature and quantity will be a key enabler / barrier
  - Impacts COP and viability



What is the Potential for HTHP?

Intermediate Heat (100-300 °C)

Total 16.4 PJ

6.6 PJ (Heat Pump Potential)

Biomass 60% (9.9 PJ)

Electrode 20% (3.3 PJ)

HTHP 20% (3.3 PJ)

NZ Electricity System Impacts

HTHP = 54 - 76 MW_{el} extra demand

Avoided generation compared to electrode boiler
78 – 100 MW_{el}
$272 M - $348 M deferred investment

Conclusions

- HTHP have potential to be part of the mix of fuel switching options
- LCOE is favourable and much better than electrode boilers
- A key limiting factor is available heat sources
  - Temperature & Quantity
  - Limited information
- Process Integration key to good outcomes

Thank you for listening.

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