

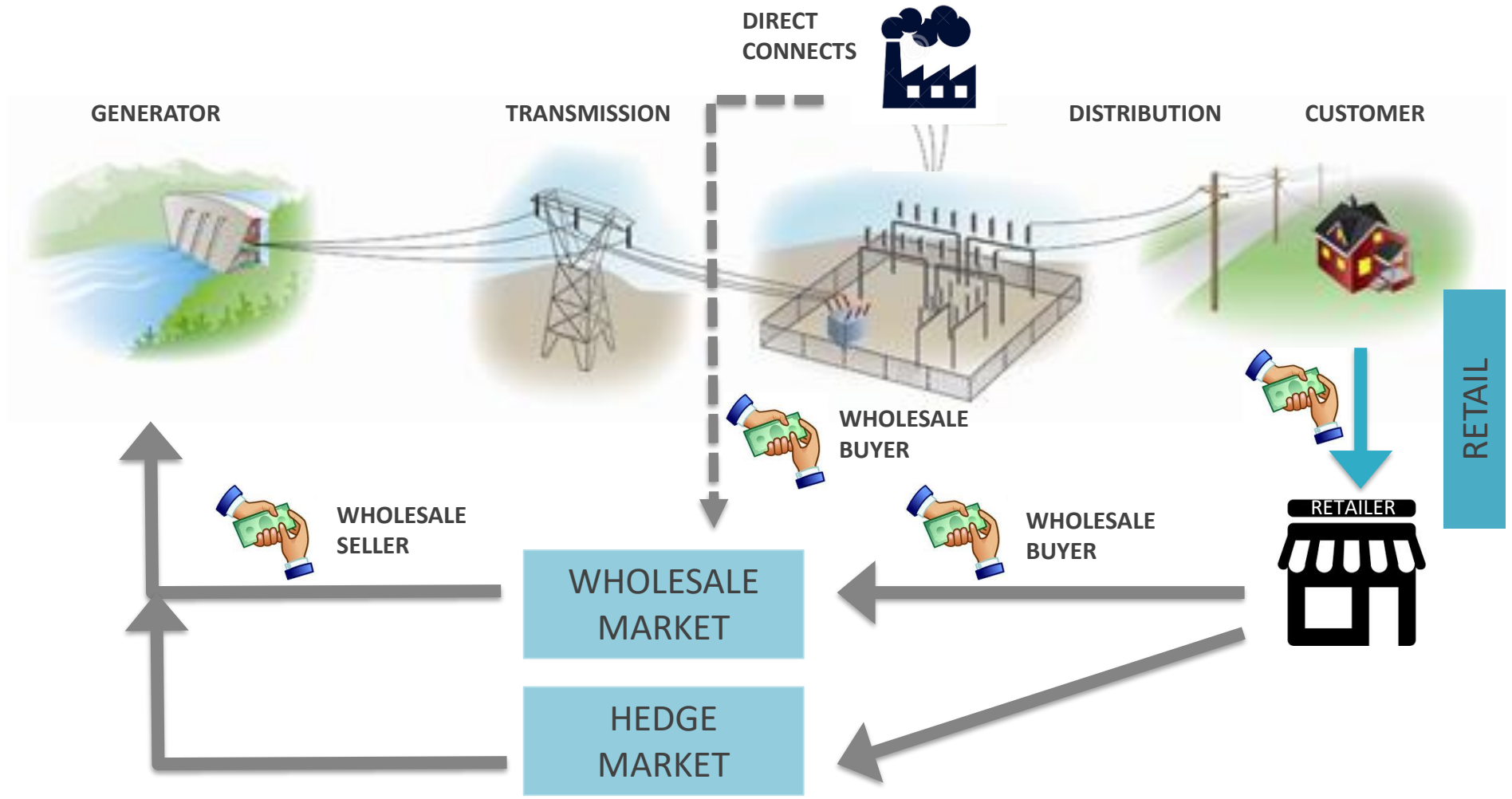
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Stephen Batstone

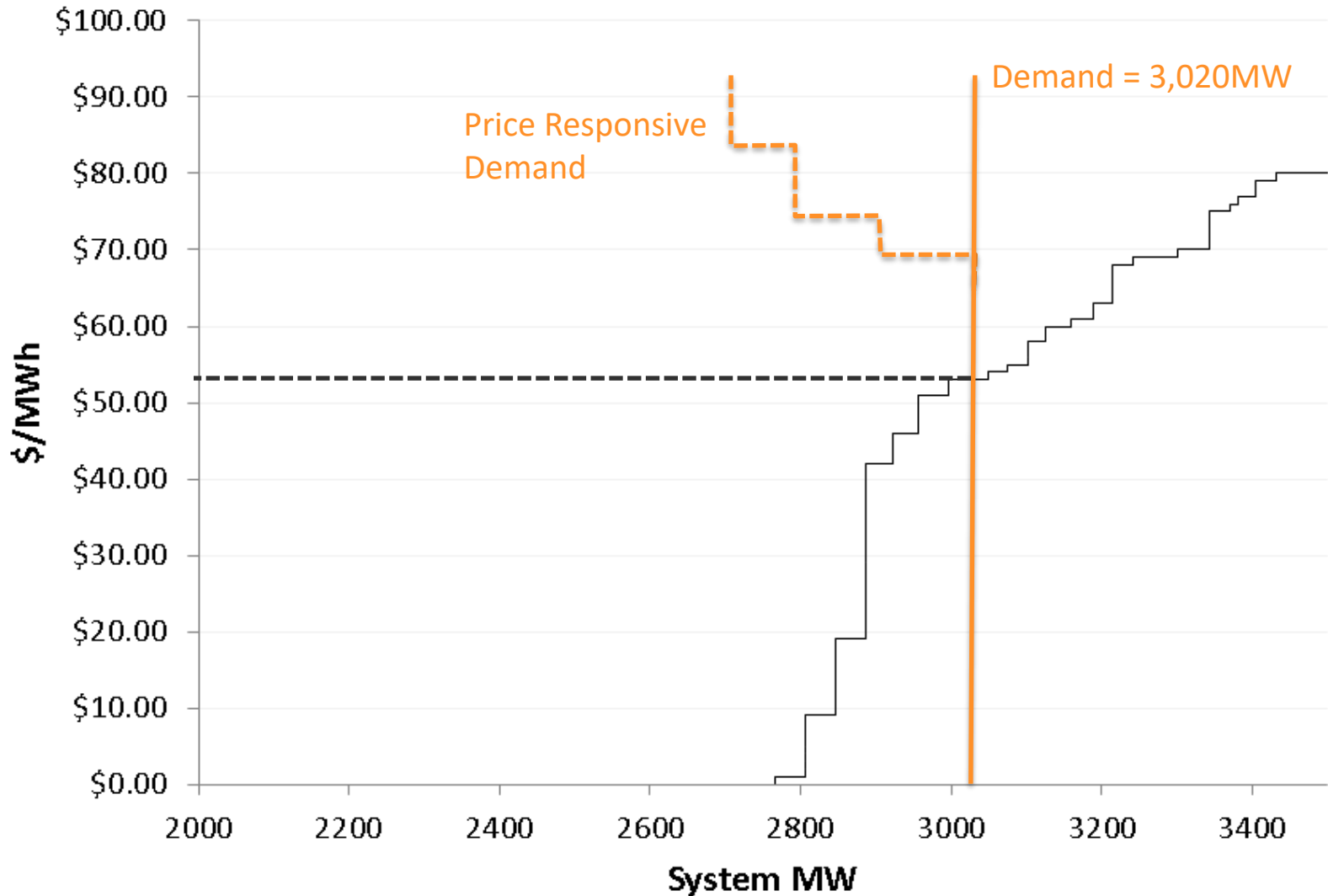
# THE NZ ELECTRICITY MARKET: TEETERING ON THE EDGE OF TRANSFORMATION?



# In a sleepy corner of the South Pacific



# It's just clearing supply and demand?



- **Forecast demand**
- **Generators make capacity available at a price that reflects their willingness to generate**
- **Clear the market!**

# Electricity markets are the most “designed” market in the world

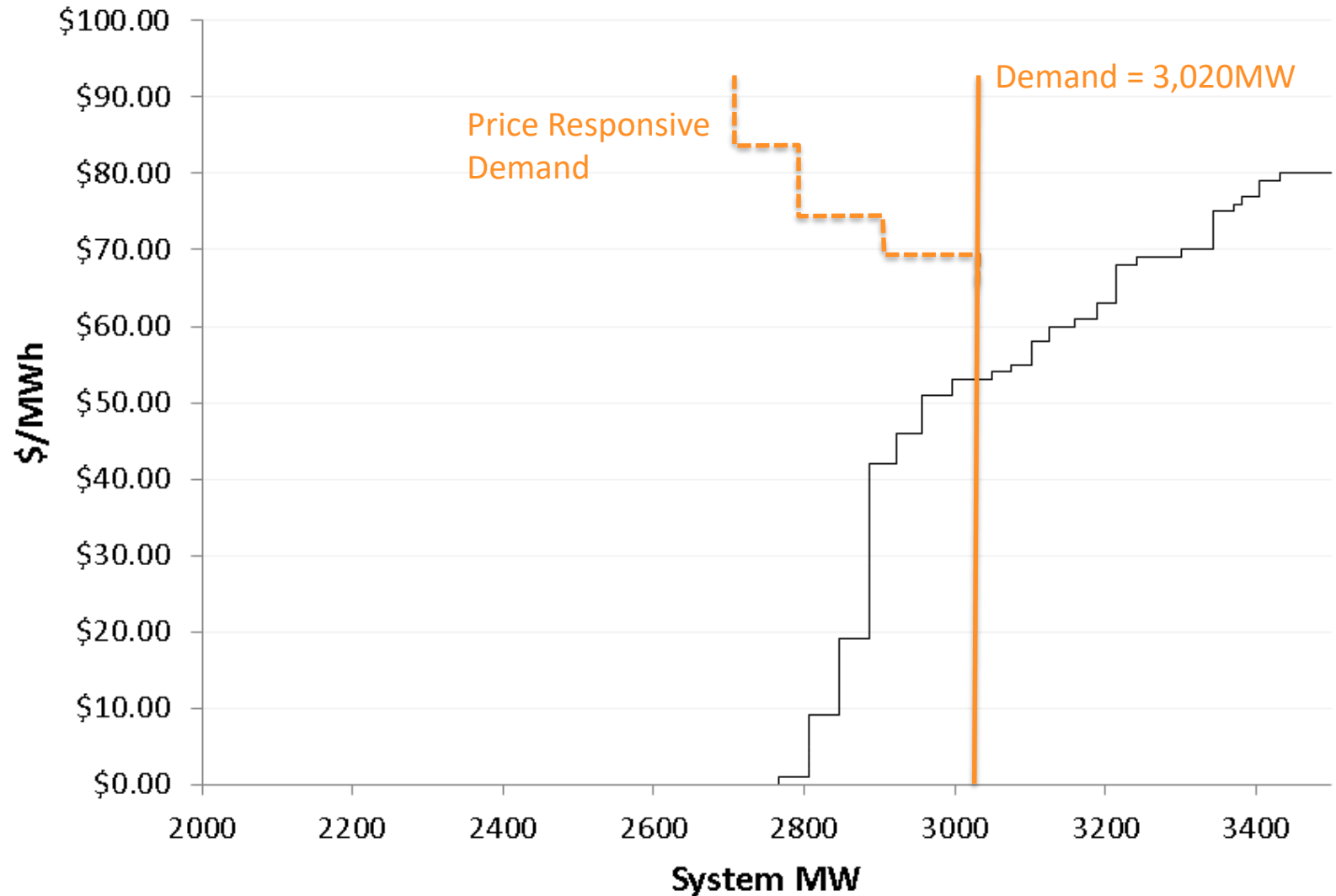
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- A vital, ubiquitous service for society with few substitutes (heat)
- Need almost absolute assurance that supply and demand balances in real time
- If it doesn't, blackouts occur
- Historically (and today) storage isn't economic
- The consumers have been disengaged (technology limitations, but also
- The “transportation” problem is driven by hard physical laws

**An enormous, complex optimisation problem with extremely little room for error**

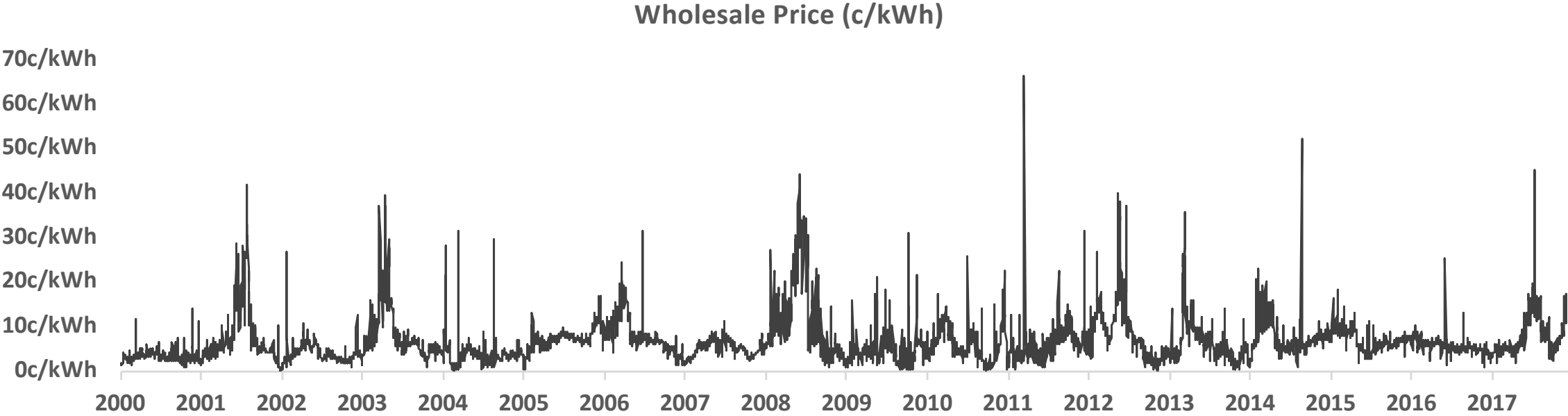
**New Zealand – globally isolated, with a weather-driven system in the Roaring 40s...with a world leading market design**

# It's just clearing supply and demand



- Market is “cleared” every half hour (solved 5 minutes).
- At ~250 locations to optimise transmission losses and recognising transmission limitations.
- Simultaneously optimising supply of electricity with two types of standby reserves.
- Produces market clearing prices at every location, for three products

# A volatile price series



# Questions

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- What sorts of long-term decisions are emerging from this market?
- How will it handle increasing renewables?
- What about the changes on the demand side?

# Questions

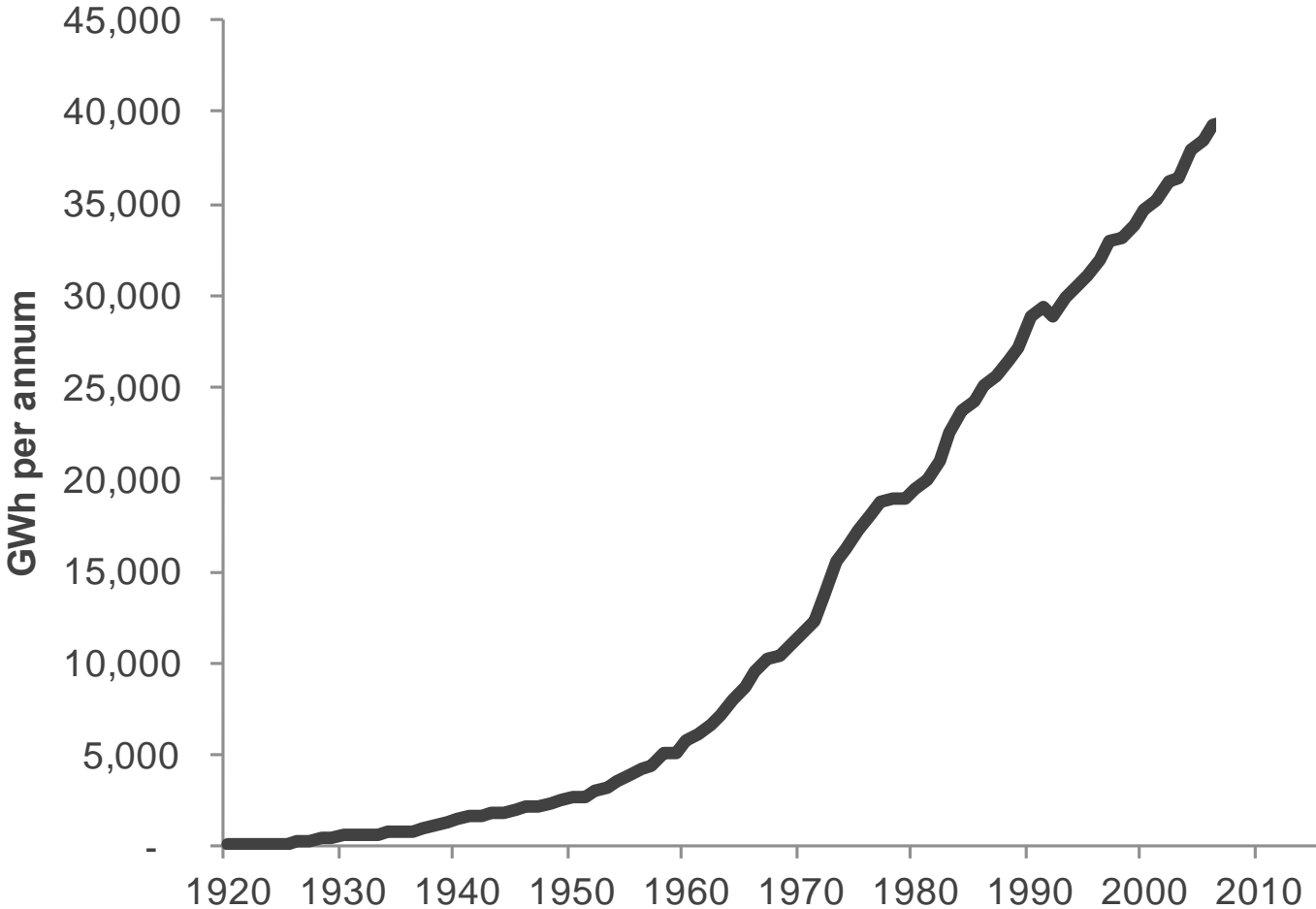
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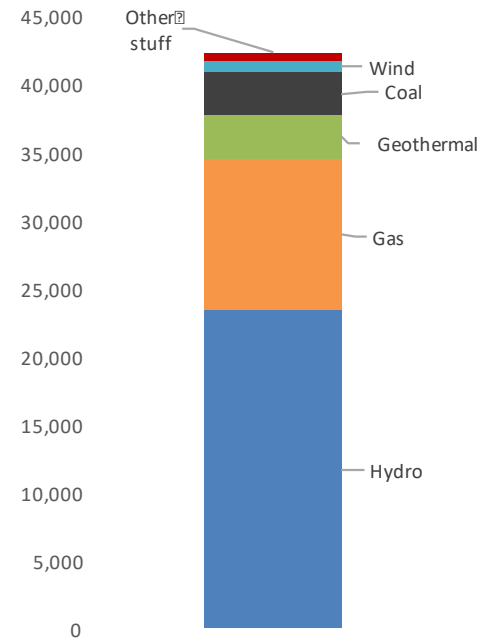


# Reliable growth....

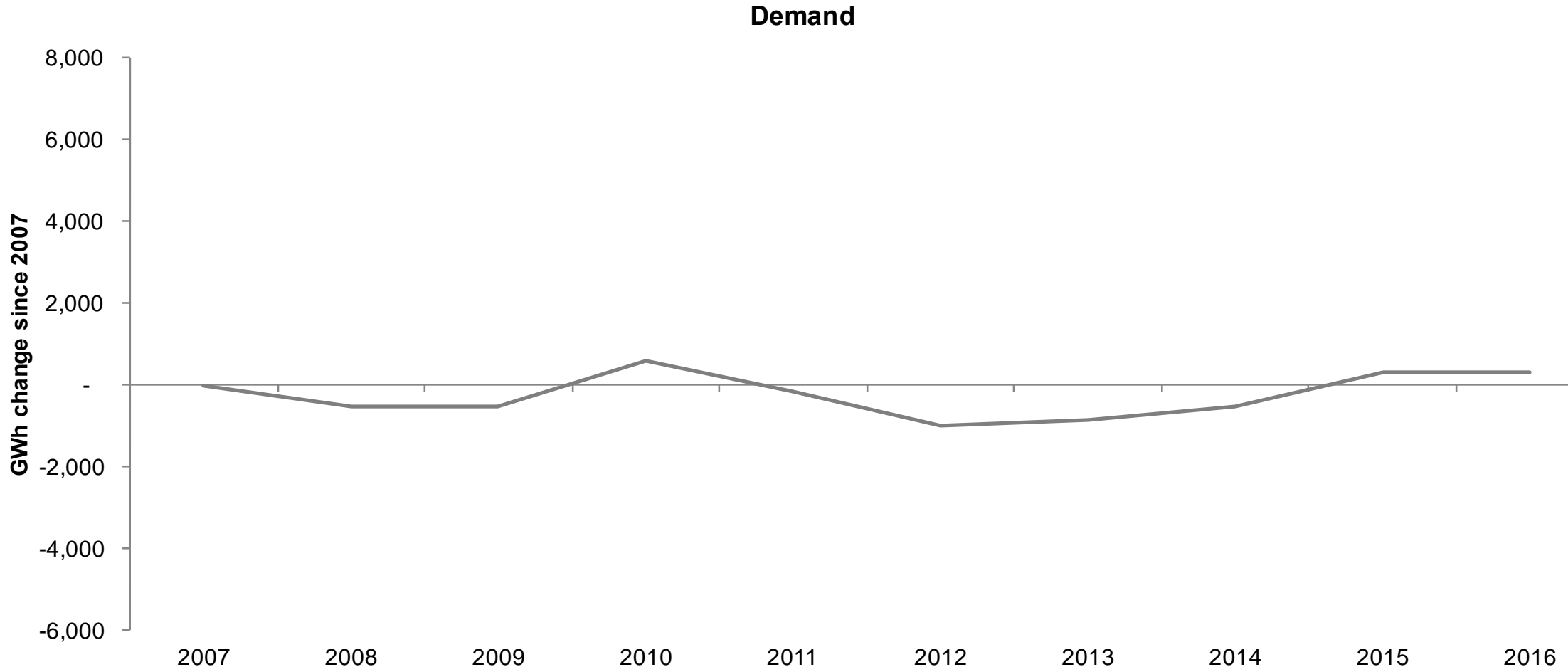
## NZ Electricity Demand



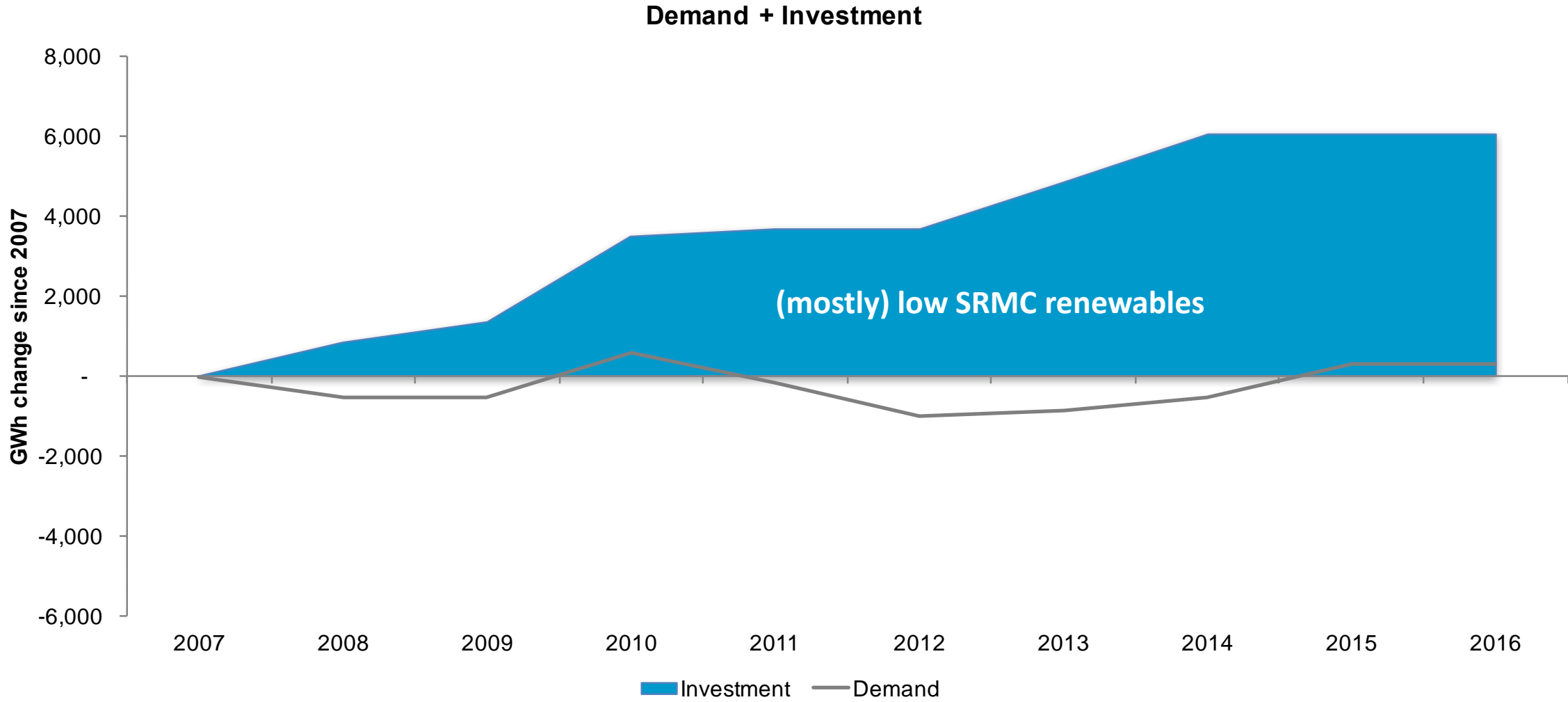
## Generation in NZ 2007



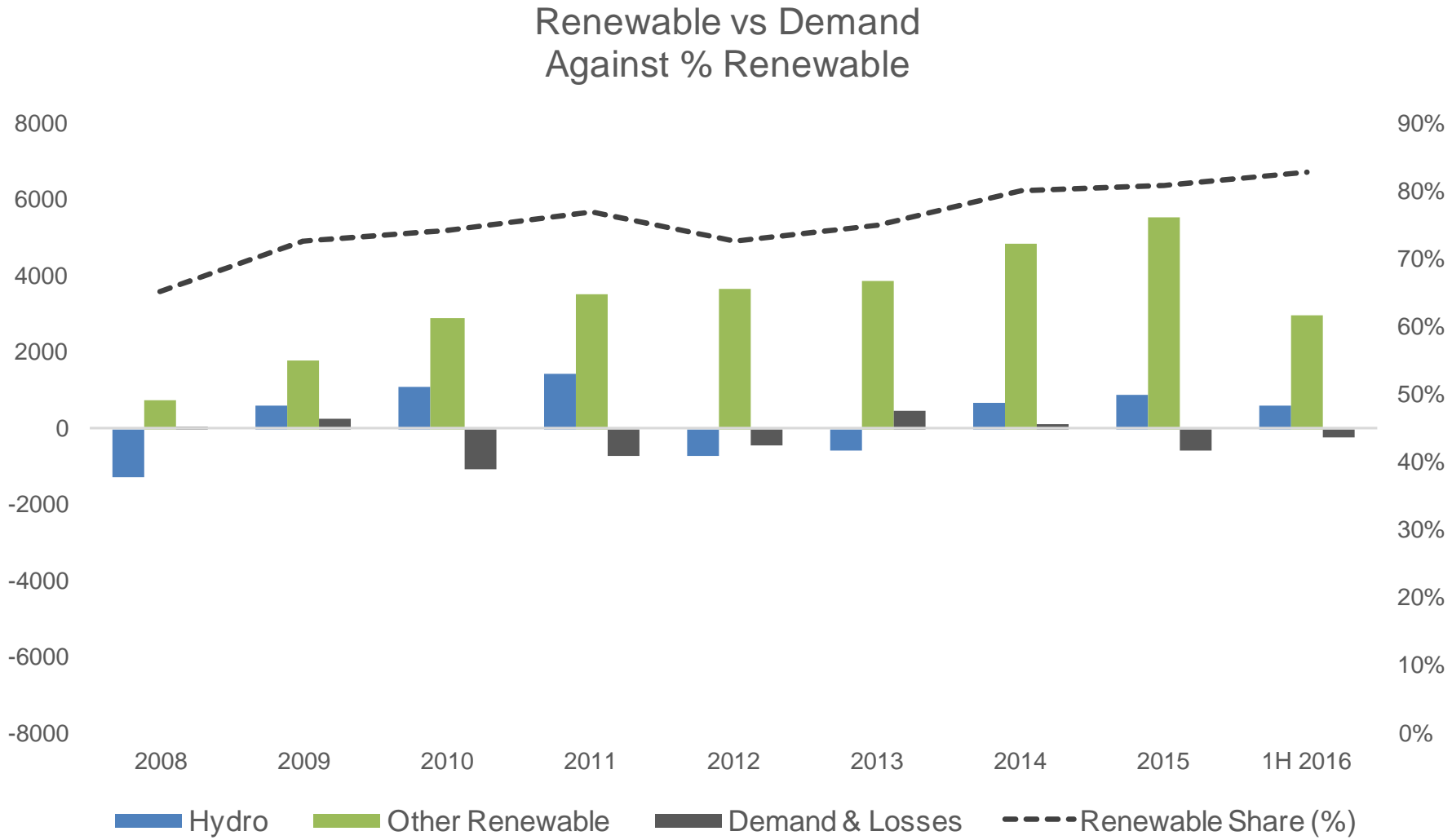
# Demand 2007-2016



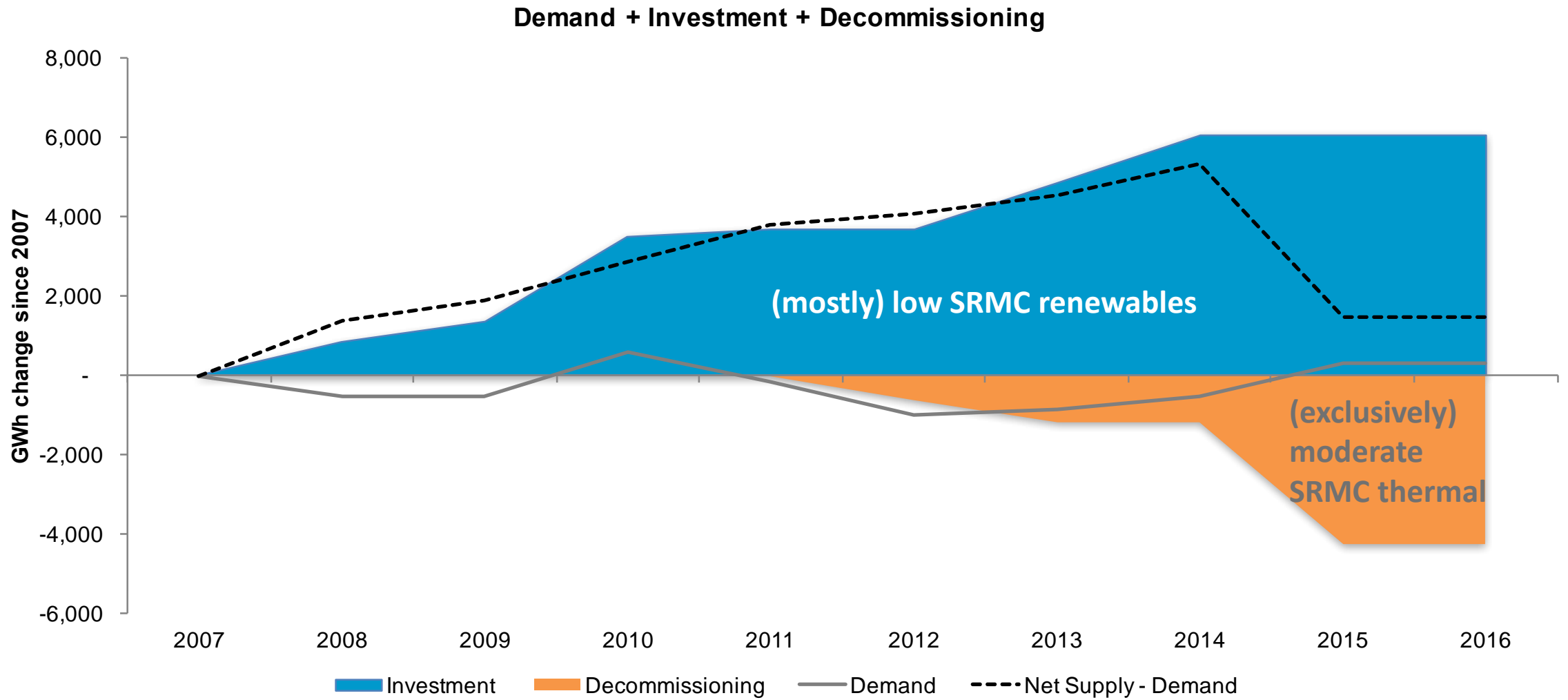
# And we built...



# Wholesale market



# Then we un-built

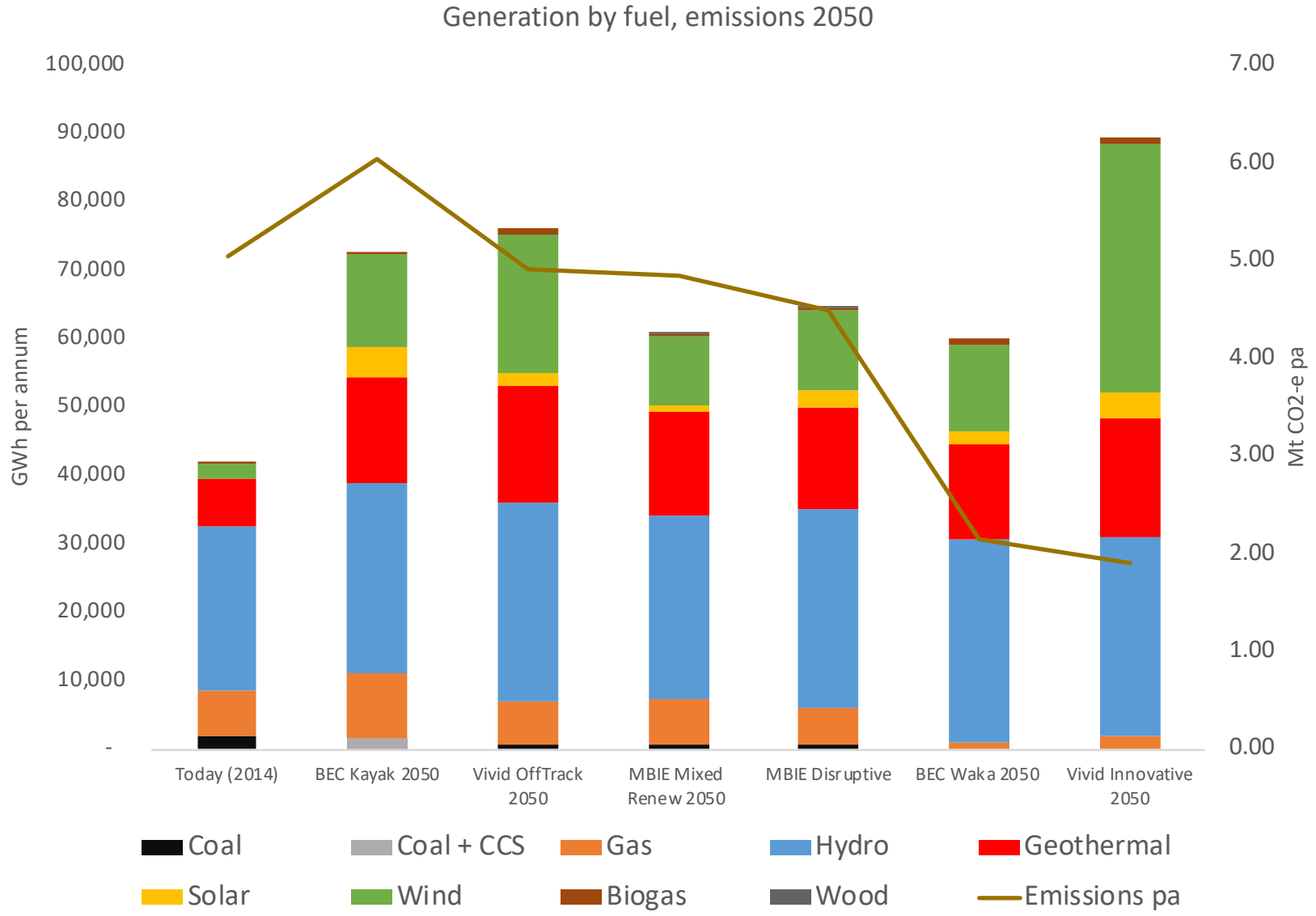


# Questions

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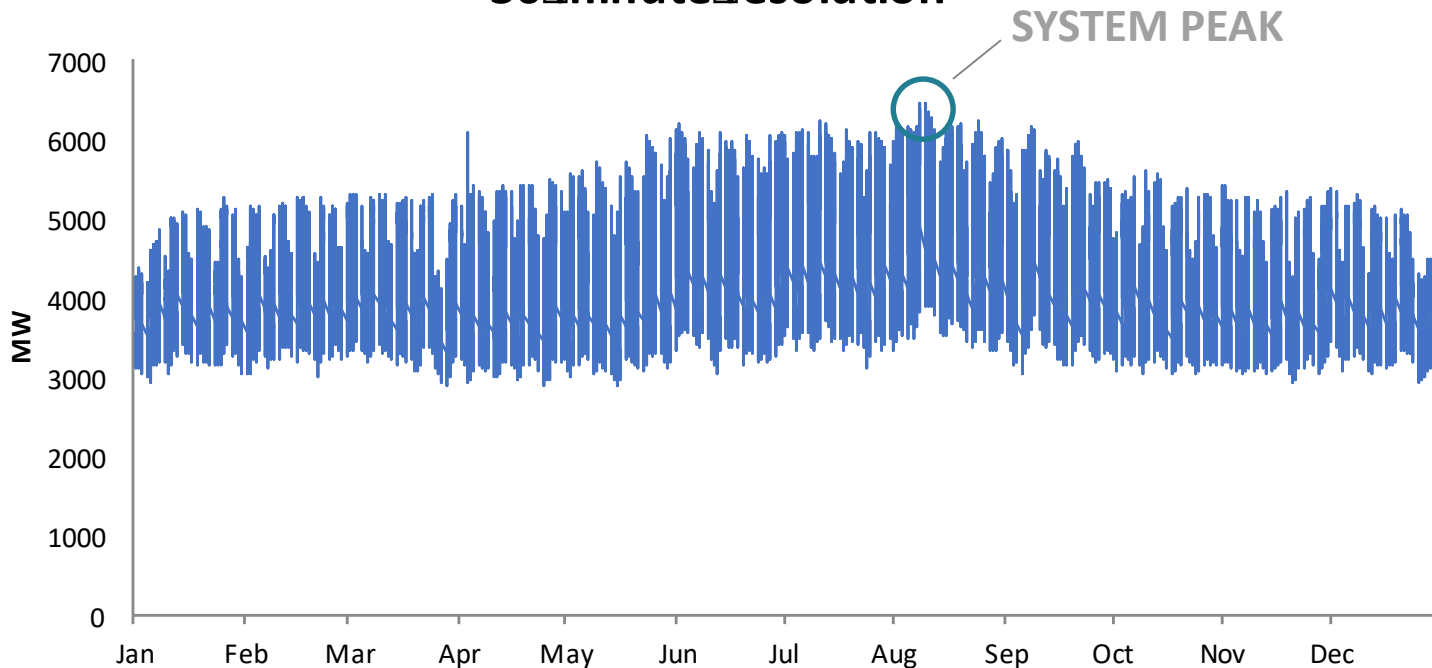
- What sorts of long-term decisions are emerging from this market?
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# Can the market handle a low-emissions electricity sector?



# How do we know if we have adequate energy resources?

NZ Electricity Demand  
30 minute resolution



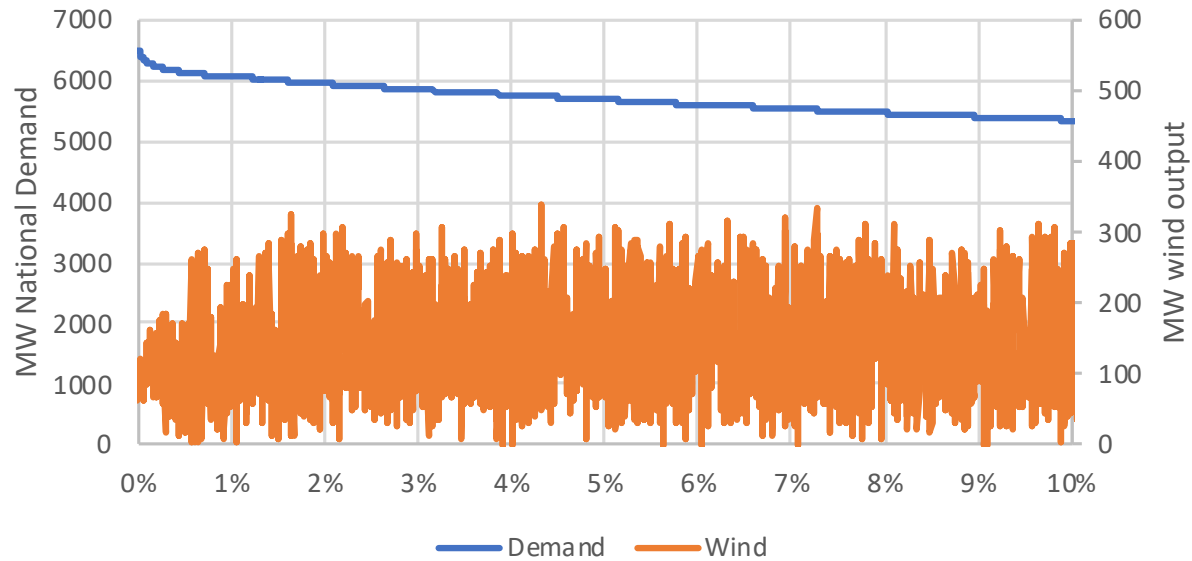
**Resource Adequacy is the ability to reliably meet demand at every point in time.**

1. The system must have enough reliable capacity to meet the system peak
2. The system must have enough available fuel (wind, rain, geo fluids, coal, gas etc) to meet total demand over any period (area under the curve)...and under different fuel scenarios



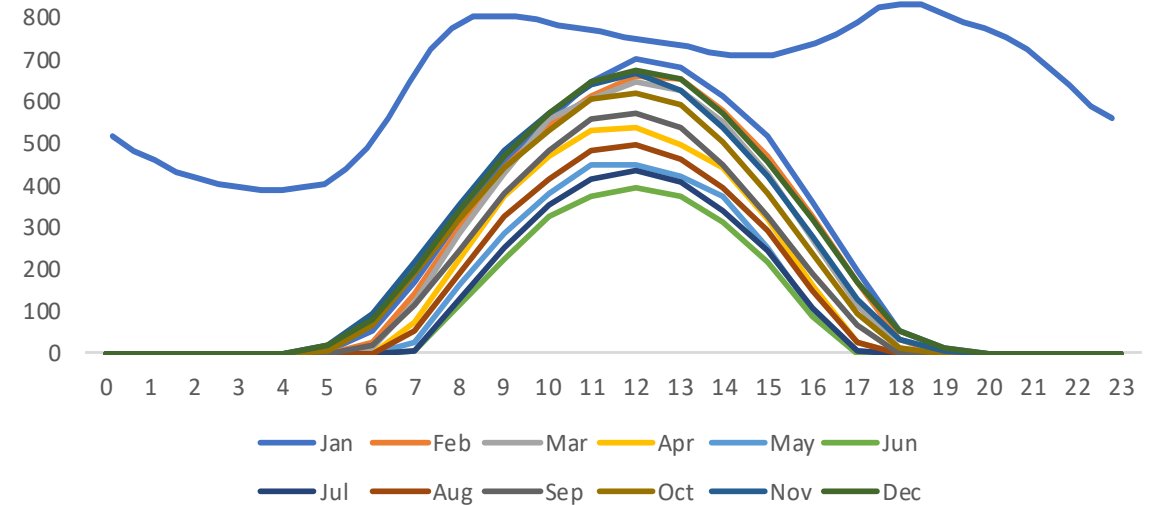
# “Intermittent” Renewables – Wind and Solar

Wind output during top 10% of demand periods

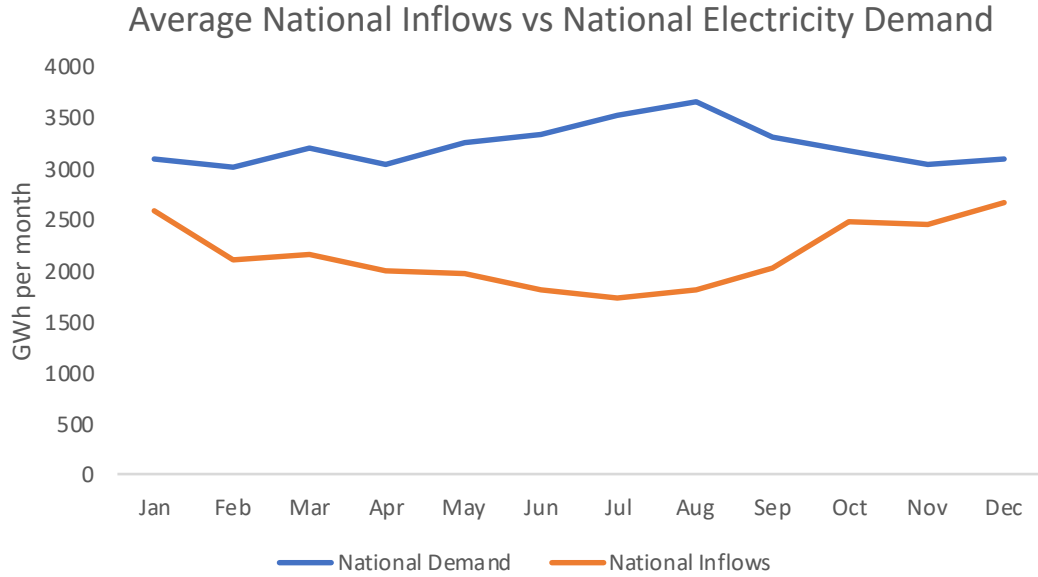


↑  
Peakers, hydro storage  
and soon battery storage  
and demand response  
can “smooth” this

Daily Solar profile



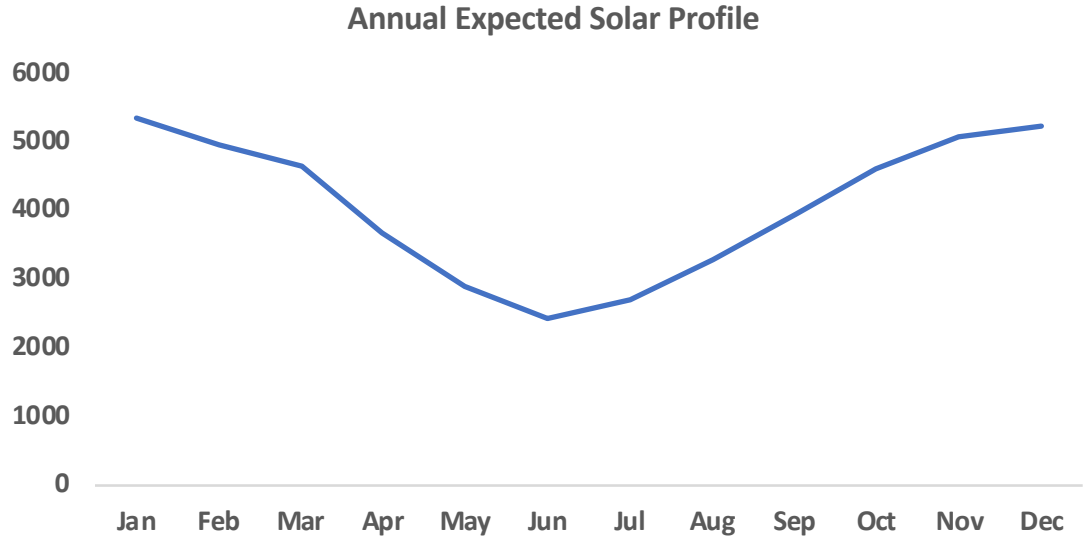
# NZ hydro – an unfortunate correlation



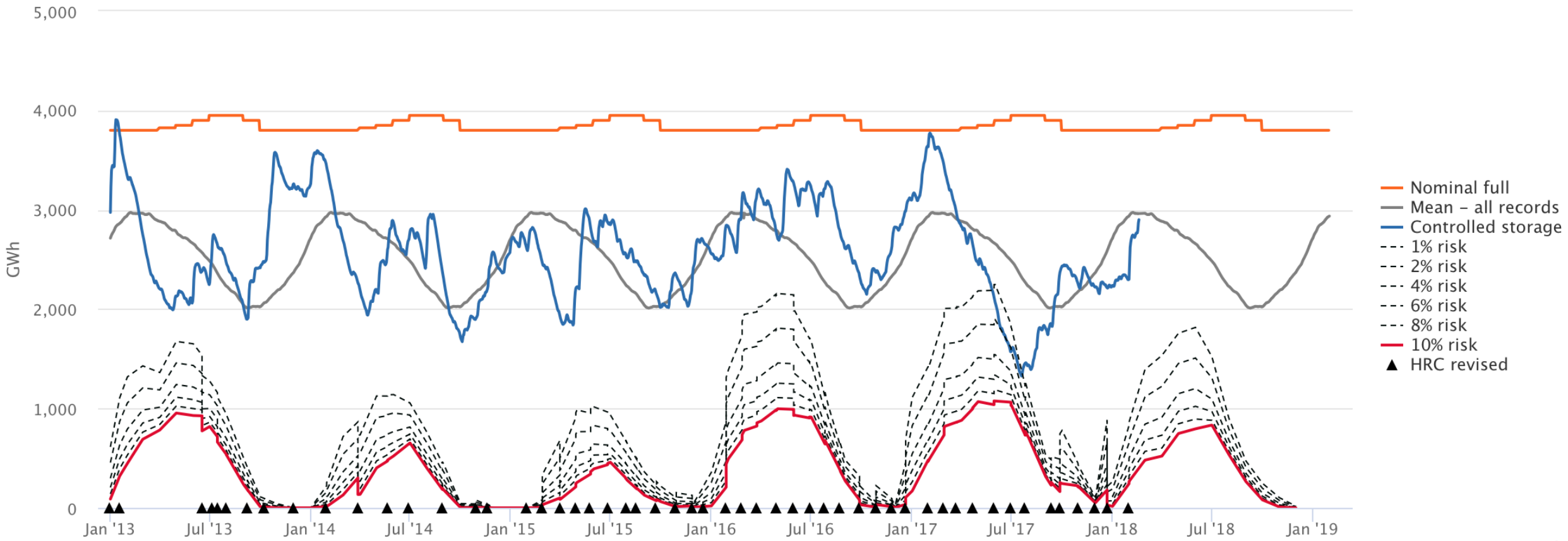
Batteries? Demand Response?

↑

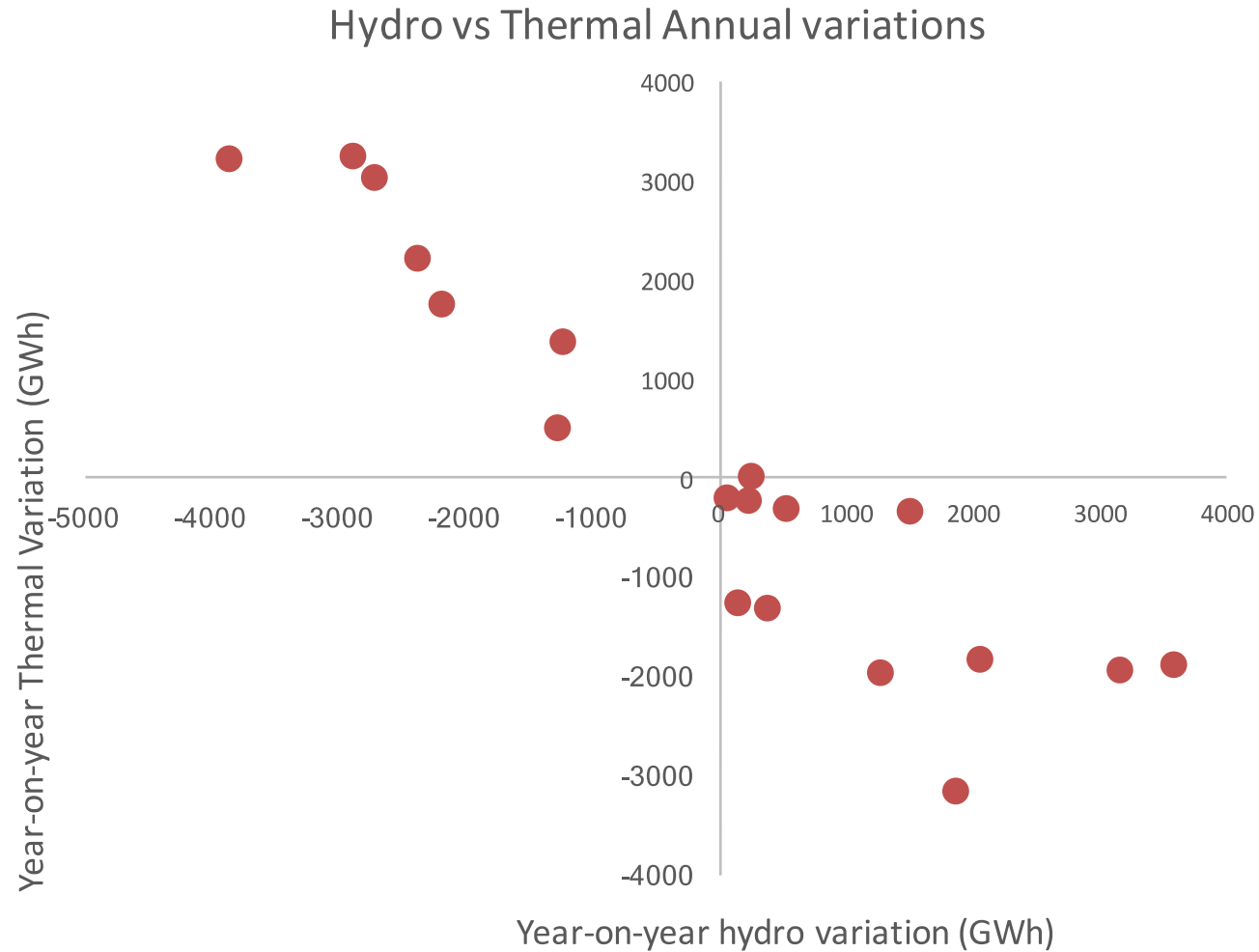
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# Hydro uncertainty



# Managing between years



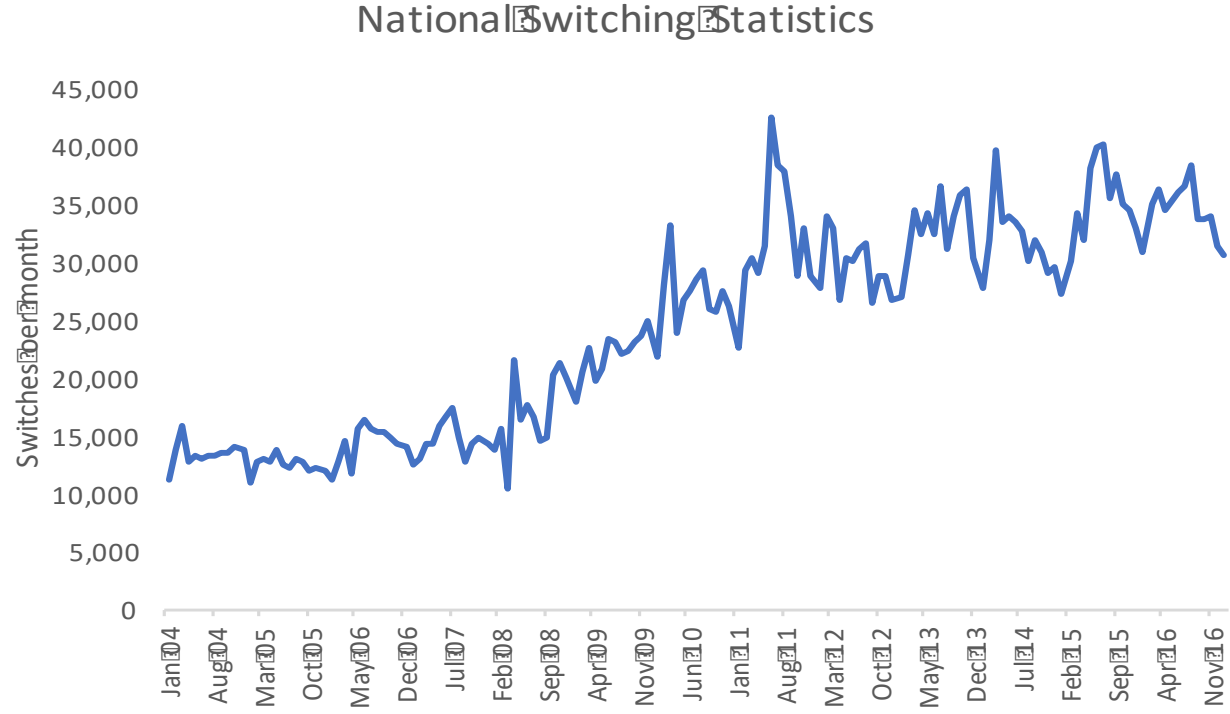
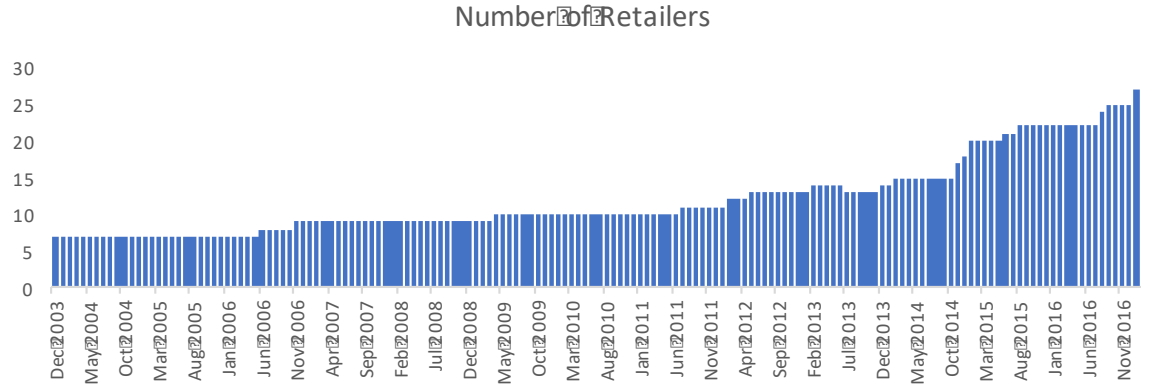
- The concept of “shifting” power through time (flexibility) is relevant to every system
- But in a hydro dominated system happens over long periods
- Currently done through fuel contracts + storage
- With a high renewables future, flexibility will be the “coin of the realm”

# Questions

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- What sorts of long-term decisions are emerging from this market?
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# Switching and new retailers




# Technology – Disruption?




**SMOKE DETECTOR**




**WEATHER STATION**




**LIGHTING**



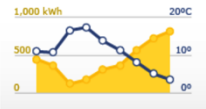
**SECURITY**



**HEATING & COOLING**



**ENERGY MONITORING**



The graph shows energy usage (kWh) on the left y-axis (0 to 1,000) and temperature (°C) on the right y-axis (0 to 20). The x-axis represents time. A blue line graph shows temperature fluctuations, and a yellow area graph shows energy usage.



# Don't forget about efficiency - the quiet competitor

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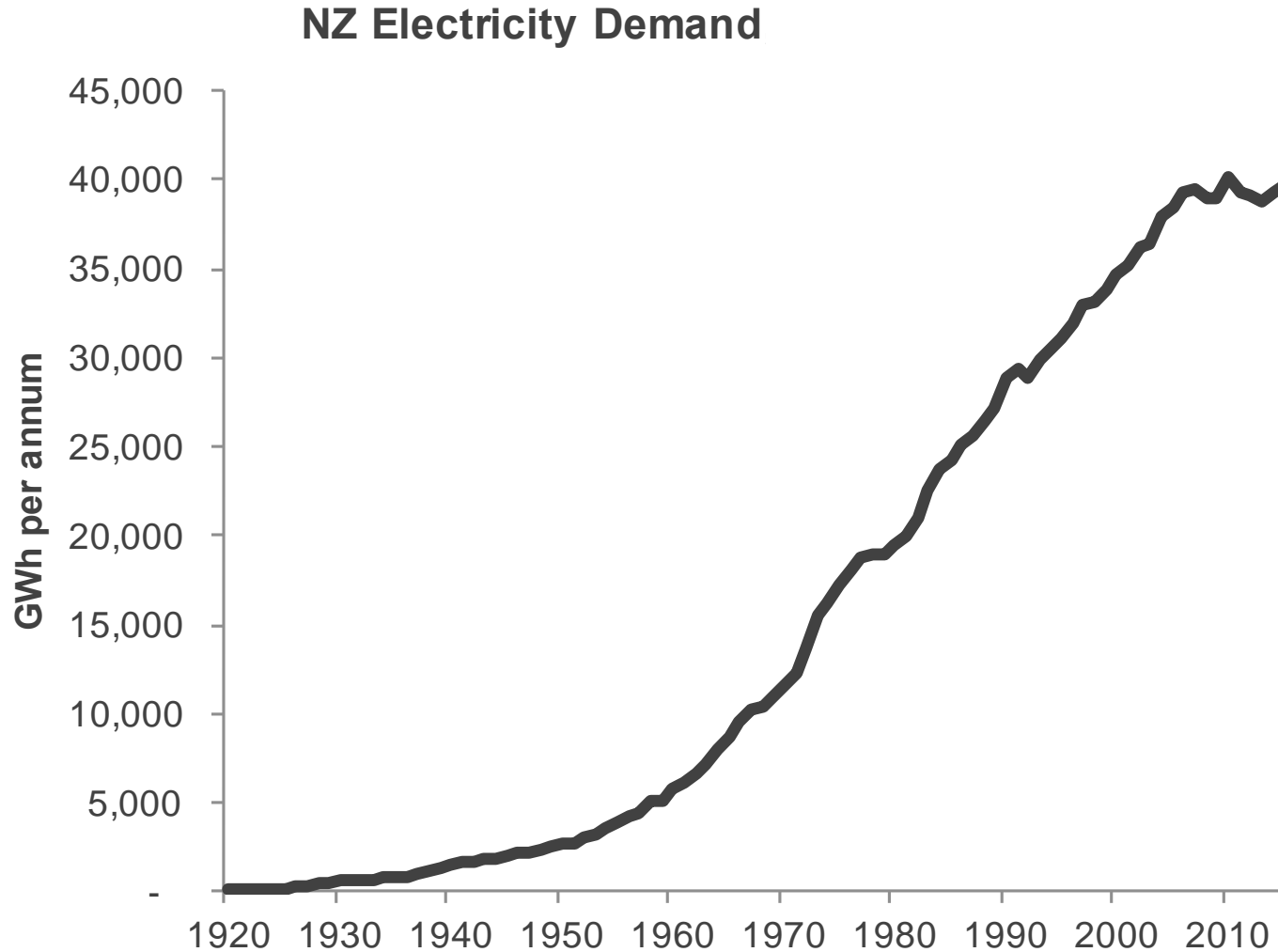


Or even just....

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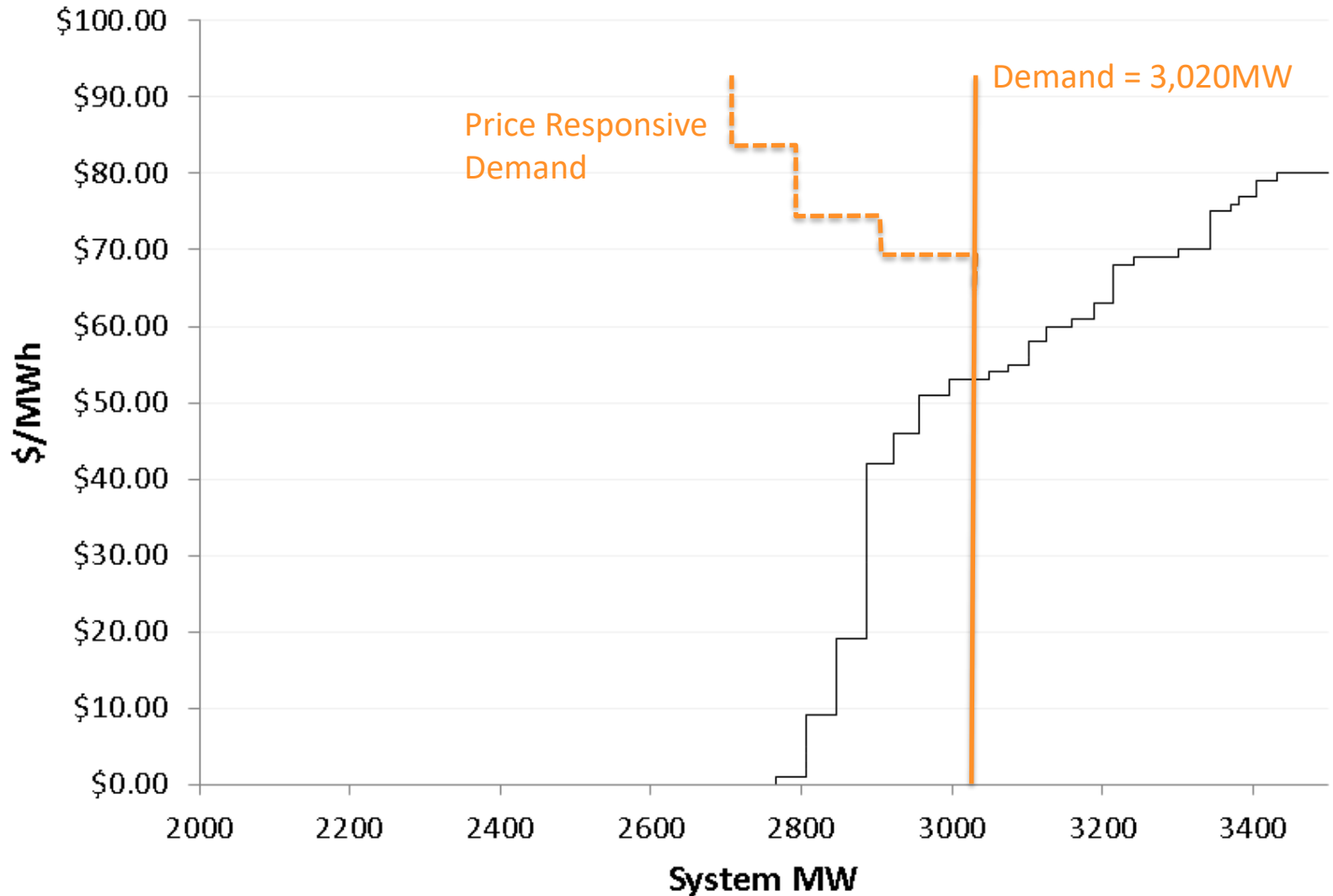


# A new dynamic?



- Meeting this demand used to be about competition between large generation investments
- Now it's also about competing with customer investments: efficiency, 'irrational' distributed generation, behaviour change.
- BUT we could also see the electrification of process heat, transport

# It's just clearing supply and demand



- So how does the new consumer participate in a half hourly market?
- How do we coordinate (optimise) the flexibility and uncertainty of distributed energy resources?

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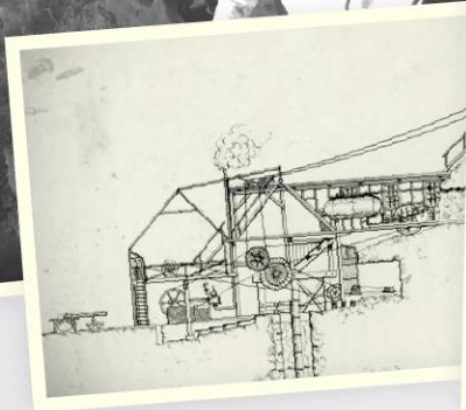
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**QUESTIONS?**