



# Gas cogeneration opportunities

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# How will gas fit into a smart energy future?



The majority of future energy grid images look like this. Does gas have a place?

# Issues we still need to overcome for the smart energy future

## Balancing renewables

- Electricity supply more dependent on sunshine and wind
- Generation can exceed demand
- Greater need for energy storage
- Peak loads on infrastructure growing faster than consumption
- Peak loads requiring non-renewable energy sources to meet demand



# Consumers will drive the smart energy future

## Decarbonising energy

- Energy generation needs to be decarbonised
- Reduce the need for non-renewables at peak loads



## Rise of the prosumer

- Greater need for real time information to manage demand side response
- Consumers want more choice and control



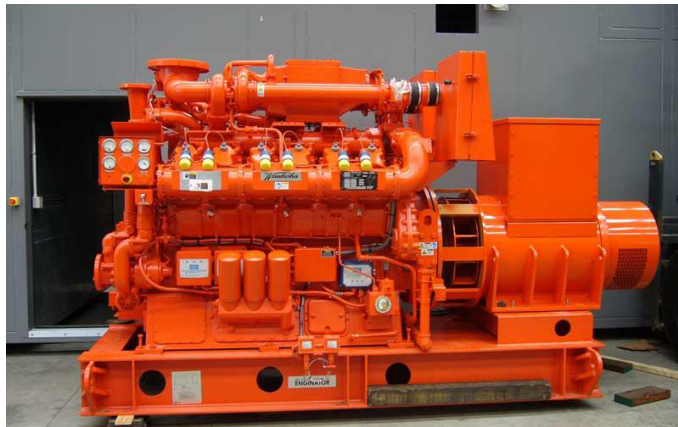


# Cogeneration – Industrial CHP through to residential fuel cell options

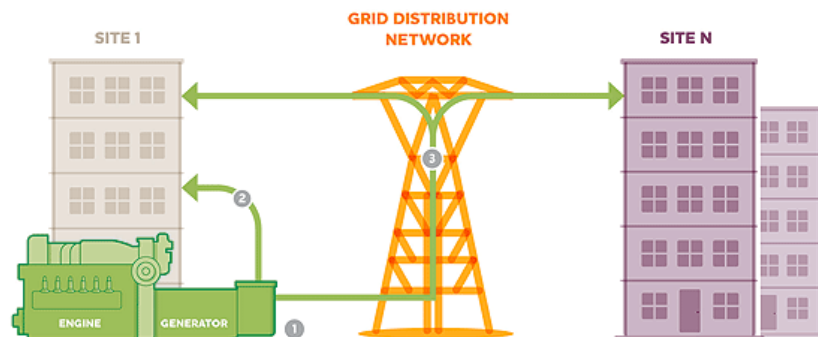


# Cogeneration and Trigeneration solutions are used worldwide to generate electricity, heat, and cooling at various (large) scales

**Trigeneration unit can service a single building ...**

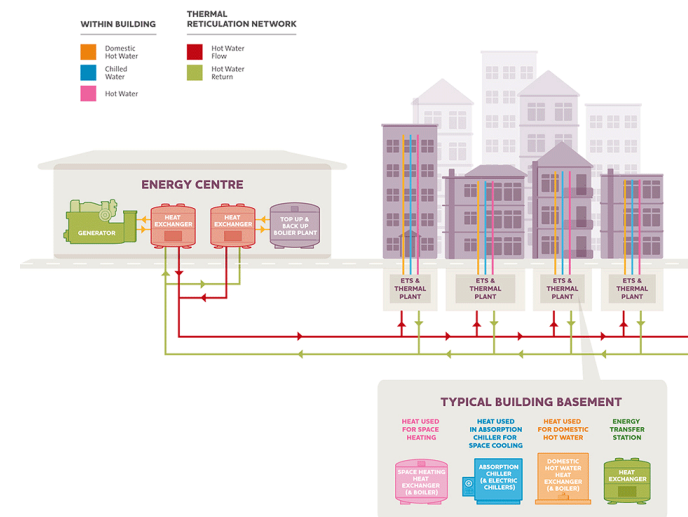


**... or sites further away using the distribution network**



- ① Cogeneration Plant at one site setup for grid parallel import and export of electricity
- ② Cogeneration Plant supplies electricity to site across a single grid feeder
- ③ Exported cogenerated electricity which is less carbon intensive can be attributed to grid feeders at same site (Site 1) or remote site (Site N) from the same Grid Distribution Network.

**... an entire district ...**

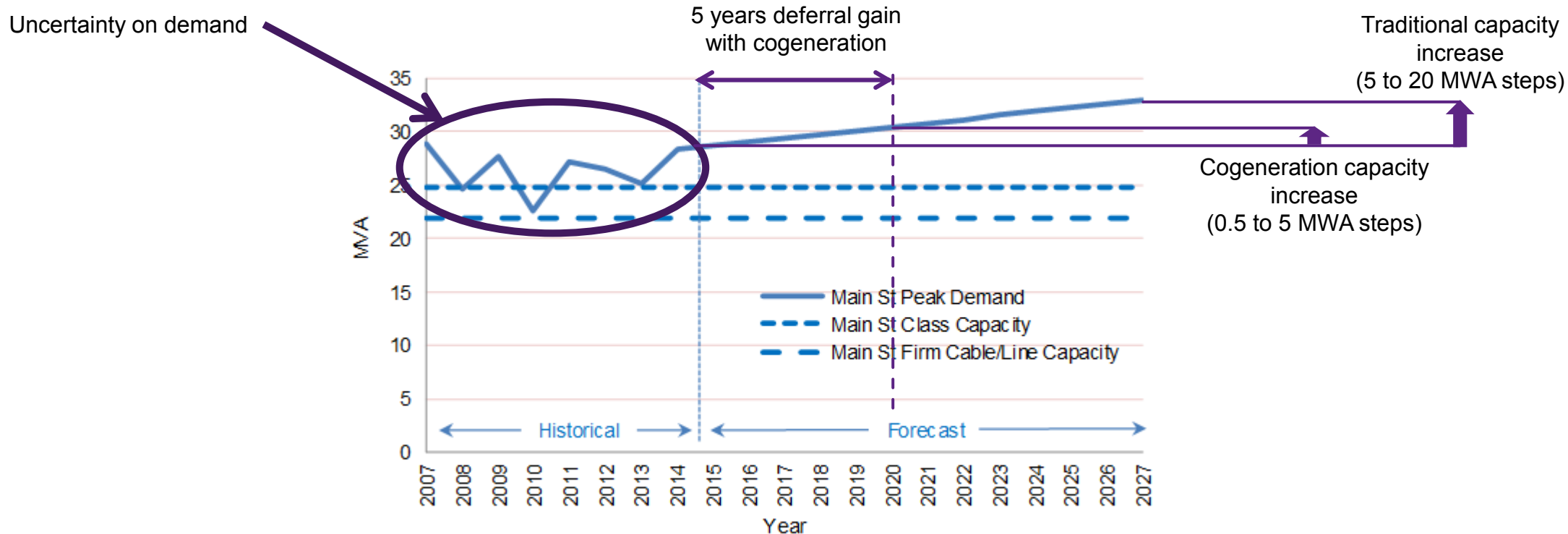


## Sectors currently using co/trigeneration

Activity	Examples
Hospitals	Wellington, Auckland
Plants	Fonterra (Hawera)
Cities	Christchurch, Sydney, New York
Building owners	Christchurch city council, New York University

# For Powerco, the potential to defer investment in Electricity reinforcement brings additional value, especially when demand growth is uncertain

Historical and future demand on Powerco's Main Street substation in Palmerston North (for illustration purposes only)



## Network benefits

- Smaller capacity increase steps
- Less risk of stranded assets
- Better utilisation of gas and electricity networks
- Deferred capex

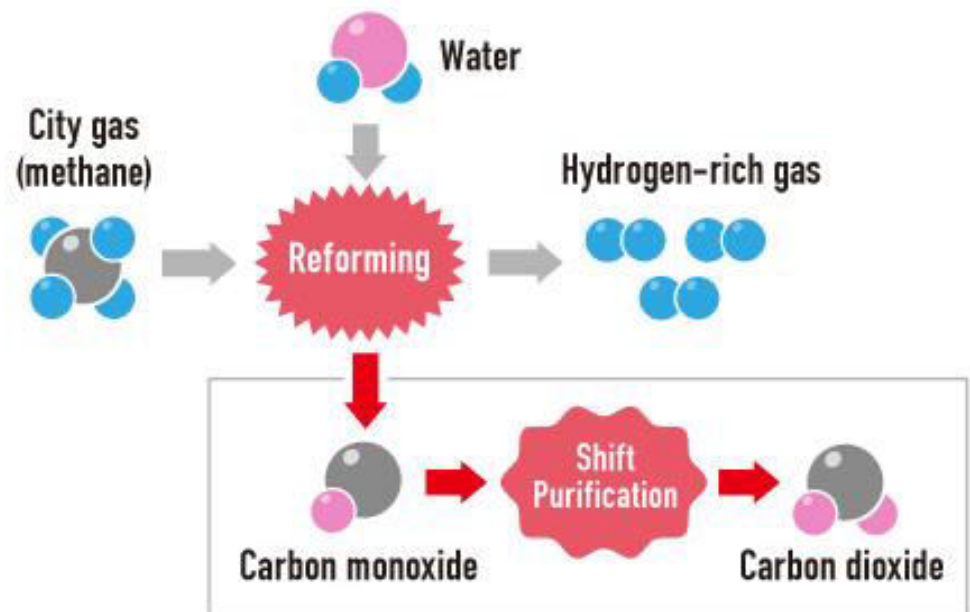
# Fuel cells: using natural gas to produce hydrogen gas

## Hydrogen production

- Hydrogen can be formed from natural gas anywhere on the existing network
- Forming hydrogen from natural gas produces around 30% less CO<sub>2</sub> than burning it

## Benefits

- No new network investment required
- Current gas network has spare capacity
- Gas doesn't need wind or sun





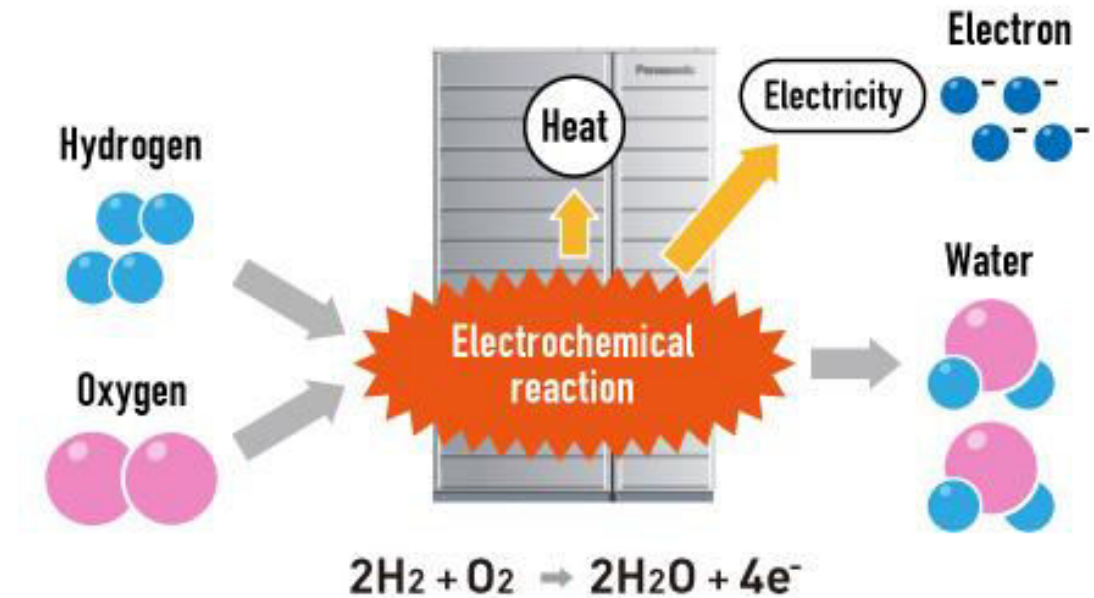
# Hydrogen gas fuel cells for energy

## Hydrogen energy

- Hydrogen gas can be converted to electrical energy through an electrochemical reaction
- Waste products are water and heat

## Benefits

- Hydrogen is a clean energy
- On demand supply
- Waste heat can be reused onsite



# Fuel cell technology is being commercialised

# High levels of electricity supply security for commercial

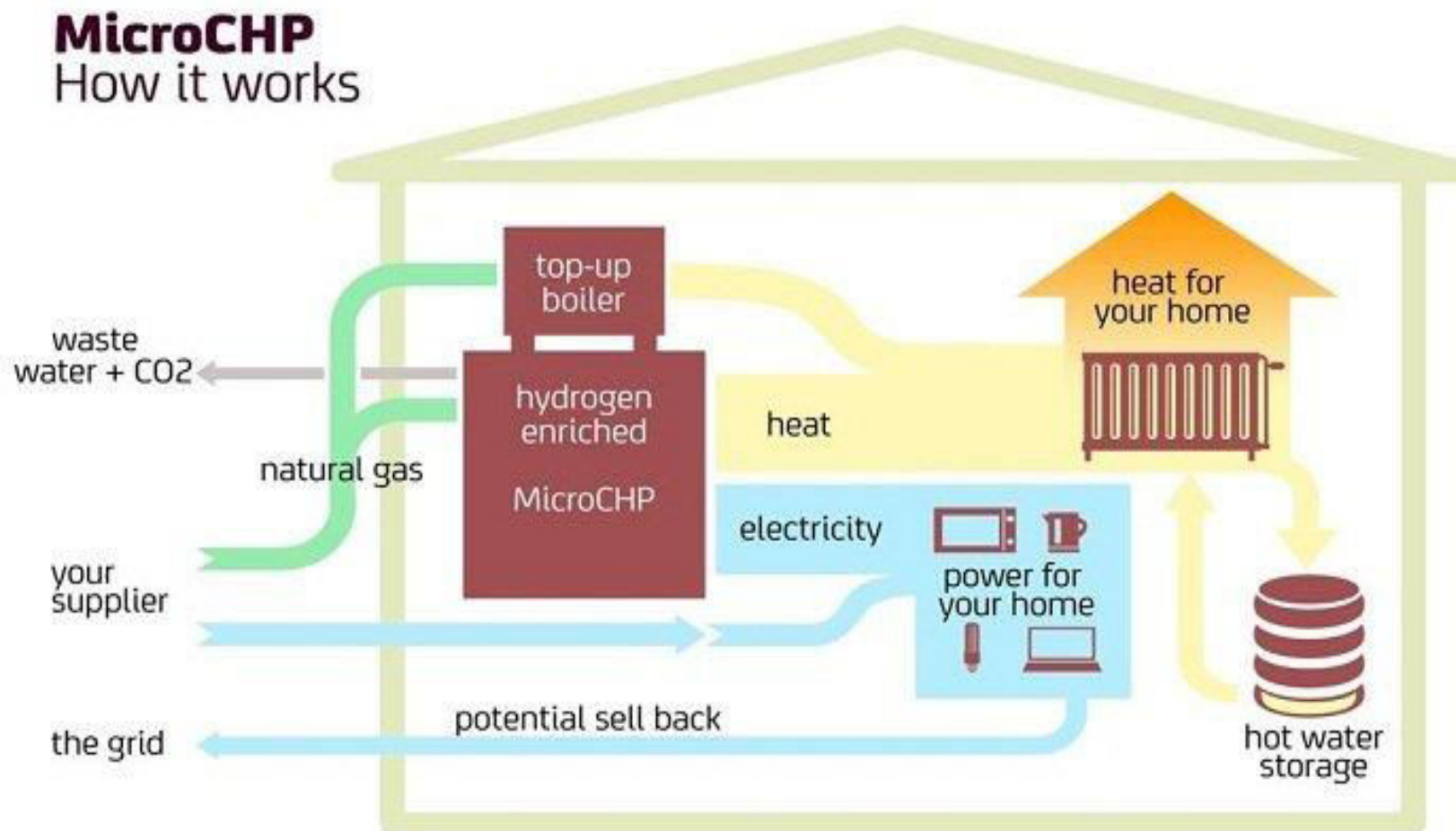
Fuel cell uses include:

- Backup (uninterruptable) power supply's for commercial/industry
- Supplementary supply for big energy users



# A complete solution for homes (combined heat and power)

## MicroCHP How it works

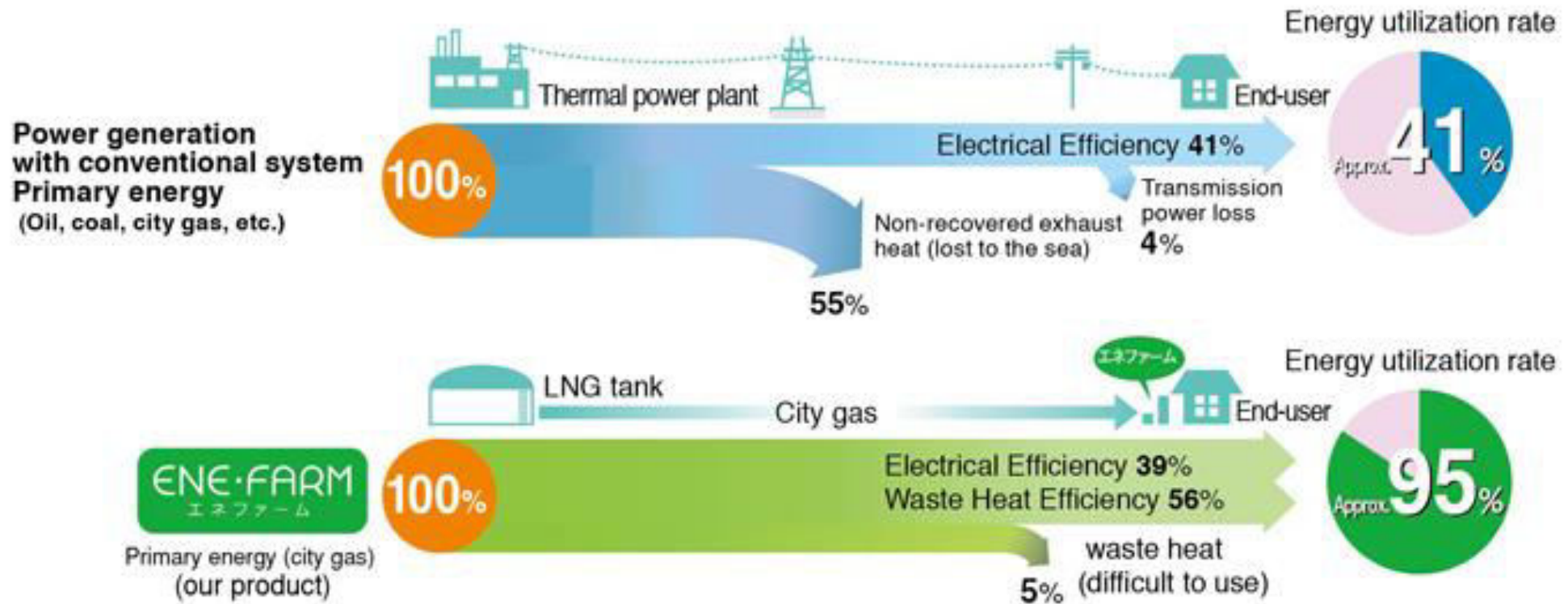


Water Tank designed by Connor Cesa from The Noun Project  
Radiator designed by José Hernandez from The Noun Project





# Fuel cell energy efficiency



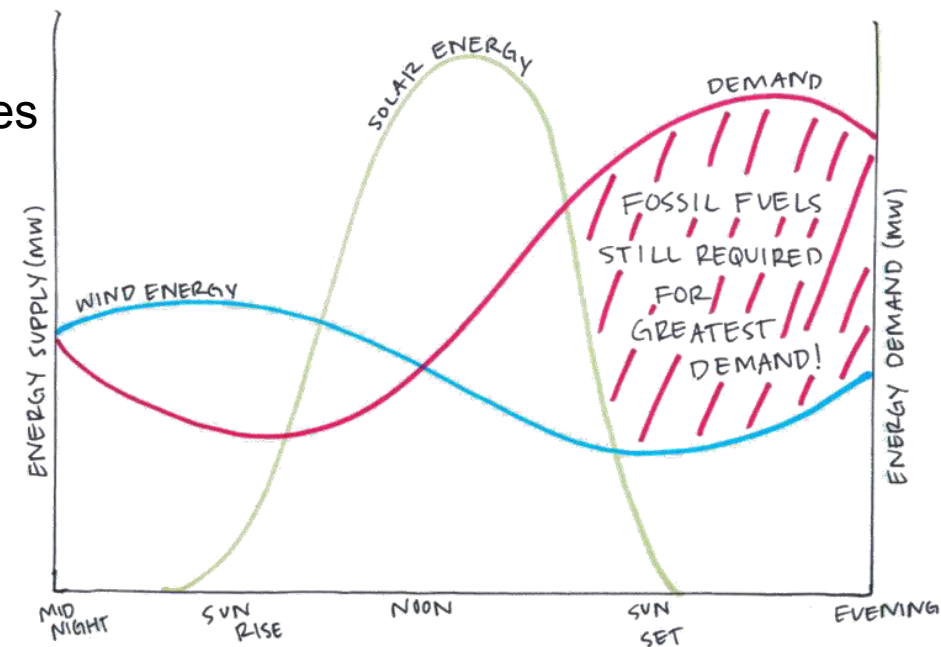
\*These energy utilization rates are based on lower heating value reference [LHV]. The heating value is determined by subtracting the condensed latent heat of water vapor when fuel gas is fully combusted.

\*\*Calculated according to the database (INFOBASE 2014) on the homepage of Federation of Electric Power Companies of Japan.

# Cogeneration in New Zealand?

## Potential benefits

- Decentralised generation
  - Taking pressure of aging networks
  - Supplement peak loads
- Support renewables by increasing diversity of energy sources
- Reduction in carbon emissions
  - Demand reduction for non-renewables at peak times
  - Reduction vs burning gas
- Increased energy efficiency
- Decrease energy costs for customers
- Affordable heating
- Can integrate with the smart grid
- Provide options for prosumers



# Cogeneration worldwide

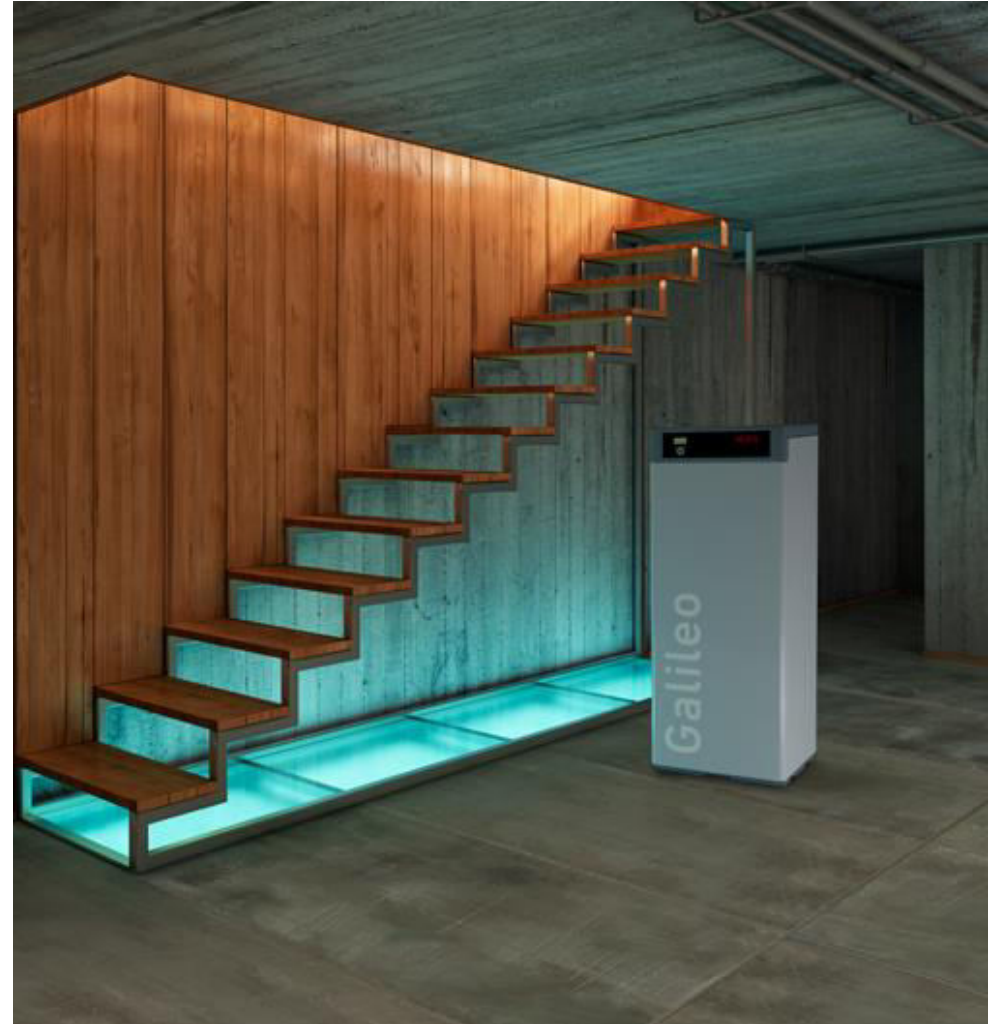
## State of the industry

Japan	Current world leaders 150,000 units installed across all of Japan
Korea	Large scale RnD Built the first fuel cell park, 59-MW in Hwasung City
Europe	Undertaking extensive field testing across multiple countries Results will assist international standards and provide information for manufacturers
US	RnD Focused primarily on commercial/industrial uses

# Pathway to cogeneration

## Current roadblocks that need to be addressed

- High capital cost and pay off period of the unit – decreasing yearly
- Limited commercially available products – immature industry
- Units prone to contamination from unclean inputs
- Lack of international standards – one of the outcomes from the EU study
- Lack of central heating systems in NZ
- Destigmatizing hydrogen gas as a fuel
- Regulation





# Next step

Let's buy one!



## The End

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