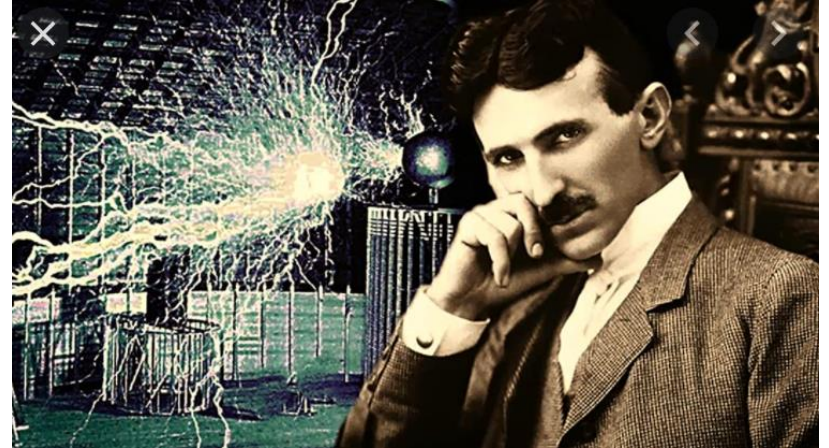
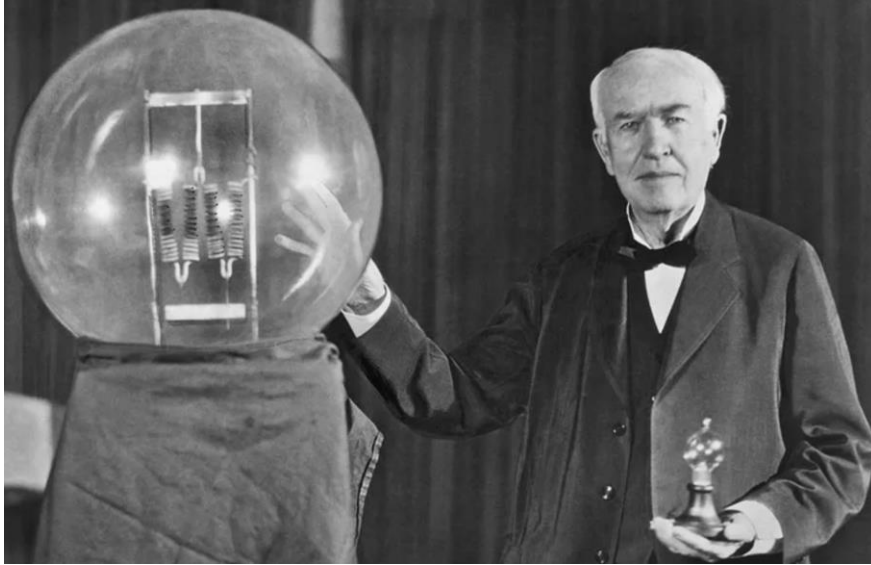


A smart distributed electricity future

Auckland University 21st February 2024

Back in the day...



Thomas Edison and Nikola Tesla would recognise the power system today; power flowing from large power stations to homes and factories

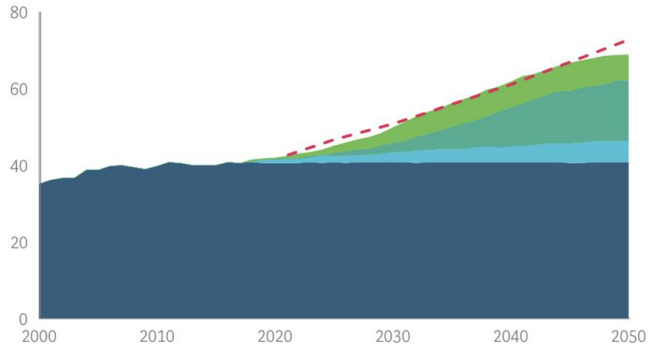
That is about to change...and more...

Electrifying everything...

- Tesla has produced 5,000,000 cars
- Ford has produced 200,000 EV, each with 1 mile of unneeded wire and loses USD36,000 per car
- VW cutting back EV production – due to a lack of sales
- EECA worked out there were not enough trees in Southland for coal conversion

Exhibit 23: 71% increase in New Zealand's gross electricity demand by 2050

(TWh, Accelerated Electrification)



Energy demand growth contribution 2019-2050

	Transpower Sub-totals shown on graph	Concept Total shown with pink dotted line
Total	+68%	+71%
Process, space and water heat	+16%	+18%
Vehicle electrification	+38%	+37%
Base growth	+14%	+16%
Historical baseline	Flat	Flat



...is catching people out.

Two main parts to the electrification challenge:



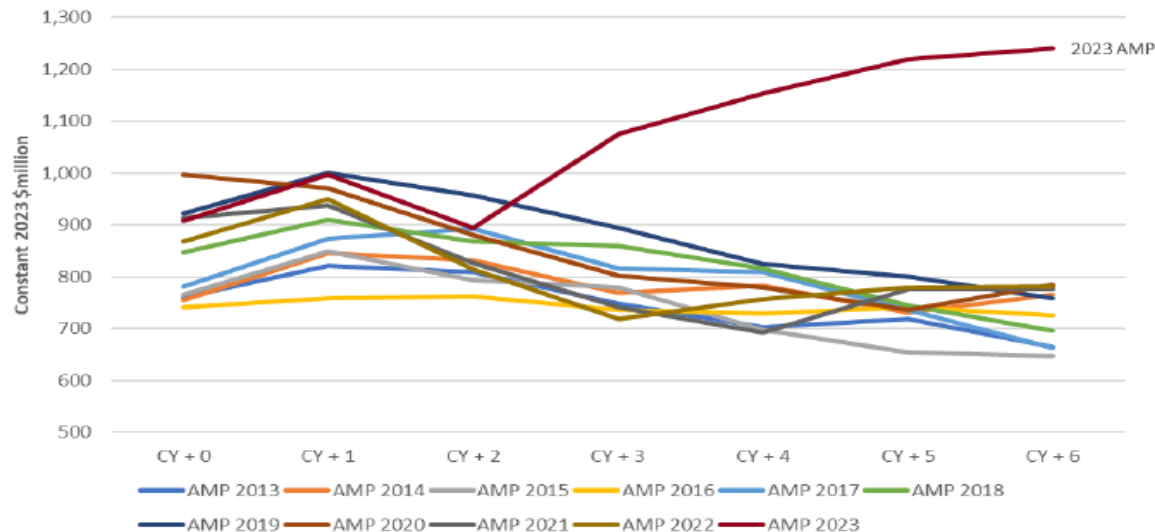
Generating enough electrons



Using them wisely: A smart electricity system

The electricity industry is starting to look at the future differently...

Figure E2 Comparison of capital expenditure forecasts from EDB AMPs forecasts



What kind of electricity system do we want? We are at a critical point...

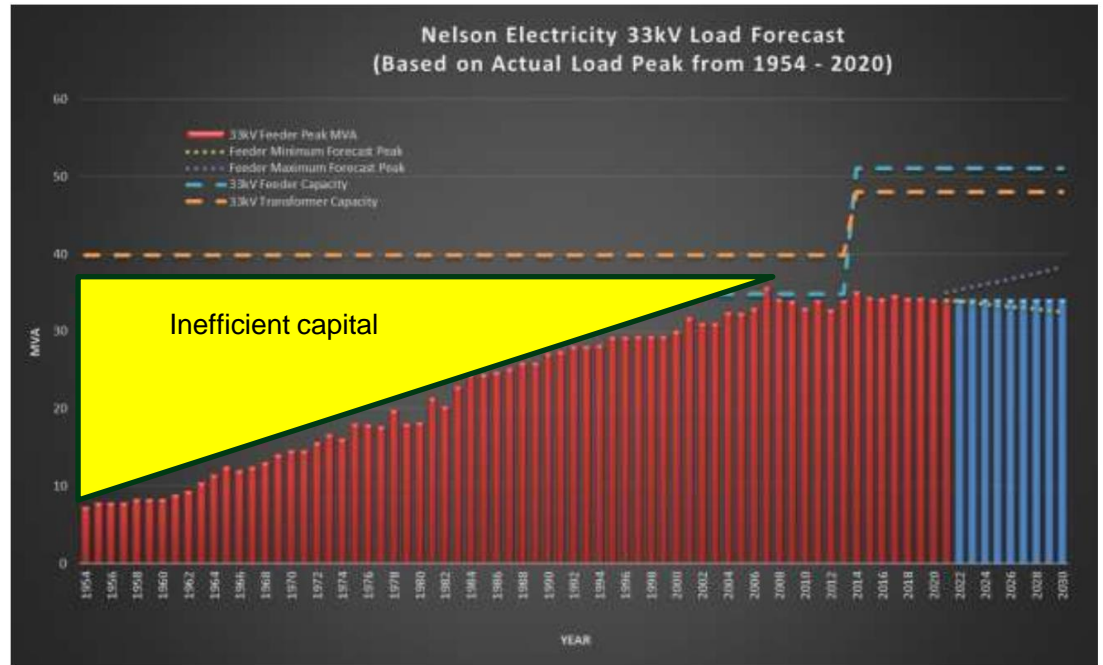
The electricity industry has
become very efficient at running
a capital inefficient system

Demand has been seen as
something that is unchangeable

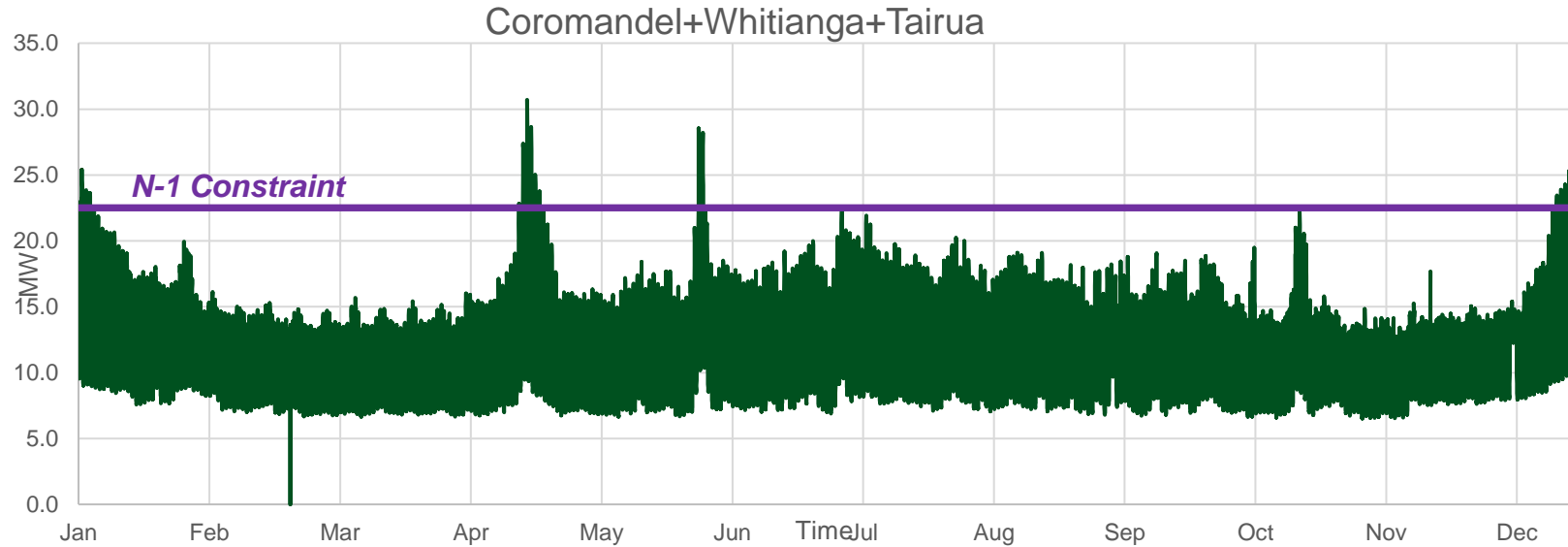
Back in the day...we built networks well ahead of demand – inefficient

Network Demand Growth Forecast

- Limited by technology
- Benefits of electricity are huge (lights, fridges, freezers etc)
- Built for future growth and did it well
- BUT: Inefficient use of capital – expensive
- With technology the electricity industry can use capital more efficiently

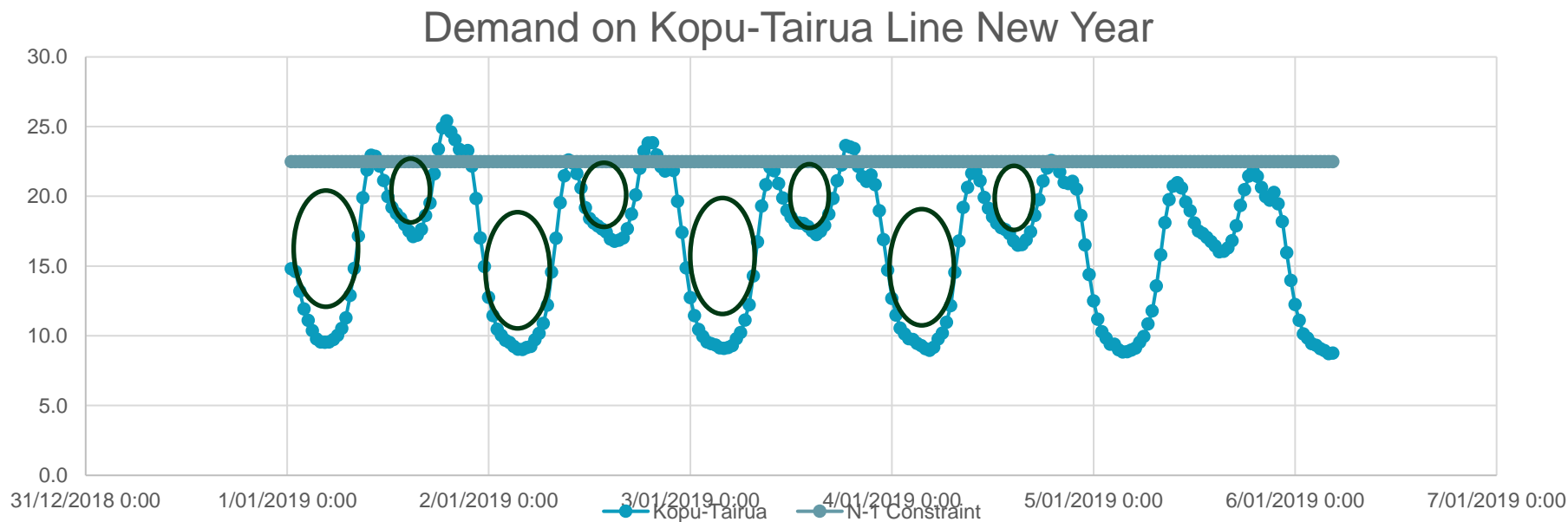


The power situation in the Coromandel



Very high usage for a small amount of time – ideal for a distributed energy solution

Improving the efficiency of the power system



A magical but real solution

We have a solution that is **magical**. At the *same time* it can help address issues at:

- The distribution transformer level
- Feeder level
- Zone substation
- Sub-transmission
- GXP
- Transmission

As well as help meeting national peak, providing power system stability services...

Is socially equitable

Provides resilience

Plus, provides visibility of the LV network

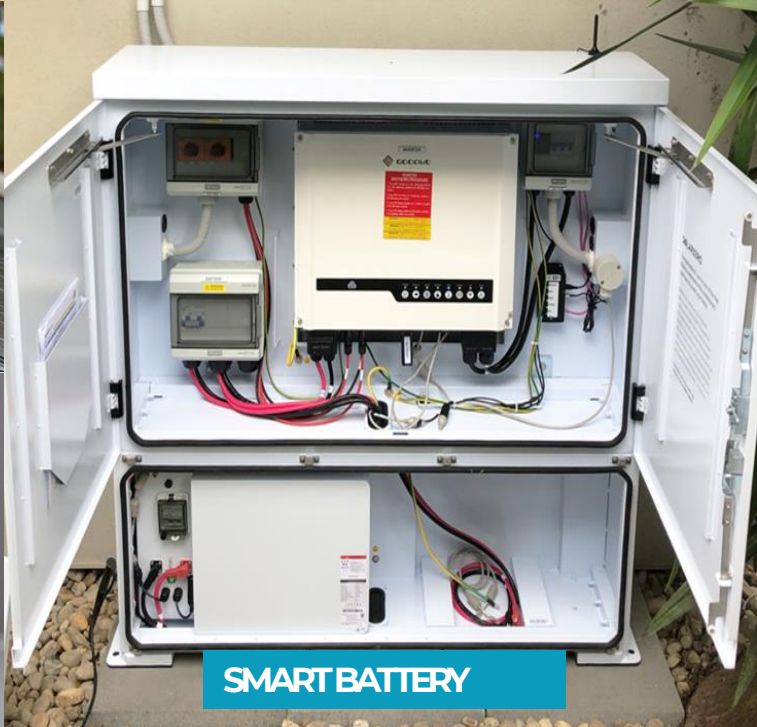
This is the magical device



SOLARPANELS



MONITORING



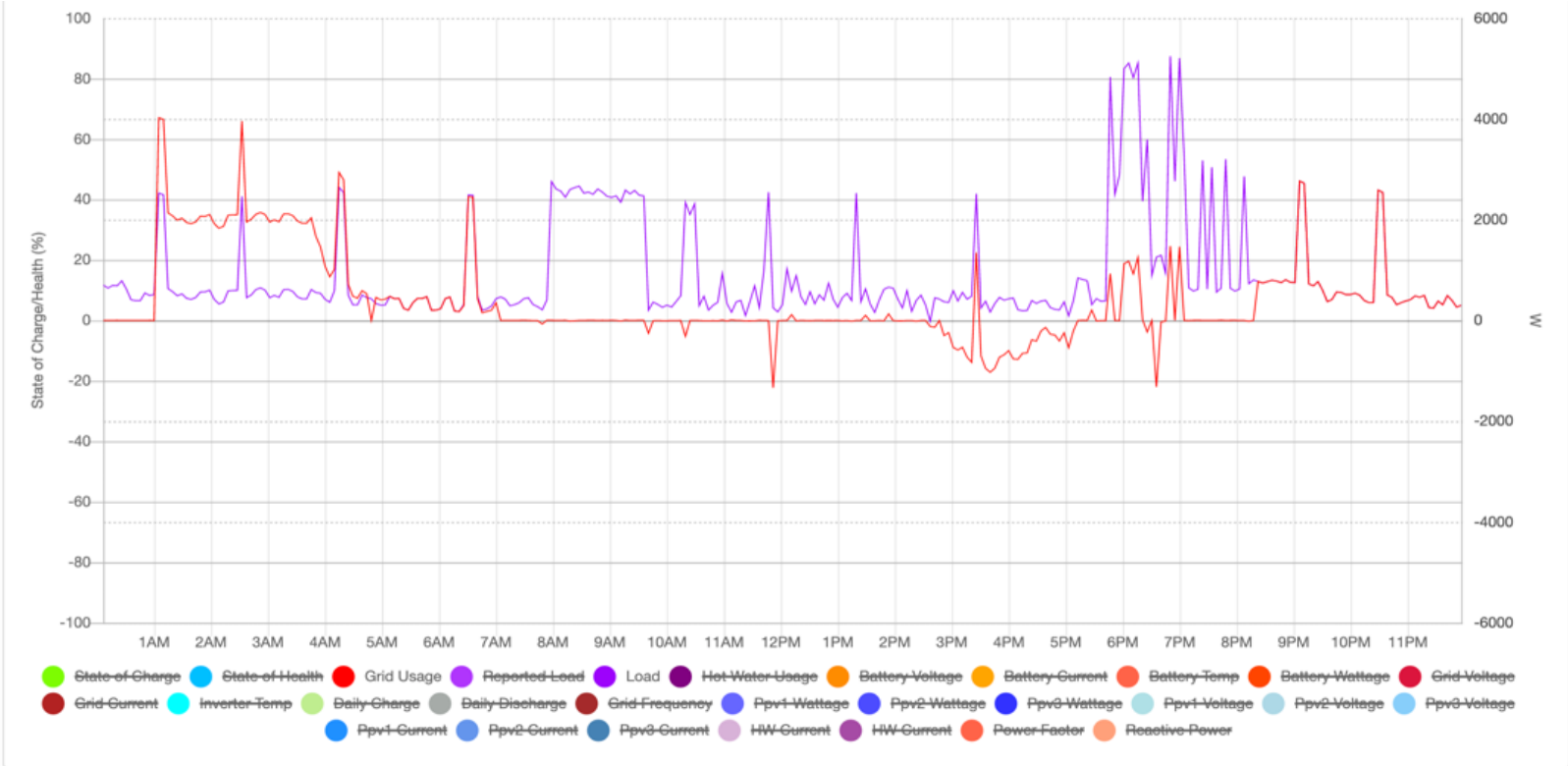
SMART BATTERY



DATA

+ Not just supporting households, but also the power system too

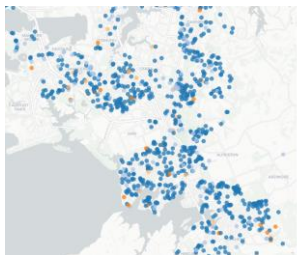
A key part of the magic - **elasticity**: solarZero's effect on our customer's energy profile



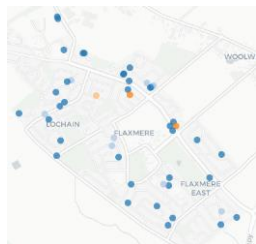
About SolarZero

- Current Scale - 12,000 systems
- Zero dollars down – electricity as a service
- Largest VPP in Asia Pacific and one of the largest in the world.
- First in the world to execute distributed battery reserves
- Winter peak product – just like a peaker plant – world first also
- Delivering non-network solutions in Upper Clutha and Coromandel deferring network upgrades, saving communities money
- Target Scale: 100,000 systems – question is, where are the priority areas and how does SolarZero know?

solarZero systems nationally (12,000)

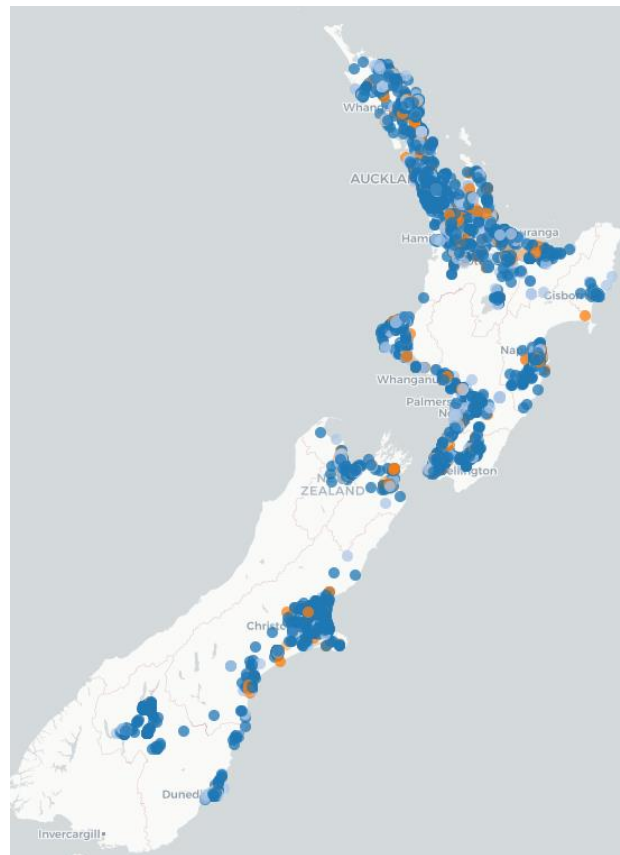
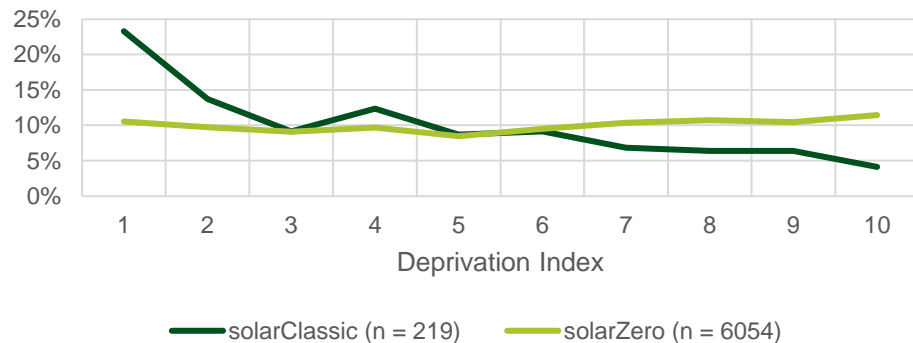


South Auckland



Flaxmere/
Hastings

Product Type by Deprivation Index - All Records



solarZero is much more than the technology (solar and battery). It's about how our communities, technology, finance and smart communication, control and data systems are brought together to **create a better power system.**

Back to the power system and the magic...

A not unusual conversation with a lines company:

- We have a resilience issue in this area
- Separately: We have a peak voltage management issue in this same area
- Separately: We have a sub-transmission issue in this same area
- Separately: We have a capacity issue coming up at the GXP
- Separately: We don't have visibility of the LV network. We may have some LV issues in this area...

Distributed batteries can provide a solution for all these issues *at the same time*

But how?

Why can distributed batteries provide the magic?

The aim of the power system is to meet demand, i.e. meet the consumer's need

The system tends to be sized similarly at each level of the hierarchy

Therefore, if demand (which may be injection) is changed:

- At the LV level: It helps the feeder, zone sub, sub trans, GXP, national grid
- Zone sub: Zone sub, sub trans, GXP, national grid
- GXP: GXP, national grid

Distributed batteries at the household/commercial level, i.e. at the point of demand, create benefits across the whole power system **hierarchy** and can provide resilience and data

Solutions at other levels provide lesser and lesser benefits the higher up the hierarchy

The planning framework used in lines company struggles to integrate between the hierarchical levels of the power system – AMPs are meant to do this, but...

The concept of **integrated** electricity system planning...

Has anyone actually used the magic? In 2011 the New York Electricity Regulator made a bold move...

DEEP DIVE

The non-wire alternative: ConEd's Brooklyn-Queens pilot rejects traditional grid upgrades

The progress on ConEd's DER project shows how New York can realize the goals of the REV initiative



BRIEF

New York utilities increasingly embrace non-wires alternatives as ConEd forges the path



Faced with a \$billions upgrade, a new approach was trialled and proved successful. Using thousands of devices to help manage electricity demand – a non-wire or non-network solution. Others have followed, e.g. Hawaii Edison and Tesla would be amazed!

Let's move to resilience...

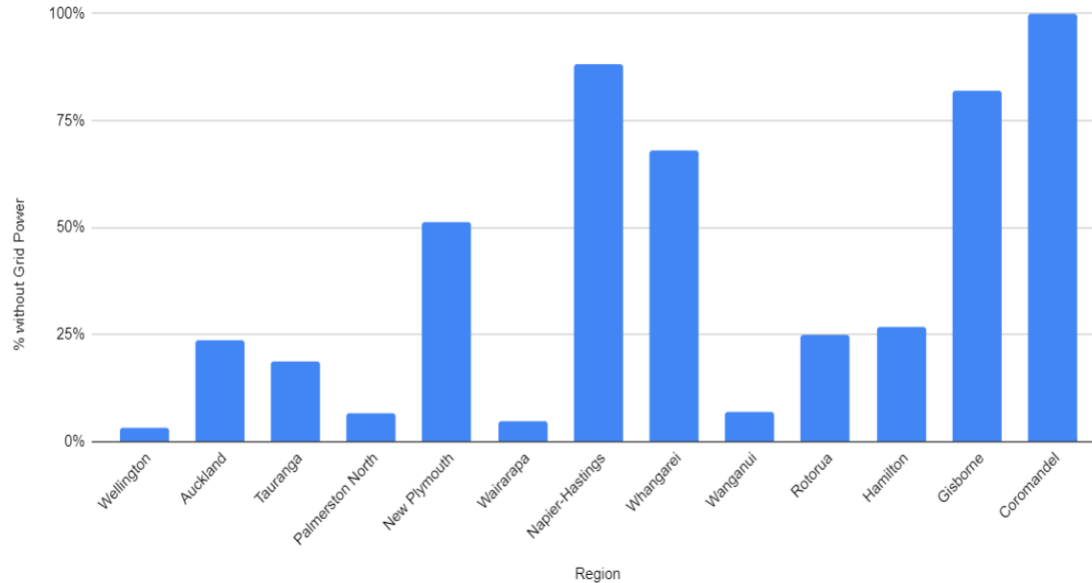
We have designed resilience to be a key part of our system:

- The hybrid inverter “islands” instantly when the grid power goes down.
- We work with customers to identify which circuits in the house should have electricity.
- Hot water, oven, cook top etc is not part of resilience.
- Each circuit has protection control so that power usage is managed.
- The solar charges up the battery when the grid is down.



Cyclone Gabrielle: Percentage of customers who suffered a grid outage

% without Grid Power vs. Region

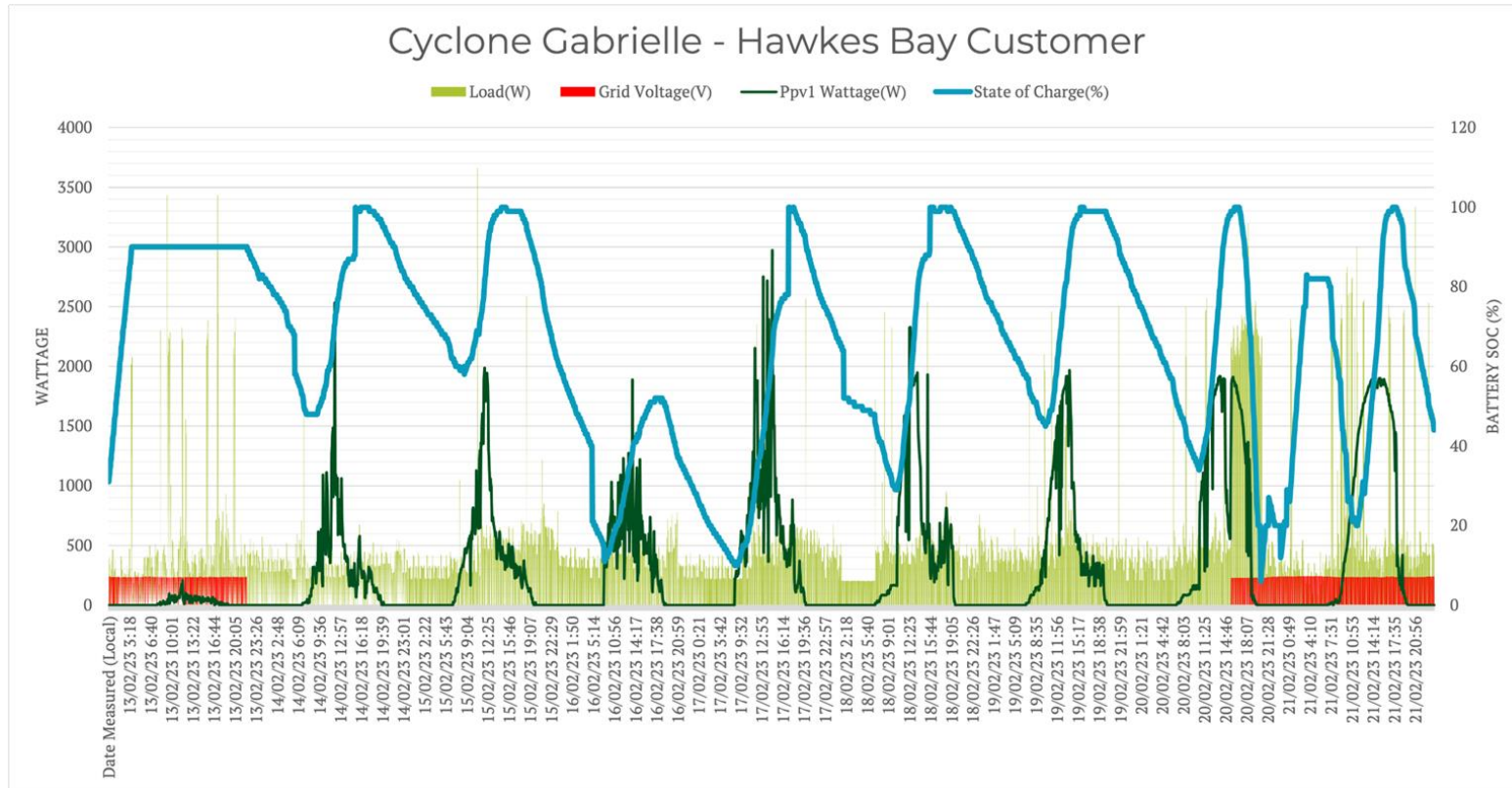


Average:
20 hours

Hawke's Bay:
51 hours

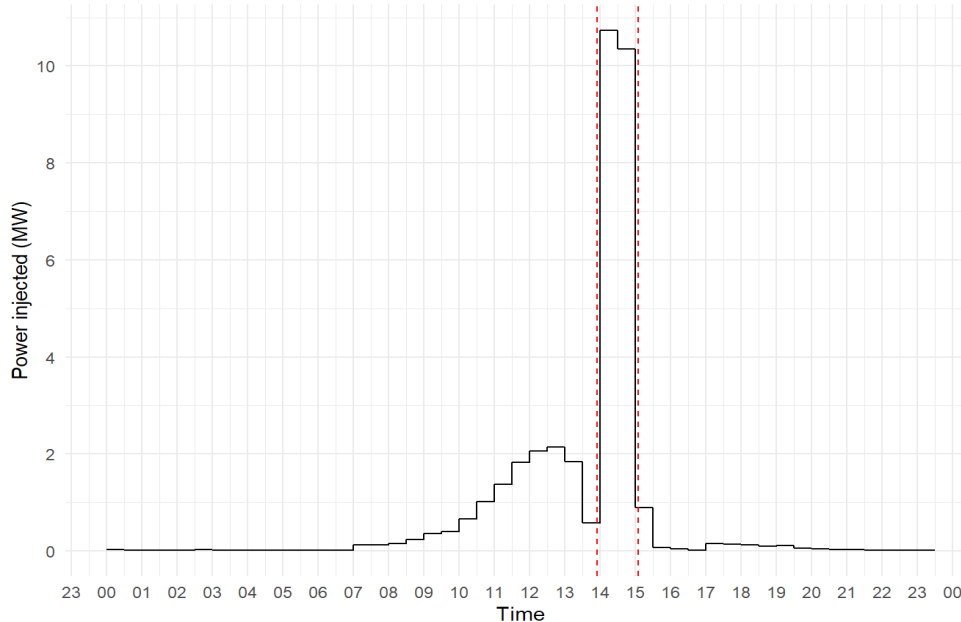
2,700 customers suffered an outage, **one third** of solarZero North Island customers. All kept their lights on

Example solarZero household – Cyclone Gabrielle



Moving on to winter peak...

30MW for two hours, mid November
50MW in 2024



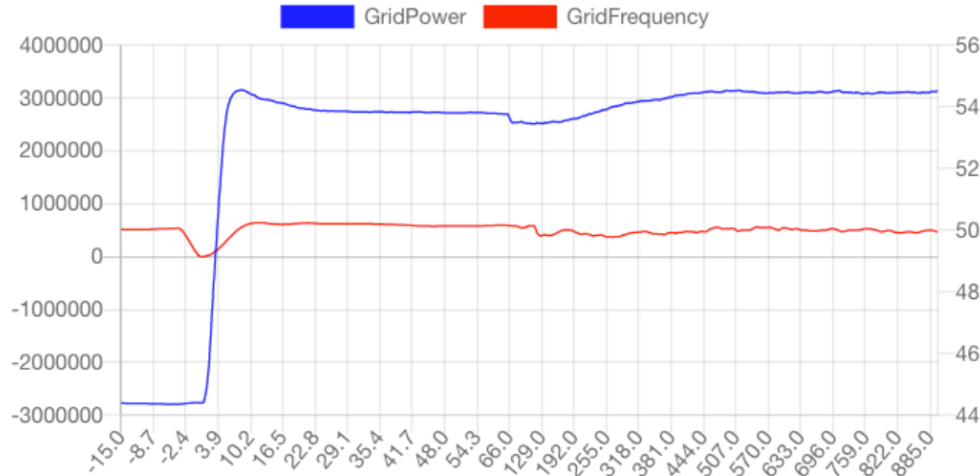
Results from ICP data

We can respond accurately to a dispatch instruction, every 5 minutes. Each battery is individually controlled

In one step the number of power stations dispatched by Transpower jumped from 200 to 8,200 and grew to 12,200...

Power system stability - frequency

Event Details

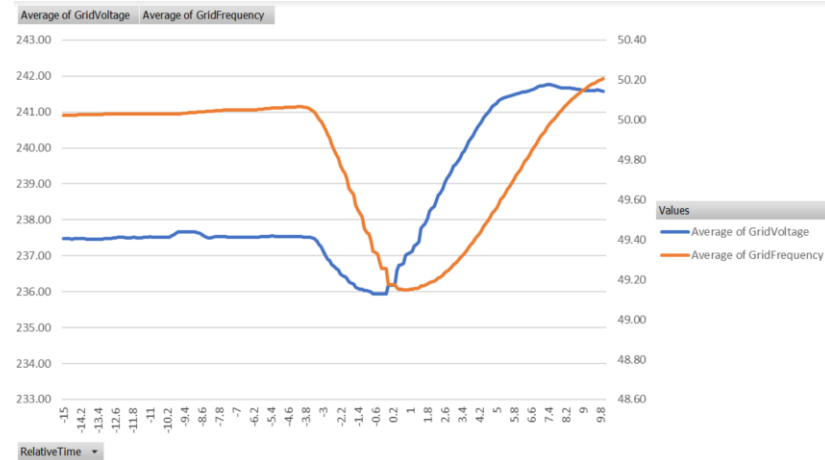


Event time: 2022/10/07 05:36 am
Grid power at event time: -2.76MW
FIR response: 5.66MW
SIR response: 5.87MW

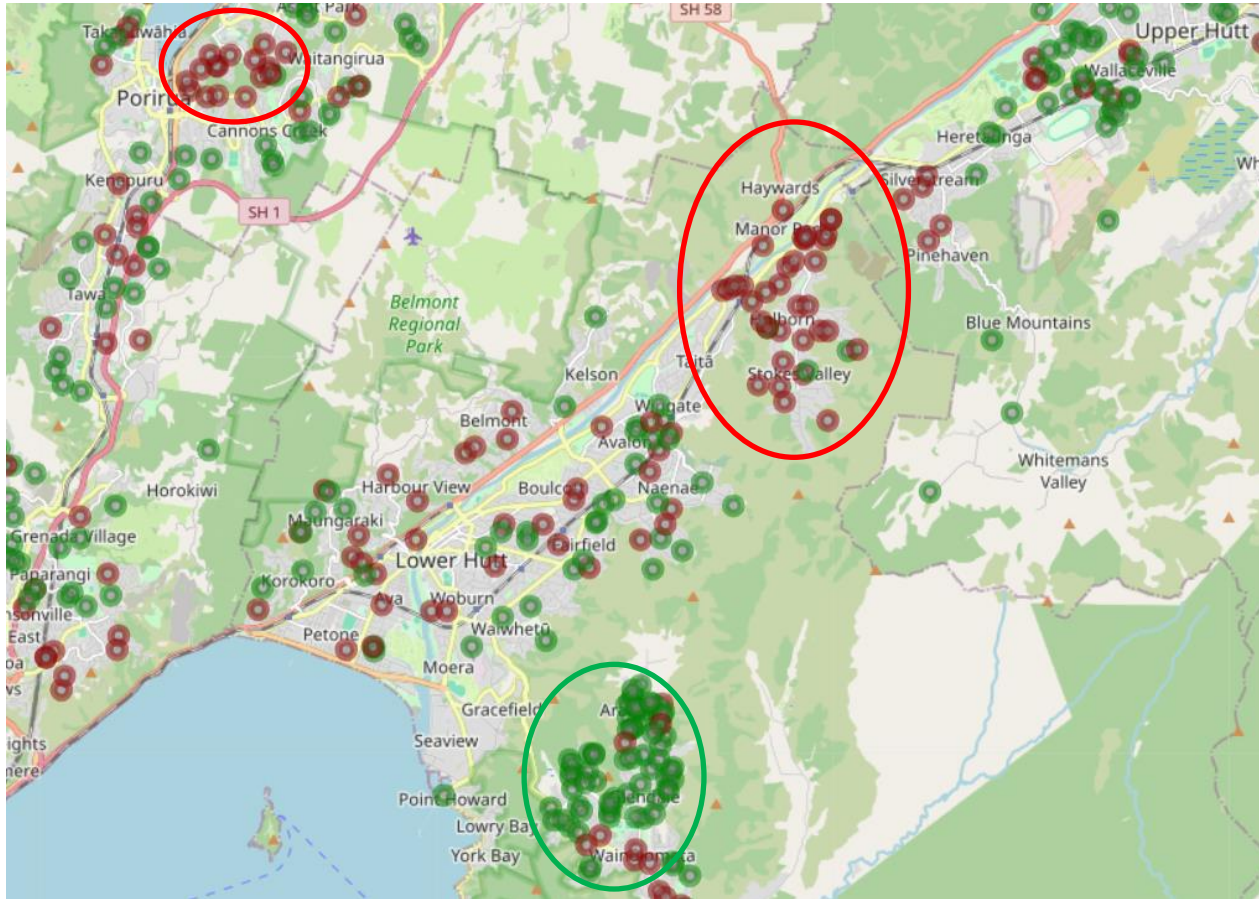
[DOWNLOAD RAW DATA](#) [DOWNLOAD PER DEVICE SUMMARIES](#)

A real frequency event

This graph contains
10,000,000+ data points from
our systems

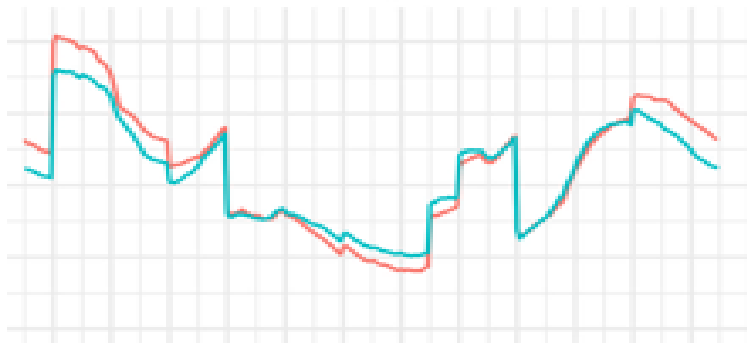


Visibility of the LV network - voltage

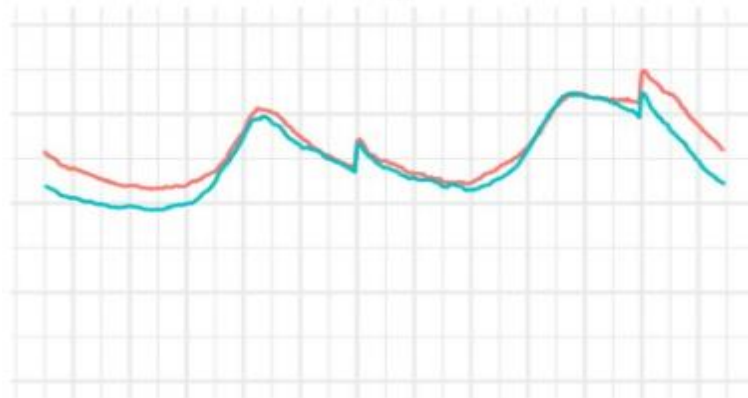


Visibility of what is happening at the household level

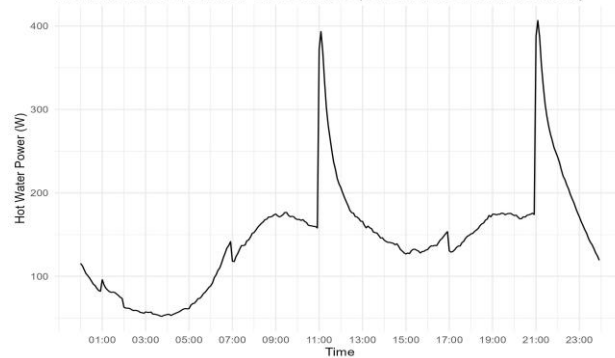
July



July



Mean Hot Water Power for each 5 minute period for the month of January



A capital efficient power system

Thousands of batteries, smart control, internet of things working together to make the power system operate smoothly, increasing capital efficiency, greater household and commercial resilience, avoiding the need for massive electricity infrastructure upgrades as the economy is electrified.

Edison might say: I told everyone that DC is important

Tesla might say: Looks good, but have you thought about doing it this way...

How to enable a capital efficient power system in a time of rapid growth?

A huge change in thinking is needed – from dealing with single issues to taking an integrated approach

A massive amount of learning is needed – almost all decision-makers in the power system need to be retrained!

Policy needs to be changed:

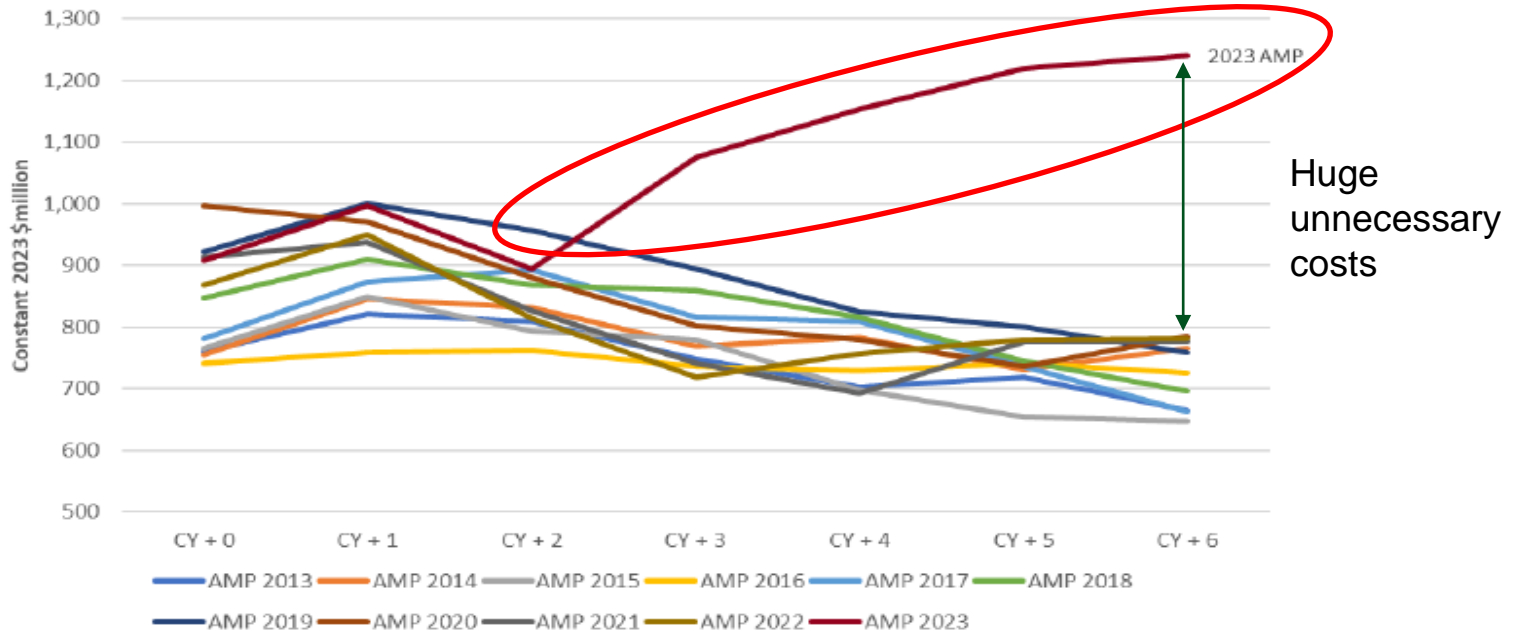
- Commerce Commission – needs to be an innovator as well as a regulator
- Electricity Authority – needs to be an innovator as well as regulator

Lines companies need to using pricing much more effectively “pricing is communication”

Actions need to be coordinated, by MBIE?

If we don't do things smartly, we end up with this...

Figure E2 Comparison of capital expenditure forecasts from EDB AMPs forecasts



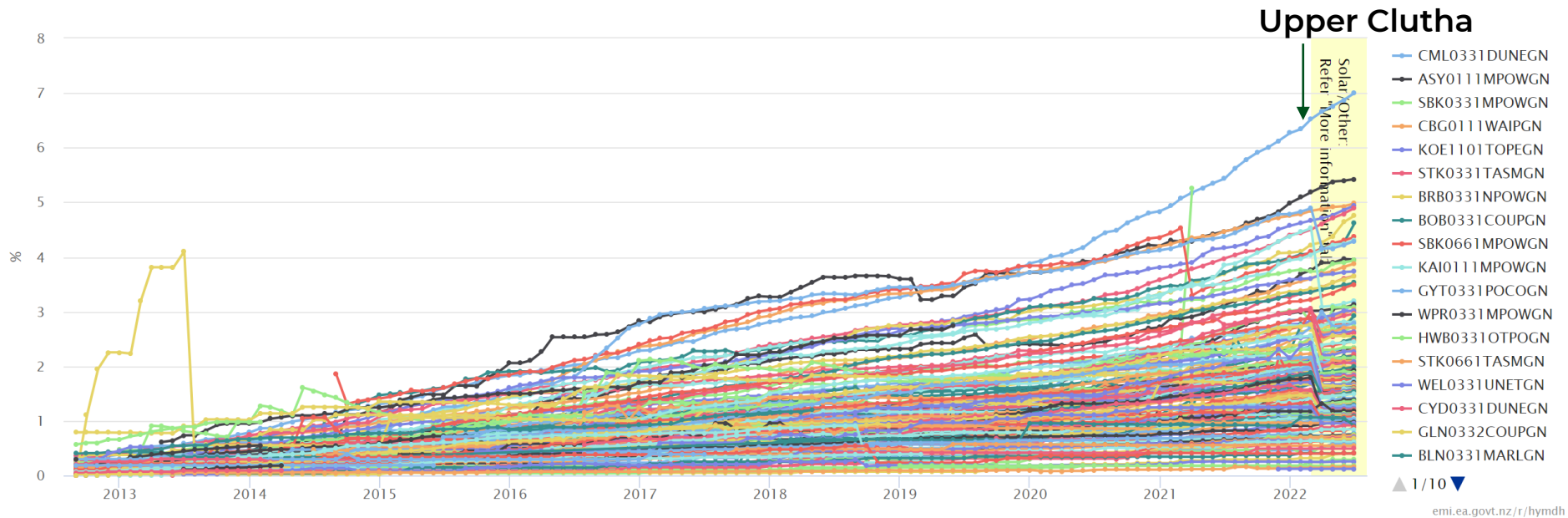
... a capital inefficient power system that costs us all way too much and is not resilient

Thank you

SOLAR ZERO

Can uptake be influenced?

Show ICP uptake rate (%) Series filter 167 of 167 Selected



Customer comments – Cyclone Gabrielle



During the Cyclone I didnt know the power had gone off until I noticed the street lights werent on...

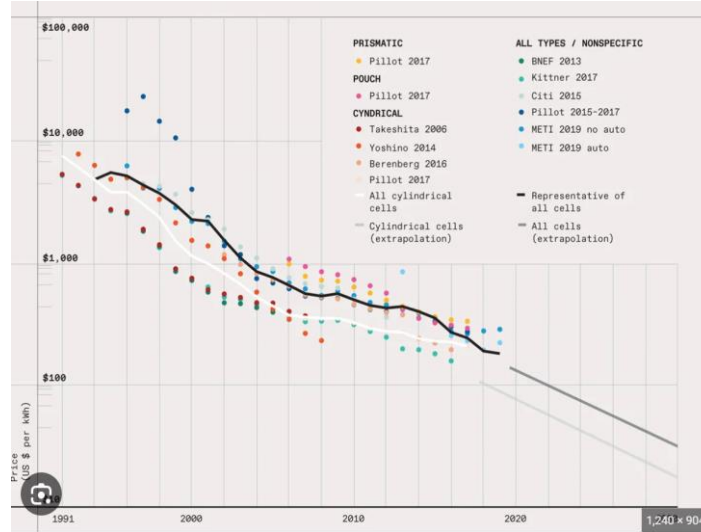
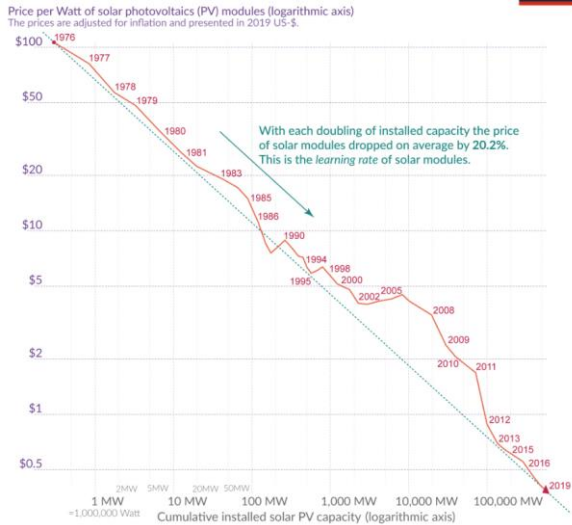
I am not sure how many people are part of your system here in Northland but safe to say that it was great to see that we lost power at 04:30 this morning for some 12 hours. Solar kept us up to date and even with no sun, just RAIN, we managed to not only keep the refrigerator going but add a large % to the battery, make coffee, and breakfast. Thank you for your system. Martin

*“We’ve been without power for over 24 hours but still have **cold beers in the fridge** - thank you solarZero!”*

“I am loving my solarZero energy service and so do my neighbours. Using the stored power in the solarZero smart battery, **I was able to help out my street here in Whangarei** as they do not have power at their homes due to Cyclone Gabrielle.”

“We had the power cut off for 12 hours from about 7pm that night. Fortunately, our solar panels were up and running from that week so we were able to use the battery power to keep a few things going that night. **We were very fortunate with the timing and very grateful.**”

Finally, Tony Seba says...



We need to think about “over generation”, just like digital photos...

New uses of electricity will emerge – hydrogen, synthetic liquid fuels...?

100% Solar, Wind, and Batteries is Possible

Thousands of combinations of SWB can deliver 100% of our electricity demand. There is a nonlinear cost tradeoff between generation and storage. To identify which combination is least expensive, we use the **Clean Energy U-Curve**.

