



Hybrid Renewable Energy Generators for Remote NZ

By Powerhouse Wind
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2. What problem we are trying to help solve? Remote
3. How? Diversity of renewable electricity generation
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Decarbonization
Energy security
Energy equity

Powerhouse Wind

- We are a small Dunedin-based Renewable Energy Company
- Knowing NZ was blessed with wind we wanted to make a wind solution for rural energy.
- We started with the wind turbine but have now developed the hybrid solution **PowerCrate™** combining solar panels with the **Thin Air 102**, offering diverse generation from solar and wind sources.
- We built this for the edge of grid market/lines companies and are looking further for other off-grid markets

Revolutionising Small Wind Power

The Thinair Wind Turbine

For Sustainable and Renewable Energy Systems

powerhousewind.co.nz

Edge of Grid Problems

- Remote area energy solutions are needed:
 - When establishing grid connected electricity is not practical, too expensive, or not reliable
 - When aging infrastructure should be substituted for better technology
- B2B Commercial solutions needed by:
 - Lines companies (LCs)
 - Remote emergency services
 - Telecoms / Airways corporations
- B2C Rural Residential are needed for:
 - Rural Communities including Marae
 - Life style block market
 - Back up power when infrastructure is there but unreliable.

3000 immediate applications est. by lines companies



*End of the line.....?**

Stand-Alone Power Solutions (SAPS)

- Renewable energy is a great option but current SAPSs usually use only solar and are a patchwork of components.
- From **Base Power, a Powerco subsidiary**, “off-grid solar solutions in NZ require diesel input more often than desirable”
- From **Marlborough Lines**, alternative power solutions are being sought for sites “with limited solar radiation”

“Great. Now find a way to get rid of the diesel ...”

From the Powerco boardroom



Solar MPPT
Inverter

Li-ion (~27 kWhr)
Battery cabinet

Basepower SAP

11kVA
Diesel
genset

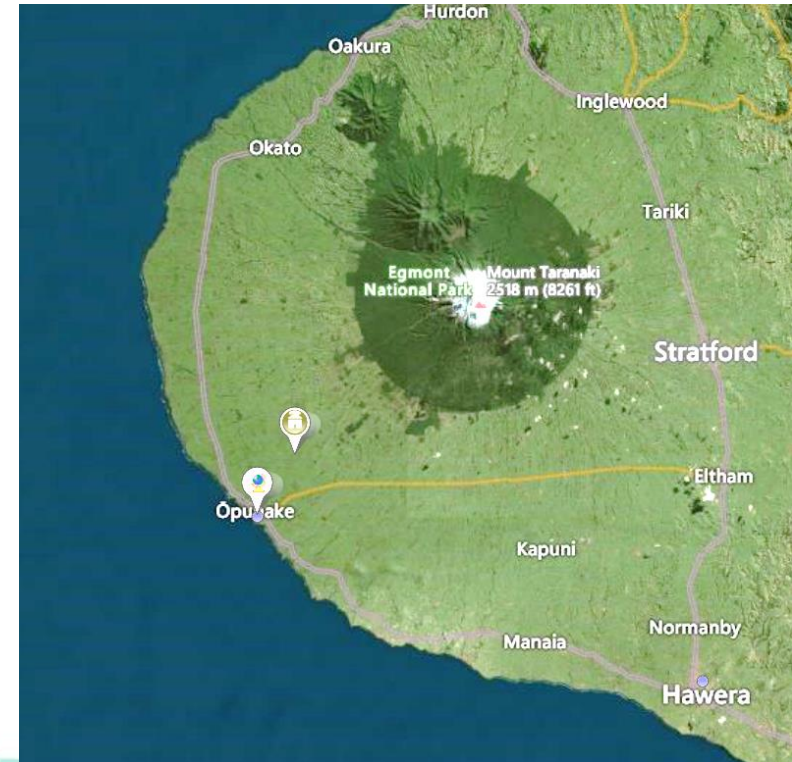
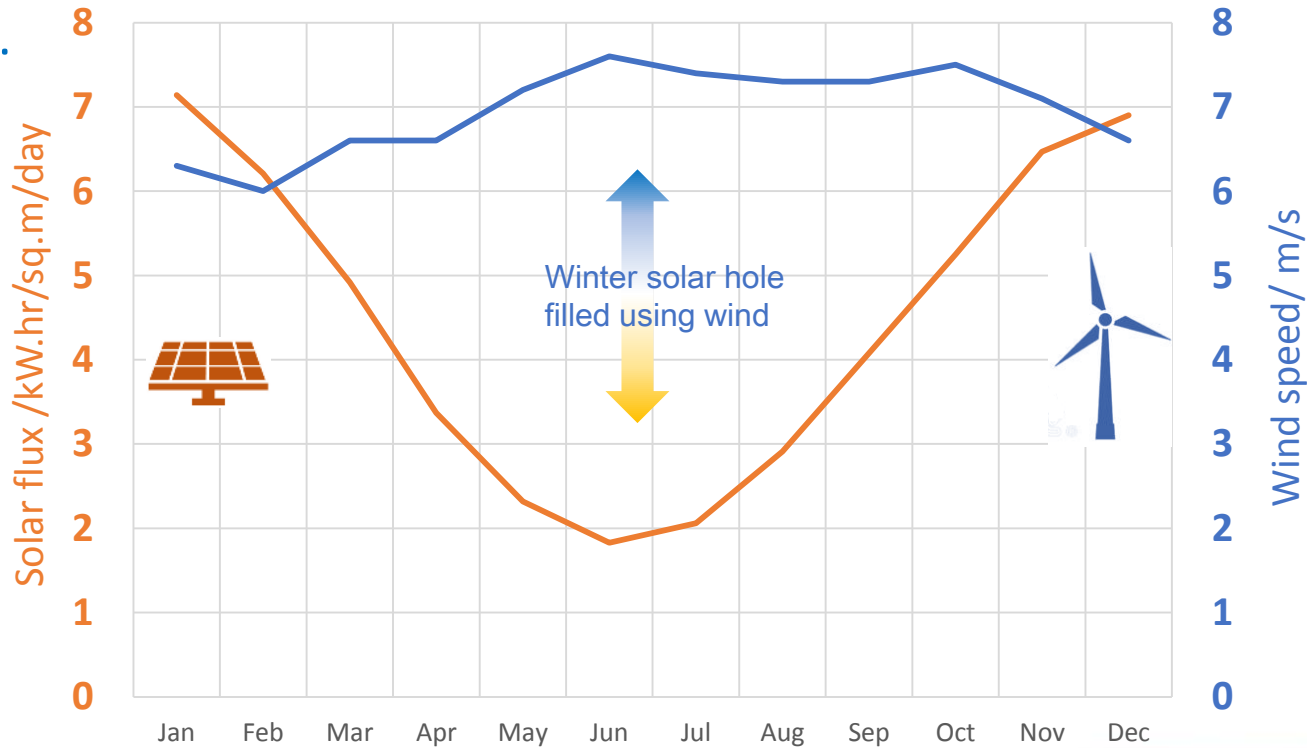


Basepower
SAPS

PV array
energy

Solar + Wind = Less Diesel

We can do better if we add wind to the equation. Wind is often complementary to sunshine, especially in the winter. Tapping both we can reduce diesel use.



Comparison of sun and wind resources throughout the year at Opunake near Parihaka*

*Data from RETScreen Expert, wind speed at 10m

How do they really add up?

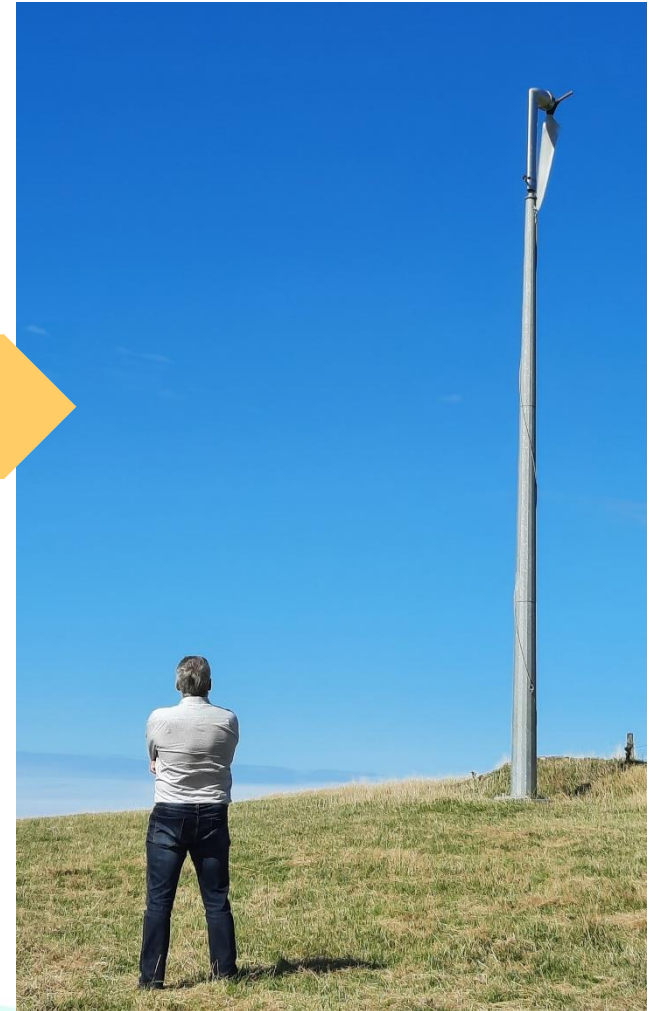
- More difficult to assess wind contribution at any site compared to solar. Wind appears stochastic and local geography is important.

Example: Musselburgh, Dunedin

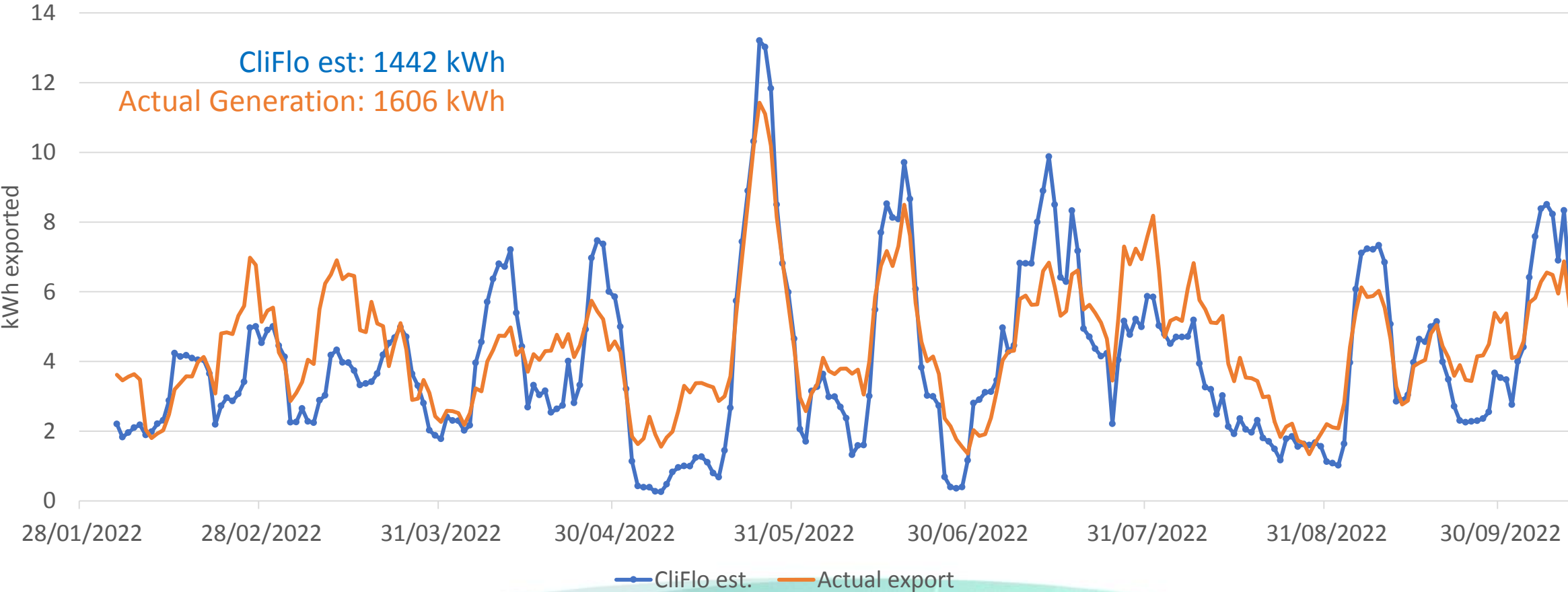
- Single turbine at a Dunedin, Blackhead Rd site -decent air and unobstructed sun - for a fixed period of 258 days
 - No panels on site – but we can predict solar panel performance accurately using NIWA SolarView,
 - Simulate 2kW PV and combine with real data for 2kW ThinAir turbine.
 - February to October wind provides ~43% of the energy.

BUT:

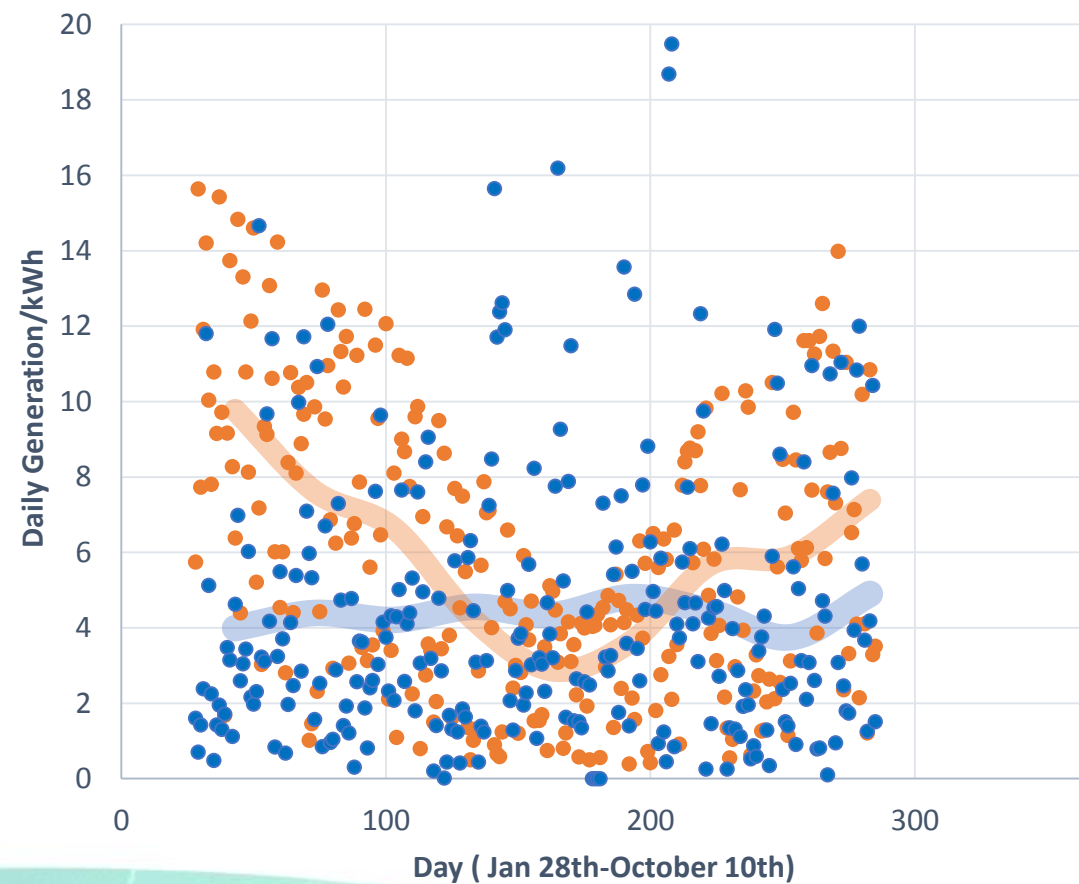
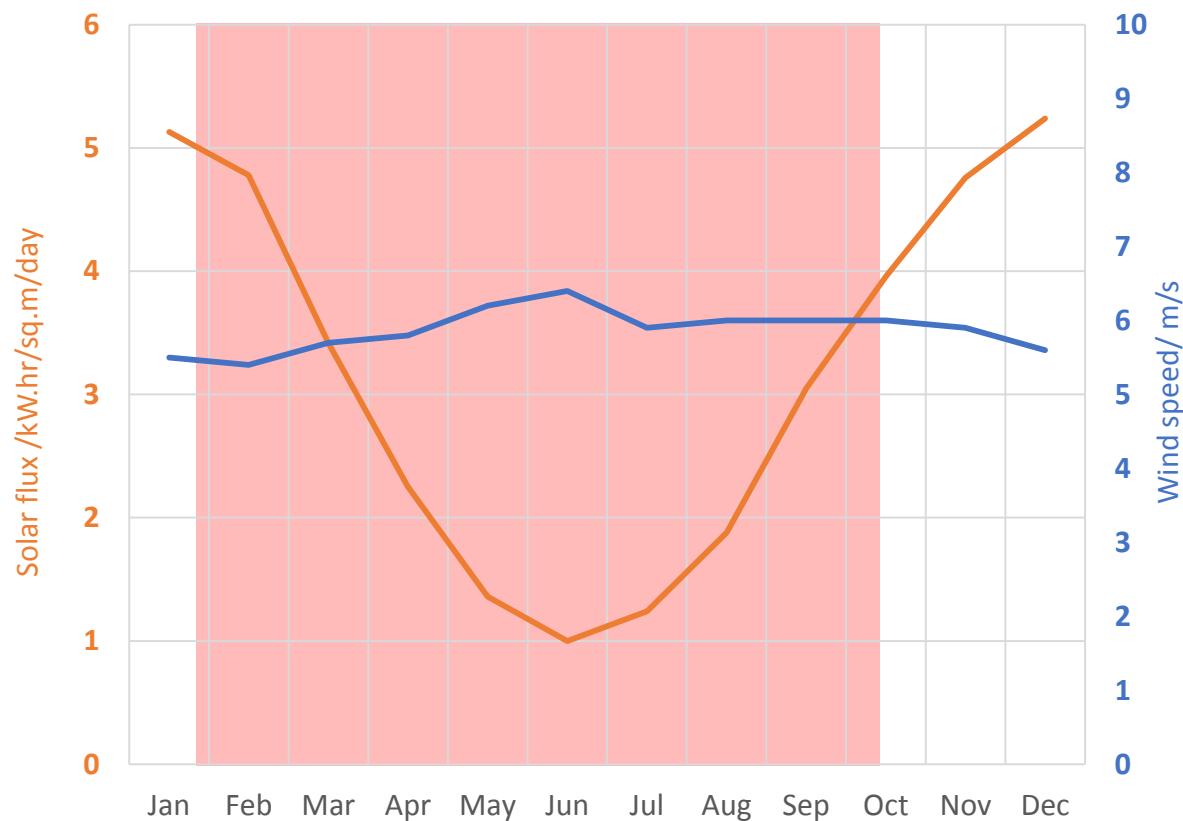
- For 90 days, wind provided the greater contribution.
- For 36 days, wind provided more than 75% of the energy.



Musselburgh wind data and Thin Air turbine performance comparison (1 week rolling average)



Helping fill the winter hole...

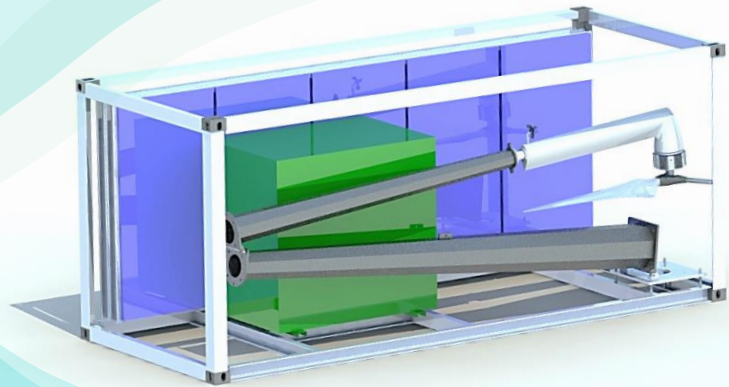


RetScreen EXPERT profile for Musselburgh

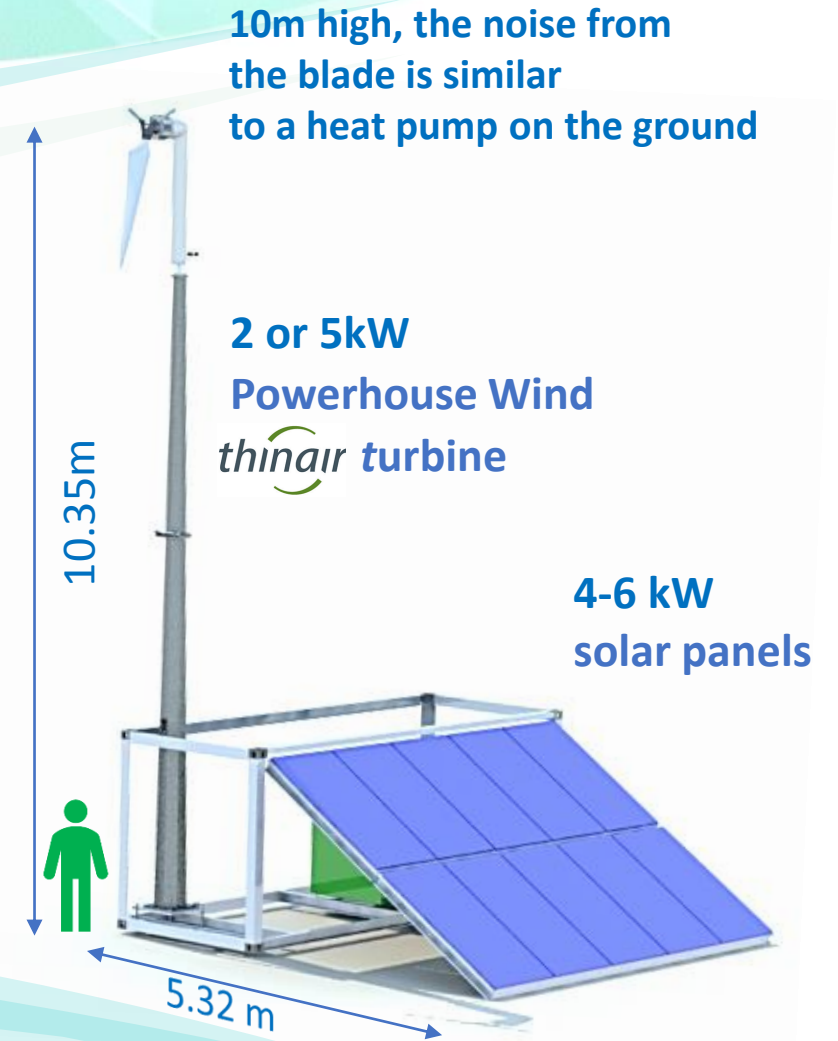
Actual wind turbine data, and solar est. from NIWA Solarview

The Hybrid PowerCrate™

An *all-in-one* Renewable Energy Station



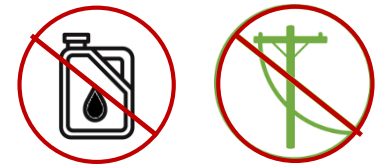
Annual energy	Currently ~6000 kW.hr/year
Peak power generation	4 kW PV 2 kW Wind
Energy storage	28 kWh (~2 days for an a small house)
Weight	3500 kg
Packaged Dimensions	6.1m x 2.62m x 2.44m (20ft container form)



Sits freely on the Land with container frame as the weighted mounting platform

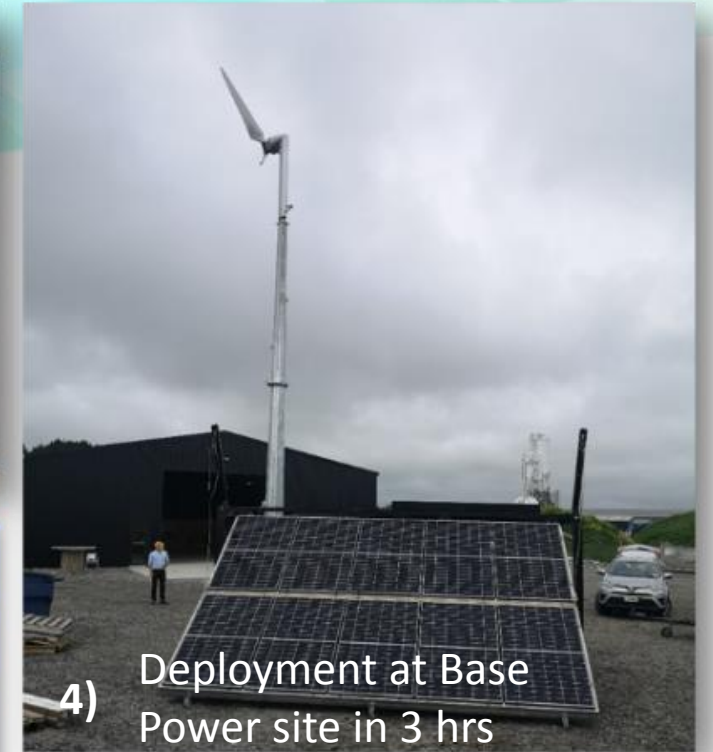
PowerCrate™ Value Proposition

- **Green Energy Security for off-grid or edge-of-grid communities**
 - PowerCrate is powered by **wind and sun to minimize diesel usage** in some climates
 - Increased **energy security through winter** and overcast days compared to a solar only system.
 - **Safe – Li-ion batteries are stored in the PowerCrate** and not near the house (**ASNZS5139 compliant**)
- **Modular, turnkey system:**
 - PowerCrate contains wind turbine, solar panels, and everything needed to make it “plug and play”. Deployed and **Factory tested before shipping** so no start-up issues.
 - **Autonomous** operation for “hands-off” peace of mind
 - PowerCrate is **relocatable**, and can be moved as required
- **Reduced consenting/planning process,**
 - **Low site prep costs. Small footprint.** Level ground and standard electrical connection to house needed
 - **3 hr deployment** by our team vs *3 days* for on-site installation of individual solar panels or wind turbine. A fast customer solution with **minimal intrusion**.
 - **Temporary** or **permanent**. The PowerCrate never needs to be a permanent fixture. Move as needed
- **Expandable and Upgradeable with you need:**
 - **PowerCrates can be daisy chained** and the battery pack expanded for more power or security
 - At Powerhouse wind **we continue to innovate** with a 5kW turbine and **hydrogen storage** in development.



PowerCrate Shipment

We factory test the entire system in Ōtepoti and deploy the system in less than 3hrs at the site to guarantee trouble-free start-up and operation



PowerCrate Deployment <3 hours

Minimal equipment: 2-person lift with an electric winch and manual hoists



PowerCrate deployment on Mt Cargill, August 2022



11:30 am

Hiab pickup
South Dunedin.



1:30 pm

Delivered to a
Mt Cargill Rd
Residence.



4:00 pm

Fully deployed.
Mt Cargill, Dunedin.

PowerCrate™ by Powerhouse Wind

All-in-one Hybrid Generator



Typical Rural Sector Energy Needs

Site Type	Description	Electricity use/ kWh/year	Peak demand/ kW
Rural house, single dwelling in Papakāinga ¹	Remote site, off grid or edge of grid dwelling	3000-14000	5-9
Rural Marae ¹	Community hui, intermittent use	9000	25
Farm house/Wool shed ²	Isolated farm house and woolshed , small water bore with submersible pump for home water	10000	15
Large dairy shed ³	Average for large dairy sheds	74000	50

One  $\approx 5000-7000 \text{ kWh/year}^4$

¹ *Renewable energy technology options for Parihaka Papakāinga*, Joshua B.R.Curd, Thesis in Masters of Engineering in Renewable Energy Systems, Massey University, 2017

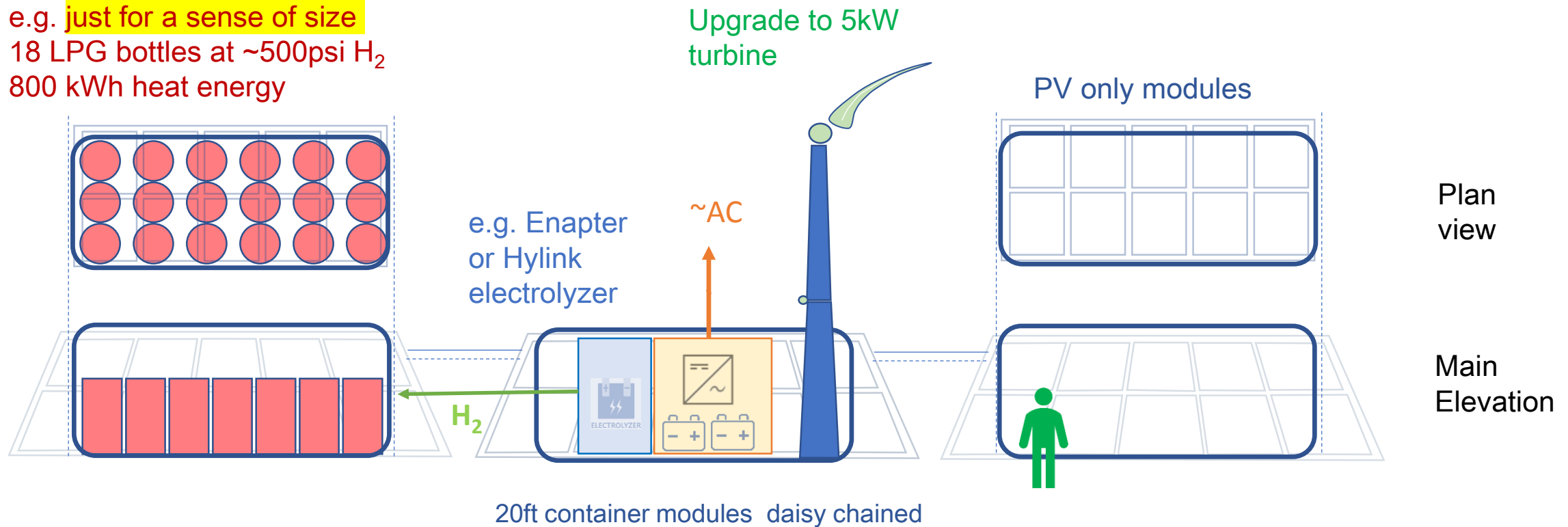
² 2020 Registration of Interest issued by Marlborough Lines Company for “Alternative Power Supplies”

³ *Energy use on the dairy farm*, Logan Bowler, DairyNZ, April 2015

⁴ based of capacity factors of 0.1-0.13

More Power?! More Capability?

e.g. just for a sense of size
18 LPG bottles at ~500psi H₂
800 kWh heat energy



Poised for Rural Electrification? e.g. Agriculture/Viticulture



LXe-261 Kubota
Electric Tractor

<https://kubota-group.eu/en/e-powered-compact-tractor-lxe-series/>



e25 Electric Tractor
22 kWh battery



e70N Electric Tractor
30 kWh battery

<https://solectrac.com/>

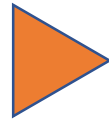


e.g. Remote Projects and Activities

Project Power

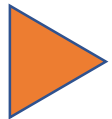
Our PowerCrate deployed at a rural New Plymouth site to generate the power for the EMROD power transmission demo.

May–June 2022



Growing electrification

- Electric construction
- Electric rural mobility options



VOLVO
Construction Equipment



L20 ELECTRIC

🏠 4,550 kg

🌙 0.8 m³

🔋 33 kWh



▶ ECO Charger ATV

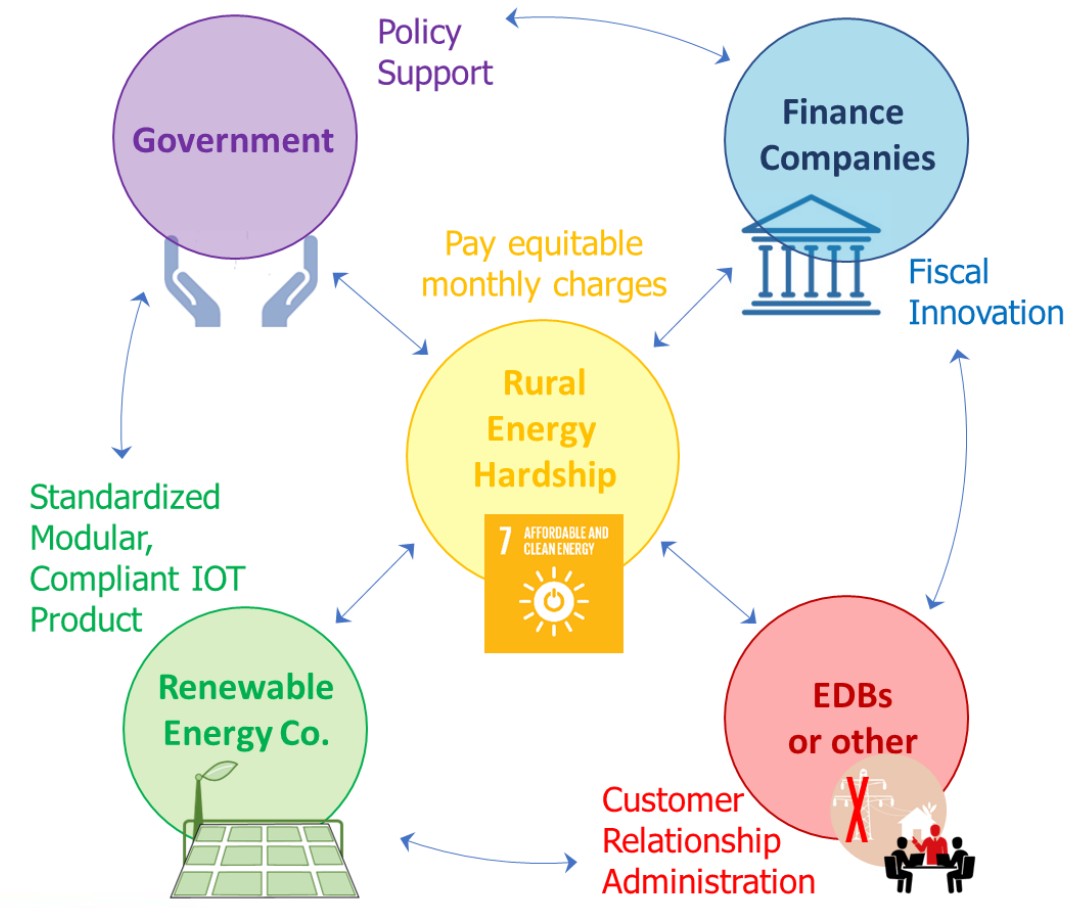
7.8-11.7 kWh

Remote Energy as a Service?



- is comprehensive** – all in one for robust energy security.
- is standardized** –easy to maintain (or outsource for maintenance)
- is modular** – easy to replace, upgrade and extend . Minimal planning needed.
- is scalable** – easy to daisy chain modules for more energy.
- is transportable** – it can relocated by hiab , train or barge, and soon helicopter.
- is reliable** – it is completely factory tested before shipping.

is conducive to EaaS



Acknowledgements : A NZ SAPS solution

- Designed, built and tested for New Zealand in Dunedin with help from our university and polytechnic friends.....
-and a cluster of small companies who supply components and systems for a home-grown product



SPUNLITE POLES



Summary

- **Hybrid power solutions, wind and solar together offer increased energy security**
 - Just how much? And for what price? How much diesel can be avoided through wind/solar diversification?
 - PHW aims to be able to present more geo-diverse data in a year
- **PowerCrate is a portable, modular, and standardized solution**
 - “Plug and play” deployment
 - Expandable – modules can in principle be daisy chained for cost-effective power and capability
 - Factory tested modules for reliability and compliance
 - Minimal site preparation. PowerCrate usually sits on the land and can be moved or removed in less than 3 hrs
- **There is a movement towards XaaS business models. PowerCrate concept supports such models**

Thank you

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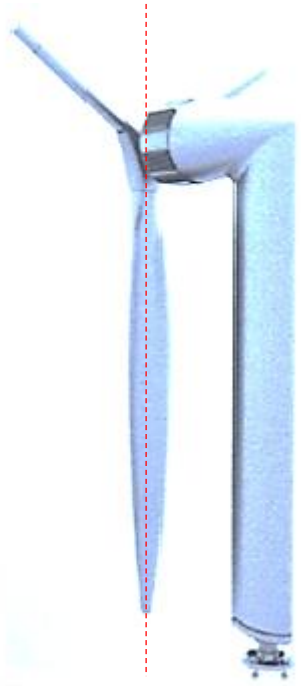
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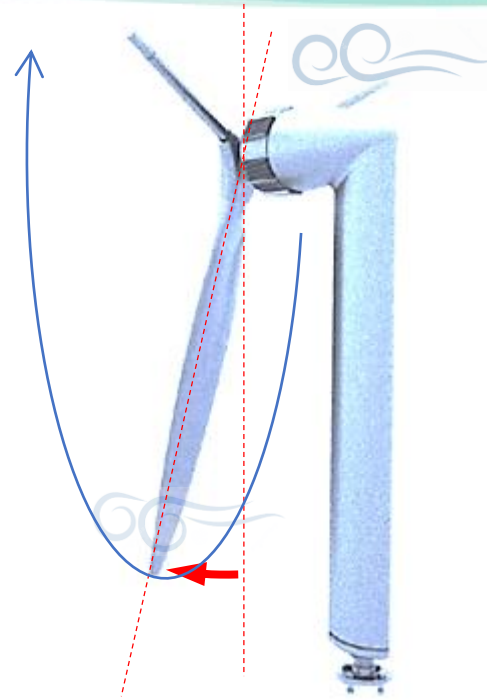
Back-up Slides

PowerCrate is enabled by Our Single Bladed Turbine Thinair is designed for Windy Aotearoa!



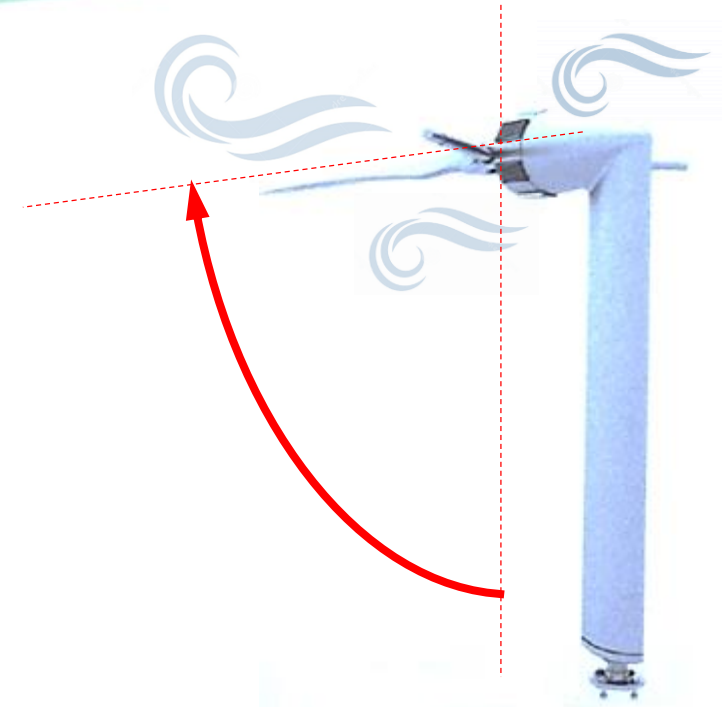
1

With little or no wind, rotor is stationary but is aligned with breeze for a quick start-up



2

At higher winds, the blade tilts slightly on its proprietary “teetering” hub to optimally transfer the wind’s energy

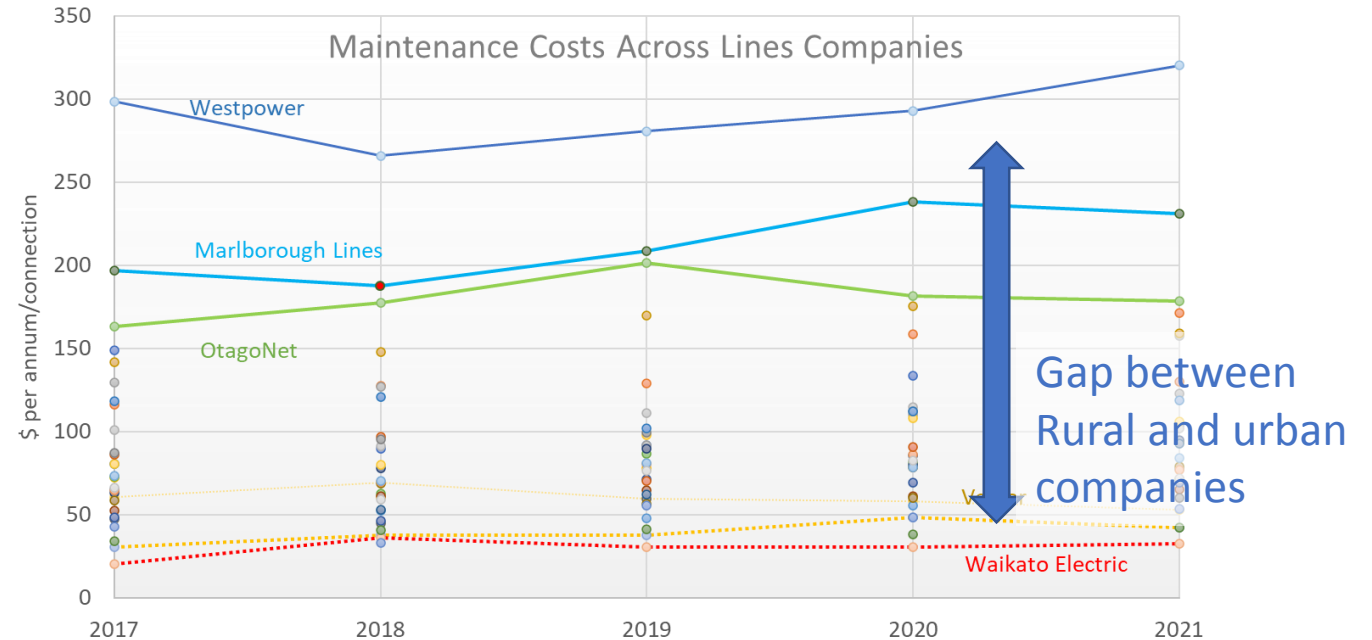


3

Storm force winds furl the single blade. Rotation stops and the blade teeters horizontally to safety.

Lines Companies & the case for SAPS

- The 29 Lines companies in NZ are legislated to guarantee an enduring supply of electricity to rural customers, even if the LC loses money.*
- **Legislation DOES allow for “alternative power” substitution**



Takeaway

**Remote customers are expensive!
Can we replace the lines with distributed renewable alternatives?**

*Electricity Industry Act 2010. In one case for example a small community of 50 customers at the top of the South Island cost their LC ~\$NZ 250,000 per annum. The act essentially forces cross-subsidization with urban customers subsidizing rural customers

Market Demand

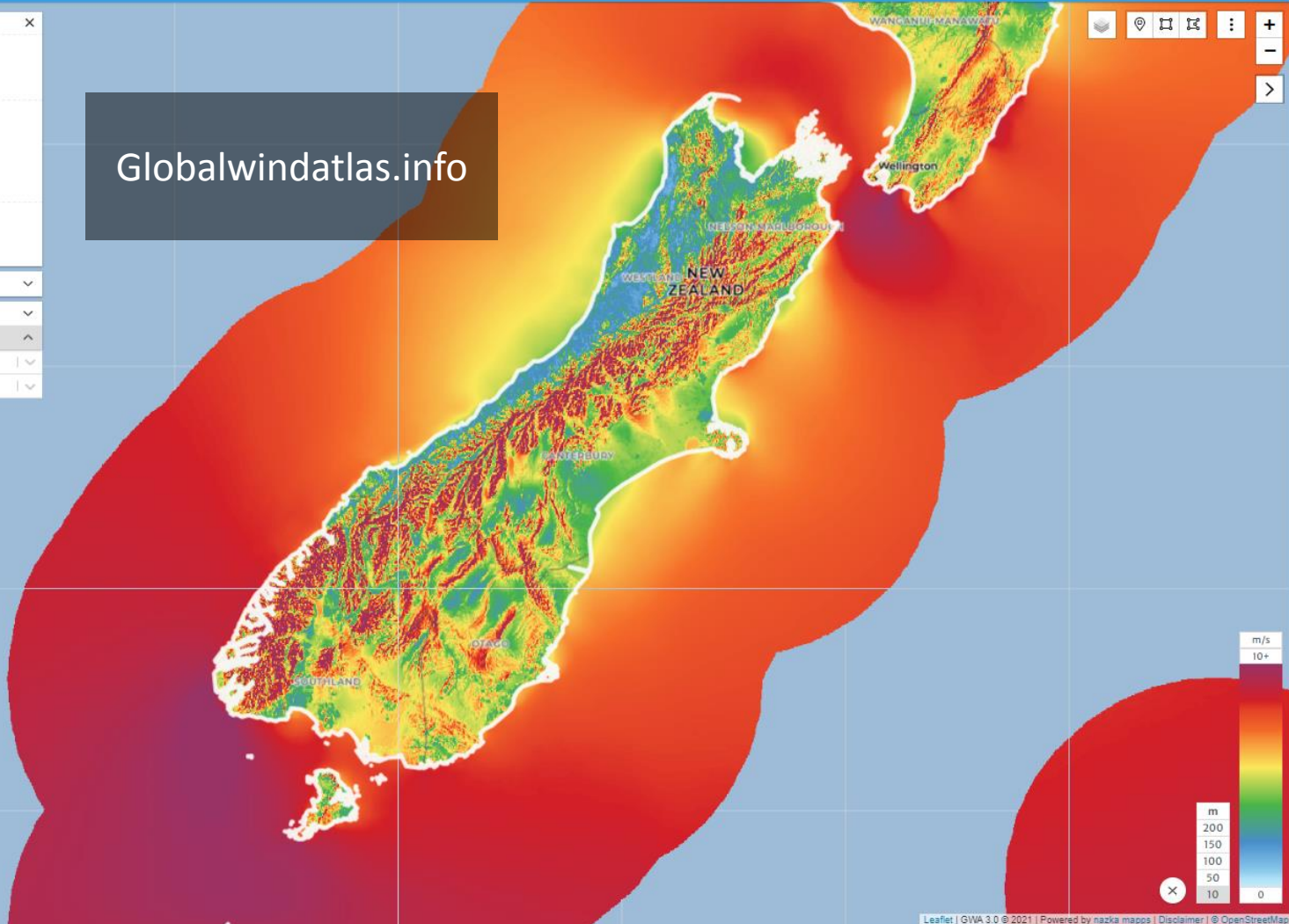
- Market demand for replacing overhead transmission is evidenced by lines companies' interest
- 2020 Registration of Interest issued by **Marlborough Lines Company** for “Alternative Power Supplies” for agricultural industry, communications and lifestyle blocks



Site type ref.	Features of 'standard' connection type	Max. daily consumption (kWh)	Peak demand (kW)
Remote.	Remote site, no overland access (i.e. boat access only), holiday home, near beach front property, northerly aspect.	10	7.5
Farm.	Farmhouse and woolshed in an isolated valley, small water bore with submersible pump for domestic water supply, limited solar radiation in winter months due to shadowing from adjacent hills.	20	15
Irrigation.	Isolated irrigation connection, 3kW pump size to pump water up to storage tank for gravity feeding stock water troughs.	60	4
Comms.	Communications tower, relatively consistent load profile (i.e. relatively low variability between average and peak demand).	20	7.5
Multi-few.	Cluster of five holiday homes in the Marlborough Sounds, in relatively close proximity (up to 0.5km across), varying aspects (i.e., clusters may be north, south, west or east facing), on typically native bush clad hillsides.	60	30

- Wind Energy Layers ▾
 - Wind Layers ▾
 - Mean Wind Speed
 - Mean Power Density
 - Terrain Layers ▾
 - Roughness Length
 - Bathymetry
 - Orography
 - Ruggedness Index (overlay)
 - Validation Layers ▾
 - Validated Countries
 - Wind Measurement Stations
 - Legend re-scale ▾
 - My Areas ▾
 - Countries And Regions ▾
 - New Zealand ▾
 - Region ▾

Globalwindatlas.info

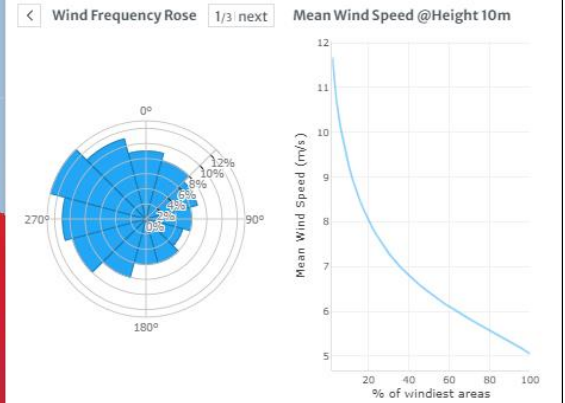
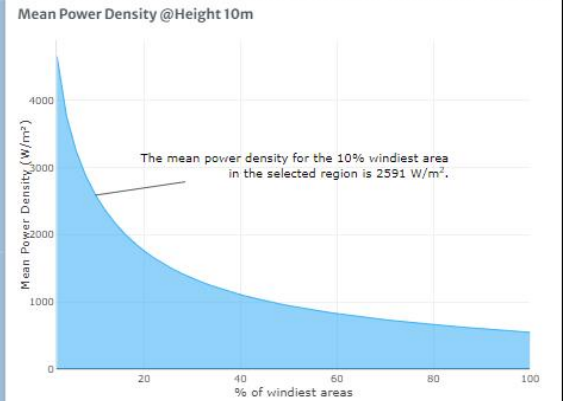


New Zealand

Region

Validation: Mean absolute bias: N/A


Data for 10% windiest areas
2591 W/m² 9.29 m/s Height: 10m



e.g. Remote BEV Construction

Increasingly EV construction* equipment in urban (on-grid) environments. Can also be used remotely with a PowerCrate



 **Kubota** U36-4 Electric 49.2 kWh
<https://kubota-group.eu/en/compact-excavator-u36-4-electric/>


* <https://bellona.org/database-emission-free-construction-equipment-by-manufacturer>

VOLVO
Construction Equipment



L20 ELECTRIC


 4,550 kg


 0.8 m³

 33 kWh



ECR25 ELECTRIC

 2,680 - 2,780 kg

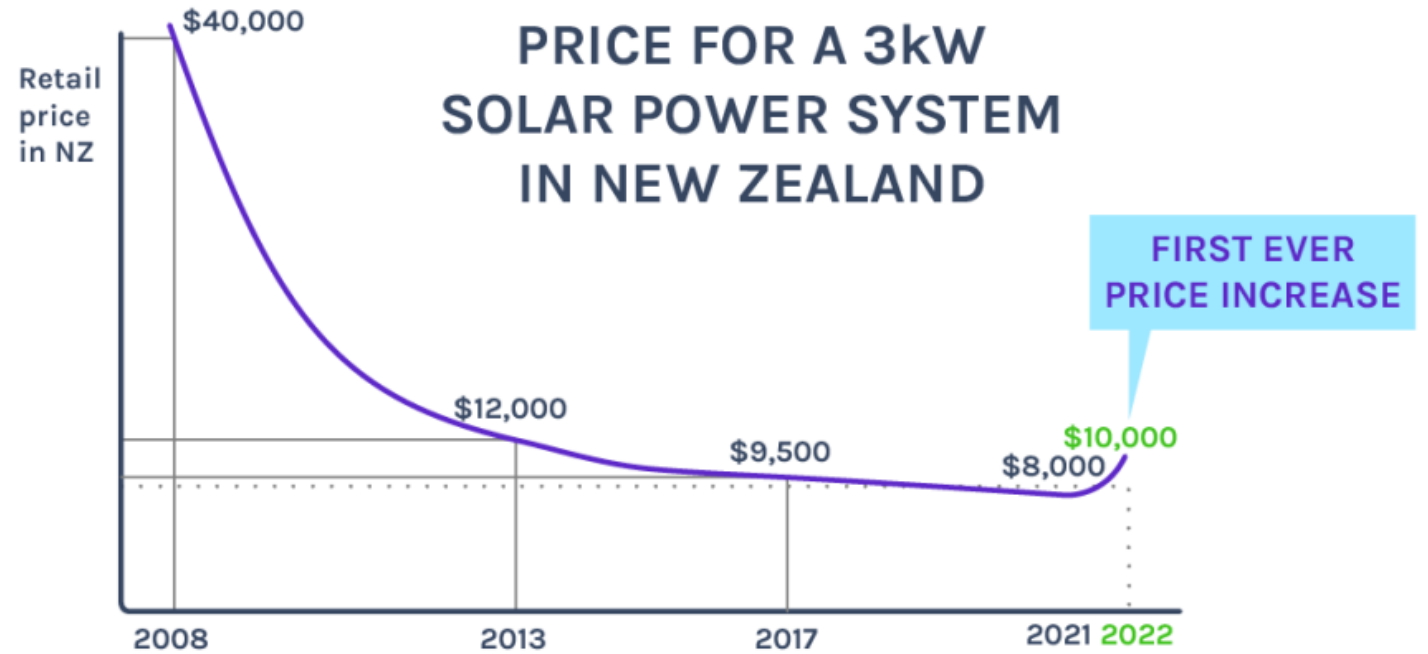
 2,461 - 2,761 mm

 20 kWh

<https://www.volvoce.com/europe/en/products/electric-machines/>

Solar panel costs

Solar Power System Size	Number Of Solar Panels	Cost, roof installed
2 kW	5 x 400W panels	\$7,500
3 kW	8 x 375W panels	\$10,000
4 kW	10 x 400W panels	\$11,600
5 kW	11 x 455W panels	\$13,500
6 kW	16 x 375W panels	\$15,000
10 kW	22 x 455W panels	\$24,500



(Approx. prices for a 3kW solar power system over the last 14 years)



<https://www.mysolarquotes.co.nz/about-solar-power/residential/how-much-does-a-solar-power-system-cost/>,

4/10/2022 price estimate