Alaska Village Electric Cooperative
AVEC ENERGY STORAGE NEED
From Ultracapacitors to Lithium Titanate Batteries

Alaska Energy Storage Workshop January 12th 2021

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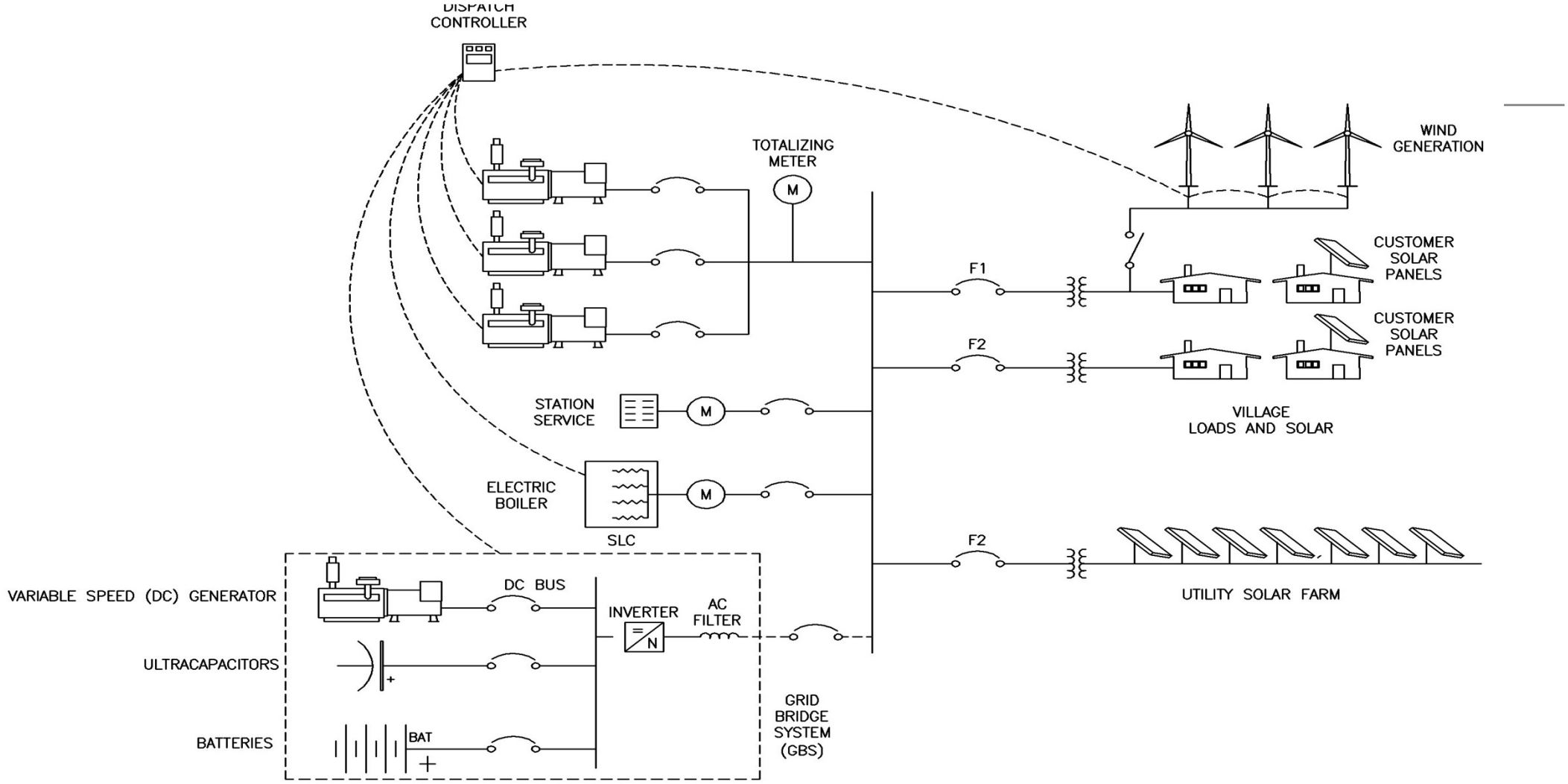
A Fully Realized Microgrid With Energy Storage



Wind is AVEC's choice of Renewable Power

- The wind resource is more available in the winter when the winds are highest, which matches our village loads that are highest in the winter.
- Controllability of wind turbines has improved in recent years (smoother, easier to dispatch).
- Larger, more cost effective turbines are now available for arctic installations (more bang for the buck).
- For instance, Installing 900 kW towers costs about 50% more than 100 kW towers

Larger Wind turbines are more cost effective

AVEC Energy Storage Needs 1

Stability

- is provided by Energy Storage connected to a inverter system and controlled to regulate frequency or rate of power swings. This function does not require a large amount of energy storage, but a good solution should be able to handle millions of cycles with good longevity.

Spinning Reserve

- Larger Turbines and the wind available for generation is not reliable, so a back-up source of power is required for reliable system operation. This can be obtained by running large diesels lightly loaded, or by providing sufficient "bridging power" for sufficient time that another diesel can be put on line. This function requires minutes of Energy Storage, and far fewer cycles per year than Stability.

AVEC Energy Storage Needs 2

Time Shifting Energy (Only now do we need a significant amount of storage)

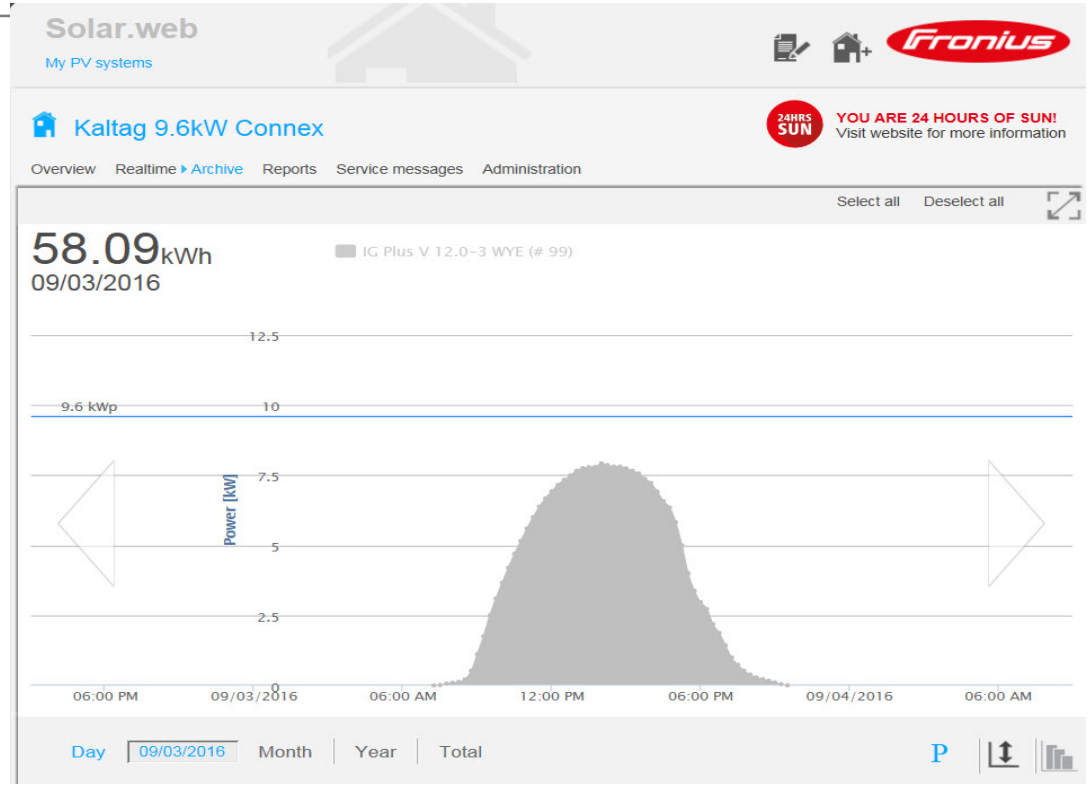
- If there is sometimes energy in surplus, then ES can allow the energy to be stored when available and then consumed at other times when the value is greater. This function requires a large amount of energy storage, but the number of yearly cycles is perhaps only a few hundred.

- Calculation of the economic payback for this purpose can be complicated. The Arbitrage value is not difficult to estimate, but how many times a year can the energy time shift occur? The cost of the battery must be paid for.

Solar is more predictable, despite Clouds

Here is the output from our solar installation in Kaltag on a cloudless day.

Weather permitting, a solar ESS installation can expect to have surplus power every day. Meteorological records are comprehensive and so relatively low risk estimations can be calculated.



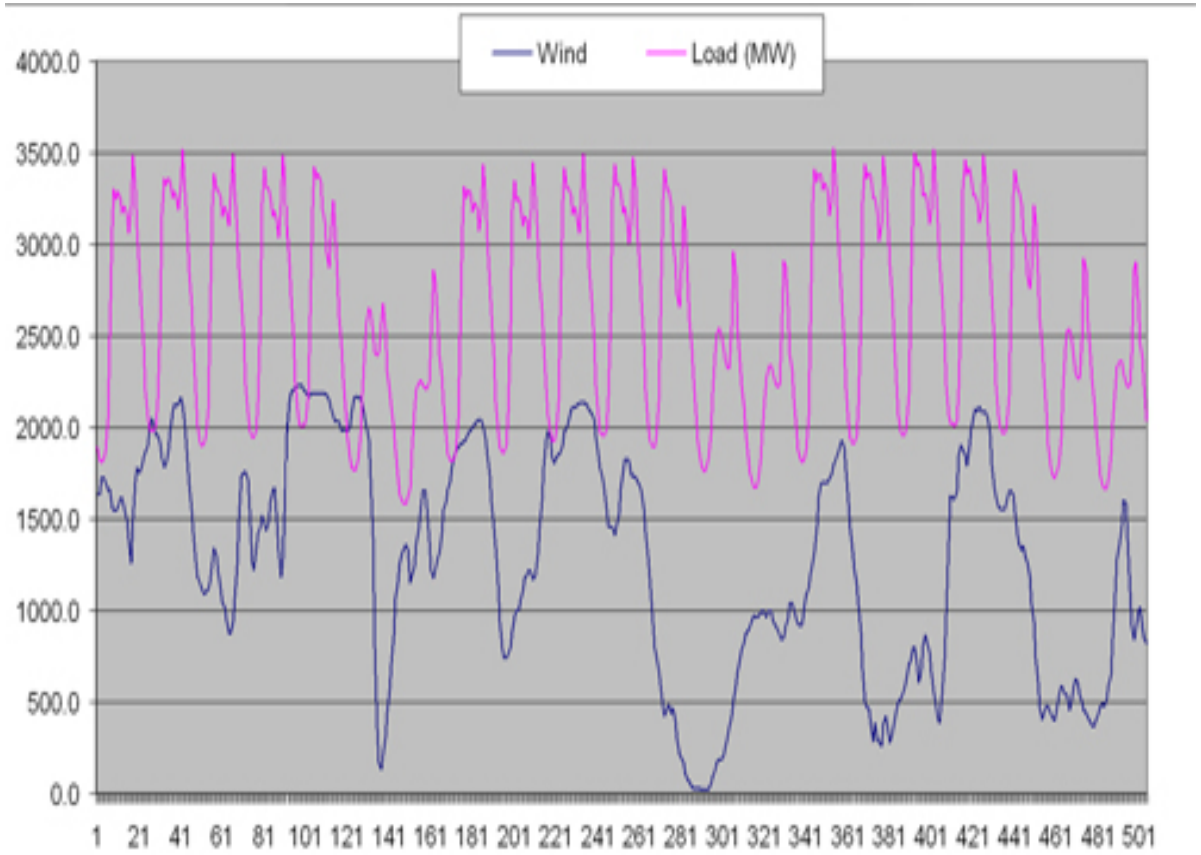
Wind is unpredictable

And here is what unpredictable wind does to your power forecasting. At least the day/night load variations are somewhat predictable.

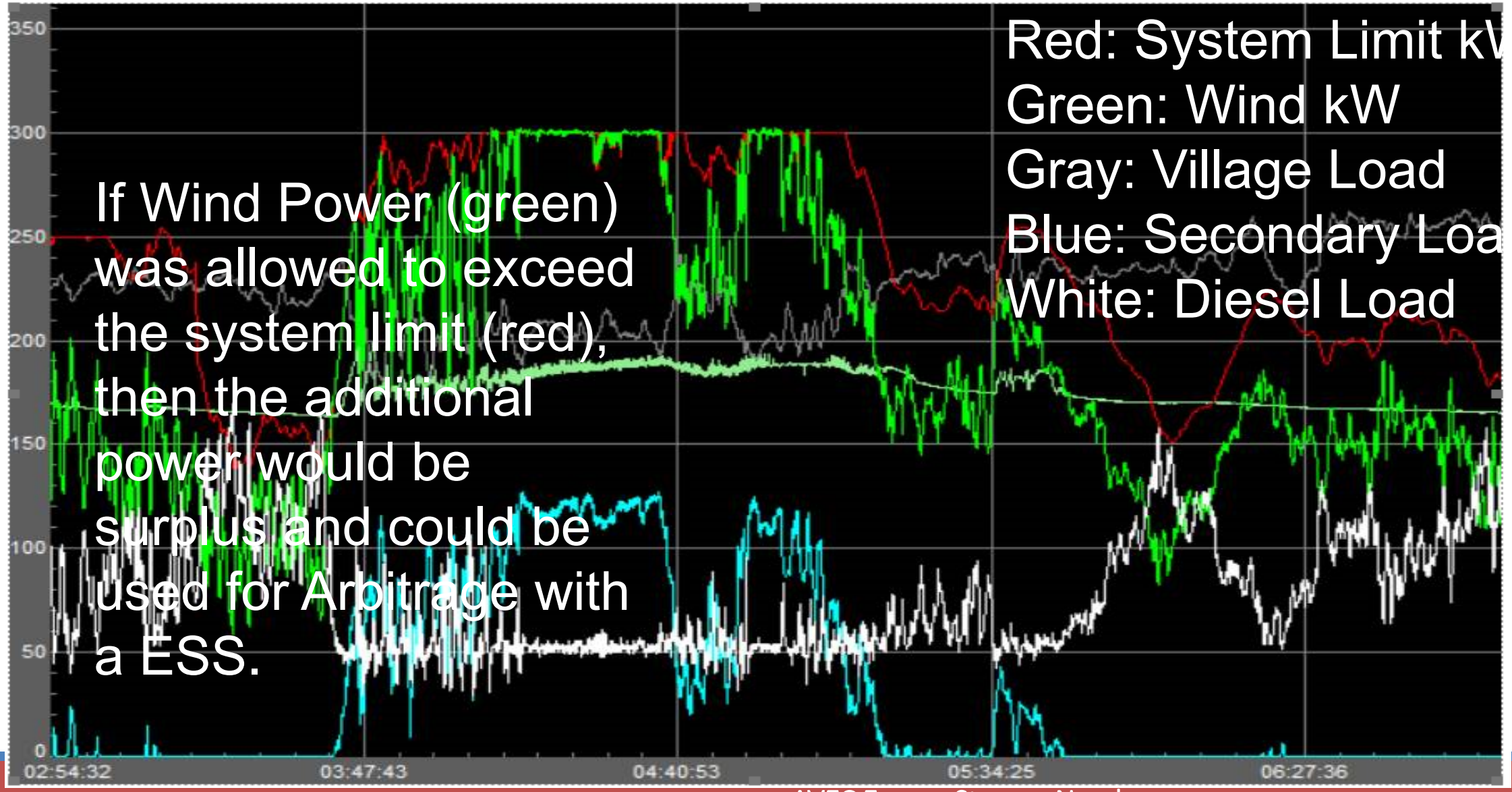
Here are 21 days of load, showing the daily variations in load (pink), and also what is typical variations in wind output.

Add the two variations together, and we have some serious operating and economic forecasting difficulties.

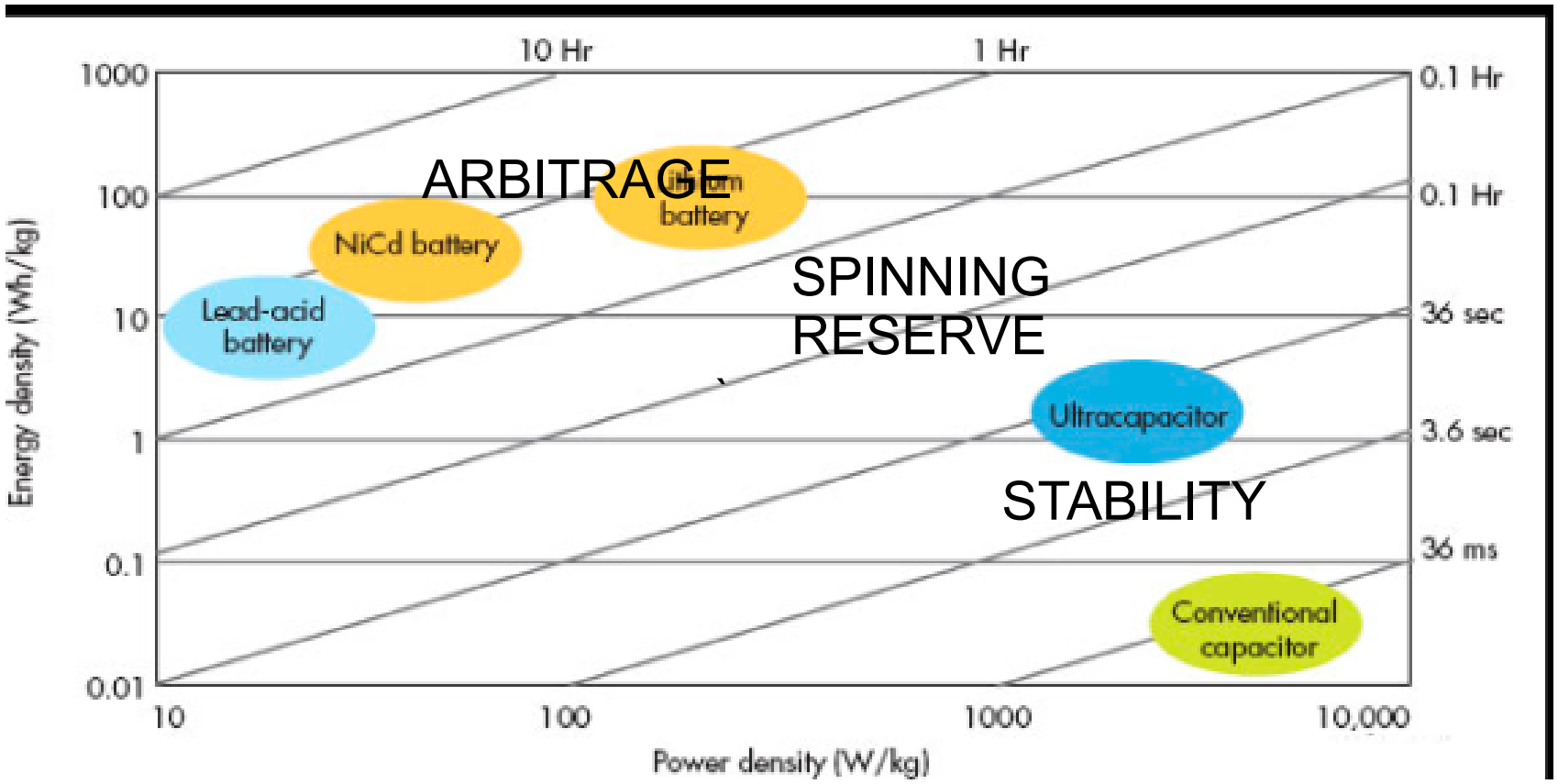
Surplus Power occurred only four times.



Large wind power in St. Marys Alaska



So which approach meets these needs?



Ultracapacitor advantages and disadvantage

- Much Longer operational life than chemical storage such as Lithium.
- Rapid and high recharge rates. (90% in 6 minutes, 95% in 10 minutes)
- Extremely high-power densities.
- The capability to charge and discharge rapidly at very high and very low temperatures. (-50°C to +65°C)
- Fire safety – lower energy density eliminates fire risk almost entirely.
- Maintenance safety – Capacitors can be discharged for servicing.
- Easy state of charge calculation (by measuring voltage)

But…

- Low energy density compared to chemical storage
- Much greater cost.

Lithium Titanate Advantages

- Possesses a greater full DOD cycle life (exceeding 16,000-25,000 cycles, depending on product)
- Rapid and high recharge rates. (90% in 6 minutes, 95% in 10 minutes)
- Extremely high-power densities.
- The capability to charge and discharge rapidly at very high and very low temperatures. (-50°C to +65°C)
- More Fire safety - eliminates the preponderance of safety failure modes present in typical lithium ion and other battery technologies (Altairnano is glad to share videos of standard FMEA testing where our modules have been shot, immersed in salt water, penetrated by nails, crushed and set on fire without going into thermal runaway, a catastrophic failure where batteries explode with great energy. Few other lithium ion technologies can make this claim).

Notes on GBS Costing

Complete Ultracapacitor 500 kW GBS components -- $600K

Hybrid Ultracapacitor + LTO 500 kW GBS components - $300K - $500K

LTO 500 kW GBS components - $200K - $400K

Double these costs for a 1000 kW system.

Questions?

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