Energy Storage 201

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IREC
Interstate Renewable Energy Council
CERTIFIED MASTER TRAINER™

GREAT NORTHERN SOLAR

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In accordance with the Department of Labor and Industry's statute 326.0981, Subd. 11,

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Storage In RE Systems

PV systems that employ Storage require significant design considerations.

Whether using batteries to "back-up" your utility grid, having them as the basis of a "stand-alone off grid system”, or supplying other service such as peak demand load shaving choosing the correct battery and sizing it correctly is challenging.

This workshop is an in-depth analysis of the issues surrounding the use of energy storage for PV applications.

Storage design, specification, use and maintenance will be covered in this workshop.

Battery types:

Lead Acid

FLA- Flooded Lead Acid

\+ Cost, availability, life

\- Maintenance,

SLA- Sealed Lead Acid

Sealed

AGM

Gel

\+ Less maintenance, upside down

\- cost, shorter life

Alkaline-Wet Cells

Liquid Pocket-Plate NiCad

+ 100% capacity, good cold weather performance

- Expense, Cadmium, disposal costs

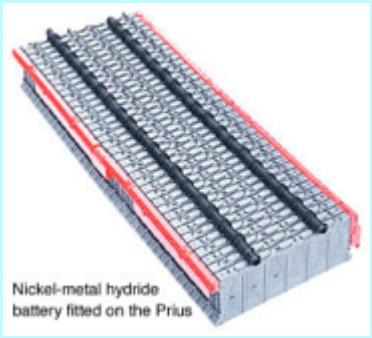
Nickel Iron

+ 100% capacity, Long Life

- Expense, Availability

Dry Cells:

NiMH -



Cobasys Nickel Metal Hydride Battery 13.2v 85ah available as a replacement for VRLA batteries by a designated service facility2 for the Chevrolet S-10EV.

+ Dry cell, Long cycle life, 100% capacity
- Cell capacity, expense

NiCad -

+ Dry Cell, good cycle life, 100% capacity
- Cell capacity, expense, Cadmium

Lithium Ion -

+ Dry Cell, good cycle life, 100% capacity
- expense, availability (charging issues, Lithium issues)

Valence - U24-12XP $ 2108.00 **! 12Vdc 110Ahr**

And Now the TESLA!!!!

Powerwall - 1

Technology: Wall mounted, rechargeable lithium ion battery with liquid thermal control.
Models: 10 kWh $3,500 For backup applications
7 kWh $3,000 For daily cycle applications
Warranty: 10 years
Efficiency: 92% round-trip DC efficiency
Power: 2.0 kW continuous, 3.3 kW peak
Voltage: 350 – 450 volts
Current: 5.8 amp nominal, 8.6 amp peak output
Compatibility: Single phase and three phase utility grid compatible.
Operating Temperature: -4°F to 110°F
Enclosure: Rated for indoor and outdoor installation.
Installation: Requires installation by a trained electrician. DC-AC inverter not included.
Weight: 220 lbs / 100 kg
Dimensions: 51.2" x 33.9" x 7.1”
Certification: NRTL listed to UL standards

Powerwall 2: Usable Capacity = 13.5 kWh,

Depth of Discharge = 100%
Efficiency - 90% round-trip,
Power = 7kW peak / 5kW continuous
Supported Applications:
Solar self-consumption, Time of use load shifting, Backup, Off grid
Warranty = 10 years
Scalable = Up to 10 Powerwalls
Operating Temperature = -4° to 122°F / -20°C to 50°C
Dimensions = L x W x D: 44" x 29" x 5.5" (1150mm x 755mm x 155mm)
Weight = 264.4 lb / 120 kg
Installation = Floor or wall mounted Indoor or outdoor
Certification:
North American and International Standards
Grid code compliant

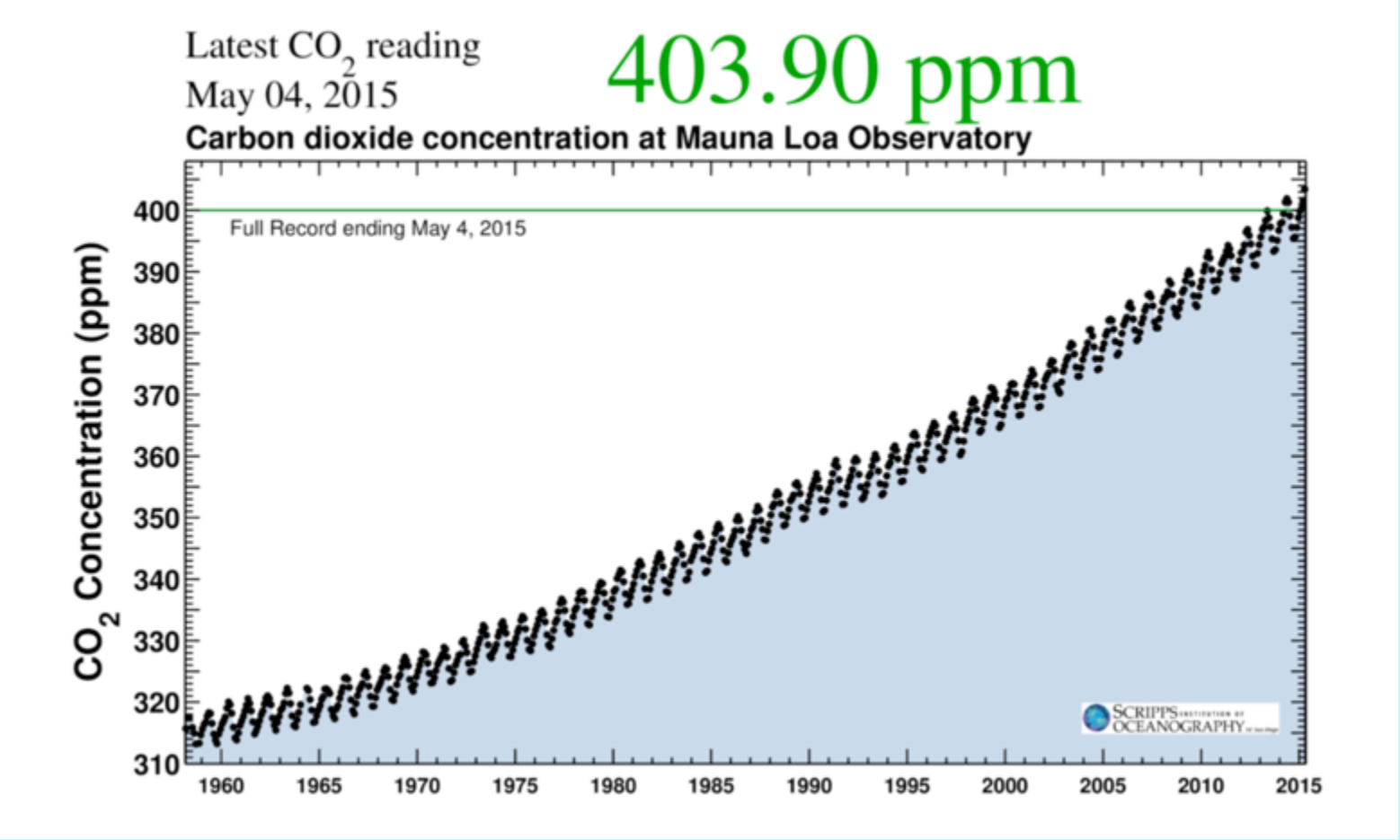
Tesla Energy – Elon Musk takes on climate change….

In the U.S., the average household uses 30kWh of power each day, at a peak use rate of 1.2kW, according to the U.S. Energy Information Agency. Tesla's Powerwall batteries can provide 2kW of continuous power and has a peak power rating of 3kW. The average home, however, would need three Tesla 10kWh batteries, at a cost of over $10,000, to meet all its energy needs, something Lux Research's Frankel is dubious will happen.

Please take a few minutes to - VIEW MR. MUSK'S PRESENTATION…
https://www.youtube.com/watch?v=KXWHqjQNJ5Y

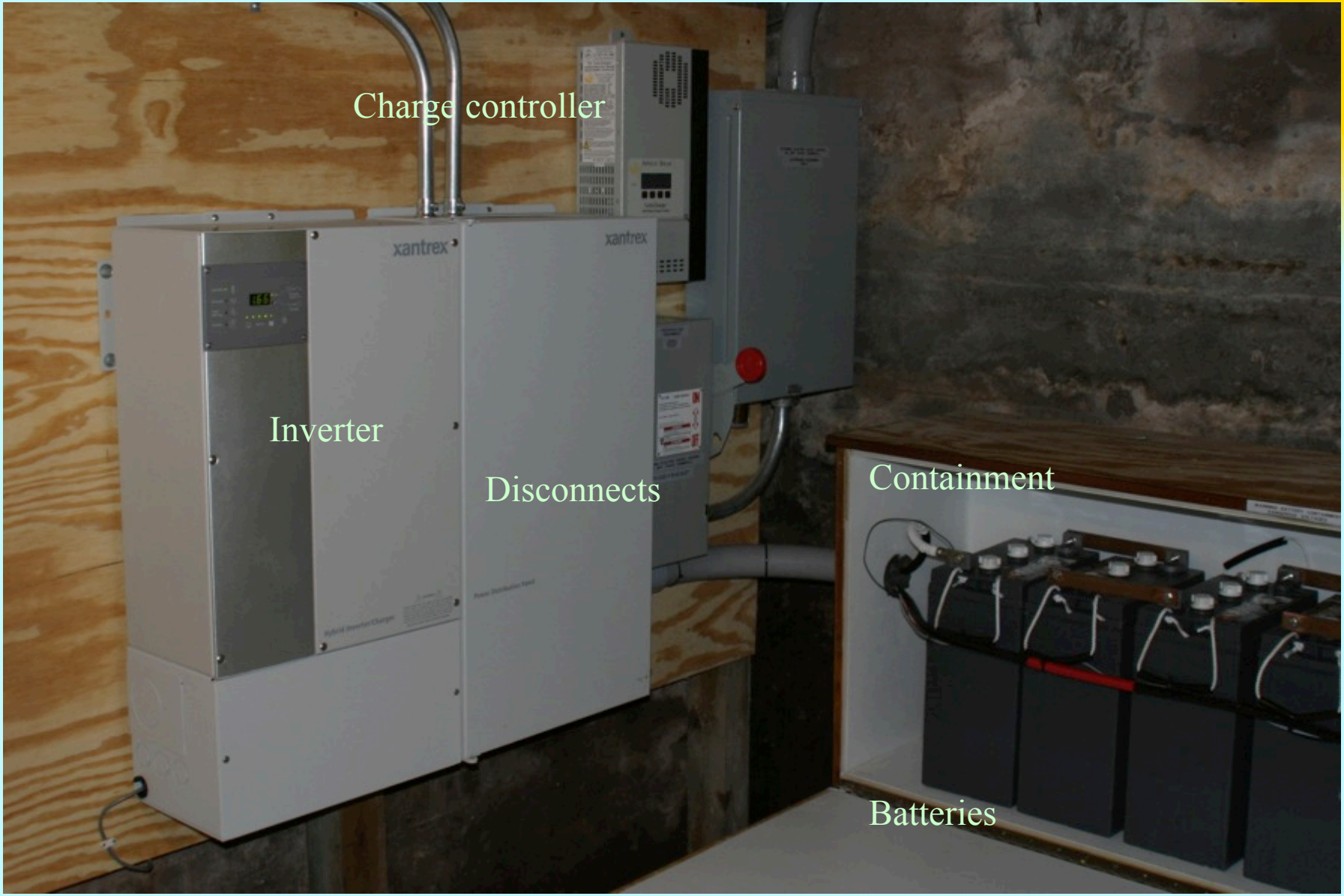
https://www.youtube.com/watch?v=yKORsrlN-2k

Taking on the reality of climate change is the most exciting element of Mr. Musk's presentation on his new battery, the scale of his vision is comparable to the scale of the problem of climate change…



June 2017 = 409.62 ppm

Moving on… Typical battery based components...



Battery design

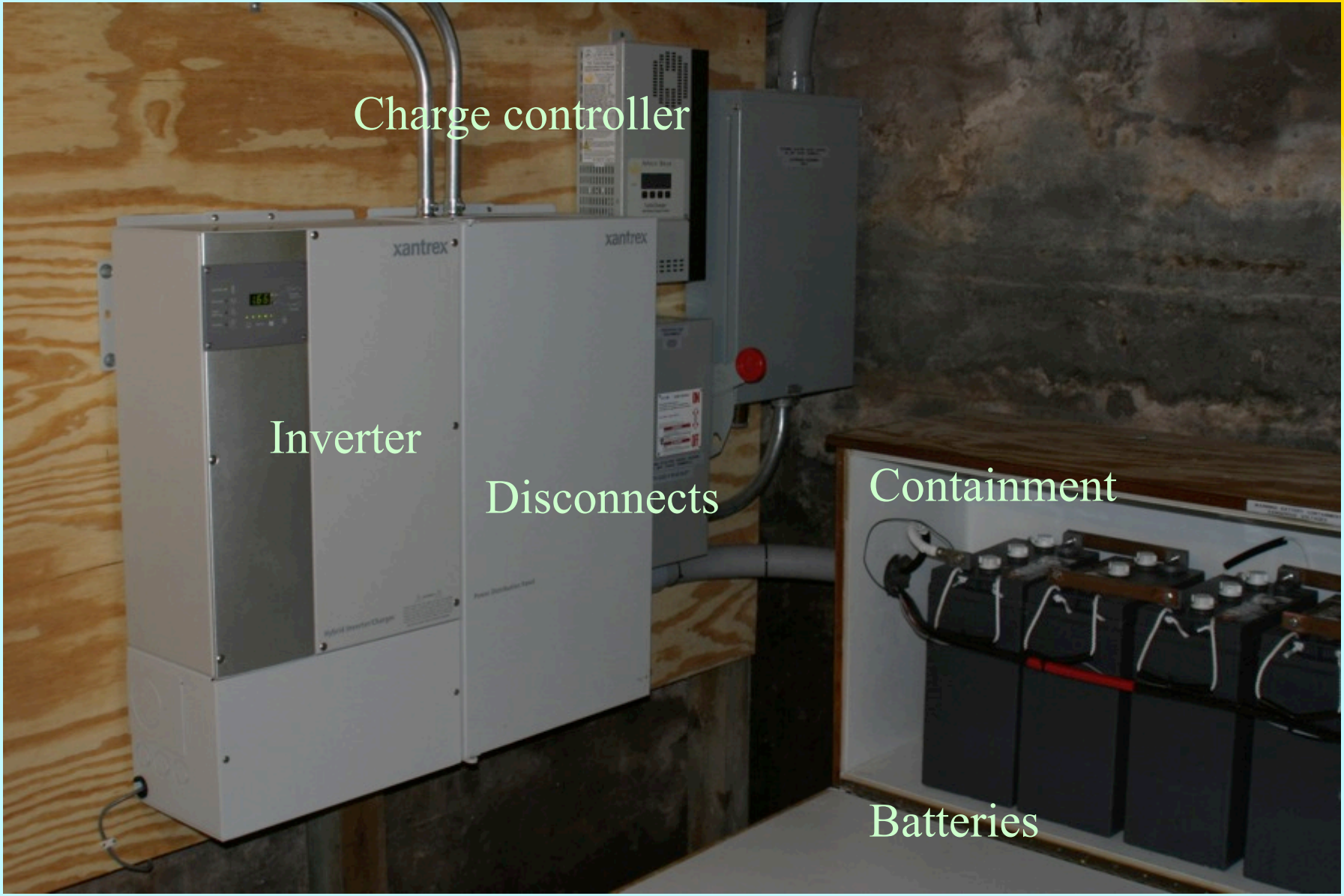
Flooded Lead acid is *still* most cost effective… Perhaps not for long…

Voltage choices - 12, 24, 48

Paralleling strings (3 max) - CRITICAL

Large battery issues:

Using large 2 volt cells becomes the design choice


Charge controller
Inverter
Disconnects
Containment
Batteries

Capacity:

Basic math – Amp hours X voltage = Watt-hours

Amp hour capacity based on
Daily watt hour consumption (DWC)
X required autonomy period (AP)
(hours, days – with PV charge source/ with out)
X Lead Acid life factor of 2

Amp hour capacity = DWC X AP X 2 / Voltage

Example: 1200 Whr X 3 X 2 /12 = 600 Ah

Balancing system components

PV/Genset

Sources must combine to provide for regular achievement of full battery state of charge (every 1 to 3 days, fast return to full state of charge lengthens battery life)

Battery

Capacity must meet load and provide for adequate autonomy, yet must not be so large that full state of charge is not regularly achieved

Loads

Must be determined accurately and conservation reduces all system costs

Client Qualification: When does a client need a Battery Based PV System?

To make successful designs with Batteries in PV systems we need to identify what makes a client one who needs batteries in their PV system. There are essentially three real needs for Batteries in PV systems:

Qualifying your clients *on their initial call* will save you
a great deal of grief and frustration.

Client Qualification: When does a client need a Battery Based PV System?

1) The client wants clean energy and has a site without Utility-Grid access

Here is the reason batteries are most often needed. If you are working with a site that is more than ¼ a mile from the Grid PV systems become cost effective.

Client Qualification: When does a client need a Battery Based PV System?

2) The client has the Utility-Grid but experiences significant Grid outages

This is the slippery slope of battery system clients, very few grid-connected clients "Need" batteries in their system. The inefficiency, added cost and significant maintenance truly begs the question – "Why do you want batteries?"

Client Qualification: When does a client need a Battery Based PV System?

3) The client demands a battery-based system because they like the idea and do not care about the decreased efficiency of the system, the greater cost, and the labor involved in the increased maintenance.

These folks get what they want, and most probably need to have maintenance contracts to make sure that the work gets done to keep the batteries happy and their investment in them useful.

4) The client's utility has limited grid access due to high grid penetration of PV (Hawaii)

This will be more common as our deployment continues to grow.

5) The utility is a "smart grid" and clients can take advantage of TOU billing, demand response, storage aggregation, and other ancillary benefits.

When the grid gets smarter our clients can as well and ROI can turn toward the ROI we see in the commercial market today (10-12% with subsidies, 5% without subsidies).