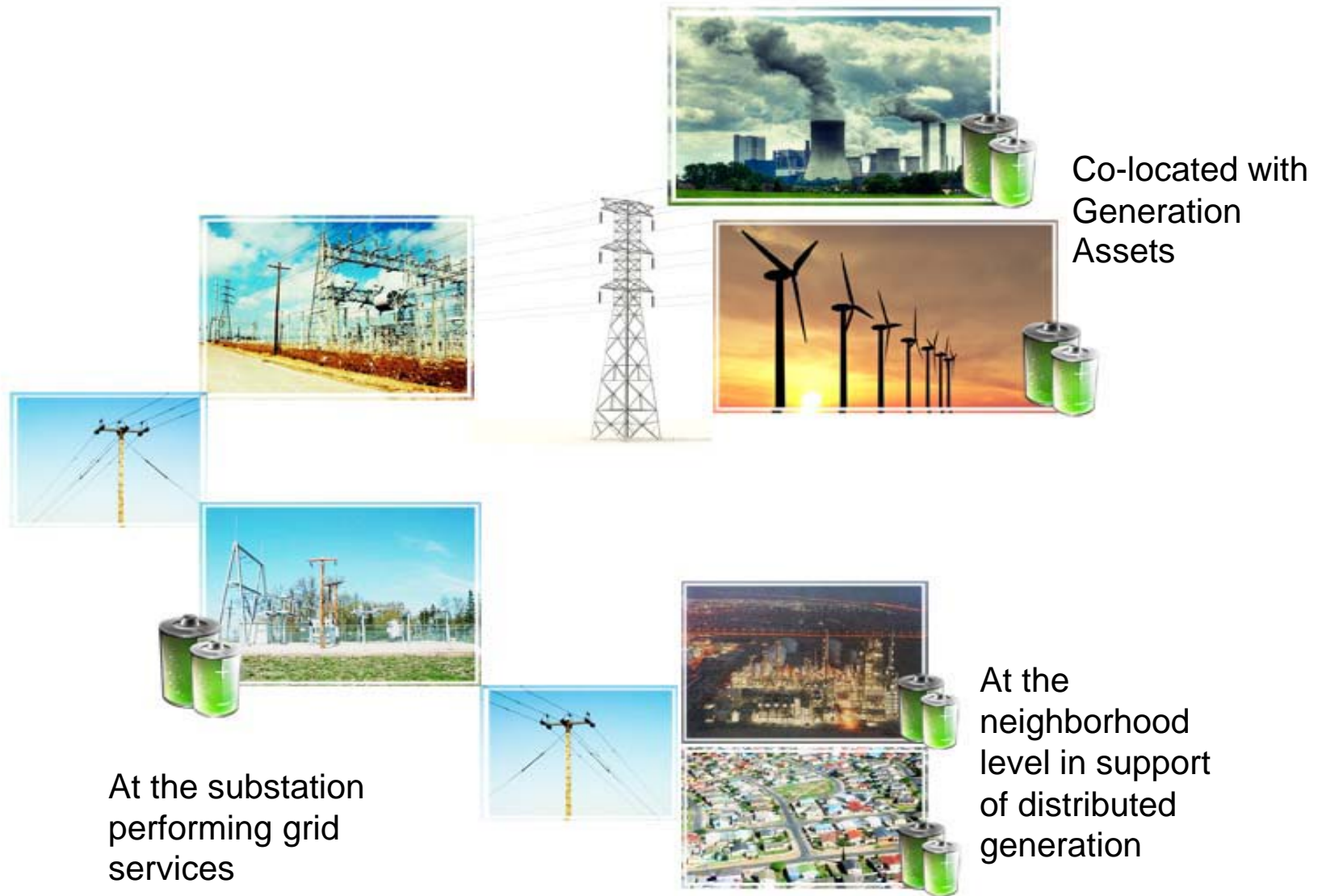




Low Cost Energy Storage

Funded in part by the Energy Storage Systems Program of the U.S. Department Of Energy through *National Energy Technology Laboratory*

Opportunity



Aquion Origins

- Founded at Carnegie Mellon University
- All materials rigorously screened for economic viability at massive scale

Basic Thesis: For grid scale energy storage to be viable, it must be low cost, long lasting and highly efficient and environmentally benign

Technology

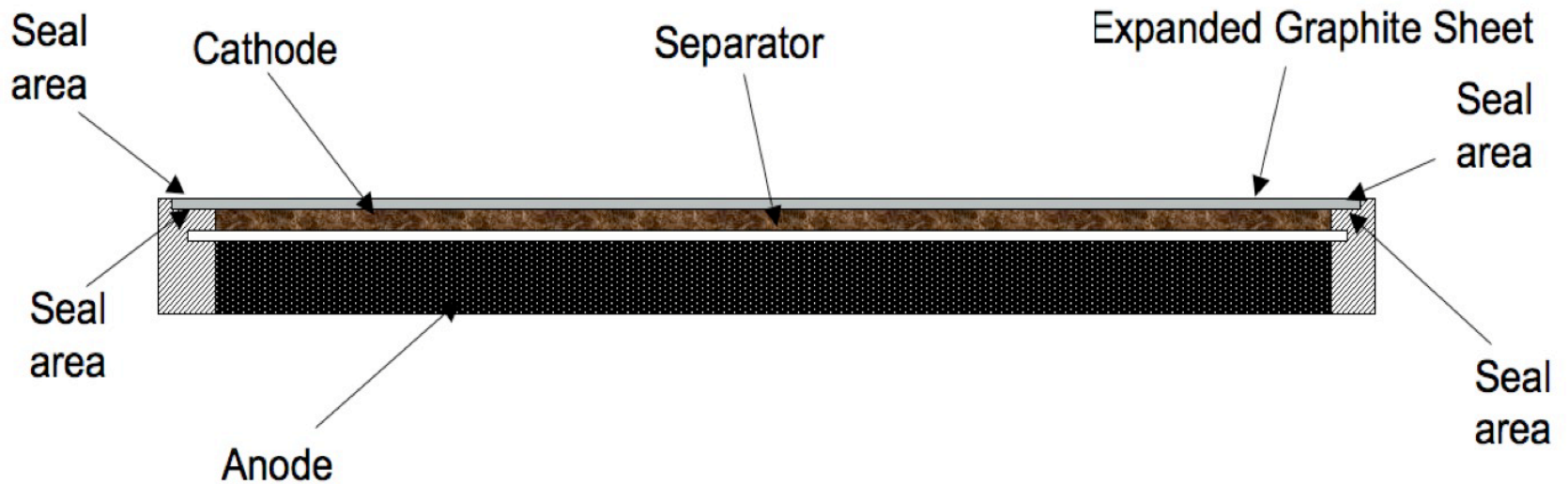
Innovations:

Active Materials

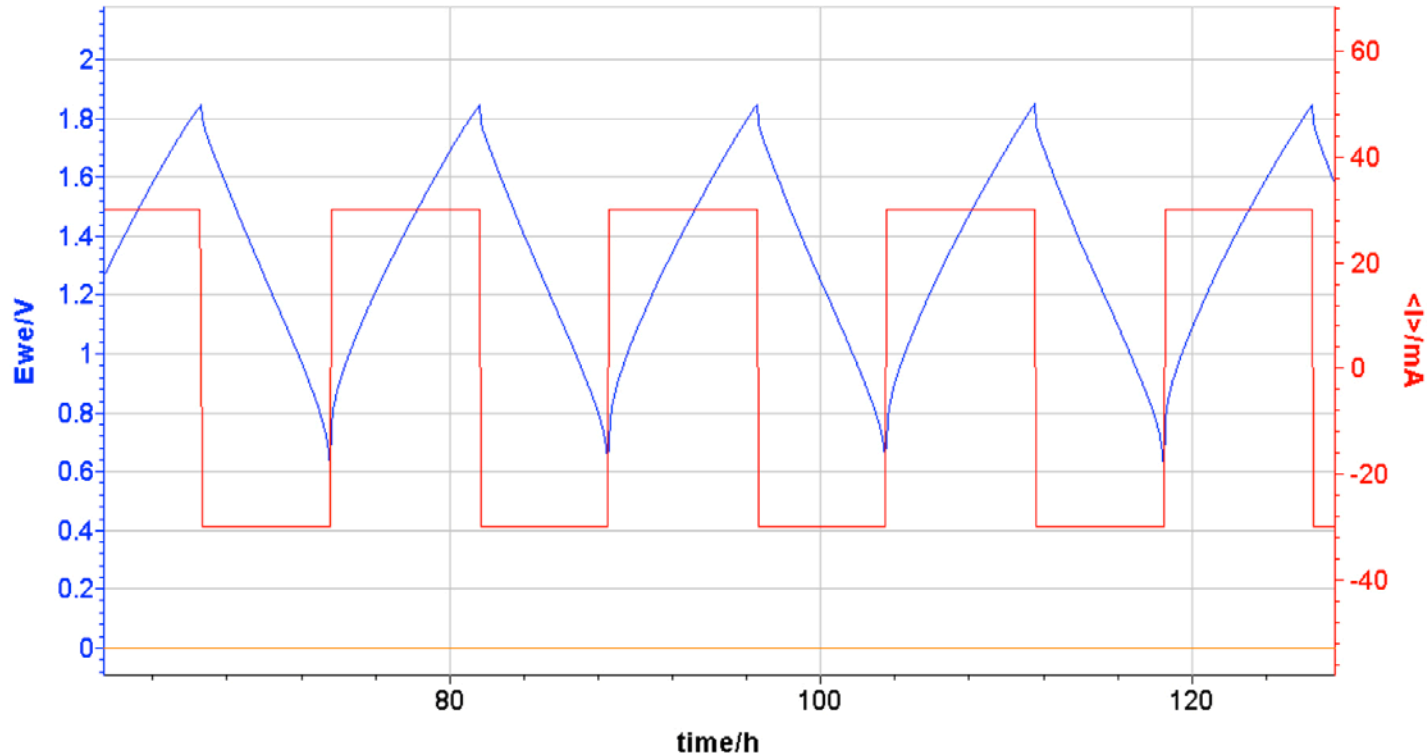
- Anode
 - Low cost, ultra high surface area carbon
 - Advances in processing and materials stream
- Cathode
 - Sodium Metal Oxide intercalation cathode material
 - Fully stable in aqueous electrolyte cycling sodium ions

The Core Device

The Unit Cell



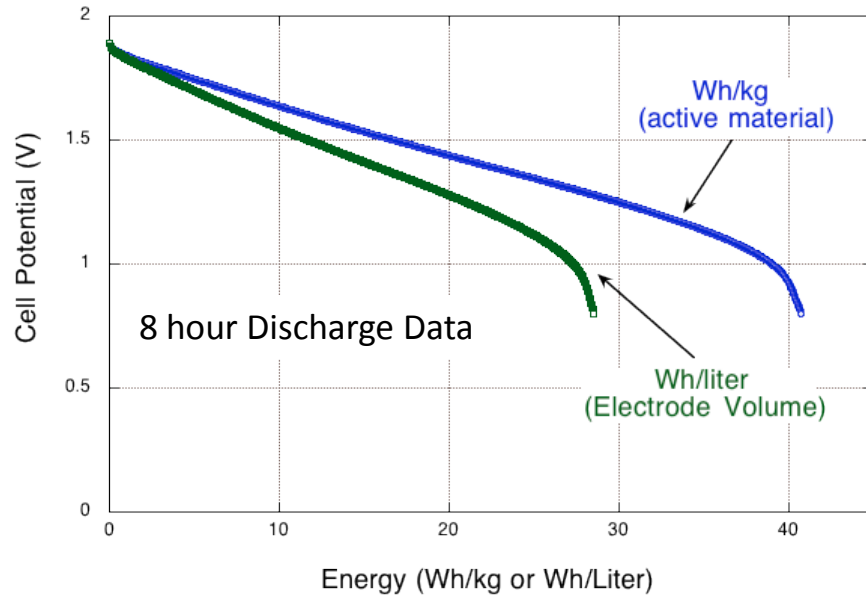
Nominal Cell Voltage Profile



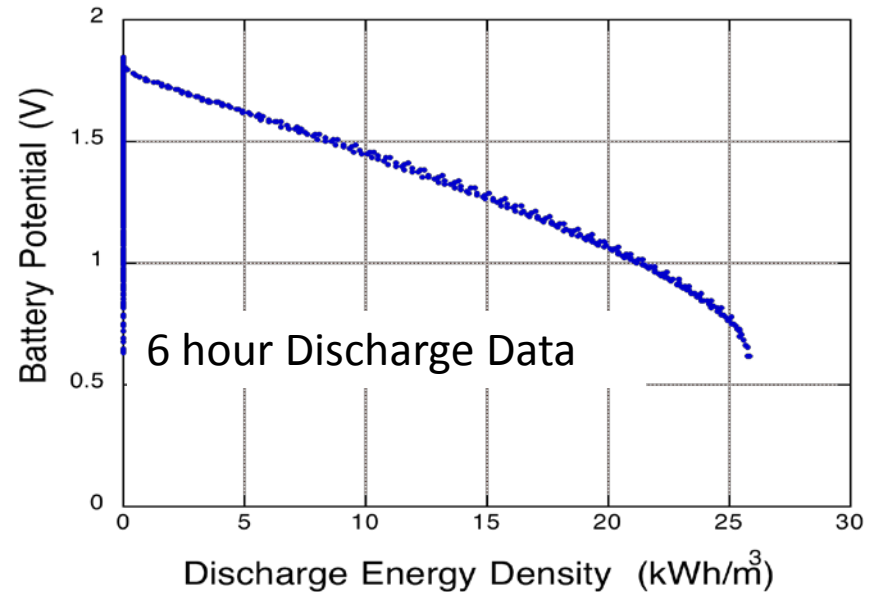
- Useable between 1.8 and 0.7 V
- Minimal voltage polarization (excellent energy efficiency)
- Consistent performance

Energy Density

Coin cell testing

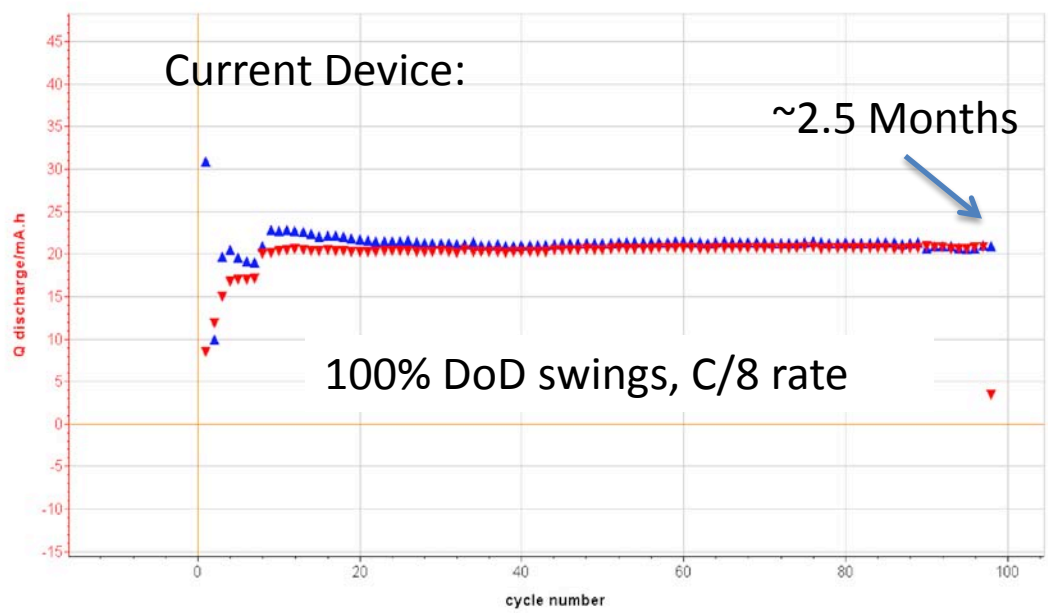


Large format pack

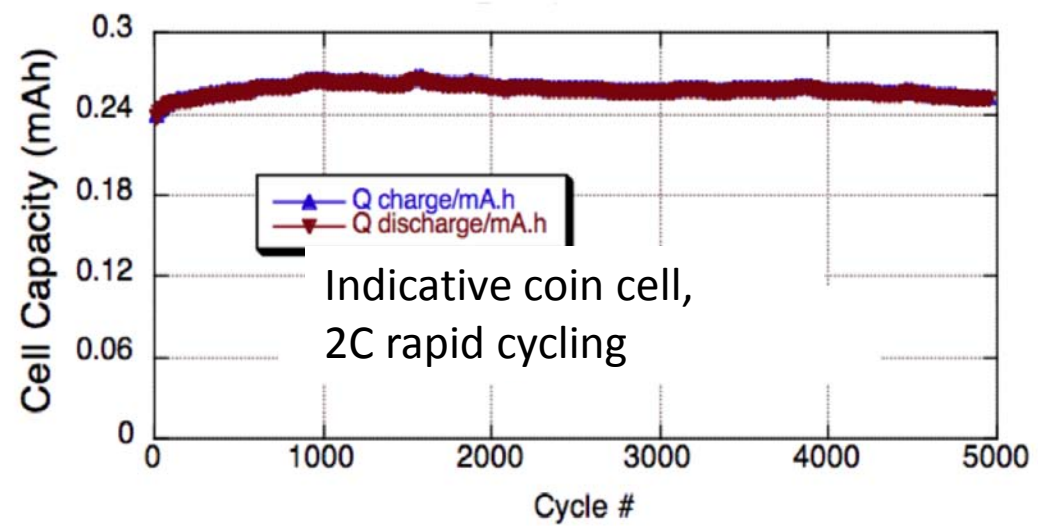


- Small coin cell result maps well to large (multi-inch electrodes) device
- Over 25 kWh/m^3 (functional material basis)

Cycle Life

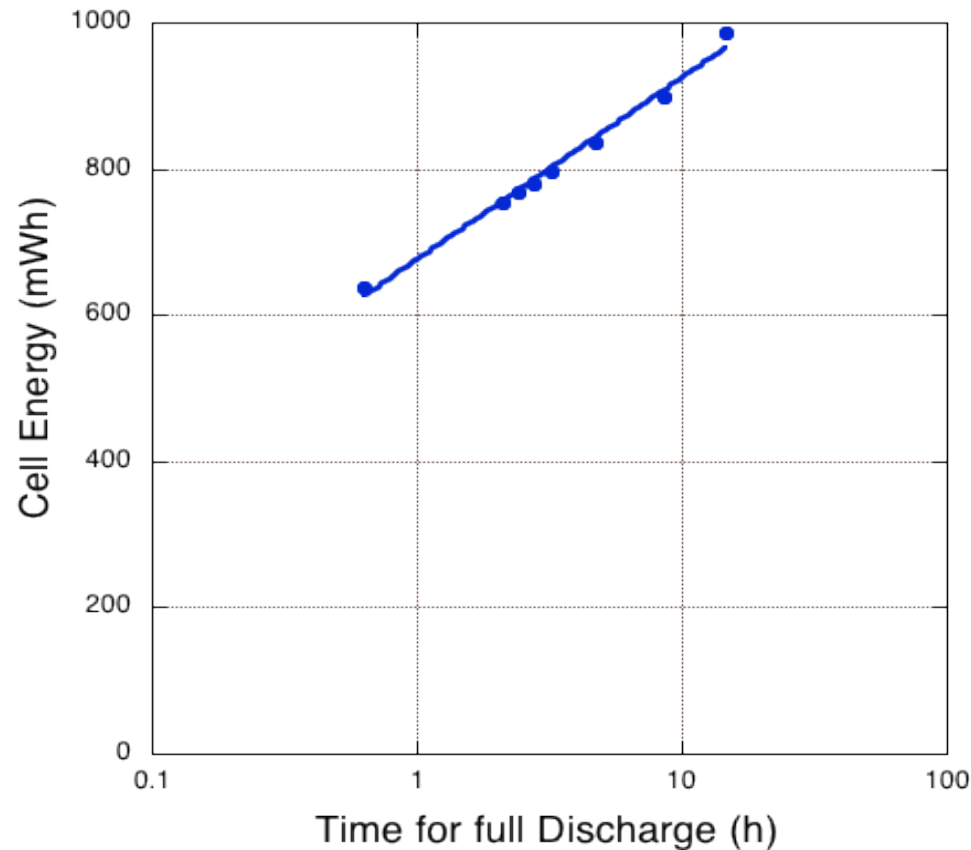


- Deep discharging of current point design shows little to no fade over 100 cycled to 100% DoD.



- Rapid cycling of indicative coin cell shows stability to at least 5000 cycles.

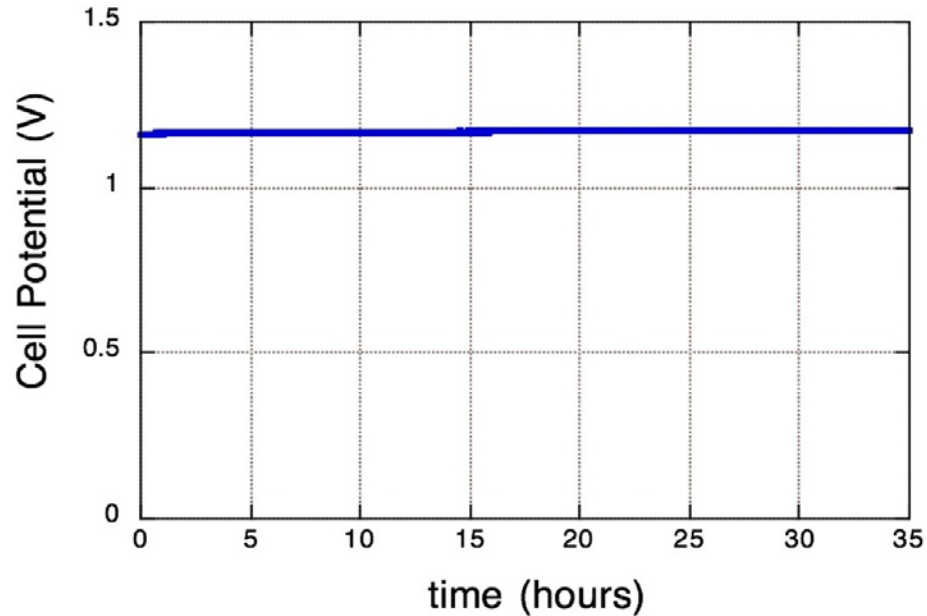
Rate Capability



- >75% of maximum energy delivered in times longer than 3 hours
- 45 minute rate is still able to produce >60% of maximum energy
- “Sweet spot” time >4 hours.

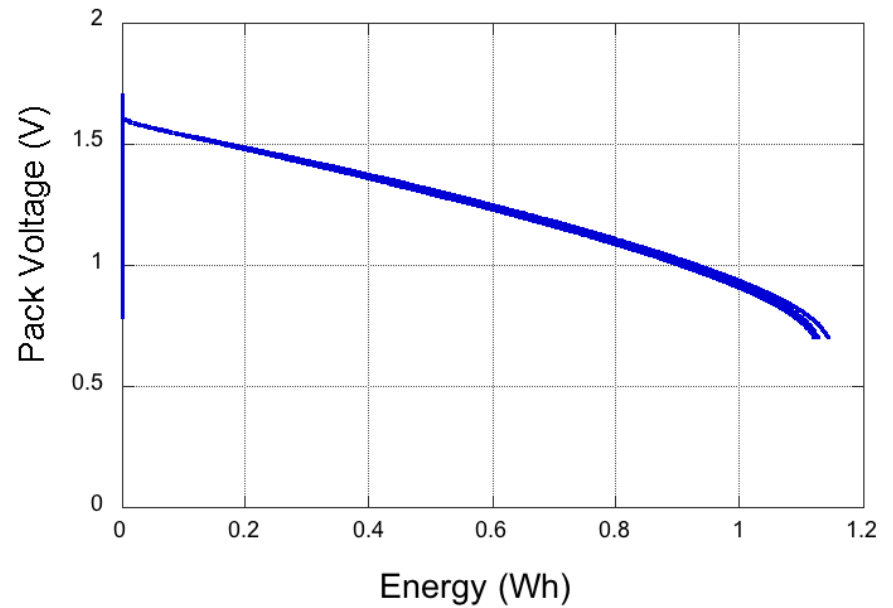
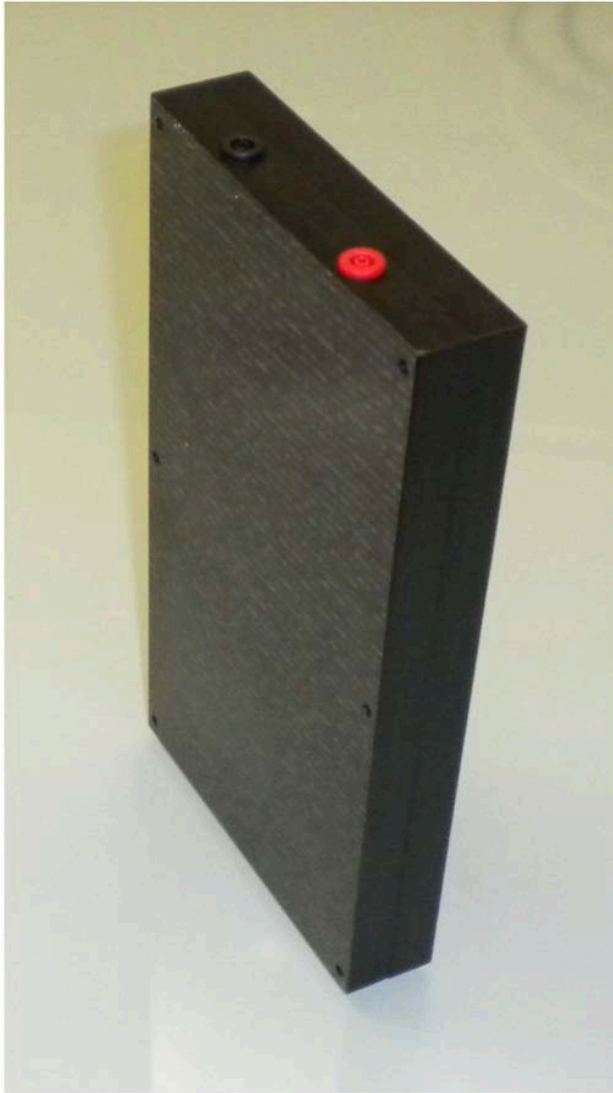
Self-Discharge

Open circuit potential of partially discharged cell:

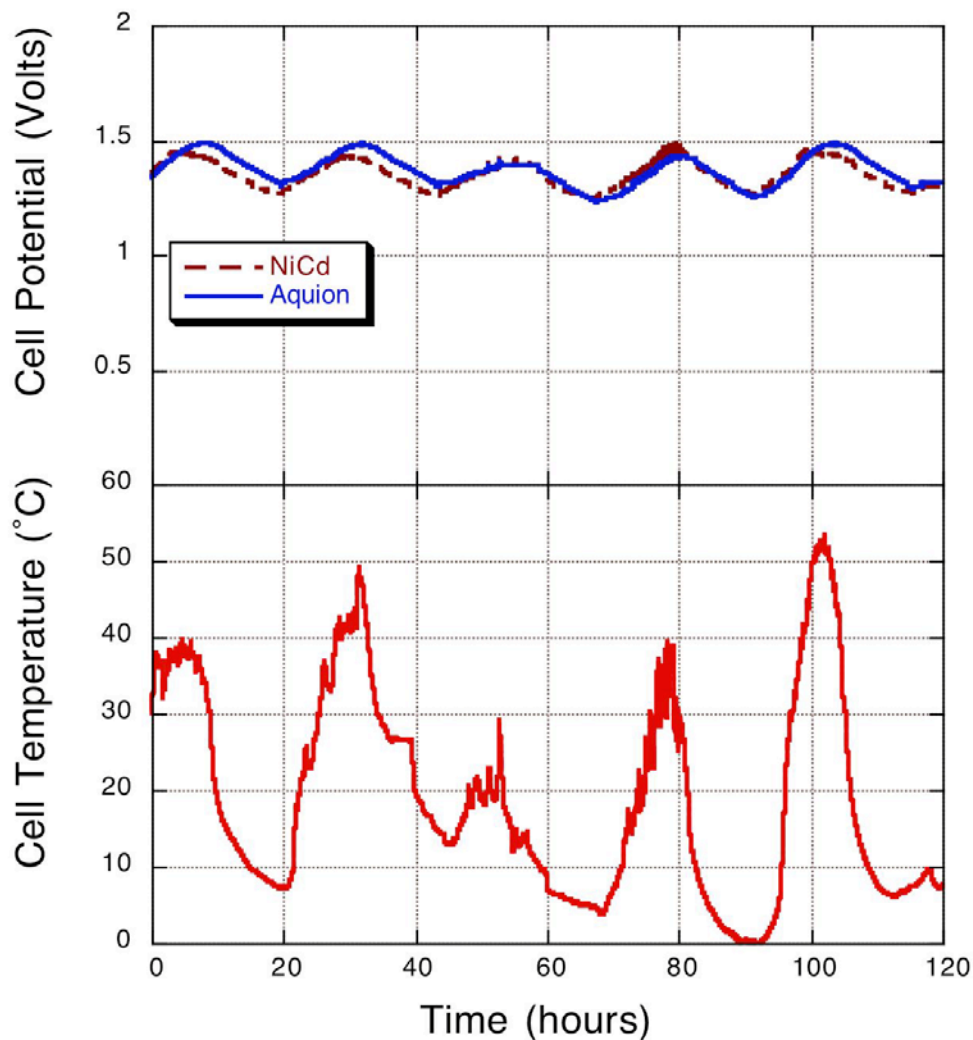


- Cell voltage is fully stable over > 35 hours at ~50% state of charge
- Cells stored for over 12 months have open circuit potentials exceeding 1 V.
- Self-discharge rate is extremely low

KEMA Test Device



Field Testing: Day/Night Solar

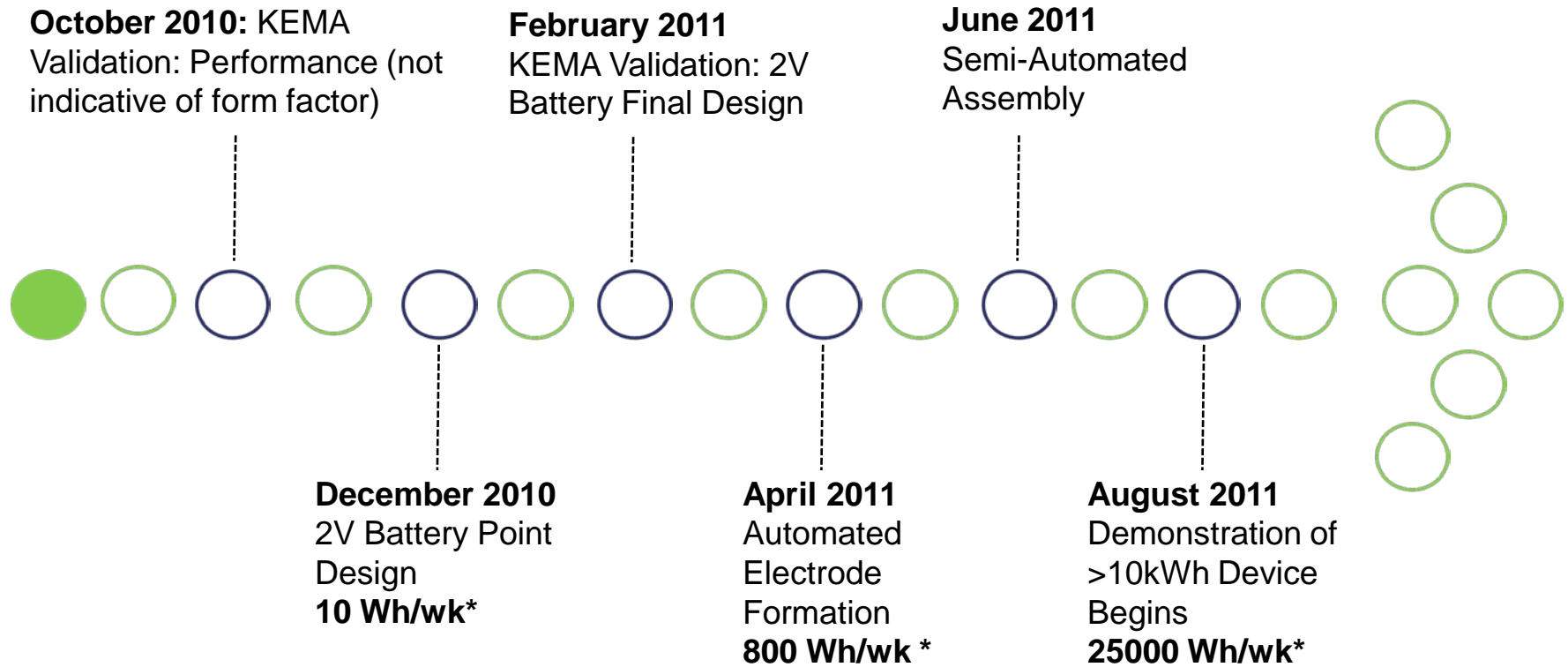


- Aquion Cells tested in solar powered night light
- NiCd cells used as baseline
- Aquion cells stable and continue to meet demand
- Broad temperature swings encountered: +/-50 °C
- > 6 Months testing logged

Aquion's Disruptive Solution

- **Capital Cost:** Competitive with Lead Acid
- **Cycle Life:** >5,000 cycles at 100% DoD
- **Round-trip Energy Efficiency:** >93%
- **High Power:** 10C continuous
 - Much higher spikes possible
- **Stand at Partial State of Charge**
 - No degradation observed
- **Environmentally friendly**
 - No lead, no toxic or corrosive materials
 - Benign, inexpensive, ubiquitous precursors
- **Safety:** Very benign materials system, no fire risk
- **Self-discharge:** Minimal over relevant time domains
- **Abuse Tolerant:** 100% discharge without capacity fade
- **Elevated temperature:** No capacity fade at 75°C
- **Zero maintenance:** Hermetically sealed

Major Milestones: Next 12 Mo's



***Production Capacity**

The Past

Fall 2009

2 FTE



Project Initiated with limited resources



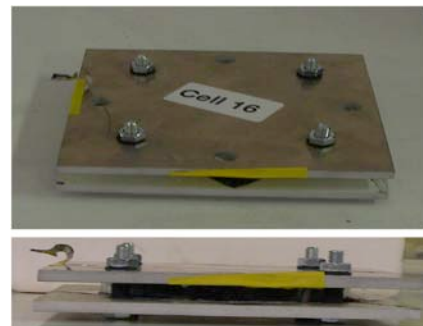
Completed chemistry development at CMU

Winter 2009

6 FTE



FOA 36 enabled increased sophistication



Developed materials with large format cells

Spring 2010

12 FTE



Developed better in house R&D facility



Demonstrated large format multi-cell devices

Facilities

Devices

The Present

As of 10/1/2010

24 FTE

Facilities



Completed Build-out of manufacturing R&D facility. Designing pilot line to fit in existing facility.

Devices

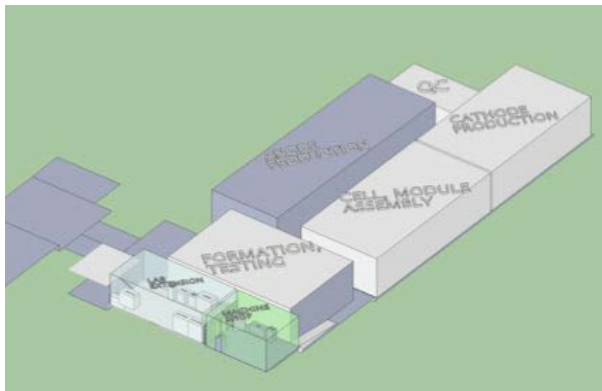


Building multi Wh batteries with extremely high performance to be validated by KEMA off-site

The Future

Summer 2011

45 FTE



Plan to commission 25kWh/wk semi-automated pilot line in early summer of 2011 where additional automation capacity can be tripled. Pilot Line will represent minimum efficient scale production.



Pilot line production will be 2V batteries in 100-800 Ah range, connectable in series and parallel to any required voltage configuration. Total delivered energy over the system lifetime far surpasses a PbA pack at comparable cost

Facilities

Devices

Questions

***For more information contact
Ted Wiley, Director of Operations***

twiley@aquion-energy.com