

What We Learned in Washington, D.C.: Notes from U.S. Department of Energy's Storage Conference

Josh Gould

Senior Manager, Research & Advisory
415-684-1020 x6730
josh.gould@cleantech.com

With a lot of anger directed at United States politicians of all stripes lately, it's quite rare for anyone to admit they learned something in Washington, D.C. But count the 500+ attendees of the U.S. Department of Energy (DOE) and Sandia National Labs-sponsored energy storage event from November 2 – 4 among the lucky few who were taught something in Washington. For those Cleantech Group subscribers who couldn't attend the event in person, this note provides a brief overview of our key learnings from this cutting edge event.

The event taught us four points in particular:

1. Storage is no longer just for startups, utilities and venture investors. Large companies are playing a growing role in the storage market both in the U.S. and internationally.
2. Though storage is a large and diverse market that will ultimately require tremendous scale, addressing the problem effectively can – and does – start small.
3. Finding the next great storage startup may require going to school – literally. Leading universities are an important focal point in incubating, funding and commercializing storage technologies.
4. Despite increased effort, funding, and attention, current storage solutions are still too expensive.

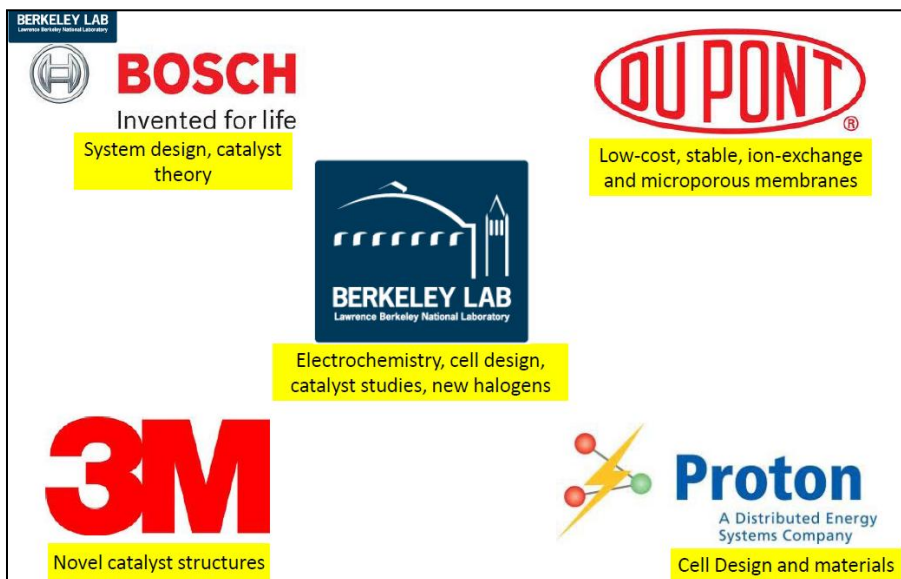
#1: Large Companies Enter Storage Market

Energy storage has traditionally been stereotyped as the province of startups and their venture investors. Of course, companies like **GE**, **Siemens** and a wide range of Asia-based players have spent plenty of time and money in the storage market. But many of these efforts have focused on market needs that have lower-rated energy requirements (in kW) and therefore addressed the consumer electronic and electric vehicle (EV) segments. Only in recent years has there been a renewed emphasis – and investment – into technologies that could scale to the grid.

The conference attendee list, as well as recent investments made by the likes of **Samsung** and **Applied Materials**, demonstrates that corporates have noticed the growing need for and addressable market size of storage and have started allocating real dollars to their efforts.

To use only one of many potential examples from the conference, Venkant Srinivasan of Lawrence Berkeley National Lab presented a research project related to hydrogen-bromine flow batteries for grid-scale storage. On this project alone, he has three major co-collaborators addressing different areas of the materials science and footing portions of the cost:

Hydrogen-Bromine Flow Battery Team



Source: Lawrence Berkeley National Lab, Sandia National Lab, and Department of Energy

Other companies that attended and, in some cases, detailed their projects in concert with the National Labs included **Boeing** and **ABB**. While their efforts are mostly in the development stage, it's safe to say that at least some of these early adopters will turn their investments into real revenue and business opportunities. And when they do, watch for the floodgate of M&A activity, corporate venture investments, and R&D dollars to open wider in the coming years, as slower-moving competitors begin to enter the market.

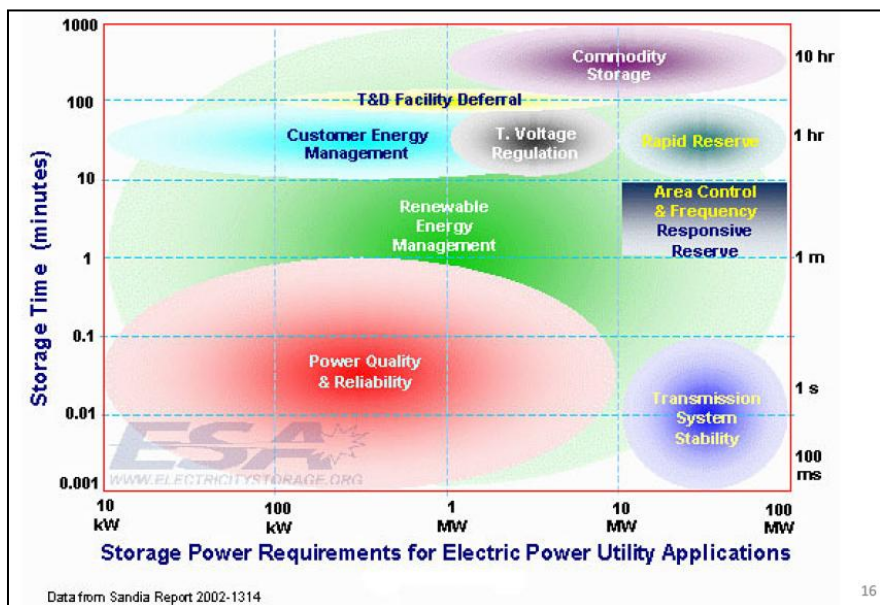
#2: Ambitions Large, Projects (Sometimes) Small

Cleantech Group estimates the addressable grid storage market to be **well over \$15 billion globally today**.¹ While any particular estimate is likely to be inexact, it's clear that the market is quite large. Given the size of this market, most readers are inclined to believe that any storage solution must start with scale. If it's a large market, why not build the largest potential storage system in MW to address it?

That approach is flawed for three reasons. First, storage can provide value not just for load shifting or arbitrage applications that can require many megawatts of storage at a particular site, but also for smaller-scale uses at the community or substation level (e.g., deferring utility transmission and distribution capital investments, or improving power quality and reliability). The best depiction of these various benefits compared to the power and discharge rates they require is below:

¹ Source: Cleantech Group research and analysis

Storage Benefit Value Streams by Discharge Time and Power Requirements



Source: Sandia National Lab and Electricity Storage Association

Second, any provider of capital wants to demonstrate the technical feasibility and economic benefits of the technology before deploying it further. Therefore, initial small scale deployments are an approach used to “de-risk” the technologies and vendors before potential future capital outlays of a much greater magnitude.

Third, and much less obviously, partnering vendors with large IPPs, companies, or utilities at an early stage is a tremendous opportunity for mutual benefit. Instead of a vendor simply asking a customer what it wants, partnering for early stage pilots lets both parties define the product simultaneously. This approach is particularly relevant in such a nascent market, where customers may not fully understand what they want and vendors may not know whether customer requirements are technically or economically feasible. Partnering at the early stages addresses this issue: the vendor receives the benefit of greater first-hand knowledge of customer needs and avoids building a product the customer doesn’t want, while the customer gets to define those needs in real-time with a vendor, building a product (and potentially a company) designed to suit these needs. All the while, each party is evaluating the other and gathering data for future deployments or products.

Examples of small initial pilots include a 10-100 kWhr pilot by sodium-ion startup **Aquion Energy** and industry powerhouses **Duke Energy** and **AES**. Major utility players like **PG&E** and **Detroit Edison (DTE)** are conducting 25kWhr and 50kWhr pilots respectively (although in DTE’s case, the project involves 20 units of 50 kWhr each).

#3: Find the Next Storage Startup at School

Of the storage projects funded by the Recovery Act, our (unofficial) calculation is that just under half of the recipients were engineering or chemistry students and faculty who spun their technologies into companies. To name just a few examples, **SustainX**, a Compressed Air Energy Storage (CAES) startup backed by Polaris and Rockport and the recipient of a GE ecomagination grant, was incubated at Dartmouth College. **Aquion Energy**, a Sodium-Ion battery startup working with AES and Duke Energy, was spun out of Carnegie Mellon. And of course, the most famous example is **A123 Systems**, now public, which was started at MIT by the university's brilliant professor of chemistry Yet-Ming Chiang.

Many of the other recipients had less formal connections with universities who provided mentors, technical insight, or education that shaped the entrepreneurs that founded promising storage companies. In addition, we heard from many graduate students and faculty who noted the growing interest among graduate and PhD students in the fields most applicable to energy storage: chemistry and materials science. The interests of graduate students seem to be a leading indicator of future innovation and startup activity in a sector. One needs only to recall the interest in graduate-level computer sciences programs in the 1990s that spawned graduate students like Jerry Yang and David Filo, and Sergey Brin and Larry Page, who founded **Yahoo** and **Google**, respectively.

We strongly believe that the early successes of university-incubated startups help to create a virtuous cycle of attracting intelligent and ambitious graduate students to storage-related fields; these students in turn lead to the next set of innovative storage startups. In short, we expect to see many innovative and successful storage startups spinning out of universities in the next 5-10 years.

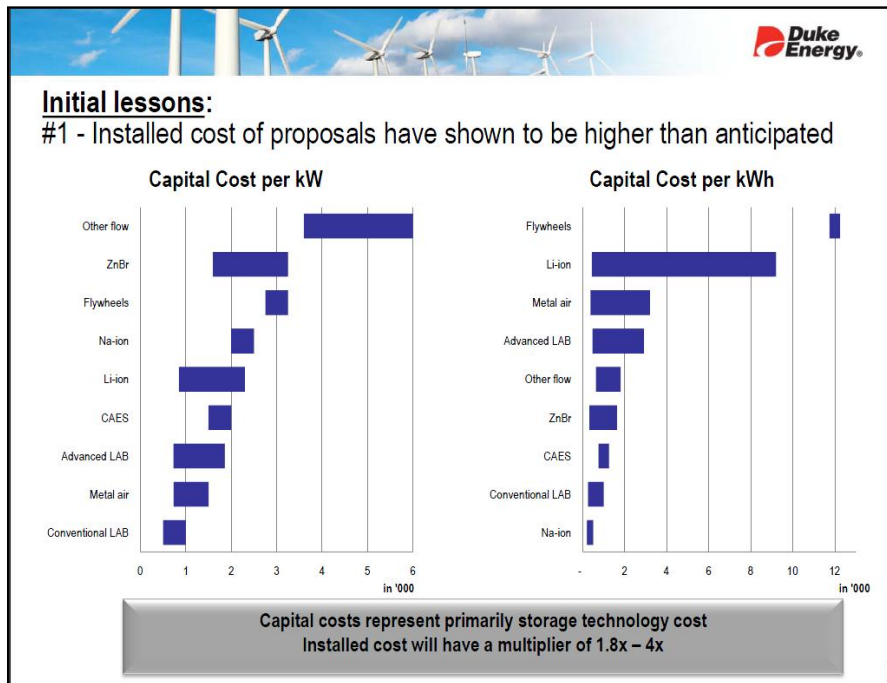
#4: Storage Still Too Expensive

Despite our general optimism for the energy storage market and the macro-trends that are driving its development, it's important to point out that most current solutions simply do not meet the market need. Indeed, categorizing the many ways in which existing technologies fail to (fully) address the desire for cheap, long-lasting, and large-scale storage would be worthy of a much longer Research Note. But for this Note, let's just focus on one of those variables: cost.

Cost involves two key problems. The first is that the capital expenditure required for storage is simply too high, particularly for electrochemical (e.g., battery) solutions. Typical CAPEX for an electrochemical solution is at least **\$1,000/kW**. This amount is at least twice as high as the number (at most **\$500/kW** and probably lower) for storage to be competitive on an unsubsidized basis with other non-storage solutions that can accomplish (at least some) of what storage could (e.g., demand response or gas-fired peakers). Note that we will cover the cost subject in much greater depth in our forthcoming briefing on energy storage.

The second issue is less obvious. Customers have found that vendors, whose estimates of storage costs are already too high for end-users, often underestimate installed costs. This includes the cost of interconnection, the associated power electronics required, and other operations and maintenance costs. **Duke Energy** provided the excellent example of how installed costs exceed estimates below:

Installed & Anticipated Storage Costs



Source: Duke Energy, Sandia National Lab and U.S. Department of Energy

In addition to innovating around the technology and materials, storage companies will also need to do a better job of estimating installed costs and working with vendors to bring those costs down. In short, while we continue to believe energy storage is a promising market, enthusiasts need to remember that significant cost reduction and technology improvements are required before storage will be incorporated at scale.

Cleantech Group delivers data and insights on cleantech innovation to help our global client base make informed, strategic decisions.

Cleantech Group Analysts & Coverage Areas

Greg Neichin Vice President, Research & Advisory	Smart Grid Energy Efficiency Software & Cleantech	greg.neichin@cleantech.com
Richard Youngman MD, Europe & VP, Research	Global Cleantech Trends Europe & Asia	richard.youngman@cleantech.com
Debjit Mukerji VP, Research	Transportation Storage & Fuels Industrial Efficiency Wind	debjit.mukerji@cleantech.com
David Cheng Senior Research Analyst	Energy Efficiency Solar Carbon Mitigation Policy & Regulation	david.cheng@cleantech.com
Josh Gould Senior Research Analyst	Energy Storage Energy Efficiency Geothermal/Nuclear	josh.gould@cleantech.com
Andrew Thomson Senior Research Analyst	Cleantech Investment Trends Renewable Chemistry	andrew.thomson@cleantech.com
Mia Javier Research Analyst	Water Waste & Recycling Hydro/Marine	mia.javier@cleantech.com
Stephen Marcus Research Analyst	Cleantech Investment Trends Agriculture Europe & Asia	stephen.marcus@cleantech.com

San Francisco
220 Montgomery Street Suite 1000
San Francisco, CA 94104
+ 1 415-684-1020
info@cleantech.com

London
175-185 Grays Inn Road
London, UK WC1X 8UE
+ 44 (0) 20 7812 0575