NYSERDA ENERGY STORAGE AND NY-BEST PROGRAM: IMPACT EVALUATION

Executive Summary

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Executive Summary

EMI Consulting and Industrial Economics, Inc., were selected by the New York State Energy Research and Development Authority (NYSERDA) to carry out a multi-stage evaluation of the New York Battery and Energy Storage Technology Consortium (NY-BEST), including 1) a 2015 market characterization of the New York energy storage industry, 2) an economic analysis of potential future market and economic impacts, 3) a patent analysis, and 4) an impact evaluation of the NY-BEST Consortium since 2010 (this report).

This impact evaluation documents the influence NY-BEST had between 2010-2015 on the energy storage market in New York State. Building from the market characterization study, this analysis situates NY-BEST's evolution from 2010 to 2015 in the broader energy storage market and describes NY-BEST's work in terms of its progress towards the short-, medium-, and long-term outcomes defined in the NY-BEST program logic model. This executive summary highlights key findings and recommendations resulting from this research.

Parallel Growth for Energy Storage Market and NY-BEST

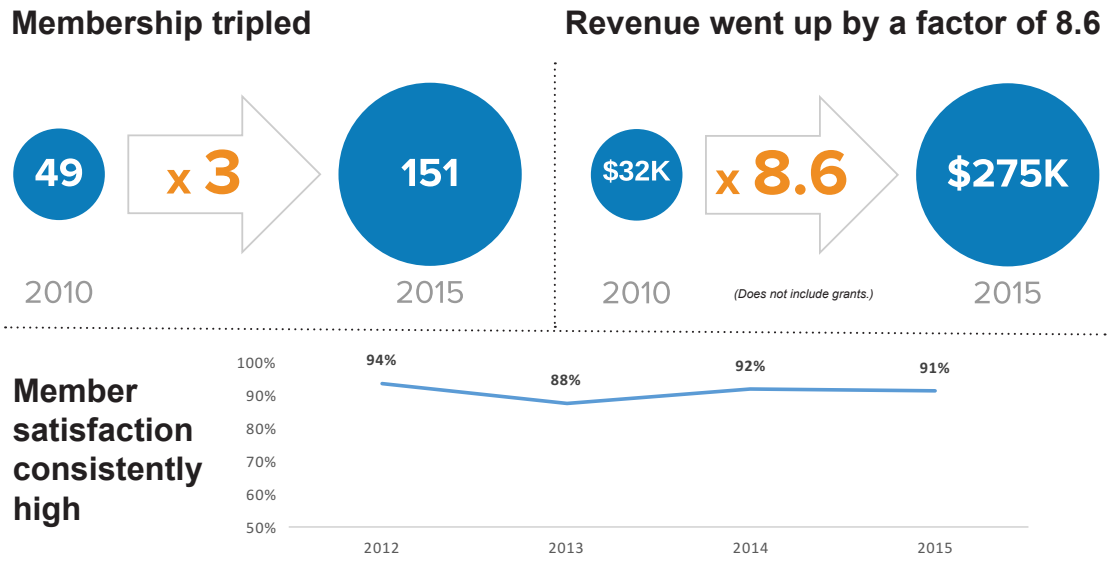
Between 2010 and the end of 2015, the energy storage market experienced substantial growth as technical advances lowered battery costs and opened up new areas of opportunity, particularly for grid storage and transportation storage technologies. As these costs decreased, the growth of the energy storage market during this time period was notable:

- New technologies (e.g., additional stationary storage units for commercial and utility applications and residential battery storage units) entered the market, as did new versions of existing technologies (e.g., electric vehicles).
- The global grid storage market segment grew from roughly 125 GW in 2010 to roughly 185 GW in 2015, and the proportion of advanced energy storage (non-pumped hydro) increased from 1% to 4% of total installed storage.
- The U.S. grid storage market grew from a valuation of $134M in 2014 to $432M in 2015. This corresponded to the addition of roughly 221 MW of utility-side grid storage in 2015.
- From 2012 to 2015 the energy storage market in New York State experienced an increase in revenues from $598M to $908M (estimated) and from approximately 3,000 to 3,900 jobs (estimated).[1]

NY-BEST was created in 2010 to support the advancement of the energy storage market. Its objectives included serving as an expert resource to energy storage-related companies and organizations, assisting in industry networking, facilitating financing for new ventures, enhancing research capabilities, and promoting policies that support establishing a strong energy storage economy within the State. Between 2010 and 2015, the consortium more than tripled its membership, increased its annual revenue by nearly a factor of 10, maintained consistently high member satisfaction, and provided networking services to over 26% of members (see Figure ES-1).

[1] Employment and revenue data from 2010 was not available in a format that allowed for a direct comparison to later years.

Figure ES - 1. Key Trends in NY-BEST Membership, Revenue, and Member Satisfaction



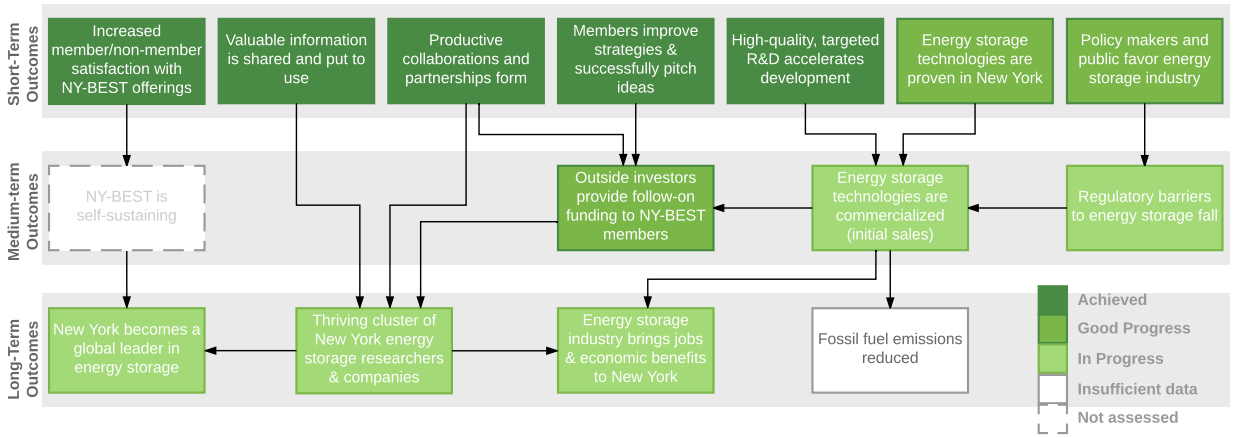
NY-BEST Achieved or Made Progress on Short- and Medium-term Goals

Between 2010 and 2015, NY-BEST achieved or made the following progress toward the consortium's short-term and medium-term goals (see Exhibit 1):

- Received positive ratings from members, with 37 of 43 members (86%) indicating they would recommend NY-BEST to a colleague (rating of 8 or higher on a 10-point scale)
- Hosted 20 conferences with total annual attendance increasing from 90 in 2010 to 1,580 in 2015; 19 webinars with total annual attendance increasing from 253 in 2012 to 1,014 in 2015, and three forums and workshops with attendance ranging from 89-100.
- Enhanced research capabilities within the State by facilitating connections between various energy storage industry organizations and helping to secure financing for new ventures; 21 of 50 NYSERDA-funded projects received follow-on funding totaling at least $74M. Sources of follow-on funding included both public (government) and private sources.
- Established the Battery and Energy Storage Test and Commercialization Center (BTCC) in Rochester in 2014 operated by DNV GL and the Battery Prototyping Center (BPC) at Rochester Institute of Technology in 2015. Since opening, BTCC has generated $1.3M in revenue (through September 2016) through conducting over two dozen testing programs on batteries and energy storage products. Several NY-BEST member firms advanced their technologies' Technology Readiness Level (TRL levels) through use of BTC and BPCC resources, including Paper Battery Company, Eos, and the Raymond Corporation.
- Published Energy Storage Roadmap documents in 2012 and 2016, calling for 2 GW of multi-hour grid storage capacity by 2025 and 4 GW by 2030.
- Participated in technical committees and standards development, and was especially active in New York's Reforming the Energy Vision proceedings.

There was not enough data available at the end of 2015 to determine whether NY-BEST had fully achieved all its long-term goals. In particular, a successful result for the long-term outcome "fossil fuel emissions reduced" requires not only that energy storage technologies are deployed and contribute to a reduction in emissions, but also that data are available to show such a reduction is attributable to energy storage technologies. While feasible, this analysis may require up to several years' worth of data following the deployment of these technologies (to account for seasonality and other unrelated effects).

Figure ES - 2. NY-BEST Progress Toward Meeting Logic Model Goals[2]



Note. This research does not address the medium-term outcome "NY-BEST is self-sustaining," thus it is not assigned a progress status in this graphic.

Funded Projects Beginning to Influence the Market

While most of the 50 NYSERDA-funded R&D projects at NY-BEST members were still in development at the end of 2015, those that had made progress towards commercialization had begun to influence the market and other research. At the end of 2015:

- 44% of the funded projects were complete.
- 42% of the projects with funds distributed secured a total of at least $74M in additional funding for their technologies. Sources of this additional funding included government agencies (such as the Advanced Research Projects Agency – Energy, or ARPA-E, the National Science Foundation, the U.S. Navy, the U.S. Army, and National Institutes of Health) and private investors (including firms like Northwater Capital, Caerus Ventures, and Energy Technology Ventures – a joint effort between GE, NRG Energy, and ConocoPhillips).
- One project was closed due to inadequate performance.[3]

[2] In a future logic model version, outcome descriptions may be further clarified. Specifically, the node "policy makers and public favor energy storage" may be better represented with language that acknowledges awareness as well as positive views towards energy storage. The node "regulatory barriers to energy storage fall" could be changed to focus on policies and regulations that allow storage deployment.

[3] One project (an advanced separator by Hollingsworth & Vose, Co.) was terminated when the technology did not show adequate performance.

- Of the 21 projects with information on developmental stages over time, eight had begun to report TRL progress towards commercialization, of which at least two (the "Aurora" line of grid storage units by Eos and an ultracapacitor by Graphenix Development) were commercially viable or in the process of being commercially licensed in 2015.[4]
- 18 of the 42 funding recipients were cited as "prior art" (evidence that a similar technology has already been developed or at least described) by at least one subsequent patent – suggesting that some funded projects were influencing developments across a range of energy storage technologies, and that this level of influence will likely increase with time.
- Without NYSERDA funding and NY-BEST support, several interviewees specifically explained that their projects would not have been able to secure funding or progress quickly.

NY-BEST Gaining Traction as Leader in Energy Storage

While actual New York State grid storage and large-scale transportation storage deployment at the end of 2015 was limited—New York currently represented an estimated 5% of national utility-side grid energy storage[5] by power capacity—experts and members viewed NY-BEST as a leader in supporting energy storage in New York and in national conversations, especially in its chosen sectors of focus: grid and large-scale transportation, and primarily battery technologies. Six interviewees specifically mentioned that NY-BEST was respected for:

- Having a positive influence on promoting policies and markets favorable to energy storage technologies within New York State.
- Serving a very helpful network for securing partnerships and financial assistance as emerging technologies develop commercially-viable products.
- Providing leadership in grid storage and large-scale transportation—its intended areas of focus—more so than in electric vehicles or portables.

However, as a few members pointed out, the trade-off of focusing its efforts in particular sectors was potentially dissuading some non-battery technology and EV producers from participating.

[4] Another technology, a metal halide battery developed by GE, progressed through the TRL scale but GE decided not to pursue commercialization of the product.

[5] This value includes pumped storage hydro projects.

Recommendations

Based on the findings of this research, we provide several high-level recommendations meant to build on NY-BEST's current activities.[6]

1. **Leverage existing connections with New York State government entities to provide additional policy support to stakeholders as the State implements the *Reforming the Energy Vision* initiative and other efforts. A key role for NY-BEST might be to identify actions that would increase market certainty around supply of and demand for energy storage in New York State.**

2. **For instances where outside investment is lacking, offer a service to formally facilitate small-scale demonstration or pilot projects by connecting commercially viable technologies with end users who may stand to benefit from such technologies, including electric utilities.**

3. **Increase engagement with technology developers beyond battery technologies (e.g., those focused on flywheels, fuel cells, thermal energy, compressed air, flow batteries, etc.) by focusing on market needs and necessary performance and price requirements.**

[6] These are abbreviated versions of the recommendations. For full recommendation text, please refer to the full report.