New York State Energy Research and Development Authority

2012–13 CAIR Annual Report on the New York Battery and Energy Storage Technology Consortium

Issued October 2013

The New NY WORKS for Energy

nyserda
Energy. Innovation. Solutions.

Photo Courtesy of Paper Battery Company

Table of Contents

Executive Summary

Energy storage can play an important role in the reduction of nitrogen oxide (NOx) and greenhouse gases in two critical sectors – transportation and the electric grid. For instance, energy storage can recapture and then deploy energy lost during braking in vehicles and store electricity until needed on the electric grid. Energy storage can also mitigate the need for new fossil-fuel powered peaking plants used infrequently during the year, increase the use of intermittent renewable energy sources, and enable distributed generation to island from the electric grid during an outage.

The New York Battery and Energy Storage Technology Consortium™ (NY-BEST) was established in 2009-10 to help position New York State as a global leader in energy storage technology for heavy-duty transportation, electric grid, and other storage applications. NYSERDA was charged with working with industry and academic partners to establish this industry-driven consortium, which is being seeded by NYSERDA with approximately $25 million through Clean Air Interstate Rule (CAIR) proceeds. NY-BEST is a New York State not-for-profit corporation and is managed by a 17-member Board of Directors elected by the NY-BEST membership. In 2010, Bill Acker was hired by the Board as Executive Director and Capitol Hill Management Services was hired to provide association management services to NY-BEST; these services continued in 2012-13.

NY-BEST has three primary strategies to build the energy storage industry in New York State: (1) facilitating product development and commercialization partnerships; (2) providing members with access to testing, characterization and prototyping capabilities; and (3) promoting research and development of energy storage technologies. This annual report is prepared pursuant to the Program Plan[1] developed with stakeholder input in 2009 and adopted by the NYSERDA Board of Directors and provides an update on NY-BEST progress, expenditures and results for the 15 months ending June 30, 2013. This 15-month report was provided to present a more complete update for the BEST Test and Commercialization Center (BTCC). NYSERDA priorities for NY-BEST during the next year are also included.

Metrics used to assess the progress of NY-BEST are included for NY-BEST Operations, Testing, Characterization, and Prototyping Capabilities, and Research and Development. Commercialization progress related to NY-BEST's activities is also presented. Funds are also budgeted for two independent, external evaluations of the NY-BEST initiative. These evaluations are planned after NY-BEST's third year of operations (covering through June 30, 2014) and again after the sixth year (covering through June 30, 2017).

Highlights during 2012-13 include:

- NY-BEST competitively selected DNV KEMA as the operations partner for the BTCC, which will begin operation at the Eastman Business Park in Rochester, NY in early 2014. NY-BEST will wholly-own the BTCC and any equipment purchased with New York State funds. DNV KEMA will staff and operate the facility, relocate an existing energy storage testing operation from Pennsylvania to Rochester, and invest up to $16 million in the BTCC. SWBR and LeChase Construction in Rochester were also competitively selected by NY-BEST as the Design and Construction Management firms, respectively.
- NY-BEST membership grew 8 percent during the past year to 124 companies and research institutions.
- NY-BEST held five conferences and seven webinars during 2013 with more than 900 participants in total. NY-BEST also represented New York State's energy storage industry at eight national conferences and participated in industry testing and development of performance standards.
- NY-BEST commissioned an Economic Impact Study for the energy storage industry in New York State and created a roadmap for advancing the sector in the State. The study found that the industry currently employs approximately 3,000 people within New York State and is responsible for more than $600 million in global product sales annually, and has the potential to grow to 10,000 or more jobs by the end of this decade and more than 30,000 jobs by 2030, commensurate with increases in product sales.[2]
- 93 percent of the $25.5 million in budgeted CAIR funds for the NY-BEST initiative have been expended, contracted, or committed. Included within this figure is a $4.350 million contract with NY-BEST to partially support operations and management which has been 44 percent expended.
- Non-NYSERDA funds earned by NY-BEST increased 43 percent from the prior year to $299,000 and unrestricted net assets (reserve funds) at NY-BEST were $226,000 at June 30, 2013, representing approximately 2.5 months of operating costs.
- Rochester Gas and Electric and New York State Electric and Gas each awarded NY-BEST $50,000 to identify key participants in the supply chain and manufacture of energy storage technologies and to assist NY-BEST in its marketing and outreach efforts.
- 31 NY-BEST research and development projects are underway including $9 million in NYSERDA CAIR funding and another $11.5 million in co-funding. 179 engineering, product development, and research staff and 19 graduate and undergraduate students are working on these projects. As of June 30, 2013, these projects have been presented 66 times at conferences and described in 30 publications. In addition, four patents have been filed and two licensing agreements to New York State startup companies have been executed.
- NY-BEST members that have presented at the NY-BEST investor conference in 2011 or 2012 have raised over $50 million.
- NY-BEST helped members with introductions to potential customers, facilitated product development and commercialization partnerships, helped members with funding applications and with investor pitches, and helped members understand and navigate financial and regulatory requirements for energy storage (described in the Commercialization Progress section).

CAIR Financial Information

Financial data through June 30, 2013 is presented in Table 1, which indicates that 93 percent of total budgeted CAIR funds has been expended or committed to a specific activity. No changes have been made to the budget since the prior year.

NY-BEST Operations

In December 2010, the NY-BEST Board hired Bill Acker to serve as Executive Director. The Board selected Capitol Hill Management Services to provide association management services and office space for NY-BEST in January 2011. John Cerveny was subsequently hired as Director of Resource Development in March 2011. These services continued during the year.

NY-BEST's objective is to build a vibrant energy storage sector in New York State. Reaching this objective involves providing support at various stages of the product development and commercialization pipeline and proactively helping to form partnerships. NY-BEST is helping to facilitate commercial introduction of energy storage technologies in New York State, building the human capital and expertise needed to sustain a vibrant commercial energy storage industry, and leveraging NYSERDA's seed resources to create a sustainable organization that provides value to its members and to New York State.

NY-BEST's operational measures and progress during the year are presented in this section.

1. Increase in the number of members and retention of existing members

Figure 1 shows that NY-BEST membership grew 8 percent to 124 members during the year and 133 percent since 2010. Appendix A presents a map of New York State members and Appendix B lists all members of NY-BEST as of June 30, 2013. The annual membership fee in NY-BEST has increased to $1,500 for corporate members; $1,000 for academic, government, and non-profit members; and $500 for start-up companies.

2. Progress toward reaching self-sufficiency

Table 2 presents sources and uses of funds by NY-BEST during 2012-13 and 2011-12. In total, $1,933,118 (or 44 percent) of the $4.350 million operating support contract between NYSERDA and NY-BEST has been expended. The remaining funds are expected to support a portion of NY-BEST's operations for another three to four years, with NYSERDA's contribution declining in later years.

Table 1. Budgeted and Committed CAIR Funds as of June 30, 2013.

Source: NYSERDA

	Budgeted	Expended/Committed [a]
NY-BEST Operations and Management [b]	$4,548,000	$4,429,898
Research and Development Awards	13,585,000	13,585,000
Technology Transfer	500,000	0
Testing and Characterization Capabilities	3,445,114	3,445,114
NYSERDA Administration [c]	2,211,000	1,732,828
Program Evaluation and Accountability	500,000	0
Brokerage Fees for NO_x Allowance Sales	266,736	266,736
New York State Cost Recovery Fee	443,000	164,585
Total	$25,498,850	$23,624,161

[a] *"Committed" includes funds already expended and those that have been committed for specific initiatives.*

[b] *A contract between NYSERDA and NY-BEST comprises $4.350 million of this amount to partially support NY-BEST's operations over approximately five to seven years as it works toward self-sufficiency.*

[c] *"NYSERDA Administration" includes the development, implementation and administration of the NY-BEST initiative including managing the research and development solicitation process and awards.*

Figure 1. Growth in NY-BEST Membership 2010 to 2013.

Source: NY-BEST reports

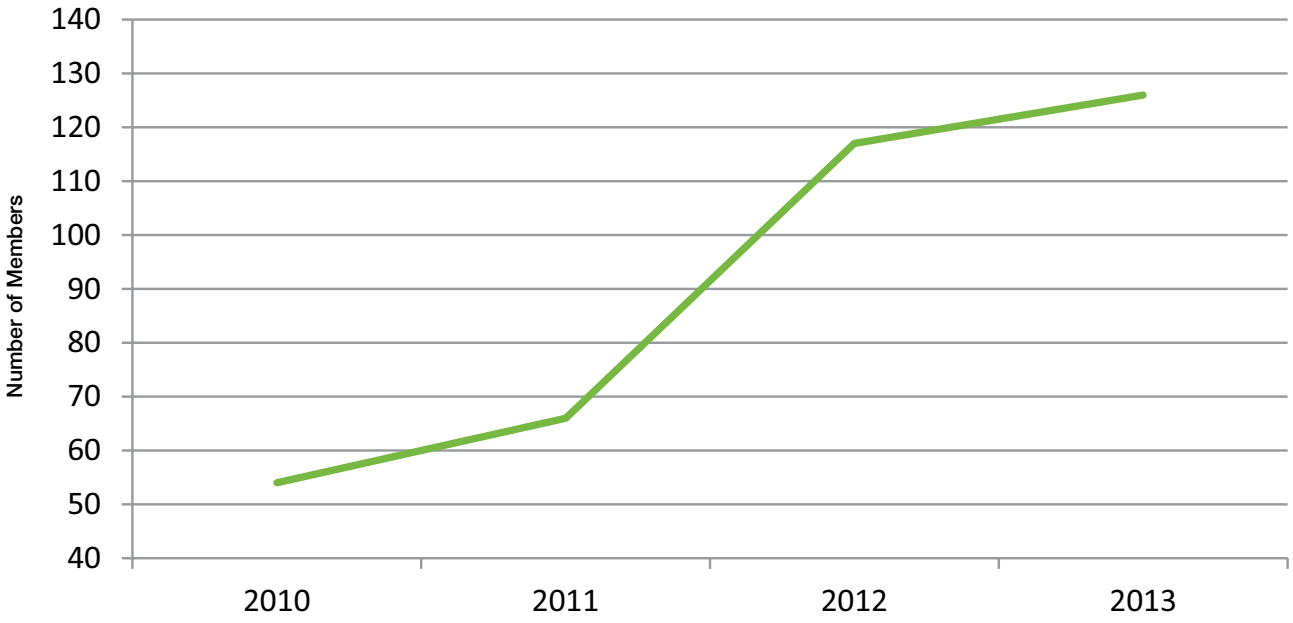


Table 2. NY-BEST Financial Summary (Accrual Basis) for the years ended June 30, 2013 and June 30, 2012.

Source: NY-BEST Financial Reports

	June 30, 2013	June 30, 2012	$ Change	% Change
SOURCES OF FUNDS:				
Membership Dues	$110,205	$85,416	$24,789	29%
Conferences	$34,384	$29,865	$4,519	15%
Sponsorships	$61,445	$43,995	$17,450	40%
Non-NYSERDA Grants	$93,472	$49,862	$43,610	87%
NYSERDA Funds	$865,537	$718,941	$146,596	20%
TOTAL REVENUE	$1,165,043	$928,079	$236,964	26%
USES OF FUNDS:				
Labor	$309,992	$306,154	$3,838	1%
Association Management	$298,320	$263,920	$34,400	13%
Professional Services [a]	$301,376	$133,501	$167,875	126%
Conferences	$81,767	$79,022	$2,745	3%
Travel	$36,797	$37,097	-$300	-1%
Other Expenses	$53,913	$60,853	$6,940	-11%
TOTAL EXPENSES	$1,082,166	$880,547	$201,619	23%
CHANGE IN NET ASSETS	$82,877	$47,532	$35,345	74%

[a] *Includes legal, accounting, marketing and other professional services for NY-BEST and the BEST Test and Commercialization Center.*

As shown in Figure 2, non-NYSERDA funds earned by NY-BEST continue to increase and are used to cover operating costs and build a reserve fund to enable a smooth transition to sustainability. The goal is for NY-BEST to have one year's worth of operating cash on hand as reserves when the NYSERDA operating funds are exhausted. At June 30, 2013, total unrestricted net assets (essentially reserve funds) was $226,000 which represents approximately 2.5 months of operations.

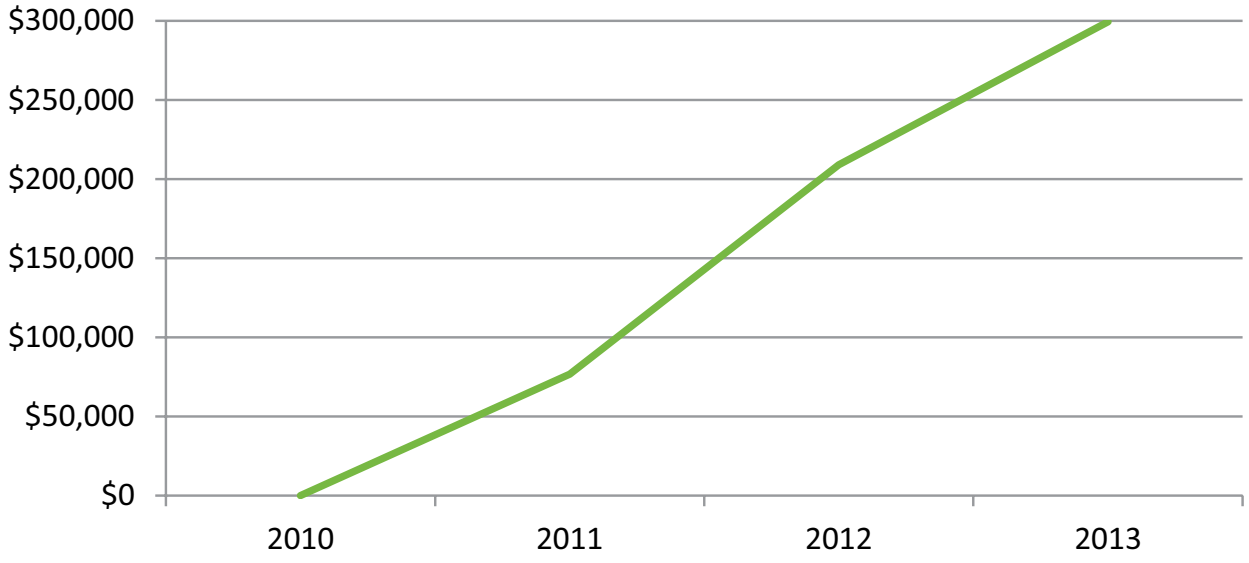
NY-BEST continues to seek outside funding. Rochester Gas and Electric and NYS Electric and Gas each awarded NY-BEST $50,000 during the year to identify key participants in the supply chain and manufacture of energy storage technologies, and to support marketing and outreach to increase use of in-state companies within the energy storage supply chain. The need for consistent, long-term financial support is a priority of NY-BEST as it works to become self-sufficient.

3. NY-BEST technology transfer activities during 2012-13 included:

- Held five conferences including: NY-BEST's Capture the Energy Annual Conference in Troy, NY, which was attended by 185 participants and included a two-day forum. NY-BEST also held three regional conferences: Energy Storage and MicroGrids in conjunction with the Pace Energy and Climate Center in New York City, a Regional Technology Conference in Rochester, NY, showcasing university technologies to industry, and a Regional Technology Conference in Albany, NY, in conjunction with the College of Nanoscale Science and Engineering. A total of 292 people attended these three conferences. NY-BEST's second annual Investor's Conference was held in New York City and featured startup companies pre-screened for readiness to approach investors with NY-BEST staff coaching companies on their strategy, messaging, and materials. Participating companies, firms, and initial indicators of follow-on funding are described within the Commercialization Progress section. All conferences were rated highly by attendees.
- Held seven webinars attended by a total of 400 individuals:
    - o U.S. Patent Law and Intellectual Property Law.
    - o Major Events from 2012 in the Industry and 2013 Outlook.
    - o Funding Opportunities.
    - o A Closer Look at Installed Energy Storage Projects on the Grid.
    - o The Roadmap for Energy Storage in New York State.
    - o Energy Storage at the Edge of the Grid.
    - o Smart Grid 2.0.
- Promoted NY-BEST and New York State's energy storage sector at eight national conferences including sponsoring and organizing the energy storage track at Advanced Energy 2013 in New York City, the Electricity Storage Association annual conference in California, Energy Storage Week in Texas, the New York Times Energy for Tomorrow conference in New York City, RETECH in Washington, D.C., NAATBatt's annual conference in Texas, the Utility of the Future Conference in Washington, D.C., and multiple Agrion energy storage conferences.

Figure 2. Total Non-NYSERDA Annual Revenue.

Source: NY-BEST Financial Reports



- Participated in developing industry testing and performance standards for energy storage products including testing protocols developed by Pacific Northwest National Lab and the U.S. Department of Energy, the International Electrochemical Commission Technical Committee for Energy Storage Systems, and the ACORE (American Council on Renewable Energy) Transportation Advisory Board.
- Redesigned the NY-BEST website and issued the NY-BEST E-News Distribution approximately twice each month including member highlights, research and commercialization highlights, and research and procurement funding opportunities for members. The e-news distribution increased to 1,160 subscribers as of June 30, 2013, which is a 30 percent increase over the previous year.
- Conducted an economic impact study of New York's energy storage industry and developed a Roadmap for the energy storage sector in New York State. The economic impact study evaluated the current energy storage industry in New York State and potential for growth and found that the sector currently employs approximately 3,000 in New York State and is responsible for global product sales of $600 million annually. Growth projections indicated up to 10,000 or more jobs could comprise New York State's energy storage sector by the end of this decade and more than 30,000 jobs by 2030. To capitalize upon this potential, NY-BEST convened stakeholders and prepared a New York State Energy Storage Roadmap to leverage New York's strengths in research, development, manufacturing, and markets for the electric grid and transportation sectors. Specifically, the Roadmap recommended stakeholders in New York from established and start-up companies, academia, research institutes, government, and end users work together to pursue three major goals:
    - o Establish robust New York markets for energy storage through appropriate technologies, policies and incentives.
    - o Create value chain clusters of companies comprised of suppliers, material and component manufacturers, system integrators, and product manufacturers to provide the manufacturing capabilities necessary to grow the sector in New York State and support global markets.
    - o Continue New York's technology leadership and stimulate commercialization of advanced technologies through research and development, collaboration and leveraging resources.
- Commercialization progress at NY-BEST members supported directly by NY-BEST staff is included in the Commercialization Progress section below.

Testing, Characterization, and Prototyping Capabilities

One of NY-BEST's key initiatives is helping companies and researchers access testing, characterization, and prototyping capabilities. These initiatives include leveraging existing assets and establishing a product commercialization center, known as the BEST Test and Commercialization Center (BTCC), to allow companies, researchers, and customers to test and validate new energy storage technologies for electric grid, transportation, and other applications. These capabilities are typically cost-prohibitive for any single entity to procure and maintain, and are not available in close geographic proximity.

In 2011, NY-BEST was awarded $3.5 million through the Finger Lakes Regional Economic Development Council to establish the BTCC at Eastman Business Park in Rochester. This award included $1 million from Empire State Development and $2.5 million from NYSERDA in System Benefits Charge funding, in addition to the $3.4 million in CAIR funds. The BTCC will provide unique testing and validation capabilities to evaluate new energy storage technologies from individual cells to megawatt sized systems in operation. The BTCC will be a wholly-owned subsidiary of NY-BEST and lease 17,000 square feet of space in Building 308 at the Eastman Business Park.

During the past year, NY-BEST issued a Request for Qualification and Quotation to select an operating partner for the BTCC. A competitive process was used including a steering committee to review proposals against established criteria, make recommendations to the NY-BEST Board of Directors, and then pursue contract negotiations. DNV KEMA Energy & Sustainability, a global energy consulting company with more than 2,300 experts specializing in energy testing, inspection and certification was selected by NY-BEST as the operating partner for the facility.[3] As part of this agreement, which was executed in August 2013, NY-BEST will wholly-own the BTCC as well as any equipment purchased with New York State funds.[4] DNV KEMA will staff and operate the BTCC, relocate an existing energy storage testing operation from Pennsylvania to Rochester, and invest up to $16 million in the BTCC. The initial five-year contract term is renewable based upon performance and provides for revenue sharing back to NY-BEST.

In addition, SWBR and LeChase Construction in Rochester, NY, were competitively selected by NY-BEST as the Design and Construction Management firms, respectively. Equipment has been identified and is being ordered, design work is nearing completion, and construction is scheduled to begin in Fall 2013 with the facility opening in early calendar year 2014.

Metrics that will be used to evaluate the BTCC and reported in next year's annual report include:

- Utilization by members of NY-BEST and by non-members and fees generated.
- Jobs at the BTCC such as technicians and equipment operators.
- Changes in Technology Readiness Levels and Manufacturing Readiness Levels for technologies examined at the BTCC.
- Commercialization success of products tested at the BTCC.

NY-BEST Research and Development

NYSERDA awards and manages all research and development funding using NYSERDA's established solicitation process with input from the energy storage community and NY-BEST. These awards complement NYSERDA's existing energy storage programs by focusing on transitioning new energy storage technologies with proven technical feasibility into working prototypes.

In total, 31 NY-BEST research and development projects have been awarded and are in varying stages of completion. In total, these projects include $9 million from NYSERDA in CAIR funding and $11.5 million in award recipient co-funding. A few projects awarded previously, including a large project with Ultralife Corporation, have not moved forward due to changes in company focus and are not presented in the section. NYSERDA funds previously committed to these cancelled projects will be used to fund new NY-BEST R&D projects.

Metrics used to evaluate research and development awards include publications, presentations at technical and business conferences, invention disclosures and patents, licensing agreements executed and licensing revenue, additional research funding received, research and development jobs supported, recognition awards and significant research accomplishments, and commercialization progress. In total, through June 30, 2013, these projects have been presented 66 times at conferences and described in 30 publications. In addition, four patents have been filed, two licensing agreements to startup companies have been executed, and 179 researchers, engineers and other staff as well as 19 graduate students are working on these projects.

The following 16 projects were awarded in March 2010 under Program Opportunity Notice 1704, which supported seed stage and product development projects:

- Binghamton University (Dr. Stan Whittingham) is pursuing a lithium air energy storage system that could develop low cost energy storage for vehicles and stationary applications.

  NYSERDA funding: $200,000 | Budgeted co-funding: $55,512

  Status: Ongoing; work has been presented at 10 events and included in four publications.

- Brookhaven National Laboratory (Dr. Feng Wang), Binghamton University (Dr. M. Stan Whittingham), and Stony Brook University[5] (Dr. Esther Takeuchi) are partnering on three projects to develop improved batteries for lower cost electric grid storage including lithium-air, lithium-ion and lithium-titanate batteries. These batteries could help increase efficiency on the electric grid by better integrating renewable energy and storing energy for peak demand.

  NYSERDA funding: $682,464 | Budgeted co-funding: $447,000

  Status: Ongoing; this work has been presented at 33 conferences and events and described in 10 publications.

- Cerion Enterprises (Rochester, NY) is developing nanoparticle materials for next-generation lithium-ion batteries, which could make the batteries smaller and lighter, which is important for transportation applications.

  NYSERDA funding: $200,000 | Budgeted co-funding: $151,072

  Status: Ongoing; work has been presented at one event, in one publication, and resulted in three patent filings.

- City University of New York (Dr. Sanjoy Banerjee) is developing a low-cost, nickel-zinc flow battery that could be used in hybrid electric vehicles.

  NYSERDA funding: $200,000 | Budgeted co-funding: $50,000

  Status: Ongoing; this work has also leveraged almost $2 million in ARPA-E and National Science Foundation funding and has been licensed to Urban Electric Power, a startup company.[6]

- City University of New York (Dr. Stephen O'Brien) worked with Columbia University to develop metacapacitors using a printable material to create high-voltage, high-energy, and high-power density capacitors for energy storage.

  NYSERDA funding: $149,597 | Co-funding: $1,649,865 including an ARPA-E award

  Status: Completed; a $1.6 million ARPA-E award was received. The technology was promoted in four presentations and seven publications. Excellent material deposition was achieved and this technology may also have application in LED lighting.

- E2TAC at the College of Nanoscale Science and Engineering (CNSE) at University at Albany (Dr. Pradeep Haldar and Dr. Manisha Rane-Fondacaro) developed new electrolytes to improve performance of ultracapacitors.

  NYSERDA funding: $200,000 | Co-funding: $116,263

  Status: Completed. Eonics, a startup company, was formed to commercialize this technology and has attracted more than $3.5 million in grants and investments. Six presentations were made and the technology was described in two publications. The protic ionic liquid electrolytes that were developed yielded more than 4 volts and increased by four-times energy and power density, and a novel salt was identified that exhibited promising conductivity and voltage for lithium-ion capacitors.

- Cornell University (Dr. Emmanuel Giannelis) developed non-flammable battery electrolytes with improved safety and performance.

  NYSERDA funding: $200,000 | Co-funding: $213,652

  Status: Completed. Electrolytes were developed with desirable properties over a temperature range of -20° to 65°C and lithium-ion cells were formed to demonstrate performance with this technology. The results are encouraging for further development.

- General Electric Co. (Schenectady, NY), under the largest NY-BEST R&D award made under this first funding round, is partnering with Alfred University, Clarkson University, Columbia University, and Stony Brook University to explore enhancements to the next generation of its sodium-metal halide batteries for uninterruptible power backup systems, electric grid applications, and heavy-duty transportation.

  NYSERDA funding: $2,500,000 | Budgeted co-funding: $2,994,000

  Status: Ongoing; this work has been presented at two conferences. GE continues recruiting machine operators for its new $170 million battery plant to manufacture these batteries, which will employ 450 at full capacity.[7]

- General Motors (previously in Honeoye Falls, NY, and now in Detroit, MI), in conjunction with Cornell University evaluated new materials for improved lithium-ion battery electrodes for automotive applications to increase performance and reduce cost.

  NYSERDA funding: $150,922 | Co-funding: $67,581

  Status: Completed. Organic cathode materials were evaluated and silicon nanowires were studied for anode electrodes. Although neither solution proved effective for automotive uses, a provisional patent was filed for the underlying technology, which was transferred to Cornell University and may be sublicensed for other applications.

- Hollingsworth & Vose, Co. (Easton, NY) explored a new advanced separator for more efficient valve-regulated lead-acid batteries used in start-stop hybrid electric vehicles.

  NYSERDA funding: $119,965 | Co-funding: $85,951

  Status: Completed. The new separators did not show adequate performance improvements to justify their cost and the project was terminated. The company is exploring other promising separator materials.

- Impact Technologies (Rochester, NY) explored a novel method to increase the lifetime of batteries by assessing battery health through in-cell measurement techniques.

  NYSERDA funding: $99,766 | Co-funding: $27,115

  Status: Completed. The results were presented at two conferences and are continuing to be evaluated. The company continues to grow and has received over $3 million in outside investment.

- Ioxus (Oneonta, NY) in conjunction with CUNY is exploring enhancements to its ultracapacitors by developing a novel electrode-electrolyte interface.

  NYSERDA funding: $200,000 | Budgeted co-funding: $200,000

  Status: Ongoing; the work has been presented at two conferences. Ioxus continues to grow now employing over 50 staff at its new manufacturing facility in Oneonta and having raised over $21 million in venture capital.[8]

- Rensselaer Polytechnic Institute (Dr. Nikhil Koratkar) developed nano-engineered silicon based electrodes that could enable greater power and energy density and reduce the cost of lithium-ion batteries.

  NYSERDA funding: $200,000 | Co-funding: $424,179

  Status: Completed. Received a $396,000 National Science Foundation grant and the work was presented at one conference and published twice. Scalable silicon structures were built and tested as anode materials for next generation, high performance lithium ion batteries. Further research is being explored to optimize these results.

- Rochester Institute of Technology (Dr. Gabrielle Gaustad) is evaluating methods that can help recycle and reuse lithium-ion batteries to minimize landfill waste and maximize reclamation.

  NYSERDA funding: $195,869 | Budgeted co-funding: $157,200

  Status: Ongoing; the project has been presented five times and described in two publications.

The second research and development solicitation issued by NYSERDA (PON 2458) is using the remaining R&D funds to transition energy storage technologies with proven technical feasibility at the lab scale into working prototypes to assess whether the technology has commercial potential. Demonstrating a working prototype is an important stage that can interest additional funders including private capital. Five proposal due dates are included in this solicitation over the next two years to allow effective partnerships to form and enable applicants to adequately plan within their organization's budget cycles. These awards are funded at up to $250,000 in NYSERDA funds over up to two years.

Eight awards were made in July 2012 under Round 1 of PON 2458 and are in various stages of completion:

- Custom Electronics Inc. (Oneonta, NY) is developing a graphene electrolytic capacitor comprised of a single sheet of carbon that has unique electrical and physical properties. Such a capacitor may provide extra energy to ride through momentary electric fluctuations or interruptions on the electric grid.

  NYSERDA funding: $250,000 | Budgeted co-funding: $250,000

  Status: Ongoing.

- E2TAC at CNSE (Dr. Pradeep Haldar) is exploring an ionic liquid electrolyte that will enhance lithium-ion capacitors for improved short-term energy storage in hybrid vehicles and power electronics.

  NYSERDA funding: $249,979 | Budgeted co-funding: $251,170

  Status: Ongoing.

- GE Energy Storage (Schenectady, NY) and Raymond Corporation (Greene, NY) will develop an electric forklift for freezer warehouses using GE's Durathon batteries, which could replace conventional lead-acid batteries which degrade quickly in cold temperatures.

  NYSERDA funding: $250,000 | Budgeted co-funding: $504,966

  Status: Contract is in development.

- Graphene Devices Ltd. (Williamsville/Rochester, NY) is developing graphene-based high energy ultracapacitors that could hold three times the energy density of current commercial devices at the same cost, and be used in smart grid devices and hybrid vehicles.

  NYSERDA funding: $250,000 | Budgeted co-funding: $250,000

  Status: Ongoing.

- Ioxus (Oneonta, NY) is further developing their advanced ultracapacitors that can store regenerated braking energy in vehicles and be used for grid applications such as pitch control in wind turbines.

  NYSERDA funding: $250,000 | Budgeted co-funding: $254,000

  Status: Ongoing.

- Paper Battery Co. (Troy, NY) is developing a production prototype of its thin and flexible ultracapacitor to provide temporary backup power in computing applications, which could reduce the need for uninterruptable power supplies and associated cooling systems.

  NYSERDA funding: $250,000 | Budgeted co-funding: $318,000

  Status: Ongoing; the company has raised nearly $3.4 million in outside funding and was named to the 2013 TiE50, a Silicon Valley list for the 50 hottest early-stage tech companies.[9]

- Primet Precision Materials (Ithaca, NY) is developing a production process that could lower the manufacturing cost of key raw materials used in lithium-ion batteries.

  NYSERDA funding: $250,000 | Budgeted co-funding: $365,835

  Status: Ongoing; the company was named one of the 50 most promising privately-held New York Green Tech companies in 2012 by Green Capital Empire.[10]

- Urban Electric Power (New York City) is developing a megawatt-hour battery for peak power reduction using a novel "flow-assisted" zinc battery with an advanced battery management system.

  NYSERDA funding: $249,847 | Budgeted co-funding: $249,847

  Status: Ongoing; the company is a startup from CUNY that has raised more than $2 million from investors and is building a research and assembly facility in West Harlem.[11]

Seven awards were made in February 2013 under Round 2 of PON 2458 and are just beginning:

- Battery Energy Storage Systems (BESS) Technologies (Albany, NY) is a start-up company from the SUNY College of Nanoscale Science and Engineering (CNSE). BESS Technologies will collaborate with CNSE and Rensselaer Polytechnic Institute on this project to develop a graphene-based electrode for lithium-ion batteries that can store more energy and charge faster than those currently deployed.

  NYSERDA funding: $218,000 | Budgeted co-funding: $218,000

- Bettergy Corp. (Peekskill, NY) will improve and demonstrate a low-cost zinc air-flow battery that could be used for grid storage applications.

  NYSERDA funding: $189,000 | Budgeted co-funding: $189,000

- Custom Electronics (Oneonta, NY) will develop an ultracapacitor with increased energy storage potential to provide short bursts of power over very long lifetimes for industrial power electronic applications and hybrid vehicles.

  NYSERDA funding: $250,000 | Budgeted co-funding: $257,300

- Eos Energy Storage (New York City), in conjunction with Consolidated Edison, will scale-up a novel zinc battery with low-cost, high energy-density and an inherently safe design to defer expensive electric grid distribution system upgrades and enhance power quality and grid resiliency.

  NYSERDA funding: $250,000 | Budgeted co-funding: $386,149

- NOHMS Technologies (Ithaca and Rochester, NY) will develop and test a new prototype for longer-lasting mobile phones.

  NYSERDA funding: $250,000 | Budgeted co-funding: $250,000

- UTS Engineering (formerly Electromotive Designs) (Ronkonkoma, NY) will develop a low-cost, easily-installed hybrid-electric add on system to recapture braking energy in buses and trucks using ultracapacitors manufactured by Ioxus in Oneonta, NY. Verizon will test the system.

  NYSERDA funding: $249,980 | Budgeted co-funding: $315,740

- Watt Fuel Cell Corp. (Port Washington, NY) will build a prototype capable of providing electricity and heat from a portable solid-oxide fuel cell for military applications and backup power during electric grid outages.

  NYSERDA funding: $249,704 | Budgeted co-funding: $812,696

Commercialization Progress

Commercialization progress for members of NY-BEST is measured by outside funding received including government grants and private investment, product sales and new products launched, licenses executed and licensing revenue, cost savings, capital expenditures, and jobs created and retained. Energy, economic, and environmental benefits realized by utilizing energy storage will also be assessed as part of the independent evaluations conducted in 2014-15 and 2017-18. Commercialization progress related to research and development awards is included in the NY-BEST Research and Development section above.

This section presents commercialization progress at NY-BEST members who were assisted by NY-BEST's staff during the year. This assistance included introductions to new partners, facilitating product development and commercialization partnerships, helping with investor pitches, identifying funding opportunities, and helping members understand and navigate financial and regulatory requirements for energy storage. In part, as a result of these activities NY-BEST members have achieved the following results:

- Investor Funding: In addition to advising and providing introductions and coaching throughout the year, NY-BEST helped eight member companies prepare for presentations at the NY-BEST Investor Conference on October 11, 2012. Attendees numbered approximately two dozen venture capital, angel and institutional investor firms including GE's investment arm, Kleiner Perkins, and Braemar Energy Ventures. While many of these relationships and negotiations take time to solidify, several NY-BEST members that have presented at a NY-BEST investor conference in 2011 or 2012 have raised funding in the past year including Eos ($15 million Series B round), Ambri ($15 million Series B round), Ioxus ($15 million Series C round), ACAL Energy ($4.3 million), MicroGen Systems ($2.6 million) and NOHMs (second round funding closed but undisclosed). Other funding efforts are in due diligence and/or not publicly disclosed.

- Grant Funding: NY-BEST routinely provides advice and guidance for member companies in their funding applications and worked closely with over two dozen members to identify specific grant funding opportunities and help them prepare, edit, review and submit more than 50 applications to federal, New York State and non-profit organizations during the year. A number of these were subsequently selected for funding including: NOHMs (a Phase II NSF SBIR of $500,000 and three Phase I SBIRs from NSF, NIH and DARPA) and H2 Pump ($500,000 from the U.S. Department of Energy). Both NOHMs and Urban Electric Power also received New York State funding through the Consolidated Funding Application (CFA) process totaling over $3 million to build manufacturing facilities for their products.

  "NY-BEST provided detailed guidance, introductions and assistance as Eos applied for funding to a number of opportunities over the past year, including state and federal sources that have resulted in over $1.25 million in awards with an additional $1 million request pending."

  - Phillippe Bouchard, Vice President of Business Development at Eos Energy Storage

  (Eos Energy Solutions is developing a low-cost, zinc-air energy storage solution for electric utility and transportation applications.)

- Facilitating R&D and Product Development Partnerships: NY-BEST plays an active role forging new partnerships among members through direct introductions and by providing numerous face-to-face networking opportunities throughout the year. Direct introductions between companies related to product development and R&D occurred 28 times over the past year. Important introductions were made for battery developers to companies in the supply chain to provide key materials, processing and/or expertise needed to move their products from the prototype stage into production. Examples where NY-BEST facilitated introductions include connecting a metals forming company to the developer of a novel battery system that promises to deliver a core subcomponent at a lower price and higher quality than existing suppliers; for a battery maker to a multinational global leader with advanced materials processing capability to facilitate moving their battery from bench top to full commercial scale production; and helping an emerging battery maker identify funding and source production equipment and partners to set up initial manufacturing.

  "NY-BEST facilitated our introductions to DNV KEMA and Raymond Corporation (an electric lift truck manufacturer in Greene, NY) who are both helping us to better understand energy storage markets and tailor our products to meet customer needs."

  - Valerio De Angelis, Interim CEO at Urban Electric Power

  (Urban Electric Power is a spin-out from the CUNY Energy Institute and is developing novel, low-cost batteries for grid-scale storage.)

- Technical and Business Guidance/Early Stage Mentoring: In the past year, NY-BEST provided more than two dozen established and start-up companies with substantive and, often, ongoing technical and business guidance. These companies included American Vanadium, Brentronics, Con Edison, Convergent Power, Cubit Power, Demand Energy Networks, Eos Energy, Evgentech, General Compression, GE, Green Charge Networks, Joule Assets, the Metropolitan Transportation Authority, MicroOrganic Technology, NOHMs, Paper Battery Company, Standard Hydrogen, Subway Labs, Triple Point Energy, and Tumalow.

This advising and services spanned areas as diverse as business development and market entry strategies to connections to resource providers in legal, financial, technical and manufacturing arenas. Evidence of the outcomes is best measured in the continued growth of the NY-BEST membership and success of individual companies through product sales and new jobs which will be collectively captured beginning next year through an annual member survey.

> *"We have business activity in several regions, and we rely on the team at NY-BEST to keep us apprised of local issues and market activity for our New York operation. Their support on legislative and regulatory issues has helped us in our application and petition filings and we depend on their perspective to present a unified front for the membership as they respond to various government offices and activities.[12] We see them as a key voice for the support of energy storage and helping New York become the regional leader in the emerging transactive energy market."*
>
> - Doug Staker, Vice President of BusinessDevelopment and International Sales at Demand Energy Networks
>
> (Demand Energy Networks provides customer-sited energy storage systems and recently commissioned one of the first such systems in New York City.)

Priorities During the Next Year

The upcoming year is NY-BEST's third year of operations with their full staffing team in place and is a pivotal year in NY-BEST's growth as the BEST Test and Commercialization Center is completed and begins operation. NYSERDA's priorities for NY-BEST during 2013-14 include:

- Successfully commissioning the BTCC, maintaining a high level of utilization of the facility, and helping members bring new profitable energy storage products to market.
- Continuing to build a self-sustaining organization and contributing to a thriving energy storage industry in New York State measured by financial success at NY-BEST, employment and sales growth at members, and greater numbers of companies participating in the energy storage value chain in New York State.
- Helping to forge new product development and commercialization partnerships between researchers, startup companies, larger established firms, and end users to leverage each other's strengths to grow their respective operations.
- Expanding partnerships with federal agencies to leverage NYSERDA's investment and support targeted initiatives to grow New York State's energy storage sector.
- Playing an active role in helping to shape testing protocols and standards that will allow validation and demonstration of new energy storage technologies and enable more rapid market adoption.

References

1 http://www.nyserda.ny.gov/Energy-Innovation-and-Business-Development/Research-and-Development/Advanced-Clean-Power/-/media/Files/EIBD/Research/Power%20Systems/CAIR%20Plan.ashx

2 NY-BEST Energy Storage Market Study and Roadmap, 2012

3 Governor Cuomo Announces Global Energy Company to Relocate Clean Energy Storage Testing Center to Eastman Business Park, http://www.nyserda.ny.gov/About/Newsroom/2013-Announcements/2013-07-23-Governor-Cuomo-Announces-Global-Energy-Company-to-Relocate-to-Eastman-Business-Park.aspx

4 A reversionary interest precludes title to equipment purchased with NYSERDA funds from transferring to NY-BEST until specific revenue and usage targets are reached in the future.

5 The Stony Brook award transferred from University at Buffalo when the Principal Investigator accepted a position at Stony Brook/Brookhaven National Lab.

6 http://www1.cuny.edu/mu/forum/2012/05/07/cuny-energy-institute-battery-system-could-reduce-buildings-electric-bills/

7 http://www.bizjournals.com/albany/blog/2012/07/inside-ges-schenectady-battery-plant.html?page=all and http://www.timesunion.com/business/article/GE-plant-to-double-down-3697727.php

8 http://www.wbng.com/news/local/Only-US-Ultracapacitor-Manufacturer-Opens-New-Oneonta-Facility-125990298.html

9 Paper Battery Co. of Troy wins Silicon Valley hot 50 tech startup honor, http://www.bizjournals.com/albany/morning_call/2013/05/paper-battery-co-of-troy-ny-wins.html

10 Primet Precision Named a Top Green Company, http://primetprecision.com/primet-precision-named-a-top-green-company/

11 Taking Battery Technology from the Lab to the Big City, http://energy.gov/articles/taking-battery-technology-lab-big-city and Urban Electric Power Takes Energy Storage from Startup to Grid-Scale, http://energy.gov/articles/urban-electric-power-takes-energy-storage-startup-grid-scale and Urban Electric Power, NYSERDA, CUNY Announce Grand Opening of New West Harlem Rechargeable Battery Manufacturing Plant, http://www.nyserda.ny.gov/About/Newsroom/2013-Announcements/2013-08-06-Grand-Opening-of-New-West-Harlem-Rechargeable-Battery-Manufacturing-Plant.aspx

12 All legislative activities performed by NY-BEST are paid entirely from non-NYSERDA funds.

Appendix A. Map of NY-BEST Members in New York State

Appendix B. NY-BEST Members as of June 30, 2013

1. A123 Systems ... *Westborough, MA*
2. Active Signal Technologies, Inc. ... *Linthicum, MD*
3. AES Energy Storage ... *Arlington, VA*
4. Alfred University ... *Alfred, NY*
5. Alliance for Clean Energy New York (ACE NY) ... *Albany, NY*
6. Altek Fuel Group Inc. ... *Brooklyn, NY*
7. Ambri ... *Cambridge, MA*
8. American Aerogel Corporation ... *Rochester, NY*
9. American Vanadium Corp. ... *Vancouver, BC (Canada)*
10. AppliedLogix LLC ... *Fairport, NY*
11. Arista Power ... *Rochester, NY*
12. Arnold Magnetic Technologies ... *Rochester, NY*
13. Ascension Industries Inc. ... *North Tonawanda, NY*
14. BAE Systems Controls ... *Johnson City, NY*
15. Battery Research, Inc. ... *Oswego, NY*
16. Beacon Power LLC ... *Tyngsboro, MA*
17. Bess-Tech ... *Albany, NY*
18. Bettergy Corp. ... *Peekskill, NY*
19. Binghamton University, SUNY ... *Binghamton, NY*
20. BlueStream ... *Port Washington, NY*
21. Braemar Energy Ventures ... *New York, NY*
22. Bren-Tronics Inc. ... *Commack, NY*
23. Brookhaven National Laboratory ... *Upton, NY*
24. Buffalo Niagara Enterprise ... *Buffalo, NY*
25. Central Hudson Gas & Electric ... *Poughkeepsie, NY*
26. Cerion Enterprises ... *Rochester, NY*
27. City University of New York ... *New York, NY*
28. Clarkson University ... *Potsdam, NY*
29. Columbia University ... *New York, NY*
30. Combined Energies LLC ... *Latham, NY*
31. Consolidated Edison Company of New York, Inc. ... *Staten Island, NY*
32. CooperHill ... *Albany, NY*
33. Cornell University ... *Ithaca, NY*
34. Corning Incorporated ... *Corning, NY*
35. Cubit Power Systems ... *Ottawa, ON (Canada)*
36. Curtis Instruments, Inc ... *Mount Kisco, NY*
37. Custom Electronics, Inc. ... *Oneonta, NY*
38. Customized Energy Solutions ... *Endicott, NY*
39. Dayton T. Brown, Inc. ... *Bohemia, NY*
40. Direct Gain Consulting LLC ... *Stone Ridge, NY*
41. DNV-KEMA, Inc. ... *Fairfax, VA*
42. E2TAC at the College of Nanoscale Science & Engineering, SUNY ... *Albany, NY*
43. Eastman Kodak ... *Rochester, NY*
44. ECG Consulting Group, Inc. ... *Latham, NY*
45. Electric Vehicle Institute ... *Baltimore, MD*
46. ElectroMotive Designs LLC ... *Ronkonkoma, NY*
47. Electrovaya ... *Malta, NY*
48. ENrG Incorporated ... *Buffalo, NY*
49. Entropy Solutions, Inc. ... *Plymouth, MN*
50. EOS Energy Storage ... *New York, NY*
51. Expansion Energy LLC ... *Tarrytown, NY*
52. Ferric Semiconductor ... *New York, NY*
53. G4Synergetics ... *East Setauket, NY*
54. General Electric ... *Schenectady, NY*
55. Genesse County Economic Development Center ... *Batavia, NY*
56. Graphene Devices ... *Williamsville, NY*
57. Green Charge Networks ... *Brooklyn, NY*
58. H2Pump ... *Latham, NY*
59. Heslin Rothenberg Farley & Mesiti PC ... *Albany, NY*
60. Hoffman Warnick LLC ... *Albany, NY*
61. Hollingsworth & Vose ... *Greenbush, NY*
62. Hydrogenics Corporation ... *Mississauga, ON (Canada)*
63. Hylie Products, Inc. ... *Watertown, CT*
64. ICL-IP America, Inc. ... *Ardsley, NY*
65. Ideal Power Converters ... *Spicewood, TX*
66. Intertek Testing Services NA, Inc. ... *Albany, NY*
67. Ioxus, Inc. ... *Oneonta, NY*
68. Joule Assets ... *Bedford Hills, NY*
69. LeChase Construction Services ... *Rochester, NY*
70. Long Island Forum for Technology ... *Bethpage, NY*
71. Long Island Power Authority ... *Uniondale, NY*
72. Mesha, LLC ... *Williamsville, NY*
73. Microgen Systems, LLC ... *West Henrietta, NY*
74. Momentive Performance Materials ... *Albany, NY*
75. Nace Electric LLC ... *La Center, KY*
76. National Grid ... *Westborough, MA*
77. New World Capital Group ... *New York, NY*
78. New York Institute of Technology ... *New York, NY*
79. New York State Electric & Gas ... *Binghamton, NY*
80. Nohms Technologies ... *Ithaca, NY*

81. Northeast Transportation Electrification Alliance . . . . . *New York, NY*
82. Northern Power Systems. . . . . *Barre, VT*
83. NSCscale. . . . . *Vestal, NY*
84. Oak-Mitsui Technologies LLC . . . . . *Hoosick Falls, NY*
85. O'Brien & Gere. . . . . *Albany, NY*
86. Primet Precision Materials, Inc. . . . . *Ithaca, NY*
87. RBC Technologies. . . . . *College Station, TX*
88. Rensselaer Polytechnic Institute . . . . . *Troy, NY*
89. Ricochet Public Relations . . . . . *New York, NY*
90. Rochester Gas and Electric . . . . . *Rochester, NY*
91. Rochester Institute of Technology. . . . . *Rochester, NY*
92. S&C Electric Company. . . . . *Chicago, IL*
93. Saft America, Inc. . . . . *Cockeysville, MD*
94. Samsung SDI. . . . . *San Jose, CA*
95. Schenectady County Community College . . . . . *Schenectady, NY*
96. Sendyne Corp. . . . . *New York, NY*
97. Sentient Corporation . . . . . *Idaho Falls, ID*
98. SiGNa Chemistry, Inc. . . . . *New York, NY*
99. Solid Cell, Inc.. . . . . *Rochester, NY*
100. Stony Brook University, SUNY . . . . . *Stony Brook, NY*
101. Subway Labs. . . . . *New York, NY*
102. Sun Catalytix. . . . . *Cambridge, MA*
103. SuperPower, Inc. . . . . *Schenectady, NY*
104. Sustainable Innovations . . . . . *Glastonbury, CT*
105. Syracuse University . . . . . *Syracuse, NY*
106. Tech City Properties, Inc. . . . . *Kingston, NY*
107. The Center for Economic Growth. . . . . *Albany, NY*
108. The Optimation-Kingsbury Companies . . . *Rochester, NY*
109. The Paper Battery Company . . . . . *Troy, NY*
110. The Raymond Corporation, Division of Toyota Industries . . . . . *Greene, NY*
111. Third Power. . . . . *Bedford, NY*
112. Toshiba . . . . . *New York, NY*
113. Tumalow . . . . . *Troy, NY*
114. Turner Construction . . . . . *Albany, NY*
115. Ultralife Corporation. . . . . *Newark, NY*
116. UniEnergy Technologies, LLC . . . . . *Mukilteo, WA*
117. Unifrax I LLC . . . . . *Niagara Falls, NY*
118. United Technologies Research Center . *East Hartford, CT*
119. University of Rochester. . . . . *Rochester, NY*
120. Urban Electric Power Incorporated. . . . . *New York, NY*
121. Veeco. . . . . *Plainview, NY*
122. Watt Fuel Cell . . . . . *Port Washington, NY*
123. Widetronix, Inc.. . . . . *Ithaca, NY*
124. Xtreme Power . . . . . *Austin, TX*

Appendix C: NY-BEST Board of Directors

The NY-BEST Board of Directors is elected by the NY-BEST membership and represents industry, the research community, end users, and government partners. Board terms are designed so that half the board seats are up for election each year to allow for continuity and member engagement.

Michael Field (Chairman of the NY-BEST Board)
President, Operations & Engineering Division, Raymond Corporation

Glen Merfeld (Vice Chair)
Manager, Chemical Energy Systems Laboratory, GE Global Research

M. Stanley Whittingham (Vice Chair)
Director of the Institute for Materials Research and Professor of Chemistry, Binghamton University

Catherine Hill (Vice Chair)
Partner, CooperHill LLC

Paul F. Mutolo (Secretary/Treasurer)
Director of External Partnerships, Energy Materials Center at Cornell University

Aubrey Braz
Vice President, Consolidated Edison Company of New York

Victor Cardona
Partner, Heslin Rothenberg Farley & Mesiti PC

Richard Fioravanti
Director of Storage Applications and Support, KEMA, Inc.

Fernando Gómez Baquero
Co-founder and CEO, BESS Technologies

Robert Mendenhall
Founder, American Aerogel Corporation

Jim Misewich
Associate Laboratory Director, Brookhaven National Laboratory

Brian Perusse
Director of Business Development, AES Energy Storage

Edward Reinfurt
Director of the Division of Science, Technology and Innovation, Empire State Development Corporation[1]

John B. Rhodes
President & CEO, New York State Energy Research and Development Authority [2]

Esther S. Takeuchi
SUNY Distinguished Professor, Stony Brook University

Wolf von Maltzahn
Associate VP for Research, Rensselaer Polytechnic Institute

Barry Watkins
Deputy Director, Alfred University (CACT)

---

[1] *The Executive Director of NYSTAR serves as a permanent director.*

[2] *The President and CEO of NYSERDA serves as a permanent director. Frank Murray served as President and CEO of NYSERDA until September 2013.*

NYSERDA, a public benefit corporation, offers objective information and analysis, innovative programs, technical expertise and funding to help New Yorkers increase energy efficiency, save money, use renewable energy, and reduce their reliance on fossil fuels. NYSERDA professionals work to protect our environment and create clean-energy jobs. NYSERDA has been developing partnerships to advance innovative energy solutions in New York since 1975.

Visit nyserda.ny.gov to learn more about NYSERDA programs and funding opportunities.

New York State Energy Research and Development Authority

17 Columbia Circle
Albany, New York 12203-6399

toll free: 1 (866) NYSERDA
local: (518) 862-1090
fax: (518) 862-1091

info@nyserda.ny.gov
nyserda.ny.gov

2012–13 CAIR Annual Report on the New York Battery and Energy Storage Technology Consortium

Issued October 2013

State of New York
Andrew M. Cuomo, Governor

New York State Energy Research and Development Authority
Richard L. Kauffman, Chairman | John B. Rhodes, President and CEO

RD-CERMD-cair12/13-r-1-v1
10/13