

New York State Energy Research and Development Authority

2011–12 CAIR Annual Report on the New York Battery and Energy Storage Technology Consortium

Annual Report
Program Period Ending March 31, 2012



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EXECUTIVE SUMMARY

The New York Battery and Energy Storage Technology Consortium™ (NY-BEST) was announced in 2009 to help position New York as a global leader in energy storage technology for heavy-duty transportation, electric grid, and other 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. The Consortium was incorporated by its 17 member Board of Directors in January 2010 as a New York State not-for-profit corporation. In December 2010, Bill Acker was hired by the Board as Executive Director of NY-BEST and Capitol Hill Management Services was hired by the Board to provide association management services.

This annual report is prepared pursuant to the NY-BEST Program Plan, approved by the NYSERDA Board of Directors in 2009 and amended in 2012, and provides an update on NY-BEST progress, expenditures, activities, and results for the twelve months ending March 31, 2012. NYSERDA priorities for NY-BEST during the next year are also included.

NY-BEST has three primary strategies to build the battery and 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. In turn, these activities help to expand the energy storage industry in New York, create economic growth and jobs, and reduce emissions through electrified transportation and electric grid storage. Program benefits span research and development, product development and commercialization.

Highlights from 2011–12 include:

- 89% of the \$25.5 million in CAIR funds has been expended, contracted, or committed to a specific activity.

- NYSERDA entered into a contract for \$4,350,000 with NY-BEST in 2010 to partially support consortium operations and management over the next five or more years. As of March 31, 2012, 20% of this amount has been expended. During the year, \$683,000 was expended and an additional \$182,000 of non-NYSERDA funding was earned by NY-BEST to partially support operations.
- Unrestricted net assets (essentially reserve funds) at NY-BEST were \$71,000 as of March 31, 2012. The goal is for NY-BEST to reach one year of operating expense as reserve.
- National Grid awarded NY-BEST a \$98,000 economic development grant.
- NY-BEST membership grew 39% in the past year to 108 members.
- 195 participants attended the NY-BEST Annual Meeting and Conference held March 7–8, 2012 in Troy, New York.
- A Regional Technology Conference was held in Rochester and an Investor's Conference was held in New York City.
- 17 NY-BEST research and development projects are underway comprising \$15+ million with \$7.5 million provided by NYSERDA in CAIR funding. These projects are helping to support 118 engineering, product development and research staff, and train 18 graduate and undergraduate students.
- NY-BEST was awarded \$3.5 million through the Regional Economic Development Council initiative to establish a Product Commercialization Center at the Eastman Business Park in Rochester.

Priorities for NY-BEST during the next year as identified by NYSERDA include:

- The Executive Director's implementation of the NY-BEST strategic plan outlining the value proposition and goals that will lead to a self-sustaining organization and contribute to a thriving energy storage sector in New York.

The Brookings Institution "Sizing the Clean Economy" report released in July 2011 ranked New York State the highest in the nation in battery technology jobs with 2,301 jobs. The report, a national and regional green jobs assessment, is the first of its kind providing a unique insight about the size, span and significance of the clean economy.^[1]

- NY-BEST continuing to move in a proactive direction toward member assistance by contacting members when funding and commercialization opportunities are identified and helping members forge commercialization partnerships.
- NY-BEST leveraging the State's \$7 million commitment (\$3.5 million CAIR and \$3.5 million Regional Economic Development Council initiative) so the \$20+ million necessary to establish the NY-BEST Product Commercialization Center at a sustainable scale is raised from private and federal sources.
- NY-BEST will continue to work with NYSERDA, the New York State Smart Grid Consortium, and others on a Brookhaven National Laboratory-led application for a U.S. Department of Energy Hub in Energy Storage due in May 2012. The successful applicant will receive up to \$120 million over five years.
- A research and development solicitation entitled "Bench to Prototype" was released by NYSERDA in April 2012. This will provide up to \$250,000 per project to transition new energy storage technologies with proven technical feasibility into a working prototype. Three due dates are included in the solicitation.

INTRODUCTION

NY-BEST was announced in 2009 and incorporated in 2010 to leverage and help coordinate New York's significant industry and academic energy storage capabilities and help position the State as a global leader in energy storage solutions. Energy storage can play an important role in the reduction of nitrogen oxide (NO_x) and other greenhouse gases in two key areas. First, electrified transportation reduces fossil fuel use and emissions, even in cases where the electricity is generated by fossil fuel. This is due to their increased efficiency compared to burning the fuels in internal combustion engines. Second, energy storage can allow increased integration of renewable energy sources into the electric grid, help with frequency regulation of the grid, and mitigate the need for new fossil fueled electric generating stations to meet peak demand.

NYSERDA was tasked with working with industry and the academic sector to help establish the consortium. In 2009, a Program Plan was developed with stakeholder input and approved by the NYSERDA Board of Directors outlining the consortium's priorities and budget. Approximately \$25 million of CAIR funds were committed by NYSERDA to help establish NY-BEST and enable the consortium to become a self-sustaining, membership driven organization. CAIR funding was provided from New York's proceeds from CAIR

allowances, which are regulated by 6 NYCRR Parts 243 and 244. These regulations established seasonal and annual emissions cap-and-trade programs designed to mitigate interstate transport of ozone and fine particulate pollution, commonly referred to as smog. Ten percent of the NO_x emission allowances allocated to New York was directed by the New York State Department of Environmental Conservation to the Energy Efficiency and Renewable Energy Technology Account, for which NYSERDA is the administrator. Through a competitive solicitation, an emissions broker was selected to assist in the sale of these allowances, which occurred during the 2009–10 program year. NYSERDA sold all allowances for total gross revenues of \$24,441,850. Details related to specific NO_x sales were included in the 2009–10 CAIR Annual Report. No additional NO_x allowances were sold or made available to NYSERDA since this date.

CAIR FINANCIAL INFORMATION

Financial data for the program through March 31, 2012 is presented in Table 1. Of total available funding, \$22,806,907 or 89% has been expended, contracted, or committed to a specific activity. Since the prior year, the budget has been updated to reflect cumulative interest earnings on CAIR funds of \$1,057,000 through March 31, 2012, and current demands on resources.

- "Research and Development" increased by \$530,000 to \$13,585,000 to meet increased demand for commercially-focused research and product development.
- The amount budgeted for Testing and Characterization remains the same. However, the category has been renamed "testing and characterization capabilities" since this could include capital equipment and operating costs to deliver these services.
- NYSERDA administration was increased by \$500,000 to \$2,211,000. The original budget planned for NY-BEST to hire its own Executive Director and staff early in its history. This did not occur until December 2010, almost 21 months after the first stakeholder workshop was held. This was due primarily to ramp-up time associated with developing bylaws, forming working groups, developing membership criteria, forming the board, planning the first organizational meeting, and the NY-BEST Board determining the job requirements and interviewing for an Executive Director. During this timeframe, NYSERDA staff performed these operational and administrative duties which greatly exceeded what had originally been

anticipated. This additional NYSERDA Administration funding is needed to ensure that adequate program oversight and administration, including on research and development awards, remains through the balance of the NYSERDA funding, which is expected to last approximately four to five more years.

- “New York State Cost Recovery Fee” increased by \$27,000 to \$443,000. This is a shared services fee assessed by the New York State Division of the Budget and billed to NYSERDA. The increase represents the assessment on the \$1,057,000 in cumulative interest earnings.

NY-BEST ACTIVITIES AND RESULTS

NY-BEST’s objective is to build a vibrant energy storage sector in New York State. This involves support along various stages of the product development and commercialization pipeline and proactively bringing organizations together to collaborate. Specifically, NY-BEST will help to facilitate commercial introduction of energy storage technologies in New York State, build the human capital and expertise needed to sustain a vibrant commercial energy storage industry, and leverage NYSERDA’s seed resources to create a sustainable

organization that provides value to its members and to New York State.

Metrics used to assess the success of NY-BEST are included within each of the following sections which cover: Consortium Operations; Testing, Characterization and Prototyping Capabilities; and Research and Development. Commercialization progress related to NY-BEST’s activities and announcements from NY-BEST members are also included.

As the consortium continues to grow, additional data points will become available. 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 independent operations (covering through March 31, 2014) and again after year six (covering through March 31, 2017).

CONSORTIUM OPERATIONS

In December 2010, the NY-BEST Board hired Dr. William Acker to serve as Executive Director. John Cervený was hired as Director of Resource Development in March 2011 and Capitol Hill Management Services was selected by the Board to provide association management services and office space for NY-BEST staff in

Table 1. Available Funding and Committed Funds as of March 31, 2012

	Budgeted ¹	Expended/ Committed ²
Consortium Operations and Management ³	\$4,548,000	\$4,429,898
Research and Development Awards ⁴	13,585,000	13,055,000
Technology Transfer	500,000	0
Testing and Characterization Capabilities	3,445,114	3,445,114
NYSERDA Administration ⁵	2,211,000	1,521,034
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	89,125
Total	\$25,498,850	\$22,806,907

Source: NYSERDA

¹ The budget reflects the pro-rated amounts included in the CAIR Program Plan approved by the NYSERDA Board of Directors and amended in 2012 as described above.

² “Committed” includes funds already expended and those that have been committed for specific initiatives.

³ A contract between NYSERDA and NY-BEST, Inc. comprises \$4,350,000 of this amount to support an Executive Director, consortium operational support, and operating expenses of NY-BEST over approximately five to seven years as the consortium works toward self-sufficiency.

⁴ In April 2012, a Program Opportunity Notice was issued comprising \$5.4 million. This PON seeks proposals in three rounds (May 2012, November 2012, and May 2013) to provide up to \$250,000 per project and bring promising energy storage technologies with proven technical feasibility to a working prototype.

⁵ “NYSERDA Administration” relates to the development, implementation and administration/oversight of this initiative including managing the research and development funding.

January 2011. Dr. Acker and his team are responsible for implementing the strategic plan that will build the membership base, contribute to industry growth in New York State, and enable NY-BEST to become a self-sustaining organization.

Metrics used to evaluate consortium operations:

1. Increase in the number of members and retention of existing members
2. Progress toward reaching self-sufficiency
3. Technology transfer activities such as conferences and workshops
4. Commercialization progress at NY-BEST members supported by NY-BEST staff is also evaluated and is included on page 13.

Progress during the past year:

1. Increase in the number of members and retention of existing members
 - Consortium membership grew 39% to 108 members between March 31, 2011 and March 31, 2012. Three organizations did not renew their membership (Xactiv, College of Staten Island which is part of CUNY, and Amphenol Industrial). Appendix 2 shows a map of New York State members and Appendix 3 lists all members of NY-BEST.

2. Progress toward reaching self-sufficiency

- Table 2 presents sources and uses of funds by NY-BEST for the years ending March 31, 2012 and March 31, 2011. Since 2010–11 included only four months of operations under an Executive Director and three months with an Association Management Firm, most line items are not readily comparable from year to year.
- Annual membership fees remained at \$1,000, discounted to \$500 for startup companies.
- Total NYSERDA funds expended increased to \$683,193 for the full year in 2011–12. In total, approximately \$875,000 of the \$4,350,000 in NY-BEST operating funds has been expended representing 20% of the available budget. It is projected that the operating funds will support NY-BEST for five to seven years, with NYSERDA's contribution declining in the later years.
- Non-NYSERDA funds used to support NY-BEST operations increased from \$51,850 to \$182,299 between 2010–11 and 2011–12.
- 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 March 31, 2012, total unrestricted net assets (essentially reserve funds) for NY-BEST were approximately \$71,000 which represents around one month of operations.

Table 2. NY-BEST Financial Summary (Cash Basis) for the Years Ended March 31, 2012 and March 31, 2011

	March 31, 2012	March 31, 2011	\$ Change	% Change
Source of Funds:				
Membership Dues	\$84,550	\$37,500	\$47,050	125%
Conferences	\$57,800	\$11,850	\$45,950	388%
Sponsorships	\$8,750	\$2,500	\$6,250	250%
Non-NYSERDA Grants	\$31,199	\$0	\$31,199	—
NYSERDA Funds	\$683,193	\$257,899	\$425,294	165%
Total Revenue	\$865,492	\$309,749	\$555,743	179%
Uses of Funds:				
Labor	\$307,481	\$83,279	\$224,202	269%
Association Management	\$270,513	\$73,947	\$196,566	266%
Professional Services	\$89,881	\$24,875	\$65,006	261%
Conferences	\$75,112	\$35,965	\$39,147	109%
Travel	\$30,716	\$7,799	\$22,917	294%
Marketing	\$25,438	\$23,895	\$1,543	6%
Other Expenses	\$31,387	\$17,358	\$14,029	81%
Total Expenses	\$830,528	\$267,118	\$563,410	211%
Change in Net Assests	\$34,964	\$42,631	(\$7,667)	-18%

Source: NY-BEST financial reports

- National Grid awarded NY-BEST a \$98,000 economic development grant for an economic impact study to identify and map out emerging markets for energy storage job growth in the State and to assist with outreach to attract energy storage businesses to New York.
- NY-BEST formed a team that submitted an application under the Economic Development Administration's i6 Green Challenge seeking \$1 million. While the proposal was not selected by EDA for funding, NY-BEST staff believes this effort helped establish NY-BEST as an economic development entity in New York State which led to follow on activities with business incubators, technology development and manufacturing support for organizations across the State.
- During 2012–13, it is imperative that NY-BEST begin securing other sources of private and public funding that can augment the NYSERDA seed investment long-term. A significant amount of emphasis has been placed on potential net revenues from the NY-BEST Product Commercialization Center which is described in below.

3. Technology transfer activities

- **Annual Meeting and Conference**
195 participants attended the NY-BEST Annual Meeting and Conference held March 7-8, 2012 in Troy, New York. The two-day forum provided an opportunity for members to learn about leading trends and innovations in the energy storage field and included featured speakers Dr. Cheryl Martin, Deputy Director of ARPA-E; Christine Furstoss, Global Technology Director at GE Global Research; Assemblyman Kevin Cahill, Energy Committee Chair; and Francis J. Murray, Jr., President and CEO of NYSERDA, along with two dozen energy storage leaders. Six sessions were held:
 - Energy Storage: Economics, Markets and Policy.
 - Energy Storage in Transportation: New Products and New Opportunities.
 - Energy Storage on the Grid—Roundtable Discussion.
 - Battery Technologies—Sorting Myth from Fact.
 - Emerging Electrical and Mechanical Technologies—What's New and What's Gaining Traction.
 - State and Federal funding opportunities.

All presentations were video or audio recorded and are available on the NY-BEST website. In a post conference survey, 97% rated the conference as very good or exceptional; attendees rated the sessions discussing available battery technologies and energy storage economics, markets and policy to be the most valuable; and 97% of attendees were very satisfied with how effectively the presenters communicated the subject matter.

- **Western New York Regional Technology Conference**

The first NY-BEST Regional Technology conference was held in Rochester on November 15-16, 2011. The conference drew nearly 100 participants for a series of nine academic presentations and a poster session that drew 22 submissions from students and faculty from Central and Western New York universities. The intent was to showcase leading academic research in energy storage to the industrial community and provide a one-stop shop for industry tech transfer specialists. This was the first in a series of what will become three regional conferences during 2012–13. These types of conferences present a valuable forum for industry to quickly keep abreast of academic developments in energy storage and forge new partnerships—particularly as it becomes cost prohibitive for companies to visit multiple universities each year.

- **Investor's Conference**

The first NY-BEST Energy Storage Investment Conference was held in New York City on December 16, 2011. NY-BEST startup companies were screened for readiness to approach investors with NY-BEST staff coaching companies on their strategy, messaging and materials. Participating companies included Ioxus, NOHMs Technologies, Urban Power Company, Green Charge Network, Paper Battery Company, Widetronix, H2 Pump, and MicroGen Systems. Participating investors included Braemar Energy Ventures, FA Tech Ventures, New World Capital, NYC Investment Fund, Rho Ventures, GE Ventures, Corning, AES Energy Storage, I2BF, Vencon Management and Good Energies. Feedback from investors was positive with a direct result of increasing their awareness and interest in the sector. The companies benefited from the exposure, coaching, and avenue for potential investment. It is important for NY-BEST to track these participants long-term to identify any follow-on investments made as a result of these initial introductions.

- **Advanced Energy 2011 Conference in Buffalo, New York**
NY-BEST organized three sessions of the Advanced Energy Conference on October 12 and 13, 2011: Fuel Cell Advances, Battery and Energy Storage—Renewable Integration, and Battery and Energy Storage—Advanced Technologies. The sessions were well attended and received positive reviews. Energy storage continued to be a major discussion topic among the attendees.
- In 2011, NY-BEST entered into an agreement with the national **Electricity Storage Association (ESA)** to jointly support mutually-beneficial policy goals that will grow the energy storage industry. National partnerships such as this are an area where NY-BEST can play a broader role in shaping national direction that will have an impact on this industry's growth.
- **Website Redesign**
A web firm was hired to redesign and increase user interface of the NY-BEST website (www.ny-best.org). This is scheduled for completion in Spring 2012.
- **E-News Distribution**
The NY-BEST E-News continued approximately every three weeks with NY-BEST and member developments, energy storage announcements, and discoveries from New York and beyond. Research and procurement funding opportunities were also provided to members of NY-BEST. The e-news distribution increased 40% from 638 subscribers at March 31, 2011 to 895 subscribers at March 31, 2012.

Priorities for Consortium Operations in 2012–13 as identified by NYSERDA:

- One of the key activities during 2012–13 will be the Executive Director's implementation of the strategic plan for NY-BEST outlining the value proposition and goals that will lead to a self-sustaining organization and contribute to a thriving energy storage industry in New York. NY-BEST needs to continue proactively providing assistance to its members such as contacting members when funding and commercialization opportunities are identified and helping forge product development and commercialization partnerships.
- NY-BEST also needs to develop partnerships with federal agencies to leverage NYSERDA's investment and make members aware of funding opportunities to

increase the success rate of federal funding awarded to New York companies and researchers.

- Finally, a key priority during the next year will be successful implementation of the Product Commercialization Center which is discussed below.

TESTING, CHARACTERIZATION AND PROTOTYPING CAPABILITIES

Access to testing, characterization and prototyping capabilities is critical for the advancement of battery and energy storage technologies. This includes helping companies access existing facilities at New York's research institutions and providing new capabilities that do not adequately exist today. This activity will be one of the signature services for NY-BEST.

Metrics that will be used to evaluate testing, characterization and prototyping capabilities include:

1. Utilization of NY-BEST testing, characterization and prototyping capabilities by members of the consortium and by non-members and fees generated through this use.
2. Jobs at NY-BEST testing, characterization and prototyping facilities such as technicians and equipment operators.
3. Changes in Technology Readiness Levels and Manufacturing Readiness Levels for technologies examined at NY-BEST testing, characterization and prototyping facilities.

Activities during the past year:

- Tom Trabold, Associate Professor at Rochester Institute of Technology, was retained by NY-BEST to interview members about required testing and prototyping capabilities that could help them more effectively commercialize energy storage technologies. This was incorporated into NY-BEST's Consolidated Funding Application which identified the following capabilities within the NY-BEST Product Commercialization Center:
 - Individual battery cell and capacitor performance testing
 - Module performance testing
 - Cell and module environmental testing including failure mode and lifetime analysis

- Large-scale (MW sized) testing capabilities for grid storage applications including grid interface, high-power testing
 - Testing protocol development and independent validation testing
 - Prototyping of commercial format cells from new experimental battery materials
 - Pilot manufacturing process development
 - Large format calorimeter for heat generation and thermal imaging
 - Integration of testing with modeling efforts for failure mode understanding and predictive modeling
 - Guidance to users on business development, supply chain, policy, and market issues in the energy storage industry.
- In 2011, NY-BEST was awarded \$3.5 million through the Regional Economic Development Council initiative to establish the Product Commercialization Center in the Finger Lakes region at the Eastman Business Park in Rochester.

Priorities for Testing, Characterization and Prototyping Capabilities in 2012–13 as identified by NYSERDA:

- During 2012–13, the highest priority is the Executive Director selling the industrial and user community on his vision for this center, receiving firm usage commitments, and leveraging the State’s investment. This includes developing a business plan for this center that includes a strategy for financial sustainability.
- New York State has now committed \$7 million toward the NY-BEST Product Commercialization Center (\$3.5 million through CAIR and \$3.5 million through the Regional Economic Development Council initiative). NY-BEST’s Executive Director has the responsibility of leveraging the State’s \$7 million commitment so the \$20+ million necessary to establish this center is raised from private and federal funds.
- Brookhaven National Lab and Stony Brook University were also awarded \$5 million by the Governor through the Long Island Regional Economic Development Council for a smart grid testing facility including energy storage devices attached to the grid. NY-BEST needs to coordinate with this center so that each complements each other and makes the best use of limited resources.¹
- A searchable database of capabilities available within New York for use by NY-BEST members was established in 2010. This database needs to continue to be

updated as capabilities are identified and procured, and the NY-BEST team can expand its facilitation role in helping members identify and access needed capabilities.

RESEARCH AND DEVELOPMENT

NYSERDA has a long history supporting development and demonstration of emerging energy storage technologies. CAIR funds are augmenting these efforts by developing technologies that could have significant value added in New York State and, in turn, create high-paying jobs. All research and development funding is awarded and managed by NYSERDA staff using NYSERDA’s solicitation process with input from the energy storage community and NY-BEST.

Seventeen NY-BEST research and development projects are underway comprising \$7.65 million from NYSERDA in CAIR funding and another \$7.47 million in co-funding. These include 15 seed-stage projects that are exploring whether the technologies hold promise for further investment and development, and two larger product development opportunities led by GE and Ultralife Corporation.

Industry-Led Commercialization Partnership Awards:

- **General Electric Co.** (Schenectady) is exploring the next generation of its sodium-metal halide batteries for use in heavy duty transportation applications, uninterruptible power backup systems, and electric grid applications. Partners on this project include Alfred University (Alfred), Clarkson University (Potsdam), Columbia University (New York City), and Stony Brook University (Long Island). *NYSERDA funding: \$2.5 million; co-funding: \$3.0 million.*
- **Ultralife Corporation** (Newark, NY) is integrating lithium-ion batteries and ultracapacitors with renewable energy sources to store electricity for the electric grid. This could enable increased renewable-energy contributions to the grid, provide backup electricity during power outages, and allow peak shaving. Partners include Rensselaer Polytechnic Institute (Troy), Rochester Institute of Technology, Dayton T. Brown (Long Island), Electrical Power worX (Alfred), FSI Systems (Farmington), and Future Energy Development (Rochester). *NYSERDA funding: \$2.36 million; co-funding: \$2.40 million.*

Lithium-Ion Technology Development:

- **Cerion Enterprises** (Rochester) is developing innovative nanoparticle materials for next-generation lithium-ion batteries. *NYSERDA funding: \$200,000; co-funding: \$151,072.*
- **Cornell University** (Ithaca): Dr. Emmanuel Giannelis is developing non-flammable battery electrolytes with improved safety, temperature and voltage performance. *NYSERDA funding: \$200,000; co-funding: \$213,652.*
- **General Motors** (Honeoye Falls) is evaluating new materials for improved lithium-ion battery electrodes for automotive applications to increase performance and reduce cost. *NYSERDA funding: \$196,090; co-funding: \$67,581.*
- **Rensselaer Polytechnic Institute** (Troy): Dr. Nikhil Koratkar is developing next-generation lithium-ion rechargeable batteries featuring nano-engineered electrodes that can enable greater power and energy density and reduce cost of the batteries. *NYSERDA funding: \$200,000; co-funding: \$396,092.*

Other Battery Chemistries:

- **Binghamton University:** Dr. Stan Whittingham is pursuing a lithium air energy storage system that could develop low cost storage for electric vehicles and the electric grid. *NYSERDA funding: \$200,000; co-funding: \$55,512.*
- **Brookhaven National Laboratory** (Dr. Jason Graetz), **Binghamton University** (Dr. Stan Whittingham), and **University at Buffalo** (Dr. Esther Takeuchi) are partnering on three projects to develop improved batteries for stationary grid scale storage applications including lithium-air, lithium-ion, and lithium-titanate batteries. These solutions could help increase renewable integration into the electric grid and reduce the need for additional fossil-fueled powered plants to meet electric demand (the University at Buffalo award is transferring to Stony Brook University in 2012 since the Principal Investigator has accepted a position at Stony Brook/Brookhaven National Lab). *NYSERDA funding: \$552,890; co-funding: \$447,713.*
- **City University of New York:** Dr. Sanjoy Banerjee, with Dayton T. Brown (Long Island), is developing a nickel-zinc flow battery that could result in less expensive hybrid vehicles. *NYSERDA funding: \$200,000; co-funding: \$50,000.*
- **Hollingsworth & Vose, Co.** (Easton) is developing an advanced separator for more efficient valve-regulated lead-acid batteries which are used in hybrid vehicles and uninterruptible power supply backup

systems. *NYSERDA funding: \$200,000; co-funding: \$143,415.*

Ultracapacitors:

- **Ioxus** (Oneonta) in conjunction with CUNY is exploring enhancements to its ultracapacitors by developing a novel electrode-electrolyte interface. Instead of storing energy electrochemically as in a battery, ultracapacitors store energy in an electric field and are excellent choices for high power, fast discharge applications. They also can withstand tens of thousands of complete charge and discharge cycles, making them more durable and longer lasting than competing technologies. *NYSERDA funding: \$200,000; co-funding: \$200,000.*
- **College of Nanoscale Science and Engineering at University at Albany:** Dr. Pradeep Haldar and Manisha Rane-Fondacaro are developing new electrolytes to improve performance of ultracapacitors. *NYSERDA funding: \$200,000; co-funding: \$116,263*
- **City University of New York** is working with Columbia University (New York City) to develop metacapacitors, a new, printable material to create high voltage, high energy, and high power density capacitors for storage. *NYSERDA funding: \$149,597; co-funding \$49,865.*

Diagnostics and Reuse:

- **Impact Technologies** (Rochester) is developing a novel method to increase the lifetime of batteries by assessing battery health through use of in-cell measurement techniques. *NYSERDA funding: \$99,766; co-funding: \$27,115.*
- **Rochester Institute of Technology:** Dr. Gabrielle Gaustad is evaluating methods that can help to recycle and reuse lithium-ion batteries to minimize landfill waste and maximize reclamation. *NYSERDA funding: \$195,869; co-funding: \$157,200.*

Metrics used to evaluate research and development awards:

1. Publications
2. Presentations at technical and business conferences
3. Invention disclosures and patents
4. Licensing agreements executed and licensing revenue
5. Additional research funding received
6. Research and development jobs supported
7. Recognition awards to NY-BEST members or affiliated researchers
8. Significant research accomplishments

9. Commercialization progress

Progress during the past year:

1. Publications resulting from research and development awards
 - Award recipients reported that projects were discussed in 10 publications
2. Presentations at technical and business conferences
 - 15 presentations of research and development projects were presented at conferences
3. Invention disclosures and patents
 - 1 invention disclosure was reported
4. Licensing agreements executed and licensing revenue
 - None reported
5. Additional research funding received

- **The City University of New York's Energy Institute** continued work under two awards totaling \$4.6 million from ARPA-E. The first award comprising \$1.6 million will allow CUNY to work in partnership with **Ultralife Corporation** (Newark, NY) to develop low-cost grid-scale storage using a flow-assisted rechargeable zinc-manganese oxide battery. The goal is a rechargeable battery system that lasts ten years and costs under \$100 per kWh. At this level, widespread adoption of grid-scale energy storage would be possible.²

The second project is developing metacapacitors with increased storage capability for use with the electric grid, working in partnership with Columbia University (New York City). NY-BEST research funding helped to leverage this funding by demonstrating in the ARPA-E proposal that this technology had been successfully peer-reviewed and funded. A \$500,000 National Science Foundation award was also received in support of this work.

- **Rensselaer Polytechnic Institute's** Dr. Nikhil Koratkar continued work under a \$396,000 National Science Foundation award to explore nanomaterials for next generation of high-power rechargeable lithium-ion batteries for electric

vehicles and electronics that can withstand extremely high rates of charge and discharge that would cause conventional electrodes to rapidly deteriorate and fail. The NY-BEST research award helped to leverage this funding by demonstrating that the technology had successfully been peer-reviewed and funded.³

Other research funding received by members of NY-BEST not related to the NY-BEST Research and Development awards include:

- **Brookhaven National Lab** (Long Island) and **SuperPower** (Schenectady) are partners with Swiss engineering firm ABB under a \$4.2 million ARPA-E grant to develop an advanced superconducting magnetic energy storage device with a goal to become cost-competitive with lead-acid batteries.⁴
- **Primet Precision Materials** (Ithaca) secured a \$2.1 million research and development contract with the Department of Defense to demonstrate how its 'NanoScission' technology could allow lithium-ion batteries to be produced at lower cost than current manufacturing processes.⁵
- **Rensselaer Polytechnic Institute** (Troy) will receive \$2 million under an NSF Engineering Research Center awarded to the University of Tennessee Knoxville to conduct work enabling a more intelligent, resilient electrical grid.⁶
- **Rochester Institute of Technology's** Pollution Prevention Institute was awarded \$2 million in New York State funding to reduce the environmental footprint and increase the productivity and efficiency of New York businesses. This could augment the battery recycling project that NYSERDA is funding through a NY-BEST R&D award.⁷
- Several NY-BEST members were awarded NYSERDA funding to support development of energy storage solutions including:
 - **ENrG, Inc.** (Buffalo) was awarded \$500,000 to evaluate increasing the company's manufacturing capacity and improving the performance of the ceramic components it produces for fuel cells and other products. ENrG is providing an additional \$770,000 toward the project.⁸
 - **Paper Battery Company** (Troy) was awarded \$1 million to continue development of a printed energy-storage device as thin and flexible as a

- piece of paper. NYSERDA's funding will be matched by an additional \$1.4 million from Paper Battery and private investors.⁹
- **Solid Cell** (Rochester), a manufacturer of solid-oxide fuel cells and equipment, was awarded \$200,000 to investigate the manufacturing of a patent-pending fuel-cell "interconnect" component.¹⁰
 - **Stony Brook University** was awarded \$187,000 to develop an energy-harvesting shock absorber that converts vibration, bumps, and motion experienced by the suspension of a vehicle or train into electric power.
 - **NOHMS Technologies (Ithaca)** was awarded \$500,000 to improve the energy density and cycle life of lithium-ion batteries with the use of innovative nanomaterials.
6. Research and development jobs supported
- The 17 NY-BEST research and development projects underway are continuing to help support 118 engineering, product development, and research staff and train 18 graduate and undergraduate students.
7. Recognition awards to NY-BEST members or affiliated researchers
- SUNY Distinguished Professor and Greatbatch Professor of Advanced Power Sources, **Dr. Esther Takeuchi**, from University at Buffalo (soon joining Stony Brook University with a joint appointment to Brookhaven National Laboratory) was inducted into the National Inventors Hall of Fame, which honors legendary inventors whose innovations have changed the world. Dr. Takeuchi, who is principal investigator on a NY-BEST research award, has earned more patents than any other woman in the United States. Dr. Takeuchi was honored for developing the battery that enabled implantable cardiac defibrillators, a feat that brought her to the White House in fall 2009 where President Obama presented her with the National Medal of Technology and Innovation.¹¹
 - A team headed by Dr. Lei Zuo at **Stony Brook University** won an *R&D Magazine's* Annual R&D 100 Award. This award, dubbed the "Oscar of Invention," recognized the team's development of an energy-harvesting shock absorber that converts vibration, bumps, and motion experienced by the suspension of a vehicle or train into electric power.¹²
8. Significant research accomplishments
- A team at **Brookhaven National Laboratory** (Upton) including Jason Graetz, Principal Investigator on a NY-BEST R&D award, fabricated a new transparent chemical reactor vessel that may give scientists in many fields a window into real-time chemistry as batteries are cycled.¹³
9. Commercialization Progress
- The following announcements relate to companies awarded research and development funding through NY-BEST CAIR funds:
- **GE** (Schenectady) continued recruiting machine operators for its new \$100 million battery plant and ultimately plans to hire 350 workers for the plant. The Durathon® batteries will be used in applications ranging from electric grid storage to heavy-duty transportation. The NY-BEST R&D award is helping GE explore the next generation of its sodium-metal halide batteries.¹⁴
 - **Ioxus** (Oneonta) opened its new manufacturing facility in Oneonta in July 2011 to develop and produce advanced ultracapacitors used in a range of industrial and consumer applications. The company has received several NYSERDA funding awards and continues to develop its ultracapacitor solutions through NYSERDA and NY-BEST R&D support. Ioxus is the only domestic developer and manufacturer of advanced ultracapacitors, and has grown to over 50 employees.¹⁵
 - **Ultralife Corporation** (Newark, NY) announced the introduction of the GenSet Eliminator™, a patent pending, innovative storage system designed to reduce generator fuel consumption and maintenance costs by 25%–30% for defense and commercial applications by enabling generators to operate less frequently and closer to their peak efficiency. This product utilizes technology developed under the NY-BEST R&D award.¹⁶
- Priorities for Research and Development in 2012–13 as identified by NYSERDA:**
- Since the first round of NY-BEST R&D awards, NYSERDA staff gathered feedback from a number of sources to identify technology development needs

which the remaining research and development funds could best address. These sources included previous award applicants, the NY-BEST Board, NY-BEST members, conferences, academic institutions, and private companies. NYSERDA staff also developed a survey for NY-BEST members seeking their input. Feedback was incorporated into Program Opportunity Notice 2458 released in April 2012 and named the “NY-BEST Bench to Prototype Solicitation.” This PON seeks proposals to transition new energy storage technologies with proven technical feasibility into a working prototype. Awards of up to \$250,000 in NY-BEST CAIR funds, co-shared equally by the applicant. Three due dates are included in the solicitation (in May 2012, November 2012, and May 2013) to align this opportunity with applicant’s internal budgets and schedules.

- NY-BEST will continue to work with NYSERDA, the New York State Smart Grid Consortium, industry and academic partners on an application due in May 2012 for a U.S. Department of Energy Innovation Hub in Storage led by Brookhaven National Laboratory. The winning applicant will receive up to \$120 million over five years.

COMMERCIALIZATION ACTIVITIES

Commercialization success is measured by the following items:

- Outside funding received by consortium members and NY-BEST including federal funds, angel investments, and venture capital
- Product sales and new products launched by consortium members
- Licenses executed and licensing revenue at consortium members and NY-BEST
- Cost savings such as research savings or avoided costs realized by consortium members as a result of their involvement with NY-BEST
- Capital expenditures by consortium members to expand their facilities in New York State
- Jobs created and retained at consortium members
- Energy, economic, and environmental benefits, such as greenhouse gas reductions, through the incorporation of energy storage technologies into transportation, electric grid, and other applications

Note: Impacts related to research and development awards are included on page 9.

During the past year, NY-BEST reported the following examples of outreach and facilitation to members:

Funding:

- Coached and wrote a letter of support for Sentient Corporation (Niagara Falls, NY) for a Navy SBIR proposal effort comprising a \$150,000 funding request submitted in Fall 2012.
- Provided coaching and feedback for H2Pump, MicroGen Systems, Paper Battery Company, Green Charge Networks, NOHMs Technologies, Widetronix, Urban Power on presenting to VC and investor community for the NY-BEST Investor Forum held in New York City in December 2011. Three participating companies have since been successful receiving investments between \$200,000 and \$500,000, and two more are in active discussions on financing. Participants indicated to NY-BEST that the Investor conference helped shape and tune their pitch and expand their circle of investor contacts.

Facilitating Strategic Partnerships for Commercialization:

- Connected Paper Battery Company (Troy, NY) with BAE Systems, Kodak, and Xerox for roll to roll manufacturing expertise and a possible manufacturing partnership and helped them connect to MTI MicroFuel Cells to purchase surplus and unused test equipment.
- Worked with Tumulow, a new startup from Rensselaer Polytechnic Institute, to develop a business plan and connect with potential partners. Tumulow has developed a method to help a facility operator define the potential financial returns in a customer side of the meter energy storage system.
- Identified testing resources for ElectroMotive Designs (Ronkonkoma, NY) at Clarkson University for unique impedance spectroscopy capabilities.
- Introduced ARPA-E awardee, Halotechnics located in California to Corning and Alfred University for expertise in high temperature glass materials.
- Introduced Joule Assets to Ultralife and Xtreme Power for collaboration on upcoming proposal efforts for a micro grid application.
- Connected Alfred University to five solid oxide fuel cell companies. Negotiations for glass seal technology licenses are underway, samples are being evaluated and a joint program has been funded between Solid Cell and Alfred.
- Introduced Eos Energy Storage and Convergent Power to NYISO staff. Discussions led to revisions in both companies’ business plans which helped shape their

marketing strategy toward customer side of meter applications until new regulations are formed.

- Provided guidance and coaching for Hylie Products leading to a battery supply contract with a battery Original Equipment Manufacturer for battery terminals and connectors. NY-BEST provided strategic coaching with respect to positioning relative to foreign competition.

Other commercial announcements by members of NY-BEST during the year included:

- **Corning** released a new non-woven glass fiber veil using a corrosion-resistant glass technology that increases cycle lifetime of traditional flooded lead-acid batteries.¹⁷
- **General Electric Research and Development** (Niskayuna) will work along with manufacturers in California, New Jersey, and Pennsylvania to improve development and design of electric vehicle charging equipment under a U.S. Department of Energy program comprising \$7 million.¹⁸
- The **Long Island Power Authority** (Uniondale) announced a request for proposals for new power capacity in the next few years. One of the 16 companies that submitted was NY-BEST member **AES Energy Storage**, which proposed the use of a 400-megawatt battery system, delivering the same power output for four hours as a medium-sized natural gas plant. The batteries could be charged at night using relatively cheap capacity from Long Island's existing combined cycle natural gas plants and then discharged during the day's high-demand periods. The proposals are under review by LIPA.¹⁹
- **Smith Electric Vehicles** (Bronx) announced it will assemble electric trucks in the South Bronx, adding 100 jobs to the region. Working with the bus fabricator Trans Tech (Warwick, NY), Smith will also be producing electric school buses.²⁰ Smith was lured to New York State based on an electric truck incentive program announced by Governor Cuomo in November 2011 that provides up to \$20,000 per vehicle to partially defray the incremental costs of an EV over an internal combustion engine.²¹
- **Plug Power** (Latham), which provides fuel cell units for materials handling and industrial trucks, raised \$20 million in a common stock offering,²² and was ranked on the Deloitte's Technology Fast 500™ list.²³

- **UTC Power**, a NY-BEST member from outside New York State, announced it will provide fuel cells to the commercial real estate market throughout the US, as part of an agreement with New York City-based Newmark Energy Solution.
- **Widetronix** (Ithaca), which designs and builds low power, long life batteries for microelectronics, completed a seed venture capital round of funding from Draper Fisher Jurvetson.²⁴

Priorities for Commercialization in 2012–13 as identified by NYSERDA:

- NY-BEST needs to continue proactively bringing members together to identify their strengths and complements to one another and to form new product development and commercialization partnerships.
- In conjunction with the Product Commercialization Center, NY-BEST can play an important role in helping to shape testing protocols and standards that will enable companies to validate and more readily demonstrate successful technologies to commercial markets.

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NY-BEST BOARD OF DIRECTORS

The 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.

Chairman of the Board: Mike Field—President, Operations & Engineering Division, Raymond Corporation

Vice-Chair Industry: Andrew J. Naukam—Vice President of Technology and Program Management, Ultralife Corporation

Vice-Chair Academic: M. Stanley Whittingham—Director of the Institute for Materials Research and Professor of Chemistry, Binghamton University

Vice-Chair At-Large: Catherine Hill—Partner, CooperHill LLC

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

Sanjoy Banerjee—Distinguished Professor of Chemical Engineering and Director of the Energy Institute, City University of New York

Aubrey Braz—Vice President, Consolidated Edison Company of New York

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

Robert K. Jaworski, Ph.D., CFA—Chief Financial Officer, Ioxus, Inc.

Hank McGlynn—President, AEYCH, LLC and former Vice President and General Manager at BAE Systems (retired)

Glen Merfeld—Manager, Chemical Energy Systems Laboratory, GE Global Research

Jim Misewich—Associate Laboratory Director, Brookhaven National Laboratory

Francis J. Murray, Jr.—President & CEO, New York State Energy Research and Development Authority (the President and CEO of NYSERDA serves as a permanent director)

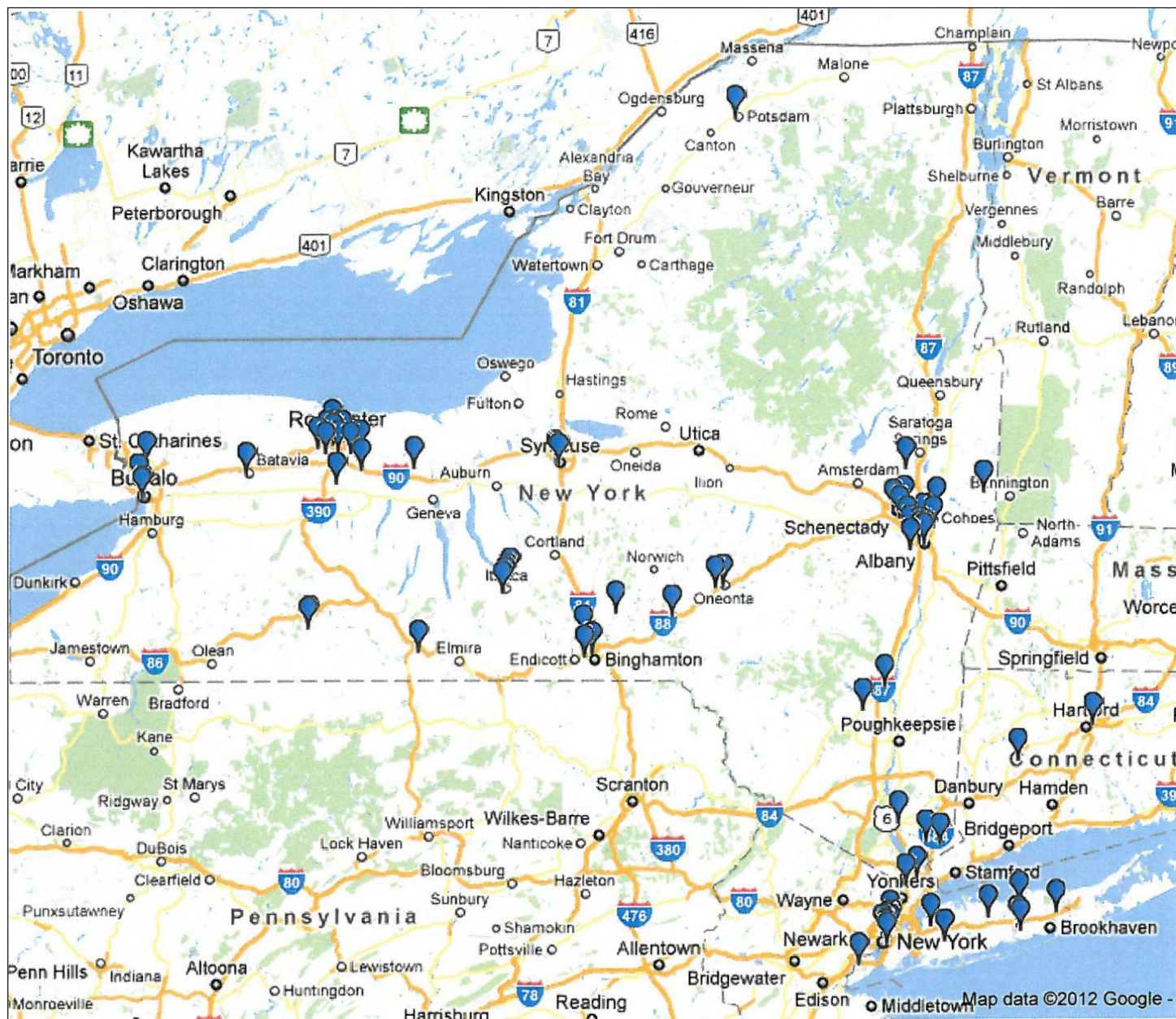
Brian Perusse—Director of Business Development, AES Energy Storage

Edward Reinfurt—Director of the Division of Science, Technology and Innovation, within the Empire State Development Corporation (the Director of NYSTAR serves as a permanent director)

Wolf W. von Maltzahn—Associate VP for Research, Rensselaer Polytechnic Institute

Barry Watkins—Deputy Director, Alfred University (CACT)

MAP OF NEW YORK STATE MEMBERS



NY-BEST MEMBERS

1.	A123 Systems	Westborough, MA	55.	Hollingsworth & Vose Company	East Walpole, MA
2.	ACAL Energy Ltd.	Honeoye Falls, NY	56.	Hydrogenics Corporation	Mississauga, Ontario
3.	AES Energy Storage	Arlington, VA	57.	Hylie Products, Inc.	Watertown, CT
4.	AEYCH	Endicott, NY	58.	Ice Energy	Latham, NY
5.	Alfred University	Alfred, NY	59.	ICL-IP America Inc.	Ardley, NY
6.	Alliance for Clean Energy New York (ACE NY)	Albany, NY	60.	Impact Technologies	Rochester, NY
7.	American Aerogel	Rochester, NY	61.	Intertek	Cortland, NY
8.	Applied Logix LLC	Pittsford, NY	62.	Ioxus, Inc.	Oneonta, NY
9.	Arista Power	Rochester, NY	63.	KEMA, Inc.	Burlington, MA
10.	Ascension Industries	North Tonawanda, NY	64.	Long Island Power Authority	Uniondale, NY
11.	BAE Systems Platform Solutions	Johnson City, NY	65.	MicroGen Systems, Inc.	Ithaca, NY
12.	Bettergy Corporation	Peekskill, NY	66.	Momentive Performance Materials	Albany, NY
13.	Binghamton University	Binghamton, NY	67.	National Grid	Albany, NY
14.	Braemar Energy Ventures	New York, NY	68.	New World Capital Group	New York, NY
15.	Bren-Tronics, Inc.	Commack, NY	69.	New York Power Authority	White Plains, NY
16.	Brookhaven National Laboratory	Upton, NY	70.	New York State Electric and Gas	Rochester, NY
17.	Buffalo Niagara Enterprise	Buffalo, NY	71.	Nohms Technologies	Ithaca, NY
18.	Center for Economic Growth	Albany, NY	72.	Northeast Transportation Electrification Alliance	New York, NY
19.	Centerstate CEO	Syracuse, NY	73.	O'Brien & Gere	Syracuse, NY
20.	Cerion Enterprises	Rochester, NY	74.	Oak-Mitsui Technologies	Hoosick Falls, NY
21.	CG Power Solutions USA Inc.	Albany, NY	75.	Plug Power, Inc.	Latham, NY
22.	City University of New York	New York, NY	76.	Primet Precision Materials, Inc.	Ithaca, NY
23.	Clarkson University	Potsdam, NY	77.	Progressive Machine & Design	Victor, NY
24.	Columbia University	New York, NY	78.	RBC Technologies	College Station, TX
25.	Consolidated Edison Company of New York, Inc.	New York, NY	79.	Rensselaer Polytechnic Institute	Troy, NY
26.	Cooper Hill	Albany, NY	80.	Ricochet Public Relations	New York, NY
27.	Cornell University	Ithaca, NY	81.	Rochester Gas & Electric	Rochester, NY
28.	Corning Incorporated	Corning, NY	82.	Rochester Institute of Technology	Rochester, NY
29.	Cubit Power Systems	Ottawa, Ontario	83.	Saft America, Inc.	Jacksonville, FL
30.	Curtis Instruments	Mt. Kisco, NY	84.	Samsung SDI	San Jose, CA
31.	Custom Electronics, Inc.	Oneonta, NY	85.	Schenectady County Community College	Schenectady, NY
32.	Customized Energy Solutions	Endicott, NY	86.	Sendyne Corp.	New York, NY
33.	Day Pitney LLP	New York, NY	87.	Sentient Corp.	Niagara Falls, NY
34.	Dayton T. Brown, Inc.	Bohemia, NY	88.	Siemens Corporate Research	Princeton, NJ
35.	Direct Gain Consulting LLC	Stone Ridge, NY	89.	Solid Cell, Inc.	Rochester, NY
36.	E Global Solutions	Alfred, NY	90.	Stony Brook University	Stony Brook, NY
37.	Eastman Business Park	Rochester, NY	91.	Sun Catalytix	Cambridge, MA
38.	Electrical Power worX Corp.	Alfred, NY	92.	SuperPower, Inc.	Schenectady, NY
39.	ElectroMotive Designs	Ronkonkoma, NY	93.	Sure Power	Lester, PA
40.	Electrovaya	Malta, NY	94.	Syracuse University	Syracuse, NY
41.	Energy & Environmental Technology Applications Center, University at Albany, CNSE	Albany, NY	95.	TechCity Properties	Kingston, NY
42.	EnRG, Inc.	Buffalo, NY	96.	The Paper Battery Company	Troy, NY
43.	EOS Energy Storage	New York, NY	97.	The Raymond Corporation	Greene, NY
44.	Ephesus Technologies	Syracuse, NY	98.	Triple-Point Energy	Bedford, NY
45.	Fermer Precision Inc.	Ilion, NY	99.	Turner Construction Company	Albany, NY
46.	General Electric	Niskayuna, NY	100.	Ultralife Corporation	Newark, NY
47.	General Motors LLC	New York, NY	101.	Unifrax I LLC	Niagara Falls, NY
48.	Genesee County Economic Development Center	Genesee, NY	102.	United Technologies Research Center	Hartford, CT
49.	Graphene Devices	Williamsville, NY	103.	University at Buffalo	Buffalo, NY
50.	Green Charge Networks	New York, NY	104.	University of Rochester	Rochester, NY
51.	H-Power America, Inc.	West Islip, NY	105.	Whiteman Osterman & Hanna LLP	Albany, NY
52.	H2Pump	Latham, NY	106.	Widetronix	Ithaca, NY
53.	Heslin Rothenberg Farley & Mesiti P.C.	Albany, NY	107.	WilmerHale	Boston, MA
54.	Hoffman Warnick LLC	Albany, NY	108.	Xtreme Power	Washington, DC



State of New York
Andrew M. Cuomo, Governor

2011–12 CAIR Annual Report on the New York Battery and Energy Storage Technology Consortium

Annual Report
Program Period Ending March 31, 2012

New York State Energy Research and Development Authority
Francis J. Murray, Jr., President and CEO