A M E R I C A N J O B S P R O J E C T

The New York Jobs Project

A Guide to Creating Jobs in Energy Storage

DECEMBER 2018

AMERICAN JOBS PROJECT

A Letter from the

American Jobs Project

The United States has a rare opportunity to create millions of living-wage jobs, reduce wealth inequality, and future-proof our economy thanks to one, rapidly growing industry: advanced energy.

Global commitments to reduce carbon emissions have created the "mother of all markets" for carbon-free power sources, and global advanced energy industry revenue is projected to grow to nearly $2.2 trillion by 2025.

With this market growth comes millions of jobs. Advanced energy technologies have long value chains, from research labs and raw materials providers, to manufacturers, project developers, installers, logistics companies, and many more. Over 10 million people were employed in the global advanced energy industry in 2017 from all backgrounds, disciplines, and skill levels, and market growth could support 24 million jobs by 2030.

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Advanced energy represents a tremendous wealth opportunity to alleviate the disparate growth in the U.S. workforce. Over the last several decades, hard-working Americans watched as wages stagnated, opportunities for good-paying jobs diminished, and economic inequality rose. Forward-thinking leaders can reverse these trends and promote equitable growth by capitalizing on the opportunity presented by the advanced energy sector.

We believe states are key to advanced energy job growth. Paralysis at the federal level threatens American competitiveness, but state and local policymakers can lead the way to promote and nurture innovation, bring ideas to market, and supply advanced energy technologies to consumers locally, nationally, and globally.

The American Jobs Project has identified a strategy to ensure states capture their share of this quickly growing industry while uplifting workers and communities across the country, providing jobs for low- and middle-skilled workers with pay above the national median. Our analysis gives policymakers tools to spur economic growth and create living-wage jobs in their states. These solutions are developed with an eye towards streamlining bureaucracy and consideration of each region's economic nuances, local conditions, and business priorities.

The American Jobs Project empowers state and local leaders to build prosperous and equitable advanced energy economies that will transform our nation's energy future for the benefit of hard-working Americans.

About Us

The American Jobs Project

The American Jobs Project is a nonprofit, nonpartisan, think-and-do tank focused on creating good-paying jobs in advanced energy and manufacturing through a bottom-up, data-driven, 360° economic development approach. Our experts tailor best practice strategies for bolstering advanced energy and manufacturing, identify assets across the value chain, estimate an industry's job-supporting potential, and support stakeholder-led initiatives by communicating ideas and analyses. Through engagement with a broad cross-section of stakeholders, we develop a shared vision of effective strategies to leverage the unique competitive advantages offered by each state and generate positive economic impacts.

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New York Battery and Energy Storage Technology Consortium (NY-BEST)

NY-BEST was incorporated in January 2010 as a not-for-profit corporation to position New York State as a global leader in energy storage. Since its formation, NY-BEST has become a well-known, well-respected, and effective industry association. Headquartered in New York's Capital Region, NY-BEST brings together industry, university, and government partners. NY-BEST's 150+ member organizations represent all facets of the energy and energy storage industries and span New York State and beyond. Members include companies ranging from small entrepreneurial ventures to large global corporations, as well as leading research universities and government partner organizations. Approximately half of NY-BEST member organizations are small businesses.

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NYSERDA

EXECUTIVE SUMMARY

New York's energy storage industry is a significant economic opportunity for job growth, having the potential to support a total of 27,400 manufacturing and installation jobs by 2030. New York can capitalize on this opportunity by bolstering the innovation ecosystem, access to capital, workforce development, and value chain.

EXECUTIVE SUMMARY

Energy storage is the key to achieving a resilient, secure, and carbon-free energy future. New York stakeholders are already taking action to capture the numerous benefits that energy storage can provide the power grid, transportation systems, and the economy. The state's forward-looking efforts to overcome barriers to energy storage deployment will open up a robust local market and attract new investment to the state. Nevertheless, there is still an opportunity to strengthen the ecosystem to ensure future investments benefit in-state manufacturers and support local workers.

A strong focus on energy storage not only means a clean energy future but numerous local jobs. New York's manufacturing industry continues to shed thousands of jobs, with local communities losing out on good wages and employment opportunities that demand all skill levels. By supporting energy storage manufacturing, New York can ensure a stronger labor market that helps workers and jobseekers access living-wage jobs and bolster local economies. Furthermore, greater energy storage deployment will create more middle-wage jobs in project development, installation, operations, and maintenance.

New York can amplify the industry's potential by harnessing its key assets:

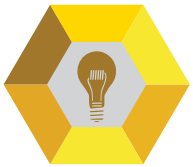
- **A rapidly growing energy storage market.** The $11.8 billion global market is estimated to grow 8.4 percent each year up to 2022.
- **Diverse manufacturing and industry assets.** New York is home to nearly 100 energy storage companies with expertise in hardware manufacturing, advanced materials, software development, and project management.
- **Cutting-edge research.** The state ranks fifth in the nation for energy storage patents due to the depth of research at New York's universities, national lab, and businesses.
- **Clean energy leadership.** State and local leaders recognize energy storage as a key enabling technology for reducing greenhouse gas emissions, increasing renewable energy generation, and improving building efficiency.
- **The opportunity to support good-paying jobs.** The American Jobs Project's independent analysis finds that New York's energy storage industry could support 27,400 manufacturing and installation jobs by 2030, backing the state's 30,000 jobs target.

Strategic state-level coordination could address key barriers for business development and technology deployment, elevate in-state companies in the marketplace, and create jobs for New Yorkers. In today's competitive, globalized economy, businesses are more likely to thrive in cities and states that offer a rich innovation ecosystem, provide fertile ground for capital investment, boast a highly skilled workforce, maintain a robust value chain, and offer clear policy signals. Through an environment of coordination and cooperation, energy storage cluster development can amplify local job creation and boost economic activity.

Capitalizing on this opportunity offers real benefits for the state economy. New York's energy storage companies currently employ 3,450 workers and generate nearly $1 billion in revenue. If New York's public and private sector leaders make concerted efforts to foster the emerging cluster, energy storage could support 27,400 jobs by 2030. Stakeholders can support these jobs by taking advantage of increasing global demand and overcoming barriers to industry growth.

SUMMARY OF RECOMMENDATIONS

The analysis presented in this report culminates in recommendations for New York's public and private sector leaders based on best practices in the United States and abroad. Each recommendation identifies strategies to address barriers and untapped opportunities in the state's energy storage industry across four foundational building blocks: innovation ecosystem, access to capital, workforce development, and value chain. While each recommendation can be viewed as a stand-alone option, the recommendations are intended to be complementary and would be more powerful if adopted as a package.



Innovation Ecosystem

Policy 1: Establish an Innovation Voucher Program

New York has significantly invested in state-of-the-art testing facilities to support energy storage technology development; however, early-stage startups face a dilemma of requiring both prototype testing to build investor confidence and funding to afford testing resources. Through an innovation voucher program, New York's leaders could enable small businesses to better access testing and consultation services at state-supported facilities.

Policy 2: Strengthen the Entrepreneurial Culture at Universities

New York's universities excel at fundamental energy storage research and having a strong focus on entrepreneurship and commercialization could multiply the economic impact of this cutting-edge research. University leaders could build a strong entrepreneurial culture on campus by adopting innovative policies and programs, such as including technology transfer as a criterion for tenure and promotion, allowing faculty leaves of absence for entrepreneurial ventures, facilitating faculty entrepreneur mentorship programs, and establishing pre-negotiated relationships with local service companies frequently used by spin-offs.

Access to Capital

Policy 3: Facilitate Startups' Access to Educated Investors

Because energy storage encompasses many diverse technologies and use cases, potential investors who lack industry expertise and want quick returns may be unable to see the value proposition of individual businesses. To overcome this information barrier, New York institutions engaged in the energy storage startup ecosystem could host industry-specific investor education events and startup-investor networking opportunities throughout the state.

Policy 4: Establish Connections to Patient Capital

Although New York offers a wealth of financial resources, energy storage manufacturers still struggle to access capital because of low funding levels, reimbursement-based grants, private match requirements, and short-term funding. To facilitate more patient capital for local companies, public and private sector leaders could engage philanthropic foundations and broker program- and mission-related investments in the state.

Workforce Development

Policy 5: Conduct an Energy Storage Workforce Development Study

Coordinated stakeholder discussions on short- and long-term workforce needs are critical to ensure sustainable energy storage industry growth in New York. State leaders could assemble a stakeholder group of industry players, education and workforce training providers, labor organizations, community-based organizations, and key government agencies to conduct an in-depth study on the types of jobs needed for energy storage manufacturing and deployment as well as the appropriate timescale for preparing the workforce.

Policy 6: Expand Integrated Basic Education and Skills Training

New York's energy storage industry will require a skilled and ready technical workforce; however, clean energy businesses still struggle to find qualified job candidates and many jobseekers lack the educational foundation to access technical training programs. Community colleges could expand Integrated Basic Education and Skills Training (I-BEST) programs to help students develop basic math and literacy competency while preparing for electrical, clean energy, and advanced manufacturing career pathways.

Policy 7: Build a State-Level Network of Qualified Energy Storage Contractors

As energy storage becomes mainstream, New York will require qualified contractors to ensure safe installations, boost customer confidence in the technology, and strengthen the local market. Similar to its requirements for solar PV contractors, NYSERDA could identify and help build relevant credentialing paths that make a contractor eligible to participate in the qualified energy storage contractor network and engage in its energy storage programs.

Policy 8: Establish an Energy Storage Job Board

Building career awareness will be critical to helping New Yorkers take advantage of the thousands of jobs that the energy storage industry could support. New York's leaders have the opportunity to create an industry-specific job board that showcases what jobs are available and serves as a resource for local businesses, jobseekers, training providers, employment agencies, and policymakers.

Value Chain

Policy 9: Map the Local Energy Storage Supply Chain

Supply chain mapping is key for understanding what industry assets exist and what gaps remain for businesses and jobs to thrive in the state. New York's leaders could build upon NY-BEST's online supply chain map to create a comprehensive and interactive resource that can help businesses facilitate connections with potential suppliers and customers as well as help policymakers and economic development organizations attract investment and recruit businesses.

Policy 10: Bolster Foreign Direct Investment in the Energy Storage Industry

Foreign direct investment (FDI) could support energy storage industry growth by strengthening in-state manufacturing, filling critical supply chain gaps, and bringing new jobs and capital into the New York economy. State and local leaders could make a concerted effort to bolster FDI outreach by identifying business recruitment targets, better marketing New York's energy storage assets, leveraging connections with international energy storage clusters and research institutions, hosting leading energy storage conferences, and dedicating funds for business attraction.

INTRODUCTION

New York can tap into the growing global energy storage market to foster and support good-paying jobs for New Yorkers. Through strategic cluster-based development of the energy storage industry, the state could support a total of 27,400 jobs by 2030.

INTRODUCTION

The American Jobs Project aims to spur job creation in the advanced energy industry by identifying state-level economic opportunities and crafting tailored solutions for in-state growth. This national initiative takes advantage of the accelerating demand for advanced energy and leverages states' competitive advantages to build robust economic clusters. State and local leaders who seek to capitalize on state resources to create living-wage jobs can use this report as a foundation for action.

New York stakeholders are well aware of the numerous benefits that energy storage can provide the power grid, transportation systems, and the economy. More than forty stakeholder interviews and extensive research conducted for this report have illuminated the state's numerous energy storage assets and remaining roadblocks to industry growth. New York is well positioned to be a leader in the billion-dollar global energy storage market and transform its clean energy economy given its diverse business network of nearly 100 companies and the New York Battery and Energy Storage Technology Consortium (NY-BEST); its energy storage research expertise; and its clean energy leadership, marked by ambitious statewide goals and collaborative stakeholder efforts. New York's leaders have an opportunity to build on the existing 3,450 direct energy storage manufacturing jobs and multiply the nearly $1 billion in revenues that energy storage companies generate in the state.

By developing its energy storage industry, New York could support an annual average of nearly 14,500 direct, indirect, and induced manufacturing jobs as well as 1,500 direct installation jobs from 2019 through 2030. This analysis estimates a total of 27,400 New York jobs associated with the energy storage industry by 2030.

This report is intended to build on the state's forward-looking efforts to accelerate local energy storage deployment, including the New York State Energy Storage Roadmap. It aims to identify opportunities to strengthen other parts of the ecosystem and further support the state's goal of 30,000 energy storage jobs by 2030, such as supporting local manufacturers and building career pathways. Strategic state-level coordination could address key barriers for business development and technology deployment, elevate in-state companies in the marketplace, and create jobs for New Yorkers.

The American Jobs Project's independent analysis shows New York's energy storage industry could reasonably support a total of 27,400 jobs by 2030, providing much-needed employment opportunities in the state. Despite steady post-recession recovery, New York lost 3 percent of its manufacturing jobs between 2010 and 2016, with some regions losing 16 to 23 percent of their manufacturing jobs over the same period. This trend means local communities are missing out on manufacturing jobs with an average salary of $74,000 and jobs throughout a supply chain that demand all skill levels. Energy storage manufacturing can facilitate a stronger labor market that helps workers and jobseekers overcome severe employment barriers and gain better wages. Furthermore, greater energy storage deployment in the state will create more middle-wage jobs in project development, installation, operations, and maintenance.

The Benefits of Cluster-Based Development

If New York's public and private sector leaders want to reap the most benefits from energy storage market growth, they should work to build a strong economic cluster for industry growth. Clusters are regionally situated groups of companies and institutions that are engaged in a particular industry and supported by repeated exchanges of information and resources. In today's competitive globalized economy, businesses are more likely to thrive in regions that cultivate the building blocks of cluster development: a rich innovation ecosystem, fertile ground for capital investment, a highly skilled workforce, a robust value chain, and clear policy signals. In fact, clusters enable businesses to leverage a trained workforce, a close network of suppliers, and a wealth of resources to overcome size limitations, improve productivity, and

HOW DOES AN ECONOMIC CLUSTER WORK?

increase operational efficiency. Studies have shown that wages are higher in industry clusters, with one study concluding that workers typically receive wages that are 6 percent higher than those of workers employed in the same industry but outside a cluster. Through an environment of coordination and cooperation, clusters can amplify local job creation and boost economic activity.

Businesses are more likely to thrive in regions that cultivate the building blocks of cluster development: a rich innovation ecosystem, fertile ground for capital investment, a highly skilled workforce, a robust value chain, and clear policy signals.

Energy storage cluster development requires a comprehensive action plan and designated leaders to coordinate stakeholder efforts and translate them into meaningful economic growth. Virtually every successful cluster—both domestically and internationally—was developed through deliberate policy, a clear strategy, and strong leadership. New York already boasts many engaged leaders and coordinating bodies, and targeting cluster gaps can help catalyze development and create an environment where businesses and workers can thrive.

NEW YORK'S ECONOMIC OPPORTUNITY IN ENERGY STORAGE

New York is well positioned to capitalize on rising market demand for energy storage and create quality jobs for New Yorkers given the state's manufacturing and industry assets, robust R&D investments, and commitment to clean energy.

WHAT IS ENERGY STORAGE?

Energy storage technologies save generated energy for use at a later time. Depending on the technology, energy can be stored as electrical, thermal, mechanical, chemical, or electrochemical energy and then later released as electricity. Technologies vary by how much energy they can store (capacity), how quickly they can discharge the energy (power rating), their cost structures, and their benefits to the power grid, utilities, transportation system, and customers. These differences enable energy storage to serve diverse applications, such as balancing electricity supply and demand, regulating power quality, facilitating use of renewable energy sources, providing emergency power, and powering electric vehicles.

Energy Storage Enables Grid Transformation. Energy storage is the key to achieving a resilient, secure, and carbon-free energy future. Storage technologies facilitate greater use of clean energy and transform the power grid into a dynamic network for supplying reliable and cost-effective electricity. Energy storage also enables transportation electrification, which means huge reductions in fossil fuel dependence and greenhouse gas emissions. Accelerated energy storage deployment will be the linchpin of the global energy transformation.

TYPES OF ENERGY STORAGE TECHNOLOGIES	
Compressed air	Pressurized air is stored in underground caverns or pressure vessels and later released and expanded to drive a turbine.
Electrochemical batteries	Energy accumulates through a reversible electrochemical reaction and is stored in a variety of complex, engineered materials.
Flow batteries	In contrast with electrochemical batteries, energy is stored in electrolyte solutions that are housed separately from the other battery components.
Flywheels	A rotor is accelerated to very high speeds and then slowed down to discharge the energy.
Hydrogen fuel cells	Hydrogen fuel reacts electrochemically with oxygen, converting the fuel's chemical energy into electricity.
Pumped hydro	Water is pumped uphill to a reservoir and later released downhill through a turbine to generate electricity.
Supercapacitors	Energy is stored as an electrical charge at the interface between a solid and an electrolyte solution.
Superconducting magnetic energy storage	Direct current flows in a cooled superconducting coil, storing energy in the resulting magnetic field.
Thermal energy storage	An umbrella term for various technologies; in one type, molten salts are heated by the sun and later used to create steam to generate electricity in a steam turbine. Others include cold storage to offset air conditioning load.

Uses and Benefits of Energy Storage

Energy storage is used in many applications; the most common to consumers are batteries for portable electronics such as mobile phones and computers. Today's use cases for energy storage associated with electricity generation and use fall predominantly into three categories: utility-scale, behind-the-meter, and transportation. Each has different requirements, motivating the development of a range of energy storage technologies.

Utility-Scale

Energy can be stored on a large scale on the power grid. Now and into the future, utility-scale energy storage will be integral to optimizing the grid and handling higher electricity demand predicted for the coming decades. Applications include:

- **Managing peak load**. Energy storage systems can be charged at low demand times and discharged during periods of peak demand. This application ensures reliable and efficient electricity delivery and reduces the need to install extra power generation capacity, thereby helping to lower electricity costs.
- **Integrating renewable energy on the grid**. Energy storage helps handle short-term power fluctuations from intermittent renewable sources. As the renewable energy portfolio grows, energy storage can also save intermittent electricity from renewables for use at a later time, such as shifting solar power to support electrical loads during evening hours.
- **Regulating frequency and voltage**. Energy storage can help maintain reliable functioning of all grid components and deliver consistent power to customers.
- **Providing reserve capacity**. Energy storage can supply emergency power safely and efficiently in the event of disruptions.

Energy storage technologies suitable for the various utility-scale applications include pumped hydro, flywheels, compressed air, batteries, hydrogen fuel cells, superconducting magnetic energy storage, supercapacitors, and thermal energy storage. Pumped hydro currently accounts for 94 percent of U.S. utility-scale storage, but recent deployments have largely been batteries and thermal storage.

Behind-the-Meter

Energy storage can also be deployed by customers on their property, whether residential, commercial, or industrial. Behind-the-meter energy storage allows customers to take greater control of their electricity usage and is useful for:

- **Managing load**. Customers can use stored power when grid electricity is expensive, thereby reducing electricity bills.
- **Supplying backup power**. Customers can store energy for use in the case of electricity disruptions from grid outages or natural disasters.
- **Facilitating use of renewable energy**. Energy storage helps balance supply from onsite renewable generation systems.
- **Providing ancillary services to the grid**. In some electric service areas, customers can deliver excess energy back to the grid to be used for ancillary services, such as frequency regulation and load shifting.

Behind-the-meter energy storage technologies include batteries, hydrogen fuel cells, and thermal storage.

Transportation

Electric vehicles (EVs), which are powered by electricity from on-board energy storage, can reduce pollution, save money, and increase energy efficiency compared to traditional gasoline-powered vehicles. The electrification of transportation includes passenger cars, public transit (buses, subways, trains), material handling equipment (forklift trucks), heavy duty transport (delivery and freight-hauling trucks), and even shipping and aviation sectors. Advantages of transportation electrification include:

- **Reducing the use of fossil fuels**. Because EVs do not run on gasoline or diesel, they can lower emissions and improve the nation's energy security.
- **Deferring large infrastructure investments**. EVs can be leveraged as a grid asset. By encouraging customers to charge EVs during low demand times and sell stored energy back during peak demand, utilities can defer investments in more costly utility-scale energy storage systems.

- **Increasing energy efficiency**. Electric motors produce less waste heat than internal combustion engines and are also able to generate energy through regenerative braking, increasing efficiency even in vehicles with high power demand like ships and trains.
- **Saving money for consumers**. EVs require less routine maintenance, have fewer components that need to be replaced, run more efficiently, and cost about half as much to fuel than traditional gasoline-powered vehicles.
- **Greatly reducing urban noise pollution**. EVs run much quieter than vehicles with diesel and gasoline engines, which is one reason for electrifying urban bus fleets.

Energy storage technologies suitable for transportation applications include batteries and hydrogen fuel cells. Hybrid battery-supercapacitor systems are being investigated for ships, and recent developments in flywheels and supercapacitors have enabled integration of these technologies into trains.

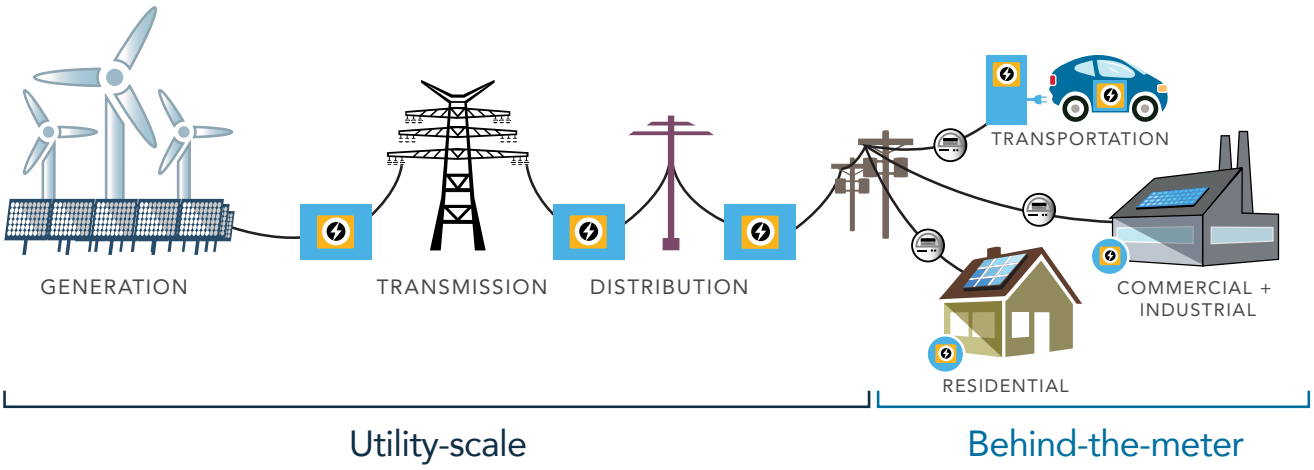
The Future of Energy Storage Technologies

There is ongoing research on energy storage technologies to improve energy density, power performance, operational performance, lifetime, safety, and cost.

A sampling of emerging technologies that will help meet diverse energy storage needs include:

- New chemistries, materials, and processes for electrochemical batteries.
- More sophisticated, adaptive, and smarter control systems that optimize storage system performance.
- New types of compressed air energy storage that reuse waste heat.
- Flow batteries with novel components that decrease cost and increase performance.
- New types of thermal energy storage that achieve higher storage densities.
- Metal air batteries with improved cycle efficiency and increased lifetime.

POTENTIAL LOCATIONS FOR ENERGY STORAGE

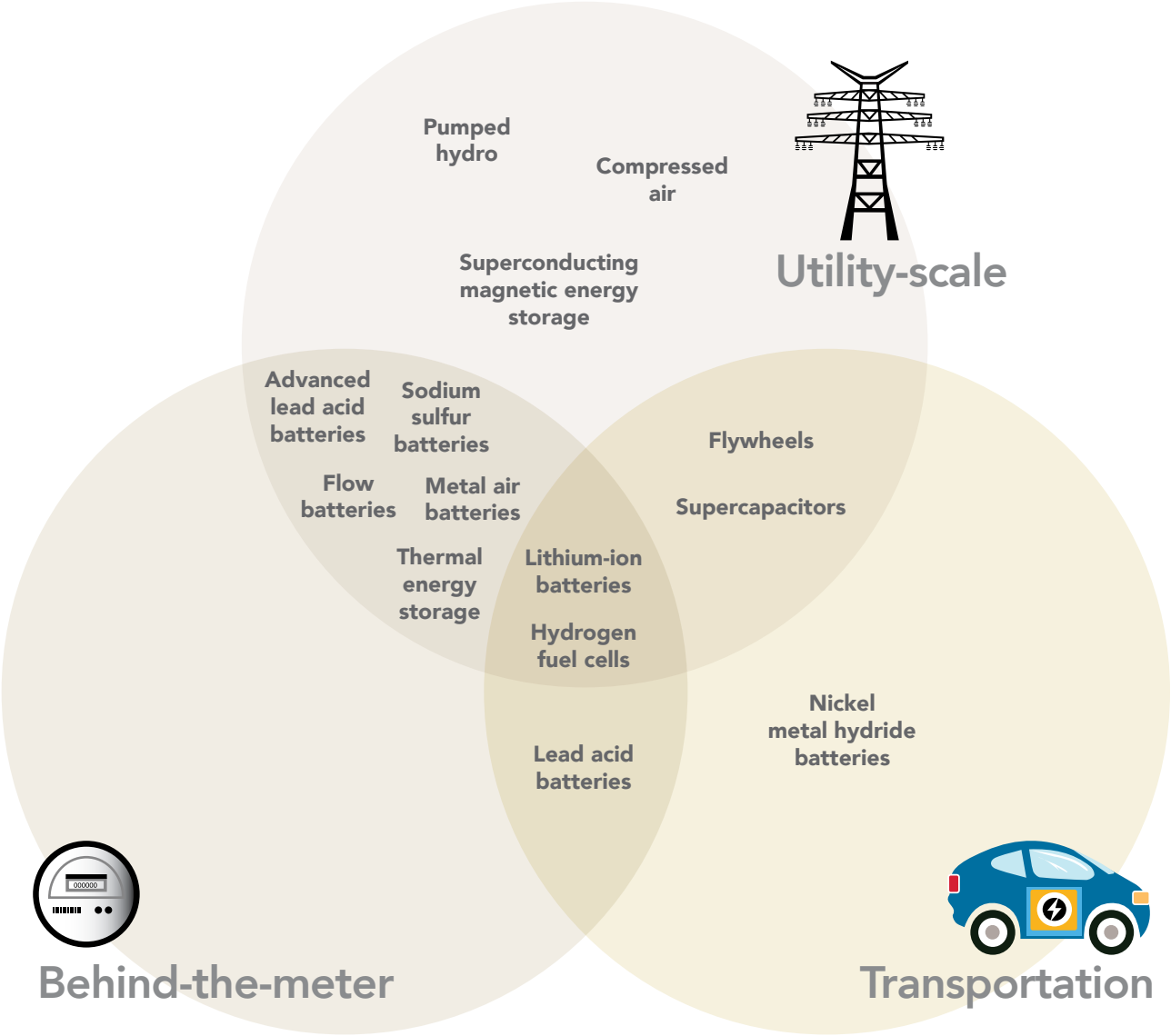


Improvements to existing technologies, systems, and processes include:

- Increasing the energy density, lowering the cost, and increasing the thermal stability of electrochemical batteries.
- New approaches to manufacturing technologies and processes.
- Improving the power density and system durability of hydrogen fuel cells.
- Developing superconducting magnetic energy storage with cheaper, more abundant materials.
- Increasing the energy and power density of supercapacitors.
- Reducing soft costs associated with installation and operation.

In transportation, the same advances in lithium-ion batteries and hydrogen fuel cells will benefit electric vehicles. Current research is focused on improving battery capacity (which translates to driving range), decreasing the time to charge the battery, and optimizing the durability, size, and cost of hydrogen fuel cells.

ENERGY STORAGE TECHNOLOGIES BY USE CASE



Why Energy Storage in New York?

New York could catalyze economic growth and job creation by harnessing its strengths in the energy storage industry. State leaders could capitalize on increasing national and global demand for energy storage by mobilizing New York's manufacturing and industry assets, leveraging its robust R&D investments, fortifying its commitment to clean energy, and creating quality jobs for New Yorkers.

Rapidly Growing Energy Storage Market

Global demand for energy storage is soaring thanks to falling energy storage technology costs and policy environments that enable greater market participation and properly value the benefits of energy storage to the electricity grid and the transportation sector. This growth is happening quickly: The $11.8 billion global market is estimated to grow 8.4 percent each year up to 2022. The long-term prospects are even stronger: The global market for utility-scale and behind-the-meter batteries is projected to attract $620 billion in investment and grow to over 940 GW in installed capacity by 2040, up from roughly 3 GW in 2018. Installed utility-scale storage capacity will likely lead the market until around 2035, when it will be overtaken by behind-the-meter capacity. While both the grid and transportation market segments will rapidly grow, demand for energy storage for electric vehicles is expected to far exceed that of stationary storage by 2040.

Lowering the cost barrier of energy storage technologies will further catalyze market growth and accelerate efforts to meet ambitious clean energy targets worldwide. Economies of scale, further technological advances and hardware improvements, and soft cost reductions can increase the accessibility and cost-competitiveness of energy storage. For example, EV battery prices plummeted 79 percent over seven years to reach $209 per kWh in 2017, while the average amount of energy that can be stored has increased 5-7 percent annually. Analysts have stated that Tesla is on track to achieve battery cell production at $100 per kWh by the end of 2018. Grid-connected storage systems have also experienced significant price drops, but they will see a more modest 8 percent annual cost decline through 2022.

Diverse Manufacturing and Industry Assets

The state's diverse manufacturing and industry assets offer a strong platform for knowledge exchange and supply chain growth to help manufacture batteries, supercapacitors, fuel cells, and EVs for the global market. The New York Battery and Energy Storage Technology Consortium (NY-BEST) is a nonprofit industry association with the mission to grow the state's energy storage ecosystem. Its efforts to expand commercialization resources, facilitate business connections, and educate policymakers support nearly 100 New York energy storage companies. The state's company base includes expertise in hardware manufacturing, advanced materials, software development, and project management. Industry players include established companies such as General Electric, Ioxus, and Lockheed Martin, as well as many startups such as C4V, Urban Electric Power, and NOHMs Technologies. New York is also expanding critical capabilities in battery recycling, with investment in the new SungEel MCC Americas lithium-ion battery recycling plant.

Cutting-Edge Research

New York ranks fifth in the nation for energy storage patents, which illustrates the depth of energy storage R&D at its universities, national lab, and businesses. The state's intellectual expertise includes next-generation battery chemistries, fuel cells, and materials science. For example, Binghamton University, Brookhaven National Laboratory, Columbia University, Cornell University, and Stony Brook University lead breakthrough research at six DOE Energy Frontier Research Centers; these collaborative projects examine the properties of molten salts, alkaline fuel cells, and other electrochemical materials, with applications to energy storage technologies. Alfred University is an internationally recognized institution for advanced ceramics, which are commonly used in batteries and can be employed in supercapacitors.

Additionally, the state's network of Centers for Advanced Technology and Centers of Excellence encourage industry-university collaborations for applied research and product commercialization,

such as Rensselaer Polytechnic Institute's partnership with Plug Power to develop an automated hydrogen fueling station. This emphasis on technology transfer has also fostered a handful of innovative energy storage companies like SUNY Polytechnic Institute spin-offs Besstech and Eonix. However, fostering a stronger entrepreneurial culture can help better leverage the innovative R&D in New York.

The state has significantly invested in state-of-the-art prototyping, product development, commercialization, and testing facilities with specialized infrastructure and expertise for energy storage innovation. In Rochester, the Battery Prototyping Center, Kodak Coating Services and Cell Assembly Center, and BEST Test and Commercialization Center round out the core battery manufacturing processes—prototyping, electrode development, pilot-scale cell manufacturing, and product testing. Businesses can also access more distributed testing resources through the university system and the Center for Evaluation of Clean Energy Technology network.

Clean Energy Leadership

The 2015 State Energy Plan, which charts a path for New York's Reforming the Energy Vision (REV) initiative, set ambitious statewide goals to improve public health, maximize energy efficiency, keep more energy dollars in the state economy, and create local jobs. By 2030, New York must reduce greenhouse gas emissions by 40 percent from 1990 levels, generate 50 percent of electricity from renewables, and reduce building energy consumption by 23 percent from 2012 levels. These goals are supported by strategic efforts to create a favorable regulatory environment, activate and accelerate the market, and have state agencies lead by example.

State leaders recognize energy storage as a key enabling technology and have made further commitments to deploy 1,500 MW of installed storage and 850,000 EVs by 2025. In June 2018, the New York State Energy Research and Development Authority (NYSERDA) and the Department of Public Service (DPS), together with stakeholders, released the New York State Energy Storage Roadmap, which recommends promising near-term actions to establish clear market signals, lower deployment costs, and reduce red tape for deployment. The Roadmap recommendations and public comments will be considered in an Order by the Public Service Commission (PSC) and new actions are expected by the end of 2018.

Although wholesale electricity markets and utility demand-side management offer some compensation mechanisms, the PSC and New York Independent System Operator (NYISO) are making steady progress on building more robust revenue streams for energy storage. The PSC has also elevated discussions on transportation electrification infrastructure needs, in response to input gathered from environmental and industry stakeholders. State incentives including the $70 million Drive Clean Rebate, at least $200 million available through the NY Green Bank, and the proposed $350 million in market acceleration incentives will help lower the cost barrier. Utilities are also investing in proving technology feasibility and benefits, with initiatives including the New York Power Authority (NYPA) 20 MW battery system and Con Edison's vehicle-to-grid demonstration project. Furthermore, while more work still remains, local efforts to streamline battery permitting and interconnection rules in New York City could reduce soft costs and serve as a foundation for the rest of the state.

Opportunity to Support Good-Paying Jobs

By advancing forward-thinking solutions, energy storage manufacturing and deployment could grow to support 27,400 jobs by 2030. (*See Appendix for jobs modeling methodology.*) The industry could bolster New York's economy while offering robust employment opportunities that cater to different education and experience levels. Despite steady economic recovery since the recession, New York still faces steep job losses in the manufacturing sector, which offers average salaries of $74,000. Between 2010 and 2016, the state's manufacturing employment dropped 3 percent while some upstate regions lost 16 to 23 percent of their manufacturing jobs. This trend is important to address: Manufacturing facilitates a strong labor market with pathways to good-paying job opportunities in the local economy, which can support historically disadvantaged groups that are facing severe employment barriers and low wages. Furthermore, building a stable, local market not only helps retain manufacturers but also fosters hundreds of middle-wage jobs in project development, installation, operations, and maintenance.

SAMPLING OF JOBS IN ENERGY STORAGE

Energy storage jobs can be categorized across four broad phases of industry development: research and development; manufacturing; installation, operation, and maintenance; and sales and support. Some occupations span multiple phases. New York's energy storage industry currently depends on research and manufacturing workers. As the local market grows, New Yorkers will have future employment opportunities in project development, installation, and sales.

Occupation	Responsibilities	Typical Education Level	Median Hourly Wage (NY, 2017)
RESEARCH AND DEVELOPMENT			
Chemists	Analyze how chemical substances interact on a molecular level for product development.	86% Bachelor's degree 7% Master's degree 4% Associate degree	$36.79
Materials Scientists	Research how physical structure affects material properties to develop and test products.	35% Bachelor's degree 33% Doctoral degree 19% Master's degree	$48.74
Chemical Engineers	Apply science and math to plan and oversee production of chemicals and other products.	82% Bachelor's degree 9% Master's degree 9% Doctoral degree	$45.77
Electrical Engineers	Design and develop electrical equipment.	70% Bachelor's degree 23% Master's degree 3% High school diploma or equivalent	$47.20
Mechanical Engineers	Design and develop mechanical equipment.	83% Bachelor's degree 7% Associate degree 5% Some college, no degree	$41.56
Electromechanical Technicians	Operate and maintain unmanned, automated, or electromechanical equipment.	41% Associate degree 30% Post-secondary certificate 13% High school diploma or equivalent	$31.83
Software Developers	Develop computer applications or specialized programs.	80% Bachelor's degree 16% Master's degree 3% Associate degree	$52.91
Commercial & Industrial Designers	Develop the concepts for manufactured products.	52% Bachelor's degree 25% Associate degree 11% Some college, no degree	$32.58

Occupation	Responsibilities	Typical Education Level	Median Hourly Wage (NY, 2017)
MANUFACTURING			
Electrical, Electronic, & Electromechanical Assemblers	Assemble electrical and electronic parts into finished products.	55% High school diploma or equivalent 25% Less than high school diploma 12% Some college, no degree	$15.03
Machinists	Operate computer and mechanically controlled machine tools.	50% Post-secondary certificate 34% High school diploma or equivalent 5% Associate degree	$21.60
Industrial Production Managers	Oversee the daily operations of manufacturing.	42% Bachelor's degree 30% Some college, no degree 15% Associate degree	$58.54
INSTALLATION, OPERATIONS, AND MAINTENANCE			
Energy Storage Installers	Install batteries, inverters, software controls, and wiring, and perform onsite programming.	High school diploma or equivalent	$21.00 (US, 2016)
Electrical Power Line Installers & Repairers	Install or repair power and telecommunications cables.	Post-secondary certificate	$40.07
Electricians	Install and maintain electrical power, communications, lighting, and control systems.	59% Post-secondary certificate 18% High school diploma or equivalent 8% Less than high school diploma	$34.26
SALES AND SUPPORT			
Sales Representatives	Sell wholesale and manufactured products.	39% Bachelor's degree 30% Some college, no degree 14% High school diploma or equivalent	$41.84

STATE ASSETS TO SUPPORT ENERGY STORAGE CLUSTER DEVELOPMENT

There are five foundational building blocks for clusters: innovation ecosystem, access to capital, workforce development, value chain, and local market. New York has many assets that can be aligned with cluster-based development, including its diverse business network of nearly 100 companies, robust energy storage R&D, and clean energy leadership.

STATE ASSETS TO SUPPORT ENERGY STORAGE CLUSTER DEVELOPMENT

New York can capitalize on its strengths in energy storage by strategically building an economic cluster. The state has the opportunity to build upon its commitments to deploy 1,500 MW of installed storage and 850,000 EVs by 2025. While the state's leaders can accelerate the local energy storage market to achieve a clean energy future, cluster-based development could leverage existing industry assets to ensure New York entrepreneurs and businesses are well positioned to participate in the market and New York workers can obtain living-wage jobs in a sustainable industry.

Clusters require several foundational building blocks coordinated for growth: an innovation ecosystem that cultivates new ideas, access to capital for new and expanding businesses, education and training for a skilled workforce, a comprehensive value chain, and a local market for New York-made goods. When reinforced by clear market signals and policy certainty, these assets translate into major opportunities for business growth and job creation in the target industry, laying the groundwork to catalyze economic opportunity for thousands of New Yorkers.

Innovation Ecosystem: Innovation is essential for business and industry competitiveness, and a strong knowledge hub can be a beacon for talent and investment. The innovation ecosystem supports fundamental research across universities and labs, fosters an entrepreneurial culture that seeks to advance and disrupt industries, and brings ideas to market.

Access to Capital: Access to investors or competitively priced non-dilutive capital can be the difference between success and failure for a new or expanding business. Consistent access to capital from the seed and early/growth stages to the late stage of development is also important. An active investment environment can attract more entrepreneurs and investors to the state.

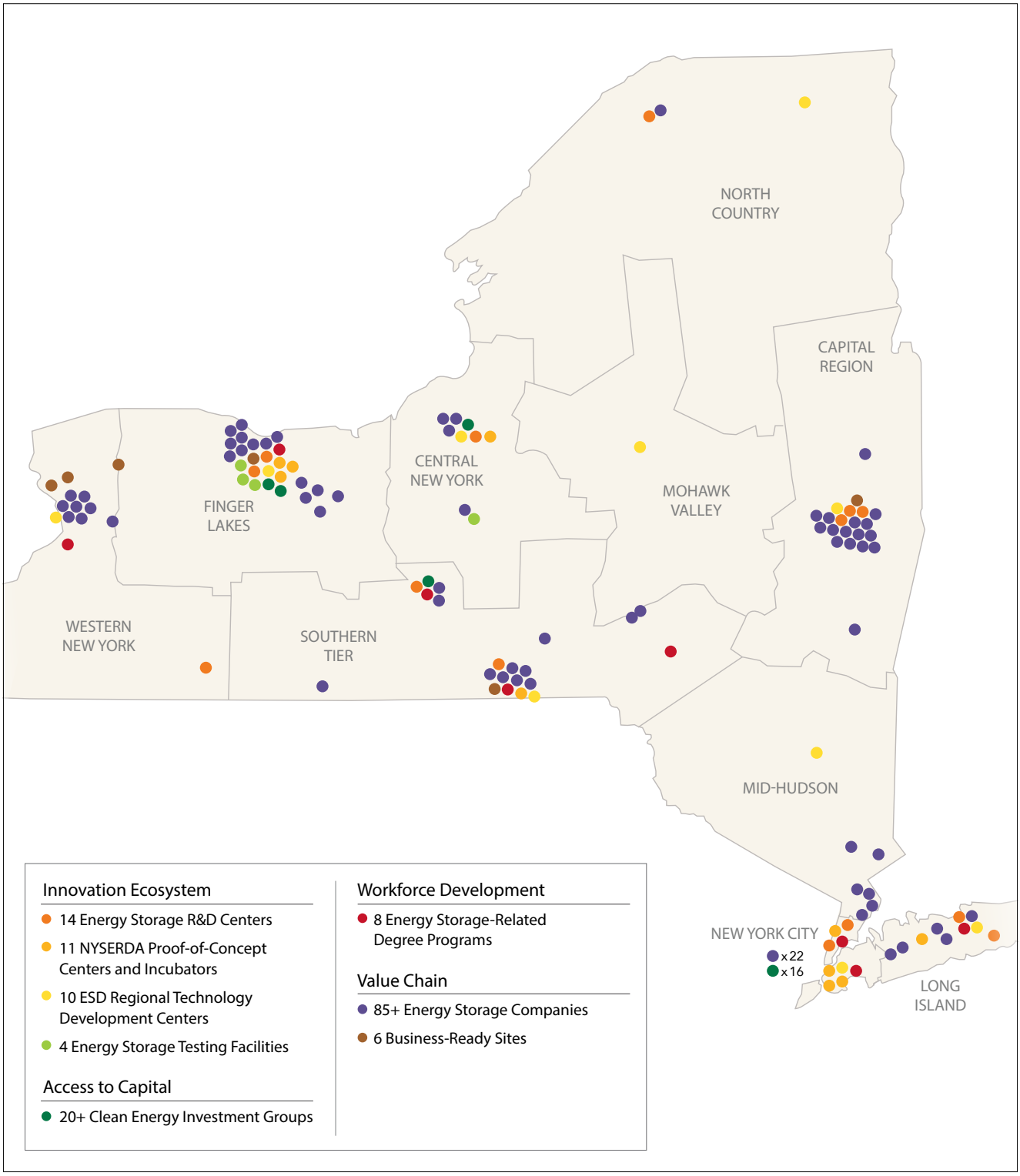
Workforce Development: Trained and skilled workers are fundamental to industry success, and strategic workforce development can support talent recruitment and retention. Workforce development requires collaboration across schools, businesses, and government offices to integrate STEM education, foster industry-ready skills via apprenticeships and career-integrated curriculum, enable stackable credentials that offer multiple entries and exits, and provide resources that match skills to available jobs.

Value Chain: An industry value chain is composed of an array of companies engaged in the manufacturing, sale, marketing, and distribution of technologies. It also includes organizations that represent business interests across these areas. This base provides a solid foundation from which to attract more companies and customers.

Local Market: Creating a local market for products sends a market signal to businesses that encourages investment in new facilities and employees. High local demand can attract a local company base that could then expand to regional, national, and global markets. Clear utility and business regulatory environments coupled with resources for project development and end-user adoption can create a strong local market.

SAMPLING OF NEW YORK ENERGY STORAGE ASSETS

New York is on its way to becoming an energy storage leader thanks to numerous state assets. The following pages give a snapshot of the state's strengths in each foundational building block and showcase significant resources for New York's energy storage industry.



INNOVATION ECOSYSTEM. New York ranks fifth in the nation for energy storage patents, which illustrates the depth of energy storage R&D that is happening across its universities, national lab, and businesses. To bring these ideas to market, New York offers an extensive regional business/technology development network and state-of-the-art testing facilities. Statewide proof-of-concept centers and incubators are among the many programs NYSERDA offers to help clean energy startups refine their product, grow their business, access funding, and build their network.

- New York has **at least 14 R&D centers** engaged in cutting-edge energy storage research.
- Companies can access resources statewide to cultivate business ventures, including **11 NYSERDA innovation assets** and **10 ESD regional technology development centers.**
- New York is home to **4 energy storage testing facilities**, with 3 located at or near the **Eastman Business Park** in Rochester.
  - **Battery Prototyping Center:** Equipment and services to prototype next-generation batteries.
  - **Kodak Coating Services and Cell Assembly Center:** High-volume electrode development and pilot scale cell manufacturing.
  - **BEST Test & Commercialization Center:** Product testing and qualification from the cell to system level.
  - **Center for Evaluation of Clean Energy Technology:** Performance testing for large-scale energy storage systems and storage-integrated solar and wind arrays.
- **NY-BEST BRIDGE Program:** Free one-on-one assistance for participating energy storage startups.
- **NYSERDA Entrepreneurs in Residence Program:** Strategic advice from seasoned entrepreneurs for NYSERDA-associated startups.

ACCESS TO CAPITAL. New York offers a wealth of financial resources to support business development, encourage private investments, and facilitate small business lending. However, companies still face challenges accessing funds due to restrictive reimbursement models, personal guarantee requirements, and timelines that are not aligned with business needs. Companies also often experience a shortfall of support at the manufacturing stage.

- **NYSERDA Ignition Grants:** Up to $100K grants for NYSERDA-supported companies to achieve near-term business development outcomes.
- **Empire State Economic Development Fund:** Funds for facilities acquisition, renovation, or construction; capital equipment; working capital; and employee training. In 2016-2017, funded 30 projects for a total of $26.6M.
- New York makes pre-seed, seed, and series A investments through the **$8M Innovation Technology Commercialization Investment Fund** and **$100M Innovation Venture Capital Fund**.
- The state has **over 20 clean energy investment groups**, with the majority located in NYC.
- New York enables better access to small business financing through loan assistance programs, such as the **Capital Access Program**, **Linked Deposit Program**, and **JDA Direct Loan Program**.
- Business plan competitions include Southern Tier's **76West**, Western New York's **43North**, and the statewide collegiate **NYBPC**.
- **New York Business Incentive Wizard:** An online capital locator tool for businesses.

WORKFORCE DEVELOPMENT. In New York, education on energy storage technology largely happens at the graduate science and engineering level, with a few training programs on solar-plus-storage systems. Some local unions have also integrated battery storage and EV charging stations into their training opportunities. Energy storage training can be embedded in more of the state's numerous electrical continuing education, clean energy, and advanced manufacturing programs to support career pathways for system design, installation, and production line jobs.

- New York has **at least 8 energy storage-related degree programs**, including clean energy and advanced manufacturing training offered at the **Northland Workforce Training Center** in Buffalo and graduate materials science education at **Binghamton University**.
- **NYSERDA Clean Energy Workforce Funding Opportunities:** $7M for training providers to deliver training and job placement assistance; $10M for businesses to support on-the-job training for new workers; and $10.5M for businesses to provide paid internship opportunities for post secondary students.
- **SUNY Clean Energy Workforce Funding Opportunities:** $15M for community colleges to support educational programs, apprenticeships, and industry partnerships. No funds allocated to energy storage-specific programs to date.
- **ESD Employee Training Incentive Program:** Refundable employer tax credits to support new and incumbent worker training and internship programs in advanced technology or life sciences.
- **Manufacturing Intermediary Apprenticeship Program:** Public-private pilot program to sponsor registered manufacturing apprentices in the Capital Region.
- **Workforce Development Institute (WDI) Interactive Grant Program:** Flexible funding to facilitate programs that build skills and strengthen an employer's ability to hire and promote workers.
- **Pathways in Technology (P-TECH):** Public-private partnerships to implement accelerated and cost-free career-connected learning in technology, manufacturing, healthcare, and finance for students across grades 9 through 14.

VALUE CHAIN. New York is home to nearly 100 energy storage companies engaged in advanced materials, hardware manufacturing, software development, and project management. NY-BEST convenes industry, government, and academia to elevate the state's energy storage industry. Regional economic development councils can also help attract and retain businesses by bolstering local ecosystem assets and leveraging clean energy incubators and business-ready sites.

- **Nearly 100 energy storage companies** do business in New York, supported by supply chain businesses including contract manufacturers and professional service firms.
- **NY-BEST:** Cluster partnership dedicated to building New York's energy storage ecosystem.
- **START-UP NY:** Incentive to operate tax-free for ten years available to new and expanding businesses that partner with higher education institutions.
- New York has numerous locations that can support high-tech manufacturing, including the following **6 business-ready sites**.
  - Eastman Business Park (Rochester)
  - IBM Huron Campus (Endicott)
  - Saratoga Technology + Energy Park (Malta)
  - Western New York Science and Technology Advanced Manufacturing Park (Alabama)
  - Cambria Technology Park
  - Niagara Airport Commercial Park

LOCAL MARKET. New York will soon be a hotbed for energy storage deployment, as in-state partners ramp up efforts to deploy 1,500 MW of installed storage and 850,000 EVs by 2025. In particular, the New York State Energy Storage Roadmap created a platform for stakeholder discussion and strategic implementation. As the state moves forward, key actions for opening up the energy storage market will be to streamline and standardize permitting requirements as well as to enable systems to "stack" multiple value streams.

- **New York State Energy Storage Roadmap:** Effort led by NYSERDA, DPS, and stakeholders to identify promising near-term market development activities, regulatory changes, and soft cost reductions to catalyze deployment.
- **Energy Storage Deployment Proceeding:** PSC to establish deployment mechanisms and a 2030 storage procurement goal.
- **NYISO Energy Storage Participation Model:** Progress on clarifying rules for participation in wholesale capacity, energy, and ancillary services markets in compliance with FERC Order 841, as well as potential rules for"dual participation" in both wholesale and retail markets.
- **EVolve NY:** Up to $250M committed by NYPA through 2025 to address EV infrastructure challenges, such as high-speed chargers along interstate highways, airport charging hubs, and model EV-friendly communities.
- **Transportation Electrification Proceeding:** PSC to address EV supply equipment and infrastructure needs.
- **Project Incentives**
  - **Proposed Market Acceleration Incentive:** $350M available for integrated solar-plus-storage projects and standalone energy storage systems.
  - **NY Green Bank:** At least $200M designated for energy storage-related projects.
  - **Drive Clean Rebate:** Up to $2K rebates for new EV purchases.
  - **Con Edison Demand Management Program:** About $32M available as per-kW incentives to large customers in NYC and Westchester for demand reduction projects, such as thermal and battery storage.
- **NYC Battery Permitting and Interconnection Guidelines:** Multi-year collaboration among city agencies, CUNY, Con Edison, and NYSERDA to provide comprehensive municipal guidelines for lithium-ion battery projects and assist permitting agencies statewide with energy storage installations.

POLICY RECOMMENDATIONS

To grow the energy storage industry, public and private sector leaders can address barriers and capitalize on opportunities across foundational building blocks, such as expanding access to entrepreneurial resources, increasing available capital for businesses, bolstering job readiness and technical skills development, and mapping strategic value chain assets. These forward-thinking policies, programs, and ideas are intended to serve as stepping stones to discussion and collaboration.

POLICY RECOMMENDATIONS

To help create tens of thousands of jobs and bolster in-state manufacturing, New York's public and private sector leaders can capitalize on the state's competitive strengths and demonstrate their commitment to the energy storage industry by implementing smart, forward-thinking policies and non-legislative solutions. The following recommendations complement New York's forward-looking market development efforts, including clarifying market rules and investing in local deployment. The strategies in this report address barriers and missed opportunities to ensure that in-state deployment benefits New York businesses and workers, such as fostering technology development and commercialization, increasing business access to financial resources, improving workforce training, and growing the in-state value chain. Robust technology demand near manufacturing facilities can help create synergies that drive innovation, train and retain talent, and attract out-of-state investors.

Whether taken as a whole or as piecemeal solutions, the recommendations could attract private investment, stimulate the state's economy, and create good-paying jobs for New Yorkers. Although they draw on model policies and programs from elsewhere, state and local leaders can also advance novel solutions that become case studies for other states.

Innovation Ecosystem: Expands access to energy storage prototyping and testing resources and fosters an entrepreneurial spirit across universities.

Access to Capital: Increases available capital for energy storage businesses and ensures funding resources are responsive to business needs.

Workforce Development: Strengthens educational pathways for job readiness skills development and technical training for the energy storage industry.

Value Chain: Maps strategic assets for energy storage industry growth and leverages them for business recruitment and economic development.

Policy 1: Establish an Innovation Voucher Program

BARRIER

New York's leaders have invested in exceptional facilities to support energy storage technology development, including the RIT Battery Prototyping Center, Kodak Cell Assembly Center, and BEST Test and Commercialization Center. Facilities that centralize prototyping and manufacturing resources can help reduce costs for businesses, encourage knowledge sharing, and accelerate commercialization. However, early-stage startups often face the "technological valley of death." They require thorough performance data to build investor confidence in their prototypes, but often struggle to secure funding to pay for testing and validation resources.

SOLUTION

New York's leaders should consider establishing an innovation voucher program that serves local innovators and helps them bridge the technology development gap. Through the innovation voucher program, small businesses could apply for vouchers to use services at state-supported energy storage testing facilities while the state could pay these facilities to work with small businesses. Services available for voucher exchange could include small-scale coating, assembly, and testing as well as consultations with technical experts to refine manufacturing products and processes. Program administrators, testing facility leaders, and small businesses could work closely together to ensure services covered by vouchers are properly valued and in alignment with industry needs. New York's leaders could look to Tennessee's RevV! program, which enables manufacturers' access to lab equipment and services (*see case study*), as a starting point for the state's innovation voucher program.

Key Players: NYSERDA, Universities, NY-BEST, Energy Storage Testing Facilities, Businesses, State Legislature

Case Study: RevV!

RevV! is a state innovation voucher program that leverages resources and expertise at Oak Ridge National Laboratory (ORNL) to support business growth in Tennessee. Through the program, local manufacturers can receive vouchers to tap into ORNL's capabilities and exceptional facilities in advanced manufacturing demonstration; advanced materials processing, characterization, and fabrication; and computational science. Managed jointly by ORNL and the University of Tennessee, RevV! was initially piloted in 2015 with $2.5 million in state funding as part of a regional cluster development strategy. It has since received a second round of $2.5 million, and in 2018 it will become a permanent program with additional funding from the state. RevV! is open to any business that employs at least ten people and currently manufactures a product. Innovation voucher amounts vary, but some companies have received as much as $125,000 to take advantage of the unique offerings of ORNL.

Policy 2: Strengthen the Entrepreneurial Culture at Universities

OPPORTUNITY

New York's universities excel at fundamental energy storage research, offering deep expertise in next-generation battery chemistries, fuel cells, and materials science. Universities could multiply the economic impact of faculty and student researchers' breakthroughs by fostering an entrepreneurial culture and streamlining technology transfer. In fact, a 2017 survey of 6,840 doctoral students in science and engineering across thirty-nine research universities found that students are 41 percent more likely to disclose inventions and 87 percent more likely to become entrepreneurs if entrepreneurial careers were encouraged alongside academic pursuits. Strengthening entrepreneurship not only means greater funding opportunities, improved industry relations, and positive publicity for the universities, but also homegrown businesses with innovations that benefit society and support local job creation.

Many leading energy storage research universities are affiliated with New York's network of Centers for Advanced Technology, Centers of Excellence, and clean energy incubators, which facilitate applied industry-university research and technology transfer; however, they have the opportunity to implement policies and programs that instill an entrepreneurial culture university-wide, not just at these centers and in business schools. These efforts would build human capital across diverse disciplines and encourage collaboration to scale New York's cutting-edge energy storage research.

SOLUTION

New York's leading energy storage research universities could adopt policies and programs that support entrepreneurship and commercialization among faculty, students, alumni, and the community. To specifically target faculty entrepreneurs, universities could acknowledge faculty members for authoring patents or accelerating university innovation by expressly including technology transfer and commercialization activities in the criteria considered for promotion and tenure (*see call-out box*). A complementary policy could be to allow one- to two-year entrepreneurial leaves of absence for faculty, during which fringe benefits are still available and accruable, as implemented at the University of Minnesota (*see case study*). Startup support programs could also connect faculty and students with seasoned faculty entrepreneurs who can offer advice and direction, as seen at the University of Utah (*see case study*).

New York's universities could also expand their impact by building entrepreneurial connections with the broader community. Specifically, university offices and programs that provide direct support to entrepreneurs could establish pre-negotiated relationships with local service companies frequently used by startups, a strategy that has seen success at the University of California, Los Angeles (*see case study*). This effort could ensure an affordable and streamlined on-ramp for startups as well as build stronger ties across the entrepreneurial ecosystem. By taking measures to promote commercialization, New York will better leverage one of its best assets for growing the energy storage industry and meeting its clean energy goals.

Key Players: Universities, Entrepreneurs

Sample Language for Incorporating Entrepreneurial Activities in Tenure and Promotion Review

Virginia Polytechnic Institute and State University (Virginia Tech)

"Economic contributions and entrepreneurship: 1. Start-up businesses (including competitive grants and contracts such as SBIR awards and other notable business achievements), 2. Commercialization of discoveries, 3. Other...Intellectual properties: 1. Software, 2. Patents, 3. Disclosures (pre-patent)"

The Ohio State University

"… creative works pertinent to the candidate's professional focus:...Inventions and patents, including disclosures, options, and commercial licenses"

The University of Arizona

"...integrative and applied forms of scholarship that involve cross-cutting collaborations with business and community partners, including translational research, commercialization activities, and patents"

Case Study: University of Minnesota

The University of Minnesota's entrepreneurial leave of absence policy allows faculty members up to eighteen months of unpaid leave to explore commercializing university intellectual property without compromising their benefits. While faculty members pursue startup projects, they continue to maintain health benefits, accrue vacation time, and earn other fringe benefits. In addition to the Venture Center, the policy is among a slate of resources that University of Minnesota advanced to maximize the impact of internal research and strengthen connections to the local business community. This effort has fostered a robust startup ecosystem that includes over 130 spin-offs since 2006, with 78 percent still active. The University of Minnesota ranked fourteenth on the Milken Institute list of top commercialization universities.

Case Study: University of Utah

In 2007, the University of Utah launched the Entrepreneurial Faculty Scholars (EFS) program to create a broad network of support for faculty members commercializing their research. The network of 155 seasoned faculty entrepreneurs university-wide help faculty members take their ideas to market. Alongside EFS, the seven-week Lean Cohort accelerator program helps faculty navigate commercialization. As a result of the strong culture of innovation, the University of Utah produced $211.8 million in licensing income and supported sixty-nine startups between 2012 and 2015. The University of Utah ranked first on the 2017 Milken Institute Innovation Index.

Case Study: University of California, Los Angeles (UCLA)

UCLA has created a dedicated program for university community members looking to commercialize, which has resulted in multiple startups. The "Startup in a Box" program aims to launch startups using university intellectual property. The program offers pre-negotiated partnerships with local law, accounting, commercial real estate, marketing, web, human resources, insurance, and financial firms. Due in part to this initiative, UCLA ranked first for the number of startups in the 2017 Milken Institute report. As of fiscal year 2016, UCLA has $65.9 million in revenue from licensing and 1,075 active U.S. patents.

Policy 3: Facilitate Startups' Access to Educated Investors

BARRIER

Despite the critical role of energy storage in building a clean energy future, moving the rapidly developing technology from lab to market remains a challenge for the industry. Because energy storage encompasses many diverse technologies and use cases, potential investors who lack industry expertise may be unable to see the value proposition of individual energy storage businesses. Investors looking for quick returns may also be discouraged by the long lead times for technology development and market growth, as startups strive to remain competitive in the fast-moving industry and regulatory authorities build out more value streams for energy storage. Furthermore, because venture capital investment is concentrated in New York City, investors may miss out on promising investment opportunities coming out of innovation hubs across the state. By bridging the information gap, investors can better evaluate risks and returns in the energy storage industry. If investors become more familiar with the benefits of energy storage and the value proposition that these startups present, New York can help bring the state's innovative research to the market and cultivate businesses and jobs statewide.

SOLUTION

New York institutions engaged in the energy storage startup ecosystem could overcome this information and geographic barrier by hosting industry-specific investor education events and startup-investor networking opportunities throughout the state. Investor education events could help investors better understand energy storage technologies, industry trends, and unique opportunities presented by energy storage startups. Startup-investor networking opportunities could take the form of reverse roadshows that take investors to visit multiple startup operations or speed dating events where investors share their expertise with startups and then engage in one-on-one conversations. With organizations like NY-BEST and New York's wealth of incubators and universities, there is no shortage of potential organizers for these kinds of curated discussions. Organizers could use the Coronado Ventures Forum as a model for facilitating education and networking for emerging industries (*see case study*). Over time, these efforts could help investors better identify and evaluate promising energy storage startups and help local innovators gain greater levels of investment.

Key Players: NY-BEST, NYSERDA, Venture Development Organizations, Investors, Startups

Case Study: Coronado Ventures Forum

CVF launched in 1994 to foster entrepreneurship outside of New Mexico's two national labs by facilitating education and networking for fledgling technology innovators and "tech-savvy" investors. Past events have featured fireside chats, panels, and networking with in-state and out-of-state investors, startup accelerators, and venture-backed companies. CVF also hosts industry-specific events to discuss challenges for local startups, where the industry is going, what investors need to know, and how other startups have achieved success. For example, CVF has offered innovators and investors a close look at opportunities in traditional energy, advanced materials, software, healthcare, and creative industries. CVF is supported by local accelerators, investment funds, municipal offices, and startup service providers.

Policy 4: Establish Connections to Patient Capital

BARRIER

Early-stage companies and small businesses typically have limited financial capital for growth and development. These companies tend to lack physical assets that can be leveraged for bank loans and have yet to establish a revenue stream. This issue is particularly acute for companies developing new energy-related technologies, such as energy storage, that are capital-intensive and exhibit longer commercialization periods. Energy storage companies also struggle to stay competitive in a fast-moving market and cannot afford to wait the long periods of time associated with grant cycles. Energy storage manufacturers require higher levels of capital than typical small business funding programs are designed for. New York has a wealth of programs designed to help startups and small businesses access capital, but many of these programs are only available to startups on a reimbursement basis, require significant matches of private capital, or require long lead times. Other funds are tapped out and are no longer investing in companies.

SOLUTION

One underutilized source of capital for energy storage startups is philanthropic foundations. Foundations are able to make two kinds of investments that offer long-term capital to companies; these are known as program-related investments (PRIs) and mission-related investments (MRIs). Through PRIs and MRIs, foundations can invest in small and growing businesses rather than just awarding grants. Because foundations can prioritize the impact of the investment rather than narrowly looking at the direct market return, they can invest in high-risk, cutting-edge technologies and provide capital on longer timelines than traditional financing options. In recent years, several organizations have set out to dramatically increase the number of PRIs. For example, after making its first PRI in 2009, the Gates Foundation now has $1.5 billion dedicated to PRIs around the globe. NYSERDA has an existing relationship with PRIME Coalition, which brokers PRIs in early-stage clean energy companies.

Public or private sector leaders could designate and fund a specialist to develop sources of PRIs/MRIs and facilitate these investments in the state. The specialist could help local and national foundations navigate the complicated requirements associated with establishing PRIs/MRIs and connect them with the energy storage startup community. A potential first action item for the specialist could be to perform an audit of the philanthropic capital and existing PRI/MRI market size in New York. The specialist could also engage with high-net-worth individuals and family offices as additional sources of patient capital. New York's leaders could use Michigan's Foundation Liaison as a model for this specialist position (*see case study*). Providing assistance for streamlining PRIs and MRIs could unlock millions of dollars of additional capital for businesses in New York's energy storage cluster, driving economic growth throughout the state.

Key Players: Empire State Development, NYSERDA, Philanthropic Community, High-Net-Worth Individuals, Family Offices

Case Study: Michigan Governor's Office of Foundation Liaison

As the first of its kind in the nation, the Michigan Governor's Office of Foundation Liaison (OFL) builds funding partnerships and strategic collaborations between the state government and the philanthropic community to support programs that improve education and health for all Michigan residents. Foundations are actively engaged throughout OFL activities. The nonpartisan Foundation Liaison comes to the state government on loan from participating foundations while contributing funders and nonprofits partly comprise the OFL Advisory Committee. Since 2003, OFL has brokered investments from seventeen foundations, totaling more than $150 million.

Policy 5: Conduct an Energy Storage Workforce Development Study

BARRIER

New York is primed to become an energy storage manufacturing leader and hotbed for deployment; however, greater consideration of short- and long-term workforce needs is critical to ensure New Yorkers can benefit from the tens of thousands of energy storage jobs on the horizon. Workforce development requires extensive coordination between labor organizations, industry, universities and colleges, elementary/secondary education institutions, training professionals, local workforce development boards, community-based organizations, and government. Early discussions that engage as many stakeholders as possible and prioritize industry workforce needs will ensure sustainable energy storage industry growth in New York.

SOLUTION

New York's leaders could gather a stakeholder group to explore detailed workforce development needs for the state's growing energy storage industry. The main goal of this group should be to create a report providing an in-depth analysis of the types of jobs needed for energy storage manufacturing and deployment, the appropriate timescale for training the workforce, the volume of workers needed at different stages of market growth and levels of expected deployment, and other critical path issues as identified by the group.

New York's Workforce Development Institute recently authored a study aimed at building the local offshore wind workforce that could serve as a starting point for the state's energy storage report (*see case study*). This study focused primarily on jobs throughout project development, not manufacturing of offshore wind technology. Energy storage, however, has more manufacturing potential in the state in the near future, so an expanded focus is warranted. The Massachusetts Clean Energy Center recently published the 2018 Massachusetts Offshore Wind Workforce Assessment, which also breaks down key industry jobs, but provides more insight into the volume and timescale needed for each job type by identifying high-priority occupations based on anticipated demand and current lack of supply. New York's energy storage workforce development study could incorporate some of these elements as well.

The study compiled by the stakeholder group could serve as a guide to create training programs and map career pathways for the energy storage industry, including developing standard curriculum and expanding apprenticeship opportunities. Through the workforce assessment, New York's leaders could develop an energy storage workforce at a pace that is appropriate for the growing industry and is well prepared to manufacture, install, and maintain energy storage systems.

Key Players: Businesses, Training Providers, Employment Agencies, NY-BEST, NYSERDA, Department of Labor, Workforce Intermediaries, Universities, Community Colleges

Case Study: New York State and the Jobs of Offshore Wind Energy

In 2017, the Workforce Development Institute published a research report for the state of New York that offers insight into the assets and needs of the state's emerging offshore wind industry. The report offers a brief primer on offshore wind technology, the phases of construction of offshore wind installations, and the jobs associated with each phase of project development. In the report, the authors discuss how the expertise in labor unions can be tapped to help support the growing industry. Also included is an in-depth assessment of the types of jobs associated with the offshore wind industry and an identification of the gaps in the existing workforce. The report also details the existing training infrastructure in New York and recommendations for improvements.

Policy 6: Expand Integrated Basic Education and Skills Training

BARRIER

As the energy storage industry grows, New York will need to prepare a skilled and ready technical workforce; however, businesses face a significant skills gap in the state. In 2017, 70 percent of clean energy employers struggled to fill engineering, technician, and installation jobs, illustrating a gap in job candidates with technical skills and experience. Employers also cited insufficient soft skills, such as communication skills and a strong work ethic, as a reason for hiring difficulty. Moreover, 41 percent of New Yorkers had a high school equivalency or less in 2017, which may limit their eligibility for post-secondary training programs and opportunities to develop these in-demand skills. If more New Yorkers are fitted with critical basic and technical skills, the state will be better positioned to attract and retain energy storage businesses for industry growth.

SOLUTION

To support energy storage workforce development, New York's community colleges should consider expanding Integrated Basic Education and Skills Training (I-BEST), a proven strategy for launching students who lack a strong educational foundation into good-paying technical careers. I-BEST programs help students develop basic math and literacy competency while receiving professional and technical training tied to a specific career pathway. I-BEST courses are taught by two instructors in one classroom: Technical career curriculum is taught by an experienced professional while basic skills instruction is led by an expert in programs such as Adult Basic Education (ABE), English as a Second Language (ESL), and General Education Development (GED). Developed in Washington State (*see case study*), I-BEST is successfully implemented across the country, including LaGuardia Community College's longstanding programs for healthcare careers (*see case study*).

New York could establish additional I-BEST programs to help its workers develop the right skills and get on the fast track to successful careers as production floor workers, engineers, technicians, and other good-paying energy storage jobs. Community colleges could solicit support for implementation through NYSERDA's funding opportunities and the philanthropic community. New York's leaders could also direct state funding to I-BEST programs and leverage federal resources under the Workforce Innovation and Opportunity Act. Because energy storage is an emerging industry in the state, community colleges could initially leverage I-BEST for electrical, clean energy, and advanced manufacturing career pathways that include energy storage-related curricula. As industry hubs develop, schools in these areas could create focused certificate and degree programs specifically dedicated to the needs of local energy storage companies.

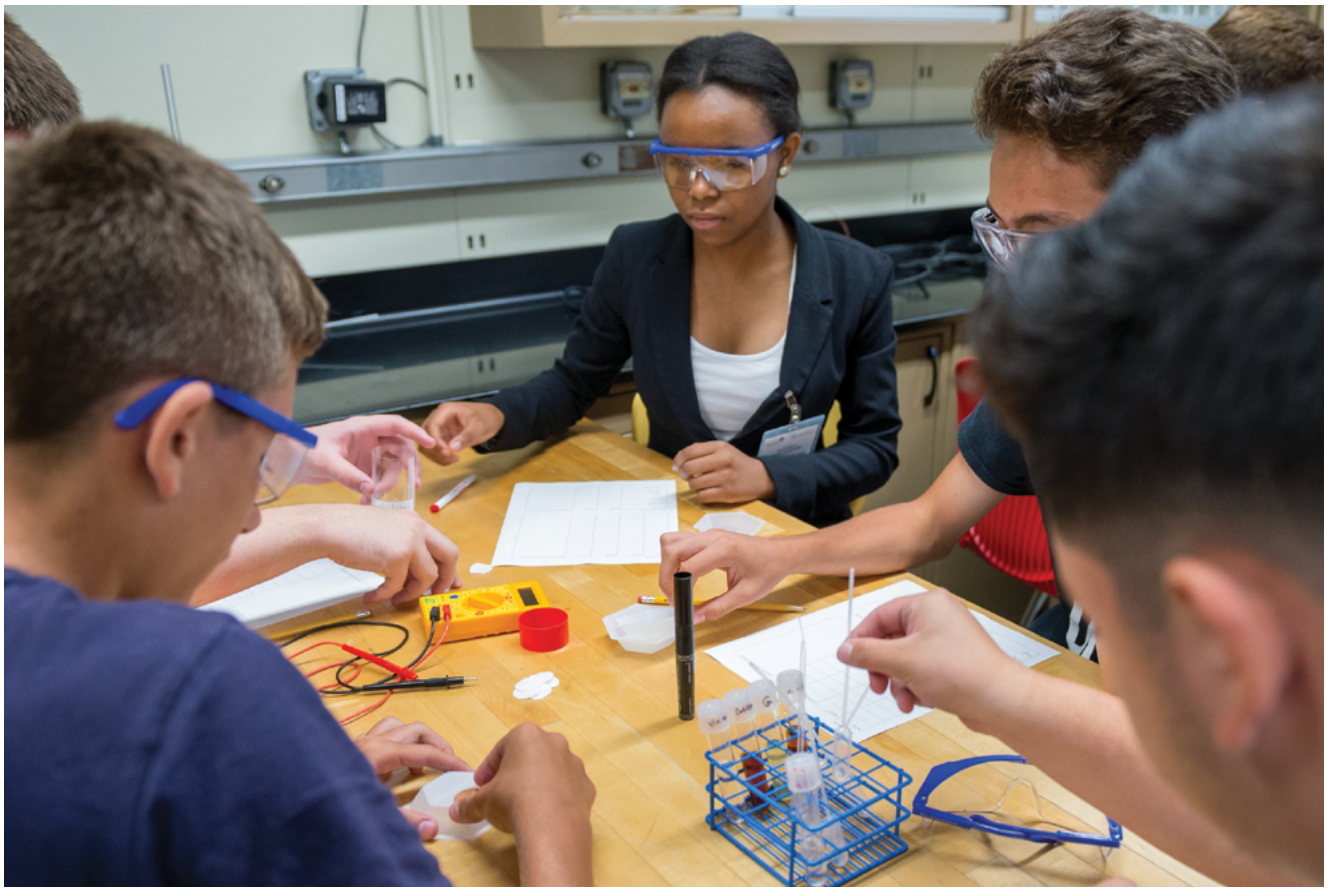
Key Players: Community Colleges, Businesses, Department of Labor, Education Department, NY-BEST, NYSERDA, Philanthropic Community, State Legislature, Local Workforce Development Boards

Case Study: I-BEST in Washington State

In 2004, Washington State implemented the first I-BEST program to help remedial students develop the basic skills they need to make it through college and into living-wage jobs. Now the state is home to over 170 I-BEST programs located across all thirty-four technical and community colleges. At Walla Walla Community College, for example, students can earn an associate degree in Energy Systems Technology, with concentrations in renewable energy, plant operations, facilities energy management, and mechanical electrical technology. Student participation is supported by state-funded Opportunity Grants in amounts up to $1,000 per academic year. I-BEST has enabled a more productive learning environment while also delivering positive employment outcomes. In fact, students who complete the program demonstrate net employment increases of 12.3 percent and earn an average of $1.61 more per hour than similar students who did not receive basic skills training.

Case Study: LaGuardia Community College's I-BEST Programs

Since 2009, LaGuardia Community College has established eight integrated healthcare career pathways based on Washington State's I-BEST model. Programs such as Supporting Adults through Vocational Emergency Medical Technician Training (SAVE) and National Council Licensing Examination (NCLEX) Preparation for English Language Learners help underserved communities achieve literacy and language proficiency while preparing them for healthcare careers. Adult learners and, in the case of the NCLEX program, immigrant nurses who have fifth- to eighth-grade reading levels can gain credentialing and employment opportunities that they might not have otherwise been able to access before the low-cost, accelerated I-BEST programs. Of the 277 SAVE students that have enrolled as of January 2016, 85 percent completed the training and passed the licensing exam and 82 percent got an EMT job within three months of program completion. The NCLEX program has a 98 percent graduation rate and 93 percent pass rate for practical nurse licensure, with licensees seeing a pay increase from $12.02 to $26.45.



Policy 7: Build a State-Level Network of Qualified Energy Storage Contractors

OPPORTUNITY

As energy storage becomes mainstream, New York will require qualified contractors to ensure safe and efficient system installations. While many energy storage vendors leverage their own network of certified installers, New York should consider developing an independent review process. Standardizing contractor requirements for energy storage can guarantee up-to-date licensing and knowledge of local installation guidelines. Safe installations will help boost customer confidence in the technology and strengthen the local market.

SOLUTION

New York could build a qualified contractor network for energy storage. Similar to its requirements for solar PV contractors, NYSERDA could identify relevant credentialing paths that make a contractor eligible to participate in its energy storage programs. For solar PV, contractors are eligible if they have one of three certifications: NABCEP Certification, IBEW-NECA Electrical Journeyman & Apprentice Training, or UL Credential. NYSERDA could connect with these national organizations to see whether their training programs include energy storage curriculum. NYSERDA could also expand eligibility to licensed journeyman/master electricians and professional engineers with training in energy storage and work with jurisdictions to ensure licensees have relevant knowledge. For example, NYSERDA could encourage jurisdictions to include questions on electrical standards and design fundamentals for energy storage system installation in licensing exams. NYSERDA could also encourage jurisdictions that require continuing education for license renewal to include training on these topics. By making sure customers have access to qualified contractors, New York can support safe and streamlined technology adoption.

Key Players: NYSERDA, Department of Labor, Municipal Licensing Departments, Training Providers, Contractor Associations

Policy 8: Establish an Energy Storage Job Board

OPPORTUNITY

The energy storage industry could mean thousands of local jobs in R&D, manufacturing, project development, and sales. While general job boards help connect New Yorkers with job openings statewide, keyword searches and standard occupational classifications may limit what energy storage job postings users see. New York's leaders have the opportunity to create an energy storage-specific platform that showcases what jobs are available and serves as a resource for local businesses, jobseekers, training providers, employment agencies, and policymakers. Many of New York's current energy storage R&D and manufacturing companies leverage relationships with local universities to recruit workers. These businesses could also utilize the job board to engage with interested candidates from other schools and outside the education system. As the industry expands to include downstream jobs and more training programs, the job board could not only build career awareness but tailor skills development for New Yorkers entering the workforce and employed in related industries.

SOLUTION

State and local leaders could develop a free online job board for New York's energy storage industry or consider building a clean energy job board that includes energy storage. Job board managers could use the Massachusetts Clean Energy Center Jobs Board and the Minnesota Clean Energy Job Board as models for ease of access and collaborative efforts to engage workers in the local clean energy industry (*see case studies*). Jobseekers nationwide can utilize the job board for free and filter openings by region, job function, job type, and experience level. In addition to job postings, New York's job platform could host descriptions of common jobs in energy storage and relevant training programs. By creating this resource, New York can better recruit and retain a robust workforce for its growing energy storage industry.

Key Players: Businesses, Training Providers, Employment Agencies, NY-BEST, NYSERDA, Department of Labor, Workforce Intermediaries

Case Study: Massachusetts Clean Energy Center (MassCEC) Jobs Board

A state-funded clean energy economic development agency, MassCEC developed a clean energy jobs and resume board to connect clean energy companies in Massachusetts with the workers they need. MassCEC's jobs board currently hosts nearly 100 job postings across multiple technologies and occupations, such as mechanical engineers, journeymen electricians, and business development specialists. Since its inception in January 2016, MassCEC's jobs board has seen over 90,000 visits to the site. Many jobseekers report they find the tool useful.

Case Study: Minnesota Clean Energy Job Board

The Clean Energy Resource Teams (CERTs) form a public-private partnership committed to empowering and connecting Minnesotans with resources for energy conservation, energy efficiency, and renewable energy generation. CERTs hosts an online job board for clean energy employment opportunities. At no cost, businesses can post jobs with details including its location in Minnesota, primary duties, job type, desired qualifications, expected salary and commitment, and application instructions. Jobseekers also enjoy free platform access and can sign up to receive new job listings via email. The job board lists jobs in engineering, construction, program management, policy analysis, and client services with Minnesota-based utilities, project developers, consultants, and nonprofits. The partnership is driven by the Department of Commerce, University of Minnesota, Great Plains Institute, and Southwest Regional Development Commission. It hosts the job board in collaboration with the Midwest Chapter of the Association of Energy Services Professionals (AESP) and Young Professionals in Energy (YPE).

Policy 9: Map the Local Energy Storage Supply Chain

OPPORTUNITY

A key early step for cluster development is to define what industry assets exist and evaluate what gaps remain. Once this groundwork is made, state and local leaders can develop a strategic plan to fill supply chain gaps, help businesses and jobs thrive in the state, and improve the cluster's market competitiveness. NY-BEST's online supply chain map offers an initial look at what energy storage companies are in the state; however, New York has the opportunity to build a more comprehensive and interactive supply chain map to serve as a business resource, marketing asset, and recruitment tool. Businesses could connect with potential suppliers and customers via the supply chain map. Policymakers and economic development organizations could leverage the resource to attract investments and recruit businesses, filling supply chain gaps and maximizing the industry's local jobs potential.

SOLUTION

New York's leaders could map companies in the local energy storage supply chain to build out an online public resource. They could build upon NY-BEST's work by first reaching out to known companies to submit an updated profile of their business capabilities, technology expertise (e.g., batteries, supercapacitors, flywheels), and supply chain position (e.g., material provider, contract manufacturer, system integrator, project developer). Then, administrators could advertise the supply chain map via incubators, universities, and industry networks and invite businesses not accounted for in the initial scan to add their profile and utilize the resource. Successful initiatives in Nuevo León, Mexico and Wisconsin demonstrate how this activity can support local business growth (*see case studies*). Administrators could enhance the impact of the supply chain map by linking the online resource to NYSERDA's qualified contractor network to direct customers to the right platform for system installations. By creating a robust supply chain map, New York can facilitate business connections and showcase its energy storage industry to the world.

Key Players: Empire State Development, NYSERDA, NY-BEST, Businesses

Case Study: Automotive Cluster of Nuevo León, Mexico (CLAUT)

Established in 2007, CLAUT is a public-private initiative to improve the competitiveness of the regional automotive sector and support local manufacturing. In an effort to determine how to support the local industry, CLAUT mapped where its member companies fit in the automotive supply chain: Components from Tier 2 suppliers are made into products from Tier 1 suppliers that support Original Equipment Manufacturers (OEMs). The supply chain map showed that 85 percent of supplies to OEMs and Tier 1 companies were imported. CLAUT saw an opportunity to integrate more local Tier 2 companies into the supply chain to improve business logistics for its members and generate more wealth within the Mexican economy. CLAUT connected with purchasing managers to identify components being imported and then funded consultants to search for and evaluate local businesses that could manufacture these components at high quality and up to industry standards. Nuevo León shared the costs of earning requisite certifications and modernizing procedures with the prime interested candidates. CLAUT then hosted a two-day event that gathered these newly integrated, local Tier 2 suppliers and well-established Tier 1 businesses to facilitate business connections. Over ten years, the initiative increased domestic supply from 15 to 35 percent in the region of Nuevo León. The largest multinational members have replaced an average of $40 million annually of imports with domestic sources.

Case Study: New York Offshore Wind Supply Chain Database

New York's offshore wind supply chain database is a free public online platform to connect local suppliers with project developers and manufacturers. The NYSERDA database boasts over 500 local organizations that are ready to capitalize on the rapidly growing U.S. offshore wind industry, including manufacturers, construction companies, and labor organizations. Organizations can request to be listed by filling out a brief survey on the offshore wind-related goods and services they can provide. To ensure the economic benefits of the industry remain within the state, NYSERDA hosted a supplier networking forum and has integrated this resource into its offshore wind request for proposals, requiring that proposers commit to giving priority to applicable New York companies in the database.

Policy 10: Bolster Foreign Direct Investment in the Energy Storage Industry

OPPORTUNITY

New York is home to numerous assets for business attraction in the energy storage industry. State and local leaders could make a concerted effort to promote these assets to attract foreign direct investment (FDI). FDI occurs when a company based in another country makes an investment in the United States by establishing operations or acquiring business assets. FDI is a common strategy to fill business gaps and inject jobs and capital into the local economy. New York ranks third after California and Texas for jobs directly supported by majority foreign-owned affiliates, yet New York does not appear in the top ten states in North America for *manufacturing* FDI. By prioritizing and coordinating FDI outreach for the energy storage industry, New York's leaders could better leverage FDI to strengthen in-state manufacturing, fill critical supply chain gaps, and create new jobs.

SOLUTION

New York's politicians, economic development program administrators, and business leaders should consider a multi-pronged approach to bolstering FDI in the energy storage industry. This approach could include identifying business recruitment targets, marketing New York's energy storage assets, leveraging connections with international energy storage clusters and research institutions, hosting national conferences, and dedicating funds for energy storage business attraction.

- **Target companies to fill supply chain gaps.** New York's business leaders could identify much-needed anchor companies and key supply chain companies that could be recruited via FDI efforts. In particular, the team could prioritize supply chain businesses that could support multiple types of energy storage technologies, such as battery cell manufacturers and large-scale system integrators. The team could then assist ESD in recruiting these companies.

- **Better promote industry assets.** Currently, the ESD FDI webpage does not highlight energy storage as an existing cluster nor does it highlight any energy storage assets as part of the state's Cleantech and Renewable Energy Cluster. The FDI webpage also misses the opportunity to highlight the exceptional clean energy manufacturing happening in the state. New York's economic development agencies should consider creating a dedicated FDI webpage that highlights the state's manufacturing climate, logistics hubs, and innovation resources as strategic assets for international companies wanting to serve the regional energy storage market. A short-term fix would be to link the FDI webpage to ESD's detailed Cleantech and Renewable Energy Cluster webpage. Further improvements could be to emphasize in-state assets that directly benefit manufacturing, such as R&D resources, incentive programs, and a talented workforce, in addition to demand-side assets.

- **Establish international business and research connections.** New York's academic, business, and government leaders could engage with international energy storage clusters and research institutions dedicated to advancing energy storage technology, such as the European Battery Alliance and the VDE Global Energy Storage Competence Cluster. Energy storage conferences in Europe, India, China, and Japan also offer New York leaders the opportunity to establish business connections that can lead to FDI. Furthermore, research collaborations can grow into more robust FDI and trade relationships, as seen with the Massachusetts–Israel Innovation Partnership (*see case study*).

- **Host leading energy storage conferences.** New York's leaders could also host industry events to elevate the state as a thought leader and innovation hub in the energy storage space. NY BEST hosts an annual Capture the Energy conference that gathers people from throughout the energy industry to discuss the critical role that energy storage plays in building a clean energy future. Additionally, the Energy Storage Association holds its annual conference in different U.S. cities each year; New York could vie for the opportunity to host this national event. By growing the stature and reach of in-state energy storage conferences, New York's leaders have the

opportunity to attract foreign businesses and connect them with numerous industry assets in the state.

- **Create a recruitment fund.** ESD could create a fund that provides incentives for energy storage companies to locate manufacturing operations in the state. This program could be fashioned after a New York program similarly designed to attract photonics companies to the Greater Rochester area (*see case study*).

State leaders have the opportunity to put New York's energy storage cluster on the map. A coordinated and widespread effort will be key to cultivating international relationships, attracting businesses, and supporting local jobs for New Yorkers.

Key Players: Empire State Development, NY-BEST, Universities

Case Study: New York Photonics Attraction Fund

In January 2018, New York Governor Andrew Cuomo committed $30 million to attract photonics manufacturers to the Greater Rochester area. The fund is a strategic expense to further grow the established photonics cluster, which is a key hub for the national AIM Photonics consortium. Administered by the Finger Lakes Regional Economic Development Council, the fund will leverage this existing asset to attract new businesses and create new jobs in the region.

Case Study: Massachusetts–Israel Innovation Partnership

The Massachusetts–Israel Innovation Partnership offers a creative model for facilitating global connections. Launched in 2011 following the governor's trade mission to Israel, the partnership grew from an industry research collaborative to a joint FDI partnership. Major Israeli companies have expanded operations to the state and Massachusetts companies have invested in Israeli intellectual property and R&D operations. As of 2015, more than 200 Israeli-founded companies have made a home in Massachusetts. These businesses accounted for $9 billion in revenue, $18 billion in total economic benefit, and almost 4 percent of the state GDP, as well as 9,000 direct jobs and 27,000 indirect and induced jobs.

Best Practices for FDI Programs

The U.S. Department of Commerce commissioned an extensive study of the most successful FDI and exporting programs around the country and found that state leaders of these programs share several key practices. The report found that they:

- Engage universities in making international connections and economic development
- Foster strong relationships with economic development resources engaged in FDI
- Collect good data about companies in the cluster
- Develop contact points at companies overseas
- Embrace and adapt to cultural differences, e.g., language-specific business cards and marketing materials
- Commit to long-term involvement in FDI efforts

Call to Action

New York's emerging energy storage cluster is a solid foundation upon which the state can grow its economy, support tens of thousands of jobs, and become a leader in the production and deployment of advanced energy technology. The policies recommended in this report are intended to help New York manufacture products within the state, foster entrepreneurship for technological advances, fund innovation with accessible capital, and equip workers with needed skills. They also complement the state's forward-looking efforts to build a local market.

To fully realize New York's potential in the energy storage industry and position the state for continued growth, policymakers will need to make a concerted effort to seize the opportunity presented by increasing global demand. As seen with the Roadmap activity, strong leadership and the collective work of many partners across government, universities, industry, and other stakeholders play an important role in promoting New York's competitive advantage in the industry and creating quality jobs. Continued collaboration and designated leadership is necessary to address barriers to cluster growth and demonstrate that the state is ripe for investment.

New York has the opportunity to support an annual average of nearly 16,000 local energy storage jobs through 2030, with total jobs related to the industry reaching 27,400 by 2030. This cluster is well positioned to capitalize on the growing energy storage market, especially considering its diverse business network, robust energy storage R&D, and clean energy leadership.

New York's leaders can draw from dozens of innovative strategies that city, county, and state governments across the country and abroad have implemented in order to create job opportunities in the advanced energy industry. Examples of these best practices and a fully cited version of this report can be found on the American Jobs Project website at http://americanjobsproject.us/. Furthermore, the American Jobs Project can continue to serve as a partner to New York by organizing working groups and conducting deeper analyses, such as identifying value chain gaps, exploring policy strategies, and evaluating the state's comparative advantage in other advanced industries.

When a state succeeds in building an economic cluster, the benefits are felt throughout the state: a more resilient state economy, a skilled twenty-first century workforce that is trained for the jobs of tomorrow, a firm base of young people optimistic about job opportunities close to home, and a rich hub for innovation and collaboration.

Growing the Energy Storage Cluster, Growing Jobs

- Establish an Innovation Voucher Program
- Strengthen the Entrepreneurial Culture at Universities
- Facilitate Startups' Access to Educated Investors
- Establish Connections to Patient Capital
- Conduct an Energy Storage Workforce Development Study
- Expand Integrated Basic Education and Skills Training
- Build a State-Level Network of Qualified Energy Storage Contractors
- Establish an Energy Storage Job Board
- Map the Local Energy Storage Supply Chain
- Bolster Foreign Direct Investment in the Energy Storage Industry

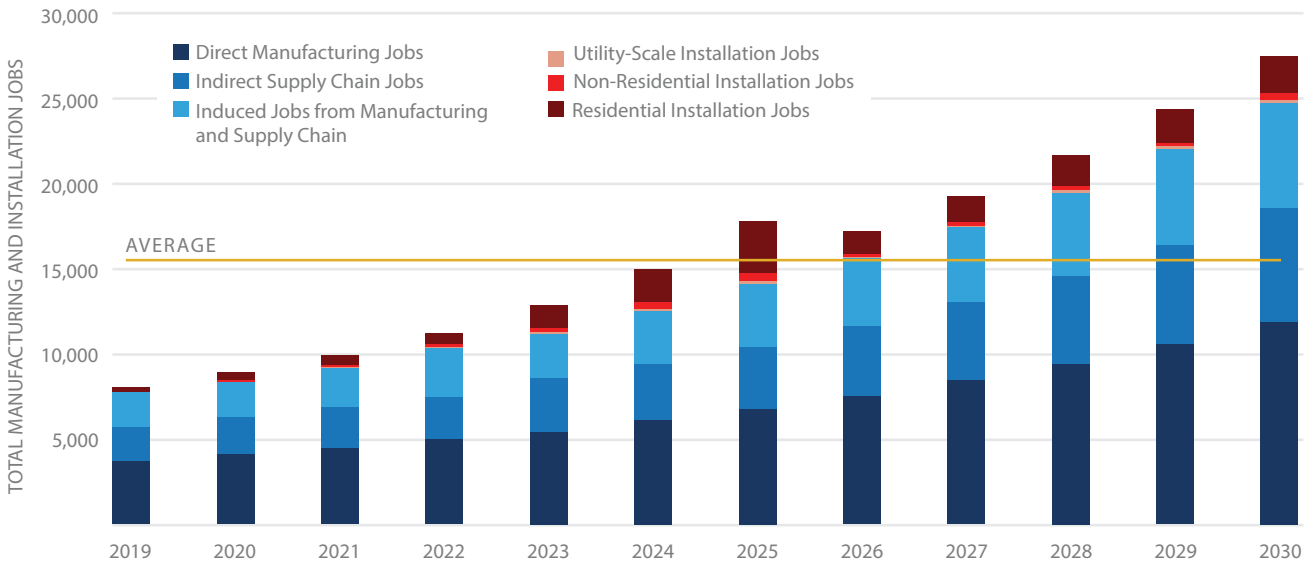
APPENDIX: ECONOMIC IMPACTS, JOB ESTIMATES, AND MODELING METHODOLOGY

The American Jobs Project believes the key to job creation lies in local action. Our job estimates are intended to start a conversation about how state and local leaders can work together to set goals and evaluate potential economic impacts.

To estimate jobs potential for the energy storage industry in New York, we utilize several reputable sources to estimate future national demand, deployment in the state, the current state market penetration for energy storage businesses, and industry benchmarks for wages and profits. We use these inputs to generate multiple industry growth scenarios based on varying levels of market penetration and supply chain concentration. Each scenario shows the average number of jobs that in-state manufacturing and deployment could support annually from 2019 through 2030. The actual number of jobs in any given year could vary significantly from the average, and the annual average is intended to be a target over the analysis timeline.

We suggest that the Median market penetration and the Midpoint supply chain concentration are realistic goals for New York. If New York can grow its market share and build a supply chain to these levels, the industry could support an annual average of almost 14,500 direct, indirect, and induced jobs from 2019 through 2030. Additionally, deployment of utility, commercial, and residential energy storage systems within the state could support an annual average of 1,500 direct installation jobs from 2019 through 2030. If growth and deployment rates remain consistent throughout the analysis timeline, there would be 27,400 total jobs by 2030. Thus, the energy storage industry could serve as a major vehicle for future state economic growth while creating quality jobs for New Yorkers.

NEW YORK ENERGY STORAGE MANUFACTURING AND INSTALLATION JOBS, 2019–2030



Definitions

Market Penetration: Amount of sales of a product as a percentage of the total sales volume for that product in a defined market.

Supply Chain Concentration: Level at which target industries could meet supply chain needs from in-state companies.

Direct Jobs: Jobs created or sustained due to direct increases in sales to companies in the target state industry.

Indirect Jobs: Jobs created or sustained due to higher demand for equipment, materials, and services from supplying industries that support the target state industry.

Induced Jobs: Jobs created or sustained due to increased local spending by employees of the target sate industry and its supplying industries.

Multiplier Effect: Refers to when the economic impact generated is larger than the initial investment due to cascading spending from target state industry to its supplying industries and workforce to products and services in the local economy.

Modeling Approach

We utilize IMPLAN, a proprietary model maintained by the Minnesota IMPLAN Group, and its 2013 data package to conduct our regional economic analysis. IMPLAN uses average expenditure data to estimate how industry spending cascades throughout the economy to suppliers and consumer-facing industries. IMPLAN tracks multiple rounds of indirect and induced spending impacts until that spending "leaks" out of the selected regional economy, as determined by local purchasing coefficients built into the model.

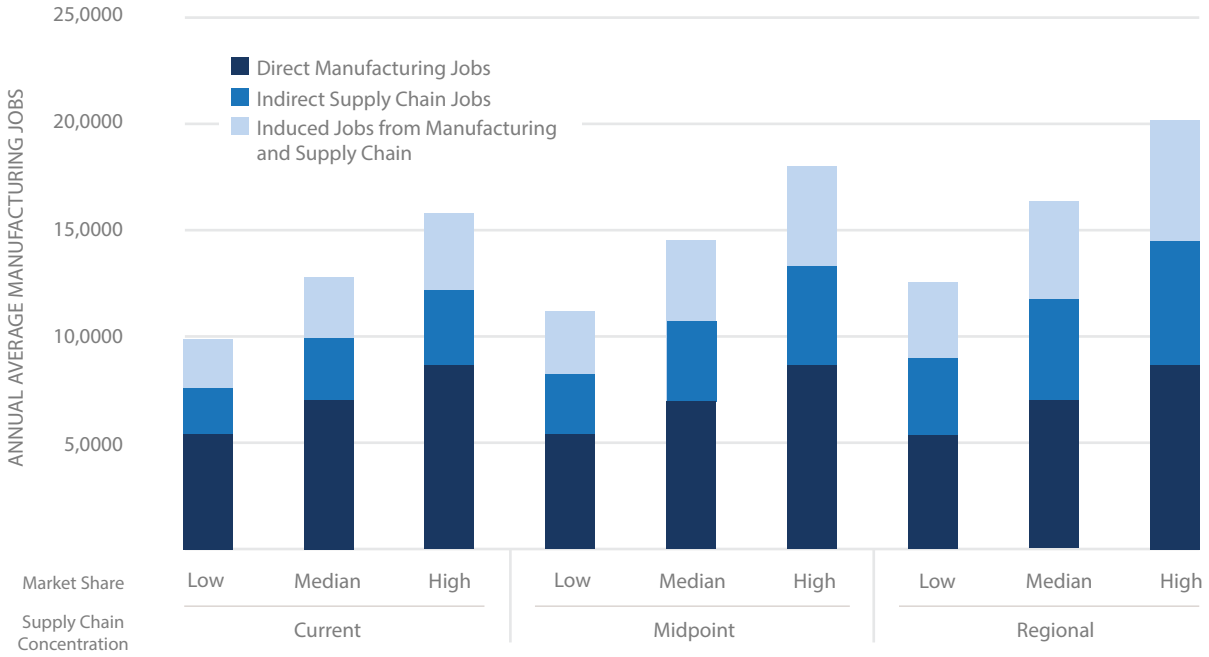
Drawing from reputable sources, we develop multiple scenarios in which New York could grow its energy storage industry. Each scenario represents varying levels of market penetration and supply chain concentration, which generate different inputs for the IMPLAN model.

Market penetration is shown at three levels (Low, Median, High), with the lower bound being New York's current market share and the upper bound being a modest increase in its market share. Another level represents the median between both bounds. We use Bureau of Labor Statistics' (BLS) Quarterly Census of Employment and Wages (QCEW) and IBISWorld data to estimate market share as a function of establishments, wages, and revenue. This calculation was matched against estimates of current energy storage employment provided by NY-BEST.

Three supply chain concentration levels (Current, Midpoint, Regional) are presented to identify the impacts of growing New York's supply chain. The lower bound uses the current state economy, demonstrating the effect of merely maintaining the present level of supply chain concentration. The upper bound uses neighboring states (PA, MA, VT, RI, CT, NJ) to represent the impacts of New York having as complete of an energy storage supply chain as in the selected states. Another level gives the midpoint between both bounds.

NEW YORK ENERGY STORAGE MANUFACTURING JOBS, ANNUAL AVERAGE, 2019–2030

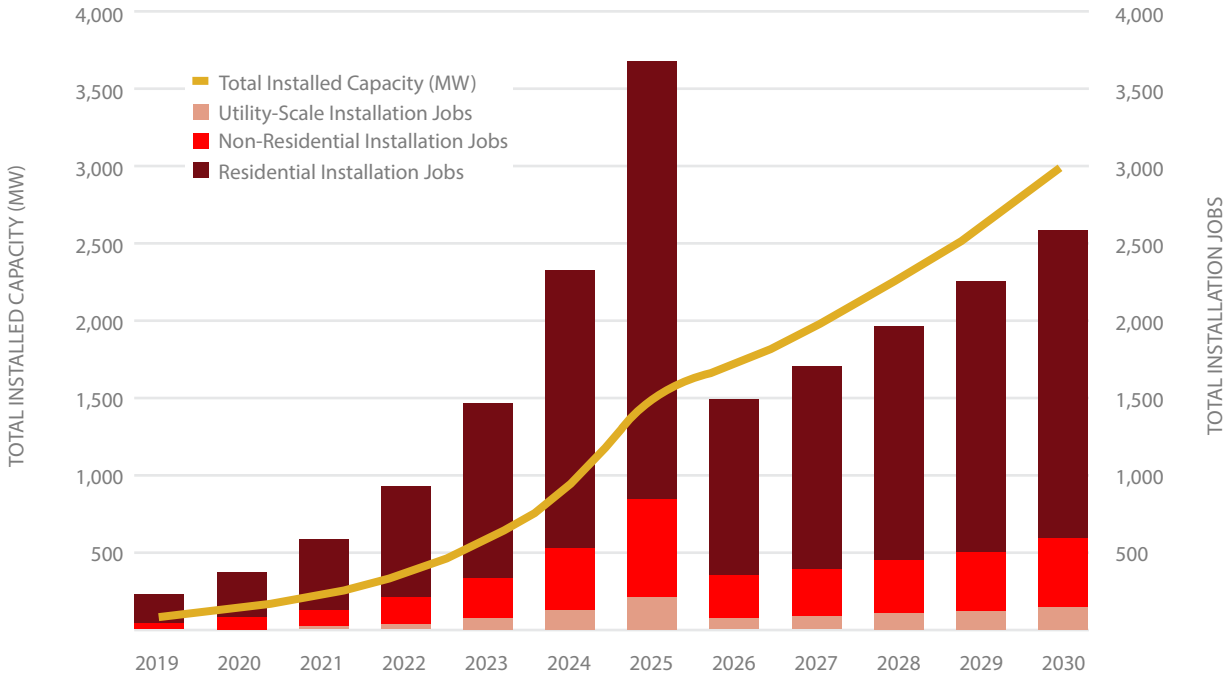
BY MARKET SHARE AND SUPPLY CHAIN CONCENTRATION



Additionally, we evaluated the job impacts of deploying energy storage in the state between 2019 and 2030. We utilized the Solar Foundation's estimates of jobs per MW of energy storage, which looks solely at direct installation jobs during construction periods. We used 1,500 MW by 2025 as an interim target and 3,000 MW by 2030 as the final target. We assume an even distribution of deployment across utility, commercial, and residential sectors. Changes in final deployment would affect these estimates significantly, as there are large differences in jobs per MW between sectors due to economies of scale per project.

It is important to note that we do not include any financial impacts associated with the construction of new facilities that may result from an increased number of energy storage firms locating in New York during the analysis timeline, nor do we include operations, maintenance, or development jobs associated with energy storage installations as these estimates would be purely speculative. Another important segment of jobs that is not included in this analysis are downstream services enabled through hardware and software connected to energy storage systems that become resources to buildings, vehicles, and the grid.

NEW YORK ENERGY STORAGE INSTALLATION JOBS, 2019–2030



Model Inputs

We define energy storage broadly, including all technologies that can store and discharge energy. Our analysis utilizes North American Industry Classification System (NAICS) codes, the basis for most macroeconomic analysis and reporting.

Estimates of market demand for energy storage are taken from Grand View Research and IBISWorld reports. Annual demand for our analysis timeline is derived from the current estimates and compound annual growth rates through 2030. We assume that the rates stay constant through 2030 since they do not project further into the future.

Estimates of average wages are taken from IBISWorld, IMPLAN, and BLS QCEW. Owner income is also derived from IBISWorld and IMPLAN wherever possible.

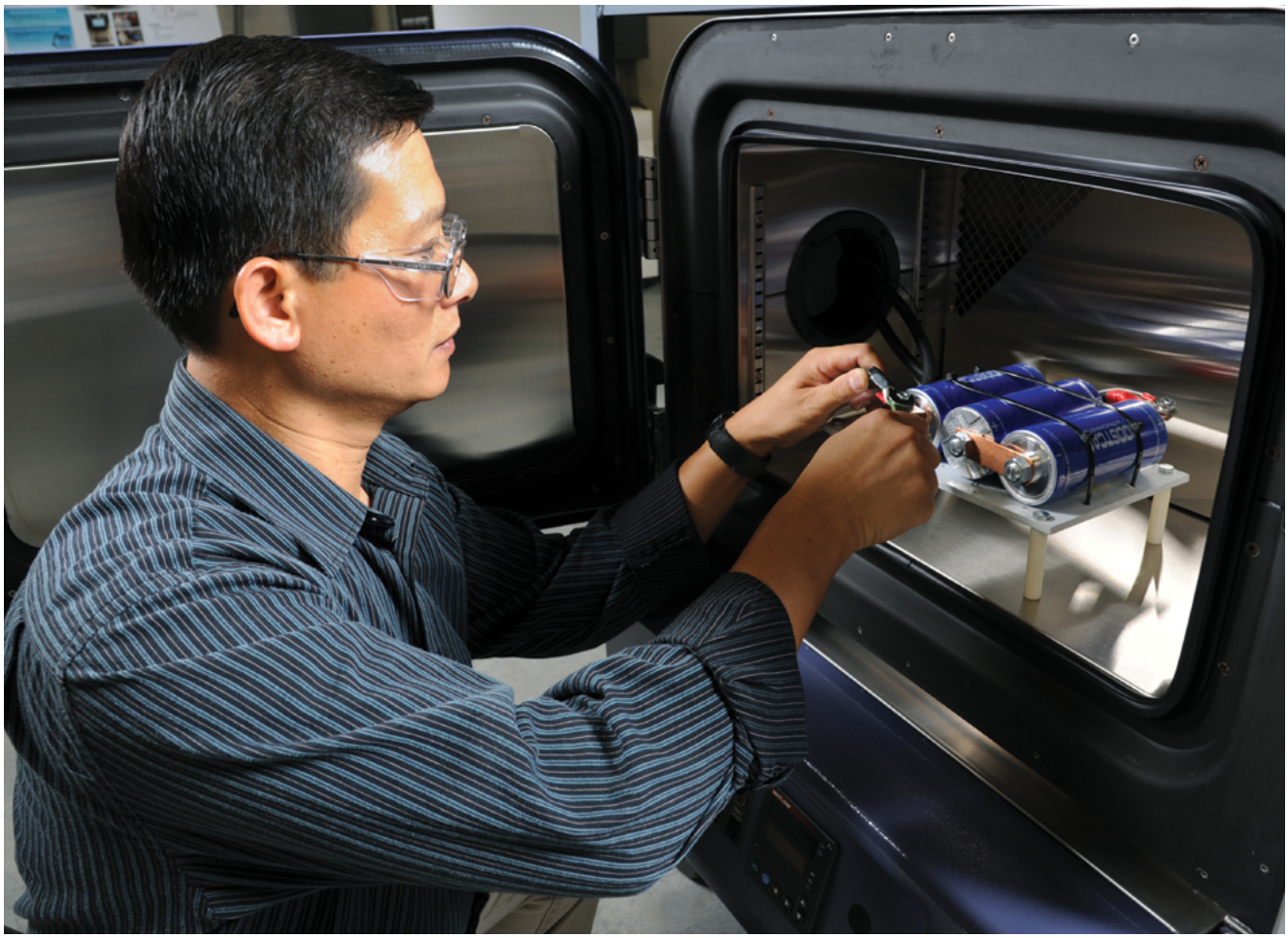
The current market penetration of New York's energy storage industry is approximated as a function of current estimated employment and firms. IBISWorld's ratio for employment per unit of revenue and the current concentration of firms in New York, as well as NY-BEST's supply chain data, are applied to Grand View Research's market demand totals to estimate current employment and revenues.

Deployment jobs are estimated using the Solar Foundation's analysis of energy storage jobs per MW of installation and analyses completed by NYSERDA.

Model Outputs

Once the data is prepared for input into IMPLAN, we run the model for each scenario and generate the following direct, indirect, and induced estimates for New York's energy storage industry: employment, labor income, GDP, total economic output, state/local tax revenue, and federal tax revenue. Only the employment outcomes are used, to which we add deployment jobs from the separate calculation. Additional output estimates are available by request.

We present employment as an average of annual jobs sustained. These outcomes are based on the total job-years, or one full-time equivalent job sustained for one year, that exist within the timeframe of our analysis. Jobs in any given year can vary greatly within the timeframe. Additionally, job losses in industries that compete with those in our analysis are not evaluated. Models do not perfectly predict behavior, so job estimates could vary based on the reality of what is purchased locally and the impact of foreign and domestic competition. The estimates presented in this report are highly dependent on sustained local action towards developing and maintaining the target state industry.



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