

APPENDIX A: Energy Storage Workforce Needs and Training Matrix

#	Workforce Need	Engineering / Technical Professionals	Business / Finance Professionals	Skilled Trades	Local Officials	Building Operators	Existing Resources	New / Expanded Resources Needed	NYSERDA Support for Energy Storage Workforce Training
1	Fundamental knowledge of energy storage technology and applications	x	x	x	x	x	<p>Professional Associations</p> <ul style="list-style-type: none"> · NYSERDA Technical Assistance Resources · New York Battery and Energy Storage Technology Consortium (NY-BEST) online courses, including "Energy Storage Technology: Understanding the Essentials" and "Understanding New York's Wholesale Energy Markets for Energy Storage: On-line Webinar Course" · NYSERDA webinars, including "Energy Storage 101," "Energy Storage Opportunities with NY State Electric Utilities" · Professional industry organization continuing education courses (e.g., IEEE Power & Energy Society courses on power, electrical engineering, microgrids) <p>Colleges & Universities</p> <ul style="list-style-type: none"> · City Tech College continuing education courses 	<ul style="list-style-type: none"> · Continuation and expansion of energy storage technology fundamentals training for a variety of audiences · Periodic updates to training content as energy storage technology and applications progress 	<ul style="list-style-type: none"> · NYSERDA PON 3981 – Energy Efficiency and Clean Technology Training (Talent Pipeline) offers funding to training providers for development and delivery of training content, which can include energy storage technology fundamentals, in addition to a wide range of clean energy areas covered under the PON · NYSERDA RFQL 4145 – Clean Energy Training Services, Category C: Grid Modernization and Energy Storage qualifies training providers to receive funding for as-needed training on topics including "smart grid, microgrid, demand response management, and grid storage and other related areas" · Promote currently available training resources, which were designed to support energy storage training needs, to appropriate audiences
2	Energy storage technical skills – industry	x					<p>Professional Associations</p> <ul style="list-style-type: none"> · Industry conferences (e.g., NY-BEST events) · Professional industry organization online continuing education courses (e.g., IEEE Power & Energy Society courses on power, electrical engineering, microgrids) · IEEE Power Engineering Society events (e.g., Sept 2019 Schenectady chapter colloquium with continuing education credits) · IEEE Power Engineering Society webinars - live and archived online library · Electric Power Research Institute (EPRI) Energy Storage Integration Council (ESIC) Energy Storage Implementation Guide online reference <p>Colleges & Universities</p> <ul style="list-style-type: none"> · RIT / Battery Prototyping Center Battery Seminars – 2-day seminars on lithium-ion battery materials, technology, and hands-on training on cell fabrication processes <p>Other</p> <ul style="list-style-type: none"> · Commercially available online training on batteries and energy storage (e.g., HeatSpring) · Commercially available classroom training (e.g., Electric Utility Consultants, Inc.) · Online courses and certifications for battery-based solar photovoltaic systems (e.g., Solar Energy International) · Online training and certificate program on Energy Innovation and Emerging Technologies through Stanford University includes courses on grid scale electricity and batteries · Schweitzer Engineering Laboratories (SEL) University protection and controls classroom training throughout the country, with a limited schedule 	<ul style="list-style-type: none"> · Expanded continuing education options on energy storage topics and technologies, including advanced level options · Training to expand expertise in DC systems for electrical engineers and electricians accustomed to working in AC systems · Training on grid fundamentals for software developers entering or working in energy storage field · Training updates on changes to electric code as related to energy storage projects 	<ul style="list-style-type: none"> · NYSERDA PON 3981 – Energy Efficiency and Clean Technology Training (Talent Pipeline) offers funding to training providers for training content including upskilling existing industry workers · NYSERDA RFQL 4145 – Clean Energy Training Services, Category C: Grid Modernization and Energy Storage qualifies training providers to receive funding for as-needed training on topics including "smart grid, microgrid, demand response management, and grid storage and other related areas" · Support for continuing education unit (CEU) / professional development hour (PDH) opportunities such as "CEU bootcamps" to encourage participation in training and expand the technical content available to engineering and technical professionals · Support updates to NYSERDA and other code training as applicable · Promotion of currently available training resources to appropriate audiences
3	Energy storage technical skills – students and researchers	x					<p>Colleges & Universities</p> <ul style="list-style-type: none"> · Energy storage programs and research centers at twelve (12) universities throughout New York State: Alfred University, SUNY Binghamton, University at Buffalo, Clarkson University, Columbia University, Cornell University, City University of New York (CUNY), University of Rochester, Rochester Institute of Technology, Rensselaer Polytechnic Institute, Stony Brook University, SUNY Polytechnic Institute, and Syracuse University <p>Professional Associations</p> <ul style="list-style-type: none"> · Industry conferences (e.g., NY-BEST events) 	<ul style="list-style-type: none"> · Academic infrastructure largely in place and will evolve and grow as research continues and the industry matures 	<ul style="list-style-type: none"> · Continued facilitation of connections between research and academic institutions and industry

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4	Power engineering degree programs and graduates	x					<p>Colleges & Universities</p> <ul style="list-style-type: none"> There are a limited number of power engineering degree programs in New York State, some at the undergrad level, some at the graduate student level, and some with both - Clarkson University, Syracuse University, University at Buffalo, SUNY Binghamton, Rensselaer Polytechnic Institute, New York University Polytechnic School of Engineering, and Buffalo State University The U.S. DOE had a Smart Grid Workforce Training program under the Recovery Act, in which six New York State schools participated. That program has ended, but it funded several labs (e.g., Buffalo State College, Syracuse University) 	<ul style="list-style-type: none"> Increased capacity of programs training students on power engineering and grid electricity topics Up-to-date content for electrical engineering programs Publicity and messaging around power engineering field to attract students 	<ul style="list-style-type: none"> Increase the visibility for institutions that do offer these programs NYSERDA PON 3981 – Energy Efficiency and Clean Technology Training (Talent Pipeline) offers funding to training providers for training content including curriculum updates, certificate program development, talent pipeline activities, and other activities to support this need NYSERDA RFQL 4145 – Clean Energy Training Services, Category C: Grid Modernization and Energy Storage qualifies training providers to receive funding for as-needed training on topics, including "smart grid, microgrid, demand response management, and grid storage and other related areas"
5	Electrician / technician training on energy storage technologies and applications			x			<p>Technician Training Organizations</p> <ul style="list-style-type: none"> Energy Storage and Microgrid Training and Certification (ESAM-TAC) is a non-profit, brand-neutral national training and certification program based on standards and codes developed or approved by various organizations, including National Fire Protection Association (NFPA), National Electrical Installation Standards (NEIS), National Electrical Code (NEC), American National Standards Institute (ANSI), and the Electric Power Research Institute (EPRI). Curriculum on safe handling, assembly, and interconnection of stationary battery systems is currently available, and they are developing an advanced course for commissioning, operations, maintenance, repair, and retrofit of systems. The full ESAM-TAC program not currently offered in NYS, but train-the-trainer resources are available when a training organization is prepared to develop a program New York International Brotherhood of Electrical Workers (IBEW) planning on launching training based on ESAM-TAC energy storage curriculum at some of their training centers throughout the State, with the possibility to expand statewide <p>Colleges & Universities</p> <ul style="list-style-type: none"> Some community colleges include brief energy storage topics as part of renewable / alternative energy programs, but it is not covered in depth <p>Other</p> <ul style="list-style-type: none"> Online courses and certifications for battery-based solar photovoltaic systems (e.g., Solar Energy International) 	<ul style="list-style-type: none"> Establishment of electrician / technician training on energy storage technologies in New York State Timely growth of energy storage content and programming at community colleges and technical schools 	<ul style="list-style-type: none"> Support train-the-trainer resources and curriculum for New York State community colleges and trade schools. NYSERDA is investigating opportunities to bring ESAM-TAC train-the-trainer sessions and curriculum to the State. Foster relationships between industry and technical training institutions to establish a link between specific training topics and available jobs. This ensures curriculum matches industry needs and avoids specialized training of new workers at community colleges and trade schools before they are needed at scale. Review programmatic requirements or recommendations for use of certified technicians in incentive programs to encourage training and certification. PON 3981 – Energy Efficiency and Clean Technology Training (Talent Pipeline) offers funding to training providers for training content and/or equipment for electrician / technician training. RFQL 4145 – Clean Energy Training Services, Category C: Grid Modernization and Energy Storage qualifies training providers to receive funding for as-needed training on topics including "smart grid, microgrid, demand response management, and grid storage and other related areas."
6	Knowledge of commercial readiness of energy storage products	x	x				<p>Professional Associations</p> <ul style="list-style-type: none"> Annual industry conferences (e.g., NY-BEST events) BEST Test and Commercialization Center resources at Eastman Business Park <p>NYSERDA</p> <ul style="list-style-type: none"> NYSERDA assistance with assessing viable energy storage options for different projects and applications <p>Other</p> <ul style="list-style-type: none"> Green Tech Media webinars, such as "Battery Energy Storage System Safety: Critical Steps for the Maturing Storage Market" 	<ul style="list-style-type: none"> Up-to-date information on industry, technology, and regulatory developments, as well as case studies, to ensure market actors understand the range of viable options for successful energy storage projects 	<ul style="list-style-type: none"> Support forums such as periodic "State of the Sector" sessions or webinars to disseminate industry updates Develop and disseminate case studies

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7	Expertise related to rate classes, interconnection process, and financial modeling of storage systems		x				<p>Professional Associations</p> <ul style="list-style-type: none"> · NY-BEST online courses · NY-BEST webinars · NY-BEST online references and direct technical assistance on topics such as tariffs, technology/product information, interconnection process, utility and NYSERDA programs, and use cases and project business models <p>NYSERDA</p> <ul style="list-style-type: none"> · NYSERDA resources on topics including Energy Storage Value Streams, NYISO wholesale electricity markets, and interconnection requirement · NY-SUN Value Stack Calculator <p>Other</p> <ul style="list-style-type: none"> · NY-ISO online and in-person training on wholesale energy markets, power system fundamentals, and other grid topics · ProtoGen Energy's Financial Advisory Spreadsheet Tool for financial analysis of battery energy storage systems, grid-interactive PV systems, and battery-PV hybrid systems · Interstate Renewable Energy Council (IREC) Model Interconnection Procedures reference 	<ul style="list-style-type: none"> · Continuation and expansion of resources on these topics as the industry evolves 	<ul style="list-style-type: none"> · RFQL 4145 – Clean Energy Training Services, Category C: Grid Modernization and Energy Storage qualifies training providers to receive funding for as-needed training on topics, including "smart grid, microgrid, demand response management, and grid storage and other related areas"
8	Information on zoning regulations and permitting processes		x		x		<p>NYSERDA</p> <ul style="list-style-type: none"> · NYSERDA "Battery Energy Storage System (BESS) Guidebook" for local officials, which consists of a Model Law, Model Permit, and Inspection Checklist · NYSERDA webinar and workshops statewide to help municipalities customize and implement best practices from the BESS Guidebook · NYSERDA workshops include: 1) Overview of the BESS Guidebook, geared toward town, planning, and zoning board members and 2) Understanding BESS Permitting and Inspecting in New York State, available for code enforcement officers · NYSERDA, NYC, and Smart DG Hub resources, such as "Energy Storage System Permitting and Interconnection Process Guide for New York City Lithium-Ion Outdoor Systems" <p>Other</p> <ul style="list-style-type: none"> · IREC's pending work to further develop best practices for permitting processes and code enforcement 	<ul style="list-style-type: none"> · Deployment of existing training resources to more jurisdictions across the State · Continued customization of reference materials for energy storage projects sited in New York City 	<ul style="list-style-type: none"> · Continue NYSERDA workshops for local officials · Maintain reference materials used by industry and authorities having jurisdiction to reflect changes and lessons learned as the industry grows and matures
9	Advanced manufacturing skills for energy storage products			x			<p>Technician Training Organizations</p> <ul style="list-style-type: none"> · Northland Workforce Training Center has existing coursework on electrical work and advanced manufacturing, and they plan to expand this into an emerging energy technologies program in coordination with business partners <p>Colleges & Universities</p> <ul style="list-style-type: none"> · Community colleges and trade schools have machinist programs, although they are not generally tailored to the energy storage industry <p>Other</p> <ul style="list-style-type: none"> · Some manufacturers have in-house training programs to meet specific needs 	<ul style="list-style-type: none"> · New and/or expanded curriculum for manufacturing technicians that includes lab skills related to batteries as well as electrical and chemical areas of expertise · Community colleges and trade schools that have machinist programs need to better understand specific needs / additional skills necessary for energy storage industry to develop / upgrade curriculum 	<ul style="list-style-type: none"> · Facilitation of connections between industry and training entities · PON 3981 – Energy Efficiency and Clean Technology Training (Talent Pipeline) offers funding to training providers for development of new training curriculum, conducting training, and other activities to support industry workforce needs

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10	Expertise in battery pack and battery system design, engineering, and production	x		x			<p>Professional Associations</p> <ul style="list-style-type: none"> · Battery Prototyping Center at RIT lab and testing resources · RIT / Battery Prototyping Center Battery Seminars - 2-Day seminars on lithium-ion battery materials, technology, and hands-on training on cell fabrication processes · NY-BEST webinar: Battery Testing, Codes, and Standards: A Primer for Energy Storage Professionals on current testing requirements and codes and standards related to batteries · Binghamton Battery Prototype Center - Training for local industry and students for pouch-cell fabrication, and materials evaluation and testing 	<ul style="list-style-type: none"> · System integration design and assembly experience · Technicians with lab and manufacturing skills necessary to work with battery materials 	<ul style="list-style-type: none"> · Facilitation of connections between industry and training entities · PON 3981 – Energy Efficiency and Clean Technology Training (Talent Pipeline) offers funding to training providers for development of new training curriculum, conducting training, and other activities to support industry workforce needs · RFQL 4145 – Clean Energy Training Services, Category C: Grid Modernization and Energy Storage qualifies training providers to receive funding for as-needed training on topics, including "smart grid, microgrid, demand response management, and grid storage and other related areas"
11	Safety training	x		x	x	x	<p>Technician Training Organizations</p> <ul style="list-style-type: none"> · ESAM-TAC curriculum includes safety information for installers <p>Other</p> <ul style="list-style-type: none"> · Manufacturers are involved in product-specific safety training related to deployment of their systems · Occupational Safety and Health Administration (OSHA) training · Green Tech Media webinars, such as "Battery Energy Storage System Safety: Critical Steps for the Maturing Storage Market" · UL online training resources on battery safety 	<ul style="list-style-type: none"> · Safety topics should be integrated into associated training related to energy storage installation, inspection, operation, and maintenance 	<ul style="list-style-type: none"> · Continue to work with manufacturers, OSHA, fire protection experts, and local officials to ensure proper safety information is available to appropriate parties
12	Inspection training				x		<p>NYSERDA</p> <ul style="list-style-type: none"> · NYSERDA's Battery Energy Storage System (BESS) Guidebook includes an Inspection Checklist for use by local jurisdictions 	<ul style="list-style-type: none"> · Deployment of existing training resources to more jurisdictions across the State · Additional guidance and reference materials, as well as train-the-trainer resources, for local inspectors 	<ul style="list-style-type: none"> · Use of NYSERDA's post-installation inspections on energy storage projects installed through incentive programs to identify lessons learned, to create additional guidance and reference materials, and to develop train-the-trainer resources for local inspectors
13	First responder training				x		<p>Professional Associations</p> <ul style="list-style-type: none"> · National Fire Protection Association offers free online training for fire department personnel and can offer in-person trainings <p>NYSERDA</p> <ul style="list-style-type: none"> · NYSERDA holds workshops for first responders on preventive safety measures required for all battery energy storage installations in New York State and an overview of incident management procedures <p>Other</p> <ul style="list-style-type: none"> · Manufacturers are involved in safety training related to deployment of their systems, which can include training and/or provision of informational materials for local first responders 	<ul style="list-style-type: none"> · Deployment of existing training resources to more jurisdictions across the State 	<ul style="list-style-type: none"> · Continue NYSERDA workshops for first responders and investigate options to offer training content via online platform