COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./DUE DATE	☐ Special Exception to Deadline Date Policy	FOR NSF USE ONLY
NSF 23-200 01/18/2023		NSF PROPOSAL NUMBER
FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.)		2315695
ITE - NSF Engines - NSF Regional Inn		

DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	UEI (Unique Entity Identifier)	FILE LOCATION
01/18/2023	1	15020000 ITE	200Y	NQMVAAQUFU53	

EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN)	SHOW PREVIOUS AWARD NO. IF THIS IS ☐ A RENEWAL ☐ AN ACCOMPLISHMENT-BASED RENEWAL	IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? (b)(4)
141368361		

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE
RESEARCH FOUNDATION FOR THE STATE UNIVERSITY OF NEW YORK, THE

AWARDEE ORGANIZATION CODE (IF KNOWN)
0028365000

ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE
4400 VESTAL PKWY E
BINGHAMTON,NY 13902-4400 US

NAME OF PRIMARY PLACE OF PERF
SUNY at Binghamton

ADDRESS OF PRIMARY PLACE OF PERF, INCLUDING 9 DIGIT ZIP CODE
4400 VESTAL PKWY E
BINGHAMTON,NY 13902-4400 US

IS AWARDEE ORGANIZATION (Check All That Apply) ☐ SMALL BUSINESS ☐ MINORITY BUSINESS ☐ FOR-PROFIT ORGANIZATION ☐ WOMAN-OWNED BUSINESS

☐ IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE

TITLE OF PROPOSED PROJECT
NSF Engines: Type 2: New Energy New York Storage Engine (NENY-SE)

SHOW LETTER OF INTENT ID IF APPLICABLE

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE
$ 15,000,000	120 months	09/01/2023	

THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW

☐ BEGINNING INVESTIGATOR
☐ DISCLOSURE OF LOBBYING ACTIVITIES
☐ PROPRIETARY & PRIVILEGED INFORMATION
☐ HISTORIC PLACES
☐ VERTEBRATE ANIMALS IACUC App. Date _____
PHS Animal Welfare Assurance Number _____
☒ TYPE OF PROPOSAL **Research**

☐ HUMAN SUBJECTS Human Subjects Assurance Number _____
Exemption Subsection _____ or IRB App. Date _____
☐ FUNDING OF INT'L BRANCH CAMPUS OF U.S IHE
☐ FUNDING OF FOREIGN ORGANIZATION OR FOREIGN INDIVIDUAL
☐ INTERNATIONAL ACTIVITIES: COUNTRY/COUNTRIES INVOLVED
☒ COLLABORATIVE STATUS **A collaborative proposal from one organization (PAPPG II.D.3.a)**

PI/PD DEPARTMENT	PI/PD POSTAL ADDRESS
PI/PD FAX NUMBER	**4400 VESTAL PKWY E** **PO Box 6000** **BINGHAMTON,NY 139026000** **US**

NAMES (TYPED)	High Degree	Yr of Degree	Telephone Number	Email Address
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CO-PI/PD				
CO-PI/PD				

CERTIFICATION PAGE

Certification for Authorized Organizational Representative (or Equivalent)

By electronically signing and submitting this proposal, the Authorized Organizational Representative (AOR) is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding conflict of interest (when applicable), flood hazard insurance (when applicable), responsible conduct of research, and organizational support as set forth in the NSF Proposal & Award Policies & Procedures Guide (PAPPG). Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U. S. Code, Title 18, §1001).

Certification Regarding Conflict of Interest

The AOR is required to complete certifications stating that the organization has implemented and is enforcing a written policy on conflicts of interest (COI), consistent with the provisions of PAPPG Chapter IXA; and that, to the best of his/her knowledge, all financial disclosures required by the conflict of interest policy were made; and that conflicts of interest, if any, were, or prior to the organizations expenditure of any funds under the award, will be, satisfactorily managed, reduced or eliminated in accordance with the organizations conflict of interest policy. Conflicts that cannot be satisfactorily managed, reduced or eliminated and research that proceeds without the imposition of conditions or restrictions when a conflict of interest exists, must be disclosed to NSF via use of the Notifications and Requests Module in FastLane.

Certification Regarding Flood Hazard Insurance

Two sections of the National Flood Insurance Act of 1968 (42 USC §4012a and §4106) bar Federal agencies from giving financial assistance for acquisition or construction purposes in any area identified by the Federal Emergency Management Agency (FEMA) as having special flood hazards unless the:

(1) community in which that area is located participates in the national flood insurance program; and
(2) building (and any related equipment) is covered by adequate flood insurance.

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) located in FEMA-designated special flood hazard areas is certifying that adequate flood insurance has been or will be obtained in the following situations:
(1) for NSF grants for the construction of a building or facility, regardless of the dollar amount of the grant; and
(2) for other NSF grants when more than $25,000 has been budgeted in the proposal for repair, alteration or improvement (construction) of a building or facility.

Certification Regarding Responsible Conduct of Research (RCR)

(This certification is not applicable to conference proposals.)
By electronically signing the Certification Pages, the Authorized Organizational Representative is certifying that, in accordance with the NSF Proposal & Award Policies & Procedures Guide, Chapter IX.B., the institution has a plan in place to provide appropriate training and oversight in the responsible and ethical conduct of research to undergraduates, graduate students and postdoctoral researchers who will be supported by NSF to conduct research.
The AOR shall require that the language of this certification be included in any award documents for all subawards at all tiers.

Certification Regarding Organizational Support

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that there is organizational support for the proposal as required by Section 526 of the America COMPETES Reauthorization Act of 2010. This support extends to the portion of the proposal developed to satisfy the Broader Impacts Review Criterion as well as the Intellectual Merit Review Criterion, and any additional review criteria specified in the solicitation. Organizational support will be made available, as described in the proposal, in order to address the broader impacts and intellectual merit activities to be undertaken.

Certification Regarding Dual Use Research of Concern

By electronically signing the certification pages, the Authorized Organizational Representative is certifying that the organization will be or is in compliance with all aspects of the United States Government Policy for Institutional Oversight of Life Sciences Dual Use Research of Concern.

Certification Regarding the Meeting Organizer's Written Policy or Code-of-Conduct that Addresses Sexual Harassment, Other Forms of Harassment, and Sexual Assault

(This certification is only applicable to travel proposals)
By electronically signing the Cover Sheet, the AOR is certifying that prior to the proposer's participation in the meeting, the proposer will assure that the meeting organizer has a written policy or code-of-conduct that addresses sexual harassment, other forms of harassment, and sexual assault, and that includes clear and accessible means of reporting violations of the policy or code-of-conduct. The policy or code-of-conduct must address the method for making a complaint as well as how any complaints received during the meeting will be resolved. The proposer is not required to submit the meeting organizer's policy or code-of-conduct for review by NSF.

Certification Regarding Family Leave Status (or equivalent)

(This certification is only applicable to career-life balance supplemental funding requests)
By electronically signing the certification pages, the Authorized Organizational Representative hereby certifies that the request for a technician (or equivalent) is because the (PI/co-PI/senior personnel/ NSF Graduate Research Fellow/postdoctoral researcher/graduate student) is, or will be, on family leave status (or equivalent) from the organization in accordance with the organization's policies. The Authorized Organizational Representative also affirms that the organization is able to fill the position for which funding is being requested, in an appropriate timeframe.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE	SIGNATURE	DATE
NAME Lisa Gilroy	Electronic Signature	Jan 18 2023 04:39 PM

TELEPHONE NUMBER	EMAIL ADDRESS	FAX NUMBER
607-777-6136	lgilroy@binghamton.edu	

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For font size and page formatting specifications, see PAPPG section II.B.2.

Appendix Items:

*Proposers may select any numbering mechanism for the proposal. The entire proposal however, must be paginated. Complete both columns only if the proposal is numbered consecutively.

PROJECT SUMMARY

OVERVIEW

Title: NSF Engines: Type-2: New Energy New York Storage Engine (NENY-SE)
PI/PD: Per Stromhaug, PhD, MBA, Associate Vice President of Innovation & Economic Development
Lead Organization: Binghamton University

Purpose and Vision. *Purpose*: NENY-SE coalesces diverse organizations across Upstate NY to accelerate innovation, technology translation, and creation of a skilled workforce to grow the capacity of the domestic battery industry. ***Vision:*** NENY-SE matures into a leading ecosystem driving U.S. national security and global competitiveness in battery technology innovation, development, and manufacturing.

Batteries are critical for the pivot to a carbon-neutral economy, with demand across the supply chain expected to grow up to 10× by 2030. While E.U. and China have implemented large-scale battery initiatives, the U.S., with 8% of the global battery production capacity, is in catch-up mode and vulnerable relative to national security, climate change, and economic stability. Recent federal initiatives call for boosting U.S. battery sector capacity through R&D, supply chain, and workforce development efforts. To this end, Binghamton University and M. Stanley Whittingham, Nobel Laureate inventor of the Li-ion battery, have assembled a cross-sector coalition to establish a battery technology ecosystem in Upstate NY, centered around an emerging energy storage cluster and Imperium 3 NY, the state's first battery gigafactory. NENY-SE will drive academia-industry collaborations, accelerate technology transfer, and train an advanced manufacturing workforce. NSF Engines funding will propel the nascent ecosystem from growth to maturity, fueled by the foundational 2022 EDA Build Back Better Regional Challenge New Energy New York initiative to grow a regional battery manufacturing hub. NENY-SE will exploit synergies by (1) expanding the focus to the entire battery lifecycle, (2) extending the region of service, (3) mobilizing resources around use-inspired R&D to complement manufacturing initiatives, and (4) growing strategic cross-sector partnerships.

INTELLECTUAL MERIT

This proposed NSF Engine will address the entire battery technology value chain to establish a tech-based, industry-driven innovation hub. With battery technology development and deployment involving multi-component distributed supply chains, NENY-SE's activities will cover the lifecycle spanning materials, components, cells, modules, and packs, system management, industrial applications, and recycling, with Industry Partners secured along each step. NENY-SE will address industry- and technology-level challenges including: material sourcing and recovery; battery component innovation; safety testing and certification; pilot manufacturing; applications integration; and workforce training. To facilitate the transition of battery innovations from lab to market, NENY-SE will synergize the partners' existing resources with new initiatives around: (1) ecosystem-building [R&D partnerships; industry challenges; supply chain buildout]; (2) funding [R&D grants, collaborative piloting and proof-of-concept]; (3) training programs [entrepreneurship and workforce]; and (4) capacity-building [regional battery testing infrastructure].

BROADER IMPACTS

The industry- and community-responsive NENY-SE programs will catalyze high-tech R&D outcomes and drive equitable economic development at the regional and national levels. NENY-SE will leverage transformational investments from the EDA and the NSF and the collective capacity of Engine Partners to strengthen the emerging battery ecosystem in Upstate NY, position the region as an international leader in the sector, and empower American battery innovation and supply chain resiliency. Demonstrated success will attract new businesses and investment to the ecosystem and regional supply chain. NENY-SE will also move NYS closer to meeting goals under the Climate Leadership and Community Protection Act, including mandates for 70% of the state's electricity to come from renewables by 2030, full transition to zero-emission vehicles by 2035, and a carbon-neutral grid by 2040. NENY-SE anticipates that the proposed activities will support >4000 trainees and result in >$2B in investments and >10,000 new jobs in the region within the next 10 years, concurrent with the launch of new programs, networks, and steadily increasing diversity and representation across all pillars of the Engine.

Keywords: Battery, energy storage, electric vehicle, climate change, grid storage
LOI ID: L23-000133;
Concept Paper ID: INQ-22-00552

PROJECT DESCRIPTION

I. OVERVIEW, VISION, AND RATIONALE.

I.A. SOCIETAL AND ECONOMIC CHALLENGES

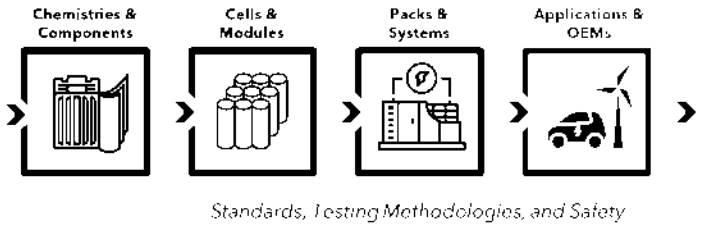
Batteries are the building blocks of modern technology and the lynchpin of the transition to a carbon-free economy. Battery technologies, in particular lithium-ion batteries (LiBs), are the dominant form of energy storage used today across various consumer, commercial, industry, and utility applications. The market is growing rapidly, with global demand expected to increase 5× by 2030 driven by increased adoption of electric vehicles (EVs) and stationary storage for the grid[1]. Concurrent with the rising demand for batteries is the increased need for constituent materials and components. With this increasing demand across the battery value chain, the sector is expected to generate 10M jobs worldwide by 2030[2].

Battery development and manufacturing are pivotal for the U.S. to attain long-term clean energy transition goals and global competitiveness, including in EVs. While the automotive industry annually contributes >$1T to the U.S. economy (~5% of GDP), and accounts for ~10M jobs, transportation accounts for 1/3 of all U.S. greenhouse gas emissions[3]. Thus, to reach its decarbonization targets and retain a resilient manufacturing base, the U.S. must develop a competitive EV industry supported by battery manufacturing. The U.S. currently produces 59 GWh annually at 8% of the world's manufacturing capacity, while demand for batteries in domestic electric vehicles alone is estimated to reach 320 GWh in 2028, requiring >25,000 new direct manufacturing jobs and >100,000 new supply chain jobs[4]. Of these, >15,000 are estimated to be needed in New York State (NYS). While China and the European Union have established industrial policies to support domestic battery and supply chain goals, the U.S. has only recently begun to prioritize the battery sector. We face a challenging dependence on unstable global supply chains and lose many early-stage domestic tech innovations to China, which is providing battery scale-up capabilities unavailable in the U.S. The global LiB supply chain is concentrated overseas; China controls >75% of cell production, >70% of active material production, and >60% of material processing. Consequently, China currently captures >90% of the value of a LiB sold in its market, while the U.S. captures <30%[1].

While increasingly recognizing battery manufacturing and supply chain security as major national priorities[1,2,4,5], the U.S. currently has limited industry capacity and reserves, and risks failing to establish a competitive global position and falling behind climate change goals. The Federal Consortium for Advanced Batteries (FCAB) has set a goal for the U.S. to secure its LiB supply chain by 2030, a need increasingly underscored by recent global crises[4]. The Department of Energy (DOE) recently released comprehensive plans to accomplish that, with planned billion-dollar investments. The landmark 2022 Inflation Reduction Act (IRA) seeks to promote domestic energy production and clean energy infrastructure, and includes provisions to increase critical minerals processing and EV production. The IRA stipulates that 100% of an EV battery's minerals and components will need to come from the U.S. or Free Trade Agreement partners to be eligible for the tax credit by 2029.[5]

For the U.S. to meet these ambitious goals and growing storage demands, attain carbon neutrality by 2050, and gain a competitive position to leapfrog Asian competitors, it must grow a domestic ecosystem to support innovation and a trained workforce throughout the entire battery technology lifecycle spanning materials, component and cell manufacturing, systems and applications, and sustainable end-of-life processing. The time and cost to get new battery technologies from lab to market need to be reduced through a centralized Engine for rapid prototyping, testing, and commercial-scale pilot manufacturing. Through public investments and private sector activity, Upstate NY is positioned to become a national leader to meet this challenge, with ambitious goals set by the state's Climate Leadership and Community Protection Act (CLCPA) relative to renewables, zero-emission vehicles, a carbon-neutral grid[7], and, more recently nation-leading plans for 6 GW of energy storage by 2030[6]. Notably, Binghamton University led a 16-member cross-sector coalition that is implementing a $113M award under the EDA Build Back Better Challenge (BBBRC) for the New Energy New York (NENY) initiative to foster the growth of a battery cell development and manufacturing hub in the Southern Tier of Upstate NY, with projects enabling pilot manufacturing and supply chain expansion. The ***New Energy New York Storage Engine (NENY-SE)*** is designed to build on this foundation to solidly root and grow an interconnected, leading ecosystem in Upstate NY to drive battery technology innovation and workforce development (WFD) across the entire sector value chain.

I.B. OVERVIEW AND VISION



NENY-SE Battery Life Cycle

NENY-SE will establish a full battery lifecycle ecosystem in Upstate NY, centered around an emerging energy storage cluster and the ***state's first LiB gigafactory opened in 2022 by Imperium 3 NY (iM3NY)***. NENY-SE will connect key industry stakeholders, support domestic development and engineering, facilitate faster transition of innovative technologies, and grow an advanced manufacturing workforce, guided by equity and environmental justice tenets. Given the complexity of battery technology development and deployment, involving multi-step, distributed supply chains, NENY-SE's activities will seek to add value across the battery lifecycle from materials processing to recycling and recovery.

The Engine will be built on a 4-tiered structure assembling key cross-sector expertise and resources:

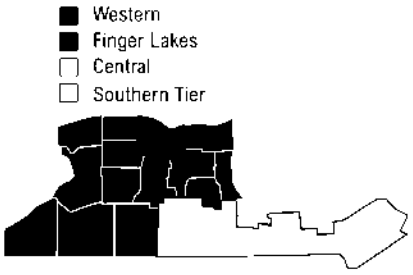
1. **Core Partners:** representing industry, non-profits, and universities with associated investment vehicles and incubators, Binghamton University (Binghamton), Cornell University (Cornell), Rochester Institute of Technology (RIT), Syracuse University (SU), New York Battery and Energy Storage Technology Consortium (NY-BEST), Charge CCC4 (C4V)/Imperium 3 NY (iM3NY), and Launch NY, will drive the direction and implementation of the Engine activities.
2. **State Partners:** Empire State Development (ESD), ***providing a 5-year $16M matching commitment to the Engine if funded***, New York State Energy Research and Development Authority (NYSERDA), and the Research Foundation for The State University of New York (RF SUNY) will provide governance and evaluation oversight, support statewide connections, ensure alignment with state priorities.
3. **Supporting Partners**: EDA BBBRC NENY coalition members and industry partners, will ensure diverse stakeholder engagement and development of industry- and community-responsive programs.
4. **External Established Ecosystem Partners:** will contribute additional expertise and guidance, support evaluation, and help the Engine become a national thought and innovation ecosystem leader.

Built on core pillars of use-inspired and industry-driven research, technology transfer, workforce preparedness, and diversity, equity, inclusion, and accessibility (DEIA), NENY-SE will deliver:

1. **Ecosystem-building activities.** By connecting R&D hubs at Binghamton, Cornell, SU, and RIT, with a growing battery startup ecosystem facilitated by NY-BEST and NYSERDA, investments driven by ESD, Launch-NY, and RF SUNY, and regional battery industry, the Engine will supercharge the commercialization of battery technologies. NENY-SE will establish mechanisms for industry to provide input and seek partnership opportunities with other companies and universities in a coordinated manner. The Engine will secure important battery R&D, testing, and manufacturing infrastructure and services to form a complete network supporting battery technology development from lab to market.
2. **Funding initiatives.** NENY-SE will fund a range of high-potential technologies at the level of university R&D, technology transfer, and academia-industry partnerships, as well as startup and scale-up company R&D, piloting, and manufacturing, via programs including seed and gap grants, corporate challenges, and investments.
3. **Programmatic support.** NENY-SE will leverage a suite of stage-specific accelerator, entrepreneurship training, and mentoring programs to support inventors, startups, and market-ready companies in bringing battery innovations from the lab to the market. Cutting-edge WFD programs will be geared to battery manufacturing to address the growing sector demand.
4. **Capacity-building initiatives.** Core Partner universities will network existing faculty and undertake multi-disciplinary hiring efforts to attract new relevant experts. NENY-SE will also work to reduce the time and cost of bringing new battery technologies to market by expanding vital testing and pilot manufacturing infrastructure resources in the region.

I.C. SERVICE REGION

The NENY-SE service region comprises 27 counties in the Western, Central, Southern Tier, and Finger Lakes regions of NYS mapping to the respective Regional Economic Development Councils (REDC)[7], spanning micropolitan and majority-rural areas with >6M residents and >100 federally designated Opportunity Zones. After decades of economic downturn, the region has begun to witness an economic reset coalescing around clean energy. Engine partners Binghamton, RIT, Cornell, and SU are expanding regional clean energy and storage opportunities by driving cutting-edge R&D, standing up incubators, and promoting community and industry partnerships. The universities individually serve as innovation hotspots within their geographies through their technology transfer offices, testing services, and incubators, and episodically collaborate in research and commercialization initiatives. Partners Binghamton, RIT, and Launch NY run 3 of the State's 6 designated Clean Energy Incubator Programs, which have attracted a stream of startups establishing operations in the region. Binghamton, RIT, and NY-BEST also host battery R&D and testing facilities, including dry rooms and small-scale pilot battery cell manufacturing lines, increasingly utilized by startups and large companies alike.



NENY-SE Region

Partner companies, such as NYSEG, Raymond Corporation, Li-Cycle, and Kodak, as well as many of the region's >1000 small- and medium-sized manufacturers (SMMs), have demonstrated growing interest and investment in battery innovation and manufacturing, while seeking collaborations with the region's research universities. Notably, Engine Partner iM3NY opened the state's first LiB gigafactory in Binghamton (2022), that is projected to generate >1000 new direct jobs in the next 5 years. Electrovaya is similarly looking to expand its operations to Upstate NY, with a planned battery manufacturing plant in Jamestown, NY. Both companies are committed to major WFD and R&D efforts, with the gigafactories expected to result in regional contracts with OEMs, and attraction of suppliers and customers to the region. NENY-SE will develop a comprehensive strategy to connect and leverage such often siloed assets across the region to create a supercharged innovation engine.

I.D. ENGINE FOUNDATION AND ECOSYSTEM MATURITY.

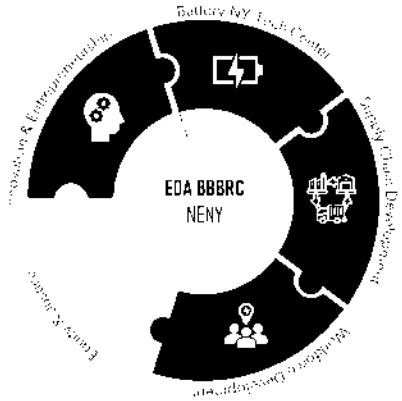
Binghamton and its Core Partners are well-positioned to build NENY-SE on the foundation of the 2022 ***EDA BBBRC award*** ($113M, including $50M in NYS matching funds). The ***16-member cross-sector coalition***, is creating a battery manufacturing industry hub in the Southern Tier of NY through 5 component projects:

1. ***Battery-NY Center*** will build a Technology and Manufacturing Development Center for the production of full-size battery cells, accelerating scale-up and qualification of batteries for various sectors.
2. ***Battery Sector Supply Chain Development*** is establishing supplier qualification and certification resources, and network existing manufacturers, to build a domestic battery supply chain.
3. ***WFD,*** through a multi-organization partnership, is addressing workforce needs of the industry cluster through training programs and strategies to overcome barriers to participation.
4. ***Equity & Justice,*** through work with community organizations, is undertaking outreach, engagement, and empowerment of underserved communities through training and wraparound services, to ensure that the economic benefits of the industry cluster are equitably accessible and shared across the region.
5. ***Innovation and Entrepreneurship*** is providing programs, funding, and support services to accelerate battery technology development from lab to market.

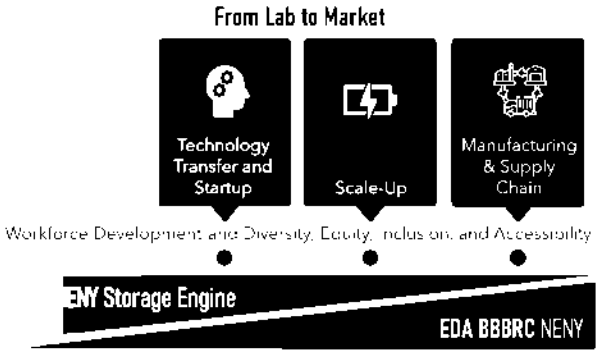
The coalition is already building on the NENY foundation as exemplified by pending ***Appalachian Regional Commission Area Development Grant applications ($1.5M total)*** supplementing each of the BBBRC NENY component projects, and a ***DOE Energy Program for Innovation Clusters (EPIC) Round 2 Prize*** 1st phase award ($50k) to Binghamton's Koffman Incubator to implement ***New Energy New York Charge-Up***, providing bootcamp and microgrant programs for early-stage startups. These recent developments

have positioned the service region as a ***Nascent-Phase Ecosystem in the battery innovation space***. NENY-SE will leverage the NSF Engines investment to fuel the transition of the Nascent Ecosystem to the Emergent, and subsequently Growth and Maturity Phase. BBBRC NENY is strategically addressing EDA's priority areas of regional economic development and resilience by advancing manufacturing readiness, with less emphasis on early-stage innovation, lacking funding for operational R&D to supply the battery technology pipeline. Thus, the proposed Engine will fill this gap and build on the BBBRC foundation by:

1. Expanding the focus from battery manufacturing to the entire battery lifecycle;
2. Extending the region of service and expanding the Partner coalition;
3. Mobilizing new resources on use-inspired R&D to synergize with existing manufacturing initiatives;
4. Growing strategic cross-sector partnerships.



NENY-SE Nascent Ecosystem



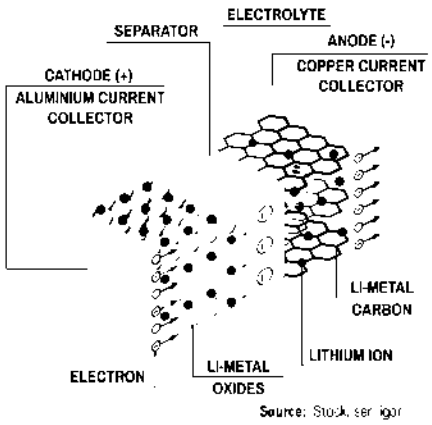
I.E. STATE OF PRACTICE AND MAJOR GAPS

Our team has a deep understanding of the battery space, driven by continuous industry feedback, whether through individual collaboration projects or larger-scale engagements, such as the 50+ "industry discovery" calls made during the design of the EDA BBBRC NENY projects or the RIT Battery Seminar (Dec 1-2, 2022) survey of industry attendees. Members of the leadership team, William Acker (Executive Director NY-BEST) and M. Stanley Whittingham (Binghamton Professor, Nobel Laureate LiB inventor) worked with Li-Bridge, a public-private alliance comprising Core Engine Partner NY-BEST, NAATBatt International, and New Energy Nexus to develop a draft gap analysis and recommendation plan for the domestic battery industry. NENY-SE will prioritize and address major sectoral challenges, from high-level industry to specific technical, to accelerate R&D, technology transfer, and deployment.

Material Sourcing. LiB production depends on 5 "critical"[8] minerals whose domestic supply is at risk for disruption: lithium, cobalt, manganese, nickel, and graphite. The U.S does not have meaningful domestic capacity in extraction, processing, and active material production for battery manufacturing, with foreign entities of concern, including China, controlling many lithium, nickel, and cobalt reserves. Beyond raw materials, U.S. production is anticipated to meet only limited percentages of the total domestic demand for battery components (i.e., anode, cathode, electrolyte, separator) and battery cells. Such gaps underscore the need for the development of alternative approaches and methods to improve extraction, refining, recycling for material recovery, active material production, and cell manufacturing, as well as introduction of new materials and battery chemistries - major focus areas of ***Engine R&D activities***.

Technical Innovation. With demand projected to far outpace supply, solving industry-level challenges and advancing the U.S. battery sector will require building on existing technologies and developing alternative approaches along the entire battery value chain. All components of LiBs are subject to intensive R&D efforts. Current specific capacities and energy densities of batteries are limited by cathode components,

with efforts focused on modifying cathode chemistries to push densities above 500 Wh/Kg. The most common LiB cathode chemistries are lithium cobalt oxide (LCO), lithium manganese oxide (LMO), lithium iron phosphate (LFP), lithium nickel cobalt aluminum oxide (NCA) and lithium nickel manganese cobalt oxide (NMC), with graphite widely used as the anode in LiBs[9]. Currently, LCO, considered a mature cathode chemistry, is the most predominant in consumer electronics, but not suitable for EV applications where LFP, NMC, NCA, and LMO dominate. While having different cost, safety, performance, and application profiles, all of the chemistries depend on critical minerals. Current anode materials such as graphite have almost reached their theoretical capacity of 372 mAh/g for LiBs[10]. To further increase battery specific capacities and energy densities, anode components based on Si and Li metals need to be explored, but the approaches face technical hurdles – mechanical expansion and dendrite growth, respectively. Liquid electrolytes have challenges around safety and leakage in battery applications. Quasi- and all-solid-state electrolytes, including polymer, oxide, and sulfide show promise, but also face technical barriers, including processing and stability issues.



Source: Stock, ser igor

U.S. Production Capacity by 2030

% U.S. demand met by U.S. production

MATERIALS	
Lithium Chemical Product	60%
Nickel Chemical Product	5%
COMPONENTS	
Electrolyte	5%
Separator	20%
Cathode	<50%
Anode	30%
BATTERY CELL	55%

Source: Li-Bridge-BCG analysis

There is a growing priority to reduce and eventually eliminate cobalt and nickel, replacing them with lower-cost cathode materials such as phosphates. More sustainable electrode manufacturing methods are also needed to replace the current approaches developed in the1990s. For example, the dominant NMC materials are made using a cost- and energy-intensive batch ceramic approach. Subsequent material coating utilizes the toxic NMP organic solvent, the elimination of which can benefit the manufacturing industry[11]. While LiBs currently predominate energy storage applications, next-generation alternatives to Li-ion, such as sodium-ion, will also need to be developed to overcome material sourcing limitations.

The Engine is well-positioned to address these technical challenges. Our academic partners will work with equipment manufacturers to develop new coating methods, with the goal of cost-effective approaches that leapfrog present technologies. The team will collaborate with Frontier, a regional coating equipment manufacturer that has entered the battery business, to alleviate the use of toxic chemicals such as NMP. Under the Engine, the planned NENY Battery-NY Technology and Manufacturing Center will obtain a UV curer for R&D on a dry low-energy approach. Core Partners Binghamton and iM3NY will work closely on a pragmatic approach to improve and replace LFP with higher energy density materials, with Binghamton participating in the DOE Battery-500 Consortium, already supporting high NMC and Li metal approaches. Core Partner SU is already leading efforts around solid-state electrolytes with their NSF IUCRC Center for Solid State Electric Power Storage (CEPS) that will be reinforced and expanded under the Engine.

Material Recovery and Recycling. Given the challenges around critical materials, recycling is becoming increasingly recognized as a potential source for the domestic supply chain. There is a need from fundamental R&D to applied engineering to achieve a low-cost recovery scheme and re-use of the critical materials in batteries. Development of new methods is complicated by the emergence of new chemistries, as well as by the variety of battery cell, module, and pack form factors for different applications. Engine Industry Partner Li-Cycle is actively working in this space, expanding their Upstate NY operations, and looking to collaborate on R&D efforts to improve current recycling capabilities and to prepare to process emerging chemistries. For example, Li-Cycle has indicated a need for new methods for iron removal in the initial stages of LiB processing, looking to academic collaborators through the Engine.

While enormous amounts of used batteries will flow back from various applications, whether or not they can safely be reused in 2nd-life applications depends on many factors, with no reliable test methods currently

existing for this purpose. Engine Core Partners RIT and NY-BEST are already embarking on a program to develop such test methods at NY-BEST Test and Commercialization Center (BTCC). Yet, these methods are currently limited to individual cells and small modules due to safety limitations, and ***the Engine*** will enable critical testing and method development at larger industry scales via a proposed expansion of BTCC.

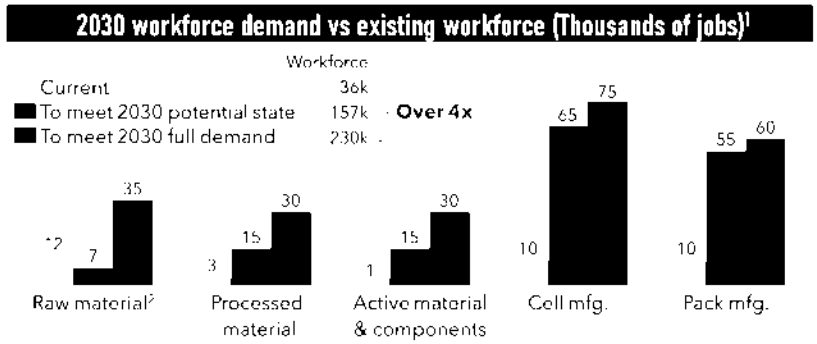
With the growing use and disposal of LiBs, there is also an increasingly urgent need to address issues related to the environmental impact of battery recycling (~18,000 stadiums full of LiBs will need to be recycled annually by 2030)[12], which can release low-value environmentally-hazardous components[13,14]. Thus, ***the Engine*** will also explore R&D around the environmental impacts of battery recycling.

Infrastructure and Commercialization Speed. Cutting-edge, complex instrumentation is needed to enable and validate the above technology innovation pipeline. Lack of hubs where innovators, startups, manufacturers, and customers can co-locate and collaborate, with access to key R&D, testing, and pilot manufacturing infrastructure is slowing down commercialization of home-grown innovations. With overwhelming demand for a limited number of existing facilities, such as RIT's Battery Prototyping Center (BPC; booked for 6 months in advance) and NY-BEST's BTCC (served >130 companies), there is a pressing need for expansion of available resources. In addition to expanding BTCC capabilities, ***The Engine will*** coordinate existing Partner facilities, including Binghamton's and iM3NY's battery dry rooms and SU's solid-state battery CEPS IUCRC facilities, to accelerate the testing and translation of new technologies. Notably, the first-in-class in the U.S. NENY Battery-NY Center to be constructed in Binghamton under BBBRC NENY will provide unprecedented scale pilot line capacity (30MWh), offering companies scale-up and pilot manufacturing capabilities that can be accessed without capital investment.

Safety and Testing. Safety concerns represent a major issue at various levels of battery development, manufacturing, and deployment. The industry demands ever increasing energy densities and faster charging capabilities, both of which compromise battery safety. Sourcing new materials for batteries and pushing materials to their limits requires extensive safety testing for continued technology innovation. Thermal runaway is a major industry-recognized safety issue, capable of causing significant damage to a battery system. Early detection of thermal runaway is still challenging to achieve reliably and economically. Battery system protection techniques are based on siloed efforts in chemistry (safer materials for anode, cathode, and electrolyte[15]), mechanical engineering (better packing design[16]), and electrical engineering (better fault detection algorithms[17]). While new approaches for anti-propagation devices are emerging, test methods need to be developed to allow proper evaluation of these devices in modules and packs.

The Engine will expand the capabilities of BTCC, allowing the systematic evaluation and qualification of large-scale battery cell, module, and pack formats and volumes, as well as of different materials for safe use. Multiple regional BTCC customers have expressed interest in cooperating on developing safety test methods and evaluating their battery and energy storage systems for safety. The Engine will also form a cross-sector working group to apply a holistic design approach in improving battery performance and system safety, and will validate the proposed technology through multi-domain battery system simulation and lab-scale hardware runs. A grid-scale pilot system demonstration is planned in the Emergent Phase.

Labor. The World Economic Forum predicts that the battery value chain will generate 10M jobs worldwide by 2030[2]. Demand for labor in the U.S. is projected to outstrip the current workforce across the entire supply chain, especially around the midstream activities. Various sources of labor will need to be tapped, including similar industries, re-/up-skilling workers, graduates, and international talent. With the EDA BBBRC NENY initiative already initiating efforts to train a battery workforce at multiple educational levels and throughout the value chain, ***the***



Engine will establish a Regional Partner Network and continually refine and design programs in an industry- and community-responsive manner, with engagement of relevant stakeholders.

Investment. Investors are particularly cautious when it comes to the clean energy sector, with payback often not meeting their expectations for return on capital employed (ROCE) of ≥15% due to high outlay requirements and long lead times, with many cleantech projects realizing <10%. Exacerbating this challenge is the relatively limited network of active investors in Upstate NY available to support emerging seed-stage and growing startups. ***The Engine will*** provide support structures for ensuring client startup investor readiness under the direction of Core Partner Launch NY (venture development organization), build connections to domestic investor hubs and international investors, and directly provide small investments into seed-stage battery companies. In addition, the testing and pilot manufacturing infrastructure described above will reduce major capital costs for companies moving toward proof-of-concept manufacturing and certification for downstream applications and clients.

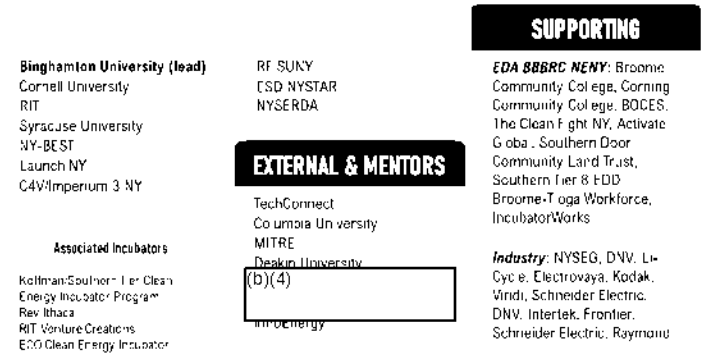
I.F. ANTICIPATED IMPACTS

The NENY-SE team can further deepen its strong collaborative structure built in the course of winning the EDA BBBRC, the complementary initiative focused on the development of a battery manufacturing hub in Upstate NY. The Engine will work synergistically with the BBBRC program in expanding support of use-inspired R&D, innovation, technology transfer and commercialization, new product deployment, and WFD along the entire battery supply chain and lifecycle. The Engine coalition anticipates that proposed activities will support >4000 trainees and garner >$2B in investments, generating >10,000 new battery supply chain jobs over the next 10 years. The Engine will establish a battery ecosystem capable of leveraging and amplifying state, federal, and private investments that will invigorate U.S. leadership in battery innovation and domestic manufacturing.

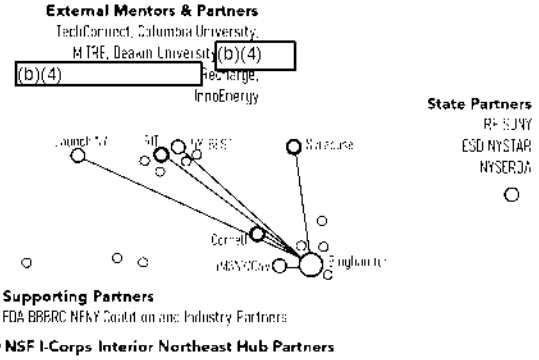
II. PROPOSING TEAM AND ORGANIZATIONAL STRUCTURE.

NENY-SE, a diverse private-public coalition based on a 4-tiered structure (**I.B**) will operate with a hub at Binghamton (with proximity to Koffman/Clean Energy Incubator, iM3NY battery gigafactory, and Battery-NY Center), and spokes in Ithaca (Cornell), Syracuse (SU), Rochester (RIT and NY-BEST), and Buffalo (Launch NY). Albany/Capital Region, while not a service area, will promote statewide connectivity through State Partners. The Partners have a significant history of major initiative collaborations, some of which will be leveraged to advance the Engine:

- **EDA BBBRC New Energy New York (NENY):** A 16-member coalition led by Binghamton consisting of research universities, community colleges, workforce development organizations, non-profits, and state organizations, developing a 5-project battery industry hub initiative. The Engine is an expansion of NENY in the number, type, and geographical distribution of partners, including the addition of industry as Core and Supporting Partners that will actively participate in Engine governance and activities.



NENY-SE Partners & Structure



NENY Storage Engine

- **NSF Interior Northeast I-Corps Hub (IN I-Corps):** A 2022 expansion of the Upstate New York I-Corps Node by Cornell (lead), with Binghamton, RIT, SU, and 6 other universities, supporting an underserved, majority-rural region, providing entrepreneurial education for high-tech academic teams. Prior to joining the Hub, partner organizations have trained 913 teams, which have raised >$115M in follow-on funding.
- **Southern Tier Clean Energy Incubator Program:** Located at the Koffman Incubator and funded by NENY/NENY-SE partner NYSERDA, the program was launched by Binghamton in collaboration with NY-BEST, Cornell, IncubatorWorks, and Northeast Clean Energy Council (NECEC), and will provide space and mentorship to Engine startups, including through a regional industry advisory board.
- **The New York State Pollution Prevention Institute (NYSP2I):** led by RIT, in partnership with Binghamton, Cornell, and additional partners, provides technical support to manufacturers and startups across the state to advance sustainability, waste-reduction, and pollution prevention.
- **Mid-Atlantic AFRL Regional Hub**: Funded by the Air Force Research Laboratory (AFRL) and led by Cornell with NENY-SE partners Binghamton, Columbia, RF SUNY and others to accelerate advances in mission-critical areas for the U.S. Air Force and U.S. Space Force. The Hub is building key connections with industry, including through targeted, grant-funded technology development initiatives.
- **University Technology Licensing Program (UTLP)**: Stood up in 2022 by Columbia, Binghamton, Cornell, and 12 other leading U.S. private and public research universities, a first-of-its-kind university-only patent pool to commercialize technologies in the engineering space, with the intent of simplifying access to and utilization of university IP by industry, and generating follow-on engagements.

II.A. PARTNER ORGANIZATIONS

High-level summaries are provided below; see Existing & New Resources for additional details.

CORE PARTNERS

Binghamton University, ***Engine lead***, one of the top publics in the U.S. and home to the 2019 Nobel Laureate M. Stanley Whittingham (Co-PI), is leading the $113.7M EDA BBBRC NENY coalition to build a battery manufacturing hub in Upstate NY. Key resources to be leveraged include the Northeast Center for Chemical Energy Storage (NECCES) battery prototyping facility, leadership of the DOE-funded Battery500 Consortium, the S3IP NYS Center of Excellence featuring multiple industry-facing R&D and testing units, Southern Tier Clean Energy Incubator, and the planned Battery-NY Technology and Manufacturing Center. ***Binghamton will oversee*** all project aspects, including implementation (**III.B**), partner coordination, finances, contracts, subawards, evaluation, and reporting, and will staff the Operations Team (**IIB, IV.A**).

Cornell University, among top U.S. academic institutions in research expenditures ($1.22B), boasts world-class programs in physical sciences and engineering, and robust advanced research infrastructure. Cornell resources to be leveraged include Cornell Laboratory for Accelerator-based Sciences and Education (CLASSE), Cornell High Energy Synchrotron Source (CHESS), Center for Alkaline-Based Energy Solutions (CABES), Cornell Energy Systems Institute (CESI), and Joint Center for Energy Storage Research (JCESR), a DOE Energy Innovation Hub. ***Cornell will contribute to*** governance and implementation.

Rochester Institute of Technology (RIT), the 3rd largest private STEM university in the U.S., is home to a leading global co-operative education program, the RIT/NY-BEST Battery Prototyping Center, Golisano Institute for Sustainability, Center for Sustainable Energy Systems, and NYSP2I. ***RIT will play a role in*** Engine governance and implementation, with a focus on WFD, early-stage prototyping, and testing.

Syracuse University, a private research university houses the NSF IUCRC Center for Solid State Electric Power Storage (CEPS), the Solid-State Battery Lab, and the Energy and Environment Research Cluster. ***Syracuse will contribute to*** Engine governance and implementation, and its New York State Science & Technology Law Center will provide IP-related resources and advice to the Engine and client companies.

Core Partner universities are powerhouses of innovation, with research expenditures of ***>$1B***, ***>350 inventions***, ***>150 patent applications***, ***>200 patents issued***, and ***>100 licenses executed*** annually, and with **>70** ***sector-relevant faculty***, and **>30 anticipated new hires** in the next 5 years in relevant fields.

New York Battery and Energy Storage Technology Consortium (NY-BEST), a nationally-recognized non-profit created in 2010 to shape NYS energy policy and position the state as a global leader in energy storage, has >185 members across the energy storage space, including manufacturers, academic

institutions, utilities, startups, government entities, engineering firms, systems integrators, and end-users. NY-BEST connects members to resources including the BTCC (see planned expansion in **III.B**). ***NY-BEST will*** play a central Engine industry liaison role and promote regional battery supply chain development.

Launch NY, a Buffalo-based venture development organization (>1400 companies served, 84 portfolio companies), is ranked among the top 5 nonprofit seed funders in the U.S., and as the most active seed fund in NYS. Launch NY operates the ***Emerging Cleantech Opportunity (ECO) Incubator***, serving >40 companies and investing in 17 (~20% of its portfolio). ***Launch NY will*** contribute to governance and implementation, and support Engine startups with investor education and potential direct investments.

Charge CCCV (C4V) & Imperium3 New York (iM3NY). **C4V** is a LiB technology and gigafactory design development company, involved in the planning of multiple gigafactories around the world, the first such factory to open being **iM3NY**. Its New York operation is the largest domestic cell manufacturing facility based on US-developed technology. Both C4V and iM3NY are members of Binghamton's Clean Energy Incubator and are looking to regional talent to fill workforce needs. Serving as the ***main industry representation on the Governance Board,*** C4V and iM3NY will provide guidance for translation of innovations based on their unique regional technology commercialization perspective, inform and collaborate on WFD, and provide access to dry rooms and manufacturing equipment for R&D and training.

NENY-SE will tap Core Partners' network of ***business incubators***, including those with ***clean energy programs*** (Binghamton's Southern Tier Clean Energy, RIT's Venture Creations, Launch NY's ECO). Together, the incubators have supported ***>350 companies*** that have ***raised >$1B*** and created ***>1000 jobs***.

STATE PARTNERS

Empire State Development (ESD), a NYS government organization for innovation and economic development, ***is committing $16M over 5 years*** to NENY-SE if the NSF grant is awarded. ESD will facilitate statewide connections and provide additional support through NY Ventures, NYS Office of Strategic WFD, and NYS Office of Contractor & Supplier Diversity.

New York State Research and Development Authority (NYSERDA) is a NYS public-benefit corporation advancing clean energy goals in the state. With its expertise across research, development, and deployment (RD&D), cleantech WFD, and environmental justice, ***NYSERDA will contribute*** to the development of the Evaluation Plan (**IV.E**)., and will refer external evaluation resources as appropriate.

The Research Foundation for The State University of New York (RF SUNY), administers >$1B annually on behalf The State University of New York, the largest comprehensive university system in the U.S. RF SUNY manages a portfolio of 1,667 patents, 820 licenses, 120 startups, and 18 incubators. ***RF SUNY will*** participate on the Governance Board, network the Engine across the SUNY system, and provide Engine clients access to SUNY Startup Summer School (S4), SUNY Venture Advisors, and SUNY Ventures.

RF SUNY and Core Partner portfolios combined yield: ***>$2B in research expenditures***, ***>600 new inventions***, ***>440 patent applications***, ***>280 issued patents***, and ***>170 licenses executed*** annually.

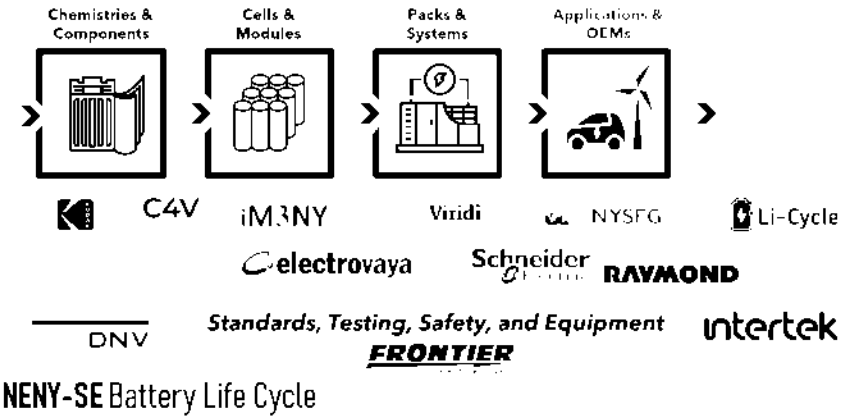
SUPPORTING PARTNERS: EDA BBBRC NENY COALITION

To implement a comprehensive ecosystem-building approach under the 2022 EDA BBBRC NENY project, Binghamton brought together a coalition of diverse stakeholders including academic institutions, non-profits, and governmental entities. **SUNY Broome Community** and **Corning Community Colleges**, 2-year community colleges in the Southern Tier, are essential for WFD and equity efforts, and expansion of the NENY Battery Academy; **The Clean Fight New York**, a nonprofit accelerator hosting a Customer and Partner Readiness Accelerator for market-ready companies, will expand programming to the technology focus areas of the Engine; **Activate Global**, leading national fellowship program for deep-tech scientists, supporting the nation's top battery innovators with dedicated NENY fellow spots each year; **IncubatorWorks** serving 4 rural counties in the Southern Tier with entrepreneurship training, ensuring participation among disadvantaged communities; **Southern Door Community Land Trust**, serving BIPOC populations in Broome County, supports broadening participation in NENY programming; **AMT**, the Manufacturing Extension Partnership (MEP) for the Southern Tier, serving >700 manufacturers, supports battery supply chain buildout; **Southern Tier 8 Economic Development District Board**, overseeing and supporting economic development initiatives across 8 counties of the Southern Tier of Upstate NY;

Broome-Tioga Workforce operates 2 One-Stop American Job Centers, ensuring engagement, support, and training of low-income, rural, and disadvantaged communities.

SUPPORTING PARTNERS: INDUSTRY

The proposer team has a strong track record of industry collaborations, connecting the Engine with companies spanning the battery value chain. The Industry Partners serving on a ***Regional Industry Group*** (**III.B.4**) will articulate current needs and inform program development. The companies will also participate in Industry Challenges and WFD, as well as collaborate on R&D projects.



Kodak, making significant investments to expand its battery electrode manufacturing capacity in Rochester, will provide practical insights into WFD needs and programs related to battery component manufacturing. **Electrovaya**, a Li-ion cell, module and pack manufacturing and technology company, will allocate representatives to play advisory roles for R&D, translation, and WFD, including the selection of learning modules and procurement of hands-on training equipment, as well as participate in pilot runs of relevant WFD learning platforms. **Viridi Parente, Inc** designs fail-safe LiB packs; headquartered in a disadvantaged urban area, the company is a sponsoring employer for GreenForce, a job-opportunity agency focused on underserved communities. Viridi will provide technical guidance on energy storage systems, advise startups, and help shape WFD and DEIA strategies for a green manufacturing environment. **New York State Electric and Gas (NYSEG)**, a NYS-serving electric and gas utility owned by Avangrid, serves on the Board of Binghamton's Southern Tier Clean Energy Incubator. NYSEG will share utility data, provide utility sector guidance, and assist with project review and evaluation, and is considering to launch a ***3-year $1.5M New Energy New York Challenge Grant Program***. **Li-Cycle Corp.**, the largest LiB recycling company in North America, is a NY-BEST Board member that will collaborate on developing training programs for the battery recycling industry, and participate in R&D and translation activities, including through Industry Challenge Grants (**III.B.1**). **DNV**, active in energy systems consulting, certification, and business assurance, operates the highly-subscribed BTCC in Rochester, NY, in partnership with NY-BEST. DNV and NY-BEST will work to expand the safety testing capabilities of BTCC, with DNV subsequently operating and maintaining the equipment post-NSF investment (**III.B.4**). **Intertek**, an internationally-recognized name, offers UL, UN, CE and other certifications necessary to ship, sell, and use LiBs, modules, and packs. Intertek will work with the Engine to plan a testing laboratory in the service region through their Satellite Lab Program. **Frontier**, producer of battery manufacturing equipment, has committed to working with Binghamton and RIT on developing next-generation cell manufacturing technologies, particularly for coating of electrodes, for testing in the Battery-NY Center. **Schneider Electric SE**, a multinational company with a strong interest in storage technologies including long-term storage and grid integration, has committed to testing battery innovations to help speed up validation and implementation. **Raymond Corporation**, a subsidiary of Toyota Industries, has a near 100-year history in the Southern Tier, designing and manufacturing electric lift trucks. Raymond serves on the Board of Binghamton's Clean Energy Incubator and has partnered with Binghamton on R&D energy storage projects. In addition to serving on the Industry Group, Raymond will provide match to company-relevant collaborative projects funded by the Engine.

EXTERNAL PARTNERS & MENTORS

NENY-SE will partner with recognized organizations from developed ecosystems to provide outside perspectives, experience, resources, and opportunities. **TechConnect**, technology discovery and

matchmaking leader backed by the world's largest proprietary ecosystem of solution providers will support the R&D and translation pillars, including by running NENY Startup Sprints (**III.B.2**). **The MITRE Corporation**, a not-for-profit operator of federally funded research and development centers (FFRDC) with expertise in LiB technology including performance and safety testing, supply chain risk assessment, techno-economic assessment, and technology deployment evaluation, will provide the Engine with a Federal Battery Technology Development and Translation Opportunity Advisor (**III.B.4**). **Columbia Tech Ventures (CTV)** leads technology transfer, entrepreneurship activities, external industry collaborations, and technology development initiatives, annually managing >400 inventions, 100 license deals, and 25 IP-backed startups across Columbia's campuses. CTV will advise on Intellectual Property (IP) policy, development of innovative IP and technology transfer frameworks, and will also provide access to the CarbonTech Development Initiative accelerator and NYSERDA EIR program for Engine innovator clients. **InnoEnergy** oversees the industrial management program of the European Battery Alliance (EBA250) and has extensive WFD programs deployed in the E.U., which are being adopted for NYS as the NENY Battery Academy. **Deakin University**, a public university in Victoria, Australia, won a $35M Trailblazer award, the Australian version of the EDA BBBRC program, for the Recycling and Clean Energy Commercialisation Hub (REACH). NENY and Deakin have reciprocated site visits and will continue to collaborate. The

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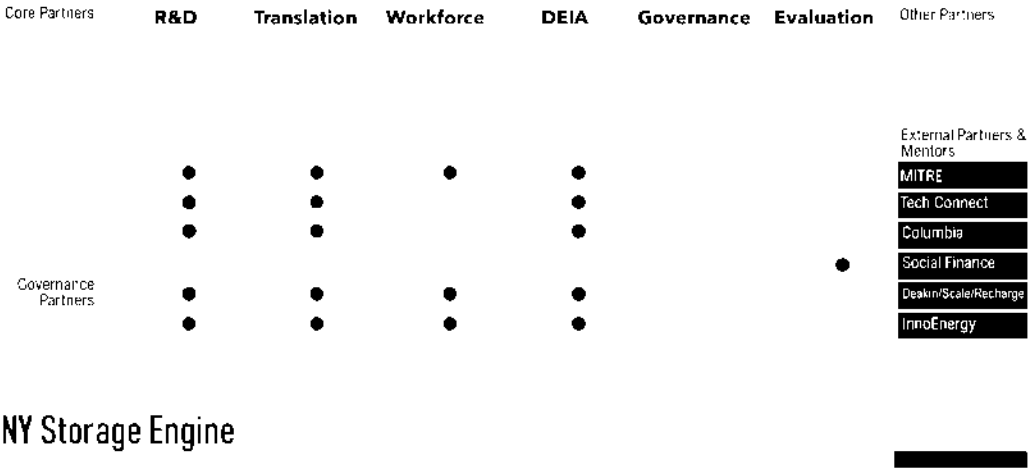


NENY Storage Engine

NENY-SE assembles an unparalleled cross-sector, multi-disciplinary team, ensuring effective utilization of Partner core competencies and resources, covering all pillars required for a successful Innovation Engine.

II.B. PERSONNEL

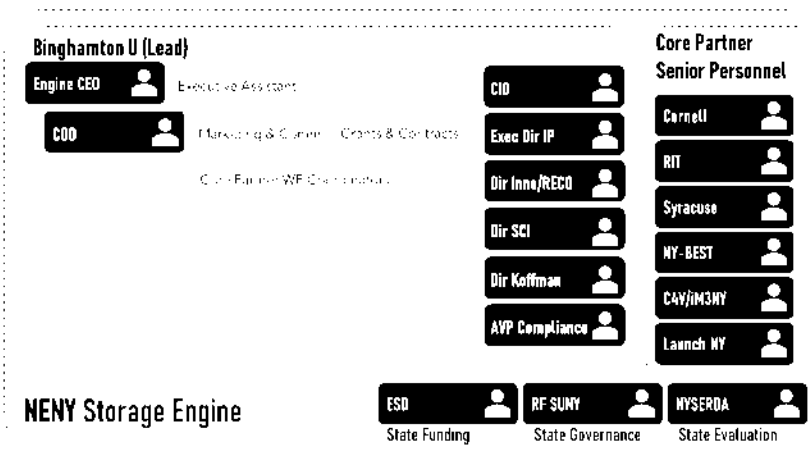
The Engine will have a distributed leadership structure, with Senior Personnel at each Core Partner coordinated by the CEO-led team at Binghamton (**IV.A**). Binghamton will provide an Operations Team, with new Engine positions (CEO, Chief Operating Officer [COO], Executive Assistant, Innovation Partnership Manager, Innovation Program Officer), and will leverage existing positions under BBBRC NENY (Regional Economic Competitiveness Officer [RECO], WFD Director, Associate Director Equity & Justice, Marketing & Communications Team, Grants & Contracts Manager). The Operations Team will oversee all Engine functions, including pillar activities, evaluation, and management, coordinating with respective counterparts at Core Partners. Binghamton Offices of Entrepreneurship & Innovation Partnerships, Sponsored Programs, Sponsored Funds, and Accounts Payable will provide the necessary IP, financial, award management, compliance, and reporting functions at an institutional level. State Partners ESD, NYSERDA, and RF SUNY will provide external support for Engine funding, evaluation, and governance, respectively. Leadership organization described in **IV.A**.

SENIOR AND OTHER KEY PERSONNEL	
▶ *Indicates Governance Board Members*	*Indicates Senior Personnel*
BINGHAMTON UNIVERSITY	***Core Partner***
▶ **Per Stromhaug,** PhD, MBA, Associate VP Innovation & Economic Development	**PD/PI and Engine CEO;** to provide overall oversight and strategy of the Engine
▶ **M. Stanley Whittingham,** PhD, FRS, SUNY Distinguished Professor	**Co-PI and Engine Chief Innovation Officer (CIO)** Binghamton faculty lead and Director of NECCES to provide overall Engine oversight, with focus on use-inspired R&D
Olga Petrova, PhD, Assistant Director, Entrepreneurship & Innovation Partnerships	Co-PD; NENY deputy Regional Economic Competitiveness Officer (RECO), to coordinate with BBBRC NENY partners and programs
▶ **Stacey Johnson,** Director of Workforce Development	To oversee development of workforce development pillar
▶ **Associate Director of Equity & Justice**	**(Search ongoing)** To oversee DEIA strategies and programs
Scott Hancock, Senior Director, Technology Transfer	To lead IP policy development and oversee Engine technology transfer strategies
Nancy Lewis, Assistant VP for Research Compliance	Designated point of contact for implementation and oversight of the research security plan
Michael Jagielski, Director, Southern Tier Clean Energy Incubator Program	Will leverage >3 decades of industry experience to mentor Engine startups
▶ **Chief Operations Officer (COO)**	**New position** to oversee Operations Team and of Engine activities
Innovation Partnership Manager	**New position** to oversee partnerships and collaborations across sectors, with a focus on use-inspired R&D and translation to practice pillars
Innovation Program Officer	**New position** to oversee program and grant funding mechanism implementation, with a focus R&D and translation pillars
Executive Assistant	**New position** to support Engine CEO and COO with administrative tasks
Binghamton Existing Positions to support Engine functions	NENY Marketing & Communications team; NENY Grants & Contacts; NENY Supply Chain Associate; Battery-NY Industry Liaison; Clean Incubator staff
CORNELL UNIVERSITY	***Core Partner***
▶ **Emmanuel Giannelis, PhD** VP Research and Innovation	Engine Core Partner lead providing oversight of Cornell Engine-related activities
Héctor D. Abruña, PhD Émile M. Chamot Professor, Department of Chemistry	Partner faculty lead to provide Engine oversight, with focus on use-inspired R&D
Tom Schryver, MBA, Executive Director, Center for Regional Economic Advancement	To provide coordination with Cornell innovation and entrepreneurship programs related to Engine activities, including leading the IN I-Corps Hub
Patrick Govang, Director Strategic Initiatives, Interim Director, Office of Corporate Engagement	Will leverage experience as Co-Director, AFRL Mid-Atlantic Hub to advise Engine
Paul Mutolo, PhD Executive Director, Director of External Partnerships CABES	Will support industry engagement.
Engine WF Coordinator	**New position** to coordinate with lead, especially around workforce
RIT	***Core Partner***
▶ **Ryne Raffaelle,** PhD, Vice President of Research	Engine Core Partner lead providing oversight of RIT Engine-related activities
Matthew Ganter, PhD, Director RIT Battery Prototyping Center	To provide oversight of RIT battery-related workforce development programs and R&D infrastructure
Engine Coordinator	**New position** to coordinate with lead, especially around workforce
SYRACUSE UNIVERSITY	***Core Partner***
▶ **J. Cole Smith,** PhD, Dean, College of Engineering & Computer Science	Engine Core Partner lead providing oversight of Syracuse Engine-related activities
Quinn Qiao, PhD, Professor, Mechanical and Aerospace Engineering	Site Director for NSF IUCRC for Solid-State Electric Power Storage Industry; Faculty lead for Syracuse
Brian Gerling, Executive Director, NYS Science & Technology Law Center	To contribute to Engine translation, technology transfer, and IP strategy
Engine WF Coordinator	**New position** to coordinate with lead, especially around workforce
NY-BEST	***Core Partner***
▶ **William Acker, PhD** Executive Director	To contribute to Engine Governance and provide oversight of industry engagement, as well as of BTCC expansion project
John Cerveny, Sr. Director & Program Manager, NENY Supply Chain Program	Lead of the EDA BBBRC NENY Supply Chain project to build a battery supply chain in NYS, and support industry engagement
LAUNCH NY	***Core Partner***
▶ **Marnie LaVigne,** PhD, President & CEO	To perform oversight and advisory functions related to startup investments
C4V/iM3NY	***Core Partner***
▶ **Shailesh Upreti,** PhD, Founder and Chairman iM3NY, CEO of C4V	To support Engine Governance by providing industry perspective, and to oversee Engine collaborations with C4V and iM3NY gigafactory
Cliff Olin, MBA, C4V Chief Business Development Officer	To provide industry insights and connect the Engine with C4V's robust battery supply chain network
DNV	***Supporting Partner: Industry***

Martin Plass, Dir. Energy Storage Testing	To oversee expansion of the BTCC battery safety testing capabilities
RF SUNY	***State Partner***
▶**Matthew Mroz**, Vice President - Industry and External Affairs	To support Engine Governance focusing on IP and technology transfer strategy, and to connect the Engine to the RF SUNY enterprise and the SUNY system
Nicholas Querques, Director New Ventures	To support Engine teams with access to SUNY Venture Advisors and fund
NYSERDA	***State Partner***
Richard Bourgeois, Manager Operations and Insights	To support development of Evaluation Plan and advise Engine Leadership
ESD	***State Partner***
Matt Watson, SVP, Division of Science, Technology & Innovation (NYSTAR)	To advise Engine leadership and connect Engine to ESD resources
COLUMBIA TECH VENTURES	***External Partner***
Oren Hershkowitz, SVP Applied Innovation and Industry Partnerships	To serve an external established ecosystem mentor, providing guidance on innovative IP and technology transfer strategies

GOVERNANCE BOARD

Initial composition reflects Core Partner representation and expertise covering all pillars. The Board will be modified/expanded as necessary to diversify representation of relevant ecosystem stakeholders.



▶Per Stromhaug, PhD, MBA, Associate VP of Innovation & Economic Development. PD, PI and Regional Economic Competitiveness Officer (RECO) for the $113.7M EDA BBBRC/ESD New Energy New York initiative, as well as PI and lead on a variety of grants (EDA, NSF, ESD/NYSTAR, NYSERDA, DOE) and programs related to technology translation and economic development. Under his tenure, the Binghamton Incubator Program established in 2013 has grown to 58 active member companies and 148 companies served.

▶M. Stanley Whittingham, PhD, FRS, SUNY Distinguished Professor, co-PI, Engine Chief Innovation Officer (CIO) Nobel Laureate inventor of the LiB technology with a long career in breakthrough industry and university research, including federally-funded collaborative projects and multi-institutional centers.

▶Stacey Johnson, NENY Director of WFD, has 2 decades experience securing significant funding and managing large collaborative economic development and WFD projects. In the past year, she secured $37M across 4 economic development initiatives.

▶Emmanuel Giannelis, PhD, VP for Research and Innovation is responsible for technology transfer, intellectual property, and research policy, leading Cornell's $1.22B research enterprise.

▶Ryne Raffaelle, PhD, VP of Research, leads RIT's research enterprise, plus a long career in energy renewables research including as a Director at NREL.

▶J. Cole Smith, PhD, Dean, College of Engineering & Computer Science, a nationally recognized researcher creating impact for areas such as logistics, national security, healthcare, and production.

▶William Acker, PhD, Executive Director NY-BEST, has decades of experience in the renewable energy space and has been leading NY-BEST for over 10 years.

▶Marnie LaVigne, PhD, President & CEO, co-founded and now heads the first venture development organization providing pro bono mentoring, venture capital, and ecosystem capacity-building for entrepreneurs in Western Upstate NY.

▶Shailesh Upreti, PhD, Founder and Chairman iM3NY, CEO of C4V, is a serial entrepreneur and founder of the iM3NY Gigafactory, leading battery innovation and manufacturing efforts in the region.

▶Matthew Mroz, Vice President - Industry and External Affairs, oversees the divisions of industry relations, partnerships, new and joint ventures, technology transfer, affiliated corporations, and intellectual property and industry risk management and policy for the RF SUNY enterprise.

III. STRATEGIC AND IMPLEMENTATION PLANS.

III.A. STRATEGIC PLAN: ENGINE YEARS 1-10

Purpose: NENY-SE coalesces diverse organizations across Upstate NY to accelerate innovation, technology transfer, and creation of a skilled workforce to grow the capacity of the domestic battery industry.

Vision: NENY-SE matures into a leading ecosystem driving U.S. national security and global competitiveness in battery technology innovation, development, and manufacturing.

USE-INSPIRED RESEARCH AND DEVELOPMENT

GOAL: NENY-SE is the leading facilitator of use-inspired research in the battery space in the US

	Objectives	Outcomes & Deliverables	Indicators/Metrics
Nascent (2023-2025)	Established frameworks for supporting use-inspired R&D	Research security plan developed and implemented; IP policy developed; Regional technology gap analysis for energy storage industry completed; Team onboarded. Deliverables: Security plan; IP policy; Gap analysis; Org. chart.	• # Publications • # Invention disclosures • # Patent applications • # Patents issued • Non-Engine grant funding (sub-metrics for commercialization awards, e.g., NSF PFI) • # of NSF I-Corps teams • # Collaborations with industry and startups (CRADAs, ISRAs) • # Options & Licenses • SBIR/STTR subcontracts (# and $) • # University spinouts formed • Licensing revenue • Demographic distribution per category
	Effective programs that accelerate battery industry use-inspired R&D	Funding RFPs prepared and released; 1st round of Engine R&D funding and projects completed; 1st industry sponsorship or project matching; Research groups and regional industry connected through targeted events. Deliverables: RFPs; Application summary, review and ranking; List of funded projects and descriptions; Report on project outcomes.	
Emergent (2025-2028)	Clear synergies driving use-inspired R&D around battery sector	Increasing # of industry-academia collaborations; Additional R&D institutions onboarded as partners; International collaboration & exchange program launched. Deliverables: List of partners, participants; Description of projects.	
	Increased regional capacity for use-inspired R&D around the battery sector	Battery-relevant faculty teams at partner institutions significantly expanded via new hires; IPR assets protected for preferential licensing programs for industry partners and startups; # of storage-related university spinouts increasing; Increasing industry matching funding. Deliverables: List of new faculty; IP disclosed and filed; List of spinouts; List of match funding.	
Growth (2028-2033)	Engine a nationally recognized hub for battery R&D	Significant licensing revenue; Engine-supported university spinouts raising significant of funding; # of international R&D collaborations is increasing; Dedicated industry funding programs established. Deliverables: News and media mentions for partners and spinouts; Description of industry funding program.	
	10x increase in industry-supported R&D projects	Licensing revenue recirculated to support private and public follow-on investment and technology transfer and use; Engine spinouts and industry partners launching products and establishing/increasing manufacturing presence. Deliverables: Technology transfer report.	

The Use-Inspired R&D and Translation of Innovations to Practice are intricately and interdependently linked, with R&D serving as a pipeline for the technology translation pillar, whereas the expansion of the startup and innovation ecosystem in the region has direct impacts in catalyzing a culture of innovation and encouraging R&D to focus on industry needs.

TRANSLATION OF INNOVATIONS TO PRACTICE

GOAL: NENY-SE is facilitating the leading battery innovation commercialization and manufacturing hub in the US

	Objectives	Outcomes & Deliverables	Indicators/Metrics
Nascent (2023-2025)	Established frameworks for supporting technology translation	Policies finalized for funding, investments, startup sprints, and corporate challenges; Promotion of funding and accelerator opportunities initiated. Deliverables: Funding policies; Promotional materials.	• # Startups launched • # Startups supported • Non-dilutive funding (SBIR/STTR, state, etc) • Revenues • Investments • Academic partnerships (# and $)
	Effective programs that accelerate battery technology translation	Funding RFPs prepared and released; 1st round of funding and projects completed; Startups connected to research teams and student talent; 1st Engine investments; 1st cohorts complete accelerators. Deliverables: RFPs; Application summary, review and ranking; List of funded projects and investments; report on project outcomes.	
Emergent (2025-	Regionally coordinated synergetic incubator network and program	Increasing # battery and storage startups joining Partner incubators and accelerators; Relationships with external investors solidified; Accelerator programs updated/expanded to meet growing demand. Deliverables: List of start-ups with description; List of partner investors; Description of programs with metrics.	

Growth (2028-2033)	Established nationally recognized battery start-up ecosystem	Increasing # of battery and storage startups locating to the region; External investors increasingly investing in Engine startups; Increasing # startups graduating from incubators. Deliverables: List of startups and graduates with description; List of investments (investor and company).	• # Private-sector partnerships (# and $) • Technology Readiness Levels • # New products launched • # Jobs created • Pilot projects (# and $)
	Engine nationally recognized for the development and the manufacturing of battery products	Engine-supported battery startups launching manufacturing operations in the region; Increasing # of international startups locating to the region; increased # new battery products made and sold by industry. Deliverables: Description of anticipated economic impact of manufacturing; List of startups; Description of products launched.	
	100x increase in $ from exits from NENY-SE startups	Increased startup exits (acquired, IPO); Investment revenue recirculated to support Engine; Battery investments funds launched. Deliverables: List/description of exits with; Description of new funds.	

WORKFORCE DEVELOPMENT

GOAL: NENY-SE has a comprehensive WFD program that meets the needs of the regional battery ecosystem

	Objectives	Outcomes & Deliverables	Indicators/Metrics
Nascent (2023-2025)	Established frameworks for supporting battery WFD	Workforce training, wraparound services, and embedded coordinators launched and onboarded. Regional workforce needs-analysis completed. Accountability policy and accessibility metrics. Deliverables: Job descriptions and resumes; Policies for wraparound services and accountability; Gap-analysis report.	• # Training programs • # Trainees • # Companies supported • # Jobs created • # Jobs retained • % Attrition rates • Trainee demographics • Regional battery industry hiring demographics
	NENY-SE Workforce development program launched	Engine-hosted LMS launched. Curriculum revision/re-certification guidelines established. Regional Partner Network launched. Deliverables: List/description of training programs/offerings; Charter for partner network; Guidelines for certification.	
Emergent (2025-2028)	Increased regional battery sector workforce	Regional sector companies, including gigafactory manufacturers, report new hires; Regional Partner Network recruitment methodologies and channels expanded; Interstate and international collaboration and exchange program established; Regional build-ready site certification locations identified and marketed. Deliverables: Updated gap analysis with future projections; Report on people trained and hired.	
	DEIA embedded in workforce development activities	Regional Partner Network Conference launched. NENY-SE Intentional Economic Development project(s) identified. 20% increase in BIPOC job placement across the NENY region. Deliverables: Conference agenda and attendee list; Report on BIPOC job placements.	
Growth (2028-2033)	Comprehensive workforce development program	Increased WF capacity in the region; Decline in attrition rates. Significant impact to reclassifying un- and underserved communities. Deliverables: Updated gap analysis with future projections; Report on people trained and hired.	
	Thriving and diverse workforce supporting all ecosystem aspects	Thriving battery ecosystem for R&D, translation and manufacturing Deliverables: Updated gap analysis with future projections; Report on people trained and hired; List of programs; List of companies hiring from the programs.	

AN ECOSYSTEM OF PARTNERS & STAKEHOLDERS

GOAL: NENY-SE has facilitated the creation of a nationally recognized comprehensive battery ecosystem in Upstate NY

	Objectives	Outcomes & Deliverables	Indicators/Metrics
Nascent (2023-2025)	Finalize Engine strategic and operations plans	Centralized Engine oversight and governance structure; Leadership and operations teams onboarded; Evaluation Plan established, communicated, and deployed; Convening of initial annual meeting. Deliverables: Strategic and operational plan; Job description and resumes; Evaluation plan and contractor agreement; Agenda and participants of annual meeting.	• # Partner organizations at various levels • # companies engaged • # community organizations engaged • # incubators engaged • # programs across the Engine • # and diversity of leadership team • Grant funding secured for Engine
	NENY-SE emerges as a recognized name in regional battery sector	Brand identity built; Marketing & communication plan developed; Website, social media established; Marketing & media campaigns started. Deliverables: Brand guide; links to website and social media platforms; list over media mentions and press releases.	
Emergent (2025-2028)	NENY-SE ecosystem infrastructure expansion	Started (Battery-NY construction) and planned (BTCC expansion) battery ecosystem infrastructure projects completed. Gap analysis of infrastructure needs completed; Projects ranked, funded and initiated. Deliverables: Infrastructure description; Operational and financial plan; List of users, projects and outcomes from centers; Gap analysis; Project descriptions, review and ranking.	

Growth (2028-2033)	NENY-SE partnership expansion framework established	Partnership expansion plan and policy (conditions) established; Additional partners engaged – academic, non-profits, industry, community, and others; New partners on-boarded and included in funded projects. **Deliverables**: Expansion framework and plan; Partner list and resources added; List over funded projects and contributions.	programs • Private funding secured for Engine programs
	NENY-SE partners offer a comprehensive battery infra-structure	Infrastructure use and gap analysis completed; Expansion of companies from inside and outside the region utilizing battery infrastructure; Battery centers financially sustainable. **Deliverables**: Gap analysis; Financial sustainability plans for NENY-SE battery centers/infrastructure; List over companies engaged with centers and outcomes (jobs created/retained; products for sale).	
	NENY-SE helps U.S. secure supply chain independence	Region is connected to and integrated with domestic supply chain. **Deliverables**: Comprehensive ecosystem analysis and report covering the outcomes from use-inspired research activities, translation activities, workforce development programs, and infrastructure investments.	

Across all pillars, metrics are expected to ramp up in the Emergent Phase, as these impact indicators require time to occur post-investment. The strategic and implementation plans will ensure that the project is able to deliver quantifiable results, with the following overarching key indicators/metrics:

Phase	Nascent		Emergent		Growth	
	Mid	End	Mid	End	Mid	End
Trainees	100	300	800	2000	3000	4000
Startups founded	1	3	6	12	17	25
Companies supported	7	15	25	35	65	100
Jobs created	50	250	1000	5000	8000	10000
Engine Partnerships	38	40	45	50	75	100

III. B. IMPLEMENTATION PLAN: NASCENT PHASE YEARS 1-2

SCOPE OF WORK

Task 1	USE-INSPIRED RESEARCH & DEVELOPMENT	*P*	*F*	*C*	*E*
1.1	Regional Industry Tech Inventory (M1-6, and annual thereafter)				
1.2	Use-Inspired R&D Funding Programs (Launching M6; at least semi-annual RFPs)				
1.3	Faculty Expansion and Engagement (New hires by M24)				
1.4	Fostering Campus Innovation Cultures (IP Policy M6; ongoing collaborations)				
1.5	Synergies with Existing Programs (Ongoing starting M1; cohorts/year program-specific)				
Task 2	**TRANSLATION TO PRACTICE**				
2.1	Translation Funding Programs (Launching M3; at least semi-annual RFPs)				
2.2	NENY Technology Collaboration Platform (Launching M3; at least semi-annual sprints)				
2.3	Startup Investment Mechanisms (Ongoing starting M3; first investments expected by M9)				
2.4	Synergies with Existing Programs (Ongoing starting M1; 1-3 cohorts/year program-s)				
Task 3	**WORKFORCE DEVELOPMENT**				
3.1	Needs and Gaps Assessments (M1-6 with annual review)				
3.2	NENY Battery Academy and WFD Programs (Launching M1; program-specific cohorts)				
3.2	NENY Team Expansion & Engagement (Workgroups expanded by M6; new hires by M12)				
3.4	NENY WFD Funding Programs (Launching M6; at least semi-annual RFPs)				
Task 4	**AN ECOSYSTEM OF PARTNERS & STAKEHOLDERS**				
4.1	Ecosystem Infrastructure (Plans & contract M1-3; Construction & procurement M4-15; Equipment Installation M16-18)				
4.2	Ecosystem Funding Programs (interdependent with tasks 1-3)				
4.3	Technical Matchmaking Assistance (Ongoing starting M2)				
4.4	NENY Workgroups and Committees (Assembled by M3; quarterly to semi-annual)				
4.5.	NENY Community Networking (Starting M3; annual convening; quarterly meetings)				
4.6	Fostering International Collaborations (Starting M3)				
	ENGINE ADMINISTRATION				
Personnel	Recruit and Onboard Engine Personnel (M1-6)				
Frameworks	IP policy; Security protocols; Evaluation plan (M1-6)				
Marketing	Strategy, website, materials development (M1-6)				
Governance	Assemble groups, boards, and committees (M3-9)				

P, programs; ***F***, funding; ***C***, capacity; ***E***, ecosystem building.

III.B.1. USE-INSPIRED RESEARCH AND DEVELOPMENT

State of Practice and Current Gaps. R&D universities in the region are increasingly focusing on topics advancing climate change goals at the scale of individual projects and of larger centers and consortia, such as the NorthEast Center for Chemical Energy Storage (NECCES), Battery 500, and the Joint Center for Energy Storage Research. Impactful academia-industry collaborations have been emerging, such as a $2.6M DOE SETO award to Binghamton and C4V to develop ways to support higher amounts of solar power on the grid, and a NYSERDA-funded project involving Binghamton and the Raymond Corp. focusing on a behind-the-meter solar-plus-energy storage system coupled with a LiB-powered forklift charging system for warehouses. However, such engagements have remained limited, with many faculty still reluctant to pursue translation-focused work due to traditional tenure, research funding, and publication considerations, lacking training, tools, and support structures for undertaking such R&D efforts.

Proposed Activities will be overseen by the Engine Innovation Partnership Manager (PM) and Innovation Program Officer (PO) in coordination with other Engine and Operations Team personnel (**II.B, IV.A**), with implementation of new programs and coordination of existing EDA BBBRC NENY program to be utilized for the Engine mission. The Core Partners will leverage their respective technology transfer and sponsored funds units, with representation on the Operations Team, for collecting metrics associated with research expenditures and outcomes, which they regularly track for various internal, state, and national reporting.

Task 1.1. Regional Industry Tech Inventory. To facilitate the design and deployment of the most effective use-inspired R&D programs, the Innovation PM and PO will work with external contractors as necessary to perform at least annual assessments of the current technology gaps/needs and priority R&D areas of committed Industry Partners and of other companies in the battery sector in the region. The data will be compiled into an inventory report to be used by the Engine team to prioritize programs and projects, and will be made available to Engine faculty, as well as startups, to facilitate collaborative R&D efforts.

Task 1.2. Use-Inspired R&D Funding Programs (*all funding programs summarized in 4.2*)**.** To encourage academic researchers to apply their expertise towards industry-responsive R&D, with a priority focus on the gaps identified in **I.E** and in the Regional Industry Tech Inventory, NENY-SE will provide the following. **(i) NENY Translation Gap Grants** will allow researcher teams to undertake industry-informed R&D. Faculty and technology transfer office interactions with industry often result in requests for additional data, testing, or development, such as safety testing or larger-scale sample production. Subsequent engagements are often stalled due to lack of resources to support such requests. While requiring industry feedback, but not an active co-development, NENY Translation Gap Grants will catalyze subsequent larger-scale industry collaborations (including NSF PFI projects), industry-sponsored projects, and licensing. Applications will require letters demonstrating industry feedback and/or completion of extensive customer discovery, such as via the NSF I-Corps program (see below). **(ii) NENY Industry Challenges** and **Translation Partnership Funding** (interdependent with ***Translation*** pillar; see **Task 2.2**): university research groups will receive funding to collaborate with and solve technical gaps for industry, as documented by a partnership agreement. It is anticipated that up to $100k/partner could be requested, $500k max/project, with required in-kind match or matching funds, preferably also with contributions from larger startups and corporations.

Task 1.3. Faculty Expansion and Engagement. The Core Partner R&D Universities have identified >70 faculty with expertise in fields relevant to battery technology. An effective Engine continuously producing timely industry-responsive innovation must work with current thought leaders and nurture the innovators of tomorrow. The Core Partners are committing to ***hiring >30 faculty in battery-technology-related fields over the next 5 years***. Binghamton is also submitting a ***Clean Energy Storage Cluster Hire proposal*** to the SUNY Empire Innovation Program (EIP), a state-funded grant program designed to recruit and retain world-class faculty at SUNY. The faculty will be included in the ***Idea Collision Series*** (**III.B.4.4**) to identify and assess tech gaps and propose teaming projects.

Task 1.4. Fostering Campus Innovation Cultures. With the Governance Board and Innovation Committee (**IV.A**) comprising representatives related to campus-wide R&D and technology transfer activities, the Core Partner universities will share best practices to promoting use-inspired research and commercialization at their institutions, and seek to reinforce and amplify them across the Engine network. **(i) Tech commercialization in tenure guidelines across universities in the region.** RIT is member of

Promotion and Tenure – Innovation and Entrepreneurship (PTIE) consortium, an NSF-sponsored nationwide effort to identify best practices for the recognition of innovation and entrepreneurship within promotion and tenure guidelines. RIT's experience and PTIE recommendations will be used to establish and promote practices across Engine member universities to support innovation and entrepreneurship. **(ii) Increasing awareness of technology transfer and commercialization.** The Core Partners will share their best practices for increasing technology commercialization recognition and competency among their faculty and students, such as ongoing informational and educational sessions on IP protection and tech commercialization to new faculty, departmental faculty meetings, and capstone and graduate engineering courses. The Binghamton team is running pilot programs incorporating customer discovery and user-informed design into senior design and capstone courses. Such activities have resulted in increased faculty and student participation in entrepreneurship training (e.g., NSF I-Corps) and spinout activity. University Partners will share and amplify such best and synergistic practices.

Task 1.5. Synergies with Existing Programs. NENY-SE will leverage and build on existing programs of Core and Supporting Partners to advance the use-inspired R&D mission. **(i) Interior Northeast I-Corps Hub (IN I-Corps)**, supported by a $15M NSF award, comprises 10 partner organizations serving rural and economically underserved regions of the Northeast, including Core Partners Cornell, Binghamton, Syracuse, and RIT. I-Corps provides funding-supplemented tech commercialization training to teams of academic innovators. Prior to joining the Hub, the partner organizations have trained 913 teams, which have raised >$115M in follow-on funding. In advancing the mission of NENY-SE, IN I-Corps will be running hybrid courses at ***ARPA-E Energy Summit***, ***NAATBatt***, and ***The Battery Show*** to provide targeted cohort-based training to university teams in the energy and battery space. **(ii) NENY Pre-Accelerator** will provide a virtual curriculum, supplemented with participation and travel stipends, to train cohorts of academic innovators from across NYS and the country to better understand technology commercialization in the energy storage sector. **(iii) NENY Startup Training Experience.** Undergraduate and graduate students from Core Partner institutions will have an opportunity to intern or train with regional clean energy, especially battery and energy storage, startups, with a dedicated ***Diversity in Cleantech*** internship track.

Culture of DEIA. Women and minority groups, particularly blacks and Hispanics, continue to be underrepresented in the science and engineering workforce, including tenure-track faculty appointments, especially in physical sciences and engineering[18]. Recognizing that a diverse faculty roster benefits innovation outcomes and ensures an inclusive and accessible environment, Core Partners will work with their respective university DEIA offices to optimize practices for the recruitment of new faculty. The universities also prioritize targeted outreach and partnerships, such as the IN I-Corps program collaboration with the GEM consortium (fellowship program to increase minority student participation in graduate STEM programs). To alleviate financial barriers for underserved and low-income student participants, all of our programs will be free of charge, with many providing, including the internships, stipends and other financial support and incentives.

Future Directions/Phase Transition. Pending the evaluation of the proposed Nascent Phase activities, we anticipate continuing these programs into the Emergent Phase, and we will utilize feedback from partners, participants, industry, NSF, and other ecosystem stakeholders to modify or replace programming as necessary to address emerging ecosystem needs in a timely manner. Expansion activities may include:

- Creation of a Battery Technology Transfer Partnering and IP Sourcing Platform in conjunction with the NENY Supply Chain platform (to be created by NY-BEST under EDA BBBRC NENY) to provide a centralized battery industry resource portal for promotion of partnerships and technology sourcing.
- Graduate scholarships to support minority students pursuing graduate degrees on relevant projects.
- Addition of corporate partners nationally that would like to leverage the Engine to charge their own product innovation by providing funding to regional academic partners for use-inspired R&D.

III.B.2. TRANSLATION OF INNOVATIONS TO PRACTICE

State of Practice and Current Gaps. Through the work of the Core, State, and Supporting Partners, including the activity of the NYSERDA-supported Southern Tier Clean Energy Incubator at Binghamton, ECO Incubator at Launch NY, and Venture Creations at RIT (**II.A**), the region is emerging as a hub for

cleantech innovation. However, despite some uptick and recent federal and state investments, Upstate NY still lacks access to capital and resources comparable to those of mature ecosystems, such as Boston or Atlanta. For example, while NY is a leading state in SBIR/STTR recipients, awards are still clustered in a few metropolitan areas[19], and venture capital firms remain predominantly active in metro New York. Expanding access to commercialization and entrepreneurship funding and resources is essential for maintaining the pivotal regional momentum around clean energy. This is even more critical for the resource- and investment-heavy battery technology sector, with the *National Blueprint for Lithium Batteries* highlighting the need for dedicated tech transfer and commercialization support mechanisms[4].

Proposed Activities will be overseen by the Engine Innovation PM and PO in coordination with other Engine and Operations Team personnel (**II.B, IV.A**). The Core Partners will leverage their respective technology transfer, business incubator, and economic development divisions, with representation on the Operations Team, for the collection of metrics associated with technology translation, which they regularly track for various internal, state, and national reporting requirements.

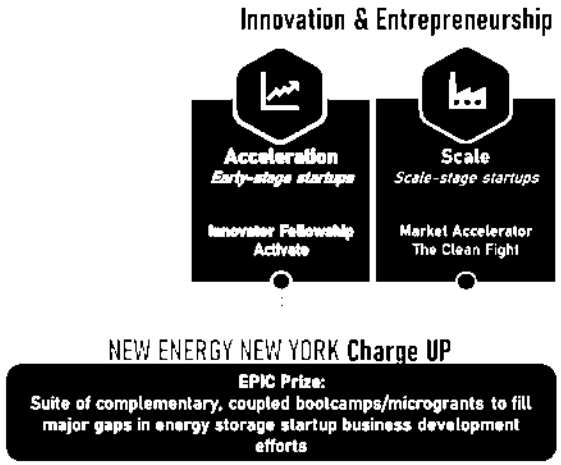
Task 2.1. Translation Funding Programs will support various aspects of the Engine's resource-intensive R&D, proof-of-concept, and pilot projects (*funding programs summarized in* **4.2**). **(i) NENY Commercialization Fellows.** With graduate students often playing pivotal roles in advancing tech commercialization, Core Partner universities have previously successfully deployed graduate entrepreneurship programs, such as Cornell's Commercialization Fellowship and Binghamton's XCEED Fellowship. Thus, the Engine will launch a Commercialization Fellows program, available on a competitive basis, to support regional graduate students working on storage commercialization-focused projects for up to 6 months. **(ii) NENY Startup Gap Funding** will provide small grants (anticipated $10-$50k) to early-stage regional startups (tentatively <$2M raised) for essential business development or proof-of-concept activities. **(iii) NENY Translation Partnership Funding** will support larger collaborative projects, which will require 2+ partners, with at least one being: (a) an academic team or an early-stage startup raising <$2M, and (b) a startup or corporate partner, the limitation that the startup cannot be the spinout of the partner academic team. Anticipated funding: up to $100k/partner, $500k max/project, with required match.

Task 2.2. NENY Technology Collaboration Platform will be launched by the Engine to connect relevant stakeholders across the ecosystem for catalyzing effective collaborative projects, including the following. **(i) NENY Startup Sprints (Startups).** Battery technologies and their management and applications encompass complex multi-component systems requiring not only multifaceted supply chains, but also diverse technical expertise and resources. Thus, startups in this sector often rely on in-licensing and/or external collaborations with academic teams, other startups, or larger corporations. NENY-SE will work with ***TechConnect*** to deliver NENY Startup Sprints, or rapid discovery programs to source novel solutions, partners, and experts on behalf of client startups. Resulting partnerships may lead to projects qualifying for NENY-SE funding. **(ii) NENY Industry Challenge Grants (Established Companies)**. Regional industry players in the battery sector are increasingly looking for collaborations with leading academic labs to address emerging technology challenges. For example, Industry Partners ***Li-Cycle*** is actively exploring solutions for removing iron during the recycling process, as well as developing forward-looking approaches to recycling batteries based on new emerging chemistries, and is looking to NENY-SE for prospective partnerships. Utility company ***NYSEG*** is currently seeking approval to provide up to $500k in matching grants annually for 3 years to fund competitive corporate challenges aimed at solutions to advance electric grid storage opportunities under NENY-SE.

Task 2.3. Startup Investment Mechanisms. Battery and energy storage startups in Upstate NY face challenges in attracting investor funding both due to particulars of the industry sector and due to more limited prospectus and geographic coverage by investor groups relative to more established ecosystems. Core Partner Launch NY will support efforts to overcome these gaps, including through a high-level oversight and advisory role on the Governance Board. With experience funding clean energy startups, Launch NY will provide access to its due diligence, investor pitch preparation, seed fund programs, and portfolio management for eligible companies referred by the Engine. Founders Go Big Incubator, dedicated to historically underrepresented founders and filling the gap in access to early-stage funding, will support relevant battery startups led by minority founders to the extent that funding is available. To amplify these efforts, the Engine will also provide seed funding to early stage startups ($25-$100k, $50k average per

investment) using the SAFE mechanism, which may be supplanted with additional funds from Launch NY, SUNY Ventures, or the New York State Venture Fund. This mechanism can also be used in lieu of match for grant applications from early startups.

Task 2.4. Synergies with Existing Programs. NENY-SE will leverage and build on existing programs of the Core and Other partners that support the technology translation mission of the Engine, including the EDA BBBRC NENY Innovation & Entrepreneurship component, providing a suite of stage-specific acceleration programs supporting the transition of energy storage technologies from lab to market.



(i) Activate Battery Fellows, a partnership with Activate Global under EDA BBBRC NENY, provides 2-year fellowships for top battery innovators coming out of academic labs, with >$300k in funding to launch their ventures and commercialize their technologies. **(ii) NENY Scale,** a partnership with The Clean Fight NY under EDA BBBRC NENY, is a program providing high-touch matchmaking with customer and capital partners, and accelerating adoption of growth-stage energy solutions through demonstration agreements, investments, and financing solutions with NY utilities, industries, capital solutions providers, and other potential NY customers. **(iii) Company Incubation.** Under EDA BBBR C NENY, Binghamton's Clean Energy Incubator is adding an Associate Director to focus on battery and storage companies, thus positioning the incubator to directly support the mission of the Engine, including by providing mentors and space in the service region. **(iv) New Energy New York Charge Up**, supported by a DOE EPIC award, will fill gaps for early-stage energy storage innovators through a suite of complementary bootcamps supplemented with microgrants around high-demand topics including incorporation, intellectual property protection, and grant writing. **(v) NENY Commercialization Vouchers**, a $3M funding program under EDA BBBRC NENY, to cover the costs of testing, certification, and other shared infrastructure usage services in the region for battery and energy storage startups. **(vi) NENY Startup Internships** (*interdependency – see **Task 1.5***) will allow earlier-stage startups to utilize regional student talent to fill major talent gaps. **(vii) Inclusive Innovation,** an SBA Growth Fund Accelerator Program, provides a seminar series with diverse leaders in innovation, entrepreneurship, and technology transfer, coupled with a minigrant and pitch program for underrepresented early-stage innovators.

Culture of DEIA. To cultivate a network of diverse experiences and perspectives and inspire underrepresented minorities to pursue entrepreneurial ventures, the Core Partner incubators have focused on recruiting women and minority founders to serve as mentors, presenters, and instructors, including through the Inclusive Innovation program. For the scale-stage acceleration, Engine Partners will actively conduct outreach to attract companies with minority executive team members and/or with solutions positioned to benefit disadvantaged communities in NYS.

Future Directions/Phase Transition. Potential expansion activities include:

- Addition of new corporate partners from across the nation;
- Addition of seed-stage and venture capital funds as new partners that would like to invest in regional start-ups, with the potential of raising a larger NENY-SE investment fund;
- Attraction of utility, corporate, and philanthropic economic development and STEM and DEIA grants to invest in human capital and infrastructure.

III.B.3. WORKFORCE DEVELOPMENT TO GROW AND SUSTAIN REGIONAL INNOVATION

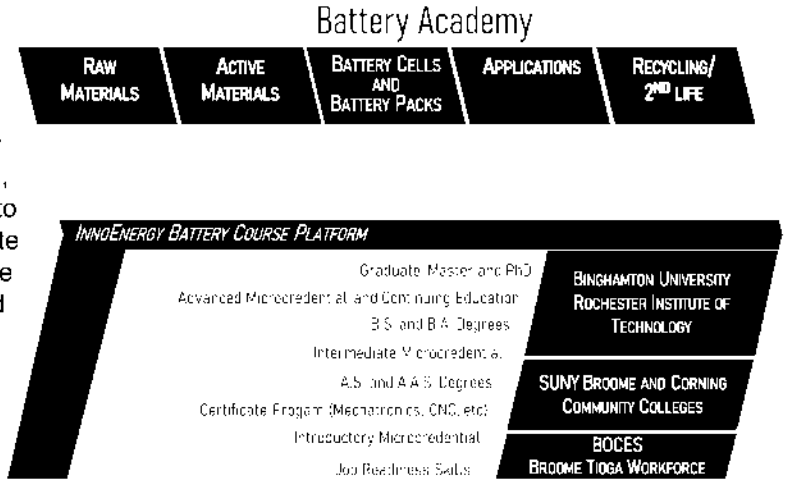
State of Practice and Current Gaps. At the current rate of growth, >200k new jobs will be required by 2030 to support the U.S. battery sector demand, which will far outstrip the existing workforce. In NYS, this need translates to 15,000 manufacturing jobs in the battery industry alone in the next 5 years, with an immediate need of >500 jobs in the next 12-18 months. During the EDA BBBRC NENY project

development, Engine partners performed preliminary mapping of regional labor needs by collecting data from ~50 companies in the battery development and manufacturing supply chains. The conversations highlighted common industry unmet needs: materials and electrical engineers; manufacturing technicians; supply chain managers. Regional companies, including Raymond, currently have >300 opening related to energy storage, with the number expected to grow at least 5× in the next 5 years. iM3NY's gigafactory is expected to create ~1000 new jobs over the next 10 years, with a need for 130 hires in the next 12-18 months. Both companies are looking to hire locally, having hosted, and hired regional student interns, underscoring the need for a targeted skilled WFD effort. Electrovaya is likewise planning to open a gigafacotry in the region (Jamestown), leading to more growth. The LiB recycling company Li-Cycle will expand its operations in Monroe County, NY with the anticipated creation of 1000 construction jobs, as well as 269 direct company openings in the next 24 months. While the region has begun prioritizing WFD efforts around this sector, Lacking, however, is the adoption of a coordinated mechanism and interconnection policies and procedures, which will be developed and optimized under the Engine.

Proposed Activities will be overseen by the WFD Director and Associate Director of Equity & Justice in coordination with other teams (**II.B, IVA**). Entrepreneurship and innovation workforce training is delivered under the R&D and translation pillar leads (see above). All partner training organizations have established mechanisms for quantitative and qualitative indicator collection for various reporting purposes.

Task 3.1. Needs and Gaps Assessments. The BBBRC NENY coalition has performed a preliminary high-level regional workforce needs assessment during the EDA and NSF proposal project design. The Core Partners, working with the Regional Industry Group (**III.B Task 4.4; IV.A**) will complete and annually update a comprehensive analysis of regional WFD assets, needs, and gaps, to drive the design of industry-responsive and community-engaging training programs throughout all phases of the Engine.

Task 3.2. NENY Battery Academy and WFD Programs. Under BBBRC NENY, Binghamton brought together multiple educational organizations (SUNY Broome & Corning Community Colleges, Broome-Tioga BOCES, Broome-Tioga Workforce, and RIT) to provide a comprehensive WFD suite across educational levels and across the battery value chain with both centralized resources and campus- or organization-specific programs tailored to trainees of the respective institutions. With these efforts kicking off in 2023, NENY-SE will utilize and build upon the following constituent programs, filling emerging gaps and expanding programming to new Engine partners



(i) Battery Academy. In partnership with InnoEnergy, the world's largest sustainable energy accelerator based in the E.U. and expanding operations to the U.S., the NENY coalition is working to adopt to the regional ecosystem and the U.S. market the ***InnoEnergy Battery Academy platform*** comprising the hybrid-format ***Battery Storage Expert*** (92 hours) and ***Battery Technician*** (30 hours) Programs, validated with the support of major industry partners. The***$2M-value*** Academy, providing a comprehensive, plug-and-play structure will be leveraged by Engine partners to advance the WFD objective, with modifications and expansions as necessary occurring past the 2-year Nascent stage. **(ii) Partner-Specific Programs.** While leveraging the centralized Battery Academy, each BBBRC NENY institution is implementing specific programs based on industry needs and trainee enrollment trends. ***RIT*** will provide hands-on experiential battery manufacturing training (at their Battery Prototyping Center) through quarterly battery manufacturing workshops, technician training sessions, and coursework leading to a Certificate in Battery Manufacturing. ***SUNY Broome Community College*** is launching introductory and intermediate battery energy storage job readiness programs and an annual summer camp for high school students. ***SUNY Corning Community College*** will launch a Manufacturing Technician program to attract out-of-workforce individuals to

manufacturing, ***Broome-Tioga BOCES*** is launching a career and technical education Clean Energy and Battery Course.

An assessment of the region will be completed in year 1 using the results of these initial pilot trainings to determine the efficacy of content translation to active employment and accessibility of programs to underserved and underrepresented peoples, thus framing the direction of expanded regional program deployment. This assessment will be developed by the WF and EJ Working Group (**Task 4.4, IV.A**) under the advisement of External Partne (b)(4) [redacted] (**IIB**).

Task 3.3. NENY Team Expansion and Engagement. Driven by the local industry, Engines WFD leadership will onboard WF Coordinators in year 1 at Syracuse, Cornell, and RIT. The Coordinators will serve as the regional liaison for programming, data collection, and community outreach. BIPOC counselors and Community Ambassadors at Supporting BBBRC NENY Partners will serve in both a practical and advisory capacity to the WF ecosystem. To ensure accessibility is prioritized to the most underrepresented in the region, In year-1, community engagement efforts including roundtables and listening sessions will be conducted in-person and virtually. Additionally, counselors will be part of an extensive internal evaluation and accountability process of which initial participation, course completion, and successful job placement of NENY-SE trainees will be tracked and evaluated.

Task 3.4. NENY WFD Funding Programs. To enable rapid evolution and testing of WFD programs, increase accessibility, and incentivize partner companies who hire and retain graduates, the Engine will establish the ***NENY Pilot WFD Funding Program*** to fund small-scale regional program pilots developed by partners or external organizations. Non-profit job opportunity agencies that recruit, train, and career counsel in Green Energy will be able to apply for funds to expand their impact and geographical footprint.

The Engine will also work with partners to apply for and leverage external WFD funding opportunities, including state match programs such as NENY-SE State Partner ESD's newly formed Office of Strategic WF Development (OSWD) $115M Pay for Performance Grant Program (P4P) requiring 25% match and a partnership between eligible applicant and industry partner for $50,000-$1,000,000 projects; and $35M WF Development Capital Grant Program requiring a 50% match and a partnership between eligible applicant and industry partner for $100,000-$3,000,000 grants.

Culture of Innovation and DEIA. To lead the country in battery storage manufacturing, it will be important to have a strong and diverse WF with people from different backgrounds, ethnicities, and beliefs. DEIA strategies are built into all aspects of NENY-SE's WFD plan and will be evaluated continuously based on commitments of at least 20% representation. During the Nascent Phase, company DEIA professionals, community leaders and influencers, and non-profit groups like Green Force will work together to develop comprehensive metrics for evaluating and assessing the effect NENY-SE is having on people who have been historically underserved. Early-stage programming is being offered free of change in an effort to mitigate unconscious bias and barriers, and wraparound services are often by extra stipends. Utilization of a virtual platform will maximize opportunities for participation, and BIPOC counselors and Community Ambassadors will be engaged in both programmatic and oversite capacities. An estimated 15-20% of the population is categorized as neurodivergent. One example of how NENY-SE will facilitate engagement of this demographic is in the alignment of industry and cooperative learning programs such as those offered at the RIT National Technical Institute for the Deaf (NTID). NTID is home to the world's first and largest Technical Institutions for the deaf and hard of hearing.

Future Directions/Phase Transition. Potential expansion activities include:

- Expanding programs to attract non-traditional students, and advancing neurodiverse WFD training;
- Development of certificate or degreed programs for power electronics based on industry input;
- With Micron announcing plans to build a semiconductor chip plant near Syracuse, NY (9,000 jobs expected), and Core Partner Syracuse University gearing up WFD plans to address the emerging need, the Engine will work to coordinate efforts to maximize synergies and reduce redundancies around WFD;
- Synergies with K-12 programs (with high-tech R&D, tech transfer, and current regional company labor needs as the main focus in the 2-year Nascent phase, higher education programs were prioritized);
- Establishing Engines Accelerator Career Hubs, which will have the capability to triage, access, and map career pathways based on each participant's current skill level through a state-of-the-art

assessment process designed to properly identify job seeker's skills, preferences, and mental preparedness. Programming will be developed that will introduce candidates to industry partners, assess specific skill competencies, expose participants to the working floor of industry, explore community culture, and determine wraparound support. This program is intended to reduce attrition rates for manufacturers in the NENY-SE region, in the context of a nation-wide increase in the last 4 years from 27% to 44%, and reduce the impact of unconscious bias resulting in increased career sustainability in underserved and underrepresented communities.

III.B.4. AN ECOSYSTEM OF PARTNERS & STAKEHOLDERS

State of Practice and Current Gaps. With NYS's ambitious CLCPA goals, as well as NYSERDA-supported Clean Energy Incubators, including Core Partners' Southern Tier Clean Energy Incubator, ECO Incubator, and Venture Creations (**II.A**), the region is emerging as a hub for cleantech innovation. Startups are noting these opportunities and setting up operations in the region, with >80 joining the clean energy incubators over the last 5 years, and with multiple Industry Partners across the battery value chain, including Kodak, Viridi, Li-Cycle, and NYSEG, looking to scale operations and partnerships in Upstate NY. Notably, iM3NY has opened the state's first LiB gigafactory in 2022 in the Greater Binghamton area, and Electrovaya is following close behind, selecting Jamestown, NY for setting up their gigafactory operations. iM3NY is networked with ~60 companies across the raw material and manufacturing machinery supply chains, as well as 30 OEMs, with the launch of the gigafactory expected to result in regional contracts with a number of these companies, as well as in the potential recruitment of various battery supply chain companies to the region. The NSF Engine investment can provide an unparalleled opportunity in connecting this growing manufacturing ecosystem with the less networked, but no less promising, academic and early-stage innovation base for synergies to benefit all stages of battery technology development across the entire value chain.

Proposed Activities will be overseen by the CEO and COO, working with the Operations Team (**II.B, IV.A**).

Task 4.1. Ecosystem Infrastructure. Lack of centralized piloting and testing facilities and infrastructure, along with growing needs for safety testing for battery and energy storage systems, has been highlighted by FCAB[4], Li-Bridge[1], and Engine Industry Partners. Companies developing battery innovations or planning entry into the battery manufacturing market require investment to mature new technologies and manufacturing techniques into commercially viable products. A significant challenge to companies in attracting this investment is demonstrating to investors that their product plans are of sufficiently low risk; yet, without investment, they cannot mature their planned product and prove technological and manufacturing viability at scale, creating a significant barrier to entry. Providing centralized infrastructure to address these challenges can both accelerate market entry and deployment of new battery technologies, as well as catalyze regional ecosystem growth, as companies seek to co-locate for expedited piloting and testing. Under EDA BBBRC NENY, Binghamton is launching the 30MWh annual capacity Battery-NY pilot manufacturing center that will allow companies to produce 1000s of battery cells of various chemistries, form factors and sizes for demonstration and qualification purposes. With the goal of further building out the Upstate NY battery ecosystem infrastructure capacity, the proposer team evaluated several regional battery development and testing infrastructure projects with significant industry input, selecting the expansion of BTCC safety testing capabilities as the first such project to be supported in the Nascent Phase. The Rochester-based BTCC, run by Core Partner NY-BEST and Industry Partner DNV, is an ISO 17025 accredited testing laboratory that provides independent battery performance and safety testing. BTCC fills a major battery technology commercialization need, with >135 companies supported (quarter of which were startups) and >5M hours of testing logged since the lab's opening in 2014. Under the Engines project, the abuse and burn test capabilities at BTCC will be expanded to modules and full-size battery packs/systems, a capability much sought by regional industry and startups. The expansion will allow additional safety and burn testing on larger battery packs and containers, as well as energy storage system demonstration projects. The facility will provide critically needed safety and abuse testing for new battery chemistries and products being developed through NENY-SE and its client startups, accelerating validation and deployment. While NSF funding will support the infrastructure expansion, BTCC operator DNV will provide personnel and resources to operate and maintain the facility post-expansion.

4.2. Ecosystem Funding Programs. As described above, the Engine will leverage a number of existing

and provide several new funding programs to support activities and outcomes across all core pillars. As these programs will promote industry-responsive projects and cross-sector collaborations, they will directly amplify networking efforts and ecosystem capacity building. With the proposed Engine funding opportunities summarized below, the COO will work with the respective pillar leads, with input from the Governance Board (**IV.A**) to finalize the frameworks of the programs, including qualifications and selection criteria, proposal review and selection process, proposal evaluation committees, and grant administration, and will subsequently engage the full Operations Team to implement the programs.

Funding	Recipients & Requirements	Expected Amounts	R	T	W
Technology Transfer Gap	Academic labs, with proof of industry or customer feedback describing need and interest in collaboration	Up to $50k	■	■	
Commercialization Fellows	Graduate Students with strong entrepreneurial interests	6-month stipend	■	■	
Startup Gap Funding	Startup companies (seed and gap for early stage)	Up to $50k	■	■	
Translation Partnership	Partnership with at least one of each (a) academic lab or early startup, and (b) a startup or an established company. Match required (can be in-kind)	Up to $100k/non-corporate partner (up to $500k total)	■	■	
Workforce/DEIA training	Testing of concepts or creation of courses and labs	Up to $100k			■

R, use-inspired R&D, ***T***, translation of innovations to practice, ***W***, workforce development.

The annual funding designated for investment into ecosystem projects from **NSF ($3.3M**) matched by **ESD ($3.2M)**, **NENY Vouchers ($1M)**, and the **proposed NYSEG Matching Grant ($0.5M)**, will allow the Engine to deploy **up to $8M annually** in high-impact grants and investments to support the Engine. This to be increased further by in-kind and matching funds from the proposing teams and industry partners.

Federal Battery Technology Development and Translation Opportunity Advisor. The NENY-SE grants will be provided with the goal of supporting the recipients reach specific R&D, technology commercialization, or program development milestones, enabling them to seek subsequent follow-on funding from state (with support of State Partners NYSERDA and ESD), federal, investor, or other funding. With this in mind, the Engine is engaging External Partner the MITRE Corporation, a not-for-profit operator of federally funded research and development centers (FFRDC) to deploy a Federal Battery Technology Development and Translation Opportunity Advisor to prepare independent market trend assessments, identify and vet relevant federal program opportunities, connect the engine to other federal agencies, DoD in particular, and advise the Engine leadership and client startups on various funding opportunities.

Task 4.3. Technical Matchmaking Assistance. Pre-commercial through growth-stage companies can greatly benefit from connections to relevant technical R&D expertise, infrastructure, and facilities for general technical consultations, access to testing equipment and instrumentation, and major collaborative projects leading to significant funding (e.g., $2.6M DOE award for a collaborative effort involving Binghamton University and C4V to develop ways to reliably support higher amounts of solar power on the grid). Thus, NENY-SE, with the Innovation PM taking the lead, will undertake matchmaking and referring battery startups to relevant faculty and resources across the state, including the Core Partners and the 64-organization SUNY system. In addition, as appropriate, the Engine will make referrals to relevant ESD-funded NYS Centers for Advanced Technology (CATs) and Centers of Excellence (COEs), including Binghamton's S3IP COE, as well as NYS DOE Energy Frontier Research Centers (EFRCs) and NSF Industry-University Cooperative Research Centers (IUCRCs). With the roster of Industry Partners and a NENY Industry Board, the Engine will also catalyze private-sector partnerships. The matchmaking assistance will facilitate further support of prospective academia/startup/industry collaborations by linking them to federal, state, and Engine funding opportunities.

4.4. NENY Workgroups and Committees. To promote the exchange of ideas and to ensure industry- and community-responsive program design, pillar-specific committees and expert workgroups will be assembled, with at quarterly meetings to inform the relevant areas (see **IV.A** for organization within the Engine). **(i) NENY Equity and WFD Committee** (established under EDA BBBRC NENY), led by WFD Director and Associate Director of Equity & Justice with representation from regional industry, community colleges, and community organizations, will provide relevant regional perspectives, and ensure development of strategies for engaging and benefiting a diverse set of stakeholders, including marginalized and underserved groups. **(ii) NENY Innovation Committee**, led by the Innovation PM and PO, will assemble relevant expertise from Core Partners related to R&D and translation, as well as from External

Partners Columbia Tech Ventures and MITRE (in the form of the Federal Opportunity Advisor, see above), will advise on the development of the respective pillar programs. **(iii) Regional Industry Group**, to be convened to the COO and Innovation Partnership Manager, will comprise representation from Industry Partners, to be expanded with additional companies, meeting quarterly to discuss current regional industry needs, as well as potential collaborations and investments, to inform industry-responsive program design and refine topic priorities for use-inspired R&D. Workforce Development Director and Faculty Lead representation will ensure effective synergies with the R&D and workforce programs.

Task 4.5. NENY Community Networking. The Engine will create and organize various opportunities to network regional battery sector and innovation ecosystem stakeholders including: **(i) NENY Annual Convening.** As planned under EDA BBBRC NENY, an annual in-person NENY Convening will be held in association with the NY-BEST Annual Fall Storage Conference. Under the Engine, this Convening will be expanded to increase representation of academic researchers, earlier-stage startups, and community organizations. **(ii) Idea Collision Series**, or topic-specific workgroups comprising faculty and industry experts, will be convened as appropriate based on recommendations by the Innovation Committee and Industry Group with the support of the Innovation PM and PO and the Faculty Leads from each Core Partner university, to explore opportunities and projects around select priority topics. For example, with battery safety emerging as a pressing issue across the industry, a proposal has been made to convene a cross-sector working group to apply a holistic design approach in improving battery performance and system safety. The workgroups will facilitate cross-department and cross-campus collaborations, provide more in-depth definitions and catalogs of current Core Partner capabilities and research programs for synergies with defined Industry Partner and Engine client startup needs, facilitate joint proposals for NENY and external grants, and propose programs for Engine expansion. In later stages of the Engine, the workgroups will connect with international collaborator teams following establishment of the Battery Collaboration and Virtual Exchange Program (**III.B.4.6**).

Task 4.6. Fostering International Collaborations. While establishing reliable domestic supply chains and protecting home-developed IP from foreign entities of concern defined by the Inflation Reduction Act, cross-pollination of ideas and R&D efforts with "friendly" countries represents additional opportunities to push battery innovation towards the breakthroughs needed to address tomorrow's growing demands. Deakin University is leading the Recycling and Clean Energy Commercialization Hub (REACH), a $265M advanced manufacturing ecosystem backed by a grant from the Australian Government's Trailblazer Universities Program. REACH at Deakin and EDA BBBRC-funded NENY represent 2 unprecedented initiatives in energy innovation and place-based economic development separated across the globe but connected through multiple parallel and synergistic activities working to advance clean energy economies and global climate goals. NENY-SE will establish a formal working relationship with Deakin and REACH to develop a Battery Collaboration and Virtual Exchange Program to facilitate joint R&D projects leveraging the collective expertise of the academic institutions, startups, and industry partners of the two hubs.

Culture of Innovation and DEIA. The assembled Core and Supporting Partner organizations cover a broad region and serve rural and high-poverty urban areas, working with community organizations to engage isolated and disadvantaged communities. With guidance of the NENY Equity and WFD Workgroup, the Engine will ensure adherence to an overarching vision of equity and justice. The Engine will further consult with State Partners ESD and NYSERDA, both of which have prioritized DEIA programs, on best practices and resources to amplify engagement and representation. The leadership team will also reinforce the importance of DEIA with their industry partners, and will assist them as necessary in developing relevant programs, as many earlier-stage startups overlook this key issue.

Future Directions/Phase Transition. Proposed expansion activities and projects to advance ecosystem capacity and networks during the Emergent Phase of NENY-SE include:

- Infrastructure capacity building in the form of Binghamton University, iM3NY, New York Power Authority, and GE Renewable partnering to develop a grid-level storage system near the iM3NY gigafactory to serve as a testbed to evaluate new battery system hardware, control function, and safety features beyond laboratory space.
- Expansion of the instrumentation and capabilities of Syracuse University's NSF IUCRC Center for Solid State Electric Power Storage (CEPS) to support R&D efforts around solid-state batteries.

- Partnership with iM3NY and Intertek to establish a testing and certification laboratory in the service region near the iM3NY gigafactory through the Intertek Satellite Lab Program.
- Partnership with Frontier through the planned Battery-NY Center on a program to modify current battery manufacturing methods.
- Larger-scale collaboration with industry partners for the creation of a technology center or a technology park in the later stages of the Engine.

IV. MANAGEMENT PLAN.

IV.A. LEADERSHIP TEAM

The NENY-SE governance and leadership structure will leverage and build upon that established by the BBBRC-funded NENY Coalition, while incorporating Engine-specific elements, with core management roles and key groups outlined below. See also ***Section II Proposing Team and Organizational Structure.***

CORE MANAGEMENT ROLES (see II.B for personnel details)	
Innovation Leadership	Chief Innovation Officer (Nobel Laureate inventor of the LiB) and CEO (track record of starting and growing incubators from 0 to >80 companies, and leading EDA BBBRC NENY)
Administration of the Engine	COO with support of respective pillar leads and Operations Team
Leadership of Core Functions	
Use-Inspired R&D	Innovation Partnership Manager and Innovation Program Officer
Translation to Practice	Innovation Partnership Manager and Innovation Program Officer
Workforce Development	NENY Workforce Development Director
Partnerships & Engagement	COO and Innovation Partnership Manager, with support of NENY Battery-NY Industry Liaison and NY-BEST Executive Director and Sr. Director & Program Manager for NENY Supply Chain Program
DEIA	NENY Associate Director of Equity and Justice
Communications & Outreach	COO overseeing the EDA BBBRC NENY Marketing and Communications Team
Evaluation and Assessment	CEO with input of respective pillar leads, and working with external partners

Governance Board, comprising CEO and leadership teams from Core Partners **(II.B)**, will oversee internal review and strategy development for pillar programs, industry engagement, and ecosystem growth, as well as operational issues and allocation of resources, receiving progress reports from the Operations Team.

Advisory Board, with function to be defined with NSF input, will assemble external sector leaders to advise NENY-SE on high-level strategy development. While the Board is to be defined post-award, the proposer team has extensive experience with external advisory boards, including the one for the Battery-NY Center under EDA BBBRC NENY.

Operations Team at Binghamton will manage Engine administrative and programmatic activities. The Team, led by the COO, reporting to the CEO, will comprise the Innovation PM, Innovation PO, WFD Director, and Associate Director of Equity & Justice, as well as an experienced marketing and communications, financial, IP, administrative, and technical support staff available under BBBRC NENY and respective university offices. The Governance Board, CEO, and COO will receive reports from the respective pillar leads on program implementation, outcomes, and input from the Innovation Committee, WFD and Equity

NENY-SE Governance

Committee, and the Regional Industry Group (**III.B.4 Task 4.4**).

IV.B. CULTURE OF INNOVATION

Transformational initiatives such as NSF Engines require novel approaches to partnerships and projects, distinct from those for smaller incubator, research center, or consortia initiatives. Project lead Binghamton has experience seizing paradigm-shifting opportunities with the 2022 EDA BBBRC NENY initiative. The EDA's challenge to promote place-based economic development spurred Binghamton to undertake unprecedented efforts to secure meaningful community and industry connections, leading to the build-out of a unique constellation of research universities, community colleges, regional WFD boards, technical skills schools, grassroots community organizations, incubators and accelerators, non-profits, and statewide government organizations. NENY pushed Binghamton to embrace DEIA efforts that go beyond the often-default targeted outreach. Moreover, both proposal efforts compelled us to apply NSF I-Corps teachings in making large numbers of "ecosystem and industry discovery" interviews. The Engine will build upon the coalition, learnings, connections, and best practices acquired to date to continue this important shift away from the "if we build it, they will come" mentality, ensuring impactful programs and investments.

The Engine will encourage innovation across the R&D university partners, including by exploring strategies for counting tech commercialization and entrepreneurship in tenure guidelines, and supporting graduate student innovators through founder fellowships (**III.B**). The Engine will further work to align corporate- and university-specific, often conflicting, approaches to innovation and IP management. While the Engine will have to work to develop innovative, but effective, technology transfer practices (see below), the shift toward collaboration is already evidenced by multiple industry partners seeking co-development projects and expressing willingness to co-sponsor Engine projects, with the most illustrative example being NYSEG's internal proposal for a 3-year $1.5M NENY corporate challenge fund.

Building bridges towards the culture of innovation is the Engine's roster of committed Industry Partners, including both long-established corporations and high-growth startups or companies with startup roots, such as C4V, iM3NY, Li-Cycle, and Viridi. These companies have compelling startup stories and can serve as positive examples of impactful technology transfer for the academic community. The Engine will further nurture innovation in the sector by networking and expanding access to instrumentation and infrastructure for pilot manufacturing and testing, including the planned first-in-the-U.S. 30 MWh-capacity Battery-NY Center. Such infrastructure investments will allow innovators in the field to test and de-risk their technologies without major capital expenditures. Engine impacts will be reinforced by ecosystem 'anchors' such as the iM3NY and Electrovaya gigafactories, the LiCycle installation, and the industry-accessible battery prototyping and testing facilities. In addition, through small pilot funding programs, the Engine will allowed innovators across the main pillars, including academic researchers, startups, and community and WFD organizations, to take measured risks to explore and test novel programs and ideas.

IV.C. CULTURE OF DIVERSITY, EQUITY, INCLUSION AND ACCESSIBILITY

Increasing diversity across the cleantech ecosystem produces benefits by integrating experiences and voices that can inform and advocate for solutions to challenges faced by low-income and BIPOC communities in particular. While DEIA initiatives often start with outreach and recruitment, meaningful outcomes can only be achieved through efforts around diversity of leadership and cultural competency to ensure an inclusive and accessible environment, with Engine action required at various levels:

- Supporting innovators and founders from diverse backgrounds, with a focus on inclusive and accessible recruitment, training, and mentoring practices;
- Ensuring that high-tech, high-growth ventures operate with awareness, knowledge, and adoption of meaningful DEIA strategies and practices;
- Engaging underrepresented communities and groups in WFD training programs via both dedicated community outreach and pathways to break barriers and increase accessibility;
- Deploying new technology in a manner that benefits underserved and marginalized communities.

Our academic partners have prioritized DEIA at the level of university-wide divisions and, having recruiting agreements with numerous minority-serving institutions, will continue to actively recruit and retain a diverse

student population at multiple levels. Fundamental to establishing economic equity is providing access to WFD at multiple levels. Using BBBRC NENY programs, the Engine will provide a comprehensive approach involving technical training programs, community colleges, universities, workforce boards, and industry partners to deliver a suite of training programs, supported by wraparound services and stipends, to enable underserved, rural, and minority groups to join the clean energy economy. In addition, State Partner ESD is committing staff time from the NYS Office of Contractor and Supplier Diversity, to assist the Engine in leveraging ESD's Minority- and Women-Owned and Service-Disabled Veteran-Owned Business Programs.

The continuing underrepresentation of women and minorities in engineering and physical sciences faculty positions and degree programs reflects systemic disparities that need to be addressed also at earlier stages of education. With the Engine prioritizing R&D, innovation translation, and high-tech workforce readiness in the battery sector, there is limited initial scope and capacity to address synergies with K-12 programs, which will be explored in the Emergent Phase. Women and minorities likewise remain underrepresented in the innovation and startup sectors, and continue to face key barriers, including mentor shortages, implicit biases, and lack of access to venture capital (Patent holders: <15% women and <1% black; SBIRs: 8-10% awarded to women and minority startups; Venture capital: 20% of investments to women owners, and only 1% to black founders)[20,21]. Engine partners have already committed efforts to promote representation in entrepreneurship, including accelerator programs for underrepresented innovators (e.g., Inclusive Innovation), Diversity in Cleantech Startup Internships, and Funders Go Big. The team will also actively conduct outreach to attract companies with minority executive team members and founders and which have solutions positioned to make significant impacts on disadvantaged communities.

IV.D. PARTNERSHIPS

Given the central importance of the technology translation and use-inspired R&D pillars, the framework for cataloging, sharing, and disseminating technologies, inventions, software, learnings, and data arising from sponsored activities, as well as any patent rights thereon, becomes a cornerstone of the industry partnership aspect within the proposed Engine – and also a critical element in its economic viability. The NSF Engine program aims to tap university research prowess in driving innovation informed and inspired by identified industry needs. There are variables such as preferential pricing and access through licensing, confidentiality, and publications to consider in designing the tech transfer schema to make it transactionally efficient, understandable, fair, and attractive to stakeholders (NSF, researchers, universities, corporate and startup partners) and aligning incentives to promote participation and complementary, follow-on investment.

NENY-SE will formulate a detailed IP Management Plan which appeals to industry, generates trust and good will, and ignites a vigorous set of use-inspired R&D projects. Once the framework is agreed upon, the task becomes to craft guidelines, procedures, and practices as well as implementing template agreements, e.g., inter-institutional, sponsored research, testing, licensing, membership, in line with the governing framework and applicable laws and regulations, e.g., ITAR and Bayh-Dole. Moreover, the Plan needs to be staffed, congruent with the Cultures of Innovation and DEIA, workable in terms of deployment within institutional operating environments and policies, and sustainable in the Engine's Mature Phase.

Engine Core Academic Partners Cornell and Binghamton have experience operating in patent pools, and are founding members of the University Technology Licensing Program (UTLP). Orin Herskowitz, SVP of Columbia Tech Ventures and the architect of UTLP, will serve as an External Mentor to provide guidance on creative IP licensing strategies. Furthermore, as all of the participating university Partners operate industry-facing testing and engineering extension centers and R&D consortia with company members, they are well-versed in understanding client needs relative to technical, IP, and administrative aspects. NENY-SE partners also need to agree to an effective set of working guidelines, with associated infrastructure, in regards to sharing of data and research results, for example in terms of confidentiality, patent application filings, and publication review and release. Depending on the nature of the data and technology, there may be a need to put electronic and physical security measures and tools into place as part of a research security plan to avoid unauthorized access or transfers.

IV.E. EVALUATION PLAN

With **the goals, objectives, and metrics set out in the preliminary Strategic Plan (IIIA) serving as a foundational framework,** the Engine will engage an independent evaluator, (b)(4) **(II.B)**, to craft a formal Evaluation Plan in conjunction with internal stakeholders and outside experts. With its expertise across research, development, and deployment (RD&D), cleantech WFD, and environmental justice aligning with core Engine pillars, State Partner NYSERDA will also contribute to the development of the Evaluation Plan, and will refer addition external evaluation resources as necessary and appropriate. (b)(4) (b)(4) will build an Evaluation Plan that defines key indicators across: Organizational growth and structure of the Engine (e.g., achievement of milestones, performance on organization goals); Development of use-inspired R&D and translation of innovation into practice (e.g., agreements and collaborations, pilots, product launches); Establishment of an effective workforce (e.g., development of curricula, number trained/placed, job/wage growth, employer and industry retention). The Evaluation Plan will include a combination of quantitative metrics contextualized by qualitative indicators. The latter will be measured through documentation of deliverables (e.g., a Diversity, Equity and Inclusion plan, job postings, meeting minutes, etc.), as well as feedback secured through interviews and focus groups with trainees, founders, employers, community groups, and funding agencies. The Plan will be embedded within Engine governance processes, and formal procedures will be established for changing or amending the plan to ensure transparency and accountability to Engine partners, NSF, and/or the broader community.

During the Nascent Phase, the Evaluation Plan will focus on outcomes and indicators reflecting the establishment of an Engine and protocols that track partner synergy, research breakthroughs, and DEIA embedded throughout. Entering the Emergent Phase, the Plan begins to assess long-term success of the Engine and the ecosystem as it relates to WFD, DEIA, translation of current research to practice, and investment from industry and governmental entities. During the Growth Phase, the Evaluation Plan takes a deeper look at partner synergies and resulting outputs, the growth numbers of the workforce, promotion of DEIA, and the leveraging of NSF funding. At this Phase, the Engine activities are expected to be reflected in significant regional impacts, as well as those for the greater domestic battery sector.

IV.F. LONG-TERM SUSTAINABILITY PLAN

As regional startups proliferate, manufacturing facilities expand, competitive products reach the market, university-industry engagements around battery technology bear fruit, the battery supply chain becomes denser, talent pathways are built for the workforce, the Engine will help the industry cluster become self-sufficient economically. While many of the proposed initiatives will deploy programs that integrate with the regular operations of coalition organizations, the Engine will pursue specific strategies to promote sustainability. For example, as appropriate, NENY-SE will leverage fees for use of facilities at academic Core Partners such as Battery-NY. The Southern Tier Clean Energy Incubator and NY-BEST have membership fees, as well for participation and access to mentoring and resources. To ensure continued support for use-inspired R&D, the core academic partners will confer regarding a fund raised from revenue-generating licensing activities and returns on investments in startups. Binghamton has experience re-investing in research enterprise via its participation in the SUNY Technology Accelerator Fund program which is structured as an evergreen vehicle. Royalties and (cashed-in) equity stemming from licensing IP generated from Engine-funded projects can be earmarked, at least in part, to provide support for other Engine-inspired activities. Returns from Engine investments, will likewise support main pillar functions.

(b)(4)

Academic Core Partners have a strong track record in securing funding for R&D, innovation, and WFD from federal, state, and foundation sources, including $113.7M from EDA and NYS to the Binghamton-led NENY coalition, $15M from NSF to the Cornell-led IN I-Corps Hub, and $10M from the Ralph C. Wilson Foundation

to Launch NY. We will continue to seek funding arising from emerging state and federal commitments to clean energy. The Engine will leverage the state's unprecedented commitment to deploying 6GW of energy storage by 2030[6] and the associated funding opportunities. At the federal level, the recently-released DOE supply chain strategic plan sets aside $6B around advanced battery technologies and supply chain. The Engine will engage MITRE to assist in identifying and pursuing the emerging federal battery technology development and translation funding opportunities (**III.B.4, Task 4.2**).

V. BROADER IMPACTS

The industry- and community-responsive NENY-SE programs will catalyze high-tech R&D outcomes and drive equitable economic development at the regional and national levels. NENY-SE will leverage the transformational NSF investment, supplemented with state matching investment from the ESD ($16M over 5 years if Engine is awarded), and the collective capacity of Engine Partners to strengthen the emerging battery ecosystem in Upstate NY, position the region as an international leader in the sector, and empower American battery innovation and supply chain resiliency. NENY-SE's equity-centered coordinated approach will spur economic development, growth of incumbent energy storage entities, identification and enablement of energy storage workforce pathways, and acceleration of industry innovation, while attracting nascent energy storage businesses and legacy manufacturing corporations to participate in the growing supply chain. Energy storage advancements will broaden the electrification of the economy, and will help the federal government and NYS meet aggressive but vital greenhouse gas emissions and climate change targets, benefitting national security as well as public and environmental health.

At the regional level, the Engine will attract new businesses and investment to generate economic and WFD returns. The 27 counties in NENY-SE's service region are predominantly rural, with >100 federally designated Opportunity Zones in a need of investment and economic resurgence. The Engine will encourage regional growth around new manufacturing opportunities, such as those associated with the iM3NY and Electrovaya gigafactories, by directly supporting these companies, as well as catalyzing the growth of other similar high-tech ventures in the region.

The proposed WFD programs will address, in part, the projected need for 200k new jobs nationally in the battery and energy storage sector by 2030 by providing training, upskilling, and reskilling along the value chain. Our university, community college, and county workforce partners will ensure these programs successfully recruit, retain, and train at levels from skilled trades to Masters and PhD in STEM. Our network of workforce and diversity coordinators will work with industry, academic, and community partners, providing wraparound services to increase accessibility, broaden diverse participation, and promote retention in these programs.

Realizing these broader impacts requires an extensive network of industry, government, academia, finance, and incubator partners. We will build upon our existing regional coalition and culture of innovation and cooperation, while providing access to new members to establish a geographically distributed, multi-disciplinary, cross-sector ecosystem that will support >$2B in investments and >10,000 new jobs in the region within the next 10 years, concurrent with the launch of new programs, networks, and steadily increasing diversity and representation across all pillars of the Engine.

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