Case 14-M-0094, Proceeding on Motion of the Commission to Consider a Clean Energy Fund

Clean Energy Fund Investment Plan: Grid Modernization Chapter

Portfolio: Innovation & Research

Submitted by:

The New York State Energy Research and Development Authority

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9 Grid Modernization

NYSERDA will focus on enhanced grid visualization (advanced sensing, communications, diagnostics and controls), planning processes and advanced materials that accelerate realization of an advanced, digitally enhanced and dynamically managed "high-performing" electric grid. Initiatives will aim to build the capacity to integrate and dynamically manage loads, clean distributed energy resources (DER), and electric vehicles, thereby lowering the carbon intensity of energy usage and increasing customer engagement in energy markets including enabling the development of community-based energy systems such as microgrids. Such a grid will enable more efficient asset utilization (e.g., reduced operating margins, reduced power demands, reduced energy losses), reduced energy costs, improved reliability and resiliency to climate change induced weather events.

The first initiative described in this Chapter is the DER Interconnection initiative, due to the current processes and methods for interconnecting DER which are unable to keep pace with applications, as evidenced by the growing backlog of projects in interconnection queues across the state. The knowledge, techniques, and devices stemming from activity under this initiative will be key to addressing the current DER application backlog, avoiding future backlogs stemming from continued adoption of DER, and accelerating technology innovation that reduces the time, cost, and complexity of interconnecting DER.

Projected additional initiatives under development include investments in innovation focused on developing a digitally enhanced and dynamically managed or "high-performing" electric grid. This more comprehensive initiative will move beyond the singular and less complex question of DER interconnection to include innovation that focuses on dynamically integrating DER into the electric power system.

Program investments and activities will be informed via engagement with stakeholders and subject matter experts.

9.1 DER Integration

9.1.1 Overview

Present Situation	• Recent trends show continued growth in the number, size, and complexity of DER interconnection projects in NY. It is expected that this trend will continue based on distributed energy resources as an outgrowth of Reforming the Energy Vision (REV), the State Energy Plan, Clean Energy Fund, and NY-Sun activities. • The electric distribution system to which these DER will interconnect is operated using older planning tools/algorithms that do not utilize real time data and computational capacities of advanced technologies. Much of the system is operated using relatively passive electro-mechanical devices that do not dynamically communicate with themselves and concern themselves with managing one-way flow of power. Systematic improvements to grid investments and operations are possible at all levels of the grid. In particular,

	the adoption of new technologies will help maximize the integration of large quantities of DER. • As alternatives are developed, validation of technology performance is critical to obtain acceptance by an engineering and standards-based utility culture focused on safety and reliability. Under-utilized and emerging interconnection technologies need to be validated before they will be accepted for use in the electric grid.
Intervention Strategy	An Innovation Program is envisioned to support modernizing NY's electric grid. The overall Grid Modernization Innovation Program will be discussed in two investment plans (two Phases). This investment plan represents Phase I focusing on interconnection of distributed energy resources (DER). Phase II, to be filed at a later date, focuses on the broader range of grid modernization topics including innovation in sensing, communications, and diagnostics. This Phase I DER Interconnection investment plan focuses on innovation to support the interconnection of DER projects in the near term. The DER Interconnection Program strategy is to: • Advance the methods, technology, and industry knowledge that will reduce the cost, complexity, and time to interconnect DER. • Advance the methods, technology, and industry knowledge required to enable accelerated interconnection of DER in areas of high DER penetration on NY's electric grid. For a visual representation of this strategy, please reference the flow chart entitled "Logic Model: Grid Modernization – Phase 1: DER Integration," which can be found in Appendix A.
Goals	This Program is focused on supporting technical advances that will facilitate interconnection of DER projects that are currently seeking interconnection in NY. The knowledge, techniques, and devices stemming from this work will also contribute to managing these types of applications in the future as DER markets develop.
State Energy Plan/Clean Energy Standard Link	Innovation that increases grid capacity to interconnect and expand the use of clean distributed energy resources (DER) is a necessary component of a comprehensive strategy to achieve: • New York State Energy Plan greenhouse gas reduction goals • Improved affordability (by reducing need for capital investment in grid infrastructure) • Clean distributed energy resource deployment targets DER is expected to be a critical element of the Clean Energy Standard

9.1.2 Target Market Characterization

Target Market Segment(s)	Target market segment is NYS electric distribution utilities, DER developers, and grid technology companies developing DER interconnection/integration solutions.
Market Participants	Market participants include: • NY electric utilities • DER project developers

	• Grid-technology companies introducing interconnection/integration products and services • Regulators • National Labs / Department of Energy (DOE)
Market Readiness	Market participants have signaled their readiness, through the NYS Interconnection Technical Working Group, to work collaboratively towards solutions but to truly achieve success will require coordination, collaboration, and technology innovation which NYSERDA is well positioned to lead.
Customer Value	The Reforming the Energy Vision (REV) proceeding acknowledges that interconnection of DER is both fundamental to REV and continues to be a barrier to widespread DER adoption. From Case 14-M-0101, Reforming the Energy Vision, Order Adopting Regulatory Policy Framework and Implementation Plan (issued February 26, 2015): "*Staff Recognizes that burdensome, costly and time consuming interconnection requirements or procedures are a barrier to penetration of DER. The proposal also recognizes that safety and system reliability require appropriate interconnection requirements and that an appropriate balance between streamlining and protecting safety and reliability must be found." (pg.88)* *"In order for distributed generation to compete on an equal footing, interconnection with the grid must be enabled through technical rules and processes that are not only safe but also efficient and expeditious. New York has been a leader in this area, initially adopting Standardized Interconnection Requirements in 1999. Much progress remains to be made, however." (pg.91)* Innovation supporting DER interconnection is not occurring passively in the scope or scale needed to support the market growth currently occurring. If not directly addressed, interconnection challenges could present a large enough barrier to stall the solar market in NY much like what happened in Hawaii in 2014[1][2]. This intervention will support REV and accelerate customer value by supporting the resolution of technical and cost barriers to DER interconnection, thereby allowing greater deployment and lower interconnection costs. By supporting achievement of NY-Sun goals and State Energy Policy, these activities will contribute to: • Interconnection of 3,000 MW by 2023 • Nearly 4,000,000 MWH of PV production by 2020 and approximately 2 million tons of GHG reduction annually.

9.1.3 Stakeholder/Market Engagement

Stakeholder/Market Engagement and Customer Discovery	Recent / Ongoing Activities • Program focus and research activities will be informed by participation in the NYS Technical Interconnection Working Group (NYSERDA is currently co-Chair with DPS).

[1] http://www.renewableenergyworld.com/articles/2014/02/the-interconnection-nightmare-in-hawaii-and-why-it-matters-to-the-u-s-residential-pv-industry.html

[2] http://files.hawaii.gov/puc/4_Book%201%20%28transmittal%20ltr_DGIP_Attachments%20A-1%20to%20A-5%29.pdf

	• 2015 NYSERDA study, completed in partnership with DPS and EPRI, entitled *Interconnection of Distributed Generation in New York State: A Utility Readiness Assessment* • NYSERDA Staff has engaged in numerous interconnection conversations with DER trade associations (i.e. NYSEIA), individual project developers, the Joint Utilities, and research organizations studying interconnection. • Program focus and research activities will be informed by REV proceedings and participating stakeholder viewpoints. Routine engagement with Public Service Commission (PSC) staff will continue to align program focus with current public policy goals.

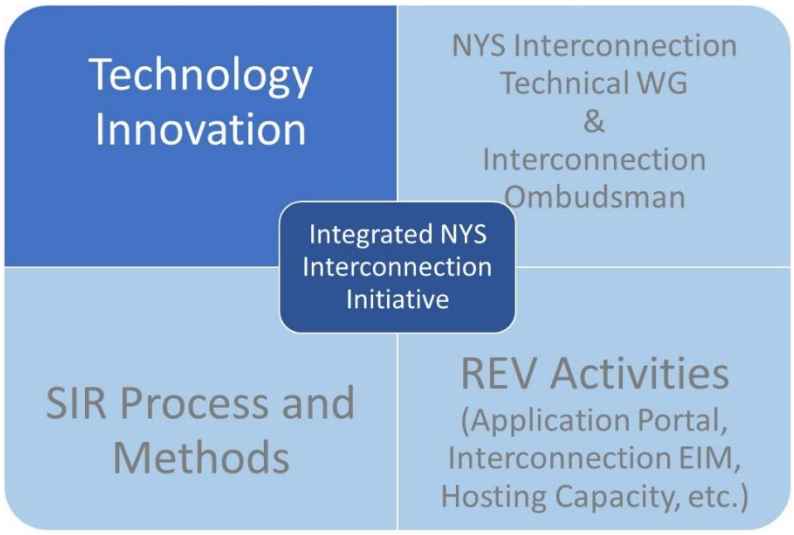
9.1.4 Theory of Change

Technology Opportunities and Barriers Addressed	**Technology Opportunities** Advance the methods, technology, and industry knowledge that will reduce the cost, complexity, and time to interconnect DER including: • Identification and adoption of innovative technologies to support DER interconnection • Adoption of smart inverters in NY • Development and deployment of new technologies and analysis methods to support optimization of available distribution system capacity **Barriers Addressed** • Current grid is unable to support the increase and effective use of DER at the level necessary to support meaningful reduction in greenhouse gas (GHG) emissions (i.e. State Energy Plan (SEP) emissions reduction goals). o System limitations and technical uncertainties have contributed to a significant backlog of DER (photovoltaic) applications pending with the utilities • Validation of technology performance is critical to obtain acceptance by an engineering and standards-based utility culture focused on safety and reliability. • Degree of innovation being tested and/or applied is insufficient across the utilities and sharing of knowledge is not yet sufficient to accelerate pace of innovation. • Achievement of public policy goals for distributed resources (e.g., NY-SUN, combined heat and power (CHP), energy storage) is severely constrained by the long timelines, complexity, and cost of the present interconnection process. • Analysis of the gaps in technologies/tools for developing advanced grid systems is incomplete.
Testable Hypotheses	• If support is provided for validation and performance testing, then new DER technology and interconnection methods will be more readily accepted by the engineering and standards-based utility culture focusing on safety and reliability. • If research and product development are focused on problems common to all electric utilities, then adoption of innovation with respect to DER integration can be accelerated.
Activities (Resources)	• *Grid Modernization Roadmap* - Retain services of a consultant(s) to conduct a comprehensive analysis of gaps and roadmap for advancement of technology and

	tools necessary to support an advanced, integrated, high-performing grid that enables seamless valuation and control of non-wires alternatives. ○ Use gaps assessment to guide program research (priorities/work streams/use cases, budget, and schedule) necessary to accelerate pace of development of technologies, applications and utility capabilities. ○ Using the gaps assessment, collaborate with NYPA and the utilities, as necessary, on the development of a laboratory (AGILe) in New York to support grid modernization research that compliments plans and capabilities of the Grid Modernization Laboratory Consortium Testing Network. • *Interconnection Support* - Engage leading research/consulting organizations, in consultation with DPS and NYSERDA, to support the work of the NYS Interconnection Technical Working Group and the activities of the NYS Interconnection Ombdusmen at DPS and NYSERDA. • *Technology Innovation Funding Opportunities* - Provide funding opportunities in support of leading-edge utilities and grid technology companies to leverage existing capabilities and validate distribution system technologies and practices that support increased penetration of DER. ○ Issue competitive solicitations for project proposals across the continuum of technology development (early stage research/ proof of concept, product engineering and testing, and product demonstration) guided by needs assessment(s). ○ Issue RFPs or other calls for proposals jointly with utilities and DPS to addresses interconnection challenges common across the system. • *Fostering Coordination* - Develop a model for collaboration between NYSERDA, NYPA, DPS, NY utilities, and grid tech companies to ensure the Grid Modernization road mapping work is compatible with and complimentary to the development of Distribution System Implementation Plans (DSIP) consistent with PSC rules. Include in such process a mechanism to ensure various REV (REV Connects), NY Prize and CEF initiatives are integrated/aligned to make optimal use of time and resources. • Continue weekly meetings with DPS and NYPA regarding DER interconnection challenges in NY and continued leadership in the NYS Interconnection Technical Working Group.
Key Milestones	<u>Milestone 1</u> • Reduction in average time, cost, and uncertainty to achieve interconnection <u>Milestone 2</u> • Technologies in operation that enable DER connectivity and increased penetration <u>Milestone 3</u> • Resolution of technical issues and uncertainties that contribute to delays in the interconnection process
Goals Prior to Exit	The potential impact of this initiative includes faster, less costly, and less restrictive DER interconnection process and requirements that support DER deployment while maintaining the safety and reliability of NY's electric grid. Goals prior to exit include lower cost and increased certainty in the DER interconnection process and requirements that support DER deployment while maintaining the safety and reliability of NY's electric grid as evidenced by: • Statewide technical standards applicable to DER interconnection that utilize leading-edge processes, study methods, and innovative technical solutions

	• DER interconnection framework that addresses all DER applications in a timely manner which does not present a barrier to project deployment • Reduction of the frequency and magnitude of utility infrastructure upgrade costs

9.1.5 Relationship to Utility/REV

Utility Role/Coordination Points	This Program is an integral part of the single coordinated endeavor by NY State to address DER interconnection. As such, it is synchronized with manifold other activities both internal and external to NYSERDA. [see figure below] • Many program funded activities involve one or more utilities. • Program activities are closely integrated with the NYS Interconnection Technical Working Group (including representation from DPS, NYPA, PSEG-LI, all NY investor owned utilities, and from the DER development community). • Program activities are closely integrated with the work of NY's Interconnection Ombudspersons. • Program activities are closely integrated with NY Department of Public Service interconnection policy and activities. • Program activity has direct correlation with REV success. Program will leverage its relationship with PSC staff for the purposes of program planning and execution with the regulated utilities. • Program activities will consider and support related key policy imperatives, including REV Connects, REV Pilots, and NY Prize to ensure optimal leverage of time and resources. 
Utility Interventions in Target Market	Utilities are, to a great extent, a customer of the program. Interventions are being driven by REV proceeding as well as increasing DER interconnection applications. Program activity with utility collaboration is expected to focus on accelerating development and use of technologies to accelerate DER interconnection and facilitate DER integration into the electric grid.

9.1.6 Budgets & Expenditures

An annual commitment budget for all activities included in this chapter is shown in Table 1. The annual expenditure projection is included in Table 2. Budgets and expenditures do not include Administration, Evaluation, or Cost Recovery Fee; these elements are addressed in the Budget Accounting and Benefits chapter filing. The budget as presented in the Budget Accounting and Benefits Chapter will serve as the basis for any subsequent reallocation request. The additional level of detail presented within the table below is intended for informational purposes only.

Table 1: Annual Innovation & Research Budget Allocation – Commitment Basis

Commitment Budget	2016	2017	2018	Total
Direct Incentives and Services	$3,800,000	$2,500,000	-	$6,300,000
Total	$3,800,000	$2,500,000	-	$6,300,000

Table 2: Annual Expenditures Projection

Expenditures	2016	2017	2018	2019	Total
Total	6%	42%	44%	8%	100%

9.1.7 Progress and Performance Metrics

Table 3 provides program Activity/Output indicators representing measurable, quantifiable direct results of activities undertaken in the initiative. Outputs are a key way of regularly tracking progress, especially in the early stages of an initiative, before broader market changes are measurable. Outcome indicators can encompass near-term through longer-term changes in market conditions expected to result from the activities/outputs of an intervention. Outcome indicators will have a baseline value and progress will be measured periodically through Market Evaluation.

Table 3. Initiative Specific Metrics

Indicators[3]		Baseline (Before/Current)	2019 (Cumulative)	2022 (Cumulative)
Activity/Outputs	# of studies, demonstrations, and product development projects initiated	0	8	8
	# of studies, demonstrations, and product development projects completed	0	8	8
	# of companies supported or other partnerships with established manufacturers or grid technology companies	0	8	8
Outcomes	Adoption of lower cost methods and devices[4] to reduce DER interconnection costs	0	4	8
	Reduction in average cost to achieve interconnection for DG projects larger than 500 kW[5]	TBD	15%	25%
	DER deployment cost savings (via reduced interconnection costs)	TBD	$18,000,000	$30,000,000

In addition to the above outcomes, NYSERDA will also assess the following broad outcome:

- Faster, less costly, and less restrictive DER interconnection process

Benefits shown in Table 4 and Table 5 are direct, near term benefits associated with this initiative's projects. These benefits will be quantified and reported on a quarterly basis and will be validated through later evaluation.

[3] TBD denotes that NYSERDA requires more data in order to quantify baseline/market metrics to the degree needed to measure against in the future. A 0 (zero) denotes that the actual value is currently believed to be zero for baseline/market metrics.

[4] Lower cost methods and devices are advances such as alternatives to direct transfer trip, less expensive grounding bank configurations, and less restrictive flicker mitigation criteria.

[5] Progress and Performance Outcome data related to DER interconnection cost and is anticipated to be collected by NY-Sun, the NYS Department of Public Service, and the NY Joint Utilities. Collection of this data began in late 2015 and early 2016, depending on the source. The accuracy and completeness of this data are key to enabling assessment of this metric.

Table 4. Direct Impacts

Primary Metrics[6]		2016	2017	2018	2019	TOTAL
Energy Efficiency	MWh Annual	-	-	-	-	-
	MWh Lifetime	-	-	-	-	-
	MMBtu Annual	-	-	-	-	-
	MMBtu Lifetime	-	-	-	-	-
	MW	-	-	-	-	-
Renewable Energy	MWh Annual	-	-	-	-	-
	MWh Lifetime	-	-	-	-	-
	MW	-	-	-	-	-
CO2e Emission Reduction (metric tons) Annual		-	-	-	-	-
CO2e Emission Reduction (metric tons) Lifetime		-	-	-	-	-
Customer Bill Savings Annual ($ million)		-	-	-	-	-
Customer Bill Savings Lifetime ($ million)		-	-	-	-	-
Private Investment[7] ($ million)		$3.35	$2.48	-	-	$5.825

Table 5. Annual Projected Initiative Participation

	2016	2017	2018	2019	Total
Participants[8]	3	5	5	-	13

9.1.8 Fuel Neutrality

Fuel Neutrality	This initiative is not being delivered on a fuel neutral basis.

[6] Impacts are expressed on a commitment-year basis, and are incremental additions in each year. Benefits are rounded to three significant figures. Totals may not sum due to rounding.

[7] This investment strategy is focused on facilitating DER interconnection and the nature of the projects anticipated to be undertaken is likely to yield modest direct private investment. Additional indirect private investment is anticipated from increased DER deployment as a result of reduced interconnection burdens.

[8] Note that total number of participants is greater than the number of companies supported as shown in Table 3. It is anticipated that some projects funded in this investment plan will involve project teams consisting of more than one organization (i.e. a grid technology company, DER project developer, and utility).

9.1.9 Performance Monitoring and Evaluation Plans

Performance Monitoring & Evaluation Plan	NYSERDA's approach to monitoring and assessing the effectiveness of the initiative and overall market development is described below. **<u>Test-Measure-Adjust Strategy</u>** • NYSERDA will monitor standard activity/output metrics including number of projects initiated and completed by type, private investment, etc. • For any new technology developments launched under the program, on a yearly basis, NYSERDA staff and contractor will reassess the Technology and Commercialization Readiness Levels for each project in the portfolio. • NYSERDA will conduct peer reviews of certain projects based on need. Examples – technical impasse, pivot point, critical milestone. • NYSERDA will assess the portfolio of projects annually with regard to goals, metrics, outputs and outcomes. **<u>Market Evaluation/Impact Evaluation</u>** • Market Evaluation will draw on the logic model and will include baseline and longitudinal measurement of key indicators of market success. • Baseline measurements of key performance indicators will occur soon following initiative approval and will address indicators including DER interconnection and deployment costs. In these areas, NYSERDA will first utilize existing information (e.g., solar balance of system cost study data including interconnection cost) and will fill gaps in information as needed and feasible for appropriate baselining. • Regular (e.g., annual or biennial) updates to key performance indicators and measurement of market change will occur once the initiative is underway. Sources of data include public and commercially available data, and primary data collection through surveys of key market actors. • A broad demonstration project impact evaluation will include projects from this area and will examine benefits of demonstration projects, rate of and success factors associated with replication, and benefits of replication projects. Cost savings will be quantified as part of this study.

Appendix A – Logic Models