NYSERDA Case Study:

Grid Modernization Synthesis (2026)

Final Report

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Table of Contents

Executive Summary

New York State's electric grid is undergoing a fundamental transformation — integrating more renewable energy, accommodating growing demand for electric vehicles, and withstanding increasingly severe weather events. NYSERDA's Grid Modernization program has been at the forefront of this transformation, funding a portfolio of grid modernization projects that have delivered substantial, measurable benefits to New York State utilities, ratepayers, technology companies, and society.

This report synthesizes findings from six NYSERDA-funded grid modernization case studies undertaken by NYSERDA between 2020-2026: **Central Hudson Gas & Electric** (distribution automation and microgrid development), **Orange & Rockland Utilities** (accelerated smart grid distribution automation), **Micatu** (fiber-optic voltage sensing), **Tagup** (machine learning-based predictive maintenance), **Switched Source** (automated phase balancing), and the **Interconnection Technical Working Group** (reducing barriers to distributed energy resource interconnection). Together, these case studies document benefits across 12 categories: knowledge benefits, energy savings, DER integration, grid reliability, cost savings, growth/ development/commercialization, job growth/regional economic value-added, replication benefits, leveraged funding and follow-on investment, environmental benefits, health and safety benefits, and net economic benefits/return on investment.

Key Findings

The returns on NYSERDA's investment are compelling. Where aggregate net economic benefits could be calculated, the results are striking. Central Hudson's NYSERDA-funded investments generated $77 million in total quantified benefits against $6 million in NYSERDA funding — a return of $12.83 for every $1 invested.[1] Orange & Rockland generated approximately $20.2 million in total benefits against $5.2 million in NYSERDA funding[2] — a return of $3.87 for every $1 invested. A forward-looking cost-benefit analysis for Switched Source's Phase-EQ device yields a benefit-cost ratio of 5.9 for a 12-device deployment in National Grid's service territory, where the utility included the Phase-EQ device in a recent rate case.

NYSERDA's investments catalyzed far larger commitments of private and utility capital. Central Hudson invested $52.9 million in full-scale grid automation following a NYSERDA-funded demonstration. Orange & Rockland committed $99.17 million in planned follow-on investments through 2044 — 19 times the initial NYSERDA investment. National Grid committed $14.25 million for Phase-EQ devices in its rate case. Con Edison received $3 million in rate case funding for predictive analytics catalyzed by the Tagup pilot.

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[1] The case studies express economic benefits in constant (real) dollars to adjust for the effects of inflation on purchasing power. The selected base-year reflects when the case study was developed; for example, Central Hudson (2020) and Micatu (2020) use $2019 as the base year, while Orange & Rockland (2025) uses $2024. This synthesis report cites the values as expressed in each of the original case studies.

[2] Expressed in 2024 dollars inflated from $3 million nominal.

The benefits are diverse and far-reaching. These investments improved grid reliability for hundreds of thousands of customers — preventing outages for 108,770 Orange & Rockland customers across three major storm events and reducing Central Hudson's outage frequency by more than 25% over eleven years. They reduced greenhouse gas emissions equivalent to the annual output of approximately 160,000 passenger vehicles through Central Hudson's energy savings alone. They advanced New York State's clean energy goals by increasing the maximum approved DER project size from 2 MW to 5 MW and enabling capacity for thousands of additional EVs and distributed generation installations. And they supported the growth of early-stage New York State technology companies, generating an estimated $19.5 million in total economic value added and nearly 140 jobs in the New York State economy from support for one company (Micatu) alone.

NYSERDA's value goes beyond funding. Across every case study, a consistent theme emerges: NYSERDA's most valuable contribution is often the ecosystem of support it provides — connecting early-stage companies to utilities, facilitating cross-utility knowledge sharing, and lending the state's credibility to technologies that risk-averse utilities might otherwise be reluctant to pilot. As the founder of Switched Source put it: *"I do not think that we would be a success if it weren't for the work that was done in New York State."*

As New York State pursues its ambitious clean energy goals under the Climate Leadership and Community Protection Act, the evidence presented in this report makes a compelling case that continued investment in grid modernization is essential — and that NYSERDA's Grid Modernization program is delivering strong, measurable results for New Yorkers.

Section 1 | Introduction

New York State's electric grid faces significant challenges from aging infrastructure, increasing demand, and the rise of variable renewable energy. Fundamental improvements to the electric power grid are needed to maintain grid reliability and resilience while meeting the state's clean energy goals. The New York State Energy Research and Development Authority (NYSERDA) promotes modernization of New York State's electric grid by funding R&D and technology development projects that can be implemented at utility scale.

NYSERDA's Grid Modernization program has supported the development and deployment of technologies that provide: enhanced grid monitoring, control, and flexibility; smart communication between utilities and the grid; increased ability to withstand disruptions; and enhanced ability to accommodate and manage variable renewable resources and electric vehicle charging. Interventions range from critical support for companies to develop, test, and scale their technologies, to utilities to demonstrate and adopt grid modernization technologies across their service territories.

Since 2020, NYSERDA and its evaluation contractor Industrial Economics, Inc. (IEc) have developed six evaluative case studies of interventions that exemplify the Grid Modernization program's work.[3] The scope of the six case studies ranges from company growth and product development/demonstration (Micatu, Tagup, Switched Source) to improved technical interconnection for distributed energy resources (Interconnection Technical Working Group) to system-level benefits across utility service areas (Central Hudson, Orange & Rockland):

- **Central Hudson's Grid Modernization Investments:** Between 2008-2020, NYSERDA funded eight Central Hudson grid modernization projects, awarding approximately $6 million. The funding supported development of automated transmission and distribution management systems, superconducting fault current limiters, and sensors/smart inverters for renewable energy integration. This case study quantifies benefits including improved grid reliability, economic cost savings, and avoided CO_2 emissions resulting from NYSERDA's and Central Hudson's investments.
- **Orange & Rockland (Orange & Rockland)'s Grid Modernization Investments:** Similar to Central Hudson, this case study focuses on NYSERDA-funded grid modernization projects with a combined $3 million of NYSERDA funding. The projects installed circuit optimization equipment and advanced sensors on 13.2 kV distribution circuits in Central Rockland County, along with online decision-making software. Deployed from 2014-2016, the smart grid technologies provided real-time power flow information, enabling Orange & Rockland to manage their system more effectively. This case study quantifies the resulting benefits: improved grid reliability, economic cost savings, and avoided CO_2 emissions.

[3] *Central Hudson's Grid Modernization Investments*, *Orange & Rockland Grid Modernization Investments*, and *Micatu's Real-Time Voltage Sensors* are available at: https://www.nyserda.ny.gov/About/Publications/Evaluation-Reports/Grid-Modernization. *Interconnection Technical Working Group (ITWG)* and *Tagup Demonstrations* are available at: https://www.nyserda.ny.gov/About/Publications/Evaluation-Reports/Renewable-Distributed-Energy-Resources.

- **Interconnection Technical Working Group:** NYSERDA co-chairs the New York Interconnection Technical Working Group (ITWG) with the Department of Public Service to help distributed energy resource (DER) developers and utilities reduce interconnection costs and timelines. This case study evaluates the ITWG's impact by analyzing reductions in interconnection costs and timelines and through interviews with project developers and utilities about NYSERDA's role and contributions.
- **Micatu's Real-Time Voltage Sensors:** Micatu is an engineering firm based in Horseheads, New York. Between 2015-2020, NYSERDA provided approximately $6 million across several awards to support development and demonstration of a real-time voltage sensor that allows grid operators to safely, reliably, and precisely manage electricity flows. With this funding, Micatu grew its business and now sells the sensor through multiple distribution channels. This case study evaluates the economic and environmental benefits of Micatu's sensor under three scenarios involving adoption by small, medium, or large utilities across New York State.
- **Tagup Demonstrations:** Tagup created an Industrial Internet of Things platform to enable low-cost, continuous monitoring of transformer data and advanced analytics to identify transformers needing service. NYSERDA provided approximately $917,000 for partnerships with Con Edison and National Grid to deploy and validate the platform. The case study evaluates funding, technology adoption, and benefits such as avoided outages and deferred capital expenditures. Additionally, it assesses potential future benefits by exploring potential future applications and customers. Since the case study was published in 2024, Tagup has pivoted into defense logistics (https://tagup.ai/). Still, the NYSERDA-funded demonstration with Con Edison catalyzed significant in-house predictive analytics investment by the utility, and the lessons learned remain relevant to grid modernization.
- **Switched Source:** Switched Source develops automated grid modernization solutions that rebalance load between phases and circuits to better utilize legacy infrastructure. Their main product, the Phase-EQ, automatically moves real and reactive load between distribution grid phases, reducing system losses and improving grid capacity. NYSERDA funded two demonstration projects, after which National Grid included Phase-EQ in their utility rate case. The case study examines projected reliability improvements, cost savings, increased DER hosting capacity (the amount of additional generation or load a circuit can accommodate without compromising reliability), avoided CO_2 emissions, and company growth.

Following this introduction, **Section 2** synthesizes the major findings across the six case studies, organized by benefit category rather than by individual case study — allowing the reader to see, at a glance, how different types of benefits manifest across multiple projects and contexts. Each benefit category section identifies which case studies documented that benefit, describes the nature of the benefit, explains how the benefit was measured or estimated, and presents quantified estimates of the benefit's value (where possible). **Section 3** identifies common success factors shared across the case studies. Conclusions are presented in **Section 4**. The results may be of interest to utilities and ratepayers looking to better understand the tangible results of Grid Modernization investments, and to evaluators who are tasked with describing, quantifying, and (where possible) monetizing such benefits.

Section 2 | Benefits of NYSERDA's Support for Grid Modernization

The six case studies document a wide range of benefits, as shown in **Table 1**. Major benefit categories, and select examples from the case studies, are described below.

Table 1: Benefits across Six Case Studies

	Central Hudson	Orange & Rockland	ITWG	Switched Source	Micatu	Tagup
Knowledge benefits	✓	✓	✓	✓	✓	✓
Energy savings	✓	✓		✓	✓	
DER integration			✓	✓		
Grid reliability	✓	✓		✓		✓
Cost savings	✓	✓	✓	✓	✓	✓
Growth, development, and commercialization				✓	✓	✓
Job growth/regional economic value-added					✓	
Replication benefits	✓			✓	✓	✓
Leveraged funding and follow-on investment	✓	✓		✓		✓
Environmental benefits	✓	✓		✓	✓	
Health and safety benefits	✓	✓			✓	✓
Net economic benefits and return on investment	✓	✓				

Knowledge Benefits

Across all six case studies, knowledge transfer emerged as a consistent and valuable benefit, enabling insights and innovations developed in one context to ripple outward to benefit a broader set of stakeholders.

Central Hudson's NYSERDA-funded grid modernization work directly informed the practices of National Grid – which emulated Central Hudson's approach to grid communications and load forecasting – and Con Edison, which modeled its enterprise-wide Geographic Information Systems deployment and online data portal for renewable energy developers on Central Hudson's example. All three utilities credited NYSERDA's facilitation of knowledge-sharing as essential to enabling this cross-utility learning in a rapidly evolving technology landscape. Additionally, **Orange & Rockland**'s grid modernization work served as a real-world testbed for G&W Electric, a provider of voltage sensors used in the project.

The **Switched Source** case study showed how results from a NYSERDA-funded pilot in New York State were shared at national conferences and directly enabled market expansion into Massachusetts and other states. Similarly, the **Tagup** case study demonstrated that pilot demonstrations with Con Edison and National Grid, while not resulting in direct software adoption, provided proof-of-concept evidence that catalyzed both utilities to pursue in-house predictive analytics programs, with Con Edison ultimately securing $3 million in rate case funding for that purpose.

In the **Micatu** case study, Orange & Rockland's pilot site served as a shared resource, providing performance data to other New York State utilities, while NYSERDA's network connections accelerated Micatu's ability to establish pilot relationships with five of the seven major New York utilities. Taken together, the case studies illustrate that knowledge transfer — whether through formal working groups, cross-utility sharing, conference presentations, or NYSERDA-facilitated introductions — is a significant and recurring benefit of NYSERDA's grid modernization investments, amplifying the impact of individual projects well beyond their original scope.

In the **ITWG** case study, the working group itself functioned as a structured knowledge-sharing platform, with technical consultants EPRI and Pterra disseminating national best practices that helped utilities and developers build shared understanding of interconnection processes, leading to streamlined project design and more selective, higher-quality project submissions. By working through technical challenges collaboratively, the ITWG not only improved outcomes for individual projects but also helped developers proactively understand and address potential issues earlier in their project design process.

> "EPRI and Pterra were essential in pushing the updated voltage flicker analysis and helping us understand why our projects were failing the screening tests."
>
> - ***Developer representative, ITWG***

Energy Savings

Energy savings are explicitly quantified in two of the six case studies — Central Hudson and Switched Source — with potential energy savings described prospectively in the Micatu case study. Additionally, Orange & Rockland's grid efficiency improvements and the deferred substation construction implicitly reflect a more energy-efficient system.

Central Hudson provides the most detailed and quantified energy savings figures. Investments in distribution automation enabled Volt/VAR optimization — a process that reduces system losses by lowering voltage to the minimum level demanded by customers in real time, thereby avoiding unnecessary electricity generation. Central Hudson's 2014 rate case estimated an annual reduction in energy costs of $5.9 million, which at an average cost of $0.08 per kWh translates to 73.8 million kWh of electricity avoided each year, or 1.5 million MWh avoided over 20 years. This reduction in electricity generation also produces significant environmental benefits, translating to 37,059 metric tons of CO_2e avoided annually and 741,188 metric tons of CO_2e over 20 years.

Micatu addresses energy savings prospectively rather than with realized figures. The case study explains that by enabling real-time voltage monitoring, Micatu's sensor allows utilities to more closely match electricity supply to demand, thereby avoiding unnecessary electricity generation. The case study states that "in the absence of real-time data, utilities must generate 'extra' electricity to ensure that fluctuations do not reduce power quality below the level required by their customers." At utility scale, a large New York State utility installing approximately 13,000 sensors could avoid approximately 75,000 metric tons of CO_2e annually, which implies a substantial quantity of avoided electricity generation — though the Micatu case study does not express this benefit directly in kWh due to data limitations.

Switched Source documents energy savings through the Phase-EQ device's ability to reduce phase imbalances and distribution system losses. The case study references approximately $10,000 in annual OPEX savings per circuit from reduced energy losses, and the Volt/VAR Optimization (VVO) Application scenario in the cost-benefit model — which assumes the Phase-EQ enhances VVO efficacy by 15 kW — generates additional energy cost savings calculated based on total projected energy savings and the $/MWh weighted rate, using EPRI's Distribution System Losses Evaluation methodology.

DER Integration

This category applies primarily to the ITWG case study, which identifies these three objectives as the pillars of its work, and the Switched Source case study, which documents increased DER hosting capacity through a different mechanism. The **ITWG** identifies these three objectives as the pillars of its work. On hosting capacity, the ITWG developed a new voltage flicker analysis model, which was adopted by New York utilities and allowed the maximum approved DER project size to increase from 2 MW to 5 MW; average solar project sizes for National Grid, NYSEG, Orange & Rockland, and RGE all reached or exceeded 4,000 kW by 2019, up from approximately 2,000 kW in 2016–2017. The ITWG also facilitated feedback from developers on the utilities' online hosting capacity maps, which helped developers strategically locate and size their projects.

Complementing the ITWG's work, the **Switched Source** case study provides evidence of increased DER hosting capacity through a different mechanism: Switched Source's Phase-EQ device unlocks between 500 and 2,500 kW of additional load-serving capacity per circuit through automated phase balancing, enabling an estimated 625 kW of additional distributed generation capacity and 50 additional EVs per device, with National Grid subsequently including $14.25 million for 30 Phase-EQ devices in its rate case as a direct result of the NYSERDA-funded demonstration.

Grid Reliability

Reliability benefits emerge as quantifiable outcomes across four NYSERDA-funded grid modernization case studies. In the **Central Hudson** case study, smart grid investments in distribution automation contributed to a 26.7% reduction in SAIFI (outage frequency) and a 14.7% reduction in CAIDI (outage duration) between 2006 and 2017, outpacing statewide improvements (**Figure 1**). These reliability improvements reduced annual interruption costs by an estimated $7.3 million, with the typical Central Hudson customer experiencing approximately 45 fewer minutes of outage duration per year.

In the **Orange & Rockland** case study (**Table 2** and **Table 3**), grid automation upgrades deployed between 2014 and 2016 also produced notable reliability improvements: when including major storms, Orange & Rockland reduced SAIFI by 13% and CAIDI by 63% compared to pre-upgrade averages, while statewide SAIFI worsened by 5% and CAIDI improved by only 27% over the same period. Across three specific storm events — Tropical Storm Isaias (2020), Christmas 2020, and Tropical Storm Ida (2021) — Orange & Rockland's automation prevented outages for 108,770 customers and shortened outages for an additional 108,925 customers, generating estimated economic benefits of at least $14.5 million.

How Do We Measure Grid Reliability?

Reliability benefits across the case studies are valued primarily using the **U.S. Department of Energy's Interruption Cost Estimate (ICE) Calculator**, which estimates the dollar cost of customer outages based on utility-specific data including customer numbers, outage frequency (SAIFI), and outage duration (CAIDI).

SAIFI: System Average Interruption Frequency Index

- Represents the **average number of interruptions a customer would expect to experience in a year**
- Measures **outage frequency** (how often outages occur)
- A lower SAIFI indicates better reliability
- Primarily influenced by system design, capital investment, maintenance, and weather

CAIDI: Customer Average Interruption Duration Index

- Represents the **average outage duration that any customer would expect to experience over the course of a year**
- Measures **outage duration** (how long outages last)
- Also expressed in hours per year
- A lower CAIDI indicates better reliability
- Affected by utility management, workforce size, and geography

SAIDI: System Average Interruption Duration Index

- Represents the **total hours of interruption that customers experience on average in a year**
- Measures **total outage duration** across the system
- A lower SAIDI indicates better reliability

SAIDI = CAIDI × SAIFI (duration multiplied by frequency)

Note: Electric utilities track SAIFI and CAIDI in **two ways**: **including or excluding major storms**. Reporting both ways allows for more accurate comparisons across utilities located in different regions that experience different weather patterns. For example, a utility in a hurricane-prone area versus one in a temperate climate can be compared fairly by looking at non-storm data.

Figure 1: Reliability at Central Hudson Compared to Statewide Average

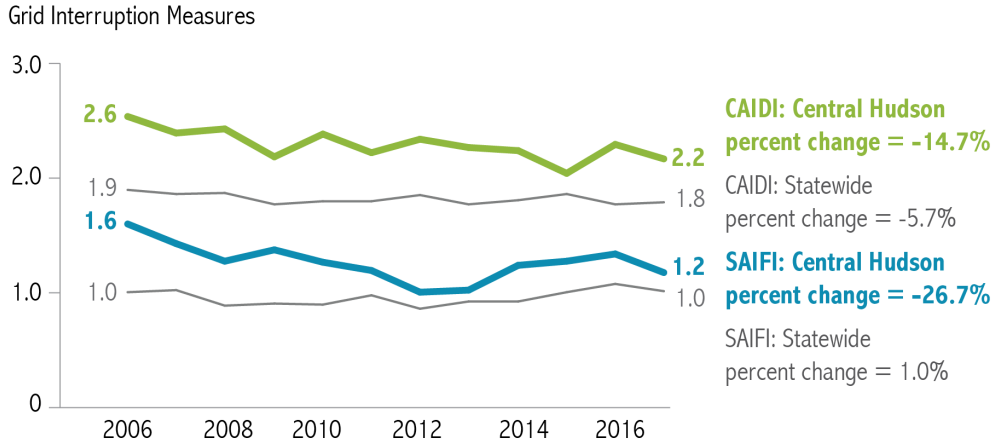


Table 2: Estimated Cost Savings of Orange & Rockland's Grid Reliability Improvements

Storms included/ excluded	Scenario	SAIFI	CAIDI	Annual Cost ($2024)	Annual Cost Savings ($2024)
Excluding major storms	Actual average yearly cost 2017 – 2022	1.03	1.70	$32,453,101	$3,910,509
	If O&R had followed statewide trend	1.15	1.70	$36,363,610	
Including major storms	Actual average yearly cost 2017 – 2022	1.39	4.41	$44,698,495	$10,741,047
	If O&R had followed statewide trend	1.67	8.64	$55,439,542	

Table 3: Estimated Cost Savings from Orange & Rockland's Grid Upgrades for Three Major Storm Events

Storm Event	Storm Year	Customers with Outages Prevented	Cost Savings ($2024)
Tropical Storm Isaias	2020	64,000	$8,571,708
Christmas 2020	2020	36,400	$4,874,244
Tropical Storm Ida	2021	8,370	$1,118,331
Total			**$14,564,283**

The **Tagup** case study contributes a forward-looking reliability dimension: although neither Con Edison nor National Grid adopted Tagup's predictive analytics software beyond the pilot phase, the NYSERDA-funded demonstrations catalyzed in-house predictive modeling efforts at both utilities, with potential annual reliability benefits estimated at up to $1.6 million for National Grid residential customers, $34–$43 million for National Grid commercial and industrial customers, and up to $6,700 and $253,000–$318,000 respectively for Con Edison residential and commercial customers, if the utilities deploy predictive analytics across their service territories to reduce transformer failures and associated outages.

The **Switched Source** case study adds another reliability mechanism: the Phase-EQ device demonstrated 500–2,500 kW of unlocked load-serving capacity per circuit, reducing phase imbalances that can cause circuit overloads and associated outages. The **Micatu** case study similarly points toward potential reliability improvements through real-time voltage monitoring, which would allow utilities to more precisely match electricity supply to demand and respond more rapidly to grid conditions, though these benefits remain prospective pending utility-scale adoption of the sensor technology. Taken together, these case studies illustrate that NYSERDA's grid modernization investments have generated substantial, measurable reliability benefits through multiple pathways – including distribution automation, predictive maintenance, load balancing, and improved sensing – and that the

aggregate economic value of these benefits to utility customers is significant and likely to grow as climate change increases the frequency and severity of storm events.

Cost Savings

All six projects documented cost savings. Within the category of savings, the most common was avoided capital expenditures (N=4), followed by O&M savings (N=3) and reduced energy costs (N=2).

Improved operational efficiency is a significant and recurring benefit across the NYSERDA-funded grid modernization case studies, manifesting through reduced operating expenditures, deferred capital investments, and more precise grid management. In the **Central Hudson** case study, investments in distribution automation enabled Volt/VAR optimization, generating $5.9 million in annual energy cost savings and avoiding two capital upgrades valued at $2.7 million each annually, for total net economic benefits of $40.7 million over 20 years. In the **Orange & Rockland** case study, grid automation upgrades enabled the utility to defer construction of a new $5 million substation by eight years, generating $1.4 million in financial benefits from the deferred capital expenditure, while also avoiding 755 truck rolls across three storm events — reducing both operational costs and safety risks for line crews.

In the **Switched Source** case study, the Phase-EQ device delivered approximately $10,000 in annual OPEX savings per circuit from reduced labor associated with manual phase rebalancing, plus $562,000 per mile in deferred line extension capital costs. Circuits that previously required annual or biannual manual adjustment could now self-balance in real time. In the **Tagup** case study, the primary value proposition was OPEX savings from avoided in-service transformer failure costs and reduced unnecessary inspection costs, as well as substantial CAPEX savings from reduced replacement inventory. Tagup estimated a 47% reduction in the required replacement inventory of network transformers for Con Edison, translating to millions of dollars in avoided capital expenditure.

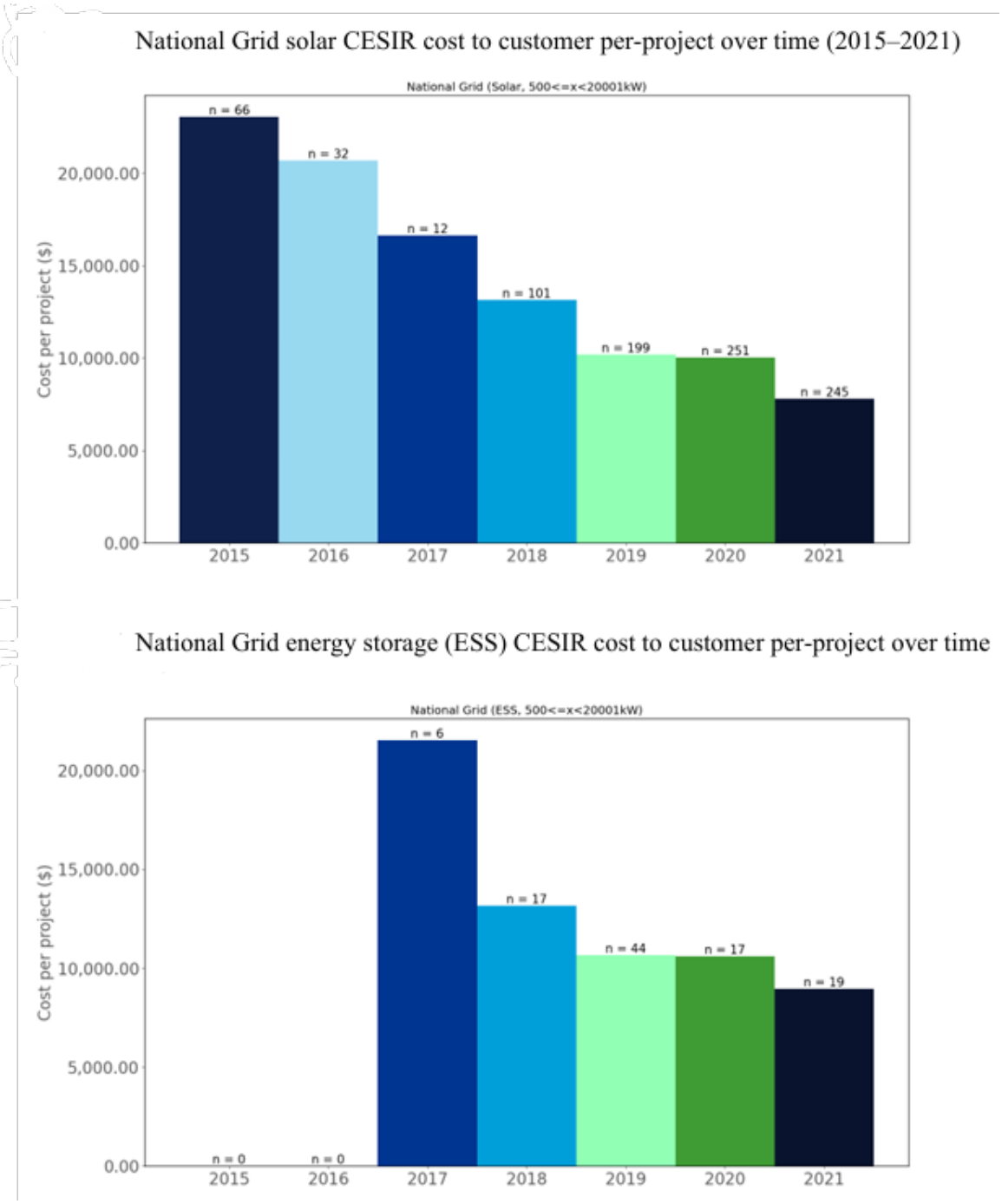
In the **Micatu** case study, the fiber-optic voltage sensor's real-time monitoring capability was described by Orange & Rockland as potentially generating substantial O&M savings at scale. These case studies demonstrate that NYSERDA's grid modernization investments generate operational efficiency benefits that reduce both the day-to-day operating costs and the long-term capital requirements of New York State's electric utilities.

> "It's not necessarily obvious on a single basis why the traditional transformers are not cost effective. But when… multiplied by a thousand poles across the system, and all the linemen required to maintain it, you can see how many dollars in O&M are in play that can be saved by using sensors."
>
> - ***Orange & Rockland (Micatu case study)***

Finally, **ITWG** contributed to reduced interconnection time and costs. Analysis of DPS data showed that Coordinated Electric System Interconnection Review (CESIR) study costs fell on a per-kW basis for National Grid, Con Edison, and Central Hudson between 2015 and 2021, with National Grid's per-project solar CESIR costs declining from over $20,000 to

approximately $8,000 (a 65% decline) and per-project storage costs declining from over $20,000 to approximately $9,000 (a 55% decline) (**Figure 2**). The ITWG also helped reduce project timelines by clarifying utilities' technical requirements, allowing developers to design projects with a higher likelihood of approval and avoid costly redesigns.

Figure 2: National Grid Solar and Energy Storage CESIR Cost to Customer Per-Project



Company/Product Development and Commercialization

This category, which applies to three case studies, includes a wide range of benefits, including: growth in customers and sales, product development and commercialization, and benefits stemming from the state's innovation ecosystem (e.g., entrepreneurial support, incubators, networks) Company growth, product development, sales growth, and commercialization emerge as particularly prominent benefits in the three case studies focused on early-stage technology companies — Switched Source, Tagup, and Micatu — where NYSERDA funding served not only as a source of research and development capital but as a critical enabler of market entry, product refinement, and commercial expansion. In the **Switched Source** case study, NYSERDA funding supported the development and field demonstration of the Phase-EQ automated phase balancing device with National Grid. National Grid's subsequent commitment of $14.25 million for 30 Phase-EQ devices in its rate case represents a direct commercial outcome of the NYSERDA-funded demonstration. The demonstration project also served as the proof-of-concept that enabled Switched Source to expand into Massachusetts and other markets; the company noted that "it would have been really hard to get traction in Massachusetts without the New York State pilot."

> "I do not think that we would be a success, I don't think our company would still be around, if we hadn't gotten the support from NYSERDA in so many different areas of our business."
>
> - ***Switched Source***

In the **Tagup** case study, NYSERDA-funded pilots with Con Edison and National Grid — while not resulting in direct software adoption — provided Tagup with the utility-sector credibility and proof-of-concept evidence needed to attract customers in other industries, including manufacturing and aviation, and the company cited NYSERDA's support as instrumental in validating its machine learning platform for asset health monitoring in a highly regulated and risk-averse sector. Although Tagup subsequently pivoted to defense logistics, Con Edison's decision to pursue a $3 million rate case investment in in-house predictive analytics, catalyzed by the Tagup pilot, illustrates the commercialization ripple effects of NYSERDA's investment.

In the **Micatu** case study, NYSERDA funding supported the development and pilot deployment of Micatu's fiber-optic voltage sensor with Orange & Rockland, which the company described as a foundational step in its commercialization journey. NYSERDA's network connections facilitated introductions to five of New York State's seven major utilities, accelerating the company's ability to establish pilot relationships that would otherwise have taken years to develop independently.

> "NYSERDA has relationships with utilities throughout New York State, so we can speak to who we need to speak to… Those contacts are priceless."
>
> - ***Micatu***

Across all three company-focused case studies, NYSERDA's role extended well beyond funding to encompass active participation in New York State's innovation ecosystem —

providing access to networks, facilitating introductions to potential customers, and lending the credibility of state endorsement to technologies that utilities might otherwise have been reluctant to pilot — demonstrating that the non-financial dimensions of NYSERDA's support are often as commercially significant as the funding itself.

Job Growth and Regional Economic Value-Added

Micatu, founded in 2011 in Horseheads, New York, grew from five employees at launch to a peak of 39 full-time equivalent employees (FTEs) in 2016, before dropping to 18 FTEs as a result of a reduction in orders. Following the signing of several large-volume sales contracts — most significantly an exclusive distribution contract with Eaton — Micatu projected growth to 60 FTEs in 2020. To estimate the regional economic impacts of this employment growth, the case study used the IMPLAN input-output model, which analyzes multiplier effects associated with changes in employment demand. The analysis found that if Micatu reached its projection of 60 direct FTEs, this would generate approximately $19.5 million in total value added to the New York State economy, comprising $8.9 million in direct effects, $5.9 million in indirect effects (ripple effects to supplier industries), and $4.8 million in induced effects (changes in household consumption). The same 60-job scenario would support 138.6 total FTE jobs in New York State — meaning 60 direct jobs at Micatu plus over 78 additional jobs in the broader state economy — suggesting an employment multiplier of approximately 2.3. Micatu reported spending all of NYSERDA's award money in New York State, concentrating these economic benefits in the Southern Tier region where Micatu's Horseheads facility is located.

Leveraged Funding and Follow-on Investment

These were common benefits identified across four case studies. For **Central Hudson**, NYSERDA provided approximately $6 million across eight awards. Central Hudson committed $52.9 million in follow-on investment ($51.3 million for distribution automation plus $1.6 million for the Denning microgrid), representing $8.80 committed by Central Hudson for every $1 of NYSERDA funding.

For **Orange & Rockland**, NYSERDA provided $3 million[4] and Orange & Rockland contributed approximately $8.7 million in cost share, representing $2.90 committed by Orange & Rockland for every $1 of NYSERDA funding. Orange & Rockland also committed $99.17 million in planned follow-on investment from 2025–2044 — 19 times the initial NYSERDA investment.

Central Hudson and Orange & Rockland committed a combined total of **$152M+ in follow-on investment**. Additionally, Con Edison and National Grid committed a combined total of **$17M+ in rate case funding** to further develop or scale up technologies that were demonstrated in NYSERDA-funded projects.

For **Tagup**, NYSERDA invested $1,226,831 across three projects. Tagup provided a cost share of $1,297,452. In addition, Tagup received $8.1 million in non-NYSERDA public and private investment from sources including the U.S. Army, U.S. Navy, and Massachusetts Clean

[4] When adjusted for inflation, this figure equates to $5.2M in 2024$.

Energy Center. Additionally, following its demonstration project with Tagup, Con Edison secured $3 million in rate case funding to continue and develop in-house predictive analytics.

Switched Source: National Grid committed $250,000–$350,000 in in-kind funding for the National Grid pilot. Following the successful demonstration, National Grid included $14,250,000 for 30 Phase-EQ devices in its rate case.

Replication Benefits

> "We took a lot of stock in [Central Hudson's approach to load forecasting] and copied some of what they were doing."
>
> - ***National Grid***

Successful demonstrations in four case studies catalyzed broader adoption — both within the original organization and beyond. In the **Central Hudson** case study, NYSERDA's funding for a demonstration of a distribution management and automation system gave Central Hudson the confidence to invest $51.3 million in full-scale transmission and distribution automation, and the success of the Denning, NY microgrid led Central Hudson to propose four additional microgrid locations under NYSERDA's NY Prize competition. Moreover, as discussed above, National Grid emulated Central Hudson's approach to grid communications and load forecasting, while Con Edison modeled its enterprise-wide GIS deployment and online data portal for renewable energy developers on Central Hudson's example, with all three utilities crediting NYSERDA's facilitation as essential to enabling this cross-utility learning.

In the **Switched Source** case study, the NYSERDA-funded beta test in Sherburne provided the proof-of-concept data needed to secure National Grid's participation in a larger demonstration in Clifton Park, which in turn led National Grid to include $14.25 million for 30 Phase-EQ devices in its rate case. Results were shared at the CIGRE US National Committee 2024 Grid of the Future Symposium and with National Grid Massachusetts, which is now deploying a Phase-EQ device, and Switched Source successfully emphasized the NYSERDA pilot in a Connecticut Innovative Energy Solutions prize application with Eversource that could lead to scaled-up deployment.

In the **Tagup** case study, while neither Con Edison nor National Grid adopted Tagup's software directly, both utilities credited the NYSERDA-funded demonstrations with providing the proof of concept that catalyzed in-house predictive analytics programs, with Con Edison securing $3 million in rate case funding for that purpose.

In the **Micatu** case study, the NYSERDA-funded pilot with Orange & Rockland served as a foundation for Micatu to establish pilot relationships with five of the seven major New York utilities, with Micatu attributing this accelerated timeline directly to the introductions NYSERDA facilitated. A separate NYSERDA-funded pilot with Con Edison demonstrated a new underground application for Micatu's sensor that is now advertised on Eaton's website and opens a previously inaccessible market segment.

Environmental Benefits

Improved operational efficiency, reduced energy use, and increased reliance on renewable energy resources results in reduced/avoided GHG emissions. The societal benefits of

avoided GHG emissions are valued using the social cost of carbon (discussed below). These benefits were quantified across four case studies.

The most substantial emissions reductions documented in the case studies come from the **Central Hudson** case study, where investments in distribution automation enabled Volt/VAR optimization. By lowering voltage to the minimum level demanded by customers in real time, Volt/VAR optimization avoids unnecessary electricity generation. This results in an estimated annual reduction of 73.8 million kWh of electricity and 37,059 metric tons of CO_2e, or 741,188 metric tons of CO_2e over 20 years, equivalent to the annual emissions of approximately 160,000 passenger vehicles. These avoided emissions translate to $28.0 million in avoided societal damages over 20 years using the SCC.

How Are Emissions Reductions Valued?

Reductions in CO_2 emissions are valued using the social cost of carbon (SCC). The SCC is a measure of the value (in dollars) of the long-term societal damages resulting from emitting one ton of CO_2 in a given year; these damages include impacts to human health, agricultural productivity, and property damage, among others.

Across these case studies, both the Central Hudson and Micatu analyses value emissions reductions using the U.S. Government Interagency Working Group on the Social Cost of Greenhouse Gases' central estimate at a 3% discount rate, while the Orange & Rockland analysis uses New York State's Department of Environmental Conservation SCC guidance at a 2% discount rate, and the Switched Source analysis applies New York State's 2023 Value of Carbon guidance. These differences reflect the evolution of both the U.S. Government's and New York State's approach to valuing carbon over the period spanning these case studies.

The **Micatu** case study offers a prospective but substantial emissions reduction scenario: if a large utility like Con Edison were to install Micatu's fiber-optic voltage sensors across its 2,200 distribution feeders (approximately 13,000 sensors), the real-time matching of electricity supply and demand enabled by the sensors would eliminate the need for surplus generation, avoiding approximately 75,000 metric tons of CO_2e annually, or 1.5 million metric tons over the 20-year sensor lifetime. This would result in an estimated $3.8 million in societal damages avoided annually and $68.5 million avoided over 20 years using the central SCC estimate – benefits that scale down proportionally for smaller utilities, ranging from $0.4 million annually to $7.8 million over 20 years for a utility the size of Orange & Rockland with approximately 250 distribution feeders.

In the **Orange & Rockland** case study, the emissions benefit is realized through a different but related mechanism: NYSERDA-funded grid upgrades improved grid efficiency sufficiently to defer the construction of a new $5 million substation by eight years, from 2021 to 2029, which is environmentally beneficial because both the energy intensity of the New York State grid and the embodied carbon emissions associated with substation construction are projected to decrease significantly over that period: The grid's carbon emission intensity is expected to fall from 0.17 CO_2/MWh in 2022 to 0.06 CO_2/MWh in 2029, a 65% decline – resulting in 5,274 fewer metric tons of CO_2e from avoided embodied carbon emissions, with a social cost of carbon benefit of $1.3 million.

The **Switched Source** case study contributes additional quantified emissions reductions from two pathways enabled by the Phase-EQ device's ability to increase load-serving capacity: the

EV integration scenario estimates 4,000 metric tons of CO_2e avoided per device (or 48,000 metric tons for 12 devices) as electric vehicles replace conventional vehicles, and the distributed generation integration scenario estimates 3,198 metric tons of CO_2e avoided per device (or 38,369 metric tons for 12 devices) as additional solar generation displaces grid electricity with the social cost of carbon valued at $135.46 per metric ton of CO_2e using New York State's 2026 guidance — incorporated into all modeled net present value calculations.

Health and Safety Benefits

Four case studies identified a range of health and safety benefits. **Orange & Rockland** provided health benefits related to reduced PM2.5 air pollution emissions from deferring substation construction from 2021 to 2029. The case study estimates that building the substation in 2021 would have produced 11,839 kg of PM2.5 eq versus 7,791 kg in 2029, a reduction of approximately 4,048 kg PM2.5 eq. Approximately 25% of this reduction (982 kg) would occur in Orange & Rockland counties in New York State, with the remaining 75% spread across the U.S. supply chain. Using the EPA's COBRA tool for local emissions and the BenMAP tool for U.S.-wide emissions, the case study estimates the total monetized health benefit of reduced PM2.5 emissions at $2.92 million ($1.02 million for Orange & Rockland counties and $1.90 million for emissions reductions across the U.S.). These estimates are likely underestimates because they do not account for reductions in volatile organic carbons (VOCs).

Orange & Rockland also provides quantified safety benefits, focused on reduced truck rolls for line crews. For three major storm events, grid automation upgrades allowed Orange & Rockland to avoid sending line crews into the field in hazardous conditions: 502 truck rolls were avoided during Tropical Storm Isaias (2020), 217 during Christmas 2020, and 36 during Tropical Storm Ida (2021), for a total of 755 avoided truck rolls across the three events. Reducing truck rolls reduces hazards associated with risk of injury for line crews, risk of traffic accidents, and air pollution from vehicle emissions. The total number of truck rolls saved is likely higher, as these three events represent only a subset of storm and non-storm events since the upgrades were deployed.

Tagup addresses safety through a different pathway: **reduced risk of catastrophic transformer failure**. Transformer failures pose significant safety and liability risks for utilities, as transformer explosions can seriously injure pedestrians or cause property damage. Con Edison has come under public scrutiny for catastrophic underground transformer failures that have injured pedestrians on New York City sidewalks. Con Edison's decision to request $4.4 million in its 2022 rate case (ultimately awarded $3 million) for predictive analytics is evidence of the value the utility places on reducing transformer failure risk across its service territory — a risk that the NYSERDA-funded Tagup pilot helped demonstrate could be managed through predictive modeling.

Micatu addresses safety through the inherent design of its fiber-optic sensor, which provides **increased safety for electric utility line workers**. Because Micatu's sensor uses fiber optics (light) instead of conventional voltage and current transformers to measure power flow, there are no conductive materials to put technicians at risk of electrocution. The exact number of injuries and fatalities that could be avoided is unknowable, but notes that avoiding even a single serious injury or fatality would be a significant benefit.

The **Central Hudson** case study documents another type of health and safety benefit. The Denning microgrid serves a facility providing care to children with critical health issues – representing a health and safety dimension to its reliability benefits. In addition, the $28.0 million in avoided societal damages from CO_2 reductions over 20 years includes human health impacts, as the social cost of carbon framework used in the analysis encompasses impacts to human health, agricultural productivity, and property damage, among others. The social cost of carbon calculations in the Micatu and Switched Source case studies implicitly include human health damages among the categories of harm avoided by reducing GHG emissions.

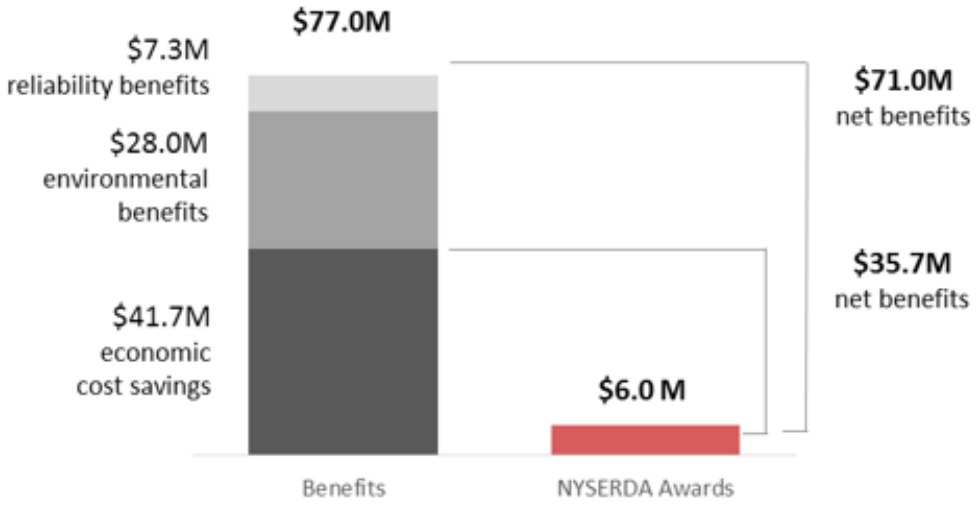
Net Economic Benefits and Return on Investment

For Central Hudson and Orange & Rockland, the evaluators were able to calculate aggregate net economic benefits and a return on NYSERDA's investment.[5]

For example, in the **Central Hudson** case study, total quantified benefits sum to **$77.0 million**, comprising (**Figure 3**):

- **$41.7 million** in economic cost savings (including $40.7 million from distribution automation and $1 million from the Denning microgrid)
- **$7.3 million** in reliability benefits
- **$28.0 million** in avoided societal damages from CO2 reductions (net of RGGI, central SCC, 20 years)

Figure 3: Summary of Net Benefits: Central Hudson Case Study



[5] The Central Hudson and Orange & Rockland case studies have a clear, well-defined investment and benefit structure that lends itself to NPV analysis. The other case studies involve either prospective/projected benefits, smaller scale (technology development and demonstration vs. utility-scale deployment), or confidential business information that prevented aggregation. Also, the ITWG case study is fundamentally different in nature; it is a working group rather than a discrete technology deployment.

After subtracting NYSERDA's $6 million investment, the **net societal benefit is $71.0 million**, or **$12.83 in benefits for every $1 of NYSERDA funding**.

Orange & Rockland reports total benefits of approximately **$20.2 million**, comprising:

- **$1.4 million** from deferred substation construction
- **$14.6 million** from reliability improvements across three major storm events
- **$1.3 million** in social cost of carbon benefits
- **$2.9 million** in health benefits from reduced PM2.5 emissions

After accounting for NYSERDA's costs of $5,216,045, the net societal benefit is approximately $15.0 million, or **$3.87 in benefits for every $1 of NYSERDA funding**.

The other case studies do not report aggregate net economic benefit figures and ROI in the same way. The Switched Source case study presents the benefit-cost analysis from the perspective of a utility that installs the Phase-EQ. For a utility like National Grid New York, installing 12 devices with 1,000 kW of increased load serving capacity was estimated to result in $26,037,000 NPV benefits and NPV benefits less costs of $21,597,000 in the "all-in" (stacked benefits) scenario, representing a benefit-cost ratio of 5.9. The Tagup case study treats OPEX and CAPEX savings as confidential business information. The Micatu case study focuses on prospective and scenario-based benefits rather than realized net economic benefits. The ITWG case study documents qualitative and directional cost reductions but does not calculate an aggregate net benefit figure.

> "NYSERDA grants have given us the freedom to experiment and try tools we are not sure of yet." The NYSERDA-funded distribution automation project "provided us a comfort level to trust the modeling… This all allowed us to go down the smart grid road."
>
> - ***Central Hudson***

> "Every time I talk to a startup that's in our space… I tell them to get their butts to New York, because I think that it is the best place for support for anything tied to grid technologies."
>
> - ***Switched Source***

Section 3 | Common Success Factors across Case Studies

The Evaluation Team identified common success factors that were shared across multiple NYSERDA-funded case studies documented in this synthesis report. These common success factors point to actionable insights that can help inform program design and/or future Program Opportunity Notices (PONs) to increase the likelihood of positive outcomes for grid modernization projects.

Overall, the Evaluation Team identified eight success factors that were common to four or more of the six case studies (**Table 4**). Each of these success factors is discussed below.

Table 4: Success Factors by Case Study

Success Factors	Central Hudson	Orange & Rockland	ITWG	Switched Source	Micatu	Tagup
NYSERDA as connector/credibility provider	✓	✓	✓	✓	✓	✓
Real-world utility demonstration/de-risking	✓	✓		✓	✓	✓
Clear pathway from pilot to scale	✓	✓	✓	✓	✓	✓
Alignment with regulatory mechanisms/policy goals	✓	✓	✓	✓		✓
Co-investment/shared commitment	✓	✓		✓		✓
Sustained multi-project engagement	✓	✓		✓	✓	✓
Multiple, quantifiable outcomes/stacked benefits	✓	✓		✓	✓	
Knowledge transfer mechanisms	✓	✓	✓	✓	✓	✓

NYSERDA as Connector/Credibility Provider

Companies and utilities that participated in the six case studies consistently cited NYSERDA's role beyond funding – serving as a convener, connector, and credibility provider within New York State's energy innovation ecosystem.

- **Micatu** credited NYSERDA's network connections as "priceless," gaining introductions to five of seven major NY utilities.
- **Switched Source** stated the company would not have survived without NYSERDA's multi-faceted support.
- **Central Hudson** benefited from NYSERDA-facilitated cross-utility knowledge sharing with National Grid and Con Edison.
- **Tagup** leveraged NYSERDA-facilitated utility partnerships to validate its platform in a risk-averse sector.
- **ITWG** relied on NYSERDA's co-chairing role to bring utilities and developers to the table.

- **Orange & Rockland**'s pilot site for remote sensors provided performance data to other New York State utilities, while NYSERDA's network facilitated Micatu's ability to establish pilot relationships with five of the seven major New York utilities.

Real-World Demonstration with Utility Partners/De-Risking for Utilities

Every successful technology project involved deployment and validation in an actual utility operating environment – not just a laboratory or simulated setting. These real-world pilots provided the proof-of-concept evidence that de-risked the technology for broader adoption. Successful projects specifically addressed utilities' risk aversion by providing third-party validation, independent performance data, and the implicit endorsement of a state agency.

- **Central Hudson:** NYSERDA-funded distribution automation demonstration gave the utility "comfort level to trust the modeling" before investing $51.3M in full-scale deployment.
- **Orange & Rockland:** The initial NYSERDA-funded pilot project (2007) upgraded two 13.2 kV electric circuits in West Nyack, with a subsequent NYSERDA-funded expansion in 2010 and deployment from 2014-2016. Orange & Rockland also committed $99.17 million in planned follow-on investment from 2025–2044 – 19 times the initial NYSERDA investment.
- **Switched Source:** Beta test in Sherburne led to larger Clifton Park demonstration, then to National Grid's $14.25M rate case commitment.
- **Tagup:** NYSERDA facilitation gave an early-stage company access to utilities that would not otherwise have engaged. Pilots with Con Edison and National Grid provided utility-sector credibility even though direct software adoption did not occur.
- **Micatu:** Orange & Rockland pilot served as a foundation for establishing relationships with five additional utilities.

Clear Pathway from Pilot to Scale

Successful projects exhibited a logical and intentional progression from initial demonstration to broader deployment or commercialization (**Table 5**). NYSERDA funding typically addressed the critical early stage, after which the technology or approach was adopted at scale through other mechanisms (rate cases, follow-on investment, market expansion).

Table 5: Scale-up Progression across Case Studies

Case Study	Early Stage	Scale-up Outcome
Central Hudson	$6M NYSERDA-funded demonstrations	$52.9M full-scale automation investment
Orange & Rockland	$3M smart grid demonstration ($5.2M in 2024$)	$99.17M planned follow-on investment (2025–2044)
Switched Source	Two NYSERDA-funded demonstrations	$14.25M in National Grid rate case
Tagup	$917K utility pilots	$3M Con Edison rate case for in-house analytics
Micatu	Pilot with Orange & Rockland	Exclusive distribution contract with Eaton (global company)
ITWG	Collaborative working group	Statewide adoption of new voltage flicker model; DER project size increase from 2 MW to 5 MW

Alignment with Regulatory Mechanisms/Policy Goals

Successful projects aligned with existing regulatory frameworks – particularly utility rate cases – which provided a built-in mechanism for transitioning from demonstration to funded deployment.

- National Grid included the **Phase-EQ** device in its rate case ($14.25M) following the NYSERDA-funded demonstration.
- Con Edison secured $3M in rate case funding for predictive analytics catalyzed by the **Tagup** pilot.
- **Central Hudson** included distribution automation costs in its 2014 rate case.
- **Orange & Rockland** planned $99.17M in follow-on investment through regulated utility planning processes.
- **ITWG** worked within the DPS regulatory framework to change interconnection standards statewide.

Co-Investment and Shared Financial Commitment

Projects that involved meaningful financial co-investment from utilities or technology companies alongside NYSERDA funding demonstrated stronger commitment and higher likelihood of sustained engagement beyond the project period.

- **Central Hudson:** Utility invested alongside NYSERDA in initial projects.
- **Orange & Rockland:** Contributed approximately $8.7M in cost share ($2.90 for every $1 of NYSERDA funding).
- **Switched Source:** National Grid committed $250,000–$350,000 in in-kind funding for the pilot.
- **Tagup:** Provided $1.3M in cost share, roughly matching NYSERDA's $1.2M investment.

Sustained, Multi-Project Engagement

Several of the most successful outcomes resulted from sustained NYSERDA engagement across multiple projects over time, rather than a single one-time grant. This allowed for iterative learning, relationship building, and progressive scale-up.

- **Central Hudson:** Eight NYSERDA-funded projects between 2008–2020.
- **Micatu:** Multiple NYSERDA awards between 2015–2020 (~$6M total).
- **Switched Source:** Two sequential NYSERDA-funded demonstration projects.
- **Orange & Rockland:** NYSERDA funded a 2007 pilot followed by a 2010 expansion project.
- **Tagup:** NYSERDA funded three projects.

Quantifiable, Measurable Outcomes/Stacked Benefits

Projects that produced clear, quantifiable performance metrics – particularly ROI figures, reliability indices (SAIFI/CAIDI), and dollar-denominated cost savings – were most successful in justifying follow-on investment to utility executives and regulators. The most compelling cases for follow-on investment were those that demonstrated diverse, mutually reinforcing benefits across multiple categories (reliability + cost savings + environmental + safety + DER integration). This "stacking" of benefits strengthened the business case for scale-up.

- **Central Hudson:** Cost savings + reliability + environmental benefits = $77M total quantified benefits. $12.83 return per $1 invested; 26.7% SAIFI reduction.
- **Orange & Rockland:** Reliability + deferred CAPEX + health + environmental = $20.2M total benefits. $3.87 return per $1 invested; 108,770 customer outages prevented.
- **Switched Source:** Phase balancing simultaneously delivers energy savings, DER hosting capacity, reliability, and emissions reductions. Benefit-cost ratio of 5.9; 500–2,500 kW unlocked capacity per device.
- **Micatu:** Sensor enables energy savings, safety improvements, O&M reductions, and emissions reductions simultaneously.

Knowledge Transfer and Cross-Stakeholder Learning

Every case study documented significant knowledge transfer benefits – insights developed in one context rippling outward to benefit a broader set of stakeholders. This amplification effect multiplied the value of individual projects.

- **Central Hudson → National Grid:** Emulated grid communications and load forecasting approaches.
- **Central Hudson → Con Edison:** Modeled GIS deployment and online data portal.
- **ITWG:** Structured platform disseminating national best practices (EPRI, Pterra) to all NY utilities and developers.
- **Switched Source:** Results shared at national conferences; enabled market expansion to Massachusetts.
- **Tagup:** Proof-of-concept catalyzed in-house programs at both partner utilities.
- **Micatu:** Orange & Rockland pilot data shared with other NY utilities.

Section 4 | Conclusions

The six case studies synthesized in this report document a broad and compelling suite of benefits generated by NYSERDA's Grid Modernization program investments. Taken together, these case studies demonstrate that NYSERDA's grid modernization portfolio has delivered substantial, measurable value to New York State utilities, ratepayers, technology companies, and society — and that the full impact of these investments extends well beyond what can be captured in any single metric or benefit category.

The Returns Are Impressive and Well-Documented

Where it was possible to calculate aggregate net economic benefits and a return on NYSERDA's investment, the results are striking. Central Hudson's NYSERDA-funded grid modernization investments generated $77 million in total quantified benefits against $6 million in NYSERDA funding, a return of $12.83 for every $1 invested. Orange & Rockland's investments generated approximately $20.2 million in total benefits against $5.2 million in NYSERDA funding,[6] a return of $3.87 for every $1 invested. These figures include economic cost savings, reliability improvements valued using DOE's Interruption Cost Estimate Calculator, and societal damages avoided from reduced greenhouse gas emissions valued using the social cost of carbon.

The Switched Source case study adds a forward-looking dimension: a cost-benefit analysis of 12 Phase-EQ devices under the central deployment scenario yields NPV benefits of $26 million and a benefit-cost ratio of 5.9, driven by avoided line extension capital costs, increased capacity for distributed energy resources and electric vehicle charging, and avoided greenhouse gas emissions.

NYSERDA Has Catalyzed Substantial Investment

Perhaps the most striking finding across the case studies is the degree to which NYSERDA's investments have catalyzed far larger commitments of private and utility capital. Central Hudson invested $52.9 million in full-scale transmission and distribution automation following a NYSERDA-funded demonstration — $8.80 for every $1 of NYSERDA funding. Orange & Rockland committed $99.17 million in planned follow-on smart grid investments from 2025 to 2044 — 19 times the initial NYSERDA investment. National Grid committed $14.25 million for 30 Phase-EQ devices in its rate case as a direct result of the NYSERDA-funded Switched Source demonstration. Con Edison was awarded $3 million in rate case funding for predictive analytics, an in-house program catalyzed directly by the NYSERDA-funded Tagup pilot. Micatu secured an exclusive distribution contract with Eaton, a global company with 96,000 employees operating in more than 175 countries, following NYSERDA-facilitated pilot projects with five of New York State's seven major utilities. These findings underscore the value of NYSERDA's role as a catalyst for private and utility-sector climate action.

[6] Expressed in inflation-adjusted 2024$.

The Benefits Are Diverse and Mutually Reinforcing

One of the most important findings of this synthesis is the sheer diversity of benefits generated by NYSERDA's grid modernization investments. These investments have:

- **Improved grid reliability** for hundreds of thousands of New York customers, preventing outages for 108,770 Orange & Rockland customers across three major storm events, reducing Central Hudson's outage frequency by 26.7% and outage duration by 14.7% over eleven years, and protecting a facility caring for children with critical health issues from power interruptions.
- **Reduced greenhouse gas emissions** equivalent to the annual output of approximately 160,000 passenger vehicles through Central Hudson's Volt/VAR optimization alone, with additional avoided emissions documented across the Orange & Rockland, Switched Source, and Micatu case studies.
- **Advanced New York State's clean energy goals** by increasing the maximum approved DER project size from 2 MW to 5 MW, reducing CESIR interconnection study costs by up to 65%, and enabling an estimated 7,500 kW of additional distributed generation capacity and 48,000 additional EVs through Phase-EQ deployment.
- **Generated economic cost savings** through deferred capital expenditures, reduced energy losses, avoided truck rolls, and predictive maintenance — benefits that should translate directly into lower costs for New York State ratepayers.
- **Improved public health and worker safety** by reducing PM2.5 air pollution from deferred substation construction (yielding $2.92 million in monetized health benefits for Orange & Rockland), eliminating the risk of electrocution for line workers through fiber-optic sensing (Micatu), reducing the risk of catastrophic transformer explosions (Tagup), and avoiding 755 hazardous truck rolls for Orange & Rockland line crews.
- **Supported company growth and regional economic development** by helping early-stage technology companies cross the "valley of death" from demonstration to commercialization, generating an estimated $19.5 million in total economic value added and 138.6 total FTE jobs in the New York State economy from Micatu's growth alone.
- **Transferred knowledge and accelerated learning** across New York State's utility sector and beyond, with Central Hudson's grid modernization approach emulated by National Grid and Con Edison, Switched Source's New York pilot enabling market expansion to Massachusetts and other states, and the ITWG providing a structured platform for disseminating national best practices to utilities and developers throughout New York State.

NYSERDA's Role Goes Beyond Funding

Across the case studies, a consistent theme emerges: **the value that NYSERDA brings is often not only the funding itself, but the ecosystem of support it provides.** The Micatu CEO described NYSERDA's network connections as "priceless." The Switched Source founder

stated: "I do not think that we would be a success if it weren't for the work that was done in New York State." The Central Hudson case study documents how NYSERDA facilitated cross-utility knowledge sharing that National Grid and Con Edison credit as essential to their own grid modernization progress. The Tagup case study shows how NYSERDA-facilitated utility demonstrations provided proof-of-concept evidence that unlocked millions of dollars in utility rate case investments and enabled Tagup to expand into new markets.

These findings suggest that NYSERDA's value as a convener, connector, and credibility-provider – introducing early-stage companies to utilities, facilitating cross-utility learning, and providing the state's endorsement to technologies that risk-averse utilities might otherwise be reluctant to pilot – is a distinctive and important dimension of its Grid Modernization program that complements and amplifies the direct financial value of its investments.

Looking Ahead

The case studies documented in this report represent only a portion of NYSERDA's broader Grid Modernization portfolio, and the full benefits of many of these investments are still being realized. As New York State's grid continues to evolve – accommodating more DERs, more electric vehicles, more extreme weather events, and more demanding reliability expectations – the investments documented in these case studies will become increasingly valuable. The evidence presented in this report makes a compelling case that NYSERDA's Grid Modernization program is delivering strong, measurable returns for New York State ratepayers, utilities, technology companies, and society – and that continued investment in grid modernization is essential to achieving the state's clean energy future.