January 31, 2025

Advanced Technology Working Group 2024 Annual Report

Respectfully submitted by the Joint Utilities of New York,

- Central Hudson Gas & Electric Corp.
- Consolidated Edison Company of New York, Inc.
- Niagara Mohawk Power Corporation d/b/a National Grid
- New York State Electric & Gas Corporation
- Orange & Rockland Utilities, Inc.
- Rochester Gas and Electric Corporation

Filed January 31, 2025

CONTENTS

1 INTRODUCTION

1.1 Background

On January 20, 2022, the New York Public Service Commission (Commission) issued its Order on Power Grid Study Recommendations (20-E-0197), directing the Joint Utilities (JU) and Department of Public Service staff to establish a working group to evaluate, test, and accelerate the deployment of advanced transmission and distribution (T&D) technologies. The Order identified dynamic line ratings (DLR), energy storage for T&D services, and power flow controls (PFC) as priority technology areas for evaluation. It required the working group to submit a research plan and progress report on those efforts. In response to the Order, the Advanced Technologies Working Group (ATWG)[1] was organized to serve in the designated capacity.

On January 19, 2024, the Commission issued an Order[2] directing the JU to implement modifications to the ATWG's processes designed to "enhance its transparency and improve information flow between technology innovators and utilities."[3] The ATWG was directed to file an annual report summarizing its activities and a calendar of major ATWG activities scheduled for the following year. This Annual Report provides information required by the Commission's Order, including a summary of the ATWG's efforts over the past year and a program calendar of ATWG activities in 2025.

Acknowledgments

This plan and report were developed by the Joint Utilities of New York, working in consultation with multiple organizations, including:

- Electric Power Research Institute (EPRI);
- Long Island Power Authority (LIPA);
- New York Department of Public Service (NY DPS);
- New York Independent System Operator (NYISO);
- New York Power Authority (NYPA); and
- New York State Energy Research and Development Authority (NYSERDA).

1. ATWG membership includes representatives from New York's investor-owned utilities, power authorities, the New York ISO, NYSERDA, and the Department of Public Service, as specified in the ATWG's *Research and Development Plan for Advanced Transmission and Distribution Technologies*, March 19, 2024, p. 4.
2. Case 20-E-0197, *Order Establishing Procedures for the Advanced Transmission Technologies Working Group*, State of New York Public Service Commission, January 19, 2024.
3. *Id.* at 12.

1.2 ATWG Objectives

The ATWG works to help ensure that the T&D systems in New York can support the achievement of Climate Leadership and Community Protection Act (CLCPA) goals. As stated in its Research and Development (R&D) Plan,[4] the ATWG works to:

- Accelerate the deployment of new and underutilized T&D technologies,
- Foster innovation to improve the functionality and cost-effectiveness of emerging or advanced technologies,
- Develop standardized tools and techniques for evaluating the suitability and application of all T&D technologies and solutions,
- Facilitate information sharing and collaboration among all interested stakeholders in New York, and
- Support the evaluation and consideration of advanced technology solutions as part of the Coordinated Grid Planning Process (CGPP) in New York.

1.3 How We Work

The ATWG has representation from three sectors: 1) New York State entities, including the Department of Public Service and NYSERDA, 2) investor-owned utilities (i.e., Joint Utilities), and 3) Power Authorities and Grid Operators (LIPA/PSEG Long Island, NYPA, and NYISO). The ATWG representatives meet monthly and may hold additional meetings as needed. The ATWG hosts multiple stakeholder engagement sessions each year and meets with technology developers and vendors to discuss advanced technologies. The Program Calendar section provides details on non-routine meetings and activities.

The ATWG creates subgroups as necessary to focus attention on various technology areas. The ATWG has had Task Forces for DLR technologies, energy storage for T&D applications, and PFC technologies. The ATWG may elect to establish a task force to explore a specific type of barrier, technology, or R&D question. Task Forces set their meeting cadence, which has ranged from bi-weekly to monthly, or longer depending on activities.

1.4 Grid Enhancing Technologies

There is a rising interest in grid-enhancing technologies (GETs) as utilities work to modernize the aging electrical grid and support the growing demand for renewable energy. Technologies typically classified as GETs include DLR, advanced PFC, and other grid monitoring and analysis tools that

4. *Research and Development Plan for Advanced Transmission and Distribution Technologies*, Joint Utilities of New York, Revised March 19, 2024, pp. 2-3.

can optimize power flow on existing lines and enhance grid reliability. GETs used alone or in combination with traditional T&D infrastructure have the potential to better integrate variable renewable resources, reduce congestion, and reduce or defer the cost of grid upgrades needed to achieve clean energy goals.

Federal initiatives are increasingly highlighting opportunities for GETs. The U.S. Department of Energy (DOE) provides R&D support, while the Infrastructure Investment and Jobs Act (IIJA) and the Inflation Reduction Act (IRA) have supported grid modernization.[5] Concurrently, the Federal Energy Regulatory Commission (FERC) is working on regulatory changes to expand GET adoption.[6]

Utilities in the United States and internationally have conducted projects that demonstrate the benefits of GETs. These projects will help the industry gain experience with GETs and identify the applications and potential for broader deployments. The ATWG's program areas align with supporting GETs deployment in New York State, and we will continue to monitor GETs developments in other regions to increase their deployment and utilization.

1.5 Coordination with the CGPP

Supporting the CGPP is an objective of the ATWG, as indicated above. In 2024, the Energy Storage Task Force (ESTF) of the ATWG worked to develop *Unified Planning Guidelines (UPG) for Energy Storage Resources Supporting Electric Transmission and Distribution in New York*. The Energy Storage UPG was designed to help planning engineers conduct transmission planning analyses for energy storage as part of the CGPP. ESTF members were joined by planning engineers and subject matter experts from the utilities to explore issues such as representing energy storage in power flow models, characterizing grid needs and the applicability of T&D energy storage, and considerations for economic and cost assumptions. As part of its ongoing coordination with the CGPP, the ATWG plans to work on UPGs for other advanced technologies that could help achieve New York State goals.

There are additional opportunities for the ATWG to support and integrate with the CGPP as it progresses through its first iteration. One key gap identified involves the development of inputs for capacity expansion models used in the initial step of the CGPP, which informs the rest of the planning process. These models require a wide range of region-specific inputs influenced by grid topology, load dynamics, asset types, costs, and use cases, including grid reliability, renewable generation, and demand management. Developing these inputs is resource-intensive and often creates bottlenecks for CGPP planners. The ATWG can address this by coordinating and facilitating utility-led studies to inform these input assumptions. These studies would focus on qualifying and

5. Innovative Grid Deployment Liftoff, U.S. Department of Energy, https://liftoff.energy.gov/innovative-grid-deployment/.
6. Federal Energy Regulatory Commission, Docket No. RM21-17-000; Order No. 1920 (May 13, 2024) and Order No. 1920-A (November 21, 2024).

quantifying the potential for energy storage and clean generation technologies at the regional level, considering factors such as land availability, permitting requirements, constructability, and other relevant factors. By supporting these efforts, the ATWG can help enhance the CGPP's capacity expansion model and its understanding of resource potential for energy storage and clean generation.

2 PROGRAM AREAS

In 2024, the ATWG expanded its focus to consider three potential new program areas identified in the Call for Advanced Technology Concept Papers (Call for Papers; see Section 3). Table 1 summarizes the ATWG's program areas.

Table 1. ATWG Program Areas

Initial Program Areas	Potential New Program Areas
Dynamic Line Rating	Advanced Conductors and Lines[7]
Energy Storage for Transmission and Distribution	DER Management
Power Flow Control	Grid Monitoring and Management

The following sections summarize the ATWG's activities in each area, including technology evaluation status, New York experience, and recommendations.

2.1 Dynamic Line Ratings

Dynamic line ratings (DLR) use real-time data—primarily weather conditions like ambient temperature, wind speed and direction[8], and solar radiation—to refine the safe power-carrying capacity of transmission lines. By contrast, static ratings use fixed assumptions that typically reflect worst-case conditions. Using current conditions enables DLR to potentially allow higher power flow under optimal conditions while maintaining safe conductor temperatures and associated sag on lines. DLR can help optimize asset usage, enhance grid reliability, and sometimes may delay or reduce the need for costly infrastructure upgrades when integrated with forecasts. The DOE and FERC include DLR as a GET.

2.1.1 Technology Evaluation Status

Since its inception in 2022, the DLR Task Force has reviewed DLR products offered by domestic and international vendors. Table 2 provides a comprehensive list of the vendors and products reviewed. The products reviewed fall into two categories: 1) line sensors and 2) data processing, analytics, and forecasting. These technologies have been demonstrated at full scale in relevant environments, qualified through testing and demonstration, and are ready for deployment.

Line Sensors

Line sensors monitor transmission line conditions in real time, measuring parameters such as

7. In its *Order Establishing Procedures for the Advanced Transmission Technologies Working Group* (January 19, 2024), the Commission directed the ATWG to investigate compact tower designs. The Advanced Conductors and Lines program areas would include these advanced transmission structures.
8. Wind direction perpendicular to the transmission line has a greater cooling effect than wind tangential to the line.

conductor temperature, line sag, wind speed and direction, ambient temperature, solar irradiance and current flow. They are typically mounted directly on transmission lines or nearby structures. Some products also incorporate Light Detection and Ranging (LiDAR) technology and cameras for remote monitoring of line sag, clearance, vegetation encroachment, and conductor movement.

Data Processing, Analytics, and Forecasting

Data processing and analytics systems integrate inputs from line sensors, LiDAR, and weather models to assess transmission line performance under dynamic conditions. These products use advanced algorithms and weather forecasting to predict real-time and future line performance ratings.

Table 2. DLR Technology Vendors and Products reviewed by the DLR Task Force.

Vendor	Product	Technology Type
Atecnum	PowerDonut PD4	Line Sensors
Cleveland/Price	Linescope	
EDM International	Span Sentry	
Franklin Electric	Line IQ, Grid Sense	
General Electric	Multilin T-NET	
Gridwell Inc. (Taiwan)	TSSG (Transmission Span Sag Guardian)	
Heimdall Power (Norway)	Neuron	
LAKI Power (Iceland)	LKX-301DLR	
MicroTronics (Austria)	Easy Monitoring Overhead Transmission (EMO)	
OFS	OFS LINEASENS	
Pike	ThermalRate	
Sensornet (UK)	Sentinel DTS-XR, PowerLine	
Southwire	Intelligent Grid Line Monitor	
Torino Power Solutions (Canada)	PLM (Power Line Monitoring)	
USI	USI Update Monitoring, CAT-1	
Ampacimon	ADR Sense, ADR Sense-O, ADR Health, ADR Software Suite, ADR View	Line Sensors; Data Processing, Analytics, and Forecasting
Lindsey Systems	TLM Conductor Monitor, SMARTLINE Transmission Line Rating System	
LineVision	Optical LiDAR Sensors, LineRate Suite	
SmartKable	Line Analyzer	
WindSim	WindSim Power Line	Data Processing, Analytics, and Forecasting

DLR Potential Study

Despite the commercial availability of multiple DLR technologies and solutions, most DLR deployments in New York are in the pilot stage. In late 2023, the DLR Task Force analyzed the various DLR technologies and projects to assess potential barriers to deployment in New York. The group found three barriers: 1) diverse solutions with a lack of standards, 2) a limited set of experience and test data, and 3) quickly changing technologies and offerings from vendors. To address these barriers, in 2024, the DLR Task Force collaborated with NYSERDA to prepare a Request for Proposal (RFP) for a DLR Potential Study in New York. The study will begin in the first quarter of 2025 and should be complete by the end of the year. The study aims to support the CGPP by assessing the potential for DLR to support the Utilities' transmission systems by 2030 and 2040. NYSERDA will manage the study, which involves four tasks:

1. Assess the extent to which certain DLR use cases have been implemented or are undergoing feasibility studies or demonstrations.
2. Develop an economic framework that the Joint Utilities can apply consistently and tailor to their service territories to assess the economics of the various use cases over the analysis period.
3. Assess the potential for DLR on various transmission lines across the Utilities' service territories.
4. Develop a final report summarizing the results from the first three phases and combining them into one statewide DLR potential.

2.1.2 New York Experience

Several utilities in New York are actively engaged in innovative DLR projects to enhance the state's electrical grid.

National Grid

In August 2024, National Grid implemented LineVision's patented LineRate DLR software and sensor platform on four 115 kV transmission lines near Syracuse, NY. The project is the largest deployment of DLR technology in the US to date and follows a successful pilot project.[9] This deployment utilizes non-contact sensors to provide real-time data about line conditions, enabling automated, condition-specific line management ratings. DLR data from the lines is integrated with the National Grid control room, where operators can use the DLR information.

New York State Electric & Gas (NYSEG)

In August 2023, as part of NYSERDA's Future Grid Challenge Program, NYSEG launched a pilot project with LineVision to deploy non-contact LiDAR sensors to monitor real-time data on overhead transmission lines. NYSEG also launched a pilot with WindSim to compare their Data Analytics and

9. *LineVision operationalizes dynamic line ratings in New York to increase transmission capacity and grid safety for National Grid,* LineVision, May 2024. (https://www.linevisioninc.com/news/linevision-operationalizes-dynamic-line-ratings-in-new-york-to-increase-transmission-capacity-and-grid-safety-for-national-grid)

Forecasting solution in the same corridor. In 2024, NYSEG completed a project under the Future Grid Challenge to evaluate the distribution network's load forecasting and planning for future energy demands, focusing on the impacts of electric vehicle adoption, heat pumps, and solar energy.

New York Power Authority (NYPA)

NYPA began investigating DLR in 2000 in collaboration with EPRI and EDM. Since then, NYPA has conducted pilot projects with Ampacimon, Lindsey, LineVision, WindSim, and Prisma on various overhead lines. EDM, Ampacimon, and Lindsey use on-conductor sensors, which may pose challenges during installation and maintenance. LineVision uses LiDAR installed on the pole, which can be used as a mobile calibration and verification unit for limiting spans. Prisma uses existing Optic Fiber Ground Wire (OPGW) as a sensor to achieve high resolution with minimal investment. WindSim uses Computational Fluid Dynamics to calculate the weather information for real-time operations and forecasts.

Con Edison

Con Edison and its partner EPRI will demonstrate three ambient air and dynamic line rating systems: Ampacimon, Prisma Photonics, and WindSim Power. This project intends to validate three types of advanced transmission line monitoring systems on Con Edison's transmission lines, and is scheduled for completion in 2026.

2.1.3 Next Steps

1. Complete a Stage One Report[10] for DLR technologies with recommendations for the ATWG. (Q1 2025)
2. Monitor the progress and results of the DLR Potential Study and provide support as needed. The ATWG will suspend the DLR Task Force pending the outcome of the DLR Potential Study. (2025)

2.2 Energy Storage for Transmission and Distribution

Energy storage can significantly enhance the electric T&D system by storing energy during periods of low demand and releasing it at peak times. By utilizing both merchant and grid planning for transmission and distribution applications, energy storage can help balance supply and demand, improve grid reliability, and enable greater integration of renewable resources. In New York, the state has set an ambitious target of deploying 6 GW of energy storage by 2030. In June 2024, the

10. Stage One Reports are developed as part of the ATWG's Technology Scouting and Assessment process. Stage One of the process is intended to survey and screen advanced technologies within specified program areas. Based on the results of Stage One, certain technologies may be selected for further technical and economic assessments. For more information on the Technology Scouting and Assessment process, see the ATWG's *Research and Development Plan for Advanced Transmission and Distribution Technologies*, Section 2.2, p. 8. (https://jointutilitiesofny.org/sites/default/files/Research%20and%20Development%20Plan%20for%20Advanced%20Transmission%20and%20Distribution%20Technologies%2C%20July%2020%2C%202022.pdf)

Commission issued an Order[11] that approved a comprehensive energy storage roadmap outlining market reforms, cost-effective procurement strategies, and research and development initiatives to promote innovation. In response to the Order, the JU filed a study addressing the non-market T&D services energy storage projects can provide.[12]

2.2.1 Technology Evaluation Status

The Energy Storage Task Force (ESTF) of the ATWG has worked to address barriers to the deployment of energy storage to support the electric T&D system, focusing on readily available technology such as lithium-ion batteries, with an emphasis on short-duration storage. This has included:

- Developing T&D energy storage use cases that provided a framework for the ongoing work of the ESTF and ATWG.
- Drafting the *Unified Planning Guidelines (UPG) for Energy Storage Resources Supporting Electric Transmission and Distribution in New York*. These guidelines provide a framework for modeling energy storage in power flow models, characterizing grid needs, and understanding the economic and cost assumptions to assess the suitability of energy storage as a potential T&D solution.
- Preparing an RFP for an *Energy Storage Potential Study for Electric Transmission and Distribution Applications in New York State*.
- Supporting the *Energy Storage Potential Study for Electric Transmission and Distribution Applications in New York State*. This Study offers information regarding potential storage applications and context for techno-economic evaluation. In line with the framework in the JU study filed with the Commission,[13] host utilities will require in-depth analyses for individual projects based on the service territory and applications. The Energy Storage Subcommittee (ESSC) will continue to support the Energy Storage Potential Study as needed.
- Providing technical input to the 2024 JU energy storage filing.[14] Amongst other things, the 2024 JU energy storage filing proposed a planning and evaluation framework that would integrate energy storage as a "tool in the toolbox" to address non-market T&D needs and account for the singular benefits energy storage could provide. Recognizing timing is important to help enable NY State goals, a flexible approval process was proposed that, along with the planning and evaluation framework, could facilitate the integration of energy storage into state planning processes that consider CLCPA achievement, such as the CGPP.
- Reviewing two Concept Papers proposing the development of a hydrogen ecosystem, including hydrogen production, transportation, and electricity generation. These technologies are in early stages of development, reflecting a lower technology readiness level given the current state of hydrogen technology.

11. Case 18-E-0130, *Order Establishing Updated Energy Storage Goal and Deployment Policy*, State of New York Public Service Commission, June 20, 2024.
12. Case 18-E-0130, *Joint Utilities' Study of Non-Market Transmission and Distribution Energy Storage Use Cases and Related Process Proposals*, Joint Utilities, October 29, 2024.
13. Id.
14. Id.

Other Energy Storage Studies

In 2023 and 2024, National Grid conducted detailed studies with the help of consultants Quanta Technology and E3 on applications of energy storage as a transmission asset to enable large scale renewables and provide flexible transmission capacity.[15] One of the studies National Grid conducted on its Northern New York service territory – and presented to NYISO Installed Capacity / Market Issues Working Group and to other state and federal stakeholders – showed that transmission connected energy storage provides non-market services for the transmission system.[16] This is an example of how energy storage could be integrated into state planning processes that consider CLCPA achievement, such as the CGPP.

The *Storage as Transmission Asset Market Study* published by the New York Battery and Energy Storage Technology Consortium (NY-BEST) in January 2023 provides use cases for storage as a transmission asset and several example projects.[17]

A whitepaper published by Zenobe explores the opportunity for Storage as Transmission to ensure power quality in New York.[18]

2.2.2 Next Steps

1. Monitor energy storage activities in New York and identify opportunities to provide support from the Energy Storage Subcommittee (ESSC) of the ATWG.[19] (2025)
2. Secure $1.5 million in state funding to perform a resource potential study for Energy Storage and Clean Generation technologies as discussed in Section 1.5. This is an efficient use of state funding as it builds on existing state investment (i.e. NYSERDA's renewable resource potential tool) and feeds relevant information into the state's primary policy planning process, CGPP. (2025)

2.3 Power Flow Control Technologies

Advanced power flow control (PFC) technologies can optimize the operation of existing T&D assets, potentially maximizing capacity, alleviating congestion, and supporting the deliverability of renewable energy. The DOE considers PFC technologies as GETs and recognizes them as a potential solution for increasing transmission capacity. As outlined in Order No. 1920, the FERC

15. *Utility-Owned Storage in New York State – Applications for Transmission System Services*, Energy and Environmental Economics, Inc. (E3), October 2024. (https://www.nationalgridus.com/Energy-Storage-and-Electricity-Transmission)
16. *Storage as Transmission (SAT) Northern NY Use Case,* National Grid, November 2023. (https://www.nyiso.com/documents/20142/41393553/NNY%20SATA_NYISO%20Presentation_2023-11-27_FINAL.pdf/cf21bd4f-4699-8085-93ea-1fcd5cad014f)
17. *Storage as Transmission Asset Market Study,* NY-BEST, January 2023. (https://cdn.ymaws.com/ny-best.org/resource/resmgr/reports/SATA_White_Paper_Final_01092.pdf)
18. *Opportunity for Storage As Transmission (SAT) to ensure Power Quality in New York,* Zenobe, November 2024.
19. In Q4 2024, the ESTF realigned its scope and transitioned into an ATWG subcommittee. The ESSC charter can be found on the ATWG website (https://jointutilitiesofny.org/advanced-technologies-working-group).

requires transmission providers to "consider more fully…alternative transmission technologies," including advanced PFC devices, during transmission planning. When applied effectively, advanced PFC technologies could assist New York in achieving its clean energy goals while managing electricity costs for customers.

2.3.1 Technology Evaluation Status

PFC devices of various types have been available for decades and are used in specific applications in New York. Advanced PFC devices promise to provide more flexible and cost-effective power flow control functionality compared to older technologies. The PFC Task Force examined a wide range of PFC technologies and potential applications to understand the current state of these technologies and their possible uses in New York (Table 3).

Technologies within this group are primarily designed to manage power flow, enhance grid stability, increase transmission capacity, and support the power quality of the AC transmission grid. Devices such as FACTS (Flexible AC Transmission Systems), phase-shifting transformers, and series compensation devices aid in optimizing power distribution and maintaining voltage stability. Additional technologies like Unified Power Flow Controllers (UPFC) and Modular Static Synchronous Series Compensators (M-SSSC) provide real-time power control to improve grid performance. High-voltage Direct Current (HVDC) technologies bolster the effectiveness of long-distance power transmission and facilitate the connection of asynchronous grids.

Table 3. Summary of PFC technologies.

Technology	Example Vendors	Technology Type	System Level
Phase-Shifting Transformer	GE Vernova; Hitachi; Siemens;	Electromechanical	Transmission
Series Compensation (capacitors and reactors)	GE Vernova; Hitachi; Siemens	Electromechanical	
HVDC (FACTS)	GE Vernova; Hitachi; Siemens;	Power electronic	
Unified Power Flow Controller (FACTS)	Siemens	Power electronic	
Static Synchronous Series Compensator (FACTS)	Smart Wires	Power electronic	
Phase Balancer	Switched Source	Power electronic	Distribution
Tie Controller	Switched Source	Power electronic	

2.3.2 New York Experience

National Grid

National Grid successfully piloted Switched Source's Phase Equalizer (Phase-EQ) in its NY service territory in July of 2024. The Phase-EQ is a shunt-connected power electronics device designed to mitigate imbalances in three-phase medium voltage (MV) distribution circuits by dynamically transferring power between phases. This functionality helps to increase the overall load-serving

capacity of the system, addressing imbalances that could otherwise limit the effectiveness of the grid. Performance data proved that the device completed the two primary objectives of installing new technology to minimize a distribution circuit's neutral current and to reduce phase current imbalance. The unit provided reduced neutral current and voltage imbalance for the pilot circuit and demonstrated its ability to unlock up to 1-2 MW of additional load-serving capacity in a cost-effective and timely manner compared to traditional infrastructure upgrades. National Grid continues to work with Switched Source to prepare to use the device as a tool to supplement traditional distribution solutions while the team continues to evaluate performance through the winter. National Grid's New York team is evaluating a program deployment for more units, while the team assists its New England counterparts on a Massachusetts deployment.

Central Hudson Gas & Electric

Over approximately three years, Central Hudson worked with Smart Wires to conduct a pilot project using SmartValve™ technology (M-SSSC) on an underutilized transmission line. Smart Wires adjusted the technology throughout the pilot to improve product operability. In September 2024, Smart Wires announced the deployment of fifteen SmartValves™ on the 345 kV Leeds-Hurley Avenue project to unlock 185 MW capacity on the existing grid.

NYPA

From 2021 to 2023, Smart Wires conducted a network study in collaboration with Right Analytics and NYPA. Through funding from NYSERDA's High Performing Grid program, the project team was able to assess wind energy projects in the future generation queue and how modular PFC (MPFC) technology could reduce the curtailment of wind generation by improving power flow efficiency. The study's results indicated that 5 MPFC deployments on the NY grid could boost wind power capacity by 309 MW – an average of 62 MW per unit deployment. According to NYSERDA's project results, the deployment cost for all five solutions is between $19.5 - $27.0 million.

2.3.3 Next Steps

1. Complete a Stage One Report for Power Flow Control technologies with recommendations for the ATWG. (Q1 2025)

2.4 Advanced Conductors and Lines

Overhead lines dominate the U.S. electric transmission system and typically use aluminum conductors attached to structures whose designs vary by voltage, terrain, and utility standards. Their capacity and performance depend on factors such as electrical conductivity, heat tolerance, mechanical strength, and the spacing of conductors (which affect electromagnetic fields and impedance). Advanced conductors—like superconductors and composite aluminum-steel or carbon-fiber cables—can significantly increase a line's capacity, efficiency, and mechanical performance. Utilities can boost capacity by rebuilding (replacing conductors and structures), or reconductoring (using existing structures), and reconductoring with advanced conductors can

double capacity at around one-third the cost of building a new line.[20]

2.4.1 Technology Evaluation Status

Advanced Conductors and Lines (ACL) was identified as a potential new program area of the ATWG following the 2024 Call for Papers. The ATWG received four Concept Papers proposing technologies that optimize existing transmission capacity and rights-of-way through improved overhead conductors, structures, and infrastructure cooling (Table 4). The deployment readiness for these technologies varies. While some technologies, such as compact tower designs and composite conductors, exhibit a higher level of commercial maturity, others, such as superconductors, are still being tested through demonstration projects.

Table 4. Advanced Conductor and Line technologies reviewed by the ATWG.

Vendor	Product	Technology Type
BOLD Transmission LLC	Low Impedance Compact Line Design	Compact Tower Design
CTC Global	Aluminum Conductor Composite Core (ACCC®)	Composite Conductor
VEIR	Superconducting Transmission Lines	Superconductor
Heat Inverse	CoolFilm	Electricity Infrastructure Cooling

Compact Tower Design

Compact tower designs enhance the transmission line's capacity by optimizing the conductors' arrangement. Compact designs reduce the physical space between lines by bundling conductors more efficiently or using advanced configurations while maintaining safety standards. This approach improves current-carrying capacity and minimizes electromagnetic interference and avian interactions. These designs often incorporate innovative, smaller, or shorter tower structures that enable tighter spacing and improved line performance without significant changes to the conductor.

Composite Conductors

Composite conductors use advanced materials and material design to improve transmission lines' mechanical and electrical performance. These conductors often feature a core made from composite materials such as carbon fiber or polymer-reinforced aluminum, which replace traditional steel cores. The result is a lighter, stronger, and more heat-resistant conductor that allows for higher current-carrying capacity with reduced sag.

Superconductors

Superconductors represent cutting-edge technology that nearly eliminates electrical resistance in conductors when operated at extremely low temperatures. These materials enable electricity transmission while minimizing energy loss, dramatically increasing efficiency and capacity.

20. *Advanced Conductor Scan Report,* Idaho National Laboratory, Revised April 2024.

Superconducting cables can carry significantly higher currents than conventional conductors in a smaller footprint. Although still in the early stages of deployment due to high costs and the need for cryogenic cooling systems, superconductors are being explored for their potential to revolutionize grid efficiency and capacity.

Electricity Infrastructure Cooling

Electricity infrastructure cooling technologies aim to enhance the efficiency and reliability of power systems by managing thermal conditions around critical components such as transformers, substations, and transmission lines. Infrastructure cooling solutions include passive thermal management films, which reflect sunlight and radiate heat away from equipment surfaces, significantly reducing operating temperatures. These materials can be applied directly to infrastructure components, offering a low-maintenance and cost-effective alternative to traditional cooling methods like forced air or liquid cooling systems.

By mitigating heat buildup, these technologies help improve energy efficiency, extend the lifespan of equipment, and reduce the risk of failures during periods of high demand or extreme temperatures. Such solutions are particularly valuable in areas with intense solar exposure or where heat-induced degradation can compromise system performance.

2.4.2 New York Experience

National Grid

In 2006, National Grid energized a 350-meter, 34.5 kV HTS cable system between its Riverside and Menands substations in Albany, New York. This project marked the first in-grid application of "second generation" HTS wire, featuring new materials designed for improved cost-effectiveness and performance. The installation also achieved the first-ever HTS cable splice and integrated three-phase terminations within a utility grid. The Albany cable system was designed to carry 800 amperes at 34.5 kV, demonstrating the potential for HTS technology to enhance grid efficiency and reliability.

National Grid is currently working with VEIR to design and deploy superconducting transmission lines in Amsterdam, NY. As part of a NYSERDA grant, VEIR will be looking to complete a technical study and demonstrate their proposed technology on an un-energized pilot at a decommissioned substation, including liquid nitrogen delivery systems, nitrogen-cooled conductors, and evaporative cooling units before expanding into the electric T&D system. Over a three-year period, the teams will begin with this proof-of-concept initial deployment before looking at a high-voltage deployment and additional transmission projects.

2.4.3 Next Steps

1. Complete a Stage One Report for Advanced Conductors and Lines with recommendations for the ATWG. (Q1 2025)
2. The ATWG recommends initiating an ACL Potential Study that will assess the potential for

Advanced Conductors and Lines to support the Utilities' transmission systems by 2030 and 2040. The ATWG will work with NYSERDA to develop an RFP in 2025. (2025)

2.5 DER Management

Distributed Energy Resource Management Systems (DERMS) will play a critical role in integrating and optimizing distributed energy resources (DERs) such as solar panels, batteries, electric vehicles (EVs), and demand response systems within the New York power system.

2.5.1 Technology Evaluation Status

The ATWG received five Concept Papers proposing technologies to support the functional capabilities typically associated with DERMS. Specifically, the five submissions address real-time monitoring and control of DERs, aggregating DERs, demand response (DR), and market platforms. The ATWG discussed the concept papers with the companies that submitted them and will determine the next steps for this program area in 2025.

2.5.2 New York Experience

- New York's Utilities have included DERMS in their Distributed Systems Implementation Plans, and several have developed roadmaps for deploying the technology.[21]
- DERMS is recognized as an enabler for achieving New York's grid flexibility potential as part of the Grid of the Future proceeding.[22]
- DERMS could facilitate the integration of DERs into wholesale energy markets, enabling New York to achieve its clean energy objectives.

2.5.3 Next Steps

1. Complete a Stage One Report for DER Management with recommendations for the ATWG. (Q1 2025)

2.6 Grid Monitoring and Management

Grid monitoring and management (GMM) technologies can potentially improve the operation and flexibility of T&D systems. Advanced technologies such as voltage optimization and inertia measurement will improve grid visibility and reliability to accommodate more inverter-based resources (IBRs) and shifting grid topology. In 2023, FERC issued Order No. 901, which directed the North American Energy Reliability Corporation (NERC) to address reliability concerns with "IBRs tripping or entering momentary cessation in aggregate."[23] GMM technologies can provide grid

21. Distributed System Implementation Plans (2023), Joint Utilities of New York, https://jointutilitiesofny.org/utility-specific-pages/system-data/dsips, accessed January 4, 2025.
22. Case 24-E-0165, *NY Grid Flexibility Potential Study: Draft Results*, The Brattle Group, December 10, 2024.
23. *Reliability Standards to Address Inverter-Based Resources*, Order No. 901, 88 FR 74250 (Oct. 30, 2023), 185 FERC ¶ 61,042 (2023).

operators with real-time visibility of IBRs and their impact on their respective T&D networks, supporting utilities in maintaining customer reliability.

2.6.1 Technology Evaluation Status

After reviewing submissions to the 2024 Call for Papers, the ATWG identified GMM as a potential program area. The reviewed products highlight the capabilities of grid monitoring technologies that can be implemented across transmission and distribution networks. The four products observed by the ATWG have been demonstrated at full scale in relevant environments and exhibit a high readiness for deployment (Table 5).

Table 5. GMM technologies reviewed by the ATWG.

Vendor	Product	Technology Type
Acelerex	REX™ Software	Distribution State Estimation
DVI (Dominion Voltage Inc.)	EDGE® Software Suite	Voltage Optimization
NewGrid	NewGrid Router	Topology Optimization
Reactive Technologies	Real-Time Inertia Measurement	Inertia Measurement

Distribution State Estimation

Distribution state estimation is a sophisticated method for monitoring the grid that offers real-time insights into distribution system conditions, facilitating the integration of distributed energy resources (DER). By using mathematical algorithms to analyze a variety of measurements (such as voltage, current, and power flow) alongside network topology information, this technology can estimate the real-time state of the distribution grid. With improved grid visibility, utilities can quickly identify faults and dynamically modify relays and other network parameters to support renewable energy integration, DER utilization, and more. The essential features of distribution state estimation underscore this technology's considerable resilience, safety, and optimization advantages.

Voltage Optimization

Optimization technologies manage and control voltage levels within a power distribution network to enhance efficiency and reliability. Collecting real-time voltage data from smart meters or voltage sensors enables data processing and the determination of optimal set points for voltage control devices. Integrating voltage information into DER management systems could enable voltage support and optimization from DERs. Voltage optimization can help utilities reduce energy losses, improve power quality, and increase hosting capacity for DERs and electrification.

Topology Optimization

Topology optimization software can use real-time voltage and power flow data to adjust network configurations, reduce congestion, improve overall efficiency, and enhance grid resilience.

Inertia Management

The collective performance characteristics of New York's electricity supply resources will change as the state pursues its clean energy goals. An increasing portion of the supply will be IBRs such as wind, solar, and battery energy storage. The decline of rotating synchronous generators as a portion of the supply will decrease the amount of inertia available to maintain system frequency stability in response to contingencies of large power plants or transmission lines. The NYISO and the JU should consider including inertia resources in long-term system planning, as more fossil generation is replaced with renewable generation, to ensure the reliability and resilience of the power system. Furthermore, NYISO and the JU should work to understand the nature of inertia in the New York power system through measurement and analysis. Building too little inertia may compromise grid reliability. Building too much will cost more than is necessary.

2.6.2 New York Experience

National Grid

In 2017, National Grid worked with Utilidata to deploy Volt/VAR Optimization (VVO) technology, AdaptiVolt, in Clifton Park, New York. By reducing the voltage on the distribution circuit, the VVO technology can reduce customer electricity demand. The National Grid project was designed to reduce demand by up to 3%.

National Grid and NYPA

National Grid and NYPA are working with Quanta Technology to develop a real-time digital simulator (RTDS) at NYPA's Advanced Grid Innovation Laboratory for Energy (AGILe) to model higher penetrations of IBRs and study grid impacts. The simulations and analysis will help the utilities analyze protective relaying methods that can mitigate the effects of IBRs on the New York power system.

NYISO and multiple utilities

Multiple partners are working with Reactive Technologies on a project to measure power system inertia in New York. The multi-year project has installed inertia measurement devices across several locations throughout the NY grid. A Future Grid Challenge Award from NYSERDA has funded the initial phase of the project. Completing the project requires further funding.

2.6.3 Next Steps

1. Complete a Stage One Report for Grid Monitoring and Management with recommendations for the ATWG. (Q1 2025)

2.7 Summary of Next Steps for Program Areas

Table 6. 2024 Summary of Next Steps for Program Areas

Program Area	Recommendation
Initial Program Areas	
Dynamic Line Rating	• Complete a Stage One Report for DLR technologies with recommendations for the ATWG. (Q1 2025) • Monitor the progress and results of the DLR Potential Study and provide support as needed. The ATWG will suspend the DLR Task Force pending the outcome of the DLR Potential Study. (2025)
Energy Storage for Transmission and Distribution	• Monitor energy storage activities in New York and identify opportunities to provide support from the Energy Storage Subcommittee (ESSC) of the ATWG. (2025) • Secure $1.5 million in state funding to perform a resource potential study for Energy Storage and Clean Generation technologies as discussed in Section 1.5. (2025)
Power Flow Control	• Complete a Stage One Report for Power Flow Control technologies with recommendations for the ATWG. (Q1 2025)
Potential New Program Areas	
Advanced Conductors and Lines	• Complete a Stage One Report for Advanced Conductors and Lines with recommendations for the ATWG. (Q1 2025) • Initiate an ACL Potential Study that will assess the potential for ACL to support the Utilities' transmission systems by 2030 and 2040. The ATWG will work with NYSERDA to develop an RFP in 2025. (2025)
DER Management	• Complete a Stage One Report for DER Management with recommendations for the ATWG. (Q1 2025)
Grid Monitoring and Management	• Complete a Stage One Report for Grid Monitoring and Management with recommendations for the ATWG. (Q1 2025)

3 PROGRAM CALENDAR

The ATWG paces its work quarterly, with activities and deliverables developed and presented at planned stages. We facilitate stakeholder engagement with the technology development community at each stage. Regularly scheduled activities include:

- Annual Report and Winter Stakeholder Webinar (Q1)
- Call for Advanced Technology Concept Papers (Q1)
- Spring Technical Conference (Q2)
- Summer Stakeholder Webinar (Q3)
- Fall Program Planning Workshop (Q4)

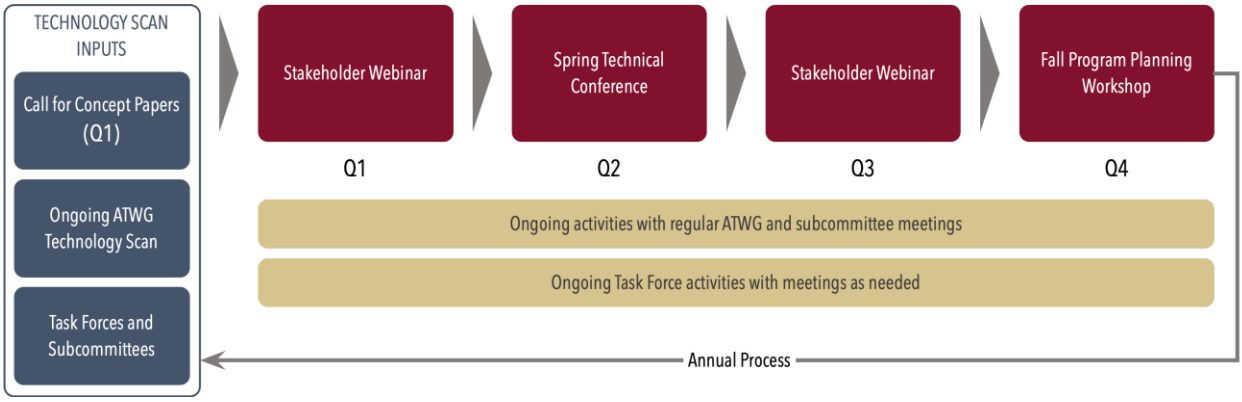

Figure 1. ATWG program calendar overview.

The ATWG representatives meet monthly and may hold additional meetings as needed. Task Forces and subcommittees set their meeting cadence, which has ranged from bi-weekly to monthly or longer depending on activities.

3.1 Winter Stakeholder Webinar

Starting in 2025, the ATWG must file an Annual Report summarizing the ATWG's activities for the prior year. The Annual Report must be filed by January 31. Following the filing, the ATWG will host a Winter Stakeholder Webinar to present a summary of the Annual Report and to invite questions and comments from the stakeholder community. We also intend to use the Winter Webinar to announce the Call for Advanced Technology Papers for the coming year.

Timing: February/March (2025)

3.2 Call for Advanced Technology Concept Papers

In 2024, the ATWG issued its first Call for Advanced Technology Concept Papers (Call for Papers). The ATWG will conduct its next Call for Papers during the first quarter of 2025. These solicitations are designed to maintain a pipeline of potential technologies and solutions to support electric transmission and distribution systems and help New York meet its clean energy goals. The ATWG plans to tailor the Call for Papers to address priority topics identified in the last cycle each year. Table 7 summarizes the objectives and requirements for submissions.

Timing: February/March (2025)

Table 7. Summary of the Scope and Submission Requirements included in the Call for Advanced Technology Concept Papers.

ATWG Advanced Technology Objectives	Concept Paper Submission Requirements
• Provide functionality that increases the deliverability of renewable energy and increases the utilization of existing delivery capacity and rights-of-way. • Enhance the reliability, security, and efficiency of the New York electricity grid. • Reduce costs for consumers and stakeholders.	• A detailed description of the technology or solution, including potential use cases and grid services that the technology may support. • Specific examples of where the technology or solution has been deployed. • An outline or preliminary plan for implementing the technology or solution within the New York electricity grid. • To the extent possible, provide cost data that can facilitate comparisons with existing and alternative solutions. • Specific benefits that the technology supports, either directly or indirectly.

In response to the 2024 Call for Papers, the ATWG received fifteen Concept Papers covering a range of technologies. Following its review, the ATWG organized the Concept Papers into four groups, as summarized in Table 8. The ATWG invited submitters to participate in discussion sessions where we could explore utility deployments, use cases, and challenges with adoption. The ATWG's assessment of the concept papers is available on our website.[24]

24. Advanced Technologies Working Group, Joint Utilities of New York, https://jointutilitiesofny.org/advanced-technologies-working-group.

Table 8. 2024 Concept Paper groups and submissions.

Group	Concept Papers
Advanced Conductors and Lines	• BOLD Transmission LLC, Low Impedance Compact Line Design • CTC Global, ACCC® Conductor • Heat Inverse, Increasing Transformer Reliability and Longevity Through Passive Heat Dissipation • VEIR, Superconducting Transmission Lines
Distributed Energy Resources Management	• Energy One Solutions International, Multi-tier Grid Optimization – Application to Cold Storage Facilities • Meltek, Aggregate Demand Management • Novele, The Intelligent Energy Storage Network for the Built Environment • Piclo, Statewide DER-Enabled Market Platform for Grid Flexibility • Smarter Grid Solutions, Increased Hosting Capacity through Flexible Interconnections • SMPnet, Optimizing The New York Power Grid: A Project For Sustainable Grid Management For Stability And Renewable Integration
Grid Monitoring and Management	• Acelerex, State Estimation and Forecasting With Dynamic Relay Settings For Distribution Protection And Control • DVI, Voltage Optimization for the Distribution Grid • Reactive Technologies, Real Time Inertia Measurement Services
Hydrogen	• Plug Power, Hydrogen Fuel Cell Technology Providing Dispatchable Zero-Emissions Electricity • Vivacity Power, Advancing Grid Modernization & Clean Energy with HYDRO-GEN™

3.3 Spring Technical Conference

Each spring, the ATWG hosts a Technical Conference to update New York's technology community on our program and progress. The Conference agenda includes reports from the ATWG and its Task Forces and the results from the Call for Papers. The session supports a dialogue between the ATWG, vendors, research organizations, and other advanced technology stakeholders. In the past, the timing of the Technical Conference has also offered an opportunity to discuss policy initiatives involving advanced energy technology in New York. The agenda from the Spring 2024 Technical Conference is provided below as reference.

Timing: April/May (2025)

Table 9. 2024 Technical Conference agenda.

Topic	Lead
Welcome	Department of Public Service
Task Force Summaries	Dynamic Line Rating Task Force Energy Storage Task Force Power Flow Control Task Force
New York R&D Opportunities for Electric T&D	NYSERDA NYPA Brookhaven National Laboratory
Initial Assessment of Advanced Technology Concept Papers	Concentric Energy Advisors
Wrap-up and next steps	Con Edison

3.4 Summer Stakeholder Webinar

The Summer Stakeholder Webinar allows the ATWG to engage the technology stakeholder community mid-way through the year. The agenda for this webinar is flexible, and the session is tailored to address current issues. These may include policy and regulatory initiatives, program updates, and insights from ongoing R&D activities. This webinar also serves as a medium for program feedback from stakeholders and an opportunity for questions. In 2024, the ATWG focused its Summer Webinar on the results of the Call for Papers.

Timing: July/August (2025)

3.5 Fall Planning Workshop

Each year, the ATWG holds an in-person workshop to review various program activities, discuss potential focus areas for the coming year, and review lessons learned to help improve the way we work. In 2025, the ATWG plans to include a public portion of the workshop to facilitate additional input and feedback from the stakeholder community that we can use to guide program planning.

Timing: October/November (2025)

4 BUDGET AND FUNDING

4.1 Ongoing Program Support

The ATWG requires $4 million in funding to support activities related to studies and analyses (see Table 10). Funding has thus far been provided by NYSERDA. The ATWG will also seek opportunities to collaborate with other funding entities such as the United States Department of Energy, technology vendors, or host utilities.

4.2 Demonstration Project Funding

From time to time, the ATWG may identify a demonstration project that would help address one or more barriers to deploying advanced technologies. Table 10 includes the $8.5 million in funding that NYSERDA has estimated for demonstration projects in 2025 and 2026.

Table 10. ATWG Activities and Budget for 2025-2026.

Activity Type	Budget	Activities	Preliminary Budget Allocation	Preliminary Budget Allocation Total
Studies and Analysis	$4 million (NYSERDA)	T&D Energy Storage Potential Study (ongoing)	$0.5M	$4 million[25]
		Energy Storage Deep Dive (Con Edison) (ongoing)	$0.5M	
		Energy Storage Deep Dive (Central Hudson) (ongoing)	$0.5M	
		DLR Potential Study (new)	$0.5M	
		ACL Potential Study (new)	$0.5M	
		Resource Potential Study for Energy Storage and Emerging Distributed Energy Resource technologies (new)	$1.5M	
Demonstration Projects	$13 million (NYSERDA)	Grid Inertia Measurement Demonstration Project	$3.0M	$8.5 million[26]
		DLR Demonstration Projects	$5.0M	
		PFC Demonstration Project	$0.5M	

25. NYSERDA has $4 million budgeted and allocated from 2024 through 2026. Recommended studies may need additional funds.
26. NYSERDA has estimated funding for pilot and demonstration projects at $8.5 million from 2024 through 2026. NYSERDA has allocated $3 million toward the Grid Inertia Measurement Demonstration Project. These funds may be supplemented by project partners including technology vendors, utilities, or other research organizations.