DE-FOA-0002740
BIL – Grid Resilience and Innovation Partnership (GRIP)

Future Grid

Topic Area 2 - Smart Grid Grants (BIL section 40107)

Lead Organization: National Grid USA Service Co., Inc. ("National Grid")

Entity Type: Electric Grid Operator

Project Location(s): Upstate New York and Massachusetts

Concept Paper Identification Code: TA2-227-E

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Technical Volume

1.0 PROJECT OVERVIEW

1.1 Background

National Grid is a leading electricity, natural gas, and renewable energy delivery company, serving the energy needs of more than 20 million people through our networks in New York (NY) and Massachusetts (MA). In April 2022, we announced our vision for a fossil-free future that has set a new climate standard for utilities across the US. Our vision includes a plan to eliminate fossil fuels from our gas and electric systems by 2050, while ensuring affordable, reliable service to all our customers. To reach this ambitious goal, National Grid will not only need to significantly increase the amount of interconnected customer-owned distributed energy resources (DER) but also integrate and optimize these resources into our network operations. Incremental funding from the Grid Resilience & Innovation Partnerships (GRIP) program will equip our NY and MA electric control center operations with the digital tools and capabilities to unlock the value of DER on our system to enable the energy transition.

With MA and NY ranking 3rd and 11th in the US in solar nameplate capacity/square mile[1], respectively, DER penetration in our service territories is already high and exponentially increasing, causing clusters of congestion on feeders, making integration of DER a priority. Our distribution system operators (DSOs) are now facing a unique set of operational constraints related to DER hosting capacity limitations, limited capability to monitor and control DER, and the challenges of managing intermittent DER. Our foundational grid modernization investments currently under deployment, although critical, will not allow us to achieve the next generation of grid modernization, to enable full integration and optimization of DER to maximize benefits to the grid. Therefore, National Grid is seeking incremental funding from the GRIP program to transition towards an adaptive network management strategy for the distribution system, leveraging DER and interfacing system data to unlock new resiliency and operational flexibility capabilities.

1.2 Project Goal

Our proposed **Future Grid** project will enable National Grid to deploy innovative digital technology solutions to maximize the value of DER through advanced network management, resource orchestration and control. The project will leverage and build upon our Future Grid 1.0 foundational investments currently being developed and deployed, which include advanced distribution management system (ADMS), distributed energy resources management system (DERMS), advanced metering infrastructure (AMI), Fault, Location, Isolation, and Service Restoration (FLISR), as described in **Table 1**.

[1] Based on data from US Energy Information Administration and US Census Bureau

Table 1 – Future Grid 1.0 versus Future Grid 2.0 Capabilities Summary

Program	Key Technologies	Capabilities	Grid & Customer Benefits
Future Grid 1.0	Foundational ADMS, AMI and DERMS	Ability to integrate and manage DER and enhance network operation and reliability	Reduce customer outages, expand customer offerings, and provide broader visibility and control of DER
Future Grid 2.0	Technology solutions that integrate ADMS, AMI and DERMS	Ability to fully integrate, optimize and orchestrate a wide range of DER for local grid active management	Integrate a variety of third-party owned DER to maximize available clean energy output and deliver network efficiency to further reduce customer outages, expand customer offerings, and reduce greenhouse gas emissions

1.3 DOE Impact

National Grid is making significant investments in foundational grid modernization technology platforms under its Future Grid 1.0 program. DOE funding will provide a once-in-a-generation opportunity to leverage and enhance the capabilities of these foundational investments to accelerate realization of the new level of grid benefits. Future Grid will serve as a showcase of an advanced smart grid necessary to manage a dynamic distribution network. Achieving NY's and MA's ambitious climate targets will be extremely challenging at the current pace of technology deployment. DOE funding will enable National Grid to drive a digital agile approach to implementation to progress quickly through initial deployment phases, and to deliver these innovative solutions at scale.

<u>DER operational flexibility</u>
National Grid's current flexible interconnection schemes, which enable dynamic operating limits, are restricted to utility-scale solar facilities under normal system conditions. In recent years, however, we have experienced an increase not only in the volume of third-party DER interconnection applications but also in the diversity and complexity of DER technologies, which now include energy storage and EV DC fast-charging (DCFC) stations. Many of these interconnection requests are now triggering significant distribution system upgrade costs and time to interconnect due to limited available grid capacity. DOE funding will be critical to integrate flexible interconnection schemes with ADMS and DERMS interfaces, which will provide real-time and adaptive control capabilities necessary to not only interconnect but also utilize these new DER technologies for the benefit of the distribution system. Additionally, with DOE funding, the benefits of flexible interconnection would not be limited to certain DER, such as solar, and the impact of DER participation in system rebalancing would greatly increase.

Today, DER is not integrated with our FLISR schemes due to the system operators' inability to adequately monitor, manage and control these resources without advanced technologies and integrations. With DOE funding, National Grid also seeks to integrate DERMS and AMI into FLISR schemes, which provide the system awareness and control capabilities for the FLISR algorithms to effectively dispatch DER for outage restoration. Without these advances enabled by DOE funding, third-party DER will continue to be disconnected during load transfers or under specific system reconfiguration events, resulting in a missed opportunity to increase system reliability. As the pace of DER penetration continues to accelerate, the effectiveness of an integrated FLISR scheme will have an even greater critical impact on improving system reliability.

1.4 Community Benefits Plan (CBP)

Job Quality and Equity

Future Grid will accelerate the integration of DER into National Grid's electric distribution system operations, which will catalyze DER investment across our service territories. The project will require a trained workforce that is equipped with the skills to support the deployment and integration of foundational grid modernization technologies. Future Grid will require nearly 180 full-time equivalents (FTEs), who will primarily consist of STEM-educated workers such as Product, Data, and Software Engineers, Solution Architects, and Data Scientists. National Grid will prioritize STEM-focused workforce development programs that increase the opportunity for diverse and minority candidates to qualify for these jobs. Additionally, the Future Grid program will bolster support for workforce development of our unionized field force labor, which includes line workers and electrical construction and maintenance crews. National Grid commits to collective bargaining with our 19 unions, as 100% of our field workforce are union employees. National Grid ensures these workers can participate in labor organizations and labor-organizing activities freely. Please refer to Sections 2 and 3 of the CBP for further details on our Job Quality and Equity strategy.

1.5 Environmental Impact & Climate Resiliency Strategy

As Future Grid focuses on the integration of digital technology solutions with smart grid systems, minimal physical construction is expected. Therefore, National Grid does not foresee the project resulting in negative or long-term environmental consequences or creating barriers to community access to natural resources or Tribal cultural resources. For more detailed information, please refer to the Environmental Questionnaire.

Climate change is considered as part of National Grid's Enterprise Risk Management (ERM) process which identifies a series of company-wide controls and actions to mitigate climate change risk. Our service territories are experiencing higher temperatures and heatwaves, and more frequent and intense storm events that can result in significant flooding, high speeds of wind, road wash outs caused by stormwater, and ice storms. Scenario analysis to 2050 guides our strategic and financial planning with respect to climate change and considers potential physical impacts to the company with average global temperature increases of 2°C and 4°C. Resiliency and reliability are at the core of our mission, with a focus on infrastructure that is flexible and adaptable, and able to recover quickly.

2.0 TECHNICAL DESCRIPTION, INNOVATION, AND IMPACT

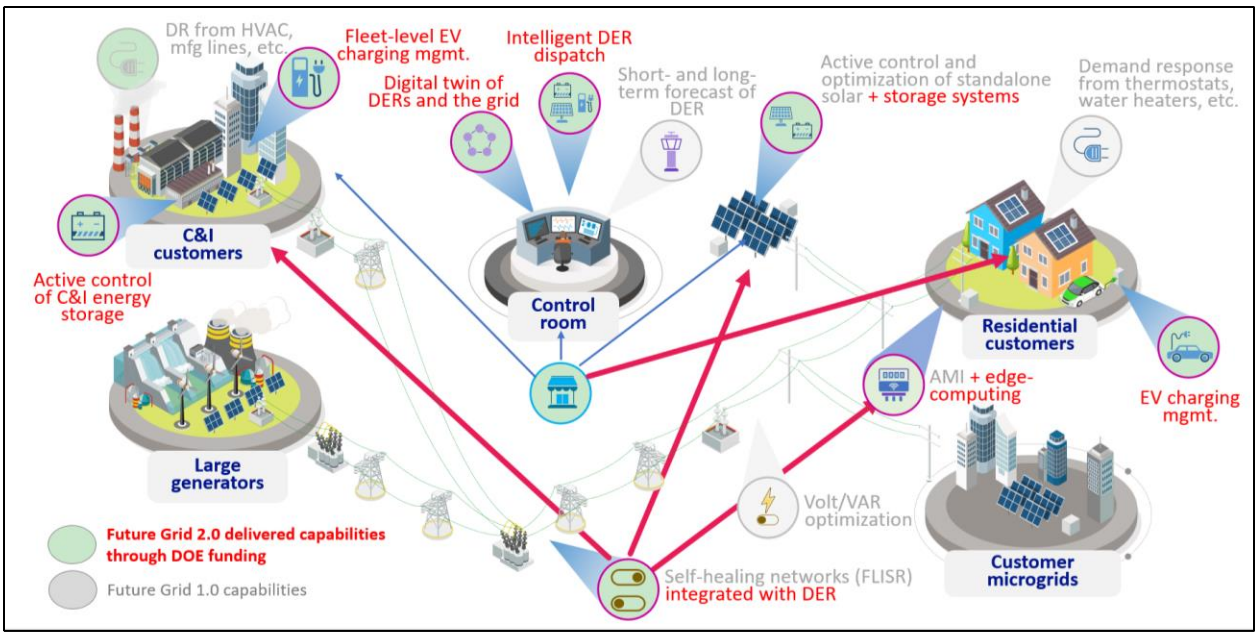
2.1 Relevance and Outcomes

To reach our goal of fossil-free gas and electric operations by 2050, National Grid will not only need to significantly increase the amount of interconnected customer-owned DER but also fully integrate and optimize these resources in our network operations. Future Grid will enable National Grid to maximize the value of DER through advanced network management, resource orchestration, monitoring, and control by leveraging foundational grid modernization efforts currently underway and further enhancing these capabilities.

2.2 Enhancing System Flexibility to meet Topic Area 2 Objectives

This proposal will enable National Grid to advance DER integration capabilities that could be replicated to support the energy transition of the utility industry. Future Grid will meet the following objectives: (i) prevent or reduce the impact of faults that may lead to system disturbances; (ii) integrate variable renewable energy resources and other DER into the grid; and (iii) facilitate the aggregation of DER, electric vehicles (EVs), and other grid-edge devices. **Figure 1** illustrates the added capabilities of Future Grid 2.0 (red text), compared to Future Grid 1.0 (gray text).

Figure 1 – Illustration of Future Grid 1.0 versus Future Grid 2.0



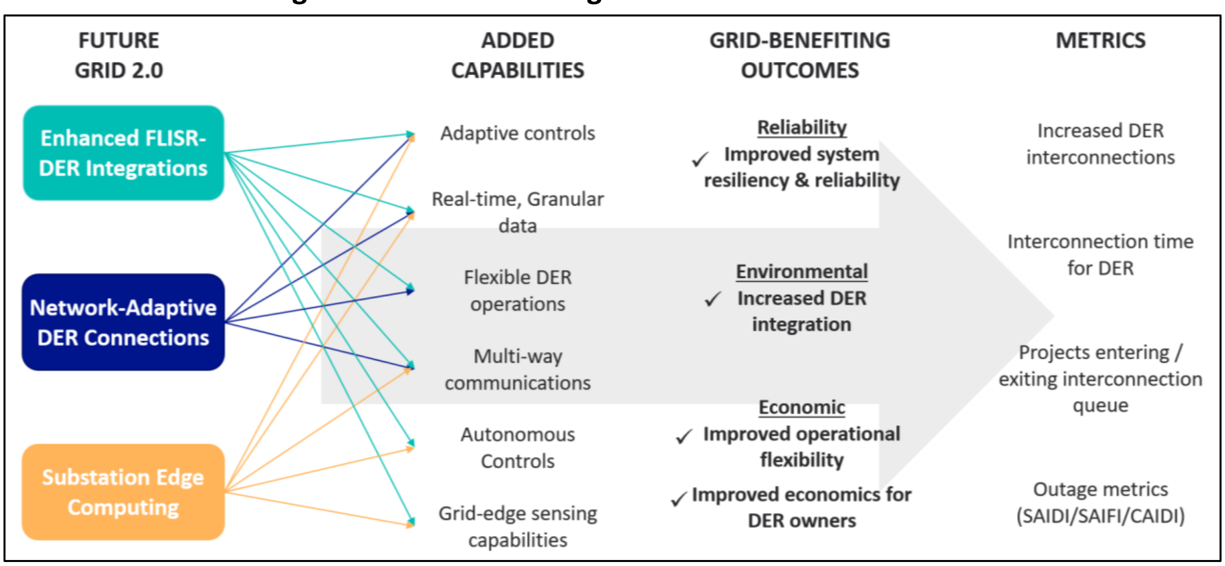
Future Grid 2.0 will deliver a more dynamic distribution system able to utilize the benefits of flexibility and reliability of DER generation. Future Grid meets the following priority investment areas of GRIP Topic Area 2: (i) improving the visibility of the distribution system to grid operators, to help quickly rebalance the electrical system with autonomous controls, through data analytics, software, and sensors; (ii) aggregation and integration of DER and other grid-edge devices to provide system benefits; and (iii) enhancing interoperability and data architecture of systems that support two-way flow of both electric power and localized analytics. National Grid will execute Future Grid across our NY and MA operating territories, leveraging these technology approaches, which consist of the three components listed below. Please see Section 2.3 – Development of Priority Smart Grid Functions, for further detail on these project components.

- **Enhanced FLISR-DER Integrations:** Enhancing National Grid's FLISR capabilities through system integrations with ADMS, DERMS, and AMI will enable grid-edge technology to leverage customer-owned DER to further reduce grid outages.
- **Network-adaptive DER Connections:** Enhancing operational flexibility of DER by integrating flexible interconnection schemes with ADMS and DERMS to enable greater amounts of DER to interconnect to the system, while also utilizing DER for critical load balancing functions.
- **Substation Edge Computing:** Deploying cloud-edge computing software to enhance interoperability between smart grid technologies to provide real-time monitoring and control of the distribution system to enable increased DER integrations, while maintaining grid resiliency and reliability.

2.3 Development of Priority Smart Grid Functions

National Grid has created a long-term DSO (Distributed System Operations) roadmap that defines pathway to unlocking grid and customer benefits. Alongside this roadmap is an associated DERMS (Distributed Energy Resource Management System) roadmap that details the technologies required to enable these grid and customer benefits. These roadmaps define the prioritization of smart grid deployments based on multiple variables including maturity, benefits, ability to implement, market changes, timing, costs, and other variables. The smart grid components selected for this proposal are the next steps in these roadmaps and through the DOE funding will enable the acceleration of these roadmap items.

Figure 2 - Grid-benefiting Outcomes of Future Grid 2.0



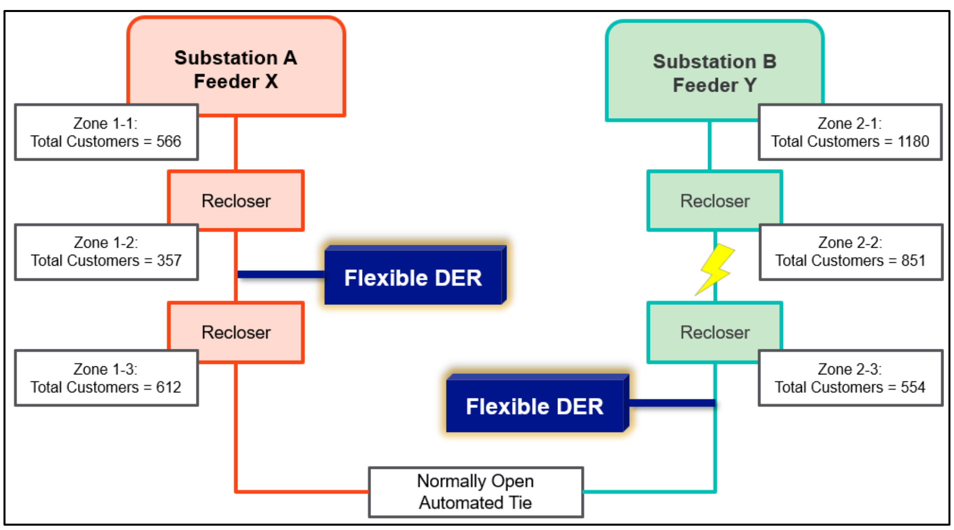
National Grid will use metrics that allow baselining and periodic measurement of value derived from Future Grid to measure and track the impact of projects delivered with DOE funding. Illustrative metrics shown in **Figure 2** identify methods for measuring impact. The final set of metrics will also include consideration of factors that are outside of the project's sphere of influence area, such as customer participation in flexible interconnections and FLISR-DER offerings. Below are descriptions of the three components that comprise Future Grid 2.0 and the smart grid functionality that each will develop to drive grid-benefiting outcomes.

Enhanced FLISR-DER Integration

Smart Grid Functionality	Enhanced data flow between ADMS, DERMS, AMI, and FLISR platforms through system integrations to minimize outage impacts
	Ingestion of real-time grid-edge data through AMI to inform power restoration strategy
	Autonomous controls of DER through DERMS to enable integration of these resources into power restoration strategy

National Grid's current FLISR solution is unable to fully integrate DER or AMI technologies, resulting in missed opportunities to leverage these resources for outage restoration management. Today, DER is considered harmful to FLISR schemes due to system operators' inability to adequately manage these resources. With DOE funding, National Grid seeks to integrate DERMS and AMI with ADMS, which will provide the system awareness and control capabilities for the FLISR algorithms to effectively dispatch DER for outage restoration. Through integration of these systems, National Grid will increase its load transfer capabilities by activating DER in our outage restoration strategies to reduce load, enabling larger portions of the distribution system to be switched over to energized parts of the distribution system, thus restoring more customers (see **example below**). Integrating FLISR with AMI will also provide remote-control capabilities and grid-edge sensing into our FLISR schemes to optimize power restoration. National Grid will track improvements to its power restoration strategy by reviewing the change in outage metrics, including system average interruption duration index (SAIDI) and system average interruption frequency index (SAIFI).

Figure 3 – Example of FLISR-DER One-Line Diagram

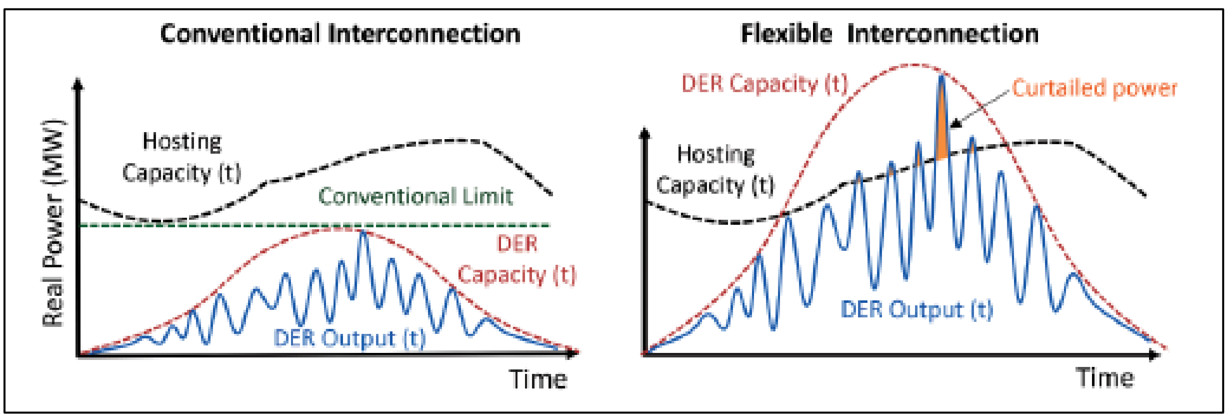


Network-Adaptive DER Connections

Smart Grid Functionality	Enhanced data flow between ADMS, DERMS, through system integrations to enable visibility and direct operations DERs
	Ingestion of near real-time of DER operations through DERMS
	Autonomous controls of DER through DERMS to enable curtailment and ramp-up capabilities
	Integration of solar PV, EVs, and energy storage into the grid to provide system benefits

With DOE funding, Future Grid 2.0 seeks to integrate ADMS with DERMS, enabling the DERMS to directly operate DER based on the centralized grid real-time operational status through ADMS. This real-time data will enhance the ability to manage and optimize DER in response to changes to grid topology, such as a major grid disturbance. This will allow National Grid to maximize availability of these resources and utilize DER flexibility as a critical balancing strategy during disruptive events, such as back-feeding of large-scale renewable energy systems during normal and abnormal system conditions. Increasing the availability of DER facilities during grid disturbances will maximize the operational economics for DER developers and allow for faster and less costly system upgrades for interconnection. Recent analyses estimate total cost savings of $4.5 million per DER interconnected, in deferral of capital investments by five years if developers and customers participate in flexible interconnections. If Future Grid 2.0 enables similar benefits to 100 DER storage and/or EC DCFC facilities, this could result in cost savings of up to $450 million over time.

Figure 4 – Conventional Interconnection Versus Flexible Interconnections



Through Future Grid 2.0, we plan to leverage this enhanced system flexibility and expand flexible interconnection offerings to other DER technologies, such as battery storage and EV charging infrastructure. For example, ADMS can detect and inform DERMS that a substation transformer is close to overloading due to EV DCFC loading, informing the DERMS to ramp down the EV DCFC to ensure safety and reliability, as shown in **Figure 4**[2]. National Grid will measure the impact of this project component by tracking the number of DER interconnections,

[2] Source: Active Resource Integration Project; Techno-Economic Analysis of Flexible Interconnection; EPRI Report: 3002025504

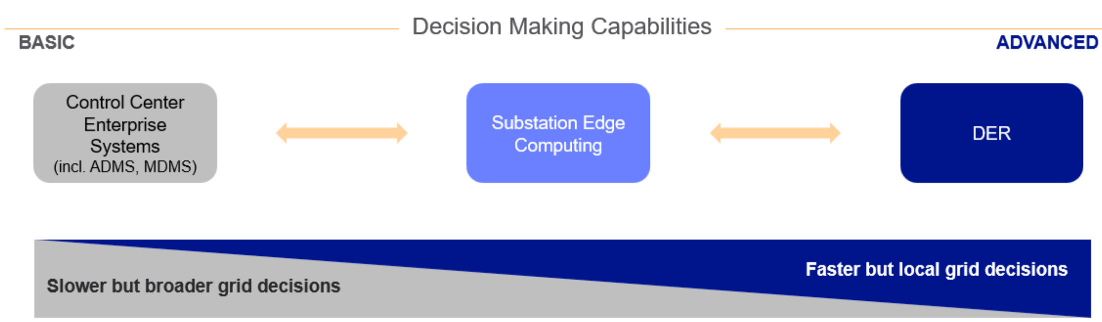
the rate at which DER passes through the interconnection process, and the statistics of DER owners entering and exiting the interconnection queue.

Substation Edge Computing

Smart Grid Functionality	Enhanced security communications and 3-way data flow between distribution substations and the cloud
	Enhancing interoperability and distribution system architecture to support increased flow of real-time data and localized analytics to provide information between grid operators and consumers
	Autonomous controls of distribution system components through data analytics, software, and sensors at the grid edge

National Grid seeks to add advanced control and monitoring capabilities by building hardened industrial grade servers that enable cloud-edge computing within the substation and to the edge of the grid. Planning for increased DER penetration requires carefully managing the impacts to power quality related to large and small-scale intermittent resources. National Grid will develop key grid infrastructure functionalities to provide the granular measurement and control points that enable automation of the distribution system at a federated level, above and beyond the existing turn-key vendor supplied solutions, enabling operators to effectively manage DER while increasing the resiliency or reliability of the system. Substation Edge Computing provides the platform that enables deployment advanced DER control above and beyond simple FLISR scheme. As DER penetration increases on National Grid's distribution systems, its customers will demand the ability to track and manage their energy usage, in real-time. SEC will enhance the interoperability and data architecture that support two-way flow of electric power and localized analytics enabling National Grid to deploy cloud-based applications, as necessary, to meet the needs of the customer. This advanced technology architecture will also complement our efforts to enhance FLISR schemes. By improving visibility of the grid, National Grid will build an improved understanding of real-time load transfer capabilities and be able to transmit such data to the grid, further enhancing our outage response strategies. Shown in **Figure 5** is the spectrum of decision-making capabilities. By deploying Substation Edge Computing, National Grid will unlock additional visibility and communications capabilities, on the right side of the visual highlighted in blue, to enhance decision making capabilities.

Figure 5 – Spectrum of Grid Decision Making Capabilities



2.2 Feasibility

National Grid will be implementing Future Grid with the support of industry-leading technology partners, including PNNL, EPRI, Hitachi, and Smarter Grid Solutions, to draw on industry experience and ensure success.

<u>Experience in Executing Tasks of Similar Risk and Complexity</u>
National Grid has successfully implemented advanced smart grid functionality through small-scale deployments and pilots. With DOE funding National Grid can push past pilot phases and scale out this technology into our broader core operations. Below are highlights from successful smart grid projects:

- **Smart Energy Solutions** – National Grid's 2012 pilot program included the deployment of 15,000 AMI meters with remote reading capabilities in Worcester, MA. Through this project, a portion of the distribution system was bolstered with advanced distribution automation equipment, advanced capacitor controls, and advanced monitoring equipment to feeder, transformer, DG, solar, and EV sites. This complemented new customer offerings such as time-of-use (TOU) rates, a web portal for customers to access interval usage data, demand response capabilities, home energy management devices/tools, and an outreach and education program. Key success metrics include: 98% customer participation in the program, $1.25 million in bill savings, and 2,300 MWh in total energy savings.
- **Volt/VAR Optimization (VVO) Deployment** – National Grid partnered with Utilidata and AdaptiVolt to develop an end-to-end real-time VVO solution for customers in MA. Beginning as a pilot program in 2013 for 16,000 customers across Rhode Island (RI), National Grid used real-time information from the distribution grid to optimize energy delivery, build resiliency, and boost sustainability leading to over 3% in energy savings for impacted customers. National Grid then expanded this program to additional projects in RI in 2016 and operations in Clifton Park, NY in 2017. The technology's ability to precisely monitor grid conditions also enabled the reliable and cost-effective integration of wind and solar power, EVs, and other DER. The roll-out of this project included enhancements to AMI, and VVO devices. To complement these efforts, National Grid also offered opportunities for customers to participate in demand response programs and TOU rates. National Grid conducted targeted outreach to impacted customers and community organizations to articulate the benefits of these programs and encourage participation.
- **Solar + Storage Non-Wires-Alternative (NWA)** – National Grid partnered with Convergent Energy + Power, a leading provider of energy storage solutions, to complete one of the first solar + storage (10MW/40MWh) systems that provided an NWA. The system, which was designed, constructed, and operated by Convergent, delivered more cost-effective, reliable, and sustainable electricity to National Grid customers in Cicero, NY while leveraging solar energy during non-peak periods.

<u>Access to Necessary Equipment and Facilities</u>
As the owner and operator of extensive electric distribution networks in NY and MA, National

Grid has adequate access to the infrastructure to accomplish this effort. In addition, National Grid owns and operates several solar PV facilities co-located with energy storage, which have been identified for their smart inverters to incorporate into DER operational flexibility testing. National Grid intends to leverage our own labs as well as labs of our innovation partners, such as EPRI, to accelerate the deployment of Future Grid 2.0 functionality. The company will be able to obtain any remaining software and hardware necessary to implement Future Grid.

Access to a Skilled Workforce

National Grid understands the importance of building a workforce with critical skills necessary for advancing smart grid efforts. National Grid has implemented a robust workforce planning strategy that spans across its business units and operations in NY and MA. The company builds its workforce planning strategy using a comprehensive workforce planning framework, which leverages detailed workforce supply analytics, such as attrition and retirement forecasts. The framework is also used by business units along with their planned workforce demand projections to build a comprehensive plan. By developing this 10-year outlook, National Grid is able to proactively build its workforce of the future, including hiring of resources prior to retirements. National Grid is confident that it has the workforce planning analytics and processes in place to enable business continuity across its organization, including business operations directly related to smart grid investments.

2.3 Innovation and Impact

DER penetration across National Grid's service territory is among the highest in the nation and exponentially increasing, resulting in operational challenges due to the intermittent nature of DER. Future Grid is charting the course that many utilities will eventually undertake to not only integrate greater numbers of increasingly larger and more complex DER projects, but also leverage them to strengthen grid resilience and reliability. This project will accelerate the transition towards an adaptive distribution network management strategy, integrating DER and interfacing system data to unlock new resiliency and flexibility capabilities. Future Grid will enable National Grid to:

- Utilize third-party-owned DERs where a FLISR scheme has been activated to temporarily bring customers back online, while repairs and restoration work are being completed
- Monitor, manage and control a variety of DER types, beyond PV solar, including energy storage and EV fast-charging stations, especially those located in lightly loaded areas of the grid for critical load balancing functions, instead of simply disconnecting them
- Facilitate the interconnection of greater numbers of DER on feeders approaching capacity limits in high penetration areas of the grid without the need for expensive and time-consuming upgrades to the system, which can cause developers to drop out of the interconnection queue
- Reduce innovative technology risks; this project will follow an agile deployment approach, which allows us to advance quickly based on learnings, driving progressive growth at scale

National Grid will collaborate with our extensive network of industry leaders to efficiently deploy this project plan and share key insights with peers across the industry. We are confident that our efforts in building the grid of the future will reduce innovative technology risk, allow us to scale-up, and pave the way for additional private sector investments in the following ways:

Drive technology maturity for the entire value chain

By collaborating with industry-leading vendors, Future Grid will drive technology maturity for the entire value chain in developing innovative products, processes, solutions, and components that can drive costs down, and can be replicated across the utility industry. The successful integration and development of incremental capabilities of grid-aware systems like ADMS, DERMS, and AMI will provide National Grid, our vendors, our technology partners, and the broader industry with improved understanding of real-time power flow, enabling DSOs to utilize flexible DER in both abnormal and "blue sky" system conditions. For example, in preparing for ADMS integrations, National Grid has identified integration and incremental capabilities required to accommodate a diverse mix of DER into our FLISR and flexible interconnection schemes. Based on discussions with ADMS vendors, we understand that current integration capabilities are limited to rooftop solar only. National Grid intends to work closely with our vendors and industry partners such as EPRI, to expand these capabilities beyond solar, which could be replicated by other utilities. Learnings from Future Grid will demonstrate the value of flexible DER capabilities to both system operators and developers, which is critical in spurring future investments in deployment of DER.

Scaling success by sharing with a partner ecosystem

While the utility industry has long discussed the value of integration between systems like ADMS and DERMS, it has not achieved widespread implementation. Future Grid will serve as a playbook for executing next-generation grid modernization. National Grid intends to continue cross-pollinating and sharing new insights derived from this project with technology partners in the industry. We have a long history of working with the Electric Power Research Institute (EPRI) and have contributed as a technical advisor on several EPRI reports. We plan to continue this important work with EPRI by sharing new data and insights derived from Future Grid. Additionally, National Grid is partnering with Pacific Northwest National Laboratory for their technical expertise in phase measurement units (PMUs), analytics, and DER management across a federated grid, as well as Carnegie Mellon University and the University of California, Berkley, to reap the full potential of the advanced technologies that will be leveraged, specifically in Substation Edge Computing.

Investment in DER by developers and customers

Future Grid will develop and deploy cutting-edge digital technologies at-scale that will allow for improved DER operational output and improve DER economics for both large-scale developers and residential DER, which in turn will encourage and likely accelerate DER investments. Please see Section 1.3 – DOE Impact for more details about the expected impact of DOE funding.

2.4 Support for State, Local Tribal, Community, and Regional Resilience and Decarbonization

National Grid operates across the US Northeast, where aggressive action to mitigate the effects of climate change is underway. Future Grid will progress on decarbonization goals, while ensuring affordable and reliable service to our customers, including our disadvantaged communities (DACs)[3].

New York Climate Leadership and Community Protection Act (CLCPA)[4]: In July 2019, NY passed the CLCPA, which is among the most ambitious and comprehensive climate and clean energy legislation in the US. The Act seeks to transform the power system by integrating more renewables into the electric grid. Key decarbonization mandates include 40% reduction in greenhouse gas (GHG) emissions by 2030, 70% renewable electricity by 2030, including specific mandates for solar, wind, and battery storage, and 100% zero-emissions electricity by 2040. The Act also focuses on creating well-paying clean energy jobs, ensuring DACs benefit from the clean energy transition, supporting new industries, and improving public health outcomes.

Massachusetts Clean Energy and Climate Plan for 2050[5]: In March 2021, the Act creating a Next Generation Roadmap for Massachusetts Climate Policy was enacted to support the Clean Energy and Climate Plan for 2050, which mandates statewide GHG emissions limits to accelerate the energy transition. Emissions are required to be 50% less than 1990 baseline emissions by 2030, with a net-zero target by 2050. Decarbonization efforts will involve rapid deployment of renewables, electric heating, and EV charging technologies, while maintaining reliability. MA aims to improve public health benefits and create over 10,000 high-paying jobs to support development of a low carbon grid.

Future Grid meets several of the regional, state and community strategic objectives:

- **Decarbonization**: Transforming the electric grid to accommodate more intermittent renewable DER will require system operators to adopt innovative strategies. National Grid is well positioned to meet this challenge, named as a Decarbonization Top Innovator in Reuters 2022 Global Energy Transition[6] for our actions in driving low-carbon electricity generation. Future Grid will deploy and integrate critical technologies to maximize the operational flexibility of large and small-scale DER, thereby reducing reliance on fossil fuel generation that directly contributes to GHG emissions and poor air quality. Future Grid also will implement advanced capabilities to enable the intelligent management of EV charging that reduces system impacts and unlocks both customer and system value.
- **Improve System Resilience and Reliability**: As mandates to increase beneficial electrification (e.g., clean heat and transportation), society's dependence on and demand for electricity is ever-increasing. Accelerating integration of National Grid's ADMS, AMI and

[3] White House Council on Environmental Quality's Climate and Economic Justice Screening Tool
[4] New York Climate Leadership and Community Protection Act (CLCPA)
[5] Massachusetts Clean Energy and Climate Plan for 2050 | Mass.gov
[6] Reuters Global Energy Transition 2022

DERMS with other enterprise systems will inform operational schemes of detailed forecasted and real-time system conditions so DER activity can be better coordinated with distribution assets to meet real-time system needs. National Grid recognizes that the reliability of the power grid varies considerably by region and community, and when the grid does fail, the consequences do not affect everyone equally. Low-income customers and DACs have greater financial and logistical challenges related to adapting to long-duration power outages (e.g., access to back-up power, finding alternative accommodations).

In collaboration with the DOE, National Grid signed a letter of intent on December 8, 2022, to welcome the opportunity to participate in the third phase of the DOE's Outage Data Initiative Nationwide (ODIN) effort to further open data standards for the management and exchange of outage information between key stakeholders in our region and across the country. National Grid has chosen to commit to ODIN with a goal of providing easy to use, small area, near real-time, standardized outage data to customers, public safety officials and the general public. Sharing ODIN compliant outage data will also inform data analytics for preventing outages and improving grid resilience, which is essential for a fully electrified future.

- **Create Clean Energy Jobs**: Successful integration of these technologies will require teams of highly skilled workers from STEM fields to implement and maintain these solutions. National Grid has established several workforce development programs in our communities. With DOE funding, Future Grid will bolster skill development programs in fields such as data science and electrical engineering in DACs, in NY and MA.

3.0 WORKPLAN

3.1 Project Objectives

Our proposed Future Grid project will enable National Grid to deploy innovative technology solutions to unlock and maximize the value of DERs across our electric distribution system through greater advanced network management, resource orchestration, monitoring, and control. The project will leverage and build upon our foundational grid modernization investments currently being deployed, referred to as Future Grid 1.0, which include ADMS, DERMS, and AMI. In parallel, Future Grid 2.0 will develop new digital technology solutions while enhancing current functionality to fully integrate, optimize, and orchestrate a wide range of DER for grid operational support. As described in more detail in this proposal, through the integration of foundational investments and incremental developments, National Grid will integrate more clean energy resources and do so more quickly and efficiently; reduce grid outages; and operate a near real-time dynamic grid.

3.2 Buy America Requirements for Infrastructure Projects

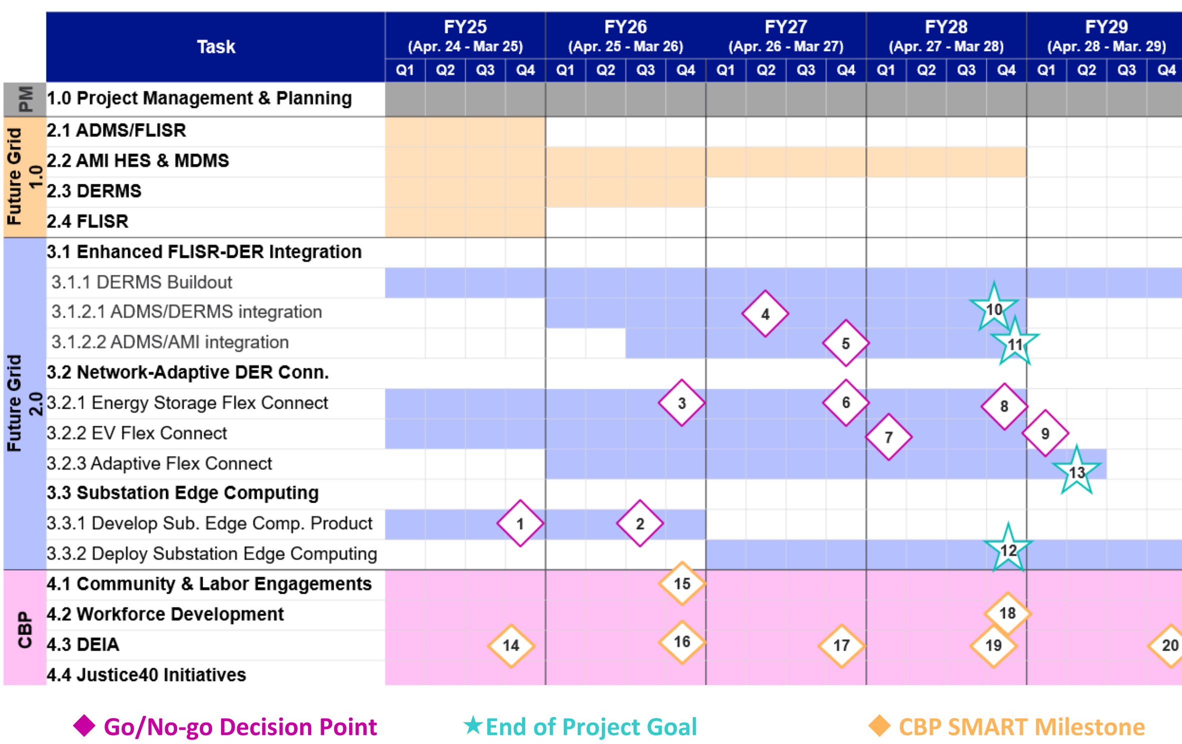
As a for-profit entity, National Grid is exempt from the Buy America Requirement. The Future Grid proposal is largely comprised of enhancements to National Grid's Information

Technology/Operational Technology (IT/OT) systems, infrastructure, and architecture with minimal work related to physical construction or installations. National Grid will, however, track spend on equipment and make efforts to buy equipment made in America when applicable.

3.3 Technical Scope Summary

The Future Grid technical proposal is organized into two major tasks: Future Grid 1.0 tasks which represent foundational investments, and Future Grid 2.0 tasks which represent new capabilities and functionalities. The proposal will be executed over five annual budget periods, beginning April 2024, to align with National Grid's fiscal planning cycles. **Budget Period 1** (FY25) will involve foundational system platform buildouts related to DERMS and AMI, preliminary system integrations, FLISR deployment, site selection analyses, and deployment of foundational communications infrastructure. **Budget Period 2** (FY26) will involve the design and deployment of minimum viable products (MVPs) for Future Grid 2.0 tasks, and the continuation of system platform buildouts related to DERMS and AMI. **Budget Period 3** (FY27) will involve iterative improvements of MVPs in prior budget period, guiding the design and development of enhanced MVPs with new functionality. **Budget Period 4** (FY28) will involve the scaling out of critical system integrations related to ADMS, DERMS, and AMI. **Budget Period 5** (FY29) will involve the scaling out of new functionality across the distribution system, leveraging critical system integrations.

3.4 Project Schedule, Milestones and Go/No-Go Decision Points:



Go/No-Go Decision Points: Each of the annual SMART Milestones listed below represents critical technical achievements, which will serve as National Grid's go/no-go decision points.

1.	Install and test telecommunications infrastructure for 1st substation
2.	Commission Substation Edge Computing equipment in 1st substation
3.	Ability to offer active management capabilities to energy storage at 1st substation
4.	Ability to integrate DER into FLISR schemes at initial 5 schemes through ADMS/DERMS integrations
5.	Ability to leverage grid edge data to inform FLISR-DER at 10 schemes, through ADMS/AMI integrations
6.	Ability to offer active management capabilities to energy storage at up to 6 substations
7.	Ability to offer active management capabilities to EV DCFC charging up to 4 substations
8.	Ability to offer active management capabilities to energy storage at up to 10 substations
9.	Ability to offer active management capabilities to EV DCFC charging up to 10 substations
End of Project Goals	
10.	Scale out ability to integrate DER, with flexible interconnection, across deployed FLISR schemes as a resource to be leveraged during outages.
11.	Ability to leverage grid edge data to inform FLISR-DER across deployed FLISR schemes.
12.	Deploy Substation Edge Computing platform at 2nd substation with 3-way communications functionality (between substations, cloud)
13.	Ability to offer adaptive flexible interconnection capabilities to existing/planned areas where NG offers active management for normal and abnormal grid configurations
CBP SMART Milestones	
14.	Energy Infrastructure Academy (EIA) program established at minimum two schools
15.	Appoint minimum one Energy Manager
16.	Over 50% of People Managers complete 12 hours of annual DEIA-related training
17.	Over 60% of allocated funds for the supplier diversity program spent at this point
18.	Training provided to over 200 diverse or DAC candidates, as part of Grid for Good Program
19.	Employee engagement scores related to DEIA increase by at least 10%
20.	Minimum 100 candidates employed into well-paying energy jobs

3.5 Work Breakdown Structure (WBS) and Task Description Summary

Task 1.0 – Project Management & Planning
Subtask 1.1 – Project Management & Planning (PMP)
Description: Within 30 days of award, National Grid will submit a Project Management Plan (PMP) to the designated Federal Project Officer (FPO). The PMP shall be revised and resubmitted as often as necessary, during the project, to capture any major/significant changes to the planned approach, budget, key personnel, major resources, etc. National Grid will manage and direct the project in accordance with the accepted PMP to meet all technical, schedule and budget objectives and requirements. National Grid will ensure that project plans, results, and decisions are appropriately documented, and that project reporting and briefing requirements are satisfied.
Subtask 1.2 - National Environmental Policy Act (NEPA) Compliance
Description: As required, National Grid will assist in a timely and effective completion of the NEPA process by providing the documentation necessary for NEPA compliance.
Subtask 1.3 – Cybersecurity Plan (CSP)
Description: Once funding is awarded**,** National Grid will submit a CSP. National Grid will revise and resubmit as often as necessary, during the project, to capture any major/significant changes.
Subtask 1.4 – Continuation Briefing(s)
Description: National Grid will brief DOE on roughly an annual basis to explain the plans, progress, and results of the technical effort. The briefing will include details of performance relative to project success criteria, milestones, and the Go/No-Go Decision point that are documented in the Project Management Plan (PMP).

Task 2.0 – Future Grid 1.0: Foundational grid modernization investments approved by National Grid regulators in their respective jurisdictions, which prime the distribution system for advancements under the Future Grid proposal	
Subtask 2.1 - ADMS	
Description: National Grid will continue its development and progression of ADMS and centralization of FLISR schemes.	
Grid-Benefiting Outcomes: • Centralized FLISR applications with fully integrated system automation • Ability to integrate solar PV into FLISR schemes with high-level modeling capabilities, assuming normal grid conditions	
Critical Milestones:	
FY25	• FLISR applications centralized with fully integrated system automation
Subtask 2.2 – Advanced Metering Infrastructure Headend System & Meter Data Management System	
Description: Buildout of the Advanced Metering Infrastructure (AMI) Headend System (HES), Meter Data Management System (MDMS), and Edge Intelligence necessary to collect meter data and notifications, manage bi-directional communication, enable near real-time analytics and decision processing. This work will complement National Grid's continued deployment of its AMI Implementation Plans across NY and MA electric service territories	
Grid-Benefiting Outcomes: • Ability to collect, manage and analyze meter data • Ability to securely manage the two-way communications network • Enable near real-time analytics	
Critical Milestones:	
FY25	• Ability to support intelligent apps residing on meter in upstate NY • Ability to support all billing rates for upstate NY • Ability to remotely manage and control up to 800,000 meters in upstate NY
FY26	• Grid-edge visibility enabled for DER integrations across distribution network
FY27	• Ability to detect early outages across distribution network
Subtask 2.3 – DERMS	
Description: Continued investments in National Grid's DERMS software platform which includes a group of individual applications that operate together in a cohesive fashion to actively manage and operate a limited set of DER through monitoring and control either directly or via an aggregator.	
Grid-Benefiting Outcomes: • Ability to actively track, plan, and operate DER through monitoring and control capabilities • Ability to model short-term load/supply forecasting for DER, and associated impact on the distribution system • Control capabilities to dispatch DER based on financial factors and physical grid conditions	
Critical Milestones:	
FY27	• Advanced Short-term Forecasting Including DER functionality in service • Grid Edge Control in service • Centralized DER Dispatch Engine in service
Subtask 2.4 – FLISR	
Description: Continued investments in FLISR control schemes. Physical deployment of automated reclosers to above-ground distribution network across NY and MA operating units.	
Grid-Benefiting Outcomes: • Build out of telecommunications infrastructure and advanced control of key switching devices to provide remote monitoring and operator control of field devices for normal operations and maintenance • Provide an automated response to system contingencies to improve grid resiliency.	

Critical Milestones:

FY25	• 30 FLISR schemes commissioned (MA) • 20 FLISR schemes commissioned (NY)

Task 3.0 – Future Grid 2.0: Advancement of smart grid functionality to improve overall system resiliency, reliability, and optimization of DER operations on its distribution system.

Subtask 3.1 – FLISR-DER Integration

Description: Enhancing current FLISR capabilities through integration with ADMS, DERMS, and AMI to enhance data ingestion to drive additional decision-making capabilities for DER within FLISR schemes.

Grid-Benefiting Outcomes:

- Ability to leverage grid edge data to inform FLISR automation capabilities with more accurate information
- Ability to leverage advanced DER control capabilities via DERMS software enhancements to safely integrate DER into FLISR schemes without affecting system reliability

Key Tasks:

- 3.1.1 DERMS Buildout
- 3.1.2 ADMS Integrations with DERMS and AMI

Critical Milestones:

FY27	• Ability to integrate DER into FLISR schemes at initial 5 schemes, through ADMS/DERMS integrations • Ability to leverage grid edge data to inform FLISR-DER at 10 schemes, through ADMS/AMI integrations
FY28	• Scale out ability to integrate DER, with flexible interconnection, across deployed FLISR schemes as a resource to be leveraged during outages. • Ability to leverage grid edge data to inform FLISR-DER across deployed FLISR schemes

Subtask 3.2 – Network-Adaptive DER Connections

Description: Integration of flexible interconnection schemes with ADMS and DERMS. Build out of key DERMS functionality including Grid-edge Control, DER Dispatch Engine, Short-term Forecasting at substations through National Grid's electric service territory in NY and MA to expand flexible interconnections functionality for DER including front of the meter distribution connected energy storage resources and electric vehicle (EV) charging.

Grid-Benefiting Outcomes:

- Buildout of key DERMS functionality to provide near-real time data of DER for enhanced monitoring and control capabilities
- Ability to offer active management capabilities, including curtailment and ramp-up functionality to front of the meter distribution connected solar PV, EV DCFC charging, and energy storage resources

Key Tasks:

- 3.2.1 – Energy Storage Flexible Interconnections
- 3.2.2 – EV Flexible Interconnections
- 3.2.3 – Adaptive Flexible Interconnections

Critical Milestones:

FY25	• Conduct site selection analysis to deploy flexible interconnection of energy storage • Conduct site selection analysis to deploy flexible interconnection of EV DCFC
FY26	• Ability to offer active management capabilities to energy storage at 1st substation • Ability to offer active management capabilities to EV DCFC charging at 1st substation
FY27	• Ability to offer active management capabilities to energy storage at up to 3 substations
FY28	• Ability to offer active management capabilities to EV DCFC charging up to 4 substations • Ability to offer active management capabilities to energy storage at up to 10 substations
FY29	• Ability to offer active management capabilities to EV DCFC charging up to 10 substations

Subtask 3.3 – Substation Edge Computing

Description: Building off previous studies in a remote lab environment, National Grid will build the necessary OT and IT infrastructure and software to support the substation edge computing product.

Grid-Benefiting Outcomes:

- Buildout of telecommunications network to enable distribution system assets to coordinate through a 3-

way data flow, between substations and the cloud to provide granular, real-time data • Virtualizing data analytics capabilities by transitioning from traditional hardware to cloud-software to enable autonomous controls • Advancing remote cloud-based computing capabilities will enable cost-efficient scalability to additional substations and eventually other grid edge components	
Key Tasks: • 3.3.1 – Develop Substation Edge Computing Product • 3.3.2 – Substation Edge Computing Deployment	
Critical Milestones:	
FY25	• Begin site selection analysis for 1st substation deployment • Install and test telecommunications infrastructure for 1st substation
FY26	• Commission Substation Edge Computing equipment in 1st substation
FY28	• Deploy Substation Edge Computing platform at 2nd substation with 3-way communications functionality (between substations, cloud)

3.6 Milestone Summary

Below is the complete list of quarterly milestones throughout the performance period, listed by Statement of Project Objectives (SOPO) task. Specific site locations and the impacted substations/feeders have not been finalized at the time of this application; however, a list of preliminary sites is included in our Locations of Work attachment. Site selection will ultimately be determined by several factors for optimal implementation, including a detailed interconnection analysis, locations of customer-owned DER, reliability metrics, and DAC prioritization. For a full list of CBP milestones, please see the CBP for further details.

Quarterly Milestones by SOPO Task *Annual SMART Milestone **End of Project Goal		
FY25	Q1	3.2 - Conduct build vs. buy analysis for energy storage product development decision 3.2 - Conduct site selection analysis to deploy flexible interconnection of energy storage 3.3 – Begin site selection analysis for 1st substation deployment 3.3 - Complete architecture and cybersecurity requirements and design
	Q2	3.2 - Conduct build vs. buy analysis for EV DCFC product development decision 3.2 - Conduct site selection analysis to deploy flexible interconnection of EV DCFC 3.3 - Design review of proposed base platform using performance specifications developed in prior lab MVP
	Q3	3.2 - Secure energy storage operator/owners to test new product features 3.3 - Issue RFP for Sub. Edge Computing hardware and software vendor(s) based on design review
	Q4	2.1 - FLISR applications centralized with fully integrated system automation 2.2 - Ability to support intelligent apps residing on meter in upstate NY 2.2 - Ability to support all billing rates for upstate NY through HES/MDMS 2.2 - Ability to remotely manage and control up to 800,000 meters in upstate NY 2.4 - Commission 30 FLISR schemes in MA and 10 FLISR schemes in NY 3.1 - Completed billing validation for FLISR-DER 3.2 - Secure EV DCFC operator adopters to test new product features ***3.3 - Install and test telecommunications infrastructure for 1st substation**
FY26	Q1	3.2 - Finalize product development cost estimates for Adaptive Flexible Interconnection business case 3.3 - Install digital infrastructure in 1st substation which will serve as foundation for Substation Edge Computing equipment

	Q2	3.1 - ADMS able to inform curtailment for existing flexible interconnections 3.3 - Select Substation Edge Computing vendor.
	Q3	***3.3 - Commission Substation Edge Computing equipment in 1st substation**
	Q4	2.2 - Grid-edge visibility enabled for DER integrations across distribution network (HES/MDMS) 3.1 - Ability to share ADMS load flow externally with dispatch engine 3.1 - Integration of grid edge data with ADMS load flow model at initial 5 feeders completed 3.1 Completed MVP backbone systems for FLISR-DER ***3.2 - Ability to offer active management capabilities to energy storage at 1st substation** 3.2 - Ability to offer active management capabilities to EV DCFC charging at 1st substation 3.3 - Kickoff of cloud infrastructure GAP analysis for access control, compliance and governance
FY27	Q1	3.3 - Stand up cloud infrastructure with core features.
	Q2	***3.1 - Ability to integrate DER into FLISR schemes at initial 5 schemes, through ADMS/DERMS integrations** 3.1 - Ability to leverage grid edge data to inform FLISR-DER at initial 5 schemes 3.3 - Evaluate embedded performance capability of base platform infrastructure components for optimal scalability
	Q3	3.3 - Define architecture specifications of the federated grid implementation
	Q4	2.2 - Ability to detect early outages across distribution network, through HES/MDMS 3.1 - ADMS able to share actual operating data with network model to guide flexible interconnections 3.1 - Completed FLISR-DER MVP Alpha ***3.1 - Ability to leverage grid edge data to inform FLISR-DER at 10 schemes, through ADMS/AMI integration** ***3.2 - Ability to offer active management capabilities to energy storage at up to 6 substations** 3.3 - Optimize virtual IED algorithms for improved efficiencies of sub edge compute product
FY28	Q1	3.1 - Proof of concept testing between ADMS vendor (Hitachi) and flexible interconnections vendor begins ***3.2 - Ability to offer active management capabilities to EV DCFC charging up to 4 substations** 3.3 - Deploy the virtual IED in the 1st substation and perform validation with lab device
	Q2	3.1 - Scale out ability to integrate DER into 25% of deployed FLISR schemes 3.1 - Ability to leverage grid edge data to inform FLISR-DER at 25% of deployed schemes 3.3 - Evaluate performance of federate control loops using software defined IEDs 3.3 - Begin specification of transaction control and measurements
	Q3	3.2 - Ability to offer adaptive flex connect capabilities to first substation 3.3 - Deploy remote human machine interface (HMI) for control center users and ADMS connectivity design
	Q4	***3.2 - Ability to offer active management capabilities to energy storage at up to 10 substations** ****3.1 - Scale out ability to integrate DER, with flexible interconnection, across deployed FLISR schemes as a resource to be leveraged during outages** ****3.1 - Ability to leverage grid edge data to inform FLISR-DER across deployed FLISR schemes** 3.3 - Identify feature set and control points for central control of federated devices by ADMS ****3.3 - Deploy substation edge computing platform at 2nd substation with 3-way communications functionality (between subs, cloud)** 3.1 - Completed FLISR-DER MVP Beta
FY29	Q1	****3.2 - Ability to offer active management capabilities to EV DCFC charging up to 10 substations** 3.3 - Stand up transaction metrics and infrastructure hooks. 3.3 - Build the POC metrics for operational transactions
	Q2	3.3 - Define the minimum brownfield installation configuration for future edge compute deployment in preparation for vendor RFP
	Q3	3.3 - Begin ADMS interconnections with Substation Edge Computing edge devices
	Q4	****3.2 - *Ability to offer adaptive flexible interconnection capabilities to existing/planned areas**

		where NG offers active management for normal and abnormal grid configurations (13) 3.3 - Finalize plan to deploy Sub. Edge Computing product to additional areas of distribution system 3.1 - Completed FLISR-DER developments ready for scale up

3.7 Project Management

Overall Approach to Project Management

National Grid's Solution Delivery Framework (SDF) consists of controls at various stages of projects which work together to minimize project risk. A critical element of the SDF is the Digital Delivery Approach (Digital). **Digital** is a way-of-working that employs an iterative approach in multidisciplinary teams, ensuring project success through early feedback. Digital is re-imagined operations and processes enabled by technology and agile ways of working to deliver on key outcomes. This process will be tailored to support DOE's project management requirements, as needed. We employ the agile project management framework which utilizes an iterative approach that includes frequent and continuous releases, with feedback incorporated throughout. The focus is on early involvement of the stakeholders with constant improvement of the product and processes. This ensures the delivery of well-designed and thoroughly tested products that match a customer's needs. Below are key highlights from National Grid's SDF:

- **Project Changes** - Implementation and Project Leads will track monthly progress of the project. On a quarterly basis, the project team will review achievement of critical milestones and take decisions on any significant changes required, related to scope or delivery approach. Any changes will be flagged with internal Leadership and the DOE well in advance to any material change to project workplan.
- **Communications Plan** - The SDF prescribes standard meetings for all projects, including kick-off meetings, planning meetings, status review meetings, stage-gate reviews, etc. National Grid will create a communications plan specific to the project that is aligned with the project's organization structure.
- **Project Management Tools** - National Grid utilizes best-of-class systems to support management for all projects including SAP for financial management, Project Online and Microsoft Project for project delivery, Jira for agile projects and SharePoint for project and document management. Established policies and procedures are in place to support all management aspects of National Grid projects and are subject to regular review by National Grid's internal and external auditors.

Project Team Roles - Please see Section 4.1 - Project Team Qualifications for the full team structure.

Roles	Overview of Responsibilities
Implementation Leads	Manage overall project schedule, budget, scope, quality, and risk of Future Grid. Maintain cross-project integration. Establish program/project standards, policies, and procedures, manage, and resolve issues and risks. Oversee project suppliers. 50% annual time commitment

Project Leads	Manage E2E product lifecycle for specific project workstream, facilitate overall product vision and sign off on final product delivery. Manage project workstream schedule, scope, and team to ensure successful progress. Iterate on product strategy as product and business requirements evolve with learnings while maintaining MVP alignment with vision. Lead validation and prioritization, MVP and Future Roadmap definition across cross-functional teams. 50% annual time commitment
Engineering Manager	Manage E2E technology execution as primary technical interface point across team with Implementation and Project Leads. Actively engage in sprint planning and manage continuous delivery of builds, releases and testing pipeline. Build front-/back-end engineering of stable, smoothly functioning digital products and define the complete API & integration points. Develop and test functioning prototypes for digital products and collect data to iterate versions
SMEs	Provide subject matter expertise. Identify areas where technical solutions would improve business performance
Solution Architect	Define as-is, and target, solution architecture diagrams across all domains to support the business and IT strategies. Responsible for documentation of IT capabilities and providing architecture policies to support the business and IT strategies.

Approach to Risk Management: The project team will track, monitor, and update the status of risks, including their associated mitigation and resolution plans in a central register or log. This ensures that when the program ends, all risks are either closed or handed over to and accepted by the appropriate workstream. Below is a list of key risks known today.

Risks	Probability	Impact to Project Timeline	Impact to Project Costs	Impact to Project Benefits	Mitigation Steps
High / Medium / Low					
Software platform integration challenges					Leverage technical partnerships to understand lessons learned to ensure well-structured architecture. Incorporate defined common interface requirements and specification in vendor RFPs.
Challenge in aligning vendor roadmap developments and Future Grid 2.0 workplan					Working closely with vendors to ensure they are notified of any planned system enhancements early and incorporate vendors in the development process. Select vendors who have similar technical development roadmaps through RFPs. Collaborate with other utilities with similar plans to influence vendor development.
Telecommunication challenges					Work closely with our communications vendors, to ensure the right communications infrastructure is in place for Future Grid 2.0 advancements and ensure fail-safes are in place (i.e., through grid edge programing).
Cost of equipment higher than estimates					Execute vendor agreements as early as possible. Contingency planned in current cost estimates.

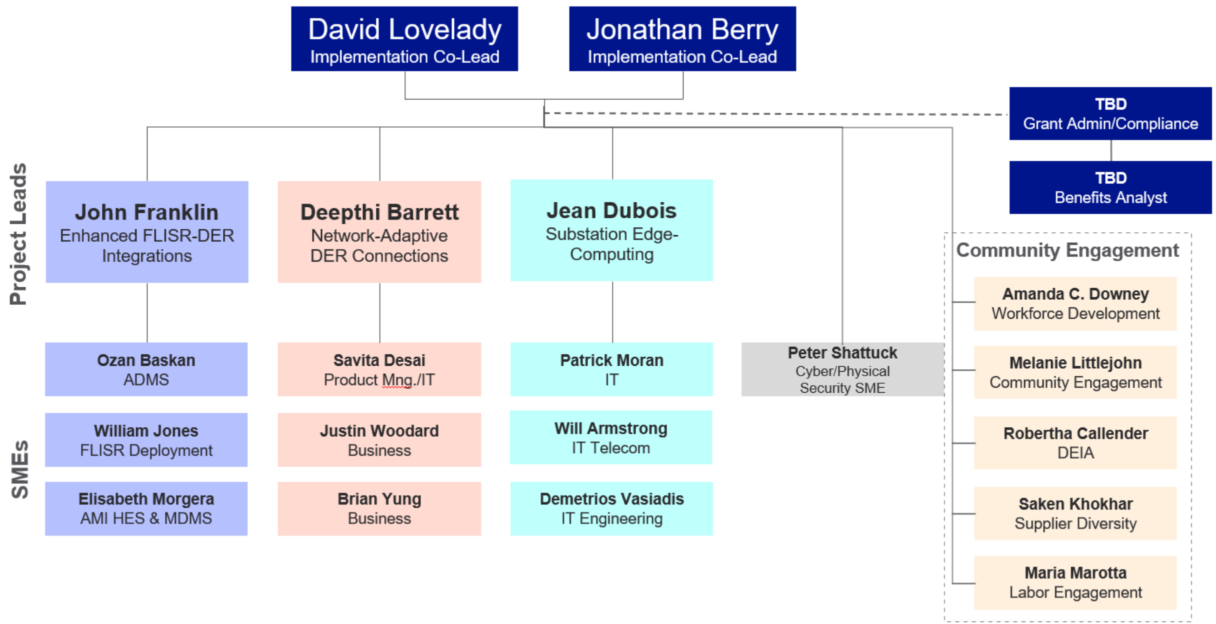
Low customer participation in Network-Adaptive Flexible Connection offering					Project team will work with Customer Energy Integration and Distribution Planning to identify developers in the DG interconnection queue seeking to connect to congested areas of the grid. DG Ombudsperson and Customer Teams will reach out to developers to articulate the value of participation. Offering will be promoted at DG Seminars and on the Distribution System Data Portal.
Low customer participation in Enhanced FLISR-DER Integrations offering					Project team will work with Customer Energy Integration and Distribution Planning to identify areas on the grid for initial rollout. Customer Teams to mass market this offering to both developers and customers with eligible DER by articulating the value of participation. Offering will be promoted at DG Seminars and on the Distribution System Data Portal.
Supply chain constraints in obtaining equipment					Execute vendor agreements as early as possible and prioritize equipment procurement for components with long lead time and establish open lines of communications with major suppliers
Inability to identify resources with specific skillsets related to digital innovation					National Grid will continue to invest in its Workforce Planning practices which leverages workforce supply analytics to develop a 10-year outlook designed to ensure business continuity

4.0TECHNICAL QUALIFICATIONS

4.1 Project Team Qualifications

Future Grid is a complex proposal that will require a diverse set of skills and experience. Key personnel have been identified, and many are already currently working together to implement Future Grid 1.0. The Implementation team will be managed by two co-leads who bring deep industry and company-specific knowledge. Co-lead David Lovelady will dedicate 50% of his time to this role, where he will represent the Business in this implementation bringing over two decades of experience in the energy industry. At National Grid, David currently serves as Director of Distributed System Operations (DSO), NY, where he is driving the company's DSO evolution with a focus in DER integration, energy storage, distribution automation, DERMS, and long-term strategic planning. Co-lead Jonathan Berry will dedicate 50% of his time to this role, where he will represent IT in this implementation plan bringing over 15 years of experience in the energy industry. Jonathan currently serves as National Grid's Vice President of Electric Product Delivery, where he leads the development and delivery of product technology strategy. Together David and Jonathan will bring critical experience and perspective to drive the successful implementation of Future Grid. Figure 6 outlines our proposed team structure, co-led by David Lovelady and Jonathan Berry. For a detailed description of the Project Leads and Project SMEs backgrounds and skillsets please see their attached Resumes.

Figure 6 – Future Grid Team Structure



Technology Partners:

National Grid has built an extensive network of leading industry stakeholders over the years, completing numerous studies, pilots, and projects that have provided key insights necessary to execute this project. We plan to leverage the technical expertise and industry experience of our vendors as we embark on these innovative improvements to our electric distribution system.

Electric Power Research Institute (EPRI): National Grid will continue our partnership with EPRI to share key insights to drive grid modernization efforts for our service territories and the broader utility industry. EPRI has committed to partner with National Grid to review and validate the system architecture, modeling assumptions, interface logic, and testing to ensure these technologies are developed efficiently without compromising the safety or reliability of the grid.

Hitachi: National Grid will continue our long strategic partnership with our ADMS vendor, Hitachi, to ensure optimal integrations with this critical system. Our partnership involved traditional platforms such as OMS, EMS, and now the more advanced technology platform, ADMS. The ADMS is a product that is iteratively improved with new functionality based on feedback from National Grid and other Hitachi customers. As National Grid's ADMS partner, Hitachi has committed to ensuring integrations with this critical system are executed successfully.

Smarter Grid Solutions: National Grid will continue its partnership with our DERMS vendor, Smarter Grid Solutions (SGS), to complete the Future Grid 1.0 work related to Short-term Forecasting, Grid Edge Control, and a Centralized DER Dispatch Engine. SGS has committed to ensuring these investments in DERMS are executed successfully.

Intel: National Grid has executed an MOU with Intel to leverage its chip technology to deliver accelerated functionality and superior security to our distribution system.

Pacific Northwest National Laboratory (PNNL): National Grid consults with Pacific Northwest National Lab (PNNL) for their technical expertise in PMUs, analytics, and DER management across a federated grid to guide the Substation Edge Computing component.

4.2 Applicant Access to Equipment and Facilities to Complete the Task

Please see Section 2.2 – Project Feasibility for further details.

4.3 Previous Innovation Efforts

With DOE funding, National Grid can push past pilot phases and scale out this technology into our broader core operations. Additionally, National Grid is an innovation leader within the utility industry and has served as technical advisor to studies that are driving grid modernization efforts to fruition. Studies include:

- **Applications of the Local Distributed Energy Resource (DER) Gateway: Low Cost, Secure DER Network Gateways for Integration of Smart Inverters -** National Grid served as a utility technical advisor to EPRI's report that studied how to effectively deploy DERMS to monitor and manage a diverse mix of DER technologies.
- **Active Resource Integration Project: Techno-Economic Analysis of Flexible Interconnection -** National Grid partnered with EPRI in publishing this report detailing the viability of flexible interconnection through innovative planning and forecasting methodologies.
- **The Value of Flexible Interconnection for Solar Photovoltaics Enabled by DERMS, Detailed Techno-Economic Analysis in New York State -** National Grid served as a utility technical advisor to EPRI for this study funded by NYSERDA. The study explored flexible interconnection capacity solutions (FICs) for DER as an alternative to conventional grid upgrades.

Please see Section 2.4 – Project Feasibility for further details on past innovation efforts

4.4 Technical Services Provided by DOE/NNSA FFRDCs

<u>Pacific Northwest National Laboratory:</u>
National Grid consults with Pacific Northwest National Lab (PNNL) for their technical expertise in PMUs, analytics, and DER management across a federated grid to guide the development and implementation of the Substation Edge Computing project component. As a partner, PNNL's sole purpose is to provide technical expertise on the Future Grid project. PNNL is not proposed as a sub-recipient on National Grid's application. PNNL will neither provide financial support to National Grid nor receive any financial support from National Grid. Additionally, PNNL will not make any contribution to National Grid's cost share, whether in the form of cash or in-kind contributions.