EVERSOURCE ENERGY

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September 17, 2015

Debra A. Howland
Executive Director
New Hampshire Public Utilities Commission
21 South Fruit Street, Suite 10
Concord, NH 03301-2429

RE: Docket No. DE 15-296, Electric Distribution Utilities
Investigation into Grid Modernization

Initial Comments of Eversource Energy

Dear Director Howland:

On July 30, 2015, the New Hampshire Public Utilities Commission ("Commission") issued an order of notice commencing an investigation into grid modernization in New Hampshire. In that order of notice the Commission made the state's electric distribution utilities, including Public Service Company of New Hampshire d/b/a Eversource Energy ("Eversource"), mandatory parties to the proceeding and provided parties until September 17, 2015 to, among other things, "provide comment on the definition, or elements, of grid modernization that should be included in this investigation." Order of Notice at 2. By this submission Eversource provides its initial submission in this investigation consistent with the order of notice.

If you have any questions, please do not hesitate to contact me. Thank you for your assistance with this matter.

Very truly yours,

Matthew J. Fossum
Senior Counsel

Enclosures
CC: Service List

THE STATE OF NEW HAMPSHIRE
before the
PUBLIC UTILITIES COMMISSION

ELECTRIC DISTRIBUTION UTILITIES

Investigation into Grid Modernization

Docket No. IR 15-296

COMMENTS OF PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE D/B/A EVERSOURCE ENERGY

1. Introduction

Customer expectations are changing. Customers today are more dependent on the electric grid than ever. The customers of Public Service Company of New Hampshire d/b/a Eversource Energy ("Eversource" or the "Company") need the grid to power electronic devices that allow them to communicate, entertain, transact, travel, and run their businesses. At the same time, the advent of new control, communications and systems technologies are providing utility companies like Eversource with numerous opportunities to modernize and automate the grid. These trends are leading to a highly dynamic operating environment that is intensifying focus on the role that Eversource's electric distribution system plays in assuring the continuity of safe and reliable electric service to customers, while serving as both an interconnection and conduit for distributed energy technologies.

In the coming years, a robust electric power distribution system has the potential to play an even more critical role in enabling economic growth, environmental sustainability and consumer satisfaction. Technological advances are making it possible to continue to transform the electric distribution grid from its historical model of one-way power flow and mechanical or even manual operation and control, to one that embraces digital automation, intelligence-based

control, and distributed energy resources ("DER") to deliver significant enhancements in safety, reliability, resiliency and asset optimization. Eversource recognizes that the future economic well-being of New Hampshire will continue to be fostered by a resilient, modern and integrated grid. In addition, Eversource's customers expect to take service from an electric grid that is resilient and reliable, allows for more options to manage usage, and that helps to reduce energy costs and enable opportunities to explore emerging customer-side energy solutions. There are tremendous opportunities to further modernize the grid by leveraging technology and operating practices to meet the goals of customers and the communities in which they reside.

The New Hampshire Public Utilities Commission ("Commission") recognized these same attributes in its July 30, 2015 order of notice in this proceeding where it stated:

> Grid modernization is a broad topic that encompasses many elements, including replacement of aging infrastructure, outage management, the integration of distributed generation, and education of customers on how to manage their energy use for the benefit of the electric delivery system and to minimize energy costs.

Order of Notice in Docket No. IR 15-296 at 1. Eversource's electric distribution and transmission systems anchors the state's – and, as part of the larger Eversource Energy group of companies, the region's – economic and environmental footprint, and therefore, must stay at the forefront of technological advances in the electric industry. As such, Eversource believes that grid modernization is necessary and essential to meet customers' increasing expectations and the demands of the modern, electrically connected society.

As explained in greater detail below, it is Eversource's assessment that to realize the benefits of a modernized grid, utility companies will need support to pursue various initial investments that will lay the groundwork for the modern grid. With those enabling investments, utilities can achieve the objectives of a modern grid in reducing outages, optimizing demand, supporting the deployment of distributed energy and improving workforce and asset

management through a grid that is smart, resilient and that facilitates meaningful and robust customer engagement. With those investments, utilities like Eversource will have a modern grid system that is capable of meeting the needs and expectations of 21st century customers in a safe, reliable and effective manner.

2. Grid Modernization Objectives

As a baseline, to begin working toward the objectives of a modern grid, utility companies will need to make initial investments in their systems. In particular, they will need to ensure that they have a sufficiently robust communications infrastructure that it can support the necessary information exchange. It is impossible to contemplate a modern grid that does not rely on a robust, high bandwidth, high speed communication system to enable real-time, automated communications to end use equipment. In addition, grid modernization will require more specific cybersecurity controls to ensure data is secured and confidentiality is maintained, both at the device level and as it travels through the communications network. Finally, there must be investments in customer education to provide them with sufficient information to fully engage with companies like Eversource, as well as the grid itself, so that they may proactively manage and direct their energy use.

With those bedrock principles in mind, stakeholders must then understand what they wish to achieve from a modernized grid. As it has made clear in a similar investigation recently undertaken in Massachusetts, Eversource believes that cost effective modernization of the electric distribution system should focus on four key objectives:

(1) reducing the frequency, duration and effects of outages;
(2) optimizing demand, including reducing system and customer costs;
(3) integrating DER; and
(4) improving workforce and asset management.

Achieving advancements in these four objectives will provide benefits to the Company's customers now and into the future, and Eversource believes these four grid modernization objectives will stand the test of time.

3. Eversource Efforts to Date

In working toward the identified objectives, Eversource has been a leader in its efforts to modernize and automate the distribution grid to attain a greater awareness of system conditions that provide a higher level of reliability to its customers. In 2009, and to improve service reliability and reduce the extent, frequency and duration of customer outages, Eversource started a pilot to test new system, control and communication technologies.[1] Eversource's pilot combined detection, assessment, decision support and network control to more efficiently reroute power around outages – limiting households and businesses affected to those closest to the damaged equipment.

The pilot involved installing a Distribution Management System ("DMS") operating platform, and, more significantly, the installation of field devices including advanced state-of-the-art reclosers with sensing capability, microprocessor based relays, and data communications systems. These field device installations permitted remote analysis of the system by aiding in data acquisition in the form of per phase currents, voltages, power factor, and fault currents and targets. Proven through the pilot was the ability to remotely detect a fault which allows supervisory operation, from a remote location, to isolate a faulted section of line to smaller blocks of customers. This isolation process frequently allows the Company to restore power to

[1] The pilot program and its results are also discussed in Eversource's most recently filed Least Cost Integrated Resource Plan which has been docketed as Docket No. DE 15-248.

some customers served from the circuit more rapidly than if the line did not have the new technology.

Deployment of the pilot took place by region over a four year period, with the Seacoast Northern area in 2011, the Southern region in 2012, and the Western region in 2014. In total, Eversource deployed these new technologies on three circuits affecting approximately 32,000 customers, encompassing 5 bulk substations, and 11 open loop configured distribution circuits. Early results have been impressive; reliability has been positively impacted with the deployment of the smart grid pilot program. There have been fewer and shorter outages, and Eversource has improved its workforce and asset management.

Additionally, Eversource has recently reported a twenty-five percent increase in reliability performance with the application of distribution automation ("DA") devices. In 2014 Eversource began a program to add additional DA technologies to the entire distribution system in a proactive, methodical way. All circuits configured as open loop, closed loop, and radial will have devices installed in order to sectionalize the line remotely down to 1,000 customer blocks (at a minimum). In more rural areas, smaller customer blocks will be designed to account for the distances that are inherent in those areas. The DA deployment is scheduled to occur over a five year term.

In addition to the pole top DA deployment, Eversource's plan calls for relay upgrades for the 117 electromechanical relays still left on the system. Under the DA program the Company will upgrade half of the relays to microprocessor based relays. These new relays will allow tighter protection coordination margins allowing additional protection points on the circuits, provide per phase electrical quantities for both real time and historical analysis, and allow more

efficient system operations. The other half of the existing relays will be upgraded through various other projects outside the DA program.[2]

Substation automation is also included as part of the DA plan. Eversource currently has forty-three 115-34.5 kV substations that are automated. These substations include 287 automated breakers, along with operations functions such as voltage control and voltage reduction. The DA plan includes automating the remaining substations which include eighty-four 12kV and 4 kV substations containing an additional 287 breakers and or reclosers. Automation of these substations will include control functions, status, voltage reduction, and per phase current measurements.

At of the end of the five year deployment, automation on the system will include nearly 1,500 units with remote oversight and control functions. Over time, reliability benefits should become increasingly evident, and operational efficiencies will be gained from these installations. In Eversource's opinion, these efforts to upgrade and automate the grid are the kinds of activities that will the Company to further the four objectives described above, and, as a consequence, provide greater benefits to customers.

Additionally, Eversource recently implemented on September 13, 2015 a new Outage Management System ("OMS"). The new OMS is a robust platform that improves situational awareness of existing system conditions. In particular, it enables Eversource to more accurately reflect the status of its system in real time and more efficiently and effectively restore power in the event of power failures. Furthermore, it enhances the Company's ability to integrate smart devices, such as those described above, that have been deployed throughout the system.

[2] Additional information on the DA program and other grid modernization and reliability enhancement measures Eversource is currently pursuing is set out in Eversource's June 10, 2015 Reliability Enhancement Program ("REP") filing in Docket No. DE 09-035.

Another ongoing Eversource effort is the deployment of Eversource's Customer Engagement Program ("CEP"), which it is launching in 2015.[3] This platform is an interactive tool that will allow Eversource to effectively reach all of its customers with energy usage information that is tailored to each customer and situation. It will include self-service efficiency assessments as well as benchmarking, which will allow business and residential customers to track energy use over time and compare their usage with similar customers in their geographic area and customer segment. Customers will learn about solutions that will save energy and reduce costs in addition to receiving information about incentives, which will increase their willingness to make efficiency improvements. In this way, Eversource is giving customers the information they need to engage with the Eversource in taking positive advantage of a modern grid.

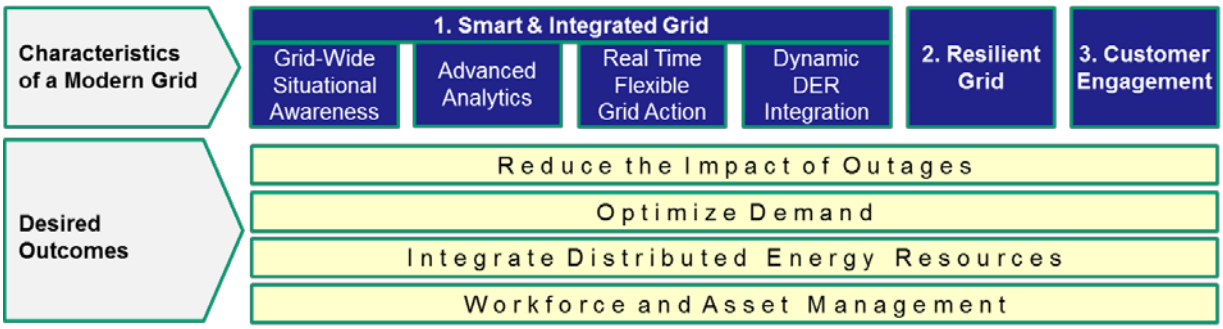
4. Grid Modernization Characteristics

Having identified the grid modernization objectives, and some of Eversource's initial efforts toward achieving those objectives, it is also important to define the key grid modernization characteristics that are desired to achieve those objectives. These characteristics will form the basis for tangible grid modernization investments to be included in future grid modernization plans and guide investments to meet the objectives over time.

Eversource has identified three primary characteristics that the Company believes form the backbone of any grid modernization effort. The three characteristics are a grid that: (1) is smart and integrated, (2) is resilient, and (3) facilitates increased customer engagement. A schematic recently used by Eversource in its deployment of a 10-year Grid Modernization Plan

[3] Additional information on Eversource's CEP may be found in the 2015-2016 Statewide CORE Energy Efficiency Plan submitted in Docket No. DE 14-216.

in Massachusetts is presented below,[4] and Eversource believes these same characteristics would apply to any grid modernization in New Hampshire:



a. Smart and Integrated Grid

Development of digital and other communications technologies have opened up significant opportunities to modernize the electric distribution network. These technologies provide cost-effective approaches for companies like Eversource to increase the level of understanding of the status of its distribution network in real time, or at any point in time. Digital technologies enable the processing of large amounts of data to provide actionable insights for better operation and management of the distribution grid. Lastly, increased awareness of system conditions coupled with sophisticated analytical engines, allow grid operators like Eversource to take real-time actions on the grid for the benefit of its customers. As a result, a more modern, smart, and interconnected grid will enable the grid and grid operator to: (1) have more grid-wide awareness; (2) use advanced analytics to inform intelligent decisions; and (3) take real-time flexible actions that improve reliability, efficiency and customer satisfaction.

Furthermore, the increased understanding about the status of the network over time would help to shape and target future capital expenditures. With greater knowledge of the status

[4] The proposed modernization plans of Eversource's Massachusetts affiliates were filed on August 19, 2015 and have been docketed by the Massachusetts Department of Public Utilities as D.P.U. 15-122 and 15-123. The plans are included as Attachment A to this submission.

and use of the system, as well as the limits or strengths of particular areas, companies like Eversource would be better able to direct their limited capital to the areas that could benefit most. Thus, a modernized grid would help provide guidance for future spending that will provide the more cost-effective benefits for customers.

In addition, Eversource's experience is that the number and size of DER deployments has increased over the last five years and the pace of requests to interconnect to the system has grown in parallel. Over the next ten years, Eversource anticipates the level of deployment of DER to continue to increase given the strong policy support for these resources and Eversource stands ready to support and engage its customers as they consider these DER options.[5] Although the Company supports the integration of DER, Eversource's priority has always been, and will continue to be, the safe, reliable and cost-effective provision of service to its customers. The interconnection of DER into the distribution grid must be accomplished in a manner that does not negatively impact these core responsibilities, and having a smart and interconnected grid will allow both enable DER deployment and protect the safe and reliable operation of the system.

b. Resilient Grid

A strong and resilient grid infrastructure is a necessary foundation for an increasingly modernized grid. Although the Company has long taken proactive steps to enhance and protect its distribution system, Eversource's distribution system infrastructure is vulnerable to weather events, such as ice storms, heavy wet snow, tropical storms, hurricanes and other wind events, as well as other occurrences such as falling tree branches and animal interference with infrastructure, all of which can cause prolonged power interruptions. Thus, investments in the

[5] Eversource notes that the Commission's decisions in various dockets including, but not limited to, Docket No. DE 15-137 relating to the adoption of an energy efficiency resource standard, Docket No. DE 15-068 relating to the purchase of the output of certain generators by utilities or others, and Docket No. DE 15-271 relating to the management of interconnections and the net metering queue, as well as potential legislative changes, may have an impact on the scope and pace of DER deployment in New Hampshire.

continued improvement of the resiliency of the electric grid must be a critical element of any grid modernization plan to provide support and protection for other grid modernization investments. Without a resilient grid, investments in items such as real-time sensing and monitoring investments are rendered moot, since the grid would lack a sufficient foundation to optimize the use of modern technology. Certain upgrades and reinforcements to the electric distribution system can make it more resilient to extreme weather events which can result in fewer customers being affected and, consequently, shorter overall restoration times associated with those events.

c. Engaged with Customers

Eversource recognizes that customers look to Eversource as a trusted energy advisor, not just an energy provider. Therefore, Eversource spends considerable time interacting with customers to better understand their needs and expectations. This research shows that customers desire more information, greater ability to control energy use and costs, and opportunities to deploy new emerging energy technologies such as distributed energy resources. At the same time, customer surveys continue to indicate that customers want to be sure they have access to very reliable service at a reasonable cost.

Essential aspects of customer engagement are that customers: (1) have more knowledge about the way power is generated, transmitted and delivered; (2) have a better understanding of the reasons power prices change; (3) are more aware of the numerous programs that assist them to better control their energy costs; (4) have an appreciation for the different tools at their disposal to deploy new energy technologies such as distributed energy resources; and (5) have new options to contribute to the optimization of system demand and costs. Through grid modernization, Eversource can develop the appropriate tools, technologies and partnerships to facilitate increased engagement between customers and the electric grid. As noted above,

Eversource has already begun doing so through its CEP. Through this tool, and others, Eversource can better understand customer needs, and customers can better understand the positive options available to them.

5. Role of Smart Meters or AMI

In addition to the legal and logistical issues related to the deployment of Advanced Metering Infrastructure ("AMI") in New Hampshire,[6] Eversource believes that a broad-based deployment, or a multi-stage roll-out, of smart meters or AMI is not cost-effective for New Hampshire customers. In its recently submitted grid modernization plan in Massachusetts, Eversource conducted a careful analysis of the costs and benefits of a broad deployment of AMI and found such deployment to be highly cost ineffective. On the cost side, AMI deployments experience a set of high fixed upfront costs beyond the smart meters themselves. Investments in communications (including cybersecurity and data privacy) that are substantially greater than would be otherwise needed achieve a modernized grid, meter data management, billing, and other IT systems are required before benefits can be accrued and these investments can and do take years to actually implement. In addition, there are significant O&M costs required to manage the systems and the data provided by AMI. Finally, there might be other alternatives that could leverage third-party investments in communication technologies that could provide similar capabilities to AMI but at lower costs to our customers.

[6] As the Commission recognized in its order of notice, unlike many other states New Hampshire law (RSA 374:62) requires that customers affirmatively consent to the use of certain "smart meters" at their premises. Even if it could be considered cost-effective, given recent experience in New Hampshire relating to the deployment of advanced metering, *see, e.g.,* Docket No. IR 15-135 relating to Eversource and Docket No. DE 12-245 relating to the New Hampshire Electric Cooperative, in Eversource's estimation broad-based deployment of smart metering would likely prove difficult and result in incomplete adoption. Such limitations would certainly impact the effectiveness of any smart meter installation.

On the benefit side, several of the benefits that AMI can provide require making assumptions about customer behavior that are highly uncertain. Pilot programs have shown that residential customers who engage in dynamic pricing do shift load in response to price signals and that the response is stronger when linked to smart thermostats. However, pilot results also show that customer interest and engagement is very low. Data analyzed by Eversource indicates that consistently across relevant dynamic pricing pilots offered in the United States, fewer than 25 percent of customers sign-up for these new rate structures. These pilots indicate that low adoption is not the failing of marketing materials or the limits of technology, but indeed that few customers are interested in these types of time varying rate ("TVR") structures.

As one example, Eversource in Massachusetts conducted a dynamic pricing pilot that showed that although customer interest in the pilot was relatively strong initially, it was very challenging to convert initial interest into participation in the pilot and then sustain the interest over time. The pilot findings included that out of the 53,000 customers contacted initially regarding participation, only 1,549 were enrolled in the pilot at the end of 2013, a 3 percent response rate. Similarly in Connecticut, a pilot conducted by Eversource also showed that the peak load impacts were gathered from only 3.1 percent of residential customers contacted.

Eversource does not believe smart meters and/or AMI are key enabling investments for the future of the modernized grid. As demonstrated by Eversource's plan in Massachusetts, there are many more cost effective technologies that can help meet the grid modernization objectives that Eversource considers to be key in any modernization program.

6. Conclusion

As Eversource has noted above, there are crucial objectives and characteristics to consider in any grid modernization program. If implemented properly, and in line with those objectives and characteristics, grid modernization can provide numerous benefits to New Hampshire customers on a cost-effective basis specifically in the following areas:

- Improved reliability and reduced restoration times;
- Improved customer service;
- Improved capital planning processes;
- Reduced end-user consumption and line losses;
- Reduced peak demand;
- Improved asset management and workforce utilization;
- Reduced costs to integrate DER; and
- Support for emerging technologies and energy policies.

With support from customers, regulators, and policy makers, utilities like Eversource can make the necessary investments to support the modernized grid. Eversource recommends that the Commission's investigation focus on the most effective and productive means to support the initial enabling investments, define the relevant objectives, and that the Commission begin to describe the process for creating a modern grid that supports those objectives. Eversource supports investments that reduce customer outages, optimize demand and system use, support the deployment of distributed energy and improve workforce and asset management through a grid that is smart, resilient and that facilitates meaningful and robust customer engagement.

Grid Modernization Plan

08/19/2015

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Appendices

Acronyms

A/C	Air Conditioning
AESC	Avoided-Energy Supply Component
AFR	Automated Feeder Reconfiguration
AMF	Advanced Metering Functionalities
AMI	Advanced Metering Infrastructure
AMR	Automated Meter Reading
AMSC	American Superconductor Corporation
ARRA	American Recovery and Reinvestment Act
C&I	Commercial and Industrial
C2	C2 Billing System
CEP	Customer Engagement Platform
CIS	Customer Information System
CL&P	Connecticut Light & Power
CMS	Customer Minute Saved
COH	Customer Outage Hours
CPP	Critical Peak Pricing
CVR	Conservation Voltage Reduction
CYME	CYME Power Engineering Software
DA	Distribution Automation
DC	Direct Current
DER	Distributed Energy Resources
DG	Distributed Generation
DNS	Distribution Management System
DOE	Department of Energy

DRIPE	Demand Reduction Induced Price Effects
DSCADA	Distribution Feeder Supervisory Control and Data Acquisition
ECS	Energy Control System
EDC	Electric Distribution Company
EMS	Energy Management System
EPRI	Electric Power Research Institute
ERP	Emergency Response Plan
ES-C2M2	Electricity Sector Cyber Security Capabilities Maturity Model
EVs	Electric Vehicles
FCM	Forward Capacity Market
GCA	Green Communities Act
GIS	Geographic Information System
GWSA	Global Warming Solutions Act
IEEE	Institute for Electrical and Electronics Engineers
ISO-NE	ISO New England
IVR	Interactive Voice Response
LMP	Locational Marginal Price
LTC	Load Tap Changer
MassCEC	Massachusetts Clean Energy Center
Mbps	Megabits per second
MPLS	Multiprotocol Label Switching
MV90	Mainframe MV-90 System - Multi Vendor 90
MW	Megawatt
NECEC	New England Clean Energy Council
NISTIR	National Institute of Standards and Technology Interagency Report
NMR	Network Meter Reading

PEV	Plug-In Electric Vehicles
PIA	Privacy Impact Analysis
PLC	Power Line Carrier
PV	Photovoltaic
REG	Resilient Electric Grid
RFCI	Remote Faulted Circuit Indication
RPS	Renewable Portfolio Standard
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SCADA	Supervisory Control and Data Acquisition
SOX	Sarbanes-Oxley Act
SPN	Strategic Partner Network
TCR	Tabors Caramanis Rudkevich
TMS	Translation Management System
TOU	Time-of-Use
TVR	Time-Varying Rates
VAR	Volt-ampere reactive
VFI	Vacuum Fault Interrupter
VVO	Volt VAR Optimization

I. The Eversource Grid Modernization Plan

A. Introduction

Eversource Energy ("Eversource" or the "Company")[1] is presenting this Grid Modernization Plan ("GMP" or the "Plan") in the context of a highly dynamic operating environment with intensifying focus on the role that the Company's electric distribution system plays in assuring the continuity of electric service to customers, while serving as both an interconnection and conduit for renewable energy technologies. In these roles, the Eversource electric distribution system anchors the region's economic and environmental footprint, and therefore, must stay at the forefront of technological advances in the electric industry. To that end, Eversource has consistently demonstrated commitment to the goal of maintaining an advanced, reliable and resilient electric grid for the benefit of its customers. However, in this highly dynamic and demanding operating environment, raising that commitment to a new level requires a paradigm shift. The grid-modernization initiative launched by the Department of Public Utilities ("the "Department") in 2012 is founded on the principle that the current operating environment requires a paradigm shift and that a planned, coordinated and comprehensive approach involving a range of stakeholder constituencies is necessary to raise the bar and achieve tangible success in grid modernization.[2] The mission of the Eversource GMP is to implement transformational change through innovation and escalation. Implementation of this GMP will deliver the benefits of a more modern and resilient grid to Eversource's customers, as intended by the Department.

Over the next ten years, a robust electric power distribution system has the potential to play an even more critical role in enabling economic growth, environmental sustainability and consumer satisfaction. Technological advances are making it possible to continue to transform the electric distribution grid from its current model of one-way power flow and mechanical or even manual operation and control to one that embraces digital automation, intelligence-based control, and

[1] This GMP is submitted jointly by NSTAR Electric Company ("NSTAR Electric"), which is referred to in the Plan as Eversource East, and Western Massachusetts Electric Company ("WMECO"), which is referred to in the Plan as Eversource West (collectively, the "Company").

[2] The Department initiated its investigation in D.P.U. 12-76. Eversource was an active participant during the course of that investigation and looks forward to implementing a program that will provide for the continued modernization of the electric distribution systems to the benefit of its customers.

distributed energy resources ("DER") to deliver significant enhancements in safety, reliability, resiliency and asset optimization. Eversource recognizes that the future economic well-being of Massachusetts will continue to be fostered by a resilient, modern and integrated grid. In addition, Eversource's customers expect to take service from an electric grid that is resilient and reliable, allows for more options to manage usage, reduce energy costs and enable opportunities to explore emerging customer-side energy solutions like solar, storage and electric vehicles. There are tremendous opportunities to further modernize the grid by leveraging technology and operating practices to meet the goals of customers and the communities in which they reside. This GMP is designed to tap into those opportunities and to create benefits for customers that would not be achievable in the absence of the GMP.

B. Key Guiding Principles

Eversource is committed to the Department's objective of achieving the cost-effective modernization of the electric distribution grid. Therefore, in developing the GMP, Eversource was guided by several key principles.

1. Achieve the Department's Grid Modernization Objectives

Eversource developed its GMP to achieve the four grid-modernization objectives identified by the Department, which are to: (1) reduce the effects of outages; (2) optimize demand, including reducing system and customer costs; (3) integrate DER; and (4) improve workforce and asset management. D.P.U. 12-76-C at 8.

Achieving advancements in these four objectives will provide benefits to the Company's customers now and into the future. Eversource fully supports these objectives and has relied on these objectives as the foundation for building the Plan. In the process of developing the Plan, the Company placed particular emphasis on technologies and investments that achieve multiple grid-modernization objectives simultaneously. In fact, each of the investments included in the Plan satisfy multiple objectives to some degree.

Based on the Company's view of the electric industry and the electric distribution business in particular, the Department's grid-modernization objectives will stand the test of time. As new

technologies emerge, a discrete and organized grid-modernization program will put the Company in the position to pursue investments that will further these objectives. The GMP provides the Company with the means to further modernize its distribution system while maintaining the flexibility to incorporate potential future technological advances and respond to public policy goals. Such flexibility is critical to the success of the Company's endeavors on behalf of customers.

2. Focus on Customers and Advancement in Customer Education

In keeping with its core focus, Eversource developed a GMP that puts the customer at the center of its grid-modernization efforts. Eversource is continually alerted to the fact that customers seek service reliability, shorter outage restoration times and lower, stable prices as their key energy expectations[3].

The reality is that the Massachusetts energy marketplace offers customers tremendous opportunity to engage with the electric grid. At the same time, the energy options for customers are complex. For customers to realize the most benefit from a modernized grid, a significant investment in customer education is needed. An education initiative that encompasses the basics of the electric distribution system, but also infuses customers with information and ideas on how to fully engage with Eversource and the electric grid will be a key to motivating customers to proactively manage their energy usage. The Company developed its GMP by aiming to meet customer needs both today and in the future.

With this in mind, Eversource has included in its Plan a focus on technologies that modernize the grid with a direct benefit to its customers. Investments that reduce the impact of outages, optimize demand, integrate DER and improve workforce and asset management will provide this benefit to customers across the Eversource system. Moreover, Eversource is providing the foundational education and information that customers will need to optimize their interaction with the grid, while continuing to serve our customers as they have questions about our modern grid.

[3] *Appendix* 1 J.D. Power's 2014 Electric Utility Residential Customer Satisfaction Study provides a copy of J.D. Power's 2014 Electric Utility Residential Customer Satisfaction Study highlighting customer expectations and perspectives.

3. Implement Cost-Effective Investments Supported by a Sound Business Case

It is critical that investments to further enable grid modernization be highly cost-effective and supported by a sound business case. Given the rate at which technology is advancing and the turnover of technologies, it is critical to identify and invest only in technologies and programs that will deliver meaningful and sustainable benefits over the full life of the asset. In developing its GMP, Eversource conducted a rigorous business-case analysis to ensure that the Company pursued investments that hold up to rigorous cost-effectiveness scrutiny. In order to develop high-quality business case analyses, Eversource partnered with Navigant Consulting, a leading international consulting company. Eversource chose Navigant because it is exceptionally qualified to perform the analysis based on years of experience in developing and applying grid modernization cost/benefit frameworks and tools, including several of the most referenced and widely applied, such as the EPRI Methodology and the DOE Smart Grid Computational tool.

At the same time, Eversource understands that important investments, especially those related to reliability and resiliency, are difficult, if not impossible, to quantify in dollar terms. To that end, the Company endeavored to identify investments that provided the highest return compared to other similar investments using similar cost effectiveness metrics.

4. Advance State Policy Goals

Eversource has developed a GMP that makes a meaningful contribution to advancing state policy goals. Massachusetts has been at the forefront of policy initiatives that support the advancement of energy efficiency and clean energy resources. Absent accelerated investment to modernize the grid, it will become increasingly challenging to support customer demand for more ways to reduce the environmental impact. In particular, Eversource is an active partner in achieving the Commonwealth's goal of increasing DER penetration. Many of the investments included in the GMP are directly focused on making DER, inclusive of energy storage,[4] an integral part of a dynamic grid optimized for two-way power flow.

[4] Recently, the Department convened a stakeholder conference on energy storage, docketed as D.P.U. 15-ESC-01. Eversource was selected to participate in a panel presentation regarding utility experience with energy storage.

5. Leverage Grid Modernization Experience

Eversource has long been a national leader in grid modernization and has invested in technologies that provide greater awareness of system conditions and automation of the grid. These technologies are pivotal to the Company's ability to provide a higher level of reliability and system resiliency to customers. Eversource has had direct experience with grid-modernization investments that have provided important advantages for customers by reducing the number of outage events, reducing the time associated with restoration after an outage event, and managing the costs associated with maintaining the grid.

Eversource has also been working to identify ways to better integrate distributed generation, especially solar generation, into its distribution systems. For example, Eversource deployed an innovative power line carrier direct transfer trip protection scheme at its solar facility in Springfield. Having proven the scheme as a low cost, highly reliable alternative to traditional anti-islanding technology, as a part of the interconnection process, the Company has worked with multiple customers to deploy the scheme at their solar facilities. Eversource has consistently invested in grid modernization technologies in the past. These investments and experiences influenced the development of the GMP and allowed the Company to analyze new and emerging technologies with a foundation of experiences grounded on practical experience. The Company will leverage this experience to enable the successful execution of its GMP to accelerate grid-modernization investments in some cases, and to invest in new and different technologies in others.

6. Adopt Transformational Technologies

The GMP includes deployment of transformational technologies that make a meaningful contribution to supporting innovation and finding new and smarter ways to deliver benefits to Eversource's customers. The path to a truly modern grid will require shifts in the business of delivering electricity to end-use customers. Many of the manual processes used today to operate and restore the grid have been in use for many years. With advances in sensing, communication and remote intelligence, Eversource is positioned to leverage new technologies to deliver the benefits of an increasingly modernized grid. This is particularly important given the increasing

complexity of the grid due to technological advancements in power distribution equipment and the proliferation of DER.

7. Establish a Flexible Foundation for the Future

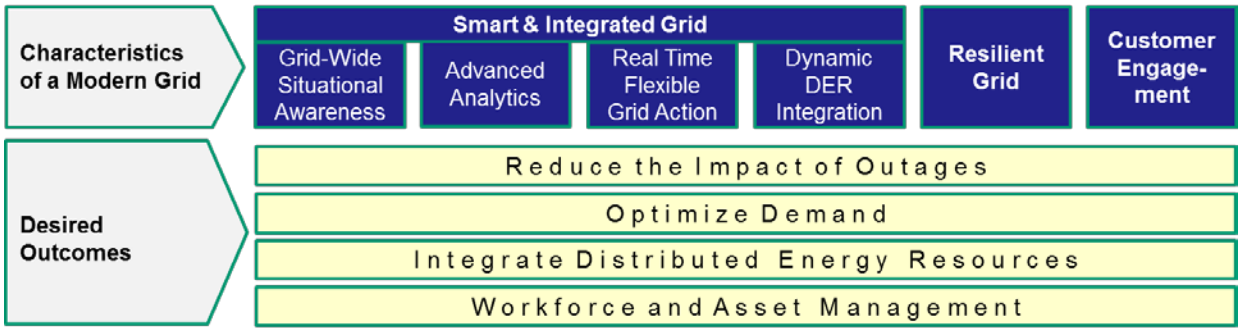
Each investment included in the GMP provides a strong foundation for the future evolution of the modern grid. Eversource's 10-year GMP vision is a road map to a more robust, flexible, dynamic and sustainable grid. Proposed investments are designed to reliably integrate into the current system, but to also provide the needed flexibility to adapt to changes in the technology landscape to support further innovation over time. In addition, the GMP was developed to set the foundation for further advanced grid modernization using a common platform of investments between Eversource's Massachusetts electric operating companies: Eversource East and Eversource West.

C. Plan Vision and Grid-Modernization Characteristics

Eversource is proposing a 10-year Grid Modernization Plan that will deliver the benefits responsive to customers' desire for an increasingly modern electric grid utilizing advanced technologies and capabilities. Grounded on the grid modernization objectives identified by the Department and supported by the Company, Eversource developed its GMP vision by first identifying the key attributes that a grid modernization plan should strive to achieve in the long term. These attributes form the basis of the tangible investments included in the GMP.

Eversource identified three primary characteristics that form the backbone of the GMP, including a grid that is: (1) smart and integrated, (2) smart and integrated resilient, and (3) facilitates increased customer engagement. Eversource's 10-year GMP vision is outlined in Figure 1 - Grid Modernization Plan Vision & Characteristics.

Figure 1 - Grid Modernization Plan Vision & Characteristics



1. Smart & Integrated Grid

Development of digital and communications technologies have opened up significant opportunities to further modernize the electric distribution network. These technologies now provide cost-effective approaches for companies like Eversource to increase the level of understanding of the status of the distribution network in real time, and at any point in time. In addition, digital technologies enable the processing of large amounts of data to provide actionable insights to better operate and manage the distribution grid. Lastly, increased awareness of system conditions coupled with sophisticated analytical engines, allow grid operators like Eversource to take real-time actions on the grid for the benefit of its customers. As a result, a more modern grid will enable it to: (1) have more grid-wide awareness; (2) use advanced analytics to inform intelligent decisions; and (3) take real-time flexible actions that improve reliability, efficiency and customer satisfaction.

In addition, Eversource's experience is that the number and size of DER deployments has increased significantly over the last five years and the pace of requests to interconnect to the system has grown in parallel. In fact, the volume of DER interconnection applications through June 2015 is up 97 percent relative to the same period in 2014. Over the next ten years, Eversource anticipates the level of deployment of DER increasing significantly given the strong policy support for these resources. Although the Company supports the integration of DER, Eversource's priority has always been and will continue to be the safe, reliable and cost-effective provision of service to its customers. The interconnection of DER into the distribution grid must be accomplished in a manner that does not negatively impact these core responsibilities.

Eversource, through its GMP, will implement enhanced approaches to integrate DER into the grid on a safe, reliable and cost-effective basis.

As the Company makes investments in the distribution system and moves to a more integrated grid, the Company will also need to provide rates that better align with the electric service requirements of customers who install and operate Distributed Generation and other Distributed Energy Resources. The service requirements of these customers differ from those of other customers. Rates for electric service to these customers are severely outdated, and are becoming increasingly inadequate as new technologies are adopted, and more DER connects to the system. A rate design for these customers that ensures a fair contribution for use of the distribution system, and that provides appropriate compensation for electricity delivered to it is needed. The Company is not proposing rate redesign of base rates as part of this filing; however, this is an important issue that needs to be resolved in order to facilitate increased installation of DER under a fair rate structure.

2. Resilient Grid

A strong and resilient grid infrastructure is necessary as a foundation for an increasingly modernized grid. Eversource recognizes the importance of a resilient grid and has developed a long-term GMP that incorporates select, but critical, resiliency investments that support the backbone of a modernized grid.

Although the Company has long taken proactive steps to enhance and protect its distribution system, Eversource's distribution system infrastructure is vulnerable to weather events, such as ice storms, heavy wet snow, tropical storms, hurricanes and other wind events that can all cause prolonged power interruptions. Other instances, such as falling tree branches and animal interference with infrastructure, can lead to outages. Thus investments resulting in the continued improvement of the resiliency of the electric grid must be a critical element of the GMP in order to provide support and protection for other grid-modernization investments. Without a resilient grid, for example, real-time sensing and monitoring investments made to enable a Smart & Integrated Grid are rendered moot, since the grid would be lacking sufficient foundation to optimize the use of the modern technology. Certain upgrades and reinforcements to the electric

distribution system can make it more resilient to extreme weather events which can result in fewer customers being affected and, consequently, shorter overall restoration times associated with those events. A more resilient grid is clearly aligned with the Department's grid modernization objective of reducing the effect of outages and, as such, is an integral part of Eversource's GMP.

3. Customer Engagement

Eversource recognizes that customers look to the Company as a trusted energy advisor. Therefore, Eversource spends considerable time talking to customers to better understand their needs and expectations. This research shows that customers want more information, more ability to control energy costs, and opportunities to deploy new emerging energy technologies. At the same time, customer surveys continue to indicate that customers want to be sure they have access to very reliable service at a reasonable cost[5]. A key characteristic of the GMP is to develop the appropriate tools, technologies and partnerships to facilitate increased engagement between customers and the electric grid.

An inherent aspect of customer engagement is that customers: (1) are more knowledgeable about the way power is generated, transmitted and delivered to a customer's premise; (2) have a better understanding of the reasons power prices increase and decrease; (3) are more aware of the multiple programs that allow them to better control their energy costs; (4) have an appreciation for the different tools at their disposal to deploy new energy technologies at their premises; and (5) have new options to contribute to the optimization of system demand and costs. The GMP encompasses a customer education and outreach strategy to provide customers the tools and opportunities to increase their engagement as grid modernization takes place.

At the same time, Eversource customers have different needs and expectations. The needs of small commercial establishments are very different from those of a large industrial manufacturer or a resident in an apartment complex. As a result, Eversource's vision of customer engagement

[5] *See Appendix* 1 J.D. Power's 2014 Electric Utility Residential Customer Satisfaction Study.

requires the development of a grid that is flexible to meet varying customer needs in a cost-effective manner.

D. Benefits to Customers

The Eversource GMP will achieve multiple objectives and, as described previously, all of the investments proposed in this plan will provide benefits across multiple objectives. The Company is committed to implementing a GMP that maximizes customer benefits and Eversource expects the key benefits of the GMP will be realized in the following areas:

- Improved reliability and reduced restoration times;
- Improved customer service
- Reduced end-user consumption and line losses;
- Reduced peak demand;
- Improved asset management and workforce utilization;
- Reduced costs to integrate DER; and
- Support for emerging technologies and energy policies.

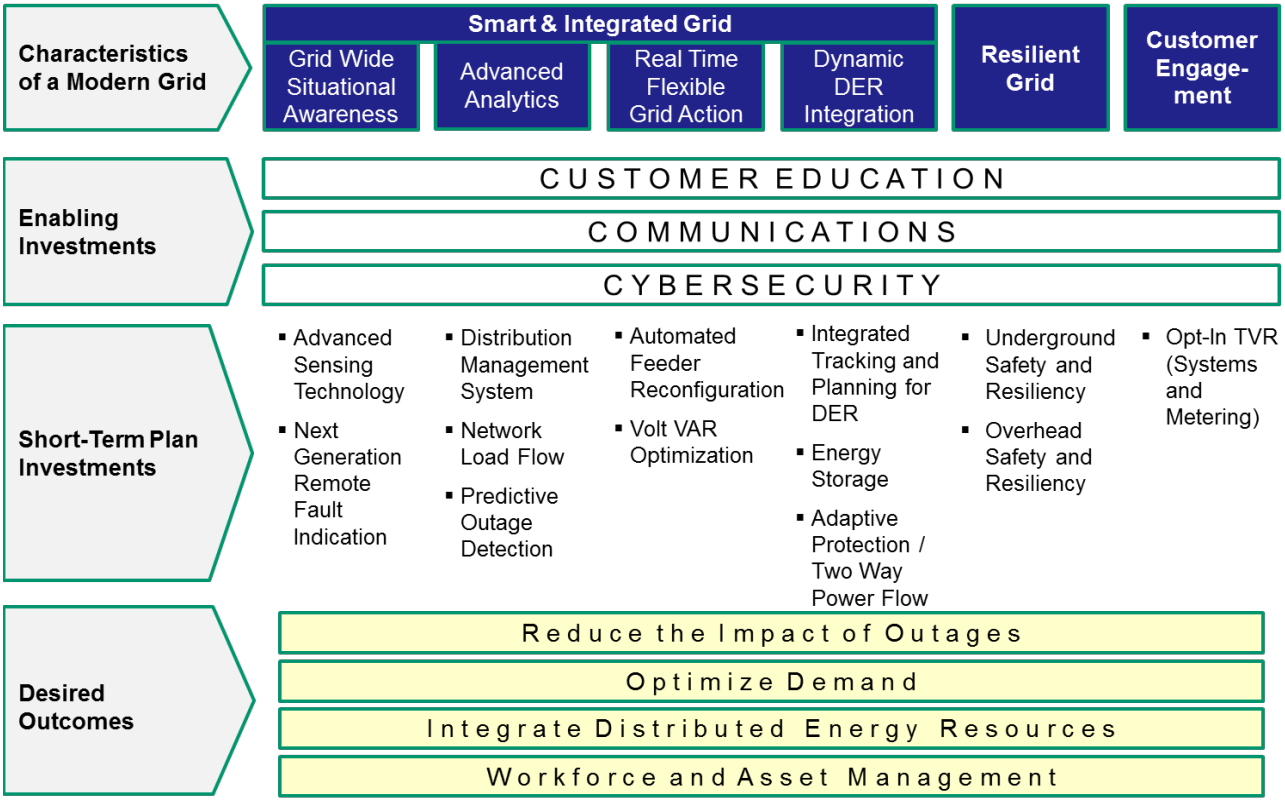
II. Short-Term Investment Plan

A. Introduction

As part of its overall Grid Modernization Plan, Eversource is proposing a short-term investment plan ("STIP") that focuses on investments in the first five years of the GMP, consistent with the Company's vision and framework outlined in the first section of the Plan.

To achieve the different characteristics outlined by its Grid Modernization vision, Eversource has identified a portfolio of different and unique investment programs representing a combination of technologies and projects. Investments made as part of the STIP will help the Company achieve the Characteristics of a Modern Grid, by investing in Enabling Investments, and STIP investments, as shown in Figure 2- Short-Term Investment Plan.

Figure 2- Short-Term Investment Plan



As shown in Table 1, below, the Company's STIP proposal includes total incremental investment of $430.7 million which will enable the Company to make notable progress to modernize the grid to the benefit of customers. Eversource has structured the remaining sections of the GMP along the three modern grid characteristics identified in Table 1 - STIP Investments: (1) smart and integrated grid; (2) resilient grid; and (3) customer engagement, followed by Enabling Investments focused on Customer Education, Communications, and Cyber Security. In the following sections, Eversource will describe the proposed technologies, projects and investment programs for its STIP along those three areas.

Table 1 - STIP Investments

		Investments		$ Millions					
				Year 1	Year 2	Year 3	Year 4	Year 5	Total STIP
Smart & Integrated	Grid-Wide Situational Awareness	Advanced Sensing Technology	Capital	$16.2	$16.2	$11.5	$8.0	$8.0	$59.9
		Next Generation Remote Faulted Circuit Indication	Capital	$1.3	$3.4	$6.4	$5.9	$4.2	$21.2
	Advanced Analytics	Distribution Management System	Capital	$0.0	$3.3	$3.3	$0.0	$0.0	$6.6
			O&M	$0.0	$0.3	$0.3	$0.3	$0.3	$1.1
		Network Load Flow	Capital	$0.0	$0.8	$1.6	$2.4	$3.1	$7.8
		Predictive Outage Detection	Capital	$0.0	$0.0	$0.2	$0.9	$1.1	$2.2
	Real Time Flexible Grid Action	Automated Feeder Reconfiguration	Capital	$8.0	$9.3	$9.4	$11.1	$9.9	$47.6
		Volt VAR Optimization	Capital	$0.0	$0.1	$1.1	$3.8	$4.8	$9.8
	Dynamic DER Integration	Integrated Planning and Tracking for DER	Capital	$3.2	$2.8	$1.1	$0.4	$0.0	$7.6
		Energy Storage	Capital	$0.4	$3.5	$2.8	$0.4	$0.0	$7.0
		Adaptive Protection/Two Way Power Flow	Capital	$0.0	$0.0	$0.1	$0.4	$0.6	$1.1
Resilient Grid		Underground and Overhead Safety and Resiliency	Capital / O&M	$50.0	$25.0	$25.0	$25.0	$25.0	$150.0
Customer Engagement		Opt-in TVR – Meters and IT Systems	Capital	$40.1	$32.9	$12.6	$9.6	$9.6	$104.8
			O&M	$0.0	$0.0	$1.1	$1.1	$1.1	$3.4
Enabling Investments		Communications	Capital	$7.3	$7.3	$7.3	$7.3	$7.3	$36.3
		Cyber-Security	Capital	$2.2	$2.8	$0.0	$0.0	$0.0	$5.0
			O&M	$0.0	$0.0	$2.0	$2.0	$2.0	$6.0
		Customer Education and Outreach Plan	O&M	$5.0	$4.0	$4.0	$3.0	$3.0	$19.0
		Capital		$78.7	$82.3	$57.4	$50.1	$48.6	$317.0
		Less: Baseline Capital Investment		($13.2)	($13.2)	($13.2)	($13.2)	($13.2)	($65.8)
		Total Incremental Capital		**$65.5**	**$69.2**	**$44.2**	**$36.9**	**$35.4**	**$251.2**
		Total O&M		**$5.0**	**$4.3**	**$7.4**	**$6.4**	**$6.4**	**$29.5**
		System Resiliency		**$50.0**	**$25.0**	**$25.0**	**$25.0**	**$25.0**	**$150.0**
		Total Incremental STIP Investment		**$120.5**	**$98.4**	**$76.6**	**$68.3**	**$66.8**	**$430.7**

B. Smart and Integrated Grid: Goals, Drivers, Investments, Technology/Project Descriptions

1. Investment Objectives

Over the next 10 years, the grid will be shaped by rapidly developing technological advances and a continued transition to a clean energy future. This landscape will be characterized by

challenges and opportunities to create meaningful value for customers across many dimensions. In order to prepare for this complex future, it will be critical to focus on multiple technologies and projects that will result in a smarter and more integrated electric distribution system. Within the Smart & Integrated grid category of investments, the Company proposes to focus on a comprehensive portfolio of 10 investment areas over the next five years directly reflecting the dimensions of a modern grid.

The Company prioritized investments that deliver the greatest gains in the Department's four key grid modernization objectives of reducing the impact of outages, optimizing demand, integrating DER and improving workforce and asset management. As a result, all of the 10 project areas support at least two of the four objectives. The portfolio also reflects the fact that state energy policy will transform the electric power sector in the Commonwealth over the next 10 years and the distribution system must be at the forefront to support this level of change. Investments must demonstrate real value to customers. Without a strong analytical framework to prioritize investments, the cost of grid modernization has the potential to greatly outweigh the benefits. Eversource supports a comprehensive value analysis that balances quantifiable benefits, such as energy savings, as well as qualitative benefits, such as increasing the transparency and efficiency of interconnecting DER to the distribution system.

The portfolio should reflect a balance of proven modernization initiatives, such as overhead feeder reconfiguration, and demonstrations of cutting edge and emerging technology, such as energy storage. A portfolio that favors one technology while ignoring another will miss an opportunity to position the grid to maximize benefits as technology continues to emerge and advance. As a whole, the five-year investment portfolio must fully support the Company's 10 year plan for grid modernization. Indeed, in large measure, the portfolio is a reflection of the fact that foundational investments are required to enable the functions of a modern grid. Without wide-spread, high-speed communications or pervasive sensing and monitoring, the grid will not have the level of flexibility or responsiveness needed to accommodate advanced technologies as they emerge in the marketplace over the longer time horizon.

2. Current Investment Practices

In its ongoing effort to improve service to customers, Eversource has a long history of installing cost-effective new technologies on its system. These deployments have focused on devices with proven track records for safe and dependable performance. Decisions on when to introduce new technology to the system are typically driven by their expected benefits with respect to improving the safe and reliable operation of the system. The value of new technology in terms of both quantitative and qualitative measures must be found to outweigh the associated costs.

In recent years, the primary focus of new technology deployment has been in the area of overhead automation. In Eversource East, overhead switches with two-way communication have been deployed, along with centralized control schemes to create auto-restoration loop schemes. In 2014, a program was initiated to install new technology that uses a locally communicating network of switching devices and reclosers that are programmed to have dynamic switching solutions that operate based on fault location, device configurations, and real-time load levels. In Eversource West, overhead automation technology consists of recloser loop schemes that operate with local logic to sectionalize faults.

In 2014, the Company began to deploy technologies to further sectionalize within existing loop schemes. New technologies for underground automation have also been deployed in Eversource East. Over the past three years, the Company has introduced vacuum fault interrupter switches that sectionalize circuits to isolate faults. Some of these fault isolating devices are remotely controlled and provide fault, status, and three-phase loading indications to dispatchers. The Company has also taken steps to augment its communications system to support Distribution Feeder Supervisory Control and Data Acquisition ("DSCADA") and automation technologies. These investments have focused on expanding the use of fiber and improving the functionality of radio communication infrastructure. Implementation of the future grid modernization investments contained in the Plan will significantly expand the Company's current capabilities and allow for optimization of past investments. Moving forward, Eversource has spread its smart and integrated suite of projects across four categories: (1) grid-wide situational awareness;

(2) advanced analytics; (3) real-time flexible action; and (4) dynamic DER integration, which will be explained in detail in the following pages.

3. Smart and Integrated Grid – Proposed STIP Investments

a) GRID-WIDE SITUATIONAL AWARENESS

Advances in sensing and monitoring technology have driven advances in all industries and across a myriad of consumer electronics products. The electric power industry has somewhat lagged behind in the availability of advanced sensing and monitoring. In some parts of the grid, operators have limited ability to remotely determine the status of key assets. For example, at peak load times, such as on a hot summer day, there is significant value in knowing the loading on circuits in order to support the increased demand. Without load data, it is impossible to optimize the system in real-time as conditions change throughout the day. Today, DSCADA devices are deployed on some assets to sense conditions such as voltage and current, and to communicate those data points back to a central data repository where they are available to system operators and engineers. There are many assets on the Eversource East and Eversource West systems with no DSCADA capabilities. In these instances, on a hot day, the only way to achieve visibility into loading conditions is for workers to take manual readings at select locations at a single point in time. System operators and engineers must then use this limited information to determine the state of the system during peak periods. Corrective actions, such as switching load to adjacent feeders or disabling recloser loop schemes, are taken based on conservative assumptions for situations when real-time data is unavailable.

Widely deployed sensing and monitoring is a threshold requirement for a modern grid; it is the foundation upon which all advanced intelligence and real-time response depends. As such, it must be considered an enabling investment for many of the investments included in the grid modernization plan.

Eversource's grid-wide situational awareness efforts consist of two investments: 1) advance sensing technology, and 2) next generation remote faulted circuit indication.

(1) Advanced Sensing Technology

In order to collect data from the grid, advanced sensors must be added to key equipment across the electric power distribution system. In some cases, sensors are deployed solely to transmit data on system conditions back to a centralized Energy Control System ("ECS"). In other cases, DSCADA devices are installed that also enable remote control of devices such as switches and network protectors.

Reduce the Impact of Outages	Optimize Demand	Integrate DER	Workforce and Asset Management
✓		✓	✓
Five Year Investment: $59.9 million			
Investments Enabled: Automated feeder reconfiguration, remote fault indication, network monitoring, predictive outage detection, automated feeder reconfiguration, integrated planning for DER, adaptive protection			

13.8 kV and 23 kV microprocessor relays: In the substation, sophisticated data collection and control at the feeder level is essential to enable the functions of a modern grid. Relay technology has improved significantly over the past five to 10 years. Microprocessor-based devices are the current standard, replacing older style electromechanical relays. In addition to collecting real-time loading data that is transmitted back to a centralized ECS, these relays allow for remote operations such as application of fast-trip and lock-out settings for worker safety or changes in protection settings. As a result, microprocessor relays are enabling investments for predictive outage detection and adaptive protection capabilities. Adaptive protection investments support the integration of DER, including emerging technologies such as advanced inverters. In Eversource East, the deployment of 500 microprocessor relays will be targeted to maximize the benefits associated with improved protection capabilities. In Eversource West, microprocessor relays will provide DSCADA capabilities on breakers that currently have no remote monitoring and control. In addition to the advanced functionalities of the new relays, system operators and engineers will have access to real-time circuit loading on an additional 106 circuits supplied by 16 substations. As a result, at the end of the five-year plan, nearly 100 percent of customers will be served by circuits with this capability. This will enable significant improvements in the accuracy and functionality of load flow tools used to support the integration of DER, as well as greatly improved situational awareness of loads during peak periods.

4 kV circuit breaker DSCADA: In Eversource East, at 4 kV underground substations that are not expected to be retired in the foreseeable future, circuit breakers will also be upgraded to have DSCADA capability. Today, system operators and engineers lack real-time visibility of loading conditions on these circuits despite the fact that many of these stations are among the most heavily loaded on the system. As a result of the GMP, the majority of the over 100,000 customers served by the 4kV underground will be served by circuits with DSCADA monitoring and control. In addition, DSCADA on 4 kV circuit breakers is an enabling investment for automated feeder reconfiguration on the 4 kV system.

At the end of the five-year STIP time horizon, over 85 percent of Eversource circuits will provide real-time load data into the Company's existing ECS. This accomplishment will be a fundamental building block for a truly flexible, reactive and modern grid.

DSCADA enable existing overhead automated devices: For automated devices located on distribution feeders, it is critical that they all have DSCADA capability. In Eversource East, this has been a priority for the last five years, enabled in part by a grant from the U.S. Department of Energy ("USDOE") to expand automation on the distribution system. As a result, almost all automated switches in Eversource East are DSCADA enabled today. In Eversource West, there are many automated devices that work solely based on local system conditions with on-board logic and no remote monitoring and control. Without DSCADA on automated overhead line devices, the Company is limited in its ability to perform load flow analysis in support of DER integration due to the lack of accurate minimum load data for circuit segments. It also precludes the possibility of a future of automated feeder reconfiguration with a centralized logic system based on real-time system conditions. As a part of the STIP, Eversource proposes to add DSCADA to the roughly 40 percent of automated devices in Eversource West that do not currently have the capability.

DSCADA enable network protectors: Similarly, in Eversource West, the secondary networks that serve customers in the downtown areas of Springfield, Pittsfield and Greenfield do not currently have DSCADA capability. Unlike in Eversource East, the protectors on network transformers in Eversource West do not transmit load information in real-time. Without this

information, load readings must be taken manually to validate load flow models in high demand periods. This creates uncertainty in validating engineering estimates of network loading, which requires the system to be built with conservative margins to guarantee it has sufficient capacity to handle high load periods which has the potential to increase capital costs. In addition, without real-time network load data, the Company limits maintenance during high heat conditions as a conservative measure to avoid stress on the system. These restrictions may be able to be relaxed with better visibility into real-time loading conditions. The relays that provide real-time load data will also have remote control capability. This will provide some degree of operational efficiency as workers will not need to manually operate equipment as frequently.

Upgrading padmount switches could translate into savings of 5,470 Customer Outage Hours per year

DSCADA enable motor operated padmount switches: In Eversource East, a number of padmount switches on the 13.8-kV underground system have motor operation for faster, more reliable manual on-site switching operation, but have no DSCADA and therefore no remote switching capability. Adding DSCADA capability will have significant reliability benefits by enabling a scheme in which switches will indicate the fault location enabling dispatch to remotely isolate the faulted cable section and restore power to all customers on the loop. As part of its STIP, Eversource will add DSCADA capability to these devices providing benefit to customers served by 13.8-kV underground circuits in areas where existing switches will be retrofitted. It is anticipated that this could translate into savings of 5,470 customer outage hours ("COH")[6] per year with a relative value of $0.79 per customer minute saved ("CMS")[7].

[6] It is important to note that projections of future benefits are based largely on an assumption that, absent the given investment, the reliability of the distribution system will be comparable to its performance in the past. There are many factors, however, such as weather and other (non-grid modernization) investments that will inevitably make the future different from the past. Nevertheless, the Company has estimated the customer outage hours avoided as a result of its Grid Modernization Plan as a means to quantify reliability benefits.

[7] Another useful quantitative measure is the dollars per customer minute saved ("CMS") which provides an indication of relative value of a given investment. Once the number of outage hours saved has been calculated, this estimate can be divided by the total project costs to derive the dollar per CMS for each investment. This is a helpful metric to determine the relative value of reliability investments.

Investment Description

The devices will be deployed across the Eversource system to improve sensing and monitoring capabilities. As noted above, these investments enable many of the functions of the modern grid proposed as a part of the overall Grid Modernization Plan. Table 2 –Advanced Sensing Technology Investment Description summarizes the quantity of proposed investments.

Table 2 –Advanced Sensing Technology Investment Description

Device Type	Eversource East STIP Quantity	Eversource West STIP Quantity
13.8 kV and 23 kV microprocessor relays	500	106
4 kV circuit breaker DSCADA	130	-
DSCADA enable existing overhead automated devices	-	168
DSCADA enable network protectors	-	134
DSCADA enable motor operated padmount switches	100	-

(2) Next Generation Remote Faulted Circuit Indication

Reduce the Impact of Outages	Optimize Demand	Integrate DER	Workforce and Asset Management
✓			✓
Five Year Investment: $21.2 million			
Enabling Investments: Communications, station and line DSCADA, distribution management system			

In order to reduce the impact of outages, there are three key opportunities: (1) deploy automation to limit the number of customers impacted, (2) reduce the time it takes to find the damage, and (3) reduce the time it takes to repair the damage. Next generation remote faulted circuit indication ("RFCI") is an innovative and cost effective way to reduce the time it takes to locate damage on the system.

As a part of the RFCI program, Eversource will deploy devices on the underground and overhead systems. This equipment is capable of sending signals indicating the presence of fault current to

a centralized ECS where system operators can use this information to direct workers to the specific zone where the damage exists. Alternate technology that relies on handheld devices rather than transmitting data to the ESC may be deployed where cost effective.

Modern RFCI represents a major advancement in electric grid restoration technology. Gains in sensing and communications capabilities have enabled the industry to develop a new device that is currently in the prototype stage. In 2015, Eversource initiated two fault indicator pilot evaluations; one on the overhead system and another with underground devices. On the underground system, Eversource is testing a system that allows repair personnel to retrieve fault indicator status with test equipment while driving past a manhole. As they pass the manhole, the fault indicators send a radio signal indicating if a fault current was present or not. Other devices currently being tested send the information back via DSCADA to the ECS indicating fault conditions or loading concerns. Fault indicators are being tested on various types of circuits that represent a range of distribution voltages, underground and overhead designs, and types of wire and cable. Initial results of the pilots on both the underground and overhead system are promising and indicate the potential for the technology to improve restoration processes.

The key benefit of advanced faulted circuit indication is a reduction in the duration of power outages. In cases where damage must be located in hard to access areas such as urban manholes, private property padmount locations and rural rights of way, customers are likely to experience particularly long outages. On the underground system, the first step in restoring power is locating the fault between two isolating devices. Without intelligence from the system to identify the precise damage location, manual techniques such as visual inspection for damage, additional device operation, traditional fault indicators and special test equipment are employed. These techniques are time consuming and typically involve entering multiple manholes or opening several pieces of equipment to locate the fault. These actions often require moving vehicles parked over manholes covers, detouring traffic and pumping water and excessive dirt out of manholes to allow access. With remote fault indication, however, system operators will be able to locate the fault from the system operations center and dispatch crews directly to the trouble area. This will reduce the amount of time it takes to restore customers, lessen associated

restoration costs and mitigate strain on the system relative to traditional fault locating practices. For example, in a typical underground outage, the number of switching steps required to locate a fault would be reduced from 12 steps down to five on average, enabling employees to focus on making the repairs rather than locating the damage locations. In addition to faster restoration, RFCI will enable the Company to provide accurate restoration information to customers in a timelier manner.

Underground remote faulted circuit indicators: In Eversource East, remote faulted circuit indicators will be deployed on the load side of every oil switch on the 4 kV underground system. Multiple fault indicators will also be installed on each 13.8-kV loop circuit. In Eversource West, remote faulted circuit indicators will be installed on the underground loop system to create zone sizes of approximately 250 customers. This deployment strategy will benefit nearly 22,000 customers in the Springfield and Pittsfield areas.

Currently, outages on the underground system represent approximately 14 percent of all COH in Eversource East and 10 percent of COH in Eversource West. Reducing the duration of these outages has historically been a challenge due to the lack of cost-effective technologies. Remote faulted circuit indication is expected to make a meaningful improvement in reliability for the customers served by the portion of the underground system where they are deployed. Eversource estimates underground remote faulted circuit indicators could result in savings of 61,300 COH per year across the Eversource Massachusetts system with an attractive relative value of $0.52 per CMS.

Eversource estimates underground remote faulted circuit indicators could result in savings of 61,300 customer outage hours per year across the Eversource system in Massachusetts.

Eversource expects overhead remote fault indicators could result in an annual savings of 8,500 customer outage hours.

Overhead remote faulted circuit indicators: On the overhead system, the primary applications of remote faulted circuit indicators are long rights-of-way and radial lines with many miles of exposure. Following an outage with an unknown location, rather than have workers patrol the

lines to visually identify the location of damage; system operators will be able to dispatch personnel more precisely to the zone where repairs are required. This intelligence is particularly valuable when patrol capability is limited by snow, ice, or darkness. An additional application is installation at siphon sections where lines dip underground. In this application, remote indicators will inform dispatch when the fault is located in the underground cable section. Eversource will prioritize the deployment of the new advanced remote fault indication technologies based on customer counts, difficult access, critical load pockets and reliability history. Eversource expects overhead remote fault indicators could result in an annual savings of 8,500 COH and a relative value of $1.55 per CMS.

Overhead remote faulted circuit indicators will also provide real-time load data that will provide additional visibility for remote load flow modeling. This will be particularly beneficial for modeling of DER interconnections in remote areas where accurate minimum load data provides better insight into the likely impact of the facility on the grid.

Investment Description

Over the five-year investment period, Eversource will conclude its pilot of remote faulted circuit indicators. Based on results to date, the Company expects to be able to begin deployment of devices on the system focusing on areas with greatest customer benefit.

Faulted circuit indicators will be installed on infrastructure such as underground cables, padmount equipment, overhead risers, and on overhead circuits in rights-of-way with challenging access conditions. A summary of the quantities included in the STIP by each investment type and region is presented in Table 3– Remote Faulted Circuit Indication Investment Description.

Table 3– Remote Faulted Circuit Indication Investment Description

Device Type	Eversource East STIP Quantity	Eversource West STIP Quantity
Underground remote fault	2,000	170

indicators		
Overhead remote fault indicators	900	125

b) ADVANCED ANALYTICS

Collecting additional real-time data is a key element of a modern grid; however, without advanced analytics there is no way to turn the data into actionable information. Going forward, the grid will be producing much more data that will be available in real-time. System operators and planning engineers will be increasingly challenged to manage and react to the tsunami of data that will characterize the modern grid. With respect to real-time operations, currently operators rely heavily on alarms indicating out-of-bound conditions. As the amount of data and alarms increase, it will become increasingly difficult to manage. Advanced analytics will enable the modern grid by processing DSCADA data using state-of-the-art intelligence to ensure operators are notified of the high priority conditions related to the safe and reliable operations of the power system. The advanced analytics investment will not only provide notifications to system operators, but it will also present operators with suggested steps to address the situation, and in some cases, the intelligent system will actually take the action itself without human intervention.

In addition to real-time operations, advanced analytics will play a major role in system planning for the modern grid. With the proliferation of DSCADA on the system, engineers will have much greater visibility into the dynamics of the system from the substation out onto feeders and into the secondary network. This will enable planners to reflect true real-time conditions on the system. Further, the ability to use scenario planning to anticipate potential areas of concern and determine the optimal response is a key feature of advanced load flow and related tools. This capability will be increasingly required to manage the complexity of DER integration and two-way power flow.

In summary, the advanced analytics efforts will encompass three different investments: 1) distribution management system, 2) network load flow, and 3) predictive outage detection.

(1) Distribution Management System

Reduce the Impact of Outages	Optimize Demand	Integrate DER	Workforce and Asset Management
✓	✓	✓	✓
Five Year Investment: $7.7 million			
Investments Enabled: Automated feeder reconfiguration, Volt VAR optimization, integrated planning for DER			

The cornerstone of the advanced analytics of the Eversource modern grid is the distribution management system.

Today, a large portion of the management of the electric grid occurs on the bulk transmission system. The bulk transmission system connects large generators to substations that serve distribution load. The transmission system operators use a tool called an Energy Management System ("EMS") to manage the operation and stability of the grid. The EMS has a model of the grid and performs load flows in real-time to ensure the electric system is stable and operating within defined voltage, current, power (real and reactive) limits. Along with the real-time operation, the EMS is used for short term planning that includes: contingency analysis; generation forecast, and load forecast.

As the electric system becomes more complex and automated with greater penetration of DER, there will be an increasing need to manage system operations with functionalities similar to an EMS at the distribution level in order to realize the benefits of optimization based on advanced analytics. The tool that will be used is called a Distribution Management System ("DMS") that has the capability of managing the electric distribution system and DER. The Institute for Electrical and Electronics Engineers ("IEEE") DMS task force has defined DMS as "a set of interconnected and well-integrated computer and communication systems for the monitoring and controlling of the electric distribution system in an optimal manner without compromising safety and asset protection." With the DMS enabling computer-assisted decision making, the Company will be able to optimize distribution system performance to minimize electrical losses, improve asset utilization, improve reliability, integrate DER and use demand side management as a resource.

There are two foundational building blocks required for a DMS to provide this level of grid management. First and foremost is a model of the distribution system that is capable of running

real-time load flows of the distribution grid based on operating limits of the grid including voltage limits and normal and emergency limits of cable and equipment. Load flows provide the current state of the system including voltages, currents, and power flow direction. The same load flow can be used to model future state configurations which are useful for planning and contingency analysis.

The second building block is the ability of the DMS to control devices using DSCADA technology. In 2015, the Company deployed a new ECS across Massachusetts. As a part of the Grid Modernization Plan, the DMS will be integrated with the ECS system to enable automatic control of devices based on DMS logic. This can be performed automatically or the DMS can present the command to the system operator to execute.

Once the DSCADA control, operating limits and load flows have been combined, the basic functionality of the DMS will be in place. This system will have the ability to accept and process data more efficiently and effectively than human operators. With substation, feeder and other equipment alarms, conditional system limits, filtering and forecasting the DMS will aid in avoiding the potential for information overload, allowing the Company to operate equipment with greater efficiency and proactively respond to emerging problems.

With this functionality as a base, advanced applications such as Automated Feeder Reconfiguration ("AFR") and Volt VAR Optimization ("VVO"), can be added. This is often referred to as an Advanced Distribution Management System. Lastly, the characteristics of DER can also be added along with forecasted generation outputs and forecasted load.

With all these building blocks in place, the DMS will provide the benefits described above as well as enable the following functions needed to manage DER for the stability of the grid into the future:

- **Available generation capacity** – an asset registry of all available distributed generation resources. The registry will identify the nameplate capacity, fuel type and capability of DER interconnected to the system. This could include real and reactive power output,

energy storage capacity, or other characteristics. This data could be provided at the level of a complete distribution circuit or even line segment.

- **Short-term generation forecast** – a function to predict DER output based on factors such as weather, device status, historical output and other information.

- **Real-time generation status** – a function to report real-time activity of DER on the system. Report could include real and reactive power output, battery state of charge and rate of charge/discharge, on/offline status, etc. If possible, these would be aggregated and reported as an attribute of the particular circuit or line segment. The forecast could produce visibility into generation on the system in the event of changes in system configuration, such as loop scheme operation.

- **Automatic generation control** – a control function by which all DER on a specified part of the distribution system may be disconnected-from or reconnected-to the grid. This could include situations such as loss of a transmission line takes a number of large generators off-line on a circuit and control is required to bring facilities back into service in a staggered process.

In addition, to the extent these capabilities are fully enabled, the DMS has the potential for further benefits of control and optimization with DER as technologies, such as advanced inverters and energy storage, become more widely deployed on the system. Examples of these benefits include: the ability to request VAR support on a circuit or line segment basis; improved phase balancing capability; immediate response of DER to changes in supply source following automated feeder reconfiguration; and management of DER on a feeder to optimally support voltage reduction mode when it is active.

Investment Description

The DMS investment consists of three categories. The first is the DMS hardware and software licenses to allow both Eversource East and Eversource West system operators to use the functionality of the DMS. The second is the interfaces with existing systems. The DMS will

have multiple interfaces with existing systems. One of the most critical interfaces is with the ECS that is in place today to manage all DSCADA devices. The third is the resources required to build out circuit level models in the DMS system to provide an accurate representation of system conditions. The accuracy of the circuit models will depend on the interface with the Company's GIS systems to ensure that as changes are made in the field they are automatically reflected in the DMS system. Accuracy of data such as conductor type, size, covering and length is critical for the DMS to calculate anticipated voltage levels and predict fault locations.

(2) Network Load Flow

Eversource operates a number of major secondary area network grids in the City of Boston, Cambridge and Springfield. Across the Eversource service territory, there are 17 secondary networks serving almost 60,000 customers.

The secondary networks are fed by several primary voltage feeders, each supplying multiple network transformers with associated network protectors. The network transformers feed an interconnected secondary street grid at 120/208V. These secondary network grids distribute power across a redundant, multiple path network, to assure the highest level of reliability for densely populated urban areas. In times of equipment or cable failure, the power is re-distributed across the remaining network transformer and protector units and associated secondary cables to assure uninterrupted power to customers. Although secondary area networks are very reliable, when an unexpected failure occurs, it has the potential to have a catastrophic impact to critical load in major metropolitan areas.

Reduce the Impact of Outages	Optimize Demand	Integrate DER	Workforce and Asset Management
✓		✓	✓
Five Year Investment: $7.8 million			
Enabling Investments: Communications, network protector DSCADA, distribution management system			

Eversource plans to replace its existing static modeling by investing in the development a state-of-the-art real-time power flow model that will simulate the power flow characteristics of the secondary network grids. The new model will be dynamic, calibrated and based on current

conditions from DSCADA enabled network transformers. By using this type of advanced power flow model, Eversource will vastly increase the knowledge and understanding of how the secondary area network reconfigures power flow under a variety of system conditions or unusual events such as equipment failure. The model will also be able to simulate the interconnection of DER under various system configuration and contingencies.

The development of a power flow model will enable Eversource to simulate how the secondary network will perform during time of equipment failure. For instance, if a high voltage cable should fail, the remaining high voltage cables, transformers, network protectors and secondary cables would all need to be able to support the customer load without exceeding their rating. A power flow model will enable Eversource to simulate and study these types of potential events in advance of them occurring. Based on the results of the studies, the electric grid would be upgraded to avoid a potential overload condition or power outage.

Over the last few years, Eversource, under a USDOE grant and as part of the Company's Smart Grid Pilot program docketed in D.P.U. 09-33[8], conducted a pilot demonstration project known as Urban Grid Monitoring and Renewables Integration project. As a part of the pilot, monitoring equipment, classified as either "major" or "minor" nodes, were installed in one of the 12 secondary network grids in the City of Boston to collect and transmit data on the health of the grid. Major nodes collect real-time line current readings using small current transformers and transfer that data to the operations center via Power Line Carrier ("PLC") communication technology. Minor nodes detect low current and high cable temperature threshold values on the individual secondary-main cables and report those alarms to the operations center via the existing cellular network. This project was undertaken to determine the benefits of enhancements to increase monitoring of secondary area networks.

Based on the results of the pilot project, Eversource is beginning to collect data to improve visibility into its secondary network, and is proposing to expand the installation of major node

[8] The Company is in the process of completing its evaluation of this project for submission to the Department as part of this docket.

sensors to additional grids across the system. The data collected by the major nodes will further validate the load flow analysis.

The advanced network load flow with data from major node sensors is expected to have a meaningful impact on the reliability of these critical assets. Although, given the redundant nature of the network, reliability for customers served by these systems is generally excellent there remains the potential for a cascading failure of equipment that could result in an event of the scale of the Scotia Street substation event in 2012. With better modeling and data on the network, Eversource will be able to identify small overload conditions before they have the potential to cascade into a major event. Lessening the potential of a low probability, very high impact event is the key benefit of an advanced network load flow tool.

Advanced load flow models will also have benefits for asset management and safety. Any reduction in the potential of a network event reduces safety risk associated with events such as manhole fires, dislodged manhole covers or smoking manholes. This will also reduce the need for Company and public officials to respond to these types of events. Further, with better insight into the impact of feeder outages, system operators will be better able to schedule repairs to maximize the use of resources and minimize impact to customers. This added insight will also provide planning engineers with a better understanding of the loading on the grid allowing for a less conservative assessment when supplying new loads which will reduce the amount of upgrades that are required to the grid.

An additional benefit of advanced network modeling is the ability to better understand the impact of DER interconnected to the network system. Currently, Eversource must be conservative with respect to requests to interconnect DER to the network due to the nature and criticality of this part of the grid. Given the complex nature of the system and the critical nature of the load it serves, without clear insight into the impact of DER the risk of allowing significant penetration on the network is considered too great. As such, currently Eversource must be conservative with respect to requests to interconnect DER to the network due to the nature and criticality of this part of the grid. With more insight into network function and load flow, however, Eversource anticipates that it will likely be possible to interconnect more DER on the network system.

Investment Description

The network load flow investment consists of two components. The first covers the investment required to build out load flow models for all Eversource networks. Engineers will use modeling software to craft a representation of the network load flow that can be used for contingency analysis. This work will include field verification of asset characteristics in cases where data is missing or suspect. The second component is the major node sensors that will be deployed on the secondary grids in Boston and Springfield, as quantified in Table 4–Network Load Flow Investment Description.

The quantity of sensors deployed is intended to be sufficient to validate load flow models for key assets. Based on the results of the sensor data it is possible that Eversource would deploy additional devices beyond the five year time horizon.

Table 4–Network Load Flow Investment Description

Device Type	Eversource East STIP Quantity	Eversource West STIP Quantity
Major node sensors	100	25

(3) Predictive Outage Detection

Reduce the Impact of Outages	Optimize Demand	Integrate DER	Workforce and Asset Management
✓			✓

Five Year Investment: $2.2 million
Enabling Investments: Communications, microprocessor relays, overhead remote fault indicators

Today, electric utilities must respond to outages as they occur on the system. However, with a more modern grid and advanced electric power distribution analytics, electric utilities would have the ability to use data to identify potential outages before they occur. The predictive outage detection investment, using advanced analytics, in combination with microprocessor-based relays and fault sensors will proactively identify high-probability fault locations on the distribution system. The protective relays will be pre-set to monitor and identify over-currents that are below the trip current thresholds. The data will then be analyzed to identify the locations of a high-probability future outage. This is a ground-breaking project that will illustrate to the industry the real potential to use advanced technology and innovative analytics to predict outages before they occur.

The predictive outage detection project will use microprocessor relays with trigger-values less than the feeder-trip values to identify potential incipient fault conditions. To correlate these data, an analytic engine will be used to match magnitude of fault current, distance along the line to the temporary fault, sine wave distortion and voltage sag. The relays will be able to detect the incipient fault conditions on the feeder while the fault sensors will be able to locate the section of the line where the incipient fault condition occurred. This information will allow field personnel to identify areas of a feeder that have seen an incipient fault condition in a timelier manner. Tuning the analytic process will be critical to finding the incipient fault locations proactively.

The ability to predict and mitigate potential outages due to vegetation or equipment deterioration will have significant benefits to Eversource customers. The primary benefit of predictive outage detection is the ability to address the cause of the incipient fault before it causes a sustained outage. Prioritization of vegetation management and feeder hardening upgrades, based on analytic outputs will be done with much higher precision. Because tree and equipment caused events represent a large percentage of Eversource outage events, an investment such as this one, designed to prevent these types of outages, has the potential to deliver meaningful benefits to

customers. An additional source of benefit is an improvement in power quality due to elimination of conditions with the potential to cause momentary disturbances.

Investment Description

The investment in predictive outage detection consists of the resources to build the analytical engine to process data and predict likely outage locations. Costs associated with microprocessor relays are included in the "sensing and monitoring" category and line sensors are included in "remote fault indication."

c) REAL-TIME GRID FLEXIBLE ACTION

With advanced sensors and analytics, the modern grid will provide much improved situational awareness for system operators, better positioning them to adapt and respond to real-time conditions. In order to achieve the greatest benefits, however, a truly modern grid must be able to act on information and intelligence with automated device operations to dynamically reconfigure the power grid to achieve system objectives. Enabled by high speed communications, the DMS is the central intelligence that will drive action on the grid in real-time. This real-time action drives benefit to customers in terms of reducing the impact of outages by restoring customers rapidly; reducing energy consumption with an advanced VVO program; responding to the impact of DER as system conditions change; and improving workforce and asset efficiency with automated operations.

The real-time flexible action elements of the STIP for Eversource include two components: (1) automated feeder reconfiguration and (2) Volt/VAR optimization.

(1) Automated Feeder Reconfiguration

✓			✓
Five Year Investment: $47.6 million			
Enabling Investments: Communications, distribution management system, DSCADA			

One of the most fundamental and valuable capabilities of a modern grid is the ability for dynamic reconfiguration to minimize the impact to customers in the event of a fault condition. With advanced technology, the grid will sense the existence of a fault, automatically isolate it to the smallest possible segment and then restore service to all customers outside the faulted zone with supply from alternate sources. This capability makes the grid flexible and dynamic with the goal of maximizing system safety and reliability. As a part of its STIP, Eversource will deploy advanced technology on the overhead system across the state and on the 13.8kV underground system in the Boston metro area.

For years, Eversource has been committed to using advanced technology to reduce outages and speed the restoration on both the underground and overhead systems. As a result, today the Company estimates that the number of customers affected by outage events is reduced by 25-30 percent due to distribution automation. Technology, however, continues to advance and create the potential for a step change in system reliability and resiliency.

As part of the STIP, Eversource proposes to enhance its existing distribution automation with a next generation topology that delivers sophisticated grid reconfiguration capabilities.

Overhead Automated Feeder Reconfiguration: Currently, in Eversource East, which is a more customer dense service area, when a fault occurs on an overhead line the design goal is to automatically isolate the fault to a section with no more than 1,500 customers. In Eversource West, Eversource designs its system with a goal of having isolation segments of no more than 500 customers. Segment size is generally determined by historical reliability such that areas with poor reliability are sectionalized down to smaller segments to minimize the number of customers impacted by an event. This methodology maximizes reliability benefit for the associated cost.

A truly dynamic and reconfigurable grid requires an even greater degree of segmentation. Ideally, the grid needs the ability to find solutions to resupply as many customers as possible

following an outage event. To implement these solutions, however, the system must have the flexibility associated with small customer segments between automated devices. The STIP calls for further reducing the number of customers affected by circuit outages and restoring power more rapidly by installing a significant number of automatic sectionalizing devices. These additional devices will allow Eversource East to reduce its target of 1,500 customers affected by an outage condition on the overhead system to 1,000 and Eversource West will be able to achieve its goal of 500 customers per segment where circuit ties are available.

In Eversource West and the coastal areas of Eversource East, a barrier to full automated feeder reconfiguration ("AFR") is the lack of alternate supply sources via circuit ties. Without the circuit ties, there is no option available to resupply unaffected customers from alternate sources. As a part of the Plan, Eversource will build out the infrastructure where cost effective to tie radial circuits to deliver the benefits of automation. Existing circuit ties will also be bolstered to increase their back-up capability where cost effective.

The Company estimates with full deployment of its Overhead Automated Feeder Configuration plan, customers could experience 115,200 fewer interruptions per year with a savings of 243,400 customer outage hours per year.

With this added sectionalization and tie capability, the grid will dramatically increase its ability to reconfigure itself based on system conditions. The act of actual reconfiguration requires intelligence to recognize the fault and make decisions to operate devices. In some cases, this logic can be located on devices such as reclosers to make decisions in the field based on loss of voltage. In other cases, the logic is centralized and the communication system transmits data on system conditions and control commands between the field switches and the DMS. A robust and modern grid must accommodate both approaches. For many applications, local logic is a simple, fast and reliable method to operate switches and isolate faults. As the complexity of the grid increases, however, local logic may be insufficient to achieve the full benefits of automated feeder reconfiguration. For example, in periods when the grid is more heavily loaded, a DMS that knows real-time loading conditions can make intelligent decisions to maximize the number

of customers that can be restored without adverse system impacts. Similarly, the DMS will be better able to recalibrate based on off-normal circuit conditions and will have the ability to find an optimal solution rather than aborting when the normal alternate supply is unavailable.

A fundamental requirement of a centralized DMS with logic controlling field devices is a robust, high speed communications system. It is critical that data be transmitted from devices and back to the field such that reconfiguration can occur rapidly. Currently, there is no system for feeder reconfiguration using centralized intelligence in Eversource West given the limitations of the existing communications systems. Building out fiber capabilities to the substations will greatly enhance the reliability and effectiveness of the existing communications infrastructure such that all of Eversource Massachusetts can leverage the capabilities of a centralized DMS for automated feeder reconfiguration.

The primary benefit of overhead automated feeder reconfiguration will be a significant reduction in the impact of outages. With advanced technology, Eversource will design its schemes to restore power to unaffected segments reducing the number of customers affected by an outage event.

Eversource is also committed to reducing the impact of outages during major events (*e.g.* storms). These events are hugely impactful to customers, causing major disruptions and in some cases requiring at-risk customers to take extreme measures to avoid being subject to power outages. These events result in significant restoration costs. Since 2010, Eversource has incurred more than $200 million in restoration costs in Massachusetts due to the increased occurrence of these large multi-day events. Even relatively small reductions in the duration and extent of these events can result in meaningful benefit to customers. Eversource expects its automated feeder reconfiguration program will have a small reduction in the duration of a major event. This benefit will be realized near the beginning through the middle of the event when repairs have been completed on the backbone and system operators can restore large numbers of customers immediately following the repair remotely from the dispatch center. The Company also estimates it will gain a limited reduction in the number of customers affected. This savings will vary significantly with the type of event. The greatest reduction will be in events where the

damage is localized in certain areas such that adjacent alternate supplies are available allowing reconfiguration to occur.

The Company estimates with full deployment of its Plan, customers will experience savings of 115,200 customer interruptions annually. The program will also reduce the average duration of outages experienced by customers on the system given that customers affected will avoid a lengthy outage as well as the fact that isolating the fault location to a smaller segment will reduce the time it takes to locate damage. Eversource estimates customers will see a savings of 243,400 COH per year. Given the magnitude of savings in terms of both outage frequency and duration, overhead automated feeder reconfiguration has the most favorable relative cost effectiveness measure at $0.51 per CMS.

In addition to reliability benefits, the addition of automated devices in the field will reduce the amount of manual switching operations. In addition to saving time for planned and unplanned switching operations, automating switches reduces operations cost, environmental impact and safety exposure. From a system planning perspective, the enhanced flexibility to shift load based on prevailing conditions has the potential to defer capital upgrades as well.

Underground Automated Feeder Reconfiguration: Historically, automation on the underground system has focused on padmount switches with automatic transfer. In Eversource West, over 80 percent of non-network customers served by the 13.8 & 23-kV underground systems benefit from having auto transfer to an alternate source such that they do not experience an outage for a fault on the mainline. In Eversource East, a smaller percentage of customers benefit from the automatic transfer. As described in the “sensing and monitoring” section above, approximately 100 padmount switches have motor operation but do not have DSCADA capability so that they can be operated remotely to restore customers.

Solutions for automation of the 4 kV underground, however, have been limited. The 4 kV underground circuits represent some of the oldest assets on the system. Customers served by these circuits can be impacted by multiple outages. In fact, across Eversource, poor performing circuit lists consistently include 4 kV circuits. In Eversource West, the 4 kV underground system is targeted to be completely eliminated by 2017. In Eversource East, complete

conversion is not possible given the extent of the system. Currently, technology is limited to vacuum fault interrupter ("VFI") switches that sectionalize circuits to isolate faults.

Eversource has worked with industry experts to identify options to bring the benefits of automated feeder reconfiguration to the 4 kV system. As a result, as a part of its STIP, the Company plans to automate 100 circuits by retrofitting existing VFI switches. This investment will also benefit from DSCADA capability on the 4 kV breakers described above. The automated feeder reconfiguration will work by automating the midpoint and tie switches on a circuit such that the midpoint will open for a fault between it and the station breaker allowing the tie to close in and automatically restore the unaffected back half of the circuit. The midpoint switch will operate like a conventional VFI and open for faults beyond it so the front half of the circuit is unaffected. This added automation should provide a 25 percent reduction in the impact of outages to the customers on circuits where it is deployed.

The reduction in the impact of outages includes both the number of customers affected and the duration of events. Eversource expects the 4 kV automation will result in a savings of 8,417 customer interruptions and 22,500 COH per year. This translates into a relative cost effectiveness of $0.57 per CMS.

Advancements in the technology used for automated feeder reconfiguration continues to evolve. What is commercially available today will most likely be very different from what will be available in five or ten years. As an example, Eversource is evaluating a device called a triple single recloser which can selectively interrupt just the damaged phase(s) on an overhead circuit and keep the other undamaged phase(s) continuing to deliver power to customers. This has the potential to be another device that can be used for reducing the number of customers affected by an outage event. Eversource proposes to draw from a portfolio of solutions, acknowledging that technology will advance, to improve the level of service in its diverse service territory. By selecting the best equipment or system to suit a particular region, circuit, or problem, Eversource will reduce the number of outages that customers experience and reduce outage duration all while minimizing system investment cost.

Investment Description

In order to achieve the benefits of automated feeder reconfiguration, the following devices in Table 5– Automated Feeder Reconfiguration Investment Description will be deployed in the field. It is important to note that automated feeder reconfiguration is heavily enabled by communications and DMS investments, covered elsewhere in the Plan.

Table 5– Automated Feeder Reconfiguration Investment Description

Device Type	Eversource East STIP Quantity	Eversource West STIP Quantity
Overhead automated switches	325	140
Overhead automated switches with circuit ties	-	100
Underground 4 kV VFI retrofit for automated feeder reconfiguration	150	-

(2) Volt VAR Optimization

One of the capabilities of the modern grid will be advanced technologies aimed at reducing energy consumption and optimizing demand using voltage and VAR optimization ("VVO"). The concept of reducing service voltage to customers in order to reduce line losses and energy consumption is not new. Utilities have long recognized that customer usage decreases with a decrease in voltage such that a few percent lowering of voltage will result in a reduction in energy consumption. In fact, in the 1990's Eversource implemented programs known as conservation voltage reduction ("CVR") by lowering voltage at the substation bus to a level that was expected to keep voltage within the +/- 5 percent tolerance range for all customers on the associated feeders and manually changing line regulator and capacitor bank settings. This CVR approach relied on using the lower end of the

Reduce the Impact of Outages	Optimize Demand	Integrate DER	Workforce and Asset Management
	✓	✓	✓
Five Year Investment: $9.8 million			
Enabling Investments: Communications, distribution management system			

acceptable voltage range with customers closer to the substation having somewhat higher voltage than customers at the end of the feeder.

This approach relied on calculations and models to determine the appropriate device settings that would be expected to produce the desired results under most conditions. Without real-time sensing, communication and control of line regulators and capacitors, however, it proved difficult to achieve meaningful levels of savings while ensuring reliable, high quality power service to customers. As the electric power grid became more complex over time with basic automation and increased penetration of DER, CVR techniques were increasingly insufficient and the programs were abandoned.

Advanced grid technology and communications capabilities have the potential to be game changers for Eversource in its ability to implement voltage management programs. In particular, the ability of the DMS to collect voltage data from along feeders in real-time, process the data and immediately send commands to substation transformers, line regulators and capacitor banks is a major departure from the CVR techniques. With visibility into real-time feeder conditions, a VVO system will reduce the potential for customers to experience low voltage. Customers are also less likely to experience voltage flicker once devices are automatically controlled based on actual field conditions rather than static settings and system models. In addition to improving customer satisfaction by enhancing power quality, by reducing peak demand, VVO has the potential to defer distribution capacity investments.

Other utilities are beginning to apply advanced voltage management techniques. Of the 99 Smart Grid Investment Grant projects administered by the USDOE as part of the American Recovery and Reinvestment Act ("ARRA"), 26 include voltage management. These and other projects explored different voltage management objectives and approaches.

Eversource is proposing a staged approach to cost-effectively deploy voltage management. In the first phase, Eversource will evaluate different voltage management approaches and select the feeders to be upgraded as a part of the VVO deployment. A key objective of the VVO program will be to determine the feeder deployment strategy that will maximize benefit to customers. For

instance, it is likely that relatively short, heavily loaded feeders will provide a greater benefit relative to rural feeders. Also, it is important to understand the impact of different types of load such as industrial versus residential on the success of the VVO program. Lastly, Eversource is very interested in understanding the impact of DER and automated feeder reconfiguration on the viability of VVO. The increasing prevalence of two-way power flow from these technologies has the potential to add undesirable complexity to the functioning of the VVO analytical engine. On the other hand, advanced voltage control may be able to mitigate some of the high voltage concerns caused by DER facilities and low voltage concerns from automatically switching load from one feeder to another. There is an important and valuable opportunity to use grid modernization technology to understand and respond to the dynamics of DER, automatic feeder reconfiguration and system voltage.

In the second phase, Eversource will introduce VVO on selected feeders. The Company will use industry accepted measurement and verification protocols to review the results and determine the appropriate next steps for future deployment. Over the five year time horizon, the Company expects to deploy VVO on approximately 15 percent of feeders serving customer load.

Based on results of a study on distribution efficiency with 22 utility participants, Eversource estimates it has the potential to achieve a 2.2 percent reduction in end use energy consumption for customers on affected circuits, as well as a small reduction in line losses on affected circuits. In addition, the program should result in approximately 0.6 percent reduction in peak load for every percent reduction in voltage for the feeders on which VVO is deployed Results of the effort will help the Company understand where to target VVO in the future in order to maximize benefits, including the enhanced integration of DER.

Investment Description

The Eversource VVO program has three investment components. The first is to upgrade the substation transformer load tap changers, line voltage regulators and capacitor banks to enable two-way communication such that the devices can be actively controlled by a centralized system in response to real-time voltage and VAR fluctuations. In addition, the program will include

adding up to five voltage sensors or meters per affected feeder. Table 6–Volt/VAR Investment Description is the number of devices the Company expects to upgrade as a part of the program.

Table 6–Volt/VAR Investment Description

Device Type	Eversource East Quantity	Eversource West Quantity
Load tap changer control DSCADA	15	10
Line capacitor and voltage regulator DSCADA	215	50
Voltage sensors or meters on VVO circuits	925	150

The second component is the centralized intelligence to collect voltage and VAR data from the system, perform analysis and send control signals to devices. This cost is incorporated into the DMS investment described above. The third component is the communications infrastructure needed to transmit data and control systems to maintain voltage in real-time.

d) DYNAMIC DER INTEGRATION

The electric power distribution industry is changing at an unprecedented pace. The driver of this change is the move from one-way power flow based on large scale, central station generation to DER positioned throughout the system. As a result, the complexity of the grid demands new thinking and new technology. Eversource understands its role as a critical partner in achieving the Commonwealth's energy policy goals to reduce carbon and increase the proliferation of clean energy technology. As a result, the Company is proposing a suite of investments to make the grid smarter and more robust in order to support the transparent, cost effective interconnection of DER on the grid.

Dynamic integration of DER efforts within the STIP encompasses three different investments: (a) integrated planning and tracking of DER, (b) energy storage and (c) adaptive protection/two-way power flow.

(1) Integrated Planning and Tracking for DER

Reduce the Impact of Outages	Optimize Demand	Integrate DER	Workforce and Asset Management
✓		✓	✓
Five Year Investment: $7.6 million			
Enabling Investments: Communications, distribution management system			

One of the most important functions Eversource performs is planning for the future design and capability of the electric distribution grid. Historically, planning has been focused on ensuring safety, reliability and sufficient capacity for peak periods. With the increased penetration of DER, planning has taken on a new complexity and new requirements. Over the next five years, Eversource proposes to make two key investments to increase its ability to plan for and optimize the integration of DER. The first is an advanced load flow model and the second is an interactive DG tracking portal for customers.

Advanced Load Flow Model: Advanced load flow capability allows for improved modeling of the distribution system power output and load flow based on the availability of data from the enhancement in the extent of DSCADA penetration. Currently, the system is modeled based on relatively static data from a limited number of sources. In many cases, that means making assumptions of load flow to the end of the feeder based on last year's peak load at the breaker and limited meter and line device data. Grid modernization technology with system-wide sensing and monitoring and advanced analytics has the potential to drive a fundamental shift in distribution system modeling to continuously plan for an evolving, reliable and integrated grid that considers many inputs and outputs. Advanced load flow capabilities will drive three primary benefits. The first is the improved ability to optimize capital asset deployment, the second is better real-time loading scenario planning and the third is enhanced integration of DER on the distribution system.

Enhanced modeling capability results in more cost-effective investments and greater predictability when determining the impact of system upgrades. From a system planning perspective, modeling the system with load flow tools that rely on more granular data enables greater insight into the system's vulnerabilities and needs; therefore, it reduces the need for

conservative assumptions which have the potential to increase costs. Modern tools will enable the Company to understand the system taking into consideration multiple conditions and scenarios. The more robust insight into the grid and potential growth and loading outcomes greatly enhances decision making with regard to prioritization of capital investments how to best respond to likely system conditions.

In addition to long range capacity planning, advanced load flow tools working in coordination with the DMS will also help day-to-day operations. Modeling capability will improve daily operations by using the data collected from DSCADA in a load flow tool in the systems operations center to perform functions such as analysis of contingency situations and drafting of switching orders based on near-real-time system conditions. For example, in high heat conditions, Eversource will have increasing capability to use real-time loading data to run scenario analysis to understand the range of potential system conditions it will experience over a 24 hour period and how to quickly reconfigure the system in the event that a piece of equipment nears its operating limit.

The third goal of this investment initiative is to better prepare the grid for the future by modeling probable and realistic scenarios to allow for the more effective and efficient integration of DER on the distribution system. Currently, the likely impact of DER on the distribution system is modeled for each DER facility as it applies for interconnection. In some cases, multiple DER facilities are modeled as a part of a group study but these analyses are also dependent on current distribution system conditions. These system impact studies continue to grow in complexity with the proliferation of DER and increased automation on the distribution system. With advanced load flow tools, the Company will have increased capacity to study the impact of each DER facility as it applies to interconnect, reducing the cost and time for developers. Also, with better insight into the distribution system based on near real-time DSCADA, the Company will be better able to engineer optimal interconnections. Further, Eversource expects that it will be able to use the advanced load flow capabilities to provide user friendly tools to DER developers that will help them gain insight as to where the distribution system can support DER and where expected capacity limits are being approached.

An ultimate goal of advanced load flow tools is to improve the Company's ability to make future capacity planning decisions taking into consideration the existence of DER on the system. Currently, when making decisions to upgrade infrastructure to accommodate increases in system load, the Company must make the assumption that distributed generation on the system will not be available in peak periods. Without the ability to control and dispatch generation, it is possible that a system will be off-line when needed to offset load. In addition, for many larger systems, protections schemes are in place to ensure they do not operate when the system has been reconfigured. Without advanced planning tools, the assumption that generation will not be available in peak conditions is a necessary conservative response to avoid reliability problems for other customers. With the availability of modern technology, however, there is a great potential to drive significant value by seeking out opportunities to better account for DER in the system planning process. Further, as technologies such as advanced inverters become more available in the marketplace, Eversource will be better positioned to take advantage of the potential benefits DER can provide to the system.

In addition to the three primary benefits outlined above, advanced load flow tools will provide further benefit to distribution engineers by enhancing existing capabilities with more data and robust models. For instance, advanced load flow tools will facilitate reliability engineering providing insight into decisions such as optimal device location on circuits and load balancing based on statistical analysis of potential failures at different locations. The tools will also assist in power quality engineering with greater visibility into power flows across the system. With respect to DER engineering, advanced load flow tools, combined with data from DG facilities will enable better understanding of the implications of inverter based generation returning to service following the loss of a circuit. Ensuring no negative impacts associated with DER pick-up will be an increasing reality of the modern distribution system.

Investment Description

Eversource currently uses two of the industry leading load flow software applications. Eversource East uses CYME and Eversource West uses Synergi. These applications are currently used for basic contingency analysis, general planning for capacity, modeling feeder

load flow and power quality studies. These tools are integrated into each Company's IT infrastructure and engineering processes. As a result, it is most cost effective to continue to use these applications going forward. In order to ensure the tools are capable of advanced functionality, a review will be completed to ensure all relevant modules are activated and interfaces with data repositories, such as GIS and meter data management, are optimized for increased usage. In particular, Eversource will ensure that the modules that enable more sophisticated engineering of DER on the system are fully functional and system planning engineers have been trained to use them.

The most significant component of the advanced load-flow investment is the creation of the model itself. As a result, the GMP includes the design, development, testing and implementation of the model. At a high level, this will include the following key steps:

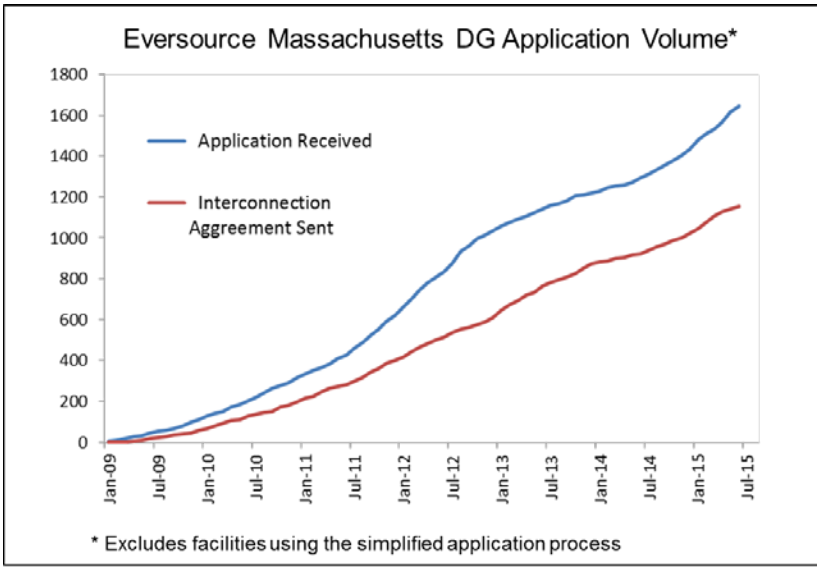
- Identifying the building blocks and potential scenarios and conditions to be modeled—Building blocks will include GIS connectivity, reliability data, line-ratings, and available meter data;
- Optimizing the integration of the various systems (and data sources) and ensuring systems interoperability
- Developing the models for the most likely scenarios to be studied and used in planning;
- Testing models and the predictability of the outputs/impacts and usefulness in future decision making process; and
- Rolling out the enhanced modeling capability and specific established models which will include updating system planning policies and processes, training and change management.

As technology continues to evolve, Eversource will continue to evaluate and identify modeling scenarios and opportunities needed to improve the decision-making process for committing investments and mitigating impacts to the system.

DER Customer Portal: Providing excellent customer service is of paramount importance to Eversource. In recent years, interconnection of DER has become one of the most active areas

where intense communication and coordination is required between customers and the Company. Adding a device responsive customer portal to our customer service team, we will be able to support customers in their DER interconnection process during the three main phases: (1) customer education and pre-application communication; (2) the interconnection process; and (3) post-installation billing. Activity in all areas has increased exponentially as seen in Chart 1– Growth in DG Interconnection Process Requests.

Chart 1– Growth in DG Interconnection Process Requests



The increase in the number of customers seeking to interconnect DER to the system has been accompanied by a growing complexity as system impact studies must take into account the large amount of existing generation. Group studies are now underway in various areas of the service territory in order to accommodate multiple customers seeking to interconnect to the same substation or circuit.

For all customers seeking to interconnect DER, Eversource seeks to improve upon the tariff mandated time frames for each step in the process. Further, the Company actively works to educate customers to ensure they understand their role in the process. Eversource understands a fair, transparent and easy to navigate interconnection process is required to provide excellent customer service for its customers installing DER.

In order to provide this level of service given the growth in application volume, Eversource is proposing to enhance the dedicated internal DG team by deploying an interactive DER Customer Portal. This will take the place of current spreadsheet and manual-based processes. The software will track all phases of the interconnection application from the pre-application report to the final interconnection agreement. It will include a secure login feature so customers can easily visit a website to view the status of their application as it moves through the process. A key feature of this software will be to provide visibility into the tariff timeline clocks. For instance, if a system impact study is on hold pending information from the customer, the website will describe the missing information and the time lapsed days since Eversource requested the information. The website will also provide an efficient mechanism for customers to ask questions of Eversource to the extent that a part of the process is unclear with the backup of a dedicated team available via phone. The portal will have information available to customers including tariff documentation, educational materials and technical standards. From the customer's perspective, the portal will provide a single point of information that will guide them through the applications process. It will act as a personal assistant managing all communications dates and supporting documentation.

The portal will also facilitate sharing of information between customers and developers with the intent to provide developers an easier process for submitting applications on behalf of customers. Both parties will have an efficient mechanism to understand where applications are in the process. Developers will also have the ability to analyze past and present application activity to support historical review, future planning and ad-hoc reporting. Eversource expects this tool will enable it to provide user friendly information to DER developers that will help them gain insight into the mapping of distributed generation on the system and expected capacity limits going forward.

Investment Description

The primary component of the DER Customer Portal is the software itself and the resources required to integrate it with existing systems and processes. This effort will include moving all

historical application data into the new system to ensure a single data repository for all DER inquiries on installed capacity, application volume and tracking statistics.

(2) Energy Storage

Given the recent advances in energy storage technology and cost-effectiveness, it is hard to imagine a modern electric distribution system that does not include energy storage.

Distributed energy storage has the potential to redefine the nature of the electric power grid. Today, the grid is characterized by the need to balance load and generation every second, primarily by dispatching generation. Early applications of storage such as pumped hydro and damned rivers are proven to provide benefit, but are typically long distances from load and rely on transmission infrastructure. Eversource is tracking and learning from other jurisdictions that have implemented local energy storage pilots and demonstrations. As part of this Plan, Eversource is contributing to the advancement of energy storage technology in Massachusetts by seeking out relatively cost effective applications that deliver meaningful benefit to customers.

Reduce the Impact of Outages	Optimize Demand	Integrate DER	Workforce and Asset Management
	✓	✓	✓
Five Year Investment: $7.0 million			
Enabling Investments: Communications, distribution management system			

If cost-effective, storage systems have the capability of serving multiple applications. The range of possible applications includes peak shaving, load shifting, system resilience, renewable intermittency mitigation and ancillary services. There are multiple applications at the transmission, distribution and end-user level that may ultimately prove to have net benefits for customers. In order to focus its efforts, however, the Company has identified the application that is likely to deliver the greatest benefit to customers today.

Massachusetts is experiencing a dramatic increase in the installed capacity of solar photovoltaic ("PV") systems on the power grid. Currently, the Company has over 11,000 PV facilities deployed across its service territory. A relatively small number of these systems make up the

majority of the installed capacity. These large solar farms are complex interconnections requiring extensive study and often major system upgrades. These system upgrades are often associated with ensuring voltage on the interconnecting circuit remains within acceptable percent tolerance ranges to avoid having a negative impact for other customers served off the same circuit and substation bus. There are certain areas where the growth in applications for these large facilities is so great that a large solution is required to ensure continued power quality. As a result, Eversource is proposing to deploy energy storage aimed at voltage smoothing to address PV intermittency.

In its December 2013 report, "Grid Energy Storage", the USDOE states that energy storage is "eminently suitable for damping the variability of wind and PV systems and is being widely used in this application"[9]. This application requires an energy storage system that can respond rapidly to fluctuating system conditions. Based on a maximum expected ramp up and ramp down rate in MW per minute and the time duration of the ramp it is possible to identify the correct size and type of storage required. In general, load following is characterized by power output that generally changes as frequently as several times per minute. In addition to the smoothing of real power support, much of the power conversion systems can provide dynamic reactive support for the distribution system.

Although there are a number of locations on the Eversource system that have large-scale solar, New Bedford is an area that is notable both for the quantity of existing generation and the number of projects proposed for deployment. For example, a substation in the City of New Bedford is served by two 115-kV transmission lines, which run generally east to west. The transmission is stepped down to distribution voltages by two 115/13.2-kV transformers (each with a normal rating of 30 MVA, emergency rating of 50 MVA). The station has ten 13.2-kV distribution feeders and served a peak load of 36.7 MVA in 2014. The nature of the load at this station is a mixture of residential, commercial and heavy industrial. There is approximately 20 MW of PV installed and operating on these circuits. Applications have been submitted for more than 25 MW of additional PV generation at this station.

[9] http://energy.gov/sites/prod/files/2014/09/f18/Grid%20Energy%20Storage%20December%202013.pdf. Page 25.

This is the type of location that requires a solution to address the impact of intermittency and thus represents an excellent potential site for an initial deployment. As a part of the project, Eversource will consider Station 636 and other potential locations to determine the optimal deployment. The project will also include refining the procedures for permitting, interconnecting, testing, and controlling an energy storage system. The eventual result will be a more streamlined process to ensure safe and effective energy storage implementations going forward. Eversource estimates that a storage system with a power rating of 3-5 MW and duration of 15-30 minutes (approximately 1-2 MWh) would be needed to help smooth this intermittency.

Energy Storage is an important tool for utilities in addressing the challenges of intermittent PV generation. A solution to address voltage fluctuations will make it possible for more facilities to come on line at the substation with a relatively less complex interconnection study process and lower system modification costs.

Further, the ability to smooth the fluctuations power output from a PV system will result in less stress on the grid by reducing cycling on the associated transformer load tap changers, voltage regulators and capacitor banks. This will support improvements in asset management at the affected substation. Lastly, filling in the gaps in the variable output of intermittent renewable sources will better enable Eversource to count on the generation capacity for system planning purposes.

Given the right conditions, it is possible Eversource will be able to realize the benefit by using the storage asset to shift power throughout the day. In the hot summer months, this would involve shifting solar power to match late-afternoon air conditioner loads. This has the possibility of extending the life of existing assets and to maximize their usage.

Investment Description

Eversource is proposing to deploy one battery energy storage project as part of the STIP. However, given the notable reduction experienced in costs for battery storage, it is possible that the Company will be able to accommodate a second, smaller project in this time period. In addition to the battery itself, the energy storage project investment cost includes all of the

balance of plant and control devices required to operate the unit. It also includes the DSCADA capability that will allow for remote dispatch of the facility as needed. As a result, the investment is enabled by both the DMS and communications infrastructure.

(3) Adaptive Protection/Two-Way Power Flow

Reduce the Impact of Outages	Optimize Demand	Integrate DER	Workforce and Asset Management
✓		✓	✓
Five Year Investment: $1.1 million			
Enabling Investments: Communications, microprocessor relays			

A complex and modern distribution system characterized by two-way power flow and sophisticated automation will require state-of-the-art protection capabilities to ensure that all automated operations are coordinated with each other such that they function without negative impact to other operations of the distribution system. Investments in adaptive protection and two-way power flow will directly support the integration of DER onto the grid. The installation of these advanced technologies will be crucial to ensure that a greater number of DER interconnections will be able to operate in a safe and reliable manner. These investments also have significant ancillary benefits associated with them; including reducing the number and duration of outages along with a reduction in maintenance cost.

The electric grid was designed for power to flow in one direction from the transmission system through the substation transformer and into the distribution grid. The substation transformer has a load tap changer ("LTC") which was designed to control voltage when power flows in one direction. In some cases the interconnection of DER on the distribution system has caused power to flow in the reverse direction; from the distribution line into the substation transformer. Upgrades to the LTC are required to ensure there is no negative impact to the transformer from this reverse flow condition.

Over many years, Eversource has installed traditional electro-mechanical relays throughout the service areas. These electro-mechanical relays, while effective at protecting the grid from faults, were not designed with advanced logic or communications required for a dynamically changing system resulting from distribution automation and multiple DER power sources. The existing electro-mechanical relays cannot protect for all the potential feeder configurations that might be expected in the future grid including unintentional islanding. Upgrading these legacy electro-

mechanical relays with microprocessor-based relays with adaptive protection is required as greater DER penetration and system automation takes place. Adaptive protection relays have the ability to provide more advanced protection logic and can communicate with other devices, which is critical to adapt to changing system conditions and avoid unintentional islanding. These advanced relays can communicate directly with DER and other feeder devices and know, in real-time, if the DER is producing power, if a distribution line has been reconfigured, or if transmission lines are out of service. In these events, the adaptive relay can enable changes in protection settings in response to prevailing system conditions.

Depending on grid conditions, the relay has the ability to adapt or change its logic and set points. The benefit of installing new adaptive protection relays and LTCs designed for reverse power flow in the substations is to proactively prepare the grid for DER while providing better voltage control, better reliability and reduced maintenance cost.

When a developer files an application to interconnect DER to the grid, one of the first steps in the process is to perform an engineering study to determine what system upgrades are required for the interconnection. Recently, the engineering studies have determined, as greater penetration of DER takes place, the normal power flow is reversing direction; flowing from the distribution side of the substation transformer into transmission line. Reverse power flow creates several unacceptable impacts including unregulated substation transformer voltage; potential unintentional islanding; and relay coordination issues. These investments will help address these impacts.

In addition to enabling DER integration, the adaptive protection relays will reduce the frequency and severity of outages. The adaptive protection relays have the ability to detect and report temporary faults. If an incipient fault is detected, in some cases, repairs can be made before it results in a permanent outage. During a fault condition, the faster operation of the microprocessor relays will reduce the amount of equipment damage. In addition, the advanced protection logic can determine which phase is faulted and in some instances the general location (distance to fault). This information, in coordination with fault indicators, will expedite locating the damage reducing the duration of the power outages.

This grid modernization investment will improve the efficiency of relay maintenance. Many of the legacy electro-mechanical relays do not have the ability to self-check and report when they are in need of maintenance. Regular maintenance cycles are performed on the electro-mechanical relays to assure they continue to operate properly. The new microprocessor adaptive relays monitor their own performance and report, via communications, if they require maintenance.

Investment Description

As described above, the technology required for advanced protection is largely the microprocessor relays and LTC controls. These investments are captured in the "sensing and monitoring" and "voltage and VAR optimization" categories. As a result, this investment relates to the resources required to understand the complex settings and engineering required to maximize the full potential of adaptive protection to integrate DER, including advanced inverters, and to reduce the impact of outages.

e) SMART AND INTEGRATED GRID – INVESTMENT SUMMARY

Smart and Integrated Grid STIP investments are summarized in the table below.

Table 7 – Smart and Integrated Grid Summary Investments

		Investments		$ Millions					
				Year 1	Year 2	Year 3	Year 4	Year 5	Total STIP
Smart & Integrated	Grid-Wide Situational Awareness	Advanced Sensing Technology	Capital	$16.2	$16.2	$11.5	$8.0	$8.0	$59.9
		Next Generation Remote Faulted Circuit Indication	Capital	$1.3	$3.4	$6.4	$5.9	$4.2	$21.2
	Advanced Analytics	Distribution Management System	Capital	$0.0	$3.3	$3.3	$0.0	$0.0	$6.6
			O&M	$0.0	$0.3	$0.3	$0.3	$0.3	$1.1
		Network Load Flow	Capital	$0.0	$0.8	$1.6	$2.4	$3.1	$7.8
		Predictive Outage Detection	Capital	$0.0	$0.0	$0.2	$0.9	$1.1	$2.2
	Real Time Flexible Grid Action	Automated Feeder Reconfiguration	Capital	$8.0	$9.3	$9.4	$11.1	$9.9	$47.6
		Volt VAR Optimization	Capital	$0.0	$0.1	$1.1	$3.8	$4.8	$9.8
	Dynamic DER Integration	Integrated Planning and Tracking for DER	Capital	$3.2	$2.8	$1.1	$0.4	$0.0	$7.6
		Energy Storage	Capital	$0.4	$3.5	$2.8	$0.4	$0.0	$7.0
		Adaptive Protection/Two Way Power Flow	Capital	$0.0	$0.0	$0.1	$0.4	$0.6	$1.1
		Capital		$29.0	$39.4	$37.5	$33.2	$31.7	$170.9
		Less: Baseline Capital Investment		($9.5)	($9.5)	($9.5)	($9.5)	($9.5)	($47.3)
		Total Incremental Capital		**$19.6**	**$30.0**	**$28.0**	**$23.8**	**$22.3**	**$123.6**
		Total O&M		**$0.0**	**$0.3**	**$0.3**	**$0.3**	**$0.3**	**$1.1**
		Total Incremental STIP Investment		**$19.6**	**$30.2**	**$28.3**	**$24.0**	**$22.5**	**$124.6**

C. Resilient Grid: Goals, Drivers, Investments, Technology/Project Descriptions

1. Investment Objectives

A strong and resilient grid infrastructure is critical prerequisite for an increasingly modernized grid. It does not make sense to make substantial investments in the deployment of advanced technology installed on the backbone of the distribution system if that backbone is not reinforced to serve as a strong, resilient platform. Many state jurisdictions have recognized the monumental task that exists in reinforcing the backbone system to support a more modernized and reliable delivery of electric

Reduce the Impact of Outages	Optimize Demand	Integrate DER	Workforce and Asset Management
✓			✓
Five Year Investment: $150 million			
Investments Enabled: Underground Electrical Safety and Resiliency Program and Overhead Safety and Resiliency Program			

service. Every aspect of the electric distribution system will eventually have to be updated in order to achieve the full vision and benefit of grid modernization. Eversource recognizes this consideration and the importance of a resilient grid.

A good example of the cross-over between system resiliency and grid modernization is the installation of remote fault indicators. This is because of the inherent difficulty of detecting a fault and getting into the underground system, with the point of entry being the manhole. The value of the fault indicator is that it functions to identify problems on the underground distribution system where it is not possible to see where the problem is. Without remote fault detection, locating underground faults involves a tedious and time consuming process to locate the fault and access the manhole to enable repairs. These actions often require moving vehicles parked over manholes covers, detouring traffic and pumping water and excessive dirt out of manholes to allow access. With remote fault indication, however, system operators will be able to locate the fault from the system operations center and dispatch crews directly to the trouble area. This will reduce the amount of time it takes to restore customers, lessen associated restoration costs and mitigate strain on the system relative to traditional fault locating practices. Conversely, once remote-sensor equipment is installed in manholes, it needs to be maintained and monitored; otherwise the significant investment that must be made to install this type of sophisticated equipment is undermined.

2. Resilient Grid – Proposed STIP Investments

In light of this prerequisite for a resilient backbone to support grid modernization, Eversource has included a system-resiliency component in its GMP to continue and expand on an incremental program that the Company has been conducting with substantial impact on service integrity and reliability. Specifically, the Company will conduct an electric-infrastructure program for the distribution system, with two components: the Underground Electrical Safety and Resiliency Program and the Overhead Reliability and Resiliency Program. These programs are designed to support inspections and reinforcement of the underground distribution system and to improve and accelerate the Company's upgrading and replacement of overhead utility poles and associated infrastructure.

From an overall perspective, the Underground Electrical Safety and Resiliency Program and Overhead Reliability and Resiliency Program are structured: (1) to assess the condition of infrastructure in use on the Eversource East system; (2) to identify infrastructure that needs repair, replacement or remediation; and (3) to perform and complete repairs, replacements and remediation of that equipment on a timely basis. The specific maintenance and capital projects that the Company will undertake through these programs will result directly from the inspection and/or assessment process. All of the activities encompassed within this program are necessary to establish the physical foundation for technology deployments that are part of the Company's GMP.

Underground Electrical Safety and Resiliency Program: The objectives of the *Underground Electrical Safety and Resiliency Program* are: (1) to enhance the safety and resiliency of electric service to customers served by the Company; (2) to mitigate the potential for stray-voltage occurrences and manhole events in the municipalities served by Eversource East; and (3) to protect equipment and investments in advanced technology installed on the underground system to maintain functionality. To achieve these objectives, the program will involve a number of activities performed on a cyclical, year-to-year basis. These activities include:

Manhole Inspections: Eversource East will inspect and assess the condition of manholes and establish priorities for corrective-maintenance repairs and capital-replacement projects arising from the inspection process. The inspection process will cover manholes using duct-manhole construction on the Eversource East distribution system. Inspections will be undertaken on a systematic and targeted basis evaluating a range of conditions and circumstances within the manhole. Inspection priorities will take into account the number of primary circuits in a manhole, the proximity of the manhole to its source station, equipment (such as transformers or switches) within the manhole and the number of previous failures (if any) within the manhole, among other factors. Stray-voltage testing will be completed as part of the manhole-inspection process.

Damage and Voltage-Indication Testing of Underground Infrastructure: Eversource will perform inspections and testing on all Company-owned or maintained low-voltage underground

secondary equipment and underground facilities accessible to the public on a rolling three-year cycle at a minimum in the City of Boston and five-year cycle in the remaining service area. This testing will include all above-grade electrical infrastructure supplied by the underground distribution system and other metallic structures located within a 10-foot radius of Eversource-owned manholes in the City of Boston. Eversource will target inspections and testing to the area's most susceptible to the occurrence of stray voltage. Eversource will take all necessary actions to repair or remediate any situations detected through this process that have the potential to cause a stray-voltage occurrence on equipment owned or maintained by the Company.

Damage and Voltage-Indication Testing of Additional Infrastructure: Eversource will test for stray-voltage on equipment including secondary risers, sweeps and conduits; secondary pedestals; padmount transformers and transformer enclosures; padmount switchgear, termination cabinets and junction boxes; and control cabinets such as pole-mounted capacitor controls, to the extent that this equipment is owned or maintained by the Company and accessible to the general public. This scope of testing will encompass approximately 70,000 locations across the Eversource East system.

Monitoring and Tracking Systems: Eversource East will maintain a monitoring and tracking system to record and document stray-voltage events, including data relating to the equipment affected, pertinent system conditions, remediation and other relevant information designed to enable root-cause analysis and targeted inspections. Eversource East will also maintain a database of manhole inspections and required repairs resulting from those inspections and will prioritize the resulting corrective-maintenance repairs and monitor and track those repairs by priority level. Eversource East will file annual reports with the Department summarizing the status of its Underground Electrical Safety and Resiliency Program detailing the activities undertaken by the Company and assessing the results.

The activities to be undertaken by the Company as part of the Underground Electrical Safety and Resiliency Program will include the following for Eversource East:

- Manhole safety and reliability inspections and completion of inspection-related repairs, replacements and remediation;
- Damage inspections, voltage-indication testing and repairs and remediation of above-grade equipment supplied by the underground electric distribution system and within 10 feet of a manhole;
- Damage inspections, voltage-indication testing and repairs and remediation of Eversource-owned secondary risers, secondary pedestals and padmount transformers in any location served by the underground distribution system and accessible to the public;
- Evaluation, assessment and potential deployment of new technology and equipment;
- Information systems to track inspections and compile results; and
- Additional forensic analysis of failed equipment and participation in an industry-sponsored cable-splicing work group.

Overhead Safety and Resiliency Program: The objectives of the *Overhead Safety and Resiliency Program* are: (1) to enhance the safety and resiliency of electric service to customers served by the Company, and (2) to protect equipment and investments in advanced technology installed on the overhead system to maintain functionality. To achieve these objectives, the program will involve a number of activities performed on a cyclical, year-to-year basis. These activities include:

Pole Inspections and Replacements: Pole inspections and replacements are prioritized by the Eversource East engineering department based on several factors including historical performance and pole vintage, adopting a "worst first" approach. The Company's experience over the past five years is that the pole refurbishment and replacement has been a singular factor in limiting damage of major weather events and aiding in expeditious restoration. Stronger poles will be better positioned to resist severe weather events and will help to protect advanced technology installed on the Company's system. As part of this program, the Company will evaluate pole replacements and utilize new composite poles in circumstances that require an even higher level of strength and resiliency than that provided by the latest standard wood pole.

Double-Pole Transfers and Removals: The Company will remove existing double-pole sets and institute strategies to mitigate the number and duration of new double-pole sets. Specifically, the Company is working to minimize the number of new double-pole sets relating to Eversource-maintained poles that require replacement as a result of pole condition or the need to upgrade pole height to accommodate overhead lines with additional load-carrying capability. If a pole replacement is required, the existing wires and equipment are transferred to the new pole in a manner that manages and mitigates the duration of the new double-poles.

Vegetation-Related Resiliency Initiatives: To achieve a greater level of system resiliency, Eversource is instituting enhanced tree-trimming cycles including areas of ground to sky clearing. Beginning in 2012, the Company commenced an initiative to perform an Enhanced Tree Trimming ("ETT") specification, clearing a 10 foot x 10 foot x 15 foot zone around the primary distribution lines, wherever possible. This enhanced zone provides improved reliability performance on blue-sky days, and more resilience under adverse weather conditions. Beginning in 2016, the Company will institute a program to preserve this enhanced clearance zone along the backbone of three-phase primary circuits that were trimmed to the ETT specification between 2012 and 2015. The Company's estimates that this represents 45 percent of the 7,200 miles cleared to the wider specification, or approximately 3,240 miles. This clearance level is in addition to performing the standard clearance on the program miles and this specification is much greater than the Company's routine maintenance specification, as it calls for clearing all overhanging limbs and/or trees. Circuits are identified through historical reliability data, and layered over the maintenance cycle to achieve efficiencies. When circuit backbones are trimmed to this specification there is a dramatic change in the aesthetics of the roadside forest along with a commensurate improvement in reliability.

The activities to be undertaken by the Company as part of the Overhead Safety and Resiliency Program will include the following for Eversource East:

- Pole inspections to determine condition of pole and to facilitate refurbishment or replacement;
- Completion of all priority distribution-pole replacements and restorations; and

- Scaling back of overhead vegetation to improve clearances and protect overhead facilities.

Investment Description:

The investment required for the Resilient Grid component of the GMP is $25 million annually. The activities that will be performed as part of the GMP Resilient Grid programs constitute both capital and expense functions. Of this $25 million, the Underground Safety and Resiliency Program and elements of the Overhead Safety and Resiliency Program account for approximately $15 million in annual (O&M and capital-related revenue requirement). Vegetation-related resiliency accounts for $10 million annually.

D. Customer Engagement: Goals, Drivers, Investments, Technology/Project Descriptions

1. Introduction and Overview

Eversource developed a targeted, opt-in TVR program that is focused on its customers' needs and provides for a more cost-effective solution than an opt-out program. As a result, Eversource is proposing in this Plan, an innovative opt-in TVR program that will engage customers in a meaningful manner, while achieving the majority of the benefits of an opt-out program at a fraction of the cost.

Reduce the Impact of Outages	Optimize Demand	Integrate DER	Workforce and Asset Management
	✓		
Five Year Investment: $108.2 million			
Investments Enabled: Opt-in TVR meters and systems			

In addition, to develop Eversource's approach to TVR, Eversource completed research on successful TVR approaches. One of the most successful is an opt-in targeted TVR, where customers can create a community of customers to bridge the entire peak load period. In addition to appealing to the concept of communities and social connectivity, the data indicates that customers are more disciplined about reducing load consistently during a short 2 hour period than customers placed onto a TVR covering the entire peak period, which is typically not the case in a traditional opt-out program. Moreover, Eversource can build on the customer's desire to help their environment, and to connect with others in the community by creating visibility at a participant or team level on their success at reducing peak load.

Eversource's opt-in TVR program will be made available to all residential and small commercial and industrial ("small C&I") customers. However, in order to maximize the value of the program, the Company will focus its marketing and outreach efforts on those customers with the discretionary load to shift. Customers with a sufficient amount of discretionary load will be able to maximize bill savings under TVR and, therefore, this strategy will enable to the Company and its customers to achieve the greatest amount of benefits in a more cost effective manner.

Offerings

For the opt-in TVR program Eversource is proposing two TVR options in addition to the Company's current Fixed and Variable Rate Basic Service offerings. The two options are (1) a Time-of-Use and Critical Peak Pricing ("TOU/CPP") rate available to residential customers and (2) a Targeted Time-of-Use ("Targeted TOU") rate available to both residential and small C&I customers, both explained in more detail below. Residential customers will have the option of electing a TOU/CPP rate or Targeted TOU rate based on their load profiles and level of risk aversion. Customers with central air conditioning and other discretionary load may benefit most from a TOU/CPP rate as they can respond to peak day events called by the Company. Other customers may elect the Targeted TOU option which utilizes Target Peak hours that are only two hours in duration to accommodate their desire greater price certainty.

These two options balance the Department's desire to more closely match price signals in the wholesale market with Basic Service prices with the need to recognize that many customers may not be comfortable with the potentially extreme price swings that accompany CPP pricing or the long duration of traditional peak period pricing.

Eligibility

These options would be available to all of the 1.3 million residential and small C&I Eversource electric customers in Massachusetts. This represents approximately 95 percent of the Eversource customer base in Massachusetts. The remaining 5 percent are streetlights and large industrial customers. Streetlights are lit based on the amount of daylight and therefore cannot respond to TVR. Large industrial customers typically procure supply from alternate suppliers which can

already offer different TVR rate structures. Proposed rate class availability for TVR is shown in Table 8- Available Rate Classes for TVR.

Table 8- Available Rate Classes for TVR[10]

Operating Company	Territory	Tariff	Class	Availability	# of customers
WMECO	Western Mass	R-1	Residential	All non-heat resi load	133,009
WMECO	Western Mass	R-2	Residential	All non-heat low income resi load	30,613
WMECO	Western Mass	R-3	Residential	All space-heating resi load	18,161
WMECO	Western Mass	R-4	Residential	All low income space heating resi load	4,132
WMECO	Western Mass	24	Small C&I	Church customers	198
WMECO	Western Mass	G-0	Small C&I	Commercial load < 349 kW	20,538
NSTAR Electric	Greater Boston	R-1	Residential	All non-heat resi and church load	544,585
NSTAR Electric	Greater Boston	R-2	Residential	All low income resi load	55,303
NSTAR Electric	Greater Boston	R-3	Residential	All space-heating resi and church load	44,884
NSTAR Electric	Greater Boston	G-1	Small C&I	Commercial load <= 10 kW	71,485
NSTAR Electric	Cambridge	R-1	Residential	All non-heat resi load	40,328
NSTAR Electric	Cambridge	R-2	Residential	All low income resi load	2,278
NSTAR Electric	Cambridge	R-3	Residential	All space-heating resi load	1,646
NSTAR Electric	Cambridge	R-4	Residential	All low income space heating resi load	179
NSTAR Electric	Cambridge	G-0	Small C&I	Commercial load <= 10 kW	5,361
NSTAR Electric	Cambridge	G-1	Small C&I	Commercial load> 10 kW and <=100 kW	2,014
NSTAR Electric	Cambridge	G-5	Small C&I	Grandfathered commercial space heating	60
NSTAR Electric	South Shore, Cape, Vineyard	R-1	Residential	All non-heat resi load	262,559
NSTAR Electric	South Shore, Cape, Vineyard	R-2	Residential	All low income resi load	28,511
NSTAR Electric	South Shore, Cape, Vineyard	R-3	Residential	All space-heating resi load	24,112
NSTAR Electric	South Shore, Cape, Vineyard	R-4	Residential	All low income space heating resi load	2,697
NSTAR Electric	South Shore, Cape, Vineyard	G-1	Small C&I	Commercial load <= 100 kW	44,550
NSTAR Electric	South Shore, Cape, Vineyard	G-4	Small C&I	Grandfathered general power customers	28
NSTAR Electric	South Shore, Cape, Vineyard	G-5	Small C&I	Grandfathered commercial space heating	827
NSTAR Electric	South Shore, Cape, Vineyard	G-6	Small C&I	Grandfathered all electric school customers	7
					1,338,065

TOU/CPP Option

The TOU/CPP option seeks to reduce summer peak load and is targeted towards customers with the discretionary load required to make an impact during this period. Under a TOU/CPP option, customers would be subject to pricing at three time periods: off-peak, peak, and critical peak. Eversource defines the peak period as weekdays from 12 p.m. to 6 p.m. Off-peak would include all other hours including weekends and holidays. Peak-period pricing will be higher than off-peak pricing and will reflect the relative price differentials observed in the ISO-NE wholesale energy market. The CPP peak period is a six-hour window compared to a more traditional eight-hour or longer peak period. Page 1 of *Appendix* 3 ISO-NE Load Profile for Summer Months

[10] The available rate classes do not represent the total universe of residential and small C&I customers. Rate classes with existing time-of-use definitions built into distribution rates would be excluded to avoid customer confusion regarding applicable peak and off peak hours.

shows the average ISO-NE hourly weekday load profile from 2012 to 2014 for the summer months of June, July, August, and September along with the proposed peak period in red. A condensed peak period is preferred compared to traditional peak period hours to better target the hours where the highest demand has been observed.

Under a TOU/CPP offering, Eversource would target twelve peak days per year in establishing a trigger for critical peak events. This was the number of events utilized in the NSTAR Electric Smart Grid pilot. Peak days typically occur in the months of July and August which means that twelve peak days would average to more than one per week during those months. Targeting twelve events per year offers a good introduction to customers unaccustomed to time-of-use pricing. The frequency of events can be ramped up in the future should there be a demonstrated reason to do so. The proposed trigger point for a critical peak event will be a megawatt ("MW") threshold, as determined below. If the load forecast for the ISO-NE Day Ahead market shows that the MW threshold will be exceeded, the Company will identify those hours within its peak period that will be affected and use a variety of communication mediums to notify customers. These critical peak hours will be subject to a very high price reflecting the scarcity of capacity during the period.

On an annual basis, Eversource would review the hourly demands at ISO-NE to determine the average of the twelve peak days over the most recent three-year period. The highest observed hourly demand in the lowest peak day will become the MW threshold. *Appendix* 4 CPP Event Threshold provides an example of this calculation where a threshold of 22,507 MW is established. At this level, the threshold would have produced six events in 2014 and thirteen events in 2013 and 2012. All of the events would have taken place during the period June through September.

NSTAR Electric's Smart Grid Pilot, which also utilized a TOU/CPP option, showed that the most common strategy for reducing electricity consumption during critical peak events was to limit the use of air conditioning with nearly half (46 percent) of participants increasing their thermostat set-point, pre-cooling their home, or turning off their air conditioning altogether during the event. In this way, CPP events will seek to lower customers' usage at the time of the

ISO-NE system peak. Capacity market obligations are based on a customer's load during the system wide peak. Thus, reducing summer peak load would reduce customers' share of capacity obligations and, in turn, decrease customer costs, assuming that all other things in the New England marketplace stay equal. Additionally, ISO-NE procures generating capacity through the Forward Capacity Market ("FCM") based on a forecast of peak loads three years in advance of a commitment period. By consistently and significantly lowering customers' usage during the summer peak periods, long term peak load forecasts will decrease and ISO-NE will procure less generating capacity. Forward Capacity Auctions, which are the means by which ISO-NE solicits generating capacity, establishes prices based on a supply and demand curve. If ISO-NE seeks less generating capacity in a given auction than it would otherwise, then prices will be lower. Lowering customers' usage at the time of the ISO-NE system peak will create savings in the short term because customers will be responsible for a lower share of the New England capacity obligation and create savings in the long term because capacity prices will be lower than they otherwise would have been.

Design of TOU/CPP Rates

The TOU/CPP price option would be designed to be revenue neutral to the Company's Fixed Price Basic Service offering. Under a TOU/CPP program, the TVR offering would be aligned with its procurement of Basic Service supply. Basic Service rates become effective twice a year (January and July) for residential and small C&I customers. CPP rates would be constructed as follows:

- Construct forecast kWh by time-of-use period;
- Calculate average energy price by time-of-use period;
- Calculate energy revenue using time-of-use prices;
- Allocate capacity costs to peak and critical peak period;
- Sum capacity and energy revenue; and
- Calculate final rates.

Appendix 5 TOU/CPP Rate Methodology provides an illustration of the proposed methodology to develop TOU/CPP rates for the first and second halves of the year.

Illustrative CPP Rates

Using a 10 cent/kWh illustrative Residential Basic Service fixed price and applying the methodology described above and presented in *Appendix* 5 TOU/CPP Rate Methodology, produces the pricing shown in Table 9 – Illustrative TOU/CPP Prices:

Table 9 – Illustrative TOU/CPP Prices

	January to June	**July to December**
Off-Peak (all other hours)	$0.06005/kWh	$0.04965/kWh
Peak (12 noon to 6 pm)	$0.27710/kWh	$0.26841/kWh
Critical Peak (variable peak hours)	$0.55875/kWh	$0.86955/kWh

Peak and Off-Peak pricing is comparable between the first and second half of the year. Critical Peak prices are notably higher in the second half of the year where July and August fall. As described previously, the Company expects CPP events to typically be called during these months.

Targeted TOU Option

Under the TOU/CPP Option, customers who have the ability and willingness to shed discretionary load for a sustained duration in the afternoon will maximize their savings. Not all customers, however, have such a load profile and some may not be willing to take on the risk of incurring the very high CPP prices. To address this customer segment, the Company is proposing a Targeted TOU option as an alternative to the TOU/CPP offering. The Targeted TOU Option will consist of targeted peak hour pricing with no CPP events to be called. The Target Peak will be condensed into three available two-hour tranches to be selected by the participant: 2 pm to 4 pm, 3 pm to 5 pm, and 4 pm to 6 pm. All other hours including weekends

will be considered off-peak. Page 2 of *Appendix* 3 ISO-NE Load Profile for Summer Months identifies the Target Peak hours under this option for the month of July. This is the month where peak days are most frequently observed in the summer. The tranches were selected based on a targeting of key hours within this month which typically corresponds to the New England system peak.

Design of Targeted TOU Rates

The Targeted TOU option is designed to be revenue neutral to the Company's Fixed Price Basic Service offering. As with its CPP rate, the Company will be establishing the Targeted TOU rates simultaneously with its Basic Service procurement for residential and small C&I customers. Targeted TOU rates will be constructed as follows:

- Construct forecast kWh by time-of-use period;
- Calculate average energy price by time-of-use period;
- Calculate energy revenue using time-of-use prices;
- Allocate capacity costs to the Target Peak hours;
- Sum capacity and energy revenue; and
- Calculate final rates.

Appendix 6 Targeted TOU Methodology details the methodology used to develop the Targeted TOU rates.

Illustrative Targeted TOU Rates

Using a 10 cent/kWh illustrative Residential Basic Service fixed price and applying the methodology described above produces the pricing shown in Table 10- Illustrative Residential Targeted TOU prices – January to June and Table 11 - Illustrative Residential Targeted TOU prices – July to December.

Table 10- Illustrative Residential Targeted TOU prices – January to June

	Off-Peak	Target Peak
Option A **(Target Peak = 2 pm to 4 pm)** **(Off- Peak = all other hours)**	$0.08982/kWh	$0.25586/kWh
Option B **(On Peak = 3 pm to 5 pm) Off-Peak = all other hours)**	$0.08982/kWh	$0.25586/kWh
Option C **(On Peak = 4 pm to 6 pm)** **(Off-Peak = all other hours)**	$0.08982/kWh	$0.25586/kWh

Table 11 - Illustrative Residential Targeted TOU prices – July to December

	Off Peak	Target Peak
Option A **(On Peak = 2 pm to 4 pm)** **(Off- Peak = all other hours)**	$0.08698/kWh	$0.28857/kWh
Option B **(On Peak = 3 pm to 5 pm)** **(Off- Peak = all other hours)**	$0.08698/kWh	$0.28857/kWh
Option C **(On Peak = 4 pm to 6 pm)** **(Off- Peak = all other hours)**	$0.08698/kWh	$0.28857/kWh

Peak and Off-Peak pricing is comparable between the first and second half of the year. Peak prices are slightly higher in the second half of the year, including the months of July and August.

The Company has allocated approximately 30 percent of capacity to the Target Peak hours in this design to align the price signals with that of the TOU/CPP option.

Participation Rate

Based on analysis of other utility deployments and its own first-hand experience with pilots in both Massachusetts and Connecticut, Eversource estimates that over the course of the STIP, about five percent of the total residential and C&I customer base may sign-up for the opt-in TVR program. The program will be marketed to all residential and small C&I customers, but the Company expects that, through its marketing program, mainly those that are well suited for this program will decide to opt-into the program.

The five-percent participation rate is an assumption that could easily change depending on customer receptivity to the program. In the cost/benefit analysis, Eversource conducted sensitivity analysis to different sets of participation rates and the results will be summarized in the cost/benefit section of the document.

Effect of TVR on Low Income Customers

Although the Company's TVR proposals are designed to be revenue neutral, individual results will vary depending on an individual customer's willingness or ability to shift load during the higher priced peak or critical peak times. This could have a detrimental effect on low income customers who opt-in to the program but cannot or do not reduce their usage during those times, as those customers are most sensitive to variability in their bills. In order to mitigate negative impacts on this segment of customers, the Company intends to partner with low-income advocates in order to provide specific and appropriate counseling and education to those customers.

The Company intends to work collaboratively with the low-income advocate organizations to engage those customers in a more holistic approach that also includes energy efficiency, and other tools to save money. Goal of the collaborative efforts is to ensure low income customers understand the range of options available to save in their energy costs.

Reconciliation of TVR

TVR has been designed to be revenue neutral to Basic Service based on a weather normalized load profile for residential and small commercial customers. To the extent that customers alter their behavior and deviate from the average load profile, there will be differences in the revenue billed and the costs incurred for Basic Service. Since TVR is backed by Basic Service procurement, the Company proposes to include TVR revenue with all other Basic Service revenue in the determination of any year end reconciliation. Basic Service reconciliation would continue to be recovered from all customers per the provisions of the NSTAR Electric Default Service Adjustment tariff (M.D.P.U. No. 104F, M.D.P.U. No. 204F, and M.D.P.U. No. 304F) and the WMECO Basic Service tariff (M.D.P.U. No. 1026BD).

Summary

A summary of the opt-in TVR program is highlighted in Figure 3– Summary of Opt-in TVR Options.

Figure 3– Summary of Opt-in TVR Options

TOU + Critical Peak Pricing *(Residential)*	Targeted TOU *(Residential and small C&I)*
▪ Available to residential customers only	▪ Available to both residential and small C&I customers
▪ Targets summer peak customers with large discretionary load	▪ Targets customers who are less willing to face sustained high peak period pricing
▪ Peak period in effect weekdays from 12 PM to 6 PM	▪ More friendly to risk averse customers
▪ All other hours are off peak plus holidays	▪ Peak period in effect weekdays and divided into 3 tranches: 2 PM to 4 PM, 3 PM to 5 PM; 4 PM to 6 PM
▪ CPP for peak day events	▪ All other hours are off peak plus holidays
▪ Peak day events called day ahead based on MW threshold at ISO	▪ No CPP events
▪ Event duration depends on forecast	

2. Customer Engagement – Proposed STIP Investments

a) OPT-IN TVR PROGRAM - METERING, COMMUNICATIONS AND HOME-AREA NETWORK APPROACH

The design strategy for the metering necessary to meet the basic requirements for either of Eversource's proposed opt-in TVR rate options can be broken down into the following two components: (1) metering approach for interval data recording of customer load; and (2) metering communications approach for collection and retrieval of the interval data.

Metering Approach - Interval data recording of customer load

The current metering technology in general use for residential and small commercial customers records a single total kWh consumption value which is then collected via drive-by Automated Meter Reading ("AMR) on a monthly basis. In order to fulfill the metering requirements needed for either of the proposed opt-in TVR rate options (TOU/CPP or targeted TOU), customer consumption will need to be recorded in either hourly or sub-hourly interval lengths via a more advanced meter than the basic AMR meter, currently in use. With the recording of interval data, the metering becomes flexible enough to support all required process steps by downstream systems for either TVR rate option.

Metering communications – Collection and retrieval of interval data

After the recording of interval data within the meter, the second basic metering requirement is how it will be collected or retrieved, referred to as the "metering communications". The required frequency for collecting the interval meter data is the most significant criteria in determining which type of communications technology to install for this purpose. For strictly billing purposes, the collection of interval data on a monthly basis fulfills the basic requirement of either of the proposed rate options. However, collecting the data on a monthly basis may not be timely enough to enable customer behavior changes required to reduce customers' load (and therefore customers' bills) during on-peak and critical peak pricing periods. In order to provide this timely feedback, some type of communication to each individual meter is needed in order to permit the interval data to be collected on a more frequent and timely basis.

For customers who opt in to either the proposed TOU/CPP or Targeted TOU rate, the Company will install different metering equipment depending on the customers' needs. The selection of which communications options best fits customers' needs will depend on the availability of the communications infrastructure with the lowest overall costs.

- ***Primary Option - Cellular Metering***

Cellular metering will be the primary metering option for the opt-in TVR program. Public/cellular carrier is currently available and ubiquitous across Eversource's service territory. It enables 2-way metering communications without the need for a metering-only communications network to be deployed and is immediately available. It will allow for a shorter start-up period for those customers electing to opt-in to the program. With cellular metering, interval data from the meter would be collected at least on a daily basis with options for more frequent collection as required. Granularity of the data into hourly intervals would be sufficient for either of the pricing programs, but could also be available in sub-hourly intervals (either 5 or 15 minutes), if needed.

- ***Secondary Option - Network Meter Reading***

Network Meter Reading ("NMR") is defined as reading meters via Eversource's private communications network. NMR will be utilized as the primary metering alternative to the cellular option in those areas where Eversource's private communication network has been deployed. NMR offers all the same benefits and capability of the cellular option with overall lower metering hardware costs, as well as lower operating costs within those defined areas where the private communication network has been installed. Under this scenario, the metering communications will be sharing the network with the Distribution Automation ("DA") equipment.

As indicated, deployment of this option is dependent on the metering communications being fully compatible with the long term private communication network strategy for DA. In addition, since the primary focus of a private communication network will be for DA equipment, the availability and timing of this metering option will be dictated by the DA roll-out schedule of

the private communication network and targeted coverage areas. If any of those conditions (i.e. compatibility, timing of required availability, or coverage area) is altered, it would ultimately affect the costs of the Plan, either by requiring additional cellular metering options, which come at a higher cost, or by requiring additional DA costs in order to support "metering-only" communication nodes within the initial five year build-out period.

Customer Home Area Network Options

For customers participating in Eversource's opt-in TVR program the Company is considering several options that will allow customers to view their meter data. The Company will choose the best option(s) available at implementation.

- ***Eversource Customer Engagement Platform ("CEP")***

This option allows the customer to use a single sign-on for all CEP functionality, including the opt-in TVR program. Customers would view this information via the Eversource webpage and have the ability to view their prior day interval meter data in various formats. The CEP would also allow the customer to receive notifications related to rate changes.

- ***Single Source Vendor***

This option requires the Company to select a vendor to offer a home area network package offering similar functionality to the CEP above.

- ***Real-Time Option***

An optional enhanced service will be available at an additional cost to customers that prefer real-time access to their energy usage data. This service will require the customer to have additional hardware installed on the meter that will communicate via the customer's internet connection. The data communicated from the meter will be sent to a single sourced vendor to provide real-time usage information and insight into their consumption habits.

b) OPT-IN TVR PROGRAM - DATA COLLECTION, BILLING AND RELATED SYSTEMS

The increase in the number of opt-in customers will require additional resources to perform the necessary functions associated with the collection, editing, and validating of the data to prepare it for accurate and timely billing and/or customer presentment. Specifically, Eversource will need to make additional investments in at least six different systems:

Complex Billing System

A new complex billing system would be required to bill the TVR rates since existing systems do not have the capability[11]. The Company has two distinct billing systems for its Massachusetts companies: C2 for Eversource West and CIS for Eversource East. Neither system can currently bill customers with complex rates requiring interval meters. This type of system will allow the Company to provide customers with electronic billing including the detail required for customers to understand the components and impacts of the TVR rate options. This new system would also provide accurate, readily available detail to our customer support centers, which is not available today, so that they can better respond to detailed billing inquiries from customers.

Eversource explored several IT architecture options to support the complex billing and associated meter data management and customer portal. The most cost effective is an architecture that connects with C2 and CIS and leverages the interfaces these systems already maintain with remittance, AR, general ledger, etc. Using this approach minimizes the interfaces needed for the complex billing engine, reducing costs and streamlining the deployment.

The new complex billing package will: support opt-in TVR rate structures proposed by the Company as outlined above; automate the ISO-NE interface for critical peak pricing; support complex rate structures; and include all interval metered customers, including net metering, special contracts, un-metered services for retail, wholesale, streetlights among others. In

[11] A complex billing engine is an additional billing system or billing module used to bill customers and rates that are not a good fit for the Company's existing mass market billing system. A complex system is often used for rates that require time varying data and meters that can capture the necessary interval data.

addition, the system will have the required flexibility to accommodate future rate structures, as required.

The new system will enable the following capabilities, necessary for the successful implementation of new and innovative complex rate structures: (1) cancel/rebill, (2) bill aging, (3) bill/payment history, (4) standard reporting, (5) credit/debit transactions, (6) user interface to maintain rates, (7) SOX controls, and (8) ease of use for call centers. As part of the implementation the complex billing system will integrate to existing C2/CIS billing systems and other systems providing meter determinants. The interfaces with these systems are required to allow use for the existing credit, revenue reporting, and self-service web and Interactive Voice Response ("IVR") capabilities.

Data Management and Storage

A new data management and storage application is required to provide access to the interval data for both customer and Company needs. Data management is critical to a successful program since participating customers will rely on access to and presentation of the interval data to make their energy usage decisions. Providing estimated, validated, and edited data the next day for a minimum of 24 periods (*i.e.,* once per hour) requires more complex processing than what is required for typical residential customers that are billed monthly or time of use customers that are billed monthly today, but are not required to view the data hourly. The system must be robust to maintain the large volumes of data and allow appropriate access to the data for customer use, as well as for Company reporting and analysis.

This new system will store interval data and the related customer, meter, billing and revenue related data for all customers with interval meters. This system will also support internal services and provide the required interval data management, data warehouse and analytics, infrastructure and interfaces and interval data needed.

Data Collection

Eversource must collect meter data to support TVR and customer data presentment for energy management, as well as support varying meter data collection modalities. The Company will use

existing Multi Vendor 90 ("MV90") and Translation Management System ("TMS") systems. MV90 and TMS are existing systems that receive the cellular calls from interval meters to collect and then analysts validate, edit and estimate the data as needed. Hourly interval data collected once per month will be sufficient for the billing of the opt-in TVR program and for ISO-NE load settlement purposes. However, the data will be collected daily for customer presentment purposes. Five and 15 minute interval data will be needed to support demand billing if needed in the future. The current systems will need to be expanded to support the new program.

Customer Data Portal

Eversource will need to invest in a new system to present interval usage and rates to opt-in customers. Data presentment will inform customers and assist in their energy management decisions. Critical peak pricing signals presentment is required so that customers recognize the change in rate in a timely manner. Rate comparisons will also be valuable to opt-in TVR customers as they can verify that their changes in energy usage have resulted in desired savings. Data presentment will take place via web portal and multiple data viewing options including smart phone and tablet. The portal will allow customers to engage with other opt-in customers as part of a team effort as well as provide access to TVR rate options and any associated programs.

Customer Notifications

Eversource will need to invest in new capabilities to communicate with customers via their preferred channel. The notifications will need to be automated and timely to ensure customers have appropriate rate signals to make informed decisions. Eversource will need to send the CPP pricing signals a day in advance via multi-media notification.

Service Orders

Eversource will need to modify certain systems, such as CIS and partner systems, to enable the creation, completion and close of orders to support interval meter installs. The TVR opt-in program will increase the volume of interval meters installations and enhanced service order capabilities will be needed to support timely installation and tracking of the TVR meters.

c) OPT-IN TVR PROGRAM - INVESTMENTS AND ONGOING COSTS

For the technologies outlined above and in order to enable the opt-in TVR program, Table 12 – Opt-in TVR Investments provides Eversource's estimates of the total costs in the 5 years of the STIP.

Table 12 – Opt-in TVR Investments

	Investments		$ Millions					
			Year 1	Year 2	Year 3	Year 4	Year 5	Total STIP
Customer Engagement	Opt-in TVR – Meters and IT Systems	Capital	$40.1	$32.9	$12.6	$9.6	$9.6	$104.8
		O&M	$0.0	$0.0	$1.1	$1.1	$1.1	$3.4
	Total Incremental STIP Investment		**$40.1**	**$32.9**	**$13.8**	**$10.7**	**$10.7**	**$108.2**

In addition, given that Eversource does not plan to deploy a communications network focused only on metering and/or the opt-in TVR program, there will be ongoing annual costs associated with the cellular charges to bring the meter data back to Eversource. Eversource anticipates these annual costs to be charged to those customers that opt-in into the TVR program.

d) OPT-IN PROGRAM EVALUATION

Eversource anticipates conducting an annual review of its opt-in TVR program to understand performance and identify any required changes. Key elements Eversource will evaluate each year include:

- What is the level of response? Small C&I and residential?
- Are there particular groups of customers showing increased interest?
- What is the impact of the program to low income customers?
- Is the program delivering the peak demand reductions expected?
- Should any of the pricing options be modified? Should the timeframes be adjusted?
- Should the program be expanded? Contracted? Discontinued?
- What has been the impact of the program on the competitive supplier marketplace? Are customers returning to basic service to take advantage of the program?
- Are the outreach efforts successful in educating customers about the opportunities?

- Are third parties providing new services that build on top of the TVR program offered by Eversource?
- Are customers satisfied with the program? Are there any major complaints?

Using responses to these and other questions, Eversource will determine if changes or enhancement to the program are necessary and will bring those proposed changes to the Department for its review and approval.

3. Opt-Out TVR Program Assessment

In its TVR Order, D.P.U. 14-04-C, the Department reached a number of conclusions regarding customer interest, engagement and behavior in relation to the implementation of an opt-out TVR program. The Company challenged certain of these findings by Motion for Reconsideration. In responding to the Company's Motion for Reconsideration, the Department stated the following:

> *During the investigation of the GMPs, parties will have the ability to challenge the underlying methods and inputs within the GMPs, including those associated with time varying rates*. See D.P.U. 12-76-C at 16-17. The Department fully expects that the GMPs filed by the electric distribution companies will be consistent with the directives in D.P.U. 12-76-C, including those regarding the common analyses and assumptions relative to time varying rates. D.P.U. 12-76-C at 20-23. *The Department notes that nothing in D.P.U. 12-76-C precludes a company from presenting evidence and argument relevant to the Department's review of the company's GMP*.

D.P.U. 14-04-D at 8 (emphasis added).

Eversource conducted a careful analysis of the TVR Order and evaluated in detail the implications of an opt-out deployment for Eversource. Eversource's analysis concluded than an opt-in TVR program is a better value proposition for its customers compared to an opt-out TVR program for the following reasons:

- ***AMF REQUIREMENTS COUPLED WITH TVR POLICY GUIDANCE ASSUME A FULL IMPLEMENTATION OF AMI, ALTHOUGH IT MAY NOT BE AN EFFECTIVE OR COST-JUSTIFIED APPROACH.***

The Department's decision in D.P.U. 12-76-B is structured so that, given current technology alternatives, a full roll-out of Advanced Metering Infrastructure ("AMI") is the only technology that will satisfy all four of the advanced metering functionalities set out by the Department.[12] Two criteria in particular dictate the implementation of AMI to satisfy the complete set of functionalities. Specifically, it is impossible to collect customer interval data in near real-time (i.e. hourly or every fifteen minutes), which could also be usable for settlement in the ISO-NE energy and ancillary service markets, absent the implementation of AMI. The same is true for the required functionality that enables two-way communication between customers and the Company.

- ***DEPLOYMENT OF AMI WOULD REPRESENT A SIGNIFICANT COST TO EVERSOURCE'S CUSTOMERS***

The implementation of AMI is a costly undertaking that involves significantly more than the replacement of meters. An AMI roll-out would entail a significant capital investment outlay across the Eversource system and would include at a minimum the following capital investment categories:

- Meters and Communications Costs
    - Meters, associated installation costs as well as costs to test and provision meters to be deployed;
    - Meter communications network costs which represents collectors, inclusive of installation costs that, depending on the technology selected, includes legal and siting fees as well as communications interoperability testing costs;
    - Project and change management costs related to a full Company AMI meter roll-out.

[12] The four advanced metering functionalities are (1) the collection of customers' interval data, in near real-time, usable for settlement in the ISO-NE energy and ancillary services markets; (2) automated outage and restoration notification; (3) two-way communication between customers and the EDC; and (4) with a customer's permission, communication with and control of appliances. D.P.U. 12-75-B, at 14.

- IT costs inclusive of:
    - A new Customer Information System ("CIS") that would be required as Eversource would need to convert all customers to this new CIS systems which involves detailed data conversion as well as building as many as 30 associated interfaces to all the other relevant internal systems that an opt-in approach avoids;
    - A new meter data management and data storage system to collect, store and process interval data, as frequently as 5 minute intervals. Meter asset systems used to store information about all meter assets;
    - ISO and Load Research Systems used to interface with internal metering, CIS and ISO-NE processes;
    - Customer data presentment and customer notification systems; and
    - Service order systems
- Stranded costs associated with existing AMR meters and systems.
    - Eversource East (formerly, Boston Edison) began deploying an Automated Meter Reading ("AMR") drive-by system in 1994. The first 300,000 meters were strategic deployments for hard-to-read locations and were deployed from 1994-1999. From 2003 through 2007, the remaining 800,000 meters were deployed to complete the entire territory. Eversource West (formerly, WMECO) followed a similar transition plan, completing its upgrade to AMR in 2005.
    - The average installation date of the current energy metering population is 2003 for Eversource East and 2001 for Eversource West. Prematurely replacing these assets en masse before they are fully depreciated, or before the end of their useful life, would create a "stranded cost."

A summary of the estimated nominal capital costs associated with a full-scale AMI deployment are presented in Table 13 – Nominal Capital Costs to Deploy AMI.

Table 13 – Nominal Capital Costs to Deploy AMI

Capital Cost Category	**Total Nominal**

Meters & Communications Costs	$281M
IT Costs	$500M
Stranded Costs	$165M
Total	**$946M**

In addition to the capital costs associated with the implementation of AMI outlined above, there are multiple areas where operational costs would be impacted including:

- Meter & communications
    - Meter equipment maintenance – Costs would increase as new meters would have more sophisticated parts that require maintenance compared to the existing metering network.
    - Communications network maintenance – Increased costs for maintenance of the communication network, inclusive of monthly operational costs to host certain portions of the network.
    - Opt-out costs – Eversource would expect that a full AMI deployment will need to contend with a vocal minority of customers who are strongly opposed to AMI meters being installed in their premises. Data from National Grid's Worcester pilot shows an AMI opt-out rate of 8.5 percent which is much higher than what has been seen in other jurisdictions at around 0.5 to 1 percent.
- Back-office support:
    - Meter data services – More analysts would be needed to support read exception processing to review and address any billing exceptions.
    - Call center – More employees will be needed to respond to increased level of calls to respond to (1) complaints related to customers being forced to an opt-out program without any choice, (2) calls to respond to questions about reasons meters are being

replaced, (3) high bill complaints once TVR program is enabled and customers are surprised by high bills, and (4) calls from customers wanting to opt-out from TVR and/or an AMI meter.

- Community energy analysts – More analysts will be needed to support a larger customer base. Similar to the call center, energy analysts would have additional work to help customers understand high bills, complaints due to the meter, etc.

- Off-cycle reads – Increased number of off-cycle reads due to communication failures not present in today's technology.

- IT – For software license fees and maintenance associated with the systems to be deployed.

- Customer education – Comprehensive outreach, marketing and education campaigns to educate customers as to the mechanics, ramifications and potential benefits of TVR.

A summary of the costs associated with the implementation of AMI for Eversource are highlighted in Table 14– Ongoing O&M Costs to support AMI Deployment.

Table 14– Ongoing O&M Costs to support AMI Deployment

O&M Category	**Annual O&M (Deployed)**
Meter & Communications	$3M
Back-office Support	$3M
IT & Cyber Security	$3M
Customer Education	$4M
Total	**$13M**

- ***IMPACT FROM AN OPT-OUT RESIDENTIAL PROGRAM IS NOT MATERIAL TO THE ISO-NE PEAK DEMAND***

The benefit of an opt-out TVR program and an AMI implementation will not be realized unless there is an aggregate response that actually reduces customer load on peak at system level on a material basis. Residential customers do not have the large discretionary load to shift in order to have a material impact on the ISO-NE peak system load. The ISO-New England system peak occurs between 1pm and 5pm, before many residential customers return from work outside the home. Customers who have the means to support sizeable households will likely have more discretionary load available, but the size of the load still remains relatively small, particularly when compared to the peak system load. As a group, residential customers are not the driver of peak loads within Eversource's service territory and account for only about 34 percent of Eversource's summer peak load.

- ***MOST RESIDENTIAL CUSTOMERS DO NOT HAVE SUFFICIENT LOAD TO SHIFT TO BENEFIT IN AN OPT-OUT TVR PROGRAM***

Air conditioners offer the greatest opportunity for residential load reductions, but the estimated central air conditioning ("A/C") penetration in Eversource's service territory is only approximately 38 percent with 2 to 3 months of use per year, compared to higher penetrations in warmer states, such as Maryland, which have 60 to 80 percent A/C penetration rate thus offering the opportunity for more significant load reductions.

Moreover, residential appliance data suggests that there is little discretionary load beyond the air conditioner. This is illustrated in Table 15 - Typical Load in 4-bedroom Home with Central A/C, which shows appliance usage in a typical 4-bedroom home. Central air-conditioning represents more than half of the household load. Lighting represents the second highest share. During peak hours, the air conditioning share of load will be even higher because lighting usage and other appliances are not likely to be in full use.

Table 15 - Typical Load in 4-bedroom Home with Central A/C

Appliance	Avg. Monthly kWh	% of Total
Central AC*	900	54%
Refrigerator	40	2%
Microwave	21	1%
Electric Oven	46	3%
Dishwasher	18	1%
Toaster	6	0%
Lighting (1)	220	13%
Clothes Dryer	68	4%
Clothes Washer	15	1%
Cable Box	56	3%
Television	135	8%
Computer	67	4%
Printer	14	1%
Cordless Phones	28	2%
Phantom Load	24	1%
Total	1,657	100%

(1) 40 sockets 10 Incan Bulbs @ 7kwh/bulb

- ***OPT-OUT CUSTOMERS SHOW LOWER RESPONSE RATES THAN OPT-IN CUSTOMERS***

Another key difference between an opt-in and an opt-out TVR program is the level of response from customers. The vast majority of TVR experience to date has been through opt-in programs. The experience to date shows that opt-in TVR participating customers are more likely to respond to TVR than the average customer. As such, the level of peak demand reduction expected from an opt-out program is expected to be less than in an opt-in program. Specifically, a recently released report from the DOE that analyzed pilots and programs supported by stimulus funds indicated that "opt-in customers had individual demand reductions that were nearly 80 percent higher than those measured for opt-out customers (25 percent vs. 14 percent), likely resulting from possible differences in motivation to reduce electricity demand for customers who opt-in, compared with those who could opt-out."[13]

- ***RESIDENTIAL CUSTOMER INTEREST ON TVR HAS BEEN LOW.***

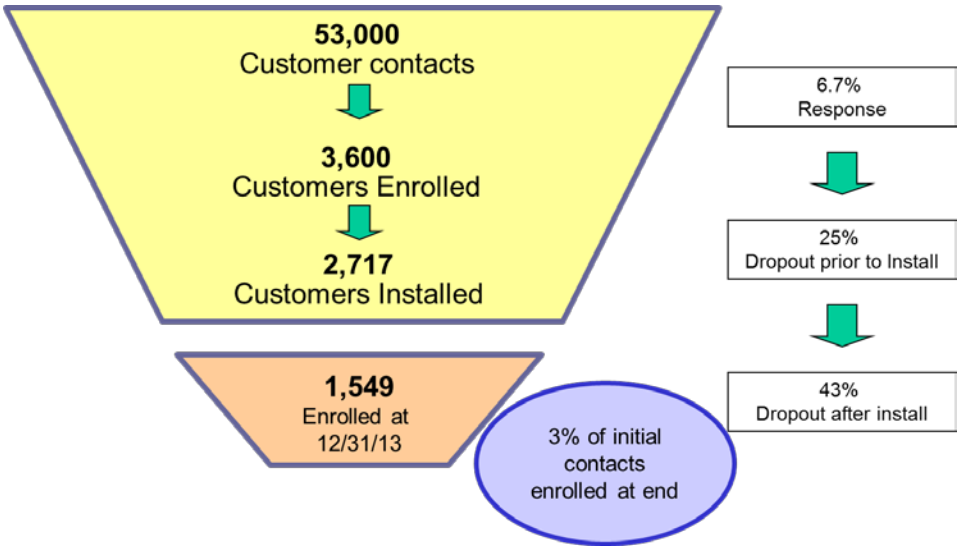
Another key element shown consistently across the TVR pilots offered in the US is that a small portion of the customers contacted decide to sign-up to these new rate structures. These pilots

[13] Cappers et al., *American Recovery and Reinvestment Act of 2009: Interim Report on Customer Acceptance, Retention, and Response to Time-Based Rates from the Consumer Behavior Studies*, June 2015, at 31.

indicate that is not the failing of marketing materials or limits of a technology, but indeed that few customers are interested in these type of TVR structures thus limiting the impact of an opt-out TVR program.

For example, although customer interest in the NSTAR Electric Smart Grid pilot was relatively strong initially, it was very challenging to convert initial interest into participation in the pilot and then sustain the interest over time. Figure 4– Customer Interest in NSTAR Electric's Smart Grid Pilot highlights that, out of the 53,000 customers contacted initially regarding participation, only 1,549 were enrolled in the pilot at the end of 2013 which represents just a 3 percent response rate.

Figure 4– Customer Interest in NSTAR Electric's Smart Grid Pilot



In addition the trend of diminishing interest over time raises questions about the long-term impacts of TVR, especially if it is mandated for all customers on an opt-out basis. Throughout the NSTAR Electric Smart Grid Pilot, enrollment declined by more than one-third over less than two years, and participation declined among those who remained in the pilot, as evidenced by declining energy impacts and reduced use of the web portal and in-home displays. The pilot shows savings in the summer of 2012 of roughly 2 percent vs. no savings in the summer of 2013. Additionally, as previously detailed, the residential sector is limited as a source of reducing peak

load costs to lower costs for all ratepayers further demonstrating that opt-out TVR is not in the best interests of the Company's customers.

The Plan-it Wise Pilot conducted by Connecticut Light and Power's ("CL&P")[14] also showed that the peak load impacts were gathered from a very small percentage of customers who actually chose to participate in the pilot. CL&P's pilot showed that customers who actively participated responded to peak pricing events; however, only 3.1 percent of residential customers contacted, respectively, actively participated in the pilot, which is a very low participation rate.

One other key demographic difference, particularly in the Eversource East service territory, is that a significant portion of the residential base rent rather than own their homes. This can limit the ability to achieve benefits from TVR due to various factors. For example: 1) if the cost of utilities are included in the cost of rent, customers do not have the monetary incentive to shift or reduce; and 2) tenants would need landlord approval and cooperation to install smart thermostats or other devices to better enable them to optimize their usage to align with TVR.

- ***SMALL C&I CUSTOMERS HAVE SHOWN LIMITED ABILITIES TO SHIFT LOAD.***

Although the foregoing discussion focuses on residential customers, many of these insights are also true of small C&I customers. These customers operate within a defined set of business hours. Unlike large industrial customers that may shift load by running manufacturing processes during off-peak hours, small business owners and offices do not have the operational flexibility to shift load.

CL&P ran one of the few pilots that tested TVR on small C&I customers, and the results demonstrated that these customers' response to TVR is very limited. For a critical peak price rate, the participants' response was only 18 percent of that observed for residential customers, while for the peak time rebate and time-of-use rate, C&I customers showed no statistical response whatsoever. Moreover, some of the required behavioral changes could have a negative impact on small businesses. For example, lighting and air conditioning load are some of the

[14] CL&P is an Eversource Energy operating company and an affiliate of NSTAR Electric and WMECO.

largest drivers of energy costs for small retail businesses. Their ability to dim lights and reduce air conditioning is limited because it can have an adverse effect on their business as it could inconvenience customers patronizing the business. Energy efficiency measures are much more attractive to these customers as they are better able to address their needs.

- ***MEDIUM AND LARGE COMMERCIAL AND INDUSTRIAL CUSTOMERS ALREADY HAVE OPTIONS.***

Many medium and large C&I customers already participate in the competitive retail energy supply market with approximately 90 percent of these customers opting out of basic service supply. These customers are heavily marketed to by 3rd party retail suppliers and have a wide range of options available to them. Some of these large C&I customers can already participate in TVR options because they have time of use metering installed. These customers can choose to take the Locational Marginal Price ("LMP") as the energy cost portion of their generation supply bill.

- ***OPT-OUT TVR PROGRAMS CAN NEGATIVELY IMPACT LOW INCOME CUSTOMERS AND THOSE CUSTOMERS WHO CANNOT SHIFT LOAD DUE TO MEDICAL OR OTHER CONDITIONS***

The NSTAR Electric Smart Grid Pilot showed that low income customers had little interest in the pilot. Despite concerted efforts by NSTAR Electric to market to all customers in the pilot territory, low income customers did not enroll in high numbers, as evidenced by the fact that only about one percent of participants were taking service under the low income rate.

In addition, in a survey of non-participants (those who were recruited to join but declined to participate), 46 percent indicated there was nothing the Company could have done to make them join. An opt-out TVR program is especially troubling for those customers who cannot shift load due to, for example, their reliance on medical devices.

- ***KEY OPERATIONAL BENEFITS FROM AN AMI DEPLOYMENT ARE INSUFFICIENT***

Eversource's analysis also indicates that the incremental operational benefits of moving to an AMI platform are insufficient to warrant the increased cost.

Eversource customers have already supported the investment associated with the installation of AMR metering technology and the incremental benefit afforded by AMI arises from the communications element, not from the metering element. Operational savings were realized with the implementation of AMR and there are no additional operation benefits that are available with the implementation of AMI. This means that the incremental benefit of AMI is largely limited to the communications element, which Eversource has determined are better addressed in other ways than the full scale implementation of AMI to support TVR and the other metering functionalities.

Two main benefits associated with moving from a manual meter system to an AMI system are the reduction of: (1) Eversource's bad debt, due to the ability to remotely disconnect customers due to non-payment; and (2) a reduction in field operations due to the fact that Eversource will not have to deploy manual meter readers to each individual customer's premises in order to generate monthly bills. Given the current environment in Massachusetts, namely that Eversource has implemented AMR infrastructure and the fact that Massachusetts' consumer protection rules require customer contact prior to disconnection, the majority of these benefits will not materialize, further demonstrating that a full scale deployment of AMI in support of an opt-out TVR program is not in customers' interests.

Conclusion

As evidenced above, there are many factors that support Eversource's proposal to focus on an opt-in TVR program instead of an opt-out TVR program. But most importantly, a strong opt-in TVR program will provide for a much better customer experience and satisfaction as customers will be presented with an option to participate and control their energy costs. In an opt-out program, customer experience will be negatively impacted as a many customers will feel dissatisfaction at having placed in a program without any opportunity to participate in the decision-making process.

E. Enabling Investments: Goals, Drivers, Investments, Technology/Project Descriptions

1. Introduction and Overview

In order to enable the functionality of a modern grid, investments must be made in certain enabling technologies that serve as a platform on which to build. The Company is proposing enabling investments in Communications, Cyber Security, and in a Customer Education and Outreach Plan, as described below.

2. Proposed Enabling Investments

(1) Communications

Reduce the Impact of Outages	Optimize Demand	Integrate DER	Workforce and Asset Management
✓	✓	✓	✓
Five Year Investment: $36.3 million			
Investments Enabled: Automated feeder reconfiguration, remote fault indication, network monitoring, predictive outage detection, Volt VAR optimization, integrated planning for DER, adaptive protection			

It is impossible to contemplate a modern grid that does not rely on a robust, high bandwidth, high speed communication system to enable real-time, automated communications to end use equipment. In fact, it is important to consider the degree to which a strong communications infrastructure builds a foundation for all grid investments in the five-year time horizon and beyond.

Eversource has been investing consistently in its communications infrastructure over time. As a result, the Company has developed robust and secure backhaul networks based on fiber and microwave technologies that extend to a portion of substations across the system. A number of different methods are employed to communicate with devices on the system. In Eversource East, a private radio network is augmented with fiber and third party cellular networks. In Eversource West, a 220 MHz private radio network is augmented with cellular when possible. These systems have served customers well to date.

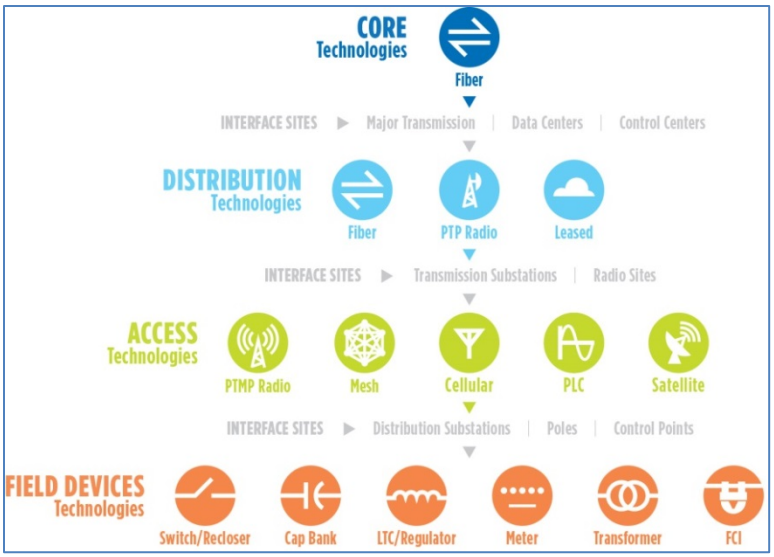
For the next generation modern grid, however, more robust communications are necessary. For example, in Eversource West today, the reclosers with DSCADA capability are limited to sending and receiving data only on command and when a device has a problem that triggers an alarm. The communications bandwidth is not currently capable of transmitting data on a regular basis for storage in a data warehouse. Regular transmission of data is a basic requirement of real-time load flows, and automated feeder reconfiguration requires higher speed and higher bandwidth than the current systems facilitate.

Another application that requires more robust communications is volt VAR control. Today, cellular and pager systems are used to turn devices on and off at different times of the year. To change settings, the changes must often be performed at the devices themselves. A modern volt

VAR control system must receive voltage data every minute, not just from voltage regulators and capacitor banks, but also from line sensors that measure voltage at additional points along the circuit. Commands from a centralized controller to devices must happen in near real time. The current communications infrastructure does not support the centralized volt VAR control that Eversource is proposing as part of its Plan.

Eversource proposes the use of private communications networks to cover most control locations where economically feasible. Private networks are important for applications that occur during emergencies, as they have greater reliability than their leased counterparts.

Figure 5– Communications Technologies Description



Investment Description

Eversource is proposing investment of $36.3 million as part of its STIP to enhance fiber and radio penetration across the service territory. The primary focus of the investment in upgraded communications capabilities will be to bring fiber to 161 substations in Eversource East and 26 substations in Eversource West where that infrastructure is lacking today. This will require the build out over 550 miles of fiber to connect these stations.

The core network will expand on Eversource's existing operational Multiprotocol Label Switching ("MPLS") network, which provides transport for SCADA communications to fiber and leased Telco-connected substations. The MPLS network will be expanded out to key transmission and communications sites that will act as district hubs for aggregating smaller distribution sites. These access network sites will contain MPLS routers, allowing the connection of the various substation networks and field area radio networks to the control centers where the DMS is located. Using MPLS technology provides a secure platform to serve multiple applications to these locations including real-time SCADA control, intrusion and video surveillance, and access to business systems at the substation. This network will be high bandwidth, with each fiber site having access to at least 20 megabits per second ("Mbps") of bandwidth. Leased sites will have access to at least 1.5 Mbps of bandwidth. These high speed links will allow all combinations to flow from field device to DMS and back in a few seconds, taking only milliseconds to get across the fiber and high bandwidth radio core.

Wireless point to multipoint and mesh base stations will be built to extend the network out from the fiber core. Existing towers and poles will be utilized where possible, and new towers and poles will be installed as needed at these locations. These new structures will be of sufficient height (up to 120' tall) to provide coverage to the adjacent feeders. The addition of these base stations will improve coverage and available bandwidth. These two improvements will allow for increased data retrieval from each device and real-time remote access for event information gathering and reconfiguration.

Eversource will utilize two radio technologies to communicate from the base stations to the end devices – point to multipoint and mesh. Both of these technologies can be deployed via licensed or unlicensed spectrums. When possible, Eversource will utilize licensed or registered spectrum. Otherwise, unlicensed spectrum will be utilized.

Point to multipoint allows many field devices to directly establish a reliable radio communication path to the base station. As a result, this type of network can be easier to deploy and troubleshoot, since there are no intermediate repeaters. If a link is not feasible, however, alternative communication technologies need to be deployed.

Mesh networks allow for multiple paths to a single end device, and they can self-form and self-heal upon the loss of any element. A mesh network can be extended to almost any location through the use of repeaters; however speed and bandwidth decrease as the hop count increases from the collector.

In addition to the point to multipoint and mesh networks, Eversource will utilize cellular communications at locations where the privately owned communications networks do not provide service. Cellular communications are best suited for applications that don't have high bandwidth and reliability requirements. In some cases, it may be desirable to utilize satellite as a communications solution. Satellite will be considered for devices that require assured reliability, but where Eversource does not have private coverage.

(2) Cyber security

Cyber Security is a core value at Eversource and the company is committed to implementing the appropriate cyber security measures into the proposed Grid Mod systems. Eversource maintains an Enterprise Cyber Security Plan that is based on ES-C2M2 (Electricity Sector Cyber Security Capabilities Maturity Model) and the Grid Mod program will be covered by this Enterprise Cyber Security plan. Due to the specific technology required for grid modernization, more specific security controls will be utilized by following the NISTIR 7628 Standards and documented in a security plan specific to the respective component of the GMP. Specific security controls will be documented and deployed to ensure data is secured and confidentiality of customer information is maintained.

The elements of the Eversource Enterprise Cyber Security Plan that will be applied to the GMP systems are outlined in the paragraphs below.

Reduce the Impact of Outages	Optimize Demand	Integrate DER	Workforce and Asset Management
✓	✓	✓	✓
Five Year Investment: $11 million			

1.0 Risk Management

All GMP related project components will be reviewed for risk using the Eversource technology risk assessment process known as CISRAQ (Corporate Information Security Risk Assessment Questionnaire). The risks for the project will be evaluated and the appropriate security controls will be specified to ensure risks are covered and any standards are met such as the NISTIR 7628 Standards which are the guidelines for grid modernization security.

2.0 Asset, Change and Configuration Management

The GMP project assets will be added to an appropriate asset management system in order to maintain an accurate system inventory. Eversource recognizes the need for accurate inventory and configuration information as a critical security control because the security program will be based around the assets that may require different levels of protection. A change management process will be used to ensure the asset inventory is maintained and appropriate approval and oversight is executed.

3.0 Identity and Access Management

Cyber and Physical Access to the GMP systems will be controlled by following Eversource Physical and Cyber access approval processes. These processes ensure the appropriate training and background checks are completed before granting access. Access to the GMP systems will require a documented request for access that will be approved by a defined system owner. These processes also include the removal of access for personnel transfers or separation of service from the company.

4.0 Threat and Vulnerability Management

In addition to the initial risk assessment (CISRAQ) done as part of the initial system design, Eversource standards require additional vulnerability assessments as changes and upgrades are done to the system. As part of the change management process, Eversource will conduct an appropriate level security review or vulnerability assessment.

The GMP systems will also be monitored for new vulnerabilities and security patches by the Eversource security team. As new alerts and patches are released, they will be analyzed for applicability and impact. Once reviewed, an implementation or mitigation plan will be documented to capture the disposition and track execution of the plan.

5.0 Situational Awareness

The Eversource Security team has many sources of outside security intelligence including a contracted Managed Security Service Provider ("MSSP"), ES-ISAC, ICS-CERT and the FBI Infraguard. Information provided by these agencies will be analyzed for impact to the GMP systems to determine potential risk and impact. In addition, logging and monitoring standards will be established specific to the grid modernization systems to ensure the appropriate level of visibility is available to monitor and alerts for security specific incidents.

6.0 Information Sharing and Communications

The Eversource Security team participates is many security information sharing organizations including ES-ISAC, ICS-CERT and the FBI Infraguard. Eversource management and internal stakeholder are also briefed on security issues. The information shared both internally and with external parties must follow Eversource Information protection and handling policies. Projects deployed as part of the Company's GMP will follow these existing processes.

7.0 Event and Incident Response

Eversource has many processes to handle incidents and ensure continuity of operations when an event causes business impact. The process in place include the Data Breach Program, Business Continuity and Disaster Recovery Plans, All Hazards Plan and IT Incident Response Plan. These processes will cover the grid modernization systems and be adjusted if there are any specific situations that need to be covered.

8.0 Supply Chain and External Dependencies

Eversource maintains a strong procurement program that gets the Eversource Security team involved when needed for specific security review of new equipment and systems. Security is typically part of the RFP review process where a vendor's security program is evaluated with a standard Due Diligence Questionnaire. The grid modernization systems will follow the existing procurement processes.

9.0 Workforce Management

Eversource maintains a Security Awareness and Training program to ensure employees are educated on important security matters. Security messages are distributed in the company daily newsletter from time to time in addition to targeted emails and training modules that are managed with the company learning management solution. It is expected that these existing programs will cover the grid modernization systems but specialized security training specific to grid modernization will be developed if necessary.

10.0 Cyber Security Program Management

Eversource maintains a Cyber Security Program that is administered by the Security Team. The program includes governance and architecture with the goal of maintaining industry standards and ensuring the confidentiality, integrity and availability of Eversource systems. Some of the standards that will be used for the grid modernization systems include NISTIR 7628, NIST 800-53 and components of NERC CIP. The Security Team will ensure that the appropriate security controls will be applied to the Grid Mod systems.

(3) Customer Engagement

Reduce the Impact of Outages	Optimize Demand	Integrate DER	Workforce and Asset Management

✓	✓	✓	✓
Five Year Investment: $19 million			

Today's energy marketplace is a complex and dynamic one, especially in a deregulated state like Massachusetts. A large majority of customers are not fully educated on how the energy marketplace in Massachusetts operates and the drivers for certain market behaviors and resulting outcomes, such as large increases in generation prices during winter months. Customers are also not well informed about the multitude of options available to better manage energy costs even in today's grid operating environment.

As a result, one of the cornerstones of Eversource's customer-facing Grid Modernization Plan is a robust customer education campaign to help customers understand the electric marketplace so they can better assess the multiple options available to manage energy costs and deploy new technologies. This kind of customer education effort should be pre-cursor to any offering of Time-Varying Rates ("TVR") as specified by the Department in D.P.U. 14-04. Once such customer education campaign has taken firm root, a TVR offering might be more likely to achieve the benefits expected of such a program.

In response to the Department's TVR Order, the Company evaluated options that would meet the overall goals of the Grid Modernization and TVR orders in the most cost effective manner. Ultimately, Eversource focused its efforts on evaluating and developing a customer-focused opt-in TVR program for its residential and small commercial and industrial ("C&I") customers. The Company's proposal will allow all of its residential and small C&I customers to have the option to participate in a TVR program. Eversource's analysis indicates that this customer-focused opt-in TVR program provides a more cost effective alternative than an opt-out option.

In this section of the Plan, Eversource first outlines its overall customer education plan, followed by an explanation of the proposed opt-in TVR program and a summary of its assessment of the opt-out TVR program.

Customer Education and Outreach Plan: Eversource customers would benefit greatly from a comprehensive education and outreach plan to fortify a broad based, basic understanding of the

workings of a modern grid in general and, potentially, TVR rates in particular.[15] To accomplish this, Eversource will leverage a powerful, engaging and actionable customer education and a multi-channel communication strategy to increase customer awareness and understanding of the benefits of Grid Modernization. The ultimate goal of all customer education and outreach efforts is to educate customers about the complexities of the electric marketplace and build positive and timely awareness of the investments Eversource is making for a resilient, modern and integrated electric grid and the customer benefits it will provide. Outreach efforts will seek to develop an effective system of communication with Massachusetts residents and businesses, given that customer education and participation are crucial to realizing the benefits of grid modernization.

Customer Education Overview and Objectives

To achieve the objectives of the Plan and deliver on our commitment to deliver reliable energy and superior customer service, Eversource will implement a comprehensive approach in educating customers. The core objectives of the customer education and outreach campaign include:

- Educating customers on the complexities of the electric marketplace and the many options available (competitive supply, distributed energy resources, electric vehicles and other concepts).
- Informing customers of the investments Eversource is making to provide a more resilient, modern and integrated electric grid in Massachusetts.
- Providing compelling and accessible information describing the benefits of grid modernization without excess jargon or overly technical language.

[15] Per Accenture's 2012 study "Actionable Insights for the New Energy Consumer" (*see Appendix* 2) "In general, electricity and energy providers are not necessarily top of mind for consumers; however, many trends in the marketplace today—smart metering, value-added products and services, and energy conservation—require greater levels of consumer interaction. Respondents spent, on average, 9 minutes interacting with a representative of their electricity provider over the past 12 months (see Figure 30). Highlighting the low level of interaction, 54 percent stated that they have not interacted with their electricity provider in the past 12 months." As such, a significant level of customer education and outreach will be necessary in order to help shift this dynamic and create additional customer engagement and awareness around grid modernization.

- Utilizing integrated channels, themes and consistent messages to maximize reach and ensure customers are exposed to messages frequently and appropriately suited for their preferred channel.
- Leveraging experience in developing, creating, and executing highly integrated, large-scale marketing and communication plans to inform and engage our customers. This includes incorporating campaign components used in multiple outreach campaigns, most recently the rebranding of our company in three states, as well as customer offerings such as Mass Save programs, gas-conversion marketing, gas-service marketing, storm preparedness, and gas/electric safety communication campaigns.
- Help customers understand how they can interact with a modernized grid. For example,
  - How they can integrate smart devices in their home to interact with the grid to optimize demand usage and reduce energy costs,
  - Help customers who have or are considering DER to get the information they need to make a decision or to manage their system from a reliable, trustworthy, partner like Eversource,
  - Help customers who have invested in clean transportation options, like electric vehicles, to connect with our grid at optimal times,
  - Help educate customers about the value of time varying rates, and to encourage participation on Eversource's innovative TVR options approach,
  - Provide our DER developers and contractors with information and education on the interconnection process and requirements.
  - Provide our TVR customers with ongoing information on how they are doing in managing their usage and integrating to the grid, and to connect them with their team members, who together cover the entire peak periods
  - To provide timely, multi-channel outreach and education in front of challenging load situations.

Customer Education and Outreach Key Themes

The key themes of the customer education and outreach efforts are as follows:

- Eversource supports grid modernization in Massachusetts and is making significant investments to support a more resilient, modern and integrated grid.
- Investments in advanced technologies will provide meaningful reliability enhancements to customers, reducing the time it takes to locate and repair damage and ultimately reducing the outage impact and duration.
- Information access to grid and technology advances, new energy options and more will engage customers and offer fast access to participation and purchase decisions.
- Beyond our everyday efforts, Eversource's GMP provides for strategic and long-term investment in new technologies and system upgrades that will support a more robust, flexible, dynamic and sustainable grid in Massachusetts.
- Eversource's GMP will support and engage our customers interested in DER interconnection not only from the grid infrastructure but also with customer service and a dedicated web portal.
- Interconnection with the grid has a defined process to ensure the safety and integrity of the grid.
- Eversource's 10-year grid modernization plan and investment will deliver on customers' needs for a modern electric grid that:
    - Is an increasingly more reliable system;
    - Is more resilient, including during storms;
    - Utilizes advanced technologies to be more aware and able to take real-time actions;
    - Can optimally integrate distributed energy resources; and
    - Provides customers with more information and choices.

Utility Collaboration

In addition to Eversource's individual customer education efforts, Eversource will work in collaboration with the other Massachusetts electric utilities to deliver a consistent, unified

and timely message across the state, leveraging when possible, the Mass Save brand to engage and emphasize the cost and energy savings opportunities for customers.

An outreach strategy that shares responsibility for desired customer outcomes has many benefits, including engaging a broader audience and persuading those otherwise less inclined to participate. Leveraging the results of the Mass Save outreach to residential and commercial and industrial customers with a cooperative utility approach, this plan will seek to model those efforts.

Eversource has discussed grid-modernization collaborative outreach strategies with both National Grid and Unitil and a collaborative effort for grid-modernization outreach can and should be achieved in certain instances, including a pre-positioning strategy and the development of common messaging concepts statewide. Differences may occur, however, in timing of outreach activities depending on the various stages of customer adoption, each requiring different communication needs. This adoption process does not support implementing collaborative communications efforts simultaneously in all cases.

The companies will continue to meet to refine the strategy and message development, provide status updates on individual implementation plans and seek collaboration opportunities, as appropriate. Eversource, in coordination with Unitil and National Grid, will also continuously review and evaluate the effectiveness of all joint statewide outreach efforts, and engage in on-going refinements to ensure that such materials support clear, consistent, and recognizable messages that help promote Grid Modernization and program awareness.

Integrated Educational and Outreach Plan Overview

Eversource will create an integrated communications plan that is designed to maximize customer reach in eastern and western Massachusetts. The plan will balance established objectives, audience profiles, channels of customers' choice, Massachusetts media market considerations and set budgets. The plan will use a strategy for optimal reach by incorporating several outreach channels including:

- Television
- Radio
- Website Pages
- Digital Marketing
- Social Media (paid and unpaid)
- Email
- Out-of-Home (billboards/street signage)
- Information in Customer Bills
- Community Collaboration
- Eversource Employee Communications
- Residential and Business Customer Contact Center

The use of the outreach channels will require a budget of approximately $3-5 million annually as further detailed below in Table 16 - Proposed Timeline and Cost Estimates. Including television advertising in the outreach campaign is an important component of the campaign. Given Boston media market pricing, this will utilize the majority of the budget; but is the best tool for reaching a densely populated state. Even with this recommended spending, adequate levels of funding will remain available for other outreach channels.

Customer education efforts will also utilize our strategic account executives, community relations team, Residential and Business Contact Center representatives, leveraging these one-on-one, person-to-person relationships and direct customer contacts. The summary of the timeline and spending estimates is presented in Table 16 - Proposed Timeline and Cost Estimates.

Table 16 - Proposed Timeline and Cost Estimates

Timeline & Cost Estimate	Channel Approach
Year 1: Campaign: educational foundation	• 2 TV campaign flights of about 6 weeks each: Boston and Springfield markets • 2 radio campaign flights of about 8 weeks each: Boston and Springfield markets

Timeline & Cost Estimate	Channel Approach
Initial creative research and campaign development Campaign assessment and evaluation **Objectives:** Build awareness of Grid Modernization Promote all available offers **Budget:** $5 million	• Digital campaign running 10 to 12 months: high-impact digital displays/streaming video integrated with ongoing digital displays • Paid social media and content for 2, 2-month flights • Out-of-Home (highly visible) displays: Boston and Springfield for about 2, 7 week flights • Bill communications (2 bill inserts and/or statement messages) • Community outreach support (direct outreach to Chambers of Commerce and other community groups) • Contact center teams trained to respond to customer inquiries in support of campaign • DER workshops for developers and contractors to train on the interconnection process and requirements.
Year 2: Educational campaign continues with additional information on customer options Adjust campaign based on assessment and evaluations **Objectives:** Building awareness and customer engagement Drive program participation **Budget**: $4 million	• 2 TV campaign flights of about 6 weeks each: Boston and Springfield markets • 2 Radio campaign flights of about 8 weeks each: Boston and Springfield markets • Digital campaign running 10 to 12 months: high-impact digital displays/streaming video integrated with ongoing digital displays • Paid social media and content for 2, 2-month flights • Bill communications (2 bill inserts and/or statement messages) • Community outreach support (direct outreach to Chambers of Commerce and other community groups) • Contact center teams trained to respond to customer inquiries in support of campaign • DER workshops for developers and contractors to train on the interconnection process and

Timeline & Cost Estimate	Channel Approach
	requirements.
Year 3: Customer options moved to forefront of messaging Campaign assessment and evaluation **Objective:** Drive participation in Grid Modernization programs/services **Budget:** $4 million	• 2 TV campaign flights of about 6 weeks each: Boston and Springfield markets • 2 radio campaign flights of about 8 weeks each: Boston and Springfield markets • Digital campaign running 10 to 12 months: high-impact digital displays/streaming video integrated with ongoing digital displays • Paid social media and content for 2, 2-month flights • Bill communications (2 bill inserts and/or statement messages) • Community outreach support (direct outreach to Chambers of Commerce and other community groups) • Contact center teams trained to respond to customer inquiries in support of campaign • DER workshops for developers and contractors to train on the interconnection process and requirements.
Year 4: Maintaining messages about customer options **Objective:** Drive participation in Grid Modernization programs/services **Budget:** $3 million	• 2 TV campaign flights of about 6 weeks each: Boston and Springfield markets • 2 radio campaign flights of about 8 weeks each: Boston and Springfield markets • Digital campaign running 10 to 12 months: high-impact digital displays/streaming video integrated with ongoing digital displays • Paid social media and content for 2, 2-month flights • Out-of-Home (highly visible) displays: Boston and Springfield for about 2, 7 week flights • Bill communications (2 bill inserts and/or statement messages) • Community outreach Support (direct outreach to Chambers of Commerce and other community groups) • Contact center teams trained to respond to customer inquiries in support of campaign

Timeline & Cost Estimate	Channel Approach
	• DER workshops for developers and contractors to train on the interconnection process and requirements.
Year 5: Maintaining messages about customer options Objective: Drive participation in Grid Modernization programs/services Campaign wrap-up, assessment and results **Budget**: $3 million	• 2 TV campaign flights of about 6 weeks each: Boston and Springfield markets • 2 Radio campaign flights of about 8 weeks each: Boston and Springfield markets • Digital campaign running 10 to 12 months: high-impact digital displays/streaming video integrated with ongoing digital displays • Paid social media and content for 2, 2-month flights • Bill communications (2 bill inserts and/or statement messages) • Community outreach support (direct outreach to Chambers of Commerce and other community groups) • Contact center teams trained to respond to customer inquiries in support of campaign • DER workshops for developers and contractors to train on the interconnection process and requirements.

Community Collaboration

Direct and proactive outreach through Community Relations Representatives who have established relationships in the communities will assist in engaging community leaders at different levels to help educate community groups about grid modernization and help drive participation in related options.

Increasingly customers are engaging locally. Therefore, a community based outreach is preferred in order to have the maximum impact, which will be focused on the following:

- Deliver messaging for core communication messages listed above, in appropriate community settings;

- Integrate into community organizations to amplify the ability to spread the educational messaging;
- Coordinate with town/community energy managers to develop a comprehensive community-based energy plan including plans for items of community interest such as DER expansion, electric vehicle charging infrastructure, community challenges and similar.
- Coordinate educational outreach sessions designed to educate consumers and small businesses on the modern grid, as it pertains to their local community;
- Work with town managers to create interest and competition in participating in various energy management programs;
- Engage customers in innovative ways to share experiences and best practices on TVR; and
- Create community based challenges that increase TVR participation and impact.

Digital Strength

Building on the success of digital communications channels will be a key focus to broaden and drive customer awareness and participation. Providing residential and business customers with comprehensive grid-modernization information through the web will become a focal point in the overall communications and outreach plan. Strategies that drive customers to the Eversource, as well as the content on the website will both continue to be refined to ensure the highest quality customer experience. In addition, outreach will leverage Eversource's strong social media presence on Facebook and Twitter. The social media platforms readily support effective peer to peer marketing, allowing customers to become brand ambassadors. Social media channels also complement and support other communication channels extremely well.

Opt-in TVR Program - Customer Education and Outreach Plan: As described previously, the Company is proposing an opt-in TVR Program for all residential and small commercial and industrial customers. Targeted outreach to customers to encourage participation in the TVR programs is a fundamental commitment of Eversource's customer outreach plan. The proposed approach to customer education and outreach will:

- Provide interested residential and small commercial customers with fast access to tools and information to enable them to use more electricity when prices are lowest, and less when prices are highest.
- Enable customers to make informed decisions on their electricity use throughout the day.
- Achieve the most cost-effective way to reduce peak demand.

Communications Plan Overview

The goal is to create awareness of and drive customer participation in the opt-in TVR programs. Our approach will ensure all key audiences have fast and easy access to user-friendly information on the basics of the new rate programs and technology to save energy and money.

Eversource will implement a comprehensive approach in educating customers and encouraging TVR program participation. The core objectives of the customer education and outreach campaign include:

- Maximizing reach to ensure all residential and small business customers are provided with easy access to TVR program information and resources.
- Providing compelling and accessible messages that clearly describe the benefit of TVR programs without excess jargon or overly technical language.
- Exploring and deploying targeted communications to unique and/or specific groups of customers throughout the state.
- Providing customers with the tools and information necessary to positively inform their understanding and decision making regarding program participation.
- Utilizing diverse communication channels to reach customers in their preferred channel.
- Ensuring fast, easy information access for customers and all stakeholders.
- Providing proactive customer education and ultimately a superior customer experience.

Customer Education and Outreach Key Themes

The key themes of the customer education and outreach efforts for the TVR program are as follows:

- Eversource is investing in its system to support TVR offerings for customers on an opt-in basis.
- By reducing demand at peak times, the Company and its customers will help reduce the wholesale and retail electricity costs in the region.
- Eversource's goal is to provide meaningful and simple ways for customers to manage their energy use and costs.
- With an awareness of when and how electricity is being used, customers can make informed decisions about their energy usage.
- By shifting high-volume electric use to off peak periods when rates are lower, customers can save money on their monthly energy bills.
- TVR offer an opportunity for customers to lower, potentially significantly depending on load characteristics and behavior, their monthly electric costs.
- All residential and small commercial and industrial customers in the Eversource service territory in Massachusetts have the opportunity to sign-up for TVR.

Evaluation of Success

The success of the Education and Outreach Plan will be measured regularly, in intervals, during the 5-year campaign to ensure messages are meaningful for customers and have a positive influence on customer awareness and participation. Evaluation tools, including digital tracking of website traffic stemming from digital campaigns, program participation rates, and feedback from program participants or those customers who have been exposed to campaign messages and communication channels, will be among those tools used to evaluate success.

In developing this communications plan for grid-modernization awareness, the Company is taking into consideration the results of the Mass Save marketing strategy Post Campaign Report, completed in April 2015. The report presents findings from the Mass Save statewide marketing

assessment, documenting the 2014 campaign design and marketing strategy and assessing its impact on customer awareness of Mass Save, and its ability to deliver clear and recognizable messages.

3. Enabling Investments – Summary of STIP Investments

A summary of Enabling Investments proposed as part of the STIP is included in Table 17 - Enabling Investments - Summary of STIP Investments.

Table 17 - Enabling Investments - Summary of STIP Investments

	Investments		$ Millions					
			Year 1	Year 2	Year 3	Year 4	Year 5	Total STIP
Enabling Investments	Communications	Capital	$7.3	$7.3	$7.3	$7.3	$7.3	$36.3
	Cyber-Security	Capital	$2.2	$2.8	$0.0	$0.0	$0.0	$5.0
		O&M	$0.0	$0.0	$2.0	$2.0	$2.0	$6.0
	Customer Education and Outreach Plan	O&M	$5.0	$4.0	$4.0	$3.0	$3.0	$19.0
	Capital		$9.5	$10.0	$7.3	$7.3	$7.3	$41.3
	Less: Baseline Capital Investment		($3.7)	($3.7)	($3.7)	($3.7)	($3.7)	($18.5)
	Total Incremental Capital		**$5.8**	**$6.3**	**$3.6**	**$3.6**	**$3.6**	**$22.8**
	Total O&M		**$5.0**	**$4.0**	**$6.0**	**$5.0**	**$5.0**	**$25.0**
	Total Incremental STIP Investment		**$10.8**	**$10.3**	**$9.6**	**$8.6**	**$8.6**	**$47.8**

III. Overall Assessment of the Short-term Investment Plan

A. Business Case Including Cost/Benefit Analysis

1. Introduction

It is critical that investment in further grid modernization is highly cost-effective and supported by a sound business case. Given the rate at which technology is advancing and the turnover on technologies, it is critical to identify and invest only in technologies and programs that will deliver meaningful and sustainable benefits over the full life of the asset.

In developing its GMP, Eversource conducted a rigorous business case and cost/benefit analysis to ensure that the Company pursued investments that hold up to rigorous cost effectiveness scrutiny. In order to develop high quality business case analyses, Eversource partnered with Navigant Consulting, a leading international consulting company. Eversource chose Navigant as it is exceptionally qualified to perform the analysis based on years of experience in developing and applying grid modernization cost/benefit frameworks and tools, including several of the most referenced and widely applied, such as the EPRI Methodology and the USDOE Smart Grid Computational tool.

2. Summary of Cost/Benefit Analysis

Introduction and Approach

The GMP includes multiple investments across the three main categories of resiliency, smart & integrated and facilitating customer engagement. The cost/benefit analysis Eversource conducted for each of investment was determined by the nature of the expected benefits, and the ability to quantify and then monetize them.

Based on the type of benefits derived, each investment was classified into three categories:

- Investments with monetized benefits;
- Investments with quantified benefits (not monetized); and
- Investments with qualitative benefits (not quantified).

Navigant's analysis focused on those investments that could be either monetized or quantified but not monetized. Detailed results from the analysis conducted by Navigant can be found in *Appendix* 7 Navigant Cost-Benefit Analysis. Investments that were difficult to quantify and that require a justification based on a qualitative assessment were analyzed by Eversource. A discussion of the qualitative benefits associated with each investment can be found in the Plan investment descriptions, above. In addition, the completed Template provided by the Department can be found on *Appendix* 8 Business Case Template.

Smart & Integrated Grid Investments

The portfolio of investments in a smart and integrated grid is designed to bring innovative and technologically sound solutions to benefit customers over the next ten years and beyond. Each of the investments will provide value on multiple dimensions. In order to characterize the full value of the portfolio, Eversource describes benefits that are either monetized or quantified or described qualitatively.

With respect to investments in VVO technology, for instance, benefits are derived from reductions in end use energy consumption and line loss reduction. The magnitude of the savings is based on assumptions that the Eversource VVO project will have results comparable to other similar efforts in the industry. The potential energy savings have a monetary value in the marketplace that can be estimated based on forecasted prices over the 15 year timeline of the analysis. The resulting value is compared to the associated cost indicating a positive benefit to cost ratio. In addition, further synergies with customers may exist with strategies and technologies that have direct energy benefits. To this end, where possible, the Company will look to integrate and leverage its significant efforts in energy efficiency.

Many investments in the portfolio provide reliability benefit to customers. These benefits can be estimated quantitatively. For example, remote faulted circuit indicators will be deployed to reduce the amount of time it takes workers to locate faults. The impact of this deployment can be characterized in terms of the hours of outage that are avoided given the extent of the deployment on the distribution system. Another useful quantitative measure is the dollars per customer minute saved ("CMS") which provides an indication of relative value of a given investment. It is important to note that projections of future benefits are based largely on an assumption that, absent the given investment, the reliability of the distribution system will be comparable to its performance in the past. There are many factors, however, such as weather and non-grid modernization investments that will inevitably make the future different from the past.

All of the investments included in the portfolio are characterized by some degree of benefits that cannot be reasonably quantified and must be described qualitatively. In some cases, benefits are important but difficult to measure. For instance, a switch that can be operated remotely has a

safety benefit by avoiding exposure for field workers. This type of benefit is difficult to capture in a meaningful way quantitatively. The most significant categories of benefits described qualitatively are those related to the integration of DER. A number of investments are focused on making it easier and more cost effective for DER to interconnect to the Eversource distribution system. Attempting to quantify the additional resources that were enabled by grid modernization efforts is not useful given that the amount of DER seeking to interconnect is driven largely by incentives and other factors outside the control of the distribution companies. Further, given the exponential growth of DER in Massachusetts in recent years, it is not reasonable to expect that the future for DER absent grid modernization investments will look anything like historical performance. As a result, descriptions of investments focus on how they will work to support the integration of DER.

Resilient Grid Investments

As described above, investments in system resiliency are a critical pre-requisite for optimizing the effectiveness of other grid modernization investments and enabling the continued, safe, reliable operation of the electric grid. The Company is proposing two categories of investments related to system resiliency, with qualitative benefits as defined below and in the Plan. The objective of the *Underground Electrical Safety and Resiliency Program* are: (1) to enhance the safety and resiliency of electric service to customers served by the Company; (2) to mitigate the potential for stray-voltage occurrences and manhole events in the municipalities served by Eversource East; and (3) to protect investments in advanced technology installed on the underground system to maintain functionality. The objective of the *Overhead Safety and Resiliency Program* is to: (1) to enhance the safety and resiliency of electric service to customers served by the Company, and (2) to protect investments in advanced technology installed on the underground system to maintain functionality.

Customer Engagement Investments

The key benefit of deployment of a TVR program is to encourage customer behavior that results in the shift of demand (kW) from the time of system peak to a time where there is no peak. Eversource, with the assistance of Navigant, conducted a detailed and rigorous analysis of the

costs and benefits of the opt-in TVR program and the detailed results are presented in *Appendix* 7 Navigant Cost-Benefit Analysis.

That analysis shows that an opt-in TVR program can provide benefits to customers, but even a well-designed and cost-effective TVR program like the one developed by Eversource will not drive material load reductions in the ISO-NE system peak that can generate enough savings to pay for the initial implementation costs. As shown in *Appendix* 7 Navigant Cost-Benefit Analysis, the benefit to cost ratio ("BCR") of the opt-in TVR program is 0.3. However multiple factors, can impact the results of that analysis.

Participation rates. The Company's analysis initially indicates that about 5 percent of its residential and small C&I customer base will be interested in participating in such program. Increases in the penetration rate will drive a better cost to benefit ratio. For example if the program were to achieve a 20 percent participation rate the BCR would increase to 0.7 as shown in *Appendix* 7 Navigant Cost-Benefit Analysis.

- **Capacity prices**. Eversource leveraged the analysis provided by TCR in terms of forecast capacity prices into the future. Any market changes that drive increases in capacity prices, could provide higher value to the opt-in TVR program.

- **Role of competitive markets**. The analysis did not include any additional benefits that could be provided by the competitive marketplace. Home energy automation solutions like smart thermostats and appliances are advancing at a rapid pace and could leverage an opt-in TVR deployment to provide additional information to consumers that could drive higher peak load reductions.

Eversource also conducted a cost/benefit analysis for the opt-out scenario. Using the cost information presented previously, Eversource used the same modeling tool that it used to analyze its proposed Plan investments. The analysis showed that the opt-out scenario is less effective than an opt-in scenario as presented in Table 18 – Cost/Benefit Analysis Opt-in vs. Opt-out.

Table 18 – Cost/Benefit Analysis Opt-in vs. Opt-out

	Opt-in Approach 20% participation	Opt-in Approach 5% participation	Opt-out Approach
15-year NPV Benefits ($ millions)	$83.4	$33.4	$42.6
15-year NPV Costs ($ millions)	$207.1	$124.0	$857
15-year Net NPV ($ millions)	($123.7)	($90.6)	($814.4)
Benefit to Cost Ratio (BCR)	0.4	0.3	<0.1

In an opt-in TVR approach, Eversource is able to gain 78 percent of the benefits, with just 15 percent of the costs providing for a more cost effective deployment for its customers. This is driven by being able to encourage the right type of customer to participate in the program, without having to deploy the metering technology to all customers; many of whom won't be interested or able to respond to TVR. A more detailed analysis of an opt-out TVR approach conducted by Navigant is in *Appendix* 9 Opt-out TVR Program Analysis..

Common Assumptions and Common Analysis Methods

To support its analysis of a TVR program, Eversource, in coordination with National Grid and Unitil, jointly conducted RFP solicitations to choose consultants to support the Companies in the development of (1) the common assumptions, and (2) common analysis methods as required by the Department.

The Electric Companies engaged Tabors Caramanis Rudkevich ("TCR") to provide forecasts of wholesale electric energy and capacity market prices, RPS compliance costs and demand reduction induced price effects ("DRIPE") for energy and capacity. The objective of TCR's report was to project electric market prices that are expected to occur in Massachusetts between 2015 and 2035 under a business as usual future. The business as usual future assumes that energy efficiency programs will continue at levels reflected in the 2014 ISO New England Regional System Plan. TCR developed these forecasts using the same methodologies it used to

prepare the 2015 Avoided-Energy-Supply-Component Study ("AESC 2015"). Detailed results from the analysis conducted by TCR can be found in *Appendix* 10 Common Assumptions – TCR Report.

The Electric Companies also engaged Concentric Energy Advisors ("Concentric") to review, analyze, and summarize other TVR pilots and programs that have been offered in the US. The Concentric analysis summarized customer response to TVR pricing based on data from 14 programs that included TVR pricing with either CPP with TOU pricing or just TOU pricing. Concentric created a very detailed database with the key information from all the 14 pilots across the US and the summary report can be found in *Appendix* 11 Common Analysis Methods – Concentric Report #1.

Using the available rate structure, price, and customer response data, Concentric developed statistical relationships to explain the impact of CPP and TOU pricing on customer demand in Critical Peak, Peak, and Off-peak periods. In addition, Concentric developed a model that used the regression results to calculate estimated demand impacts for a price ratio. Detailed results from the analysis conducted by Concentric can be found in *Appendix* 12 Common Analysis Methods – Concentric Report #2.

B. Meeting the Department's Grid Modernization Objectives

As demonstrated in greater detail above, the investments proposed by Eversource advance all of the Department's grid modernization objectives in multiple ways as highlighted by Table 19 – Investment Impact on Grid-Modernization Objectives.

Table 19 – Investment Impact on Grid-Modernization Objectives

			Reduce the Impact of Outages	Optimize Demand	Distributed Resource Integration	Workforce and Asset Management
Smart & Integrated	Grid-Wide Situational Awareness	Sensing and Monitoring	✓		✓	✓
		Next Generation Fault Indication	✓			✓
	Advanced Analytics	Distribution Management System	✓	✓	✓	✓
		Network Load Flow	✓		✓	✓
		Predictive Outage Detection	✓			✓
	Real Time Flexible Grid Action	Automated Feeder Reconfiguration	✓			✓
		Volt VAR Optimization		✓	✓	✓
	Dynamic DER Integration	Integrated Planning and Tracking for DER	✓		✓	✓
		Energy Storage		✓	✓	
		Adaptive Protection/Two Way Power Flow	✓		✓	✓
Resilient Grid		Underground and Overhead Safety and Resiliency	✓			✓
Customer Engagement		Opt-in TVR		✓		
Enabling Investments		Communications	✓	✓	✓	✓
		Cyber-Security	✓	✓	✓	✓
		Customer Education and Outreach Plan	✓	✓	✓	✓

C. Meeting State Policy Objectives

Eversource's STIP investments will also provide meaningful support to help Massachusetts advance its energy policy objectives.

- Investments to enable a more dynamic integration of DER are anticipated to lead to a reduction in integration costs, which in turn helps the state meet its goals associated with the Renewable Portfolio Standard ("RPS"), the installation of 1,600 MW of solar by 2020, the Global Warming Solutions Act ("GWSA") and the Green Communities Act ("GCA").

- Any peak load reduction impact from the TVR program will also help reduce total demand which may lead to a reduction in total system costs.

- By using the capabilities of the volt/VAR investment, Eversource expects energy usage to be reduced enabling Massachusetts to further its aggressive energy efficiency goals.

- Department's SQ requirements to meet specific SAIDI and SAIFI requirements, ERP, and DG interconnection standards that require timelines and process adherence as it relates to the process to shepherd customers through the interconnect application and approval process.

- Ultimately, the GMP, by reducing demand, energy consumption, line losses and costs to integrate DER, supports a reduction in carbon emissions thus supporting progress towards meeting the goals set out by the GWSA.

D. Performance Metrics

The Department directed the electric distribution companies to jointly propose a common list of statewide metrics, as well as individual utility metrics, to be included in their Grid Modernization Plans. A set of fifteen proposed metrics across the four grid-modernization objectives was provided to the utilities for initial consideration in D.P.U. 12-76-A.

Eversource established an internal Grid Modernization Metrics Working Group to support the Company's efforts in determining appropriate metrics. This team has worked across Eversource to assess options for metrics in conjunction with the Plan, and worked jointly with the National Grid and Unitil metrics working teams.

Eversource, National Grid and Unitil established a joint plan for the internal teams to review the Department's proposed statewide metrics proposals to assess the viability and measurability of each, followed by a joint utility meeting held on March 15, 2015 to review findings. At this meeting the joint group established four sub-teams, one for each major grid modernization objective, to bring together subject matter experts to continue to refine and select statewide metrics. During the April through June 2015 timeframe, these sub-teams worked within their own utility and jointly with the other utilities exploring various proposals for metrics and establishing common definitions and calculation methods. As a result of these teams' work,

some of the Department's proposed performance metrics were chosen for statewide metrics and some were not due to concerns over the ability to measure them consistently across all utilities or to demonstrate the GMP impact. One example of this is the proposal to include Reduction in System Peak Demand as a measure of Optimizing Demand. There are multiple external factors that influence the calculation that cannot be quantified to yield a fair comparison resulting from grid modernization investments, plus not every utility will be proposing investments geared to influencing system peak demand at the same level. Instead, the utilities have agreed that a measurement of change in load for customers on a TVR rate during a CPP timeframe would be appropriate as a statewide metric since it will be impacted less by external factors and is aligned to each utilities' Grid Modernization Plan focus. A specific plan for how this will be measured will need to be developed as part of the GMP implementation.

The statewide performance metrics presented in each utility's plan reflect the decisions of these grid modernization metrics teams.

Additional work will be necessary, as the plans are approved and progress, to determine additional detailed specifications to drive consistency of measurement across the utilities for the statewide and internal performance metrics, as well as setting up mechanisms internal to each utility to ensure capabilities for capturing the required details required for measurement.

The Eversource GMP is comprised of both customer and system-related investments that are designed to make numerous improvements in each of the key modernization objectives. The metrics selected will be able to capture and illustrate the impacts to the system and customers from the Plan.

1. Proposal for Statewide Performance Metrics

The proposed statewide performance metrics presented below in Table 19 reflect the decisions of the joint utility teams. As stated above, additional collaboration will be necessary as to determine additional specifications to drive consistent measurement across the utilities, as well as to set up systems in order to measure specific investment benefits.

Reduce the Impact of Outages Metrics

The utilities will be implementing multiple technologies that will support avoiding and minimizing outages to the electric systems through increased automation. The teams chose two measures for statewide use that illustrate the breadth of customer and system coverage for these investments. The first measure, Customers Benefiting from Grid Modernization Devices, will capture the percentage of the customer base served from areas where automation devices are installed and able to reduce the impacts of outages. Over time as outages occur, the utilities will also be measuring through internal metrics the actual number of avoided or minimized outages that occur. However from a plan perspective, understanding the protection provided to customers through these investments, whether an outage occurs at a certain location or not, is important. The second measure, System Automation Saturation, illustrates the level of automation on the system on a per customer basis, measured by dividing into the number of customers served a value that represents a count of one for each fully automated device and a count of one-half for partially automated devices as defined and agreed to by the joint utility group.

Optimize Demand Metrics

In this category, all utilities will be proposing TVR rate plans, and therefore the cross-utility metrics teams chose two statewide metrics that will illustrate customer interest and intent relative to load reduction or shifting through the TVR rate programs. Therefore we will measure the percentage of customers who desire to participate in a TVR rate and also the change in behavior during critical peak events or timeframes. The specific process to measure the change in behavior during peak events is not yet designed or developed.

Integrate Distributed Resources Metrics

The utilities will implement a variety of technologies that will facilitate growth of DER on our electrical distribution systems. The utilities agreed with the metric proposed by the Department, the number and type of interconnected distributed generation. The utilities refer also to the Timeline Enforcement Mechanism requirements and reporting as a key indicator of utility

alignment with customers to facilitate the interconnection process in a timely and effective manner.

Improved Workforce and Asset Management Metrics

Two statewide metrics are proposed for this objective, focused on capabilities to obtain and utilize information about the status and state of the electric system through the use of sensors as well as communications infrastructure and DMS. Intelligence gained through sensor information is essential in enabling efficient processes (e.g., making repairs when required and prior to failure) and reducing operating costs (e.g., automating the capture of data collection and analysis of information from field devices). These metrics in Table 20– Proposed Statewide Performance Metrics will illustrate the progress in installing sensors as defined in each utility's GMP, as well as a metric providing a percentage of the distribution circuits equipped with sensors.

Table 20 – Proposed Statewide Performance Metrics

Objective	Metric	Comments
Reduce the Impact of Outages	Customers Benefiting from Grid Modernization Devices	#, % of our customer base whose electric service can now benefit by minimizing or preventing outages due to the installation of automated devices on the distribution system. This metric includes all automation on the system, not just investments from the GMP.
	System Automation Saturation	Illustration of the level of automation on the electric distribution system, designed to improve reliability. As more automation is installed, the metric's calculated result will be a reduced value. This measure includes all automation on the system, not just investments from the GMP.
Optimize Demand	CPP Event Load Reduction	Measures the kilowatt hour reduction achieved from customers on a TVR rate during a Critical Peak Pricing event. This measure will reflect CPP events occurring after customers begin participating in a TVR rate structure.
	TVR Customers	#, % of customers who are signed up for a TVR rate. (DPU-

Objective	Metric	Comments
		recommended metric). This measure will reflect customer counts after customers begin participating in a TVR rate structure.
Integrate Distributed Resources	DG Interconnections	# DG interconnections to the electric system, organized by nameplate capacity, estimated outputs and type of customer-owned or operated units. The metric will include all DG connections, not just those occurring during the GMP period. DPU-recommended metric. *Note: cross-utility DG Working Group efforts and the DPU's Time Enforcement Mechanism provide additional insights to utility efforts in connecting distributed resources.*
Improve Workforce & Asset Management	Sensors Installed through GMP	#, % of sensors installed on the electric distribution system as specified in approved GMP. (DPU-recommended metric.) This measures progress in completing the GMP relative to installation of sensors.
	Circuits with Sensors	% of electric distribution circuits with installed sensors, which will provide information useful for proactive planning or intervention. This measures all sensor installations, not just those within the GMP. Measure is a variation of a DPU-recommended metric.

2. Proposal for Company Specific Metrics

Eversource also worked to develop a more inclusive set of performance and infrastructure metrics that will be useful in guiding and illustrating the impacts to the Grid Modernization Plan. In Table 21 below, each metric listed is coded with an S representing 'statewide' or C representing 'company-specific'. This set of metrics will be evaluated throughout the GMP process, enhancing as necessary to illustrate the plan's progress and focus. Mechanisms to accurately measure the impact from GMP investments will need to be designed and implemented to support measurement of several of the Grid Modernization performance metrics.

Information about the Company Specific Metrics:

Reduce the Impact of Outages Metrics

Based on Eversource's grid modernization investment strategy, the company also will measure benefits from expanding the automation of the system and adding capabilities for real-time system information and analysis, such as the actual number of avoided outages and the number and percentage of distribution circuits equipped with automation. .

Optimize Demand

Additional Eversource-specific metrics are chosen to demonstrate efforts to educate and market new rate options and technologies to customers and their subsequent actions to reduce energy.

Integrate Distributed Resources

A number of proposed grid modernization investments will support this objective. The Eversource metrics will include a review of changes in costs to interconnect.

Improve Workforce and Asset Management

In addition to the two statewide metrics, an additional metric in Table 21 – Proposed Performance Metrics (Statewide & Internal) is proposed to track our progress in modeling our distribution circuits in advanced analytic software, which will be a key enabler to support more effective planning and decision-making, reduced operating costs, and provide customers and system operators with more and better information.

Table 21 – Proposed Performance Metrics (Statewide & Internal)

Objective	Statewide (S) and Company-Specific (C) Metrics
Reduce the Impact of Outages • *Supports MA Service Quality Reliability*	Customers Benefitting from Grid Modernization Devices (S)
	System Automation Saturation (S)
	Circuits with Automation (C)

Objective	Statewide (S) and Company-Specific (C) Metrics
Performance Goals	Outages Avoided (C)
Optimize Demand • *Supports MA Energy Efficiency Goals*	Load Reduction During CPP Events (S)
	TVR Customers (S)
	Customers Reached through TVR Marketing (C)
Integrate Distributed Resources • *Supports MA Green Communities Act, RPS, RGGI Goals*	DG Interconnections by Type (S)
	Average DG Costs (C)
Improve Workforce & Asset Mgt • *Supports MA Service Quality Reliability Performance Goals*	Sensors Installed per the GMP (S)
	Circuits with Sensors (S)
	Circuits Modeled with Advanced Analytics (C)
All Objectives	GMP Plan Elements Completed vs. Plan (C)

IV. Stakeholder Engagement

A. Objective and Overall Approach

As outlined in the introduction of the GMP, Eversource developed its Plan paying attention to the feedback received from stakeholders. To that end, Eversource planned and convened a meeting on April 14, 2015 with several key stakeholders in Massachusetts to provide them with information about Eversource's goals and priorities for grid modernization and to seek input on the priorities, benefits, and trade-offs of meeting the Department's grid modernization objectives.

This meeting represented the first step in Eversource's process of soliciting and integrating stakeholder input into its Plan. The meeting was facilitated by Catherine Morris from the Consensus Building Institute. After the stakeholder meeting, Eversource continued to meet individually with stakeholders to further gather feedback on the Plan. In the development of its GMP, Eversource considered all of the input provided by stakeholders to the extent it was possible.

B. Summary Feedback from Stakeholder Meeting

The key focus of the stakeholder meeting was to seek input into the grid modernization objectives and goals. The session was structured around each of the grid modernization objectives. A summary of the key feedback received is summarized below in four different tables around each objective (*see* Table 22 – Stakeholder Feedback on Reduce Effect of Outages Objective, Table 23 – Stakeholder Feedback on Integrated DER Objective, Table 24 – Stakeholder Feedback on Optimize Demand Objective, and Table 25 – Stakeholder Feedback on Asset and Mobile Workforce Management Objective:

Table 22 – Stakeholder Feedback on Reduce Effect of Outages Objective

<table>
<tr><td colspan="2">Key Outcomes</td></tr>
<tr><td>Shared by Eversource</td><td>Proposed by meeting participants</td></tr>
<tr><td>• Reduce outage durations
o Reduce number of customers impacted by outages
o Reduce the frequency of outages
• Improve situational awareness (i.e., more information when outages occur)
• Provide more accurate information about individual customer outages & estimated restoration times</td><td>• Criticality (sensitivity to loss of power) of certain customers
• Consideration of differential impacts of different types of outages on different customers (e.g. momentary outages can upset sensitive systems)
• Improve situational awareness, including for first responders
• Minimize cost increases for customers</td></tr>
<tr><td colspan="2">Key Strategies</td></tr>
<tr><td>Shared by Eversource</td><td>Proposed by meeting participants</td></tr>
<tr><td>• Automation to isolate faults to the smallest possible customer segment
• Sensing on power lines with predictive analytics to identify and mitigate likely causes of outages
• Technology to conduct remote restoration operations on underground infrastructure
• Remote monitoring and control in substations
• Ability to configure circuits with flexibility to maximize the value of assets
• Real-time visibility of customer outage status</td><td>• Differentiate between day-to-day outages and unusual events when considering how to meet this objective
• Place the cost of investments needed for greater reliability on those customers who value greater reliability
• Use distributed energy resources and intentional islanding (e.g. micro-grids)
• Define criteria by which “criticality” (of customers, of infrastructure) would be defined
• Use demand optimization to reduce outages</td></tr>
</table>

Table 23 – Stakeholder Feedback on Integrated DER Objective

<table>
<tr><td colspan="2">Key Outcomes</td></tr>
<tr><td>Shared by Eversource</td><td>Proposed by meeting participants</td></tr>
<tr><td>• Enable increased penetration of distributed resources without negative operational impacts (i.e., power quality, reliability)
• Enable faster connection of distributed resources
• Achieve a more transparent interconnection process
• Provide more visibility into the system for targeted deployments
• Improve ability to plan for system needs taking into account DER</td><td>• Increase the capacity for hosting DER and avoid the need for new central generation
• Minimize cost increases for non-participating customers
• Enable faster and least-cost connection of distributed resources
• Optimize penetration and location
• Develop a plan to achieve optimum DER penetration; share information about where it is needed and most valued on the system</td></tr>
<tr><td colspan="2">Key Strategies</td></tr>
<tr><td>Shared by Eversource</td><td>Proposed by meeting participants</td></tr>
<tr><td>• Advanced load flow modeling to understand the impact of DER on the system
• Tools to more easily manage voltage imbalances from DER
• Equipment to address two way power flow (i.e., transformer equipment upgrades, protection and control)
• Real-time visibility and tracking of interconnection application process
• Ability to store energy to</td><td>• Identify locations where DER would add the most value
• Use price signals to identify optimal locations
• Develop mechanisms to gain real-time visibility of DER performance
• Develop ability to dispatch DER on a rational basis (e.g. price)
• Implement tools to manage “VAR” support with DG</td></tr>
</table>

manage DER variability

Table 24 – Stakeholder Feedback on Optimize Demand Objective

Key Outcomes	
Shared by Eversource	Proposed by meeting participants
• Reduce system peak • Improve power factor • Reduce line losses • Improve power quality	• Reduce system costs for all customers • Minimize costs to non-participating customers • Improve system utilization and efficiency • Reduce outages and better integrate DER • Reduce feeder-level peaks • Improve MAIFI
Key Strategies	
Shared by Eversource	Proposed by meeting participants
• Manage peaks with time-varying rates • Dynamic optimization of voltages to improve system efficiency • Manage peak loads from electric vehicles • Balance peak load with energy storage in areas with high DER penetration	• Use load control devices • Use demand management programs (e.g. storage cooling) • Share information about state of the system with both users and DER • Enhance coordination between ISO-NE and Eversource • Incentivize DER • Manage short-term intermittency from DER

- Enable more third-party DER
- Use storage provided by electric vehicles for peak load management
- Use automated metering for TVR

Table 25 – Stakeholder Feedback on Asset and Mobile Workforce Management Objective

Key Outcomes	
Shared by Eversource	Proposed by meeting participants
• Faster response time in emergency conditions • Identification of potential equipment failures before they occur • Reduced maintenance expenses • Defer replacement capital expenditures • More efficient and productive field workforce	• Enable faster and least-cost connection of distributed resources • Reduce customer costs
Key Strategies	
Shared by Eversource	Proposed by meeting participants
• Increased sensing on the distribution system for greater visibility into real-time operating conditions • Systems that predict when equipment replacements need to be made • Mobile data technology to improve communication between field workers and centralized dispatch • Tools to allow mobile workforce to be more productive	• [none proposed]

In addition to the above input on key outcomes, strategies, and metrics for each of the four objectives, meeting participants provided the following cross-cutting comments:

- There are interdependencies between the objectives that should be recognized in the investment analysis. For example, increasing integration of distributed energy resources can help with demand optimization and improving resiliency.

- It would be useful to identify those strategies / investments that promote multiple outcomes across the four objectives.

- There are also interdependencies and interconnections between the outcomes and the strategies across the four objectives.

- Eversource should conduct a more granular analysis of costs and benefits, e.g. by customer class and by critical loads.

- It would be helpful to document the value of investments made. For example, quantifying the number of outages avoided as compared to present performance.

C. Conclusion

Engagement with various stakeholders was an extremely useful exercise and helped inform the Company's filing. The Company included several of the suggestions in its filing and it will continue to work with stakeholders throughout the Department process and implementation of the plan after Department approval.

V. Research, Development and Demonstration

A. Innovation's Role in Grid Modernization

In order to ensure that its grid-modernization vision outlined in this GMP is met, innovation will play an important role. Over the course of many years, Eversource has developed a robust and beneficial relationship with multiple stakeholders in the innovation space including academic institutions, research entities and vendors to ensure that the Company is continually apprised of new or improved technologies and processes, including grid modernization technologies and processes. By leveraging these relationships, Eversource has gained the benefit of the vendors' and institutions' expertise and experience with both emerging and newly developed technologies and processes that, in turn, enables the Company to make informed decisions about which processes and technologies are best suited for short and longer-term company needs.

B. Proposed Research and Development Approach, Funding Mechanism and Funding Level

In its grid-modernization decision, the Department required each of the electric distribution companies to file research, development and deployment plans which focus on the testing, piloting, and deployment of new and emerging technologies to meet the four grid modernization objectives.

Eversource welcomes the opportunity that the Department's decision provides to further expand on its current efforts and views targeted research and development ("R&D") investments in furtherance of grid modernization objectives as an appropriate tool to foster innovation in Massachusetts and provide for measureable progress in the adoption of new technologies and technology-related processes.

Eversource's proposed approach to R&D within this GMP will focus on developing research partnerships with universities and/or research centers that are located in Massachusetts or have strong ties to the Commonwealth. The goal is to create dedicated efforts to fund R&D that helps Eversource advance the four grid-modernization objectives by identifying technologies, processes and systems that can be rolled into our Plan in the future years. By establishing

agreements with local universities and/or research centers, Eversource will be ensured access to staff knowledgeable about the Company, Massachusetts and the energy space which will lead to better research results.

Eversource has initiated a dialogue already with several research organizations including Worcester Polytechnic Institute ("WPI"), Wentworth Institute of Technology, Northeastern, and the Fraunhofer Center for Sustainable Energy Systems.

In order to fund this collaborative research with universities and/or research institutions, Eversource is requesting a funding level of $1.5 million per year. This level of funding is comparable to other research efforts the Company has undertaken in other service territories and is line with research efforts from other utilities in the US.

C. Decision-Making Process and Focus Areas for R&D Efforts

Eversource will determine the research efforts to be conducted in a given year within a pre-defined scope of activities. Using the annual funding, Eversource will establish different projects to advance a particular area of research with a university and/or research organization. Projects can span one or multiple years depending on the topic and importance to the Company. As the Company identifies and structures projects, Eversource will seek additional funding from other sources such as Massachusetts Clean Energy Center ("MassCEC"), Department of Energy, Department of Energy Resources ("DOER"), other utilities either inside or outside of the region, and organizations and companies investing in the energy space like venture funds from large enterprises.

Prior to funding a research project, Eversource will: 1) select the target research area from one of the pre-defined focus areas (as listed below), 2) identify the goal of the research and develop a list of research questions to guide the research efforts, 3) assess the degree to which the R&D effort might advance each of the Department's four Grid Modernization objectives. The output of each R&D project (e.g. whitepaper, database, or other analysis) will be filed with the Department as part of the Company's annual compliance filing.

Eversource is also proposing to establish a set of pre-defined focus areas for R&D efforts in order to provide focus and establish clear guidelines regarding the scope of projects to be identified, and to allow the Company to communicate to universities and research institutions the areas that are in scope vs. out of scope.

The specific focus areas identified by Eversource are explained below and include:

Sensing and monitoring, advanced analytics, real-time flexible action and dynamic integration of DER

Eversource will support R&D projects that help Eversource further understand the role new technologies and approaches can play in meeting the core characteristics identified for its investment plan.

Energy Storage

Eversource will investigate through R&D the impact of energy storage into the distribution system. Potential areas of research include:

- Assessment of energy storage as an asset management tool.
- Assessment of energy storage as a power quality tool.
- Assessment of energy storage as a backup power for critical loads in remote areas with long feeders supporting small loads.
- Planning tools to incorporate storage into the distribution planning processes.
- Electric distribution impact assessment of behind-the-meter energy storage for ancillary services.
- Potential secondary use of EV batteries for energy storage purposes.

Electric Vehicles

The Company has substantial and broad-based experience with electric vehicles (“EVs”) and to date it has pursued initiatives in three areas: (1) working to anticipate and address utility infrastructure requirements resulting from EV adoption: (2) developing approaches to align

utility assets and EV customer's charging patterns for the betterment of the utility grid; and (3) supporting EV drivers and customers interested in installing EV charging infrastructure.

The Company has efforts underway in all three areas. In the first area, the Company participated in a study organized by the Electric Power Research Institute ("EPRI") titled "Understanding the Grid Impacts of Plug-In Electric Vehicles (PEV): Phase 1 Study -- Distribution Impact Case Studies". This study determined that modest grid impacts would be expected in the next five to ten year period, with the utility assets closest to the customers more likely to be impacted by EVs clustering. Faster / higher capacity charging rates were associated with increased transformer overloads.

In the second area, Eversource has advanced a research pilot in Massachusetts called Plug My Ride at Home. The Eversource pilot builds upon the lessons learned by other utilities attempting to encourage off-peak charging to mitigate the grid impacts. Many of these other utility programs were expensive to implement or placed additional costs on customers to install special metering. The Plug My Ride at Home pilot leverages the technologies embedded in the vehicles and specially purposed charging stations to not just manage the timing of EV charging but also the speed / capacity of charging.

In the third area, the Company is supporting customers by providing support resources from the PEV Tech Center and the "Plug My Ride" website (www.PlugMyRide.org). In addition the Company has recently submitted studies in D.P.U. 12-95 that serve as aids in identifying infrastructure requirements at DC Fast Charging locations and in high-density urban environments (a.k.a. garage orphans).

Over the next five years, additional EV R&D activities are anticipated inclusive of the following potential efforts:

- Perform modeling that quantifies the cost impact to the utility from various EV charging patterns. Such a study could help guide decision making on future EV charging initiatives.

- Leverage lessons from the current Plug My Ride at Home pilot and develop recommendations for EV charging at home. Since Eversource is still in the early stages of the existing pilot, it is too soon to describe the exact structure of what the next program for EV charging at home could look like.

- Workplace charging.
- DC fast charging.
- Garage orphan charging.
- Vehicle-to-load applications.

Cyber Security

Eversource will continue to investigate cyber security impacts of actively managed resources on the distribution system, including behind-the-meter resources as part of its R&D portfolio.

Impact of grid modernization technologies on low income customers

Eversource will continue to engage the low income community. Based on discussions with the low income community, Eversource will examine the impact that certain grid modernization initiatives may have on low income customers. As part of its R&D efforts, the Company intends to conduct focus group analysis to better understand what impact TVR and other grid modernization may have on low income customers. The Company will work collaboratively with the low income customer groups to complete the analysis and share the findings with broader stakeholder groups.

New pricing options

As more DER is integrated into the grid, an important element of research will focus on new pricing options. In order to facilitate this area of research, Eversource intends to install meters at certain distribution delivery points and points of production of a sample of residential customers who install PV (and other DER in the future) in order to provide meter data that supports research to develop new pricing options. The goal would be to install a sufficient number of

meters to provide meaningful data that, individually and collectively, would support determination of appropriate service requirements and cost responsibilities. In addition, this data would assist in the development of cost allocation and rate design options intended to resolve a number of issues associated with deployment of residential PV and other future DER technologies.

Customer engagement and behavioral response

Once customers begin to sign for new pricing programs like the proposed opt-in TVR program, Eversource expects to continue to conduct R&D efforts to understand whether there are any other behavioral programs that could help increase the response rates from customers. For example, today the Company provides home energy reports to customers that compare their usage to other neighbors to drive increased energy conservation. A similar approach could be used to compare peak load reduction behavior to help customers understand the potential opportunity to further save and contribute to the program. Similar R&D efforts aimed at understanding how behavioral programs could help improve customer engagement will be also considered by the Company.

Microgrids

Eversource is evaluating grid-modernization solutions that support Massachusetts' goals for a more resilient, reliable grid that also allows for more integration of cleaner DER. In the past, Eversource has studied microgrids, along with undergrounding and emergency back-up as one several potential "system hardening" options to achieve greater grid resiliency and reliability in targeted areas of towns and municipalities. In the future, and given that microgrids are still a nascent technology, R&D efforts are still needed to better understand their operation and impact to system safety and reliability. For example, Eversource will be interested in understanding how a microgrid will connect and disconnect from the main electric distribution system and how it will transition from grid connect to island mode to ensure the safe and reliable operation of the main electric distribution system, as well as of the microgrid.

D. Pilot and Demonstration Projects

A demonstration project is a critical step in the R&D process that bridges the divide between proven concept and full roll-out. The key benefit of the demonstration phase is gaining knowledge from the first installation to inform the effectiveness of all future deployments. Eversource sees a demonstration project as the "first of many". In comparison, pilots tend to focus on testing particular technologies in order to gain knowledge, but not necessarily to inform effectiveness of future deployments. In this way, pilots are "one of a kind" type efforts.

For example, in recent years, Eversource received a grant from the DOE to conduct R&D on new sensor technology for real-time monitoring and alarms on a portion of the downtown Boston secondary network. The grant enabled the Company to deploy thousands of first generation sensors and study the benefit of the technology for understanding the state of the system. In the five-year plan, Eversource is leveraging the knowledge gained during this demonstration experience to expand deployment of sensors to more areas of Boston, Cambridge and Springfield focusing on delivering value to customers.

In the future, Eversource sees the opportunity to leverage pilots and/or demonstrations to further gain knowledge and advance new technologies. Some examples of the type of pilots and demonstrations that the Company is evaluating include:

- Deployments of multiple technologies targeted to a certain geographic area. The benefit of this type of demonstration is to understand how the interaction of multiple technologies impacts total benefits delivered to customers. For example, in an area with high DER penetration, Eversource may deploy investments such energy storage, automated feeder reconfiguration, adaptive protection and volt VAR optimization to better understand how factors such as voltage and power quality are impacted. Regional demonstrations would have benefit in both urban and rural areas of the service territory.

- Establishment of a Grid Modernization Test Bed. The concept behind the Test Bed is to either set-up a distribution feeder or substation to test technologies, or to do so in a simulated testing environment. Such an environment would be heavily instrumented to

obtain real-time power flow data and operational state of distribution control assets. By using a Test Bed concept the time from idea to execution could be shortened, thereby accelerating the innovation cycle for the next generation of technologies.

At this stage the Company is proposing to focus its attention on the implementing the core elements of its Grid Modernization Plan and is not proposing any new or unique pilot or demonstration as part of this Plan. In the future, if Eversource identifies pilots and/or demonstrations that can provide value to its customers and require additional funding, the Company will bring forth specific proposals for the Department's review and approval as part of one of its future annual reconciliation filings.

E. Utility Collaboration

In addition to the R&D approach outlined previously, Eversource, along with National Grid and Unitil, proposes to collaborate and share their R&D findings, both privately with each other and with external stakeholders. Collaboration will maximize the benefits from our collective R&D investments benefiting Massachusetts electric customers.

To facilitate collaboration, periodic confidential meetings will be held amongst the utilities to facilitate the free flow of information that may be sensitive in nature or may discuss specific products, technologies or funding sources. It is anticipated that each utility will provide a brief overview of each project in their portfolio including lessons learned and best practices. Discussion will also encompass identifying new technologies and funding opportunities for R&D and how the utilities can collaborate on additional research that benefits all Massachusetts customers. These opportunities may include responding to opportunities from Federal or State programs or could arise from public/private partnerships.

F. Regional Stakeholder Collaboration

In addition and to ensure that Eversource collects the broadest possible stakeholder engagement, it will conduct, in collaboration with the other utilities, an annual forum where a selected stakeholder group will be invited to inform the utilities on the challenges they foresee and discuss the innovation and partnership models necessary to potentially meet the challenges. The

first stakeholder engagement forum was conducted on June 25, 2015 with great success. This forum engaged the clean energy community and was sponsored by utilities in collaboration with the New England Clean Energy Council ("NECEC"). Eversource and the other utilities remain open to other stakeholder ideas and they are free to present them to any of the three utilities. Further, utilities may invite specific stakeholders or vendors to the meetings when specific information on a technology or funding opportunity is needed.

Besides the annual innovation forums, Eversource plans to leverage regional organizations and efforts to advance grid modernization innovation. Some of these efforts include:

MassCEC and the DOER

Eversource, MassCEC, and DOER are working to identify areas of mutual collaboration in at least two key areas: (1) energy storage, and (2) MassCEC's InnovateMass program.

In the energy storage area, Eversource will be an active participant in an Energy Storage Study that MassCEC has solicited in partnership with DOER (collectively, "the Study Team") to evaluate the economic development and market opportunities for energy storage, while examining potential policies and programs that could be implemented to better support energy storage deployment in Massachusetts. Eversource will participate in Study Team activities to identify opportunities to leverage Eversource's energy storage project as part of the state's efforts to establish and support the Commonwealth's energy storage market. Specifically, through a consultant driven stakeholder process, Eversource and the Study Team will explore whether there are opportunities to leverage funding to assist in the development of innovative projects in the Commonwealth including those that enable increased penetration of renewable energy onto the grid.

Eversource will also work with MassCEC to support the InnovateMass program. Eversource will work with MassCEC to identify teams that have promising clean energy companies developing technologies that support its Grid Modernization R&D efforts. Once a team is identified, Eversource will evaluate the feasibility of participating in the program and, where feasible, co-apply for an InnovateMass award as a demonstration site host. In addition,

Eversource will seek to identify opportunities to provide technical mentoring to teams participating in the program.

New England Clean Energy Council

In 2014, Eversource joined NECEC's Strategic Partner Network ("SPN"). The SPN aims to help leading corporations, which aim to grow their energy innovation strategic roles to build relationships in the cleantech community, develop new practices for open innovation, investment and strategic partnerships, and derive value faster and more efficiently. Other companies that participate in the SPN include GE, National Grid, Saint-Gobain, Shell and Schneider Electric.

University of Connecticut ("UConn")

Eversource and UConn have agreed to establish a Center to enhance the distribution of reliable power and promote economic growth throughout the region. The Center will enable Eversource to tap into UConn's internationally recognized faculty, students and state-of-the-art facilities to innovate, apply new technologies and establish innovative science-based solutions. These solutions will enhance the delivery of reliable power and provide needed data and analytic support for effective decisions to manage the risks of extreme weather events. Center activities will focus on: predictive storm-based damage modeling, vegetation management, smart hardening of an integrated and modernized grid and cyber security. Eversource will endeavor to leverage the learning from the Center to all of its operations inclusive of those in Massachusetts.

MA Energy Efficiency Advisory Council ("EEAC")

Eversource will also look for collaboration opportunities with the EEAC to coordinate efforts around TVR and energy efficiency programs. As indicated in the opt-in customer education section of the Plan, Eversource will seek to leverage the Mass Save brand to engage and emphasize the cost and energy savings opportunities for customers. In addition, Eversource will explore R&D opportunities to test additional energy efficiency opportunities that could be associated with a customer that already is in a TVR program.

Fraunhofer Tech Bridge program

Eversource will participate, as needed, in Fraunhofer CSE's TechBridge program which helps promising early-stage, clean energy start-ups build, develop, and validate their technologies to accelerate commercialization by developing and testing prototypes, deploying field demonstrations and performing third-party evaluation. By tapping into the deep industry knowledge at Fraunhofer, TechBridge executes targeted, low-cost projects from an industry perspective that move a product toward commercialization.

MIT Utility of the Future

Eversource is a participant of MIT's Utility of the Future study which brings together a diverse consortium of companies to address emerging issues in the electric power sector. The study's objective is to evaluate new and emerging technologies and combinations of these technologies, such as rooftop solar, distributed generation, and demand response implemented in the distribution sector. In addition, this study will look at how the distributed and the centralized power systems will be coordinated in the delivery of energy services. The study is expected to be completed in 2016 and Eversource will leverage its finding to inform its Grid Modernization Plan.

AMSC Homeland Security Resilient Electric Grid ("REG") Utility Group

Earlier in 2015 Eversource joined the REG Utility Group which is an industry group working in cooperation with the government to focus on securing the nation's electricity grids. The group aims to reduce the impact to critical electrical infrastructure caused by acts of terrorism, extreme weather, or equipment failure. AMSC's Resilient Electric Grid system is an innovative approach to the underground power distribution system that increases reliability and capacity in urban environments. By interconnecting substations in a new way that is not possible with traditional technologies, the REG system enables significant increases in urban grid reliability while also increasing load serving capacity without adding new transformers.

VI. Grid Modernization Plan Beyond Short-term Investment Plan

As a portfolio of investments, the STIP five-year plan supports the Company's ten-year plan for grid modernization. The Company envisions many of the investments that are part of the STIP will continue beyond the first five years of the Plan. At the same time, during the first five years, the Company will gain considerable experience and there will be considerable advancements in technologies, therefore forecasting with precision beyond five years is difficult. The Grid Modernization Plan should have the flexibility to evolve over time and the Company will endeavor to incorporate learning and new technologies over time.

A. Resilient Grid - Years 6 to 10

From an overall perspective, the Underground Electrical Safety and Resiliency Program and Overhead Reliability and Resiliency Program are structured as cyclical activities that would continue in parallel with grid-modification over the long run in order to: (1) assess the condition of infrastructure in use on the Eversource East system; (2) identify infrastructure that needs repair, replacement or remediation; and (3) perform and complete repairs, replacements and remediation of that equipment on a timely basis. The specific maintenance and capital projects that the Company will undertake through these programs will result directly from the inspection and/or assessment process. All of the activities encompassed within this program are necessary to establish the physical foundation for technology deployments that are part of the Company's GMP.

B. Smart and Integrated Grid - Years 6 to 10

The path to a modern grid will continue into the future. The investments proposed in the STIP set a strong foundation that Eversource will build upon as a part of its ten year plan. Although specific investments in year six and beyond will be shaped by advances in technology and prevailing system conditions, the Company has set a path for full deployment of the STIP portfolio to maximize benefit to customers.

For a number of investment categories, that means continuing to build capabilities leveraging state of the art technology to ensure continued cost effectiveness. Investments in

communications infrastructure will continue throughout the ten year time horizon to ensure maximum effectiveness of DSCADA devices and to enable even more capabilities for applications such as AFR and advanced load flow. Eversource also expects to continue to invest in advanced sensing and monitoring. Although some assets, such as feeder breakers will be almost completely DSCADA enabled at the end of five years, advances in technology for monitoring and control will extend to assets across the distribution system, including more sensing on the urban secondary networks. Similarly, in order to support state energy policy goals, Eversource will likely need to deploy technologies for adaptive protection and two-way power flow to accommodate the penetration of DER across the system. These investments will be shaped by industry trends with respect to advances in technologies such as inverters, energy storage and electric vehicles.

The pace of deployment of some investment categories in the second half of the ten year plan is highly dependent on the results experienced in the first five years of the plan. For instance, to the extent VVO investments meet expectations for delivering cost effective benefit to customers, Eversource will move rapidly to expand deployment beyond the 15 percent proposed in the STIP. Energy storage is another investment that, if proven effective in meeting objectives, could be deployed more widely beyond year five in targeted applications. Additionally, predictive outage detection has the potential to be expanded for use across the system once benefits are confirmed.

The remainder of investments will continue to be optimized in subsequent years with the potential for substantial upgrades or augmentations given currently unforeseen technology developments. Some portions of the investment portfolio such as the DMS and integrated planning and tracking for DER, will be in place by the end of five years. In year six and beyond they will function as fundamental enablers delivering benefits in terms of improved reliability, planning and DER integration capabilities. Similarly, in the second half of the ten year plan there will be relatively less emphasis on deploying devices for AFR or remote faulted circuit indicators given the number of devices that Eversource expects to deploy as a result of the STIP.

As with all investments, the Company will evaluate technologies as they emerge and adjust its plan to continue to maximize benefits to customers. In the future The Company expects to see (1) rapid advancements in technology; (2) increased proliferation of distributed clean energy interconnections; (3) demand for even more high-speed communication infrastructure to all points on the distribution grid; (4) challenges associated with aging infrastructure; and (5) continued customer demand for safe and reliable service at all times.

The following is a summary of ways in which STIP portfolio supports programs and activities envisioned in the second half of the 10-year plan.

Rapid advances in technology

The STIP emphasizes a foundation of situational awareness leveraging recent advances in the cost effectiveness of sensing throughout the distribution system. Widespread sensing and monitoring is the basis for advanced analytics required to effectively incorporate technologies such as advanced inverters and distributed energy storage as they continue to emerge in the six to 10 year time horizon.

Increased proliferation of distributed clean energy interconnections

The Green Communities Act and the Global Warming Solutions Act will continue to drive increases in the percentage of energy derived from clean, distributed resources. The STIP recognizes the need to prepare for this clean energy future. In particular, the advanced load flow and planning tools are fundamental investments that will enable Eversource to maximize the value of DER and to safely and reliably integrate DER at penetration levels much greater than today.

Demand for even more high-speed communication infrastructure

Communications infrastructure will continue to be an enabling investment for the modern grid beyond the five-year time horizon. STIP investments focus on building fiber connectivity to substations and from the substation out onto the grid. Beyond five years, the Company will

continue to seek out ways to optimize secure communication with overhead and underground field devices. Examples of potential technology advancements include mesh networks enabled by fiber to the substation and support for 61850 communications protocols for substation automation.

Challenges associated with aging infrastructure

The STIP recognizes the importance of a resilient grid as a threshold investment for a smart, integrated grid. Over the next 10 years, the electric power industry will continue to address challenges of an aging infrastructure. Investments proposed in STIP, such as sensing and automation of the 4-kV underground in Eversource East, are based on a recognition that technology should be deployed where appropriate to ensure the reliability of assets into the future. These investments will support asset strategy in the six to 10 year time horizon regarding optimal use of technology as a means to address aging infrastructure.

Continued customer demand for safe and reliable service at all times

Eversource understands its customers' ever increasing reliance on electric power to function in the modern world. In the STIP, reducing the impact of outages is one of the key objectives and drives significant investment in technologies proven to make measurable improvement in reliability. In the ten year plan, advances in technology are expected to drive even more reliability benefit to customers. The Company's commitment to providing safe and reliable service will continue to be the foundation of its investment plan in the six to 10 year time horizon and beyond.

C. Customer Engagement – Years 6 to 10

In years six to 10 of the Plan, the Company expects to continue its customer education plan and will also look to refine and optimize its opt-in TVR program.

Building on the strong foundation set by the customer education and the opt-in TVR programs which are part of the STIP, Eversource will be well positioned and will have the required

flexibility to consider and develop new programs that will provide for increased customer engagement. At the same time, the Company expects that there will be multiple changes in the marketplace that will also provide additional options to customers.

The Eversource Customer Education plan would adapt to the changes in the marketplace and would continue to support adoption of new technologies and options for customers. With the understanding that customer awareness would have increased as a result of the initial five-year education plan, a modified outreach and education plan would be recommended. An integrated communications approach would continue to be utilized, however communication channels, frequency and spending would be changed appropriately to meet objectives and goals.

In years six to 10, the Company expects that additional customers will become interested in the TVR program. Given the unique design of the Company's proposed opt-in TVR program coupled with the Company's comprehensive customer engagement and education strategy, it is conceivable that as many as 20 percent of the customer base might be on one of the opt-in TVR programs offered. In addition, the investments that will allow the company to offer an opt-in TVR program, will also position Eversource to have the flexibility to offer more complex pricing options in years 6 to 10 of the Plan. Some of the options that will exist include:

- New opt-in TVR programs. Over time and as Eversource learns about customer behavior from its initial deployment of the program, the Company expects to be in a position to propose and launch new opt-in TVR offerings that can better provide value for the investments already undertaken.

- New pricing programs to replace net metering. The system capabilities deployed as part of the opt-in TVR program will allow Eversource to consider alternative models that might require a more complex billing algorithms to properly price distributed energy resources like solar.

- Behavioral campaigns that provide additional information to incent customers to further reduce their use during peak times. These campaigns could be similar to the Home Energy Reports currently employed to drive lower overall energy usage.

- New programs to properly price other distributed energy technologies such as customer-sited energy storage and electric vehicles.

VII. Conclusion

Eversource is presenting a proposed Grid Modernization Plan that represents a balanced and cost-effective approach to meet the Department's grid-modernization objectives, while meeting customer expectations for reliability and superior customer service.

The GMP emphasizes all the key characteristics of a modern grid. It focuses initially on resiliency as the backbone of a modern grid. It proposes multiple cost-effective programs to make the system smarter and more able to integrate distributed energy resources. Lastly, it provides for a customer-centric, innovative and cost-effective opt-in TVR approach.

The electric distribution system will continue to play a significant role in the region's economic and environmental wellbeing today and into the future. Eversource will continue to be at the forefront of industry and technology advances to ensure that the system employs the latest proven technologies while providing clear customer benefits.

Eversource looks forward working with the Department as it begins its review and assessment of this Plan and also appreciates in advance the input it will receive from its customers and interested stakeholders.