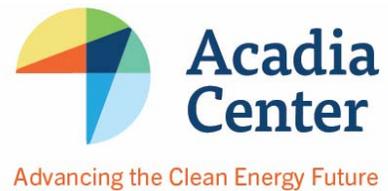


# Massachusetts Grid Modernization

## Detailed Review of Utility Proposals

December 2015



### Background

In 2014, the Massachusetts Department of Public Utilities (DPU) required investor-owned utilities to develop grid modernization plans,<sup>1</sup> which utilities proposed in August 2015. In a companion high-level summary<sup>2</sup> Acadia Center describes how the plans inadequately address the fundamental challenges and opportunities created in the transition to a clean, distributed, customer-centric energy system. Acadia Center additionally compares the Massachusetts Grid Modernization proceeding with New York's more ambitious Reforming the Energy Vision (REV) proceeding in a separate document.<sup>3</sup> This document provides greater detail on the specific proposals within Massachusetts utilities' grid modernization plans.

### Detailed Summary of Proposed Plans

The grid modernization order requires utilities to propose 5 year Short Term Investment Plans (STIPs) supported by a comprehensive business case analysis. The STIP must include an approach to achieve Advanced Metering Functionality (AMF)<sup>4</sup> within 5 years, or an alternative proposal supported by a business case analysis. The investments in the STIP are eligible for preauthorization of costs, provided that the STIP includes a plan to achieve AMF. Targeted cost recovery through a Capital Expenditure Tracker Mechanism is available for the STIP.

### Short-Term Investment Plans: Grid-Focused

**National Grid** proposes four potential investment scenarios for both grid- and customer-focused investments:

- *Balanced Plan Scenario*
- *AMI-Focused Scenario*
- *Grid-Focused Scenario*
- *Opt-In Scenario*

The *Balanced Scenario* proposes an ambitious set of investments for grid-facing technologies. This includes a rollout of distribution automation technology and volt-ampere reactive (volt-VAR) optimization for the highest value feeders and a system-wide investment in advanced distribution management and monitoring. These system-wide investments would enable more extensive investments in distribution automation and volt-VAR optimization in years 6 through 10 of the grid modernization plan. The *Grid-focused Scenario* and *Opt-in Scenario* both contain the same grid-facing investments as the *Balanced Scenario*. The *AMI-focused Scenario* only includes volt-VAR optimization for grid-facing technologies, and this investment is more limited than the *Balanced Scenario* in both the short and long term.

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<sup>1</sup> DPU Order 12-76-B

<sup>2</sup> Available at: <http://acadiacenter.org/document/grid-modernization/>

<sup>3</sup> Available at: <http://acadiacenter.org/document/grid-modernization/>

<sup>4</sup> AMF refers to the functionality of AMI, and in this document both terms are utilized as appropriate.

National Grid does not include a range of investments to integrate distributed generation in their STIPs but does discuss them in a separate, Distributed Generation section. The Distributed Generation section proposes measures to improve application processing, system analysis and planning, online tools for customers, and targeted system upgrades. National Grid proposes a new filing for cost recovery for these investments and, until another mechanism is approved, proposes to recover costs associated with integrating distributed generation through the Interconnection Tariff.

**Eversource** proposes a grid-focused STIP containing a reasonably comprehensive set of smart grid investments, along with substantial investments in resiliency. On smart grid, this includes advanced distribution monitoring, automation, and management systems, along with significant investments in distributed generation integration that National Grid declined to include – such as tracking and planning for DG and two-way power flow. Distributed generation integration also includes a proposal to undertake one significant storage project in New Bedford for the purpose of voltage smoothing to accommodate high solar PV penetration. Although resiliency investments were not categorized as “grid modernization” in last year’s order, Eversource argues that significant resiliency investments are a necessary prerequisite. Because of this, Eversource proposes \$150 million of safety and resiliency investments over 5 years, including \$50 million in tree trimming.

**Unitil** proposes a grid-focused STIP with a wide range of investments to enable distributed generation and automate the grid along with an investment to better direct their outage restoration workforce. The STIP also includes annual studies to determine circuit-by-circuit capacity to incorporate distributed energy resources.

### Short-Term Investment Plans: Customer-Focused

**National Grid** proposes different levels of customer-focused investments across the four potential scenarios. The *Balanced Scenario* proposes a full rollout of advanced metering infrastructure to all customers across the service territory. Phased deployment across 6 separate areas would be preceded in each area by customer education and outreach. Significant back-office and communications investments are included to enable AMI and customer load management. National Grid proposes to fund customer-facing elements of customer load management through the energy efficiency programs, and to pay for necessary utility software, portals, and management systems through the STIP. Using efficiency funds for grid-enabled efficient appliances should only be allowed for customer facing load control measures that also save energy and are cost-effective based on energy savings alone,<sup>5</sup> and investments will need to be apportioned appropriately between grid modernization and efficiency programs depending on intended outcomes. The *AMI-focused Scenario* contains the same customer-facing investments as the *Balanced Scenario*. The *Grid-Focused Scenario* is on an identical timeline as the *AMI-focused* and *Balanced Scenario*, but only 30% of customers are offered advanced metering and TVR on an opt-out basis and the remaining 70% of customers are offered AMI and TVR on an opt-in basis. The *Opt-In Scenario* would only provide advanced metering and TVR on an opt-in basis. As a result, smart meter deployment, customer load management investments, and the associated outreach and education are spread over 10 years.

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<sup>5</sup> An example of this would be a connected refrigerator. The incentive for the refrigerator should be based on the energy savings, but the utilities should prioritize eligibility of models that can be grid-connected through AMI or internet connectivity.

**Eversource** declines to invest in AMI, which the company acknowledges “is the only technology that will satisfy all four of the advanced metering functionalities set out by the department.”<sup>6</sup> Instead, the proposal includes two different opt-in TVR designs with associated enabling metering. The metering option proposed would rely on hourly data transmission using cellular technology, with a secondary option of networked meter reading in areas where the communication network for distribution automation has been rolled out. Further analysis is needed to determine whether these approaches could meet DPU’s four requirements<sup>7</sup> of “advanced metering functionality:”

- 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.

Hourly data transmission using cellular technology is unlikely to satisfy criteria #1 or #3, precluding the ability to monetize certain services in ISO-NE markets and missing the opportunity to utilize advanced demand management techniques.

Three possible options are proposed for managing load of customers who opt-in to TVR, but no concrete proposal is evident. The Eversource STIP does contain a 10-page long section titled “Opt-Out TVR Program Assessment”<sup>8</sup> that questions DPU’s orders, presents high costs<sup>9</sup> and low benefits of advanced metering and TVR, and projects negative impacts on low-income customers.

**Unitil** is in a unique situation due to prior installation of advanced metering that has some, but not all, of the functionality required by the Department. In particular, the current Unitil advanced metering cannot record demand with sufficient granularity to enable TVR. As a result, Unitil proposes only opt-in to full AMF and TVR starting in 2020. In addition, Unitil’s STIP proposes an Energy Information Web portal to enable customers to better understand and manage their load along with a pilot on “gamification” – a set of techniques to encourage customer load management.

## Business Case Analysis

In order to justify the STIP, the DPU requires a detailed description of the proposed investments and schedule for deployment, rationale and business drivers, identification and quantification of all quantifiable benefits and costs, and identification of all difficult-to-quantify or unquantifiable benefits and costs. The business case is DPU’s primary lens for deciding whether to accept the STIP.

As required by the Department, the utilities enlisted a consulting firm to develop common assumptions for certain elements of the business case. Tabors, Caramanis, and Rudkevich developed energy prices, capacity

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<sup>6</sup> August 19<sup>th</sup>, 2015 Eversource Grid Modernization Plan in DPU Dockets 15-122/15-123, at 87.

<sup>7</sup> DPU Order 12-75-B, at 14.

<sup>8</sup> August 19<sup>th</sup>, 2015 Eversource Grid Modernization Plan in DPU Dockets 15-122/15-123, at 86.

<sup>9</sup> AMI costs are estimated at \$946 million including stranded costs of existing meters. Without stranded costs, it is \$781 million. For comparison, Eversource’s supply infrastructure proposals are estimated to cost a total of \$4.4 billion for Northern Pass (\$1.4 billion) and Access Northeast (\$3 billion).

prices, demand reduction induced price effects (DRIPE) and renewable portfolio standard (RPS) compliance cost inputs, using similar modeling to work undertaken for the energy efficiency programs. Similarly, response to TVR was determined in a joint analysis for the utilities by Concentric Energy Advisors. All benefit-cost analyses were conducted on a 15-year time frame, using company-specific weighted average cost of capital as a discount rate. Company-specific demand and energy forecasts were also used, as well as other features of each distribution territory. It is important to note that the monetized benefits in all utilities' cost-benefit analyses do not include many of the major benefits of grid modernization, including avoided transmission and distribution capacity and other major benefits from enabling additional distributed energy resources. Including these benefits would lead to higher benefit-cost ratios.

**National Grid** developed benefit-cost analyses for most portions of the STIP, resulting in estimated benefit-cost ratios of 0.9 for the *Balanced Scenario*, 1.2 for the *AMI-focused Scenario*, 0.6 for the *Grid-focused Scenario*, and 0.56 for the *Opt-in Scenario*. Monetized benefits include operation and maintenance (O&M) savings, deferred capital investments, enhanced revenues from lower theft, energy and generation capacity benefits, and reliability. Incremental greenhouse gas reductions were quantified but not monetized beyond compliance costs directly included in energy prices. National Grid chose not to quantify or monetize benefits from integrating distributed generation, avoiding transmission and distribution capacity investments, or optimizing system planning.

**Eversource** only attempted to develop cost-benefit analyses for TVR and volt-VAR optimization and declined to monetize reliability benefits. All TVR programs, which include the costs of metering, are projected by Eversource to have a benefit-cost ratio much lower than 1. The volt-VAR optimization programs are estimated to have a benefit cost ratio of 2.15.

**Unitil** developed an overall cost-benefit analysis for its STIP proposal, including monetizing reliability benefits. The analysis shows an overall benefit-cost ratio of 1.5, with major net benefits from grid reliability and workforce management improvements, and major net costs from distribution generation enablement.

## Rate Design

Under a companion order to grid modernization the utilities were required to establish default time-of-use (TOU) rates for basic service with a critical peak pricing component. National Grid proposes an opt-out TOU rate structure that appears to conform to grid modernization objectives, but the company also proposes to increase monthly customer charges which reduce customer control and may undermine grid modernization objectives. Eversource declines to comply with the DPU order requiring default TOU pricing, proposing instead limited, opt-in TOU pricing that the company projects only 5% of customers would adopt. Unitil proposes opt-in TVR and critical peak pricing.

**National Grid** proposes a set of changes to distribution rates that would establish tiered fixed charges, add new fees on stand-alone solar projects and other types of distributed generation, and decrease volumetric rates and net metering credit values for solar. A similar, revenue-positive proposal was in National Grid's subsequent rate case<sup>10</sup>, from which the following specifics are drawn. In the first phase, fixed charges would be increased in a more traditional manner from \$4 per month to \$5.50. The first phase would eliminate the current inclined block structure and raise the volumetric rate to 4.3 cents per kWh. The second phase would establish a new customer charge system with four tiers based on maximum monthly consumption over the previous twelve months. The

<sup>10</sup> DPU Docket 15-155.

tiers are defined as (1) \$6 per month for a maximum less than 250 kWh, (2) \$9 per month for those between 251 and 600 kWh, (3) \$15 per month for those between 601 and 1,200 kWh, and (4) \$20 per month for those above 1,200 kWh. The second phase raises the same revenue as the first phase, so the increased customer charges lower the per kWh retail rate by over one cent per kWh. A similar approach is proposed for commercial customers.<sup>11</sup>

The decrease in volumetric rates will reduce compensation to customers feeding power back into the grid. Reducing the per-kWh rate would decrease the credit value received by customer-generators under rules for net metering in Massachusetts, thus undermining the economics of distributed generation. In addition, National Grid proposes to establish new fees on distributed generation projects without on-site consumption. The new fee would be based on a calculation of nameplate capacity adjusted by a capacity factor from ISO-NE. For each kW-month, there would be a fee of \$7 for projects connected to the distributed system at a high voltage location, and a fee of \$8.50 for projects connected at a low voltage location. This fee would not apply to existing projects, but could undermine community shared solar and other categories of new stand-alone solar projects.

Additionally, reducing the per-kWh retail rate would undermine incentives to save energy. By reducing the portion of energy bills that consumers can control by saving energy, the proposal would undermine energy efficiency incentives. The tiered structure of National Grid's fixed charge proposal could preserve some incentive to save energy and enter a lower tier, but lag time in tier adjustment, overall complexity, and interactions with tier thresholds could nonetheless reduce the attractiveness of saving energy.

In attempting to reduce impacts on low income consumers and preserve energy efficiency incentives, National Grid's tiered fixed charge proposal may be an improvement over proposals for undifferentiated fixed charge increases,<sup>12</sup> but potentially adverse impacts on distributed energy resources and the objectives of grid modernization merit close scrutiny of the proposal. The proposal must also be considered in broader national context, as utilities across the country propose to shift rate recovery away from volumetric per-kWh consumption and toward fixed charges<sup>13</sup> in order to provide more certainty in revenue recovery.

Furthermore, National Grid has not shown the detailed analysis of distribution-specific costs and benefits needed to justify this particular rate redesign. It is also worth noting concurrent legislative deliberations to develop a long-term framework for solar energy, including potential rate designs based on the value of solar.<sup>14</sup>

A more thorough proceeding to undertake smart redesign of distribution rate and other necessary and complementary rate design would be welcome. This past February Acadia Center released UtilityVision, a set of

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<sup>11</sup> August 19<sup>th</sup>, 2015 National Grid Grid Modernization Plan in DPU Docket 15-120, at 198-204.

<sup>12</sup> In 2014, Eversource's affiliate in Connecticut, Connecticut Light & Power, requested an increase in the residential monthly customer charge from \$16 to \$25.50 and was granted an increase to \$19.25. Connecticut Public Utility Regulatory Authority Docket No. 14-05-06. Subsequently, Connecticut enacted a law that would limit the residential monthly customer charge going forward to certain categories of costs, directly related to metering, billing, service connections and the provision of customer service. Section 105 of June 2015 Special Session Public Act No. 15-5. This will likely limit future increases in the monthly customer charge and could lead to decreases in customer charges in subsequent rate cases.

<sup>13</sup> For discussion of the numerous jurisdictions in which utilities have proposed increased fixed charges, and potential customer impacts, see: <http://www.utilitydive.com/news/the-fight-over-solar-moves-from-net-metering-to-rate-design/327742>.

<sup>14</sup> See: <http://acadiacenter.org/document/next-generation-solar-policy-framework-for-ma/>

proposals for reforming the utility system that includes proposals for short-term and long-term rate design focusing on establishing the right value for DER, aligning how consumers pay and get paid, and utilizing bi-directional rates.<sup>15</sup> Additional insight may be gleaned from a white paper released by the New York Department of Public Service, providing in-depth analysis of how rate design can contribute to reducing the local and regional peaks that drive infrastructure investment costs.<sup>16</sup>

In the Grid Modernization Plan, National Grid proposes default time-of-use rates with critical peak pricing for all customers, with an option to elect a flat rate with peak time rebates, as specified in Order 14-04-C. The specifics of the proposal are taken from National Grid's Smart Grid Pilot Program, Docket 09-32. For the default rate, the off-peak period would be weekends, holidays, and weekdays between 8 p.m. and 8 a.m. and the on-peak period would be weekdays between 8 a.m. and 8 p.m. Critical peak pricing hours would be variable, based on an analysis of regional demand patterns, and customers would be notified of higher electricity rates a day in advance. For the optional flat rate, hours for the peak time rebate will be defined in the same manner as critical peak pricing hours.

**Eversource** proposes a limited, opt-in TVR program that it anticipates 5% of customers would adopt over flat price basic service. TVR for generation service would be made available to all residential and small commercial and industrial (C&I) customers, but marketing would be targeted to customers with discretionary load to shift. A Time-of-Use and Critical Peak Pricing ("TOU/CPP") rate would be offered to residential customers, and would consist of peak (12pm-6pm weekdays), off-peak (all other hours), and critical peaks (twelve peak summer days based on day-ahead load projections from ISO-NE). Based on experience from the company's Smart Grid Pilot, Eversource predicts limiting air conditioning through increasing thermostat set-points, pre-cooling, or turning off air conditioning would reduce peak demand, providing capacity market savings to all customers. An alternative opt-in Targeted TOU option would be provided to residential and small C&I customers who would choose a two-hour peak of 2pm-4pm, 3pm-5pm, or 4pm-6pm. All other hours including weekends would be considered off-peak. Eversource proposes to recover costs associated with the opt-in TVR programs from participating customers, which would likely increase costs of participation and requires further justification in light of system-wide benefits produced by TVR participants.

**Unitil** proposes opt-in time-of-use rates for generation service with critical peak pricing starting in the fourth year of grid modernization investments. The offering would include a fixed ratio of prices between off-peak, on-peak, and critical peak pricing periods – specifically the on-peak to off-peak ratio would be 3.28 to 1 and the critical peak to off-peak ratio would be 7.67 to 1.

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<sup>15</sup> Available at: <http://acadiacenter.org/document/utilityvision/>

<sup>16</sup> The white paper discusses how in order to fully capitalize on demand as a resource available to reduce total system costs, rate design must signal value and compensate customers for the benefit their distributed energy resources (DER) provide to the system. Mass-market rate design that combines a fixed charge with a volumetric charge fails to encourage customer or market participant action to reduce peak and optimize usage, instead, time varying rates and precise attribute unbundled rates are necessary to spur further proliferation of DER and effectively lower system costs. *See Case 14-M-0101 Staff White Paper on Ratemaking and Utility Business Models*, July 28, 2015, at 73-107.

## Performance Metrics

In order to evaluate the progress toward grid modernization, the Department required the utilities to develop statewide and company-specific metrics to track– but not yet reward – progress in two broad categories:

- 1) Infrastructure metrics that track the deployment and implementation of grid modernization technologies and systems; and
- 2) Performance metrics that measure progress towards the objectives of grid modernization (reducing the effects of outages; optimizing demand and reducing costs; integrating distributed resources; and improving workforce and asset management)

The Department provided an illustrative list of possible statewide metrics. Utilities were directed to describe the process used to develop its own proposed metrics and explain how each metric relates to the Order objectives, including goals that are not easily quantifiable or within the company’s complete control. The metrics are intended to record and collect information and are not tied to incentives and penalties at this point; a significant difference from New York’s REV proceeding which proposes to tie utility earnings to specific performance metrics. It is also worth noting that REV proposed metrics encompass a broader range of objectives and include categories addressing affordability, energy efficiency, system utilization and efficiency, and market development, among others.

### Statewide Metrics

Companies convened a Joint Utilities Working Group to conduct a cross-utility review process and agreed on the following statewide infrastructure metrics:

Metric	GM Objective
System Automatic Saturation (a measure of the amount of automation on the electric distribution system)	Reduce impact of outages
Total number and % of customers on TVR	Optimize demand
Total number of grid-connected distributed generation facilities, nameplate capacity and estimated output for each unit, and type of customer-owned or operated units	Integrate DER
Number/% of sensors installed v. what is planned in the GMP	Improved workforce/asset management
Percentage of circuits with installed sensors	Improved workforce/asset management

The following are proposed statewide performance metrics:

Metric	GM Objective
Customers benefitting from grid modernization devices	Reduce impact of outages
Load reduction due to TVR customers participating in declared critical peak pricing event (CPP)	Optimize demand

The Companies adopted only four of the fifteen infrastructure and performance metrics proposed by the Department and proposed two new statewide metrics developed by the Working Group. The Working Group rejected, among others, the Department’s proposed metric of reducing system peak demand and reduction in peak demand from GMP investments. Utilities declined on the basis of technical inability to isolate GMP investment impact on peak demand from other contributing factors, despite the fact that energy efficiency program impacts are estimated with reasonable accuracy against the variables – including weather and customer behavior – that utilities cite as impediments.

### Utility-Specific Metrics

**National Grid** offered the most comprehensive description of the metrics development process. The company formed a working group to identify existing company metrics, define new company metrics, and compare against statewide grid modernization performance metrics to ensure consistency. The working group then evaluated and modified the proposed metrics based on a number of factors including stakeholder feedback, internal feedback, and correlation of benefit-cost analysis to proposed metrics. National Grid proposed to report to the Department on an annual basis the statewide and company-specific metrics. National Grid developed four company-specific performance metrics: (1) percentage of technology installed per planned year; (2) percentage of technology installed per the overall plan; (3) percentage of technology installed by spending per planned year; (4) percentage of technology installed by spending per the overall plan. For progress on research, development, and deployment (RD&D), customer load management (CLM) and marketing, education, and outreach (MEO) efforts the company proposed written reports in lieu of hard company-specific infrastructure metrics due to the difficulty in defining meaningful, quantifiable metrics for these pieces of GMP.

**Eversource** established an internal Grid Modernization Working Group to develop company-specific metrics. The company chose not to divide the metrics into infrastructure and performance, instead labeling all of six company-specific metrics as “performance.” Considering a lack of detail for the company-specific metrics, it is difficult to make a thorough assessment, but at least several internal metrics appear substantially identical to statewide metrics, such as outages avoided and customers reached through TVR Marketing. Eversource only included the description of the statewide-metrics development process in detail and declined to provide the specifics of the company-specific metrics development and stakeholder feedback solicitation process as directed by the Order.

**Unitil** omitted any discussion of the statewide or company-specific metrics development process and stakeholder feedback solicitation process despite the Department’s direction to do so. Unitil chose to separate metrics into “build” and “impact” types per the Department of Energy classification, which roughly correspond to “infrastructure” and “performance” categories respectively. Unitil included extensive rationale for each of the statewide and company-specific metrics, which focus on three broad categories: (1) DER enablement, (2) Distribution automation; and (3) Customer empowerment. Unitil is the only company that included customer satisfaction/empowerment metrics as suggested by the Department.

### Marketing, Education & Outreach

Educating customers about the opportunities and practical impacts of new technologies and rate structures is recognized universally by the utilities as essential to getting the most value out of grid modernization. Utilities acknowledge that grid modernization will require a significant shift in customer engagement, as most customers consider energy a low interest category. In designing statewide and company-specific Market, Education and

Outreach (MEO) plans, the utilities draw on experience gleaned through previous pilots, ongoing demonstration projects, and efforts undertaken through statewide energy efficiency programs. Radically divergent grid modernization proposals from the utilities – particularly in relation to customer programs – appear to confound efforts to pursue a statewide MEO approach. The few early acting opt-in customers of Eversource and Unitil would need targeted MEO efforts whereas programs designed to reach all of National Grid’s customers under the universal AMI and TVR proposals would necessarily be more comprehensive.

**National Grid** proposes a phased MEO effort to match deployment of AMI. Initial efforts will focus on using a diverse array of new and traditional media and grassroots outreach to build awareness of grid modernization offerings with subsequent efforts shifting to customer engagement and satisfaction through provision of information through AMI and supporting mechanisms. Periodic surveys of messaging, awareness, and satisfaction will be conducted over the first five years to inform MEO efforts. MEO efforts will also be informed by experience gleaned through National Grid’s Smart Energy Solutions program offering AMI and TVR to 15,000 customers in Worcester.<sup>17</sup>

National grid proposes to use data analytics to target customers most likely to take advantage of specific programs. Pre-implementation efforts will use radio, newspaper, social and digital media to build general awareness of grid modernization and deployment timelines. During early implementation MEO efforts will move in parallel paths for early deployment customers and those targeted for later deployment.

**Eversource** proposes a limited customer engagement plan to support opt-in TVR projected to be adopted by 5% of customers. As noted above in the summary of short-term investment plans, the company questions the DPU’s logic in requiring default TVR. Eversource justifies opposition to TVR in part based on DOE research finding that “opt-in customers had individual demand reductions that were nearly 80% higher than those measured for opt-out customers (25% vs. 14%).”<sup>18</sup> With TVR participation projected by Eversource to be quite low, however, it would appear that 25% response from a 5% of customers would have far less benefit (an overall 1% system-wide demand reduction) than a moderately lower response of 14% from all 95% of eligible customers (an overall 13% system-wide demand reduction).

**Unitil** provides a high-level summary of MEO efforts through existing and new channels to educate consumers on the benefits of grid modernization and engage customers as appropriate to participate in specific programs.

## Research, Development and Deployment

The grid modernization order required a research, development and deployment (RD&D) component to focus on testing, piloting, and deploying new and emerging technologies to meet grid modernization objectives. This should include a portfolio of projects and participation in relevant state and regional efforts resulting in a significant increase in RD&D efforts for new technologies. In response to the order, National Grid acknowledges the need for enhanced RD&D efforts and budgets (which typically account for less than 1% of utility revenues), and proposes enhanced research and a range of pilot programs to evaluate the impacts and benefits of new technologies. Eversource lists collaborative research efforts with other utilities, trade groups, and academic institutions, but does not propose any pilots. Due to the company’s small size, Unitil has not historically pursued

<sup>17</sup> See: [https://www.nationalgridus.com/masselectric/a3-1\\_news2.asp?document=9113](https://www.nationalgridus.com/masselectric/a3-1_news2.asp?document=9113)

<sup>18</sup> Eversource Grid Modernization Plan in DPU filing 15-122/15-123, at 92.

significant RD&D efforts, and anticipates largely relying on collaboration with other utilities. All utilities propose sharing information confidentially among themselves, and with external stakeholders through annual forums.

**National Grid** proposes a \$29.3 million, 10 year RD&D effort focusing on integrating DER and electric vehicles, reducing carbon emissions, and enhancing asset utilization and safety. National Grid proposes to participate in relevant state, regional and national research efforts, and seek external funding where possible to support RD&D costs. Specific pilots include:

- Vehicle-to-Grid (V2G) Study – to assess the potential for electric vehicle batteries to support grid operations.
- Microgrid Demonstration Project – to provide 5 days of power during utility outages by enabling continuing use of distributed generation in the event of an outage (DG is currently disconnected during outages), supported by deployment of an additional 1MW of combined heat and power (CHP) and 1MW solar PV.
- Distributed Energy Storage – to test deployment of utility-scale energy storage to complement renewable generation and improve power quality.
- Targeted Inverter Conversion – to explore the potential for advanced inverters to improve integration of DG and reduce interconnection costs.
- High Density Community Energy Storage – to target areas with high numbers of small solar installations and test charging/discharging approaches and pursue bundled participation in ancillary services market.
- Short Term Renewable Forecasting – to more accurately account for the capacity benefits of renewables and reduce energy and capacity costs.
- Sensor Analytics – to monitor and anticipate system failures.
- Fault Location Analysis – to predict faults on the system, building on algorithms developed by the Electric Power Research Institute (EPRI).
- DC to DC Fast Charging – to explore benefits of charging electric vehicles directly with direct current (DC) output from solar PV installations and avoid losses in conversion to and from alternating current (AC) power.
- Analytics for Asset Management – to anticipate critical equipment lifecycles and improve asset management.

**Eversource** proposes an RD&D budget of \$1.5 million per year to support collaborative research with universities and research institutions. Focus areas are energy storage, electric vehicles (including grid impacts, vehicle-embedded charging controls, and V2G), cybersecurity, low-income impacts of grid modernization, new pricing models, behavioral response, and microgrids. No pilot or demonstration projects are proposed.

**Unitil** proposes a contribution of \$430,000 over the course of the grid modernization 10 year horizon to support collaborative RD&D.

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