Readiness for Advanced Measurement and Verification in the Northeast

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About NEEP

NEEP was founded in 1996 as a non-profit whose mission is to serve the Northeast and Mid-Atlantic to accelerate regional collaboration to promote advanced energy efficiency and related solutions in homes, buildings, industry, and communities. Our vision is that the region's homes, buildings, and communities transformed into efficient, affordable, low-carbon, resilient places to live, work, and play.

Disclaimer: NEEP verified the data used for this brief to the best of our ability. It reflects the opinion and judgments of the NEEP staff and does not necessarily reflect those of NEEP Board members, NEEP Partners, or project participants and funders.

Introduction

Northeast Energy Efficiency Partnerships (NEEP) has been tracking the evolution of the advanced measurement and verification (M&V) industry through projects and publications. As this is a fast-moving field, we continue to research new vendors, technologies, and services offered in advanced M&V. NEEP's Advanced Building Analytics Tools List which is available online[1] is periodically updated and describes many vendors and products. With this brief, NEEP examines advanced M&V from a different perspective – that of states and program administrators supporting energy efficiency programs in the region who have adopted or have the potential to adopt features of advanced M&V[1].

Objective

This brief was motivated by the question, *How ready are states and program administrators in the region to adopt advanced M&V as part of the energy efficiency program process?* It seeks to provide a high-level assessment of readiness to adopt advanced M&V, and looks at three elements that we suggest are indicators of readiness because they demonstrate that program administrators and state energy officials have experience with aspects of advanced M&V. These indicators include: regional penetration of advanced metering infrastructure (AMI), which makes granular metering data broadly available for a service territory; use of Advanced M&V software (Software-As-A-Service), which has many applications; and delivery of some of the trending energy efficiency program designs where advanced M&V can be applied. The information in this brief and associated summary table was obtained by a collection of web searches, correspondences with program administrators, and responses to a survey questionnaire about advanced M&V-related activities provided to selected state energy officials or program administrators in the region. The collected information is somewhat anecdotal but illustrates the range of conditions in the region. It is NEEP's intention that this information can assist utilities, evaluators, and the greater efficiency community to share current experience with advanced M&V, to understand the range of potential opportunities for a state or organization to become ready to adopt advanced M&V, and to inform future applications of metering, advanced M&V tools, and new program designs.

Advanced M&V

Advanced measurement & verification (M&V) refers to the use of tools and services pertaining to data collection and analytics that support measurement and verification activities along with many other uses. It allows for automated, ongoing analysis of energy consumption data and enables the examination of impacts at a whole-facility level. Some of the tools and services include software capable of processing of large volumes of data, machine learning software, collection of granular interval metering data, and two-way feedback using smart devices such as controls or meters.

Advanced M&V is important to evaluators and the broader energy community because it offers tools and resources to support many operations, including describing and assessing energy consumption and energy efficiency program performance. Program administrators can use software to analyze data and customers can receive energy usage information through dashboards. Advanced M&V offers data, technologies, and tools that

[1] The U.S. Department of Energy, Weatherization and Intergovernmental Programs Office, awarded the Connecticut Department of Energy and Environmental Protection a grant for the Standardized, Sustainable and Transparent EM&V pilot. The project partners team includes DEEP, Eversource Energy, LBNL, NEEP and United Illuminating. The supporting states are NH, NY, RI, and VT. For background see https://neep.org/initiatives/emv-forum

can help energy efficiency programs succeed in an evolving energy field that is increasingly focused on distributed energy resources, carbon reduction policy goals, and the use of buildings as grid assets. Program administrators and regulators can use advanced M&V to identify savings opportunities, to optimize the performance of current programs, and to leverage program and/or evaluation resources.

Advanced Metering Infrastructure (AMI) - an Information Resource

Overview

Advanced metering infrastructure (AMI) is an integrated system of smart meters, communications networks, and data management systems that enable two-way communication between utilities and customers. It has improved the way utilities are connected with their customers by providing reliable service and carrying out various operations comparatively easily and quickly. The system provides a number of important functions that were not previously possible or had to be performed manually, such as the ability to automatically and remotely measure electricity use, connect and disconnect service, detect tampering, identify and isolate outages, and monitor voltage.[2] From the customer perspective, smart meters are helpful because they report actual usage and can reduce response times during outages. They can enable a host of functions for utilities, including time-of-use rates and delivery of some energy efficiency program designs that focus on impacts assessed at a customer or whole building level, such as Pay-for-Performance (P4P) and behavioral programs.

While AMI has many applications, it offers value to program evaluation because it provides granular data (often at 15-minute interval as opposed to monthly billing histories) to program administrators and is available for all customers, enabling geographically targeted analyses. Smart appliances such as smart thermostats or building controls and other commercially available devices can provide consumption data that is useful for evaluation purposes. While AMI is not the only source of high frequency data that can be available for evaluation purposes, advanced software has the capability to process large volumes of data that come from AMI. It is reasonable to expect that experience with advanced M&V software and the development of trending program designs will evolve and expand with any increase in penetration of AMI. Thus, we examine it as one indicator of a state or efficiency organization's potential readiness for Advanced M&V.

Utilities have ramped up their installation of AMI throughout the United States. In the Northeast, penetration of AMI is mixed; it is very significant or growing in few states and quite limited in others. According to Energy Information Administration (EIA) 2017 data, there are about 78.9 million advanced meters installed nationwide. Installations in Northeast states are shown below:[3]

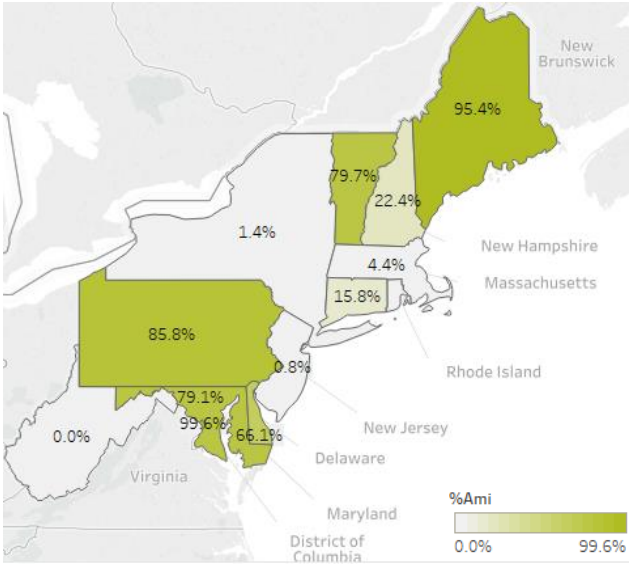
Utility Characteristics State	Number AMI- Meters	Total Number of Meters	AMI Penetration (% of Total Meters))
DC	277,998	280,098	99.25
ME	749,745	795,173	94.29
PA	5,221,850	6,117,967	85.35
VT	301,057	374,647	80.36

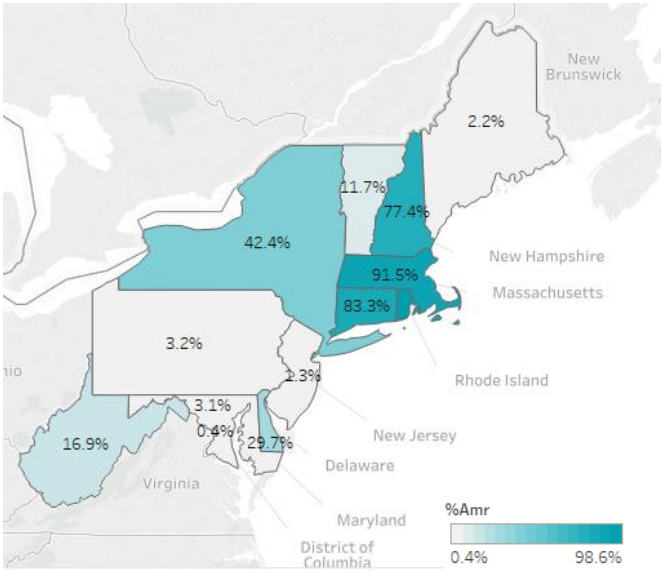
[2] Advanced Metering Infrastructure and Customer Systems, https://www.energy.gov/sites/prod/files/2016/12/f34/AMI%20Summary%20Report_09-26-16.pdf

[3] https://www.eia.gov/electricity/data/eia861/

MD	2,044,133	2,610,769	78.30
DE	309,651	471,601	65.66
NH	162,500	736,707	22.06
CT	250,727	1,691,669	14.82
MA	147,545	3,266,843	4.52
NY	130,207	8,290,157	1.57
NJ	38,489	3,487,947	1.10
WV	8,303	1,028,929	0.81
RI	257	524,716	0.05

The maps below provide a comparison of residential use of AMI (green) and automated meter readings (AMR) (blue) in the Northeast and Mid-Atlantic.[4] AMR is an automated way to collect kWh readings and sometimes also peak kW demand. In AMR systems, data is collected by a drive-by vehicle or hand-held device. AMR is different from AMI in that it is typically a one-way data collection system, with data collected on a monthly, or at most daily, basis.[5]





State Snapshots

Experience with AMI in the Northeast and Mid-Atlantic regions varies from state to state and, in some cases, from company to company within a state. In this region, the American Recovery and Reinvestment Act (ARRA)

[4] Images compiled from the Energy Information Agency and Form EIA-861 responses, https://www.eia.gov/electricity/data/eia861/

[5] https://www.elp.com/articles/powergrid_international/print/volume-13/issue-10/features/amr-vs-ami.html

provided funding that spurred companies to adopt AMI. Absent the support from ARRA, many companies have found investment costs to be barriers to adoption of AMI as a grid-edge tool.[6]

AMI penetration is extensive in some states and very low in others. For example, AMI meters have been deployed to all customers in the District of Columbia, while less than two percent of customers in New York have AMI meters. As shown in the graphic above, states with high penetration of AMR have lower penetrations of AMI. However, even in states where the technology is not used extensively, AMI use is increasing.

Maine:

Central Maine Power Company (CMP) has been able to deploy more than 622,000 smart meters throughout its service territory, reaching all residential, commercial, and industrial customers. With the help of AMI, CMP is able to fulfill reconnection service orders remotely and in less than seven minutes. The AMI project has also helped CMP to build a technology platform where customers can view their electricity usage information as well as alternative electricity rates from third-party energy providers. CMP also offers optional time-of-use (TOU) rates for residential customers. This information helps customers manage their electricity bills. CMP uses the available information for various purposes such as assessing load shapes and impacts on customer consumption after they are provided with information about their consumption patterns.[7]

Similarly, the Emera companies, which provide transmission and distribution services to 154,000 residential, commercial, and industrial customers in Maine, have deployed AMI. With the help of AMI, customers are able to monitor and manage their energy use and will also be able to see the renewable energy part of their fuel mix.[8]

Vermont

Five of the 17 utilities in Vermont provide AMI to their customers, and these five utilities serve the vast majority of customers in the state. They include: Green Mountain Power, which serves approximately 85 percent of the state; Washington Electric Co-op; Vermont Electric Co-op; Stowe Electric; and Burlington Electric.

Two products from Green Mountain Power that are enabled by AMI are a time-of-use rate for commercial and industrial customers and a demand response voluntary curtailment program. Also, Efficiency Vermont is undertaking a variety of research and development projects that explore how AMI data can be leveraged to optimize energy efficiency measurement approaches and opportunities to capture additional or deeper savings. As noted in Vermont's Triennial Plan for 2018-2020, Efficiency Vermont plans to continue to leverage customer AMI data for these purposes (see Appendix 2). NEEP held an M&V 2.0 workshop in 2018 that highlighted Vermont's AMI-related activities.

District of Columbia

According to EIA's 2017 data, the District of Columbia (DC) has the highest AMI penetration not only among the Northeast states but in the country. Potomac Electric Power Company (PEPCO), a public utility that supplies electric power to the city of Washington, D.C. and to surrounding communities in Maryland provides AMI for all of its customers.

[6] https://neep.org/events/how-advanced-our-metering-infrastructure-tales-northeast
[7] https://www.energy.gov/sites/prod/files/2016/12/f34/AMI%20Summary%20Report_09-26-16.pdf
[8] http://emerasustainability.com/2016/wp-content/uploads/2018/10/Emera-sustainability-report2016.pdf

New York

The EIA estimate of 1.5 percent penetration of AMI meters in New York represents an expansion over the 0.4 percent penetration noted in 2017 by GreenTech Media[9]. Consolidated Edison, Orange & Rockland, and National Grid are gradually increasing deployment of meters. For example, most of Con Edison's mass market residential customers are currently billed on a volumetric monthly bill, but the utility is installing AMI in its service territory in the next six years. Currently, the focus is on the process of establishing back-office systems and work on the communications infrastructure in the first deployment areas. Con Edison is coordinating its roll out of Pay-for-Performance efficiency programs with the deployment of AMI. More information about the AMI deployment can be found in the AMI Customer Engagement Plan[10] from July 2016.

Connecticut

Federal funding from ARRA was used to fund deployment of AMI by the Connecticut Municipal Electric Energy (CMEC) in Norwich, Connecticut.[11] As part of its "ConnSMART Program", it delivered about 22,000 smart meters and advanced communication networks, along with multiple pilot programs, to introduce dynamic pricing to the customers of the four participating municipal utilities (Groton Utilities, Jewett City Department of Public Utilities, Norwich Public Utilities, and South Norwalk Electric and Water). Dynamic pricing refers to charging higher prices during periods with higher demand[12]. The goals of the program are to: 1) allow customers to view their energy consumption at their convenience through an energy web portal and/or an in-home display, and 2) allow the participating utilities to manage, measure, and verify targeted demand reductions during peak periods. The communication and data management systems are aimed to provide enhanced wholesale power purchasing and forecasting capabilities, and ultimately a reduction in the cost of service for customers.

In 2011, the United Illuminating Company (UI) updated its electric grid with smart meters for its 324,000 customers and began development of a secure communications platform enabling two-way data flows.[13] There are approximately 221,000 residential accounts with AMI meters and 335,000 total residential, commercial, and industrial customers overall[14].

These are some of the ways interval data is used at UI:[15]

- Load research
- Cost-of-service studies
- ISO & RNS settlements
- Studies to measure impacts of various programs on customer energy usage, e.g., Peak Time Rebate Demand Study
- Fulfill end user data requests
- Fulfill supplier data requests
- Calculation of missing register reads
- Theft of service detection

[9] https://neep.org/events/how-advanced-our-metering-infrastructure-tales-northeast

[10] http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7bC523F2AF-15AC-4CAB-93BB-58174C8BF35E%7d

[11] https://openei.org/wiki/Connecticut_Municipal_Electric_Energy_Cooperative_Smart_Grid_Project#cite_note-smartgrid-2

[12] Time of Use (TOU) rates are one example of dynamic pricing.

[13] https://www.tdworld.com/smart-grid/uil-holdings-secure-smart-meters-and-ami

[14] https://www.uinet.com/wps/portal/uinet/networksfooter/ourcompany/whoweare

[15] Janes Loscalzo, United Illuminating, email 12/13/18

- Helps with identification of outage start and end times

Eversource, another Connecticut utility, owns and maintains a fleet of approximately 8,500 interval meters (AMR) among its commercial and industrial (C&I) customers. This includes all C&I customers on a TOU rate, as well as a small number of non-TOU rate customers with interval data meters that are used for mandated load research purposes. The communication technologies used by these interval meters has evolved over time from analog telephone lines to meters with cellular and ethernet connectivity. The meters predominantly collect usage data in 15-minute intervals, though some collect data in hourly or five-minute intervals.

Rhode Island

AMI penetration is included as one element of Rhode Island's Power Sector Transformation Settlement in a rate case with National Grid. The settlement sets in motion the development of a suite of grid modernization programs that will better enable the state to benefit from clean energy resources. The settlement includes "establishment of a stakeholder process around advanced metering infrastructure (AMI)[16]".

New Hampshire

Currently, only the New Hampshire Electric Cooperative has AMI.[17] The New Hampshire Senate recently passed SB 284, which establishes a statewide online energy data platform regulated by the public utilities commission and operated by the state's electric and natural gas utilities; the bill is currently under review in the House of Representatives. Even without statewide AMI penetration, New Hampshire is positioning itself to be ready for a future that recognizes that "[a]ccess to granular energy data is a foundational element for moving New Hampshire's electric and natural gas systems to a more efficient paradigm in which empowering consumers is a critical element. By enabling the aggregation and anonymization of community-level energy data and requiring a consent-driven process for access to or sharing of customer-level energy usage data, the state can open the door to innovative business applications that will save customers money as well as facilitate municipal and county aggregation programs.. Such a program of robust data would also likely to be useful in local planning, conducting market research, fostering increased awareness of energy consumption patterns, and the adoption of more efficient and sustainable energy use" [18].

Massachusetts

In 2015, Massachusetts utilities submitted plans to the Massachusetts Department of Public Utilities (MA DPU) to deploy AMI in response to the MA DPU's 2014 grid modernization order. In May 2018, after three years of review, the MA DPU decided to table the approval of AMI, along with other customer-facing investments that the utilities proposed, arguing that the utilities needed to make a stronger case for undertaking these investments.[19] The MA DPU decision noted concern that responses submitted in 2015 were no longer relevant in 2018 because the technology and possible uses had changed significantly since the original filing. Additionally, the investor-owned utilities within Massachusetts were split on whether AMI would have a positive benefit for the customer. It was not clear whether there would be widespread customer participation in time-varying rates or whether customers would benefit from these. An increasing number of customers have switched to

[16] https://www.utilitydive.com/news/rhode-island-approves-national-grid-modernization-plan-rate-increase/530924/
[17] https://www.nhec.com/filerepository/june_final.pdf
[18] https://legiscan.com/NH/text/SB284/id/1968150
[19] https://sepapower.org/knowledge/massachusetts-could-lead-the-nation-in-clean-energy-but-for-one-shortcoming/

competitive supply in recent years; however evidence of wide adoption of dynamic pricing products by suppliers is lacking.

Maryland

Maryland uses AMI extensively for a variety of purposes, as outlined in the table below[20]. These include providing energy use information to customers as part of behavioral energy efficiency programs, forecasting and load research, end use analysis, and innovative rate and billing approaches.

Uses of AMI by Maryland Utilities	
Behavioral Energy Efficiency	• AMI data is used to provide information to customers through online access to interval data collected by smart meters installed at their homes. Customers are provided with suggestions and advice for how they can conserve energy and lower their energy bills. In addition to online features, AMI data allows for home energy reports, high usage alerts, and weekly usage alerts which can be delivered via e-mail, phone, or SMS text.
Forecasting/ Load Research	• Sales Forecast Models – Historical AMI hourly load profiles by rate class are used to estimate sales as a function of weather, economy, and other factors, and the resulting statistical relationships are used to drive class-based sales forecasts for budget and planning purposes. • PJM Retail Load Settlement – Daily AMI load profiles by rate class are used to estimate the hourly load of all customers at the retail supplier level, for daily reporting requirements to the PJM RTO for each supplier's retail load settlement. • Peak Load Contributions – AMI data for each customer is used to develop peak load contributions (PLC), a weighted average of loads during five high capacity and five high transmission days/hours, for daily reporting to PJM RTO for each supplier's market obligations. • Unbilled Electric Sales Estimates – AMI loads for each customer and for each calendar month are used as inputs to develop unbilled sales estimates at the customer class level (each monthly accounting close cycle).
Rates/ Billing	• Cost of Service Analysis – Hourly historical AMI loads are aggregated by customer class for the purposes of providing peak load and energy estimates by rate class for the cost of service model. • Bill Comparison Analysis – AMI loads for customers are used to analyze the difference in electric bills which would result from alternative rate structures such as time-of-use rates, demand rates, etc. • Hourly Service Billing – POLR customers who are on the hourly service tariff have monthly supply rate calculated using hourly AMI metered load. • Billing for net metering, community solar pilot operations, and EV TOU rates. • AMI data utilized for the Prepaid Pilot and PC44 TOU Rate Pilot. • Automated meter reprogramming to accommodate rate design changes (No need for meter change-out) • Examples: TOU pilots with rating period changes; net metering
End-Use Analysis	• Hourly AMI loads by customer are used in modeling the impact of demand response programs (AC control and peak time rebates) for use in program operation as well as PJM reporting requirements.

[20] Sheldon Switzer, Baltimore Gas and Electric, email, 12/6/2018

	• AMI data used to evaluate customer usage during specified hours on peak savings days to determine the amount of electricity customers save during an event compared to their typical usage. Results are reported to customers in a very timely manner showing energy saved and bill credits. • Peak Rewards Device Operability: Algorithm developed using AMI data to identify non-operating air conditioning control devices. A list of premises is sent to the field personnel for inspection. • AMI data used to identify homes most likely to have electric water heaters. This information was used for the marketing of the peak rewards water heater program.
Data Provided to Third Parties and Suppliers	• AMI data provided to electric suppliers at the account level which is used to develop offers and calculate charges. In aggregate, they use this data for PJM Settlement and analysis on overall load shape. • Residential and commercial gas choice customer's daily usage data is used to calculate a daily delivery requirement for third-party gas choice suppliers serving BGE mass market customers. • AMI data provided to other entities (government agencies, brokers, aggregators, solar projects, etc.).
Miscellaneous Uses	• CVR – Voltage Regulation (AMI data and analysis provides ability to lower the voltage at the substation; AMI provides customer voltage data that can be used to optimize voltage levels; Detailed data analysis leads to tailored capital system enhancements that are designed to greatly improve customer voltage profiles) • Remote Meter Reading (Eliminates need to drive-by or visit customer premise; Eliminates need for estimated bills; Reduction in meter reading employees and contractors • Troubleshooting for voltage problems • Outage Management (detection and restoration – more efficient crew management and resources during storm restoration; avoidance of unnecessary truck rolls) • Remote turn-ons/turn-offs (disconnects for non-payment and reconnects do not need technicians to visit site – no truck rolls) • Open/Close Accounts – turn off/on, name changes • Increased ability to identify potential theft of energy • Distribution Planning – using AMI data for transformer load studies • Information available for discussions with customers (programs and opportunities; high bill alerts and assistance) • High temperature alerts/high temperature disconnects • Over current disconnects

Software as a Service (SaaS) Tools – Meeting Multiple Needs

Overview

Software-as-a-Service (SaaS) tools are software applications that monitor and report energy consumption and include tools such as customer management dashboards. They can be used in a variety of ways, including in whole building-oriented efficiency programs, characterizing/segmenting customers for targeted marketing, and supporting demand response programs. As discussed in NEEP M&V workshops and webinars and noted in

NEEP's briefs,[21] there are more tools for the commercial and industrial sector than for the residential sector. And, as discussed in NEEP M&V workshops and webinars, these tools are used in the private sector to support demand response programs and to identify energy and demand savings opportunities at a whole building level.

The state snapshots below provide some examples of how utilities in the region are currently using SaaS tools. The applications range widely from data management to customer engagement platforms, and from market research and targeted marketing to microgrid operation. It is clear that energy efficiency program evaluation is not among the applications and not a focus of interest at this time. However, there are indications that awareness and interest exploring the role these tools can play in meeting energy efficiency program needs is emerging. For example, both National Grid, NY and utilities in Connecticut have developed project to test SaaS tools as an evaluation resource.

State Snapshots

Maine

Isle au Haut is using an energy management software platform to run a microgrid heat pump system, which will turn extra electricity into heat. The project is undertaken by Dynamic Organics which is collaborating with a Portland-based software company, Introspection Systems.[22]

Pennsylvania

A utility resource management software company named ARCOS, LLC has implemented its SaaS product, ARCOS Callout, at Peoples Natural Gas, the largest natural gas distribution company in the state. The product will modernize the utility's current customer contact callout response system used for responding to gas leaks, restoring service, and also providing status reporting on restorations.[23]

PPL Electric Utilities, which serves about 1.4 million customers in Pennsylvania, has chosen Sensus to provide equipment and services under its Remote Operator Controller Switch program. Sensus services support PPL's efforts to reduce customer outage minutes by identifying fault locations and sectionalizing circuits rapidly.[24]

Vermont

Vermont Energy Investment Corporation (VEIC) uses a number of products developed in-house that leverage smart devices, submetering, and AMI data. Some have been released more broadly as open source software, and others are primarily used by VEIC's engineering teams. These uses were discussed in NEEP's M&V 2.0 workshop. Examples include:

- Peak identification and savings opportunity analysis
- Customer targeting based on AMI load profiles
- Import and aggregation of submetering data for project specific analyses
- Smart Thermostat Analytics Toolkit (STAT) focused on remote auditing and weatherization opportunity identification

[21] See https://neep.org/advanced-measurement-verification-mv-brief-evolving-industry and https://neep.org/auto-mv-industry-brief-how-fast-emv-paradigm-changing

[22] https://bangordailynews.com/2018/03/05/energy/maine-islands-plan-to-build-its-own-energy-grid-could-change-the-game-for-remote-communities/

[23] https://www.arcos-inc.com/press-releases/

[24] https://sensus.com/news-events/news-releases/ppl-electric-utilities-reduces-customer-outage-minutes-with-sensus-solution/

- Use of a "sense[25]" home energy device a pilot of a behavioral energy efficiency program. The device detects and monitors end uses in a home and employs machine learning to provide feedback to customers and program implementers.

Connecticut

For Eversource, SaaS applications include: customer engagement platform software, demand management system software, and an interval data management system. In addition, The U.S. Department of Energy has awarded the Connecticut Department of Energy and Environmental Protection (DEEP) funds to test and understand the application of Advanced M&V tools with existing commercial and residential programs. The Connecticut utilities-Eversource and United Illuminating- are key participants in this pilot, and manage these energy efficiency programs.

The research includes comparing to traditional EM&V practice-as defined by the team[26] in terms of savings certainty, timeframe, and other aspects such as labor requirement with the performance of M&V2.0 tools. It also includes assessing how advanced capabilities of M&V 2.0 tools are best integrated or coordinated with supplemental evaluation and analysis (more broadly referred to as "EM&V 2.0") generally and how the CT utilities, with CT DEEP, can learn from and apply the findings from M&V 2.0 more broadly to program evaluation framework and activities. For this study, an open source software tool provided by Lawrence Berkeley National Laboratory was used to analyze billing data from some C&I efficiency program participants as part of the C&I pilot. A residential pilot is under development. Results of both are expected within a year.

New York

The New York State Energy Research and Development Agency (NYSERDA) currently has several initiatives in the market that use advanced analytics software products to run diagnostics on customer energy consumption to identify opportunities for savings, some of which would be eligible for NYSERDA or utility incentives.

NYSERDA will soon launch a solicitation to procure an advanced M&V solution for calculating normalized metered energy consumption (NMEC) gross energy savings for its upcoming Pay-for-Performance pilot, which is being issued through NYSERDA's residential program.

NYSERDA also offers cost-share incentives in the commercial, industrial and multifamily sectors for Real Time Energy Management (RTEM) projects. NYSERDA evaluates and qualifies RTEM vendors, who can then offer their customers cost-share incentives. Qualified RTEM vendors are also provided technical guidance and resources.

The NYSERDA industrial team has implemented some EMIS/Industrial RTEM activities as a subcomponent of this effort: Strategic Energy Manager (SEM) and On-Site Energy Manager (OSEM).

National Grid NY conducted a comparison of a SaaS tool with traditional billing analysis modeling in an evaluation of a residential home performance gas efficiency program, and demonstrated that the SaaS tool produced relatively comparable results. Conclusions from the pilot included the following:

- Partnership between the evaluation contractor and the advanced M&V vendor was critical to the pilot's success;

[25] https://sense.com/

[26] For the purposes of this research traditional practice consists of estimates of savings based on engineering calculations that were developed as part of the commercial and industrial energy efficiency programs and it consists of comparisons with third party billing analysis conducted for residential program evaluation.

- Advanced M&V aligned with traditional billing analysis;
- Reliable savings estimates were generated early in the program year;
- Continuous automated impact measurement can be integrated into evaluation to inform where to target evaluation efforts, Technical Reference Manual (TRM) updates, and program planning.[27]

New Hampshire

New Hampshire has a customer engagement platform that utilizes self-service tools and helps customers to learn more about energy efficiency. It also develops a customized energy savings plan for customers.[28]

The Home Performance with ENERGY STAR (HPwES) program is using a new energy audit software which will provide reports to customer regarding their calculated energy savings with other information. It will also provide project review by the NH utilities and also facilitate contractor billing. This new tool will be implemented during the 2018-2020 three-year plan.

Maryland

The Maryland legislature passed the EmPOWER Maryland Act in 2008, which led the state to develop a state energy database that uses an energy management software called EnergyCAP. With the help of this SaaS, Maryland is improving its data transparency, performance contracting, bill auditing and analysis, deregulated commodity purchasing, and demand response, and improving its organization systems.[29]

Trending Energy Efficiency Programs – Opportunities for Advanced M&V

Overview

Energy efficiency programs in the Northeast and Mid-Atlantic region featuring advanced M&V whole building programs include behavioral programs, strategic energy management, Pay-for-Performance, and promotion of various smart technologies such as smart thermostats and lighting controls. Many are whole building programs, meaning that they are designed to capture savings from multiple activities and measures within a facility and that the impacts may be reported at the facility rather than widget level[30]. We describe all of these as trending because some programs are being piloted while others are formal programs, but also because these program designs are emerging throughout the region.

Behavioral Programs

Behavioral efficiency programs offer a cost-effective way to reduce energy consumption. Typically, in these programs, behavioral insights from behavioral science, economics, and psychology help to improve the performance of traditional efficiency programs. By employing behavioral science principles, program

[27] See presentation from S. Bonanno, National Grid, in https://neep.org/sites/default/files/EM%26V%20Fall%20Meeting_Calling%20All%20Pilots.pdf

[28] https://www.puc.nh.gov/Regulatory/Docketbk/2017/17-136/INITIAL%20FILING%20-%20PETITION/17-136_2017-09-01_NHUTILITIES_EE_PLAN.PDF

[29] https://cdn2.hubspot.net/hub/313940/file-501283463-pdf/Case_Studies_(Final)/EnergyCAP_CaseStudyMaryland.pdf?t=1537810027125

[30] This is noteworthy because looking forward in the energy industry, the ability to characterize energy performance and impacts at the building-level rather than the measure level will likely be useful to support efficiency as a grid-edge resource.

administrators are able to design better programs that achieve more savings or increase participation rates. Customers are also able to make better decisions to manage their energy use and costs when they have access to the right information and tools. Massachusetts, West Virginia[31], New Jersey[32], New York and Rhode Island are among the states that implement behavior programs enabled by Opower's Home Energy Reports. [33] Evaluation of this type of behavior program is done at the whole house level using billing histories in an econometric analysis of randomized control trials (RCT) according to the method outlined in the U.S. DOE Uniform Methods Protocol[34].

National Grid's program started as a small implementation of Opower Home Energy Reports (HER) in New York. Today it is a multi-state engagement that touches 2.6 million customers where National Grid operates. In addition to driving savings, National Grid's HER reports have also improved customer sentiment. In a highly competitive market, customer satisfaction is paramount for success, and it starts with personalized customer engagement. "National Grid deployed our first Opower Energy Efficiency program back in 2009 to help customers better understand and manage their energy use," said John Isberg, Vice President of Customer Solutions at National Grid. "Since then, we have seen significant energy savings and a positive impact on our customer sentiment as they look for greater control over their energy spend. This program is essential to our future success in navigating the rapidly changing energy landscape, especially as customer expectations continue to shift."

Over the past several years, National Grid has augmented its energy efficiency program with several other behavior-oriented programs available from Opower. These include digital self-service energy management web tools, which give customers personalized energy insights and recommendations, and segmented campaigns to improve participation in programs such as income assistance. Also, in response to the New York Reforming the Energy Vision (REV) initiative, National Grid deployed an innovative Opower peak management program in its Clifton Park, New Jersey territory. This program, called Peak Time Rewards, encourages customers to reduce peak electric load and overall electric and gas consumption with reward points that can be exchanged for gift cards. This unique program enables National Grid to offer a price signal to its customers without making changes to the billing system.

Strategic Energy Management Programs

Strategic Energy Management (SEM) is a holistic approach to managing energy use in (but not limited to) industrial, commercial, and municipal facilities in order to continuously improve energy performance and achieve energy, cost and carbon savings over the long term. SEM focuses on business practice change from senior management through ground level staff, improving organizational culture to reduce energy waste and improve energy productivity.

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[31]From the Opower behavioral programs across the country - In its HERS program, Potomac Edison (serving Maryland and West Virginia) is sending its customers information on how their usage compares with their own usage in past and to that of the neighbors with similar homes, also tips on for reducing consumption. https://www.nrdc.org/sites/default/files/pay-for-performance-efficiency-report.pdf

[32] Opower's technology is being used by the South Jersey Gas, a subsidiary of energy services holding company South Jersey Industries (NYSE:SJI) providing natural gas service in New Jersey for launching its energy efficiency program. It will provide customized and personalized views of the energy use and also Home Energy Report to nearly 170,000 households in South Jersey with a goal of making those household more energy efficient.
https://www.businesswire.com/news/home/20160315005149/en/SJG-Selects-Opower-Launch-Energy-Efficiency-Program

[33]https://www.oracle.com/corporate/pressrelease/oic2018-national-grid-041018.html

[34] https://www.energy.gov/sites/prod/files/2015/02/f19/UMPChapter17-residential-behavior.pdf

SEM generally follows the Plan-Do-Check-Act model. An organization's level of SEM implementation falls on a continuum, often with a range of both breadth and depth when implementing the core elements:

- Reduced energy use and costs
- Reduced greenhouse gas emissions
- Improved processes
- Reduced risk to energy price fluctuations
- Pursued certification designating leadership in SEM

For most organizations that adopt SEM practices, M&V is conducted to estimate performance - for example, energy consumption which may be applied to individual measures or facilities. Then, results may have a variety of uses, including early program feedback, the basis for performance contract payments, and as inputs to evaluations. Impact evaluation focuses on estimating savings for a program. The U.S. DOE published an evaluation protocol for SEM programs as part of the Uniform Methods Project.[35] The evaluation, measurement and verification (EM&V) approaches used to estimate gross energy savings from SEM programs typically include use of whole building or whole facility regression models[36].

Most states in the Northeast that encourage the adoption of SEM – New Hampshire, New York, Massachusetts, Rhode Island and Vermont – have programs that use a cohort design approach. This is a highly efficient means of delivering cost-effective training and guidance to industrial customers. Cohort programs encourage customers to share in their challenges and success, and in the process develop a support network that encourages perseverance, accountability, and friendly competition. This increases the likelihood of SEM implementation and observable savings, while reducing the need for extensive one-on-one coaching.

Successful SEM cohort program designs are those with solid foundations in organizational change management and continuous improvement principles. They incorporate a process of executive commitment, metrics building, quick-win facilitation, communication planning, and employee engagement.

Recently, New York and Vermont have started to incorporate DOE's 50001 Ready approach to SEM adoption. This is a self-guided approach for facilities to establish an energy management system and self-attest to the structure of ISO 50001 - a voluntary global standard for energy management systems in industrial, commercial, and institutional facilities. U.S. DOE is committed to encouraging more and more states to utilize its 50001 Ready tools for SEM adoption as it continues to find ways to simplify the process. See NEEP's SEM webpage for updates on this.

Pay for Performance Programs

Pay-for-Performance (P4P) programs reward energy savings on an ongoing basis as savings occur, often by examining data from a building's energy meters rather than providing up-front payments to find energy-saving measures. Key drivers for P4P include:

- Meeting energy efficiency or broader demand-side management (DSM) goals for energy efficiency
- Using EE as a resource on the grid
- Financing EE investment using cash flow from the energy savings

[35] https://www.nrel.gov/docs/fy17osti/68316.pdf
[36] https://neep.org/emv-best-practices-recommendations-industrial-sem-programs

- Targeting specific sectors for EE savings
- Developing an EE services market
- Providing a strategy that can incentivize persistence in energy savings

Starting in the late 1980s, demand side management (DSM) bidding and standard offer programs developed as the first generation of utility administered P4P programs, changing the way utilities acquired energy savings. Both procurement mechanisms typically used similar contractual agreements in which an implementer or aggregating entity conducted retrofits for customers and received incentive payments for the resulting savings over time from the utility. Implementing entities often passed some or all of the incentive through their prices to customers for EE projects. However, in the past 10 years or so, P4P energy efficiency efforts employing whole-building, meter-based approaches, new financing mechanisms, and operational savings have emerged. Many of these approaches have been enabled by the availability of smart meter data and companies that conduct data analytics. P4P approaches that have been tried in recent years include:

- P4P within utility DSM program
- P4P EE in wholesale capacity markets
- P4P in private sector models

Current P4P programs are supported hugely by M&V 2.0 methods. M&V 2.0 includes continuous measurement of energy savings at the customer meter to provide near real-time insight into energy efficiency program performance. M&V 2.0 promises better accuracy, more reliability, and higher levels of transparency, and supports P4P programs by increasing the granularity of energy usage data and providing improved data access and data analytics.

P4P program approaches vary across states according to regulatory regimes, program sizes, and goals, among other factors. In the Northeast and Mid-Atlantic region, states that participate in P4P programs include New York, New Jersey, Massachusetts, and Vermont.

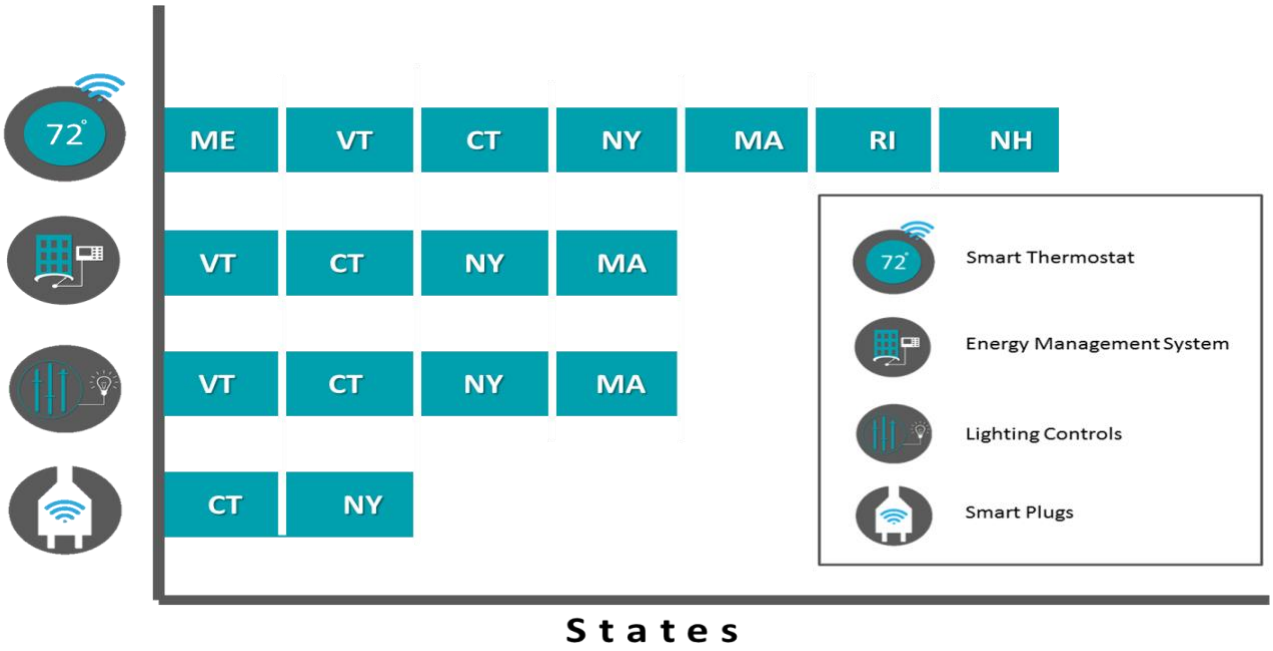
New Jersey's P4P program was launched by the New Jersey Board of Public Utilities' Clean Energy Program (NJCEP) in 2009 as a market transformation initiative with a comprehensive, whole building approach. Participants of its P4P Existing Buildings (P4P EB) and P4P New Construction (P4P NC) projects require participants to verify energy savings projections before public funding is fully invested. To date, over 850 projects have been launched and while it has been well worth the effort, NJCEP has found that paying for performance has its challenges. One issue that was solved by integrating an M&V components, was the ability to verify proposed savings estimates. By adding this M&V component, NJCEP was able to offer rich incentives with a higher level of assurance that savings would be achieved as proposed.

In New York, the P4P program pilot is currently being launched by NYSERDA. It will leverage an implementation of the CalTRACK methodology[37] as the standard for savings calculations. The data produced from this solution, as currently panned, will be used for calculating payable savings for performance contracts, delivering continuous performance feedback to all immediate stakeholders, and additional savings analytics. In addition, the AM&V tool's ability to target customers with high savings potential may also be tested.

[37] https://www.openee.io/post/normalized-metered-energy-consumption-a-data-driven-path-to-achieving-californias-energy-efficiency-doubling-goals

Smart Technologies Programs

Energy efficient technologies with built-in connectivity and smart functionality are increasingly being incorporated into efficiency program offerings. Smart thermostats are likely the most popular program offering, especially since ENERGY STAR completed a specification for the product category in early 2016, giving programs a qualified product list to reference. Smart plugs have also been introduced into some programs, as well as more commercial offerings through building energy management systems and lighting controls. The graphic below shows the uptake of various smart technologies by programs in the Northeast and Mid-Atlantic region. This listing is not comprehensive, especially as these emerging products continue to be added to portfolios, but these were the program offerings that emerged through our stakeholder interviews.



Conclusion - Readiness for Advanced M&V

Are states ready to adopt advanced M&V as an evaluation tool? Anecdotal evidence provided from a review of several key indicators suggests that several states in the region are poised to do so and many have experience that opens up the opportunity for further steps in that direction. While adoption of AMI in the region is moderate, it is growing. Even without AMI, there is recognition that rapid feedback to customers and granular loadshape data, such as what is available from smart devices, is an important resource that can help encourage changes in customer behavior or lead to optimization of energy efficiency programs. Moreover, as indicated in this brief, the question of whether to adopt advanced M&V as an evaluation tool is being asked or studied in pilots with SaaS tools in at least three states (New York, Vermont, and Connecticut).

As seen in the following table, many states in the Northeast currently have energy plans that support various advanced M&V programs. While some states like Connecticut, Massachusetts, and New York have extensive program offerings, other states are only just ramping up.

State	Energy Efficiency Programs	AMI Programs?	Programs with software as a service tools?	Whole Building Savings Programs?	Programs that promote smart technologies?	Pilot programs that test M&V2.0?	Building benchmarking programs?	Programs with whole-building load shapes?
CT	Conservation & Load Management Plan	✓	✓	✓	✓	✓	✓	✓
DC	Clean Energy	✓	✓	✓			✓	
DE	DESEU Strategic Plan			✓	✓		✓	
MA	Three Year Energy Efficiency Plan	✓	✓	✓	✓	✓	✓	✓
ME	Efficiency Maine Trust Triennial plan	✓	✓	✓	✓			
NH	NH Statewide Energy Efficiency Plan		✓					
NY	Distribution System implementation plan	✓	✓	✓	✓	✓	✓	✓
PA	Energy Efficiency and Conservation Program	✓	✓	✓	✓			
RI	Energy Efficiency Program Plan	✓		✓		✓	✓	
VT	2018-2020 triennial plan	✓	✓	✓	✓	✓	✓	✓
WV	5 year Energy Efficiency Plan	✓	✓	✓	✓		✓	

Along with the development of state energy plans, there is growing state and utility interest in decarbonization goals and recognition of the industry trend for energy efficiency to be integrated with other distributed resources and for buildings to be grid assets. These trends may increase demand for features that advanced M&V offers, including:

- rapid feedback;
- two-way feedback;
- the ability to target customers by location or use patterns or other features;
- the ability to understand customer impacts at a facility level rather than or in addition to the widget level.

There are both challenges and opportunities with advanced M&V. One challenge is the need for company investments of many kinds, from financial investment to infrastructure investments to investments in training and cross-company interaction/collaboration that may not currently be in place. Another challenge is that

advanced M&V is not directly applicable to some core energy efficiency program evaluations; however, it is important to note that program evaluation is not typically a one-size-fits-all endeavor. Also, while AMI is not a necessary requirement for advanced M&V, it can be an asset to the process and neither AMI nor leveraging of AMI for program evaluation is mainstream in this region.

Some opportunities that advanced M&V presents are already being recognized. More may become evident as the industry evolves. One opportunity is that advanced M&V can meet multiple needs of utilities as well as needs of energy efficiency program administrators and evaluators. It can help make a company competitive by serving customer engagement. Embedding evaluation with implementation through the use of Saas tools and use of trending program designs can optimize energy efficiency. As the industry continues to evolve to where efficiency is integrated with other resources and interacts more dynamically with the grid, the whole building focus and the two-way feedback offered by advanced M&V will help the region more fully value energy efficiency as a resource. The region is ready to expand its use of advanced M&V by sharing information from the body of experience that exists within the region.

Appendix 1: Survey Questions

ADVANCED M&V SURVEY QUESTIONS

2018

NEEP is working with the U.S. DOE and State Energy Partners on a research project on advanced M&V. Advanced M&V refers to tools and services pertaining to data collection and analytics. The tools and services include software capable of processing of large volumes of data, machine learning software, collection of granular interval metering data, and two-way feedback as in smart devices such as controls or meters. These provide automated, ongoing analysis of energy consumption data and enable examination of impacts at a whole facility level.

As one part of this project, we are exploring stakeholders' current experience with data, software tools, and efficiency programs that will help inform our collective understanding, adoption, and development of advanced M&V resources and best practices going forward in the region. With this survey, we seek to characterize relevant information from states about applications of building energy consumption and related data in energy efficiency programs from program administrators and states. These may include whole-building efficiency pilots, benchmarking programs, Strategic Energy Management (SEM) programs, and programs with residential smart technologies and commercial EMIS systems.

Please respond as you are able to the questions below:

1. Do the customers in your company or state have AMI (advanced metering infrastructure)? How extensive? If not, are there plans to get it?
2. Does the program administrator make use of any proprietary or open source Software as a Service tools? If yes, for what purposes? (Customer engagement, diagnostics on customers' energy consumption – opportunities for savings, used in energy efficiency programs? used in Demand Response? used for M&V? used as an evaluation tool? other?)
3. What energy efficiency programs does your organization have that focus on whole building savings? (Behavioral programs, Industrial Strategic Energy Management/Continuous Improvement, Pay for Performance, building energy code advancement, retro commissioning, other)?
4. What smart technologies are promoted as part of their programs? (Smart thermostats, energy management systems, lighting controls, other?)
5. Are you conducting any pilot programs that test "M&V2.0" software or use of data from smart technologies as an evaluation tool or diagnostic tool?
6. Is your organization involved in building benchmarking?
7. Is your organization involved in planning or integrated program design in which whole-building load-shapes are used or useful?

Appendix 2: Summaries of Various State Plans

Connecticut: 2019-2021 Conservation and Load Management Plan

The 2019 – 2021 Plan invests $693 million toward making Connecticut more energy efficient and provides an economic lifetime benefit of $2.3 billion dollars. It also aligns with Connecticut's 2018 Comprehensive Energy Strategy (2018 CES).

Connecticut's passage of Public Act 18-50—An Act Concerning Connecticut's Energy Future – provided for energy efficiency budgets and also changed the structure of how energy efficiency programs are funded in the state to help deter future funding diversion efforts[38]. Public Act 18-50 also:

- Introduced a new state policy to reduce energy consumption by 1.6 million MMBtus, or "the equivalent megawatts of electricity," annually each year for 2020-2025.
- Revised the state's general statutes, requiring program administrators to be fuel blind in their delivery of energy efficiency services.
- Added "demand management" to the Companies' legislatively directed program mandates.

Page 10 of the Plan provides a helpful chart overview of 2019-2021 Plan Priorities by sector.

The Plan outlines seven overall priorities:

1. Advance State Energy & Environmental Policy Goals:

    - Recognizing the CES's focus on decarbonization, the program administrators will explore and pilot a strategy with incentives to increase the adoption of cost-effective, low-carbon heating technologies (such as water and air-source heat pumps, and heat pump water heaters) in Connecticut's residential and C&I buildings, with a goal of reducing the use of deliverable fuels. The program will target customers with less efficient electric resistance heating equipment and those seeking to add air conditioning. Heat pump heating pilot installations will begin in July 2019, after the diverted funding is partially restored. Future efforts regarding low-carbon heating technologies will be considered during the 2020 and 2021 Plan Update process.
    - The program administrators, DEEP and the EEB will work together to evaluate the current cost-effectiveness tool and develop a Resource Value Test that screens cost-effective energy-efficient measures for both energy savings and environmental attributes (such as reductions in GHG emissions). This new screening methodology may allow the programs to support additional energy efficiency measures, including air-source and ground source heat pumps. The proposed revisions to the benefit-cost test will be considered during the 2020 and 2021 Plan Update processes. This would better align CT's benefit-cost testing with the strategies outlined in the CES.

2. Offer Tailored Solutions for Market Segments While Ensuring Equitable Distribution:

[38] During the 2016 – 2018 Plan period some funding for energy efficiency was diverted to Connecticut's general fund.

- Promote the integration of energy efficiency and renewable energy strategies, financing programs, and solutions, including working with the Connecticut Green Bank.
- Target the following C&I market segments: Aerospace and Defense; Information, Communications, and Technology; Distribution, Fulfillment Centers & Warehousing; and Utilities and Transportation.
- Program administrators will work to secure their role as the primary source of energy information and target underserved customers and market sectors.

3. Focus on Direct Savings to Customers: Program administrators will direct the energy efficiency funds toward core-savings solutions in the residential and C&I sectors.

4. Develop and Maintain a Sustainable Workforce for Connecticut:
    - Implement workforce development strategies for the energy efficiency industry, including supporting technical classes, trainings, and certifications for the state's technical high schools and universities, and promote certification offerings. Some of this was originally slated for the 2016-2018 plan, but was delayed due to the funding diversions.
    - Expand program administrators' trade ally networks, host networking sessions for vendors and trade ally partners to collaborate on energy efficient approaches and projects.

5. Continuous Commitment to Deliver Comprehensive Energy Efficiency Strategies:
    - For the residential and C&I sectors, programs will have tiered incentive structures to promote multi-measure and multi-end use comprehensive projects.
    - Allow for flexibility in programs to respond to the changing energy efficiency landscape. This includes strategies such as code initiatives, leveraging financial offerings, moving incentives upstream (particularly for commercial kitchen equipment and residential window rebates), targeting market segments, and deepening trade ally networks and partnerships.

6. Implement Effective Demand Reduction Strategies: Evaluate the effectiveness of demand reduction pilots in the 2016-2018 Plan and determine if full-scale demand reduction strategies and demand response programs should go forward in 2019-2021 in the residential and/or C&I sectors. The Plan recognizes the importance of reducing winter peak demand in CT, even though summer peak demand is higher.

7. Continue to Explore and Implement Financing Options:
    - Introduce new Small Business Energy Advantage recapitalization strategies to leverage energy efficiency funds with private capital.
    - Develop new guidance for home performance vendors who come across health and safety issues while conducting energy assessments in a home.

For lighting programs, develop and investigate needed program adjustments to address changes in federal standards, EISA enforcement, and lighting market trends. Planning assumptions for the 2020 and 2021 program years will be analyzed and updated during the 2020 Plan Update process.

For evaluation, continue collaborating with NEEP, DEEP, and the Lawrence Berkeley National Laboratory on the EM&V 2.0 pilot that begun in 2017.

Maine: Triennial Plan IV: FY 2020-2022

Total budget for the three year period of $166.7 million for electric, natural gas and unregulated fuels programs. (See Plan Page 4-1 for budgets by sector and program.) For comparison, The Triennial Plan III (FY 2017-2019) estimated Efficiency Maine Trust costs of $216.8 million.

Program Implementation Priorities:

- Acquiring Resources: The top priority is reducing energy costs in Maine by the "maximum achievable cost-effective" energy efficiency (MACE) through acquisition of demand-side energy resources that are cost-effective, achievable, and reliable.

  This is done by investing in energy conservation projects that satisfy the Trust's stringent cost-effectiveness test. Maine screens for eligibility at the project level, defined as a bundle of related measures installed concurrently. Any project that has a benefit-to-cost ratio greater than or equal to one is eligible for inclusion in the Trust's programs. This screening is conducted at the net level, as opposed to the gross level. Costs and benefits include those experienced by the participant, the program administrator, and the utilities.

- Transforming the Market:
  - Build economies of scale for newer, high-efficiency products like ductless heat pumps and heat pump water heaters through incentives, contractor and distributor training and informational materials.
  - Workforce development through training (online, in-store, and workshops) and emphasize certification and licensing requirements for trade allies.
  - Promote general energy education and awareness through website, social media and digital advertising
  - Support innovative pilot initiatives through the Innovation Program and continue funding custom projects. The Innovation Program tests the potential of new technologies and strategies. It helps in the early stages of market transformation by advancing new, untested products and strategies to the point that they can be incorporated into the Trust's initiatives. The Innovation Program is not limited to a specific customer sector. Approximately 0.5 percent of the Trust's total program budget is allocated to this program. Competitive solicitations will be used to screen and select pilot programs for commercialized products or new ways of delivering cost-effective measures.

- Maintaining Fairness:
  - Allocate sufficient funds to the low-income sector (statutory mandate for the greater of $2.6 million or 10 percent of the Electric Efficiency Procurement and an appropriate percentage from the Natural Gas Conservation Fund) and small businesses.

- Continue to allocate funds on the basis of opportunity for cost-effective energy savings, an approach that began with Triennial Plan III. Previously, funds from electric and natural gas customers were allocated based on the percentage of total load represented by each customer class. Under the new approach, the Trust administers a variety of programs targeted to different customer types and utilizes different channels for accessing programs. The goal is for customers from every customer class throughout the state to more easily access cost-effective energy conservation programs.

- Leveraging the Private Sector: Take a market based-approach to designing programs so that the marketing and installation of efficiency measures are incorporated into the normal activities of the existing supply chain.

- Reducing the Environmental Impacts of Energy: Energy efficiency and clean alternative energy resources reduce or mitigate harmful environmental impacts more cost-effectively than other ways to do so. These energy resources will be deployed in a way that also advances Maine's environmental policies.

Notable Program Changes/Observations for Triennial Plan IV:

- There is still a significant opportunity for retrofit lighting savings in the C&I Prescriptive Program and Small Business Initiative programs. The C&I Prescriptive Program budget reflects the opportunity that can be captured through a market program driven mainly by contractors and end users.
- For ductless heat pumps, the Trust expects its programs to significantly influence both the number and quality of heat pumps installed in the State.
- All distributor initiatives will be grouped under a single program to consolidate delivery and administration. The program will continue to mark down many of the Triennial Plan III measures for this plan, as they remain cost-effective. These include HPWHs, boilers, furnaces, commercial kitchen equipment, and screw-in LEDs. The Trust expects more HVAC measures to be purchased through the distributor channel than through the downstream programs that the Trust offered during the previous plan period.
- For lighting through the Retail Initiatives program, the Trust will update the Plan when the DOE rulemaking process to finalize standards on general service lamps is done. For the purposes of the current plan, the Trust modeled the program opportunity without EISA 2020 enforcement. If EISA is enforced, it would reduce but not eliminate the number of cost-effective measures through Retail Initiatives.
- The market for HPWHs (with incentives) is expected to grow compared to the last Triennial Plan period. HPWHs will continue to be offered through Retail Initiatives and Distributor Initiatives.
- For the Low-Income program, the Trust will increase its efforts to market directly to customers in the Statewide Arrearage Management Program (AMP) and work with AMP stakeholders and the Low Income Advisory Group to consider ways to expand offerings for AMP participants.
- The Renewables Program will focus on community demonstration grants.

Evaluation:

- The Trust plans to update its Technical Reference Manual (TRM) at least annually by incorporating new measures and new results from program evaluations and other relevant research. TRM data for measures that change frequently, like LED bulbs, will be reassessed quarterly.
- During the plan period, the Trust will conduct independent evaluations of its major programs. The Trust expects to begin issuing RFPs in FY2020 to select evaluators for independent third-party program evaluation.
- The Trust plans to continue its participation in the Evaluation Committee of CEE and will review other opportunities on a case-by-case basis.

Massachusetts: 2019 – 2021 Energy Efficiency Plan

See also: MA Plan Summary by Acadia Center

The Massachusetts 2019-2021 Energy Efficiency Plan calls for a $2.77 billion investment in energy efficiency programs, which is $200 million more than the 2016 – 2018 Plan. It is designed to deliver portfolio benefits of $8.5 billion. The Plan focuses on *Energy Optimization* for all customers, with a more holistic and integrated approach to helping customers address their energy use and associated costs based on individual needs and goals. This approach builds on integrated gas and electric program delivery and will provide fuel neutral customer education and assistance. New strategies will promote strategic electrification and the adoption of cost-effective clean energy technologies, such as cold climate heat pumps. The Plan targets installation of 62,000 cold climate air source heat pumps across the residential, income-eligible, and commercial and industrial sectors.

The 2019-2021 Plan also focuses on lowering demand during summer and winter peak demand periods. One strategy to achieve this are new statewide *Active Demand Reduction Offerings* for the residential and commercial and industrial sectors. Incentives will be provided to customers who can verifiably shed load in response to peak events that are determined by Program Administrators. There is a strong focus on winter reliability efforts, with a targeted winter electric demand reduction of 500 MW to be achieved by active demand offerings, building weatherization, and temperature optimization through Wi-Fi thermostats. The Plan also includes a new specialized storage performance offering with enhanced incentives to customers to dispatch energy storage during daily peak hours in the summer and winter months.

The Plan is intended to be more inclusive for low to middle-income customers, recognizing it may have been difficult for these customers to access program offerings in the past, and the strong opportunity for savings in this sector. Program Administrators will offer enhanced strategies and community outreach efforts targeting renters, moderate income customers, and non-English speaking customers. For example, Program Administrators are offering 90% incentives for insulation for landlords of all low-rise buildings (≤ 3 stories) who are willing to complete all recommended insulation and air sealing.

In the residential sector, there will be a strong focus on increasing the number of weatherized homes and HVAC system upgrades. The Residential New Homes and Renovations program will continue to use the pay-for-savings model (which was new for the 2016-2018 Plan). Program Administrators will have a fully optimized pay-for-

savings incentive structure for the 2019-2021 Plan and will closely monitor impacts to participation and savings. The Plan also encourages the use of Passive House design principles.

In the commercial sector, there will a focus on whole building approaches. This includes an advanced, integrated design path and enhanced support to increase collaboration among owners, designers, and Program Administrators early in the process. There will also be simplified and expedited paths for operations and maintenance savings, as well as advanced lighting controls training opportunities for contractors.

The Program Administrators will provide the following key data sets quarterly that will be used as the primary metrics for planning and measuring success in this Plan:

- Net lifetime all-fuel savings (MMBtu) (excluding MMBtus associated with active demand reduction efforts)
- Demand savings (MW) for electric Program Administrators
- Net lifetime electric savings (MWh) (excluding fuel conversions and active demand reduction efforts) for electric Program Administrators
- Net lifetime gas savings (therms) for gas program administrators

Program administrators will also continue to report all savings metrics that are currently reported, including any and all positive and negative annual and lifetime MWh, therms, MMBtu of oil, MMBtu of propane, and gallons of water.

Evaluation projects will continue to have a statewide focus, as much as possible, and to integrate electric and natural gas. Projects will be conducted in the following research areas: Residential, C&I, and Special and Cross-Cutting. The Plan's EM&V study-specific expenditure budget is $51.6 million (2017 expenditures multiplied by three). This does not include potential study costs or internal staffing costs.

Massachusetts will continue to use the TRC test to determine cost-effectiveness. Under the updated Green Communities Act, for the purpose of cost-effectiveness review, programs are aggregated by sector. If a sector fails the cost-effectiveness test as part of the review process, its component programs shall either be modified so that the sector meets the test or shall be terminated.

[1] The U.S. DOE, Weatherization and Intergovernmental Programs Office, awarded the Connecticut Department of Energy and Environmental Protection a grant for its Standardized, Sustainable and Transparent EM&V Integrating New Approaches pilot (means of its State Energy