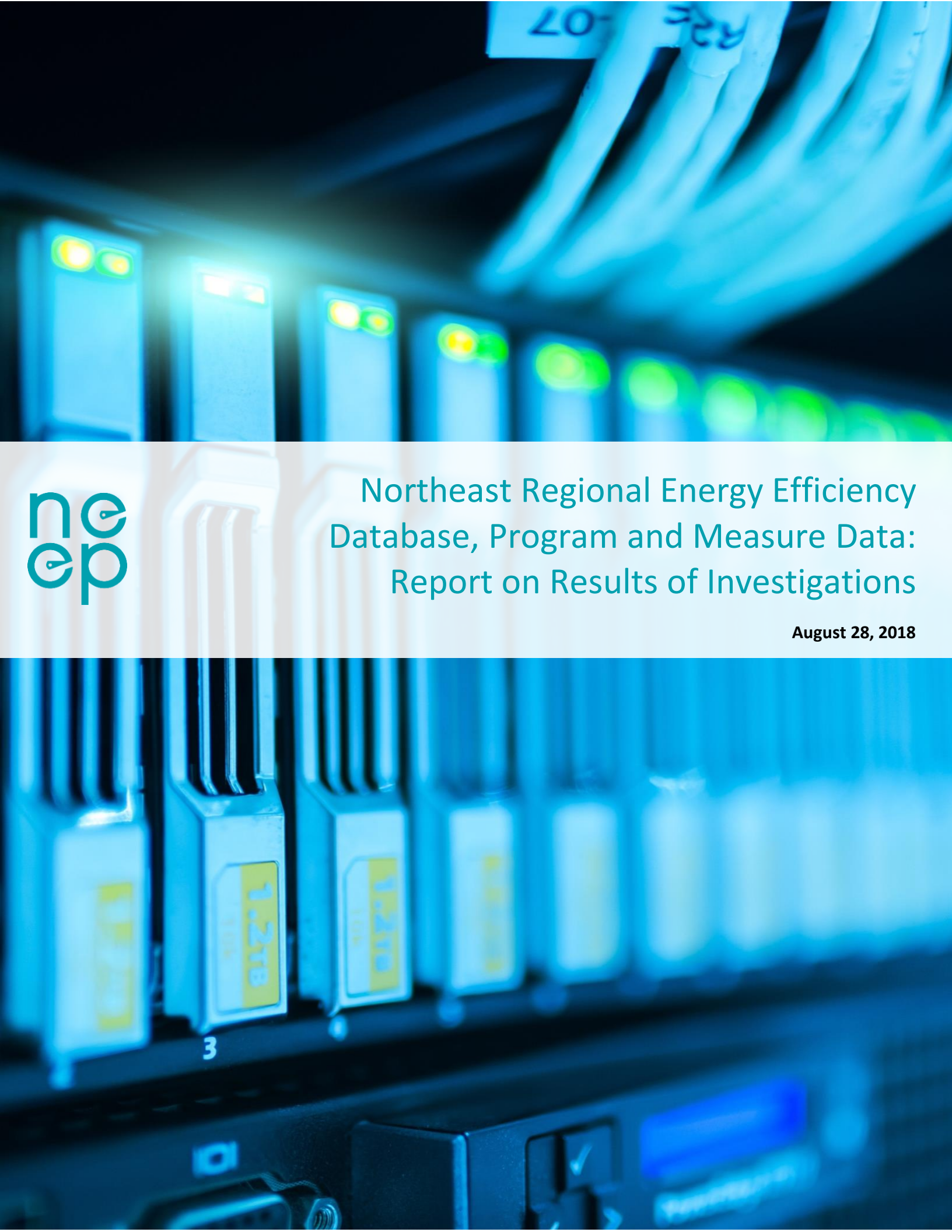

Northeast Regional Energy Efficiency Database, Program and Measure Data: Report on Results of Investigations

August 28, 2018

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Figures and Tables

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Finally, as this report is a profile of energy efficiency activity in the Northeast region, NEEP would like to take this opportunity to acknowledge the input and information provided by many individuals including program administrators and staff of state energy offices, ISO-New England, and ACEEE, many of whom contributed to the initial development of the REED database. They also were key sources of information for continued updates to the REED database as well as to the background information about measure and end-use metrics state energy efficiency program practices.

About NEEP

Founded in 1996, NEEP is a non-profit whose goal is to assist the Northeast and Mid-Atlantic region to reduce building sector energy consumption 3% per year and carbon emissions 40% by 2030 (relative to 2001). Our mission is to accelerate regional collaboration to promote advanced energy efficiency and related solutions in homes, buildings, industry, and communities. We do this by fostering collaboration and innovation, developing tools, and disseminating knowledge to drive market transformation. We envision the region's homes, buildings, and communities transformed into efficient, affordable, low-carbon, resilient places to live, work, and play. To learn more about NEEP, visit our website at http://www.neep.org.

Disclaimer: Northeast Energy Efficiency Partnerships (NEEP) verified the data used for this white paper to the best of our ability. This paper reflects the opinion and judgments of the NEEP staff and does not necessarily reflect those of NEEP Board members, NEEP Sponsors, or project participants and funders.

Introduction

This report summarizes the results of data collection and research conducted by the Northeast Energy Efficiency Partnerships, Inc. (NEEP) to characterize energy efficiency programs and measures in the Northeast and Mid-Atlantic region. The purpose of the project is to provide information useful to the U.S. Energy Information Administration (EIA) for various national analysis and modeling activities, including informing the inputs to the *Annual Energy Outlook*.

The project included two types of activities: (1) updating the Regional Energy Efficiency Database (REED) and (2) metrics research. The Regional Energy Efficiency Database (REED) was updated to include data for the program year 2016 for 10 states in three of the census divisions EIA uses in the National Energy Modeling System (NEMS). These divisions are: New England (Maine, Connecticut, Massachusetts, Rhode Island, and Vermont); Middle Atlantic (New York); and South Atlantic (Delaware, District of Columbia, and Maryland). New Jersey and Pennsylvania do not now report data to REED. NEEP also investigated processes and methods to determine what it would take to populate REED with examples of measure costs and cost-effectiveness metrics, incentive values, and associated administrative costs for each state in REED. The research involved collecting qualitative and quantitative information to help characterize energy efficiency programs at the level of individual measures or end uses. The exercise of data collection also provided insights about what kinds of data are readily available from a region for use by EIA.

This report is the first of this kind from NEEP for EIA. We hope that energy efficiency stakeholders will find this combination of program/sector data from REED, measure-specific metrics, and qualitative information about program practices useful as well. The next phase of data collection to be delivered in 2019 will include a REED update with program year data from 2017, as well as additional metrics research to further develop the quantitative and qualitative picture of energy efficiency program practices representative of companies and states in the region.

REED Database

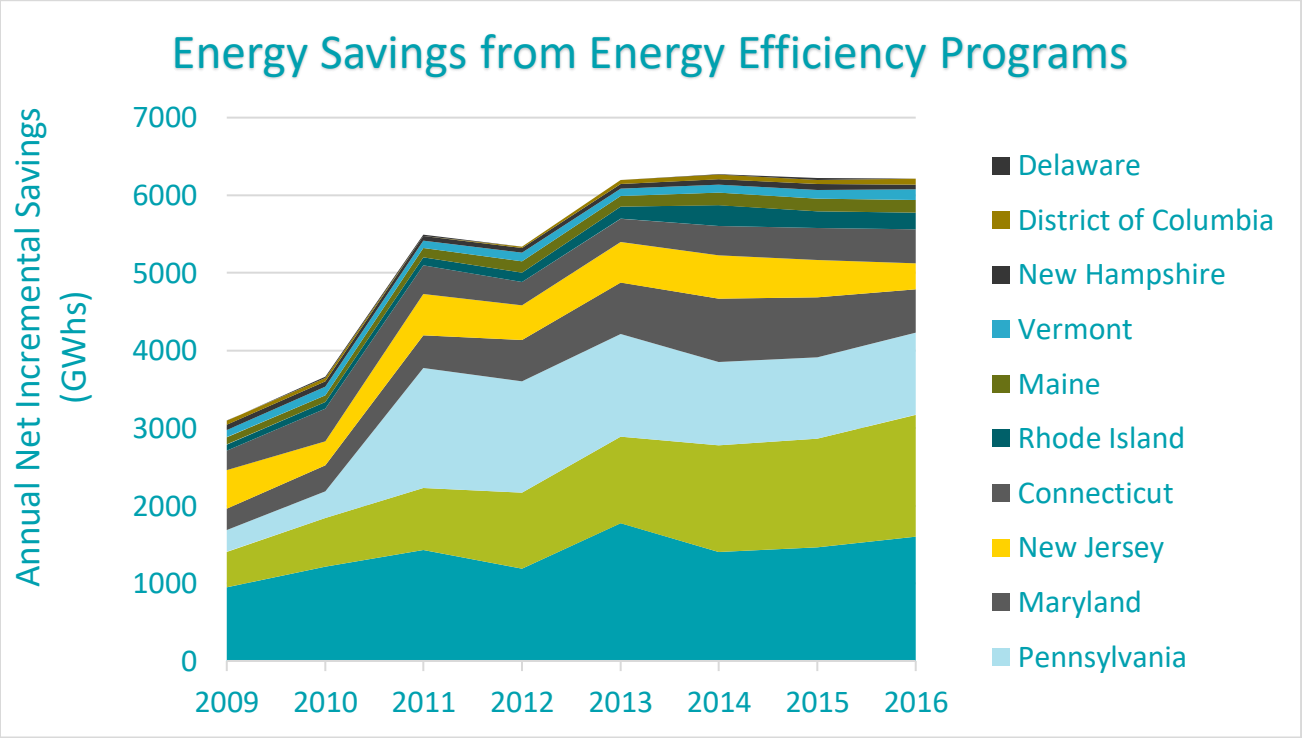
The Regional Energy Efficiency Database (REED) serves as a regional platform for the consistent reporting of Northeast and Mid-Atlantic electric and natural gas energy efficiency programs. REED currently contains program-level data from 2011 through 2016 for the following 10 states: Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. The database contains the following information:

- Annual & Lifetime Energy Savings
- Peak Demand Savings
- Avoided Air Emissions
- Program Expenditures
- Job Creation Impacts
- Cost of Saved Energy
- Program Funding Sources
- Supporting Information

REED is updated annually and can be used to inform state and regional policies, as well as state benchmarking and other research and analysis activities. REED provides information on program savings and expenditures by program sector and type, making REED a valuable resource that gathers program-level data for the region from various sources into one location. These data are not reported elsewhere in such a way.

In the winter of 2018 REED was populated with program year data for 2016. The following graphs are examples of how the data from REED can be used. In addition to making the data publically available in REED, the data are also presented in the Energy Efficiency Snapshot[1] and REED Renderings.[2]

Figure 1. Energy Efficiency Program Savings in Northeast States, 2009 - 2016



[1] NEEP, *Energy Efficiency Snapshot*, July 2018, Available at: http://www.neep.org/sites/default/files/resources/EE%20Snapshot%20Summer%202018.pdf
[2] NEEP, REED Renderings, Available at: http://www.neep.org/tags/reed-renderings

Figure 2. Levelized Cost of Saved Electricity in Northeast States, 2009 - 2016

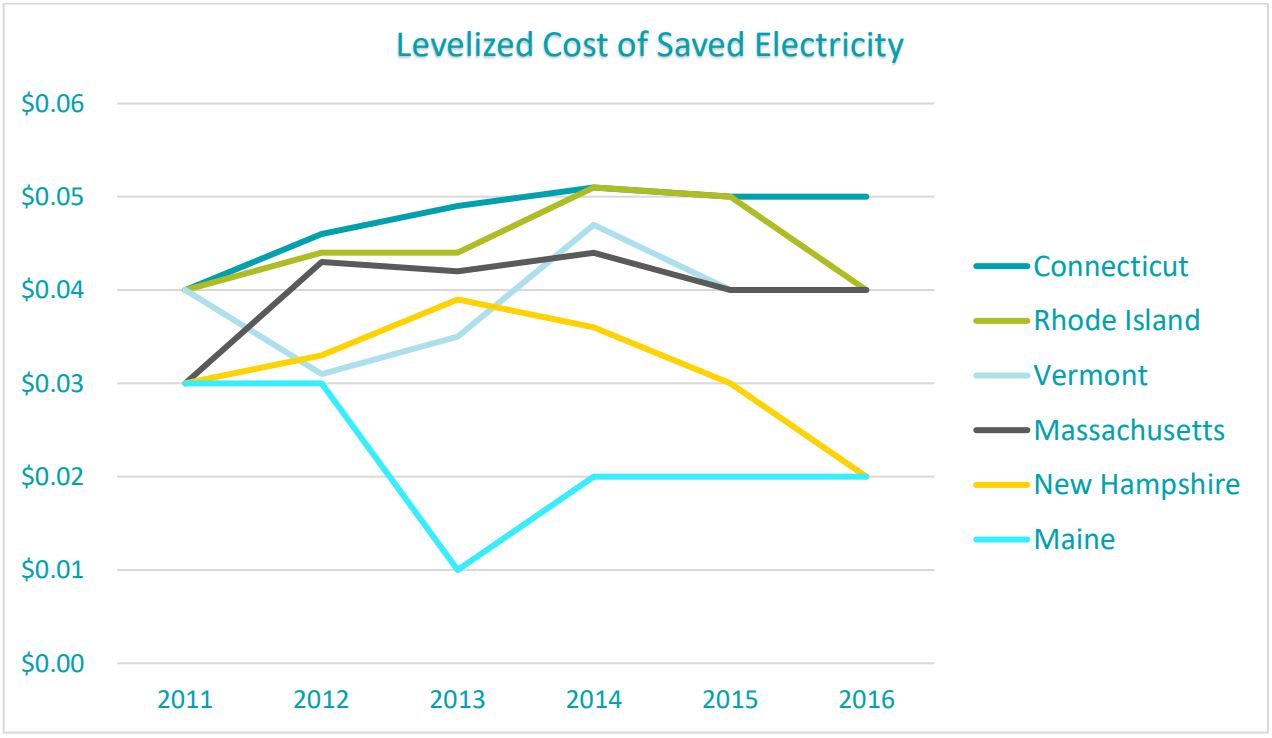
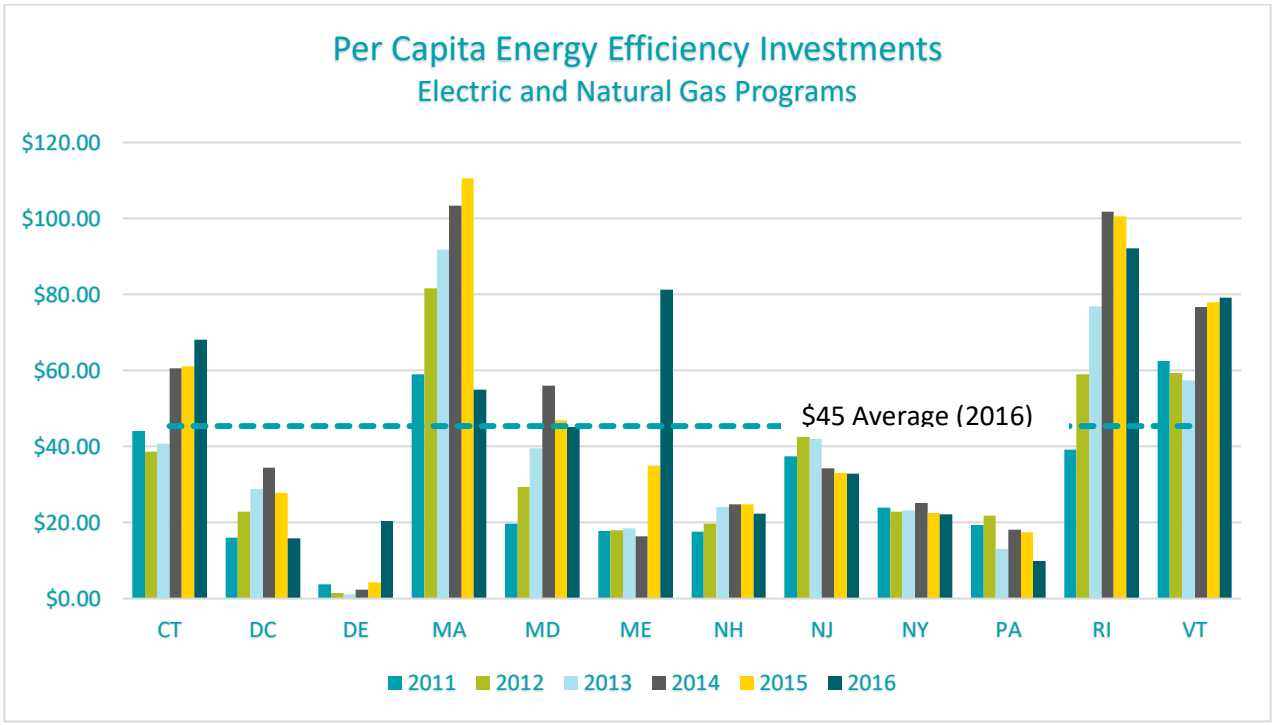


Figure 3. Electric and Gas Energy Efficiency Program Investments per Capita in Northeast States, 2009 - 2016



Data Collection Process

NEEP obtains data for REED from various sources. Utilities provide information on energy savings and expenditures, funding sources, and jobs. ISO-New England provides electric data for its territory, and the utilities provide data on natural gas. Utilities in the New York Independent Service Operator (NYISO) and PJM Interconnection LLC (PJM) markets report electric and natural gas data. In New York, the Department of Public Service and the New York State Energy Research and Development Authority (NYSERDA) report electric and natural gas, but the Long Island Power Authority only reports electric savings. NEEP calculates the cost of saved energy for all states.

The data collection for REED has evolved during the lifetime of the database and is strongly dependent on relationships with utilities, program administrators, and regulatory authorities in each state. With these relationships we are able to continue to populate the REED database on a voluntary basis. Utilities see the value in having their information reported in REED and made available on a regional basis at the program sector level. Each year, the data collection process starts by confirming that the contact from the previous year will be completing the data collection tables and assisting NEEP in the quality assurance process. Maintaining this aspect of the relationship where the respondent is willing to answer any questions and address discrepancies is very important to the quality assurance process. Some states are much more receptive and willing to help than others. Certain states refer NEEP to the annual reports[3] to address any issues, while others address questions directly.

The tables that are completed to update REED include

- General information regarding reporting requirements
- Savings and expenditure data
- Funding sources
- Cost of saved energy—calculated by NEEP and confirmed by state
- Jobs (not all utilities have information on jobs)

Once this information is compiled for each state, the quality control process begins. This part of the process takes a significant amount of time.

Quality Assurance Process

The following is an overview of the process followed to verify information provided in the data collection tables:

Step one

- **Table 1. General information on reporting requirements**: Verify that provided information is complete and makes sense compared with information from previous years. The supporting savings data and assumptions section is used for the "EE Resource Directory."
- **Table 2a State expenditures**: Compare REED values to the annual report expenditure value by separating expenditures by utility and then program sector within the utility. Compare current year totals and expenditure category percentages to previous years to see the difference.
- **Table 2b State savings**: Compare REED savings value to annual report savings value by separating savings by utility and then sector. Compare total energy savings to previous years (net and gross, annual

[3] See Appendix L for state profiles of each state in the region, including the energy efficiency plans and current annual report.

and lifetime). When comparing the energy savings, make sure the type (net versus gross) is the same as in the annual report.

- Caveat: Behavior and CHP programs are not reported in ISO-NE data; therefore, those need to be requested by each utility in the territory and added to the data.
- Caveat: NEEP calculates the net and gross lifetime savings for both electric and natural gas programs for the District of Columbia. Expenditures are also calculated based on gross annual savings.
- Caveat: In the Massachusetts data, each sector has a group of programs that have no attributable savings because these are "difficult to measure." The Department of Public Utilities (DPU) states that cost-effectiveness for these programs is determined at the sector levels. Programs with attributable savings are subject to cost-effectiveness testing.
- Caveat: Maryland has some programs with natural gas savings that do not have associated expenditures. In these programs, the natural gas savings are incidental savings from electric utilities reporting natural gas savings from electric energy efficiency installations, and there is no program budget associated with this. NEEP does not correct for this discrepancy.
- Caveat: Low-income savings are not broken out by utility in Maryland. Utilities cannot claim savings from U.S. Department of Housing and Community Development (DHCD) programs, and therefore, they are reported separately. This separate reporting started in the 2016 program year data. NEEP does not correct for this change.
- Caveat: Ensure that the unit of data reported in an annual report is the same as REED (therms for natural gas), and if not, be sure to do the conversion. Maine, Rhode Island, and New Hampshire are examples of where the annual reports are in million British thermal units (MMBtu).
- Caveat: Because New Hampshire utilities report separately, their information needs to be combined for the various tables. Adjusted percentages for funding sources are calculated by NEEP.
- Caveat: New York reporting requirements have changed under the Clean Energy Fund, established in 2016. The Department of Public Service reports NYSERDA program information. NYSERDA also reports some programs under the Clean Energy Fund, but expenditure information for all programs is aggregated to the electric sector. Therefore, it appears for some programs that there are not any natural gas expenditures when there are savings, but natural gas expenditures are aggregated and included under electric expenditures. Currently, NEEP does not adjust for this discrepancy, but it may explore doing so in the future

- **Table 3. Funding sources**: Ensure information provided is complete and makes sense compared with what was provided in previous years. Make sure the "other" categories are specific and clear.
- **Table 4**. **Cost of saved energy**: Calculate levelized cost of saved energy for each state.
- **Table 5. Jobs**: Ensure information provided makes sense compared with previous years. Ensure methodology is transparent.

Step Two

- Update state factors—population, megawatthour (MWh) sales, therm sales, utility revenue.
- Update regional factors—air emissions and transmission and distribution (T&D) line loss—from the regional transmission organizations.

Step Three

- Update state notes page with any information that will make the quality control process transparent. Also update it with policies that may affect program savings and expenditures.

Step Four

- Calculate cost of saved energy by state. Levelized cost of saved energy is calculated at the state level for electric and natural gas programs. This cost is then confirmed with the main contact for each state. For the next program year (2017) data collection process the recent 2018 Avoided Energy Supply Cost Study's (AESC) discount rate[4] will be used (1.88% instead of 2.46% used in 2016). During this step, NEEP uses the AESC discount rate for each state reported in REED, as well as state-specific discount rates when available.

Step Five

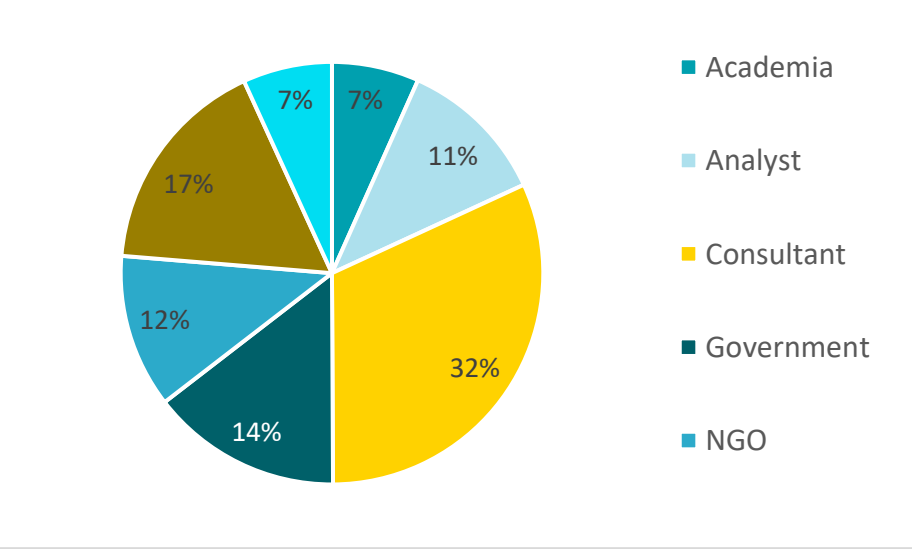
- Once steps one to four are complete, the information is uploaded to the database. The updated regional factors also need to be uploaded to the database.

Future Opportunities for REED

There are future opportunities for improvement to the REED database. These improvements include items to enhance reports, such as adding data labels to bar graphs and incorporating reference lines indicating avoided emissions goals. They also include adding the ability of users to produce time series reports.

By understanding the users of the REED database, NEEP can scope additional opportunities. REED would benefit from a survey of the different types of value REED brings to users based on the type of organization (e.g., government versus consultants). The figure below shows REED users by organization type based on current tracking. An assessment of potential value add could also explore further program sector level data that may be incorporated into the database. One noteworthy consideration is that states are beginning to move cost-effectiveness testing away from the measure level. For instance, Massachusetts passed legislation in 2018 that broadens cost-effectiveness screening to ensure that programs "obtain energy savings and other benefits with value greater than the costs of the program" rather than energy savings and system benefits. It also requires that energy efficiency program cost-effectiveness testing be aggregated and screened by sector rather than by measure.[5]

Figure 4. REED Users by Organization Type, 2016-2018



[4] AESC available at: http://www.synapse-energy.com/sites/default/files/AESC-2018-17-080.pdf
[5] MA Legislature, H4857, Enacted during Regular Session 2017-2018, Available at: https://malegislature.gov/Bills/190/H4857

NEEP is currently working with its REED database hosting service (Peregrine) to develop a new report for the energy savings data in REED. As the system is currently set up, if the user selects all columns when downloading the full dataset, (e.g., net annual electric meter level savings), all columns are downloaded but not all the rows with the actual data. Therefore, a new report that pulls all of the energy savings data in one spreadsheet will be created. A note will be added to the current report stating that if the user wants more filters besides the summary one selected, they must go to a different report. Most users of REED download summary data and do not encounter the discrepancies that occur when downloading the full dataset with all columns. It may also be worthwhile to publish some caveats for users, as well as study how to make this dataset more user-friendly. By making improvements on the back end, REED users can be assured the data they extract from REED is accurate and reliable. NEEP is planning to have this modification completed early in 2019.

Metrics Research

Overview

NEEP sought to collect data from the entire region on the cost-effectiveness and incentive values of residential and commercial energy efficiency measures and end uses. This effort had several goals. One was to deliver information to EIA for use in refining assumptions used in the residential National Energy Modeling System (NEMS) modules related to measure cost and types of efficiency measures. Measure-level information is helpful because the NEMS Residential and Commercial Demand modules are constructed using a bottom-up approach including major end-use equipment types. A second goal was to gain an understanding of what it would take to collect such measure-level information on a more routine basis. The experience of collecting these metrics could help inform how feasible it is for EIA to pursue getting this type of information from states in other regions. It could also help inform the possibility of adding measure-level incentive costs, administrative costs, and cost-effectiveness metrics to the REED database as a future design modification.

The research involved collecting both qualitative and quantitative information to help characterize energy efficiency programs at the level of individual measures or end uses. The annual update of the REED database gives NEEP access to contacts and sources of data on energy efficiency program impacts. The inputs to REED are primarily delivered to NEEP at the company level by end use and sector and then aggregated for state-level reporting in the REED online database. The program impacts are publicly available data from annual reporting, and they are defined and reported somewhat consistently across the companies and states in the database. NEEP was able to leverage the contacts it has for REED in its search for measure-level cost-effectiveness data. In drilling down for measure-specific metrics, however, NEEP found that there is greater variety in the types, sources, and availability of cost-effectiveness information.

The sources of information which proved to be most complete and useful were spreadsheets containing cost-effectiveness screening inputs. These spreadsheets were complete in that they provided all the information of interest—incentive costs, administrative and customer costs, cost-effectiveness (in dollars per kilowatthour [kWh])—at the measure and program level. They are available from individual companies, from measure-level cost-effectiveness screening tools, and from program tracking of results.

In the course of our search, we learned that some companies have more sophisticated program tracking tools than spreadsheets. We also learned that the measure-level program screening or tracking information is not always available, publicly or otherwise. The readily available information from annual plans and annual reports

on cost-effectiveness and performance is typically at a program or sector level; measure and end-use details must be sought out. New York utilities report energy efficiency results at the program level without separating natural gas and electric costs and impacts. Further, the utilities may have different approaches to measure screening[6]. Maryland regulators do not require tracking or reporting of measure- and end-use-level metrics on incentive expenditures; an evaluation consultant to Maryland utilities provided some provisional data at our request with the understanding that it be considered illustrative. Two companies we approached were not able to fulfill our request to prepare summary extracts from their tracking systems. Even when the spreadsheets full of information are routinely used by program administrators for their program planning and reporting, obtaining the information involves some customized outreach to contacts. Thus, compiling information on a routine basis for the region would involve establishing relationships and processes over time. This process would go beyond some of the outreach that exists for populating the REED database with company and state program impacts.

Given the challenges experienced with obtaining measure-level cost-effectiveness screening inputs and the fact that representative information from states at the measure level would serve EIA's purposes, NEEP focused on collecting cost-effectiveness metrics from large or representative companies within states for which the information was available.

Another source of information that was readily available throughout the region was program incentives by measure and program type. These incentives are posted on customer-facing websites by companies or organizations delivering energy efficiency programs.

We note that technical reference manuals (TRMs) are the most universally available public sources of measure-specific program information. Every state included in the REED database will have one. (New Hampshire plans to develop one). These manuals provide the algorithms with which to calculate savings impacts and, in some cases, provide deemed savings assumptions at the level of program type. However, there are many challenges with using these as sources of the measure metrics of interest to EIA. Many are not in spreadsheet format; one would have to make assumptions about impact parameters to develop impact estimates; and one would have to match incentive information and customer costs from other sources in order to develop cost/kWh estimates. (Customer costs may vary by company even if the measure-level savings impacts are consistent statewide.) With concurrence from EIA, NEEP did not pursue using measure-specific impacts from TRMs for this study.

Energy Efficiency Program Incentives

NEEP collected data on energy efficiency program incentives by measure, program type, and company for representative companies in the Northeast and Mid-Atlantic states, based on information available at program administrator websites. The data were compiled in summary tables in a workbook that contains a spreadsheet for each state. The Program Incentives Master Spreadsheet, which includes links to the source data, is included in Appendix A. The data are organized in rows corresponding to separate measure categories and columns that contain the following information for each measure category:

- Sector—eligible customer population
- Measure—specific description of eligible measure
- Incentive ($)—incentive amount per defined unit of measure

[6] Personal communication with Stephen Bonanno, National Grid NY, February 2018 and John Zabliski, Rochester Gas and Electric, October 2017.

- Additional Details—supplementary incentive information
- Program—program offering the specified incentives
- Dates Available—dates that incentive amounts are in available to participants

The data sources and program administrators are also identified in the spreadsheets.

Measure Impact and Cost Data

NEEP reviewed the measure cost, savings, and incentive data provided for each state and developed documentation of the file contents in the form of a "ReadMe" tab that was incorporated into the Excel workbooks. The workbooks are provided in Appendices B through F. The documentation is designed to assist EIA in the interpretation of the data and to enable direct comparison of the measure-level cost and impact values among the states. The ReadMe documentation includes the following information:

- For each spreadsheet contained in a workbook: the name of the spreadsheet, a general description of the contents, the column headings, and a description of the data listed under each heading
- A key to coded fuel types (Connecticut only)
- A glossary of acronyms and abbreviations used in the workbooks

The following table lists the program administrator source sampled for each state.

Table 1. Source of Measure Incentive, Cost, and Impact Data

State	Incentives	Impacts	In Appendix
Maine	Efficiency Maine		A
Vermont	Efficiency Vermont and Vermont Gas	Annual Savings Claim Summary	A and H
New Hampshire	Eversource and Liberty Utilities	Eversource and Liberty Utilities	A,B,C,D
Massachusetts	National Grid	National Grid	A,E F
New York	Consolidated Edison		A
Connecticut	Eversource	Eversource	A and B
Rhode Island	National Grid		A

Maryland	Baltimore Gas and Electric	Annual State-level Residential Summary	A and G
Pennsylvania	First Energy		A

The Connecticut, Massachusetts, New Hampshire, and Maryland energy efficiency programs are administered by the electric and natural gas utilities. Program design and implementation are consistent across utility service territories in each state. For prescriptive measures, the same incentives, incremental cost, and savings assumptions are employed in the calculation of aggregate program impact and cost-effectiveness. The organization of the data content of the files is similar in that the rows of the spreadsheets correspond to specific measure categories sorted by program, and the columns list the values of each metric for every measure and program.

Measure categories can be generally differentiated according to the market targeted by a specific program. One program type is often referred to as New Construction or Lost Opportunity. It is designed to promote efficient measure adoption for new construction, major renovation, and replacement of equipment that is no longer operational or approaching the end of its useful life. It targets "market-driven" transactions between building owners and occupants and trade allies that are assumed to occur independently of program influence. In other words, the program is designed to influence the efficiency of the product purchased and installed but not the timing of the transaction. The measures delivered in this type of program are variously characterized as "lost opportunity," "normal replacement," or "replace on burnout." The determination of incremental cost, energy savings, and customer incentives or rebates accordingly reflects the baseline assumption that the alternative to the efficient measure is a new product that conforms to current standards of energy efficiency.

Another program type targets the timing of equipment replacement, the installation of equipment controls, or other measures that condition the utilization of existing equipment (e.g., weatherization, pipe and duct insulation, etc.). It is referred to as "retrofit" or "early replacement." Measures delivered through these programs are designed to influence the customer to replace equipment that is still operational and not planned (for instance due to renovation or occupancy) or to make building system modifications that would not otherwise occur.

A given measure can be part of both types of programs, but it will have a different baseline, and other parameters may also differ. While this characterization of measure categories is not generally made explicit in the data, it can usually be inferred from the program name. The distinction is critical to a valid interpretation of the data so that meaningful comparisons can be made among the values provided for the same measures. So, for example, the data values listed under the heading of "measure cost" for the same measure type (e.g., refrigerator) in different programs may be derived from the incremental cost of an efficient model compared to a baseline new standard.

Measure Cost Research Survey

In consultation with EIA staff, NEEP developed a survey in order to collect qualitative and descriptive information about company and state energy efficiency program practices. This survey was distributed to

program administrators and state staff in June 2018 with responses due in July 2018. Responses were solicited from Vermont, Rhode Island, Connecticut, Massachusetts, New York, Pennsylvania, Maryland, Maine, and Delaware. Maine, Delaware, and New York were unable to respond due to resource constraints and Massachusetts partially responded. The table below identifies the organizations that provided responses to the surveys. To supplement information provided in the surveys, links to publicly available annual reports, plans, and budgets for New England and Mid-Atlantic states are provided in Appendix L.

Table 2. Survey Respondents

State	Organization
Vermont	Vermont Public Service Department
Massachusetts	Commonwealth of Massachusetts Department of Energy Resources
Rhode Island	National Grid
Connecticut	Eversource CT
Maryland	Southern Maryland Electric Cooperative
Pennsylvania	Pennsylvania Public Utility Commission

The survey questions were designed to collect information about the following categories:

- Program Planning Cycle—timing and frequency of filed program plans
- Program Evolution—current trends in program incentives, funding, and expenditures
- Program Design—types of measures that qualify for incentives and the basis for incentive amounts
- Program Participation—share of eligible participants expected not to participate
- Cost-Effectiveness Calculations—benefit and cost categories included in cost-effectiveness calculations
- Utility Data—number of residential and non-residential customers, percentage of electric sales and electric savings

The survey responses are briefly discussed and data are summarized in the tables below. A copy of the survey and the tables of utility characteristics are included in the Appendices I and J, respectively.

Vermont responses were provided for three program administrators: Efficiency Vermont, the predominant energy efficiency delivery in Vermont; Burlington Electric Department; and Vermont Gas. Unless noted, the same process and timelines for the efficiency programs apply for these companies: National Grid, the respondent that serves the entire state of Rhode Island; and Eversource, the predominant utility in Connecticut. Southern Maryland Electric Cooperative was the only respondent from Maryland. While this is not one of the larger service territories in Maryland, we note that Southern Maryland Electric Cooperative (SMECO) and the other Maryland utilities have some statewide coordination.

Program Planning Cycle

As shown in the table below, multiyear planning is the prevailing practice in the Northeast. Program plans typically follow three-year cycles, with annual updates (Connecticut, Vermont). Rhode Island submits annual plans and a non-binding illustrative three-year plan. Pennsylvania is the notable exception in that the Pennsylvania Utility Commission determines the length of the planning cycle.

Table 3. Energy Efficiency Planning Cycles and Schedule for Next Plan

State	EE Planning Cycle	Next Plan Submission
Vermont[7]	Triennial, 2018–2020	Nov 1, 2018
Massachusetts[8]	Triennial, 2019–2021	Oct 31, 2018
Rhode Island[9]	Annual, 2019	Oct 15, 2018
Connecticut[10]	Triennial, 2019–2021	Nov 1, 2018
Maryland[11]	Triennial, 2021–2023	Sept 20, 2020
Pennsylvania[12]	3–5 years, 2021–TBD	Nov/Dec 2020

[7] Current Efficiency Vermont Plan: Efficiency Vermont 2018-2020 Triennial Plan.
[8] Current MA Plan: http://ma-eeac.org/plans-updates/
[9] Current RI Plan: http://www.ripuc.org/eventsactions/docket/4755-NGrid-EEPP2018_11-1-17.pdf
[10] Current CT Plan: http://www.dpuc.state.ct.us/DEEPEnergy.nsf/c6c6d525f7cdd1168525797d0047c5bf/8525797c00471adb85257ed1005ea786?OpenDocument
[11] Current SMECO Plan: http://www.psc.state.md.us/search-results/?keyword=9157&search=all&search=case&x.x=0&x.y=0
[12] Current PA Plan: http://www.puc.state.pa.us/filing_resources/issues_laws_regulations/act_129_information/energy_efficiency_and_conservation_ee_c_program.aspx

Program Evolution

The survey affirmed that efficiency programs are typically structured around customer segments (such as residential or small commercial), baseline assumptions (e.g., normal replacement/replace on burnout, early replacement or retrofit[13], and new construction) and sometimes major end uses (lighting, HVAC, custom). It is not possible to quantify the typical life of a program for any measure category. Various measure categories can extend across several programs, and each program has several measure categories. Programs tend to endure for many years—even decades. However, as the table below shows, the list of eligible measures evolves, phasing in or being eliminated as markets evolve and new technologies emerge. All energy efficiency programs are phasing out lighting technologies because the combined effect of Energy Independence and Security Act (EISA) standards and the rapid penetration of light-emitting diode (LED) bulbs has substantially changed the lighting baseline for efficiency programs. As a result, elimination of incentives or significant reductions in changes in incentive levels are expected for lighting measures throughout the region (we note that the recent imposition of tariffs on Chinese imports to the U.S. may increase prices of LEDs and may introduce uncertainty into expectations about incentive values for lighting products being offered by programs). Compact fluorescent lightbulbs (CFLs) were almost entirely phased out of programs in Rhode Island in 2017 and are not offered in 2018, and within 2 to 5 years, incentives for most types of LEDs will no longer be provided as reported in the survey response from Rhode Island, for example. Also in Rhode Island, commercial sector luminaires without controls may not receive incentives in 2020–2021.

Table 4. Program Evolution: Measures Phasing In and Out

	EE Measures Phasing In	EE Measures Phasing Out
Vermont	Many—HVAC, smart technologies, commissioning, behavioral	Fossil heat pumps, lighting, some natural gas commercial techs
Rhode Island	Many—HVAC, smart technologies, commercial gas technologies	CFLS (2017), LEDs (>2020), commercial and industrial (C&I) luminaires without controls (2020)
Connecticut	Advanced controls, heat pumps	Residential retail lighting
Maryland	Smart thermostats, other smart home technologies	Change lighting baseline
Pennsylvania	Behavioral (Home Energy Reports), smart thermostat demand response	CFLs

[13] Rhode Island does not offer early replacement of measures. Several programs in Maryland assume a mixture, including a residential HVAC program assumes a mixture of retrofit and normal replacement;

Another driver leading to the phase out of measures is the increasing stringency of the shell measure and equipment codes or standards; this phase out is true for the Vermont building energy code, which states that "it is expected that the next energy code update will make the [Efficiency Vermont] residential new construction program not cost effective." Based on recent results relating to increasing baselines, commercial sector new construction below 50% efficiency, flat roof insulation, cavity insulation, and energy recovery ventilation may be phased out. Also the following commercial natural gas technologies may be phased out: infrared heaters, direct-fired makeup air units, commercial pre-rinse spray valves, fryers, and modulating burner controls.

All of the utilities are phasing in additional energy efficiency technologies or categories. Advanced controls for lighting and smart technologies for whole buildings and homes are frequently cited as emerging technologies being phased in. As noted by one respondent, they provide "energy insights, HVAC optimization, and demand response opportunities," so automating home management and integrating efficiency with other resources and savings opportunities are benefits that extend beyond energy efficiency for the customers and the program administrators.

With respect to natural gas efficiency, Rhode Island is considering phasing in various commercial sector measures including: faucet laminar flow restrictor for hospitals, natural gas modulating valve for commercial dryers, and ozone laundry systems. Vermont Gas Systems is not phasing in new measures but is undertaking other changes motivated by various drivers. For example, drivers include reducing customers' carbon footprints by providing renewable natural gas as a service offering and bundled offerings that include solar applications and smart thermostats, as well as seeking to increase customer participation in energy efficiency in hard to reach markets.

HVAC and Whole Building Program Practices and Trends

In several places, behavioral programs are being phased in as they offer natural gas and electric savings potential. Vermont and Pennsylvania are adding residential behavioral programs and home energy reports. For the commercial sector, Efficiency Vermont is expanding its Continuous Energy Improvement Program and considering Building Operator Certification, while Rhode Island is considering Strategic Energy Management (similar to the Continuous Energy Improvement Program) as an initiative. One note to consider is that the observed reductions in energy consumption in some behavioral programs might not lend themselves to be directly tied to any specific appliance or end use. Customers do not receive incentives, and program administrators do not attribute savings to specific measures but can claim savings in these programs.

Several states (Vermont, Rhode Island, and Connecticut) noted that they are phasing in or expanding offerings associated with HVAC. These offerings displace oil and electric resistance heat, reduce greenhouse gas emissions, or move toward strategic electrification. This fact is true for Rhode Island, where mini-split heat pumps for multifamily customers, mid-stream promotion of heat pump water heaters, and cold climate heat pump promotions are being added or are under consideration and a pilot on Zero Energy Homes is being conducted. Similarly, Vermont has a strong focus on HVAC, deploying whole home heating with ducted heat pumps "to fill the gap that ductless heat pumps have in the Vermont market." To benefit the ratepayer, Efficiency Vermont is "aggressively pushing whole home wood heating" with stoves, boilers, and furnaces.

The survey also explored the issue of the eligibility for efficiency incentives by fuel type for HVAC or whole building-related measures. Whole home and building programs are important to consider for several reasons.

Whole building programs typically address multiple end uses and measure types. Looking ahead, an emerging trend in energy efficiency programs is the examination of efficiency impacts at a whole-building level. Depending on the program administrator, both whole building programs and HVAC end-use targeted programs may impact several fuels, such as programs that deliver electric and natural gas efficiency measures as a bundle or that are delivered in combination with renewables incentives, or such as programs that incentivize fuel-switching. The survey found that programs in the region vary with respect to these features. Eligibility for programs by fuel type and stipulations on fuel-switching vary geographically, as shown in Table 5 below.

Table 5. Eligibility of HVAC Measures in Efficiency Programs by Fuel Type

State	Eligible Measures (regardless of primary fuel type)	Stipulations on fuel-switching?
Vermont	Yes for Efficiency Vermont and Burlington Electric; limited to water heating for Vermont Gas	Yes
Massachusetts	Yes	No
Rhode Island	No response given	In 2018, oil and displacement by heat pumps allowed
Connecticut	Yes— Residential weatherization	No

Maryland	Very few (shower heads, e.g.)	Yes—No fuel-switching
Pennsylvania	Must reduce electricity	Fuel-switching is allowed for some HVAC measures

Program Funding and Incentives

As shown in the table below, the survey solicited information about expected trends in funding levels and incentives. Comments in several of the surveys provide insight into drivers of incentive changes. Lower baselines resulting from market transformation or a need to reduce program costs for other reasons, such as declining avoided costs, may drive incentives down. A need to increase market participation in programs or measures may drive incentives up. In Rhode Island, for example, the survey respondent noted "some lighting measures for LEDs and their associated incentives will most likely be phased out over the next 2–5 years. Given the high portion of net MWh annual savings that comes from LED bulbs, this will have a significant impact on incentives offered over the next five years." It is possible Rhode Island will increase incentives on other measures to help meet savings targets that lighting no longer can fill. As noted by the survey respondent from Maryland, "many of the utility programs are looking at moving to midstream program offerings for appliances and HVAC." The impact of this change on incentives depends on its implementation. "..[U]nder the Energy Star Retail Products Platform, a smaller incentive is given to the retailer to encourage stocking, promoting, and selling more efficient products. Other midstream approaches will look at passing the incentive to the distributor who will take a small amount for administrative costs but pass the rest to the contractor who in turn passes it to the customer. Other products may go to an instant discount so the customer will get the discount at the register." And in Vermont, aside from shifting residential lighting incentives to other electric savings measures, the ramp up of thermal goals by Efficiency Vermont means that incentives will be more aimed at fossil fuel savings. Burlington Electric anticipates "pushing new commercial new construction incentives higher to better influence high performance construction practices."

Table 6. Funding Trends and Incentive Changes

State[14]	Funding Levels	Incentive Changes
Vermont	Stable/increase in Vermont Gas	Removing lighting incentives, increasing fossil fuel-

[14] No information on these issues was provided by the survey respondent from Massachusetts

		saving measures
Rhode Island	Stable	Removing LED incentives
Connecticut	Increasing trend since 2014; 2017/18 cut	Changes are assessed annually
Maryland	Stable	Change to midstream and instant discount for residential appliances and HVAC
Pennsylania	Stable	No change

The timing for implementing updates to measure qualifications or incentives in response to changing baseline or other conditions varies in the region. Generally, changes are put in place in time for the next planning cycle. As noted above, most states have triennial cycles. Changes are reflected in updates to technical reference manuals as well. In the survey, however, some states (Maryland, Vermont) noted that they assess or incorporate changes into program delivery on an ongoing basis.

Connecticut and Vermont have seen steady increases in energy efficiency budgets over recent years but may be stabilizing in the current period. Connecticut's funding experienced a hiccup in 2017–2018 as 25% of the annual funding was reduced and a portion was recently restored; most funding is tied to levels of electric and natural gas sales. Efficiency Vermont's electric efficiency budget "is essentially flat" for the 2018–2020 planning period[15]. Vermont Gas System's portfolio funding is trending toward increasing: 5% per year for 2017 and 2018, 4% for 2018–2019, and 2% for 2020.

Maryland, Pennsylvania, and Rhode Island respondents noted that the level of program portfolio funding is expected to remain relatively stable in the near future. As noted by one respondent, "because the programs are funded by rate payers, utilities have to be mindful of running cost-effective programs and looking at reducing the expense to the customer." Pennsylvania's budget for energy efficiency is capped; per Act 129, "the total cost of any plan…shall not exceed two percent of the electric distribution company's revenue as of December 31, 2006." Rhode Island notes annual variations in budget can be in the 5% range.

[15] The budgets associated with unregulated (e.g., thermal) fuels are based on Regional Greenhouse Gas Initiative (RGGI) and Forward Capacity Market (FCM) revenue estimates and are harder to characterize for Efficiency Vermont and for Burlington Electric Department. For Efficiency Vermont, this budget increased 26% from 2015–2017.

Incentive Design and Cost-Effectiveness

Cost-effectiveness, which is fundamental to energy efficiency program design, is a key consideration in incentive design. As shown in the table below, respondents to the survey indicated that while there is no single parameter that determines what incentives are based on, $/kWh or $/therm saved and benefit/cost screenings were the two most commonly cited factors. A 2011 comparative study of incentives[16] notes that factors influencing differences in incentives across states and programs may include:

- Savings goals for the state, portfolio, and individual program or end-use group within a program
- Program and measure cost-effectiveness
- Effectiveness of program design, marketing, and delivery
- Size of the target end-use market
- Regional market barriers—product availability, infrastructure development to deliver measures, energy costs to end user
- Available budget
- Program and end-use measure uptake (participation levels) relative to goals
- Measure adoption curve point and market transformation
- Free ridership and spillover levels
- Characteristics such as customer preferences or the mix of business types in the customer base

We note there is little or no research on how increasing or decreasing incentive levels affect the level of participation with all of these factors in play. One recent comparative investigation (using a very small sample of programs from North America—not Northeast-focused) found little correlation between incentive levels and program impacts.[17]

Table 7. Basis for Incentives

State	Stage of incentive change implementation	Basis for Incentives A: % of incremental cost B: Customer payback C: $/kWh or $/therm D: Benefit-cost screening
Vermont	Ongoing/annual planning	BCD

[16] TetraTech. State of Massachusetts, Industry Practices and Policies on Energy Efficient Program Rebates and Incentives. Available at: https://www.seventhwave.org/sites/default/files/ma-rebates-incentives-study.pdf

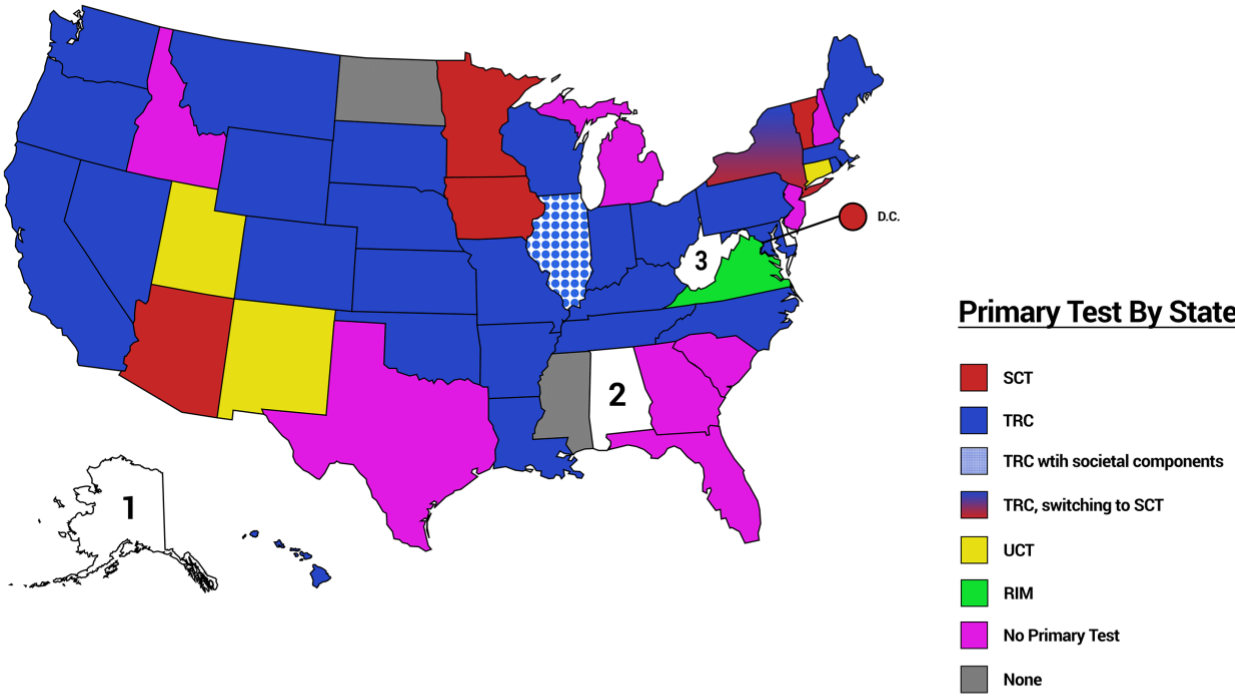
[17] Personal communication, Arlene Lanciani, CEE Summer Meeting, May 31, 2018.

Massachusetts	With evaluation updates	ABCD
Rhode Island	Annual planning	CD
Connecticut	Annual planning	ACD
Maryland	As needed	ABCD
Pennsylvania	Within five-year planning	A

States vary with respect to what benefits are accounted for in their cost-effectiveness calculations. As shown in the figure below, in the Northeast in particular, there is significant variation in the choice of primary cost-effectiveness test used[18]. Looking ahead, it may be increasingly difficult to generalize about cost-effectiveness assumptions within states. Guidance published in 2017 by the National Efficiency Screening Project, the *National Standard Practice Manual*, recommends that each state develop and use a resource value cost-effectiveness approach aligned with the various energy-related policies set forth in the state[19].

Figure 5. Primary Cost-Basis Tests by State (Where SCT = Societal Cost Test; TRC = Total Resource Cost Test; UCT = Utility Cost Test; RIM = Rate Impact Test)

[19] The manual is available at: https://nationalefficiencyscreening.org/national-standard-practice-manual/.



1 - No formally approved ratepayer-funded energy efficiency programs
2 - The Commission permits rate recovery for energy efficiency programs that are cost-effective for all retail customers.
3 - Appalachian Power is required to have a 3rd party program evaluator.

Survey Respondents identified the following elements accounted for in cost-effectiveness calculations. Of these, avoided fuel costs are the common factor.

Table 8. Basis for Incentives

State	Benefits Accounted for in Cost-Effectiveness Calculations A: Avoided fuel B: Avoided water	Costs Accounted for in Cost-Effectiveness Calculations A: Participant measure costs	Primary Cost-Effectiveness Test

	C: Deferred equipment replacement D: Avoided environmental compliance E: Avoided externalities F: Other non-energy benefits	B: Other participant costs C: Shareholder incentive	
Vermont	ABCDEF	AB	Societal
Massachusetts	ABCDEF	A	Total resource cost
Rhode Island	ABCDEF	ABCDEF	Societal
Connecticut	AD	C	Program administrator
Maryland	ABCDEF	AB	Total resource cost
Pennsylvania	AB	A	Total resource cost

Quantification of avoided costs for energy efficiency measures for all six New England states is based on one joint study that applies a consistent methodology, and program administrators use this study to screen future energy efficiency measures. Starting in 2015, a study has been performed on a three-year cycle, with the most recent results delivered in spring of 2018. A significant finding is the general decline in avoided costs when comparing with 2015, as shown in the table below.

The main drivers of the decline include lower projected costs of natural gas and lower Regional Greenhouse Gas Initiative (RGGI) prices. Avoided energy costs constitute about 30% of the avoided cost. Other drivers include changes anticipated to Forward Capacity Market (FCM) demand, supply, and market rules; revised DRIPE[20] methodologies; new inputs for Renewable Energy Credit (REC) markets related to changes in state renewable procurement policies; and new categories of avoided costs included transmission and delivery (T&D) and the value of reliability.

[20] DRIPE stands for Demand Reduction Induced Price Effect, one of the benefits of energy efficiency included in New England cost-effectiveness analyses.

Table 9. Illustration of Avoided Electricity Supply Cost (AESC) Components, 2018 versus 2015, Summer On-Peak, West Central MA Sub-Region[21]

	AESC 2015	AESC 2015	AESC 2018	AESC 2018, relative to AESC 2015	
	2015 cents/kWh	*2018 cents/kWh*	*2018 cents/kWh*	*2018 cents/kWh*	*% Difference*
Avoided Retail Capacity Costs	2.91	3.05	1.72	-1.33	-44%
Avoided Retail Energy Costs	6.29	6.60	4.63	-1.97	-30%
Avoided Renewable Energy Credit	0.96	1.01	0.39	-0.62	-61%
Subtotal: Capacity and Energy	**10.16**	**10.66**	**6.75**	**-3.92**	**-37%**
CO2 non-embedded	**4.88**	**5.13**	**4.36**	**-0.76**	**-15%**
T&D	**-**	**-**	**2.11**	**2.11**	**-**
Value of Reliability	**-**	**-**	**0.01**	**0.01**	**-**
Capacity DRIPE	-	-	0.91	0.91	-
Energy DRIPE	1.18	1.24	1.91	0.67	54%
Subtotal: DRIPE	**1.18**	**1.24**	**2.81**	**1.58**	**128%**
Total	**16.22**	**17.02**	**16.05**	**-0.98**	**-6%**

As illustrated by the tables below, there is little variation in avoided energy costs for electricity across the New England region; however, natural gas avoided costs vary between northern New England and southern New England (SNE). Northern New England (NNE) 2018 avoided natural gas costs are lower than in 2015 and lower than southern New England due to NNE's proximity to the low-cost natural gas in Canada.

[21] Source of this table is: Powerpoint presentation May 8, 2018, "New England's Avoided Energy Supply Cost (AESC) Study, 2018" by Pat Knight, available at: https://neep.org/sites/default/files/EM%26V%202018%20May%208%20Meeting_Introduction.pdf. The full AESC report published March 30, 2018 is available at: http://www.synapse-energy.com/sites/default/files/AESC-2018-17-080.pdf.

Table 10. Illustration of Geographic Consistency across New England States in Avoided Electricity Supply Cost (AESC), 2018, Summer On-Peak[22]

	15-year levelized value for summer peak ($/kWh)
Connecticut	$0.050
Massachusetts	$0.050
Maine	$0.046
Connecticut	$0.052
Rhode Island	$0.049
Vermont	$0.050

Table 11. Illustration of Subregional Variation in Avoided Natural Gas Supply Cost (AGSC) in New England, 2018[23]

	15-year levelized value for all retail end uses ($/MMBtu)
SNE	$7.40
NNE	$7.18

[22] Ibid.
[23] Ibid.

Summary

Findings

Data from REED help provide an overview of energy efficiency program impacts in New England, New York, and the mid-Atlantic over time. Within each state, total savings were relatively consistent between 2014 and 2016, although they varied on a per capita basis from year to year.

The update process for REED has been documented. It relies on inputs from a variety of organizations in the region. Its quality benefits from long-standing relationships with states and regional organizations such as the American Council for an Energy-Efficient Economy (ACEEE) and ISO-NE, which help promote consistency and reinforce or leverage collection schedules. The experience of updating REED for 2016 identified some opportunities for a small number of modifications that will improve clarity and accuracy in some reports.

Because most of the contacts who provided inputs to REED do not collect or report measure-level impacts, measure-level costs, or cost-effectiveness, the process of gathering this information dominated this phase of the project. We focused on two approaches. The first approach was to obtain measure-level cost-effectiveness screening inputs that are developed by program administrators primarily for internal operations. We collected these inputs from representative program administrators in a subset of states where the information was available and considered the information useful as indicators rather than a comprehensive profile. The second approach was a web-based search for customer-facing publicly reported program incentives. This approach has the advantage that information could be obtained from every state. However, the level of detail and ease of accessing it varied. The screening inputs provide the most valuable details, but they are not available across all states. As with the current REED data collection, getting screening inputs on a routine basis, comprehensively, for all companies or states that have the information would require customized relationship development as well as significant investment in standardization across states and companies.

Looking ahead, it is possible that there could be more variability and uncertainty in energy efficiency program performance across states over the next three to five years. One much-discussed reason is the phase out of lighting measures that is underway and expected to accelerate in the region. Program administrators face a need to meet their goals with less reliance on savings from lighting end uses. The decline of natural gas prices leading to lower avoided costs adds a challenge; some program administrators introduce behavior programs or move to midstream incentive strategies for more non-lighting measures to realize economies and expand the program reach. As efficiency becomes integrated with demand response, bundled with renewables program offerings, or aligned with strategic electrification policies, the measure mix, incentives, and metrics relevant to decision makers may all change.

Recommendations

The REED update identified some areas where minor improvements from the REED hosting service could refine REED quality assurance, and we are initiating discussions with the hosting service to obtain estimates of effort required.

Given the evolving nature of the energy industry, we recommend an assessment of REED in the near future. This assessment would provide an opportunity to review its current uses and users as well as to explore potential future modifications that would help continue and potentially broaden its relevance as an information source.

Based on the experience of collecting measure-level metrics on costs and impacts, we advise against considering REED as a repository for a comprehensive database on incentives and measure screening inputs at this time. It would involve a very significant investment, and indications are that EIA's needs can be met with representative indicator data rather than comprehensive information. Besides, it is not possible to get comparable measure-level information from public sources across the board.

We recommend seeking similar measure-level data from some additional companies or states in the region to provide a more complete regional cross-section.

We also recommend conducting some simple comparative research on the data collected. For example, understanding the range of variation in incentives across states by program and end use or examining some year-to-year changes in measure-level costs and impacts by end use categories may yield insights that could make future data collection more targeted. This examination may support recommendations of what could serve as good indicators.

Considering the evolving nature of the industry, we also recommend supplementing the qualitative information provided in surveys with a scan of regulatory changes that are scheduled or pending. Specifically, building a schedule of codes and standards changes in states in the region may help with forecasting baseline changes that will affect impacts. Beyond that, a quick scan of the next generation of efficiency plans to determine the extent to which program investment levels by sector or end use may change, may be useful to forecasting. Many of the plans are due out in the coming months.

Appendix[24]

A. *Program Incentives Master Spreadsheet*
B. *Eversource CT and NH 2018 Measure Cost Workbook*
C. *Liberty Utilities Gas 2017 Measure Cost Workbook*
D. *Liberty Utilities Electric 2017 Measure Cost Workbook*
E. *National Grid MA Gas 2017 Measure Cost Workbook*
F. *National Grid MA 2017 Electric Measure Cost Workbook*
G. *Maryland 2016 Residential Average Measure Cost and Savings Table*
H. *Efficiency Vermont 2017 Electric Resource Acquisition End Use Breakdown Spreadsheet*
I. *Survey Questions*
J. *Utility Data from Survey Questions*
K. *Primary and Supplemental Cost-Effectiveness Tests by State, 2017*
L. *State Profiles: Spreadsheet with Links to Annual Reports, Plans, and Budgets for New England and Mid-Atlantic States*

[24] These appendices are provided as separate files accompanying this document.