Regional End Use Load Profile (EULP) Priority Research and Data Sharing Recommendations

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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 home, buildings, industry, and communities. Our vision is that the region's homes, buildings, and communities are transformed into efficient, affordable, low-carbon resilient places to live, work, and play.

Disclaimer: 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.

Executive Summary

This report is the third and final report produced through NEEP's Regional End Use Load Profile (EULP) Project, which was conducted from 2020-2021 with support from the Massachusetts Clean Energy Center (MassCEC) and the New York State Energy Research and Development Authority (NYSERDA). The first two project reports are:

- Sharing Load Profile Data: Best Practices and Examples (May 2020): This report provides guidance to facilitate effective data sharing among energy data users. It presents background information and definitions important to data sharing. It outlines data sharing barriers and best practice guidelines to help overcome those barriers for several applications in which data sharing is feasible and potentially beneficial. Three data sharing case studies demonstrate the best practice guidelines in actual projects. While the primary focus of the brief is sharing electric load profile data, it is relevant to other energy-related uses.
- Regional End Use Load Profile Data Inventory and Needs Assessment (April 2021): This report provides a summary assessment of EULP data currently available in Massachusetts, New York, and the Northeast region and identifies regional needs for EULP data in order to guide recommendations for future priority EULP research. The report highlights how quality EULPs can contribute to the energy industry in many ways, including providing a better understanding of the value of energy efficiency, demand response, and other distributed resources, and helping with planning and forecasting efforts.

This report condenses the high-level recommended research areas identified in the Regional EULP Data Inventory and Needs Assessment report and explores two priority areas for future EULP research:

- Integrating EULP and advanced metering infrastructure (AMI) data into energy efficiency program design and evaluation, measurement, and verification practices to better align programs with the decarbonization policies and goals that are being established and pursued across the region.
- Integrating EULP and AMI data into transmission and distribution planning to better understand and account for distributed energy resources.

The report closes with an update on data sharing policy developments across the region since the Sharing Load Profile Data: Best Practices and Examples report was completed last year, including highlights of data sharing efforts and a call for consideration of a regional data sharing working group.

Introduction

Many states in the NEEP region are establishing and pursuing decarbonization goals, leading to a shift towards a decarbonized grid. This movement is starting to change many aspects of the current energy regulatory space. It will require a departure from the large scale, status quo electricity distribution model with long transmission lines to a new model with manageable, localized loads. This shift will change the way that regulators think about energy management and resiliency.

State climate plans and/or energy efficiency plans throughout the region include the following potential applications of end use load profiles (EULPs):

Table 1: End Uses Identified in State Climate Plans[1]

EULP End Use	State Climate Policy	MA	NY	ME	NH	VT	CT	RI
Energy Efficiency Planning	Time of Use Rates				x	x	x	
	Peak Demand Reduction	x	x	x		x	x	
	Efficient Appliances	x	x	x	x	x	x	
	Electrification of Space and Water Heating	x	x	x		x	x	x
Transmission and Distribution Planning	Distributed Energy Resources	x	x	x	x	x		x
	Scaling Renewable Energy	x	x	x	x	x	x	x
	Minimize Infrastructure Buildout	x	x	x	x	x	x	x
	Energy Storage	x	x	x	x	x	x	x

[1] Massachusetts, 2020: Release of 2030 CECP Draft.https://www.mass.gov/files/documents/2017/12/06/Clean%20Energy%20and%20Climate%20Plan%20for%202020.pdf;
New York, https://www.dec.ny.gov/docs/administration_pdf/irchap8.pdf;
Maine, Four Year Plan for Climate Change, https://climatecouncil.maine.gov/future/sites/maine.gov.future/files/inline-files/MaineWontWait_December2020_printable_12.1.20.pdf; 2009:
New Hampshire Climate Action Plan, https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/r-ard-09-1.pdf;
Vermont, https://legislature.vermont.gov/assets/Legislative-Reports/Executive-summary-for-web.pdf.;
Connecticut, Governor's Council on Climate Change Recommendations for 45% by 2030, https://portal.ct.gov/-/media/DEEP/climatechange/publications/BuildingaLowCarbonFutureforCTGC3Recommendationspdf.pdf;
Rhode Island, 2018: Resilient Rhody, Climate Action Plan, http://climatechange.ri.gov/documents/resilientrhody18.pdf.

Incorporating these state-level decarbonization policies into the regulatory space will require:

- Implementation and better understanding of programs that lower the grid's energy use to optimize performance, and
- Overseeing a more intricate system of energy infrastructure comprised of flexible, distributed energy resources.

Current energy planning mechanisms rely on assumptions and do not provide data that is granular enough to optimize the design and implementation of these policies and programs. For example, most current grid planning and energy efficiency program design is based on forecasts that provide an overview of energy use on an aggregate level, but do not provide building or appliance energy usage.[2]

The National Renewable Energy Laboratory (NREL), Lawrence Berkeley National Laboratory (LBNL), and Argonne National Laboratory are currently in the final year of a three year United States Department of Energy (U.S. DOE)-funded study, End-Use Load Profiles for the U.S. Building Stock, that will help bring end use load profiles into the policymaking realm by making more granular data available. This national EULP study will result in EULPs for the residential and commercial building stock in multiple regions of the United States. This includes modeled aggregate profiles that represent the end use load profile in one or more customer segments in a utility territory or region, as well as modeled individual profiles to represent real building patterns with normal spikes and variability between individual buildings (such as occupancy and use). The study results will be publicly available in September 2021. NEEP's regional EULP project has been coordinating its efforts with the national study.

This report identifies two areas for priority EULP research. These research areas build upon: 1) data that will be available from the national EULP study, 2) existing and planned energy efficiency evaluation, measurement and verification (EM&V) studies in the northeast region, and 3) state decarbonization and climate goals:

- Integrating EULP data into energy efficiency programs to align program design and EM&V with decarbonization policies.
- Integrating EULP data into transmission and distribution planning to better understand and account for distributed energy resources.

The report concludes with a discussion about data sharing challenges and developments in energy data sharing policies and practices since the regional EULP project's Sharing Load Profile Data: Best Practices and Examples report was completed in 2020.

Incorporating EULPs into Energy Efficiency Planning and EM&V for Greater Alignment with Decarbonization Efforts

This section examines using EULPs in energy efficiency planning processes to help establish and implement programs that reduce peak load and shift energy use to help achieve decarbonization goals. Energy efficiency program administrators can benefit in many ways from incorporating end use load profiles into energy efficiency

[2] Mims Frick, Natalie, Wilson, Eric J, Reyna, Janet, Parker, Andrew S, Present, Elaina K, Kim, Janghyun, Hong, Tianzhen, Li, Han, & Eckman, Tom. End-Use Load Profiles for the U.S. Building Stock: Market Needs, Use Cases, and Data Gaps. United States. https://doi.org/10.2172/1576489.

program planning and EM&V, including proper accounting of program impacts in the cost-benefit test and more comprehensive program evaluation through more granular data.[3]

Achieving aggressive decarbonization goals will require energy efficiency program administrators to not only reduce energy use overall through their programs, but also to understand ***when*** energy efficiency programs are reducing energy use. The timing of energy usage is increasingly important in energy efficiency program planning as more programs are designed to deter usage during peak periods. Lowering demand on the grid during peak periods is very important for reducing emissions because it facilitates incorporation of renewable energy sources. End use load profiles are key to this planning process since they show how and when energy is used, and account for seasonal variation. This data is more granular than traditional annual energy efficiency program evaluation approaches. EULPs will be increasingly important further down the road as energy efficiency programs begin to incorporate additional demand response technologies.

The following policy highlight sections examine evolving practices to shift electricity usage in response to time-based rates or other forms of programs targeted at reducing peak demand, and how to properly value these programs through cost-benefit testing using a new metric introduced in California.

Policy Highlight: Time of Use Programs

When aggregated, large appliances (refrigerators, washers and dryers, and dishwashers) in households can account for 30 percent of electricity used in residential buildings in the United States.[4] Time of Use programs spread this aggregated use across the customer base, which reduces peak electricity demand and lowers stress on the grid. These programs are typically designed so that customers agree to not run a large appliance, such as a dishwasher, during peak periods in exchange for a discount on their utility bill.

Time of Use programs that are focused on large appliances (refrigerators, washers, dryers, and dishwashers) are particularly beneficial to consumers since altering their time of use will not significantly affect the comfort of the indoor environment. This is in contrast to demand response programs that target heating and cooling, which may have indoor comfort impacts.[5] Additionally, appliance-based programs can use price signals to incentivize customers to participate, which can lower customer rates.[6] Furthermore, as more utilities begin offering time-of-use rates, utilities can create education campaigns to aid customer understanding of how use of specific appliance affects their bills, and to help customers manage their energy costs. These education campaigns should also address consumer qualms about shifting washer and dryer usage into the middle of the night or adjusting refrigerator temperature.

Currently, regulators and program designers often use a loadshape estimate for each appliance that is derived from a single normalized daily use profile. This means that the appliance loadshape is the same for each day of the year.[7] This is problematic because many factors influence the use profile of an appliance or a building. These factors include whether it is a workday or weekend, the number of occupants in the home, climate, and whether

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[3] Mims Frick, Natalie, Wilson, Eric J, Reyna, Janet, Parker, Andrew S, Present, Elaina K, Kim, Janghyun, Hong, Tianzhen, Li, Han, & Eckman, Tom. End-Use Load Profiles for the U.S. Building Stock: Market Needs, Use Cases, and Data Gaps. United States. https://doi.org/10.2172/1576489.
[4] Cetin, K.S., P.C. Tanares-Velasco, and A. Novoselac, Appliance Daily Energy use in New Residential Buildings, Energy and Buildings 84, 2014, 716-726, at 716.
[5] Appliance Daily Energy use in New Residential Buildings, at 716.
[6] End-Use Load Profiles for the U.S. Building Stock: Market Needs, Use Cases, and Data Gaps, at 10.
[7] Appliance Daily Energy use in New Residential Buildings, at 723.

individuals work from home or commute.[8] More equipment-specific loadshapes can provide hourly profiles of kW and kWh savings and be helpful in constructing savings loadshapes that show individual and net effects of efficient controlled appliance usage profiles as compared to the baseline. This data will help improve current programs offerings and help identify gaps or new programs that could help manage peak energy usage.

Policy Highlight: Cost-Benefit Test

Many state climate and decarbonization plans include electrification policies that seek to convert to a more electric grid and utilize cost-effective, flexible resources. Energy efficiency planning will likely serve as the key mechanism to regulate this grid transition. Therefore, now is the time to examine how to properly evaluate and account for benefits that come from programs that can reduce and shift energy usage, whether it be on an hourly, daily, seasonal, or annual basis, and incorporate more clean energy resources.

EULPs can help not only in designing energy efficiency programs but also in updating a state's cost-benefit test used for these programs. Without EULPs, the costs and benefits of energy efficiency programs are not clear because the metrics being used are not particularly granular. For example, a cost-benefit test that evaluates a program that shifts load is unlikely to account for the actual impacts of changing energy use to lower peak demand. Additionally, these tests do not adjust to account for the different energy resources and how they interact on the grid. Studies from the National Resource Defense Council have shown that when program administrators and implementers correctly prioritize energy efficiency measures, states can see three times the amount of benefits through lower electric rates and less carbon emissions.[9]

Regulators should consider a new metric that broadens program administrator and implementer focus from lowering annual energy use to cost effectively attaining energy efficiency that best meets the whole energy system's needs and policy goals. This metric will be able to identify costs and benefits of programs that seek to reduce peak demand and utilize storage or off-grid resources. These include more broadly used programs like time-of-use rates and smart devices, as well as programs that seek to integrate more demand response resources, such as grid interactive buildings and micro grids.

The Natural Resources Defense Council in California has proposed such a metric, total lifetime benefits (TLB), in its work at the California Public Utilities Commission (CA PUC).[10] The TLB metric is a dollar value that calculates savings through utilizing the loadshape of an energy efficiency resource and identifying the hourly values based on energy, capacity, and GHG compliance costs.[11] To determine the TLB of an energy efficiency portfolio, implementers would identify total energy efficiency resources and input them into the avoided cost calculator,[12] which is a California-specific tool that is able to calculate the economic value of an energy system and related policy benefits on an hourly basis. For example, when the calculator determines that there is a period of time where the electric grid is short on capacity, then the value of the energy efficient resource to be deployed at that time will increase.[13] Using this granular data will identify when there are gaps in program deployment and

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[8] Appliance Daily Energy use in New Residential Buildings, 722.
[9] Natural Resources Defense Council, , Using the Total Economic Value of Benefits to Set Resource Energy Efficiency Goals, November 14, 2013, CA PUC Rulemaking, 13-11-005, page 2-3, available at https://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=339544779.
[10] Using the Total Economic Value of Benefits to Set Resource Energy Efficiency Goals, page 6.
[11] Using the Total Economic Value of Benefits to Set Resource Energy Efficiency Goals, 6.
[12]Energy+Environmental Economics, Avoided Costs Calculator for Distributed Energy Resources, available at https://www.ethree.com/public_proceedings/energy-efficiency-calculator/
[13] Ibid.

encourage program administrators to design programs that target those gaps, thereby ensuring that energy efficiency fulfills identified capacity needs. The CA PUC has adopted this metric for its next round of programs with the nomenclature total system benefit (TSB) metric.

Future Research Needs for Energy Efficiency Planning

After reviewing energy efficiency planning policies and loadshape studies from states in the Northeast region, two areas of further research stand out to help evolving energy efficiency planning:

1. Loadshape data that provides more granular information about the use of appliances in energy efficiency planning.
2. Loadshape data that can be used in jurisdiction-specific cost-benefit tests to align energy efficiency planning with decarbonization policy.

Loadshape data that provides more granular information about the use of appliances in energy efficiency planning

In September 2021, the national EULP study will result in publicly-available modeled aggregate profiles that represent the EULP in one or more customer segments in a utility territory or region, as well as modeled individual profiles to represent real building patterns with normal spikes and variability between individual buildings (such as occupancy and use). These loadshapes can help identify more granular use patterns among utility territory and certain residential sectors which can aid in program design. While this provides more granular data for energy efficiency planning, data on specific appliances could improve program delivery models and results.

Loadshape data that provides more granular information about the use of appliances in energy efficiency planning can help to improve current efficiency programs and will also aid future energy efficiency planning as program administrators not only look at ***how*** to reduce usage but also ***when*** it is more important to reduce usage. As new distributed energy resources like smart devices or appliances, electric vehicle charging, and battery storage come online, energy efficiency planning must look at how all of these technologies can efficiently work together.

A few states in the Northeast region have started to establish more granular loadshape profiles for appliances and attempted to disaggregate energy use within the state.

- Massachusetts has studied and published a year-by-year residential baseline comparison in the Three-Year Massachusetts Residential Baseline study. This allows for a statewide side-by-side breakdown of residential energy usage by appliance. With this data, utilities, program administrators, and state policymakers can make more informed decisions about how to change energy usage in the state.
- In 2019, Vermont released the Vermont Energy Efficiency Market Potential Study. The study assessed the energy efficiency potential associated with the state's three designated energy efficiency utilities for a period of 20 years (2021–2040). The study utilized data compiled from metering studies, EM&V, and engineering algorithms to further disaggregate energy intensities into more granular end uses and technologies. Utilizing pre-existing data sets, the study disaggregated industrial and commercial uses and residential uses across the state.

Loadshape data that can be used in jurisdiction-specific cost-benefit tests to align energy efficiency planning with decarbonization policy.

The national EULP study will result publicly-available modeled aggregate profiles that represent the end use load profiles for buildings in one or more customer segments in a utility territory or region, as well as modeled individual profiles to represent real building patterns with normal spikes and variability between individual buildings (such as occupancy and use). By aggregating these building loadshapes, energy efficiency planners can calculate a more accurate cost of energy based on ***when*** and ***how*** energy is used. The national EULP study is focused only on baseline consumption loadshapes; there is a need for savings loadshapes for energy efficiency and beneficial electrification measures. Utilizing more detailed loadshape data can identify where energy efficiency programs would be most cost-effective and create the best long-term investment aligned with state decarbonization goals.

Implementing this data could be helpful for programs that look to use thermostats to offset peak load or to invest in battery and storage or other technology that require larger upfront investment. In Massachusetts, the 2019 Residential Wi-Fi Thermostat Direct Load Control Offering Evaluation and the 2019/20 Massachusetts Winter Thermostat Optimization Evaluation examine customer adaptation and the impact of thermostats on savings. Also, the 2019/2020 Residential Energy Storage Demand Response Demonstration Evaluation – Winter Season report evaluated solar and battery technology to determine the validity of battery response programs for reducing system peak demand and flattening the solar PV output curve for residential customers.

Further research will be needed for regulators considering a metric similar to the total system benefit (TSB).[14] Data that can provide more localized information about energy usage for a given community or utility territory will help integrate this metric into current cost-benefit tests for energy efficiency planning and ensure that they are cost-effective and location-specific. In addition to territory-based data, research that identifies loadshapes for various technologies (such as smart appliances or electric vehicle charging), loadshapes for emissions impacts relative to energy source, and loadshapes for distributed energy resources that will be coming online will be valuable.

In the Northeast, states have only begun to account for carbon emissions. Massachusetts' new law requires each three-year MassSave plan to report actual achieved emissions reductions. Reporting this type of information can be valuable to help develop a way to measure GHG emissions if a state were to use a TSB or similar metric that looks at granular emissions data.[15]

EULPs for Transmission and Distribution (T&D) Planning with Distributed Energy Resources

The groundswell of beneficial electrification and strategic electrification policies in the Northeast region will require a shift in resource planning practices to using more granular data and innovative resource planning practices. Part of the decarbonization process will include modernizing the electrical grid to account for

[14] CA, Public Utilities Commission, Administrative Law Judge's Ruling Inviting Comments on Draft Potential and Goals Study, April 23, 2021, Rulemaking 13-11-05. https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M378/K738/378738180.PDF.

[15] Massachusetts, S9 Creating a next-generation roadmap for Massachusetts climate policy, https://malegislature.gov/Bills/192/S9.

challenges from the growth of peak electricity demand, the increase in renewable and distributed electricity generation, and the degradation of transmission and distribution (T&D) infrastructure.

Unlike current transmission and distribution planning, where supply side resources are limited to a few resource types, energy efficiency and distributed energy resources take many different forms—including energy efficiency, demand response, solar photovoltaics (PV), electric vehicles (EVs), and battery storage. As distributed energy resources come online, resource planners must have the ability to evaluate them as grid resources and integrate them into transmission and distribution planning on the same level as electricity generation from a power plant. Loadshapes will be valuable in providing foundational data that will help guide these new aspects to energy system and T&D planning.

As programs evolve to align with decarbonization goals, it will be valuable for regulators, program implementers, and operators to know how much demand can be expected on a more granular level than current forecasting practices can predict. Integrating EULPs into system and transmission and distribution planning can allow for a cost-effective portfolio of energy resources on the local, state, or regional level that best meets a state's complete energy system needs and policy goals.

The following policy highlight sections will look into how further research could be helpful with integrating distributed energy resources, such as grid interactive buildings, into transmission and distribution planning, as well as using EULPs to optimize long-term transmission and distribution planning, such as non-wires alternatives (NWA) and non-pipes alternatives (NPA) proposals.

Policy Highlight: Grid Interactive Efficient Buildings (GEBs)

Grid interactive efficient buildings (GEBs) are buildings which operate dynamically with the grid to make electricity more affordable and integrate distributed energy resources (DERs) while meeting the needs of building occupants.[16] A GEB may combine elements of energy efficiency programs, demand response programs, solar energy generation, and battery storage. GEBs are important to decarbonization policy since they provide demand flexibility benefits to the grid and, similar to how energy efficiency and demand response programs now operate, can be compensated for performance to help with grid optimization.[17]

The Rocky Mountain Institute (RMI) estimates that demand flexibility available in buildings has the capability to reduce peak energy demand by eight percent in the United States, avoiding an estimated $9 billion a year in utility capital investments. RMI also estimates that flexible buildings can supply an additional $4 billion per year in value to the electric grid through load shifting and providing energy services back to the grid.[18]

While buildings are a major source of carbon emissions, not many state climate plans consider implementing policies that would bring GEBs or net-zero buildings online. So far, only Massachusetts, Maine, and Vermont have identified it as a potential grid reduction policy in their climate plans. This could be because regulatory barriers exist that potentially deter investment in these programs. Current data used in transmission and distribution planning practices cannot measure the benefits provided by the independent load flexibility of

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[16] Northeast Energy Efficiency Partnerships, Grid-Interactive Efficiency Buildings (GEBs) Tri-Region Status Report, January 2020, page 4, available at https://neep.org/sites/default/files/resources/NEEP%20GEBs%20Report_Final.pdf.

[17] NSPM, Chapter 11 Multiple On-Site DERs, 11-8, available at https://www.nationalenergyscreeningproject.org/wp-content/uploads/2020/08/NSPM-DERs_08-24-2020.pdf.

[18] Dyson, Mark, James Mandel, et al. "The Economics of Demand Flexibility: How "flexiwatts" create quantifiable value for customers and the grid." Rocky Mountain Institute, August 2015.

GEBs.[19] For example, the National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources (NSPM for DERs) identifies that the benefits and costs of GEBs will depend on factors like DERs employed within the building or home, size and layout of the building, operational patterns, and existing building capabilities. As states look to use GEBs, loadshapes can be used to help plan and manage this technology's interaction with other parts of the grid.

Policy Highlight: Non-Wires (NWA) and Non-Pipes (NPA) Transmission Planning

Integrated resource planning (IRP) is an additional policy area in which loadshape data is important, especially when considering non-wire alternatives (NWA) or non-pipes alternatives (NPA). IRPs consider all energy resources to determine what is needed to serve customer energy demands and meet state policy goals. To better evaluate the cost effectiveness of these programs and incorporate distributed energy resources, regulators need tools that enable to them identify and change ***when*** and ***how*** energy is used and generated.

As states move to a decarbonized grid, NWA and NPA are important regulatory decisions because they seek to optimize the use of renewable and efficient resources to alleviate need to build new supply side resources and avoid costly transmission and distribution upgrades.[20] Additionally, these proceedings examine issues related to grid resiliency and independence. Yet, current planning practices tend to undervalue energy efficiency and other distributed energy resources because they do not fairly compare them with other resource options.

To change this framework, regulators must ensure that transmission planning recognizes the benefits of and accounts for the economic value of ***all*** energy system needs and related policy objectives that a particular resource provides, such as reducing carbon emissions or lowering peak usage.[21] Shifting this framework can allow regulators and energy providers, such as utilities, to rely less on more expensive supply side resources, which avoids costly transmission and distribution system upgrades.

This new framework for transition and distribution planning requires innovative resource planning and a focus on the most effective way to acquire the most energy system benefits for each dollar spent.[22] To implement such a framework, regulators should consider adopting a metric that is able to identify not just how to ensure adequate energy to meet peak demand, but also how to invest in infrastructure that fulfills all of the energy system's needs and meets state policy goals. This metric would operate similarly to the total lifetime benefits (TLB) metric described above, but would be applied in transmission and distribution planning dockets to better capture non-energy impacts of energy generation and identify and incorporate distributed energy resource.

The TLB is a dollar value that calculates savings through utilizing the loadshape of an energy efficiency resource and identifying the hourly values based on energy, capacity, and GHG compliance costs.[23] A metric that estimates the total lifetime benefits of a transmission and distribution plan would consider the total available resources on the grid (including distributed energy resources) and related policy costs and benefits to calculate the economic value of energy system and related policy benefits on an hourly basis.

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[19] Northeast Energy Efficiency Partnerships, Grid-Interactive Efficiency Buildings (GEBs) Tri-Region Status Report, January 2020, page 9, available at https://neep.org/sites/default/files/resources/NEEP%20GEBs%20Report_Final.pdf.

[20] Natural Resources Defense Council, restructuring Portfolios to Bring out the Best in Energy Efficiency, November 14, 2013, CA PUC Rulemaking, 13-11-005, available at https://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=339544779.

[21] Designing Cost-Effectiveness Tests for Demand Side Management Programs, page 2.

[22] Designing Cost-Effectiveness Tests for Demand Side Management Programs, page 6.

[23] Using the Total Economic Value of Benefits to Set Resource Energy Efficiency Goals, 6.

Future Research Needs for Transmission and Distribution Planning with DERs

After reviewing transmission and distribution plans and decarbonization policies from states in the Northeast region, two areas of further research stand out to help evolving transmission and distribution planning:

1. Loadshapes for distributed energy resources that will incorporate more flexible grid technology into current transmission and distribution planning.
2. Loadshapes to better inform long term transmission and distribution planning including non-wires and non-pipes, and creation of a total lifetime benefit metric for grid planning.

Loadshapes for distributed energy resources that will incorporate more flexible grid technology into current transmission and distribution planning

In September 2021, the national EULP study will result in publicly-available modeled aggregate profiles that represent the EULP in one or more customer segments in a utility territory or region. This data can be incorporated into transmission planning to provide more granular detail on energy need, but additional studies are needed to identify loadshapes that can account for various distributed energy resources and how they are able to interplay with energy need and provide more flexible demand.

In the Northeast, many states have identified distributed energy resources, such as renewable energy, energy storage, and other initiatives in their climate plans, but many of these policies are still in early planning stages and have yet to be enacted. Below are some initiatives that have been implemented through energy efficiency programs:

- SmartCharge Electric Vehicle Program Impact Evaluation: This report describes the results and findings from an impact evaluation of Con Edison's 2018 SmartCharge NY program, which was designed to reduce electric vehicle (EV) charging during Con Edison's peak period. This evaluation focuses on the private vehicle portion of the program, which uses a FleetCarma C2 device to record program participant EV charging events. The impact evaluation calculated peak demand reductions attributable to the program for two peak periods: the NYISO peak period and the Con Edison summer weekday peak period.
- In 2019, Rhode Island released the 2017 Residential Wi-Fi Thermostat DR Evaluation. This evaluation found that National Grid's ConnectedSolutions demonstration project, which tests controllable thermostats as a demand reduction technology (testing various thermostat models from multiple thermostat vendors), was successful in demand reduction and customer acceptance.
- New Hampshire has a limited number of metering studies. In 2020, the state released a demand reduction study utilizing battery meter data, Cross-State C&I Active Demand Reduction Initiative Summer 2019 Evaluation Report, which examined the impacts of battery storage to reduce demand on the ISO-NE Forward Capacity Market. New Hampshire is recognizing the importance of collecting metering data to help evaluate tools to create a more flexible grid.

Loadshapes to better inform long term transmission and distribution planning including non-wires and non-pipes, and creation of a total lifetime benefit metric for grid planning.

The national loadshape study will provide modeled aggregate profiles that represent the EULP in one or more customer segments in a utility territory or region. This data can be incorporated into transmission planning to provide more granular detail on energy need. Because the national EULP study is only focused on baseline consumption loadshapes, there is still a need for savings loadshapes for energy efficiency, beneficial electrification, and demand flexibility measures. This can be helpful in current transmission and distribution planning to verify if there is need for infrastructure buildout by looking at energy usage at the building level within territories on a much more granular level.

Most Northeast states reference decentralizing their energy grid in climate plans with the intention of changing the grid's structure so that it is able to use energy from multiple, decentralized sources. Some of the policies highlighted in climate plans include distributed energy resources such as micro-grids or scaling renewable energy. These policies will require transmission and distribution plans to both establish need and compare demand energy resources on equal footing to current infrastructure investment in light of policy goals. Therefore, additional loadshape research is needed to create loadshapes for distributed energy resources, as well as to allow for comparisons of the non-energy impacts of various sources of generation.

New York and Massachusetts have taken initial steps in this area. These states have initiated proceedings to change how they evaluate transmission and distribution planning. While these are both in the natural gas space, the proceedings will look to find new ways to evaluate the costs and benefits of distributed resources and their potential to offer a better form of investment.

- In June 2020, the Massachusetts Office of the Attorney General requested an investigation into the impact of continuing natural gas distribution practices, in light of the legally binding statewide limit of net-zero greenhouse gas emissions by 2050.[24] As a result, the Massachusetts Department of Public Utilities has opened an inquiry to examine the role of gas local distribution companies (LDCs) in helping the state achieve its 2050 climate goals. Specifically, it "requires the Department to consider new policies and structures that would protect ratepayers as the Commonwealth reduces its reliance on natural gas, and it may require LDCs to make significant changes to their planning processes and business models."[25] Proposals from each LDC are due March 1, 2022.
- The New York Public Service Commission initiated a docket to establish "a proposal for a modernized gas planning process that is comprehensive, suited to forward-looking system and policy needs, designed to minimize total lifetime costs, and inclusive of stakeholders." Staff issued a draft proposal in February 2021[26] that presented a non-pipeline alternatives (NPAs) frame for alternative solutions to tradition natural gas infrastructure. Part of this proposal includes an avoided cost of gas (ACG) "best practices" working group that will assist in calculating an ACG for energy efficiency and other purposes.

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[24] Petition of the Office of Attorney General, Requiring an Investigation into the impact on the continuing business operations of local gas distribution companies as the Commonwealth achieves its target 2050 climate goals, June 2020, DPU 20-80, available at https://eeaonline.eea.state.ma.us/DPU/FileRoom//dockets/get/?number=20-80&edit=false

[25]Investigation by the Department of Public Utilities on its own Motion into the role of gas local distribution companies as the Commonwealth achieves its target 2050 climate goals ,D.P.U. 20-80, October 2020, https://eeaonline.eea.state.ma.us/DPU/FileRoom//dockets/get/?number=20-80&edit=false

[26] CASE 20-G-0131 - Proceeding on Motion of the Commission in Regard to Gas Planning Procedures, Staff Gas System Planning Process Proposal (Feb. 12, 2021), available at: http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={89D286C6-CAB7-4D3B-8BE9-4B73ED09BECE}.

EULP Data Sharing Policies and Practices

As highlighted in this report, end use load profile data is valuable for both 1) energy efficiency program planning and evaluation, and 2) transmission and distribution planning, particularly as state energy plans and policies increasingly focus on decarbonization. Actually obtaining EULP data for these purposes, however, can be difficult. This is because EULP studies are very costly to conduct and may not fit into program planning and/or program evaluation budgets. As an alternative to conducting their own EULP studies, states and program administrators may seek to obtain EULP data from other entities through data sharing arrangements. Data sharing, however, can become difficult because EULP data is typically tied to sensitive information, which leads to limits on access. These limits are motivated by the recognition that energy consumers have a legitimate privacy interest in the disclosure and use of their energy consumption data. Releasing data to third parties raises security and privacy concerns regarding potential breach of confidentiality, unauthorized disclosure, and use beyond the intended purpose of data sharing. EULP data, therefore, is not commonly shared across program administrators and jurisdictions.

As part of the regional EULP project, NEEP has helped facilitate the sharing of data from state agencies and program administrators in the NEEP region to NREL and LBNL for use in the national EULP study. This included convening a teleconference of energy program evaluation staff, advisors to Massachusetts utilities, NYSERDA staff, NREL, and U.S. DOE staff in September 2019 to identify and explore the availability of commercial and residential efficiency program loadshape data sources. NEEP also provided names of studies and associated contacts to NREL in 2019 and 2020 as an outcome of this regional outreach and research. Furthermore, NEEP engaged in an extensive research effort to catalog relevant energy efficiency program evaluation studies in order to develop its Regional End Use Load Profile Data Inventory and Needs Assessment report and update the Repository of Evaluation studies. The COVID-19 pandemic forced multiple regional projects into a delay, which caused further data facilitation to be put on hold.

The following sections focus on data sharing barriers and best practice guidelines to facilitate EULP data sharing, and highlight states that are enacting policies to provide for more public access to energy data. While the energy data being shared is not always EULP data, these state-level data sharing efforts are illustrative of an overall recognition of the value of and push towards greater access to energy data. The final section discusses the potential formation of a regional working group that would facilitate discussion between states to create ways to share valuable energy and EULP data.

Data Sharing Barriers and Best Practice Guidelines

The Sharing Load Profile Data: Best Practices and Examples report that was completed in May 2020 outlines two key barriers to sharing EULP data and best practice guidelines for overcoming those barriers. The two key barriers and associated best practice guidelines to overcome those barriers are:

1. ***Barrier = Applicability***: The first barrier to data sharing is when data available for sharing is not applicable to the data application of interest. In these cases, attributes of the source data are not aligned with attributes of the information required by the user in a specific application. User needs and source data attributes must be aligned.
    a. ***Best Practice Guidelines*** to overcome the applicability barrier:

i. **Select the measure or end use categories**. Decide which measures or end-use equipment category load profiles to produce.
ii. **Define required load profile parameters and compliance standards**. A load profile parameter is a measurable characteristic of the 8760 annual hourly load profile values. It can typically be expressed as the sum or average of a defined subset of the annual values, e.g. seasonal peak load coincidence factor (CF), annual equivalent full load hours (EFLH), or seasonal on/off-peak energy period per cent of EFLH.
iii. **Define measurement boundary**. EULP data are derived from separate measurements of the operation of a subset of energy-consuming equipment at each site. It is important to accommodate different source data needs of program administrators. Programmatic differences in measure categorization and corresponding differences in prescribed savings calculations (as set out in technical reference manuals) have implications for data collection protocols employed at each site.
iv. **Specify normalization variables**. Normalization of EULP data is a critical attribute of source data that enables general applicability to a range of use cases. In energy efficiency applications, EULPs are often normalized on the basis of connected kW or nominal equipment capacity, such as tons of cooling or controlled horsepower of a motor control.
v. **Specify level of site aggregation and segmentation**. The cost savings from data sharing relies on pooling sample data across different customer populations to form aggregate estimates that are applicable to each constituent population.
vi. **Create a flexible user interface for end use load profile data**. Each EULP contains all consumption data required to calculate any load profile parameter that is required for a specific application. A user interface is required to automatically perform appropriate calculations for a set of default parameters. It is also important to provide flexibility to calculate user-defined parameters required by another application. The interface must also enable users to specify appropriate population weights to customer segments in order to minimize aggregation bias
vii. **Explore opportunities to leverage secondary data**. Primary data collection efforts from program administrators must comply with accepted protocols and standards of practice adopted for measurement and verification (M&V) of energy efficiency measure savings. End-use monitoring data collected as part of program impact evaluations are a potential source of usable site data that can supplement, or in some cases defer, new primary data collection activities.

2. ***Barrier = Access***: The second barrier to data sharing is difficulty gaining access to the applicable source data. Access to customer-specific energy usage data is generally restricted, especially if the source data includes personally identifiable information, i.e. names, addresses, and other data that can be used to determine customer identity.
    a. ***Best Practice Guidelines*** to overcoming the access barrier:
        i. Service providers should inform customers regarding its privacy and data security policies and practices.

ii. Give customers complete access to their own data.
iii. Provide customers with ability to grant and revoke third-party access to their data.
iv. Require prior customer consent for data disclosure to a third party.
v. Secure customer data against unauthorized access.
vi. Adopt a standardized data exchange protocol for the authorized transfer of customer energy usage data from service providers to third parties.
vii. Execute a contractual agreement to binding terms of use between service providers and third parties seeking access to customer data, including registration with the service provider.
viii. Enable third-party access to customer data without prior consent only if the shared data set cannot be used to reveal identities of individual customers.

EULP data sharing is affected by both the applicability and access barriers. The following section focuses on data sharing policies and practices that address the data access barrier.

Examples of Data Sharing Policies and Practices

Despite the challenges associated with data sharing, recent developments at the national and state levels are signaling that data sharing is growing in importance, enough to warrant the effort and innovation required to make it happen. Examples of data sharing efforts are highlighted in NEEP's *Emerging Regulatory Support for Data Access and Sharing* section of the Sharing Load Profile Data: Best Practices and Examples report. The following recent data sharing efforts in California and the NEEP region provide additional examples of overall recognition of the value of energy data and the push towards greater data access.

California has been a national leader in developing energy data sharing and access policies. In 2011, the California Public Utilities Commission adopted rules protecting the privacy and security of customer electric usage data generated by smart meters and transmitted by the smart grid. One of California's largest utilities, Pacific Gas and Electric (PG&E), which provides electricity and natural gas to over five million customers, has developed a web-based Energy Data Hub that is easily accessible and allows customers to access their energy usage data and/or share it with a third party.

The PG&E Energy Data Hub includes a user-friendly Summary of Data Access Programs document that outlines 10 PG&E data access tools. This summary provides information about each tool including eligible requestors, relevant customer segments, types of available data (i.e. meter, billing, and/or real-time usage) and latency, number of years, and number of service agreements required. It also provides information about intended audience for the tool. For example, customers who want to monitor energy of each load in their home in order to start conserving could use the Stream My Data tool, while large C&I customers enrolled in a demand response program who want to download their interval data and graphs could use the InterAct tool. This clear and transparent view of PG&E data sharing programs translates the complex data sharing environment into easily understandable and accessible tools. PG&E's approach to data sharing follows the best practice guidelines outlined in NEEP's Sharing Load Profile Data: Best Practices and Examples report.

States in the NEEP region are also engaging in new or expanded data sharing efforts. For example, **New York** is providing greater access to energy data. In 2020, the New York Public Service Commission (NY PSC) initiated a proceeding to address strategic use of energy-related data. Last month, the NY PSC issued an order as an outcome of this proceeding: Adopting a Data Access Framework and Establishing Further Process. New York's new energy data framework is intended to provide for safe and fair access to and appropriate use of energy related data that will help New York achieve its aggressive energy goals, including economy-wide carbon neutrality. The framework will be the sole source of statewide data access requirements and will collect, integrate, analyze, and manage energy-related information from New York's electric and gas utilities and other sources. Under the new framework, energy data users, including energy companies and consumers, will be able to use queries to filter, aggregate, and analyze data of interest. New York's new centralized data structure will also benefit ratepayers and streamline the data reporting practices of New York utilities.

Massachusetts also has a variety of energy data resources under development, including a new Residential Customer Profile online dashboard, city/town information on MassSave data, and a municipal partnership mapping tool. Massachusetts program administrators recently held a public webinar to provide information about these data resources.

The Customer Profile Dashboard uses the Veracity by DNV data platform to provide information about customer energy usage, program participation, savings, and incentives. It also allows for targeted geographical analysis by providing data at the census block level. The dashboard provides data visualizations that uphold customer confidentiality rules. The municipal partnership mapping tool will overlay demographics with a geographic display of program participation. This data can be used to help redistribute programs in a way to better serve communities and demographic groups that haven't been adequately targeted. The MassSave city/town information can be used to help towns track their greenhouse gas (GHG) emissions reductions and progress toward climate action plan goals.

Maine is also focusing on increased access to customer energy data. This month, a bill (H.P. 1237) was introduced to the Maine legislature to require the Maine Public Utilities Commission to establish a statewide online energy data platform to provide electric and natural gas customers with access to their energy usage information, while still protecting customer privacy. NEEP will be tracking this bill's progress through its Legislative Tracker.

Formation of EULP Data Sharing and Implementation Working Group

As a next step to efficient and effective use and implementation of EULP data in energy efficiency program planning and transmission and distribution planning, states in the NEEP region may consider forming a EULP data sharing and implementation working group. This group could include members of the Northeast EULP project's regional advisory committee, as well as other regional stakeholders with an interest in more extensive use of EULP data in energy efficiency program planning and T&D system planning.

The working group could serve as a vehicle to help navigate the thorny issues associated with sharing energy data and to develop and facilitate methods for EULP data sharing across jurisdictions and entities. Currently, there is very limited cross-jurisdiction sharing and use of metering and EULP data that is produced through energy efficiency evaluation studies. Typically, energy efficiency program evaluation reports that are publicly available are often summary reports, while underlying data is not available due to privacy or other data sharing constraints. The working group could discuss possible methods for greater access to and use of this underlying data, drawing on lessons learned from energy data sharing efforts highlighted above. Potential future activities for this working group could also include joint EULP studies that leverage funding from a group of jurisdictions and development of a EULP data sharing platform.

Conclusion

As states continue to adopt and pursue decarbonization goals, access to and analysis of EULP and other energy data will be critical to help chart our path towards a decarbonized grid. Detailed energy data can provide a better understanding of the value of energy efficiency, demand response, and other distributed resources, and can also help with demand side resource program planning, grid planning, and energy forecasting efforts.

This report identified two areas for priority EULP research, building upon the data that will be available from: 1) the national EULP study, 2) existing and planned energy efficiency EM&V studies in the Northeast region, and 3) state decarbonization and climate goals:

- Integrating EULP data into energy efficiency programs to align program design and EM&V with decarbonization policies.
- Integrating EULP data into transmission and distribution planning to better understand and account for distributed energy resources.

More fully integrating EULP data into the energy efficiency program planning process and T&D planning will be easier and more cost-effective if stakeholders are able to share this data. Recent efforts to promote and facilitate energy data sharing in the NEEP region and across the country demonstrate that it’s possible to overcome data sharing barriers. Forming a regional EULP data sharing and implementation working group is one possible way to help the region integrate EULP data into planning efforts and support the shift to a decarbonized grid.