Near-Term Rate Strategy Recommendations

Accompanying Recommendations to Near-Term Rate Strategy Report

December 2024

Massachusetts Interagency Rates Working Group

A Collaboration to Advance Near- and Long-Term Rate Design and Ratemaking that Aligns with the Commonwealth's Decarbonization Goals

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Executive Summary

The **Interagency Rates Working Group (Working Group)**, which includes representatives from the Executive Office of Energy & Environmental Affairs, the Department of Energy Resources, the Massachusetts Clean Energy Center, and the Attorney General's Office, was formed to advance near- and long-term electric rate design and ratemaking that aligns with the Commonwealth's decarbonization mandates.

The Working Group, supported by Energy & Environmental Economics, Inc., explored barriers and opportunities for electric rates to support the energy transition. Electric rate design and ratemaking must prioritize affordability, such that no resident experiences undue energy burden (energy burden is defined here as the percent of income spent on energy bills), alongside the reduction of the barriers to transportation and building electrification to facilitate the clean energy transition. The objective of the **Near-Term Rate Strategy Report** is to identify rate designs that better support the adoption of electrification in Massachusetts in the near-term, or prior to the widespread deployment of advanced metering infrastructure (AMI) meters that will enable additional, more advanced electric rates. The Working Group has thus far focused on residential electric rates.

Summary of Recommendations

The Working Group prepared these recommendations following the development of the Near-Term Rate Strategy Report and robust stakeholder engagement. The recommendations are focused on potential rate designs that would enable Massachusetts' households to make cost-effective electrification choices that support and advance the Commonwealth's climate and clean energy goals. The **Near-Term Rate Strategy Recommendations** focus on the following areas: rate structure; marketing, education, and outreach; monitoring and evaluation; complementary programs and policies; and implementation. Specifically, the Working Group recommends that:

- All electric distribution companies (EDCs) offer an optional, seasonal heat pump rate, with differentiated volumetric rates to reduce energy burden for customers transitioning from gas heating to electric heat pumps;
- The Commonwealth further considers an additional non-bypassable fixed charge, exercised in a targeted manner to include specific policy or public benefits programs;
- Marketing, education, and outreach efforts associated with the seasonal heat pump rate should be customer-centric, and should identify potential barriers to participation and then mitigate or remove those barriers to create an experience for customers that is easy, convenient, and as frictionless as possible;
- The Massachusetts Department of Public Utilities (DPU) and EDCs monitor and evaluate seasonal heat pump rates, including information and analysis related to enrollment and customer outcomes, in addition to changes in energy usage and bill impacts; and
- The Household Energy Expenditure Model (HEEM), as described in the Near-Term Rate Strategy Report section below, or similar form of granular rate impact analysis, that considers energy cost impacts on a variety of Massachusetts' households, be developed and used as an instructive tool for the DPU and EDCs to analyze rate impacts in the future.

Introduction

The **Interagency Rates Working Group (Working Group, or IRWG)** was formed to advance near- and long-term electric rate design and ratemaking that aligns with the Commonwealth's decarbonization mandates. The Working Group includes representatives from the Executive Office of Energy & Environmental Affairs (EEA), the Department of Energy Resources (DOER), the Massachusetts Clean Energy Center (MassCEC), and the Attorney General's Office (AGO).

Goals and Objectives of the Working Group

The **Massachusetts Clean Energy and Climate Plan (CECP)**[1] identifies electrification as a core strategy to reduce greenhouse gas (GHG) emissions in the building and transportation sectors. The Commonwealth has identified existing electricity rates as a barrier to widespread electrification and achieving the Commonwealth's decarbonization mandates.[2] The **Massachusetts Commission on Clean Heat Final Report** provided several recommendations related to aligning rate design with the Commonwealth's decarbonization mandates, including both near- and longer-term actions to address "the operating costs barrier to adoption of clean heating technologies."[3] Namely, the Commission on Clean Heat recommended that EEA "pursue opportunities to defray electric operating cost increases in the near-term and incentivize the expanded adoption of heat pump technology, particularly for LMI [(low- and moderate-income)] households."[4] In addition, the Commission on Clean Heat identified additional research needed regarding rate design.[5] While this Working Group was not developed to address all of the Clean Heat recommendations directly, they inform the Working Group's objectives.

In addition, the Working Group explored options and engaged with stakeholders throughout the development of the rates studies and recommendations, with the objective of gathering and understanding stakeholder perspectives, and providing early information and engagement, ahead of and to help inform later process during DPU's evaluation of rate design topics and proposals.

The Working Group developed a project scope to comprehensively look at the barriers and opportunities for electric rates to support the clean energy transition. Electric rate design and ratemaking must prioritize affordability, such that no resident experiences undue energy burden (defined here as the percent of income spent on energy bills), and the reduction of the barriers to

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[1] Reference includes the Massachusetts Clean Energy and Climate Plan for 2025 and 2030 and the Massachusetts Clean Energy and Climate Plan for 2050.
[2] *Final Report of the Massachusetts Commission on Clean Heat* at 23-24.
[3] *Final Report of the Massachusetts Commission on Clean Heat* at 24.
[4] *Final Report of the Massachusetts Commission on Clean Heat* at 25.
[5] The Commission on Clean Heat recommended that "[the DPU] should initiate an evaluation of the current electricity structure and alternative rate design options to identify opportunities that can better align energy prices with the cost of service and equity goals." The Commission recommends that the DPU's investigation include opportunities to redesign/restructure current rates and offerings to more accurately reflect the cost of service for clean heat technologies and approaches to minimize additional cost burdens on low-income customers. (*Final Report of the Massachusetts Commission on Clean Heat*, November 30, 2022, at 24-26, https://www.mass.gov/info-details/commission-on-clean-heat-issues-final-report).

transportation and building electrification to facilitate the clean energy transition. The Working Group acknowledges that the upfront costs to electrify are also significant barriers to the adoption of electric vehicles (EVs) and heat pumps, and the Commonwealth must continue to pursue strategies to lower upfront costs, especially for low- and moderate-income customers. However, the recommendations discussed herein are limited to addressing the operating costs of electrification – i.e., rate design and ratemaking for residential customers. While the recommendations included herein focus on the application of rate designs for residential customers, the Working Group notes that several recommendations may also be appropriate for commercial customers facing barriers to electrification. With the support of Energy & Environmental Economics, Inc. (E3) and the review, input, and insight from stakeholders, the Working Group developed three primary products to support a set of final recommendations of the Working Group. The three primary products include:

Figure 1: Interagency Rates Working Group Deliverables

Electric Rates Asssement	Near-Term Rate Strategy Report	Long-Term Ratemaking Study
• Define the current state of electric rates in Massachusetts, describe the policy and regulatory landscape that shapes rates, and compare Massachusetts against other states' electric utilities	• Address operational cost barriers to near-term electrification through rate design offerings available before electric consumers receive AMI meters	• Present a vision and recommendations for advancing ratemaking mechanisms and rates for a decarbonized energy system and the associated technologies and capabilities available

Rate Design and Ratemaking Priorities

The Working Group developed the following rate design and ratemaking priorities, informed by several rounds of stakeholder feedback, discussed more fully below. These priorities draw from traditional rate design and ratemaking considerations, with additional specificity to support the development of rates that align with the Commonwealth's climate goals and emission reduction mandates.

Figure 2: Near- and Long-Term Rate Design and Ratemaking Priorities

Promote electrification by removing operating barriers inherent in electric rates	• Design cost-based electric rates that encourage ratepayers to electrify end-uses • Create rate design features targeted to reducing energy burden for ratepayers - while maintaining safe and healthy living conditions
Increase adoption of cost-effective distributed energy resources (DER) to advance decarbonization and electrification	• Promote DER and equitably allocate costs (e.g., the costs of interconnection, incentive programs, etc.) through rate design
Integrate distribution system planning into the utility's business-as-usual operations and investments	• Promote least-cost electric system investments that accommodate transportation and building electrification and other new loads
Promote operational efficiency to facilitate the transition of the distribution grid	• Utilize price signals to achieve effective load management, including peak demand reduction, which may defer or avoid electric system investments • Improve grid reliability, efficiency, and resiliency

Near-Term Rate Strategy Report

MassCEC retained the services of E3 to support the Working Group. E3 conducted an analysis of near-term rate strategies that would support electrification and energy affordability goals for residential customers with current electric metering technology.

The objective of the **Near-Term Rate Strategy Report** is to identify rate designs that better support the adoption of electrification in Massachusetts in the near-term, defined as the period before widespread deployment of AMI meters that would enable additional, more advanced electric rates. This includes carefully considering the energy burden of electrification for LMI consumers and prioritizing the development of solutions to address unaffordable and unsustainable levels of energy burden. We note that for some households with low energy burden, low energy bills are the result of lack of air conditioning (A/C) systems in their homes. These households should also be targeted for electrification and expansion of their cooling systems, in tandem with weatherization and other energy efficiency measures that can help mitigate increases in electricity usage and bills, which are needed to adapt to climate change.

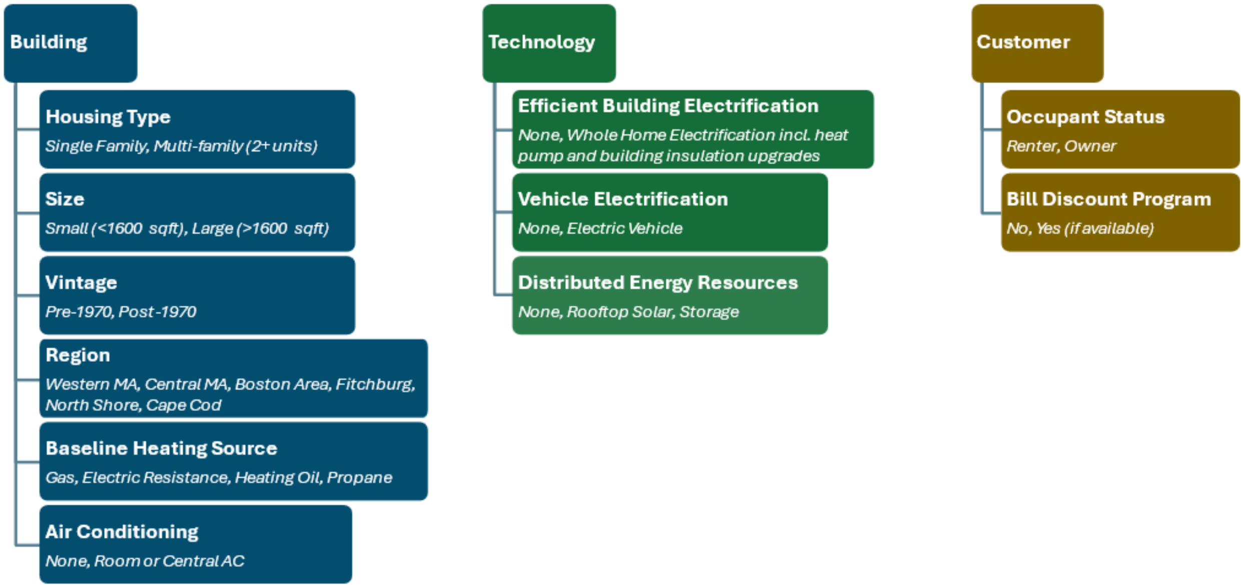
The Massachusetts Workbook of Energy Modeling Results demonstrates the required scale of decarbonization in the buildings, transportation, and electric power sectors.[6] The 2030 modeled targets consistent with sector limit GHG emission mandates include: 230,000 households with upgraded envelopes (i.e., type of weatherization); 572,000 households with heat pumps; 1,000,000 light-duty EVs; and 3.2 gigawatts (GW) of offshore wind, 8.36 GW of solar, and 2.68 GW of energy storage.

Achieving these targets will require widespread adoption of new clean energy technologies, including by individual residents. Electric rates must be designed to support residents in their adoption of electrification technologies and associated usage patterns to ensure that the transition to clean energy does not result in unaffordable and unsustainable energy burdens.

An important contribution of the Near-Term Rate Strategy Report is a novel method of providing more granular analysis of the impact of rate changes on different types of Massachusetts' households that vary in terms of their energy usage (see Figure 3). The E3 analysis included the development of a new modeling tool, called the Household Energy Expenditure Model (HEEM). HEEM uses data on Massachusetts-specific household-level characteristics and estimated load profiles to calculate energy costs for a range of household types.

[6] https://www.mass.gov/doc/massachusetts-workbook-of-energy-modeling-results/download.

Figure 3: HEEM Customer Prototypes[7]



The household characteristics considered in the analysis include type of home (single- or multi-family), size and age of a home, location (region), baseline heating fuel, presence of A/C, level of electrification technology adoption (including heat pump and building insulation upgrades, and EV), occupant status (renter or owner), and enrollment in a bill discount program. HEEM was used to calculate household energy cost and energy burden for over 9,000 different household prototypes (see Figure 3).

HEEM allows for an improved understanding of the range of energy cost experiences of Massachusetts' households during the energy transition. HEEM illustrates bill impacts beyond a basic analysis of singular circumstances based on average usage. This more granular analysis is increasingly important given that the energy transition introduces several new variables that impact energy usage, all of which are important for the DPU to consider when assessing the bill impacts of rate changes. For example, HEEM can illuminate how a rate change will differently impact a customer in a large, new, well-insulated home with heat pumps compared to a small, older vintage apartment in a multifamily building with electric resistance heating. Additional analytical methods, described in Appendix: Near-Term Rate Strategy Report Affordability Feedback for the Interagency Rates Working Group, can provide further insight into differential electric rate impacts by race, age, and other demographics.

Because new rate designs will impact different types of households in diverse ways, the Working Group recommends that the DPU and the utilities consider adopting a more advanced rate analysis method compared to the standard method that looks at bill impacts of new rates for customers with average usage. A modeling tool, such as HEEM, alongside analysis such as that described in Appendix: Near-Term Rate Strategy Report Affordability Feedback for the Interagency Rates Working

[7] *See* Appendix to E3 Near-Term Rate Strategy Report, Figure 40.

Group, could be used to analyze more granular rate impacts to diverse household types going forward.

Barriers to Electrification and Affordability with Current Rate Design

As presented in the Near-Term Rate Strategy Report, the Working Group identifies the following key barriers to electrification and affordability with current rate design. The Working Group's recommendations are focused on providing rate designs that enable Massachusetts' households to make cost-effective electrification choices that support and advance the Commonwealth's climate and clean energy goals.

Converting from Gas to Electric Heating Can Increase Energy Burden

Current electric rates can present a barrier to the adoption of electrification technologies. The impact on total household energy costs and therefore the energy burden of adopting electrification technologies depends on a household's baseline technology and the electrified alternative adopted. In Massachusetts, 54% of homes are heated by natural gas, 26% are heated by fuel oil, 13% are heated by electric resistance, and 7% are heated by other sources.[8] **A typical customer switching from natural gas, the most common heating source in Massachusetts, to air-source heat pumps, the most common electrified home heating option, will face an increase in the cost of energy.**[9] Households switching from heating oil to air-source heat pumps, as reflected in Table 1, may also experience increases in the cost of energy, driven by the price of heating oil relative to electricity rates. This presents a barrier to Massachusetts' policy goal to achieve widespread deployment of electrification technologies to reduce emissions. Without an alternative rate offering that addresses this barrier, households may be unwilling to adopt heat pump technology at a pace and scale necessary to achieve the Commonwealth's electrification targets. In fact, negative customer experience related to increased energy burden of operating a heat pump under current electric rates may further jeopardize the trajectory of the Commonwealth's clean energy policies and climate goals by deterring further investments from being made.

On the other hand, households heating via electric resistance are likely to see immediate bill savings from switching to heat pumps.[10] It is also the case that electric resistance heating is more common in low-income, multifamily housing.[11] Households converting from electric resistance to heat pumps will also see a benefit from new or increased access to efficient space cooling. Therefore, prioritizing the conversion of households that use electric resistance heating, as the Massachusetts 2025-2027

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[8] Other sources include but are not limited to propane, wood, and thermal solar. *See* accompanying E3 Near-Term Rate Design to Align with the Commonwealth's Decarbonization Goals, at 28-29. ("Near-Term Rate Strategy Report").

[9] For instance, E3 estimated that a large, multi-family home with room A/C may experience a monthly bill increase of approximately $98, or nearly 20%, when replacing gas heating with electric heat pumps (Near-Term Rate Strategy Report at Figure 16). This increase reflects a net monthly bill increase from heating electrification only, reflected in a lower gas bill alongside a higher electric bill.

[10] Near-Term Rate Strategy Report, at Figure 14.

[11] Near-Term Rate Strategy Report, at Figure 26.

Energy Efficiency and Decarbonization Plan emphasizes,[12] will advance both affordability and energy equity.

Table 1: Estimated Cost of Heat Delivered by Fuel in Winter 2024-25[13]

Fuel	Retail Cost	Cost of Heat Delivered *(Range reflects device efficiencies)*
Natural Gas		
National Grid	$2.49 per therm	$26-$31 per MMBtu
Eversource	$2.37 per therm	$25-$30 per MMBtu
Unitil	$3.32 per therm	$35-$42 per MMBtu
Electricity (Electric Resistance)		
National Grid	$0.34 per kWh	$100 per MMBtu
Eversource	$0.32 per kWh	$93 per MMBtu
Unitil	$0.45 per kWh	$132 per MMBtu
Electricity (Cold-Climate Heat Pump)		
National Grid	$0.34 per kWh	$31-$39 per MMBtu
Eversource	$0.32 per kWh	$29-$36 per MMBtu
Unitil	$0.45 per kWh	$41-$51 per MMBtu
Fuel Oil	$3.43 per gallon	$28-$31 per MMBtu
Propane	$3.33 per gallon	$43-$48 per MMBtu

Further compounding this challenge, under current conditions, **electric rates are expected to increase over the next five years, which may result in heat pumps being even more expensive compared to fossil fuel alternatives**. The base distribution charge will increase annually, consistent with the DPU-approved performance-based ratemaking adjustments for each EDC.[14] Similarly, the transmission charge is expected to increase given forecasts by the Independent System Operator of New England (ISO-NE) of the Regional Network Service (RNS) rate, which is used to calculate charges for wholesale regional transmission service in New England. The RNS rate is expected to increase 20% in 2025 and nearly 41% by 2029.[15] Additionally, electric supply rates generally reflect wholesale electricity markets predominantly driven by the price of natural gas in New England. Unpredictable gas markets and additional energy services impacting energy supply prices make it challenging to predict rate impacts from energy supply. However, because electric supply rates are still largely driven by natural gas prices, as the price of natural gas falls the electric rate necessary to reflect cost parity with gas heating will also be reduced. The Long-Term Ratemaking Study explores electricity supply costs further.

[12] Massachusetts 2025-2027 Energy Efficiency and Decarbonization Plan at 12. https://ma-eeac.org/wp-content/uploads/Exhibit-1-2025-2027-Three-Year-Plan.pdf.
[13] Near-Term Rate Strategy Report, at Table 4.
[14] *See* Orders D.P.U. 22-22 (2022), D.P.U. 23-80 (2024), and D.P.U. 23-150 (2024).
[15] https://www.iso-ne.com/static-assets/documents/100014/a05_pac_rns_rate_forecast_presentation.pdf.

Further, many costs associated with various other electric bill charges can reasonably be expected to increase between now and 2030, including charges that account for the cost of AMI, EV programs, grid modernization, provisional system planning for the interconnection of distributed generation (DG), Electric Sector Modernization Plans, long-term renewable energy contracts, net metering, distributed solar (Solar Massachusetts Renewable Target, or SMART),[16] energy efficiency programs (Mass Save), and residential bill assistance programs. Several other charges may increase electricity rates as well, such as revenue decoupling and vegetation management. These charges fluctuate depending on various factors but are generally expected to increase as the scale of the programs they support grow; recent trends in these charges can be analyzed further in the electric rates database that was developed as part of the Working Group's scope.[17]

Energy Affordability and Equity, and the Role of Rate Design

A holistic approach to addressing unaffordable and unsustainable energy burdens is necessary to advance electrification in the Commonwealth. Currently, energy efficiency, DG, and discount rates offer opportunities for participating customers to reduce their bills. Energy efficiency and DG also aim to lower the need for further investments in the electric system, reducing total system costs for all ratepayers.

However, because the programs supporting each of these efforts are funded primarily through volumetric rates,[18] energy rates are not fully reflective of the cost to provide service to customers. As a result, all customers pay higher electric rates to support these programs. At the same time, not all customers are benefitting from the programs to the same extent. For example, renters utilize Mass Save programs at low rates compared to the number of renters in the Commonwealth.[19] Similarly, customers in certain cities and towns have more successfully utilized Mass Save incentives, and these cities overall tend to have higher-income residents.[20] Stakeholders also noted challenges for renters and affordable housing associated with heating costs shifting from landlords to renters.

[16] The SMART program offers incentives for solar developers, with bonus incentives for battery storage, community solar, and low-income participation. DOER is working with stakeholders to modernize the program and plans to release a new iteration of it in 2025.

[17] *Massachusetts Electric Rates Database*, prepared by E3: https://www.mass.gov/doc/massachusetts-residential-electricity-rates-database/download.

[18] Other programs, such as utility ownership of solar generation and EV rebates, are also funded through volumetric rates.

[19] *See* Massachusetts Program Administrators, *2013-2022 Residential Non-Participant Study*, Appx. B (2024) (demonstrating a negative correlation coefficient between renter status and program participation, indicating that areas with high rates of renter occupancy participate in energy efficiency programming at lower rates than the statewide average), available at https://ma-eeac.org/wp-content/uploads/MA24X24-B-RNPS-Final-2013-2022-Residential-Nonparticipant-Study-20241016.pdf.

[20] *Id.* at 28 (showing a 35.2 percent participation gap between income-eligible and market-rate programs, 2019–2022); *id.* at Appx. C (showing participation rates by municipality across the Commonwealth); Massachusetts Program Administrators, *2013–2022 Massachusetts Residential Customer Profile Study*, at 14–15 (2023) (showing lower participation rates in environmental justice communities compared to non-environmental justice communities), available at https://ma-eeac.org/wp-content/uploads/MA23X19-B-RCPSDURB-2022-RCPS-Results-Brief.pdf. *See also* Elizbeth A. Stanton, Emrat Nur Marzan, and Sagal Alisaiad, *Accessing Energy Efficiency in Massachusetts: An Initial Review of Data*, at 3 (2018) ("Families in towns and Boston neighborhoods with median household incomes of $45,000 or less averaged 1.9 percent in savings, while the remaining towns and neighborhoods averaged 2.7 percent").

Energy affordability efforts need to recognize the impact of different bill components: while energy efficiency programs provide important ways for participating customers to reduce their consumption and, accordingly, their bill (and have enabled significant GHG emission reductions), the energy efficiency surcharge adds costs to all customers' bills. Similarly, net energy metering and SMART incentivize and support DG by providing bill credits to participants. Distributed solar generation is an important element of decarbonizing electricity in the Commonwealth, but these programs also increase customer bills because participants receive bill credits and contribute less to programs funded via volumetric rates. Energy affordability programs reduce bills for low-income customers, and costs are distributed among all customer classes through a volumetric reconciling mechanism, further increasing bills.

The DPU opened an investigation into energy burden with a focus on affordability for residential ratepayers[21] and subsequently narrowed the scope of the proceeding to further investigate tiered discount rates, recovery of revenue shortfall, arrearage management programs, disconnection protections, outreach, and enrollment and verification.[22] The member agencies of the Working Group have been and will remain partners in the work to advance energy affordability through that proceeding; the Working Group conducted the Near-Term Rate Strategy Report and prepared its accompanying recommendations to be complementary to the energy burden proceeding.

Discount rates, which provide a percent discount on the total electric bill, are an essential component supporting energy affordability, and the Working Group supports ongoing efforts to modify discount rate programs to more meaningfully address high energy burdens faced by many households in Massachusetts. For example, the DPU approved a tiered discount approach for National Grid's low-income discount rate. The Working Group commends the DPU for this decision and for prioritizing affordability. The Working Group also recognizes that further improvements to existing energy affordability programs are necessary to reduce high energy burdens for residential ratepayers, as is being further explored by the DPU.[23]

However, while increasing discounts or participation is often seen as a solution to making energy more affordable for low- and moderate-income households, relying too heavily on this approach can have unintended consequences—particularly for the state's goals of electrification and decarbonization, as it will increase the cost of electricity for all ratepayers, resulting in less customers willing to electrify. To ensure energy affordability without undermining broader policy objectives, we must extend efforts beyond rates, including by reducing upfront and operation costs, through energy efficiency initiatives (e.g., weatherization and heat pumps),[24] point of purchase rebates for EVs for income-qualified customers (including for used EVs),[25] and tax credits for electrification measures. While there are several programs and initiatives that are necessary to

[21] Notice of Inquiry by the Department of Public Utilities on its own Motion into Energy Burden with a Focus on Energy Affordability for Residential Ratepayers, D.P.U. 24-15 (2024).
[22] D.P.U. 24-15-A Interlocutory Order (2024).
[23] Id.
[24] Mass Save, https://www.masssave.com/en.
[25] Massachusetts Offers Rebates for Electric Vehicles (MOR-EV), https://mor-ev.org/.

support affordability, the Near-Term Rate Strategy Report and the accompanying recommendations is limited to addressing near-term actions specific to rate design for residential customers.

Stakeholder Engagement

Public outreach and engagement were critical inputs to the development of the underlying analysis and these recommendations. The Working Group conducted a robust stakeholder engagement strategy including technical sessions, focus groups, and public listening sessions. Throughout the process, stakeholders have also had the opportunity to send written comments to a dedicated Working Group email inbox. All written comments are available for public review on the Working Group website, and a summary of comments is available in the Appendix: Summary of Stakeholder Feedback.

The Working Group conducted the following series of stakeholder engagement events to support the development of this report:

Phase I: Framing and Scoping

The Working Group hosted a series of workshops before work began on the Near-Term Rate Strategy Report, or Study, to provide stakeholders an opportunity to provide input on framing the purpose and scope of the Study. After an initial general listening session, the Working Group held sector-specific workshops with consumer and advocacy groups, the EDCs, electricity suppliers, municipal light plants, and DG and DER organizations, to enable deeper conversation on each stakeholder group's priorities.

Stakeholder Engagements:

- Initial presentation on Purpose and Scope of Study: May 6, 2024
- Comment & Dialogue: Consumer and Advocacy Organizations: June 12, 2024
- Comment & Dialogue: Electric Distribution Companies, Municipal Light Plants, and Suppliers: June 13, 2024
- Comment & Dialogue: Distributed Energy Resources/Distributed Generation: June 18, 2024

Phase II: Near-Term Rate Strategy Review

Following the development of the Near-Term Rate Strategy Draft Results, the Working Group hosted a series of workshops to present the results of the Study to stakeholders and solicit feedback. After holding sector-specific workshops, the Working Group held a synthesis workshop to summarize comments for stakeholders and encourage cross-sector conversation.

Stakeholder Engagements:

- Initial presentation on Draft Results of the Near-Term Rates Strategy: August 12, 2024
- Comment & Dialogue: Electric Distribution Companies, Municipal Light Plants, and Suppliers: August 19, 2024
- Comment & Dialogue: Consumer and Advocacy Organizations: August 22, 2024

- Comment & Dialogue: Distributed Energy Resources/Distributed Generation: August 23, 2024
- Synthesis Workshop: September 4, 2024

The Working Group carefully considered all feedback received from stakeholders and worked to meaningfully incorporate this feedback into the scope of the Near-Term Rate Strategy Report and the Near-Term Rate Strategy Recommendations. A summary of comments is provided in the Appendix, and stakeholder feedback is highlighted throughout the recommendations below.

Phase III: Equity Analysis

In response to feedback from stakeholders, the Working Group expanded the consulting expertise on the project to add an expert on energy affordability and energy justice. Dr. Destenie Nock of Carnegie Mellon University and Peoples Energy Analytics offered expertise in how energy usage patterns and energy affordability differ by demographics such as race and age, and for other vulnerable groups. Dr. Nock provided feedback directly to E3 on the Near-Term Rate Strategy Report and on the Working Group's recommendations. In addition, Dr. Nock developed a supplemental report on how additional data and analysis could provide a more complete assessment of the impact of electric rate design and ratemaking on equity and affordability outcomes. Finally, Dr. Nock also developed a memorandum defining energy affordability, which discusses the information needed to comprehensively understand how each part of the energy system impacts electricity bill affordability. Dr. Nock's supplemental report and memorandum defining energy affordability are provided in Appendix: Near-Term Rate Strategy Report Affordability Feedback for the Interagency Rates Working Group and Appendix: Defining Energy Affordability. Dr. Nock presented her findings to stakeholders and responded to stakeholder questions and feedback.

Dr. Nock developed a set of six recommendations summarized below.

1. **Adopt a clear definition of energy affordability**. The typical application of energy burden, the percent of income spent on energy, does not consider access to reliable and sufficient energy services and energy limiting behaviors to decrease energy expenses. Dr. Nock provides a recommended definition of energy affordability in Appendix: Defining Energy Affordability.
2. **Utilize increased demographic designations in analyzing rate impacts**. Not accounting for race and age, in particular, risks an incomplete understanding of differential impacts across the population.
3. **Enhance data-driven methods to assess rate impacts and target at-risk customers**. Pairing enhanced demographic data, energy bill and/or meter data, and weather data provides a robust toolset to identify hotspots for energy affordability issues.
4. **Develop a holistic view of housing related energy burden**.
5. **Take an integrated approach to supporting at-risk customers**. Targeted and informed customer outreach can facilitate uptake of assistance programs such as rebates for energy efficiency upgrades and bill assistance for households most in need, where these programs can improve energy affordability and equity.

6. **Support the upfront costs of fuel switching**. Upfront costs of electrification for low-to-moderate income households and rental units underscore the importance of robust upfront incentives with targeted marketing, such as those offered through Mass Save.

This set of recommendations is broader than the scope of the Near-Term Strategy Report and Recommendations; however, they provide guidance on energy affordability broadly, and point out levers for improving affordability in the near- and long-term, including how future AMI data can be used to advance energy equity in the Commonwealth.

Recommendations

The Working Group prepared these recommendations following the development of the Near-Term Rate Strategy Report and robust stakeholder engagement. The following recommendations are categorized as follows: rate structure; marketing, education, and outreach (MEO); monitoring and evaluation; and complementary programs and policies.

The Working Group also aims to support the DPU as it implements its mandates to prioritize affordability, equity, and reductions in GHG emissions, in addition to safety and reliability of service.[26] This mandate extends explicitly to all decisions or actions regarding rate designs,[27] and the Working Group is attendant to this requirement in the recommendations that follow.

I. Rate Structure

The Working Group explored four rate options to reduce operating cost barriers to electrification, using the options available prior to AMI being widely available to residential customers. Following detailed analysis and feedback from stakeholders, the Working Group identified the optional, seasonal heat pump rate as providing the greatest potential benefits while balancing other rate principles and objectives. The seasonal heat pump rate supports building electrification by addressing the operating cost barrier inherent in current electric rates. Transportation electrification is equally as important, though prior to deployment of AMI, the Working Group recommends other mechanisms to further incentivize transportation electrification in the near-term in the Complementary Programs and Policies section. Most stakeholders favored an optional seasonal rate for heat pump owners as their preferred near-term rate option, expressing that this rate provides an incentive to electrify without creating unintended impacts for non-electrifying customers or distributed energy resource owners.

Deploy an Optional Seasonal Heat Pump Rate

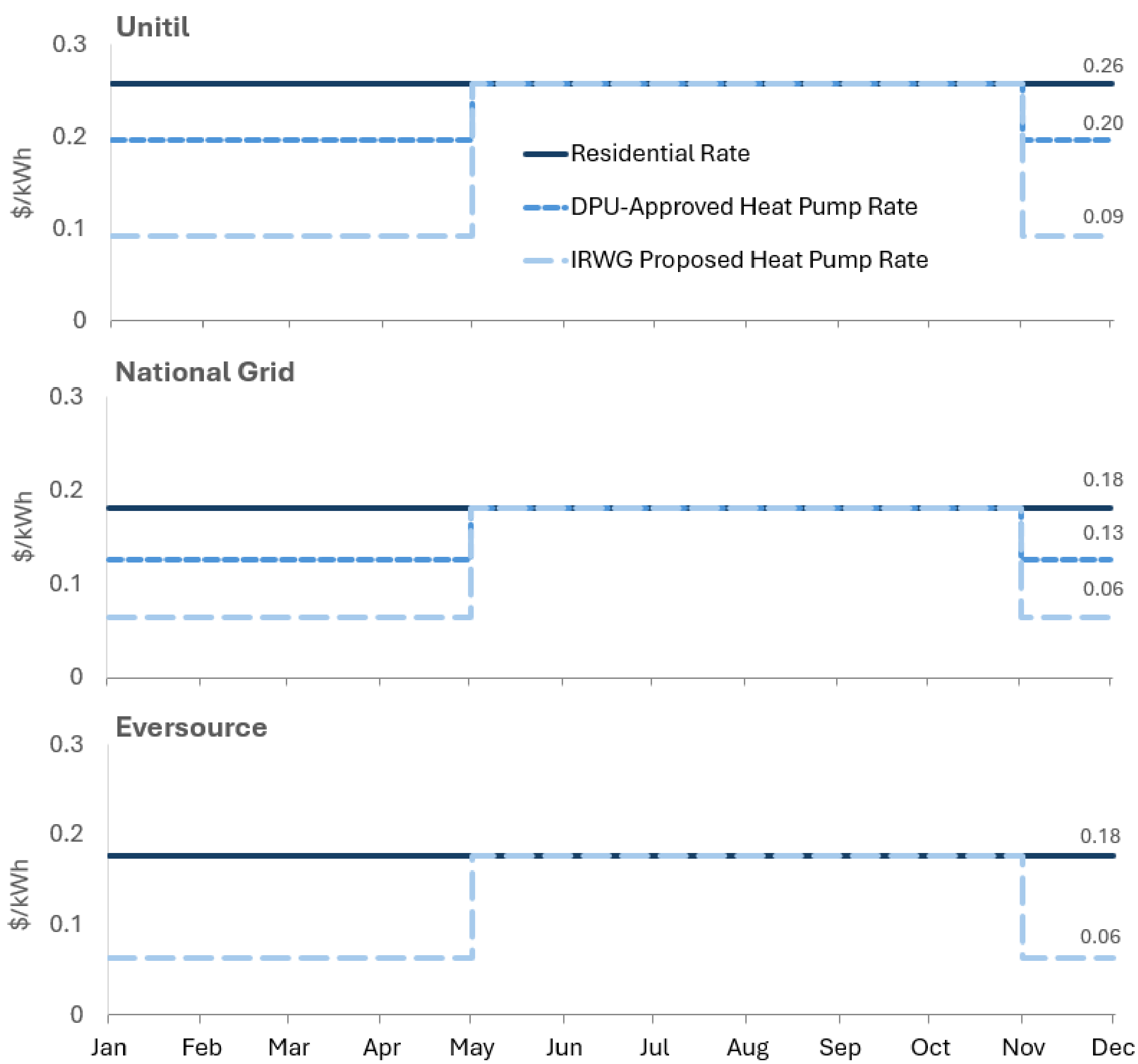
The Working Group recommends each EDC expeditiously deploy an optional seasonal heat pump rate, with seasonal differentiation that is cost reflective and that will bring winter season heating costs more in line with natural gas heating.[28] A seasonally differentiated heat pump rate can be designed to support the Commonwealth's electrification and emission reduction targets by incentivizing customer adoption of heat pump technology. Further, customers adopting heat pumps through Mass Save should be seamlessly enrolled in the seasonal heat pump rate.

The DPU recently approved a seasonal heat pump rate for Unitil in D.P.U. 23-80 and directed National Grid to adopt a similar rate in D.P.U. 23-150.[29] The DPU found that heat pump rates are "a reasonable, cost-efficient solution to mitigate the potential high bills associated with heat-pump implementation

[26] G.L. c. 25, § 1A; c. 164, § 141.
[27] G.L. c. 164, § 141.
[28] The Near-Term Rate Strategy Report presents the cost of heat delivered via different heating technologies (*see* Table 4), which informs the level of electric rates relative to natural gas rates necessary to reach parity in heating costs.
[29] D.P.U. 23-80 (2024); D.P.U. 23-150 (2024).

faced by residential and low-income customers within the context of current rate structures, while maintaining a rate structure that accurately reflects the cost to serve customers during this stage of electrification."[30] **However, the Working Group finds that there are important modifications to these rates that are necessary to ensure the rates can reduce energy burden for customers switching from gas to heat pumps as will be required to meet our emission reduction mandates.**

Figure 4. Illustrative Comparison of Total Delivery Rate for Standard Residential Customers, the DPU-Approved Seasonal Heat Pump Rate, and the IRWG Proposed Seasonal Heat Pump[31]



[30] D.P.U. 23-150 at 510 (2024).

[31] Figure 4 compares illustrative rates of the DPU-approved heat pump rate and the Working Group's proposed seasonal heat pump rates based on the current total delivery rate for residential customers.

The heat pump rates approved by the DPU are available to all residential customers who install and use heat pumps in all or part of their homes. During the winter, when heat pumps result in increased electricity use, heat pump rate customers are charged a lower kilowatt-hour (kWh) rate. This rate structure provides a lower winter volumetric charge that decreases the cost of operating a heat pump. As designed, the heat pump rate structure includes a fixed customer charge and a volumetric summer rate (i.e., May to October) per kWh, consistent with the residential rate offering. The winter volumetric kWh rate is set to recover the same level of total costs collected from an average residential customer, so that the rate is revenue-neutral and minimizes cost-shifts to other ratepayers.

The Near-Term Rate Strategy Report modeled a seasonal heat pump rate that increases the electricity rate during the summer season to offset the revenue deficiency associated with eliminating the entire delivery component from the winter rate. Several stakeholders raised concern that increasing electricity costs for households during the cooling season could lead to higher energy burdens in the summer and, due to the increasing concern with extreme heat, this would not lead to an equitable outcome. Instead, the DPU - in approving the seasonal heat pump rates for Unitil and National Grid - has proceeded with a minimal winter charge to collect revenue without increasing the summer rate. The Working Group recommends expanding on this approach to maintain bill savings for heat pump adoption, while mitigating energy expenditures for households during the summer months.

The following considerations were provided by stakeholders and/or explored by the Working Group in arriving at this recommendation:

Seasonal Differentiation Needs to be Applied Beyond the Base Distribution Charge

The Near-Term Rate Strategy Report demonstrates that the recently approved Unitil heat pump rate does not lead to overall bill savings for customers switching from gas to heat pumps.[32]

Part of the reason for this result is that the heat pump rate only applies to the distribution charge, which in 2023 accounted for approximately one-quarter to one-third of the customer's bill.[33] The Unitil heat pump rate design lowers the base distribution charge from $0.09576 per kWh to approximately $0.03419 per kWh providing a savings of $0.06157 per kWh off of a total residential retail rate of over $0.45 per kWh.[34] Table 2 provides a comparison between the DPU-approved seasonal heat pump rate and the Working Group's recommendation; seasonally differentiating the transmission and other reconciling mechanism charges included in retail rates makes winter electric rates comparable to gas heating costs.

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[32] Near-Term Rate Strategy Report, Figure 31.

[33] Based on 2023 rates across the MA EDCs. Massachusetts Electric Rates Database, accessed here: https://www.mass.gov/info-details/interagency-rates-working-group.

[34] D.P.U. 23-80, Exhibit Unitil-JDT-6 (Compliance 7-5-24). (https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/19329263). Massachusetts Electric Rates Database, accessed here: https://www.mass.gov/info-details/interagency-rates-working-group.

Table 2. Illustrative Comparison of Unitil's Seasonal Heat Pump Rate

	DPU-Approved Seasonal Heat Pump Rate ($/kWh)		Working Group Recommendation ($/kWh)	
	Summer	**Winter**	**Summer**	**Winter**
Supply	0.19304	0.19304	0.19304	0.19304
Distribution	0.09576	0.03419	0.09576	0.03419
Transmission	0.03501	0.03501	0.03501	0.01250
Other	0.12686	0.12686	0.12686	0.04530
Total	0.45067	0.38910	0.45067	0.28503
Differentiation	-	0.06157	-	0.16564

The cost-effectiveness of heating electrification depends on electricity and gas rates, in addition to the underlying technology efficiencies. Table 1 shows that under current gas rates that the majority of Massachusetts' households pay, the breakeven electricity rate to deliver the same unit of heat with an air-source heat pump is as low as $0.25 per kWh. For the seasonal heat pump rate to reach cost parity with gas heating and ensure customer bill savings from electrification, the differentiation must be applied to parts of the electric rate beyond the distribution charge, such as to the transmission charges and other reconciling charges during the winter season.[35] This would reflect the lower marginal cost of delivering electricity during those periods. **Therefore, the Working Group recommends all EDCs offer a seasonal heat pump rate similar to those recently approved and directed by the DPU, but expanded to apply beyond the distribution charge for a larger winter differentiation to be cost-based and ensure energy bill savings for customers transitioning from gas heating to electric heat pumps**.

Given that electric rates are expected to increase over the next five years, it is even more important to establish a seasonal differentiation that will be robust enough to reduce the operating cost barrier of switching from gas to electric heating, while minimizing seasonal spikes in energy bills. A rate with seasonal differentiation based on the base distribution charge alone may be eroded by rate increases in other components of the electric bill.

Reflect Cost of Service

A seasonal heat pump rate (i.e., a technology-specific rate) can be designed to be a cost-reflective near-term solution. The adoption of heat pumps can alter customer load shapes in predictable ways, which supports the design of efficient and equitable rates.[36]

[35] Two reconciling mechanisms are established in statute and may not be differentiated: G.L. c. 25, § 19 sets the energy efficiency charge at $0.00250 per kWh and G.L. c. 25, § 20 sets the renewable resources charge at $0.00050 per kWh.

[36] The principles of efficiency and equity are well-established ratemaking principles and are further described in the Massachusetts-context in the Near-Term Rate Strategy Report at 84-85.

Distribution companies incur incremental costs when they need to invest in infrastructure to meet customer, local, or system peak demand.[37] Each EDC's system is currently summer-peaking, so the distribution system is built to serve the capacity of a peak summer day. In the winter, there is available capacity, or headroom, on the system, meaning that EDCs are unlikely to incur incremental system costs when usage increases during the winter season in the near-term. The EDCs expect to eventually switch from having summer-peaking to winter-peaking systems estimated to occur in mid-2030s as more buildings electrify: National Grid in 2036,[38] Eversource in 2035,[39] and Unitil in 2033.[40]

Similarly, the regional transmission system is also summer-peaking. ISO-NE forecasts the switch from a summer-peaking system to a winter-peaking system in the mid-2030s.[41] Therefore, integrating transmission costs into a heat pump rate, as recommended above, also maintains cost reflectivity in the near-term.

By implementing a seasonal rate, winter charges can be lower when the system is less strained and additional marginal usage does not increase system cost, while summer rates can reflect the impact of additional marginal demand and the cost of providing the grid infrastructure needed to serve that peak cooling demand. As a result, this rate structure can send more appropriate price signals for customers than the current rate which does not vary by season.

Address Summer Bill Increases from Access to Air-Conditioning

While switching from conventional A/C to heat pumps yields more efficient cooling, households without existing cooling systems will have new access to A/C upon adopting a heat pump. Access to A/C is an important benefit, especially given the impact of climate change on summer temperatures and increased risk of heat stress and illness. In particular, access to A/C is essential for certain populations that may be more susceptible to heat-related illness, such as those with medical conditions or who are older. These same priority populations may also be on fixed or lower incomes and be less able to afford the increased energy burden of A/C.[42] Low-income households are also slightly more likely to lack A/C at all, or use room A/C.[43]

The Near-Term Rate Strategy Report demonstrates that the modeled seasonal heat pump rate would provide annual savings to electrifying customers relative to existing rates, despite the increase in

[37] Customer peak demand drives site-level systems and infrastructure investments, such as service drops. Local peak demand, or circuit- or feeder-level peaks, drive additional infrastructure upgrades, such as reconductoring. System peak demand drives large-scale infrastructure needs, such as upgraded substations.
[38] https://www.nationalgridus.com/media/pdfs/our-company/massachusetts-grid-modernization/future-grid-full-plan.pdf at 406.
[39] https://www.eversource.com/content/docs/default-source/default-document-library/eversource-esmp%20.pdf at 14.
[40] https://unitil.com/sites/default/files/2024-01/Unitil-ESMP-2025-2050-DPU-FINAL.pdf at 212.
[41] ISO New England, 2023 Regional System Plan. https://www.iso-ne.com/system-planning/system-plans-studies/rsp.
[42] ResilientMass Plan and Massachusetts Climate Change Assessment further explore the disproportionate impact of heat on EJ communities and priority populations.
[43] Near-Term Rate Strategy Report, Figure 26.

incremental summer A/C energy demand.[44] In other words, customers who now have access to A/C after they adopt heat pumps will see summer bills increase due to greater energy use, though the increased summer bills will be offset by even greater winter bill savings. While on average, a customer may expect to see annual bill savings under the seasonal heat pump rate, the Working Group remains mindful that households receive bills monthly and can be sensitive to month-to-month fluctuations. There may be households that experience increased energy burden during summer months associated with increased cooling services; complementary programs and policies, such as energy efficiency, solar, and balanced billing, are better suited to address these needs than what rate design can offer alone. Further, the EDCs use of an integrated approach for targeting at-risk customers will be essential in providing comprehensive assistance to households, particularly the most vulnerable.

Minimize Cost-Shifting to Non-Participants

One key concern with new rate structures is cost-shifting, where non-participants (those not on the rate) subsidize the costs for those on the rate. The Near-Term Rate Strategy Report identified that universal rate design changes (i.e., increasing the fixed charge or transitioning to a seasonal rate for all ratepayers) may lead to modest bill increases for non-electrifying customers in the near-term.[45] However, a technology-specific seasonal rate can be designed such that minimal cost-shifting occurs from electrifying customers to non-electrifying customers.

A seasonal heat pump rate can ensure that participants pay their fair share of system costs, which, as discussed above, remain relatively fixed in the near-term. The winter volumetric charge of a seasonal heat pump rate can be set on a revenue neutral basis, such that, based on the expectation for increased kWh usage, the rate will still recover the same level of total fixed costs. It recognizes that a customer adopting a heat pump will utilize more energy on a per kWh basis, but will have minimal upward pressure on the fixed or system costs, provided that the system remains summer peaking. This approach maintains an EDC’s revenue allocation target by reducing the volumetric rate to the customers adopting the beneficial electrification technology.

For example, a residential customer using 600 kWh per month at $0.33/kWh will contribute approximately $200 to system costs. If the same customer instead uses 1,500 kWh during a winter month, the fact that the usage is not during the system’s peak season makes it unlikely that the increased usage will increase system costs in the near-term. Therefore, the customer can be charged $0.13/kWh and still contribute the same amount toward their cost to serve, approximately $200 in system costs. As a result, the seasonal heat pump rate can minimize cost-shifting to non-participants as the participating customer is paying for their costs to the system and not driving incremental system costs.

[44] Near-Term Rate Strategy Report, Figures 33 and 34.
[45] Near-Term Rate Strategy Report, Table 8.

Streamline Eligibility and Verification

Technology-specific rates risk being complex and costly to implement *if* verification of eligible technologies and submetering appliances is required.

To ease the administrative burden and encourage participation, eligibility for the seasonal heat pump rate can be streamlined by allowing customers to self-attest to their use of a heat pump, as has been allowed for Unitil and National Grid's heat pump rates. The Working Group does not recommend changes to this approach. Verification of technologies is unnecessary; self-attestation is common for determining eligibility for other utility tariffs designed for customers adopting specific technologies.[46] Self-attestation reduces the complexity and time typically required for verification, thereby lowering implementation costs while still ensuring that the rate is targeted at the appropriate customer group. As further described below, the Working Group recommends the EDCs, in their roles as program administrators of Mass Save, streamline heat pump rate enrollment for customers receiving heat pump rebates. In the near-term, residential heat pump installations occurring through Mass Save is a meaningful form of verification to counterbalance the risk of self-attestation.

As discussed above, the Working Group recommends a heat pump rate that is both cost reflective and designed to close the operational cost differential for a customer converting from natural gas to air source heat pumps. This means that households that convert from other delivered fuels or electric resistance and enroll in the heat pump rate may see bill savings greater than is needed to bring those customers to bill parity.[47] In fact, most households converting from other delivered fuels or electric resistance heating would not need a technology-specific rate to see bill savings from air-source heat pump installation. Households converting from electric resistance heating in particular will see lower energy costs while reducing heating-related electricity usage.[48] While it would not be administratively feasible to limit eligibility to customers converting from natural gas, there can be more targeted outreach to those customers. The Working Group recommends that the DPU, utilities, and stakeholders explore cost-effective ways to conduct targeted marketing and educational efforts to individual households.[49]

The recommended seasonal technology-specific rate would be whole-home, meaning that it would not require separate, or sub-, metering for the heat pumps. This simplifies customer education and cost. Further, even though all household loads would be subject to the heat pump rate, the Near-Term Rate Strategy Report indicates that a heat pump rate could still result in bill savings for households with EVs and heat pump(s).[50]

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[46] *E.g.*, Central Maine Power's seasonal heat pump rate requires self-attestation, https://www.cmpco.com/documents/40117/46385123/a-seasonal_06.29.23.pdf/13c3d872-e9d9-48f3-030d-f261ba6b8456?t=1688039790490.
[47] *See* Near Term Rate Strategy Report at Table 8.
[48] *See, e.g.*, Near-Term Rate Strategy Report at 29 (54% of MA households heat with natural gas, 26% with fuel oil, 13% with electric resistance, and 7% with other sources).
[49] *See* Appendix: Near-Term Rate Strategy Report Affordability Feedback for the Interagency Rates Working Group.
[50] Near-Term Rate Strategy Report at 67.

Rate Option Can Serve as Bridge to Time-Varying Rates

More sophisticated rate design, such as time-varying rates (TVR), requires deployment of AMI. The EDCs expect to have full deployment of AMI by 2025 for Unitil, 2028 for National Grid, and 2029 for Eversource.

Figure 5. AMI Deployment Timeline

The timing of each EDC's next rate case following AMI deployment is also important because that is one venue in which the EDC or other parties can propose TVRs. Across the three EDCs, assuming no delays in AMI deployment and that TVRs are proposed and approved in subsequent rate cases, wide-spread TVR will likely be in effect between 2029 and 2033.[51]

A seasonal rate can act as a steppingstone to future, more granular TVRs, which can support robust demand management. A seasonal rate will educate consumers that electric costs vary temporally. In the near term, customers on the seasonal heat pump rate will observe that electricity costs are currently lower in the winter and higher in the summer. This introduces customers to the concept of differential pricing based on system conditions.

The DPU expects the EDCs with approved heat pump rates to monitor the impact of the heat pump rates, as well as progress towards increased electrification in the Commonwealth, and include an analysis and discussion in each EDC's next base distribution rate case regarding the successes, failures, and lessons learned from its offerings, including the proposal of any necessary changes to the heat pump rate.[52] The Working Group emphasizes the importance of reviewing the rates to ensure they continue to align with the goals of energy efficiency, affordability, and decarbonization. Insights from monitoring and evaluation can inform adjustments to rate structure, outreach efforts, or complementary programs. Further, the DPU has recently emphasized this flexibility for the National

[51] Unitil will file its next rate case in mid-2028 for rates effective approximately mid-2029 (*see* D.P.U. 23-80 at 36-37 (2024). Eversource may file a request to extend its current performance-based ratemaking plan term for another five-year term in mid-to-late 2027, in which case Eversource would file its next rate case in early 2032 for rates effective in early 2033. If an extension is not granted, Eversource's stay-out provision will be extended by one year for a rate case filing in early 2029 for rates effective in early 2030 (*see* D.P.U. 22-22 at 55-56 (2022)). National Grid will file its next rate case in late-2028 for rates effective late-2029 (*see* D.P.U. 23-150 at 80-82 (2024)).
[52] D.P.U. 23-80 at 408-409 (2024).

Grid seasonal heat pump rate, indicating it will be an interim offering until the next distribution rate case, or until an alternative is approved.[53] When AMI enables additional TVR structures, the seasonal rate could evolve to include time-of-use components that better reflect real-time grid conditions. This gradual transition helps customers acclimate to more complex pricing structures while still realizing financial benefits from managing their energy use.

It is important to note that the electric summer system peak will change to a winter peak in the future (as discussed above), such that the pattern of lower winter prices and higher summer prices being observed by seasonal rate customers today will change. As with many other aspects of the energy transition, this will require sufficient marketing and outreach to prepare customers as well as flexible rate designs to account for these changing conditions. While this transition is expected to occur in the mid-2030s, the glidepath to a winter-peaking system will be gradual and informative as we assess actualized grid impacts of increasing heat pump and other electrified technologies. The Working Group's recommendations include considerations for monitoring and evaluation to account for any changes that may be necessary to continue to support a decarbonized grid.

Consider a Non-Bypassable Fixed Charge for Public Benefits Programs

The Near-Term Rate Strategy Report explored an additional fixed charge as a rate design lever to reduce the high volumetric rate that is a barrier to electrifying building and transportation end-uses. The Working Group identifies this lever, exercised in a targeted manner, as an area for further consideration. Electrification of buildings and transportation is key to achieving decarbonization goals, yet a volumetric charge penalizes customers for increased electricity usage, even when that increased usage is due to switching away from fossil fuels like oil or gas to electric heat pumps.

Several stakeholders provided feedback to the Working Group expressing concern about the impact of higher and non-bypassable fixed charges, citing concern that this lever would discourage energy efficiency and the adoption of DG like rooftop solar as well as impact low-income ratepayers. Electric rates include fixed charges, which do not vary based on a customer's consumption, as well as volumetric charges, which are directly related to the amount consumed. The electric system requires significant infrastructure to ensure safe and reliable service, and the costs of this infrastructure represent a portion of the electric rates paid by customers.

Electric rates also include many charges that are not directly related to a customer's usage, like the costs for important programs with widespread public benefits such as Mass Save decarbonization incentives or low-income discounts. Historically, program costs were collected through volumetric rates to encourage energy conservation and efficiency. Today's higher electricity rates, however, discourage customers from pursuing the adoption of clean energy technologies—like heat pumps—central to the Commonwealth's decarbonization strategy, and from using enough electricity to meet essential needs, a problem that is exacerbated because public benefits programs also are funded through volumetric charges. Further, customers who have the means to reduce their energy consumption, whether through energy efficiency upgrades or the installation of DG (like rooftop solar), can reduce the amount they pay into public benefits programs (because these programs are funded through volumetric charges; when a customer adopts rooftop solar or deploys energy

[53] D.P.U. 23-150 at 512-513 (2024).

efficiency, their billed volumetric consumption is reduced because they use less energy). These are often the same customers who can afford significant energy efficiency and solar investments, allowing them to further benefit from reduced consumption while contributing less to the public benefits funds that they initially drew from for energy efficiency upgrades and to offset costs associated with the installation and operation of rooftop solar.

A non-bypassable fixed charge – a monthly charge that cannot be avoided by any customers, including DG owners – may be appropriate for certain public benefits programs. A non-bypassable fixed charge could fund crucial programs that support the state's energy, affordability, and decarbonization goals in a way that does not increase volumetric charges, a key barrier to electrification. This would ensure that all customers, independent of increases or decreases in usage, contribute fairly to the cost of these programs. A non-bypassable fixed charge for specific programs or policies, if designed appropriately, can help reduce barriers to electrification, ensure equitable cost recovery, be more cost-reflective, and provide more stability to customers' bills through the year. The Working Group recommends further consideration of a non-bypassable public benefits fixed charge through the facilitated stakeholder process discussed in the Implementation section below.[54]

II. Marketing, Education, and Outreach

The effectiveness and success of the Working Group's rate design recommendations, particularly the optional seasonal heat pump rate, will depend on customer awareness and adoption of such offerings. The Working Group recommends the EDCs, in their roles as program administrators of Mass Save, streamline enrollment for the heat pump rate for customers receiving heat pump rebates.

The overall focus of the EDCs' MEO efforts to make customers aware of the seasonal heat pump rate should identify potential barriers to participation and then tailor MEO efforts to mitigate or remove those barriers to create an experience for customers that is easy, convenient, and as frictionless as possible. While the specific approaches and goals of the EDCs' MEO efforts will vary for each specific rate, program, and initiative, and by location, in general, MEO efforts should be customer-centric and should:

- Minimize technical terms that can cause frustration and/or confusion to customers;
- Use plain-language terms that are simple and easy for customers to relate to and understand (e.g., at a 5th grade reading level);
- Provide a single point of contact for all (or several) relevant rates/programs/initiatives;
- Reduce and simplify documentation and/or verification requirements;
- Ensure that customers can easily reach knowledgeable utility staff with any questions (e.g., customer service representatives that answer calls or website inquiries should know the answer to questions or know how to get the answer quickly);
- Recognize and respond to language needs for limited English proficiency customers;

[54] The Working Group notes that the programs or policies considered public benefits will be a subject for further deliberation, and provides the Mass Save decarbonization incentives and low-income discounts as illustrative.

- Tailor efforts to meet customers where they are (e.g., by providing the right information so that customers make informed choices);
- Use language that resonates with audiences of different cultural backgrounds (i.e., a multi-cultural communication strategy);
- Recognize that different communities will have different barriers to participation, different needs, and different motivations and may respond to messaging differently;
- Use a variety of outreach channels (e.g., email, phone, radio, internet, social media and in-person events);
- Encourage collaboration and partnerships with community members and community groups, particularly from communities that are underrepresented in the clean energy transition and/or in the specific rate/program/initiative; and
- Target individual households based on their needs and risks;
  - Use meter (and eventually AMI) energy usage data along with available income data to identify the risks that households face, and then communicate opportunities for electrification and reduction of financial burdens to these households;[55] and
  - Use direct to household channels (e-mail, texting, in-app messages) to communicate about programs that benefit low-income households.

In designing MEO efforts, EDCs and/or program administrators should draw from best practices; MEO professionals; and the experience of other utilities, including utilities in the Commonwealth as well as other jurisdictions.[56] To ensure that MEO efforts are effective, they should be evaluated regularly and revised as needed. This approach should include (1) message testing (qualitative and quantitative) before material is deployed; and (2) identifying and tracking key performance indicators.[57] Appropriate key performance indicators include:

- participation rates (including enrollment rates);
- penetration rates (i.e., the number of eligible customers who participate in a rate or program) at the census tract or block group level;
- bill savings;
- energy limiting behavior (i.e., households that under-consume energy during summer and winter months);

[55] *See* Appendix: Near-Term Rate Strategy Report Affordability Feedback for the Interagency Rates Working Group for further discussion of energy use data informing targeted marketing.

[56] *See, e.g.,* American Council for an Energy-Efficient Economy, *Adapting Energy Efficiency Programs to Reach Underserved Residents*, at 4 (last modified Nov. 2023), https://www.aceee.org/sites/default/files/pdfs/adapting_energy_efficiency_programs_to_reach_underserved_residents_-_encrypt.pdf; Questline, *How to Reach Low-Income Customers of Energy Utilities* https://www.questline.com/blog/how-to-reach-low-income-customers-of-energy-utilities/#:~:text=For%20energy%20utilities%2C%20building%20awareness,bill%20assistance%20and%20budget%20billing; Erifili Draklellis et al, *Five Steps for Utilities to Foster Authentic Community Engagement* (last modified June 2, 2022) https://rmi.org/five-steps-for-utilities-to-foster-authentic-community-engagement/.

[57] This approach to evaluating MEO efforts may highlight barriers to participation that can be mitigated through changes to rate/program design. Thus, staff tracking and evaluating MEO efforts should be in regular contact with rate/program administrators to ensure that relevant information from MEO evaluation is used to inform program design.

- customer satisfaction; and
- customer engagement level.

The cost-effectiveness of implementing the EDCs' MEO efforts should also be tracked and evaluated (e.g., cost per leads, advertising response rates). This information should be shared publicly online in a format that is easy to find and understand, and not solely in utility filings.[58]

Examples of Ongoing and Planned MEO Efforts

Ongoing or planned MEO efforts serve as examples and should be used to inform future cost-effective MEO approaches to increase enrollment in seasonal heat pump rates.

In National Grid's most recent electric rate case, D.P.U. 23-150, the Department approved National Grid's proposed $3 million annual budget for MEO, as well as $1.235 million annually for 10 additional full time staff members to support its new tiered discount rate.[59] National Grid's planned education and outreach includes multiple media channels, such as radio, television, and digital channels, translation of outreach and educational materials, and working with community-based organizations. The Working Group recommends that these efforts by National Grid should expand to directly target and message to consumers who are estimated to be at-risk, which can be done cost-effectively using e-mail, text messaging, and in-app messages.[60]

With regards to the heat pump rate that the DPU approved for Unitil (electric) in D.P.U. 23-80, Unitil plans to promote awareness and adoption through additional informational resources on its website, a series of targeted messages utilizing direct-to-customer channels such as on-bill messaging and email campaigns, and geo-targeted social media outreach where available.[61] Further, the DPU directed Unitil to begin outreach and education to promote awareness of the new rate offering.[62]

Consider Leveraging Mass Save® as a Clearinghouse for MEO

As program administrators of Mass Save, the EDCs are well-positioned to reach customers who are exploring heat pump installation. Mass Save program administrators should be directed to assist recipients of heat pump rebates to enroll in the rate. Historical Mass Save data also can be used to target materials and outreach to households that have already installed heat pumps. The MEO efforts to promote the seasonal heat pump rate offering should be complementary to the efforts already

[58] The DPU has examined procedural enhancements to its public notice requirements to increase public awareness of and participation in Department proceedings and issued an Order Establishing Tiering and Outreach Policy (D.P.U. 21-50-A) in February 2024, that should be informative to utility filings and DPU approaches to outreach.
[59] D.P.U. 23-150 at 604 (2024).
[60] Peoples Energy Analytics directly messages at-risk customers using monthly and daily energy usage data, for an estimated cost of less than a penny per household. Peoples Energy Analytics uses energy meter data (monthly and daily) to identify different risk levels of households (pipe freeze, heat stroke, and high bills). Then using this information, they design targeted marketing strategies (e-mails, text messages), which go to individual households to let them know about the programs they qualify for. These programs are chosen based on their risk category. This information can also be used to pre-qualify homes for assistance programs.
[61] D.P.U. 23-80 at 400 (2024).
[62] Id. at 409 (2024).

underway in promoting Mass Save incentives and rebates. To maximize the benefits of the seasonal heat pump rate, the Working Group recommends:

- Mass Save heat pump incentive marketing should include discussion of the seasonal heat pump rate and low-income discount rates;
- All heat pump installations should be paired with enrollment on seasonal heat pump rate and low-income discount rates for eligible customers (e.g., customers should be provided notice of or affirm awareness of the switch to a heat pump rate as part of Mass Save installation and verification process);
- The EDCs should target MEO to prior Mass Save customers that have deployed a heat pump to inform them of the availability of the seasonal heat pump rate; and
- Mass Save infrastructure should be leveraged to educate manufacturers, installers, and other contractors (e.g., water heater contractors, plumbers, electricians) about seasonal heat pump rates.

Leverage Seasonal Rate Offerings for Targeted Electrification Pilots

Seasonal heat pump rates also can be leveraged to support planned pilot projects for strategic electrification. In its landmark Order DPU 20-80-B on the future of gas, the DPU directed the Massachusetts Local Distribution Companies (LDCs, i.e., natural gas utilities) to work with the EDCs on demonstration projects for decommissioning portions of the gas system through strategic electrification. The LDCs must file these pilot projects with the DPU for approval by March 1, 2026. The DPU directives for these pilot programs include requirements for the use of innovative electrification and decarbonization technologies to ensure cost-effectiveness. If seasonal heat pump rates are available, they could help reduce costs for customers in these targeted electrification pilot programs.

III. Monitoring and Evaluation

It is important to monitor and evaluate the performance of the optional seasonal heat pump rate to ensure it meets its goals of achieving cost savings for participating ratepayers.

The DPU directed Unitil and National Grid to provide annual reporting on the "number of customers opting into (and off) the new tariffs, twelve months of pre- and post- installation monthly kWh use, and monthly peak kW use, if possible."[63] They also required the utilities to include the number of customers, by rate class, opting into the heat-pump rate who received a heat pump rebate through the Mass Save program, as well as the number of customers who received a rebate through the Mass Save program but have not opted into the heat pump rate.[64]

The DPU expects the utilities with approved heat pump rates to monitor the impact of the heat pump rates, as well as progress towards increased electrification in the Commonwealth, and include an analysis and discussion in its next base distribution rate case regarding the successes, failures, and

[63] D.P.U. 23-80 at 408 (2024); D.P.U. 23-150 at 513 (2024).
[64] D.P.U. 23-80 at 408 (2024).

lessons learned from its offerings, including the proposal of any necessary changes to the heat pump rate.[65] Similarly, National Grid's heat pump rate will be an interim offering available until National Grid's next base distribution rate case, or until an alternative is approved by the DPU.[66]

The DPU has already determined a robust set of monitoring and reporting requirements for heat pump rates. The Working Group recommends the following additional monitoring and evaluation requirements.

Enrollment and Customer Outcomes

The EDCs should report the following information on a quarterly basis, if feasible:

- Heat pump installations relative to baseline (pre-program) and year-over-year;
- Estimate of total households with heat pumps that are enrolled in the seasonal heat pump rate; and
- An analysis of available time-interval data for households enrolled in the rate program, to the extent AMI meters are installed and operating, compared to available time-interval data for households on R-1 and R-2 rates.

All reported data should be disaggregated by rate class (e.g., R-1 versus R-2) and geography, including whether the household is in an environmental justice (EJ) community or not. Tracking the program's ability to enroll otherwise traditionally underserved ratepayers is essential to identifying potential barriers and achieving equitable access. EDCs should compare enrollment rates of R-2 households with heat pumps relative to enrollment rates of R-1 households with heat pumps.

Changes in Energy Usage and Bill Impacts

The DPU requires "twelve months of pre- and post- installation monthly kWh use, and monthly peak kW use, if possible." In addition, to the extent information is available, monthly usage should be compared before and after enrollment separately for the subset of customers that had heat pump(s) installed for at least one heating season prior to enrollment. This will allow for an analysis of any changes in usage that may be attributable to the rate program, separate from changes in bills attributable to the installation of heat pump(s). An analysis of available energy usage data for households across seasons should be completed for those enrolled and not enrolled in the rate program across the first several years of implementation. This will allow for understanding how household energy usage shifts with rate changes, seasons, and technology changes. Monthly data is sufficient, but to the extent AMI meters are installed and operating, daily or hourly energy usage information should be used. Finally, for each enrolled customer, shadow billing should be reported for what that customer would have otherwise paid each month had they not been enrolled in the rate program.

[65] D.P.U. 23-80 at 408-409 (2024).
[66] D.P.U. 23-150 at 512-513 (2024).

IV. Complementary Programs and Policies

While this report focuses on recommending rate designs that can better support electrification, we recognize that rate design will need to be complemented with other programs and policies to advance decarbonization in the Commonwealth. In addition to rate design, complementary program offerings provide necessary incentives for the adoption of, and load management associated with, clean energy technologies. The following sections summarize existing or developing programs and policies that are essential complements to rate design.

Demand Response and Load Flexibility Programs

Reducing peak demand is essential to maintain customer affordability by deferring or avoiding grid infrastructure upgrades, the costs of which are passed on to ratepayers. Demand response and load flexibility programming allows the EDCs to work with customers to manage peak demand and create bill savings for all ratepayers.

The existing demand response and load flexibility programs in the Commonwealth include National Grid's EV Off Peak Charging Rebate Program, ConnectedSolutions, and the Clean Peak Standard (CPS). These pre-AMI demand response and load flexibility programs rely on rebate-style payments that reduce customer bills. While the rebate-style payment can continue to shift peak energy usage and reduce total system costs while also continuing to incentivize electrification, in the long-term, following deployment of AMI, advanced rate design can provide more accurate and granular price signals to reduce peak-demand. Even with advanced rate design, demand response and load flexibility programs can complement well-designed dynamic rates by further incentivizing customers to shift energy use away from high-cost periods and allowing for the avoidance or deferral of grid infrastructure investment.

EV Managed Charging Programs

EVs are a critical electrification technology, whose advancement is a Commonwealth priority supported by a variety of EV and charger installation incentives. While EVs are a key climate technology, the Commonwealth's ambitious EV targets are projected to contribute to approximately 20% of new electric load by 2050.[67] This makes EV managed charging programs especially crucial in balancing the Commonwealth's electrification agenda, particularly in the near-term when AMI-enabled advanced rate design is not available.

National Grid already has implemented a residential off-peak charging rebate program which has successfully shifted approximately 80% of weekday EV charging load off-peak with over five thousand enrollees. It plans to begin enrollment in a similar off-peak charging rebate program for fleet customers this year.[68] Eversource and Unitil do not currently have EV-managed charging programs, but Eversource has proposed an EV managed charging programs in D.P.U. 24-195, filed on December 18, 2024. Unitil is expected to file a proposal with the DPU in the near future. In addition,

[67] Phase Scenario, https://www.mass.gov/doc/massachusetts-workbook-of-energy-modeling-results/download.
[68] https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/19070892.

many municipal light plants also administer successful managed charging programs that remain illustrative.

Peak Demand Reductions

Massachusetts has multiple programs designed to reduce peak demand from various load types and customer classes (e.g., residential, commercial, etc.). While the Near-Term Strategy Report focuses on recommendations for residential customers, peak demand reductions from commercial and industrial customers will also be essential to managing load. In preparation for growing electrification load, these existing programs need to continue and evolve. For instance, ConnectedSolutions, a peak demand response incentive program for products that have coincident load with summer peak, can start to incentivize reductions of coincident load during the winter peak as heat pump adoption increases.

The Commonwealth also administers the CPS, which provides incentives for implementation of energy storage, demand response, and renewable generation during periods of high grid stress. The CPS can not only reduce grid burden, but also reduce GHG emissions by shifting the energy supply to cleaner sources while enhancing grid reliability.

Upfront Incentives for Decarbonization Technologies

Mass Save provides rebates and financing to reduce the upfront cost of heat pumps. The Program Administrators, in coordination with the Energy Efficiency Advisory Council (EEAC), have filed the 2025-2027 Energy Efficiency and Decarbonization Plan which calls for an additional $1 billion focused on equity programming. Through Mass Save, Massachusetts' customers can leverage zero-interest financing through the HEAT loan, which allows customers to spread the cost over time and align payments with energy savings – so long as the operating costs of heat pumps are lower than a customer's legacy heating system. Additionally, the Massachusetts Community Climate Bank's Energy Saver Home Loan Program helps eligible Massachusetts homeowners cut their energy use and reduce or eliminate their reliance on fossil fuels.[69]

Ensuring an affordable and equitable transition for households using natural gas for heating to instead use efficient heat pump technologies will necessitate complementary rates and energy affordability programs. The Commonwealth's implementation of a seasonal heat pump rate, open to customers on the low-income discount rate, as has been the case in the DPU-approved heat pump rates for Unitil and National Grid, can complement existing programs, such as Mass Save's income-eligible programs, which can reduce or even eliminate the upfront cost of heat pump installation.

Similarly, the Massachusetts Offers Rebates for Electric Vehicle (MOR-EV) program provides rebates and financing to reduce the upfront cost of EVs.[70] Through this program, Massachusetts' customers can leverage rebates for the purchase or lease of eligible battery electric vehicles (BEVs) and fuel-cell EVs, including passenger cars, medium-, and heavy-duty trucks. MOR-EV also offers rebates for

[69] https://www.masshousing.com/en/mass-community-climate-bank/energy-saver-home-loan.
[70] https://mor-ev.org/.

used EVs, a rebate adder for income-eligible residents, and a rebate adder for medium- and heavy-duty vehicles in EJ areas.

In addition, the Commonwealth supports DER and DG through several key ratepayer-funded initiatives, including the SMART program, net metering, and the Renewable Energy Portfolio Standard (RPS). The SMART program offers incentives for solar developers, with bonus incentives for battery storage, community solar, and low-income participation. DOER is working with stakeholders to modernize the program and plans to release a new iteration in 2025. Net metering allows DG owners to receive credits on their electricity bills for exporting excess generated renewable energy to the distribution grid. Massachusetts also administers the RPS, which incentivizes renewable energy development by generating renewable energy credits (RECs) that load-serving entities must acquire to meet compliance obligations.

In addition, the Massachusetts Department of Environmental Protection is developing a Clean Heat Standard (CHS), which is a proposed regulatory program that would require heating suppliers to reduce their GHG emissions by implementing clean heat technologies. When coupled with cost-reflective rate design, the CHS can increase penetration of clean heat technologies.

Weatherization and Energy Efficiency Upgrades

Massachusetts offers numerous incentives for weatherization and energy efficiency upgrades.

Through the Mass Save program, Massachusetts' residents can leverage zero-interest financing to improve their homes' building envelopes with insulation, air sealing, and weatherstripping. Mass Save customers can also use Mass Save rebates to purchase energy-efficient appliances such as Energy Star-certified refrigerators and dryers. Further, in 2022, Massachusetts supplemented appliance efficiency standards and established minimum energy and water efficiency standards for specific products not already subject to federal appliance efficiency regulations. Products covered by these updated standards include residential faucets and showerheads, water coolers, and ventilation fans.

Massachusetts is leading the nation in the development and adoption of the opt-in Stretch and Specialized Building Energy Codes, which require new buildings to meet high thermal performance standards, dramatically decreasing the heating and cooling loads for buildings built to the code, thus enabling cost-effective electrification in new construction without significantly increased electric service load requirements.

The Commonwealth also supports the deployment of federal incentives for the Home Energy Assistance Program (HEAP, formerly known as the Low-Income Home Energy Assistance Program), which provides financial assistance to low-income households attempting to weatherize, and the Weatherization Assistance Program (WAP), which provides free energy efficiency upgrades for low-income households.[71]

[71] https://www.mass.gov/info-details/learn-about-home-energy-assistance-heap.

Implementation

Among the near-and long-term recommendations, there is an appropriate degree of phasing that should be considered during implementation. Many of the near-term recommendations are most effectively addressed expeditiously to maximize the public interest while other long-term recommendations will be more appropriately investigated and addressed at longer timescales.

Near-Term Recommendations

The Working Group's primary recommendation for the near-term is for the DPU to require all the EDCs to establish a seasonal heat pump rate, similar to those recently approved and directed by the DPU for Unitil and National Grid, but with larger winter differentiation to ensure energy bill savings for customers transitioning from gas heating to electric heat pumps. In addition to the rate structure recommendation, the Working Group provides additional recommendations on MEO; monitoring and evaluation; and complementary programs and policies.

These recommendations, principally the seasonal heat pump rate, can be implemented in the near-term and are essential for affordability and decarbonization. The Working Group seeks to advance implementation of seasonal heat pump rates across utilities in Massachusetts to enable customer enrollment by next winter (2025/2026). To further this goal, DOER is considering petitioning the DPU to investigate the near-term recommendations and direct the utilities to establish, or modify, the seasonal heat pump rates as recommended by the Working Group. The Working Group appreciates the EDCs' progress on heat pump rates thus far, as well as the EDCs' participation in the Working Group's stakeholder sessions. The Working Group looks forward to coordinating with the EDCs to explore how to implement several of the Working Group's near-term recommendations.

Long-Term Recommendations

The Working Group has identified areas for further consideration and will be addressing issues related to AMI-enabled rate design, ratemaking, and regulatory mechanisms in its Long-Term Ratemaking Recommendations. The Working Group determined that these areas could benefit from additional stakeholder deliberations and thus supports a facilitated stakeholder process to further discuss and consider the areas covered in the Long-Term Ratemaking Study and Long-Term Ratemaking Recommendations. The Working Group intends to engage key stakeholders, referred to as the Massachusetts Electric Rates Task Force (Task Force), to consider issues that may be included in a separate, future petition to the DPU. The Working Group's analysis and recommendations will serve to inform stakeholders engaged in the Task Force. The Working Group expects that an investigation at the DPU will be a necessary step to implement comprehensive changes related to AMI-enabled rate design, ratemaking, and regulatory mechanisms.

Appendix

Stakeholder Feedback Summary

Grid Impacts of Heat Pumps and Electric Vehicles

There is a strong emphasis on ensuring that EV charging and heat pump adoption are coordinated with the grid to avoid peak loads. Comments highlight the need for electricity rates for these technologies that reflect system costs and, where possible, advance peak demand reductions.

Affordability for Low- to Moderate-Income Households

Many comments prioritize making electrification affordable for low- and moderate-income households. This includes recommending bill assistance, energy efficiency programs, and rate structures that protect vulnerable populations from excessive costs. Affordability and equity concerns are central, suggesting a need for additional support to avoid disproportionate impacts on low-income households.

Technology-Specific and Seasonal Rates

Stakeholder comments generally favor seasonal rates, especially for heat pump users, as a means to lower winter heating costs. There is support for differentiated rates to encourage electrification, particularly for customers who use energy-efficient technologies like heat pumps. There was some concern about the longer-term impacts of technology-specific rates creating inequities between customers who have electrified and those who have not. Additionally, some stakeholders recommended revaluating a seasonal rate when the electric system becomes winter-peaking.

Dynamic Pricing

Some comments advocate for the implementation of dynamic pricing, where customers would be charged based on peak demand, though capped at certain levels to protect affordability. Dynamic pricing could incentivize flexible load management through the use of smart technologies.

High Fixed Charges

Several comments express concern over the impact of high fixed charges, which could discourage energy efficiency and the adoption of DERs like rooftop solar. The preference is for rate designs that maintain a volumetric component, ensuring that customers are incentivized to reduce usage. Others argued that an income-graduated fixed charge is the best way to address both equity and electrification.

Alignment with Decarbonization Goals

Many emphasize that rate design must support the state's decarbonization goals by promoting renewable energy and discouraging fossil fuel reliance. This includes ensuring that electrification efforts are paired with energy efficiency measures to minimize overall energy consumption.

Near-Term Rate Designs Concept

Some stakeholders suggested that the state should wait to implement any new rate design options until AMI has been fully deployed, saying that interim rate design options could confuse customers and make it more difficult to enroll customers in AMI-enabled rate designs like TVR. Some argued that the state's focus should be on implementing TVR rates as quickly as possible.

Consumer Education

Stakeholders encouraged the Working Group to think carefully about educating consumers about any new rate offerings. Some expressed concern about these rates changing consumer behavior or being adopted without considerable education efforts. Automatic enrollment for heat pump customers could be one option to address this.

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Near-Term Rate Strategy Report Affordability Feedback

Destenie Nock, PhD

Executive Summary I reviewed the Near-Term Rate Strategy Report (Near-Term Report, or Report), focusing on its structure around energy rates and the identified potential impact on diverse households. Based on my assessment, I have several recommendations intended to ensure that the Near-Term Report addresses energy affordability, considers vulnerable groups, and incorporates a more data-driven and holistic approach. When discussing how to craft a holistic approach, I reference previous case studies in other regions to provide examples of how data has been used in practice to identify affordability gaps. I also discuss my recommendations for how a similar analysis can be conducted in the future to ensure robust consideration of energy affordability and energy burden, as well as recommendations for how electrification initiatives can be designed to reach vulnerable households and protect people from significant bill impacts due to electrification and rate changes. Overall, my goal is to illustrate how an analyst or a Commissioner at the Department of Public Utilities (DPU) could use these expanded analyses to support decision-making in proceedings with impacts to energy affordability and rate design.

Recommendations:

1. **The Near-Term Report should include a clear definition of energy affordability**
    - A foundational component of the Near-Term Report should be a clear and comprehensive definition of energy affordability. Energy affordability is the ability for households to access the energy they need to maintain comfortable living

conditions, participate in modern society, and manage energy costs without facing energy poverty or undue financial strain. This encompasses an ecosystem of factors, including the cost of energy, energy usage, the efficiency of end uses, access to modern energy technologies, and the impact of policies and rate structures. I have developed a separate Appendix wherein I suggest a definition of energy affordability and a framework for thinking about the landscape of contributing factors. See "Defining Energy Affordability" by Dr. Destenie Nock in the Appendix.

2. **The Report and subsequent analyses should utilize additional demographic designations**
    - The Report should incorporate more detailed demographic data, particularly for racial and age groups, when analyzing the impact of energy rates on household electrification efforts. Currently, the analysis focuses on analyzing rate impacts across income and housing types, including units that are rented versus owned. Yet, various racial and age groups – for instance, households with children under 5 and households necessitating medical devices – experience unique challenges, particularly when they intersect with the low-income category. Thus, race and age should be considered explicitly (in addition to income) when evaluating affordability and equity outcomes.[72] For instance, in the U.S., Black, Indigenous, and People of Color (BIPOC) populations are younger than the White population (based on the U.S.

[72] There is evidence that living in minority communities often means there is limited access to energy technologies and resources. *See*: Reames, T. G. (2016). A community-based approach to low-income residential energy efficiency participation barriers. Local Environment, 21(12), 1449-1466; Sunter, D. A., Castellanos, S., & Kammen, D. M. (2019). Disparities in rooftop photovoltaics deployment in the United States by race and ethnicity. Nature Sustainability, 2(1), 71-76.

Census Bureau).[73] In 2017, the White population is the only subgroup with people under 40 accounting for less than half of the total population and people over 60 accounting for more than a quarter of the total population (see Figure 1). Americans who are 80 and older make up 4.8% of the White population but no more than 2.5% of any other subgroup (e.g., Black, Hispanic). The lower life expectancy for BIPOC communities is one factor in the lower incomes of these populations.[74] Thus, folding in this demographic data is important in establishing a knowledge base that will allow for better policies and protections to be designed and implemented to make sure the most vulnerable homes are not left behind. Note that identifying families with children under the age of 5 is distinct from households under 40 and worth parsing out in any analysis. Both the elderly and young children are vulnerable to economic, social, and environmental shocks.

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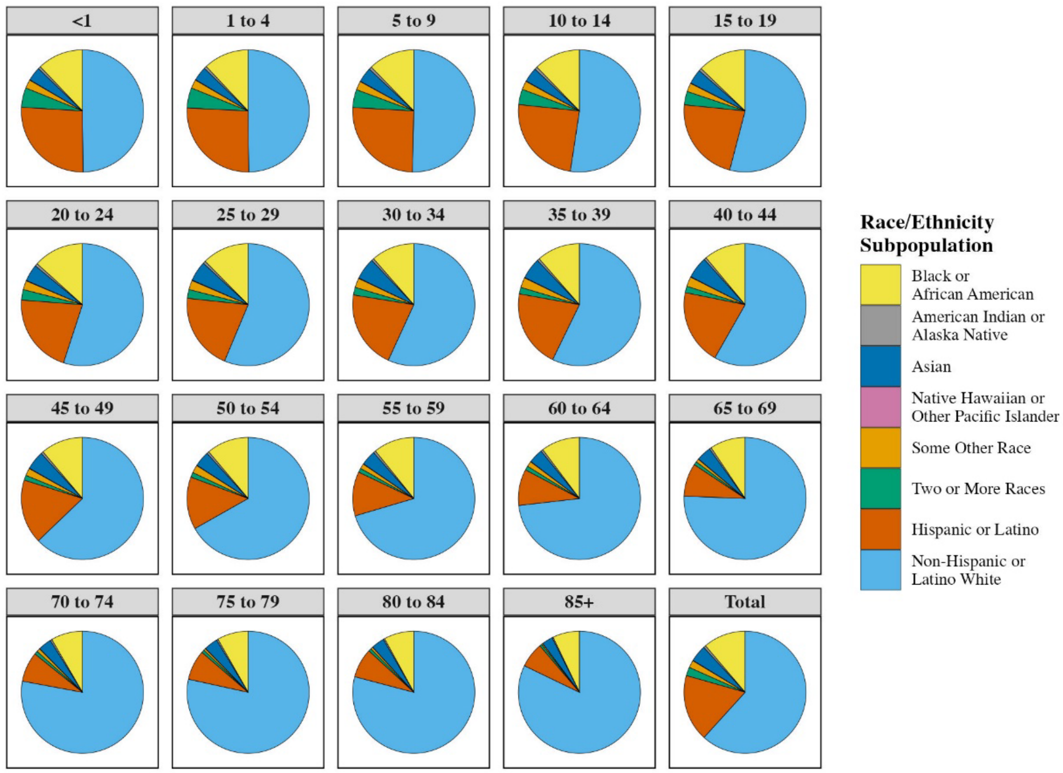
[73] This information was sourced from Dennin et al. (under review) which analyzed census data. Data source: U.S. Census Bureau. American Community Survey (ACS). *Census.gov: Our Surveys & Programs* https://www.census.gov/programs-surveys/acs.

[74] When looking at the intersection of race, ethnicity and class, scholars have found that persons at these intersections can have challenges overcoming procedural, distributive and intergenerational equity barriers. Sources: Brown, M. A., Soni, A., Lapsa, M. V., Southworth, K., & Cox, M. (2020). High energy burden and low-income energy affordability: conclusions from a literature review. Progress in Energy, 2(4), 042003; Carley, S., & Konisky, D. M. (2020). The justice and equity implications of the clean energy transition. Nature Energy, 5(8), 569-577.

Figure 1: Racial categories by age group for the US.[75]



- To fill this gap, I recommend that income, age, and race information from households across utility service territories be collected using survey or census data. This can be done through utilities themselves, or in partnership with third parties (companies, analysts, or university researchers). Surveys, similar to the surveys conducted by utilities in other jurisdictions,[76] would be the gold standard because this would allow for the analysis of the intersection of race, age, and income. Detailed household information can also be captured by utilities when new forms or enrollment are made for various reasons. In the absence of survey data, the utilities or state agencies can

[75] The data was sourced from the US Census, and the chart was sourced from Dennin, Luke, Destenie Nock, Nicholas Z. Muller, Medinat Akindele, Peter J. Adams. “Supplementary Information: Modeling wildland fire smoke damages in the U.S. and unpacking impact disparities by social vulnerability” (2025). In Press.
[76] Cong, S., Nock, D., Qiu, Y. L., & Xing, B. (2022). Unveiling hidden energy poverty using the energy equity gap. *Nature Communications*, *13*(1), 2456.

connect household information to census demographics. If census data is not available, then zip code data can be used. For an example of using locational data, see Huang et al. 2023.[77]

- Once this additional demographic information is available, it should be used to investigate multiple risks across households (e.g., inability to heat and cool homes, energy limiting behavior, and the level of energy burden (i.e., spending on energy bills)).[78] This data investigation can be conducted by the utilities (at the direction of the DPU) or the DPU itself, in collaboration with another third party. Bill data should be tied with individual risk metrics by linking address, income, and demographic information, and identifying disparities in energy usage and spending habits across income and demographic groups. When identifying energy limiting behavior, high-income groups should be used as a baseline for energy usage across outdoor temperatures since these high-income households are less likely to have a budget constraint on energy spending habits, and thus would prioritize comfort and safety

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[77] Huang, L., Nock, D., Cong, S., & Qiu, Y. L. (2023). Inequalities across cooling and heating in households: Energy equity gaps. *Energy Policy*, *182*, 113748. https://www.sciencedirect.com/science/article/pii/S0301421523003336.

[78] Cong, S., Nock, D., Qiu, Y. L., & Xing, B. (2022). Unveiling hidden energy poverty using the energy equity gap. *Nature Communications*, *13*(1), 2456; Kwon, M., Cong, S., Nock, D., Huang, L., Qiu, Y. L., & Xing, B. (2023). Forgone summertime comfort as a function of avoided electricity use. *Energy Policy*, *183*, 113813; Huang, L., Nock, D., Cong, S., & Qiu, Y. L. (2023). Inequalities across cooling and heating in households: Energy equity gaps. *Energy Policy*, *182*, 113748; Brown, M. A., Soni, A., Lapsa, M. V., Southworth, K., & Cox, M. (2020). High energy burden and low-income energy affordability: conclusions from a literature review. Progress in Energy, 2(4), 042003; Scheier, E., & Kittner, N. (2022). A measurement strategy to address disparities across household energy burdens. Nature Communications, 13(1), 288.

over minimizing bill spending.[79] The gap in cooling and heating use (i.e., energy limiting behavior and the energy equity gap)[80] as well as energy burden thresholds should be used to identify the risks. These risk metrics should be calculated at the individual level, which can then be used to target interventions and distribute information to customers about incentives and programs.

3. **The Commonwealth should ensure there are robust protections for low- and moderate-income households**

   - Households with low- to moderate-incomes (LMIs) need protections against high rates, particularly given that electrification (e.g., switching from natural gas to electric heating, adopting electric vehicles) can raise overall energy expenses. Specific rate structures or discounts should be available to protect these households from increased financial strain. I note that the DPU supports the use of tiered discount rates and has approved a tiered discount rate for National Grid.[81] I think that the Report has good recommendations for differentiating seasonal rates, but there should be more emphasis for moving extreme temperature expenses (winter and summer) to less extreme seasons (spring and fall) to help households maintain

[79] *See* the work of Dr. Nock in her papers detailing energy limiting behavior. YouTube: https://www.youtube.com/watch?v=F2ps44sAiI8
Academic paper: Huang, L., Nock, D., Cong, S., & Qiu, Y. L. (2023). Inequalities across cooling and heating in households: Energy equity gaps. Energy Policy, 182, 113748.

[80] https://www.nature.com/articles/s41467-022-30146-5

[81] The National Grid tiered discount contains 5 tiers, with the highest being up to a 71% discount. *See* Executive Summary for D.P.U. 23-150 (National Grid Rate Case): https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/19692111; The DPU selected tiered discount rates (TDRs) for further investigation in D.P.U. 24-15: https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/19692111.

consistent bills. This is similar to balanced billing, where the utility charges a household the same amount every month of the year, with annual adjustments based on consumption and rates. To enhance the uptake of low-income households using balanced billing, there should be direct and targeted marketing to vulnerable households. E3's analysis finds that over a full year, there are net savings with the seasonal heat pump rate, as opposed to just moving costs from one season to another. Pairing seasonally differentiated rates with low-income discount rates, including tiered structures that have been approved and considered recently in the Commonwealth,[82] can provide some protection. However, some households may need additional protections during the energy transition, such as bill caps.

- I also recommend that the DPU rethink the existing fixed and volumetric charges[83]. I support introducing a non-bypassable fixed charge for public benefits that would ensure stable and equitable funding for crucial programs that support the Commonwealth's energy, affordability, and decarbonization goals (such as Mass Save and low-income discount rates), while also eliminating a key barrier to electrification. This would ensure that all customers, independent of increases or decreases in usage, contribute fairly to the cost of these programs. I note that a non-bypassable fixed charge, even for public benefits, may increase energy burden for

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[82] I understand that the MA DPU recently approved a tiered discount rate in D.P.U. 23-150, and has indicated interest in further considering tiered structures in D.P.U. 24-15.

[83] Fixed charges should include fixed infrastructure (i.e., distribution and transmission system charges) and the costs for important programs like Mass Save energy efficiency or low-income discounts. Volumetric charges should be based on variable costs.

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LMI, so this option should be compared against the total cost to households for the volumetric charges. I note that in Massachusetts, by law, the costs associated with on-site generation are supposed to be explicitly tied to affordability for low-income customers.

4. **The DPU should support data-driven methods to assess rate impacts, and to target programs and program designs to alleviate burdens for at-risk customers**
   - The Report did a nice job of looking into different housing types and investigating how electric heat pumps and electric vehicles will add to a household's energy burden (i.e., the percent of income spent on energy bills).[84] To enhance future analyses, I recommend utilizing data-based methods, such as monthly billing data or advanced metering infrastructure (AMI) data, to determine the rate impact on low-income and at-risk customers specifically (rather than only focusing on housing and fuel types).[85] In the Report, there is a good analysis on housing types using modeling, and this can be enhanced by benchmarking this against actual energy usage and bill data from energy utilities. Such data could identify households struggling to maintain safe

[84] Simcock, N., Jenkins, K. E., Lacey-Barnacle, M., Martiskainen, M., Mattioli, G., & Hopkins, D. (2021). Identifying double energy vulnerability: A systematic and narrative review of groups at-risk of energy and transport poverty in the global north. Energy Research & Social Science, 82, 102351.

[85] Huang, L., Nock, D., Cong, S., & Qiu, Y. L. (2023). Inequalities across cooling and heating in households: Energy equity gaps. *Energy Policy*, *182*, 113748.; Peoples Energy Analytics is also a company that can be used as an example of using AMI and monthly data to identify affordability gaps, and they deploy targeted marketing.

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indoor temperatures during extreme weather periods (winter[86] or summer[87]). A data-driven approach will ensure that affordability interventions target those most affected by unaffordable bills.

- AMI will also allow for greater visibility into price responsiveness across income groups once time-varying rates (TVR) are rolled out. This will allow analysts, utilities, and the DPU to see if low-income households are getting hit hardest by on-peak pricing (especially during extreme weather events when poor insulation in combination with high heating/cooling loads and high on-peak rates have a compounding effect on household spending needs).
- I recommend that the types of data-driven efforts be expanded to directly target and message consumers who are estimated to be at-risk. This can be done using e-mail, text messaging, and in-app messages.[88] In addition, people who are at-risk often have other touchpoints outside of the utility that can be helpful. For example, targeting households with young children can mean direct messaging collaborations with the Department of Health and Education, as well as hospitals. For at-risk adults with

[86] Huang, L., Nock, D., Cong, S., & Qiu, Y. L. (2023). Inequalities across cooling and heating in households: Energy equity gaps. *Energy Policy*, *182*, 113748. https://www.sciencedirect.com/science/article/pii/S0301421523003336

[87] Cong, S., Nock, D., Qiu, Y. L., & Xing, B. (2022). Unveiling hidden energy poverty using the energy equity gap. *Nature Communications*, *13*(1), 2456. https://www.nature.com/articles/s41467-022-30146-5; Kwon, M., Cong, S., Nock, D., Huang, L., Qiu, Y. L., & Xing, B. (2023). Forgone summertime comfort as a function of avoided electricity use. *Energy Policy*, *183*, 113813. https://www.sciencedirect.com/science/article/pii/S0301421523003981.

[88] For an example of this suggestion, *see* Peoples Energy Analytics, which directly messages at-risk customers using monthly and daily energy usage data, for an estimated cost of less than a penny per household. http://www.PeoplesEnergyAnalytics.com.

equipment, connections to social workers, hospitals, and/or clinics, pharmacies and medical supply stores can be great ways to capture their attention.

- To ensure that data on new rates is used to inform future electrification efforts and affordability programs, analyses should be conducted to identify energy limiting behavior and energy insecurity within individual households across heating and cooling seasons for those enrolled and not enrolled in the seasonal heat pump rate. I recommend that the utilities (at the direction of the DPU) or the DPU itself, in collaboration with another third party, conduct an analysis using available energy usage data (monthly or daily level) at the individual household level for all households in the region. The analysis should include three years of energy usage prior to when the customer was enrolled in the seasonal heat pump rate and then be conducted periodically over the course of the first five years of implementation to investigate affordability impacts. This will demonstrate how household energy usage shifts with rate changes, seasons, and technology changes. Monthly data is sufficient, but to the extent AMI meters are installed and operating, daily or hourly energy usage information should be used. The utilities should use meter (and eventually AMI) energy usage data along with available income and demographic data to identify the risk types that households face, and then communicate opportunities for electrification and reduction of financial burdens to these households. Then, utilities should use direct-to-household channels (e-mail, texting, in-app messages) to communicate about programs that benefit low-income and at-risk households, targeting affordability programs for individual households based on their needs and risk types.

5. **The utilities, the DPU, and the Commonwealth should take a Holistic View of Housing-Related Energy Burdens**
    - A comprehensive view of energy burdens, energy limiting behavior, and how higher rates may cause households to use less electricity is essential. Housing quality issues, such as poor insulation or leaky windows, contribute to higher energy costs and exacerbate the financial burden on households. I appreciate that the analysis in the Report modeled housing structures of different ages. It would be great if this type of information could be used to identify how electricity rates should change by housing type, housing infrastructure, and/or income group. Rates could have consumption thresholds for different discount levels for income-eligible ratepayers. Addressing these housing-related barriers to affordability as part of a comprehensive electrification strategy can improve access to energy efficiency measures, reducing energy usage for households in the long term, thereby enhancing energy affordability overall.
6. **The utilities, the DPU, and the Commonwealth in general should take an integrated approach for supporting at-risk customers**
    - The utilities, the DPU, energy efficiency program administrators, and the Commonwealth more generally should take a holistic approach to support at-risk customers, particularly those who are the main targets of electrification initiatives. The Report investigates housing types and low-income homes, which is a good start.

Moving forward, this type of analysis could inform multi-faceted assistance, combining rate protections, home efficiency improvements, and targeted outreach to ensure ratepayers can participate in electrification without financial strain. Particularly, targeted marketing will provide a streamlined, cost-effective way to make sure households have adequate information about their electrification and affordability options.

7. **Support for upfront costs of fuel-switching**
    - While the Near-Term Report addressed the operational costs of electrification in great detail, I think there is an opportunity to more robustly address the fact that upfront costs will continue to be a large factor in whether low- to moderate-income households can electrify. In Massachusetts, there are generous incentives for subsidizing heat pumps – 100% of costs are covered for low-income households. The utilities and energy efficiency program administrators should use targeted marketing (see above recommendations for more detail) to make sure people are aware of these incentives, as well as new rate designs and affordability programs. In addition, moderate-income homes should be included in this heat pump benefit. This support can help make electrification more accessible and affordable for a broader range of income levels.

Conclusion The recommendations provided here aim to strengthen the Near-Term Rates Strategy Report by making it more equitable, data-informed, and focused on long-term energy affordability. I have also discussed broader recommendations on how vulnerable ratepayers can be provided more robust support as the Commonwealth works to meet its electrification goals. By adopting these recommendations, the transition to electrification can become more accessible and sustainable for all households, particularly those most vulnerable to rising energy costs and energy-related hardships.

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Defining Energy Affordability

Destenie Nock, PhD

In my feedback to the IRWG on the Near-Term Rate Strategy Report, I recommended that the work should include a clear definition of energy affordability. I developed the definition presented here to support the work of the Massachusetts Interagency Rates Working Group (IRWG) in their consideration of near- and long-term electricity rates that support decarbonization. In this report I detail a proposed framework for a comprehensive definition of energy affordability. I then enumerate the components that contribute to it, and the data sources, data challenges, and data needs for each component.

Definition

Energy affordability ensures that households can access the energy they need to maintain comfortable living conditions, participate in modern society, and manage energy costs without facing energy poverty or undue financial strain.[89] This means having access to enough reliable, clean energy to meet essential needs such as heating, cooling, lighting, cooking, and powering appliances, while still having sufficient financial resources to cover other living expenses.[90] Energy affordability

[89] Brown, M. A., Soni, A., Lapsa, M. V., Southworth, K., & Cox, M. (2020). High energy burden and low-income energy affordability: conclusions from a literature review. Progress in Energy, 2(4), 042003; Scheier, E., & Kittner, N. (2022). A measurement strategy to address disparities across household energy burdens. Nature Communications, 13(1), 288; Heindl, P., & Schüssler, R. (2015). Dynamic properties of energy affordability measures. Energy Policy, 86, 123-132; Cong, S., Ku, A. L., Nock, D., Ng, C., & Qiu, Y. L. (2024). Comfort or cash? Lessons from the COVID-19 pandemic's impact on energy insecurity and energy limiting behavior in households. Energy Research & Social Science, 113, 103528.
[90] Welsch, H., & Biermann, P. (2017). Energy affordability and subjective well-being: Evidence for European countries. The Energy Journal, 38(3), 159-176; Also, *see* the United Nations Sustainable Development Goal 7. https://sdgs.un.org/goals/goal7

also necessitates a balanced approach, where the cost of energy is reasonable relative to household income and individual circumstances, preventing individuals from having to choose between paying for energy and other basic needs like food, healthcare, or housing.[91] Conversely, energy is not affordable if the cost of energy influences an individual's ability to heat and cool their home to avoid adverse health risks.

Energy affordability encompasses an ecosystem of factors, including: the cost of energy bills, the efficiency of energy end uses, access to modern energy technologies, and the impact of policies and rate structures.[92] Further, energy affordability is influenced by factors such as rate structures, household income, location, energy-efficient infrastructure, and equitable access to renewable energy solutions.[93] One method to measure energy affordability is to calculate the percent of income (energy burden) a household spends to maintain an adequate level of warmth or cooling.[94] The World Health Organization recommends indoor temperatures of 70°F (21°C) in living rooms and 64°F (18°C) in other occupied rooms during daytime hours.[95] I note that currently in the U.S. the energy burden

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[91] Miniaci, R., Scarpa, C., & Valbonesi, P. (2014). Energy affordability and the benefits system in Italy. Energy Policy, 75, 289-300; Carley, S., Graff, M., Konisky, D. M., & Memmott, T. (2022). Behavioral and financial coping strategies among energy-insecure households. Proceedings of the National Academy of Sciences, 119(36); Hernández, D. (2016). Understanding 'energy insecurity' and why it matters to health. Social science & medicine, 167, 1-10.

[92] Hernández, D., & Bird, S. (2010). Energy burden and the need for integrated low-income housing and energy policy. Poverty & public policy, 2(4), 5-25.

[93] Simcock, N., Jenkins, K. E., Lacey-Barnacle, M., Martiskainen, M., Mattioli, G., & Hopkins, D. (2021). Identifying double energy vulnerability: A systematic and narrative review of groups at-risk of energy and transport poverty in the global north. Energy Research & Social Science, 82, 102351.

[94] In her 1991 book, Fuel Poverty: From Cold Homes to Affordable Warmth, Brenda Boardman introduced the concept of fuel poverty, defining it as a household needing to spend more than 10% of its income to maintain adequate warmth. Currently in the U.S. the affordability threshold is often set to 4-6% of income. Citation: Boardman, B. (1991). Fuel poverty: from cold homes to affordable warmth.

[95] The World Health Organization has many recommendations for indoor temperatures. They highlight that cold indoor temperatures are often a consequence of outdoor temperature, structural deficiencies, including

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affordability threshold is often set to 4-10% of income[96] and that energy burden often does not include a temperature indicator.[97] Thus, I suggest including energy limiting behavior metrics,[98] in addition to energy burden, to paint a more holistic measure of energy affordability.

Components of Affordability

Energy affordability encompasses several key components, all of which interrelate to energy bills, energy usage, and the technologies employed to produce and manage energy. Here are the primary components:

1. Energy Costs (Energy Bills)

- **Rate Structures**: The way utilities structure pricing, such as inclining block rates (where higher usage results in higher per-unit costs), time-of-use (TOU) rates (where prices vary based on timing of peak demand), seasonal rates (where bills can be very high in winter or

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a lack of insulation and airtightness, and lack of heating. As outlined in this chapter, cold indoor temperatures have been associated with increased blood pressure, asthma symptoms and poor mental health. *See* https://www.who.int/publications/i/item/9789241550376

[96] Brown, M. A., Soni, A., Lapsa, M. V., Southworth, K., & Cox, M. (2020). High energy burden and low-income energy affordability: conclusions from a literature review. Progress in Energy, 2(4), 042003; Cook, J. J., & Shah, M. (2018). Reducing energy burden with solar: Colorado's strategy and roadmap for states (No. NREL/TP-6A20-70965). National Renewable Energy Lab. (NREL), Golden, CO (United States).

[97] In addition to lacking temperature analysis, most energy burden studies do not analyze household spending on transportation energy or water services. In addition, these energy burden studies do not tend to include different sources of financial support. From 2013–2014, household energy burdens were estimated to be 16.3% for low-income households and 3.5% for non-low-income households. Sourced from: Eisenberg, J. F. (2014). Weatherization assistance program technical memorandum background data and statistics on low-income energy use and burdens (No. ORNL/TM-2014/133). Oak Ridge National Lab. (ORNL), Oak Ridge, TN (United States).

[98] Cong, S., Nock, D., Qiu, Y. L., & Xing, B. (2022). Unveiling hidden energy poverty using the energy equity gap. Nature communications, 13(1), 2456; Huang, L., Nock, D., Cong, S., & Qiu, Y. L. (2023). Inequalities across cooling and heating in households: Energy equity gaps. Energy Policy, 182, 113748; Cong, S., Nock, D., Laasme, H., Qiu, Y. L., & Xing, B. (2023). Understanding energy limiting behavior in different climate zones: case studies of three utility service regions. https://www.researchsquare.com/article/rs-3361275/v1

summer months and lower in spring and fall months), or fixed rates, can significantly affect affordability.[99] Rate design, for instance, can disproportionately negatively affect households that use less energy but pay a higher percentage of their income on fixed charges, such as if they are low- or moderate-income, or on a fixed income. Additionally, rate design can also hurt certain vulnerable households if they are higher energy consumers (for instance, due to using resistance heating, having many occupants in the home, and/or having a low-quality housing unit), or if the consumer struggles to adequately manage bill volatility across seasons (e.g., energy bills are higher in winter and summer, than in spring or fall) due to inflexible loads.

- **Energy Poverty Stemming from Financial Strain**: Households are often considered energy poor when they spend a large proportion of their income on energy bills, typically defined as over 6-10% of household income, and when they are under consuming energy to the point where they place themselves at a health risk (i.e., energy limiting behavior or energy insecurity).[100] Therefore, households can be at risk of energy poverty if they have low- or moderate-income, fixed-income, or single-income, or based on usage (such as medical devices, disabilities, or working hours/living situation). Energy poverty is characterized by, for

[99] Miniaci, R., Scarpa, C., & Valbonesi, P. (2014). Energy affordability and the benefits system in Italy. Energy Policy, 75, 289-300.
[100] Brown, M. A., Soni, A., Lapsa, M. V., Southworth, K., & Cox, M. (2020). High energy burden and low-income energy affordability: conclusions from a literature review. Progress in Energy, 2(4), 042003.

instance, an increase in utility disconnections, and a decrease in adequate indoor temperature regulation (i.e., energy limiting behavior),[101] causing adverse health risks.[102]

- **Subsidies and Assistance Programs**: Programs like the Low-Income Home Energy Assistance Program (LIHEAP, renamed HEAP in Massachusetts), utility discount rates, or utility bill arrearage management programs can help reduce the burden of energy bills for low-income households.

2. Energy Usage

- **Efficiency of Homes and Appliances**: Older, inefficient appliances or poorly insulated homes can lead to higher energy consumption, inflating energy bills. Increasing energy efficiency through home upgrades (like insulation, efficient lighting, and smart thermostats) can reduce overall usage and increase affordability.

  The quality of homes and appliances is heavily influenced by policies. For example, in Massachusetts energy efficiency upgrades (e.g., insultation, smart thermostats, etc.) have been incentivized through Mass Save rebates. In addition to this, strong federal appliance standards have helped ensure the efficiency of energy technologies in the home. Strict state policies regarding building codes have largely reduced the heating load. These efforts have reduced energy usage and lowered energy bills for those that are able to access and adopt

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[101] For more about energy limiting behavior, *see* research by Dr. Nock and her company. Research paper 1: Cong, S., Ku, A. L., Nock, D., Ng, C., & Qiu, Y. L. (2024). Comfort or cash? Lessons from the COVID-19 pandemic's impact on energy insecurity and energy limiting behavior in households. Energy Research & Social Science, 113, 103528; Research paper 2: Cong, S., Nock, D., Qiu, Y. L., & Xing, B. (2022). Unveiling hidden energy poverty using the energy equity gap. Nature communications, 13(1), 2456; Company work is at Peoples Energy Analytics.

[102] Sometimes these energy hardships are referred to as energy insecurity. Hernández, D. (2016). Understanding 'energy insecurity' and why it matters to health. Social science & medicine, 167, 1-10.

these technologies (e.g., homeowners) but there is still more work to be done in identifying gaps in adoption capabilities (e.g., renter populations and those in older homes).

- **Behavioral Factors**: How individuals use energy (e.g., heating/cooling practices, appliance usage habits) influences consumption. Awareness and education about structural and social barriers to energy-saving behaviors are essential for improving affordability.
- **Individual circumstances**: Energy usage varies by many lifestyle factors, some of which are dictated by circumstances not within an individual's control, making them vulnerable to energy insecurity or poverty, such as having to power medical devices, accommodate disabilities, and having to maintain an indoor temperature regulation necessary to support health and comfort.
- **Energy limiting behavior:** Households are considered to be exhibiting energy limiting behavior when they reduce their energy use to save money on bills, thereby putting themselves at risk of adverse health impacts. For example, this can include turning off working air conditioning and heating systems, being unable to fix a broken heating or cooling equipment, or being unable to purchase cooling equipment.[103] This can be considered a subset of behavior factors.[104]

[103] Huang, L., Nock, D., Cong, S., & Qiu, Y. L. (2023). Inequalities across cooling and heating in households: Energy equity gaps. Energy Policy, 182, 113748; Kwon, M., Cong, S., Nock, D., Huang, L., Qiu, Y. L., & Xing, B. (2023). Forgone summertime comfort as a function of avoided electricity use. Energy Policy, 183, 113813. https://www.sciencedirect.com/science/article/pii/S0301421523003981.
[104] Cong, S., Ku, A. L., Nock, D., Ng, C., & Qiu, Y. L. (2024). Comfort or cash? Lessons from the COVID-19 pandemic's impact on energy insecurity and energy limiting behavior in households. Energy Research & Social Science, 113, 103528. https://www.sciencedirect.com/science/article/pii/S2214629624001191.

- **Demand Side Management (DSM)**: Programs that encourage users to shift their usage to off-peak times or reduce consumption during peak times can lower overall energy costs, making energy more affordable for those that are able to participate.

3. Energy Technologies

- **Clean Energy Adoption**: In Massachusetts, there is the ability to take advantage of distributed generation (DG) and net energy metering incentive programs. Technologies like solar panels or wind energy can lower long-term energy costs, especially if paired with battery storage to manage intermittent supply. However, the upfront cost of these technologies can be a barrier for lower- and fixed-income households, and can be inaccessible to renters based on landlord uptake. I note that the Commonwealth has made significant efforts and progress in expanding access via the establishment of a variety of community solar offerings to reach these customers (e.g., renters, low-income and fixed-income) and are continually improving community solar offerings.
- **Electrification and Regenerative Energy Systems**: Shifting to electrified systems (like heat pumps, electric vehicles, and induction stoves) can reduce energy bills. There can be further savings if households also adopt on-site clean energy. Thus, Massachusetts should continue to support policies which reduce or eliminate the upfront cost of electrification appliances for low- and moderate-income households.

4. Policy and Regulation

- **Regulatory Frameworks**: Government policies, such as renewable energy incentives, energy efficiency standards, and carbon pricing, impact the affordability of energy technologies and the cost of energy for consumers. Utility regulatory frameworks and business models, such as the regulated rate of return and other incentive structures, also impact the cost of energy and impact the ability and willingness of utilities to address affordability challenges.

- **Data Sharing and Communication**: As discussed in the following section, data regarding the amount of energy households are using by location, heating and cooling systems in a home, income and demographic group, house size, occupant age, and house age could be used to understand affordability challenges across the state. However, responsive policy and regulation enables the creation and sharing of data.
- **Decarbonization Policies**: Efforts to reduce carbon emissions, such as transitioning to clean and renewable energy sources and the other enabling investments, such as the electric grid, can have mixed effects on affordability. While clean energy may be cheaper in the long term, the short-term costs of transitioning from fossil fuels can raise prices unless mitigated by subsidies or policy support.
- **Equity in Energy Transition**: Ensuring that vulnerable populations, such as lower- and fixed-income households or marginalized communities, benefit from energy transitions is essential for affordability. Without equitable access to efficiency upgrades, and improvements in the housing quality, these groups may face higher costs while others benefit from lower bills. In addition, there is concern that low-income households will be some of the last to completely electrify and phase out of the gas network. As less customers are on the natural gas network the costs of maintaining that system will be high, and thus, the electricity sector may need to supplement the final phase out of fossil fuels.

5. Local Factors

- **Geography and Infrastructure**: Energy costs vary by region due to differences in energy sources, weather patterns (which affect heating/cooling needs), and infrastructure. Remote or underserved areas may face higher energy costs due to limited access to clean, affordable energy technologies or reliance on more expensive fuel types.
- **Climate**: In colder or hotter climates, energy usage for heating and cooling is a significant component of energy bills. Efficient systems can lower costs, but the investment in those systems can be a barrier to affordability.

These components highlight the complex relationship between energy usage, technologies, and affordability, particularly for lower-income households and other vulnerable populations. Programs that combine energy efficiency, clean energy adoption, and policy support can help mitigate energy costs while promoting equitable energy use. The following figure summarizes the ecosystem of components contributing to energy affordability.

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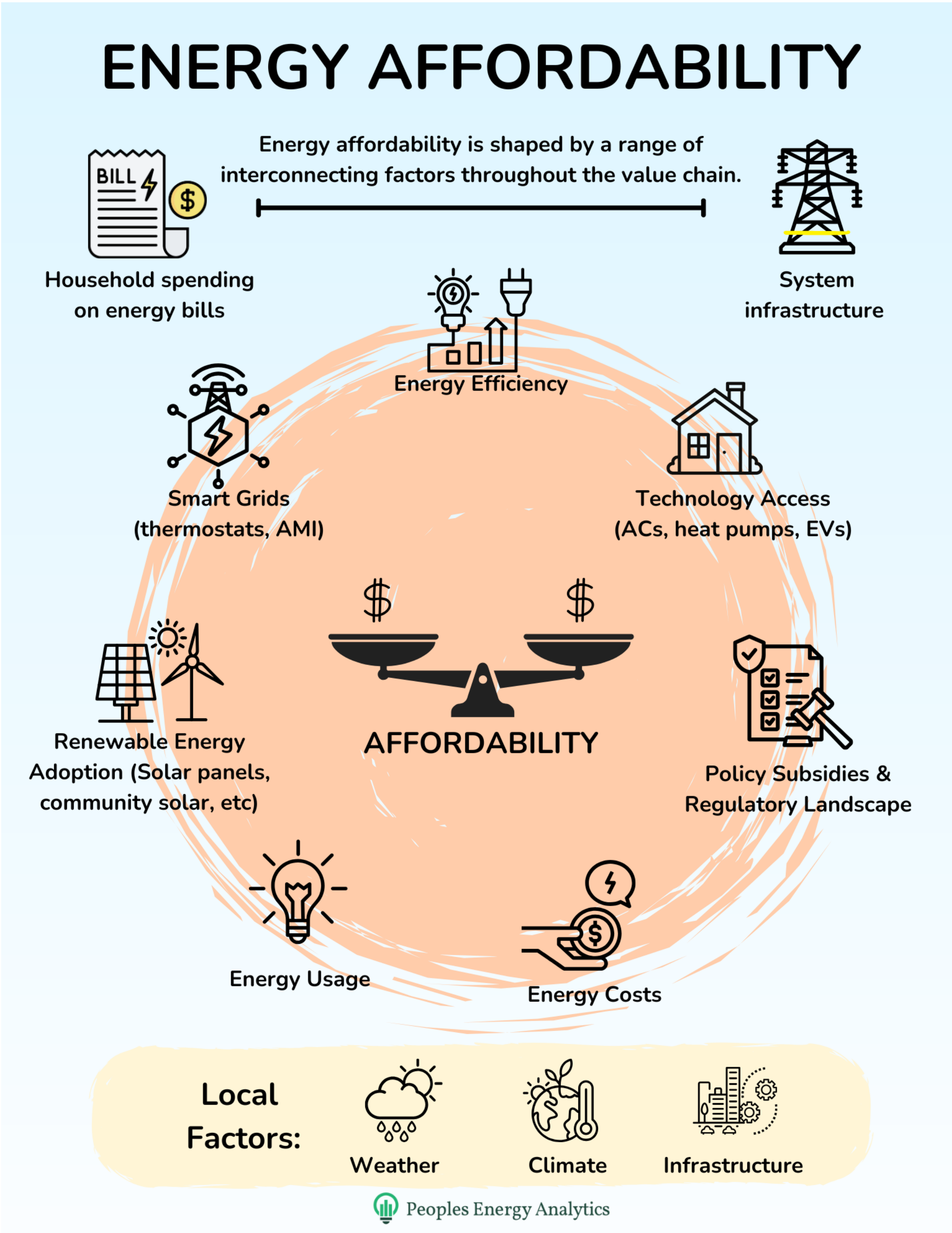

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Data Sources, Needs, and Challenges

Addressing energy affordability requires collecting, analyzing, and managing various types of data from multiple sources. Each component of energy affordability presents unique data needs and challenges. Below is a breakdown of the key data sources, data needs, and data challenges for each of the components. This data should be used to create a model of energy risks for each individual household, and to identify energy affordability challenges across a utility's territory in real time. This model would be used for an in-depth system analysis which would then allow regions, regulators, utilities, and community advocates to understand how the energy system, or changes to the system impacts individuals. The measured impacts should include energy bill spending relative to other household expenses (i.e., energy burden adjusted for cost of living),[105] thermal comfort and safety (i.e., energy limiting behavior), as well as infrastructure deficits and needs.

1. Energy Costs (Energy Bills)

Data Sources:

- **Utility Bills**: Monthly or annual billing data from energy providers and utilities.
- **Rate Structures**: Public records from utilities or government agencies on pricing mechanisms (e.g., tiered rates, time-of-use rates).
- **Census and Economic Data**: Information on household income and demographics (e.g., U.S. Census Bureau, Eurostat).

[105] Zhang, J., Nock, D., & Li, X. (2024). Ignoring cost of living misses the true level of energy burden.

- **Subsidy and Assistance Program Data**: LIHEAP data, utility discount programs, or energy subsidies information.

Data Needs:

- Accurate data on household energy consumption and costs over time.
- Information on energy pricing structures and how they vary by region and customer class.
- Household income levels to measure energy burden (i.e., the percentage of income spent on energy).

Data Challenges:

- **Multiple sources of energy use**: Electricity bills do not encompass all energy costs, which is increasingly true as end uses such as transportation electrify. Access to bill data for all energy uses would increase accuracy and understanding, such as the cost of delivered fuels and transportation fuels.
- **Privacy Concerns**: Access to individual household energy bills and income data may be restricted due to privacy protections.
- **Inconsistent Reporting**: Energy bills may be reported differently across utilities, making it hard to compare data.
- **Hidden Costs**: Fees, taxes, or other charges on energy bills may vary, obscuring actual costs.

2. Energy Usage

Data Sources:

- **Meters**: Ideally real-time data from utilities on energy consumption at the daily, hourly, or sub-hourly timescale. If AMI has not been deployed, then monthly meter data can be used.
- **Surveys and Household Energy Audits**: Surveys on appliances, insulation, heating/cooling systems, and behavior (e.g., Residential Energy Consumption Survey).
- **Building Codes, Characteristics, and Standards**: Data on building materials, insulation, age, size, location, energy efficiency codes, and other building characteristics.

Data Needs:

- Real-time or near-real-time energy consumption data at the household and appliance level. The ideal time step is energy usage at the daily or sub-hourly timescale. If AMI has not been deployed, then monthly meter data can be used.
- Data on energy efficiency of buildings, appliances, and HVAC systems.
- Behavioral data on how households use energy and make decisions about the use of energy.

Data Challenges:

- **Access to Meter Data**: Utility companies may not share detailed consumption data due to privacy concerns.
- **Self-Reported Data**: Surveys may rely on self-reported information, which can be inaccurate or incomplete.

- **Granularity**: Getting detailed, appliance-level usage data can be difficult and costly. To overcome this hurdle load disaggregation devices and software can be used.

3. Energy Technologies

Data Sources:

- **Clean and Renewable Energy Installations**: Data on solar panels, wind turbines, and battery storage systems (e.g., National Renewable Energy Laboratory databases) at the household and community level. (i.e., utility scale).
- **Smart Grid Infrastructure**: Data from utility companies on grid modernization systems and device deployments, and grid capabilities.
- **Energy Performance Data**: Manufacturer and third-party performance reports on energy-efficient appliances and systems.

Data Needs:

- Data on the cost, performance, environmental impacts, and lifespan of clean energy systems and energy-efficient appliances.
- Adoption rates and distribution of renewable energy technologies across different income groups and geographies. This would include which homes have installed this technology behind the meter, and which community scale projects have been established.
- Data on incentives or subsidies for energy technologies.

Data Challenges:

- **Upfront Costs**: Data on actual installation and maintenance costs can be difficult to obtain.

- **Equitable Access**: Gathering data on how technology adoption varies across socio-economic groups and regions.
- **Technology Integration**: Data on how new technologies integrate with existing energy systems and the challenges of scaling these technologies.

4. Policy and Regulation

Data Sources:

- **Government Energy Reports**: Regulatory filings, government databases, and energy commission reports (e.g., Department of Energy, Federal Energy Regulatory Commission).
- **Utility and Policy Databases**: e.g., DSIRE (Database of State Incentives for Renewables & Efficiency), state public utility commission records.
- **Energy Poverty and Assistance Program Data**: Data from agencies managing energy assistance programs (e.g., LIHEAP and WAP).

Data Needs:

- Comprehensive data on energy policies, subsidies, and assistance programs at local, state, tribal, and federal levels.
- Data on the impact of regulatory changes on energy prices and affordability.
- Information on policy-driven technology adoption (e.g., subsidies for solar panels or energy efficiency upgrades).

Data Challenges:

- **Timeliness**: Policies change frequently, and there can be a delay in the availability of up-to-date data.
- **Quantifying Impact**: Measuring the direct impact of policies on household affordability is complex and often indirect.

5. Local Factors (Geography, Climate, Infrastructure)

Data Sources:

- **Weather and Climate Data**: Data on temperature patterns, heating degree days, cooling degree days (e.g., NOAA, local weather stations).
- **Geospatial Data**: Geographic Information Systems (GIS) data on energy infrastructure, remote or underserved areas, and access to different energy technologies like solar panels, EV charging infrastructure. Data sources can include satellite data, and local surveys.
- **Census and Demographic Data**: Information on population density, household composition, and regional economic data (e.g., U.S. Census Bureau).

Data Needs:

- Regional data on energy demand influenced by weather (heating/cooling needs) and infrastructure (housing quality/age, insulation, grid reliability, renewable sources). This is partially addressed by E3's HEEM analysis (which uses ResStock),[106] and can be enhanced by benchmarking against utility data, once it becomes available.

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[106] HEEM stands for Household Energy Expenditure Model. *See* E3's Near-Term Rate Strategy Report.

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- Data on regional fuel types and energy costs.
- Local data on building efficiency and the adoption of energy-efficient technologies by census track. Ideally the adoption of energy efficiency appliances would be captured at the building/household level so it can be paired with energy usage data from energy utilities. In the absence of available building data, this can be modeled with trends and averages using models like NREL's ResStock.

Data Challenges:

- **Regional Disparities**: Energy usage and needs vary significantly across geographic locations, making data comparison challenging.
- **Weather Volatility**: Unpredictable weather events can make energy needs fluctuate dramatically.
- **Infrastructure Limitations**: Data on energy infrastructure in rural or underserved areas may be incomplete or outdated. Energy infrastructure can include availability of high-quality internet in the area (necessary for interacting with smart thermostats, participating in demand response, and some distributed generation technologies).

Overall Data Challenges Across All Components:

- **Data Silos**: Many data sources (utility, demographic, technology, policy) are siloed and not easily integrated, which limits the ability to assess affordability holistically.
- **Privacy and Accessibility**: Individual household data on energy usage and income is often private and accessing detailed consumption data can be restricted by utilities or regulators.

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- **Data Granularity**: Many datasets lack the granularity needed to provide actionable insights at a household level, such as specific energy use behaviors, appliance performance, or the precise impact of subsidies.
- **Data Collection Costs**: Collecting detailed, real-time data on energy usage and technology adoption is expensive and resource intensive.

Conclusion

By addressing these data needs and overcoming the associated challenges, researchers and policymakers can better understand and improve energy affordability, especially for vulnerable populations. My objective with highlighting all of the data needs and challenges is not to say that this effort is insurmountable, but rather, that affordability is multidimensional and complex. There are multiple opportunities for improving affordability efforts in the region, and here the goal is to highlight the opportunities to use data to spur progress towards energy affordability goals. By knowing the challenges, goals, and data opportunities the region can better design the solutions needed to ensure energy is affordable for every household.

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