Interagency Rates Working Group Study

Near-Term Rates Report

August 12, 2024

Energy+Environmental Economics

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Outline

+ **Study Context**
  - Understanding electricity bills today
  - Interagency Rates Working Group (IRWG) rate design study deliverables
  - Key research questions
+ **Methodology Overview**
  - Household Energy Expenditure Model (HEEM) model description
  - Customer energy usage today
+ **Energy Burden in Low-Income Homes Today**
+ **Exploring Energy Bills with Today's Rates**
+ **Near-Term Rate Design**
+ **Exploring Energy Bills with Alternative Rates**
+ **Implementation Considerations and Key Takeaways**
+ **Appendix**

Executive Summary

- **Building electrification with existing electric rates leads to higher energy bills for many households, especially those heated by natural gas**
- **Low-income households, especially those living in older, electric resistance heated homes, face high energy burdens today**
  - Utility bill discount programs and state/federal bill assistance programs help reduce this burden
  - Shell improvements reduce heating and cooling demand, and can both reduce bills today and bill increases from electrification
- **Vehicle electrification reduces customer energy expense, but not enough to offset bill increases for building electrification**
  - Existing rebates for managed charging provide relatively small savings (~$9 / month / vehicle)
- **Higher fixed charges, seasonal variation, and declining block structures are promising alternatives to existing high volumetric rate structures:**
  - All options better align rates with utility costs of service, provide varying price signals to encourage building electrification, and have limited impacts on non-electrifying households, but face unique challenges
- **Technology-specific rates allow for larger changes to volumetric rates and yield significant bill savings under electrification**

Study Context

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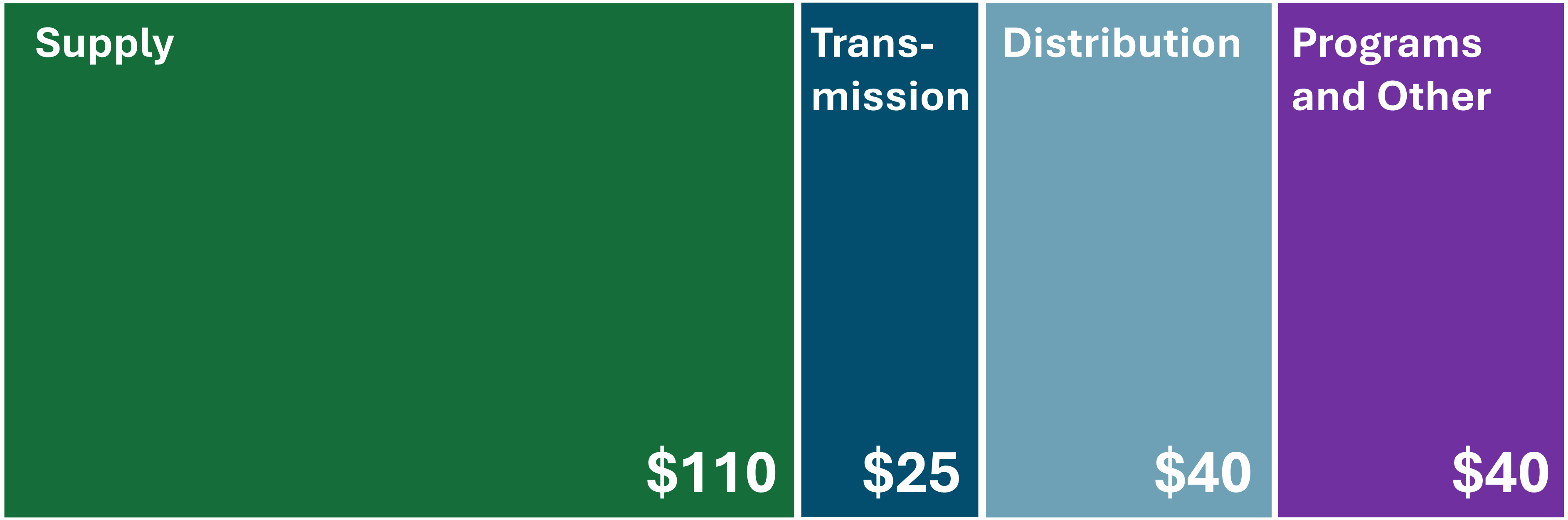
Electric bills cover costs of grid hardware, supporting labor, program funding, and electricity itself

Example monthly electricity bill, 600 kWh/month customer
$/month

Total bill: $215

Cost of building and operating transmission system connecting generators & distribution systems
Service provided by: Utilities, ISO-NE



Funding for bill assistance, energy efficiency, clean energy, etc.
Service provided by: Variety of state and utility programs

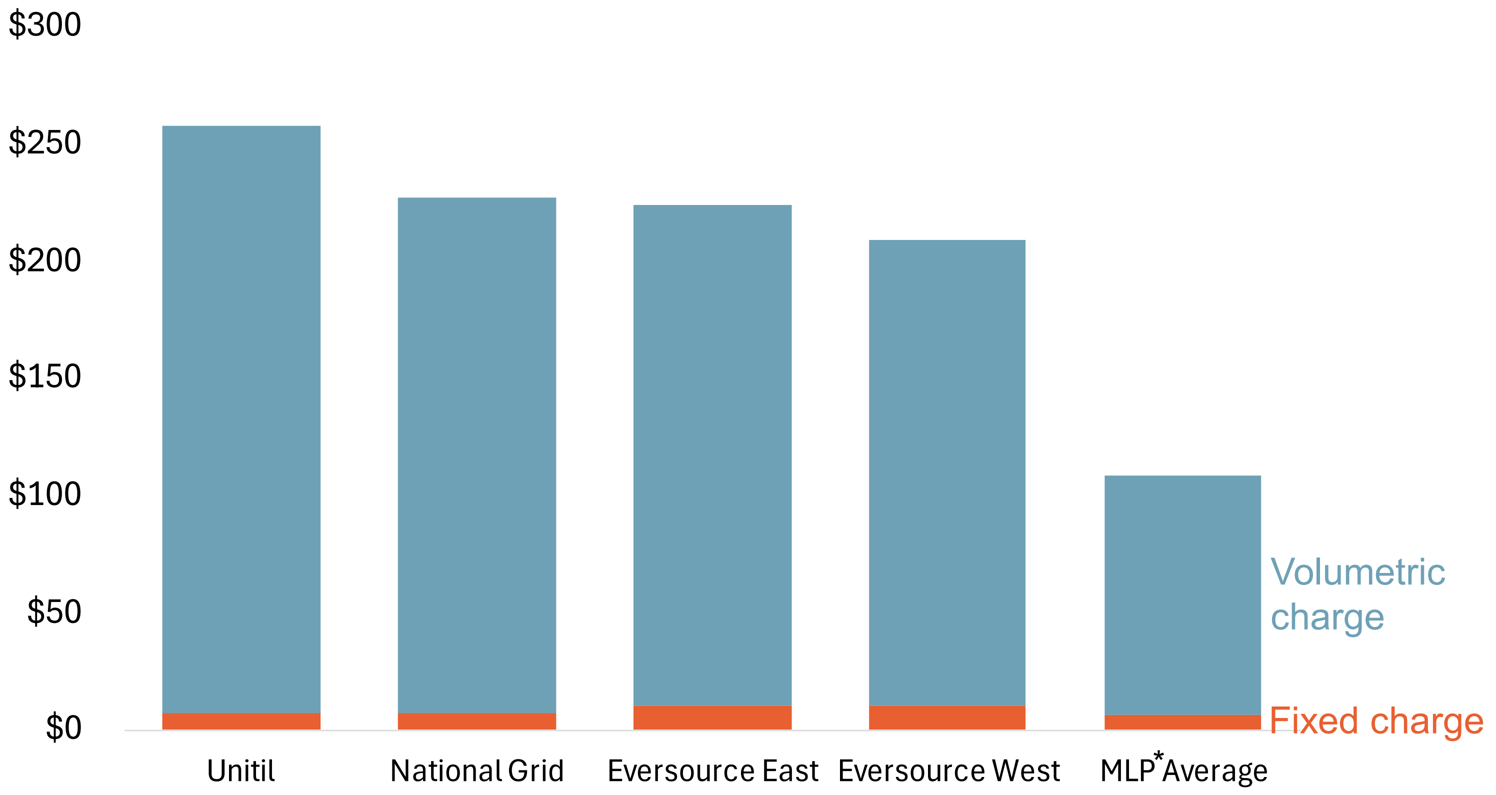
Wholesale cost of electricity generated or procured
Service provided by: Utilities, municipal aggregation, or competitive supply

Cost of building and operating distribution system delivering electricity to homes and businesses
Service provided by: Utilities

Electric rates recover costs through a combination of fixed and volumetric charges

- **Residential electric rates are composed of volumetric ($/kWh) and fixed (monthly $/customer) components**
  - "Rate design" refers to the determination of how costs are recovered across different bill components
  - High volumetric rate components could impede electrification of vehicles and buildings, since high volumetric rates could lead to bill increases for customers that adopt electric devices

Example 2023 monthly electricity bills for 600 kWh/month customer
$/month



Rate design changes the way customers pay for electricity, but does not change the total amount of revenue that utilities collect

*MLP = Municipal Light Plant

This study will provide guidance to realign electric rate structures with the grid and policy goals of the future

- **The Interagency Rates Working Group's goal is to advance near- and long-term electric rate designs that reduce energy burden while incentivizing transportation and building electrification**
- **Key components of this study will include:**
  - Exploring the bill impacts of existing and new rate designs across a wide range of representative MA residents
    - Task will include assessment of existing electric rates in the state as well as novel rate structures offered in peer jurisdictions
  - Identifying a potential roadmap of near-term and long-term rate design options for the Commonwealth
    - Task will include synthesis of policy, technology, and regulatory ratemaking considerations in MA in the near- and long-term

IRWG rate design study deliverables

1. Understand state of **existing electric rates** and energy expenditure in MA
   - *Spring/Summer 2024*
   - *Key deliverable: Electric Rates Database*

Focus of this presentation

2. Identify **near-term rate strategies** to support state electrification and energy affordability goals with today's electricity metering technology
   - *Summer 2024*
   - *Key deliverable: Near-Term Electric Rate Design Report*
3. Conduct **long-term ratemaking study** to lay out vision for electric rates in deep decarbonized system with availability of advanced metering infrastructure (AMI)
   - *Summer/Fall 2024*
   - *Key deliverable: Long-Term Electric Rate Design Report*

Key research questions

+ What do different households pay in energy bills today and how does that differ across household characteristics (heating fuels, home vintage, single family vs. multi family, service territory, discount rate status, etc.)?
+ Which types of households face the most significant energy burden today?
+ How does electrification affect household energy burden, especially for low-income homes?
+ How can different rate designs improve the cost effectiveness of building and transportation electrification, while supporting energy affordability for both electrified and conventional households?
+ What are the bill impacts of alternative rate design features across different household energy profiles?
+ What are the implementation challenges to consider for these alternative rate designs?

Methodology Overview

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Modeling explores diversity of bills with and without electrification under current and alternative rate designs

Building

- **Housing Type**
  Single Family, Multi-family (2+ units)
- **Size**
  Small (<1600 sqft), Large (>1600 sqft)
- **Vintage**
  Pre-1970, Post-1970
- **Region**
  Western MA, Central MA, Boston Area, Fitchburg, North Shore, Cape Cod
- **Baseline Heating Source**
  Gas, Electric Resistance, Heating Oil, Propane
- **Air Conditioning**
  None, Room or Central AC

Technology

- **Efficient Building Electrification**
  None, Whole Home Electrification incl. heat pump and building insulation upgrades
- **Vehicle Electrification**
  None, Electric Vehicle
- **Distributed Energy Resources**
  None, Rooftop Solar, Storage

  To be developed for long-term rate analysis

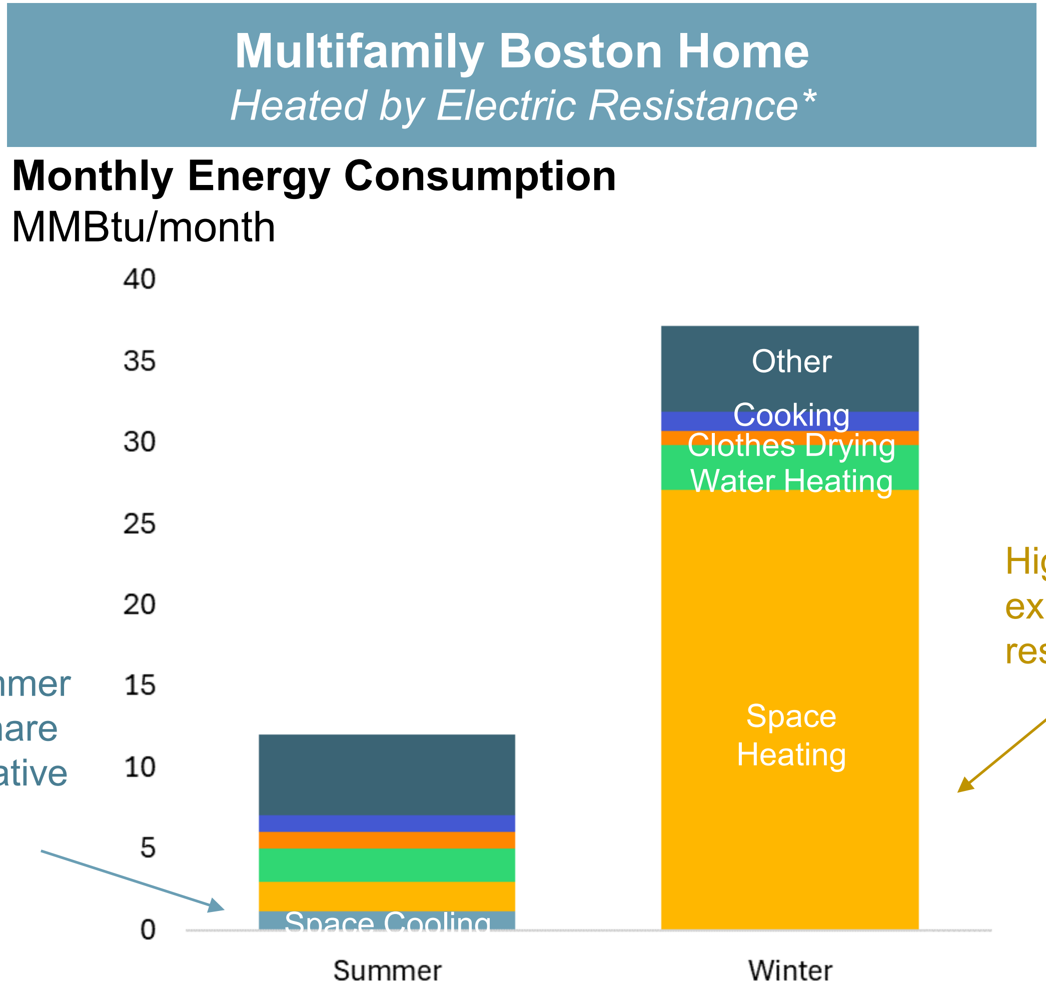
Customer

- **Occupant Status**
  Renter, Owner
- **Bill Discount Program**
  No, Yes (if available)

Guiding Questions:

- *Which households face high energy burdens today?*
- *Which customers see largest bill increases from electrification?*
- *How would customer bills change under alternate rate designs?*

Space heating is the most dominant energy end use for homes in Massachusetts



Space cooling in the summer accounts for a smaller share of total energy usage relative to space heating

High space heating demand is especially expensive for customers with electric resistance and fuel oil heating

*Pre-1970 vintage, Room AC, 700 sqft

Electrification entails significant changes to household energy profile and efficiency

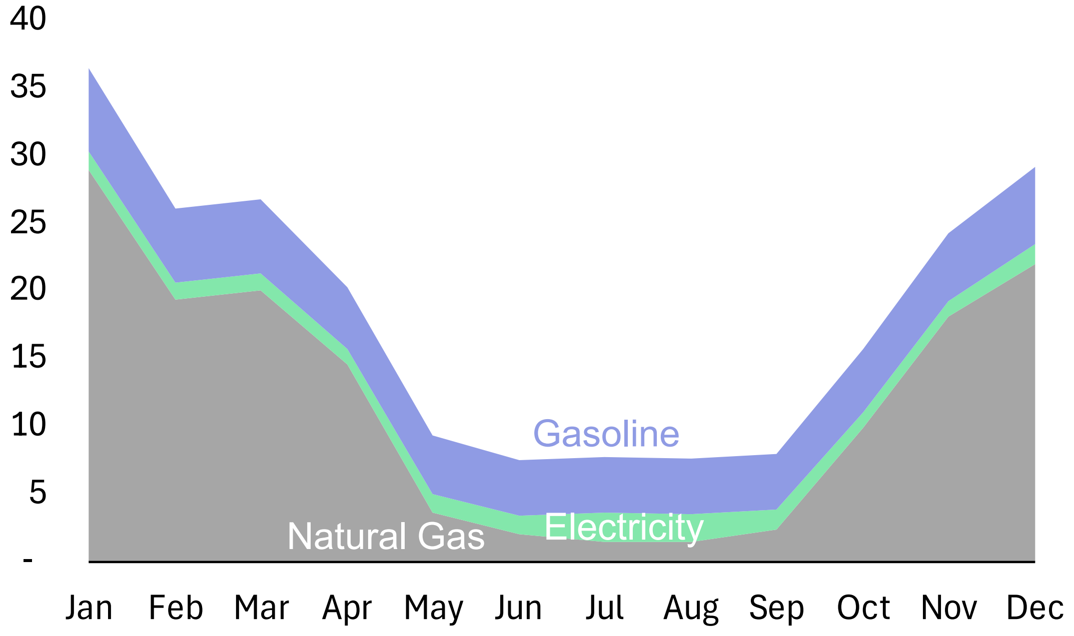
Multifamily Central MA Home - Baseline
Heated by Natural Gas, Gasoline Vehicle

Electric kWh/mo = **400 kWh***

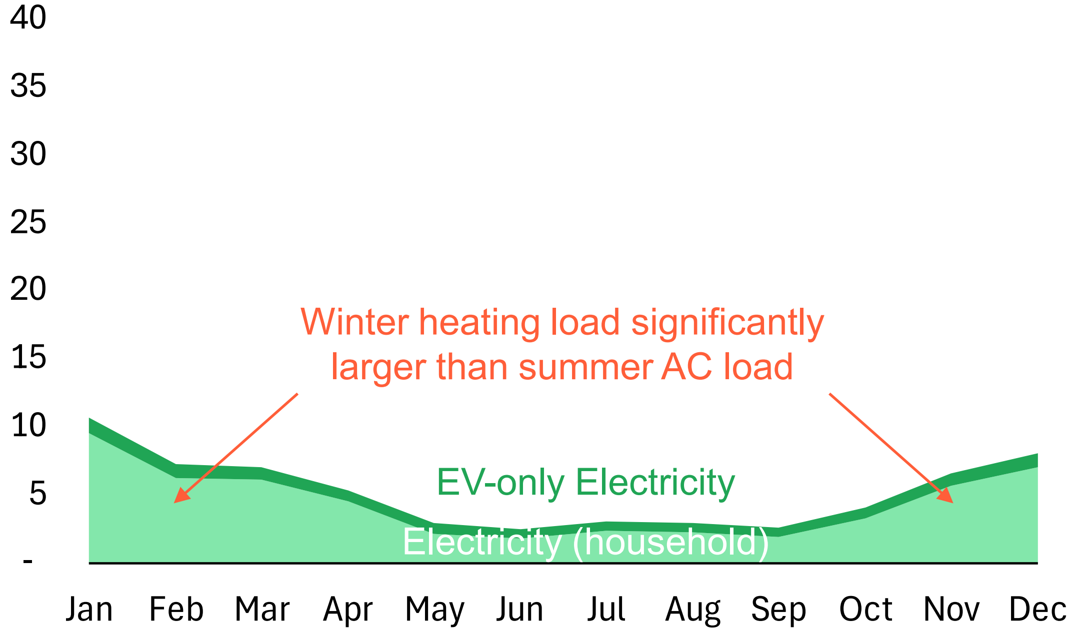
Multifamily Central MA Home - Electrified
All-Electric Home, Insulation Improvements, Electric Vehicle

Added electric kWh/mo: **850 kWh***(heat + appliances) + **250 kWh** (EV)
Total = **1,500 kWh**

Monthly Energy Consumption *(Incl. Vehicle Use)*
MMBtu/month



Monthly Energy Consumption *(Incl. Vehicle Use)*
MMBtu/month



*Prototype shown = 1,700 sqft home. Larger homes, incl. single family homes, have higher baseline electricity use and see proportionally higher increases with electrification.

Energy Burden in Low-Income Homes Today

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Key Income Level Definitions and Bill Assistance Programs

- **Maximum income level eligible for energy bill assistance programs: 60% of State Median Income (SMI)***
  - For a 4-person household, this is **$94,608 / year, ~300% of Federal Poverty Level (FPL)***
- **Key bill assistance programs for low-income households include:**
  - **Low-Income Home Energy Assistance Program (LIHEAP):** provides federally funded assistance for home energy bills and other energy-related expense
  - **Utility Bill Discount Rates:** provides flat discount on total gas and electric bill, utility-specific and funded by rates

LIHEAP Benefits Information *($/year)*

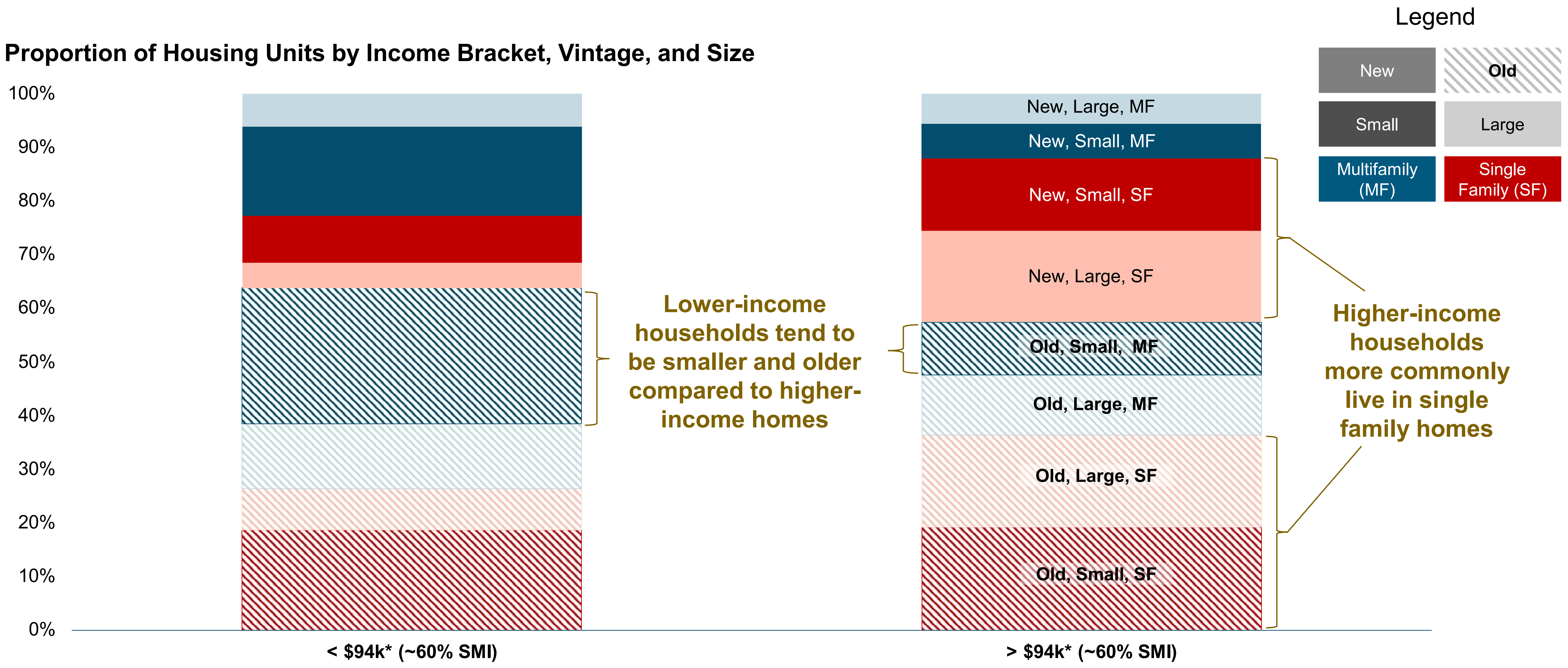
Occupant Status	Income Level*	Deliverable Fuel (Oil, Propane, etc.)	Utility and Heat-included-in-Rent
Homeowner / Non-Subsidized Housing Tenant	100% FPL	$600	$500
	60% SMI	$430	$355
Subsidized Housing Tenant	100% FPL	$420	$350
	60% SMI	$300	$250

Utility Bill Discount Rates *(% of bill)*

Utility	Electric Discount	Gas Discount
Eversource	42%	25%
National Grid	32%	25%
Unitil	40%	25%

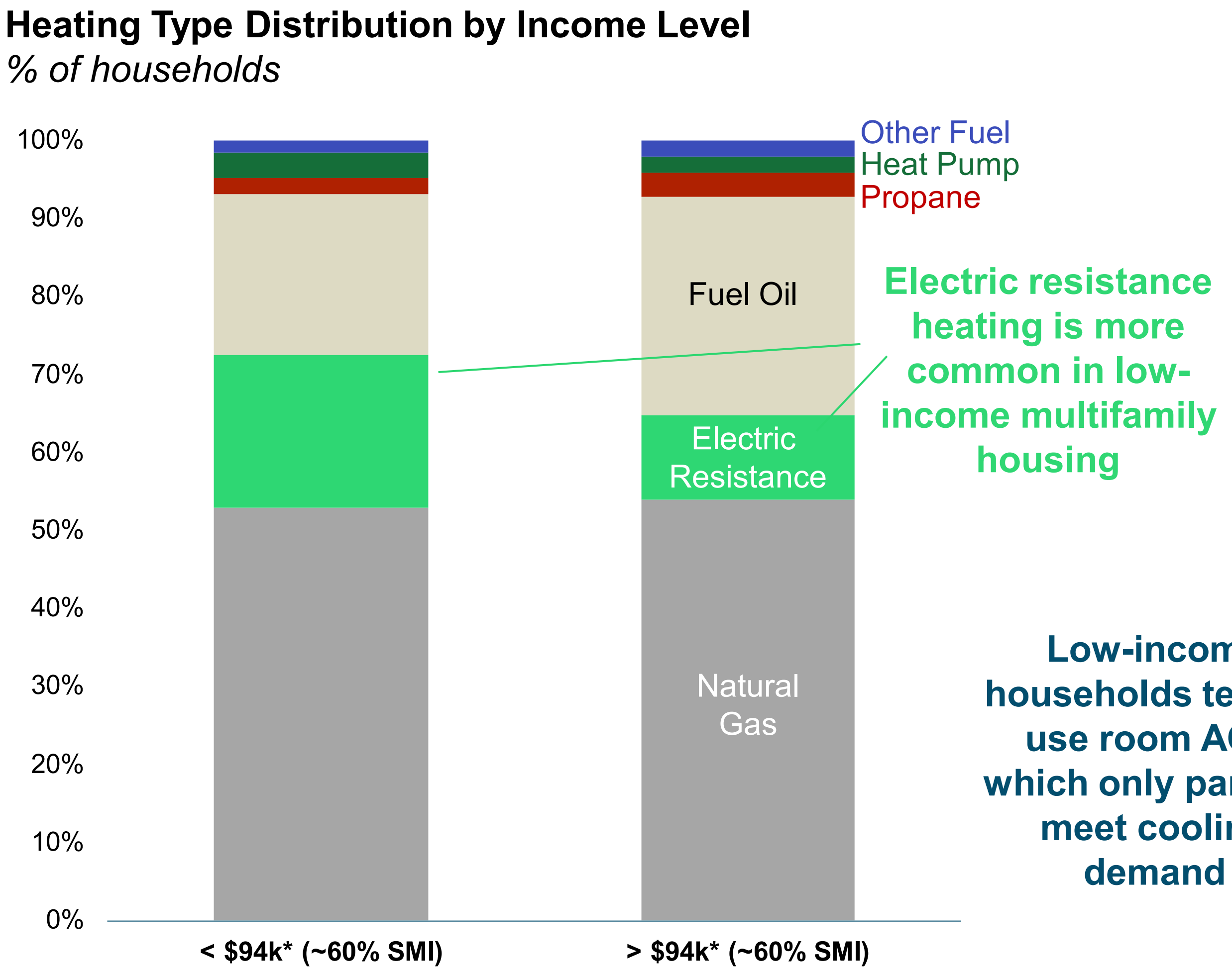
*For 4-person household in 2024, SMI = $157,680/yr, FPL = $31,200/yr

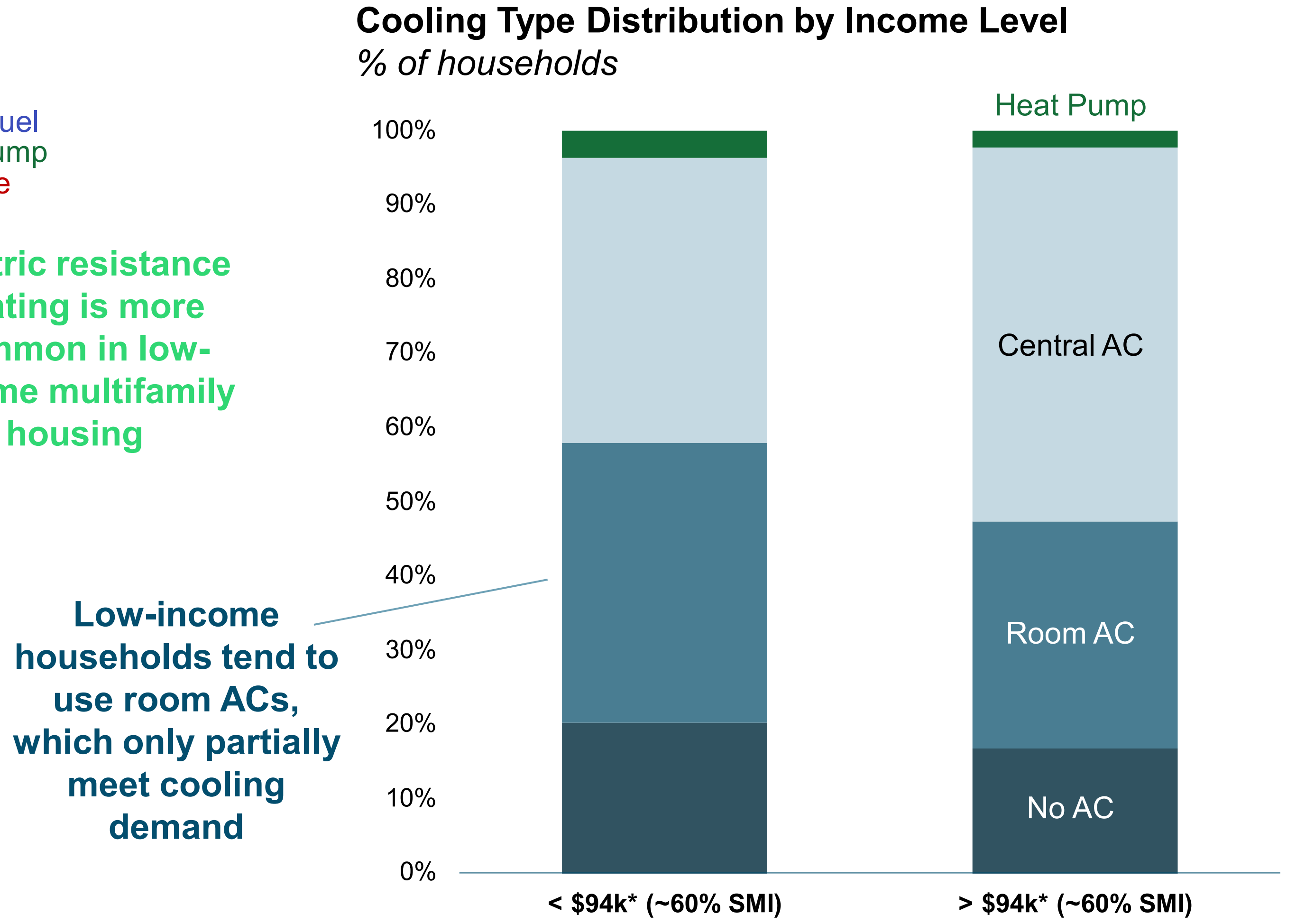
Lower income households tend to be older, smaller and in multifamily buildings



*for a four-person household

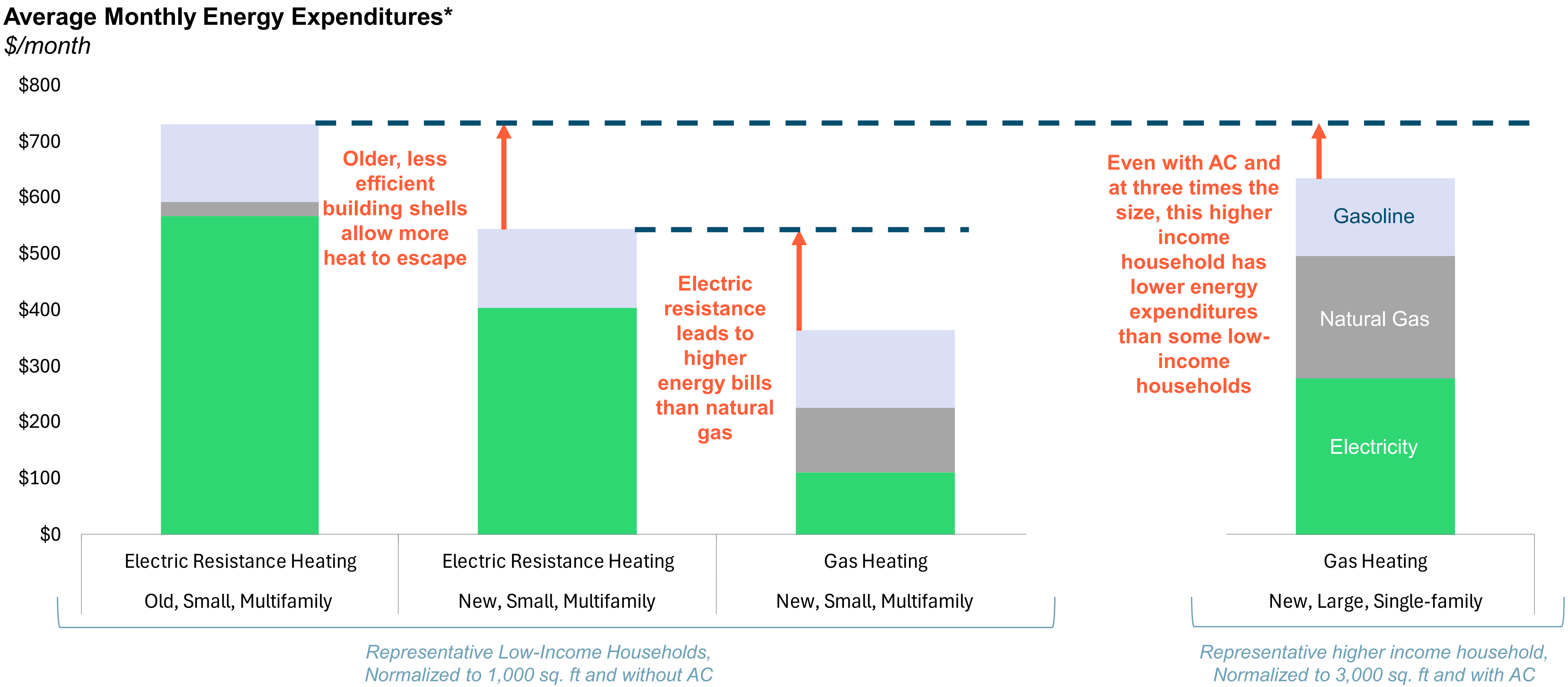
Low-income homes rely disproportionately on expensive electric resistance heating and lack central air conditioning





*for a four-person household

Older homes using electric resistance heating, common for low-income households, have higher energy costs

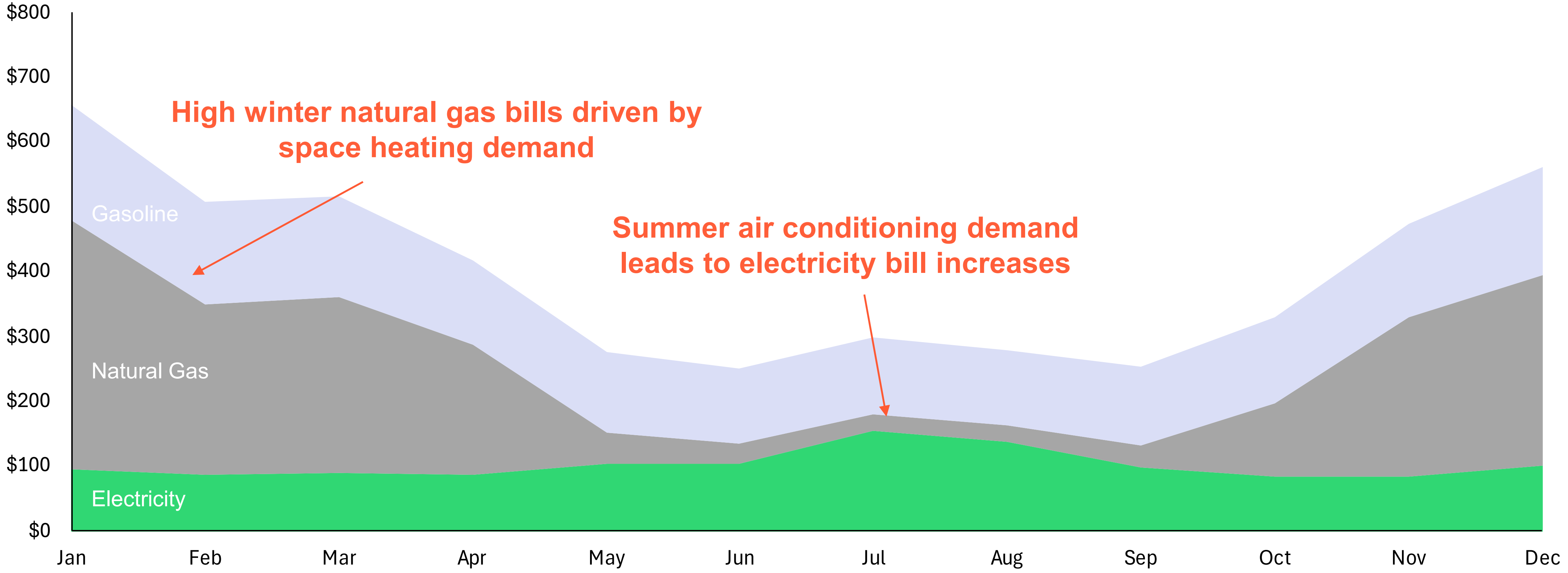


*Energy expenditures shown are before any utility bill discounts. The effect of bill discounts is shown on the next slide.

Seasonal volatility of energy bills presents challenge for low-income households

Low-Income Multifamily Home* with **Natural Gas Heating**
Including Bill Discounts

Monthly Household Energy Bills
$/month



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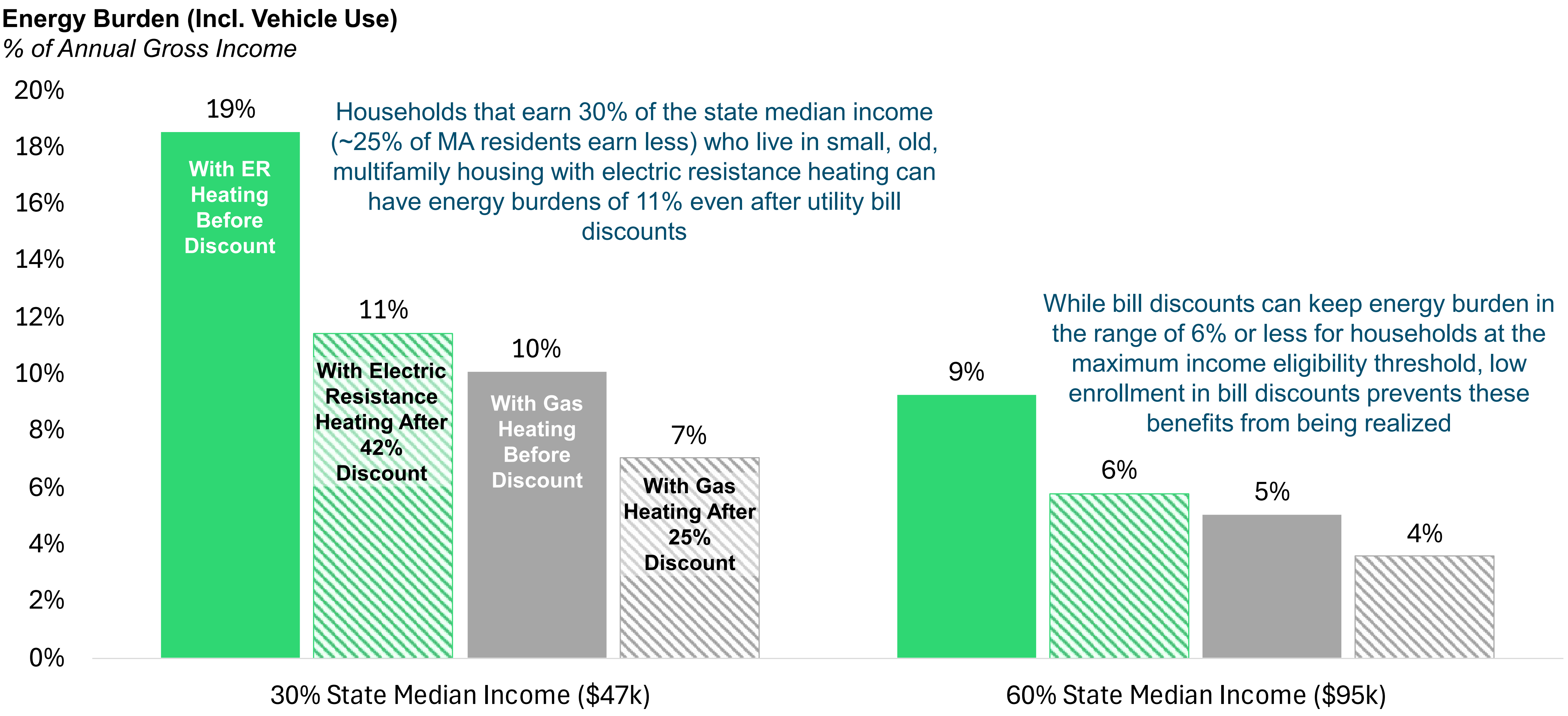
*1,700 sqft, Pre-1970s, Central MA, Room AC

Bill discounts do not provide sufficient reduction in energy burden for lowest-income households



Important considerations about low-income homes to inform rate and policy design

- **Existing research documents low-income, Black, Hispanic, Native American, and older adult households having disproportionately high energy burdens both in the Boston metro area and nationally[1]**
  - Systemic inequities cause these factors to influence the likelihood of living in older, inefficient homes, as well as relying on electric resistance heating, all of which lead to high energy burdens
    - Additionally, these residents are more likely to rent rather than own their homes, facing high energy bills as a result since landlords have limited incentives to invest in energy efficiency
  - In addition to rate design considerations and utility programs, improving access to weatherization, energy efficiency, and housing opportunities could begin to mitigate these undue energy burdens
  - Low enrollment in bill discount programs[2] and higher participation in third party electric supply contracts (that can be more expensive than utility basic service) amongst low-income households can exacerbate energy burden
- **Hidden energy poverty is caused by high energy costs affecting household decisions to use energy services (e.g., turning on the heat later in the season or maintaining a low thermostat setpoint in the winter)**
  - For example, black households experience a greater need for health services caused by low indoor temperatures[3]
  - Hotter summers and colder winters would exacerbate the health impacts of low-income households restricting cooling or heating energy use

1. ACEEE. *"How High Are Household Energy Burdens? An Assessment of National and Metropolitan Energy Burdens across the U.S.?"*, Sept. 2020
2. DPU 24-15. *"Comments of The Metropolitan Area Planning Council"*. March 2024.
3. DPU 24-15. *"Initial Joint Comments of Environmental and Consumer Advocates"*. March 2024.

Exploring Energy Bills with Today's Rates

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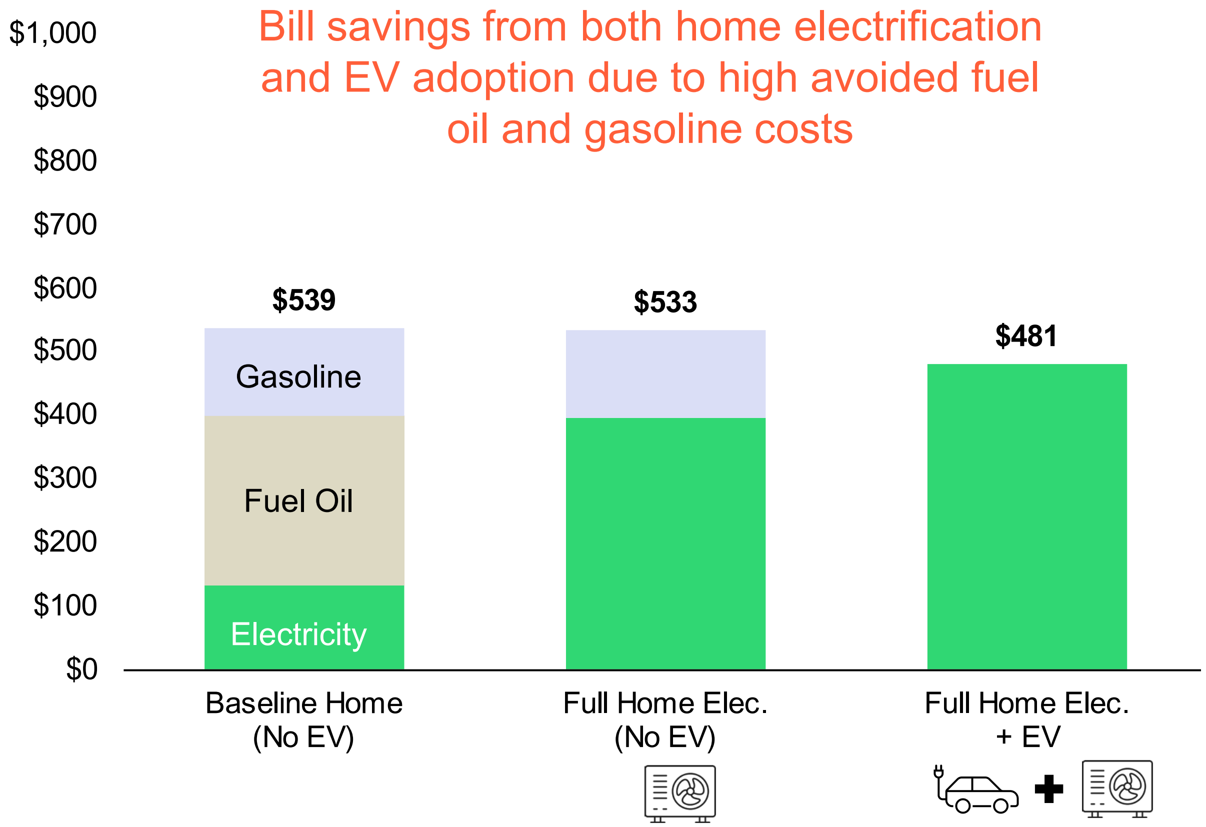
Fuel oil customers see bill savings from home electrification

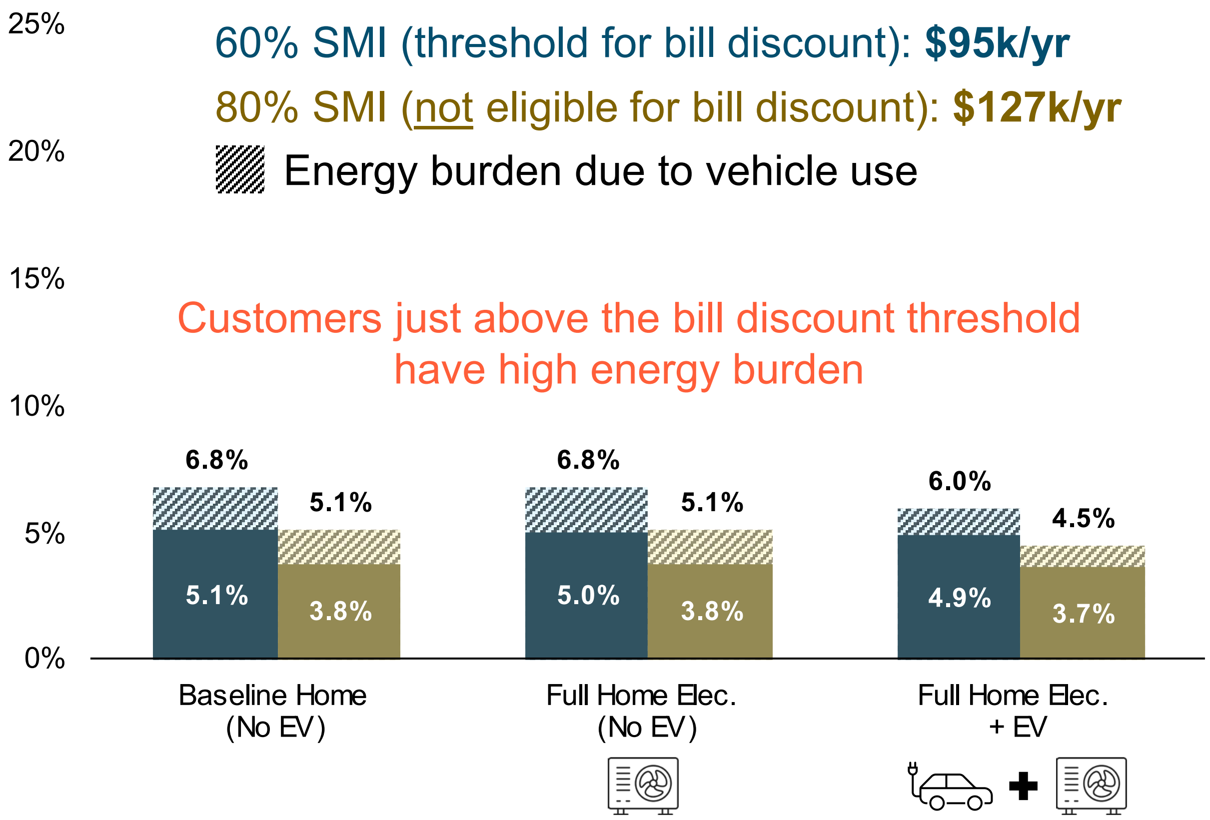
~26% of MA homes heated by fuel oil

Pre-1970 Home with Fuel Oil Heating, No Bill Discount*

Monthly Avg. Energy Expenditure (*Incl. Vehicle Use*)
$/mo



Monthly Avg. Energy Burden (*Incl. Vehicle Use*)
% monthly income**



*1,100 sqft, Central MA, pre-1970 vintage, with room AC

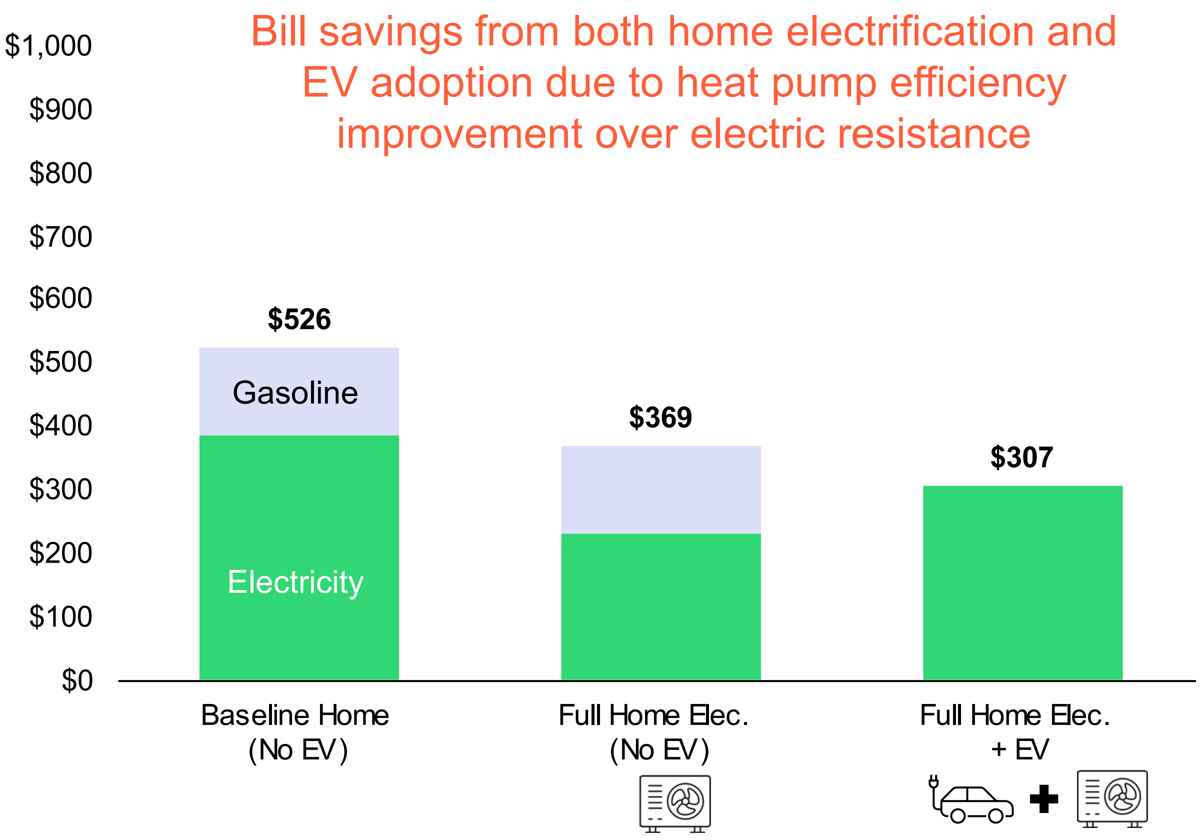
*** Commonly cited metric of 6% energy burden does not include personal vehicle use*

Heat pump efficiency gains drive bill savings for electric resistance customers

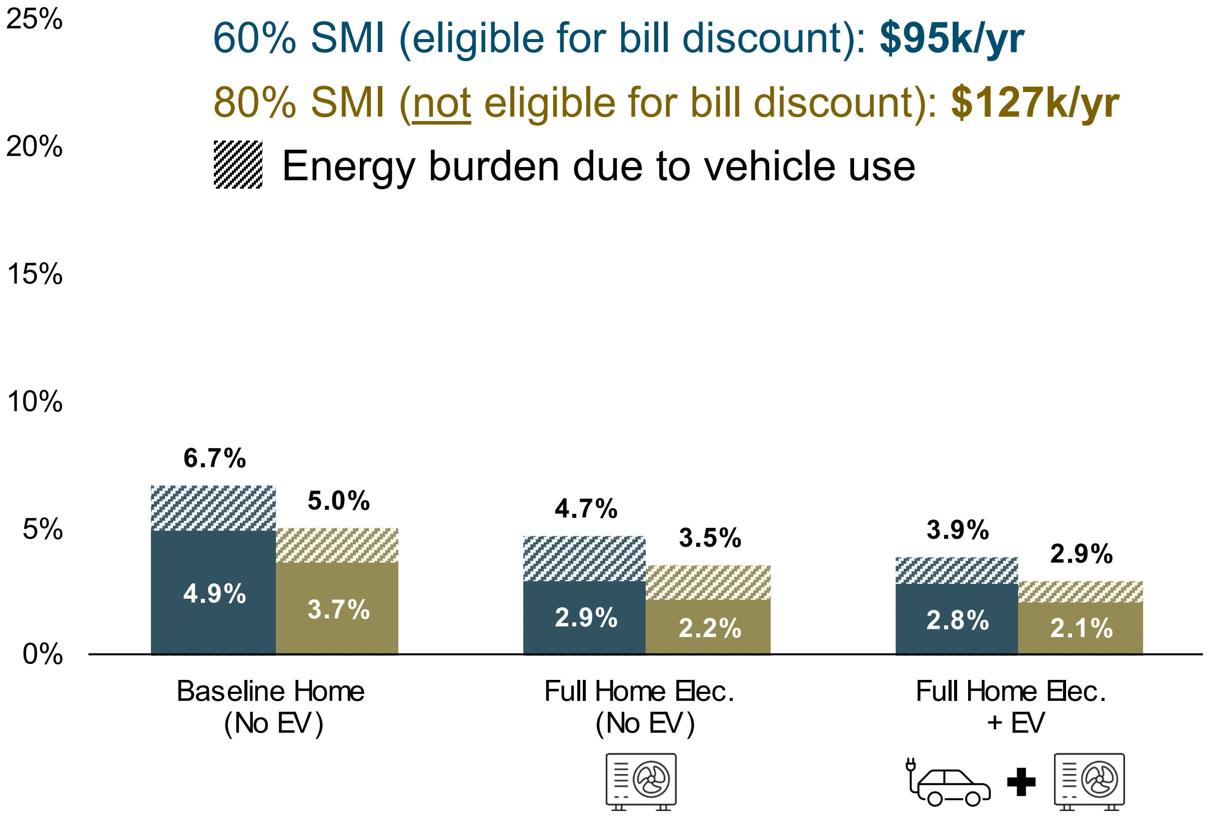
~13% of MA homes heated by electric resistance

Pre-1970 Home with Electric Resistance Heating, No Bill Discount*

Monthly Avg. Energy Expenditure *(incl. Vehicle Use)*
$/mo



Monthly Avg. Energy Burden *(incl. Vehicle Use)*
% monthly income



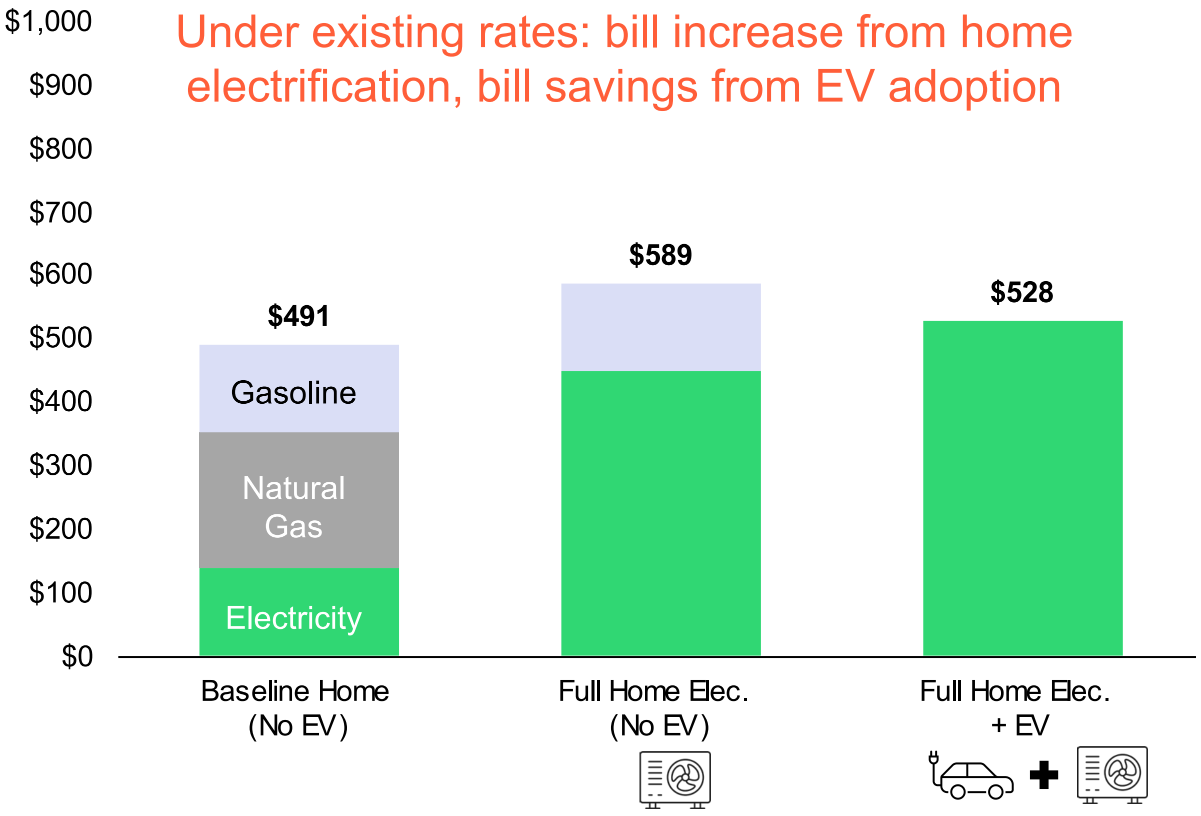
*850 sqft, Central MA, post-1970 vintage, with room AC

Natural gas customers face bill increases from electrification

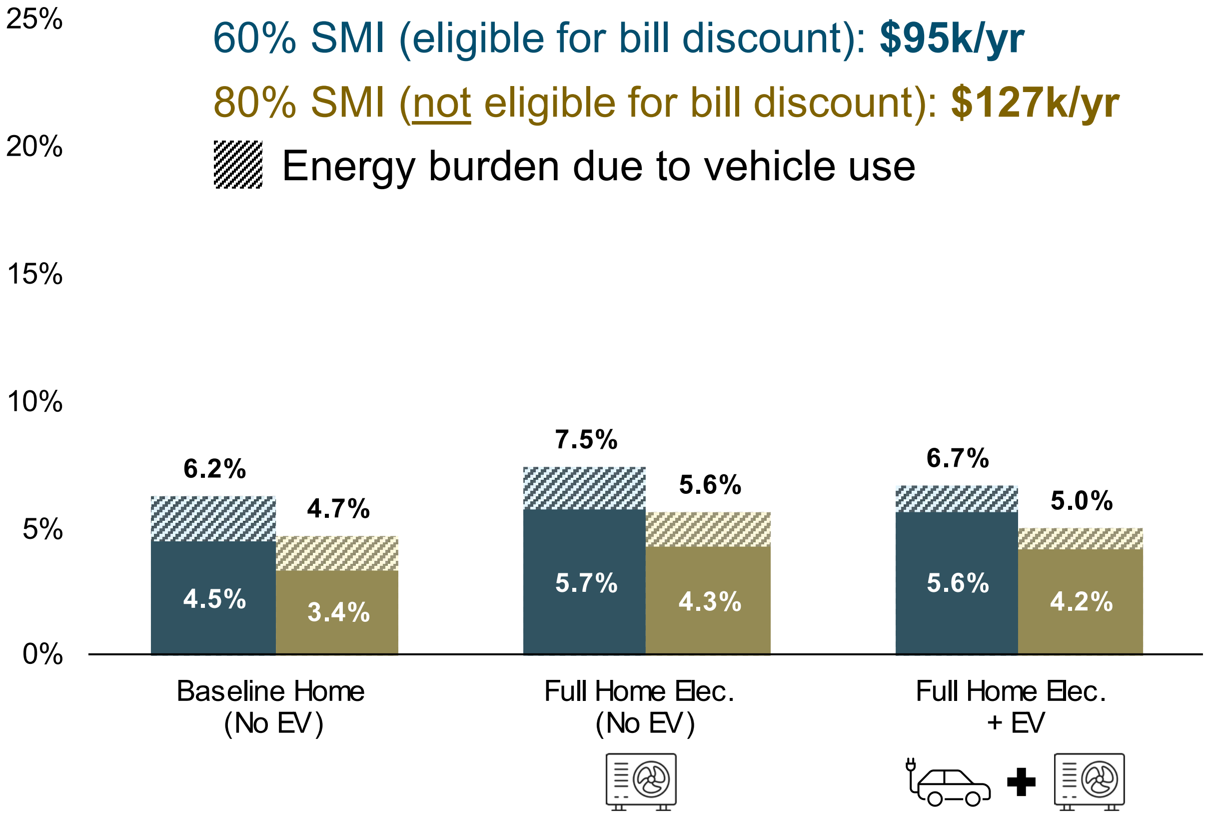
~54% of MA homes heated by natural gas

Multifamily Home* with Natural Gas Heating, No Bill Discount

Monthly Avg. Energy Expenditure *(incl. Vehicle Use)*
$/mo



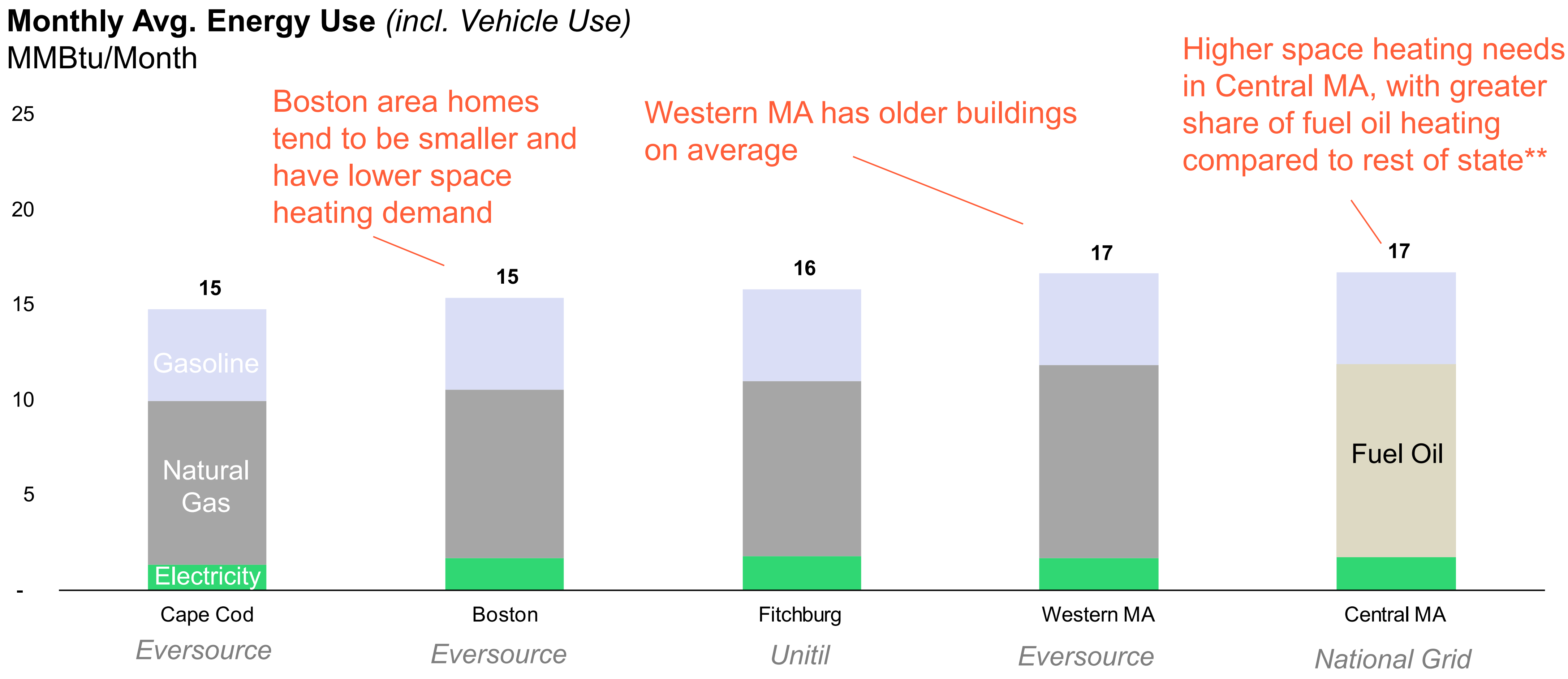
Avg. Energy Burden *(incl. Vehicle Use)*
% monthly income



*1,700 sqft, Central MA, post-1970 vintage, with room AC

Energy demands across the Commonwealth are similar, with higher space heating needs in Central and Western MA

Single Family Homes* with Natural Gas Heating, No Bill Discount

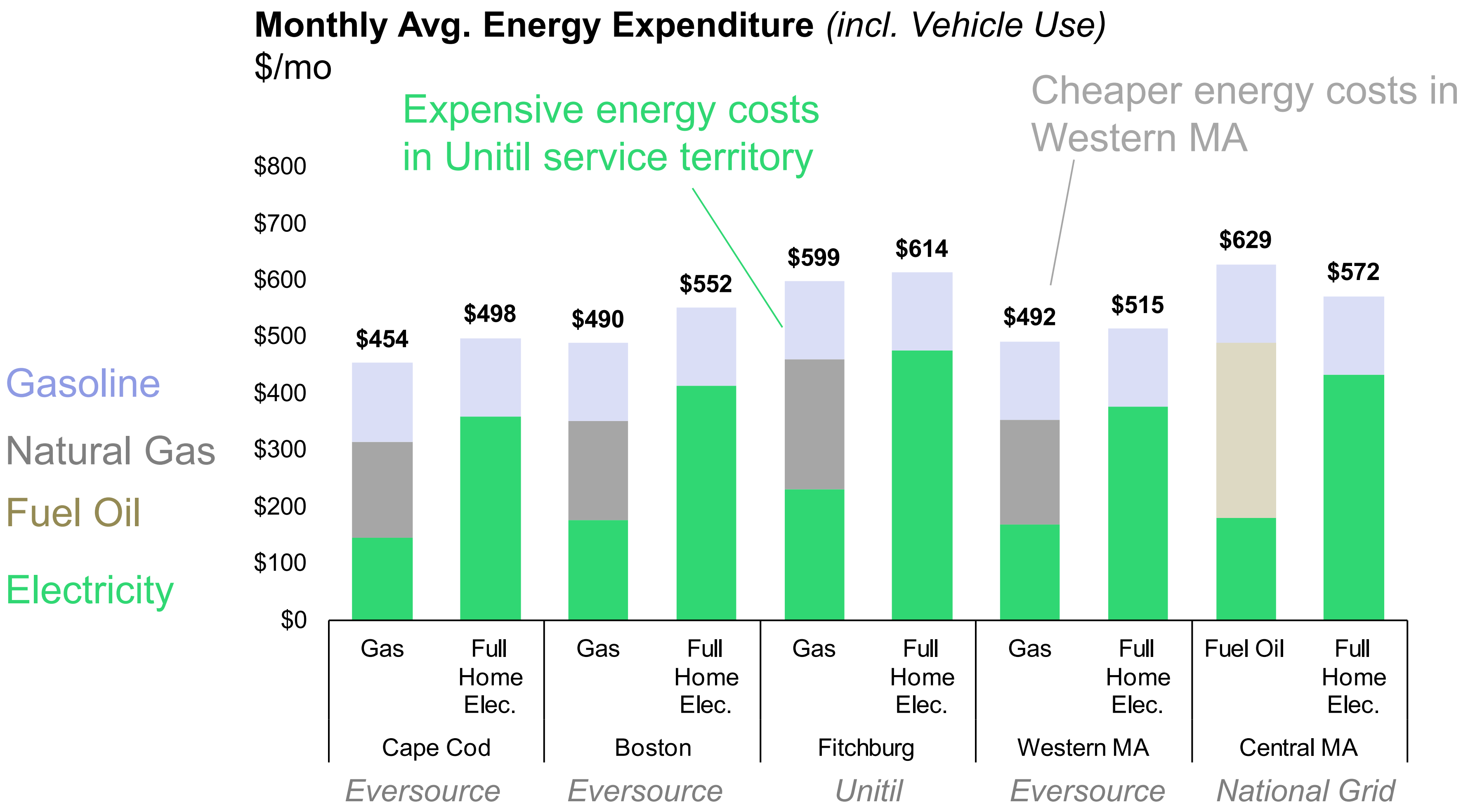


*1200 sqft, pre-1970 vintage

**47% fuel oil heating in Central MA vs. 28% in rest of state

Differences in per-unit electricity and gas costs drives regional energy bills variation

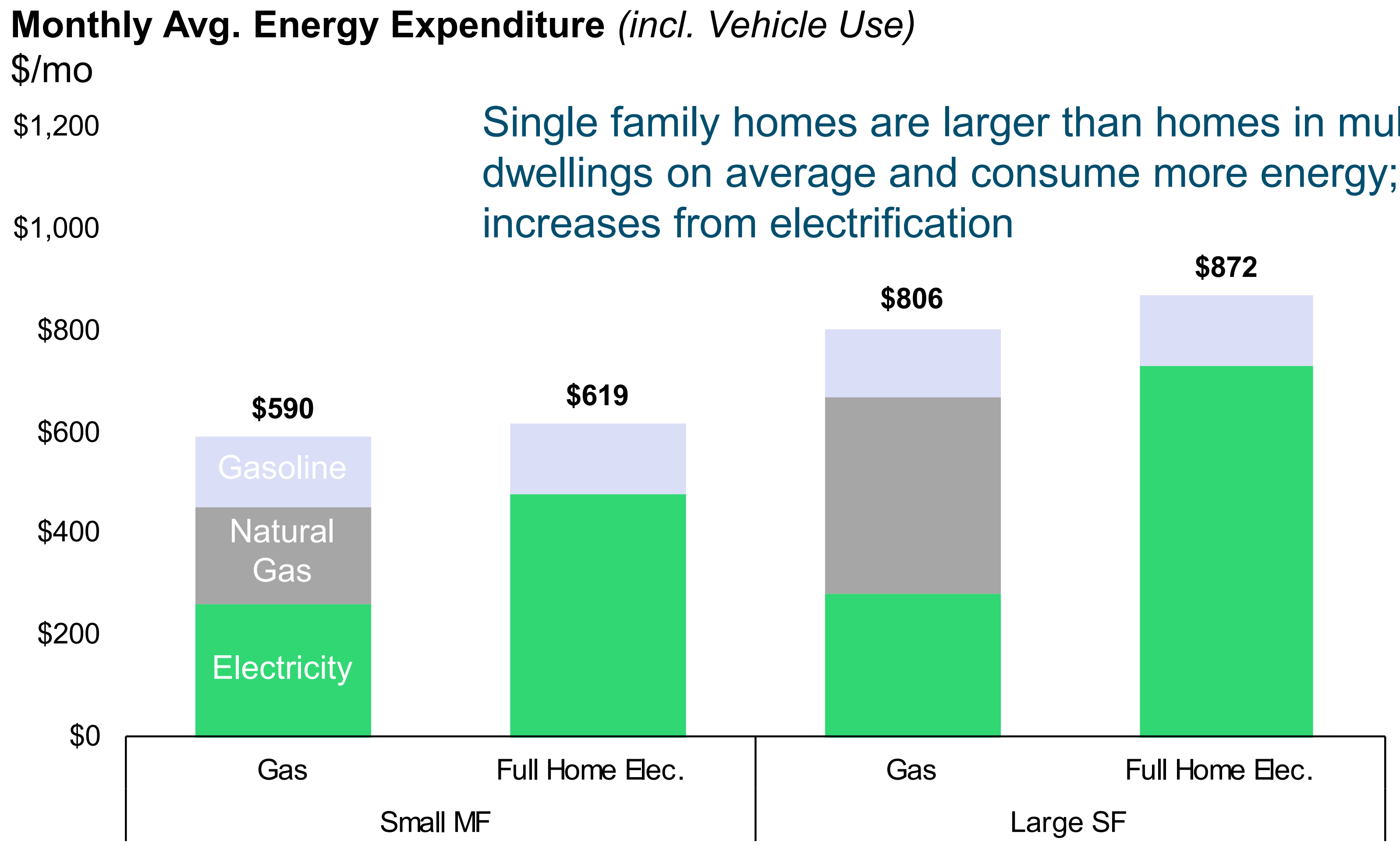
Single Family Homes* with Natural Gas Heating, No Bill Discount



*1200 sqft, pre-1970 vintage, with varying energy consumption as shown on prior slide

Single family and multifamily gas customers face similar bill increases from electrification today

Boston Homes* with Natural Gas Heating, No Bill Discount

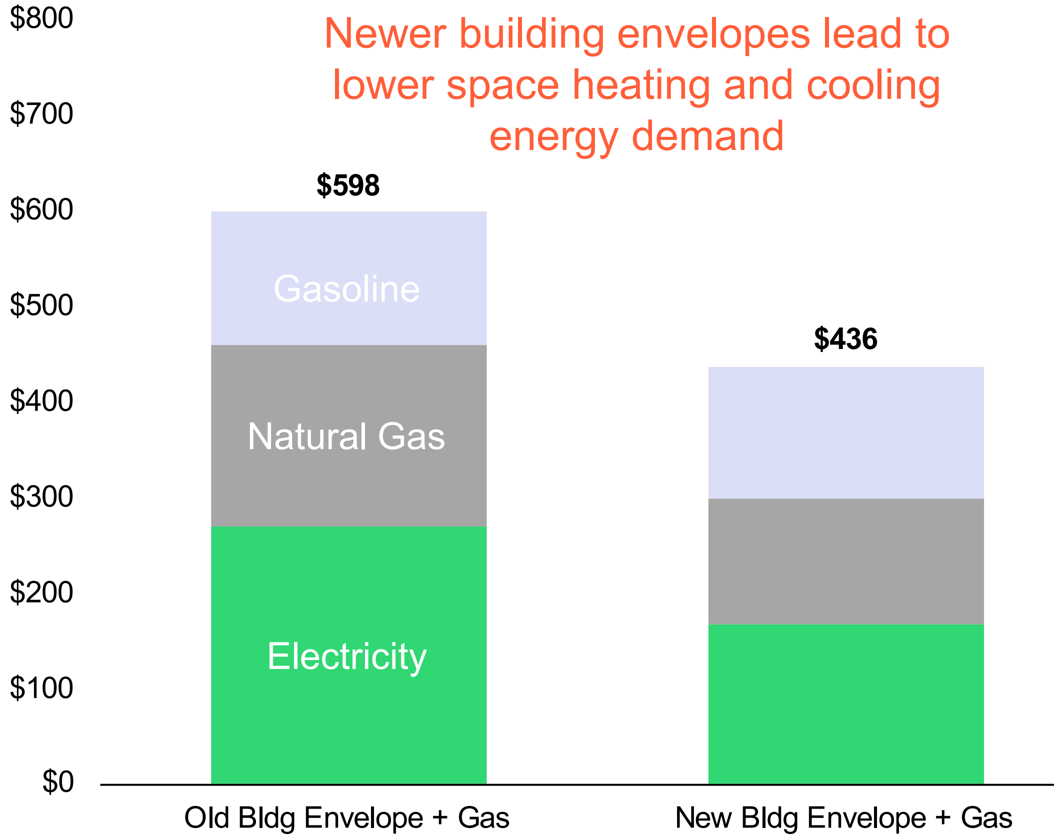


*Pre-1970 vintage

Older buildings require more energy to heat and cool spaces, driving up bills

Single Family Boston Homes with Natural Gas Heating, No Bill Discount

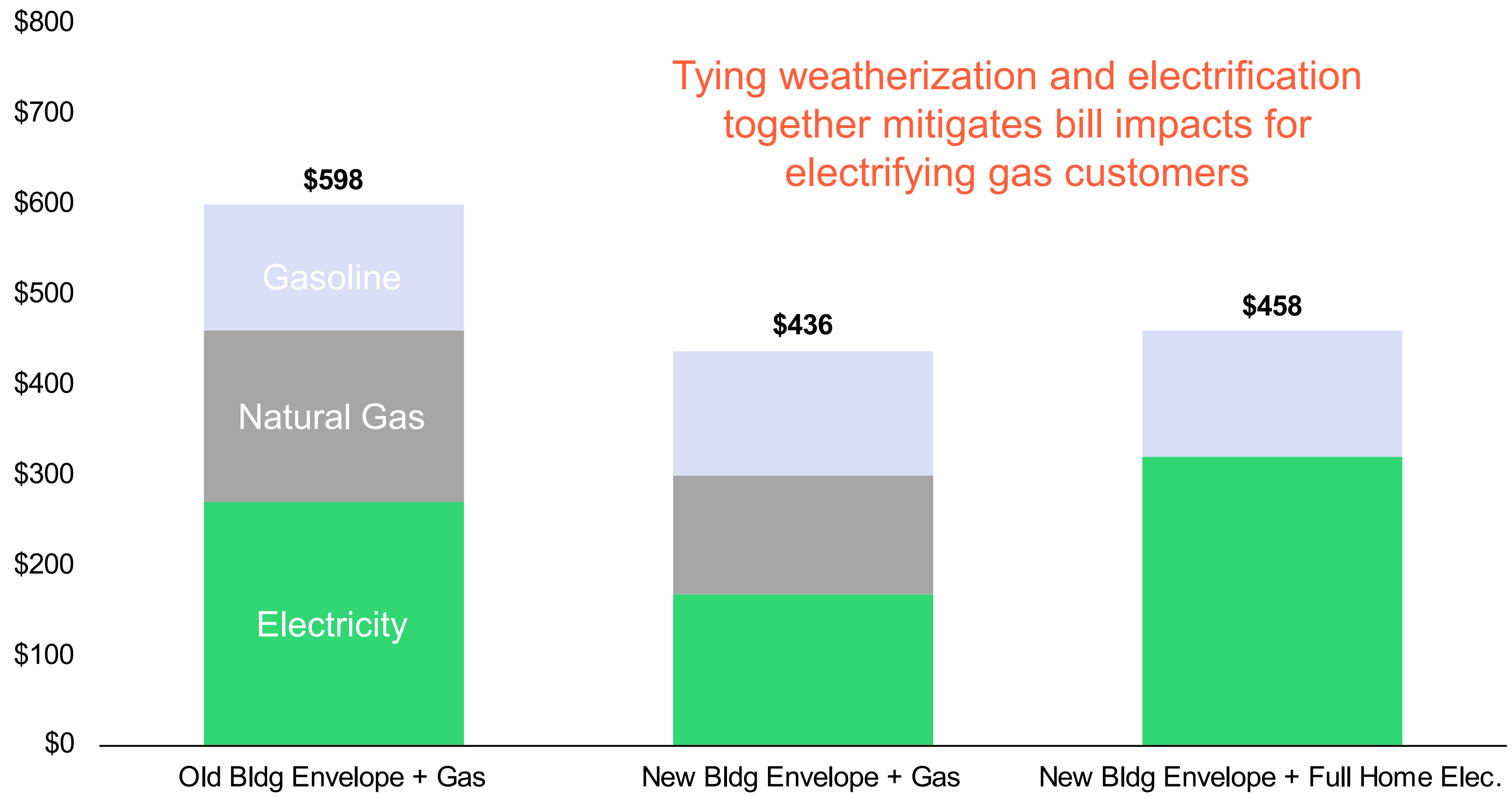
Monthly Avg. Energy Expenditure *(incl. Vehicle Use)*
$/mo



Including a shell upgrade with electrification of a gas household comes close to offsetting the bill increase

Single Family Boston Homes with Natural Gas Heating, No Bill Discount

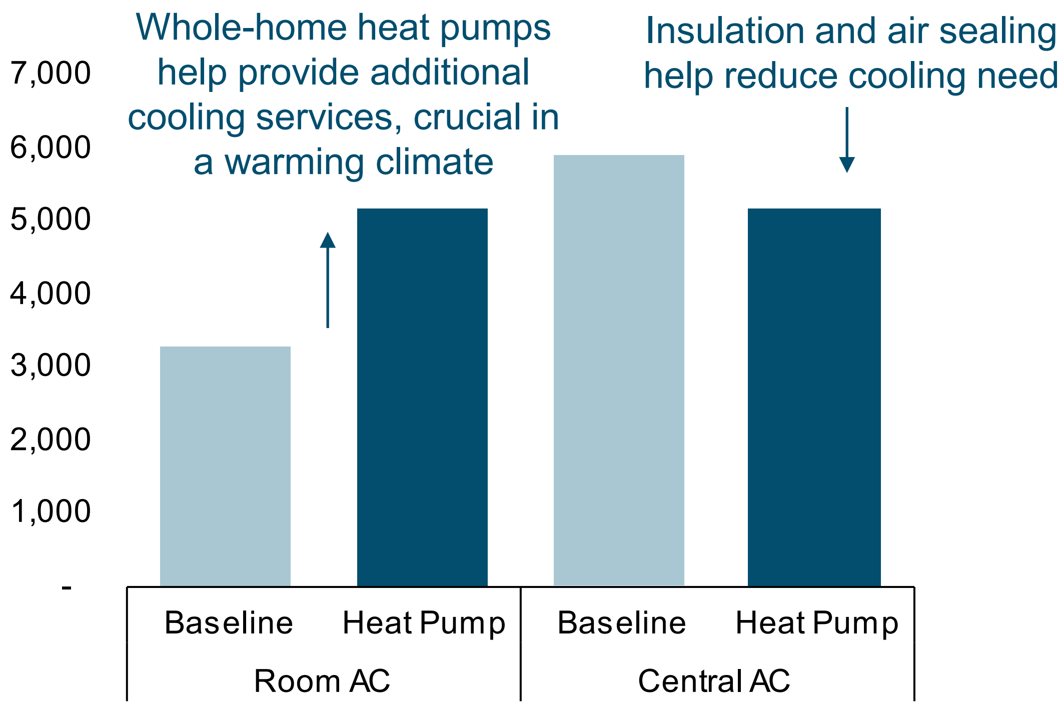
Monthly Avg. Energy Expenditure *(incl. Vehicle Use)*
$/mo



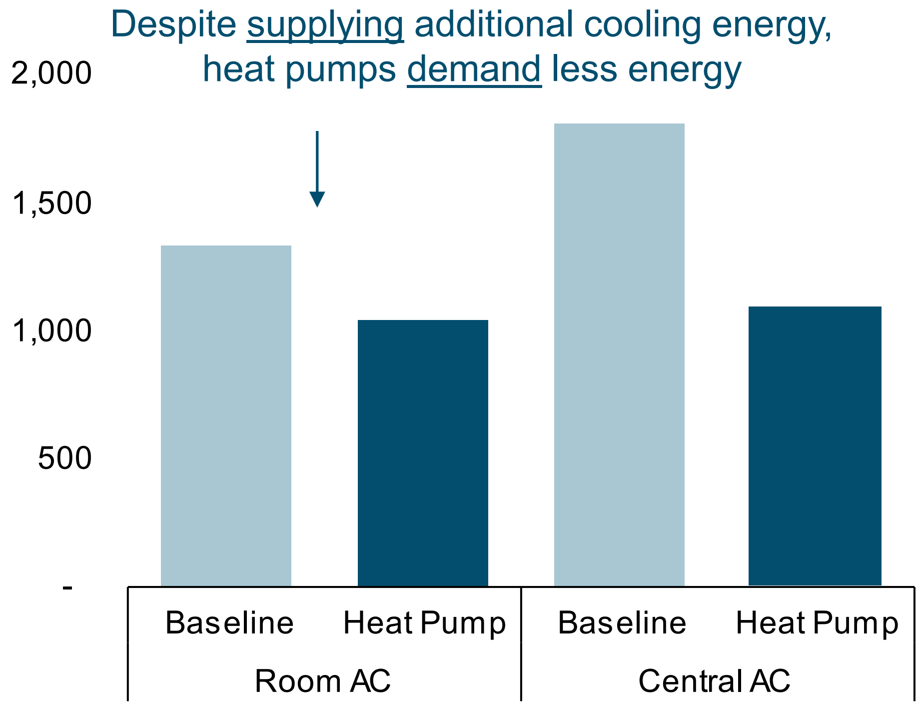
Homes with AC today will be able to meet additional cooling demand with heat pumps more efficiently

Multifamily Boston Homes with Natural Gas Heating, No Bill Discount

Annual Cooling Energy Delivered*
kWh/yr



Annual Cooling Energy Consumed
kWh/yr



Current lack of central AC in many low-income households means that these residents will benefit from additional cooling services

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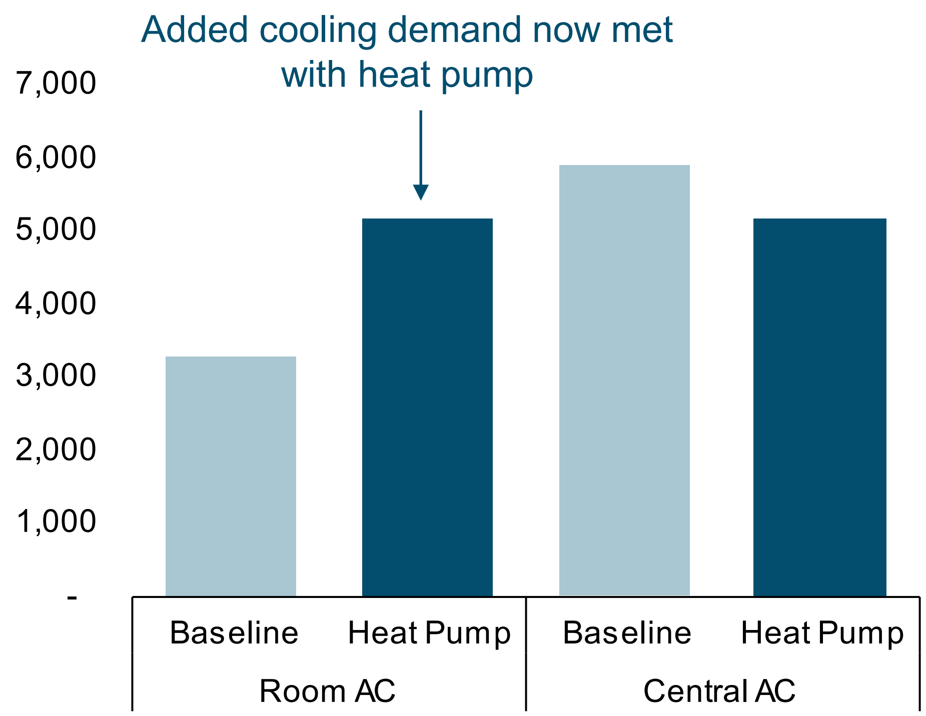
Energy delivered = energy service demand, or energy output from device

Homes without AC today will now be able to cool their homes but will face bill increases

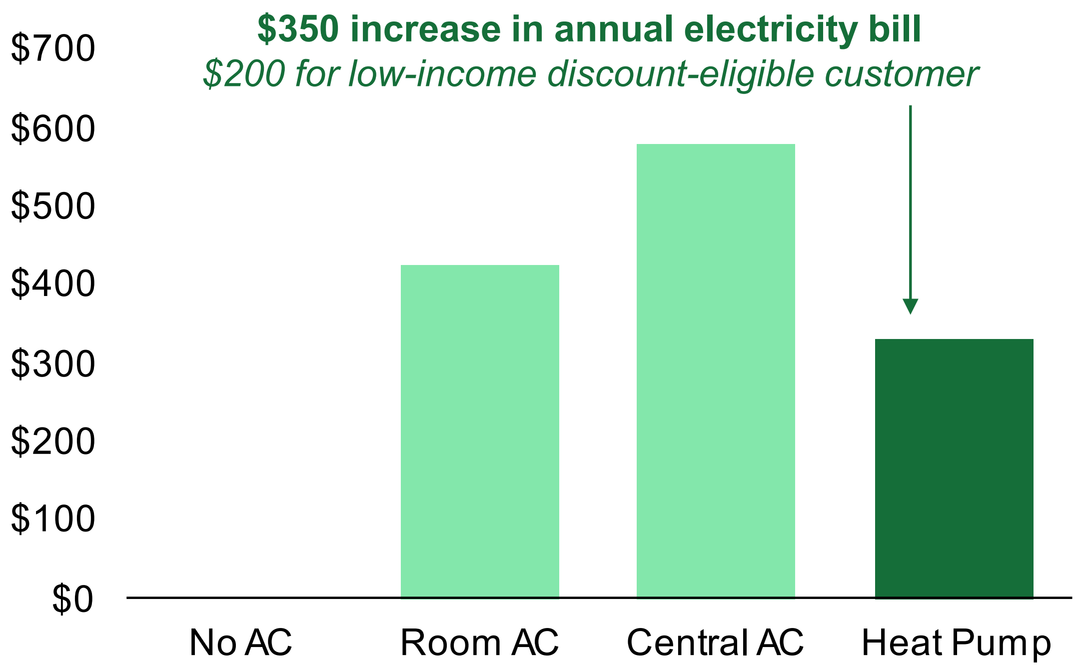
12% of households in MA
15% of households earning <60% SMI

Multifamily Boston Homes with Natural Gas Heating, No Bill Discount

Annual Cooling Energy Delivered
kWh/yr



Annual Cooling Expenditure
$/yr

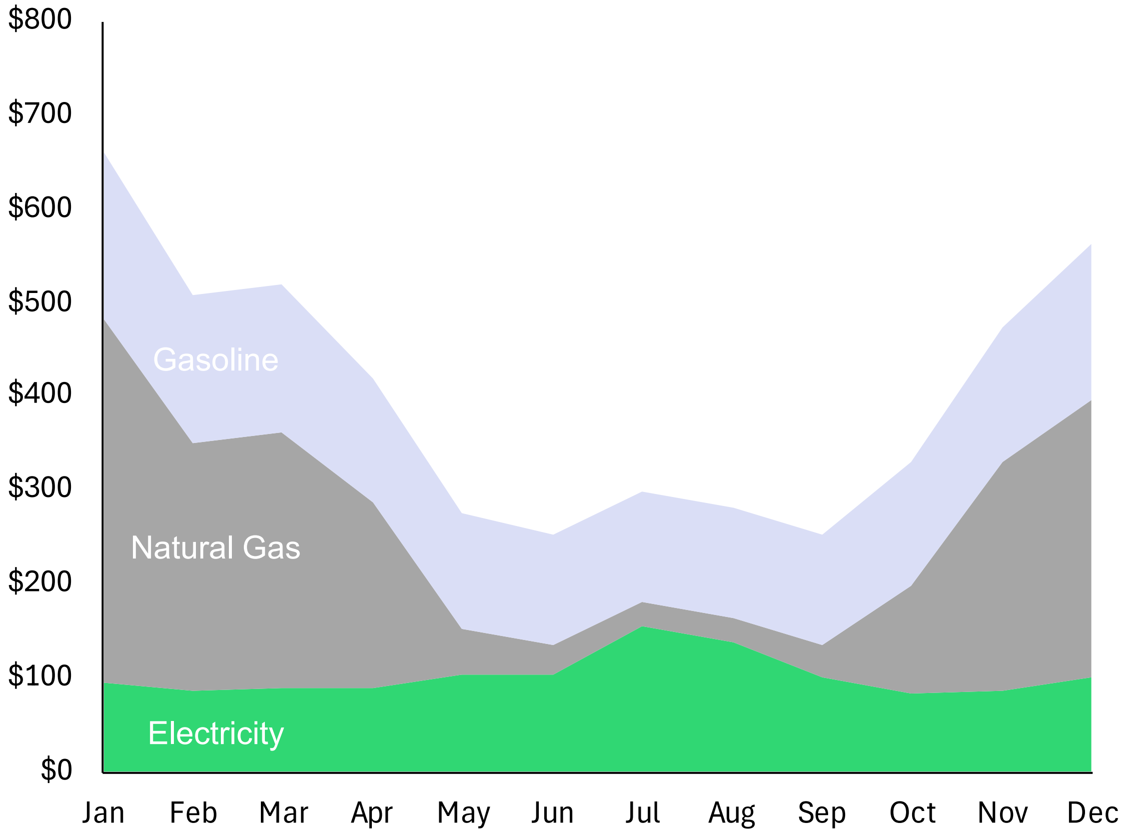


Lack of central AC in many low-income households means that these residents are likely to see bill increases associated with additional cooling services

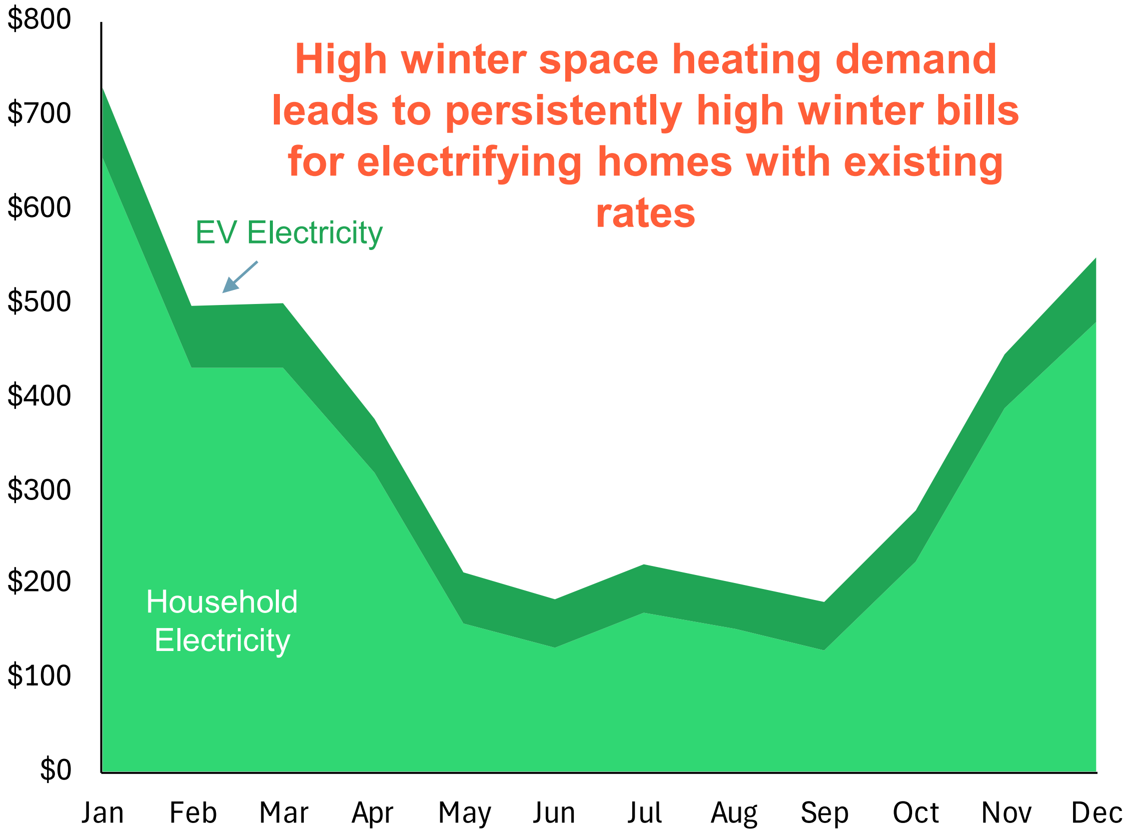
Seasonal energy bill volatility remains with electrification under existing rates

Low-Income Multifamily Home* with **Natural Gas Heating** *Including Bill Discounts*	Low-Income Multifamily Home*, **Full Home Elec. + EV** *Including Bill Discounts*

Monthly Household Energy Bills
$/month

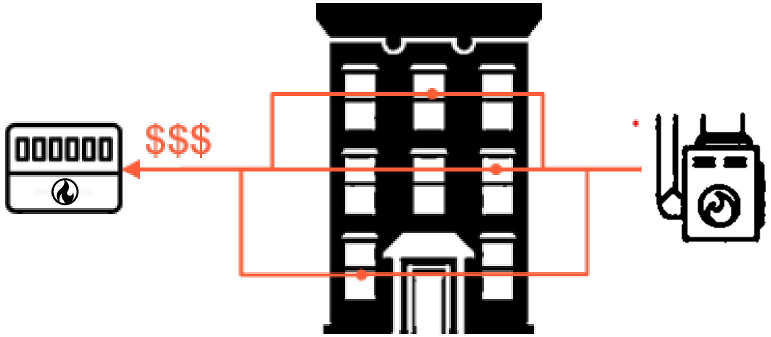


Monthly Household Energy Bills
$/month

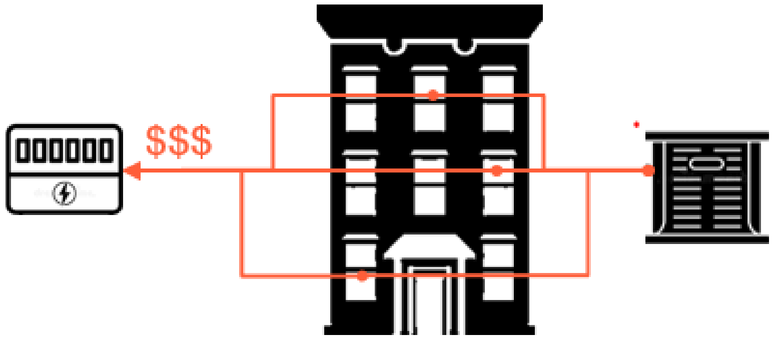


*1,700 sqft, Pre-1970s, Central MA, Room AC

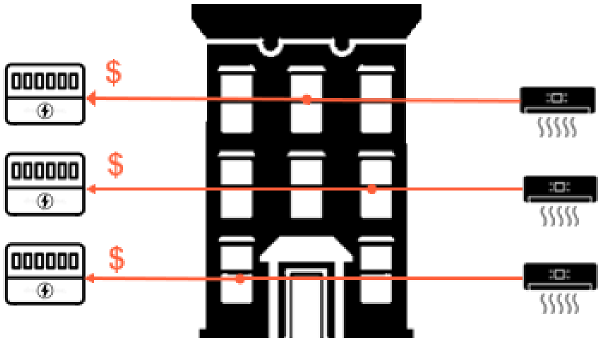
Electrification of multifamily buildings with central boilers/furnaces may shift heating costs to renters



Central heat pumps would keep heating energy costs on the building owner bill, likely included in rent

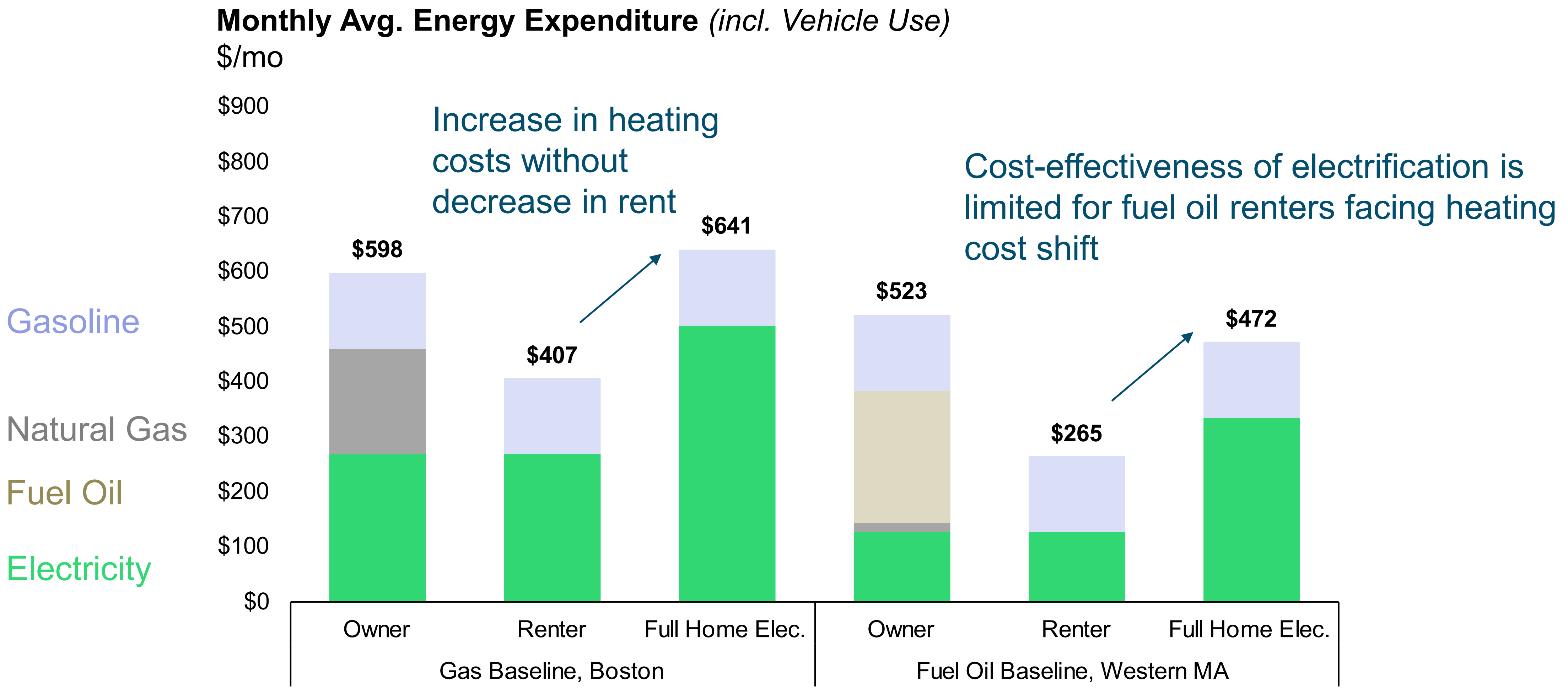


Non-central heat pumps may push heating energy costs on the tenant bills, possibly without corresponding decrease in rent



Renters not directly paying for heat today may face significant bill increases from electrification

Pre-1970 Multifamily Boston Home with Natural Gas Heating, No Bill Discount



Near-Term Rate Design

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Core policy objectives have changed since the 1970s… How can rate design keep up?

1970s through 2000s ***Conservation*** as the overarching policy goal	2020-2045: ***Electrification*** as the overarching policy goal

- **Key rate design priority: *increase volumetric rates to incentivize energy conservation***
- **Rate design approaches include:**
  - *Volumetric pricing*, with most costs recovered through a *volumetric* (c/kWh) charge
  - Very low *fixed charges*, as they do not encourage conservation
  - *Inclining block* pricing that increases the price of electricity at the margin

- **Key rate design priority: *decrease volumetric rates to decrease cost of heat pump usage and EV charging***
- **Rate design approaches include:**
  - Higher *fixed charges* that reduce the *volumetric* (c/kWh) rate
  - *Declining block* pricing that decreases the price of electricity at the margin
  - *Seasonal rates* that reduce prices in winter
  - *Time-varying* rates that provide lower prices for flexible technologies
  - *Technology-specific* rates that reflect different charges for electrified customers

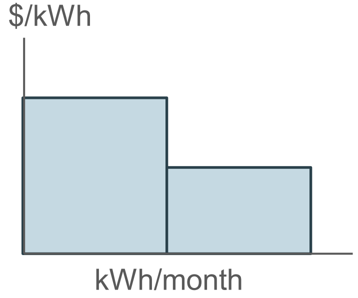
Near-term options rely on reducing volumetric charges

In the near term (*i.e.*, before advanced metering infrastructure or AMI is widely adopted), time-varying rates are not on the table. Near-term options will rely on reducing the volumetric component of rates

Lower volumetric rates

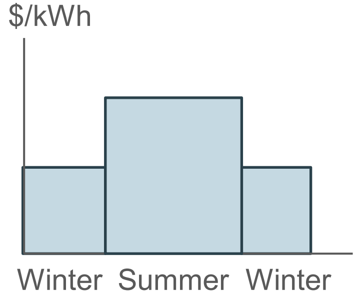
Need to recover missing revenue elsewhere

Declining Block
Charge less for usage beyond a certain level



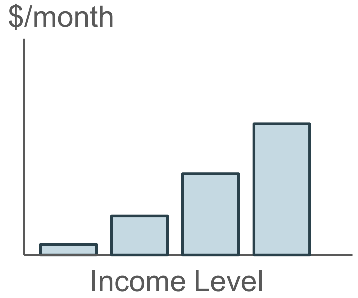
Costs that do not depend on usage are recovered in the first block of usage

Seasonal Rate
Differentiate summer vs winter charges



Many system costs are tied to summer peak loads (in near term)

Higher Fixed Charge
Increase fixed charges, perhaps based on income



Income graduation can help mitigate affordability concerns from fixed charges

- These elements are not mutually exclusive, and could be combined for even greater volumetric rate reductions
- These rate designs could apply to **all** residential customers or could be offered as **technology-specific** rates for EV and/or heat pump owners
  - Technology-specific rates have the advantage of more closely aligning utility costs of service with customer bills for high usage customers

Example rates w/ advanced design elements

Utility	Rate Description	Design Elements	Details
San Diego Gas & Electric	**Time-Varying-Rate (TVR)** for Electric Vehicles	TVR, technology-specific, higher fixed charge + lower volumetric rate	3-period time-of-use rate
Salt River Project (SRP)	Residential **Demand Price** Plan Pilot	TVR, demand charge, higher fixed charge + lower volumetric rate	Volumetric rate about ½ of SRP's base TOU plan, demand charge is tiered to incentivize peak reduction
Central Maine Power	**Seasonal Heat Pump** Pilot	Seasonal, technology specific	For customers with heat pumps, volumetric charge is deeply reduced from November to April, with higher fixed charge compared to basic service rate
Versant Power (Maine)	**Declining Block, Technology-Specific Rate**	Tiered rate (declining), technology-specific	Lower volumetric charge above 600 kWh/mo. 50% of home heating needs must come from heat pump
California Investor-Owned Utilities	**Income Graduated Fixed Charge** (IGFC)	Higher fixed charge, lower volumetric rate	$6 or $12 fixed charge for income-eligible customers, $24.15 for rest of state

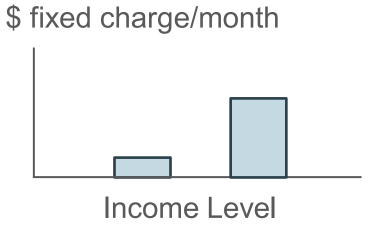
Four alternative rates were modeled to explore the impacts of different rate design levers

Existing Eversource rate (status quo):
$10/month fixed charge
34¢/kWh volumetric (17¢ delivery + 17¢ supply)

Each rate option (or lever) can be implemented without AMI and can be combined with other rate design levers

Option 1 — Higher Fixed Charge

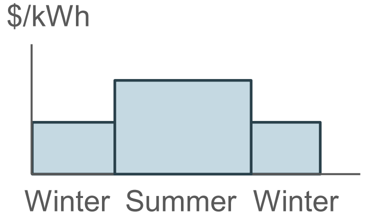
Fixed charge: **$30** (+$20/month)
Volumetric rate: **30¢/kWh** (-4¢/kWh)
$30/mo fixed charge is similar to peer jurisdiction levels and is roughly equivalent to other delivery costs collected via volumetric rates*



Income graduation limited to current utility bill discount in this analysis

Option 2a — Seasonal

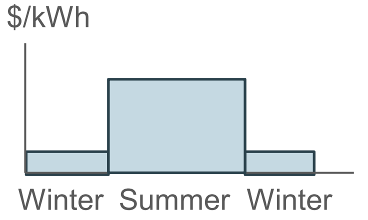
Summer rate: **37¢/kWh** (+3¢/kWh)
Winter rate: **29¢/kWh** (-5¢/kWh)
60% of utility delivery costs recovered in summer rate



Many system costs are tied to summer peak loads (in near term) – this option differentiates only base distribution costs

Option 2b — Seasonal (Electric Heating)

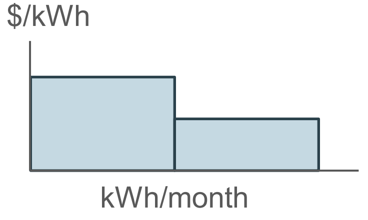
Summer rate: **42¢/kWh** (+8¢/kWh)
Winter rate: **16¢/kWh** (-18¢/kWh)
100% of utility delivery costs recovered in summer rate



This option expands on Option 2a by also differentiating other delivery charges between seasons

Option 3 — Declining Block (Electric Heating)

Tier 1 rate: **34¢/kWh** (+ 0 to 1¢/kWh)
Tier 2 rate: **17¢/kWh** (-17¢/kWh)
100% of utility delivery costs recovered in first tier (500 kWh/mo)



Costs that do not depend on usage already recovered in the first block of usage

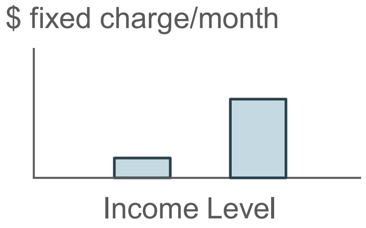
*California Public Utilities Commission approved a $24.15 fixed charge for non income-eligible bill discount ratepayers in 2024

High volumetric rates benefit households participating in Net Energy Metering (NEM)

Absent rate design specifically designed for rooftop photovoltaic (PV) customers, lowering volumetric rates presents the risk of decreasing the incentive to adopt PV by lowering compensation for exported energy

Option 1 — Higher Fixed Charge

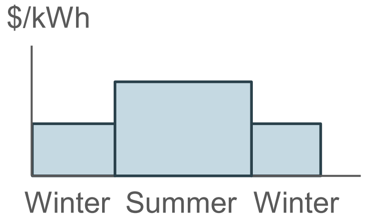
Fixed charge: **$30** (+$20/month)
Volumetric rate: **30¢/kWh** (-4¢/kWh)



Lower volumetric rates reduce solar export revenue and higher fixed charges increase the monthly cost for NEM customers

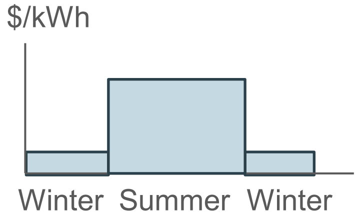
Option 2a — Seasonal

Summer rate: **37¢/kWh** (+3¢/kWh)
Winter rate: **29¢/kWh** (-5¢/kWh)



Option 2b — Seasonal (Electric Heating)

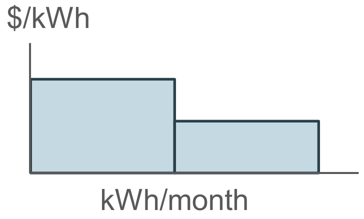
Summer rate: **42¢/kWh** (+8¢/kWh)
Winter rate: **16¢/kWh** (-18¢/kWh)



High summer volumetric rates increase revenues for NEM customers

Option 3 — Declining Block (Electric Heating)

Tier 1 rate: **34¢/kWh** (+ 0 to 1¢/kWh)
Tier 2 rate: **17¢/kWh** (-17¢/kWh)



Impact on NEM customers depends on kWh threshold used to define blocks; larger users would receive lower per kWh revenue under this design

Exploring Energy Bills With Alternative Rates

Energy+Environmental Economics

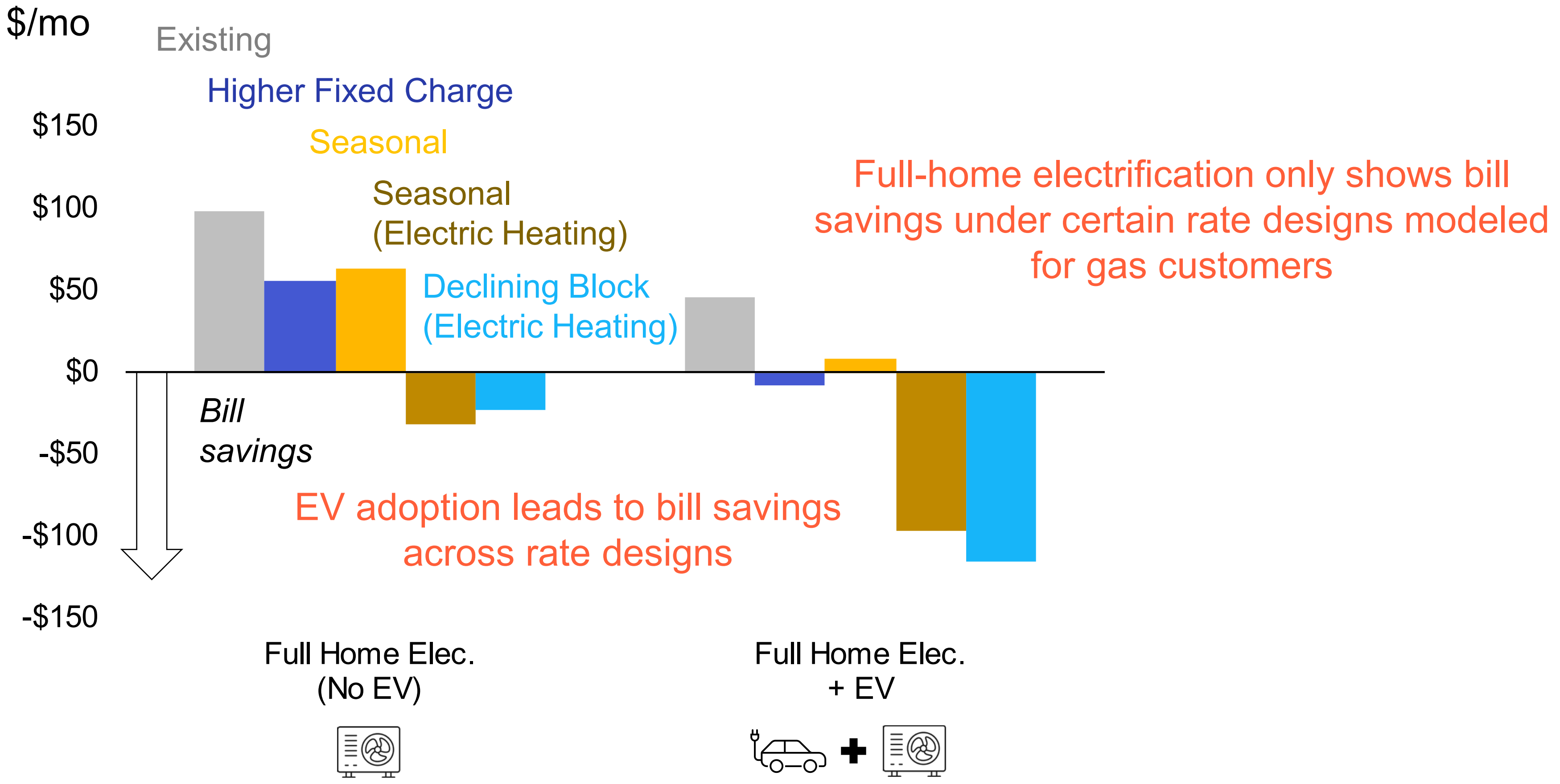
Heat pump rates can unlock bill savings for electrifying natural gas customers

Multifamily, Central MA, Room AC, 1700 sqft

~54% of MA homes heated by natural gas

Home with Natural Gas Heating, No Bill Discount

Change in Monthly Avg. Energy Expenditure, Relative to Fossil Baseline



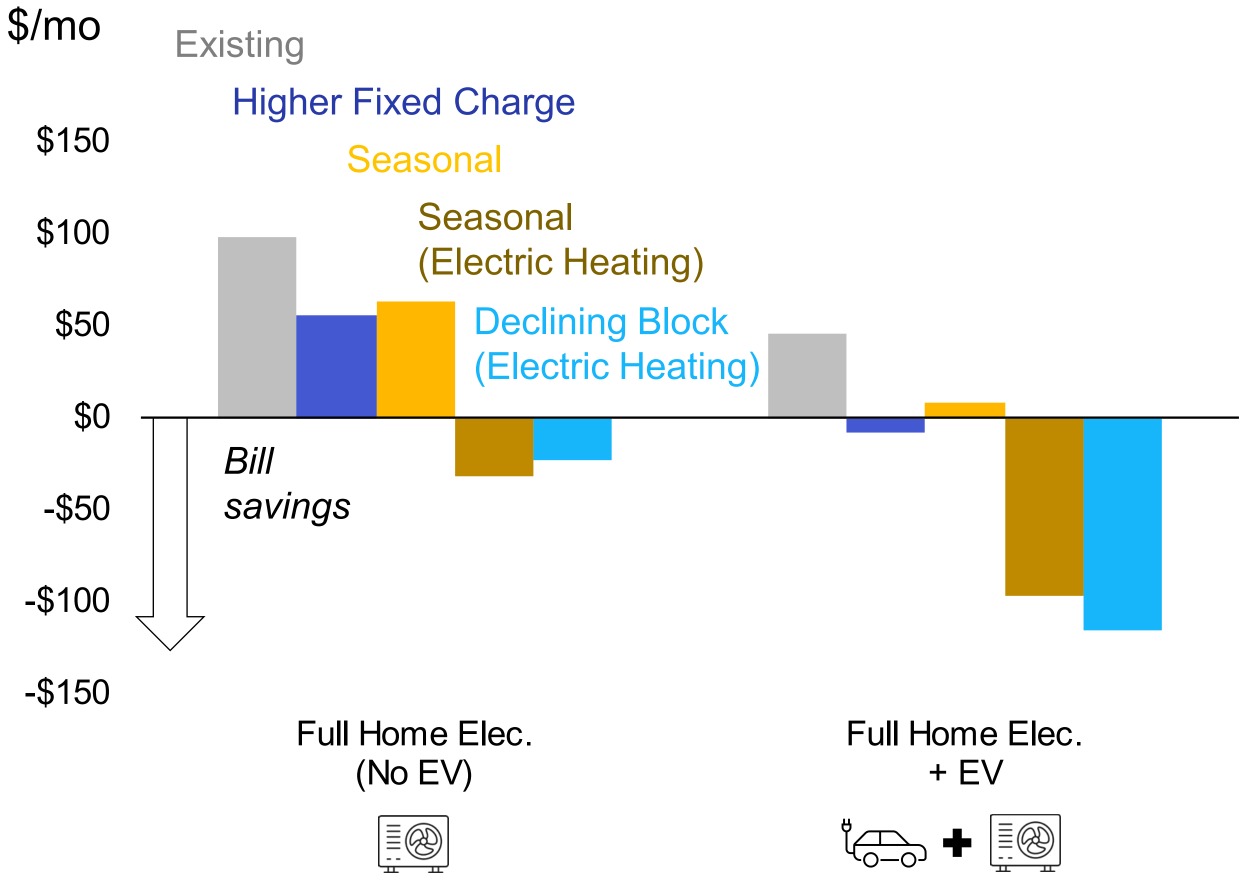
Universal rate design changes may lead to modest bill increases for non-electrifying customers

Multifamily, Central MA, Room AC, 1700 sqft

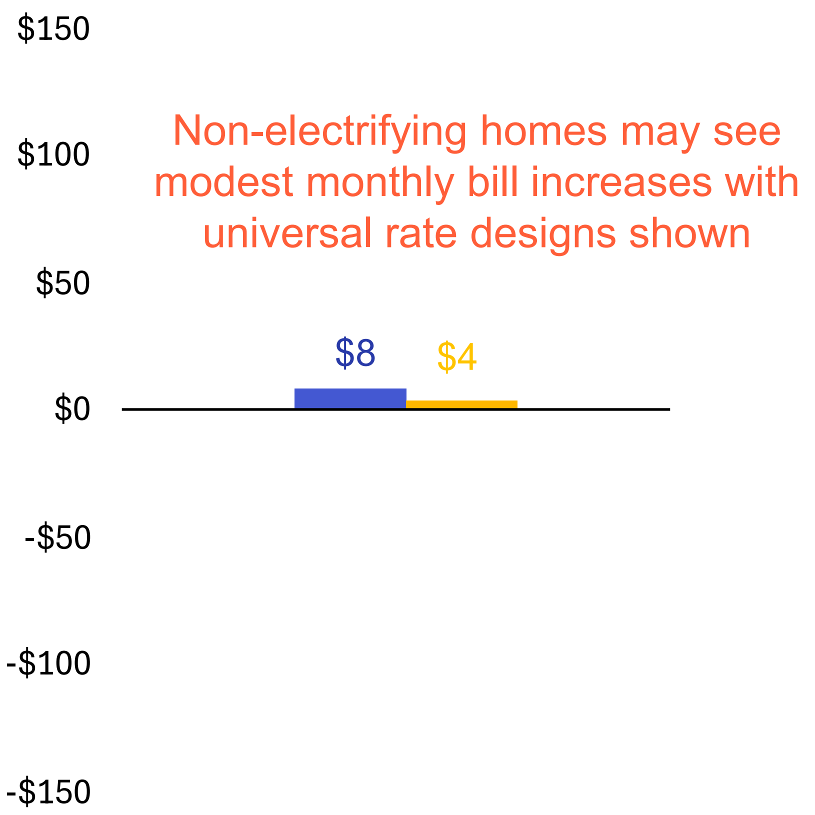
~54% of MA homes heated by natural gas

Home with Natural Gas Heating, No Bill Discount

Change in Monthly Avg.* Energy Expenditure, Relative to Fossil Baseline



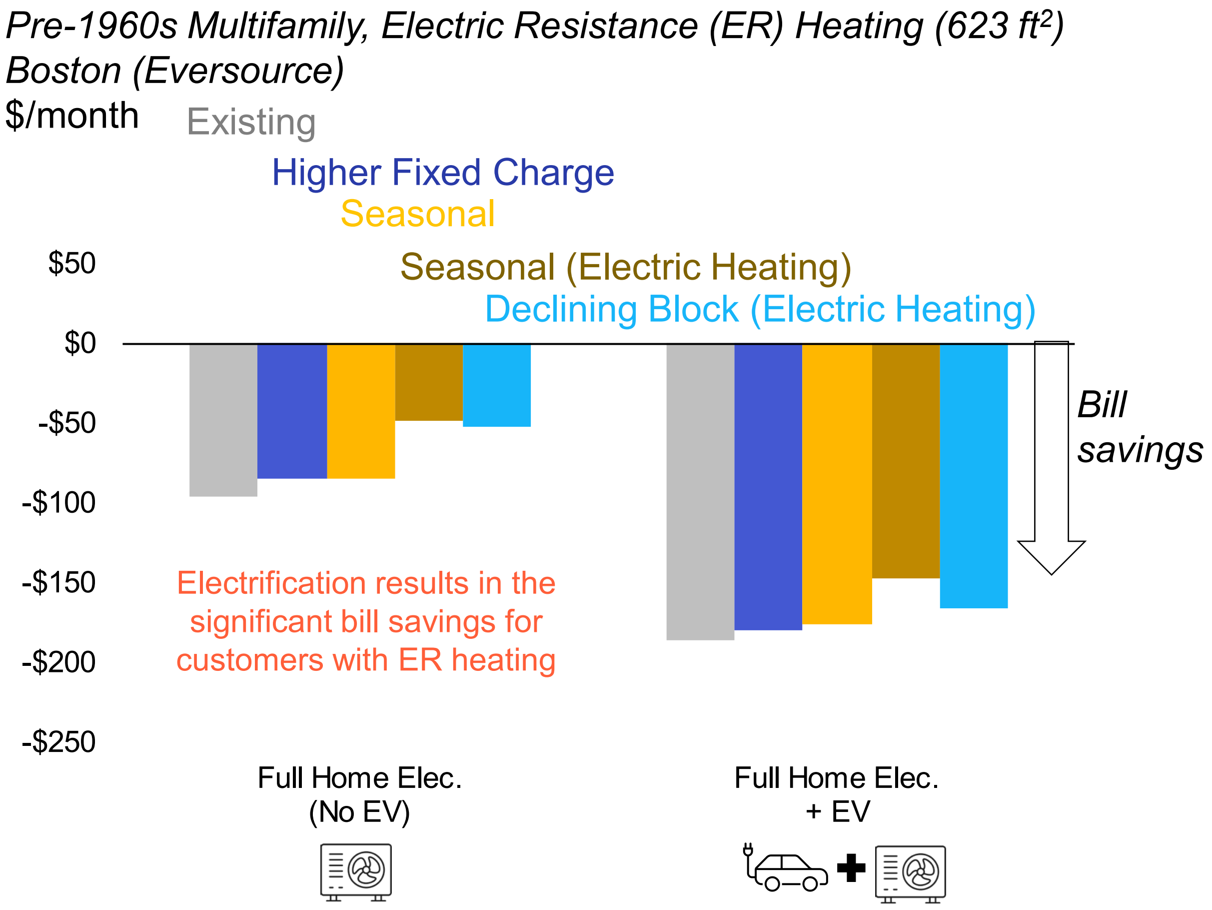
Change in Monthly Avg. Energy Expenditure, Relative to Existing Rates ($/mo)

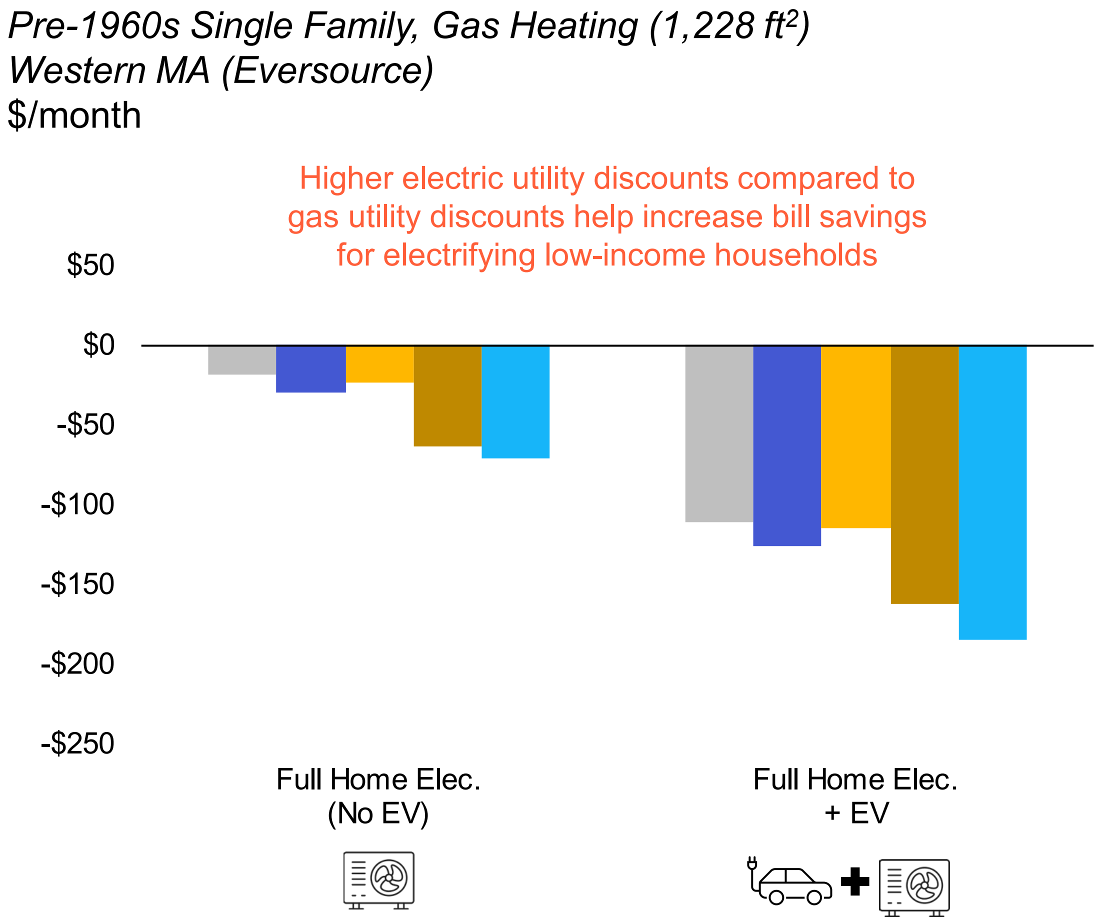


*Later slides highlight monthly bill impacts to show rate design lever impacts on bill volatility

Modeled rate designs would yield significant benefits for low-income homes regardless of existing heating fuel

Change in Monthly Avg. Energy Expenditure for Electrifying Low-Income Customers, Relative to Baseline Heating

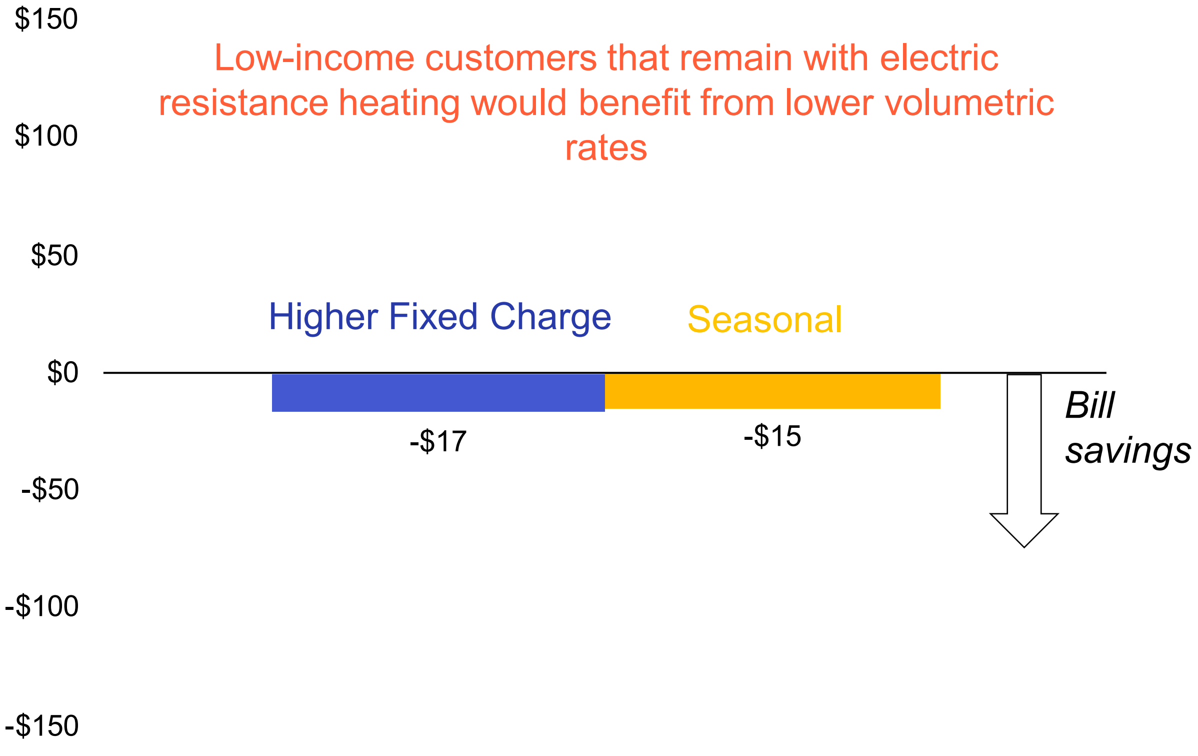




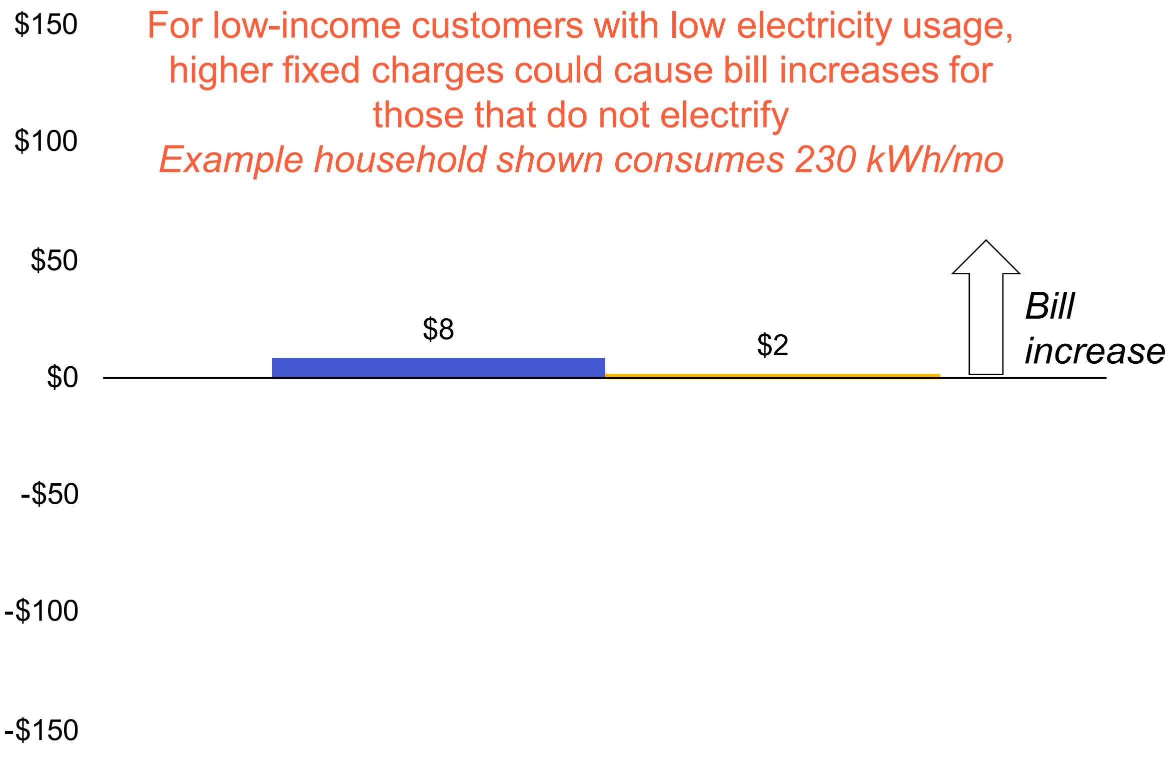
The bill impacts of universal rate changes on non-electrifying low-income customers vary by existing heating fuel

Change in Monthly Avg. Energy Expenditure for Non-Electrifying Low-Income Customers, Relative to Existing Rates

Pre-1960s Multifamily, Room AC, Electric Resistance Heating (623 ft^2)
Boston (Eversource)
$/month

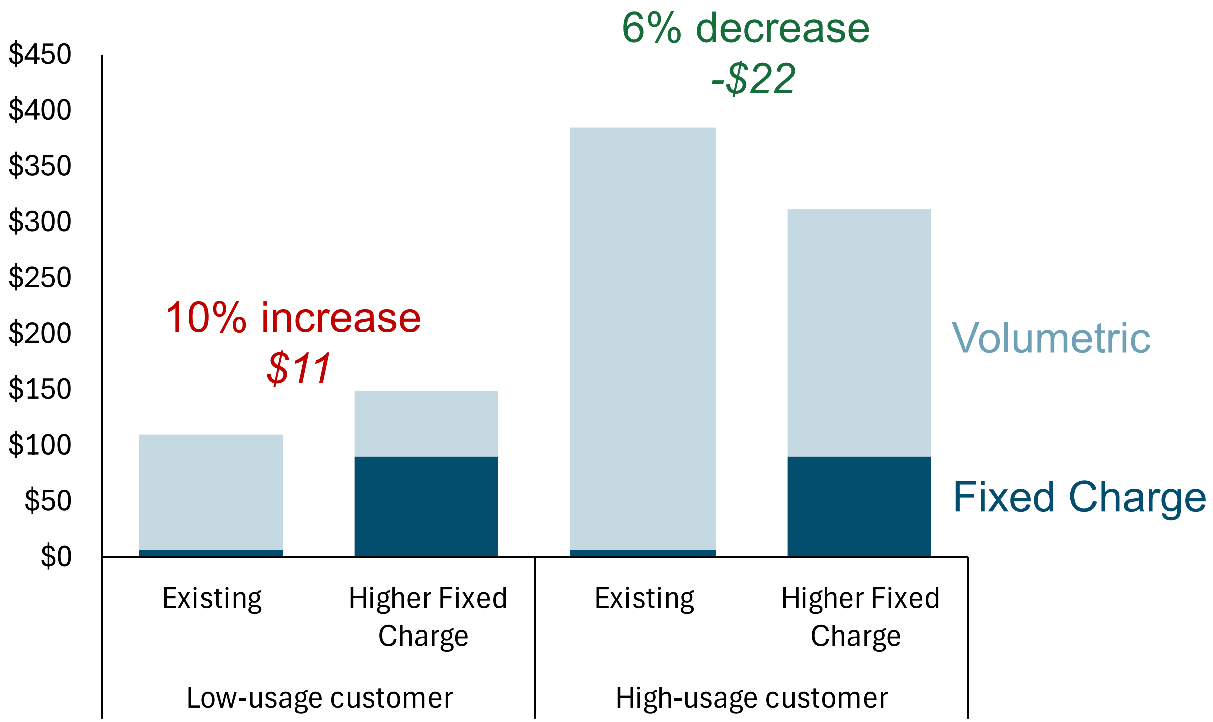


Pre-1960s Multifamily, No AC, Gas Heating (850 ft^2)
Western MA (Eversource)
$/month



Low usage customers would see small bill increases from universally raising fixed charges without income graduation

Monthly Avg. Electricity Bill
$/mo



300 kWh/mo

1,700 sqft Multifamily home
Central MA
Gas Boiler, No AC

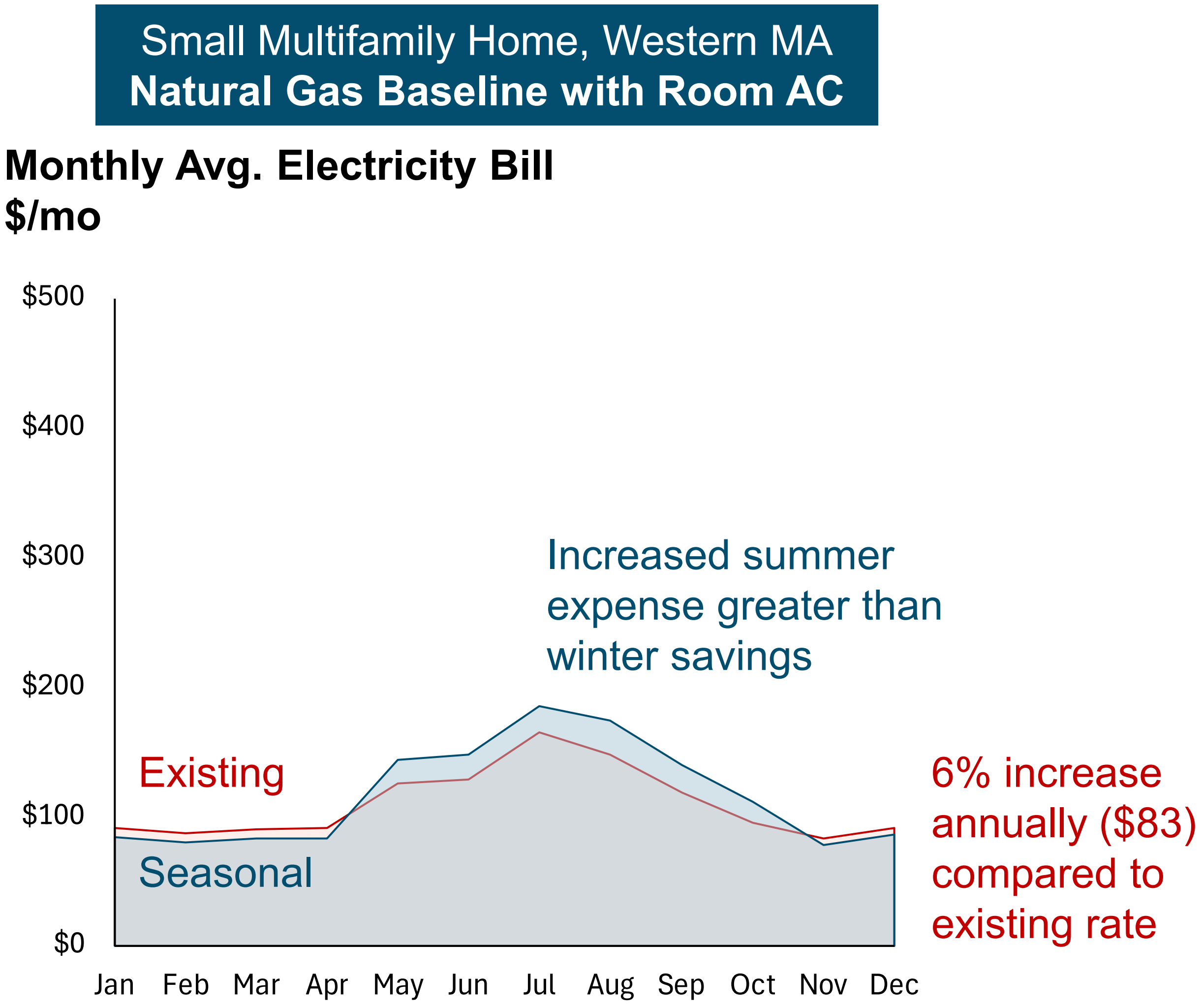
1,100 kWh/mo

1,700 sqft Multifamily home
Boston
Full Home Elec.

- **Smaller homes with low electricity usage* would face bill increases from expanded fixed charges**
  - Lower consumption would translate to lower absolute $ bill increases but higher % increases in expenditure
- **Income-graduated fixed charges could help avoid bill increases for low-income customers**
  - Existing bill discount programs could be used as a starting point to implement lower fixed charges for eligible customers

*lower than average household electricity consumption

Customers with high AC load would see bill increases from universal seasonal rates

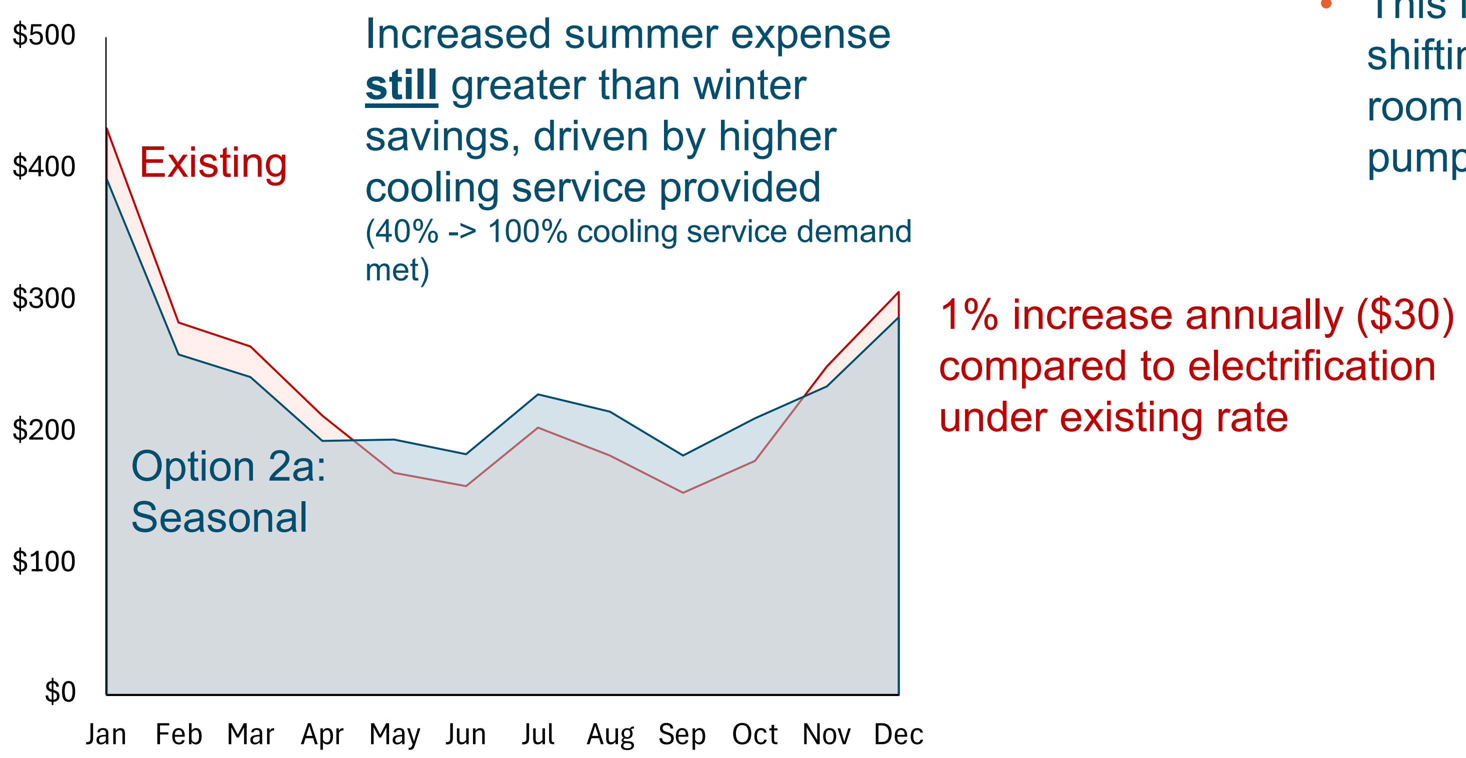


- **Homes with "peaky" summer AC usage (i.e. high summer load compared to rest of year) would see largest % increases in bills**
- **Larger homes with high air conditioning load would see the largest $ increases from adoption of higher summer rates**
- **Homes adopting with electric heating (resistance or heat pump) would see biggest benefits**

Greater winter discounts are needed to encourage heat pump adoption

Small Multifamily Home, Western MA
Fully Electrified

Monthly Avg. Electricity Bill
$/mo



- **Customers adopting heat pumps would need to see more significant winter savings to be able to offset summer air conditioning expense**
  - This is especially applicable to customers shifting from no air-conditioning or limited room air-conditioning to whole home heat pumps

Greater winter discounts are needed to encourage heat pump adoption

Small Multifamily Home, Western MA
Fully Electrified

Monthly Avg. Electricity Bill
$/mo

20% decrease annually ($545) compared to electrification under existing rate

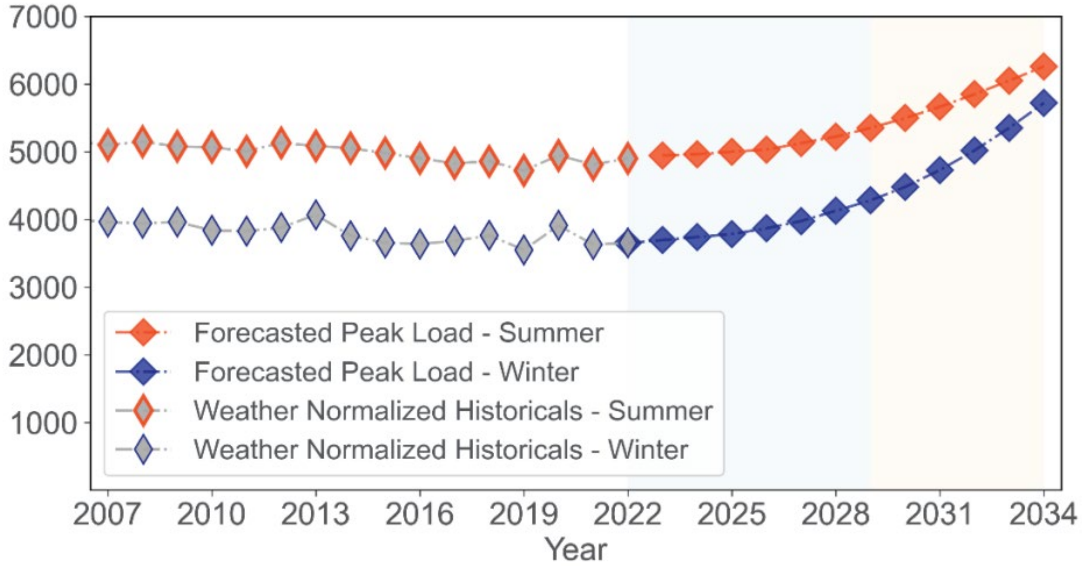
+ **Customers adopting heat pumps would need to see more significant winter savings to be able to offset summer air conditioning expense**
  - This is especially applicable to customers shifting from no air-conditioning or limited room air-conditioning to whole home heat pumps
  - Technology-specific heat pump rates that provide deeply discounted winter heating would help ensure bill savings relative to both existing rates and fossil fuel baseline technology

Technology-specific rates come with unique challenges

+ **Increased adoption of heat pumps is expected to create a winter peaking system**
  - With infrastructure investment driven by winter usage, a winter-discounted seasonal rate would be inappropriate
  - To avoid the rate outliving its appropriateness, it would need to be established with a clear timeline/process for sunsetting
+ **Given the relatively flat nature of EV load over the year, seasonal rates provide no additional signal to promote transportation electrification**

National Grid Aggregate Peak Demand*

MW



+ **Declining block rates provide no conservation signal in summer when current grid needs drive infrastructure cost**
+ **Class-wide declining block rates have faced criticism for their potential impact on low usage customers, but technology-specific eligibility can allay this concern**

Each rate lever comes with pros and cons when considered individually

	Higher Fixed Charge	Seasonal	Seasonal (Tech-specific)	Declining block (Tech-specific)
Electrification Affordability			No impact on EV bill affordability	
Baseline Affordability	Beneficial if using graduated fixed charges	High cost for summer AC	N/A	N/A
Alignment with Cost of Service		Rising winter peak will flip seasonality		
Unintended Consequences			NEM customers may be over-credited during summer	Weakens signal for summer conservation
Ease of implementation	Politically challenging			

Implementation Considerations and Key Takeaways

Energy+Environmental Economics

Rate design is "step 1," but implementation will also be crucial

- **Should new rates be "opt-in" or "default" (*i.e.*, opt-out)?**
  - Opt-in rates may have lower adoption, but will face fewer concerns from customers and stakeholders
  - Under opt-in, incentives or programs could require customers to adopt new rate options (e.g., Mass Save, Net Energy Metering)
  - Default (opt-out) rates would have higher adoption; shadow billing could help mitigate concerns regarding bill impacts
- **Technology-specific rates will have unique considerations**
  - These rates would be "opt-in" by definition, but validation may be challenging and expensive
- **Rate reform may be coupled with potential changes to bill discount programs**
  - CA example: the lower approved income-graduated fixed charge will have affordability benefits for customers enrolled in bill discount programs. Income verification was a barrier to developing larger discounts without adverse impacts for middle-income customers
  - Percent-of-Income Payment (PIPP) programs are in development and implementation in other jurisdictions
  - Tiered low-income discount rates (as proposed by National Grid in D.P.U. 23-150) would help extremely low-income households
- **Other considerations**
  - Rates will need periodic re-evaluation and certain rates (e.g., seasonal rates) may ultimately need sunsetting if the seasonal system peak shifts
  - Bill protections may be needed for renters who didn't pay for space and/or water heating prior to heat pump adoption
  - Before widespread AMI rollout, some benefits of time-varying rates could be achieved through programs (e.g., for managed charging), although existing bill savings from these programs are limited

Key takeaways – electrification and affordability
Current rates

- **Customers currently heating with electric resistance are guaranteed to see bill savings upon installing a heat pump – often up to $150 per month**
  - This is a common heating arrangement for low-income residents in multifamily buildings, where electrification could reduce energy burden by ~3%
- **Customers currently heating with oil tend to see bills decrease slightly upon installing a heat pump**
- **Customers currently heating with gas tend to see bill increases upon installing a heat pump – often up to $100 per month**
  - This is a common heating arrangement for low-income households, where electrification could increase energy burden by ~2%
- **Vehicle electrification tends to reduce customer bills, but not enough to offset bill increases for gas customer electrification**
  - Limited access to at-home charging for multifamily residents could push them to using higher cost public charging options however
  - Existing rebates for managed charging provide relatively small savings
- **Increased access to cooling will benefit residents who electrify, though this may contribute a small amount to bill increases**
  - This is especially relevant for low-income households, most of which tend to not have central air conditioning today
- **Shell improvements reduce heating and cooling demand, and can offset bill increases for gas customer electrification currently living in older homes**

Key takeaways – electrification and affordability
Near-term rate alternatives

+ **Higher fixed charges, seasonal variation, and declining block structures better align rates with utility costs of service compared to existing flat volumetric retail rates**
+ **Changing basic service rates for <u>all</u> customers is limited by a desire for gradualism and minimizing bill increases for non-electrifying customers**
  - Volumetric rate reductions of less than 5¢/kWh reduce electric heating bills meaningfully, but cannot overcome the bill increase of electrifying a gas household
  - Impacts on electrification bill savings could be improved by combining mechanisms: The suppression of volumetric charges by a high fixed charge can create headroom for shifting more costs from winter into summer
    - This can mitigate impacts on low-income customers who already struggle with high summer bills
  - Higher fixed charges and seasonal rates can also combine with incentive programs and future time-varying rates to create improved electrification incentives
  - Impacts of high fixed charges on low usage customers can be mitigated with income-graduated fixed charges
+ **<u>Technology-specific</u> rates allow for larger changes to volumetric rates and significant bill savings under electrification, but come with their own challenges**
  - A seasonal rate with cheaper winter prices would need to be phased out as a winter peak arises
  - A declining block rate provides a reduced conservation signal during the summer when the system is most stressed

Appendix

Energy+Environmental Economics

Near Term Rate Options

Modeled Option

Existing Eversource rate (status quo):
$10/month fixed charge
34¢/kWh flat volumetric charge (17¢ delivery + 17¢ supply)

New rates change cost recovery for ***delivery***.
Supply rates are assumed unchanged.

Change from Status Quo

#	Description	Limited	Moderate	Bookend
1	Higher Fixed Charge (Universal)	Fixed charge: **$30** (+$20/month) Volumetric rate: **30¢/kWh** (-4¢/kWh) *~Programs & Other Costs Only**	Fixed charge: **$40** (+$30/month) Volumetric rate: **28¢/kWh** (-6¢/kWh) *~Programs + Limited T&D*	Fixed charge: **$94** (+$84/month) Volumetric rate: **17¢/kWh** (-17¢/kWh) *~Programs + All T&D*
2a	Seasonal (Universal) *Summer: May-Oct, Winter: Nov-Apr*	Fixed charge: **$10** (no change) Summer rate: **37¢/kWh** (+3¢/kWh) Winter rate: **29¢/kWh** (-5¢/kWh) *60% of cost recovery in summer*	Fixed charge: **$10** (no change) Summer rate: **44¢/kWh** (+10¢/kWh) Winter rate: **22¢/kWh** (-12¢/kWh) *80% of cost recovery in summer*	Fixed charge: **$10** (no change) Summer: **50¢/kWh** (+16¢/kWh) Winter rate: **16¢/kWh** (-18¢/kWh) *100% of cost recovery in summer*
2b	Seasonal (Electric Heating) *Summer: May-Oct, Winter: Nov-Apr*	Fixed charge: **$10** (no change) Summer rate: **27¢/kWh** (-3¢/kWh) Winter rate: **26¢/kWh** (-4¢/kWh) *50% of cost recovery in summer*	Fixed charge: **$10** (no change) Summer rate: **35¢/kWh** (+1¢/kWh) Winter rate: **22¢/kWh** (-12¢/kWh) *75% of cost recovery in summer*	Fixed charge: **$10** (no change) Summer rate: **42¢/kWh** (+8¢/kWh) Winter rate: **16¢/kWh** (-18¢/kWh) *100% of cost recovery in summer*
3	Tiered (Electric Heating) *Tier 1: <=500 kWh, Tier 2: >500kWh*	N/A	Fixed charge: **$10** (no change) Tier 1 rate: **30¢/kWh** (-4¢/kWh) Tier 2 rate: **28¢/kWh** (-6¢/kWh) *75% of cost recovery in tier 1*	Fixed charge: **$10** (no change) Tier 1 rate: **34¢/kWh** (+ 0 to 1¢/kWh) Tier 2 rate: **17¢/kWh** (-17¢/kWh) *100% of cost recovery in tier 1*

*2024 programs portion of bill for avg. customer is $29 for Eversource, $27 for National Grid

HEEM Key Inputs and Data Sources

Legend

Public Data	Existing E3 Model	New E3 Modeling

Input Data

Baseline Energy Use	Buildings (Elec & Gas)	NREL ResStock
	Vehicles (Gasoline)	Bureau of Transportation Statistics
Electrification	Buildings (All-electric)	NREL ResStock
	Vehicles (EV)	E3 EV Load Shape Tool
Rates and Pricing	Electric	Existing rates / Alternative rates
	Gas & Gasoline	Existing rates and pricing
DER Profiles (Long-Term Rates)	*Solar + Storage*	*Model developed for HEEM*
	Managed EV Charging	*E3 EV Load Shape Tool*

Long Term Rates Study

Model

HEEM
Household Energy Expenditure Model

Outputs

1. Monthly household energy expenditures ($/mo, by fuel)
2. Energy burden (%)
3. Electrification bill impact ($/mo)

Electrification Scenarios Modeled in HEEM

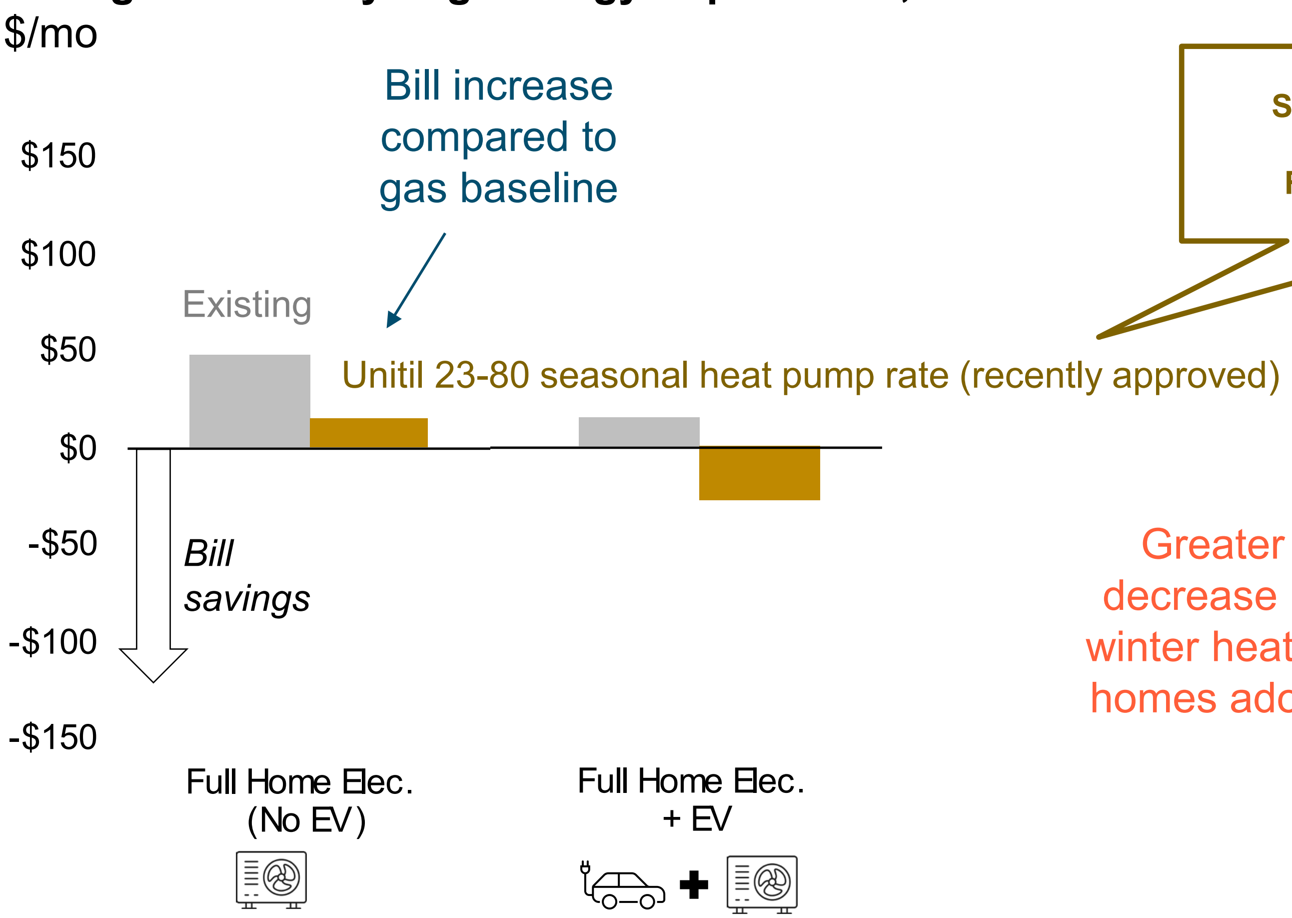
E3 modeled whole-home device electrification with either all-electric and hybrid space heating, as detailed below:

End Use	**Whole-Home Electrification** *(this presentation)*	**Whole-Home Electrification with Hybrid Space Heating**
Space Heating	High efficiency cold-climate air source heat pump *(3.2 COP)*	ASHP with existing fossil fuel backup (2.7 COP)
Water Heating	Heat pump water heater *(3.45 UEF)*	
Cooking	Induction range (85% COP)	
Clothes Drying	Heat pump clothes dryer *(3.93 combined energy factor)*	
Envelope	Light envelope upgrade *(Attic floor insulation and air sealing)*	

Approved rate provides bill savings for electrifying customers compared to existing rate but still yields price increase compared to gas baseline

Unitil Service Territory Multifamily Home with Natural Gas Heating, No Bill Discount

Change in Monthly Avg. Energy Expenditure, Relative to Fossil Baseline



Summer rate: same as existing
Winter rate: ¢7 discount
Fixed charge: $1.50 increase

Greater volumetric rate decrease needed to unlock winter heating bill savings for homes adopting heat pumps