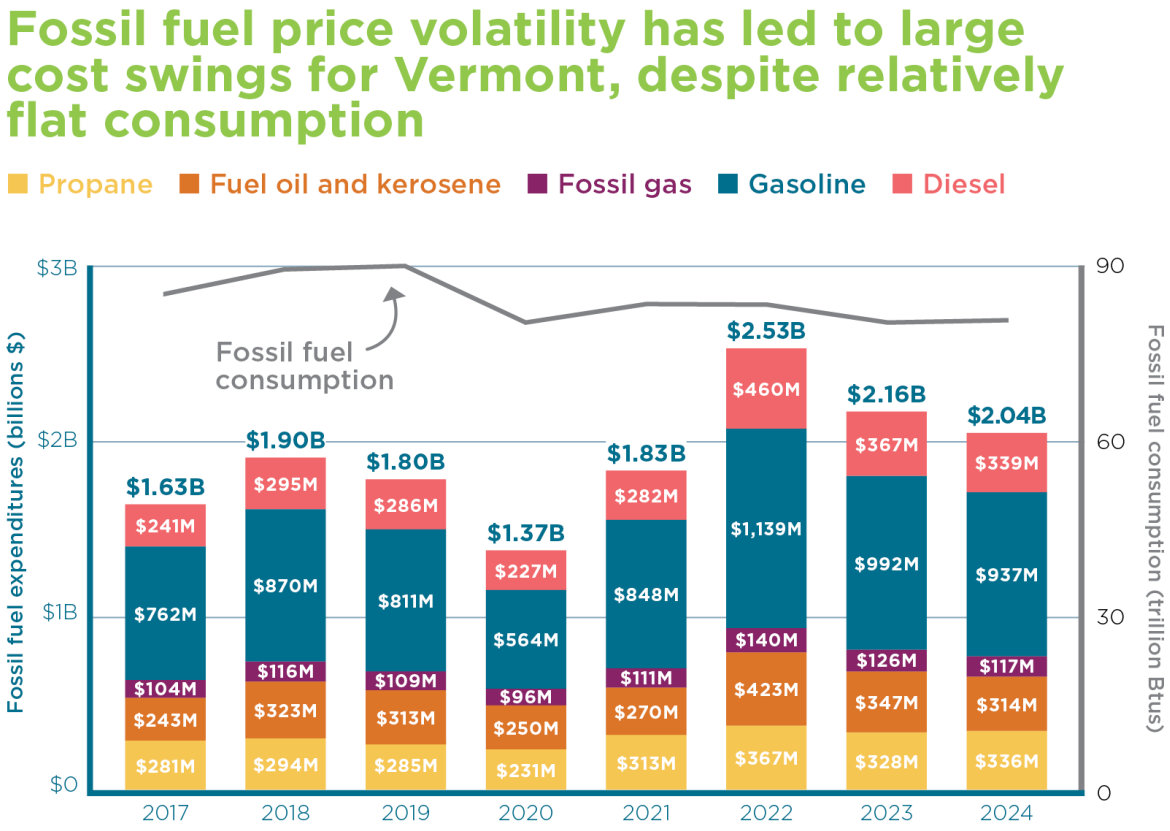
The Vermont Climate Economy: Energy, Resilience, and Opportunities Related to Climate Action

This chapter describes the economic impact of Vermonters' energy choices. Those choices include the purchase of fuels and also energy utilizing appliances and equipment and other related investments. Beyond the direct impacts of the costs, the circulation of the money spent represents a significant portion of the Vermont economy.



Sources: Gasoline and diesel sales volumes from Vermont Department of Taxes via the Joint Fiscal Office; fuel oil, kerosene, and propane sales volumes from Vermont Department of Taxes; fossil gas sales volumes and prices from VGS; other fuel prices from Vermont Department of Public Service and EIA. **Note:** This estimate only includes Vermont sales of gasoline, diesel, propane, fuel oil and kerosene, and fossil gas. It does not include sales of aviation gasoline or jet fuel from the transportation sector or of fossil fuel-based electricity generation (less than 10% of Vermont's electricity portfolio).

Figure 12

In summary, this graph shows that Vermont continues to spend billions of dollars for the purchase of fossil fuels, with over $2 billion per year spent on fossil fuels for transportation and heating each of the past three years. While there are some changes in overall fossil fuel volumes

used, we are not yet seeing the scale of reductions necessary to meet the greenhouse gas emissions reduction requirements established in the Global Warming Solutions Act (GWSA).

As shown in the following graph, fossil fuel prices since the first Climate Action Plan was adopted in 2021 continue to show large fluctuations. Prices dropped during Covid but spiked in 2022 to the point where fuel oil and diesel prices reached more than $5 per gallon.

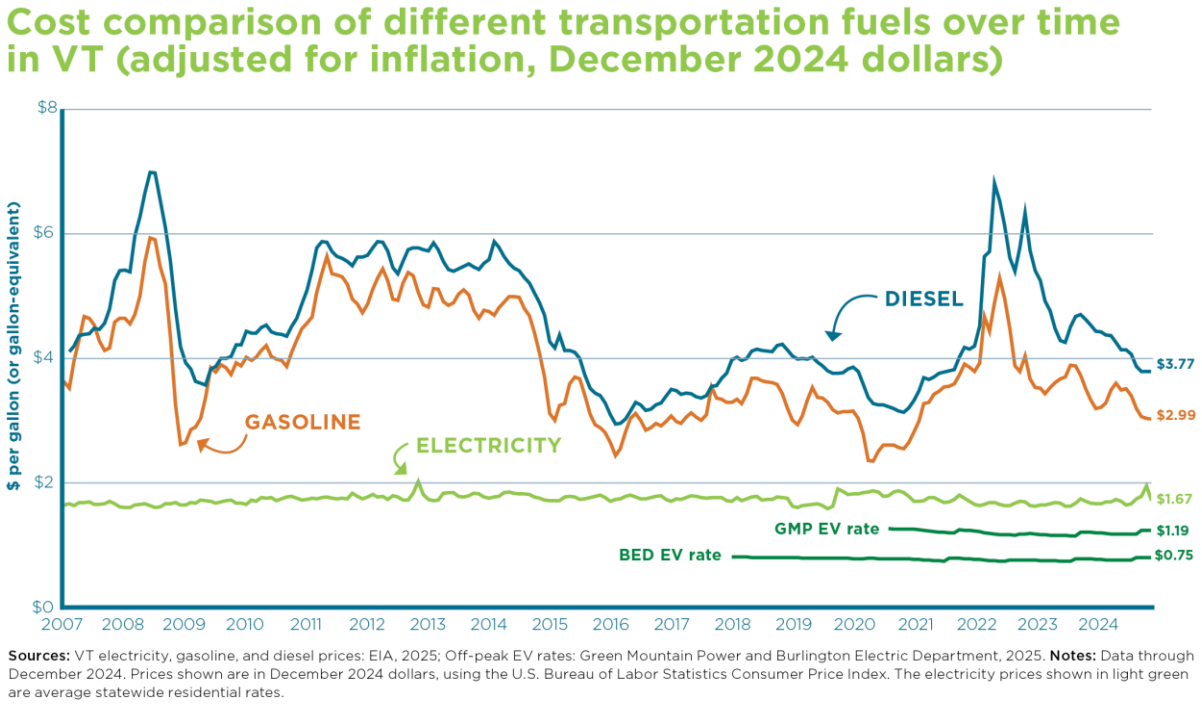


Figure 13

Additional investment

Beyond the purchase of energy and fuels in Vermont, each year, Vermonters, businesses, and property owners also buy cars, appliances, and other equipment that uses energy. Many of the ways to reduce our use of fossil fuels involve the replacement of inefficient, polluting equipment with more efficient and less polluting electric or renewably fueled equipment. In some cases, the purchase of more efficient equipment and appliances lead to lower lifetime

costs but also require additional upfront cost, both of which are important in considering the overall economic impact of a cleaner energy future.

The following table provides a picture of estimated average annual spending in Vermont on the purchase and replacement of heating, cooling and cooking appliances, many of which have traditionally been powered by fossil fuel.

Table 5:

Annual Energy Equipment Choices in Vermont	# of units	Cost per unit	Total cost	Reference for unit numbers	Reference for unit costs
Heating system replacements	11,300	$5,700	$64.4 million	Zero Emission Heating Standard Study[1] EAN	Blend for boiler and furnace[2]
Heating systems for new construction	1,680 residential	$20,000	$33.6 million	Zero Emission Heating Standard Study EAN	Above plus estimate for distribution system
Heat pumps to supplement existing systems	11,000	$9,700	$107 million	Zero Emission Heating Standard Study EAN	Blend of costs from NV5 Potential Study Appendices
Wood stoves to supplement existing systems	2,000	$3,000	$6 million	2020 Vermont Single Family Existing Homes Baseline Study[3]	Author's review of retail prices

[1] https://eanvt.org/wp-content/uploads/2025/02/ZEHES-analysis-report-FINAL.pdf
[2] Boiler https://www.thisoldhouse.com/heating-cooling/reviews/boiler-replacement-cost.
Furnace https://www.angi.com/articles/how-much-does-it-cost-install-new-furnace.htm
[3] Estimate based on Report's number of homes with wood heating appliances

Window unit air conditioners	15,000	$400	$6 million	2020 Vermont Single Family Existing Homes Baseline Study[4]	Author's review of retail prices
Hot water heating replacements[5]	23,500	$1,500	$35.3 million	Zero Emission Heating Standard Study EAN	PSD Tech Ref Manual for HPWH. Author's review for others.
Hot water heating for new const'n.	1,680 residential	$2,000	$3.4 million	Zero Emission Heating Standard Study EAN	PSD Tech Ref Manual for HPWH. Author's review for others.
Cooking appliance replacement	15,000	$1,000	$15 million	Estimate based on average replacement time of 20 years	Author's review of Retail prices
Cooking appliance for new const'n.	1,680 residential	$1,500	$2.5 million	Zero Emission Heating Standard Study EAN	Retail price plus installation

In total, these annual purchases amount to more than $250 million. These numbers provide important context for the design of incentive programs meant to encourage the replacement of fossil fueled appliances, both when such equipment reaches the end of its useful life as well as to promote replacement of a working appliance.

[4] This study reported an increase in room air conditioning penetration which represents about 6,000 homes per year and the replacement of existing air conditioners represents about 9,000 per year.
[5] A mix of resistance, combustion, and heat pump (HPWH)

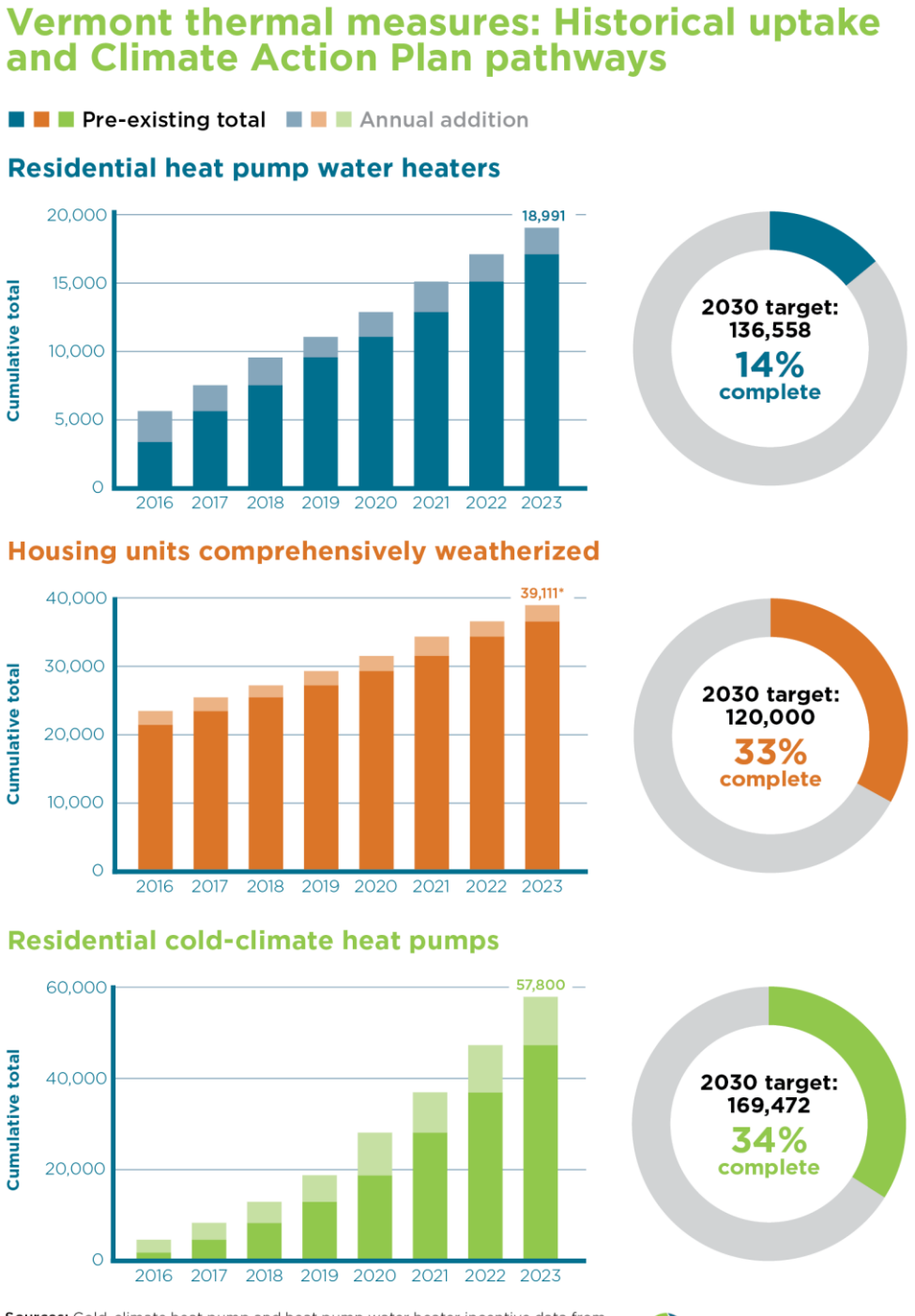

Vermont thermal measures: Historical uptake and Climate Action Plan pathways
Pre-existing total
Annual addition
Residential heat pump water heaters
Cumulative total
20,000
15,000
10,000
5,000
0
18,991
2016 2017 2018 2019 2020 2021 2022 2023
2030 target: 136,558
14% complete
Housing units comprehensively weatherized
Cumulative total
40,000
30,000
20,000
10,000
0
39,111*
2016 2017 2018 2019 2020 2021 2022 2023
2030 target: 120,000
33% complete
Residential cold-climate heat pumps
Cumulative total
60,000
40,000
20,000
0
57,800
2016 2017 2018 2019 2020 2021 2022 2023
2030 target: 169,472
34% complete
Sources: Cold-climate heat pump and heat pump water heater incentive data from Efficiency Vermont, 2024, and Burlington Electric Department, 2024. Weatherization data from the Vermont Department of Public Service, 2024. 2030 targets from Energy Futures Group/VT ANR, "Vermont Pathways Analysis Report 2.0," 2022. Notes: Data include residential measures only. *2023 weatherization data are preliminary.
Energy Action Network

Figure 14

There is appropriate interest in considering the investments necessary to transition to a lower greenhouse gas emitting future. For thermal energy needs, the electrification of heating systems requires the purchase of heat pump systems that often cost more up front than the oil, propane, or natural gas combustion devices they are replacing; additionally, switching may necessitate changes to the existing ductwork and electrical system to accommodate the heat pump. However, these up-front costs can be balanced by multiple years of reduced expenditures on heating fuels, depending on the fuel one is replacing and the utility territory they are located in. This hurdle of higher up-front costs to realize lower annual and lifetime costs points to the important role of grants and incentives (especially for Vermonters with lower- and middle-incomes) and financing programs (especially for middle- and upper-income Vermonters).

In addition to appliance purchase costs, Vermonters have been gradually carrying out weatherization actions to improve the quality and efficiency of existing homes and buildings. Historically, this has occurred at a level of about 2,000 homes per year, though that number often increases when additional federal funding has been available, as in recent years.[6] Weatherization costs are a combination of materials purchases and the labor for installation.

A different and more dramatic investment is represented in the purchase of vehicles in Vermont. In Fiscal Year 2024, Vermonters purchased new and used vehicles with an annual net cost of about $2.4 billion.[7] In addition to the purchase price and fuel costs described earlier, Vermonters spend money for repairs, registration and insurance. To get an overall number, the total vehicle miles travelled in Vermont (7.15 billion in 2023)[8] can be applied to a fleet average of 80 cents per mile,[9] meaning Vermonters spend more than $5.7 billion on vehicle-based transportation needs.

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[6] Based in part on the Annual Report from the Office of Economic Opportunity and supplemented by estimates on subsidized weatherization from Efficiency Vermont

[7] This calculation is based on the collection of the vehicle Purchase and Use Tax. For both new and used car purchases, the tax is based on the difference between the purchase price and the trade-in value of the car being replaced (when appropriate). This means that the tax represents the increase in the vehicle stock value in the state.

[8] https://vtrans.vermont.gov/sites/aot/files/documents/VT_VMT_FC_2023.pdf

[9] Bureau of Transportation Statistics, https://www.bts.gov/content/average-cost-owning-and-operating-automobilea-assuming-15000-vehicle-miles-year

In total, it is estimated that Vermonters annually spend more than $1 billion on home heat and appliances, of which about 80% is represented by fuel costs, and more than $5.7 billion on vehicle-based transportation needs, of which about 20% is represented by fuel costs. Fossil fuel purchases result in a large flow of dollars to out-of-state entities (on average 75%)[10] because no fossil fuel production takes place in Vermont.

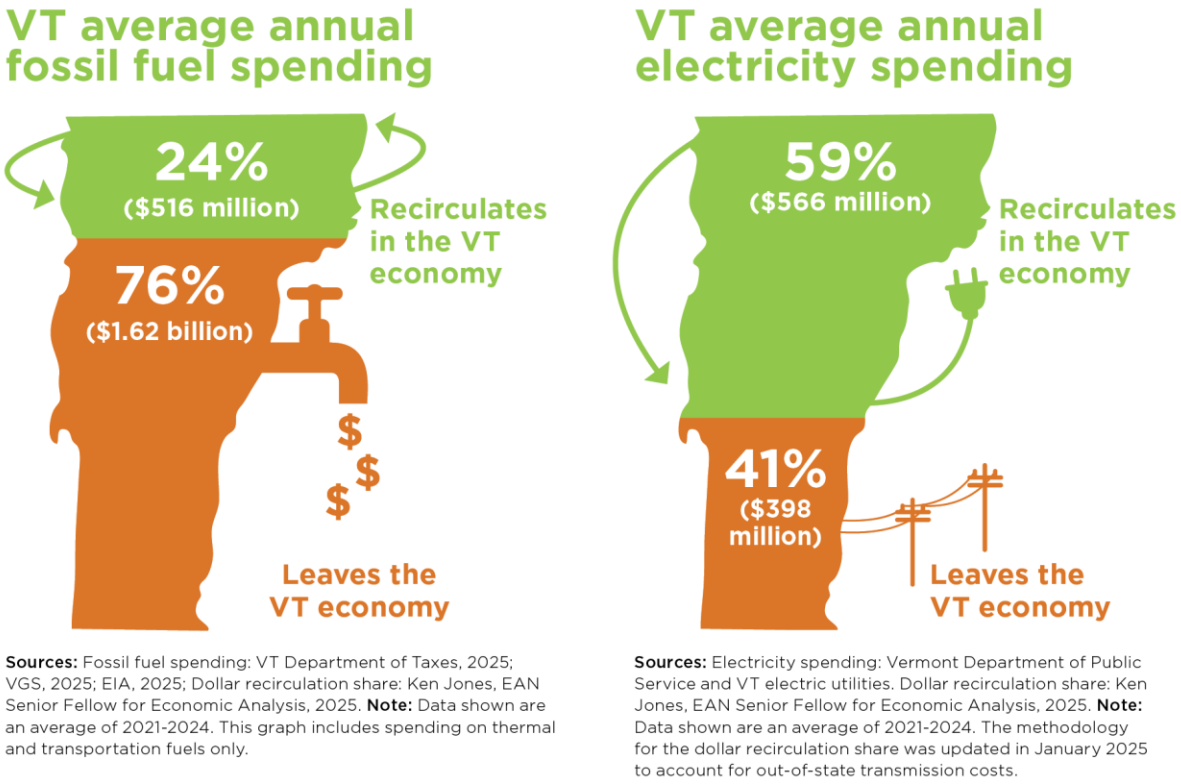


Figure 15

To put these large numbers into context, Vermont's GDP totaled more than $35 billion in 2023. There is no simple calculation of Vermont's energy GDP. The calculation would include the in-state portion of fuel (electricity, fossil and renewable) amounting to about $1 billion and the in-state portion of capital expenditures for cars, trucks, HVAC equipment and building construction which may add another $1 billion. The remaining billions of out-of-state expenditures for fuel and capital purchases must be paid for by the export of Vermont goods and services.

[10] https://eanvt.org/wp-content/uploads/2025/01/EAN-APR-2024-updatedJan2025.pdf (page 7)

In addition to the cost of the fuel itself, another portion of fuel purchase dollar costs is in Vermont employment. Because fuel purchases have not changed significantly since the first Climate Action Plan, the employment numbers for those involved in fossil fuel delivery have largely remain unchanged. There remain about 3,500 people employed at gas stations and convenience stores and 1,100 involved in fuel oil and propane deliveries. On top of these numbers, there are several hundred people employed in the wholesale movement of fossil fuels. Costs beyond employment include those related to transportation and business operations. Beyond fossil fuel delivery, there is also employment related to the installation and maintenance of fossil fuel-based equipment not reflected in the jobs numbers above.

The Clean Energy Economy

As with other sectors of the economy, the expenditures by Vermonters are reflected in economic activity that results in local employment and, for investors, a return on their capital. The Clean Energy Economy includes the development of renewable energy supplies, design and installation of efficiency technologies, and the several support sectors that result in retail sales and service.

Each year, the Department of Public Service produces a report that focuses on the employment associated with the Clean Energy Economy. The most recent report reflects conditions through the year 2024.[11] At that time, more than 18,000 people were employed in the Clean Energy Sector which represents about 6% of the Vermont workforce.

The largest subsectors within the whole include solar installations, weatherization, the installation of heating systems and production of woody biomass. It is also important to recognize that some of that employment includes workers carrying out functions in the non-Clean Energy Economy, the full-time equivalents in the Clean Energy Sector is closer to 13,500 people.

[11] https://publicservice.vermont.gov/sites/dps/files/documents/VCEIR_2024_Slide%20Deck.pdf

Beyond the thermal and transportation sectors, Vermont has focused on the efficient use of electricity for more than 25 years. These electric efficiency investments have helped avoid the need for new electricity supplies and distribution and transmission investments.

Efficiency Vermont is overseen by the Public Utility Commission to use funds from ratepayers to support cost-effective investments in electric efficiency. In 2023, Efficiency Vermont invested more than $40 million in “electric resource acquisition” spending. These are direct investments in businesses and residential properties to reduce electricity use. In 2023, the electricity reductions amounted to more than 72,000 Megawatt hours (MWh). These savings accumulate over time, and in their 2023 annual report, Efficiency Vermont reports that the lifetime savings from the past three years of investments is more than 3 million MWh. At current rates, this amounts to more than $480 million in customer savings.

One set of strategies worthy of note is an increase in the use of liquid and gaseous biofuels. Liquid biofuel feedstocks include waste fats, oil, and grease which can be sourced locally, but larger volume liquid biofuels rely on seed oil crops that are largely grown in more intensively cropped parts of the US and Canada.

Renewable Natural Gas (RNG) can be derived from animal manure waste which has multiple benefits when compared to management that allows for methane release to the air. RNG is also created in the anaerobic treatment of wastewater and other food wastes. To the extent that these activities take place in Vermont, it displaces the purchase of natural gas from the Canadian pipeline.

Forest resources have also long been used to provide heat. Modern wood heating appliances are more efficient in their use of wood. Cord wood and wood chips primarily come from in-state sources. Wood pellets, while produced in Vermont, currently largely come from out-of-state suppliers.

Current costs of climate related damages

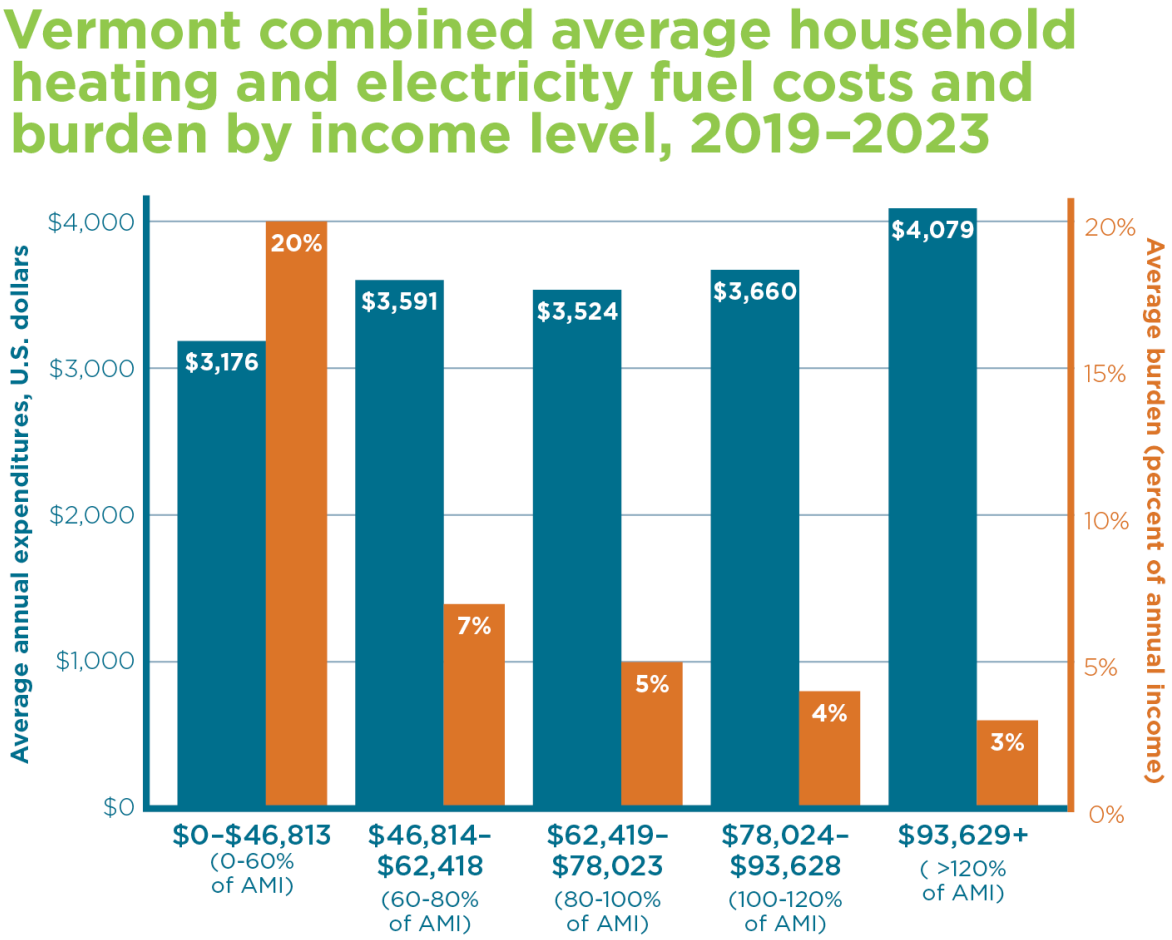
Elsewhere, this Plan includes information on the updated calculation for the Social Costs of Greenhouse Gases that assigns a dollar amount to each ton of greenhouse gas emitted. Those calculations are based on global impacts and report the incremental damage from each ton emitted. A different way to look at economic damages is to consider the actual costs in Vermont that have arisen from climate-related impacts on economic activity. It is possible to look at trends in damages and, utilizing advances in attribution science, estimate how much greater damages have been due to climate destabilization.

The most obvious examples of climate related damages in Vermont are the increasing frequency and severity of flooding events. From 2011-2024, Vermont tied for the 5th highest number of climate related disaster declarations of any state in the U.S., with the 4th highest per capita climate disaster costs, as measured by FEMA and HUD assistance dollars.[12] Unfortunately, FEMA and other federal government payments represent only a fraction of the total costs that Vermonters face in repairing the damages from climate-related events. As noted in the first report, insurance payments are in addition to FEMA payments and the continuing trend of increasing insurance premiums reflects the increasing payments that are necessary in addressing climate-related damages. Furthermore, insurance companies that work in multiple states must also address climate-related damages that are resulting from increases in hurricane and wildfire events taking place outside of Vermont. In this way, Vermont pays a portion of the costs of the climate related damages resulting from out-of-state occurrences.

Recognizing the Important Aspect of Equity in the Energy Economy

It is typical and yet somewhat misleading to talk about the Vermont economy as the total of dollars in terms of income and expenditures. Unfortunately, such a presentation, including in this section, misses the important fact of the distribution of costs and income to different portions of the Vermont population.

[12] https://rebuildbydesign.org/wp-content/uploads/2024/07/Atlas-of-Accountability-Fact-Sheet.pdf



Source: U.S. Census Bureau, 2019-2023 American Community Survey 5-year Public Use Microdata Samples.
Notes: Income categories are based on 2019-2023 median household income in Vermont of $78,024. Energy burden refers to the share of annual household income spent on energy. Costs include fuel only and are not inclusive of equipment and maintenance costs.

Figure 16

Understanding that the $2 billion plus dollars spent on fossil fuels means that some households are spending 20% or more of their overall income on those purchases is critical in the design of strategies to move us to a lower carbon future. Energy burdens above 6% are considered to be high and above 10% are considered severe.[13]

A corollary to the direct expenditures for energy purchases is the very different cost of capital when households need to borrow to make purchases for their home or transportation. Any

[13] https://www.aceee.org/sites/default/files/pdfs/ACEEE-01%20Energy%20Burden%20-%20National.pdf

program that increases household debt has a much greater negative impact on a low-income household than on a moderate- or upper-income household.

Resilience and Adaptation

This version of the Climate Plan includes the consideration of resilience and adaptation as a necessary direction for Vermont to pursue in the context of rapidly changing climate conditions. Vermonters have and will, to an increasing extent, need to make investments to reduce the economic danger from future climate related events such as floods, drought, and high temperature events. As with mitigation, these activities will require investments and those investments will yield local economic activity as well as a reduction in future costs. Concurrent with the development of the Climate Plan, the Agency of Natural Resources led the development of a Resilience Implementation Strategy that sought to catalog existing programs and identify critical gaps within the resilience and adaptation work supported by state government. As a next step, the Treasurer will be examining possible approaches to expand funding for this work.[14] In addition to state-led work, there are also considerable resilience and adaptation efforts underway at the regional and local levels. A visit to the website: https://floodready.vermont.gov provides a snapshot of the planning activities underway in each of Vermont's municipalities. As resilience and adaptation efforts are growing rapidly at all levels, developing a more fulsome understanding the economics of resilience and adaptation will require additional research and data collection.

[14] See https://climatechange.vermont.gov/resilience