Energy Action Network

ANNUAL PROGRESS REPORT

for VERMONT

2024

on EMISSIONS, ENERGY, EQUITY, and the ECONOMY

Contents

EAN is dedicated to providing the latest data and highest quality analysis to ground and inform Vermont's energy and climate conversation. *We produce the Annual Progress Report for Vermont because we believe that achieving constructive progress toward Vermont's energy and climate commitments should begin with — and always return to — a careful, fact-based assessment of the latest evidence. This report includes the latest available data from many official sources, from local to international levels.[4] Thank you to the broad and diverse array of data providers and reviewers whose generous collaboration makes this report possible.*

4. Because different sources release data on varying timelines, the latest available data can be very recent or delayed as much as five years, depending on the source.

Globally, 2023 was, by far, the hottest year ever recorded.[1] The extreme temperatures continued into 2024. For 15 months straight, from June 2023 to August 2024, every single month set a new record for average monthly global temperatures.[2] These hotter temperatures are supercharging storms, raising sea-levels, creating extreme droughts, and intensifying wildfires.

The consequences have already been devastating for people and ecosystems around the world, including in Vermont. The July 2023 flooding we experienced was precipitated by the second "100-year rainfall event" in Vermont in just the last 12 years and was then followed by additional severe flooding in 2024. The frequency and intensity of these extreme events are directly related to the impact of fossil-fueled climate destabilization.

The climate crisis is a collective action problem. We will only be able to avoid its worst consequences if communities, states, and nations take responsibility for reducing the climate pollution they create, in line with science-based targets. Vermont — or any other state or country — cannot solve this challenge alone. But we can do our part and refuse to pass the buck.

And Vermont's responsibility is significant. As of the latest data, our state has made the least progress toward the emissions reduction commitment that the U.S. made as part of the Paris Climate agreement, while creating the second highest amount of climate pollution per person, of any state in New England.[3]

At other times in our history, Vermonters have had to decide whether to step up and do our part or whether to shirk responsibility — whether to lead, for the sake of Vermonters and the example we set, or whether to succumb to a defeatist mindset of "we're too small to make a difference." For the sake of our people and for the message we send to younger and future generations, EAN embraces the scientific and moral imperative to step up and do our part again.

Climate action is not easy. It requires real change at both the policy and personal levels, with each often requiring upfront investments to avoid future costs. But the science and economics show that **action now is not nearly as challenging or as costly as the consequences of inaction — especially for the youngest and most vulnerable among us.**

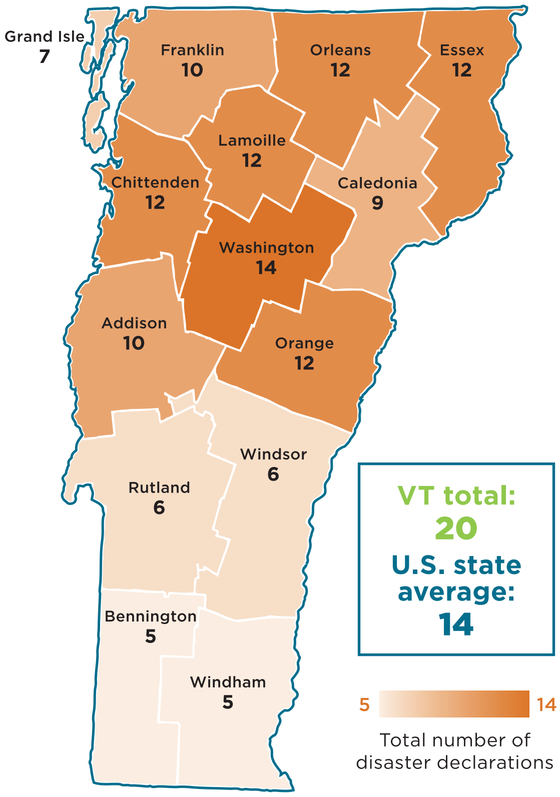
The responsibility to do our part is also a major opportunity. We can lower energy costs and re-localize our energy dollars by investing in weatherization, heat pumps, advanced wood heating, electric vehicles, and more. This will stop the drain of billions of dollars a year to out of state fossil fuel corporations for a polluting, high-cost, and price-volatile product. Moving beyond fossil fuels can be a win-win-win opportunity to save consumers money, strengthen Vermont's economy, and improve public health.

1. NOAA, "2023 was the world's warmest year on record, by far," January 12, 2024.
2. NOAA, "Earth had its hottest August in 175-year record," September 12, 2024. **Note:** August 2024 was the last month of data available before this report went to press.
3. EAN, "Assessing Vermont's climate responsibility: A comparative analysis of per capita emissions," 2023.

1. Climate disruption is here

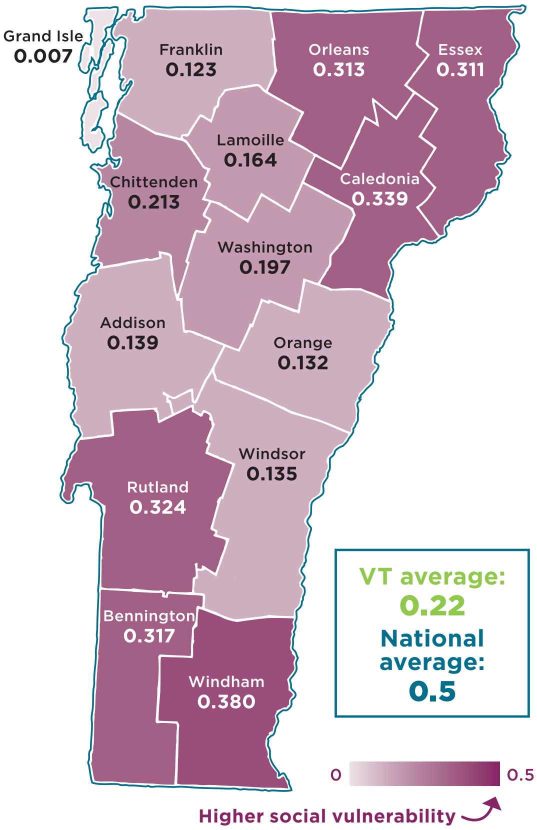
Climate disruption is already causing significant harm and costs, both around the world and here in Vermont. **Across the Northeastern U.S., extreme precipitation events have increased more than 60% over the last 60 years.**[1] In July 2023, Vermont experienced historic flooding that damaged more than 4,000 homes and 800 businesses and resulted in two deaths.[2] Vermont was hit again with flooding in July 2024, causing two fatalities and damage to many more homes, businesses, farms, and roads. Starting with Tropical Storm Irene, Vermont has experienced a high number of increasingly devastating rainfall events in the past 13 years. Looking ahead, the latest National Climate Assessment projects that the amount of rain on the wettest days in Vermont would increase yet another 20% to 25% in the coming decades under a 2°C (3.6°F) warming scenario.[3]

Climate-related federally declared disasters in Vermont, 2011–2023



Source: Rebuild by Design, "Atlas of Accountability," 2024. **Note:** There were 20 total disaster events that impacted one or more counties in Vermont.

Social vulnerability index by Vermont county



Source: Centers for Disease Control and Prevention, National Social Vulnerability Index 2020 Database. **Note**: Darker colors indicate higher relative social vulnerability. "Social vulnerability" includes factors such as poverty, lack of access to transportation, and crowded housing that may weaken a community's ability to prevent human suffering and financial loss in a disaster. Values range from 0 to 1, with higher values indicating greater vulnerability.

Vermont experienced the 7th highest number of federally declared climate disasters (20 total) of any state in the U.S. between 2011 and 2023, with the 5th highest per capita disaster costs ($684 per person), as measured in federal assistance dollars.[4] Washington County, in particular, tied for the 2nd highest number of climate-related federal disaster declarations out of *all counties in the U.S.* But communities across the entire state have been increasingly impacted by climate disasters, and areas with higher levels of social vulnerability tend to have fewer resources to recover from these events.

In addition to flooding, many Vermont communities — from St. Johnsbury to Burlington — experienced their warmest winter ever recorded in 2023/24.[5] Vermont was not an anomaly: globally, 2023 was the hottest year ever recorded.[6] Higher temperatures continued into 2024. In fact, **every month from June 2023 to August 2024 broke the record for the highest average global temperature for that month.**[7]

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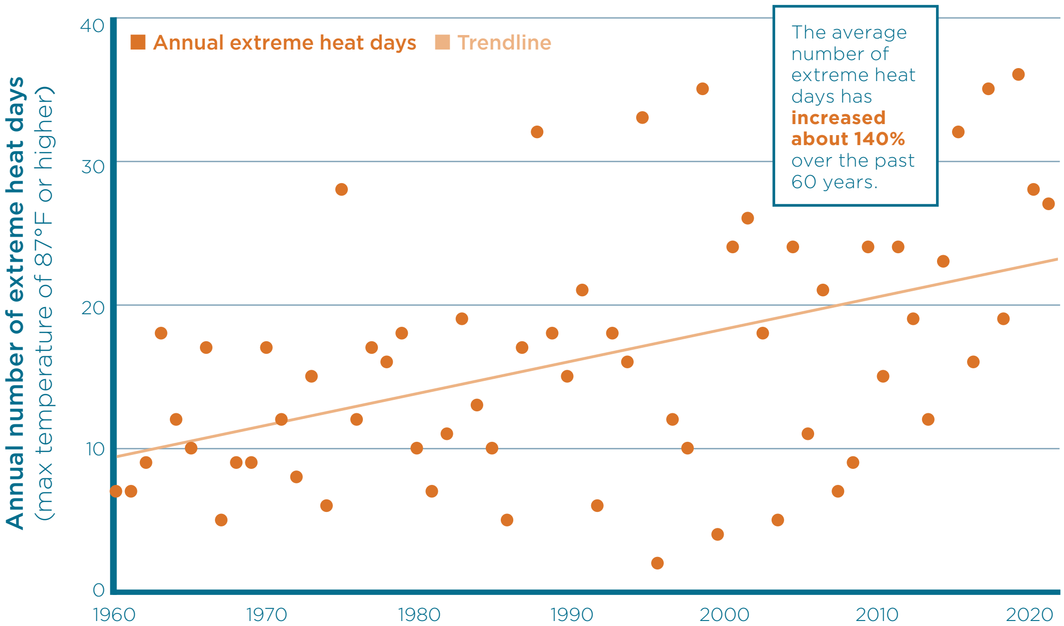
1. U.S. Global Change Research Program, "Fifth National Climate Assessment," 2023.
2. VTDigger, "Preliminary tally indicates Vermont floods damaged more than 4,000 homes and 800 businesses," July 26, 2023.
3. U.S. Global Change Research Program, "Fifth National Climate Assessment," 2023.
4. Rebuild By Design, "Atlas of Accountability," 2024.
5. VTDigger, "Warmest winter on record: Several Vermont communities hit new highs," March 4, 2024.
6. NASA, "NASA Analysis Confirms 2023 as Warmest Year on Record," Jan 12, 2024.
7. NOAA, "Earth had its hottest August in 175-year record," September 12, 2024. **Note:** August 2024 was the last month of data available before this report went to press.

2. True resilience requires adaptation and mitigation

In the face of the devastating effects of increasing climate disruption, additional focus on resilience is vital. Climate resilience refers to the ability to prepare for, recover from, and adapt to the multitude of impacts of climate destabilization. However, **there can be no durable resilience without mitigating (i.e., reducing) the pollution that is causing climate disruption in the first place**. Thankfully, many pollution reduction strategies are simultaneously resilience or adaptation strategies, including weatherization, increased use of heat pumps, and battery storage.

Extreme heat days in Burlington, VT, 1960–2022

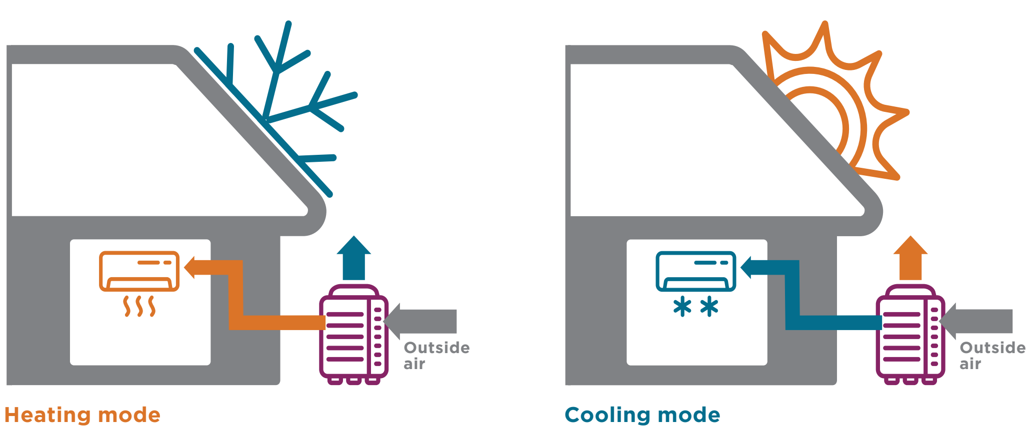


Source: Burlington Weather Station, 2024. **Note:** In Vermont extreme heat is considered 87°F (31°C) or higher.

Vermont is seeing a significant increase in extreme heat during summer months. Burlington, for example, has seen an average increase in extreme heat days of about 140% since 1960. Extreme heat can have serious health and safety impacts, particularly for the most vulnerable populations. In 2018, Vermont experienced a heat wave with six days straight reaching above 90°F, resulting in over 100 emergency department visits and four deaths.[1] Those who died during the heat wave were primarily older Vermonters who lived alone in homes without air conditioning.

Heat pumps are an example of a solution with mitigation, adaptation, and resilience co-benefits. In addition to reducing reliance on fossil heating fuels during the colder months, the same heat pump can provide cooling in summer months. And, if flooding does occur, heat pumps don't pose the health and safety risks of fossil fuel equipment, which can create hazardous waste spills in homes and leak into waterways.[2]

Heat pumps provide both heating and cooling



1. Vermont Department of Health, 2021.
2. VTDigger, "Seeking shelter: Vermonters displaced by floods find housing solutions through family and friends," August 3, 2023.

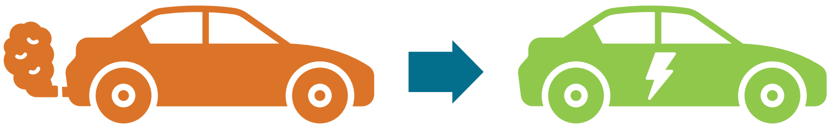
3. Delaying action is costly

A question commonly heard is: how much will it cost to combat climate change? A question that is at least as important to ask is: **what is the cost of *inaction?* Because when we don't act, that is also a choice with real costs and consequences.** As we have seen from recent flooding events, responding to climate change is and will be expensive. The choice we face now is whether to proactively invest in solutions that will reduce climate disruption, or wait and reactively pay ever-increasing costs when emergencies occur.

The Social Cost of Greenhouse Gases (SC-GHG) helps us answer these questions in a comprehensive and evidence-based way. **The SC-GHG is "the monetary value of the net harm to society from emitting a metric ton of that GHG into the atmosphere in a given year."**[1]

The U.S. Environmental Protection Agency (EPA) estimated the social cost of emitting one metric ton of CO_2 in 2020 at $190.[2] This means that when a Vermont driver switches from gasoline to electric, over the life of the vehicle they avoid causing more than $7,000 in costs and damages to society from the car's climate pollution, in addition to individual savings of more than $9,500 on fuel and maintenance. When scaled up, if Vermont meets our Global Warming Solutions Act (GWSA) obligations, we will avoid 100 million metric tons of GHG emissions, preventing more than $25 billion in societal costs and damages.

Lifetime cost savings of switching to an electric vehicle



Estimated savings on fuel and maintenance: ~$9,500

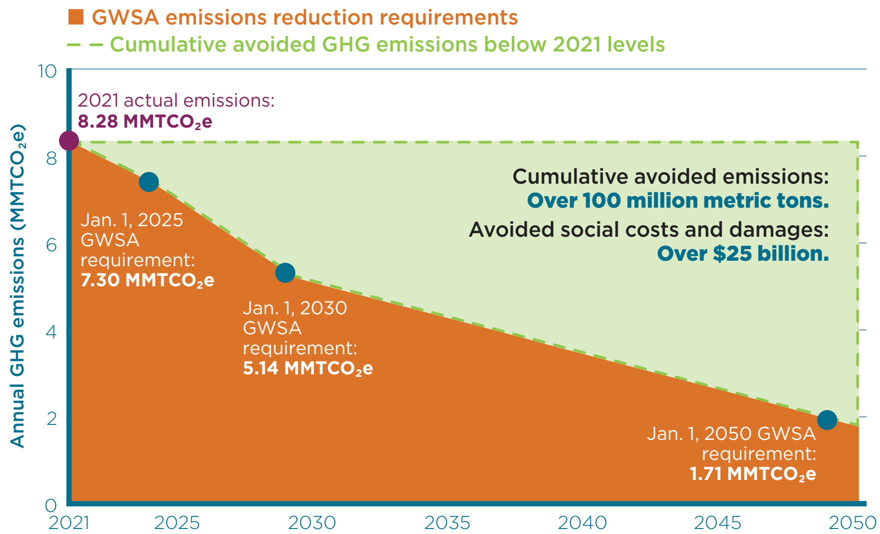
+

Avoided social costs from reduced fuel-related GHG emissions over the life of the vehicle: ~$7,000

Sources: Annual mileage assumed to be 11,084 based on 2022 data for Vermont from Federal Highway Administration; Fuel economy assumptions from the 2021 Vermont Transportation Energy Profile; Gasoline and electricity prices are 2023 averages for Vermont from EIA; gasoline emissions factors from EIA and EPA; electricity emissions intensity assumed to decrease linearly to 100% carbon-free by 2035; Social Cost of GHG values from the EPA (2023), using a 2% discount rate. Calculation based on a vehicle lifetime of 8 years, per assumptions in the 2023 Vermont Tier III Technical Reference Manual. **Note**: Upfront vehicle costs vary based on make/model and incentive eligibility; because of this variance, upfront vehicle costs are not quantified here. All costs and savings presented in 2024 dollars.

Cumulative avoided GHG emissions by 2050 and avoided social costs

VT Global Warming Solutions Act compliance scenario



Sources: Vermont Global Warming Solutions Act, 2020; Vermont Agency of Natural Resources, "Vermont Greenhouse Gas Emissions Inventory and Forecast, 1990-2021," 2024; U.S. EPA, "Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances," 2023. **Note:** Avoided social costs of GHGs are based on avoided emissions in the years 2022-2049, though the costs and damages may not necessarily occur within the same time period.

Delaying climate action ends up being most costly to the most vulnerable — both here in Vermont and around the world. Vermonters with lower incomes are more likely to live in a floodplain or lack access to cooling. Globally, it is poor people and marginalized communities who are most exposed to the impacts of climate destabilization, from sea level rise to intensifying drought. The question we face is how large the costs of inaction will grow to be — and for whom — if we continue to delay necessary investments in a clean energy transition.

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1. U.S. EPA, "EPA Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances," November 2023.

2. In November, 2023 the Environmental Protection Agency (EPA) released updated estimates of the SC-GHG, following the recommendations of the National Academies of Science, Engineering, and Medicine and incorporating recent advances in the scientific literature. The EPA's estimates are conservative, both because they omit some key damages and costs related to climate change (including morbidity and harms to biodiversity and ecosystem services, among others), and also because they significantly discount future costs to younger generations as compared to present costs to older generations.

4. Getting off fossil fuels benefits Vermont's economy, health, and more

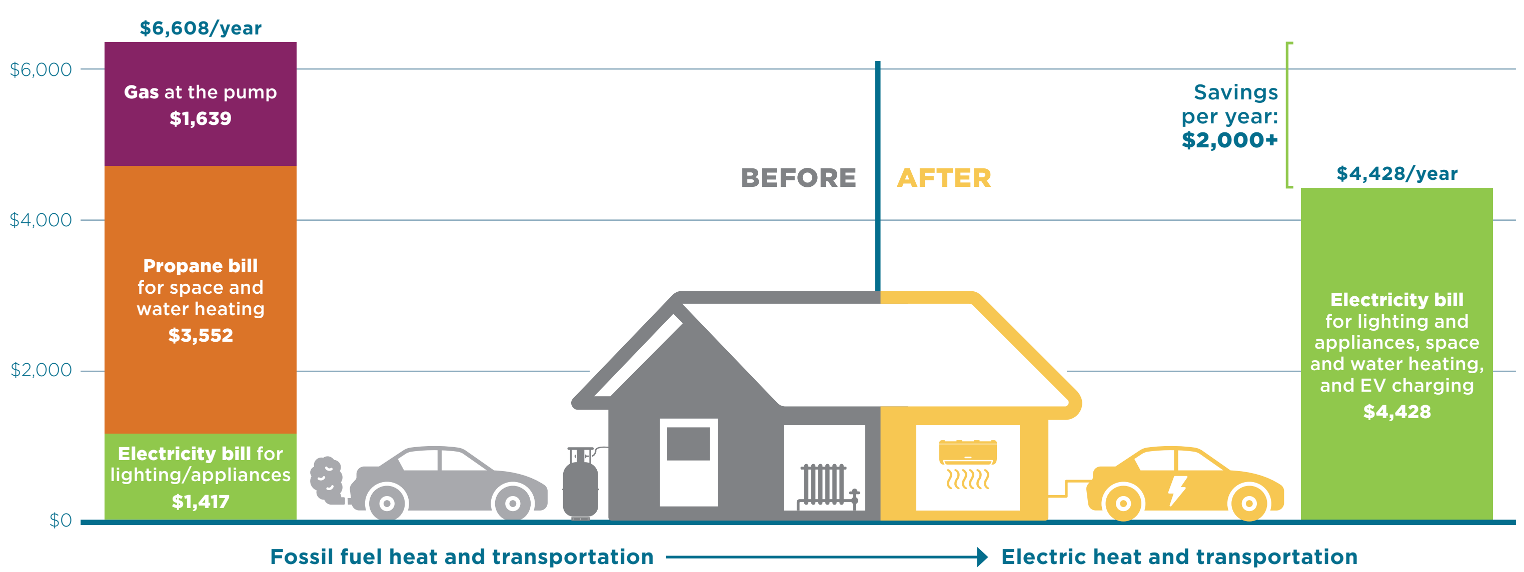
Reducing climate pollution in Vermont is an opportunity that presents many social, environmental, and economic benefits — from saving money to strengthening our economy to improving public health.

At the household level, transitioning away from fossil fuels to efficient electric options for space heating, water heating, and transportation can result in significant cost savings each year. **Although each home will be different, beneficial electrification has the potential to reduce household energy expenditures by a third, or even more**. For example, a single-family household could save more than $2,000 per year in energy costs by switching away from propane heat and a gas powered vehicle to efficient electric alternatives.

However, **households must be prepared for changes in billing and payment after electrification.** A typical Vermont household might be used to paying for gasoline weekly or biweekly, and for heating fuel (propane or fuel oil) three or four times per winter.

Co-benefit opportunities from reducing Vermont's climate pollution

Estimated annual energy bill costs for a sample Vermont single-family household, before and after electrification



Sources: Energy bill savings calculated based on the average monthly prices for propane, gasoline, and electricity in 2023, from the Vermont Department of Public Service and EIA. Electricity bill costs for lighting and appliances reflect statewide average annual household electricity expenditures (Efficiency Vermont, "Vermont Energy Burden Report," 2023). Annual transportation fuel costs calculated using average fuel efficency of 23.4 MPG for vehicles registered in VT from the 2021 Vermont Transportation Energy Profile and VT average annual vehicle miles traveled (VMT) of 11,084 miles/year from the Federal Highway Administration. **Note:** Actual energy bill savings will depend on a number of factors, including a household's electricity rate. Several Vermont utilities offer lower electric rates for managed EV charging, providing additional savings to households with access to those rates. Upfront equipment/vehicle costs vary based on model and incentive eligibility; because of this variance, upfront costs are not quantified here. Savings estimates are for a one car household. Savings will be higher for households replacing multiple gas vehicles with electric vehicles.

After replacing their gasoline car with an electric car, and their propane or oil heating system with a cold-climate heat pump, all of the household's energy expenses will now appear on their monthly electric bill. While the electric bill will go up, *overall* costs across all energy bills will be lower.

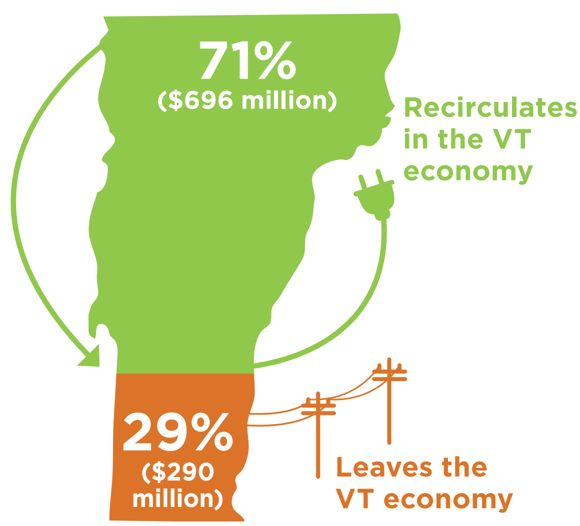
Fossil fuels are high-cost, price-volatile, and 100% imported — leaving Vermonters subject to unpredictable global commodity markets. For example, fuel oil prices spiked to $5.48/gallon in November 2022, more than $2.00/gallon higher than in November 2021.[1] In contrast, investments in heat pumps, heat pump water heaters, advanced wood heating, and electric vehicles can provide lower and more stable prices.

Beneficial electrification can also support the statewide economy by re-localizing our energy dollars. Fossil fuels create a significant drain on the state's economy, with 75% of the dollars we spend on them leaving the state. This amounted to a $1.7 billion drain on Vermont's $43 billion economy in 2023.[2] In contrast, spending our energy dollars on electricity essentially flips that ratio, keeping more of our energy dollars in Vermont while supporting local jobs.

Vermont fossil fuel spending, 2023

Sources: Fossil fuel spending: Vermont Department of Taxes, 2024; VGS, 2024. Dollar recirculation share: Ken Jones, Senior Fellow for Economic Analysis, 2024. **Note:** This graph includes spending on thermal and transportation fuels only.

Vermont electricity spending, 2023



Sources: Electricity spending: Vermont electric utilities. Dollar recirculation share: Ken Jones, Senior Fellow for Economic Analysis, 2024.

Reducing climate pollution through electrification also provides health benefits. In addition to producing GHG emissions, fossil fuel combustion emits other harmful air pollutants, including nitrogen oxides (NO_x), fine particulate matter (PM2.5), and carbon monoxide (CO). Moving beyond fossil fuels for transportation, heating, lawn maintenance, and other appliances can reduce indoor and outdoor air pollution. Weatherization can also improve air quality and make homes more safe and comfortable. Together these solutions improve the air we breathe, both in and outside the home, while also reducing our climate impact.

In sum, **moving away from fossil fuels is a win-win-win opportunity, helping preserve the things we love for generations to come.**

Federal Funding Makes Climate Solutions More Affordable

The Inflation Reduction Act (IRA) of 2022 directed nearly $400 billion in federal funding to climate and energy initiatives. This included funding for expanded tax credits and rebates for decarbonization solutions, including heat pumps, electric vehicles, rooftop solar, and more. These federal incentives can be combined with state and utility incentives to make clean energy solutions more affordable. Already, Vermonters have been twice as likely as residents of other states to take advantage of IRA tax credits, with the 3rd highest uptake rate of IRA efficiency tax credits in the nation.[1]

Visit homes.rewiringamerica.org/calculator to learn more about available incentives.

1. U.S. Department of the Treasury, 2024; Heatmap, "The First IRA Tax Credit Data Is In," August 2024.

1. Vermont Department of Public Service, Retail Prices of Heating Fuels, 2024.
2. Federal Reserve Economic Data (FRED), 2024.

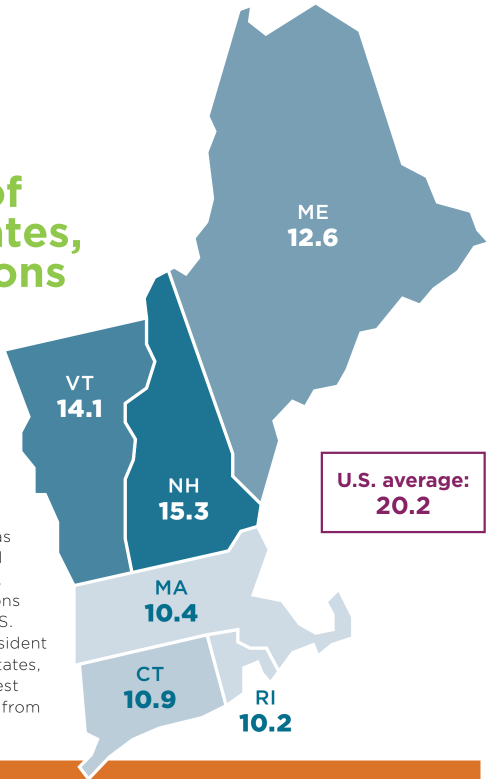
5. Vermont is often a leader, but not always

Vermont has a history of innovation and leadership in energy efficiency, clean energy, and climate action. At the same time, we are currently lagging on many key measures of climate leadership and energy progress compared to other states.

For each of the measures where we lag, the primary problem is the same: Vermont's disproportionate use of highly polluting, high-cost fossil fuels and a corresponding lack of regulatory and policy action.

GHG emissions of New England states, 2019, in metric tons per capita

Sources: Vermont ANR, "Vermont Greenhouse Gas Emissions Inventory and Forecast: 1990 - 2020," 2023; Connecticut DEEP, "Connecticut Greenhouse Gas Emissions Inventory: 1990-2021," 2023; Maine DEP, "Ninth Biennial Report on Progress Toward Greenhouse Gas Reduction Goals," 2022; Massachusetts DEP, "Massachusetts Annual Greenhouse Gas Emissions Inventory: 1990-2020, with Partial 2021 & 2022 Data," 2022; Rhode Island DEM, "2019 Rhode Island Greenhouse Gas Emissions Inventory," 2022. Clean Energy NH, 2023; U.S. Census Bureau, "Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico," 2019. **Note:** 2019 is the latest year for which comparative data is available from all New England states.



Where Vermont is LEADING	Where Vermont is LAGGING
Among the first states to establish a legal requirement to reduce climate pollution with the 2020 **Global Warming Solutions Act**	**Least progress made toward 2025 GHG emissions reduction target** of the Paris Agreement of any state in New England[1]
First state to pass a **Climate Superfund Act,** requiring fossil fuel companies to pay for climate damages	**2nd highest per capita GHG emissions** of any state in New England[2]
First state to create an **energy efficiency utility** (Efficiency Vermont)	**No cap on climate pollution** outside of the electric sector
First state after California to adopt the **Advanced Clean Cars II program,** which requires that all new vehicle sales be zero-emission by 2035	**No central policy or regulation to reduce GHG emissions from transportation *fuels*** has been advanced legislatively or administratively
Highest number of EVs per capita in New England and highest number of public EV chargers per capita of any state in the country[3]	**Highest annual vehicle miles traveled** (VMT) per capita in the Northeast[4]
Highest number of heat pumps installed per capita in New England[5]	**No central policy or regulation yet implemented to address thermal sector GHGs** (A Clean Heat Standard is in development but not yet implemented)
2nd state in the country to pass a **100% by 2035 Renewable Electricity Standard**	Among the 4 states with the **highest reliance on fuel oil and propane** for home heating[6]
Least carbon-intensive electricity portfolio in the U.S., making electrification especially beneficial[7]	**3rd highest average energy burden** (share of household income spent on energy costs) in the U.S. (8.3%)[8]

1. As of 2019, which was the most recent year for which emissions data are available for all New England states.
2. EAN, "Assessing Vermont's climate responsibility: A comparative analysis of per capita emissions," 2023.
3. Alternative Fuels Data Center, 2024. Note: Washington, D.C. not included.
4. EAN, "Assessing Vermont's climate responsibility: A comparative analysis of per capita emissions," 2023.
5. Efficiency Vermont, 2024.
6. Atlas Buildings Hub, "Fuel Oil and Propane Space Heating Across the United States," 2023.
7. EPA eGRID, 2024.
8. NREL, State and Local Planning for Energy (SLOPE) Tool, 2024.

6. Progress requires policy

Vermont is not currently on track to meet our emissions reduction obligations. This is not because we don't have the available technology — it's primarily because we are failing to utilize the evidence-based policy and regulatory solutions available to us and that are recommended in Vermont's Climate Action Plan.

The existing economic dominance of fossil fuels in Vermont and beyond requires policy and regulation to intentionally transform markets — especially if we are to create an energy transition that is just and equitable. While incentives are necessary to help encourage change, they are insufficient on their own. Comprehensive policies and targeted regulations are also necessary to ensure the scale and pace of progress that science indicates is needed for Vermont to do our part to reduce the climate pollution we are responsible for.

The places that are making the most climate progress are taking a comprehensive approach, including three key elements:

- **Performance standards for energy equipment and importers of fossil fuels**
- **Caps on emissions from the highest polluting sectors**
- **Investments in equity-focused, pollution-reducing programs and incentives**

Vermont has not fully utilized performance standards for equipment and importers of fossil fuels. And, unlike Quebec, California, Washington, Oregon, and New York, Vermont has yet to establish or commit to a cap on emissions from our most polluting sectors. While Vermont has successfully made some investments in equity-focused incentives, that is only one leg of the stool. Without the other two legs, we have little chance to achieve our climate commitments and energy goals.

Comparison of key climate policies among selected states

✓ Enacted ✓ In development

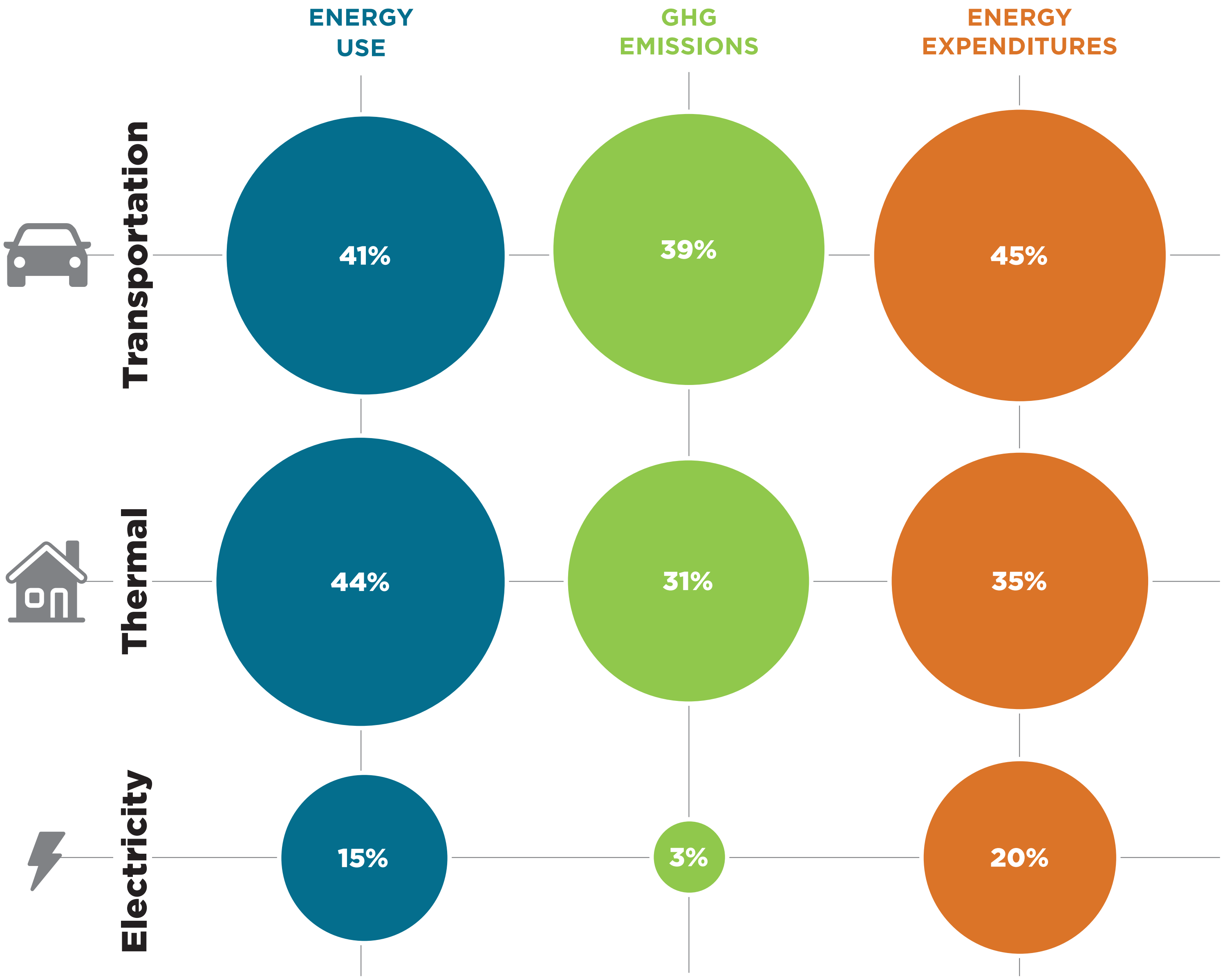
	VT	MA	MD	NY	CA	OR	WA
Multi-sectoral **Cap-and-Trade or Cap-and-Invest** program				In development	Enacted	In development	Enacted
Zero Emission Vehicle Standard (ACCII/ACT)	Enacted	Enacted	Enacted	Enacted	Enacted	Enacted	Enacted
Low-Carbon Fuel Standard for transportation					Enacted	Enacted	Enacted
Clean Heat Standard for thermal sector	In development	In development	In development				
Zero-Emission Heating Equipment Standard			In development		In development		
100% Renewable/ Clean Electricity Standard	Enacted by 2035			Enacted by 2040	Enacted by 2045*	Enacted by 2040	Enacted by 2045

***Note:** Allows fossil fuel generation with carbon capture and storage (CCS) for a portion of the 100% requirement.

Statewide total energy and emissions context

There are a number of ways to look at the impacts of Vermonters' energy use. But any way we look at it, if we think about "energy" only in terms of electricity, we are missing most of the picture. In 2021, 73% of Vermont's greenhouse gas (GHG) emissions came from energy use, with the largest sources, by far, being the transportation and thermal sectors. **The largest share of Vermonters' energy expenditures is for fossil fuels for transportation (mostly gasoline), followed by heating (mostly fuel oil and propane).**

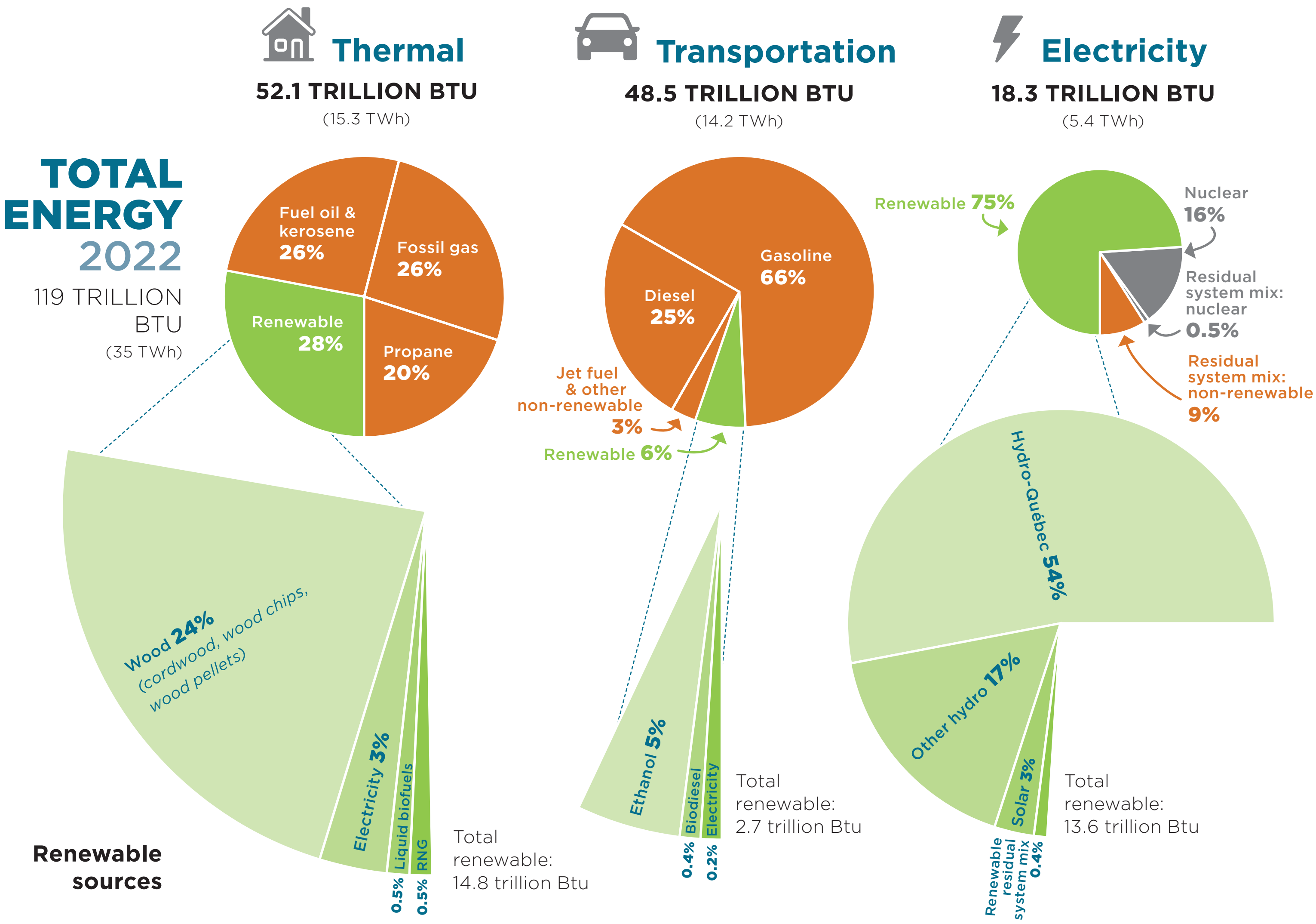
A total energy transformation requires policy and programs to decarbonize transportation and heating. Electricity GHG emissions and costs are important — especially as more of our thermal and transportation load shifts to electricity — but **getting off fossil fuels for transportation and heating present the biggest opportunity to reduce energy use, climate pollution, and energy costs in Vermont.**



Sources: For 2022 energy use: Vermont Department of Taxes, 2024; EIA State Energy Data System (SEDS), 2024; Vermont Department of Public Service, 2022 Electric Utility Resource Survey. For 2021 GHG emissions: Vermont Agency of Natural Resources, "Vermont Greenhouse Gas Emissions Inventory and Forecast: 1990-2021," 2024. For energy expenditures: Efficiency Vermont, "2023 Vermont Energy Burden Report," 2023. **Note:** GHG emissions do not add up to 100% because only the energy sectors are shown, which are responsible for 73% of VT's total emissions (27% of GHG emissions come from non-energy sectors). Transportation represents a larger share of emissions and energy use than shown in previous years due to a change in the data inputs and methodology of VT's most recent GHG Emissions Inventory.

Vermont's energy use by sector

Of Vermont's total energy use, the largest share (52.1 trillion Btu) is for thermal purposes, primarily for space and water heating. While less energy is consumed for transportation than heating in Vermont, transportation is our most fossil fuel dependent energy sector: **94% of Vermont's transportation energy came from fossil fuels in 2022, compared to 72% in the thermal sector.** The electricity sector is the most renewable of Vermont's three energy sectors (75% renewable), but is currently the smallest by energy use.



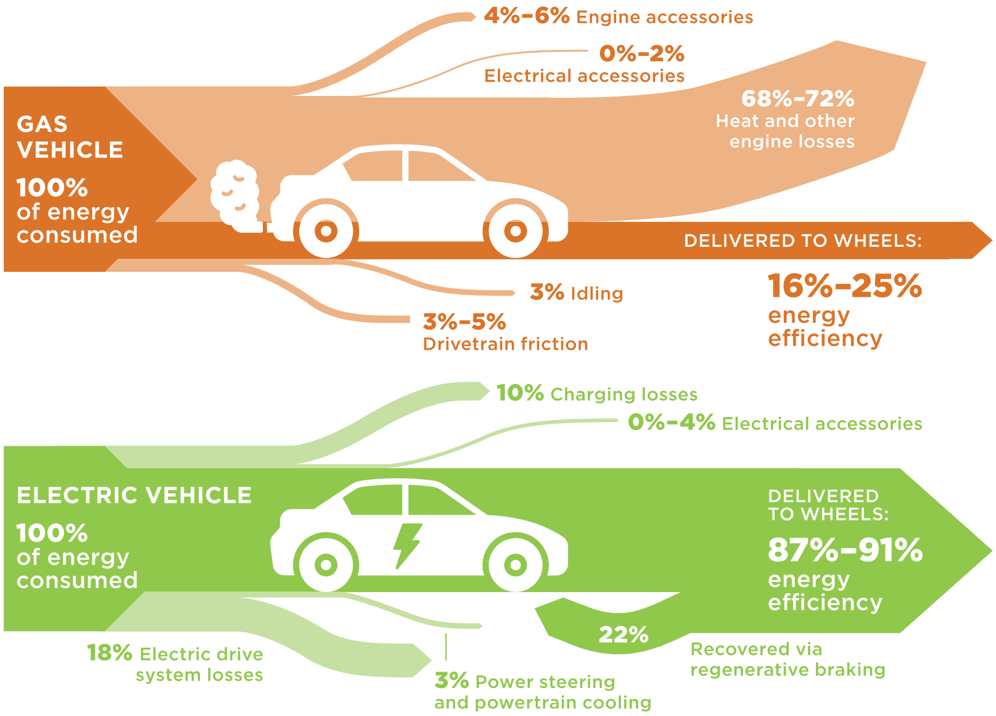
Sources: Energy Information Administration, 2024; Efficiency Vermont, 2024; Vermont Department of Public Service, 2024; Vermont Department of Taxes, 2024; EAN, 2024. **Notes:** The electricity pie chart does not include electricity used for thermal and transportation purposes, as that electricity usage is shown in the respective thermal and transportation pie charts. Percentages may not sum exactly to 100% due to independent rounding. The electricity pie chart shows Vermont's electricity portfolio after accounting for RECs. One result of this is that wind and biomass generation in Vermont do not show up as electricity resources, since RECs from those resources are primarily sold out of state. Fuel oil includes a small amount of kerosene, which accounts for 0.6% of total thermal energy use.

As we continue to electrify the transportation and thermal sectors, total energy use across all three sectors is expected to decline, perhaps significantly. This is because modern electric heat pumps and electric vehicles are significantly more efficient than the fossil fuel equipment they are replacing. **As more energy use is shifted to electricity, less energy input will be needed to achieve the same outcomes.**

EAN's convention is to account for the electric energy used for transportation and heating within the transportation and thermal pie charts, respectively. This means that as Vermont electrifies, instead of seeing the electricity usage for electric vehicles and heat pumps in the electricity pie chart, we will see increasing amounts of electric energy usage within the thermal and transportation pie charts. The electricity pie chart primarily represents electricity used for appliances (or "plug loads") and lighting.

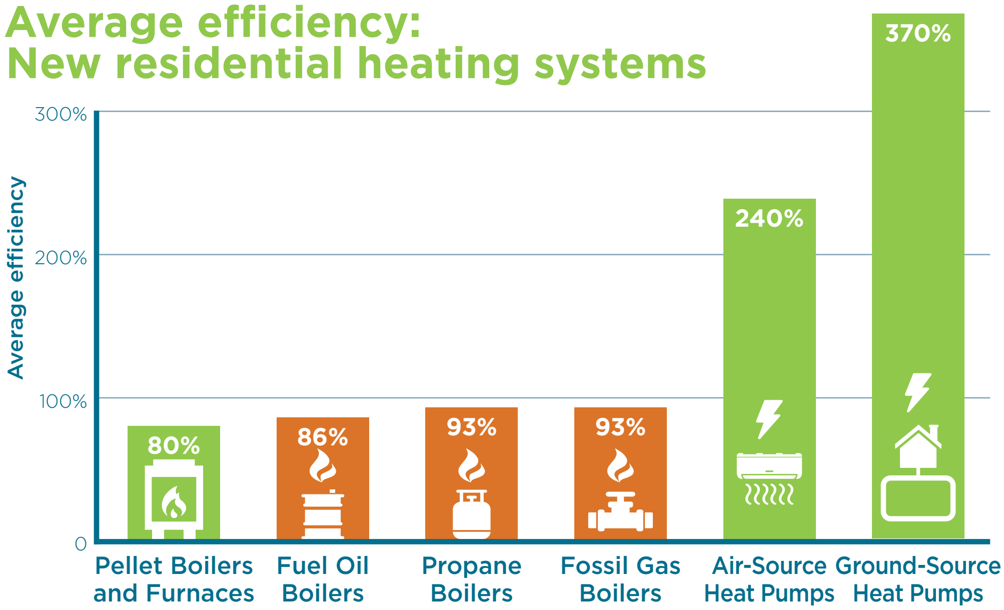
Electrification lets us use less polluting energy — *and* less energy overall

Efficiency of energy use: Gas vehicles vs electric vehicles



Source: Fueleconomy.gov. **Note:** Estimates shown are for combined city and highway driving.

Average efficiency: New residential heating systems



Sources: Pellet stoves, air-source heat pumps, and fuel oil, propane, and fossil gas boiler efficiencies: Vermont Public Utility Commission, "TAG Tier III Annual Report," 2021. Ground-source heat pumps: US Energy Information Agency, "Updated Buildings Sector Appliance and Equipment Costs and Efficiencies," 2023. **Notes:** Heating efficiency refers to the average rate at which an appliance converts energy from fuel to heat output, expressed as a percentage. Heat pumps are capable of achieving efficiency rates greater than 100% because the energy input is used to transfer—rather than generate—heat. Efficiency rates for air-source heat pumps can vary considerably depending on outdoor air temperature. The efficiency presented here is an average over the course of the heating season.

Electrifying transportation and heating reduces emissions and costs in two major ways. First, it allows us to switch from climate-polluting fossil fuels to lower-cost and cleaner electricity. But the benefits of electrification go even further. **Because modern electric technology is significantly more energy efficient than combustion, EVs and heat pumps also reduce emissions and costs by using far less energy to perform the same tasks.**

In the case of vehicles, EVs are much more efficient at converting energy into propulsion than fossil fuel vehicles. This is because most of the energy used by internal combustion is wasted via heat and other engine losses, with only 16%–25% of the total energy delivered to the wheels. **The same amount of energy that moves a fossil vehicle 1 mile can move an electric vehicle 4 miles.**

Heat pumps have similar efficiency benefits over fossil fuel heating equipment. Heat pumps achieve efficiency rates greater than 100% because the energy input is used to transfer rather than generate heat. **This allows heat pumps to achieve average efficiencies that are three or four times greater than combustion-based heating appliances.**

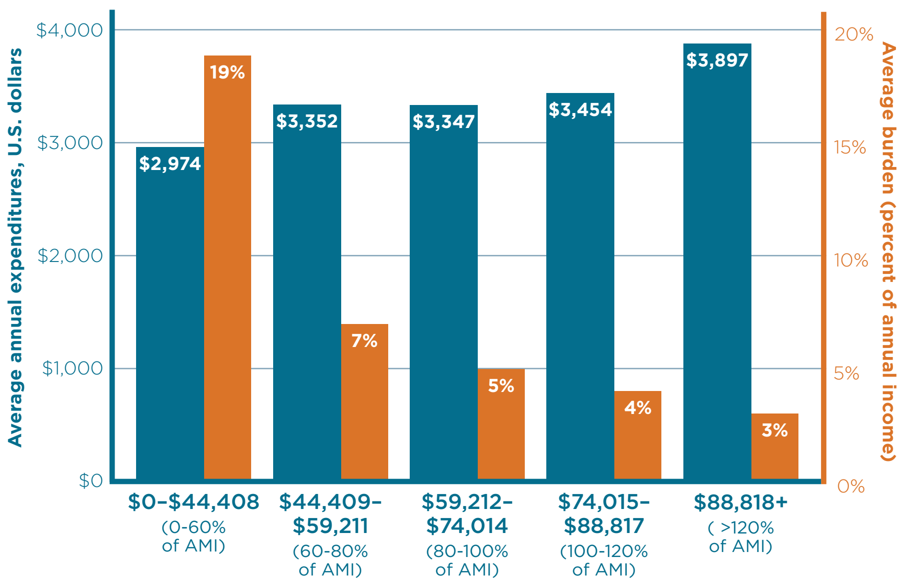
In short, beneficial electrification with high-efficiency equipment is not just about switching to a cleaner source of energy — it's also about reducing overall energy use.

Energy equity and energy burden

Vermont households with lower incomes typically use less energy than those with higher incomes. Nevertheless, **households with lower incomes usually face far higher energy burdens.** "Energy burden" is the share of household income spent on energy costs.

Vermont households with the lowest incomes — those earning less than 60% of the area median income (AMI) — spend an average of 19% of their income on heating fuel and electricity (not accounting for associated equipment and maintenance costs, for which data are not available). Households at or above 100% of AMI, on the other hand, typically spend 4% or less of their income on heating fuel and electricity costs.

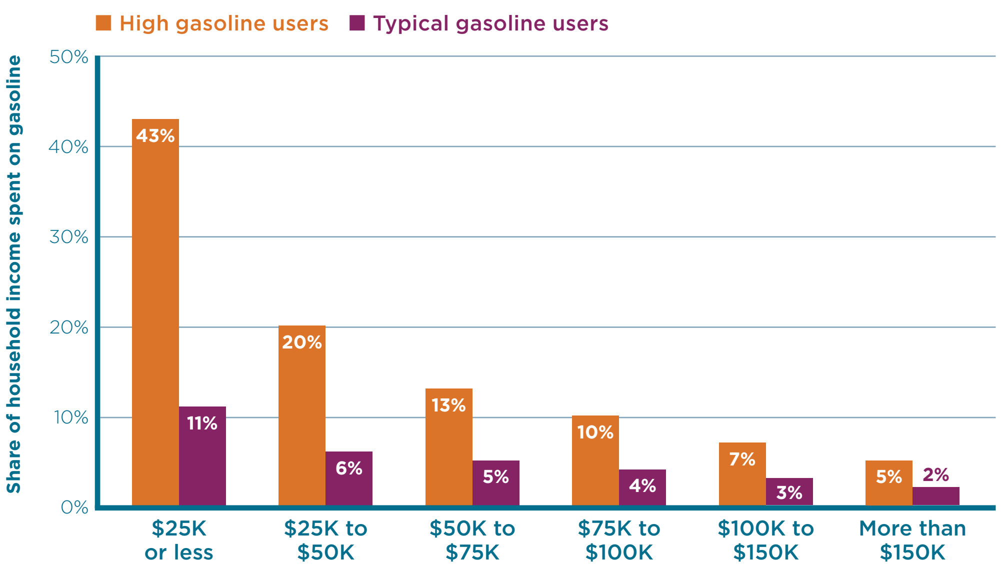
Vermont combined average household heating and electricity fuel costs and burden by income level, 2018–2022



Source: U.S. Census Bureau, 2018-2022 American Community Survey 5-year Public Use Microdata Samples. **Notes:** Income categories are based on 2018-2022 median household income in Vermont of $74,014. 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.

The same trends can be seen when we look at transportation fuel costs: households with lower incomes spend a much higher share of their income on gasoline than those with higher incomes. High gasoline users in Vermont — those drivers in the top 10% of gasoline consumption nationally — have higher transportation-related energy burdens across all income levels. However, high gasoline users with low incomes (primarily rural Vermonters) face particularly high transportation cost burdens, with those making less than $25,000 per year spending an average of *43%* of their income on gasoline.

Gasoline energy burden by income in Vermont



Source: Coltura, Gasoline Data Center, 2024. **Note:** Data include only expenditures on gasoline and are not inclusive of other transportation or vehicle ownership costs. "High gasoline users," which Coltura refers to as "Superusers," are the top 10% of light-duty vehicle drivers in the U.S. in terms of gasoline consumption. 14% of Vermont drivers fall into this category.

High energy burdens increase the risk of transitioning into poverty or of experiencing long-term poverty by 150-200%.[1] Higher energy burdens are also correlated with "greater risk for respiratory diseases, increased stress and economic hardship, and difficulty in moving out of poverty."[2]

Reducing reliance on fossil fuels can have significant benefits when it comes to lowering costs for those who face the highest energy burdens.

1. Jeremiah Bohr and Anna C McCreery, "Do Energy Burdens Contribute to Economic Poverty in the United States? A Panel Analysis." Social Forces, 2019.
2. ACEEE, "How High Are Household Energy Burdens," 2020.

Vermont is not on track to meet our climate commitments

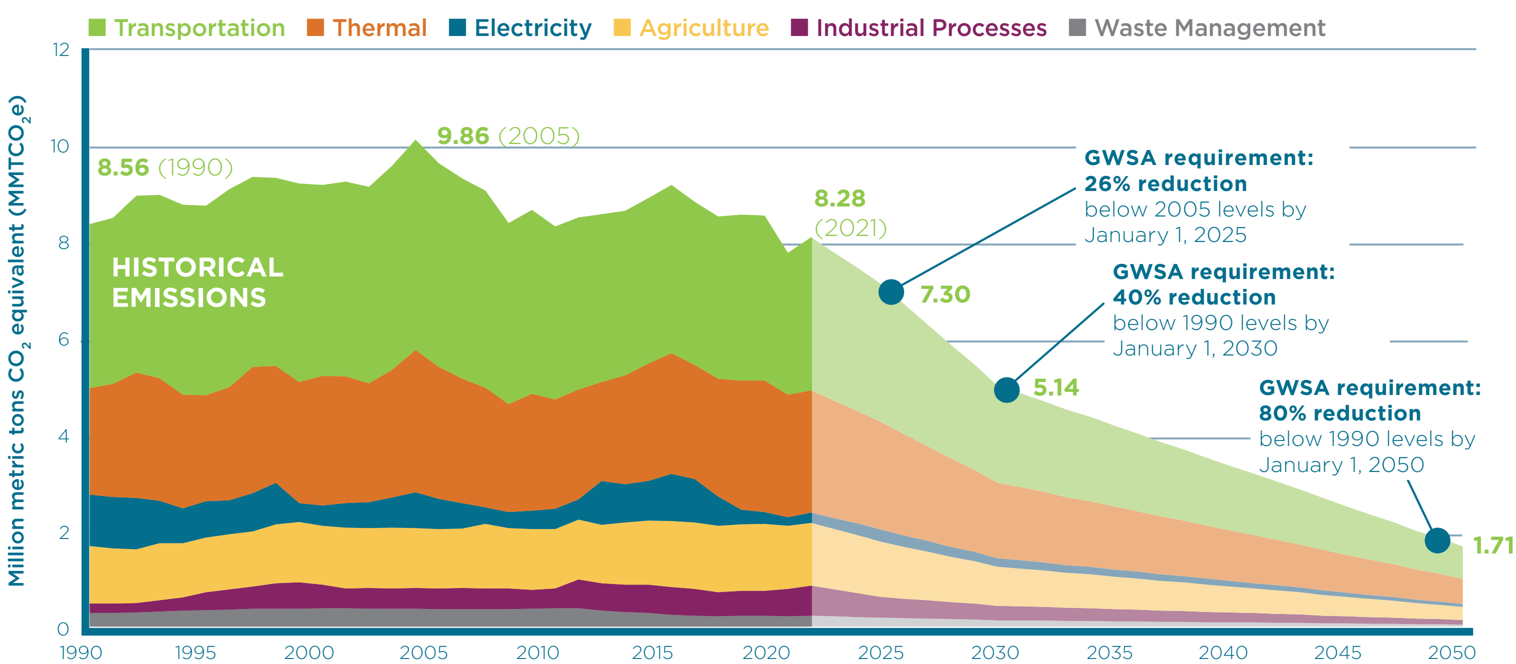
Vermont's Global Warming Solutions Act (GWSA) established legal obligations for statewide GHG emissions reductions by January 1 of 2025, 2030, and 2050. The latest data from the Vermont Agency of Natural Resources' Greenhouse Gas Inventory and Forecast (Vermont's GHG Inventory) show that 2021 annual emissions were 8.28 million metric tons of carbon dioxide equivalent ($MMTCO_2e$), or 16% below 2005 levels.[1]

As of 2024, official Vermont GHG Inventory data had not yet been published for 2022 or 2023.[2] However, by analyzing fossil fuel sales data from the Vermont Department of Taxes from those years, EAN has been able to calculate the vast majority of emissions for Vermont's most polluting sectors: transportation and thermal. The result shows that **Vermont is very unlikely to meet our pollution reduction obligations in line with the GWSA by January 1, 2025.**[3]

Vermont's climate progress needs to ramp up even more to meet the January 1, 2030 GWSA requirement. Annual GHG emissions will need to be about 3 million metric tons lower in 2029 than they were in 2021, equivalent to reducing diesel or fuel oil consumption by almost 300 million gallons.[4]

Cutting emissions in the highest polluting sectors is key to ensuring that Vermont can achieve the emissions reductions required by the GWSA. In 2021, transportation was the highest emitting sector, accounting for 39% of Vermont's GHG emissions, followed by the thermal sector, at 31%.[5] Together, these two sectors are responsible for the vast majority of our statewide climate pollution. Vermont is not currently on a path to meet its climate obligations without additional policy and rulemaking action, especially in these sectors.

Vermont's historical GHG emissions and future requirements



Source: Vermont Agency of Natural Resources, "Vermont Greenhouse Gas Emissions Inventory and Forecast: 1990-2021," 2024. **Note:** A small amount of emissions from the "fossil fuel industry" category (i.e., fugitive emissions from fossil gas pipelines in VT), accounting for 0.4% of Vermont's overall emissions in 2021, does not show up on this graph.

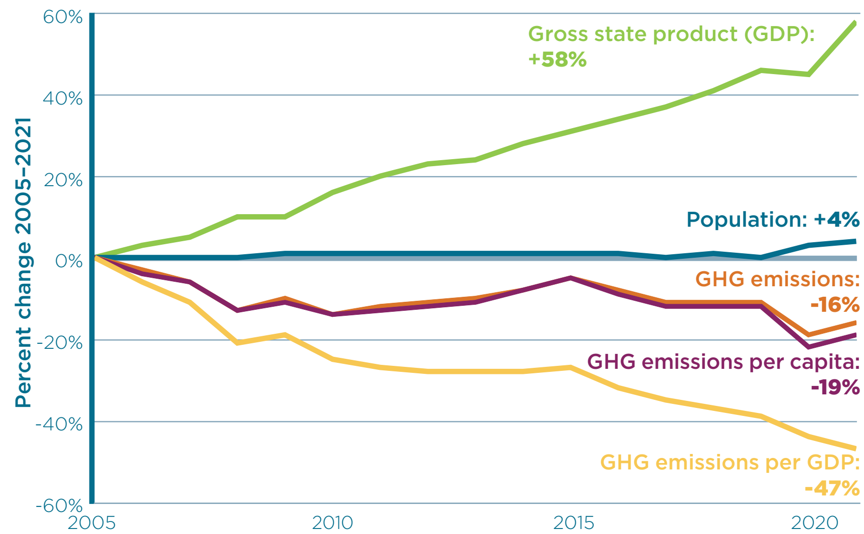
1. When changes are made to the data inputs and methodology of the Vermont Greenhouse Gas Inventory, those changes must be reflected in all years going back to 1990. Thus, changes made in the inventory published in 2024 show different annual historical GHG totals than those reported in previously published Inventories. A major reason for the differences is that ANR is now using fuel sales data from the Vermont Department of Taxes to calculate thermal sector (RCI) emissions rather than less precise survey data from the Energy Information Administration's (EIA's) State Energy Data System (SEDS).
2. Typically, Vermont GHG Inventory data is published on a 3-year time lag.
3. Jared Duval and Lena Stier, "Analyzing changes in fossil heating fuel use in Vermont, 2018-2023," 2024.
4. U.S. EPA, Greenhouse Gas Equivalencies Calculator.
5. In the GHG Inventory published in 2024, ANR moved reporting of GHG emissions from "other dyed diesel" (which is used for things like construction, farm and logging equipment, rail, and other off-road, non-stationary sources) to the transportation sector rather than the thermal/Residential, Commercial, and Industrial (RCI) sector, where they had previously been reported. This resulted in the 2024 Inventory reporting higher transportation sector emissions and lower thermal (RCI) sector emissions over the 1990-2021 period than had been reported in previous inventories.

A closer look at Vermont's climate progress

Vermont's total annual GHG emissions in 2021 were 16% lower than 2005 levels. Much of this difference came from the transportation sector, which saw emissions reductions of 1.07 $MMTCO_2e$ (-25%). Electricity sector emissions declined by 0.42 $MMTCO_2e$ (-66%) and thermal sector emissions by 0.21 $MMTCO_2e$ (-8%). **As of the latest data, electricity is the only sector that can confidently be expected to meet its sectoral reduction target by 2025.**[1]

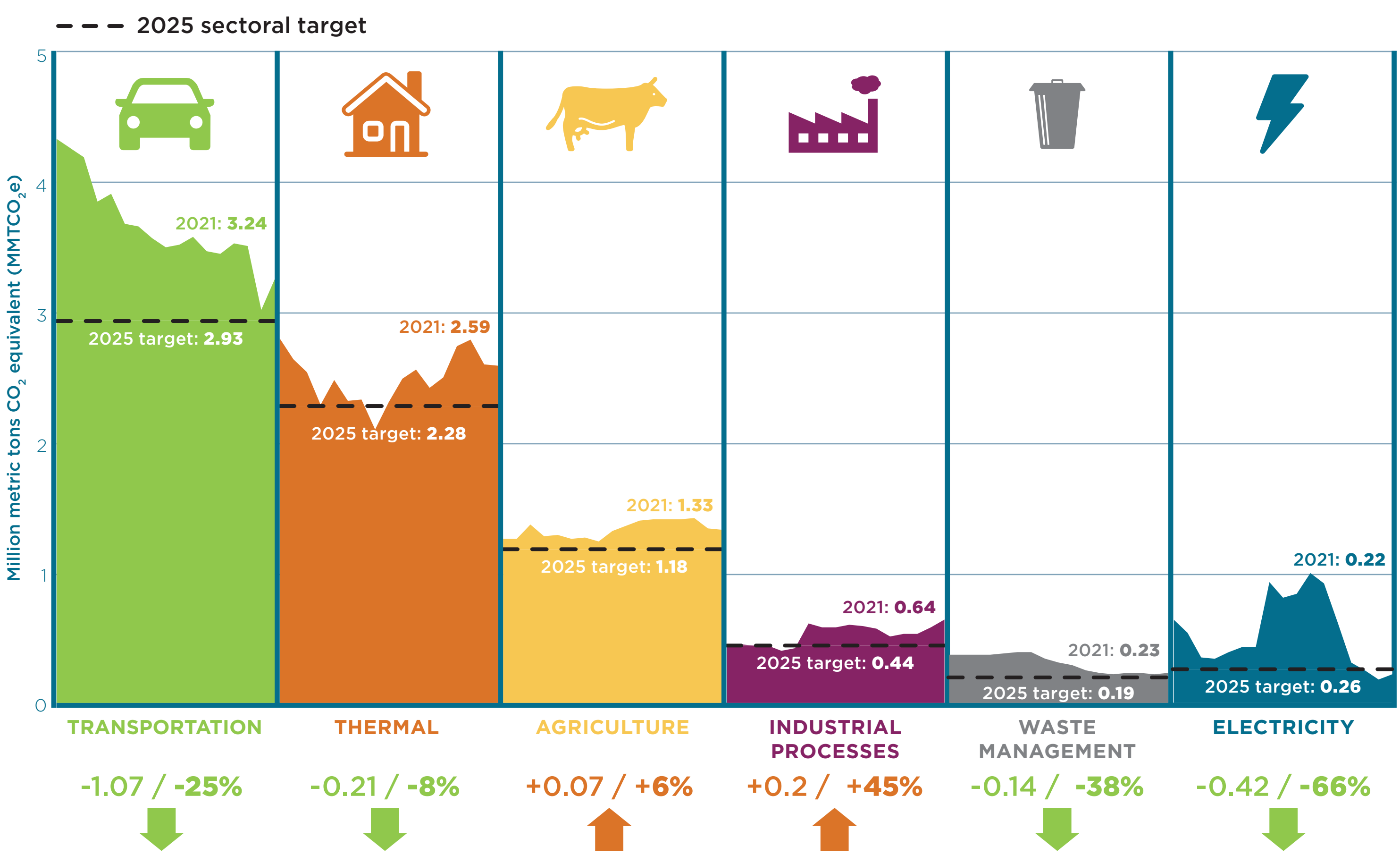
Although Vermont's science-based legal obligations require reductions in *total* emissions, it can be informative to look at "emissions intensity" metrics, for comparison of emissions per person or per dollar of output. **Since 2005, Vermont's GHG emissions have decreased even as its economy and population have grown.** As a result, we have seen percentage reductions in GHG emissions per capita and per dollar of GDP that have been even more significant than Vermont's total emissions reductions.

Percent change in VT GHG emissions, population, and GDP, 2005–2021



Sources: Vermont Agency of Natural Resources, "Vermont Greenhouse Gas Emissions Inventory and Forecast: 1990-2021," 2024; Federal Reserve Bank of St. Louis, 2024; U.S. Census Bureau, American Community Survey, 2024.

Vermont GHG emissions by sector, 2005–2021



Source: Vermont Agency of Natural Resources, "Vermont Greenhouse Gas Emissions Inventory and Forecast: 1990-2021," 2024. **Note:** A small amount of emissions from the "fossil fuel industry" category (i.e., fugitive emissions from fossil gas pipelines in VT), accounting for 0.4% of Vermont's overall emissions in 2021, is not shown on this graph.

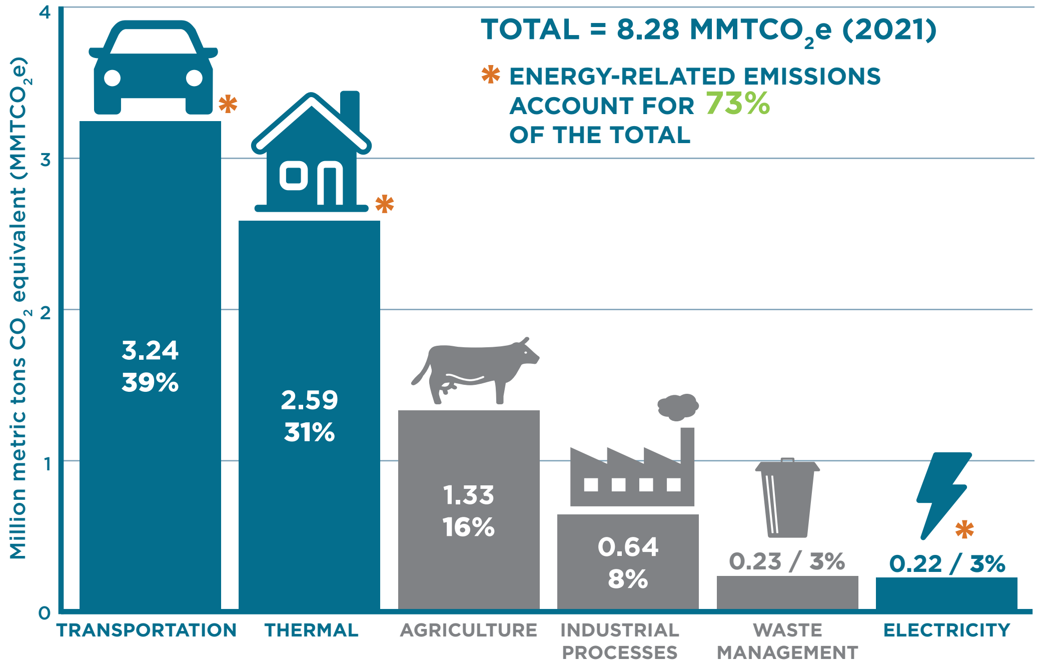
1. The Vermont Climate Council established sectoral emissions targets for GWSA compliance as part of development of the initial Vermont Climate Action Plan (CAP). 2018 was chosen as the reference year for establishing these targets, as it was the most recent year for which GHG emissions data were available when the initial CAP was written in 2021.

Accounting for Vermont's emissions

There are multiple approaches to measuring GHG emissions, including: 1) in-boundary inventories, 2) consumption-based inventories, and 3) lifecycle assessments.

In-boundary GHG inventories, like Vermont's GHG Emissions Inventory published annually by the Agency of Natural Resources, estimate emissions produced within a state's borders.[1] An in-boundary inventory, also called a sector-based or production-based inventory, is consistent with guidelines for GHG accounting from the Intergovernmental Panel on Climate Change (IPCC) and Environmental Protection Agency (EPA). This is why Vermont and other states use an in-boundary approach for their official GHG inventories.[2]

Vermont's in-boundary GHG emissions by sector, 2021



Sources: Vermont Agency of Natural Resources, "Vermont Greenhouse Gas Emissions Inventory and Forecast: 1990-2021," 2024. **Note:** A small amount of emissions from the "fossil fuel industry" category (i.e., fugitive emissions from fossil gas pipelines in VT), accounting for 0.03 MMTCO$_2$e of Vermont's overall emissions in 2021, does not show up on this graph.

Consumption-based emissions inventories (CBEIs) account for emissions related to consumption of products and services, regardless of where those emissions physically originate from. CBEIs assign responsibility for emissions to the consumer rather than the producer — i.e., emissions are accounted for wherever the consumer lives, rather than where emissions were physically produced. CBEIs do not count emissions produced in-state from products that end up being exported to other states.

Given the complexity of supply chains and the number of assumptions that must be utilized, CBEIs are much more difficult and costly to conduct — and have a higher degree of uncertainty — than official in-boundary emissions inventories. Only two states, Oregon and Minnesota, are known to have produced CBEIs in addition to in-boundary inventories. Neither state's CBEI has replaced its in-boundary inventory for official tracking. That said, CBEIs can provide helpful supplemental and comparative information.

Whether a state has higher in-boundary or consumption-based emissions depends largely on its balance of emissions-intensive imports and exports. Oregon, for instance, has higher consumption-based emissions than in-boundary emissions,[3] whereas Minnesota produces higher in-boundary emissions than CBEI emissions.[4] While a CBEI has not yet been completed for Vermont, supplemental lifecycle emissions analysis has been conducted related to our use of energy.

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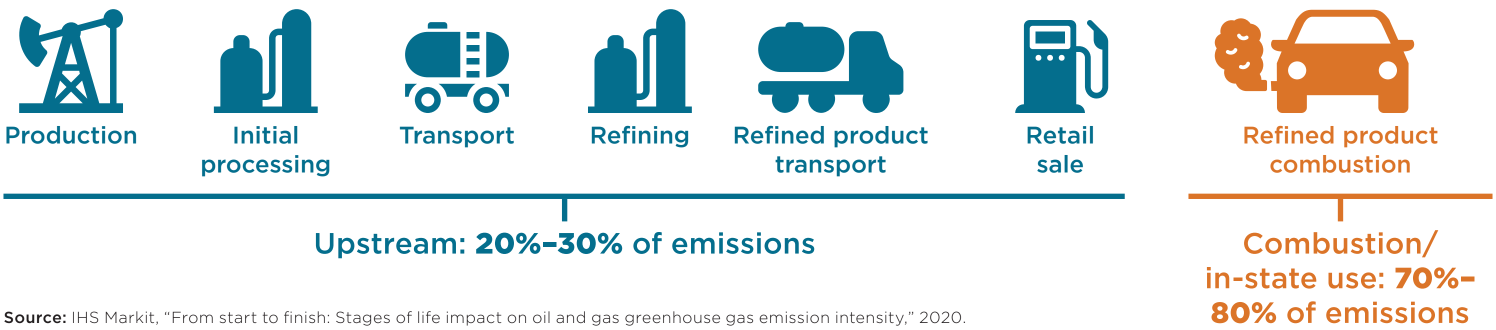
1. With the exception of the electricity sector, which is based on electricity consumption (as accounted for via retirements of Renewable Energy Credits, or RECs), rather than in-state generation.
2. Vermont's in-boundary GHG emissions inventory is published annually by the Vermont Agency of Natural Resources.
3. Oregon Department of Environmental Quality, 2024.
4. Minnesota Greenhouse Gas Emissions Inventory, 2021.

Lifecycle GHG emissions analysis applied to fossil fuels

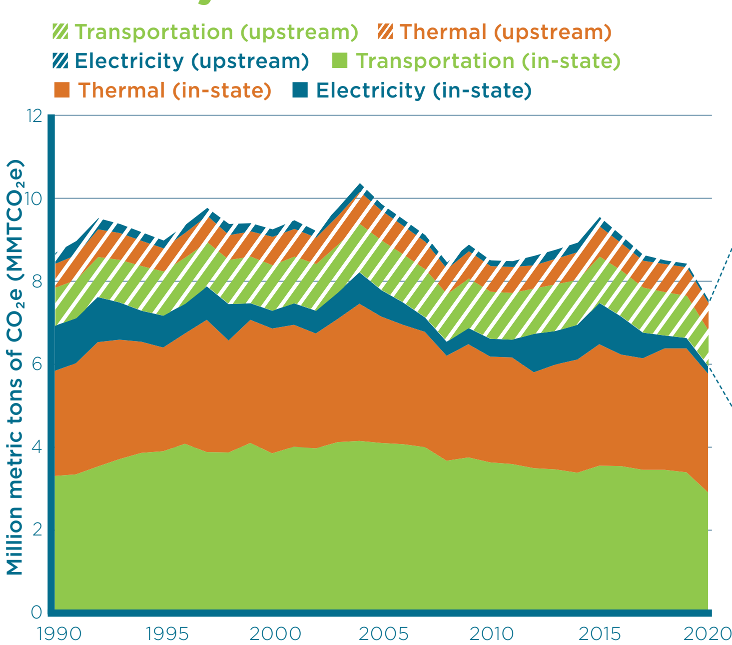


Source: IHS Markit, "From start to finish: Stages of life impact on oil and gas greenhouse gas emission intensity," 2020.

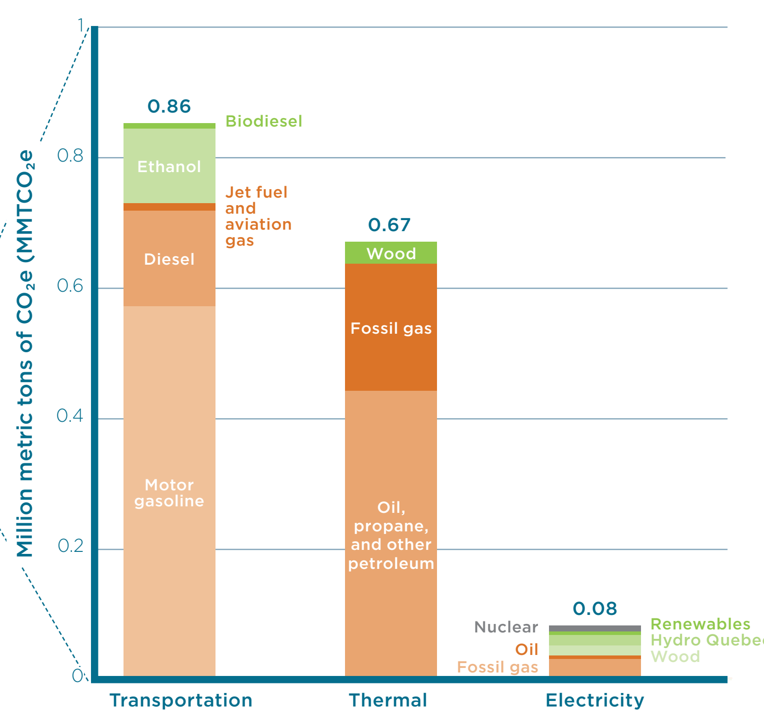
Lifecycle emissions assessments account not just for the emissions created at end use (i.e., combustion emissions from the end use of a fuel) but also for "upstream" emissions (i.e., emissions associated with mining, refining, and transporting that fuel). In 2020, upstream emissions associated with energy use in Vermont were 1.61 $MMTCO_2e$. When added to in-state emissions from the energy sectors, that brought total lifecycle emissions from energy use to 7.51 $MMTCO_2e$. Therefore, the majority of lifecycle emissions are produced at the time of end use (e.g., during combustion of gasoline to move a vehicle). Upstream emissions accounted for just 21% of full lifecycle energy emissions in 2020.[5]

Whether looking at lifecycle, consumption-based, or end-use emissions, **the largest amount of Vermont's climate pollution, by far, comes from the use of fossil fuels for transportation and heating.**

Lifecycle emissions from energy use in Vermont (1990–2020): Transportation, thermal, and electricity



Upstream emissions from energy use in Vermont, 2020

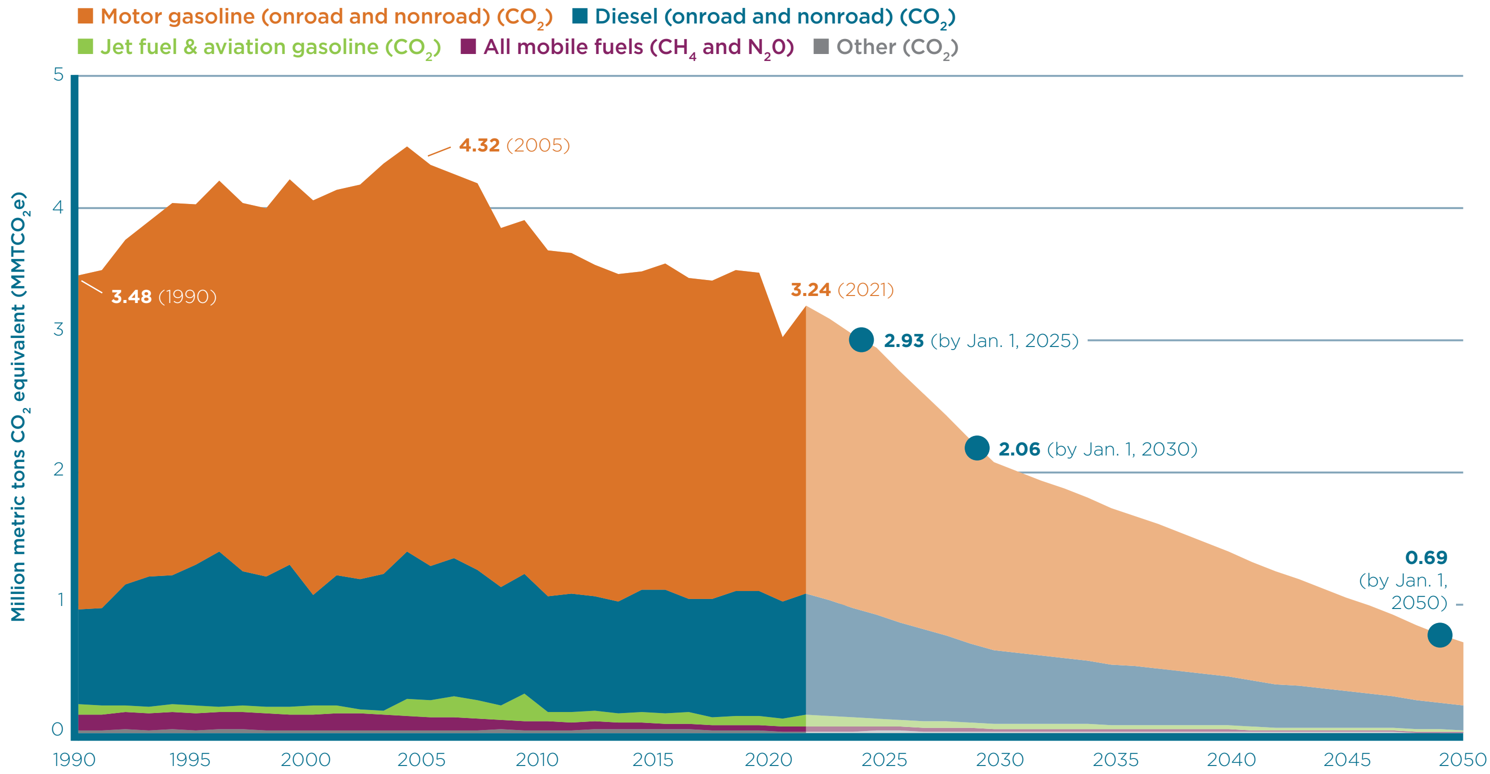


Source: Eastern Research Group, prepared for the Vermont Agency of Natural Resources, "Vermont Energy Sector Life Cycle Assessment," 2024. **Note:** Biogenic emissions are not shown in this graph for consistency with Vermont's official GHG inventory and IPCC inventory guidelines. In-state refers to in-boundary emissions associated with activities that occur within Vermont and is the approach used in Vermont's official GHG inventory and in accordance with EPA guidelines.

5. Vermont's lifecycle emissions analysis has not yet been updated to reflect the methodology changes made in the most recent in-boundary GHG emissions inventory, published in July 2024. Because of this, the in-state emissions shown here are slightly different than those reported elsewhere in this report.

Transportation sector greenhouse gas emissions and energy use

Historical VT transportation GHG emissions and future sector targets



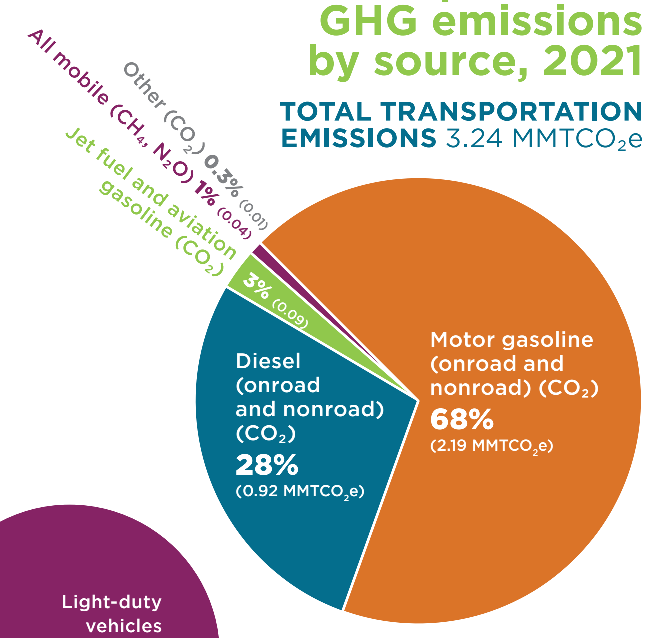
Source: Vermont Agency of Natural Resources, "Vermont Greenhouse Gas Emissions Inventory and Forecast: 1990-2021," 2024. **Note:** The VT Climate Council set sectoral emissions targets for GWSA compliance, which are represented by the blue dots on the graph.

Transportation GHG emissions totaled 3.24 $MMTCO_2e$ in 2021, making up the largest share (39%) of Vermont's statewide climate pollution. Emissions from the transportation sector declined by about 14% from 2019 to 2020 as a result of the pandemic, but then saw a partial rebound in 2021, increasing by 7% relative to 2020 levels.

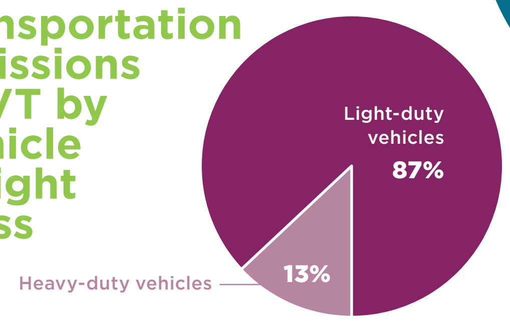
Fossil fuels account for 94% of the energy we currently use for transportation — a much higher share of fossil fuel dependence than in any other energy sector. Nearly 70% of Vermont's transportation climate pollution comes from the use of motor gasoline, most of which is for on-road use. Of the share of GHG emissions that come from on-road vehicles, the vast majority (87%) is from fuel use in light-duty passenger vehicles. Therefore, **reducing reliance on fossil fuels used for personal vehicles presents a key opportunity to decarbonize the transportation sector as a whole.**

VT transportation GHG emissions by source, 2021

TOTAL TRANSPORTATION EMISSIONS 3.24 $MMTCO_2e$



On-road transportation emissions in VT by vehicle weight class



Source for chart above: Vermont Agency of Natural Resources, "Vermont Greenhouse Gas Emissions Inventory and Forecast: 1990-2021," 2024.

Source for chart at left: U.S. EPA, National Emissions Inventory, 2020.

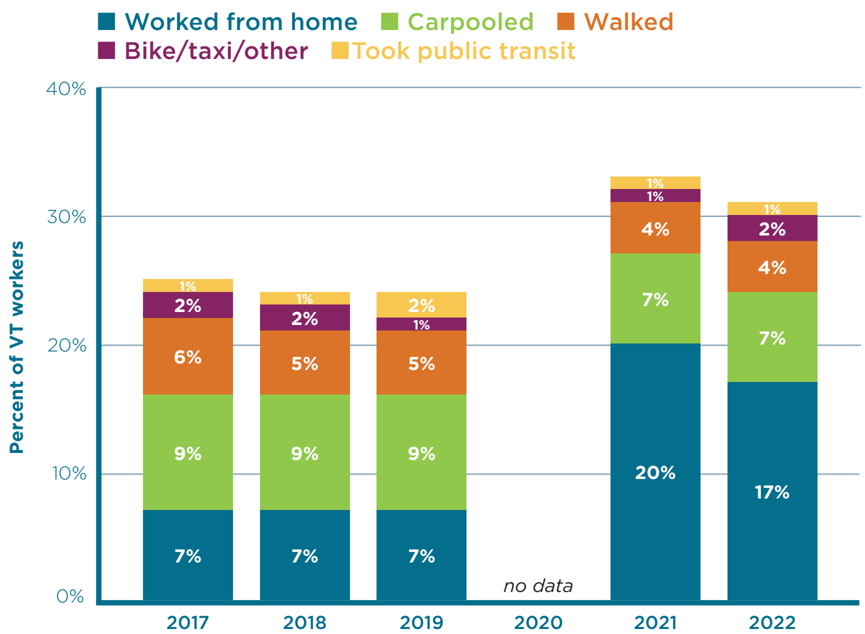
Solutions in the transportation sector

The most effective and sustainable path to reducing GHG emissions in Vermont's transportation sector will involve a combination of vehicle electrification and decreasing per capita vehicle miles traveled (VMT), particularly in single-occupancy vehicles.

Because Vermont is a rural state with low population density, the majority of our residents rely on personal vehicles to get around. In 2022, about 70% of working Vermonters reported that they primarily commute to work in a single-occupancy vehicle. Less than 1% used public transit to get to work and only 4% walked.

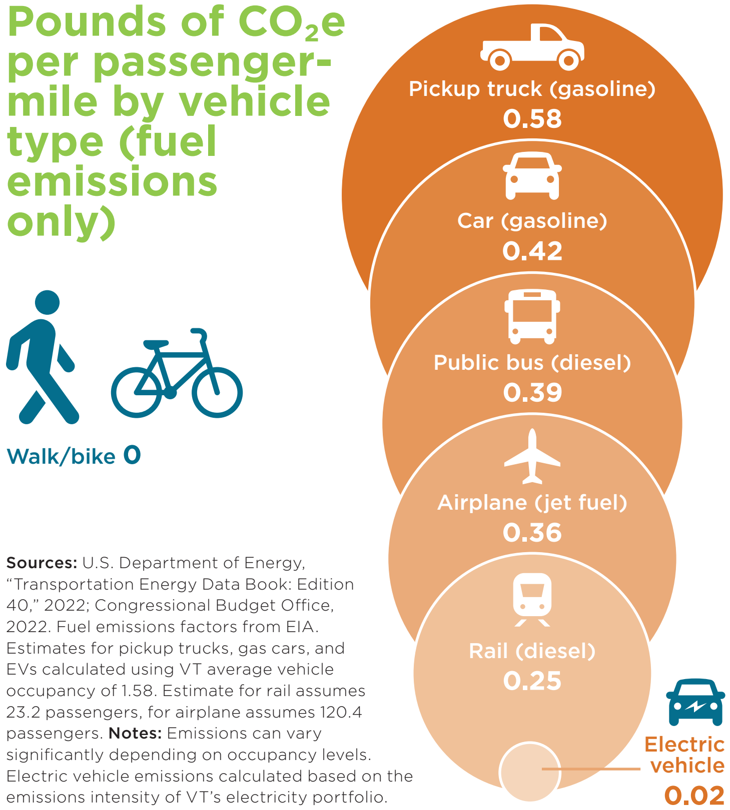
The pandemic brought about significant shifts in commute modes, as the share of Vermonters working from home more than doubled between 2019 and 2021. However, there has been a partial rebound toward pre-pandemic levels of commuting as many Vermonters have returned to in-person work.

Usual commute mode in VT other than by single-occupancy vehicle, pre- and post-pandemic



Source: U.S. Census Bureau, American Community Survey 1-year estimates, 2017-2022.
Note: 2020 data not available due to the pandemic.

Pounds of CO_2e per passenger-mile by vehicle type (fuel emissions only)



Sources: U.S. Department of Energy, "Transportation Energy Data Book: Edition 40," 2022; Congressional Budget Office, 2022. Fuel emissions factors from EIA. Estimates for pickup trucks, gas cars, and EVs calculated using VT average vehicle occupancy of 1.58. Estimate for rail assumes 23.2 passengers, for airplane assumes 120.4 passengers. **Notes:** Emissions can vary significantly depending on occupancy levels. Electric vehicle emissions calculated based on the emissions intensity of VT's electricity portfolio.

Vermonters drive more miles, per capita, than residents of any other state in the Northeast.[1] Reducing per capita VMT by shifting single-occupancy vehicle trips to less-polluting modes — such as public transportation, walking/biking, working remotely, and carpooling — can help reduce Vermont's transportation sector emissions, especially when done alongside a transition to EVs. Innovative programs in Vermont are helping underserved populations get the transportation services they need while reducing climate pollution. These include examples like Gopher/Community Rides VT, which provides rides in electric vehicles for central Vermont residents with low incomes and limited access to transportation, and CarShare Vermont.

Reducing per capita VMT can also bring down costs for drivers. An RMI analysis estimated that a 20% reduction in per capita VMT, paired with increased EV adoption, could save Vermont households nearly $2,000 per year.[2]

1. Federal Highway Administration, 2023.
2. RMI Smarter MODES Calculator, 2023.

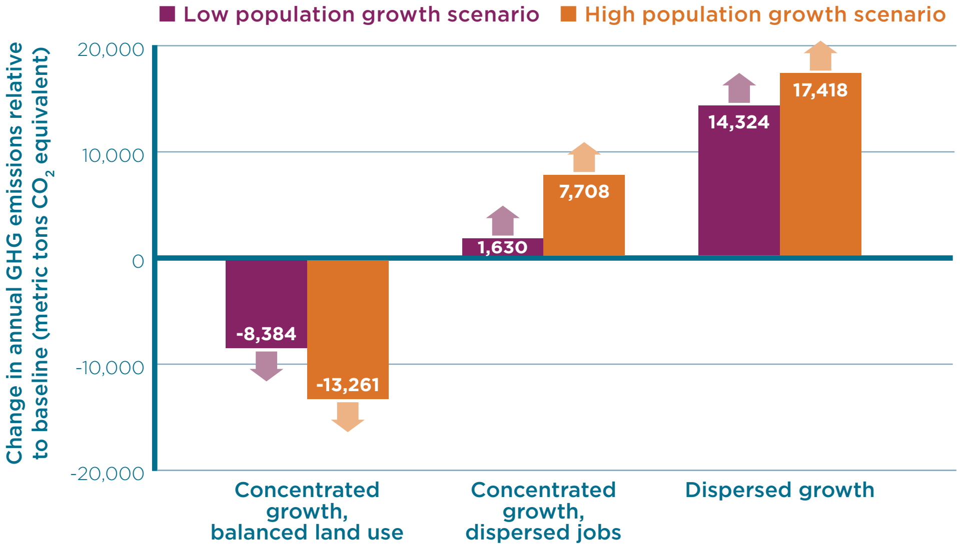
Smart growth and shifting development patterns

Reducing reliance on personal vehicles is not just about individual choices, it's also about broader, systems-level choices.

Many communities throughout Vermont are currently facing severe housing shortages. Construction of new homes in Vermont has remained at low levels for decades, resulting in insufficient supply relative to demand, especially for affordable housing. The Vermont Housing Finance Agency projects that the state will need 24,000 to 36,000 more year-round homes by 2030.[1]

As Vermont works to build more housing, we can promote future development that is concentrated in compact, walkable, and transit-accessible communities. By doing so, **Vermont would ensure that growth and development happens in ways that create more sustainable communities and supports Vermont's traditional settlement patterns around town centers**. This approach to development would reduce annual GHG emissions and provide important co-benefits to Vermonters.

Estimated annual GHG emissions impacts of different development scenarios in Vermont by 2050



Source: RSG and VHB, prepared for the Vermont Agency of Transportation, "Vermont Smart Growth, VMT, and GHG Research Project Report," 2024. **Notes:** The low growth scenario assumes a 3% population increase by 2050, and the high growth scenario assumes a 13% increase. In the "Concentrated growth, balanced land use" scenario, future development is modeled on places in VT that exemplify smart growth practices today. In the "Concentrated growth, dispersed jobs" scenario, future residential development is concentrated in already dense areas while job growth is allocated to lower density areas. In the "Dispersed growth" scenario, low-density development occurs across all developable land in VT, regardless of existing infrastructure and community designations.

A recent study contracted by the Vermont Agency of Transportation found that a smart growth development approach ("Concentrated growth, balanced land use" scenario) — in which residential and employment growth is concentrated in downtown areas and village centers — could reduce transportation GHG emissions by more than 13,000 metric tons annually by 2050.[2] Other benefits of smart growth include reducing traffic-related injuries and fatalities, as well as reducing infrastructure costs related to road construction and maintenance. On the other hand, if future growth were dispersed across all developable land in Vermont ("Dispersed growth" scenario), GHG emissions could *increase* by more than 17,000 metric tons annually, and we would see further forest fragmentation and loss of Vermont farmland.

Job proximity has a significant effect on commute distance and therefore GHG emissions. **Co-locating housing and employment within compact communities maximizes the potential for emissions reductions and other benefits associated with reducing vehicle miles traveled.**

The Vermont Legislature passed H.687 (Act 181 of 2024) to revise Act 250, the state's land use and development review law. This revised law includes provisions to encourage more compact and affordable housing development and make it easier to build new housing in already-developed areas, including creating temporary Act 250 exemptions for housing projects within Vermont's designated downtown areas and village centers.

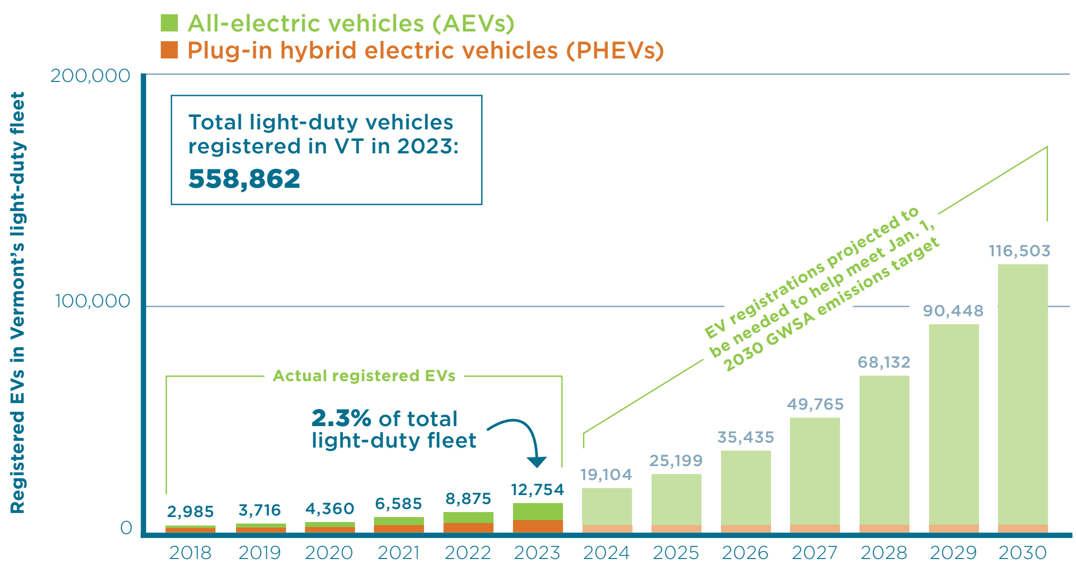
1. Vermont Housing Finance Agency, "Vermont Housing Needs Assessment: 2025-2029," 2024.
2. RSG and VHB, prepared for the Vermont Agency of Transportation, "Vermont Smart Growth, VMT, and GHG Research Project Report," 2024.

Vermont's growing EV fleet

Transitioning to electric vehicles (EVs) is one of the highest-impact pathways to reduce statewide GHG emissions. **In order to meet Vermont's climate obligations and to save more drivers money, EV adoption will need to continue to ramp up significantly through 2030 and beyond.**

As of July 2024, there were 15,074 EVs registered in Vermont. This included 8,743 all-electric vehicles (AEVs), and 6,331 plug-in hybrid electric vehicles (PHEVs), which run on electricity but also have a gasoline engine.[1]

Vermont EV registrations and future Pathways targets



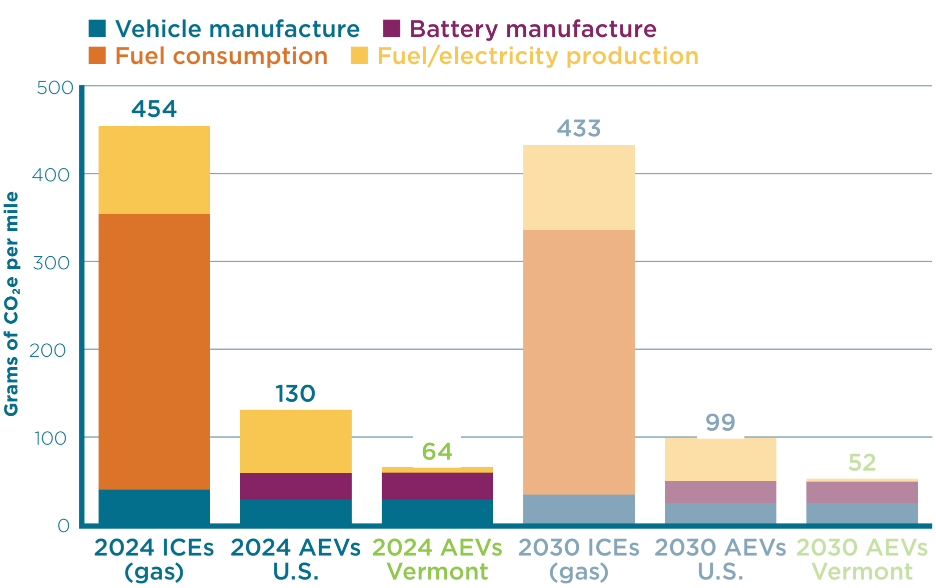
Source: Drive Electric Vermont, 2024; Energy Futures Group/Cadmus for VT Agency of Natural Resources, "Vermont Pathways Report 2.0," 2022; VT Agency of Natural Resources, 2024.

The number of registered EVs has nearly tripled since 2020, but EVs still only made up 2.3% of Vermont's total light-duty fleet of 558,862 vehicles as of the end of 2023. The Vermont Pathways Analysis, conducted as part of the 2021 Vermont Climate Action Plan, projected that 116,500 gasoline vehicles will need to be replaced with electric vehicles by 2030, a nearly 10-fold increase from 2023 levels.

EVs have significant climate benefits over gasoline cars, whether accounting just for fuel use, or on a more comprehensive lifecycle basis. While Vermont's GHG Inventory reports "tailpipe" emissions from the use of transportation fuels, there are also GHG emissions associated with the manufacture of vehicles. EVs are much less polluting than internal combustion engine (ICE) vehicles, both at the tailpipe and over the full life of the vehicle, despite being responsible for more GHG emissions in the initial production phase, due to battery manufacturing.

Across the U.S., electric sport utility vehicles (SUVs) are, on average, about 3.5 times less climate polluting than gas SUVs on a full lifecycle basis. **In Vermont, with our relatively clean electricity portfolio, electric SUVs are 7 times less climate polluting on a lifecycle basis.** As both the U.S. and Vermont electricity portfolios continue to decarbonize, GHG emissions associated with charging an EV will decline even further.

Lifecycle GHG emissions of gas vs electric SUVs in the United States and Vermont



Sources: ICCT, "Life-cycle greenhouse gas emissions of U.S. sedans and SUVs with different powertrains and fuel sources," 2024. Vermont electricity emissions based on 2020 life cycle emissions from Vermont Agency of Natural Resources/ERG, "Vermont Energy Sector Life Cycle Assessment," 2024. **Notes:** AEV = all-electric vehicle, ICE = internal combustion engine vehicle. Emissions from AEVs are presented separately for the US and Vermont because Vermont's electricity portfolio is much lower-emitting than the national average. Emissions from AEVs in 2030 are expected to be lower than in 2024 because of reduced production-related emissions and continued decarbonization of the electricity sector.

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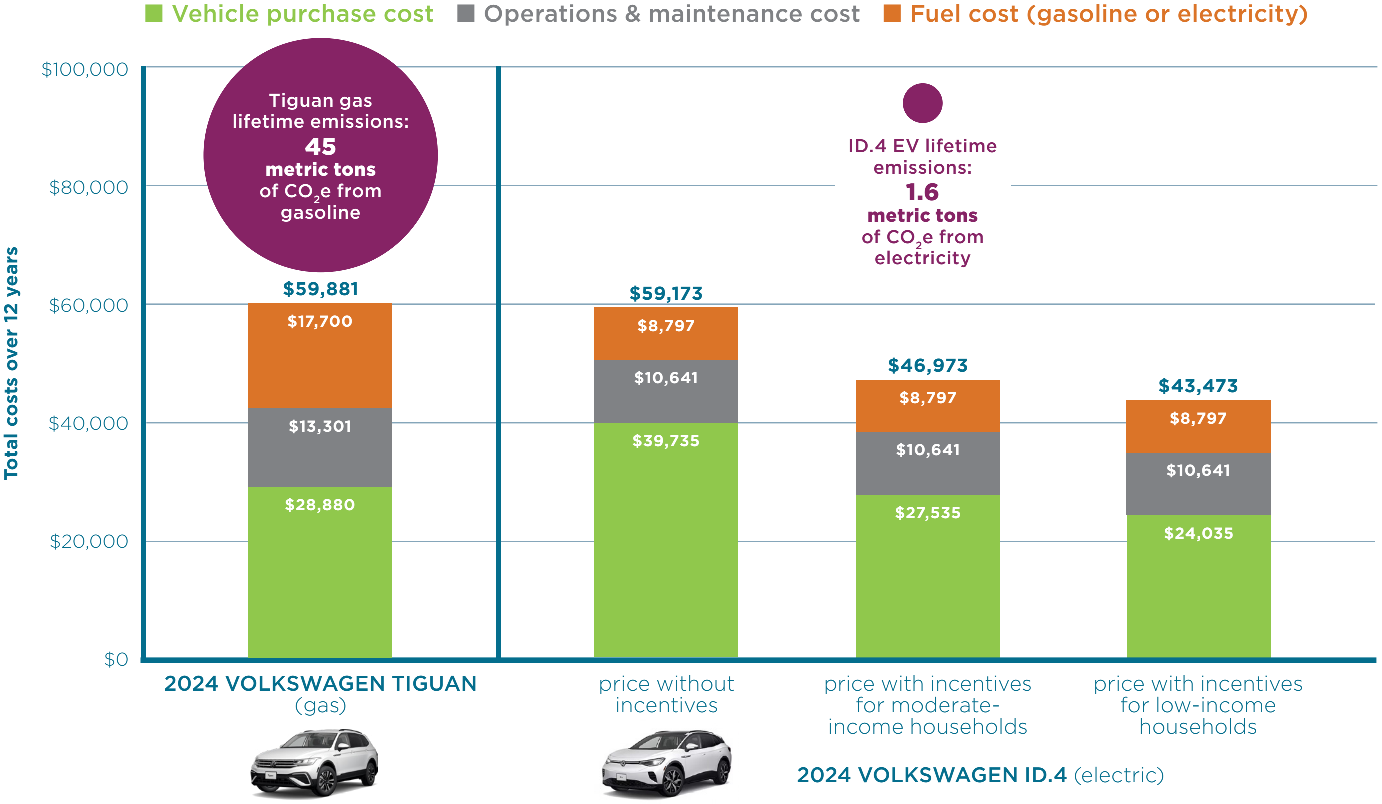
1. These numbers aren't reflected on the graph because full 2024 data were not available at the time of publication.

EVs can save drivers money through time, especially with incentives

When comparing vehicle costs, it is important to look at the whole picture. While many electric vehicles have higher manufacturer's suggested retail prices (MSRPs) than comparable gas models, once federal, state, and utility incentives are factored in, the upfront cost of a new EV is now frequently less than that of a new gas vehicle. Additionally, there are new, more affordable EV models being released each year.

All together, **EV drivers benefit from much lower lifetime costs of ownership than drivers of gas and diesel vehicles**. For instance, the lifetime cost of a 2024 Volkswagen ID.4 (all-electric) is estimated to be $13,000 to $16,000 lower than the cost of a comparable gas-fueled Volkswagen Tiguan, while creating only a small fraction of the emissions.

Lifetime costs and GHG emissions of comparable gas vs electric vehicles in Vermont

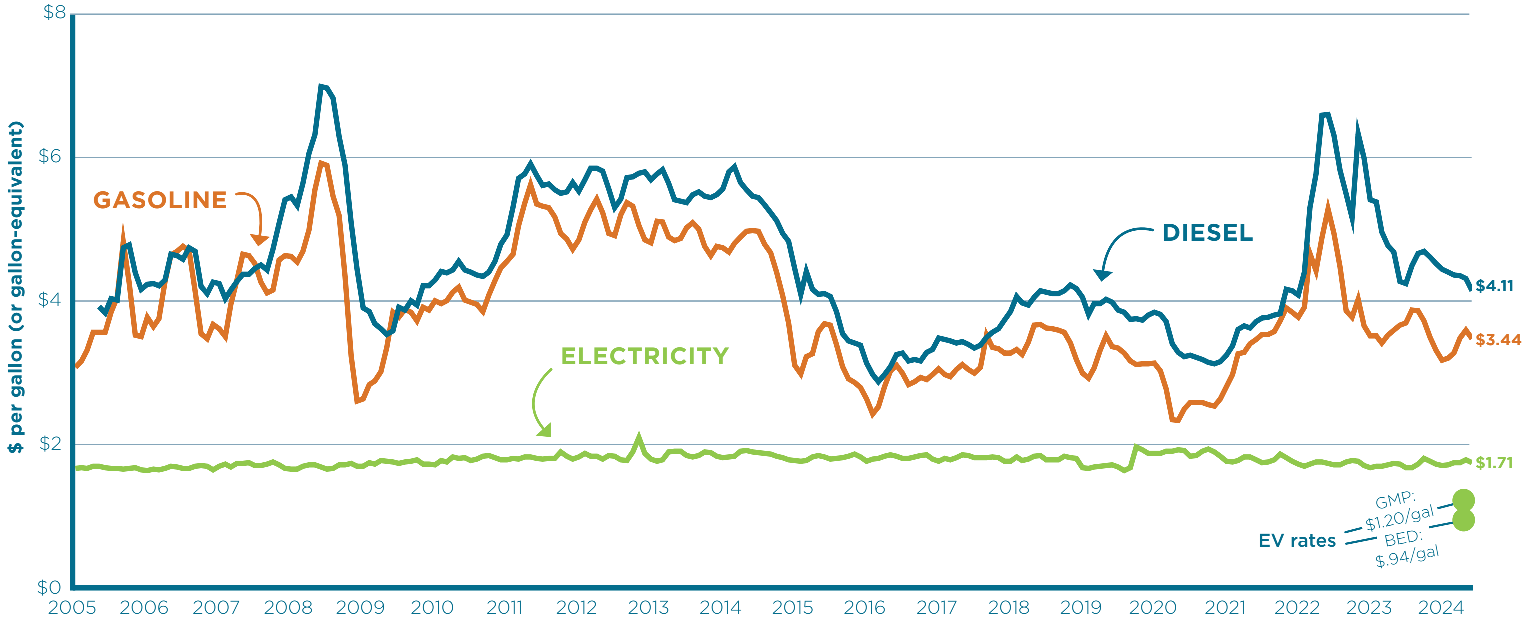


Sources: Vehicle costs represent the base MSRP for 2024 models. Gasoline emissions factors from EIA; electricity emissions factor calculated based on Vermont's 2021 GHG Emissions Inventory (VT ANR). Fuel costs calculated based on 2023 average gasoline prices from the Vermont Department of Public Service and 2023 average VT electricity prices from EIA. Operations and maintenance costs from AAA 2023 "Your Driving Costs" study. Operating costs and fuel costs are calculated based on an annual mileage of 11,084 miles (2022 VT per capita VMT from the Federal Highway Administration). **Notes:** Charging costs for EVs can be even lower than presented with the use of EV charging rates offered by some VT utilities. Incentive amounts include federal, state, and utility incentives. Additional incentive funding may be available through the Replace Your Ride program if scrapping an old gas vehicle. Vehicle efficiency ratings are from manufacturer reporting; however, actual efficiency rates are often lower in cold temperatures.

Gasoline and diesel are consistently higher cost and more price-volatile than electricity when compared on a gallon-equivalent basis. Vehicle charging at average electric rates in Vermont is equivalent to paying $1.71/gallon for gasoline, but can be even lower through utility programs for off-peak charging. Burlington Electric Department (BED) has an EV rate of 11.13¢/kWh (equivalent to about $0.94/gallon), and Green Mountain Power's (GMP) EV rate is 15¢/kWh (equivalent to about $1.20/gallon). Because of this, EV drivers usually save hundreds of dollars each year on fuel costs. All-electric vehicles also typically have lower maintenance costs, further bringing down the lifetime costs of the vehicle.[1]

1. AAA, "Your Driving Costs," 2023.

Cost comparison of different transportation fuels over time in VT (adjusted for inflation, June 2024 dollars)

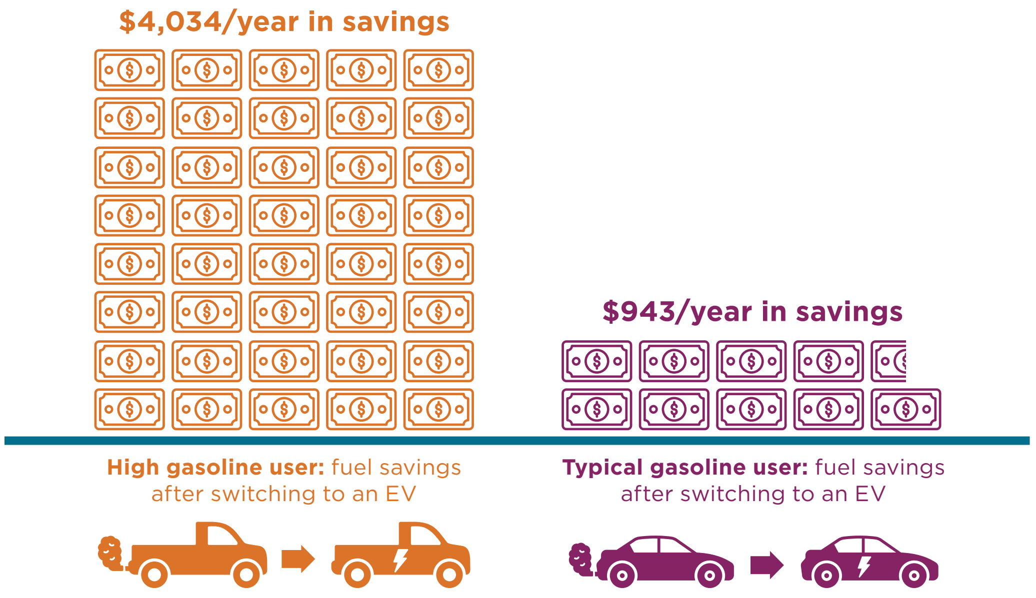


Sources: VT gas and electric prices: EIA, 2024. Diesel: Vermont Agency of Transportation, 2024. EV rates: Green Mountain Power and Burlington Electric Department, 2024. **Note:** Data through June 2024. Prices shown are in June 2024 dollars, using the U.S. Bureau of Labor Statistics Consumer Price Index.

Vermonters who use the most gasoline — referred to as "high gasoline users" or "gasoline superusers"— can save the most on fuel costs when switching to an electric vehicle. **On average, high gasoline users can save more than *$4,000* per year by switching to an EV, compared to just under $1,000 per year for typical gasoline users.**[2]

Prioritizing EV adoption among high gasoline users is an emerging strategy to accelerate pollution reduction and save those with the highest transportation cost burdens more money. Some municipalities and utilities are beginning to introduce programs to do just that. For example, in 2024 Burlington Electric Department pioneered an additional EV incentive specifically for high-mileage drivers, setting a leading example for this type of program, both here in Vermont and nationwide.

Average annual fuel savings from switching to an EV: Vermont high gasoline users vs. typical gasoline users



Source: Coltura, Gasoline Data Center, 2024. **Note:** High gasoline users are defined as the top 10% of U.S. light-duty vehicle drivers in terms of gasoline consumption. Approximately 14% of Vermont drivers fall into this category (Coltura refers to these drivers as "gasoline superusers"). Gasoline consumption depends on both vehicle miles traveled and vehicle fuel efficiency (MPG). On average, high gasoline users in Vermont consume 1,874 gallons of gasoline per year.

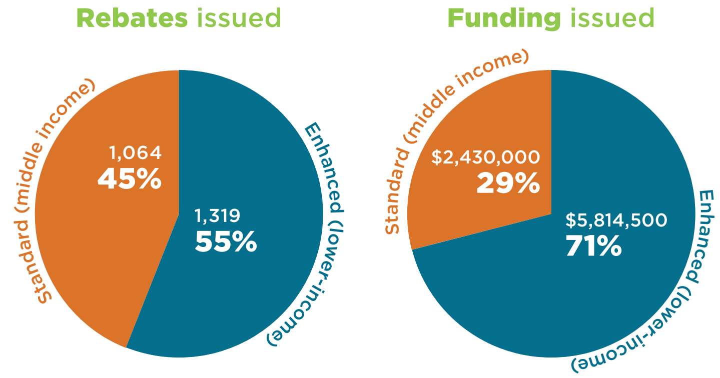
2. Coltura, 2024.

Equity and EV incentive distribution

Almost 2,400 Vermonters with low and moderate incomes have participated in Vermont's incentive program for new EVs. **Vermonters with lower incomes have received just over half of the total incentives issued, but because incentive levels are higher for Vermonters with lower incomes, this translates to more than 70% of all incentive dollars**. Continuing to maintain high levels of uptake among Vermonters with lower incomes is important for ensuring that all Vermonters are able to access the benefits and savings associated with driving an EV.

While incentives for new EVs are important, about two-thirds of Vermonters purchase *used* vehicles. Thankfully, **there are now federal, state, and utility incentives available for the purchase of used EVs as well.** Vermonters with low or moderate incomes can get between $4,250 to $16,500 off the price of a used EV. To learn more about the incentives you may be eligible for, visit driveelectricvt.com.

Vermont state incentives for new EVs, by income level



Source: Drive Electric VT/Center for Sustainable Energy, State Incentive Electric Vehicle Sales Dashboard, 2024. **Notes:** Data shown here covers incentives issued for new EVs between July 7, 2022, and July 30, 2024. Detailed information on income eligibility for the enhanced and standard incentives can be found at driveelectricvt.com/incentives.

Potential cost of a used EV after incentives

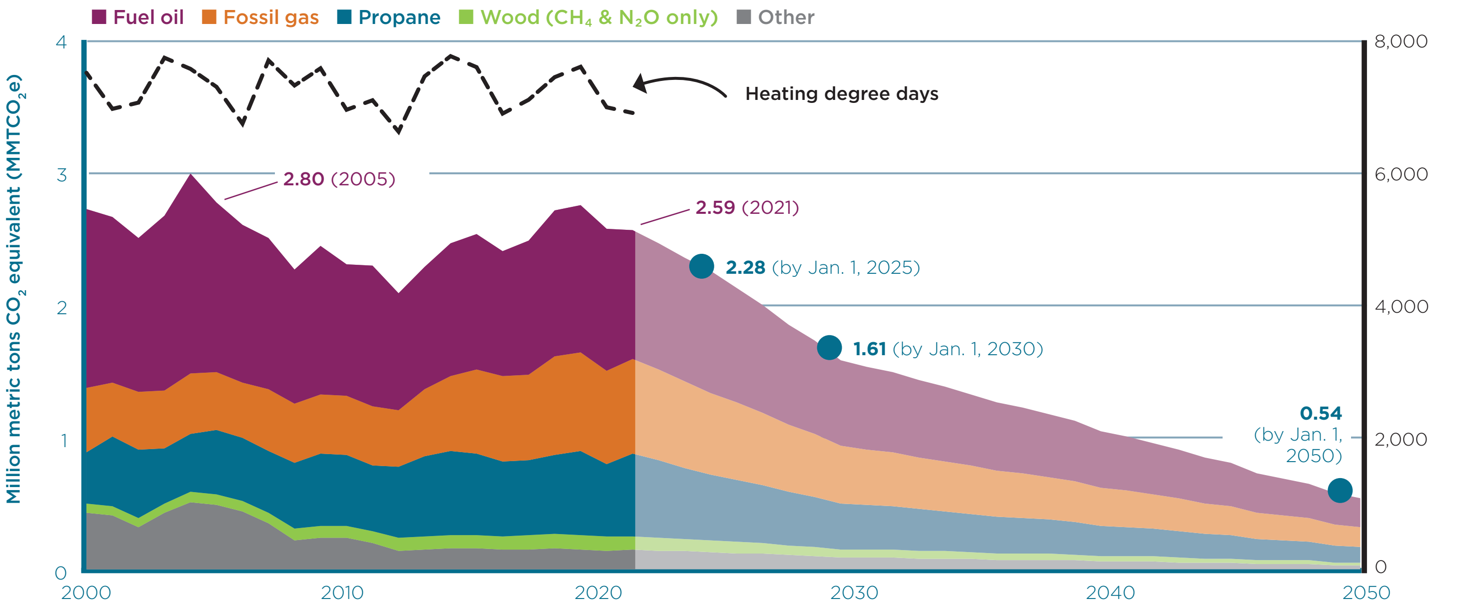
	Standard incentive	< $57,000 income incentive
Used 2022 Chevrolet Bolt EV 1LT Hatchback 4D: Typical listing price	**$20,043**	**$20,043**
Federal: Tax credit	-$4,000	-$4,000
Electric utility: Rebate*	-$250 to -$1,500	-$900 to -$2,500
State: MileageSmart**	$0	-$2,500 to -$5,000
State: Replace Your Ride (if applicable*)	$0 to -$2,500	$0 to -$5,000
Total incentives	**-$4,250 to -$8,000**	**-$7,400 to -$16,500**
Cost after incentives	**$12,043 to $15,793**	**$3,543 to $12,643**

Sources: Incentive amounts and eligibility: Drive Electric VT. Pre-incentive vehicle cost: Kelley Blue Book, typical listing price for a used 2022 Chevrolet Bolt EV 1LT Hatchback 4D. **Notes:** To learn more about incentive eligibility and requirements, visit driveelectricvt.com. *Exact incentives vary by utility. **Exact incentive amounts for MileageSmart and Replace Your Ride can vary based on household income and size, eligibility for other benefits, vehicle price, and remaining funding available. Replace Your Ride is only available to consumers scrapping an old gas or diesel vehicle.

In addition to upfront vehicle costs, the cost of installing an at-home EV charger can be a barrier to adoption for households with lower incomes, especially if electrical panel upgrades are required. While several Vermont utilities offer full or partial rebates to help cover the cost of charging equipment, most don't cover installation costs. And, although some Vermont utilities are working to address the issue, renters and those who live in multi-family buildings also often lack access to EV charging altogether. An equitable EV transition means ensuring that all Vermonters have affordable and convenient charging options.

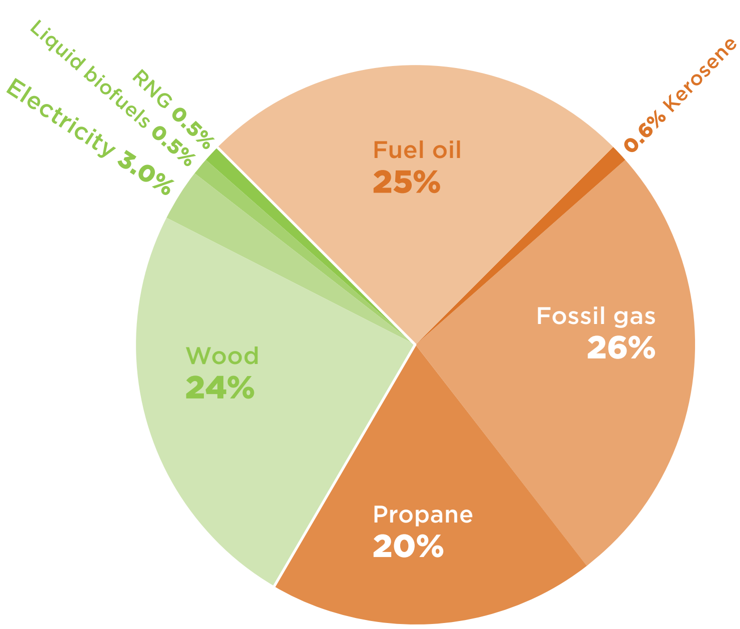
Thermal sector greenhouse gas emissions and energy use

Historical VT thermal GHG emissions and future sector targets



Sources: GHG emissions: Vermont Agency of Natural Resources, "Vermont Greenhouse Gas Emissions Inventory and Forecast: 1990-2021," 2024. Heating degree days: NOAA Climate Prediction Center, 2024. **Notes:** Heating degree days are a measure of how cold the temperature was on a given day, and compares the mean outdoor temperature to a standard temperature of 65F. It is measured by subtracting the mean temperature from the standard temperature and aggregated over the entire year. The VT Climate Council set sectoral emissions targets for GWSA compliance, which are represented by the blue dots on the graph.

VT thermal energy sources, 2022



Sources: VT Department of Taxes, 2024; Energy Information Administration (EIA) State Energy Data System, 2024; Efficiency Vermont, 2024; VGS, 2024. **Notes:** Percentages do not add up to 100% due to independent rounding. Electricity used for heating is estimated based on the number of heat pumps installed in Vermont and the number of homes estimated to be heated with electric resistance systems.

The thermal sector, which consists of Residential, Commercial, and Industrial (RCI) fuel use, was responsible for 2.59 $MMTCO_2e$ in 2021, making up 31% of Vermont's statewide GHG emissions.

A large majority (72%) of Vermont's thermal energy use is fossil fuel based, primarily consisting of fossil gas[1] (26%), fuel oil (25%), and propane (20%). In recent years, however, fuel oil sales have been declining relative to other fossil heating fuels.[2] Despite increasing adoption of cold-climate heat pumps and heat pump water heaters, electricity remains a very small share (only 3%) of total thermal energy use. Wood heat makes up most of the rest of Vermont's thermal energy use, primarily from cord wood, but also including wood chips and pellets.

Thermal sector GHG emissions have historically moved in line with how relatively warm or cold each year is (as measured by heating degree days).

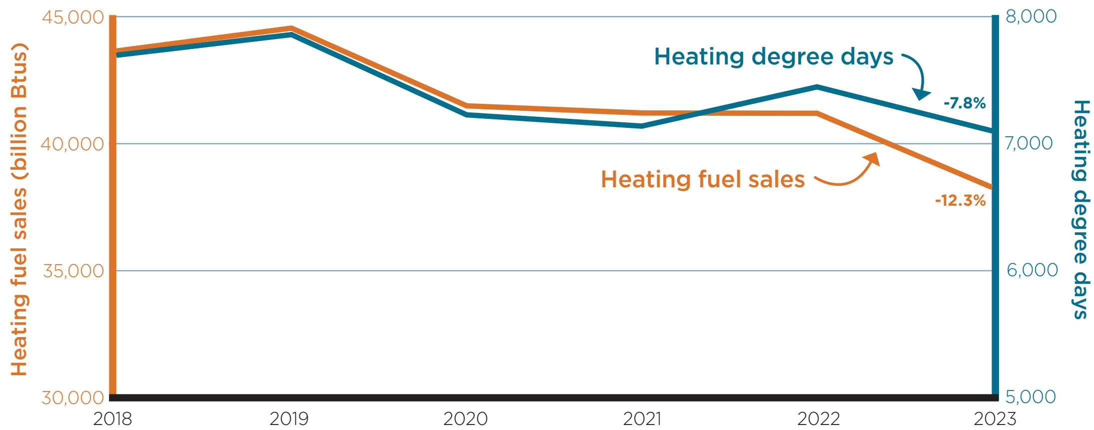
1. Fossil gas is also sometimes referred to as "natural gas," "utility gas," "fossil natural gas," "pipeline gas," "fracked gas," "methane," or "gas."
2. Jared Duval and Lena Stier, "Analyzing changes in fossil heating fuel use in Vermont, 2018-2023," 2024.

However, **Vermont's thermal sector GHG emissions have begun to decouple from heating degree days, primarily due to increasing heat pump adoption.**[3] By reducing dependence on fossil heating fuels we can durably cut emissions — regardless of how cold future winters are.

More than half (53%) of Vermont's thermal sector GHG emissions come from fuel use in homes, while 35% come from commercial buildings. **Weatherization, heat pumps, heat pump water heaters, and certain types of advanced wood heat and biofuels (specifically those with lower life-cycle emissions), all present opportunities to reduce emissions from heating homes and other buildings.**

Investing in weatherization and transitioning heating from fossil fuels toward electricity and other renewable options are not just pollution reduction strategies — they are also *resilience* strategies. Specifically, better insulated homes improve health and comfort, during both extreme cold and heat events. Meanwhile, **fuel tanks and the toxic fossil fuels they hold present dangerous health hazards, especially during flooding events.** When fossil fuels leak into water they harm human health and the environment and also make clean up and recovery efforts that much more difficult and costly, as seen in the aftermath of the 2023 and 2024 floods.[4]

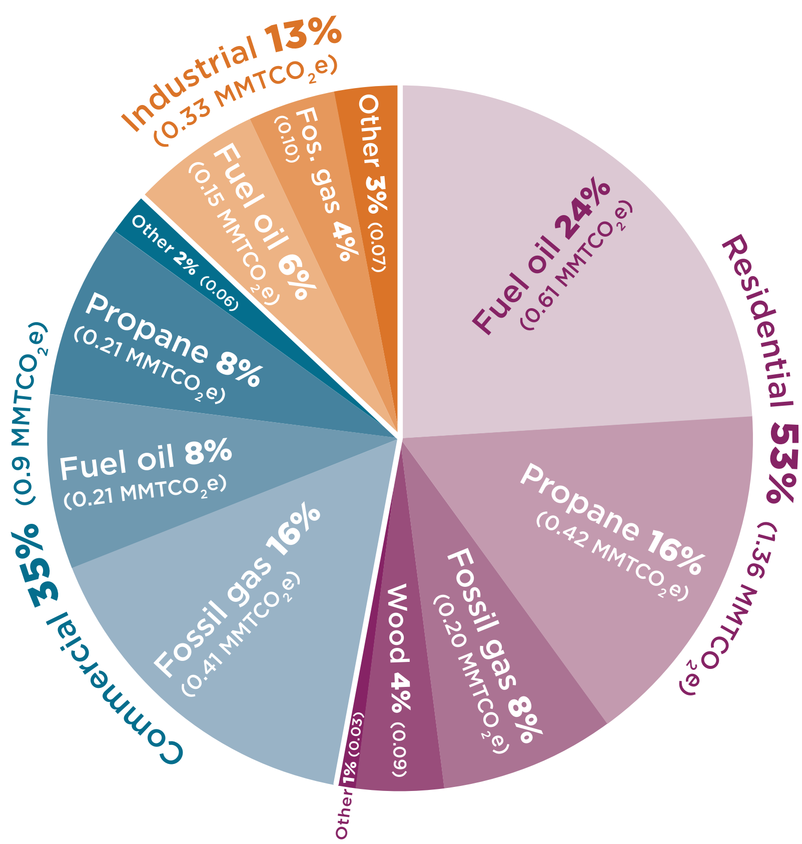
Total fossil heating fuel sales and heating degree days in Vermont, 2018–2023



Sources: Heating fuel sales data: Vermont Department of Taxes, 2023; VGS, 2023. Fuel heat content conversion factors: U.S. Energy Information Administration, 2023. Heating degree days: NOAA Center for Weather and Climate Prediction, 2023. **Note:** Heating degree days are a measure that compares the mean outdoor temperature on a given day to a standard temperature of 65 degrees Fahrenheit.

Vermont thermal GHG emissions by sector and fuel type, 2021

TOTAL THERMAL EMISSIONS 2.59 $MMTCO_2e$



Sources: Vermont Agency of Natural Resources, "Vermont Greenhouse Gas Emissions Inventory and Forecast: 1990-2021," 2024. **Note:** Percentages do not add up to 100% due to independent rounding.

3. Jared Duval and Lena Stier, "Analyzing changes in fossil heating fuel use in Vermont, 2018-2023," 2024.
4. VTDigger, "Seeking shelter: Vermonters displaced by floods find housing solutions through family and friends," August 3, 2023.

Vermont's progress on adopting key thermal solutions

The solutions that can deliver the largest share of Vermont's necessary thermal sector GHG emissions reductions, as modeled for Vermont's 2021 Climate Action Plan (CAP), include weatherization and heat pumps for space and water heating. These graphs show the scale and pace of adoption achieved to date for these key solutions, relative to CAP targets.

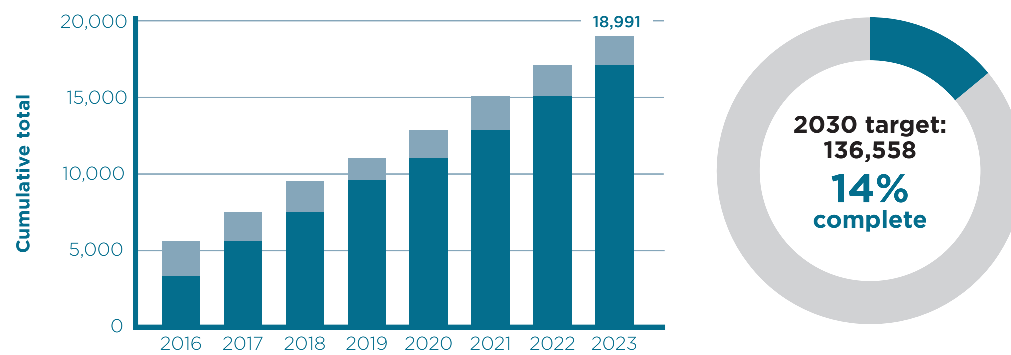
While it is possible to heat many well weatherized homes with modern cold-climate heat pumps alone, often clean heating is not a one-or-the-other or a one-size-fits-all situation. Practical solutions depend on many variables. With Vermont's older buildings and cold climate, the best heating solutions frequently involve multiple renewable heating options working in combination, in the interest of reliability and resilience. For instance, advanced wood heating can provide supplemental or back-up heat to heat pumps, or vice versa.

While interest in and demand for these solutions is increasing, **Vermont doesn't yet have the workforce in place necessary to scale adoption to the level required to meet the CAP targets.** Additional investment is needed to attract, train, and retain new workers for weatherization and heat pump installation.

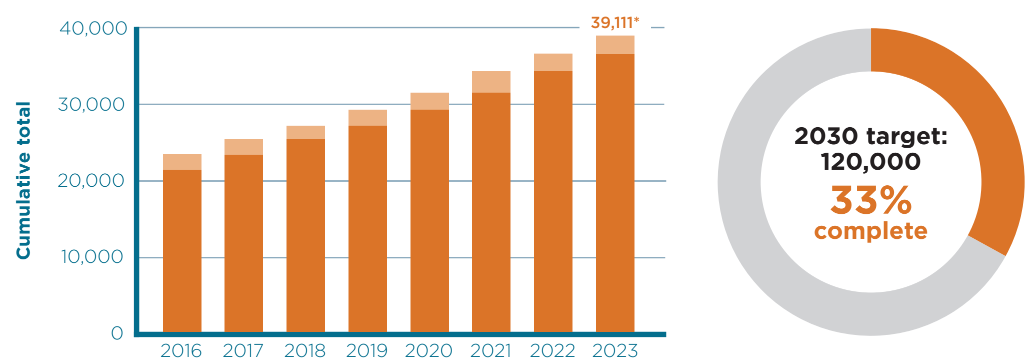
Vermont thermal measures: Historical uptake and Climate Action Plan pathways

Pre-existing total | Annual addition

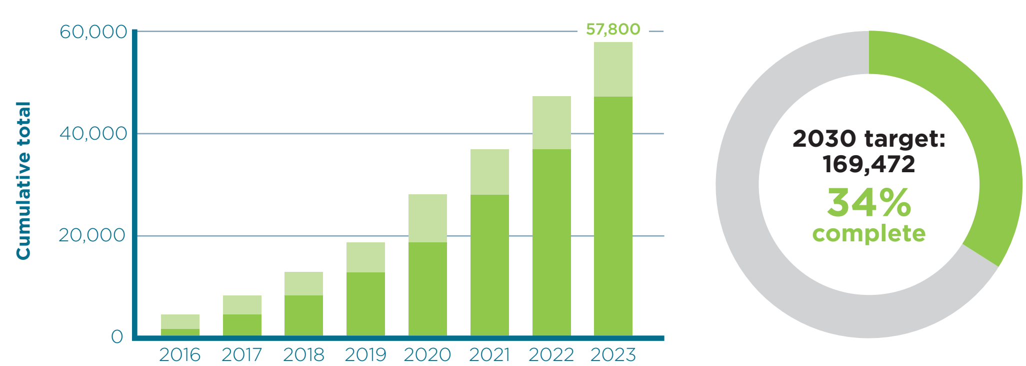
Residential heat pump water heaters



Housing units comprehensively weatherized



Residential cold-climate heat pumps



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.

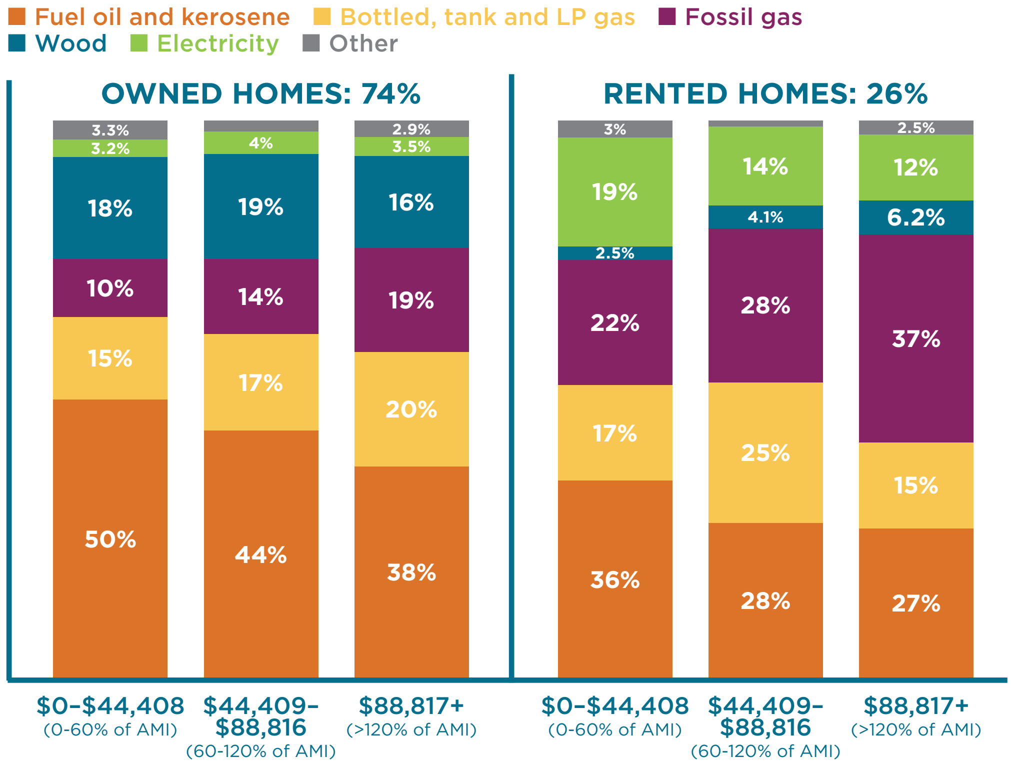
If Vermont is to meet our legal climate obligations by 2030, a business-as-usual approach will not be sufficient. Vermont's Affordable Heat Act (Act 18 of 2023) began the process of designing a Clean Heat Standard to meet the thermal sector's share of responsibility for emissions reduction. **A Clean Heat Standard is intended to significantly increase the pace of weatherization and heat pump adoption, with the majority of resulting incentives intended to support Vermonters with low and moderate incomes.**

Equity in the thermal sector

Households with lower incomes don't have the same access to improved heating options as their higher-income neighbors, placing already cost-burdened Vermonters at the mercy of some of the most expensive and least efficient ways to heat their homes. In particular, households with lower incomes are disproportionately dependent on three of the highest-cost heating sources: fuel oil, kerosene, and inefficient electric resistance systems.[1]

In rental units, which make up 26% of Vermont housing units, there is often a split incentive where the landlord is responsible for installation of heating equipment and weatherization, but the tenant pays the utility bill. This dynamic disincentivizes improvements that could lead to financial savings and a healthier home for many renters.

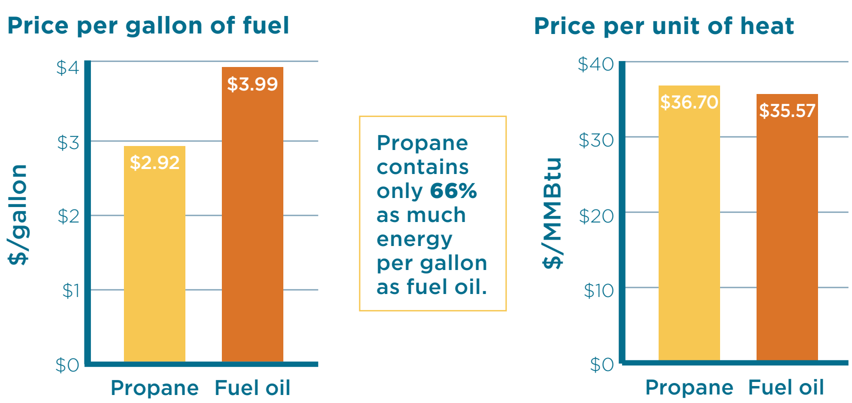
Vermont primary household fuel use by income and housing type



Source: U.S. Census Bureau, 2018-2022 American Community Survey 5-year Public Use Microdata Samples. **Note:** Income categories are based on 2018-2022 median household income in Vermont of $72,014. Data is self-reported.Percentages may not sum exactly to 100% due to independent rounding.

The use of electricity for heating provides a good example of this issue. ***Electric heat pumps*** are one of the most efficient, clean, and cost-effective ways to heat a home over time — but they have relatively high upfront purchase and installation costs. On the other hand, ***electric resistance heating*** (such as electric baseboard heating) is one of the most expensive ways to heat a home over time, yet it has very low upfront purchase and installation costs. This is a big reason why so many renters in the lowest third of the income distribution are still dependent on high-cost electric resistance systems.

Propane and fuel oil price comparison in Vermont



Sources: Vermont Department of Public Service, Retail Prices of Heating Fuels, Dec 2023; EIA, 2024. Efficiency Vermont Technical Reference Manual, 2023. **Notes:** This comparison uses average prices from December 2023 for illustration. Price per MMBtu assumes average equipment efficiencies of 81% for fuel oil and 87% for propane.

Making sure Vermonters have accurate information about energy costs is an important consumer protection issue. For instance, while the price per gallon for propane has historically been lower than the price per gallon of fuel oil, the price per *amount of delivered heat* has historically been lower for fuel oil. This is because propane has only 66% as much energy per gallon as fuel oil.[2] A lack of clear information about true costs harms households with lower incomes and the highest energy burdens the most.

1. Vermonters who live in mobile or manufactured homes are disproportionately dependent on kerosene for heating.
2. U.S. Energy Information Administration, Monthly Energy Review: Appendix A, 2024.

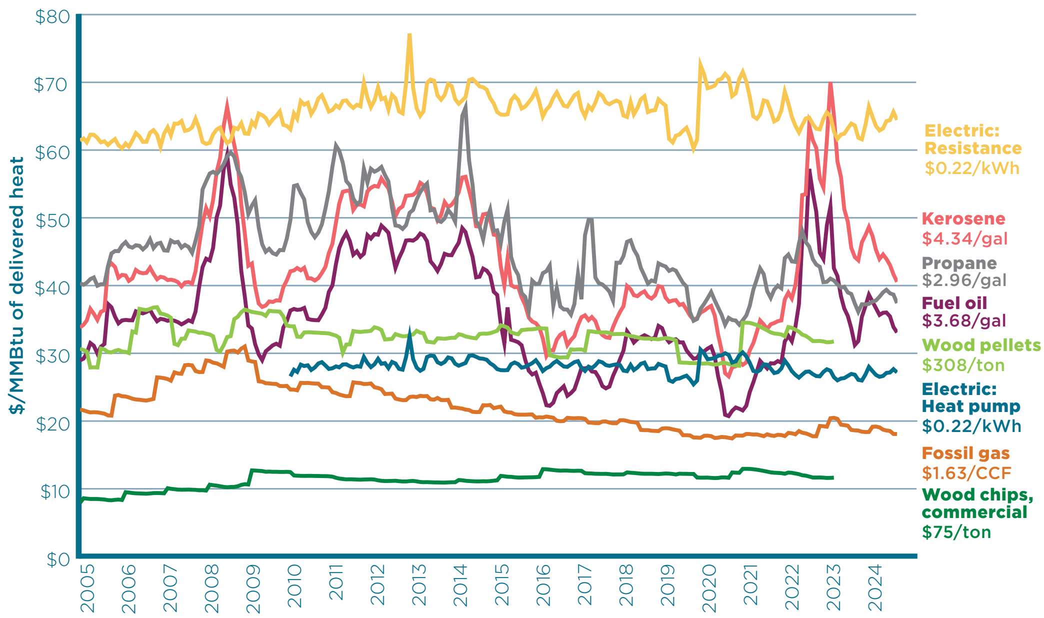
Vermonters can save money with cleaner heating technologies

Fossil heating fuels like propane, fuel oil, and kerosene are high cost and price volatile. **Switching to fossil fuel free heating equipment, such as cold-climate heat pumps and advanced wood heat, can lower a household's energy costs while providing much more stable heating prices.** The unpredictable heating costs created by fossil fuel price volatility are especially challenging to Vermont households with lower incomes and those facing energy insecurity.

Based on average equipment life spans, each year an estimated 10,000–12,500 Vermont households replace their space heating systems and roughly 20,000–25,000 replace their water heaters. **This time of change-out is a key moment of opportunity to replace old, dirty systems with more efficient and cleaner upgrades — and is also when Vermonters can avoid locking in decades of further pollution and high and unpredictable heating costs.**

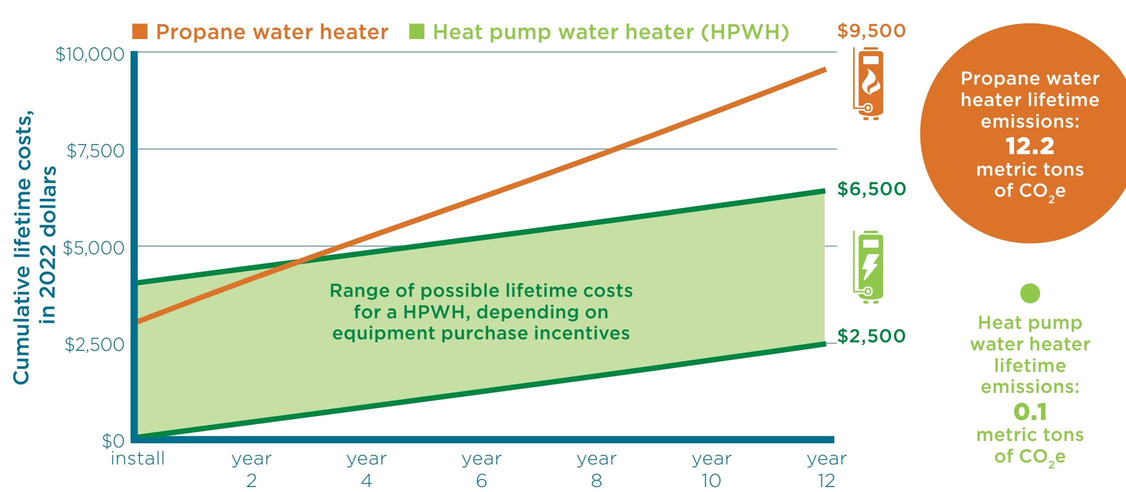
Heat pump water heaters consistently provide much lower total costs over time, even when the upfront price of a fossil fuel water heater is lower. Some current incentives cover the full cost of heat pump water heaters for eligible consumers. Depending on incentive levels, heat pump water heaters start saving Vermonters money either right away or within 3 years, compared to propane water heaters.

Cost comparison of different heating fuel options over time (adjusted for inflation, June 2024 dollars)



Sources: Fuel oil, propane, kerosene prices: VT Department of Public Service, Retail Prices of Heating Fuels, 2024. Fossil gas: VGS, 2024. Electricity: EIA, 2024. Wood chips, wood pellets: Biomass Energy Research Center, 2023. **Notes:** Electricity prices presented here are a statewide average but vary by utility territory. The reason propane is usually more expensive per MMBtu than fuel oil but less expensive on a per gallon basis is because propane has a lower energy content per gallon (66% of the energy of fuel oil per gallon). Prices reflect data availability at the time of publication: through June 2024. Prices shown are in June 2024 dollars, using the U.S. Bureau of Labor Statistics Consumer Price Index.

Lifetime costs of propane water heater vs. heat pump water heater (installed cost + fuel)

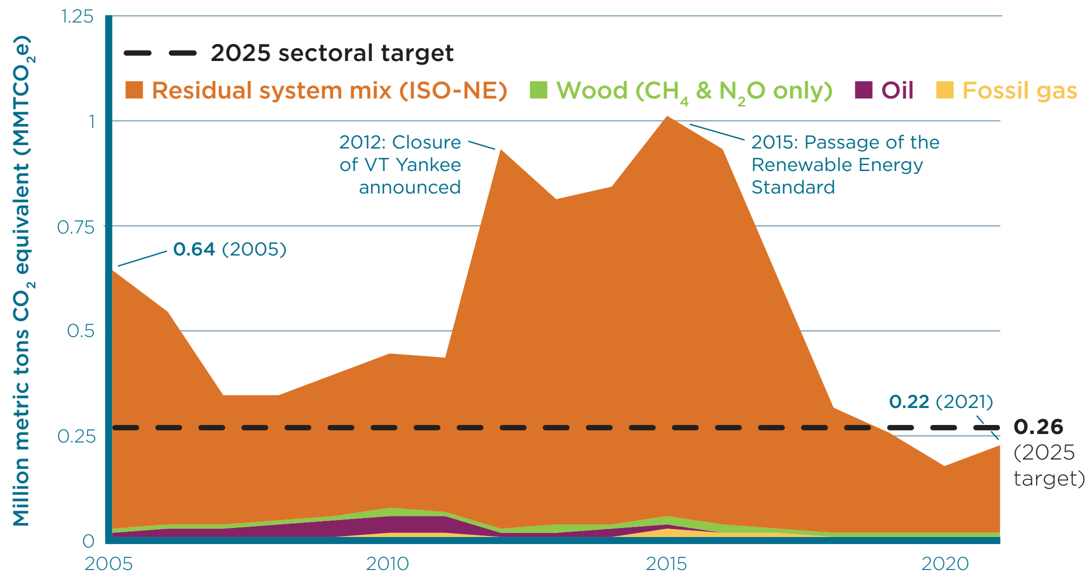


Sources: Annual energy load and efficiency assumptions from the Efficiency Vermont 2023 Technical Reference Manual; Propane emissions factor from EPA; Electricity emissions factors assume a linear reduction over time, reaching zero emissions by 2035 in accordance with Vermont's Renewable Energy Standard. Prices shown are in 2022 dollars and reflect projections from EIA's 2023 Annual Energy Outlook for 2024-2035. **Note:** While installed costs of propane water heaters can vary, there is greater variation in heat pump water heater installed costs due to the availability of incentives. Different installed costs for heat pump water heaters reflect federal tax credits and state-level incentives for various income levels, including Switch and Save and Weatherization Assistance Program incentives that can bring the upfront cost as low as $0.

Electricity sector greenhouse gas emissions and energy use

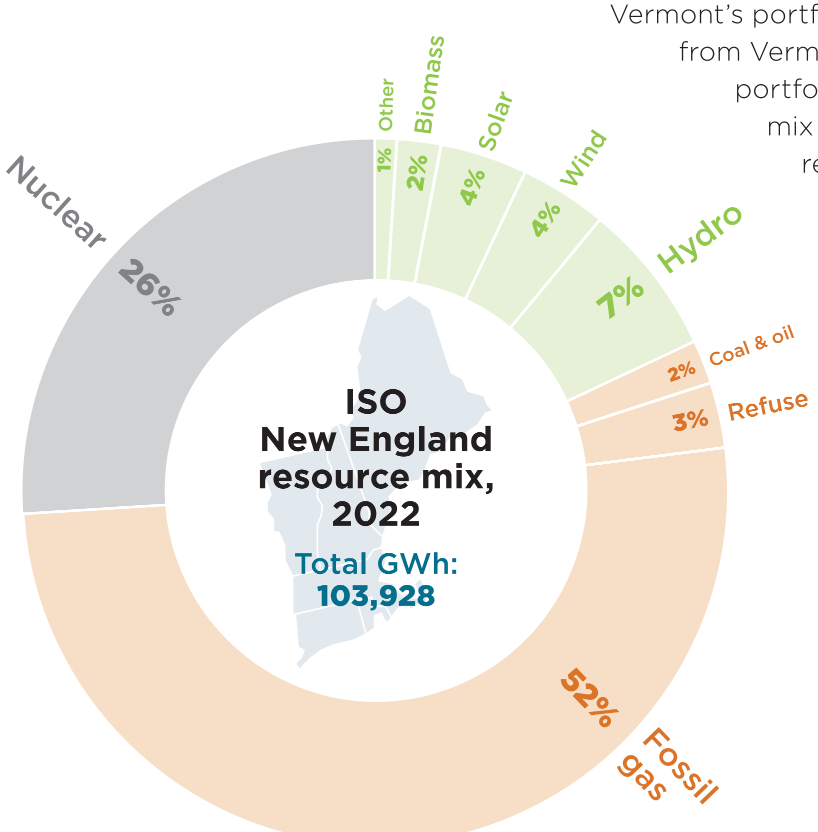
Vermont's electric power sector is much lower GHG emitting than our other energy sectors. In 2021, the electricity sector was responsible for just 3% of statewide climate pollution. **Vermont's GHG emissions from electricity declined 66% between 2005 and 2021, so much so that the state has already achieved the electricity sector's proportional share of the 2025 GWSA emissions reduction target.**

VT electricity GHG emissions (2005–2021) vs 2025 sectoral target



Source: Vermont Agency of Natural Resources, "Vermont Greenhouse Gas Emissions Inventory and Forecast: 1990-2021," 2024.

Vermont is part of a regional electricity grid, operated by an independent system operator, ISO New England (ISO-NE). ISO-NE has a significantly higher GHG emitting power supply than Vermont's portfolio. One reason for the reduction in emissions from Vermont's electricity sector is that the share of our portfolio that comes from the ISO-NE residual system mix has been declining. In 2015, this residual mix represented 52% of Vermont's electricity portfolio. As of 2022, it was only 10%. It's also worth noting that while fossil fuel resources represent the majority of the total ISO-NE resource mix, this mix has become more renewable and carbon-free over time, increasing from 4% renewable in 2010 to 17% renewable in 2022.

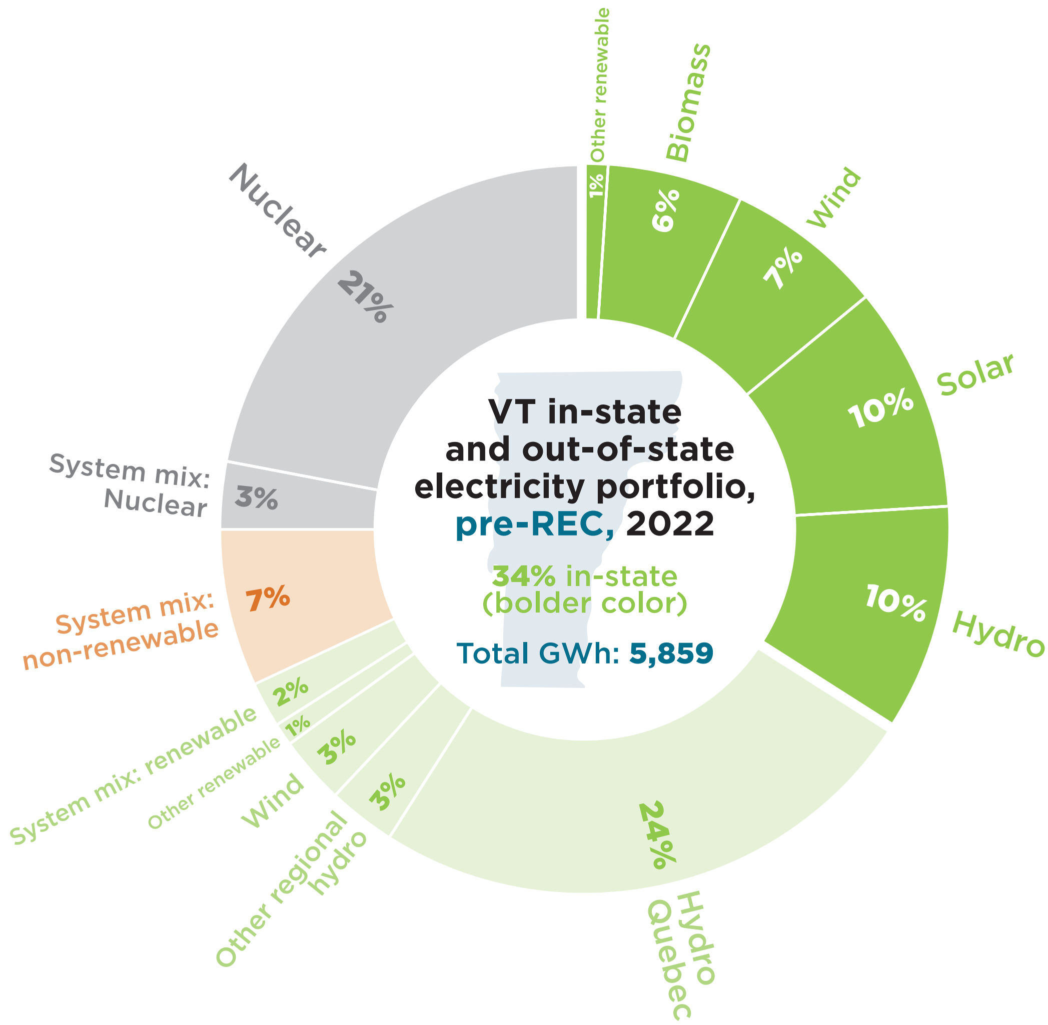


Source: ISO-NE, "Net Energy and Peak Load by Source Report," 2023.
Note: Totals do not add up to 100% due to independent rounding.
ISO New England is New England's regional grid operator.

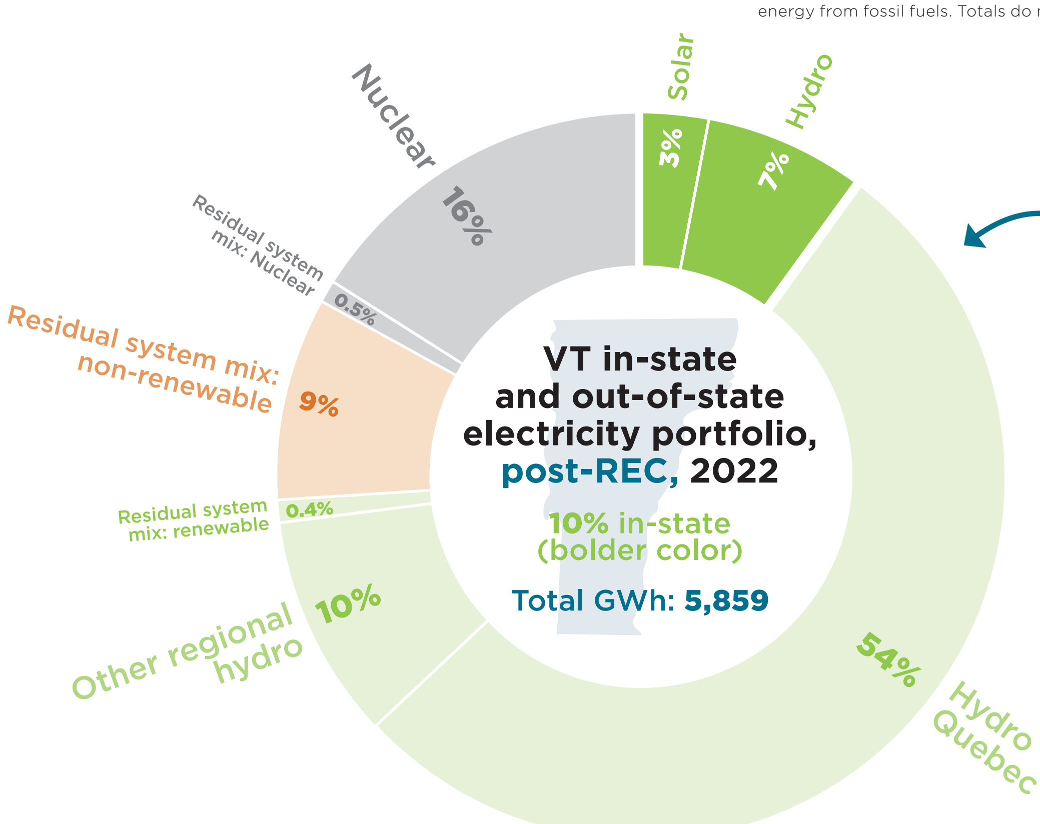
Vermont's electricity sector GHG emissions are reported on the basis of utilities' retirement of Renewable Energy Credits (RECs), which are the marketable property rights to the renewable attributes of power generation. This is consistent with the rules and practices of Vermont's Renewable Energy Standard (RES), emissions accounting in most other New England States, and the regional electricity market in which we operate.

Regardless of whether one considers electricity sector emissions via our purchased portfolio (post-REC accounting), as Vermont officially does, or from energy deliveries to Vermont (pre-REC accounting), the key takeaway is the same: *less than 10% of Vermont's electricity purchases come from fossil fuel sources.*

Vermont has long had the least carbon intensive electricity portfolio (CO_2e/MWh) of any state in the U.S. With the passage of the updated Renewable Energy Standard in 2024, Vermont will only strengthen this position, as we move to 100% renewable electricity by 2035. Because of the high and increasing renewability of Vermont's electricity portfolio, electrifying our highest-polluting sectors — transportation and thermal — delivers both immediate and long-term GHG emissions reductions.



Sources: Vermont Department of Public Service, 2022 Electric Utility Resource Survey; ISO-NE, "Net Energy and Peak Load by Source Report," 2023. **Notes:** Non-renewable is primarily energy from fossil fuels. Totals do not add up to 100% due to independent rounding.



Vermont's post-REC electricity mix is what legally determines Renewable Energy Standard compliance and is what is officially used to measure electricity sector GHG emissions in Vermont's GHG Inventory.

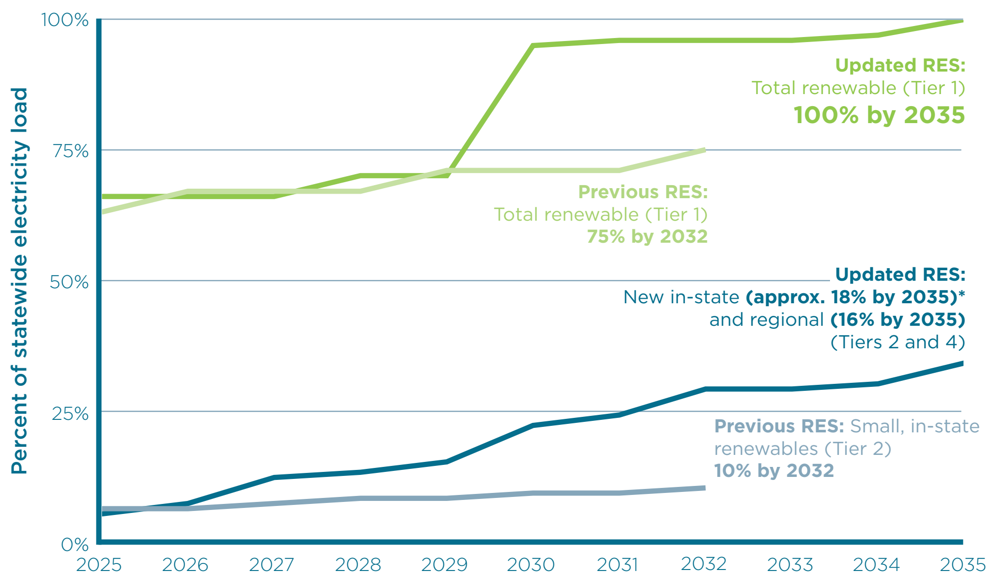
Sources: Vermont Department of Public Service, 2022 Electric Utility Resource Survey; NEPOOL GIS Residual Mix, 2022.
Notes: Non-renewable is primarily energy from fossil fuels. Totals do not add up to 100% due to independent rounding.

Vermont's Renewable Energy Standard

With the updates to the Renewable Energy Standard (RES) via Act 179 of 2024, **Vermont became the second state in the country, after Rhode Island, to require utilities to deliver 100% renewable electricity by 2035.** Achieving an even more renewable and carbon-free electricity grid will help ensure that Vermont maximizes the pollution reduction benefits from electrification of transportation and heating.

The updated RES increases the requirements for overall renewable electricity, in addition to establishing more specific requirements for new in-state distributed generation and new regional renewables. The RES consists of five tiers of requirements.

Vermont Renewable Energy Standard requirements: Previous RES (Act 56, 2015) vs. updated RES (Act 179, 2024)



Source: Vermont General Assembly, Act 179, 2024. **Notes:** Actual requirements in the updated RES vary by utility. Percentages shown for each tier are estimates based on the current size of each utility relative to Vermont's total electricity load. Previous RES compliance was based on electricity sales, rather than total electricity load. Electricity load includes transmission and distribution losses that would not be counted in sales. *There are provisions in the RES that reduce the Tier 2 requirement to slightly lower than 20%.

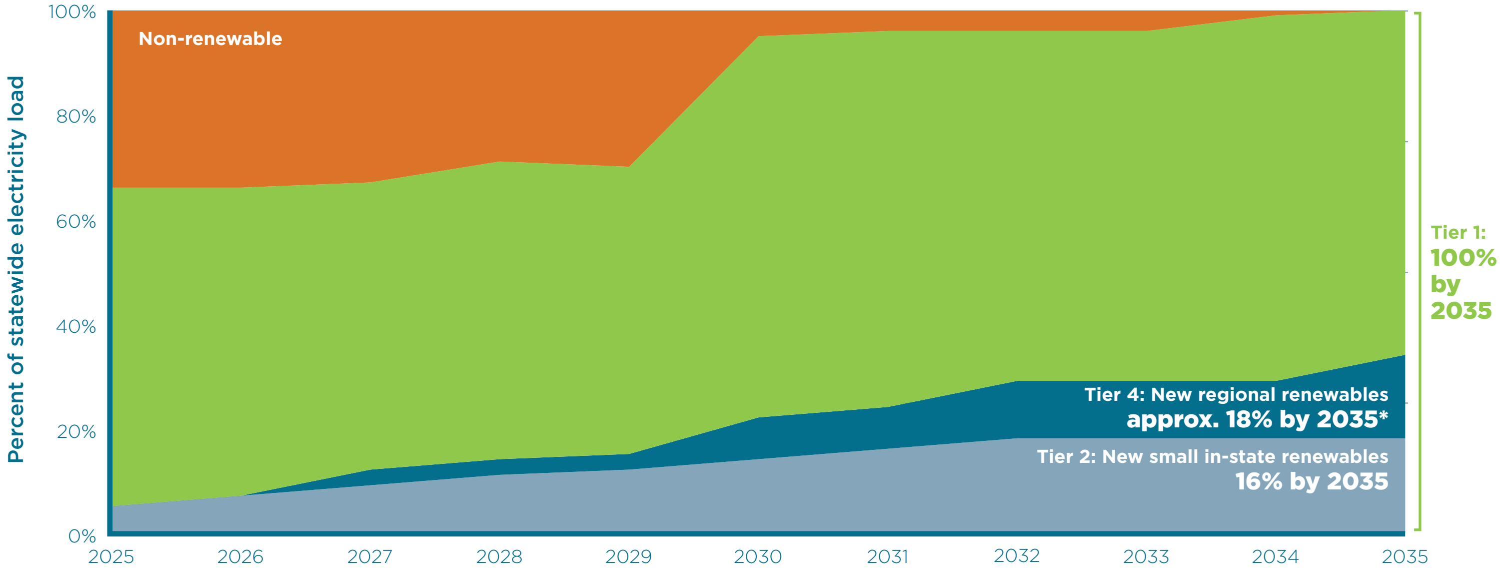
TIER 1 requires utilities to increase the share of electricity they purchase from renewable sources over time, reaching 100% renewable by 2030 for Green Mountain Power (GMP) and Vermont Electric Co-op (VEC) and by 2035 for all other utilities. Three Vermont utilities — Burlington Electric Department, Washington Electric Co-op, and Swanton Electric — are already 100% renewable on the basis of their annual REC retirements.

In addition to setting more ambitious targets for renewables in general, the updated RES also significantly increases the amount of *new* renewable energy that utilities must procure. The law increases the **TIER 2** obligation, doubling the amount of electricity that utilities must purchase from new small-scale, in-state renewables, with utilities that are not already 100% renewable required to reach 20% by 2035. Larger utilities are required to meet this target by 2032.

Tier 3 is the only tier that does not directly address renewable electricity purchasing requirements and will be addressed on the next page. The 2024 updates to the RES also created two new tiers, Tier 4 and Tier 5.

TIER 4 requires utilities to purchase increasing amounts of electricity from new renewable resources located anywhere in the region. Like Tier 1, this tier establishes a more ambitious target for the state's largest electric utility, Green Mountain Power. Under Tier 4, GMP must meet 20% of its annual electricity load with new regional renewables by 2035, while all other utilities are only required to achieve 10% by that same year. These targets are expected to average out to about 16% of statewide electricity load in 2035.

Updated Vermont Renewable Energy Standard (Act 179) requirements

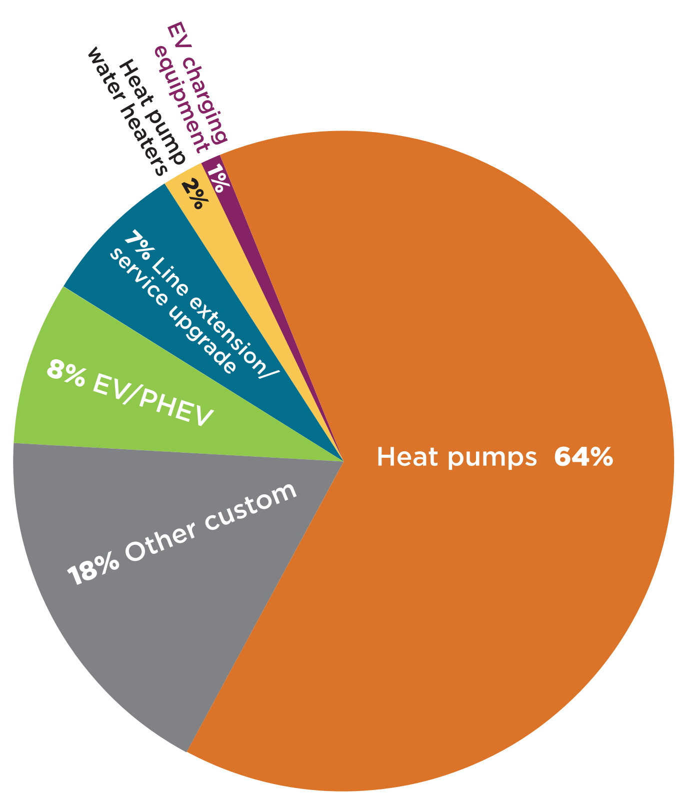


Source: Vermont General Assembly, Act 179, 2024. **Notes:** Actual requirements in the updated RES vary by utility. Percentages shown for each tier are estimates based on the current size of the load served by each utility relative to Vermont's total electricity load. *There are provisions in the RES that reduce the Tier 2 requirement to slightly lower than 20%

TIER 5 establishes increasing requirements for the renewability of *future load growth.*[1] This tier helps to ensure that as we electrify our transportation and heating, the increased demand for electricity is met with clean, renewable sources. For the three Vermont utilities that are already 100% renewable, the Tier 5 obligation goes into effect right away, requiring an increasing percentage of new load growth to be procured from renewable resources starting in 2025. Beginning in 2035, Green Mountain Power and the municipal utilities that are members of Vermont Public Power Supply Authority (VPPSA) must meet additional load growth with 100% renewable electricity.

Vermont's RES also requires utilities to continue to invest in energy transformation projects that reduce fossil fuel use for their customers. These requirements fall under **TIER 3** of the RES and were not updated in the revisions made under Act 179. To meet the Tier 3 obligation, Vermont utilities have created programs that incentivize the purchase and installation of cleaner technologies in the thermal and transportation sectors — such as heat pumps and electric vehicles. This aspect of the RES is one way that Vermont has started to promote a total energy transition through policy.

2022 Tier 3 savings by measure



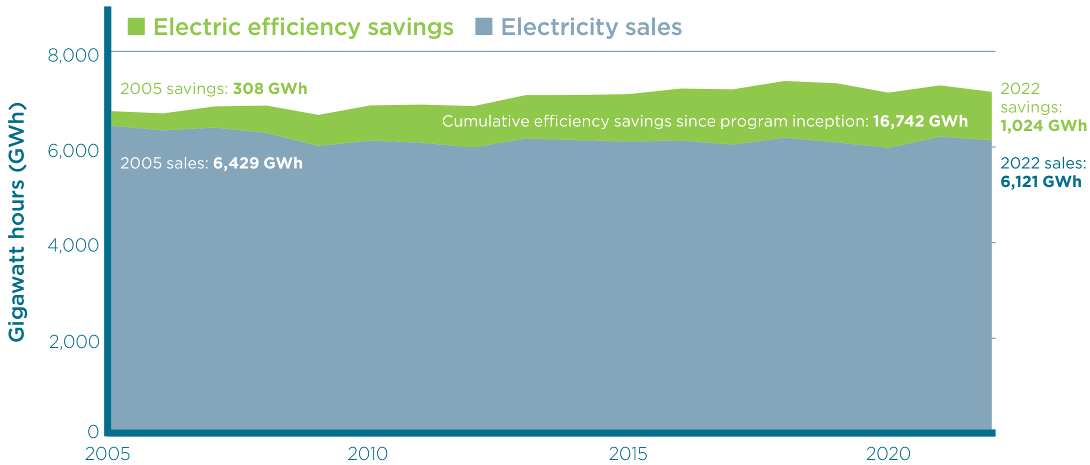
Source: Vermont Department of Public Service, "2024 Annual Report on the Renewable Energy Standard," January 2024.

1. Renewable energy procured under Tiers 2, 4, and 5 also counts toward a utility's Tier 1 obligation.

Electrification and the grid

Continued installation of new renewable energy resources and increasing electrification of the transportation and heating sectors require careful planning to ensure the reliability of Vermont's electric transmission and distribution system. Additional energy storage and demand management strategies, as well as infrastructure improvements, will help the electricity grid become more flexible and resilient even with increasing generation and load.

Electricity savings from Vermont electric efficiency utilities, 2005–2022

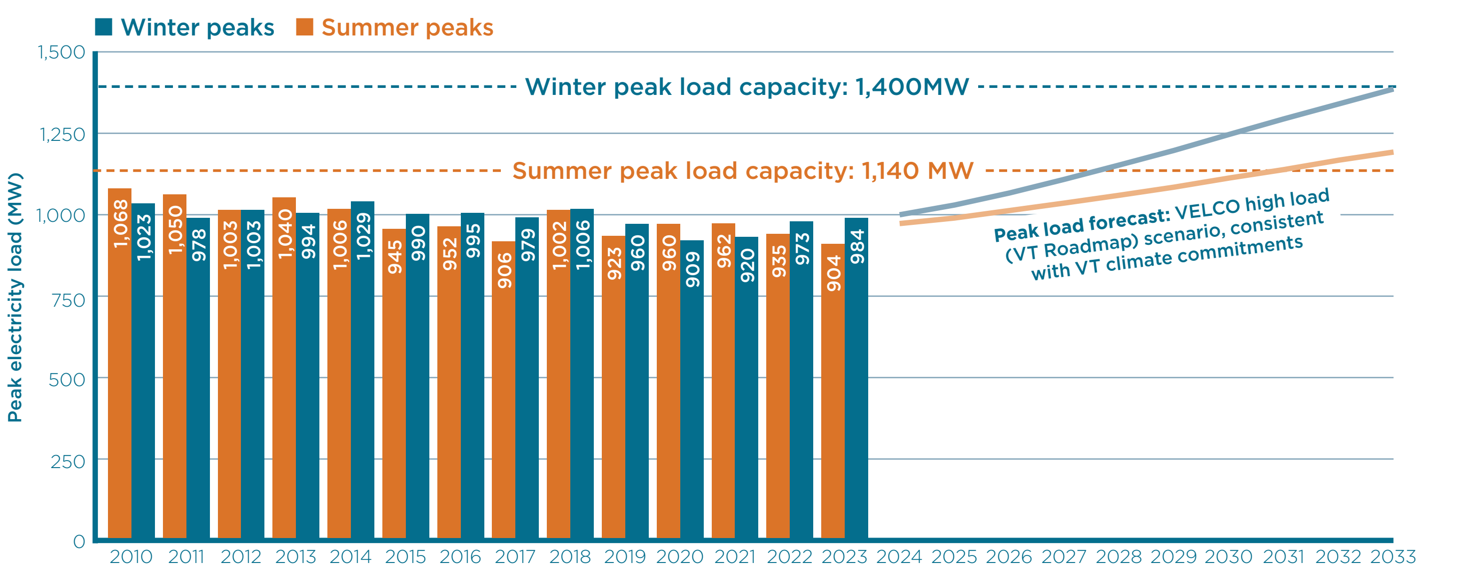


Source: Vermont Department of Public Service, "Annual Energy Report," 2024. Data includes Efficiency Vermont and Burlington Electric Department. **Note:** Efficiency Vermont programs began in 2000 and Burlington Electric Department programs began in 1990.

Fortunately, Vermont has a number of load control and efficiency strategies to build upon. Investments made since 1990 by Vermont's electric efficiency utilities, Efficiency Vermont and Burlington Electric Department, resulted in annual electricity savings of over 1,000 Gigawatt hours (GWh) or nearly 15% of total sales in 2022.

These historical gains in electric efficiency, along with distributed renewable generation, have helped reduce Vermont's electricity load (both on an annual basis and during peak periods) over the last two decades, creating considerable headroom for additional load. In the past five years, Vermont's annual peak load has stayed below 985 MW, well under the historic peak of 1,118 MW in 2006.

Vermont historical and forecasted peak loads



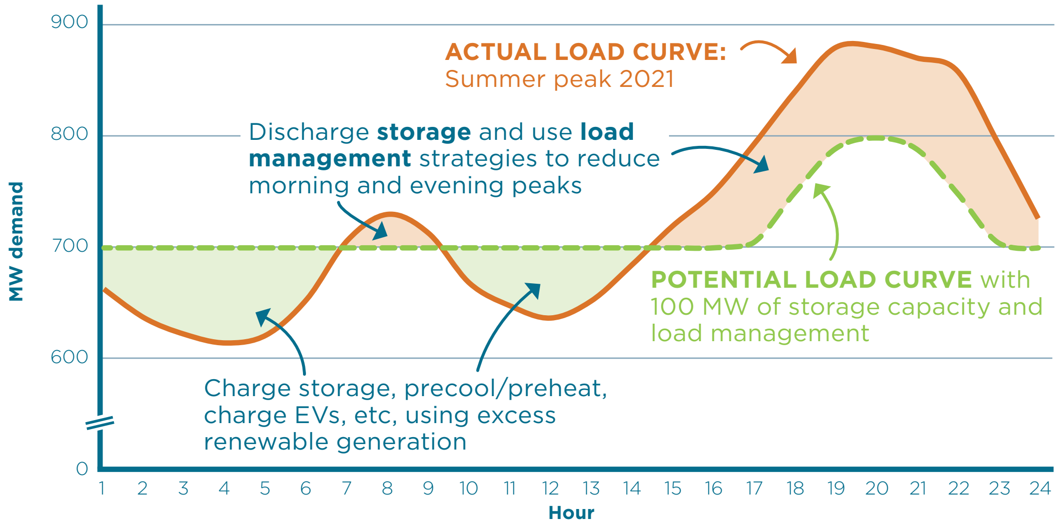
Source: VELCO, "2024 Vermont Long-Range Transmission Plan," 2024. **Note**: Peak load forecast shown is for a high growth scenario consistent with Vermont climate commitments.

However, due to anticipated levels of beneficial electrification, the Vermont Electric Power Company (VELCO) projects significant growth in the use of electricity over the next 10 years, particularly in their high growth scenario that is consistent with Vermont climate policy.[1] The forecast estimates that Vermont's summer peak

1. VELCO, "2024 Long-Range Transmission Plan," 2024.

load could increase more than 30% by 2033, while the winter peak could increase more than 40%.[2] **Coordinated planning and investment in load management strategies is necessary to allow this level of growth without exceeding the capacity of the transmission system.**

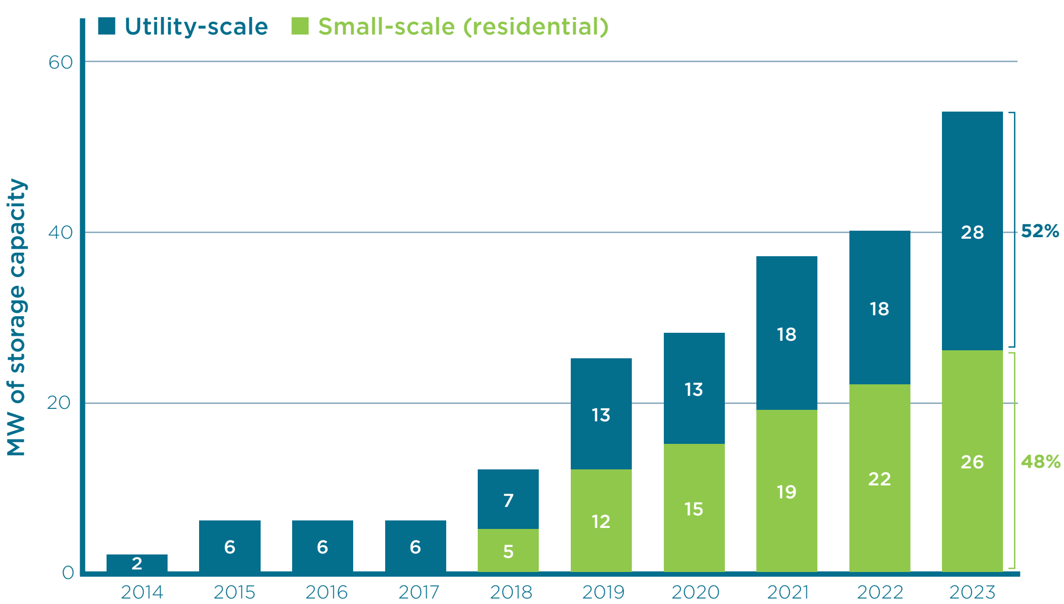
Flexible load management and energy storage: Scenario to flatten VT's load curve



Source: ISO-NE, Hourly load reports for Vermont, 2023. **Note:** Aside from the actual load curve, the other portions of this graph are illustrative.

Vermont electric utilities have also introduced a number of flexible load management (FLM) strategies in recent years. **FLM strategies can help shift electricity loads away from periods of peak demand — when the power supply tends to be more expensive and less clean — thereby improving grid resilience, saving money, and reducing GHG emissions**. For example, some utilities have managed EV charging programs or offer lower rates for off-peak EV charging. Green Mountain Power and Vermont Electric Co-op, among others, have also introduced home battery storage programs, facilitating thousands of residential battery installations across the state, which allow customers and utilities to draw on stored power during periods of peak demand as well as during power outages.

Installed battery storage capacity in Vermont, 2014–2023



Source: Vermont Department of Public Service, 2023.

Battery storage is becoming increasingly important, especially as we electrify heating and transportation and build additional intermittent renewable resources, such as wind and solar. In the last few years, Vermont has significantly scaled up battery storage at the residential, community, and utility level, more than doubling capacity since 2019. As of the end of 2023, Vermont had 54 MW of battery storage deployed, nearly half of which were small-scale residential installations. This is equivalent to about 6% of Vermont's 2023 summer peak load.

In the near term, Vermont has sufficient capacity to accommodate increased adoption of EVs and electrified heating systems. However, continuing to deploy load control and storage measures will be increasingly necessary to maintain the reliability and resilience of the grid, and to reduce the need for additional transmission assets as we approach 2030 and beyond.

2. This forecast also projects Vermont's total annual electricity use could increase by more than 1,000 GWh (21%) in the next 10 years, from just under 5,500 GWh in 2023 to over 6,500 GWh in 2033.

Who We Are

Energy Action Network (EAN) consists of hundreds of public sector, non-profit, utility, business, and higher education partners working collaboratively toward a mission of achieving Vermont's climate and energy commitments in ways that create a more just, thriving, and sustainable future.

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Margaret Fowle

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Debbie New, Susan Smiley

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Johanna Miller, Dan Fingas

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Sophia Donforth, Mariah Keagy

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Kevin Chu

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Jenna Antonino DiMare

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Gus Seelig, Craig Peltier

Vermont Housing Finance Agency (VHFA)
Maura Collins, Mia Watson

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Rebecca Foster, Jennifer Wallace-Brodeur, Justine Sears, Alison Donovan, Adam Sherman, Damon Lane

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Mathew Rubin

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Abby White

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Ted Brady, Abby Friedman

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Energy Balance, Inc.
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Vermont Economic Development Authority (VEDA)
Sam Buckley

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Michael Lazorchak

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Tom Dunn, Betsy Bloomer, Hantz Presume, Mark Sciarotta, Shana Louiselle, Kyle Landis-Marinello

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Rebecca Towne, Andrea Cohen, Jake Brown, Cyril Brunner

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EAN's Past Funders:
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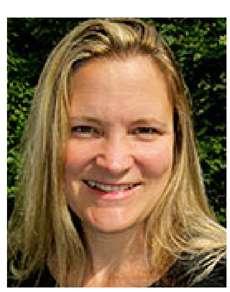

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CARA ROBECHEK
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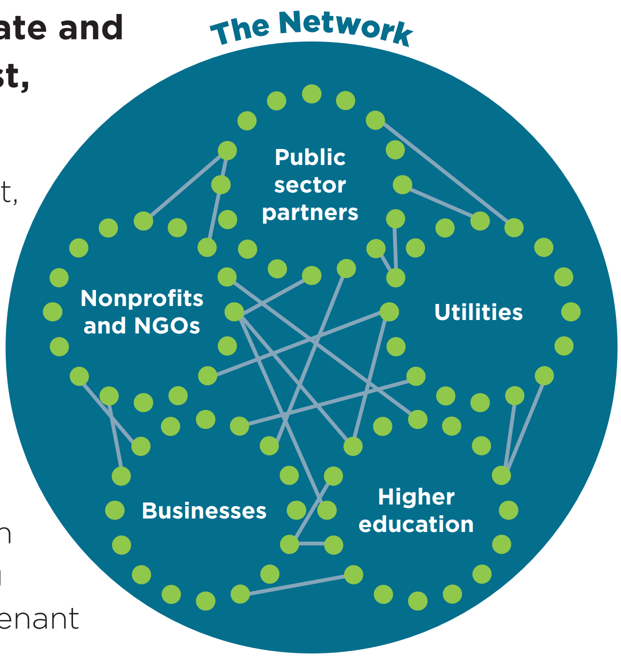
LENA STIER
Data Manager & Research Analyst

About EAN

Energy Action Network consists of a ***network*** and an ***organization.***

The *Network's* mission is to achieve Vermont's climate and energy commitments in ways that create a more just, thriving, and sustainable future.

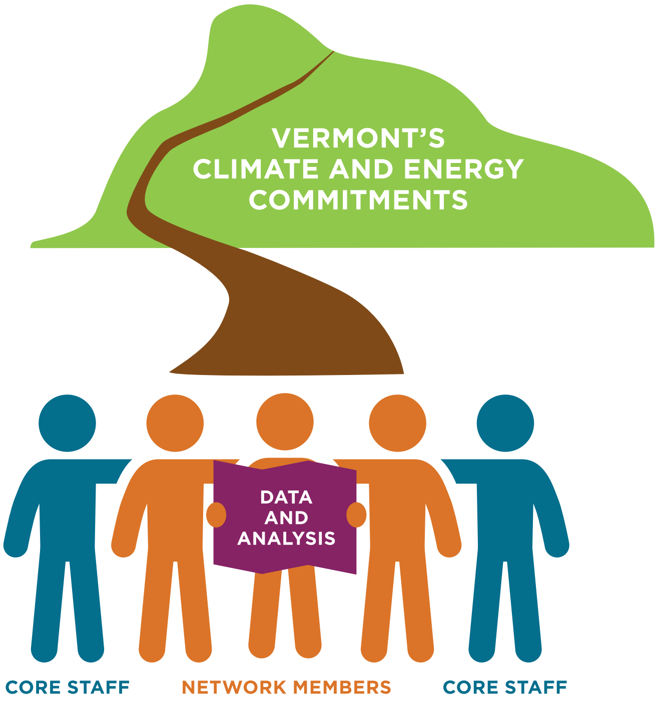
The Network consists of hundreds of public sector, non-profit, utility, business, and higher education partners working collaboratively to achieve this mission. Since 2020, EAN has structured much of our collaborative work through Network Action Teams, coalitions, and working groups selected by EAN members and partners for their potential to help Vermont rapidly, cost-effectively, and equitably reduce fossil fuel use and greenhouse gas pollution. Active teams in 2024 include the Climate Workforce Coalition, Clean Heat Working Group, and Network Action Teams supporting Weatherization at Scale, Networked Thermal Systems, and Tenant Weatherization Protection.



The *organization's* mission is to ensure that Vermont makes evidence-based energy and climate decisions that are grounded in high-quality data and analysis, and collaboratively developed for effective and durable progress.

The organization plays two key roles.

1. Conducting **climate and energy data tracking, research, and analysis** on behalf of all Vermonters
2. Facilitating **effective collaboration** in service of the Network's mission by:
   - Stewarding a common agenda for Network members and partners,
   - Coordinating mutually reinforcing activities to develop, share, and advance high-impact ideas, and
   - Ensuring regular communication to and across the Network.



ENERGY ACTION NETWORK

9 Bailey Avenue #2, Montpelier, VT 05602

EANVT.ORG

Thank you!

EAN's 2024 Annual Progress Report for Vermont on Emissions, Energy, Equity, and the Economy is the result of a collaborative effort, enabled by our broad and diverse network of members and public sector partners. We would like to particularly thank the following agencies and organizations for their contributions to the content, data, and analysis within the report: Vermont Agency of Natural Resources, Vermont Department of Public Service, Vermont Agency of Transportation, VEIC and Efficiency Vermont, VELCO, and the UVM Transportation Research Center.

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The primary co-authors of the report are EAN's staff — Jared Duval, Lena Stier, and Cara Robechek. Design and layout is by Dana Dwinell-Yardley (ddydesign.com). Photo of Jared Duval on page 38 by Mike Dougherty/VTDigger.