ENERGY ACTION NETWORK

ANNUAL PROGRESS REPORT

for VERMONT 2020/2021

Emissions

Energy

Equity

and the Economy

From EAN's Executive Director & Board Chair

We Are Vermonters

Our shared Vermont values unite and inspire us: from freedom and unity also spring responsibility, innovation, and community resilience. We care about each other, our environment, and honoring the past while working for a better future. We are committed to building on Vermont's history of independent leadership by caring for our neighbors and leaving our state — and the world — better than we found it.

We Can Do This

Meeting the challenge of the climate crisis and reducing our greenhouse gas emissions have long been a moral responsibility. Now, with the passage of the Global Warming Solutions Act (GWSA) and the creation of the Vermont Climate Council, doing so is also a legally binding requirement. **The good news is that meeting these requirements is an opportunity to bolster Vermont's economy and to help make the essential services of energy — heat, transportation, and powering appliances — less expensive for Vermont households and businesses.**

Now Is the Time

We have entered a new era of accountability and opportunity. Vermont's dependence on fossil fuels is responsible for 76% of our GHG emissions and creates a major drain on the Vermont economy — an average outflow of nearly $1.5 billion a year to pay for imported fossil fuels. The cost of fossil fuels has historically been higher and more volatile than electric and renewable alternatives, putting an unpredictable strain on Vermonters' budgets.

By transitioning to more efficient transportation and heating solutions that use Vermont's low-carbon electricity and renewable fuels, much more of our energy dollars will stay and recirculate in the state. This is a pathway for sustainable economic development that saves Vermonters money and creates good, family-supporting jobs.

We Must Follow the Facts

There is no one silver bullet to fight climate change and transition to a low-carbon economy. But we do have silver buckshot: many proven and available solutions that can cut pollution, save money, and strengthen our economy. EAN's Emissions Reduction Pathways Model aims to help identify the most promising opportunities which, all together, can help us meet our legal requirements.

While we can do this, it will not be easy. As Vermont has done during the COVID-19 pandemic, we will need to commit to fact-based conversations guided by science, evidence, and high quality analysis. **EAN's Annual Progress Report for Vermont is our contribution to that effort, with the aim of grounding and helping to inform crucial conversations across Vermont about where we stand and what it will take to get where we want to go.**

We Can Lift A Burden

The climate crisis and our current fossil fuel dependence disproportionately impacts lower income and disadvantaged Vermonters. Energy insecurity, health issues, and housing affordability are just a few of the "energy" impacts faced by hundreds of thousands of Vermonters. EAN's mission is to address this inequity by helping Vermont achieve a more "just, thriving, and sustainable" energy future.

This means *how* we reach our energy and climate goals matters greatly. Policies and programs must ensure that all Vermonters have access to safe and reliable energy, that all Vermonters share in the benefits of the low-carbon transition, and that all Vermonters who face energy insecurity are prioritized for help.

Our Leadership Matters

While Vermont produces the most climate pollution per capita in the Northeast, we have major opportunities to build on past innovation and recent progress. Our Renewable Energy Standard, which has helped Vermont have the lowest GHG emission electricity portfolio of any state in the country, is a prime example. But rather than focus primarily on just one energy sector, we now need to claim a leadership role in energy policy across the board — for the benefit of Vermonters and as an example for the rest of the country.

While our transportation and thermal sector GHG emissions remain stubbornly high, the silver lining of having such a relatively clean electricity sector is that whenever Vermonters electrify how we get around and heat our homes, we achieve bigger emissions reductions from those actions than anywhere else in the U.S. Working together we can cut pollution and energy costs while revitalizing our economy and improving the resilience of our communities. This can improve the lives of our fellow Vermonters while also providing a powerful example that can have influence far beyond our borders — especially in other rural states.

Creating a Better Future Together

Meeting challenges and opportunities of this scale and complexity require the best of many people. **That's why our Network exists — because when we combine our expertise, wisdom, and will, the impact we have can be far more powerful and durable.** No one of us has all the answers and the evolving nature of energy and climate issues should keep us ever vigilant, curious, and humble. But working in concert, with civility, respect, and dedication, we can meet our responsibilities to each other, our state, and future generations.

Jared Duval
Executive Director

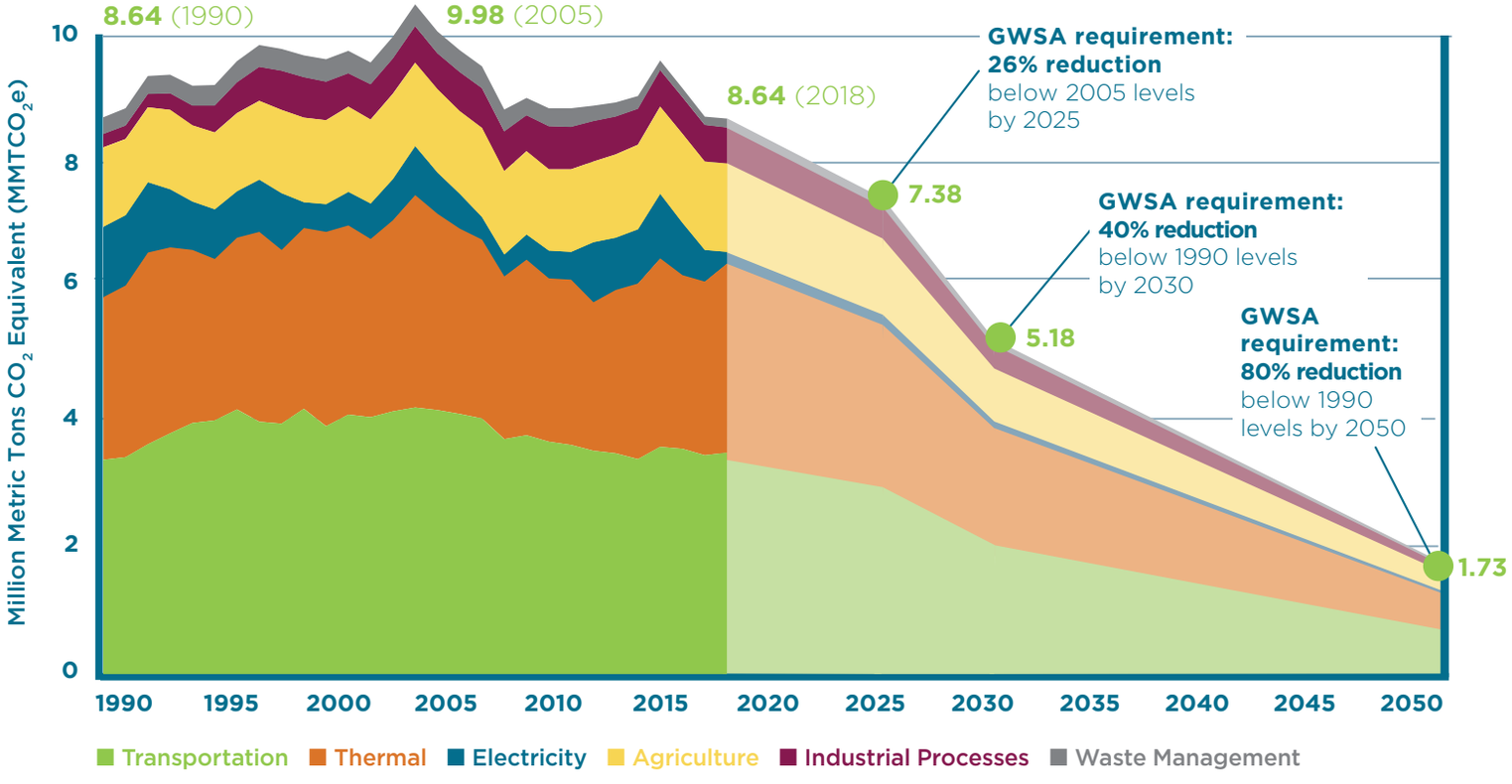
Leigh Seddon
President

1. Meeting Vermont's GHG emissions reduction commitments is now law

The Global Warming Solutions Act (GWSA) became law in 2020, requiring that Vermont reduce greenhouse gas pollution 26% below 2005 levels by 2025, 40% below 1990 levels by 2030, and 80% below 1990 levels by 2050.

After trending upward between 2010 and 2015, Vermont's greenhouse gas (GHG) emissions started declining in 2016, a trend that continued through 2018. **As of 2018, the latest available data, GHG emissions were 13% below 2005 levels and were equal to 1990 levels.** While we are now trending in the right direction, rapid, bold, and comprehensive work is still needed to ensure that we meet Vermont's responsibility under the GWSA.

Vermont's historical GHG emissions and future requirements



Source: Vermont Agency of Natural Resources, Vermont GHG Emissions Inventory and Forecast (1990-2017), 2021.

Vermont's increasingly clean electricity purchases played the primary role in achieving this decline, delivering 91% of the net reduction in statewide GHG emissions comparing 2015 to 2018. As of 2019, electricity related GHG emissions were nearly 83% below 1990 levels—primarily due to Vermont's Renewable Energy Standard (RES), which went into effect in 2017 and requires an increasingly clean and renewable electricity supply through 2032. The RES should help get us more than a third of the way toward meeting our 2025 emissions reduction requirements. However, the RES alone will not be nearly enough: **reaching our GWSA requirements for 2025, 2030, and 2050 will require far more progress in the transportation and thermal energy sectors, in particular.**

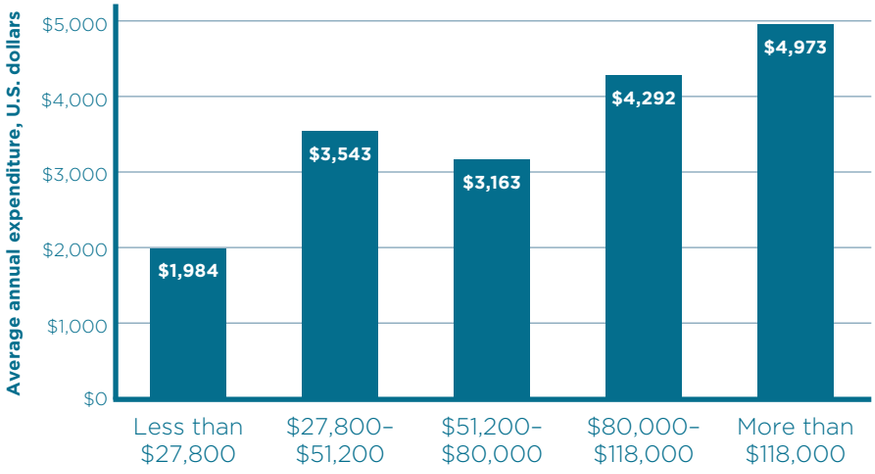
2. Benefits and costs need to be shared more equitably

The impacts of the COVID-19 pandemic on society have been wide-ranging, with the long-term effects still difficult to predict. While we saw a temporary decline in emissions due to pandemic related shutdowns, damaging our economy is *not* a desirable or sustainable way to meet emissions targets. **Instead, we need to quickly move beyond fossil fuels for all our energy needs — an approach that leads to economic health, not economic pain.** And we need to make sure that all Vermonters receive the benefits of a clean energy transition.

The pandemic has laid bare existing inequities in our society as low-income and people of color were hit harder than others by both COVID and the related economic crises. Public discourse around racial justice in the summer of 2020 and beyond reminds us that our energy and climate challenges do not exist in isolation from other societal challenges. In fact, they are interlinked and exacerbated by racial and economic inequities.

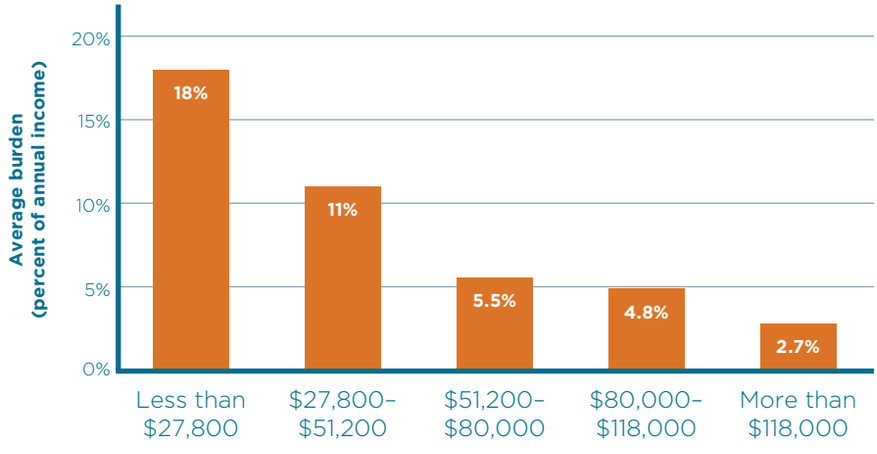
EAN has been working with Network members to deepen our analysis of energy inequities in Vermont. Efficiency Vermont's 2019 Energy Burden Report has been a cornerstone of this work; it found the average energy burden (the percentage of household income spent on energy) varies by town from 6% to 20%. Notably the towns with the highest energy burdens are not spending more dollars on energy, but instead have lower median incomes. New analysis by EAN further highlighted how energy burdens break down by income.[1] **The lowest-income Vermonters purchase much less energy than upper-income Vermonters, but that energy spending takes up a much greater share of their household budget.**

Combined heating and electricity expenditures in Vermont, by income quintile



Source: U.S. Census Bureau, American Community Survey, 2018.

Combined heating and electricity energy burden in Vermont, by income quintile



Source: U.S. Census Bureau, American Community Survey, 2018.

Although data limitations prevented us from analyzing energy issues by race in Vermont, national assessments have shown that structural inequalities in U.S. energy systems cause energy insecurity to disproportionately affect BIPOC (Black, Indigenous, and people of color) households, and Black households in particular, with lasting, generational effects.[2]

The crises of the past year drove home the point that it's not enough to meet the numerical targets of Vermont's energy and emissions reduction commitments — *how* we do so also matters. EAN is committed to creating a more just, thriving, and sustainable future for all Vermonters.

1. Energy Action Network, "Energy Inequity and Burden in Vermont", Jennah Slayton, 2020.
2. Lewis, et al., "Energy efficiency as energy justice: addressing racial inequities through investments in people and places", 2019.

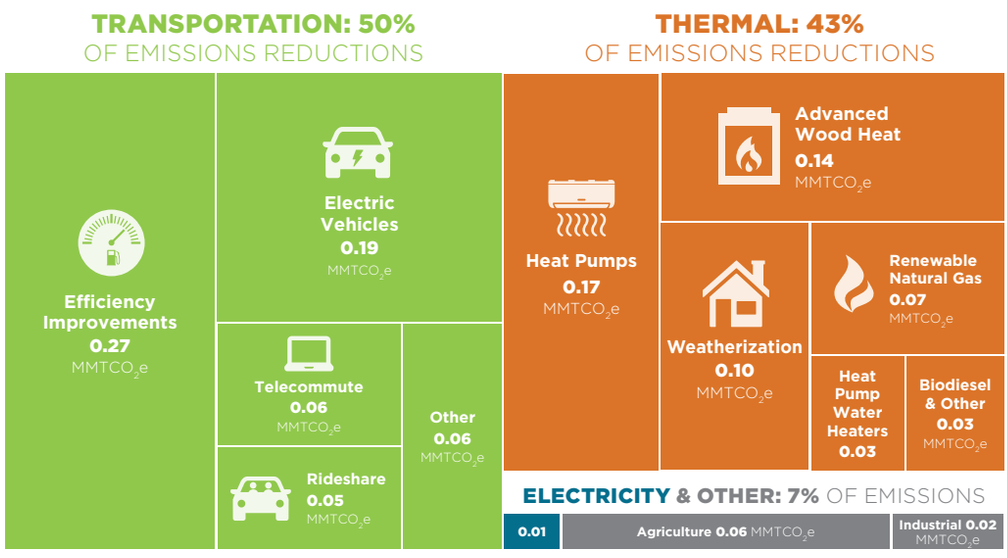
3. Vermont's climate commitments are achievable — here's our model

The EAN Emissions Reduction Pathways Model (EAN Pathways Model) shows that it is possible to meet the energy portions of our 2025 and 2030 emissions reduction commitments under the Global Warming Solutions Act (GWSA) with currently available energy technologies and proven best practices.

However, while the EAN Pathways Model shows that emissions reductions are technically possible, it will require significant policy action and investments to achieve the scale and pace of change needed. The Model relies mainly on adoption of efficient and renewable technologies along with behavioral changes in transportation to collectively reduce emissions. The Model illustrates what we currently see as the most feasible combination of measures to allow us to reach our GWSA commitments.

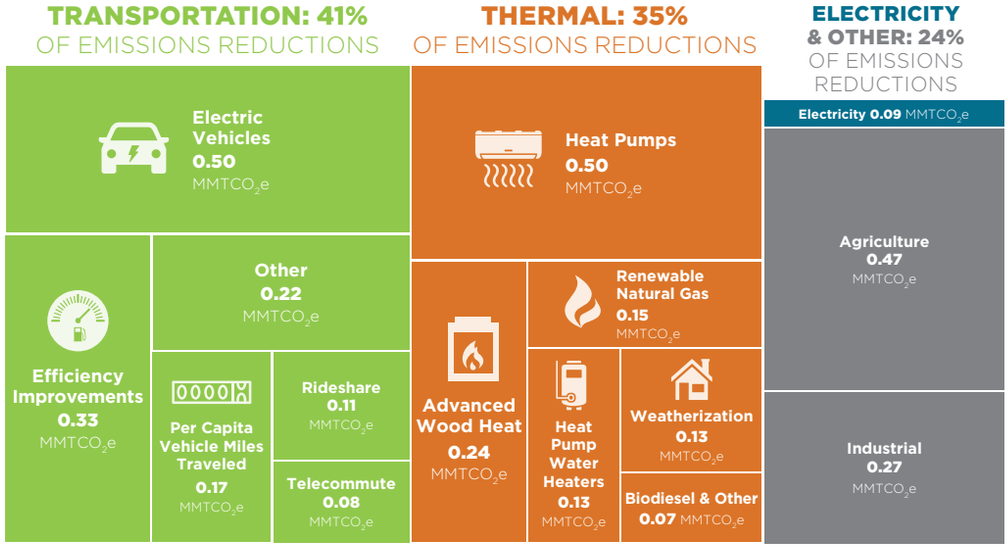
Modeled emission reductions for 2025

Total reductions of 1.26 MMTCO$_2$e to meet Vermont's statutory emissions reduction requirements



Modeled emission reductions for 2030

Total reductions of 3.46 MMTCO$_2$e to meet Vermont's statutory emissions reduction requirements



Source for both graphs: EAN Emissions Reduction Pathways Model, 2021

The measures in the Model primarily focus on presently proven and available emission reduction measures for which there exist peer-reviewed literature and measured characteristics. This model is also informed by information and insights we have collected about technology adoption curves for key measures, as well as projections around market development, including timing and availability of supply and technological feasibility to implement. Markets and technologies will, of course, change over time, so options and characterizations are also subject to change, especially over longer time horizons.

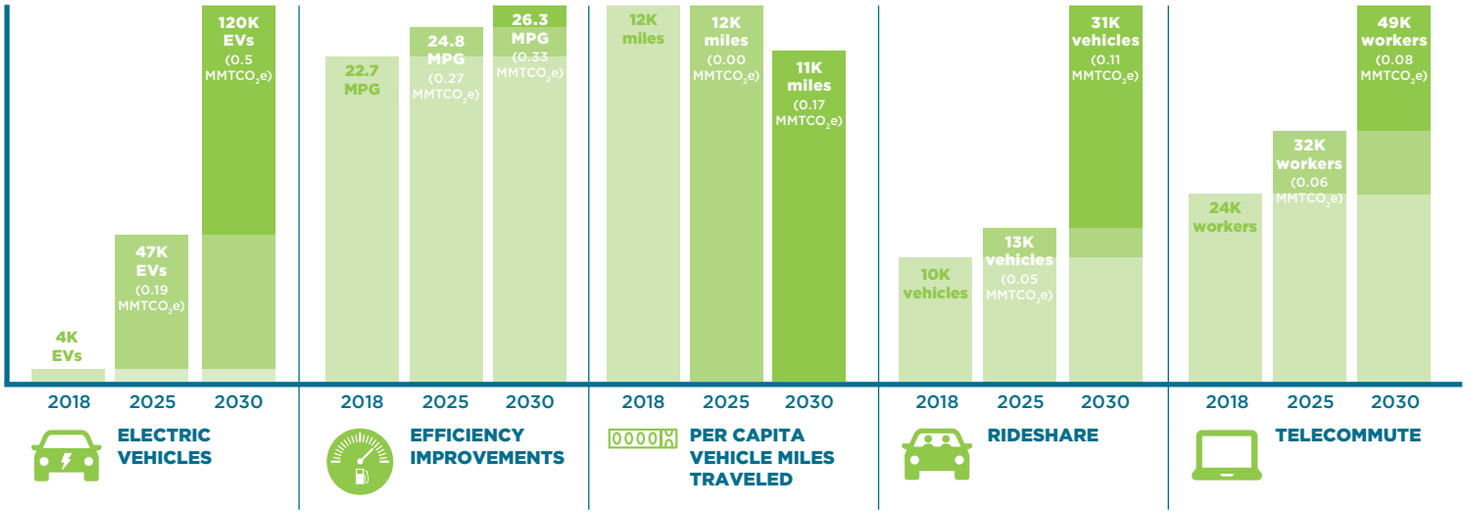
It is worth noting that the Model only addresses emissions from the energy sectors and does not attempt to suggest pathways to reduce the 24% of GHG emissions that come from other sectors. Vermont's agriculture sector is responsible for 16% of GHG emissions, industrial processes for 6%, and

waste management for 2%. Each of these sectors also need to reduce their emissions to help reach the GWSA requirements.[1]

Because the vast majority of Vermont's emissions (74%) come from the transportation and thermal sectors, it is in those sectors that the most significant improvements are needed. The graphs on these pages highlight the highest-impact transportation and thermal measures in the Model as of April 2021, and show the scale of change needed by 2025 and 2030 as compared to a 2018 baseline.

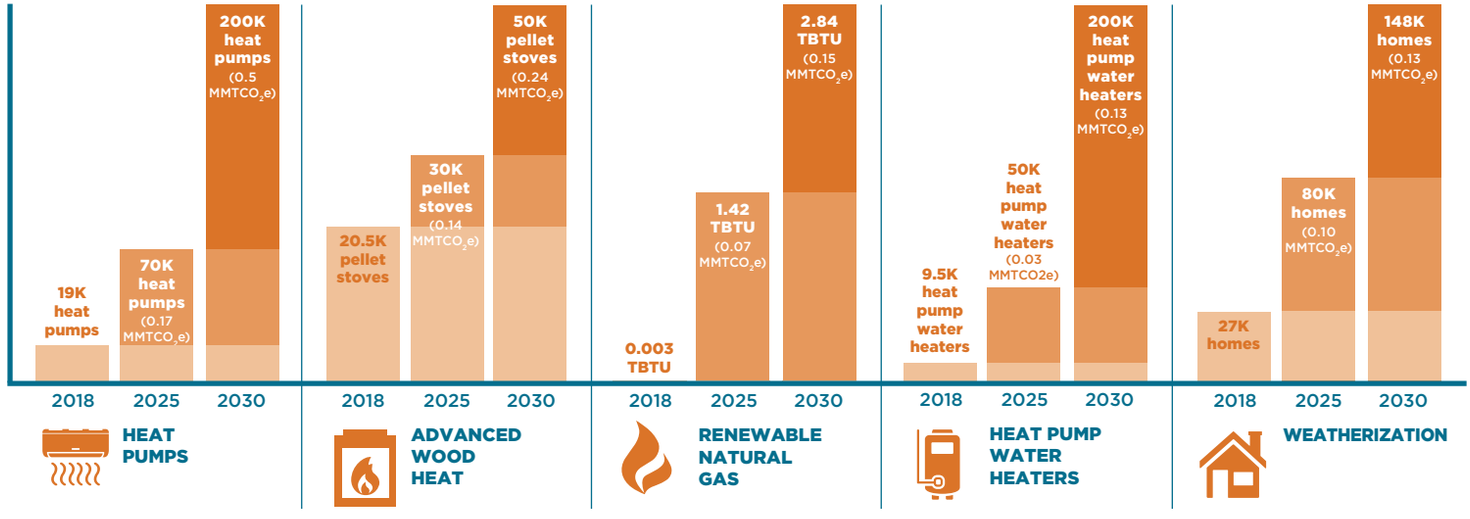
The charts on page 6 show the cumulative emissions reductions that could be achieved using the highest impact measures from the EAN Pathways Model at the scale shown in the figures on this page. These are just the highest impact measures in the transportation and thermal sectors and sectors and do not include all of the modeled measures needed to achieve the GWSA requirements. **We would need ALL of the pathways and measures together at the scale and pace modeled in these figures to reach our GWSA requirements.** If we fall short on any of the pathways, other pathways and/or measures would be needed to make up the difference.

Highest impact transportation measures in EAN Pathways Model



Source: EAN Emissions Reduction Pathways Model, 2021. Note: graph shows cumulative unit counts and is scaled based on unit count growth, not GHG reduction. For comparison of relative emissions reduction impact, see chart on previous page.

Highest impact thermal measures in EAN Pathways Model



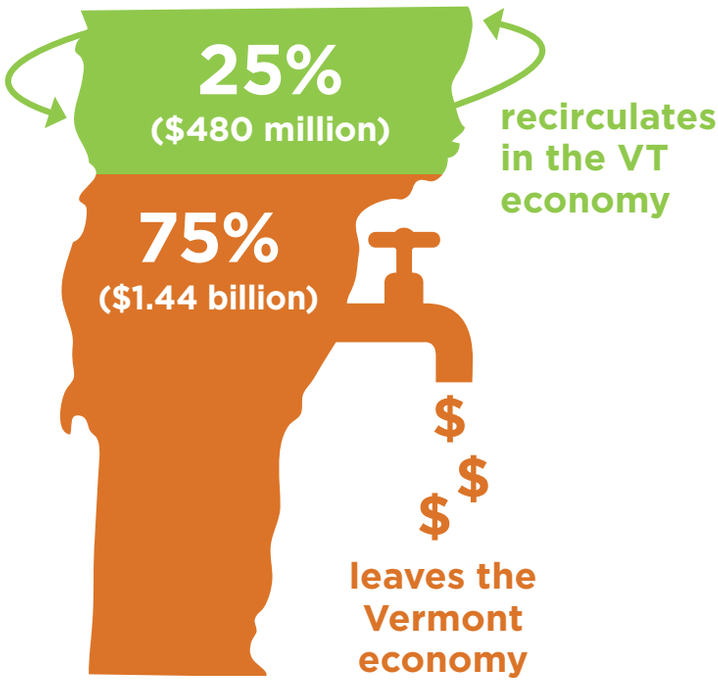
Source: EAN Emissions Reduction Pathways Model, 2021. Note: graph shows cumulative unit counts and is scaled based on unit count growth, not GHG reduction. For comparison of relative emissions reduction impact, see chart on previous page.

1. The EAN Emissions Reduction Pathway Model continues to be refined, and EAN is happy to share the most up-to-date version on request.

4. Vermont's economy will benefit from reducing fossil fuel dependence

Transitioning away from fossil fuels to more efficient, low-carbon technologies will keep money in Vermont and create jobs, while helping reach Vermont's greenhouse gas reduction commitments. Over the last decade, Vermonters have spent an average of almost $2 billion a year on 100% imported fossil fuels, with 75% of those dollars draining out of Vermont. That is a significant proportion of our approximately $33 billion Gross State Product.[1] In 2018, the most recent year for which we have full data, Vermont spent over $1.9 billion on fossil fuels, with over $1.4 billion draining out of our state economy.[2]

Average annual fossil fuel spending in VT, 2009–2018



Source: Vermont Agency of Commerce and Community Development, 2021.

In contrast, **the efficient and renewable alternatives keep a far higher share of our energy dollars recirculating in Vermont, helping employ our neighbors, and improving our state economy.** Vermonters spent over $835 million on electricity in 2018, with over $520 million, or 62% of that amount, recirculating within the state. Similarly, 60% of the money spent on weatherization and 80% of the money spent on wood heat stay in state.[3] There is room to grow significantly in each of these areas.

Fossil fuel prices are also generally higher and more volatile than electricity and wood prices. **That means that a switch to electric vehicles, heat pumps, and/or advanced wood heat often allows consumers to save money year after year with lower-cost, less price-volatile renewable alternatives, while helping to create good, local jobs.** Far from a sacrifice, moving beyond fossil fuels is a win-win for Vermont consumers and the Vermont economy.

In 2020 the Vermont Agency of Commerce and Community Development (ACCD) independently analyzed previous modeling by EAN ("The Path to Paris") that looked at ramping up the seven highest impact thermal and transportation pathways. Although ACCD has not yet analyzed the 2021 EAN Emissions Reduction Pathways Model, their conservative analysis of EAN's previous model indicated that a rapid, large-scale shift from imported fossil fuels to more efficient and low-carbon sources (primarily electricity) for transportation and heating over the next 15 years could cumulatively:

- Prevent over $1.1 billion from draining out of the Vermont economy
- Save Vermonters nearly $800 million
- Create jobs with $300 million in new in-state investment[4]

1. Federal Reserve Bank of St. Louis, FRED, 2021.
2. Vermont Agency of Commerce and Community Development, 2021.
3. Vermont Agency of Commerce and Community Development, 2021.
4. Vermont Agency of Commerce and Community Development, 2020.

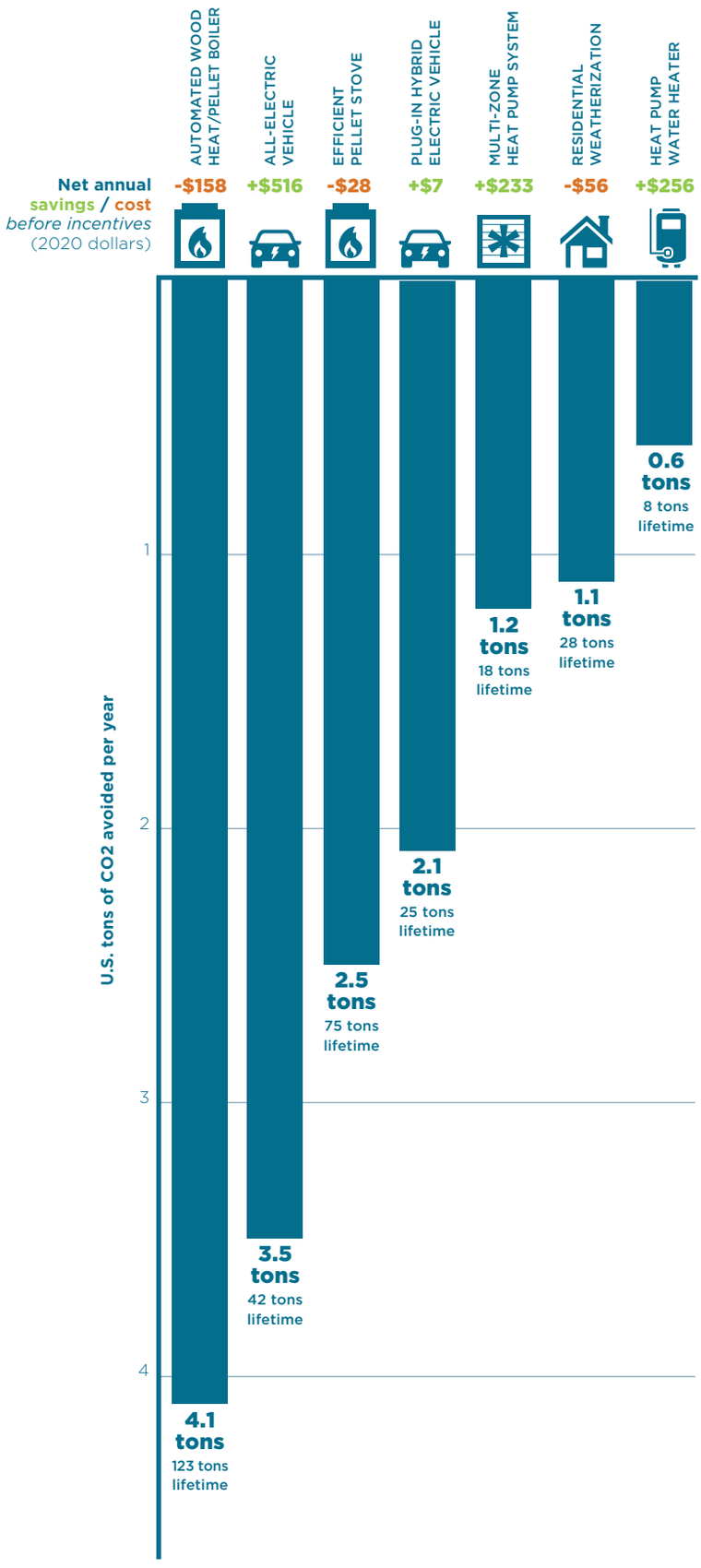
Reducing GHG emissions can benefit Vermont consumers and workers

Every dollar that we stop sending out of state for imported fossil fuels and instead spend with our local electric utilities not only reduces our climate pollution, it also reinvests in and helps grow the Vermont economy. We have already reached the point where, even on a narrow cost-benefit analysis basis, the vast majority of the time it saves consumers money to purchase an electric vehicle instead of a new fossil fuel vehicle, invest in a heat pump water heater, or choose a heat pump space heating system instead of installing new propane or fuel oil systems.[1] With incentives in place the same can be true for advanced wood heat systems and weatherization. These investments can achieve significant reductions in Vermont's emissions, as many of them reduce CO_2 by 1–4 U.S. tons per household per year.[2]

It is important to note that these costs and savings estimates were calculated at a time of historically low fossil fuel prices in 2020. **As fossil fuel prices increase, the energy actions presented here will almost certainly provide an even greater economic benefit for households.** Historically, fossil fuel prices have risen higher and proven to be much more price volatile than electricity or wood heat.

Pre-pandemic, 6% of our workforce — approximately 19,000 Vermonters — were employed in the clean energy sector, the highest share of any state in the nation.[3] These jobs tend to pay well, providing a strong foundation to support a family. The median wage for a clean energy job is approximately $27/hour as opposed to the $19/hour statewide median wage.[4] Even within the same field there is often a premium for working in clean energy. For example, an electrician working in energy efficiency averages a 28% higher hourly rate than the average Vermont electrician.

Household $ savings and GHG reductions from energy actions



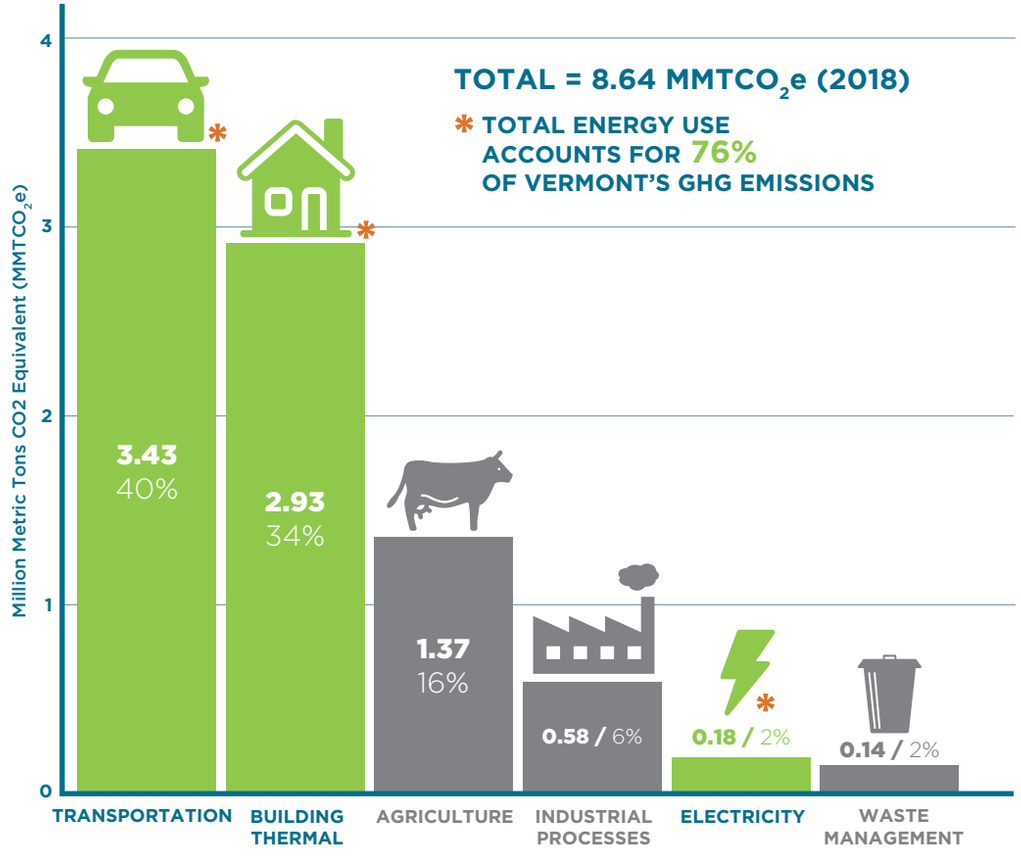
Sources: Household Savings: Vermont Agency of Commerce and Community Development, 2020. Tons of CO2 avoided: Vermont Public Service Department, CO2 Cost Effectiveness Model, 2020.

1. Note: Savings from electrification of transportation and heating will vary by utility territory, depending on electricity rates.
2. Vermont Agency of Commerce and Community Development, 2020.
3. Clean Energy Development Fund, Clean Energy Industry Report, 2020.
4. Clean Energy Development Fund, Clean Energy Industry Report, 2020.

5. An economy-wide and total energy policy framework is needed

The overarching framework of the Global Warming Solutions Act (GWSA) provides a major opportunity for economy-wide emissions reduction. However, **one of the greatest barriers to meeting our renewable energy and GHG emissions reduction commitments is that Vermont policy and regulatory requirements are currently focused primarily on just one of our energy sectors: electricity.** Our continued use of fossil fuels to meet our transportation and thermal energy needs means that emissions remain stubbornly high, with these two sectors currently accounting for over 74% of Vermont's greenhouse gas pollution. A focus on electricity generation and purchases alone is not nearly enough.

Vermont's GHG emissions by sector, 2018



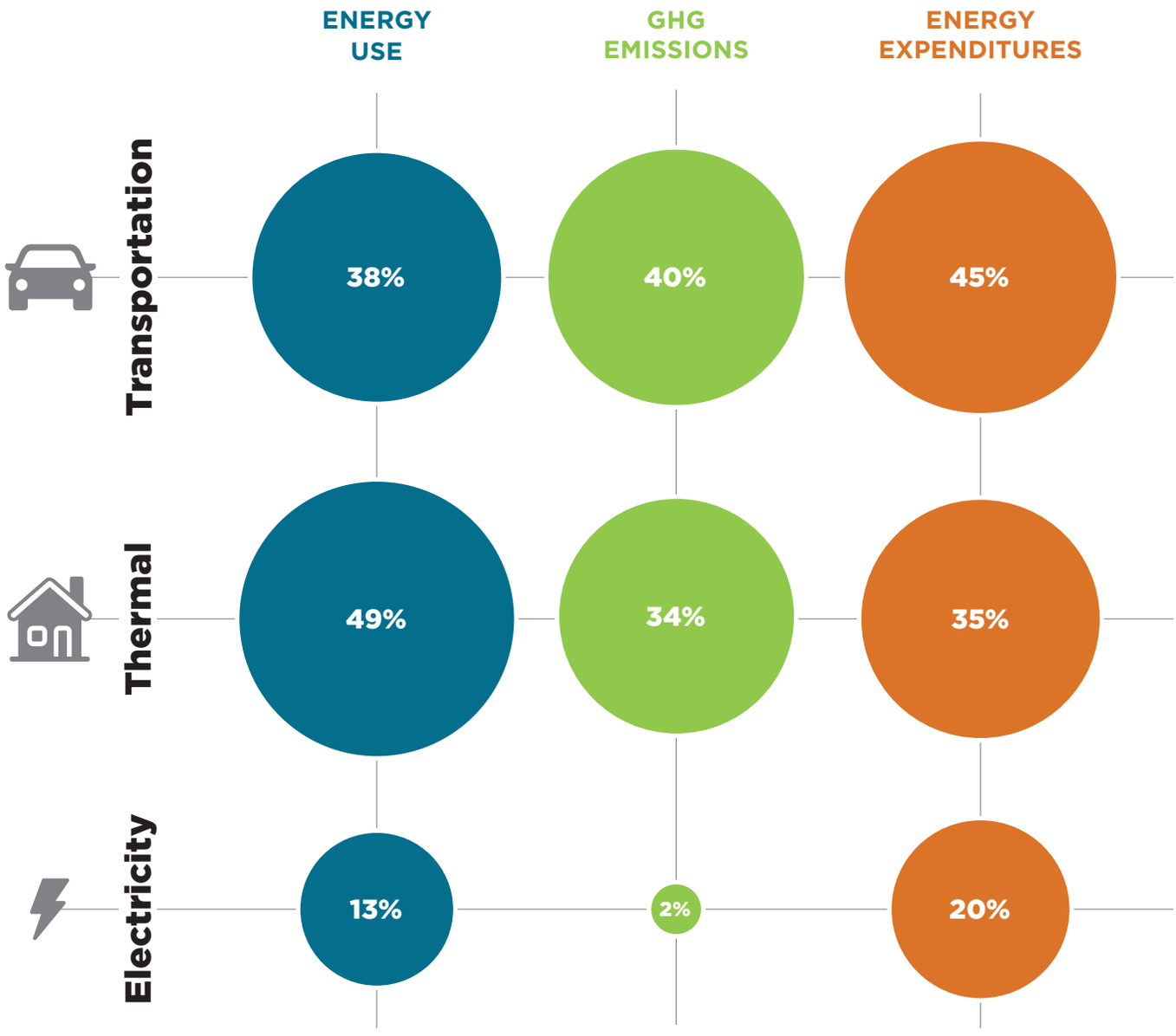
Source: Vermont Agency of Natural Resources, Vermont Greenhouse Gas Emissions Inventory and Forecast (1990-2017), 2021.

If Vermont is going to meet the GWSA requirements, the state will need to establish new policy and regulatory frameworks. It will need to require fossil fuel reduction, promote efficiency, and invest in the adoption of lower-impact transportation and heating alternatives.

Policy also plays an important role in ensuring an equitable energy transition. While some Vermonters have the means to make more climate-responsible purchasing decisions that will also often save them money in the long run, many others lack the funds to make the up-front investment to change their vehicle or heating system. That is why it is imperative that assistance—from incentives to low-interest financing—is provided to lower and middle income Vermonters, so that all benefit from the savings this transition offers.

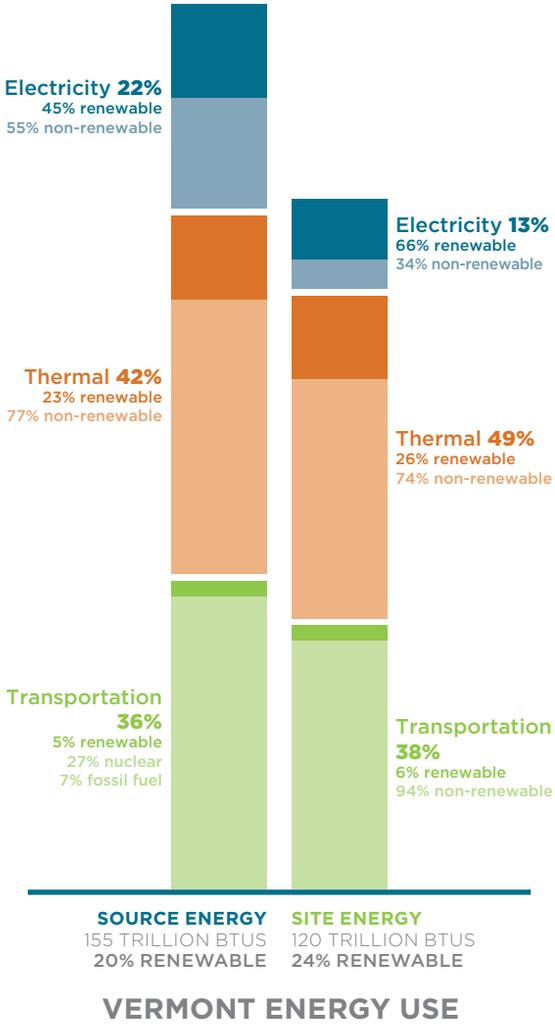
What do we mean by 'total energy'?

There are a number of different ways to look at the impacts of Vermonters' use of energy. **But any way you look at it, if we think about "energy" only in terms of electricity, we are missing a very large part of the picture.** In Vermont, 76% of greenhouse gas emissions come from our energy use, with the largest portion coming from the transportation sector, followed by our heating and cooling of buildings. We also spend the most money on transportation, followed by thermal energy (mostly for heating). Electricity emissions and costs are important — especially as more of our thermal and transportation load shifts to electricity — but whether you look at relative energy used, greenhouse emissions, or energy expenditures, fossil fuels used for transportation and heating pose the biggest challenges in Vermont. **A total energy transformation requires policy and programs to change our transportation and thermal energy sectors, not just the electricity sector.**



Source for Energy Use: Thermal and transportation based on EIA 2018 site energy; electricity from PSD site energy, after accounting for RECs.
Source for GHG Emissions: Vermont Agency of Natural Resources, Vermont Greenhouse Gas Emissions Inventory and Forecast (1990-2017), 2021.
Source for Energy Expenditures: VEIC, Vermont Energy Burden Report, 2019.

What is Vermont's energy footprint?



Sources: EIA and Vermont Department of Public Service (PSD). Note: Source energy for Electricity is pre-REC, Site energy for Electricity is post-REC.

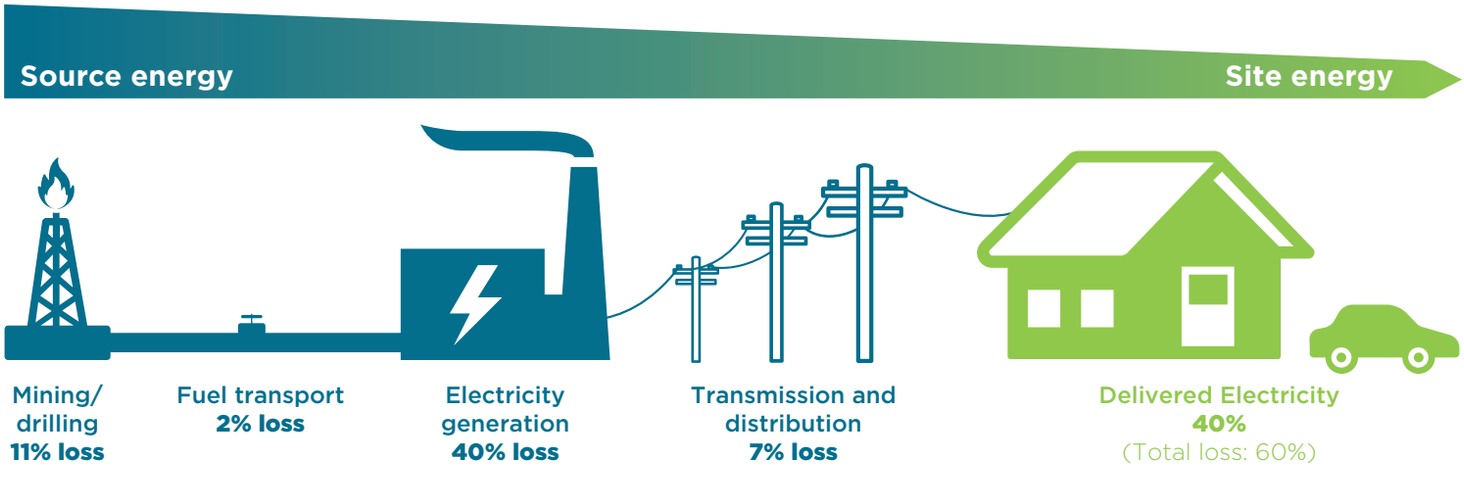
Site vs. source energy

There are two ways to measure energy use: site energy and source energy. Site energy is the amount of fuel and electricity directly consumed by a building, vehicle, or appliance. Source energy traces the fuel and electricity used (on site) back to the raw fuel input required to make and deliver that energy. Both measurements are valid, but source energy is the more comprehensive view and enables a complete assessment of energy efficiency and GHG emissions associated with our energy consumption.

On the facing page, we break down each sector in terms of fossil fuel and renewable energy use, looking at both source energy and site energy.

How renewable are we?

Using site energy, which is the metric that the Vermont Department of Public Service chooses to use to track progress toward Comprehensive Energy Plan milestones, **Vermont has reached 24% renewable combined between the three energy sectors,[1] and is on track to meet the first Comprehensive Energy Plan milestone of 25% renewable by 2025 ahead of schedule.** The majority of this progress has come from the electricity sector, with transportation and thermal lagging significantly further behind. Thermal and transportation make up 48% and 39% of our energy use yet are only 27% and 6% renewable, respectively.

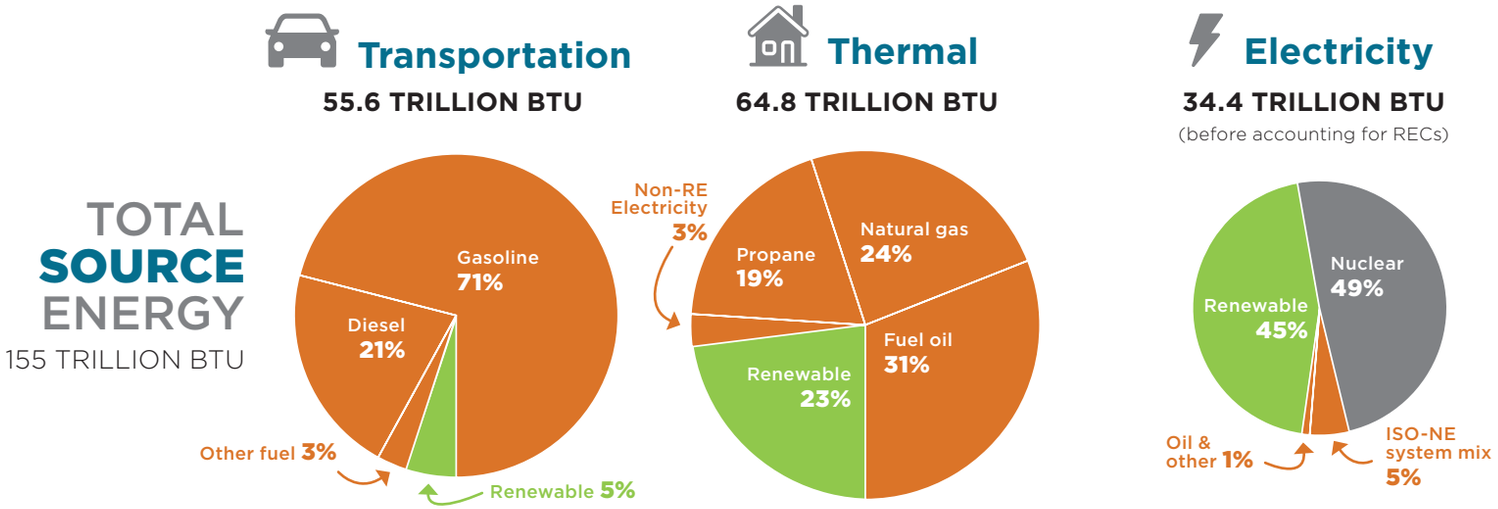


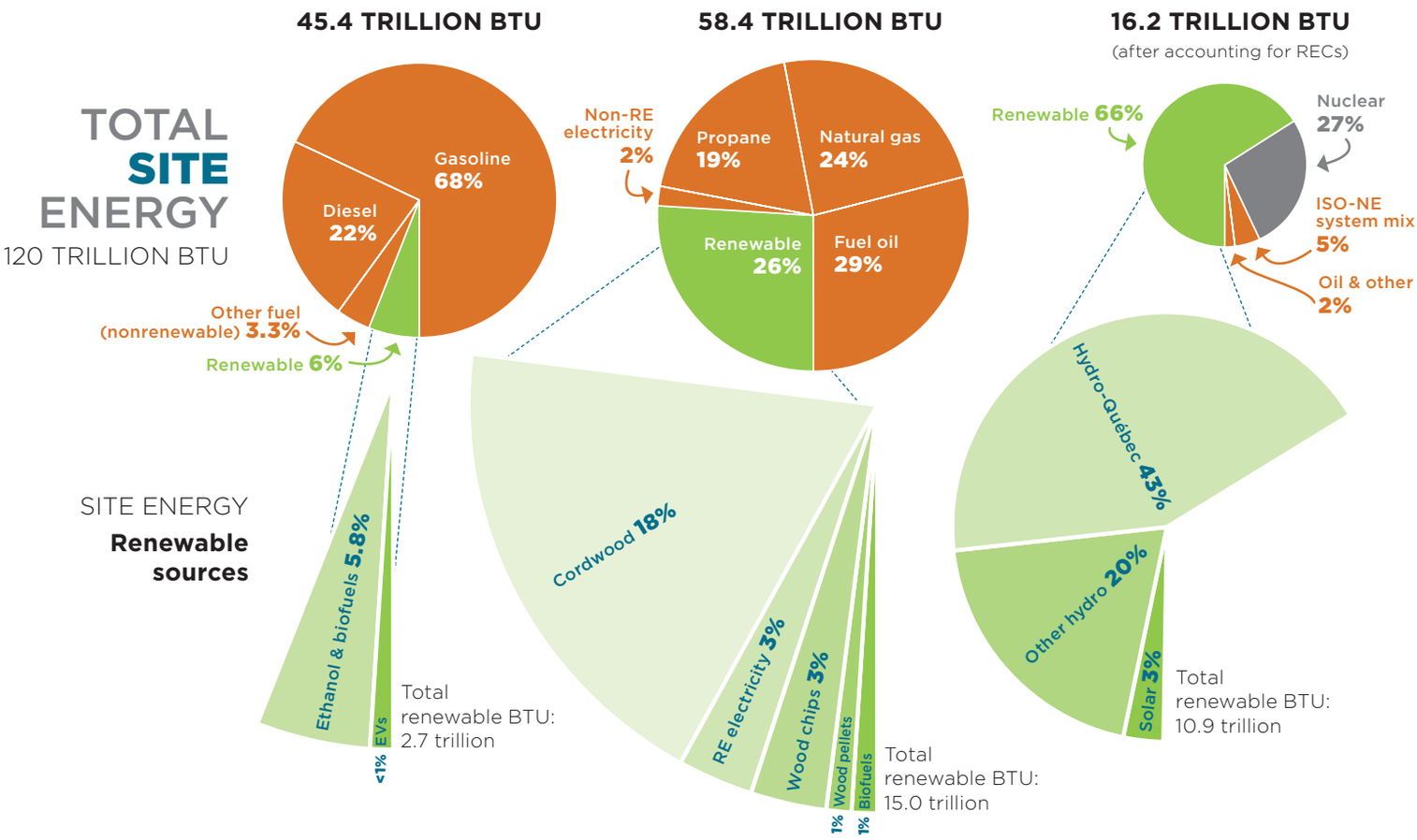
Note: Typical losses for a combined cycle natural gas plant in New England.

1. EIA, 2018; Efficiency Vermont, 2020; Vermont Department of Public Service, 2019; Vermont Agency of Natural Resources, 2020.

Total energy breakdown

As we electrify our transportation and home and building heating, the distinctions between energy sectors that have historically been categorized and tracked separately become less cut and dried. Specifically, the question arises: where should we account for electricity used in the transportation sector, say for EVs, or in the thermal sector, say for heat pumps? EAN's convention is to account for the portion of electricity used for transportation and thermal purposes within the transportation and thermal pies, respectively, rather than in the electricity pie. This means that over time the renewable electricity portions of the thermal and transportation pies will continue to grow, as beneficial electrification of those sectors ramps up.





Sources: Energy Information Administration, Efficiency Vermont, Vermont Department of Public Service, Vermont Agency of Natural Resources, and Energy Action Network.

Understanding how Vermont accounts for greenhouse gas emissions

When measuring and reporting on GHG emissions, there are two main approaches.

In-boundary inventories (also sometimes called territorial, sector-based, or production-based inventories) aim to account for the emissions that occur *within a state's geographic boundaries.* This is the type of inventory that nearly all countries, provinces, and states use, following Intergovernmental Panel on Climate Change (IPCC) protocol. In the case of Vermont, this means the *emissions that are produced within the state of Vermont.*[1] When you see emissions totals in this report, they are from the official Vermont Greenhouse Gas Emissions Inventory and Forecast, conducted by the Vermont Agency of Natural Resources, which is an in-boundary inventory.

Consumption-based inventories (CBEIs) aim to account for the *lifecycle* emissions that occur *as a result of residents' consumption,* regardless of when or where, geographically speaking, those emissions occur. In the case of Vermont, this would mean the emissions that are caused by Vermonters' consumption of goods and services. This inventory approach is most often used by corporations and cities. Some states, notably Oregon and Minnesota, have also produced CBEIs to supplement their in-boundary inventories. However, those CBEIs have not replaced Oregon and Minnesota's in-boundary inventories for purposes of official State tracking and legal and policy compliance.

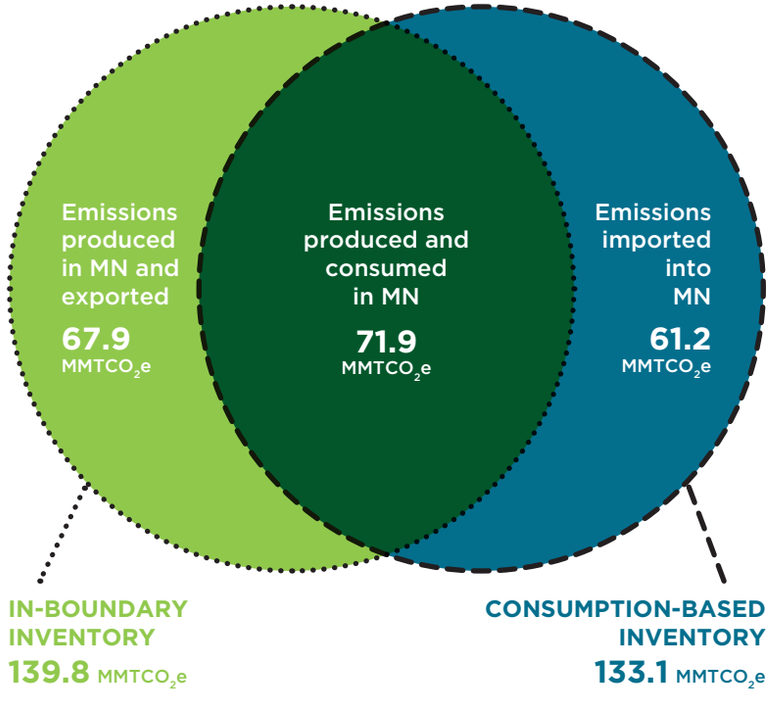
A key factor is to avoid double counting, which can happen when switching between the two types of inventories. The chart below right, an example from Minnesota, illustrates this.

Global Warming Potential Values

Another key factor in conducting emissions inventories is the choice of Global Warming Potential (GWP) value. U.S. Environmental Protection Agency (EPA) guidance is to use GWP100, which accounts for the energy absorbed by greenhouse gases over 100 years. This helps to account for particularly long-lived gases, like Carbon Tetraflouride (CF_4), which has an average lifetime of 50,000 years.[1] Some scientists, however, argue for a GWP20 standard to give greater weight to shorter-lived but nevertheless potent GHGs like Methane (CH_4). In the interest of transparency, a good practice is to present GWP20 and GWP100 values side by side, for example: CF_4: 4915/6990 and CH_4: 86/32. Note: CO_2, as the reference gas, always has a GWP value of 1.

1. Environmental Protection Agency. "Understanding Global Warming Potentials"

Minnesota's in-boundary and consumption-based inventories



Source: Minnesota Pollution Control Agency, "Consumption-related emissions."

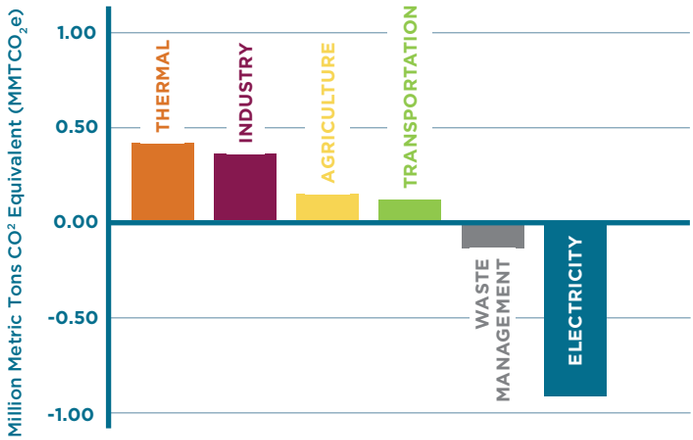
1. This is true with the exception that Vermont's electricity emissions are based on consumption, whether in or out of state, post-REC accounting.

Vermont's climate conversation is primarily an energy conversation

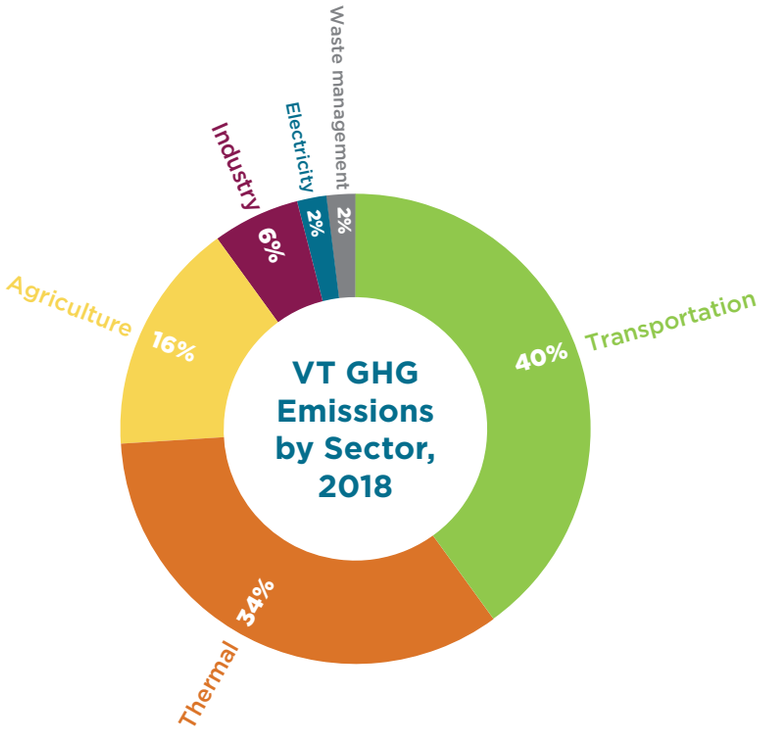
Compared to a 1990 baseline, emissions from thermal, industry, agriculture, and transportation have all increased. Electricity consumption and waste management are the only two sectors where emissions have declined. **This data reinforces the point that as progress continues in the electricity sector, the focus on transforming the the transportation and thermals sectors must increase.**

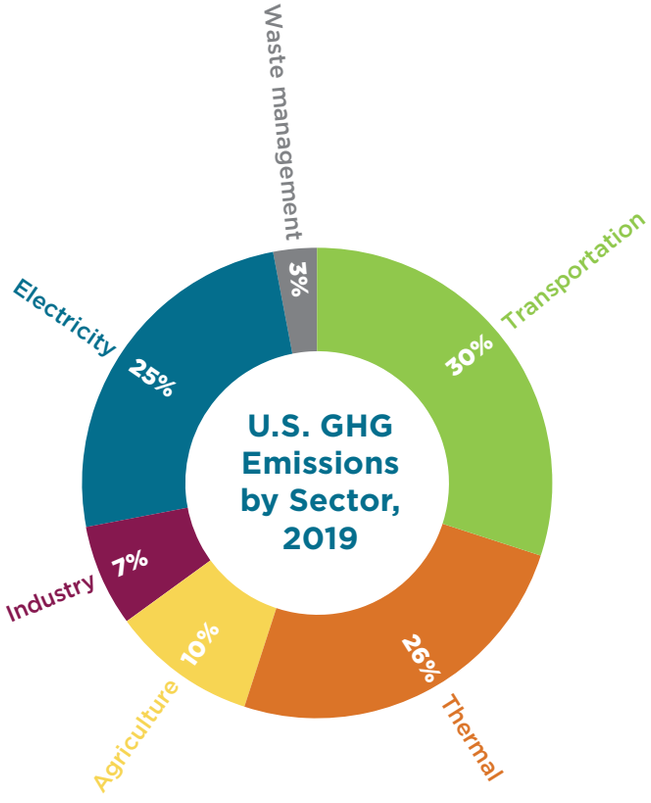
It has been the case for many years that the two biggest sources of GHG emissions in Vermont, by far, are from transportation and thermal. Nationwide, electricity has historically been the largest source of GHG emissions. However, in 2016 U.S. emissions from the transportation sector exceeded U.S. electricity sector emissions for the first time, and that gap continues to widen. As of 2019 U.S. thermal sector emissions are also now larger than those from the electricity sector. **Therefore, solutions that we identify and implement in Vermont for emissions reductions in these sectors will be valuable for the rest of the country.**

Net change in Vermont GHG emissions, 1990 vs 2018



Source: Vermont Agency of Natural Resources, Vermont Greenhouse Gas Emissions Inventory and Forecast (1990-2017), 2021.

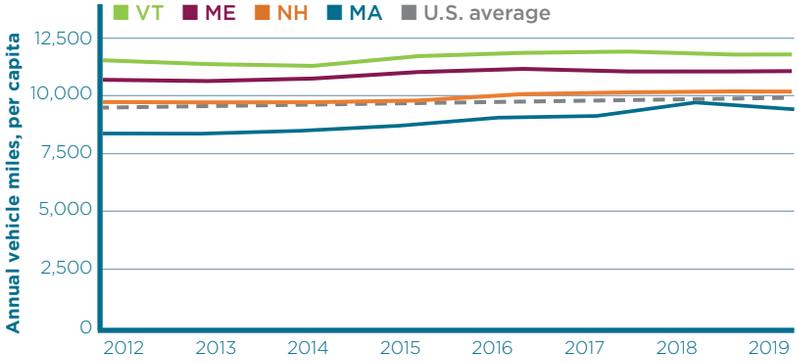




Source for U.S.: U.S. Environmental Protection Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019, 2021.
Source for VT: Vermont Agency of Natural Resources, Vermont Greenhouse Gas Emissions Inventory and Forecast (1990-2017), 2021.

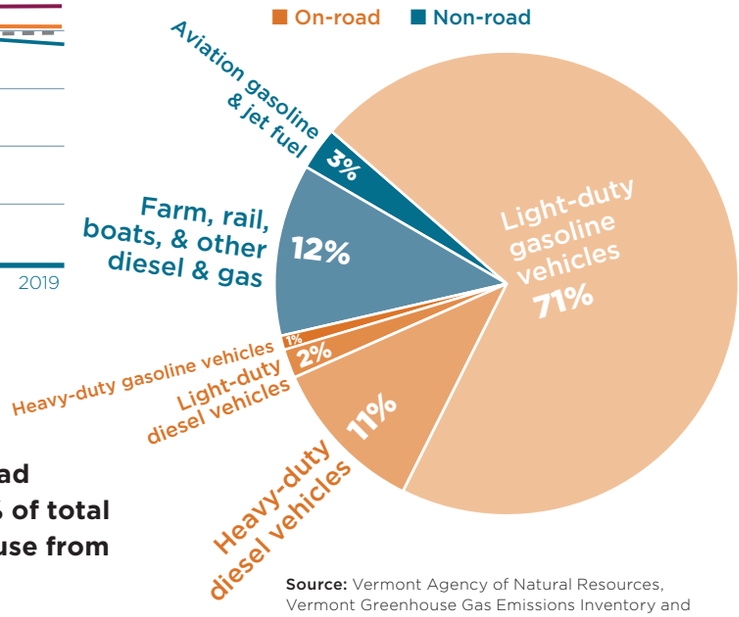
Vermont's transportation emissions — sources and solutions

Vehicle miles traveled, per capita



Source: Federal Highway Authority: Highway Statistics, 2019; U.S. Census Bureau, 2021.

VT GHG emissions from transportation by type and fuel, 2017

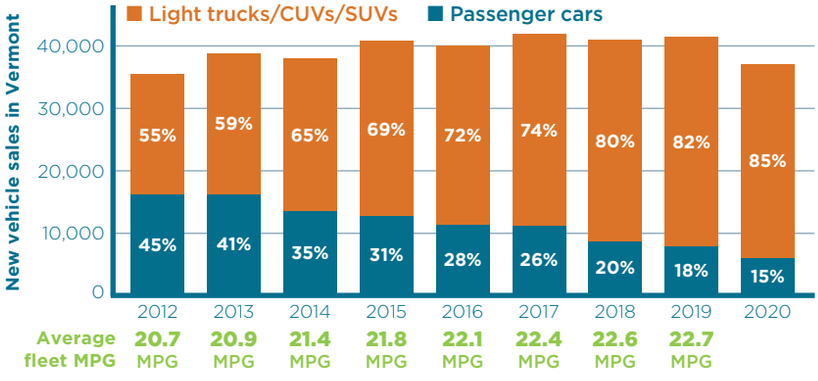


Source: Vermont Agency of Natural Resources, Vermont Greenhouse Gas Emissions Inventory and Forecast (1990-2017), 2021.

Vermont's transportation sector makes up 40% of the state's greenhouse gas emissions. This is because the overwhelming majority of Vermont's transportation energy use (94%) comes from fossil fuel sources.[1] **On-road gasoline use from the light duty fleet accounts for 71% of total transportation emissions, followed by on-road diesel use from heavy duty vehicles at 11%.[2]**

Vermont's per capita annual vehicle miles traveled, at 11,773 miles in 2019, are higher than both the national average and that of surrounding states. The rural nature of our state and our settlement patterns are key contributing factors.

New vehicle sales in Vermont by type



Sources: Sales: VADA, 2021. Fleet MPG: UVM/VTrans, Transportation Energy Profile, 2019. Note: Fleet MPG is average combined MPG (avg city and avg highway).

Additionally, **while vehicles are getting more efficient overall, Vermonters have been buying bigger vehicles, limiting the benefit we could be getting from increasing fuel efficiency standards.** In 2020, 85% of all new vehicles sold in Vermont were SUVs, crossovers (CUVs), or light trucks, compared to 55% in 2012. This aligns with global trends, where a doubling in market share for SUVs has been the second-largest contributor to the increase in global CO_2 emissions since 2010.[3]

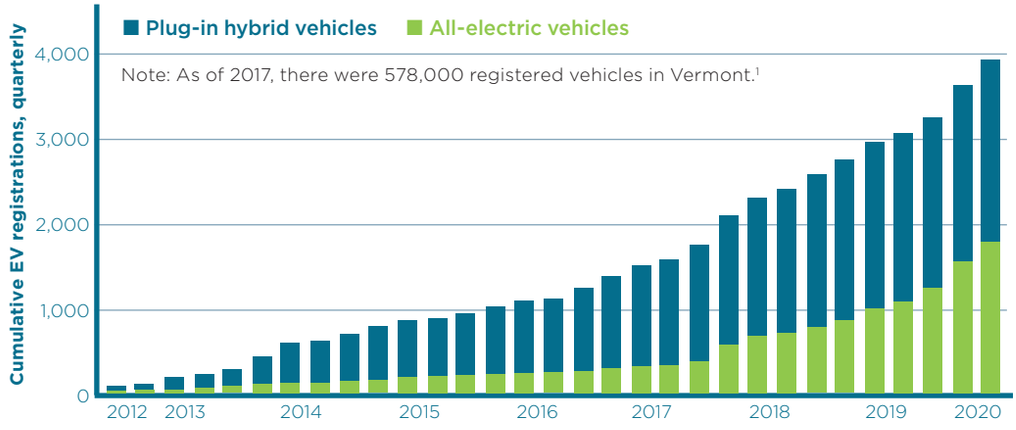
Regardless of size, switching from fossil-fueled vehicles to electric vehicles will lead to significant transportation emissions reductions. This is especially true in Vermont, because we have the lowest carbon electricity profile in the country. There has been encouraging growth in electric vehicle registrations in the state over the last decade, with electric vehicles making up around 4% of Vermont's private vehicle registrations in the last year.[4] Additionally, the share of electric vehicles sold that are all-electric (compared to plug-in hybrids, or PHEVs) has been increasing. All-electric vehicles have a smaller carbon footprint than PHEVs, so increasing their share of total EVs sold will have a positive impact.[5]

1. EIA, 2018,
2. Vermont Agency of Natural Resources, VT Greenhouse Gas Emissions Inventory and Forecast (1990-2017), 2021.
3. International Energy Agency (IEA), World Energy Outlook, 2019.
4. Vermont Vehicle & Automotive Distributors Association (VADA), Vermont Auto Outlook, 2021.
5. Congressional Research Service, 2020, "Environmental Effects of Battery Electric and Internal Combustion Engine Vehicles". Union of Concerned Scientists, 2015, "Cleaner Cars from Cradle to Grave."

Making our transportation more efficient

Transportation efficiency means lower energy use and GHG emissions per mile traveled. It is highly dependent on the vehicles we choose to use; **electric vehicles are far more efficient than gas or diesel cars, and smaller cars are generally more efficient than SUVs and pickup trucks.**

Vermont electric vehicle registrations

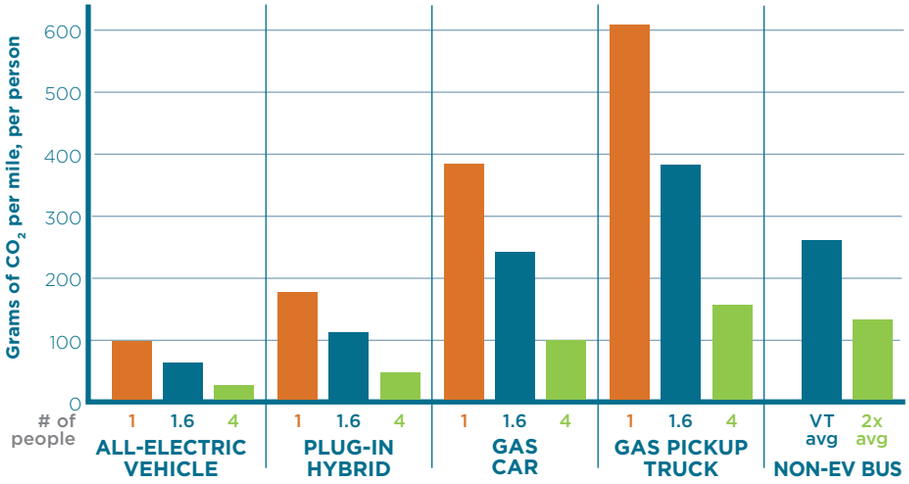


Source: Registration values based on Vermont Department of Motor Vehicles registration data; processed by VEIC 2012-2013; processed by Vermont Agency of Natural Resources 2014-present; July 2020 from Drive Electric VT.
1. Vermont Agency of Transportation, The Vermont Transportation Energy Profile, 2019.

Yet transportation efficiency isn't just a question of driving more efficient vehicles; it is also closely related to land use patterns. **Smart growth development centered around transit hubs and housing within walking distance of businesses and employers increases our transportation options and reduces vehicle miles traveled.** Vermont households that live within a half-mile of a downtown drive 30% less than the median household in the state.[1] "Complete Streets" designed for all users also influence travel choices — missing sidewalks and bike lanes are significant barriers to active transportation options.

The most immediate and inexpensive way to cut GHG emissions from vehicle use is to ride-share when possible, instead of driving alone. The EAN Emissions Reduction Pathways Model for how to achieve Vermont's 2025 and 2030 emissions reduction requirements outlines the need to reduce single occupancy commutes and increase transit ridership. However, the share of Vermont commuters who drive alone was on the rise pre-pandemic with less than 10% of commuters carpooling to work. Meanwhile transit ridership had only just started to trend upward after several years of decline before being set back by COVID.[2]

Emissions per passenger, by vehicle



Source: Union of Concerned Scientists, How Clean is Your Vehicle tool, 2021; Argonne National Laboratory, GREET model, 2021; Vermont Agency of Transportation, FY20 Public Transit Route Performance Report, 2021.
Note: 1.6 passengers is the national average in a car trip.

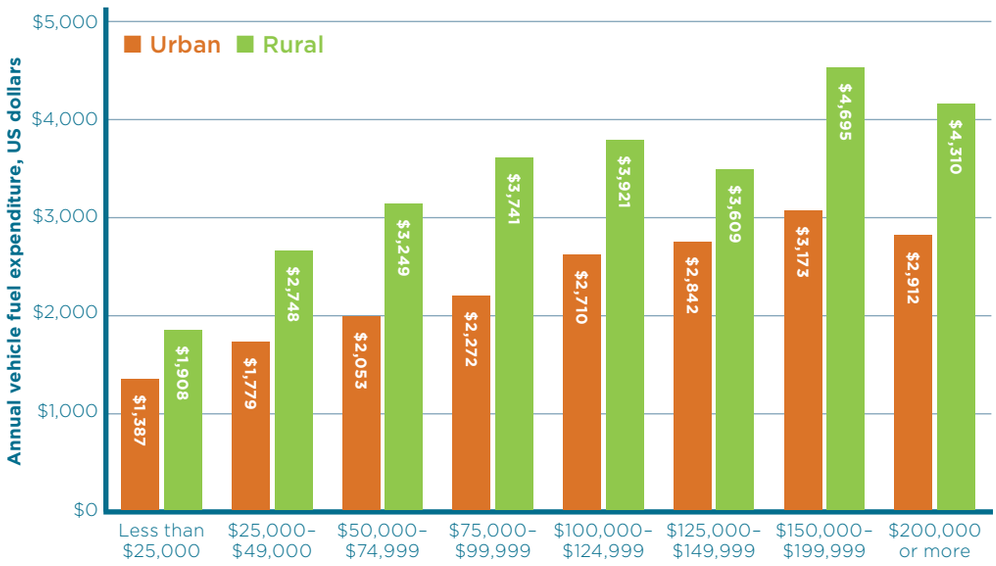
Our most efficient transportation options are active transportation — walking and biking — and telecommuting. About 5.8% of commuting trips in Vermont are taken by foot or bike.[3] Telecommuting was more common than walking and biking to work in Vermont before the COVID-19 pandemic, with Vermonters telecommuting at a rate of 7% compared to the national average of 5.7%.[4] The long-term impacts of the COVID-19 pandemic on transportation remain to be seen. While transit ridership has decreased in the short-term, the rise in teleworking may represent a cultural shift that could help lead to durable emissions reductions.

1. Federal Highway Administration. Analysis by ACCD.
2. Vermont Agency of Transportation (VTrans), The Vermont Transportation Energy Profile, 2019.
3. U.S. Census Bureau, American Community Survey: Commuting Characteristics by Sex, 2019.
4. Vermont Agency of Transportation (VTrans), The Vermont Transportation Energy Profile, 2019.

Transportation equity

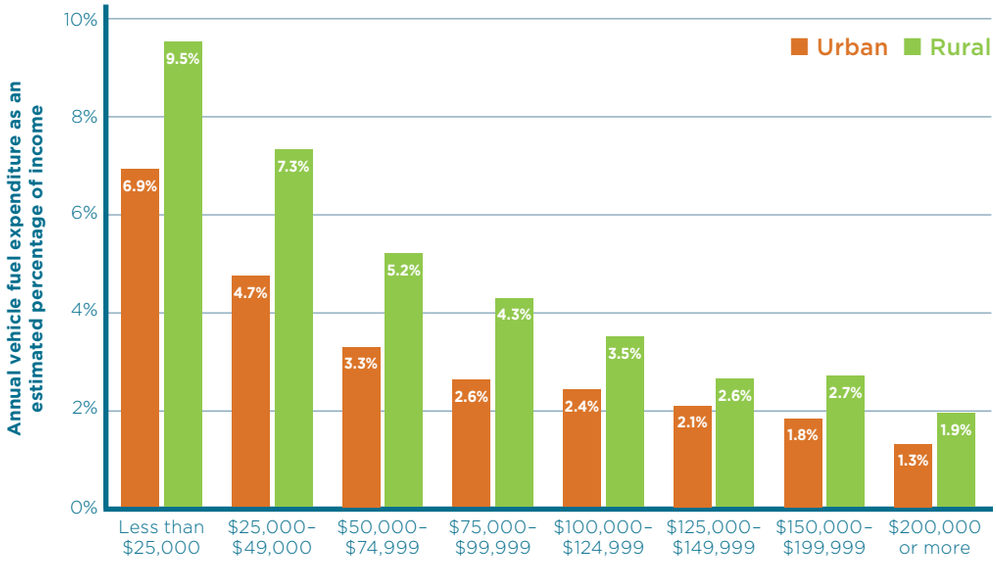
There are many disparities in access to safe and affordable transportation between different demographic groups in Vermont. **For our neighbors who are older, have disabilities, or have low incomes, inadequate transportation options can create a major barrier — reducing employment and education options, as well as making it harder to get to medical appointments, grocery stores, and social engagements.** About 7% of Vermont households do not have a vehicle, and most are households that cannot afford a car.[1]

2017 annual vehicle fuel expenditure by income and location-type, northeast U.S.



Source: U.S. Department of Transportation, National Household Travel Survey, 2017.

2017 annual vehicle fuel burden by income and location-type, northeast U.S.



Source: U.S. Department of Transportation, National Household Travel Survey, 2017.

Higher-income drivers in the northeastern U.S. drive more miles and consume more fuel than lower income drivers, whether they live in rural or urban areas. While rural drivers spend more on fuel than urban drivers across all income levels, those in higher income brackets consume more no matter where they live. Notably, the highest income drivers consume more than double the lowest income drivers.[2]

The most important factor in terms of equity is that **lower income Vermonters spend a much higher share of their income on transportation fuels, especially if they live in rural areas.** In the northeastern U.S., drivers making more than $75,000 per year average less than 5% of their income spent on transportation fuels, while rural drivers making less than $25,000 per year average almost 10%. In fact, drivers in the lowest income brackets spend up to five times more on transportation (as a % of household income) than higher income drivers, money that could be used for essential medical care, food, and other services. In addition, lower income rural residents drive cars that are on average 4 years older (12 years vs. 8 years) than those whose income is over $100,000/year. This means higher and more urgent maintenance and repair costs along with higher emissions per mile traveled.[3]

1. Vermont Agency of Transportation (VTrans), Vermont Public Transit Policy Plan, 2020.
2. U.S. Department of Transportation, National Household Travel Survey, 2017.
3. Ibid.

The economic benefits of transportation electrification

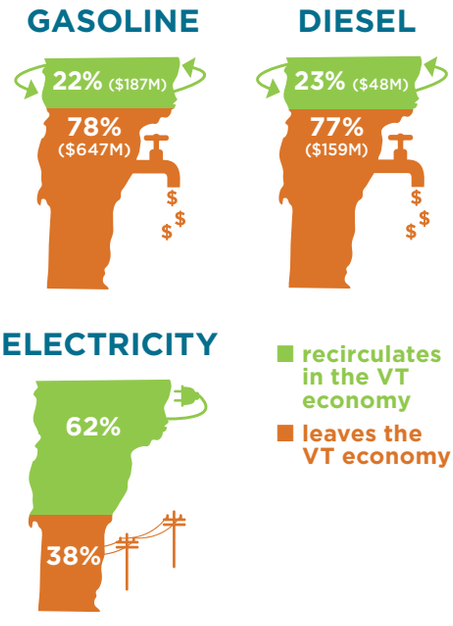
Shifting from fossil fuel to electricity as our primary energy source for transportation can benefit both consumers and the Vermont economy. In 2019, Vermonters spent approximately $1 billion for transportation fuels. 77% of this total left the state's economy.[1] In contrast, for every dollar we spend on electricity, 62 cents recirculates in Vermont, supporting local lineworkers, tree trimmers, and clean power producers, among others.

As the chart below illustrates, **drivers of gasoline and diesel passenger vehicles are subject to wide price swings from month to month and year to year.** Electric vehicle charging costs have proven to be lower on a gallon equivalent basis and much more stable. And when drivers utilize one of the off-peak charging programs provided by some electric utilities, the cost decreases even further. For example, Burlington Electric Department offers an EV rate that is just $0.60/gallon equivalent, while Green Mountain Power's EV rate is around $1.00/ gallon equivalent.

Electric Charging Infrastructure

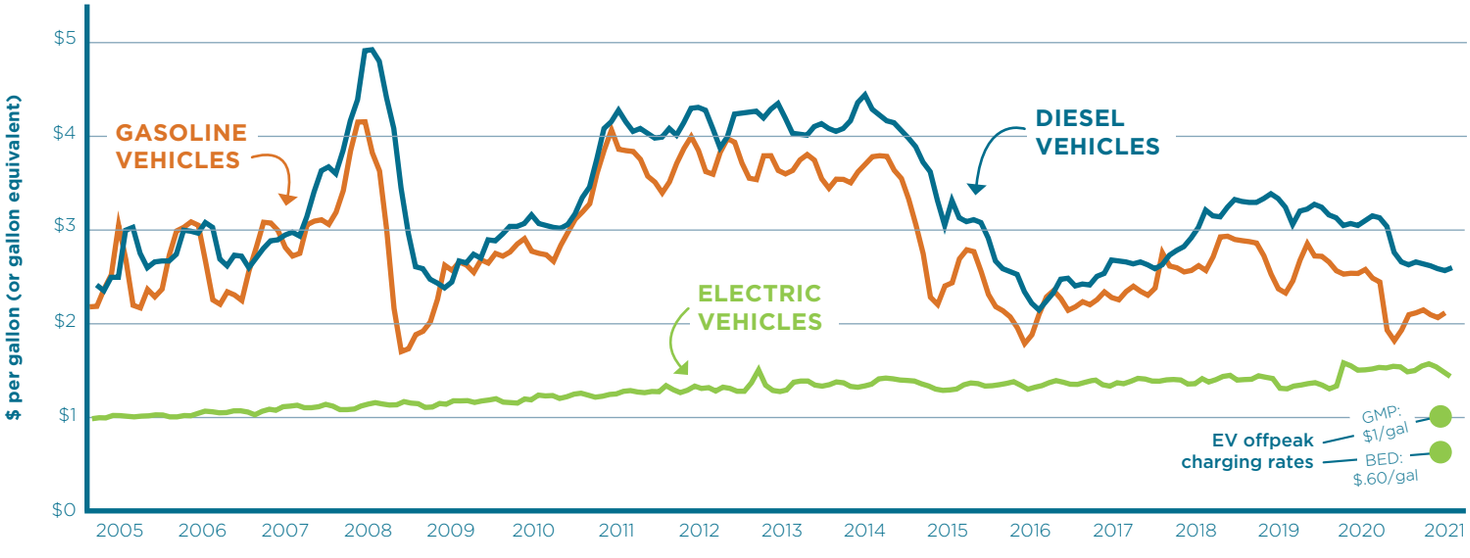
EV deployment on the scale envisioned in the EAN Pathways Model will require large increases in EV charging equipment at homes, workplaces, and public locations. To support the level of EV adoption in the EAN Pathways Model for 2025, we may need well more than 2,000 Level 2 charging plugs at multi-unit housing and workplaces, as well as over 1,500 public Level 2 charging plugs (almost 2.5 times the number currently available), and about 380 public DC fast charging plugs (more than six times the current number).[2]

How much money stays vs. leaves the state for different transportation fuel options?



Source: Vermont Agency of Commerce and Community Development, 2021. Note: All data from 2019.

Gasoline and diesel vehicles are more expensive to drive than EVs



Sources: Gas and Electric — Drive Electric VT (via EIA); Diesel — Vermont Agency of Transportation (VTrans).

1. Vermont Agency of Commerce and Community Development, 2021.
2. U.S. Department of Energy, EVI- Pro Lite, 2021. Depends on assumptions such as percentage of fleet that is PHEV vs BEV, fleet range, power levels of chargers, etc.

Electric vehicles: Increasing options, decreasing costs

While the average sticker price of an electric vehicle is typically higher than a comparable fossil-fueled model, available incentives often bring the upfront cost of electric vehicles below that of comparable fossil fuel cars. **In order to promote transportation equity, it is critical to continue to design electric vehicle incentives and infrastructure around the needs of lower-income and other disadvantaged communities.** The table below shows a subset of the wide variety of lower-cost electric vehicle options already available in Vermont.

Leasing may be a better option for those individuals who don't have enough tax liability to use the federal tax credit. Through leasing, they can receive at least a portion of the credit. With many standard monthly leases under $250/month, many Vermonters can already find an affordable electric vehicle to suit their needs.

Lower-cost electric vehicle examples

	Nissan Leaf EV	Chevrolet Bolt EV	Hyundai Ioniq PHEV	Kia Niro PHEV	Subaru Crosstrek PHEV
Base cost (MSRP)	$31,600	$36,620	$25,350	$28,500	$34,995
Standard Monthly Lease	$179	$239	$169	$249	TBD
Vehicle Type	Hatchback	Crossover	Hatchback	SUV	Crossover (AWD)

Source: www.driveelectricvt.com/why-go-electric/compare-vehicles. Note: PHEV is a Plug-in Hybrid Electric Vehicle that has a gasoline engine in addition to the electric motor.

Comparing operating costs, including cost per mile and maintenance costs, electric vehicle drivers in rural Vermont stand to save roughly $1,500 during the first year of ownership, and over $21,000 over a 14 year lifetime of the vehicle.[1]

Electric vehicle incentives

	NISSAN LEAF (ALL-ELECTRIC)		NISSAN SENTRA (GAS)
	Standard incentive	**<$50,000 AGI***	
Starting Price	**$31,600**	**$31,600**	**$19,310**
Manufacturer's Incentive	-$6,000	-$6,000	-$0
State Incentive	-$2,500	-$4,000	-$0
Utility Incentive (varies)	-$1,500	-$2,500	-$0
Current price after incentives	**$21,600**	**$19,100**	**$19,310**
Replace Your Ride*	-$0	-$3,000	-$0
Price After RYR	**$21,600**	**$16,100**	**$19,310**
Federal Tax Incentives**	up to -$7,500	up to -$7,500	
Total Price	**$14,100**	**$8,600**	**$19,310**

Source: Drive Electric Vermont, 2021.
*Replace Your Ride Incentives are anticipated for implementation in 2022, for individuals with an adjusted gross income (AGI) of $50,000 and married-filing-jointly with an AGI of $75,000.
**Federal Incentives are currently tax-based, and do not carry over into more than one tax year. The incentive can be passed through into lease agreements, allowing purchasers without the taxable income to benefit from the lower lease price.

1. Union of Concerned Scientists, Clean Transportation Strategies for Rural Communities in the Northeast and Mid-Atlantic States, 2020.

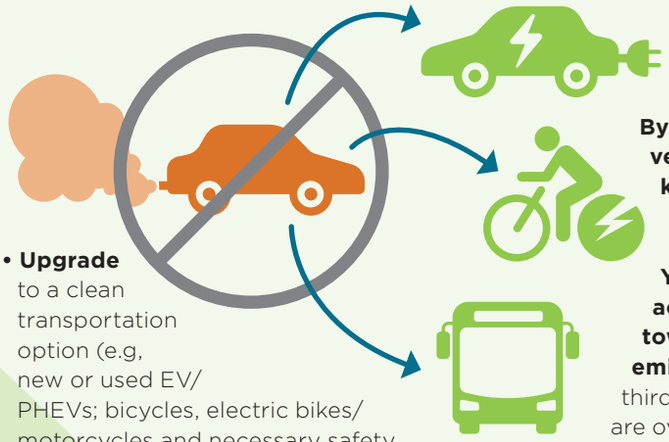
TRANSPORTATION NETWORK ACTION TEAMS Network Action Team projects were selected by the Network membership through a competitive process as part of EAN's 2020 Annual Summit. Four concepts were chosen based on their potential to help Vermont meet the legal requirements of the Global Warming Solutions Act in innovative and equitable ways. Two of these focused on transportation.

Replace Your Ride

Goal: Help lower-income Vermonters switch to clean transportation options affordably, while also accelerating the reduction of greenhouse gas emissions from transportation.

Replace Your Ride is designed to **significantly reduce both purchase and operating transportation costs for lower-income Vermonters.** Modeled after the successful Clean Cars 4 All programs in California, it will offer up to $3,000 to:

- **Scrap** an older, higher-maintenance, higher-polluting vehicle (10 years or older)
- **Upgrade** to a clean transportation option (e.g, new or used EV/ PHEVs; bicycles, electric bikes/ motorcycles and necessary safety equipment, and/or vouchers for transit and other shared-mobility options)
- **Stack** on top of existing incentives to ensure the highest incentives are targeted to the lowest-income Vermonters for more affordability (see p. 20).



By scrapping older vehicles instead of keeping them on our roads through trade-ins, Replace Your Ride also accelerates progress towards reducing GHG emissions. Over one third of Vermont's vehicles are over ten years old, which often means higher emissions and higher maintenance costs. For each older vehicle taken off the road, EPA estimates the tailpipe emissions reduction to be up to ten times that of a newer equivalent vehicle replacement, and significantly more if replaced by a zero emissions vehicle.

The Future of Rural Transit

Goal: Prepare Vermont to have the most efficient, equitable, and cost-effective rural transportation system in the U.S. by combining public and school transportation into a single electrified public transportation system.

In most of the world, public transportation is one system serving schools along with the rest of the community, saving money and adding functionality to the system. Even in Vermont, children in Burlington ride the public bus to school. The idea of combining school and public transportation frequently comes up in community forums, but there are many barriers that have gotten in the way of making progress on the idea.

The Future of Rural Transit project has received grant funding to further study the concept and design a pilot for combined transit in Vermont. The Network Action Team has conducted outreach and education efforts to identify suitable partners and routes for piloting this concept, and is conducting a detailed feasibility study looking at the opportunities and barriers of combining services, evaluating right-sizing vehicles and fleet sizes, and drawing from what Vermont and other states are learning about fleet electrification. Once the feasibility study is complete, they expect to design a demonstration pilot deploying electric buses to serve 1 or 2 rural school systems and surrounding communities.

Photo courtesy of VEIC

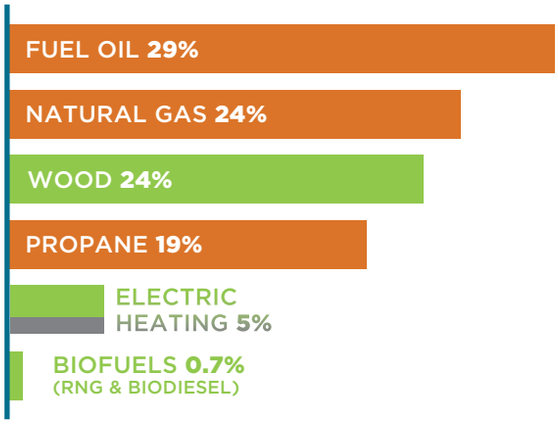
Network members and partners supporting these efforts: *VEIC, VT Clean Cities Coalition, VTrans - Public Transit, UVM Transportation Research Center, Drive Electric Vermont - VEIC, Vermont Vehicle & Automotive Distributors Association (VADA), Vermont Energy Education Program (VEEP), Green Mountain Transit (GMT), Regulatory Assistance Project (RAP), Capstone Community Action, Community Engagement Lab, AARP, Vermont Center for Independent Living, VT Superintendents Association, Green Mountain Power, Vital Communities, Regional Planning Commissions, efficiency and distribution utilities, environmental groups, legislators, and school and community leaders.*

Vermont's thermal emissions — sources and solutions

The thermal sector accounts for about 34% of Vermont's GHG emissions, making it the state's second largest source of climate pollution, behind transportation. The majority (74%) of Vermont's thermal energy use is fossil fuel based. More than half of the emissions are generated at the residential level, followed by the commercial sector. Tackling thermal emissions means changing the ways we heat our homes and businesses.

The good news is that, no matter where you live in Vermont and no matter type of building you're trying to heat, there are efficient, clean heating technologies that can work, right now. The main clean heat technologies currently available in Vermont involve efficient electric heat via heat pump systems, advanced wood heating options, renewable natural gas, and/or B100 biodiesel.

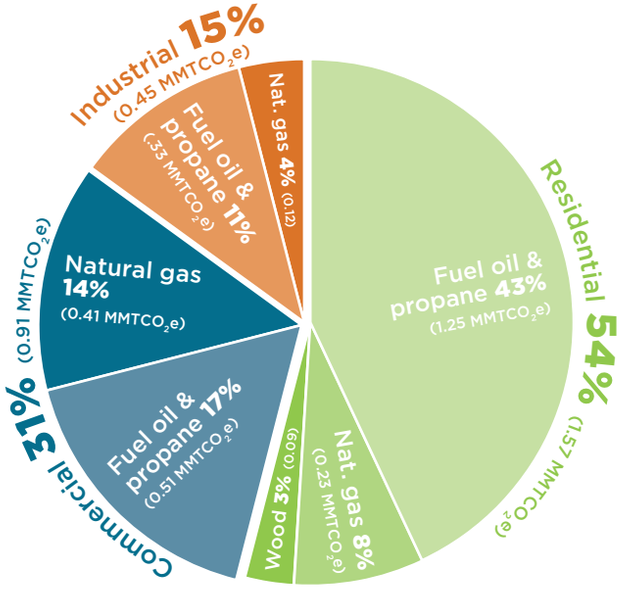
Vermont heating energy sources, 2018



Source: EIA, 2020; Vermont Department of Public Service, 2020; Efficiency Vermont, 2020; Vermont Agency of Natural Resources, 2020

Vermont's electricity portfolio is around 93% carbon free, so using an efficient electric option, such as heat pumps, is a powerful way to cut emissions. Heat pump adoption is increasing significantly in Vermont. While wood heat is not necessarily a carbon neutral option, it is almost always "carbon better" than fossil fuels — especially when wood is locally and sustainably sourced. For example, wood can achieve more than a 50% reduction in GHG emissions compared to fossil fuels.[1] Additionally, sustainably sourced B100 biodiesel can be a "carbon better" replacement for many fuel oil users, as can renewable natural gas for natural gas users.

Vermont thermal GHG emissions by sector and fuel type



Source: Vermont Agency of Natural Resources, Vermont Greenhouse Gas Emissions Inventory and Forecast (1990-2017), 2021.

Clean heating is not an either/or situation. **Often the best solutions involve multiple clean options working in combination, providing supplemental or back-up heat to each other — especially after weatherization has occurred.** Home or business owners should always consult with efficiency and heating professionals before changing a heating system because the best options vary greatly depending on individual circumstances.

The commercial sector is responsible for roughly 31% of VT's thermal GHG emissions, which comes from about 25,000 commercial buildings.[2] Unlike the residential sector, where fuel oil and propane use create the vast majority of GHG emissions, in the commercial sector natural gas is responsible for almost half of the GHG emissions. These buildings can benefit from many of the same technologies as discussed above. Advanced wood heat systems, including pellet and chip boilers and furnaces, or heat pump systems, are examples of specific technology types that can help the commercial sector become cleaner and more efficient.

1. SIG-NAL, 2015
2. Vermont Agency of Natural Resources, 2021.

The multiple benefits of weatherization

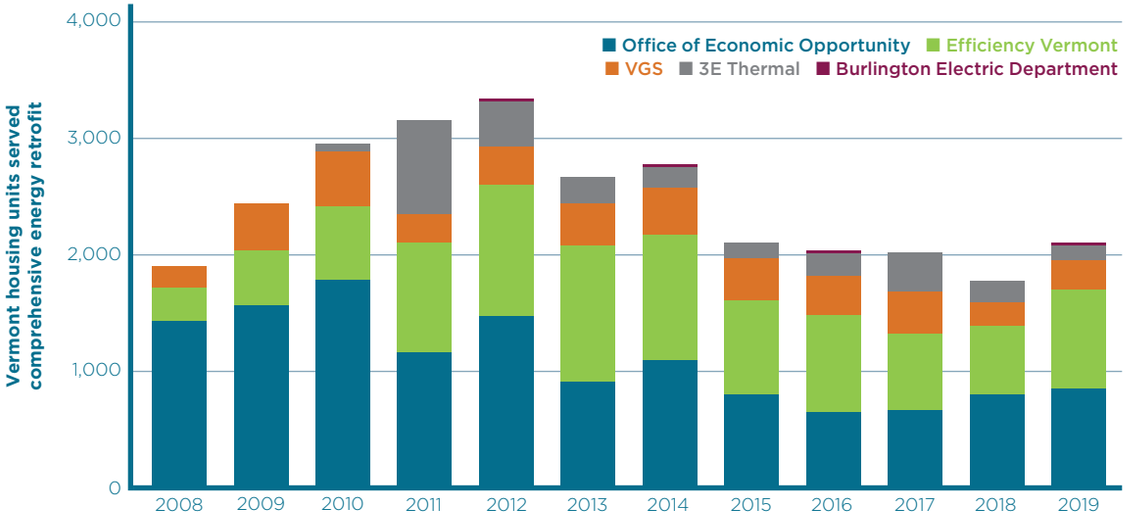
Housing units by year built

Source: U.S. Census Bureau: American Community Survey 5-year Estimates, 2013-2017

Weatherization reduces heating costs while creating a more comfortable home, reducing greenhouse gas emissions, and decreasing dependence on fossil fuels. Vermont's housing stock is older than the U.S. average and much of this housing is in need of significant efficiency improvements. Because 54% of Vermont's thermal emissions come from the residential sector, **we likely need to weatherize around 120,000 more homes by 2030 as part of achieving the state's Global Warming Solutions Act (GWSA) emissions reduction requirements.**

The good news is that investing in home weatherization is an investment in our communities. Weatherizing our housing stock improves health and comfort and can help preserve the character of Vermont's villages and town centers. When we invest in home weatherization, most of the money spent goes to local contractors, supporting jobs for our neighbors as we lower our heating bills year after year. **Weatherizing an additional 120,000 homes by 2030 would create over 4,700 new jobs.[1] And for every dollar invested in weatherization, approximately 60 cents will recirculate in the Vermont economy, while only 25 cents of every dollar spent on fossil fuels stays and recirculates in the Vermont economy.** Weatherizing this many homes is projected to avoid $1.2 billion in fossil fuel expenses over 25 years, which would help keep an additional $500 million in the Vermont economy over that time frame.[2]

Weatherization track record



Source: Vermont Department of Public Service, 2020.

Unfortunately, Vermont is not weatherizing homes as quickly as is needed to help meet our GWSA emission reduction requirements. Between 2008 and 2019, 29,289 Vermont homes were weatherized, an average of only 2,000–2,500 units a year.[3] After rising from 2008 to 2012, partially as a result of increased federal funding, since 2013 the number of homes comprehensively weatherized annually has been flat or declining. We need to scale progress rapidly to weatherize approximately an additional 53,000 homes by 2025 and 120,000 homes by 2030. That is an average of 12,000 homes per year, or five to six times our current pace.[4]

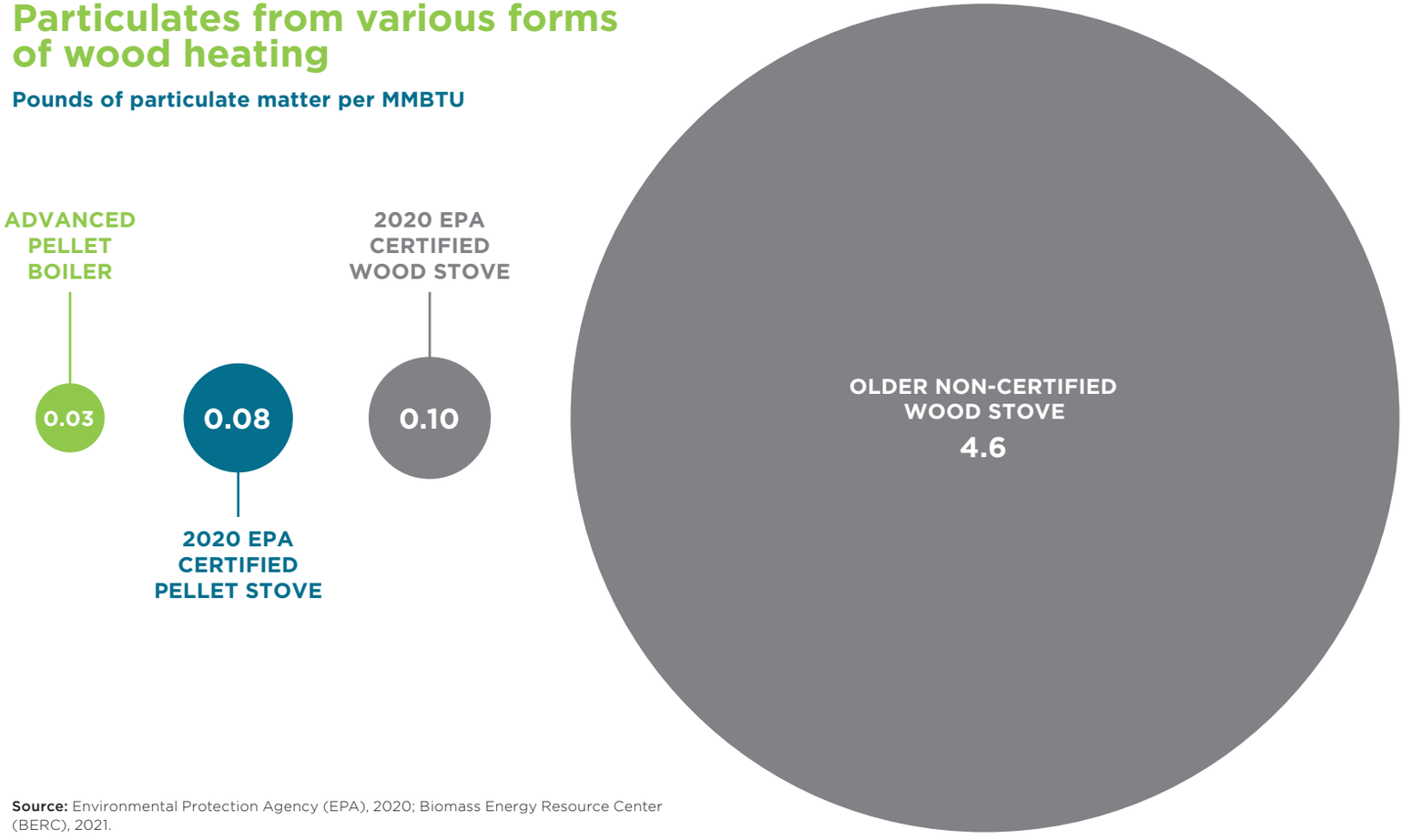
1. American Council for an Energy-Efficient Economy, "How Does Energy Efficiency Create Jobs?", 2011.
2. Vermont Agency of Commerce and Community Development, 2020.
3. Vermont Department of Public Service, Annual Report on Vermont's Progress Toward Building Energy Fitness Goals, 2019.
4. EAN, EAN Emissions Reduction Pathways Model, 2021.

More comfortable and healthy homes

In addition to energy savings, advanced, efficient, and renewable technologies can improve indoor air quality and create greater indoor comfort, leading to better respiratory health and overall well-being.[1] The Vermont Department of Health reports strong evidence for the positive impact of home weatherization on general health, productivity, social health, and upper respiratory health. They estimate that, over the course of 10 years, the health and fuel-savings from a weatherization project are nearly three times greater than the initial investment. **Comprehensively weatherizing the 90,000 low-income homes in Vermont that remain to be weatherized could prevent over 10,000 emergency room visits, nearly 600 hospitalizations, and 22 deaths over a ten-year period by reducing the health impacts caused by asthma, cold, and heat.[2]**

Particulates from various forms of wood heating

Pounds of particulate matter per MMBTU



Source: Environmental Protection Agency (EPA), 2020; Biomass Energy Resource Center (BERC), 2021.

The type of fuel and equipment used also bears heavily on health impacts. In 2020, public health research concluded that communities with higher exposure to particulate pollution experienced higher COVID-19 hospitalizations and death rates.[3] Moving away from diesel and gasoline vehicles and from fossil fueled heating systems is one way we can improve air quality and health, but not all renewable alternatives are created equal. Specifically, there is wide variation in the particulate matter produced by different forms of wood heating. While automated pellet boilers and then EPA certified pellet stoves are the healthiest of wood heating options, heating with open fireplaces, outdoor wood boilers, or old wood stoves produces significant amounts of particulates and is unhealthy. **Vermont's heavily renewable electricity supply is a much cleaner and healthier alternative for heating needs than fossil fuels, and newer, more efficient forms of advanced wood heating are healthier than older wood stoves.**

1. Vermont Department of Health, Climate Change and Health in VT, 2017.
2. Vermont Department of Health, Weatherization + Health Report, 2019.
3. Wu et al., Air pollution and COVID-19 mortality in the United States: Strengths and limitations of an ecological regression analysis, 2020.

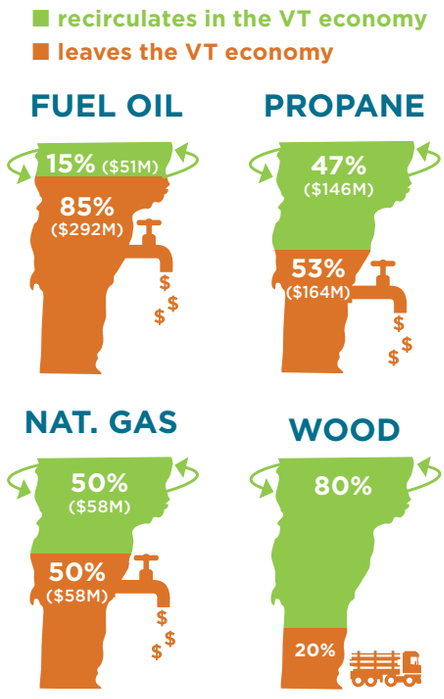
Fossil heating is (mostly) a strain on Vermonters and a drain on VT's economy

Prices for fossil fuels like propane and fuel oil have been historically high and volatile. **Switching to electric heat pumps and/or wood heat options can lower a household's energy costs and offer more stable fuel prices.**[1] Home weatherization also results in decreased fuel costs as the resulting efficiency gains lead to reduced energy use.

Switching to non-fossil fuel heating sources is also a boon to Vermont's economy, as more of the money spent on heating stays in state. In 2018, Vermont spent over $769 million on fossil fuels for heating.[2] Of that, 67% left the Vermont economy entirely. In contrast, a greater share of money spent on electricity and wood for heating stays in state. For electricity, an average of 62 cents per dollar stays in state. For wood heat, an average of 80 cents per dollar spent stays in state. If more households switch to these heating sources then more money will stay local, helping to employ our neighbors and strengthen our local economy.

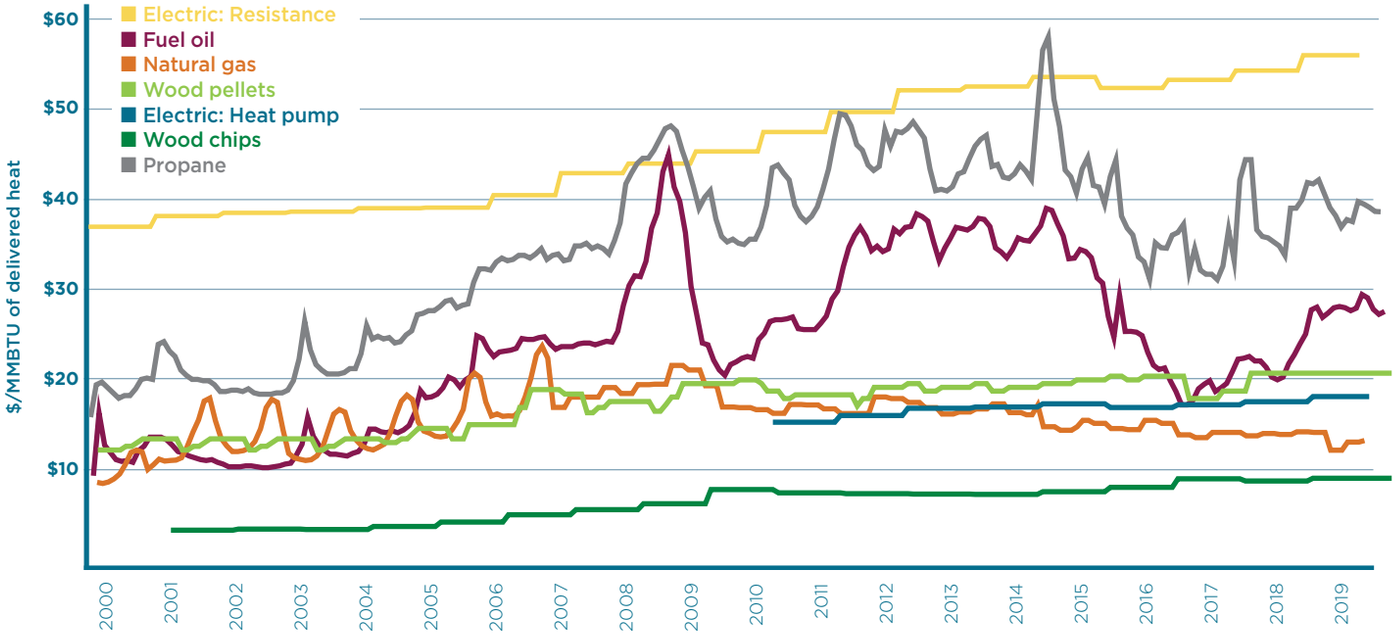
Given the life cycles of heating equipment, each year about 12,500 Vermont households replace their space heating systems and roughly 25,000 replace their water heaters.[3] **This time of change-out is the key moment of opportunity to replace old, dirty systems with more efficient and clean upgrades — and is also when we can avoid locking in decades of further pollution and unpredictable heating costs.**

How much money stays vs. leaves the state for different heating options?



Source: Vermont Agency of Commerce and Community Development, 2021. Note: All data from 2018.

Cost comparison of different heating options over time



Source: Biomass Energy Resource Center, 2019. Note: electricity prices presented here are a statewide average. Electricity prices vary by utility territory.

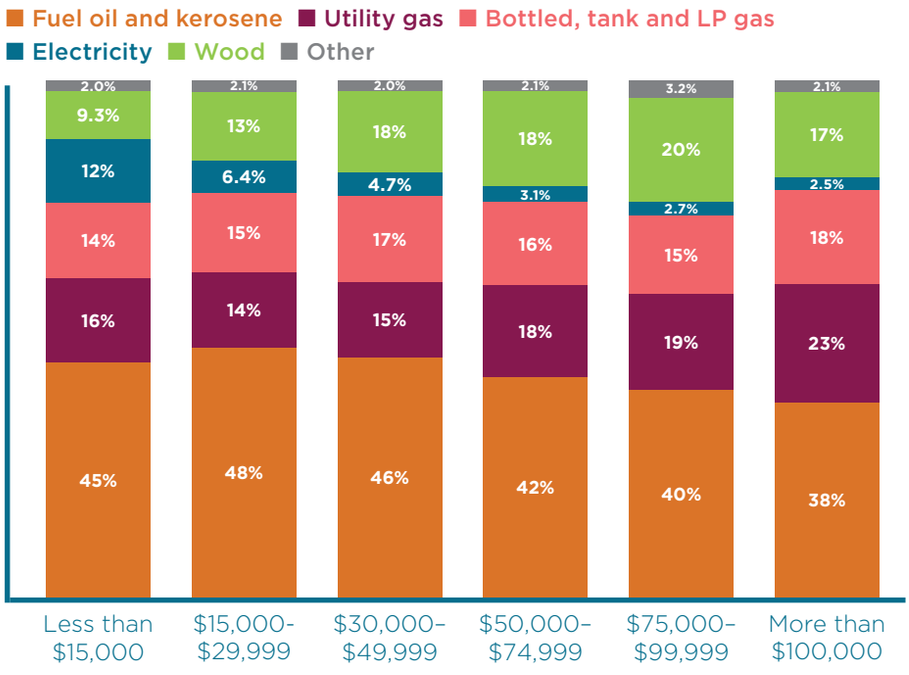
1. Net electricity savings or costs from heating with heat pumps vary by heat pump type and by utility territory, depending on electric rates.
2. Vermont Agency of Commerce and Community Development, 2021.
3. EAN, 2020.

Thermal energy equity

Unfortunately, low-income households don't have the same access to improved heating options as their higher-income neighbors, placing already burdened households at the mercy of some of the highest cost and least efficient ways to heat their homes. **Lower-income households are disproportionately dependent on two of the highest-cost heating sources: Fuel oil and inefficient resistance electric systems.**

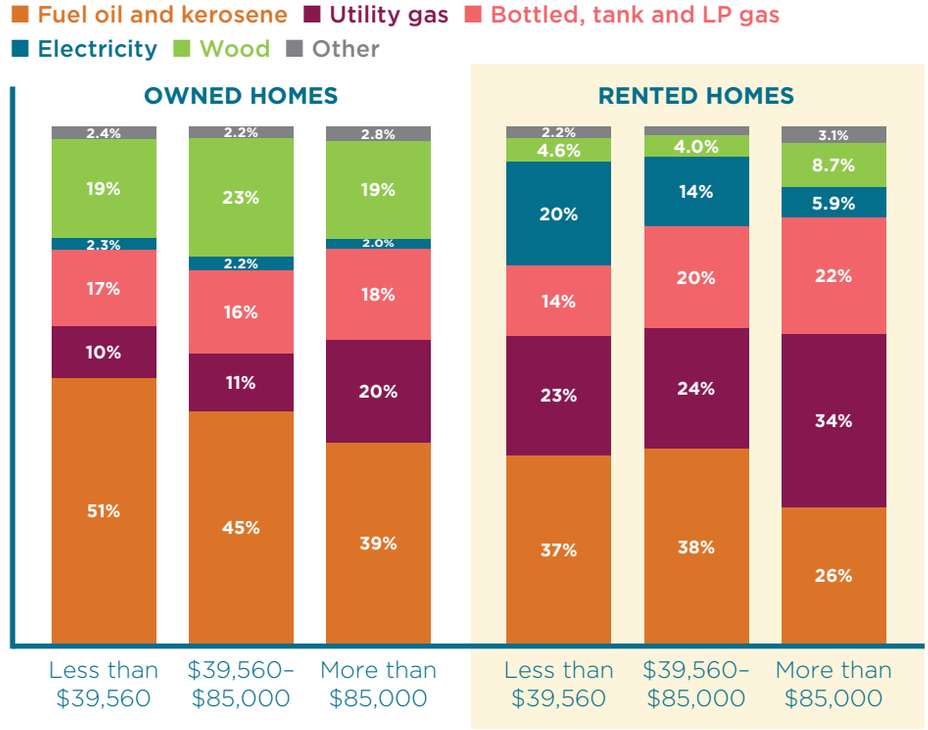
In Vermont, 73% of households own their home, while 27% rent, and there are big differences in how owned versus rented homes are heated. **In rental units there is often a split incentive, where the landlord is responsible for installation of heating equipment and weatherization, but the tenant pays the utility bill.** This disincentivizes improvements that could lead to financial savings and a healthier home for many renters. 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, but they have relatively high upfront purchase and installation costs. On the other hand, electric resistance heating is the most expensive way to heat a home, yet it has very low upfront purchase and installation costs. This is a big reason why a full 20% of renters in the lowest third of the income distribution are still dependent on inefficient and high-cost electric resistance systems. Renters also are much less likely to have the ability to use low-cost, locally sourced wood to heat their homes, across the income spectrum.

Vermont household fuel use by income



Source: U.S. Census Bureau, American Community Survey, 2018.

Vermont household fuel use by housing type



Source: U.S. Census Bureau, American Community Survey, 2018.

High relative costs of home heating for low income Vermonters can lead to other inequities. Low income households are more likely to find themselves choosing between adequate home heating and buying enough food for their families.[1]

1. Lewis et al., 2020; Hernandez, 2013; Hernandez, 2016

THERMAL NETWORK ACTION TEAMS Network Action Team projects were selected by the Network membership through a competitive process as part of EAN's 2020 Annual Summit. Four concepts were chosen based on their potential to help Vermont meet the legal requirements of the Global Warming Solutions Act in innovative and equitable ways. Two of these focused on thermal energy.

Weatherization at Scale

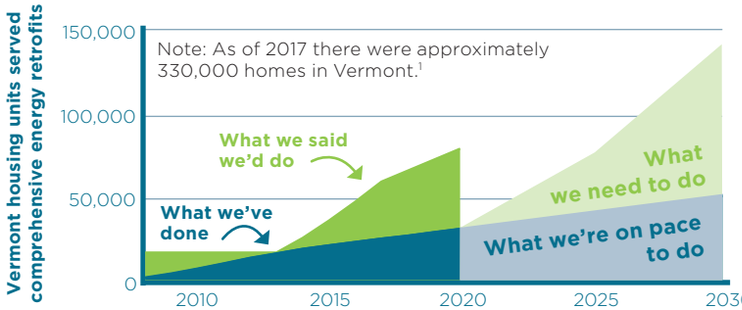
Goal: By 2030, weatherize *every* home of low-to-moderate income Vermonters who make less than 120% of average median income — including renters.

The framework of Vermont's ambitious climate goals is built on a foundation of energy efficiency, yet we have not mobilized the funds required to invest in weatherization at scale to shift the trajectory of our greenhouse gas emissions. This project proposes a massive recapitalization of Vermont's weatherization investment to fund more than 100,000 home retrofits for low- and moderate-income households over the next decade.

The initiative calls for an all-of-the-above funding plan, including:

- **Establish innovative funding partnerships** and consider non-traditional revenue sources, including leveraging private funds and non-state bonds.
- **Consider alternative repayment models:** Research to-the-meter or on-bill financing models to pair with grants (incentives) and stretch available funds to meet the goal.
- **Deploy partnership model** to work with fuel dealers, community action agencies, efficiency and distribution utilities, weatherization contractors, and private construction to speed weatherization work, and explore fuel switching possibilities.

Weatherization: actual & projected



Sources: What We've Done: Vermont Department of Public Service, "2019 Report on VT's Progress Toward Building Energy Fitness Goals"; What we said we'd do: 10 V.S.A § 581. Others: EAN.
1. Vermont Housing Finance Agency (VHFA), Vermont Housing Needs Assessment: 2020-2024, 2020.

Clean Heat Standard

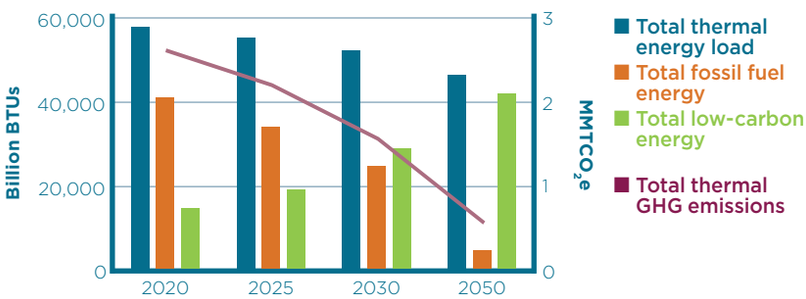
Goal: Building on the success of Renewable Portfolio Standards (RPSs) that have worked well to transform the electricity sector, Vermont should create a Clean Heat performance Standard (CHS), applied on a competitively neutral basis to all major suppliers of heating fuels in Vermont.

The power sector, and to a lesser degree, the pipeline gas sector, have been paying for and delivering the overwhelming majority of the greenhouse gas reductions we have seen in Vermont to date, while the fossil fuel sector has delivered only a small share of the total savings we need to lower customer bills and carbon pollution in coming years. **Our power sector gains did not happen on their own — they resulted from government policies that required improved performance by energy suppliers, ramping up over time.** As Vermont's second largest source of GHG emissions, fossil heat providers must now make similar improvements.

Policymakers and stakeholders are working together to answer key questions about a Clean Heat Standard design, including:

- Where should the point of regulation for the standard be?
- What clean heat options — e.g., heat pumps, advanced wood heat, solar thermal, biofuels — should qualify to earn CHS credits? And do they all earn equal credits?
- How can the CHS be designed to lower costs to, and deliver maximum benefits to lower-income households and rural and disadvantaged communities?
- How can the CHS be designed to assist historic fossil heat providers with fair and realistic opportunities to change what they sell and how they serve customers?

Thermal sector GWSA model



Source: EAN Analysis, 2021.

Network members and partners supporting these efforts: *VGS, Energy Futures Group (EFG), Vermont Housing Finance Agency (VHFA), Efficiency Vermont, NeighborWorks of Western Vermont, Regulatory Assistance Project (RAP), Vermont Public Power Supply Authority (VPPSA), Vermont Department of Public Service (PSD), Vermont Public Utility Commission (PUC), Energy Co-op of Vermont, environmental groups, legislators, and others.*

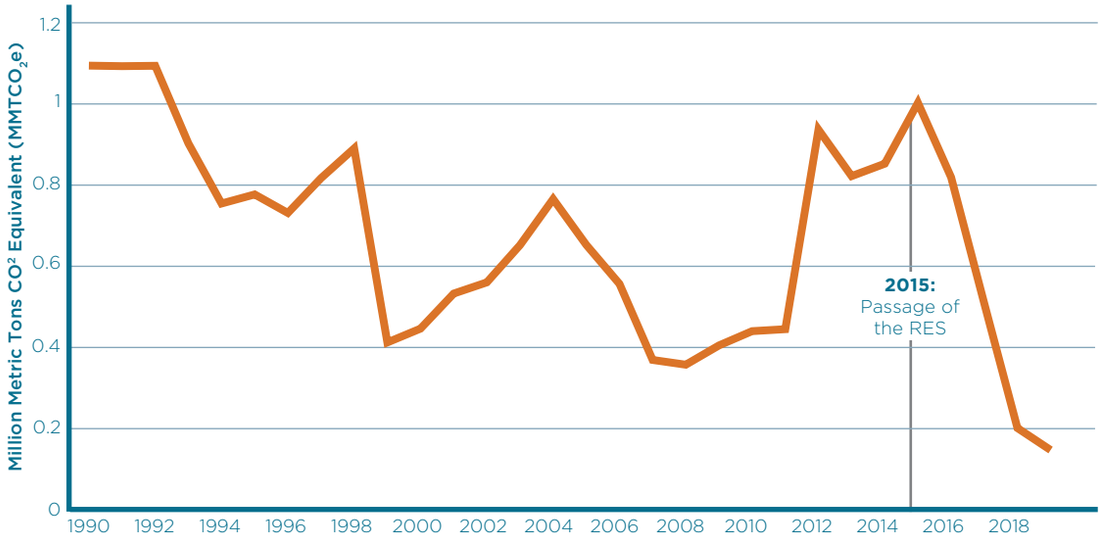
What's behind trends in Vermont's emissions from electricity?

Vermont's electricity purchases in 2019 were markedly cleaner than they were previously, following a trend that began in 2016 and then accelerated in response to several factors. These include the implementation of the Renewable Energy Standard (RES) in 2017, changes in energy purchasing by Vermont utilities, and a cleaner state portfolio that relies less and less on the regional electricity mix.

Nearly all of the GHG emissions from Vermont's electricity consumption are attributable to that portion of electricity that we purchase from the regional system mix through ISO-New England (ISO-NE), the independent system, or grid, operator for New England. Between 2017 and 2018, the ISO-NE system mix portion of Vermont's electricity portfolio decreased from 30% to 5%.[1] At the same time, the renewability of the ISO-NE mix has also been increasing: from just 4% in 2010 to 17% in 2018.[2]

The net result of these trends was a drop of more than 80%—from 0.81 to 0.13 MM tons—in Vermont's electricity sector GHG emissions between 2016 and 2019.[3] **Vermont now has the least carbon intensive electricity portfolio in the U.S., both overall and per capita.** While there is still more progress we can and must make in the electricity sector, Vermont's relatively low-emitting electricity portfolio already makes the electrification of other sectors especially beneficial, as discussed in the Transportation and Thermal sections of this report.

Greenhouse gas emissions from the electricity sector



Source: Vermont Agency of Natural Resources, Vermont Greenhouse Gas Emissions Inventory and Forecast (1990 - 2017), 2021.

Consistent with Vermont's Renewable Energy Standard (RES), Vermont's electricity sector GHG emissions are reported based on the emissions profile of our electricity purchases, post-REC accounting.

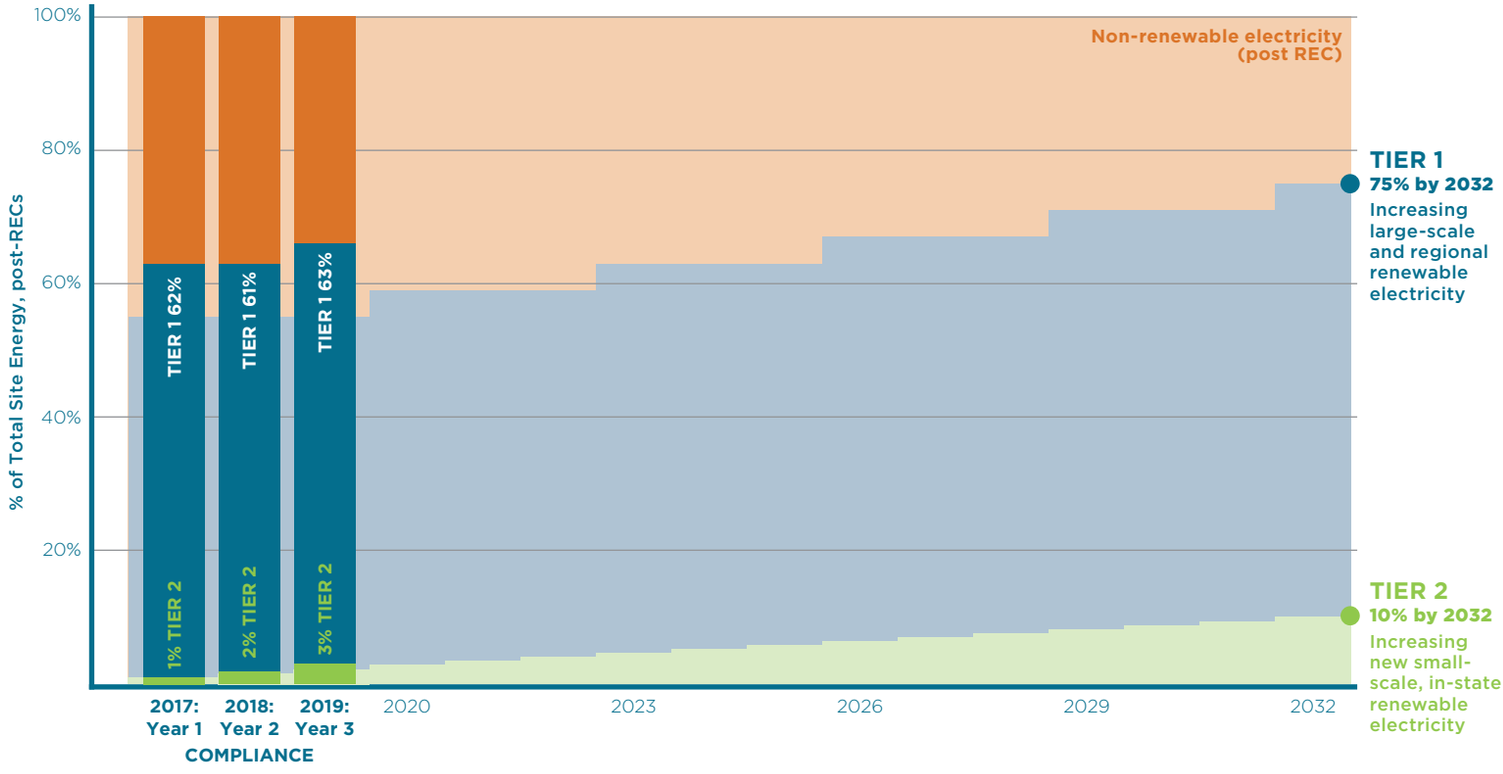
However, emissions from electricity purchases are not always the same as emissions from electricity use. Some point out that "there is no Vermont electricity," since we are part of the ISO-New England grid. Technically speaking, we do utilize the same electricity pool as every other state in the region, given the unique physical properties of electricity (i.e. electrons do not respect state borders).

While this may be true, Vermont's low carbon electricity contracts do impact the carbon intensity of the ISO-New England grid. **While we do not have control over the electricity that other states purchase, we can directly control what type of electricity we purchase.** It is also worth noting that, after California and Upstate New York, the "grid mix" from ISO-NE is still one of the lowest-emitting in the United States. For instance, charging an EV anywhere in ISO-NE territory is the equivalent of getting 150 miles per gallon from a GHG emissions perspective.[4]

1. Vermont Department of Public Service, 2019 Electric Utility Resource Survey, 2020.
2. ISO-NE, 2018 ISO New England Electric Generator Air Emissions Report, 2020.
3. Vermont Agency of Natural Resources, Vermont Greenhouse Gas Emissions Inventory and Forecast (1990–2017), 2021.
4. Union of Concerned Scientists, "Are Electric Vehicles Really Better for the Climate? Yes. Here's Why", 2020.

Vermont's Renewable Energy Standard: A lever for change

Vermont Renewable Energy Standard targets and compliance



Source: Vermont Department of Public Service, 2020.

Vermont's Renewable Energy Standard (RES) requires utilities to increase their share of electricity coming from renewable sources over time. **Data from 2019 shows that utilities have exceeded initial RES Tier I requirements, achieving 66% total renewable electricity for Vermont.** Tier I allows for Renewable Energy Credits (RECs) — which are the marketable property rights to the renewable attributes of power generation — to come from any source of renewable electricity. To date nearly 100% of Tier I RECs came from hydropower and the Hydro-Quebec System Mix. All utilities met the 2019 Tier II requirement of 2.2% small scale, in-state renewable electricity. Three Vermont utilities — Burlington Electric Department, Washington Electric Co-op, and Swanton Electric — are 100% renewable, pre- and post-REC. Additionally, Vermont Electric Co-op and Green Mountain Power have announced public commitments to be 100% renewable by 2030 (and 100% carbon-free by 2023 and 2025, respectively). [1]

Tier III of the RES requires utilities to either procure additional renewable distributed generation eligible for Tier II, or acquire fossil fuel savings from energy transformation projects that reduce fossil fuel use for their customers. In response, Vermont utilities have created programs that incentivize renewable technologies in the transportation and thermal sectors — such as electric vehicles and heat pumps. This aspect of the RES is one way that Vermont has started to promote a total energy transition through policy. **In 2019, all Vermont utilities met the Tier III requirement of 3.3% of their electric sales, primarily through energy transformation projects that reduced fossil fuels.[2]**

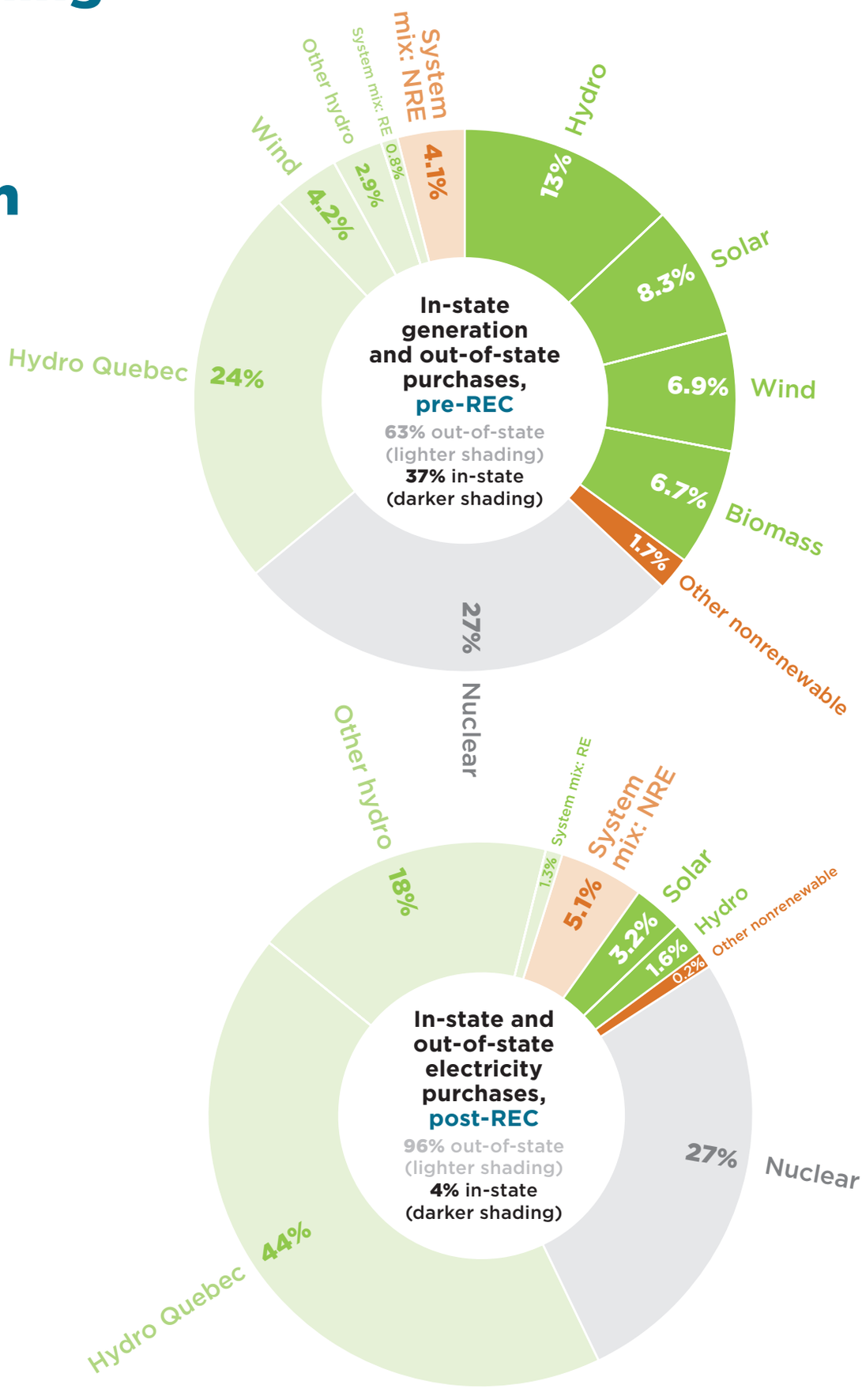
1. Vermont Department of Public Service, 2020.
2. Ibid.

Understanding where Vermont's electricity comes from

There are several ways to analyze Vermont's electricity profile. While we generate electricity from a variety of renewable sources in Vermont, the high-value Renewable Energy Credits (RECs) from many of those resources are sold. In 2019, Vermont utilities sold high-value solar, wind, and biomass RECs out of state, and bought lower cost hydro RECs to fulfill the first tier of Vermont's Renewable Energy Standard (RES).

Going a step further, we can also compare in-state and out-of-state electricity generation and purchases, both pre-and post-REC accounting. In 2019, 35% of pre-REC generation was composed of in-state renewables. This shifts down to 4% when looking at post-REC purchases.

Either way of looking at the data shows that Vermont's electricity consumption is 94%–95% carbon-free and less than 6% fossil fuel.



Source: Vermont Department of Public Service, 2019 Electric Utility Resource Survey, 2020.

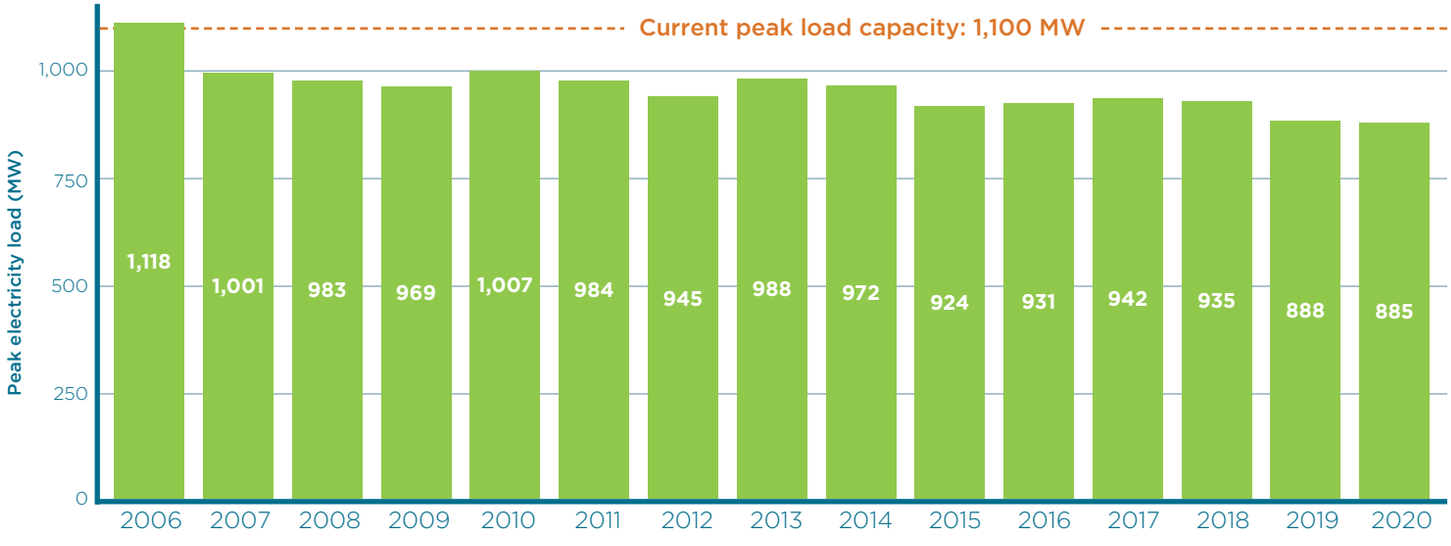
How will beneficial electrification impact Vermont's generation, transmission, and distribution systems?

Beyond a direct reduction in electricity sector emissions, a cleaner electricity mix has a second, much more powerful benefit. When Vermonters switch from fossil fuels to electricity — say for an electric vehicle, heat pump system, or other technology — we benefit from using the *having the least GHG intensive electricity portfolio of any state in the country* (either when measured based on in-state generation or based on in- and out-of-state purchases). Beneficial Electrification — or switching from fossil fuels to electricity for heating and transportation to achieve GHG and other pollution reductions — is more effective in Vermont than in any other U.S. state because of our our comparatively clean electricity portfolio.

Furthermore, thanks in large part to the great work done on electric efficiency by efficiency utilities Efficiency Vermont and Burlington Electric Department and new, in-state distributed renewable electricity generation, a significant amount of headroom now exists in our electric transmission and distribution system. **This means we can accommodate widespread beneficial electrification while saving all ratepayers money.**

The Vermont Electric Power Company (VELCO) reports that our electricity system is already capable of serving a peak load of about 1,100 megawatts. In both 2019 and 2020, Vermont's annual peak load was less than 890 megawatts (our historic high was 1,118 megawatts in 2006). For context, charging 100,000 EVs simultaneously would likely add about 100 MW to our peak load, and that's without accounting for EV control measures already in place.[1]

Vermont annual peak electricity load, 2006–2020



Source: VELCO, 2021; Vermont Department of Public Service, 2020; ISO-NE, 2021.

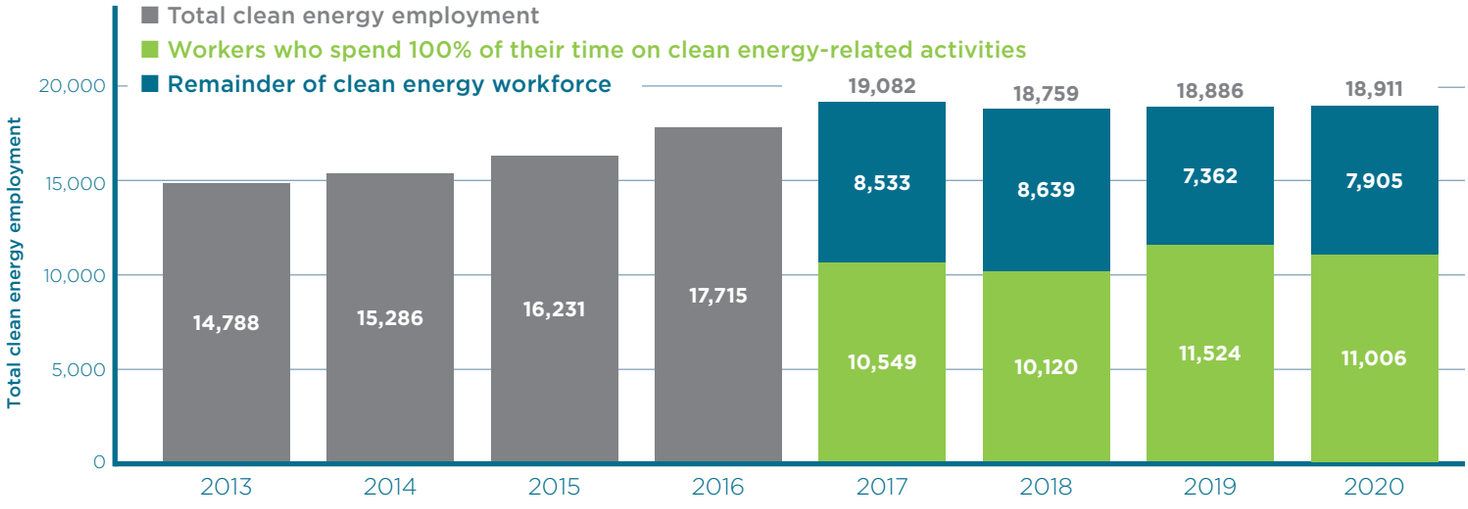
In short, our current transmission system is capable of handling high levels of electrification through 2030 (though relatively smaller scale upgrades at certain points on the distribution system will be necessary, and increased use of load flexibility may be needed). VELCO's 2021 Long-Range Transmission Plan specifically states that even when modeling a "high load" scenario through 2030 we are "able to address transmission concerns."[2] Beyond 2030, VELCO projects the heavy use of load management (for example, not charging EVs at periods of peak demand) and adjustments in tie-line flows as being increasingly necessary to accommodate high loads.

1. VELCO, Vermont Long-Range Transmission Plan Forecast, 2021.
2. VELCO, Vermont Draft Long-Range Transmission Plan, 2021

Beneficial electrification creates jobs for Vermonters, yet electricity is taxed more than heating fuels

As of January 2020 (pre-pandemic), Vermont had nearly 19,000 clean energy jobs, mostly in energy efficiency and renewable energy. Overall, clean energy jobs account for 6% of all jobs in Vermont, a concentration of clean energy employment two and a half times higher than the national average.[1]

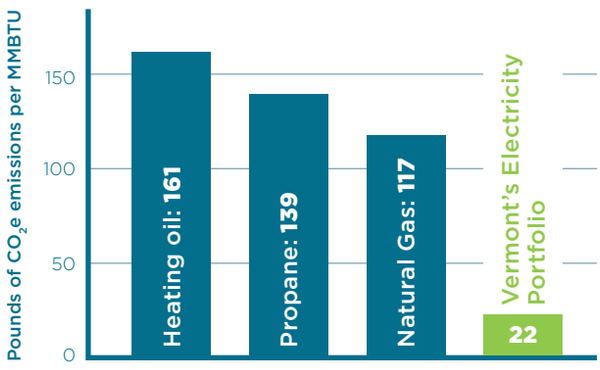
Vermont clean energy employment, 2014–2020



Source: Clean Energy Development Fund, Vermont Clean Energy Industry Report, 2020. Note: 2020 employment figures were released pre-pandemic.

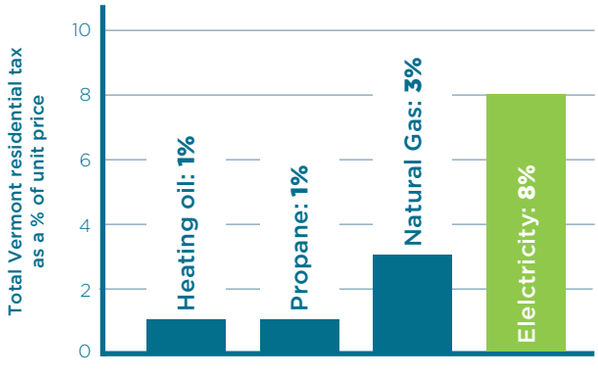
Beyond creating more Vermont jobs per dollar spent than fossil fuel, Vermont's electricity is much lower GHG emitting that any of the fossil fuel heating options. However, Vermont currently imposes higher taxes and fees on electricity while allowing the most polluting energy sources that hold Vermont's economy back — fossil fuels — to contribute the least to public investment.

Pounds of CO_2e emissions per MMBTU



Source: EIA, Emissions Factors for Greenhouse Gas Inventories, March 2020.

Vermont taxes and fees as percent of unit cost



Source: Vermont Department of Public Service, 2019; Vermont Fuel Dealers Association, 2021.

1. Clean Energy Development Fund, Vermont Clean Energy Industry Report, 2020.

Vermont statutory emissions requirements & administrative energy targets, 2020 status

OVERALL STATUS

Undetermined

Already met or on track to meet

Not met or not on track to meet

CHANGE FROM LAST YEAR'S EAN REPORT

Year-to-year progress flat

Increasing rate of year-to-year progress

Decreasing rate of year-to-year progress

	GOAL OR STATUTE	TARGET	TARGET DATE	STATUS 2019 EAN REPORT	STATUS 2020/1 EAN REPORT	TREND 2020
GHG EMISSIONS	**Act 153** (Vermont Global Warming Solutions Act of 2020): Reduce greenhouse gas emissions at least 26% below 2005 levels by 2025.	-26%	2025	-9% (2016)	-13% (2018)	↑
	Act 153 (Vermont Global Warming Solutions Act of 2020): Reduce greenhouse gas emissions at least 40% below 1990 levels by 2030.	-40%	2030	+5% (2016)	+0% (2018)	↑
	Act 153 (Vermont Global Warming Solutions Act of 2020): Reduce greenhouse gas emissions by 80% below 1990 by 2050.	-80%	2050	+5% (2016)	+0% (2018)	↑
TOTAL ENERGY	**CEP (2016):** Meet 90% of the state's energy needs through renewables — including thermal, transportation, and electric (Note: Energy sourced in-state and out-of-state)	90%	2050	24% (2016)	24% (2018)	→
	CEP (2016): Reduce total energy use (from 2010 levels) by over 30% by 2050 through efficiency and conservation, across thermal, transportation, and electric.	-30% 83 TBTU	2050	+1% 119 TBTU (2017)	+1% 120 TBTU (2018)	→
	30 V.S.A. 8002 (2015): RES Tier III - Require 2% of utility sales (BTU equivalency) in 2017 to reduce fossil fuel consumption, rising to 12% in 2032. Projects must be new, in-state, and in service in 2015 or later.	2% 12%	2017 2032	2.6% (2018)	3.3% (2019)	↑
	24 V.S.A. 4302(c)(7) (2016): Develop energy plans for regions and municipalities consistent with the CEP goals.	11 regions	2018 for RPCs Voluntary for towns	11 approved (regional) 38 approved (town) (2020)	11 approved (regional) 69 approved (town) (2021)	↑
TRANSPORTATION	**CEP (2016):** Reduce total transportation energy use by 20% from 2015 levels by 2025.	-20% 39.1 TBTU	2025	-2.6% 49.3 TBTU (2016)	-10% 45.3 TBTU (2018)	↑
	CEP (2016): Reduce transportation-emitted GHGs by 30% from 1990 levels by 2025.	-30% 2.32 $MMTCO_2e$	2025	+5% 3.49 $MMTCO_2e$ (2016)	+3% 3.43 $MMTCO_2e$ (2018)	→
	CEP (2016): Hold vehicle miles traveled (VMT) per capita to 2011 levels.	11,390	2030	11,888 (2017)	11,773 (2019)	↑
	CEP (2016): Reduce share of single- occupancy vehicle commute trips by 20% of 2011 levels (79.5%).	-20%	2030	+1.84 81.4% (2017)	+1.84 81.4% (2017)	N/A
	CEP (2016): Double the share of bicycle and pedestrian commute trips from 7.8% to 15.6%.	15.6%	2030	6.8% (2017)	7.7% (2018)	↑
	CEP (2016): Triple the number of state park-and-ride spaces from 1,142 to 3,426.	3,426	2030	1,639 (2019)	1,815 (2020)	↑
	CEP (2016): Increase public transit ridership by 110% to 8.7 million annual trips	8.7M	2030	4.74M (2018)	5.12M (2019)	↑
	CEP (2016): Increase Passenger Rail Trips: Quadruple Vermont-based passenger rail trips from 2011 levels (91,942) to 400,000 trips annually.	400,000	2030	96,696 (2018)	99,280 (2019)	↑
	CEP (2016): Increase the share of renewable energy in all transportation to 10% by 2025 and 80% by 2050.	10%	2025	6% (2018)	6% (2018)	N/A
	CEP (2016): Increase Renewably Powered Vehicles: Increase % of the vehicle fleet that are Electric Vehicles to 10% by 2025.	10%	2025	0.71% (2019)	0.8% (2020)	↑
THERMAL	**CEP (2016):** To reduce total fossil fuel consumption across all buildings by an additional one-half percent each year, leading to a total reduction of 6% by 2017 and 10% by 2025.	10%	2025	-6.1% 32.5 TBTU (2016)	+5.5% 36.5 TBTU (2018)	↓
	CEP (2016): Cold Climate Heat Pumps: Install 35,000 cold climate heat pump systems by 2025.	35,000	2025	16,255 (2018)	18,940 (2019)	↑
	CEP (2016): Increase wood's share of building heat to 35% by 2030.	35%	2030	26% (2016)	24.3% (2018)	↓
ELECTRICITY	**30 V.S.A. 8002 (2015):** RES Tier 1 - Total Renewable Electric - Obtain 55% of annual electric sales from renewables for each retail electricity provider in Vermont by 2017, and 75% by 2032. RECs retained (in-state and out-of-state).	55% 75%	2017 2032	62% (2018, site energy, post-REC)	64% (2019, post-REC)	↑
	30 V.S.A. 8002 (2015): RES Tier 2 – Distributed Generation - Require 1% of electric sales to come from distributed generation in 2017, rising to 10% by 2032. Projects starting in mid-2015 are eligible, and new NM and SO projects count if RECs are retired (in-state).	1% 10%	2017 2032	1.6% (2018)	2.20% (2019)	↑
	30 V.S.A. 8005a(c) (2011): Issue Standard Offer contracts to new SO plants until a cumulative capacity of 127.5 MW is reached (new plants 2.2MW or less commissioned on or after Sept 30, 2009) (in-state).	127.5 MW	2022	103.9 MW under contract 70.6 MW projects commissioned (2019)	112.97 MW under contract 69.86 MW projects commissioned (2020)	↑

SOURCES:
GHG Emissions: Vermont Agency of Natural Resources, Vermont Greenhouse Gas Emissions Inventory and Forecast (1990 - 2017), 2021.
Total Energy: ANR, 2020; EIA, 2018; PSD, Electric Retail Sales, 2020; Efficiency Vermont, 2020; VAPDA, 2021.
Transportation: EIA, 2018; Efficiency Vermont, 2020; Federal Highway Authority, Highway Statistics, 2020; U.S. Census Bureau, 2020; VTrans, 2020; American Community Survey, 2018, Vermont Transportation and Commute Statistics; Amtrak, 2020; Drive Electric Vermont, 2020.
Thermal: EIA, 2018; PSD, 2020; ANR, 2020; Efficiency Vermont, 2020.
Electricity: PSD, Electric Utility Resource Survey, 2019; PSD, Retail Sales, 2019; PSD, Electric Retail Sales, 2020; VEPP, 2020.

Meeting Vermont's emissions reduction requirements and renewable energy targets

Tracking Progress of Key Technology Pathways

SECTOR	UNIT	2010 Baseline	Latest Achieved[1]	2025 Energy Milestone[2]	2030 Energy Milestone[2]	2050 Energy Milestone[2]	EAN Target Description
TRANSPORTATION							
Electric Vehicles & Plug-in Hybrids	# of Vehicles	100	**3,912**	**46,000**	120,000	417,199	Total number of electric vehicles and plug-In hybrids
			0.84%	**10%**	26%	90%	% of light-duty vehicle fleet (LVF)
Light-Duty Vehicle Fleet Efficiency (LVF) (combustion engines only)	Fleet MPG	20.3	**22.7**	**24.8**	26.3	32.3	
		N/A	**12%**	**22%**	30%	59%	% fuel efficiency increase of LVF combustion engine fleet (over 2010)
Heavy Duty Transport & Commercial EVs	# of Vehicles	0	**6**	**86**	1,095	26,576	
				0%	3%	78%	% of Heavy Duty Fleet
Biofuels[3]	Million Gallons	28.7	**28.39**	**27.8**	26.5	15.5	
			5%	**5.6%**	7.1%	14.3%	% of total fuel use for combustion engine fleet (LVF, commercial, industrial). Aviation not included
Single Occupancy Vehicle Commute Reduction	% Commute Trips	79.2%	**81.4%**	**48%**	32%	14%	% of work commute trips in single occupancy vehicle
Public Transit Ridership Increase	Annual Riders (millions)	4.58	**5.12**	**8.24**	11.62	29.64	Total annual public transit ridership
			0.9%	**1.4%**	1.9%	5%	% of commuters on public transit
Total Transportation Electricity	TBTU		**0.05**	**0.9**	3.2	7.5	
Total Transportation Biofuels	TBTU		**2.62**	**2.28**	2.31	2.95	
Total Transportation Fossil Fuel Energy	TBTU		**42.6**	**37.8**	27.1	3.4	
Total Transportation Energy	TBTU	50.6	**45.4**	**41**	32.6	13.8	Total energy used for transportation
Renewable Energy Share	%	4.5%	**6%**	**10.1%**	21.8%	91%	% of total transportation energy from renewable resources
THERMAL							
Building Efficiency Savings	Buildings Weatherized	7,308	**29,289**	**80,000**	148,102	262,767	Cumulative buildings weatherized for efficiency
			10%	**28%**	52%	93%	% of housing units weatherized

Wood Heat	TBTU	10.2	**13.06**	**12.45**	11.55	10.80	Includes cordwood, pellets, and woodchips
		25%	**25%**	**26%**	26%	28%	% of heating demand met by biomass (Residential and Commercial)
Liquid Biofuels	TBTU	0	**0.28**	**1.80**	4.22	14.53	
		0%	**0.5%**	**3.7%**	9.5%	37.5%	% of heating demand met by liquid biofuels (residential & commercial)
Heat Pumps	Total # of heat pump systems	0	**18,940**	**70,000**	200,000	250,000	
	TBTU		**0.72**	**4.18**	12.86	16.80	Delivered thermal energy to buildings
Total Thermal Heat Load	TBTU	41.2	**51.66**	**48.43**	44.55	38.73	VT residential & commercial heating/cooling load
			25%	**18%**	8%	-6%	% energy reduction/increase for building heat over 2010
Total Industrial Heat & Process	TBTU	8.4	**6.8**	**6.6**	6.5	6.1	Thermal energy for industrial heat & manufacturing processes
Total Thermal	TBTU	49.6	**58.4**	**54.7**	47.9	38.1	Total thermal energy, including industrial process
Renewable Energy Share	%	22%	**26%**	**34%**	57%	95%	% of total thermal energy from renewable resources

ELECTRIC

Tier 1 Existing Renewables	GWh	N/A	**3,461**	**3,805**	4,561	6,363	Based on Tier 1 Requirements through 2030
		N/A	**55%**	**63%**	71%	N/A	Required Achievements
		N/A	**64%**	**70%**	76%	77%	Projected Achievements
Tier 2 In-State Renewables (solar, wind, hydro, methane)	GWh	N/A	**115**	**315**	528	1,653	Based on Tier 2 Requirements through 2030
		N/A	**1.6%**	**5.8%**	8.8%	N/A	Required Achievements
		N/A	**1.6%**	**5.8%**	8.8%	20%	Projected Achievements
Total Electric Consumption [4]	GWh	5,665	**5,406**	**5,436**	6,001	8,264	Total electric retail sales
Electric Renewable Share[5]	%	N/A	**66%**	**69%**	85%	97%	% of electricity sales from renewable resources (Post-REC) EAN projections for 2025-2050
Total Electric Energy Use (excluding transport & thermal)[6]	TBTU	18.6	**16.2**	**16.0**	16.0	20.0	Retail electrical use, excluding Transport and Thermal Sectors

Total Energy Demand	TBTU	119	**117**	**110**	94	69	Total site energy used in all sectors
Total Renewable Energy %[7]	%	21%	**24%**	**27%**	44%	92%	% of total site energy from renewable resources

1. Transportation data is the latest available from the Energy Information Administration (EIA) (2020), the UVM Transportation Research Center (2019, 2020), and Drive Electric Vermont (2020). Thermal data from EIA (2020), Efficiency Vermont (2020), VGS (2020), and the Department of Public Service (PSD) (2020). Electric data from the PSD (2020) and VELCO (2020).
2. Projections are those of the April 2021 EAN Emissions Reduction Pathways Model to meet State GHG emission targets.
3. Includes Light Vehicle Fleet (LVF) and Commercial-Industrial Fleet (CIF). Includes corn-based ethanol used as gasoline additive (5%).
4. VT 2018 Utility Retail Sales. 2050 GWH total based on EAN estimate.
5. Electric Renewable Energy % based on utility retail sales. Accounts for REC transactions.
6. Based on 2019 Vermont electric sector data. Allocations to Transportation and Thermal Sectors done by EAN.
7. Total Renewable Energy % is based on PSD site data and accounts for REC transactions after 2017.

Who We Are

Energy Action Network (EAN) consists of over 100 active members including businesses, non-profits, utilities and energy service providers, and institutions of higher education, along with over 100 local, state, and federal public partners. All EAN members share a mission of achieving Vermont's climate and energy commitments in ways that create a more just, thriving, and sustainable future for Vermonters.

Business and Finance

3E Thermal
Randy Drury, Fritz Fay

AllEarth Renewables
David Blittersdorf

Bee the Change
Mike Kiernan

Bourne's Energy
Peter Bourne, Levi Bourne, Jim Kurrle

Black Bear Biodiesel
Jim Malloy

Building Energy
Russ Flanigan

Built by Newport
Dave Laforce

Butternut Mountain Farm
David Marvin, Ira Marvin, Emma Marvin

Casella
Joe Fusco

Catalyst Financial
Bob Barton, Marianne Barton

Catamount Solar
Kevin McCollister

C.T. Donovan Associates, Inc.
Christine Donovan

Downs Rachlin Martin PLLC
John Hollar, Will Dodge

Dynapower
Adam Knudsen, Richard Morin

EAPC Wind Energy
Robert Sherman

Eco-Equipment Supply, LLC
Steven Wisbaum

Encore
Chad Farrell, Phillip Foy, Derek Moretz, Chad Nichols, Kate Desrochers

Energy Balance, Inc.
Andy Shapiro

Energy Co-op of Vermont
Brian Gray

Energy Futures Group
Richard Faesy, Chris Neme, Gabrielle Stebbins, Dan Mellinger, David Hill

Forward Thinking
Jeff Forward

Fresh Tracks Capital
Cairn Cross, Lee Bouyea

Gardener's Supply
Jim Feinson

Grassroots Solar
Bill Laberge

Green Lantern Group
Luke Shullenberger, Bill Miller, Sam Carlson, Ralph Meima, David Carpenter

KSV
Harrison Grubbs

Maclay Architects
Bill Maclay

MMR
Justin Johnson

Montpelier Construction
Malcolm Gray

National Life Group
Ross Sneyd

New Leaf Design
Tom Perry

Norwich Solar Technologies
Jim Merriam, Joel Stettenheim, Martha Staskus, Jacob Flanigan

NRG Systems
Justin Wheating, Anna Grady

Packetized Energy
Paul Hines

Pellergy
Andy Boutin

Pomerleau Real Estate
Ernie Pomerleau

Regulatory Assistance Project (RAP)
Rich Cowart, Rick Weston, David Farnsworth, Nancy Seidman

Reiss Building and Renovation
Chuck Reiss

Seventh Generation
Ashley Orgain

Stone Environmental, Inc.
Barbara Patterson, Nick Floersch, John Hanzas, Carleigh Cricchi

SunCommon
James Moore, Duane Peterson

Sunrun
Chris Rauscher

Sunwood Biomass
David Frank

Vanesse Hangen Brustlin, Inc (VHB)
Carla Fenner, Scott Johnstone

Vermont Economic Development Authority (VEDA)
Sam Buckley

Vermont Energy Contracting & Supply Corp.
Mark Stephenson

Vermont Green Building Network
Jenna Antonino DiMare

Vermont Housing and Finance Agency (VHFA)
Maura Collins, Chris Flannery

Vermont Wood Pellet Co.
Chris Brooks

VSECU
Rob Miller, Laurie Fielder, Simeon Chapin, Lisa LaSante, Valerie Beaudin

Nonprofits

Associated Industries of Vermont (AIV)
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Audubon Vermont
David Mears, Margaret Fowle

Biomass Energy Resource Center (BERC)
Adam Sherman

Building Performance Professionals Associations of Vermont (BPPA)
Jonathan Dancing, Malcolm Gray, Russ Flanigan, Chuck Reiss, Tom Perry

Capstone Community Action
Sue Minter, Paul Zabriskie

Champlain Valley Office of Economic Opportunity (CVOEO)
Dwight DeCoster

Climate Economy Action Center of Addison County
Spencer Putnam

Community Engagement Lab
Paul Gambill, Jenn Wood

Conservation Law Foundation
Jen Duggan

Drive Electric Vermont (DEV)
David Roberts

Fairbanks Museum
Adam Kane

Intervale Center
Travis Marcotte

Lake Champlain Regional Chamber of Commerce
Tom Torti, Catherine Davis, Austin Davis

Local Motion
Karen Yacos

NeighborWorks of Western Vermont (NWWVT)
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New England Grassroots Environmental Fund (NEGEF)
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Northeastern Vermont Regional Hospital
Laural Ruggles

Northern Forest Center
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Public Assets Institute
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Shelburne Farms
Marshall Webb, Megan Camp

Sustainable Heating Education Outreach
Jeff Rubin

Sustainable Transportation Vermont
Jack Hanson, Richard Watts, Brianna Jasset

Sustainable Woodstock
Michael Caduto, Jenevra Wetmore

The Nature Conservancy
Heather Furman, Phil Huffman, Lauren Oates, Eve Frankel

Vermont Businesses for Social Responsibility (VBSR)
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Vermont Climate and Health Alliance
Dan Quinlan

Vermont Council on Rural Development (VCRD)
Paul Costello, Jenna Koloski, Jon Copans, Margaret McCoy

Vermont Energy and Climate Action Network (VECAN)
Johanna Miller, Ian Hitchcock

Vermont Energy Education Program (VEEP)
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Vermont Energy Investment Corporation (VEIC)
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VT Independent Power Producers Association
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Vermont Interfaith Power and Light
Ron McGarvey, Richard Hibbert, Sam Swanson

Vermont Land Trust (VLT)
Nick Richardson, Abby White, Marc Mihaly

Vermont League of Cities and Towns (VLCT)
Abby Friedman

Vermont Natural Resources Council (VNRC)
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Vermont Passive House
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Vermont Public Interest Research Group (VPIRG)
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Vermont Sustainable Jobs Fund (VSJF)
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Vermont Vehicle and Automotive Distributors Association (VADA)
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Vital Communities
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Utilities

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Efficiency Vermont (EVT)
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Green Mountain Power (GMP)
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Hardwick Electric Department
Mary Westervelt

Vermont Electric Power Company (VELCO)
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Vermont Electric Cooperative (VEC)
Rebecca Towne, Andrea Cohen, Jake Brown

Vermont Gas
Neale Lunderville, Tiana Smith, Jill Pfenning, Tom Murray

Vermont Public Power Supply Authority (VPPSA)
Ken Nolan, Melissa Bailey, Julia Leopold

Washington Electric Co-op (WEC)
Patty Richards, Barry Bernstein, Roger Fox, Stephen Knowlton

Higher Education

Dartmouth College, Tuck School of Business
April Salas

Goddard College
Catherine Lowther

Middlebury College
Diane Munroe, Dan Suarez, Jon Isham

Northern Vermont University
Jason Shafer

Norwich University, Center for Global Resilience and Security
Tara Kulkarni

University of Vermont (UVM)
Jon Erickson, Richard Watts, Amy Seidl, Abby Bleything

UVM Extension
Sidney Bosworth, Sarah Tichonuk

UVM Gund Institute
Taylor Ricketts, Jeannine Valcour, Stephen Posner

UVM Transportation Research Center (TRC)
Greg Rowangould, Dana Rowangould, Jonathan Dowds

UVM Vermont Clean Cities Coalition
Peggy O'Neill-Vivanco

Vermont Law School
Kevin Jones

Vermont Technical College
Pat Moulton

Public Partners

LOCAL

Legislators: *Vermont's State Representatives and Senators*

Town Energy Committees: *Town Energy Committees from across Vermont*

Cities: *Burlington (Mayor Miro Weinberger), Montpelier (Mayor Anne Watson), South Burlington (Paul Conner, Director of Sustainability)*

REGIONAL

Regional Development Corporations: *Adam Grinold (Brattleboro Development Credit Corporation), Dave Snedeker, Alison Low, Irene Nagle (Northern Vermont Development Association)*

Regional Planning Commissions: *Adam Lougee, Andrew L'Roe (Addison), Peter Gregory, Geoff Martin (Two Rivers Ottauquechee), Jim Sullivan, Allison Strohl (Bennington County), Melanie Needle, Charlie Baker, Marshall Distel (Chittenden), Catherine Dimitruck, Linda Blasch (Northwest), Dave Snedeker, Alison Low (Northern Vermont Development Association), Chris Campany, Marion Major, Colin Bratton (Windham), Bonnie Waninger, Zachary Mia (Central Vermont)*

Green Mountain Transit Regional Transit Authority: *Chris Damiani*

STATE

Agency of Agriculture, Food and Markets: *Anson Tebbetts, Diane Bothfeld, Alex DePillis*

Agency of Commerce and Community Development: *Lindsay Kurrle, Ken Jones*

Agency of Natural Resources: *Julie Moore, Billy Coster*

Agency of Transportation: *Joe Flynn, Michele Boomhauer, Dan Dutcher, Ross McDonald, Dan Currier*

Department of Buildings and General Services: *Dan Edson*

Department of Environmental Conservation: *Peter Walke, Heidi Hales, Collin Smythe, Megan O'Toole*

Department of Financial Regulation: *Michael Pieciak*

Department of Forests, Parks and Recreation: *Michael Snyder, Sam Lincoln, Paul Frederick, Emma Hanson*

Office of Economic Opportunity (OEO): Low Income Weatherization: *Geoff Wilcox*

Public Service Department: *June Tierney, Ed McNamara, TJ Poor, Anne Margolis, Andrew Perchlik, Maria Fischer, Phillip Picotte, Ed Delhagen, Kelly Launder, Claire McIlvennie*

Vermont Public Utility Commission: *Anthony Z. Roisman, Margaret Cheney, Riley Allen, Tom Knauer*

Vermont Housing and Conservation Board (VHCB): *Gus Seelig, Jen Hollar, Craig Peltier*

Vermont Center for Geographic Information (VCGI): *John Adams, Tim Terway*

Vermont State Treasurer: *Beth Pearce*

FEDERAL

Office of Congressman Peter Welch: *Rebecca Ellis*

Office of Senator Bernie Sanders: *Katie Thomas, Haley Pero*

Office of Senator Patrick Leahy: *Tom Berry, Chris Saunders*

USDA Rural Development, VT/NH Office: *Jon-Michael Muise, Ken Yearman*

2021 Board of Directors & EAN Staff

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L.W. Seddon Consulting, President

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REBECCA FOSTER
VEIC, Chief Executive Officer

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Energy Co-op of Vermont, General Manager

LINDA MCGINNIS
EAN Senior Fellow

DARREN SPRINGER
Burlington Electric Department, General Manager

SARAH BROCK
Vital Communities, Energy Program Manager

RICHARD COWART
Regulatory Assistance Project, Principal

NEALE LUNDERVILLE
VGS, President & Chief Executive Officer

STEPHANIE YU
Public Assets Institute, Deputy Director

Additional Senior Fellows:

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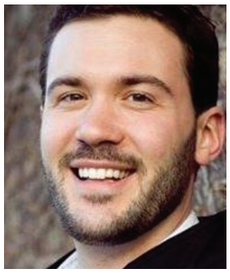
Center for Sustainable Energy (CSE), Senior Director, Transportation and DER Markets

CHRISTINE DONOVAN
CT Donovan Associates, President and Founder

Staff



JARED DUVAL
Executive Director

CARA ROBECHEK
Network Manager

MEI BUTLER
Dashboard and Data Manager

Thank you!

EAN's 2021 Annual Progress Report for Vermont is a collaborative effort, reflective of our diverse network members and public partners. We would like to thank the following agencies and organizations for their contributions to the content, data, and analysis within the report: the Vermont Department of Public Service, Vermont Agency of Natural Resources, Vermont Agency of Commerce and Community Development, Vermont Agency of Transportation, the Vermont Energy Investment Corporation, and the UVM Transportation Research Center.

The primary co-authors of the report are EAN's core staff — Jared Duval, Mei Butler, Cara Robechek, and Carolyn Wesley — and EAN Senior Fellow Leigh Seddon. Design and layout is by Dana Dwinell-Yardley: ddydesign.com.

Mission & goals

Energy Action Network (EAN) works to achieve Vermont's climate and energy commitments in ways that create a more just, thriving, and sustainable future for Vermonters.

EAN is working to help Vermont meet the requirements of the Global Warming Solutions Act, which includes reducing greenhouse gas pollution to 26% below 2005 levels by 2025, to 40% below 1990 levels by 2030, and to 80% below 1990 levels by 2050, and to meet the goals of the Comprehensive Energy Plan, including achieving 90% of Vermont's total energy needs from renewable sources by 2050.

Collective impact approach

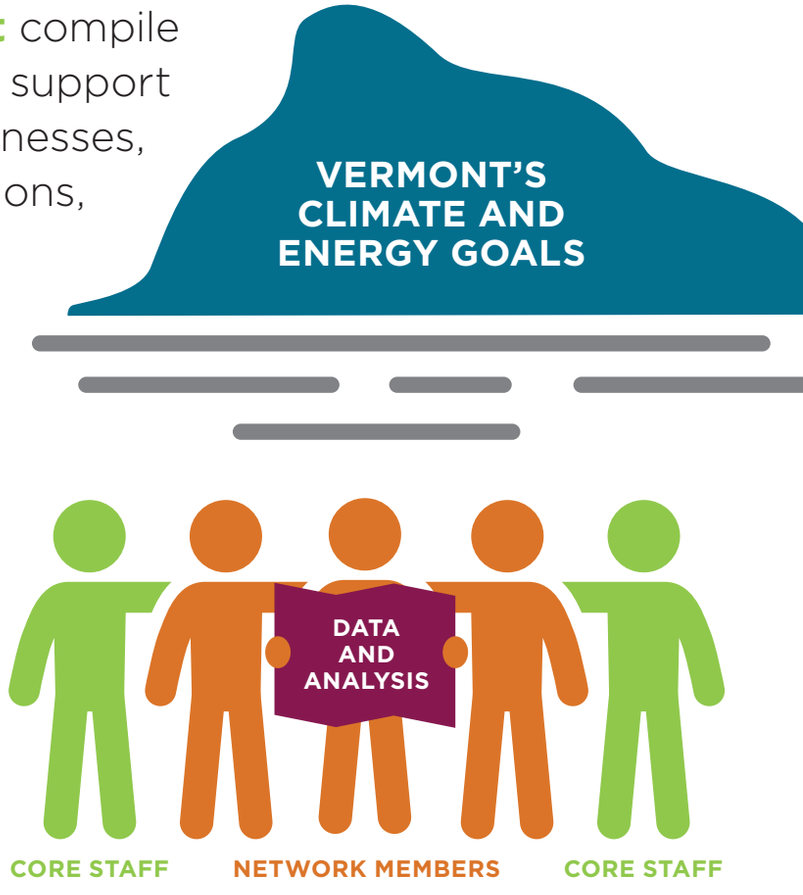
Energy Action Network (EAN) is a diverse network of nonprofits, businesses, public agencies, and other organizations working together in a collective impact framework and supported by a core staff to further the Network's mission.

We approach our work together through two key lenses:

1) Total energy transformation: We work toward efficient and renewable energy use across *all* sectors.

2) Strategic leverage areas: We work to enable systemic change at a scale and pace necessary to achieve Vermont's energy and emissions commitments, focusing on Policy & Regulatory Reform, Capital Mobilization, Public Engagement, and Technology Innovation. We also support Network Action Teams working on strategic projects identified and selected by the Network.

The core staff of the EAN Nonprofit compile **data and analysis,** and convene and support the **EAN Network** of nonprofits, businesses, public agencies, and other organizations, as we journey together to achieve **Vermont's climate commitments and energy goals.**



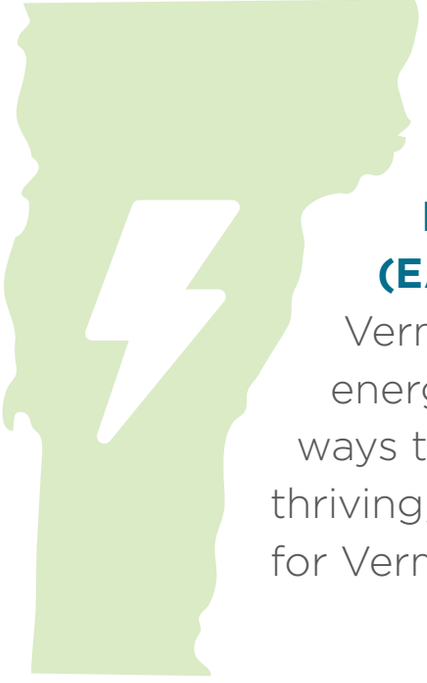
The core staff of EAN supports the work of Network members in the following ways:

- **Steward a common agenda** for Network members and partners.
- **Collect data and measure results** through regular tracking and analysis.
- **Coordinate mutually reinforcing activities** to develop, share, and advance high-impact ideas.
- **Ensure continuous communication** to and across the Network.

ENERGY ACTION NETWORK

17 State Street, Suite 205, Montpelier, VT 05602

EANVT.ORG
VTENERGYDASHBOARD.ORG



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