Energy Action Network Members

Over 100 Network Members
Energy Action Network Public Partners

Over 100 Public Partners
Vermont’s historic emissions and future requirements

GWSA requirement: 26% reduction below 2005 levels by 2025
GWSA requirement: 40% reduction below 1990 levels by 2030
GWSA requirement: 80% reduction below 1990 levels by 2050

Source: Vermont Greenhouse Gas Inventory: 1990-2016, Vermont Agency of Natural Resources, 2020
Vermont’s GHG emissions by sector

TOTAL = 9.76 MMTCO$_2$e (2016)

* TOTAL ENERGY USE ACCOUNTS FOR 80% OF VT’S GHG EMISSIONS

<table>
<thead>
<tr>
<th>Sector</th>
<th>Emissions (MMTCO$_2$e)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRANSPORT</td>
<td>4.34</td>
<td>44.5%</td>
</tr>
<tr>
<td>BUILDING THERMAL</td>
<td>2.68</td>
<td>27.5%</td>
</tr>
<tr>
<td>AGRICULTURE</td>
<td>1.19</td>
<td>12.2%</td>
</tr>
<tr>
<td>ELECTRIC GENERATION</td>
<td>0.81</td>
<td>8.3%</td>
</tr>
<tr>
<td>INDUSTRIAL PROCESSES</td>
<td>0.58</td>
<td>5.9%</td>
</tr>
<tr>
<td>WASTE</td>
<td>0.15</td>
<td>1.5%</td>
</tr>
</tbody>
</table>
Total net change in VT GHG emissions, 1990 vs 2016: 1.11 MMTCO2e
Per capita emissions

(metric tons CO2e per person)
Wealthier Vermonters Consume More Heating Fuels and Electricity than Lower-Income Vermonters
Upper-Income VTers: Higher Avg. Vehicle Fuel Expenditures; Rural Drivers Higher than Urban

Vermont 2009 Annual Vehicle Fuel Expenditure by Income and Location-Type

- Location Type:
  - Urban
  - Rural

<table>
<thead>
<tr>
<th>Income Group</th>
<th>Annual Vehicle Fuel Expenditure (US Dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than $20,000</td>
<td></td>
</tr>
<tr>
<td>$20,000 - $39,999</td>
<td></td>
</tr>
<tr>
<td>$40,000 - $59,999</td>
<td></td>
</tr>
<tr>
<td>$60,000 - $79,999</td>
<td></td>
</tr>
<tr>
<td>$80,000 - $99,999</td>
<td></td>
</tr>
<tr>
<td>More than $100,000</td>
<td></td>
</tr>
</tbody>
</table>
Upper-income Rural NE Drivers Drive More Miles On Avg. than Lower-income Rural NE Drivers

Average Annual Miles Driven per Rural NE Household Driver by Income

- Less than $25,000
- $25,000 - $49,000
- $50,000 to $74,999
- $75,000 to $99,999
- $100,000 to $124,999
- $125,000 to $149,999
- $150,000 to $199,999
- $200,000 or more
Sources of VT’s Transportation GHG Emissions

- Onroad Gasoline
- Onroad Diesel
- Jet Fuel & Aviation
- Gasoline
- Other Nonroad

Onroad Gasoline

Jet Fuel & Aviation

Gasoline

Other Nonroad

Onroad Diesel
Vermont Has the Highest Vehicle Miles Traveled (VMT) Per Capita in the Region

Vehicle miles traveled per capita, 2015

- **VT**: 11,698
- **ME**: 11,014
- **NH**: 9,799
- **CT**: 8,807
- **MA**: 8,722
- **RI**: 7,417
- **NY**: 6,473
Vermont Has the Highest Vehicle Miles (VMT) Per Capita in Northern New England

Vehicle miles traveled per capita

Source: Federal Highway Authority: Highway Statistics; US Census Bureau
As cars get more efficient, we’re buying bigger cars

<table>
<thead>
<tr>
<th>Year</th>
<th>Light trucks/SUVs</th>
<th>Passenger cars</th>
<th>Average fleet MPG</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>55%</td>
<td>45%</td>
<td>20.7 MPG</td>
</tr>
<tr>
<td>2013</td>
<td>59%</td>
<td>41%</td>
<td>20.9 MPG</td>
</tr>
<tr>
<td>2014</td>
<td>65%</td>
<td>35%</td>
<td>21.4 MPG</td>
</tr>
<tr>
<td>2015</td>
<td>69%</td>
<td>31%</td>
<td>21.8 MPG</td>
</tr>
<tr>
<td>2016</td>
<td>72%</td>
<td>28%</td>
<td>22.1 MPG</td>
</tr>
<tr>
<td>2017</td>
<td>74%</td>
<td>26%</td>
<td>22.4 MPG</td>
</tr>
<tr>
<td>2018</td>
<td>80%</td>
<td>20%</td>
<td>22.6 MPG</td>
</tr>
<tr>
<td>2019</td>
<td>84%</td>
<td>16%</td>
<td>22.7 MPG</td>
</tr>
</tbody>
</table>
Vermont heating energy sources

- Heating oil: 32%
- Natural gas: 23%
- Cordwood: 19%
- Propane: 17%
- Wood chips: 3.2%
- Renewable electricity: 2.8%
- Nonrenewable electricity: 1.7%
- Wood pellets: 1.2%
- Other renewable: 0.1%
GHG Emissions from Thermal Fuel Use in VT

RCI Total: 2.68 MMTCO2e

- Residential 52% (1.39 MMTCO2e)
- Commercial 32% (.86 MMTCO2e)
- Industrial 16% (.42 MMTCO2e)

Path to Paris: 2.3 MMTCO2e reduction by 2025

TRANSPORTATION: 34%
- 3,541 EVS (2019)
- 22.7 MPG (2018)
- 81% of work commutes (2017)

- ADD 90,000 EVS
- INCREASE NON-EV FLEET MPG BY 5%
- REDUCE SOLO COMMUTES

0.405
18%

THERMAL: 39%
- 17,717 HEAT PUMP SYSTEMS (2019)
- 21,421 PELLET UNITS (2018)
- 27,186 BUILDING RETROFITS (2018)
- 11,687 HEAT PUMP WATER HEATERS (2018)

- ADD 25,000 ADVANCED WOOD HEAT SYSTEMS
- ADD 90,000 ADD’L RETRO-FITS

0.370
16%

ELECTRICITY: 16%
- 1,000 GWh from new solar, wind, or hydro

0.373
16%

OTHER: 11%
- 62% of generation (2019)
- OTHER REDUCTIONS

0.25
*Draft* Modeled Thermal Pathways: 2025 and 2030

Thermal goals for 2025 and 2030

Source: EAN Pathways Analysis
*Draft* Modeled Transportation Pathways: 2025 and 2030

Transportation goals for 2025 and 2030

ELECTRIC VEHICLES
- 2018: 4K EVs
- 2025: 60K EVs
- 2030: 190K EVs

ALTERNATIVE COMMUTE OPTIONS
- 2018: 2.8K bus riders
- 2025: 4.5K bus riders
- 2030: 6.3K bus riders

BIOFUELS
- 2018: 4.5 million gallons
- 2025: 11.2 million gallons
- 2030: 26.7 million gallons

HIGH EFFICIENCY VEHICLES
- 2018: 12K hybrids
- 2025: 35K hybrids
- 2030: 86K hybrids

HEAVY DUTY AND BUS ELECTRIFICATION
- 2018: 6 EVs
- 2025: 55 EVs
- 2030: 399 EVs

Source: EAN Pathways Analysis
Modeled emission reductions for 2030

*Draft* Findings

EAN’s GWSA Pathways Analysis: 2030

**Total reductions of 3.83 MMTCO₂e for Vermont to meet its statutory emission goals**

**THERMAL**
30% OF EMISSIONS

- **Advanced Wood Heat** 0.59 MMTCO₂e
- **Other** 0.20 MMTCO₂e
- **Heat Pumps** 0.32 MMTCO₂e
- **Weatherization** 0.11 MMTCO₂e
  - **Renewable Natural Gas** 0.11 MMTCO₂e
  - **Hot H2O Heat Pumps** 0.05 MMTCO₂e

**TRANSPORTATION**
47% OF EMISSIONS

- **Electric Vehicles** 0.76 MMTCO₂e
- **Alternative Commute Options** 0.24 MMTCO₂e
  - **Biofuels** 0.45 MMTCO₂e
- **High Efficiency Vehicles** 0.18 MMTCO₂e
- **Other** 0.02 MMTCO₂e

**ELECTRICITY & OTHER**
23% OF EMISSIONS

- **Electricity** 0.01 MMTCO₂e
- **Agriculture** 0.46 MMTCO₂e
- **Industrial** 0.26 MMTCO₂e

Source: EAN Pathways Analysis
Key Findings of GWSA Pathways Analysis

• Meeting our emissions reductions targets is possible – we have the technology and know-how.

• To do so, we will need to follow best-practice demonstrated by other countries, provinces, and states. Broadly:

  • Dis-incentivize polluting fuels and equipment
  • Incentivize clean energy and equipment
  • Use performance standards and consumer protection regulations to phase out the sale of inefficient and polluting equipment.

• Doing so can mean significant cost-savings for Vermonters and improvement of the Vermont economy.
Electric vehicles are less expensive to drive than gas vehicles.

Renewable heating options are usually lower cost and more price stable than fossil fuel options.
Economic impacts of EAN’s Path to Paris: 2020 - 2035

- DECREASE in out-of-state spending: $1.115 billion
- INCREASE in in-state investment: $323 million
- Net consumer savings: $792 million
FOSSIL FUELS

- 25% ($500 million) Recirculates in the VT economy
- 75% ($1.5 billion) Leaves the VT economy

ELECTRICITY

- 62% ($495M) Recirculates in the VT economy
- 38% ($297M) Leaves the VT economy

WOOD

- 80%² ($92M) Recirculates in the VT economy
- 20% ($23M) Leaves the VT economy

[Legend: Green = Recirculates in the VT economy, Orange = Leaves the VT economy]
Vermont clean employment growth by technology, 2014–2019

**ENERGY EFFICIENCY**
- 2014: 7,800
- 2015: 7,974
- 2016: 8,585
- 2017: 10,610
- 2018: 10,570
- 2019: 10,708

**RENEWABLE ENERGY**
- 2014: 4,546
- 2015: 5,111
- 2016: 6,965
- 2017: 6,529
- 2018: 6,263
- 2019: 6,114

**CLEAN TRANSPORTATION**
- 2014: 666
- 2015: 792
- 2016: 929
- 2017: 1,276
- 2018: 1,259
- 2019: 1,397

**OTHER**
- 2014: 1,147
- 2015: 1,214
- 2016: 1,236
- 2017: 666
- 2018: 667
- 2019: 667
Vermont median hourly wages for clean energy jobs

<table>
<thead>
<tr>
<th></th>
<th>RENEWABLE ENERGY</th>
<th></th>
<th>ENERGY EFFICIENCY</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Entry</td>
<td>Mid</td>
<td>High</td>
<td>Entry</td>
</tr>
<tr>
<td><strong>Electricians</strong></td>
<td>$13.57</td>
<td>$19.43</td>
<td>$28.89</td>
<td>$18.91</td>
</tr>
<tr>
<td><strong>HVAC workers</strong></td>
<td>$13.10</td>
<td>$20.77</td>
<td>$32.66</td>
<td>$18.43</td>
</tr>
<tr>
<td><strong>Installation, maintenance, and repair technicians</strong></td>
<td>$13.10</td>
<td>$20.77</td>
<td>$32.66</td>
<td>$14.84</td>
</tr>
<tr>
<td><strong>Sales representatives</strong></td>
<td>$17.60</td>
<td>$28.71</td>
<td>$56.74</td>
<td>$30.55</td>
</tr>
<tr>
<td><strong>Engineers</strong></td>
<td>$24.99</td>
<td>$37.21</td>
<td>$56.61</td>
<td>$23.78</td>
</tr>
</tbody>
</table>
What is Energy Burden?

Energy burden measures the percent of income used for energy spending. This measurement allows us to acknowledge that energy spending does not affect everyone equally.

\[
\text{Quantity of energy consumed} \times \text{price of energy} = \text{Spending on energy}
\]

\[
\frac{\text{Spending on energy}}{\text{Income}} = \text{Energy burden}
\]

Energy Burden and Income

Lower-income Vermonters purchase much less energy than upper income Vermonters…
... but spend a far greater proportion of their income on energy than do upper income Vermonters.
Lower-income households use fuel oil and electricity disproportionately more frequently and utility gas and wood disproportionately less frequently than higher-income households.
Renting as a Barrier to Affordable Fuel

- Split incentives discourage energy upgrades in low-income households
- Renters use wood disproportionately less than homeowners
- Renters use electricity (resistance) disproportionately more than homeowners
Renting as a Barrier to Affordable Fuel

Tertile 1: Less than $39,560
Tertile 2: $39,560 to $85,000
Tertile 3: More than $85,000
Low-income households purchase the least amount of energy, have the highest energy burden, and suffer the most intensely from energy burden.
Upper-Income VTers: Higher Avg. Vehicle Fuel Expenditures; Rural Drivers Higher than Urban

Vermont 2009 Annual Vehicle Fuel Expenditure by Income and Location-Type

- **Location Type**
  - Urban
  - Rural

**Annual Vehicle Fuel Expenditure (US Dollars)**

- Less than $20,000
- $20,000 - $39,999
- $40,000 - $59,999
- $60,000 - $79,999
- $80,000 - $99,999
- More than $100,000

In the chart, it is evident that rural drivers incur higher average vehicle fuel expenditures compared to their urban counterparts across all income groups.
Upper-Income Northeasterners Have Higher Avg. Vehicle Fuel Expenditures; Rural Drivers Higher than Urban

Northeast 2017 Annual Vehicle Fuel Expenditure by Income and Location-Type

Source: US Department of Transportation, 2017 National Household Travel Survey
Lower-income VT’ers Spend a Higher Share of Income on Vehicle Fuel than Upper-income VT’ers

Vermont 2009 Annual Vehicle Fuel Expenditure Burden by Income and Location-Type

Annual Vehicle Fuel Expenditure as an Estimated Percentage of Income

Income Group:
- Less than $20,000
- $20,000 - $39,999
- $40,000 - $59,999
- $60,000 - $79,999
- $80,000 - $99,999
- More than $100,000

Location Type:
- Urban
- Rural

Chart showing the annual vehicle fuel expenditure burden for different income groups and location types.
Lower-income Rural NE’ers Spend a Higher Share of Income on Vehicle Fuel than Upper-income Rural NE’ers

Northeast 2017 Estimated Annual Vehicle Fuel Expenditure Burden by Income and Location-Type

Source: US Department of Transportation, 2017 National Household Travel Survey
Lower-income Rural NE’ers Tend to Drive Older Vehicles Than Upper-income Rural NE’ers

Rural NE 2017 Household Average Vehicle Age by Income
Upper-income Rural NE Drivers Drive More Miles On Avg. than Lower-income Rural NE Drivers

Average Annual Miles Driven per Rural NE Household Driver by Income

- Less than $25,000
- $25,000 - $49,000
- $50,000 to $74,999
- $75,000 to $99,999
- $100,000 to $124,999
- $125,000 to $149,999
- $150,000 to $199,999
- $200,000 or more

Average Miles Traveled

0 5000 10000 15000

Income Group
Electric and Hybrid Vehicles are Much Less Expensive to Drive, per Mile Traveled

Average Cost per Mile Traveled by Vehicle Fuel Type in 2017

Source: US Department of Transportation, 2017 National Household Travel Survey
## Electric vehicle incentives

<table>
<thead>
<tr>
<th></th>
<th>NISSAN LEAF (ELECTRIC)</th>
<th>NISSAN SENTRA (GAS)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Starting Price</strong></td>
<td>$31,600</td>
<td>$19,310</td>
</tr>
<tr>
<td>Federal Tax Credit</td>
<td>-$7,500</td>
<td>-$0</td>
</tr>
<tr>
<td>State Incentive</td>
<td>-$2,500</td>
<td>-$0</td>
</tr>
<tr>
<td>OEM Discount</td>
<td>-$6,000</td>
<td>-$0</td>
</tr>
<tr>
<td>Utility Incentive</td>
<td>-$1,500</td>
<td>-$0</td>
</tr>
<tr>
<td><strong>Price after Incentives</strong></td>
<td><strong>$14,100</strong></td>
<td><strong>$11,600</strong></td>
</tr>
</tbody>
</table>
Six Initial Takeaways re: Transportation Equity

• 1. Upper-income Vermonters consume more transportation fuel than lower-income Vermonters

• 2. However, lower-income Vermonters spend a far higher share of their income on transportation fuels

• 3. The lowest-income rural NE drivers drive vehicles about 12 years old (vs. upper-income, at approx. 8 years old)

• 4. Upper-income rural NE drivers ($>100k household income) drive many more miles than the lowest-income NE drivers ($<$25k hh income) -- 15k miles/yr. vs. 10k miles/yr.

• 5. Electric and hybrid vehicles are much less expensive to drive per mile (fuel and maintenance savings).

• 6. After incentives, many EVs are already less expensive up-front than comparable gas models
Key Takeaways

• We can meet our emissions reduction requirements with proven and available technologies and best practices.

• To do so, we will need a major focus on moving beyond fossil fueled transportation and heating.

• Doing so is a major opportunity to strengthen the Vermont economy, create good-paying jobs, save Vermonters money, and improve equity.