A Review of Home Heating Energy Efficiency in Vermont

Presented to the Vermont Senate Committee on Natural Resources and Energy

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Background

- Global Warming Solutions Act (2020)
- Climate & Energy Plans
- Energy Efficiency Programs
- Energy Inequity

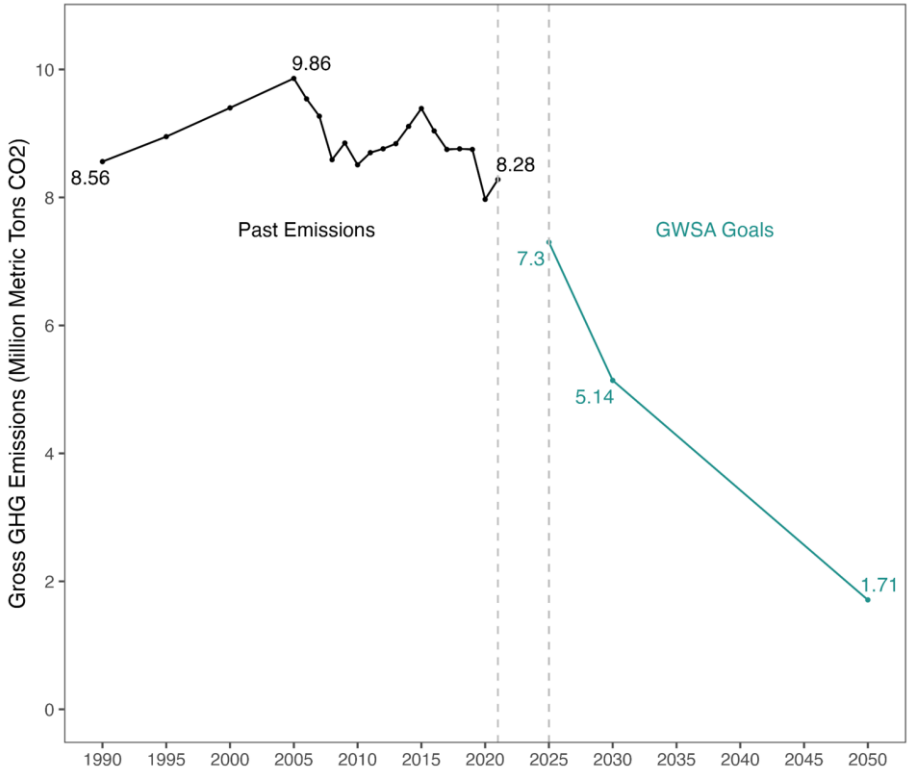

Figure 1: Past Emissions and Global Warming Solutions Act Emissions Goals, 1990-2050
Source: Vermont Agency of Natural Resources

Problem Statement

What policies would be the most cost-effective and equitable for achieving Vermont's climate and energy goals in the thermal sector?

Methodology

1. Literature Review

2. Expert Interviews
    - 15 expert interviews and consultations

3. Data Analysis
    - Regression models and future projections

4. Maine Case Study

What Energy Upgrades are Available to Households in Vermont?

Weatherization

Average Weatherization Assistance Program Project Nearly $12,000.

Weatherization work less desirable than new construction.

Weatherization important for older housing stock, mobile homes.

25%

of Vermont homes were built before 1940

Cold-climate Heat Pumps

Average Whole-home heat pump installation costs over $15,000 in VT

Savings outweigh costs for homes currently using fuel oil and propane
→ Positive present value

More efficient in weatherized homes

Necessary as cooling needs increase

Biofuel

What is biodiesel vs. renewable diesel?

Factor	Biodiesel	Renewable Diesel
Heating Usage	Requires blending	100% replacement
Carbon reduction	Up to 78%	Up to 85%
Cold-weather performance	Can gel in cold temperatures	Good
Availability	Some regional production	Imported from other regions

Source: Hui Xu et al

Natural Gas

Natural gas cleaner than fuel oil and propane
Not as clean as biofuel and heat pumps

Renewables projected 56% of electric production, 2040
→ Gains from heat pumps increase

Natural gas cheap in coverage territory
Expansion not cost-effective

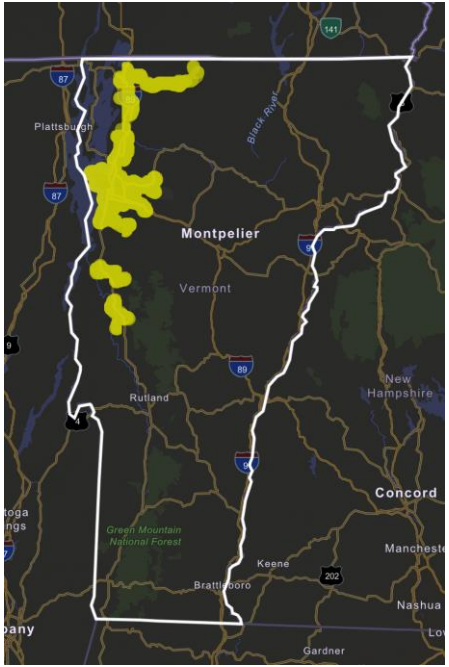

Figure 2: Map of Vermont Gas Systems Coverage
Source: Vermont Gas Website

What Prevents Households from Installing Energy Efficiency Upgrades?

The Energy Efficiency Gap

Can lower income households access energy efficiency upgrades?

Towns with higher income have more heat pumps per house, in VT

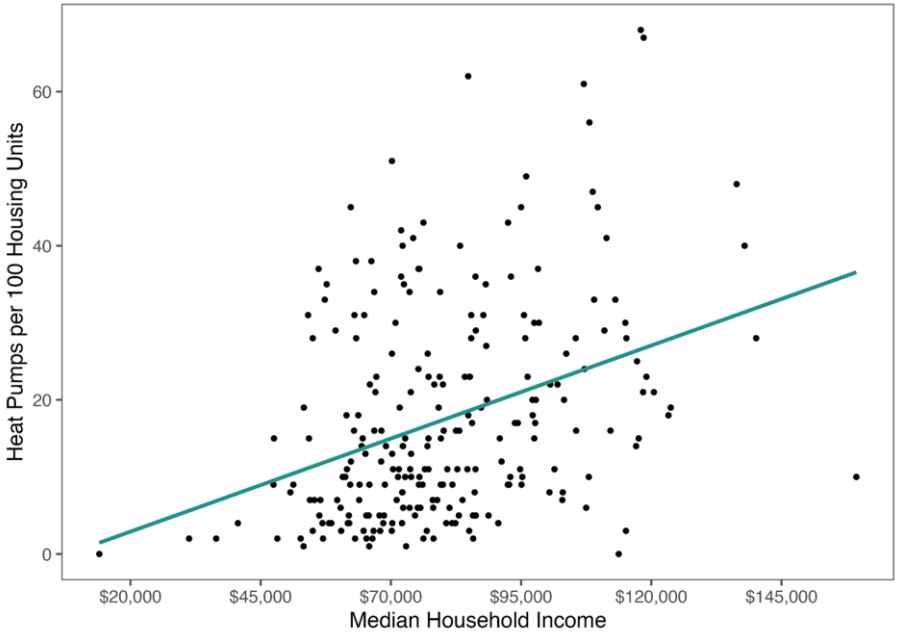

Figure 3: Median Household Income and Heat Pumps Adoption by Town, 2023
Source: Authors' calculations using Energy Action Network, 2023 American Community Survey, and 2020 Census data

The Energy Efficiency Gap

Do homebuyers consider the cost of energy when purchasing a home?

- Weatherized homes are 3-5% more expensive
- Homes with heat pumps are 4-7% more expensive

Yes, homebuyers accurately consider energy savings from more efficient homes.

However, homebuyers vs. homeowners face different barriers

Barriers to Energy Efficiency Upgrades for Homeowners

High Upfront Cost

- Weatherization and heat pump projects cost $10,000+

High Discount Rate

- Present value of future savings is lower → less adoption
- Discount rate increases as income decreases

Lack of Attention and Knowledge

- Homeowners may not have time, knowledge of programs

Risk

- Individual risk of weatherization or heat pump nonperformance
- Correlated risk of change in energy prices

What Policies Could Increase Energy Efficiency Upgrade Adoption?

Policy Evaluation Criteria

1. Cost-effectiveness
    - Government expenditures or impact on consumer prices
    - Maximizing welfare gains, minimizing excess subsidy

2. Progress made toward climate and energy goals
    - GHG emissions abatement

3. Equitable distribution of energy burden focusing on low- and moderate-income households
    - Progressive vs. regressive

Policy Proposals

Policy Proposal	Cost-effectiveness	Progress Towards Goals	Equity
1. Clean Heat Standard	□	□	□
2. Fuel Tax Increase	□	□	□
3. Thermal Efficiency Benefit Charge	□	□	□
4. Biofuels Blending Requirement	□	□	□
5. Low-interest Financing Programs	□	□	□
6. EEU Modifications	□	□	□

1. Clean Heat Standard (CHS)

Requires fuel distributors to offset GHG emissions using clean heat credits

Cost: $955,923,033 in the first 10 years

- Cost passed to consumers in fuel prices

Climate Goals: Predicted 2.07 million metric tons of CO2 reduction

Equity: Low-income and rural Vermonters may face challenges accessing services, and small fuel distributors could struggle with implementation

2 & 3. Fuel Tax and Thermal Efficiency Benefit Charge

Year	Fuel Tax Revenue ($0.02 / gallon)
2018	$4,948,704
2019	$5,083,792
2020	$4,693,089
2021	$4,719,194
2022	$4,708,314
2023	$4,402,747
Average	$4,735,371

Source: Vermont Department of Taxes

Levies an additional charge on fuel oil and propane sales

Cost: Raise the price of fuel by an amount approximately equal to the tax

Climate Goals: Disincentivize fuel consumption and fund clean heat initiatives

Equity: Disproportionately burden lower-income households

4. Biofuels Blending Requirement

Requires heating oil to be blended with increasing percentages of biofuel

Cost: Depends on cost of importing biofuels from other states

Climate Goals: 4.8 million metric tons of CO2 by 2050

Equity: Disproportionately impact low-income households, and small fuel distributors

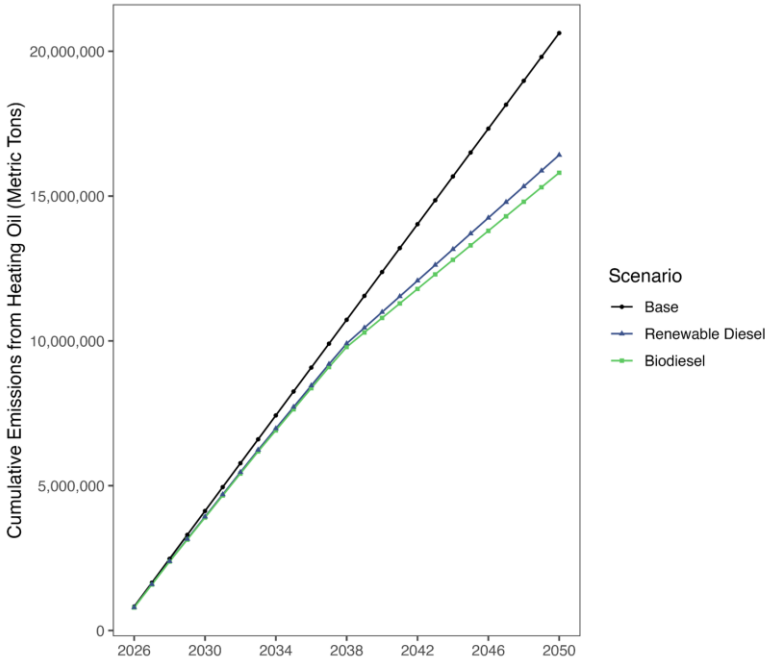

Figure 4: Emissions Abated by Biofuel Blending Requirements, 2026-2050 Forecast
Source: Authors' calculations

5. Low-interest Financing Programs

Scenario	a. High-efficiency purchase	b. High-efficiency purchase using excess subsidy
1. Base Rebate	53.4%	37.9%
2. Double Rebate	56.9%	36.4%
3. Loan and Base Rebate	60.7%	33.7%
Aim to:	*Maximize*	*Minimize*

Source: Kenneth E. Train and Terry Atherton

Provides households low-interest home energy loans for energy efficiency upgrades

Cost: Financing more cost-effective than rebates

Climate Goals: Increases adoption of energy efficiency upgrades

Equity: Progressive and resolves barriers to adoption

6. Energy Efficiency Utility (EEU) Modifications

Shift EEUs' focus towards reducing greenhouse gas (GHG) emissions through a climate mandate and restructuring project completion rules.

Cost: Optimizes budgets for climate goals without increasing overall funding.

Climate Goals: Prioritize carbon reduction alongside energy savings to align EEUs with Vermont's climate objectives.

Equity: EEUs' existing low-income programs ensure equitable access to energy efficiency services

What Are Some Challenges to Implementation?

Structural Challenges to Energy Upgrade Expansion

1. Trades Workforce Shortage

2. Grid Infrastructure and Resilience

3. Community Engagement

Conclusion

Policy Proposal	Cost-effectiveness	Progress Towards Goals	Equity
1. Clean Heat Standard	✗	✓	✗
2. Fuel Tax Increase	–	✓	✗
3. Thermal Efficiency Benefit Charge	–	✓	✗
4. Biofuels Blending Requirement	–	✓	–
5. Low-interest Financing Programs	✓	✓	✓
6. EEU Modifications	✓	✓	✓