Vermont's Pathways Scenario Modeling Input

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The Vermont LEAP model

- GHG emissions model for VT, developed using LEAP and NEMO
- Models energy consumption and production in all sectors, associated GHGs, non-energy GHGs, costs of one scenario vs. another
- Modeling period: 2015-2050 with projections starting in 2024
- Emissions coverage: Major GHGs (CO2, CH4, N2O), local air pollutants (CO, NOx, NMVOC, PM10, PM2.5, BC, OC, SO2, NH3), SF6



2025: Full model update for next CAP

Goals, in two streams:

- 1. Baseline Scenario Updates (now)
 - 1. Update current or recently-available historical data that feed into Baseline Scenario
 - 2. Align current/historical GHG emissions from all sectors with latest GHG inventory
 - Including non-energy GHGs from AFOLU, waste, IPPU
 - 3. Incorporate new trends or other forecasts
 - 4. Make structural changes to improve transparency, general ease-of-use, ability to incorporate subsequent data updates, and ease of reporting
- 2. Mitigation Scenario Updates (next)
 - 1. Updated mitigation measures and scenarios for next Climate Action Plan

Modeling process

Baseline model updates

Updating mitigation measures in model

23 Mitigation measures covering all sectors

Combine individual mitigation measures into mitigation scenarios that achieve pre-set targets:

Scenario #1: achieves a 40% emission reduction in calendar year 2029 and 80% reduction in calendar year 2049 from 1990

Scenario #2: the 2029 target is delayed 5 years (40% reduction achieved in 2034), and the 2049 target (80% reduction) is maintained

Revised Baseline Update Results

Note: these are draft results. Transportation sector baseline excludes implementation of ACCII nor ACT. Updates to the commercial, electricity sector, and NG T&D are still not reflected in this chart.

80% below 1990 -by-2050

GHG Emissions from all sectors in Baseline Scenario

Mitigation measures

Cross-cutting	Residential	Commercial	Transport	Industry	Power Generation	Non-Energy
1. B20 Biodiesel	2. Advanced wood	2. Advanced wood	11. B100 Heavy Duty	18. B100 in Industry	20. Increased BTM PV	23. Combination of
	neating	neating	venicies	19. Renewable	21. Early HQ exit	non-energy measures
	3. B100 Heating	3. B100 Heating	12. E15 Ethanol	Industrial Gas	22. Renewable	
	4. Fossil cooking phase	4. Fossil cooking phase	13. ICE Sales phase out		electricity	
	00t by 2040	001 by 2040	by 2035			
	5. Heat pump space heating	5. Heat pump space heating	14. Managed EV charging			
	6. Fossil water heating phase out by 2040	6. Fossil water heating phase out by 2040	15. Sustainable aviation fuel			
	7. Biogas	7. Biogas	16. Vehicle to grid			
	8. Renewable distributed gas	8. Renewable distributed gas	17. VMT reductions			
	9. Weatherization at	10. District heating				
	Scale					

Seeking feedback on the mitigation measures, their implementation levels, and prioritization.

Cross-cutting

Measure	Description
B20 Biodiesel	20% biodiesel (by volume) in transport, industrial diesel and heating oil by 2050.

Residential and commercial

Applicable to both sectors:

Measure	Description
Advanced Wood Heating (AWH)	Introduction of high-efficiency pellet boilers to displace oil and propane boilers in buildings. By 2045, AWH displaces 20% of these systems in the commercial sector, and by 2050, 80% in the residential sector.
B100 Heating	Gradual introduction of biodiesel (B100) into heating oil starting in 2024, fully replacing fuel oil in both residential and commercial sectors by 2040.
Fossil Cooking Phase Out 2040	Eliminates fossil fuel use for cooking by shifting all fossil-based residential and commercial cooking to electricity by 2040.
Heat Pump Space Heating	Accelerated adoption of high-efficiency heat pumps to replace fossil fuel heating systems. By 2040, high efficiency heat pumps meet heating demands of up to 80% of residential and commercial buildings.
Fossil H2O Heating Phase Out 2040	Transitions all residential and fossil-fueled commercial water heating to electricity by 2040, primarily through heat pump technologies.
Biogas	Expands biogas use to supply 80% of distributed natural gas by volume by 2050.
Renewable Distributed Gas	Expands biogas use to supply 30% of distributed natural gas by volume by 2050. Based on Energy Action Network (2021). Emissions Reduction Pathways Model.

Residential and commercial

Additional measures in residential sector:

Measure	Description
Weatherization at Scale	Increased weatherization, targeting ~120k households by 2030, and the number of households in EVT's "high weatherization" scenario by 2050.

Additional measures in commercial sector:

Measure	Description
District Heating	Expands commercial district heating using 100% renewable heat from wood waste solids, with the McNeil project in 2027 and four additional dedicated heat plants by 2040.

Measure	Description
B100 Heavy Duty Vehicles	By 2050, 88 – 94% penetration of 100% biodiesel retrofits amongst most heavy duty vehicles.
E15 Ethanol	By 2040, 15% ethanol by volume in transport gasoline.
ICE Sales_Phase Out 2035	Starting in 2035, no ICE vehicles sold for road transport.
Managed EV Charging	By 2040, 75% of EV charging follows a load-shifting program.
Sustainable Aviation Fuel	By 2050, 50% of jet kerosene is replaced by SAF.
Vehicle to Grid	By 2040, 15% of passenger and class 1_2a vehicles provide 10kW of capacity.
VMT Reductions	By 2050, 10% reduction in VMT compared to baseline.

Measure	Description
B100 in Industry	By 2040, 100% of diesel used in industry is biodiesel.
Renewable Industrial Gas	By 2050, 80% of natural gas used in industry is biogas.

Power Generation

Measure	Description
Increased BTM PV	By 2035, 2.4x more BTM PV compared to baseline (2050 values: ~3,800MW vs ~1,500MW.)
Early HQ Exit	Contracted energy purchases from Hydro Quebec are curtailed in 2030 rather than 2038.
Renewable Electricity	By 2050, at least 99% of electricity is produced from renewable sources.

Non-Energy

Measure	Description
Non Energy Measures	 Collection of all top-down estimates for non-energy mitigation potential: By 2040, Enteric Fermentation emissions are 70% of baseline scenario value. By 2030, Manure Management emissions are 70% of baseline scenario value. By 2050, soils sequester approx. 100,000 metric tons of CO2 annually. By 2050, ODS substitution reduces emissions 6x compared to baseline value. By 2030, ~10% decrease in semiconductor manufacturing emissions. By 2050, bring wastewater methane emissions to half of baseline value.

Questions and discussion

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Thank you!