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# Analysis of Buildings / Thermal Energy Sector Emissions Reduction Policies for Vermont

PRESENTATION TO THE CROSS-SECTOR MITIGATION SUBCOMMITTEE

11/30/23





# Today's Presentation

1. Key Findings
2. Objectives and Approach
3. Emissions Results
4. Societal Benefits and Costs
5. Complementary Models
6. Conclusions
7. Discussion and Questions



# Introduction to Team





# Key Findings

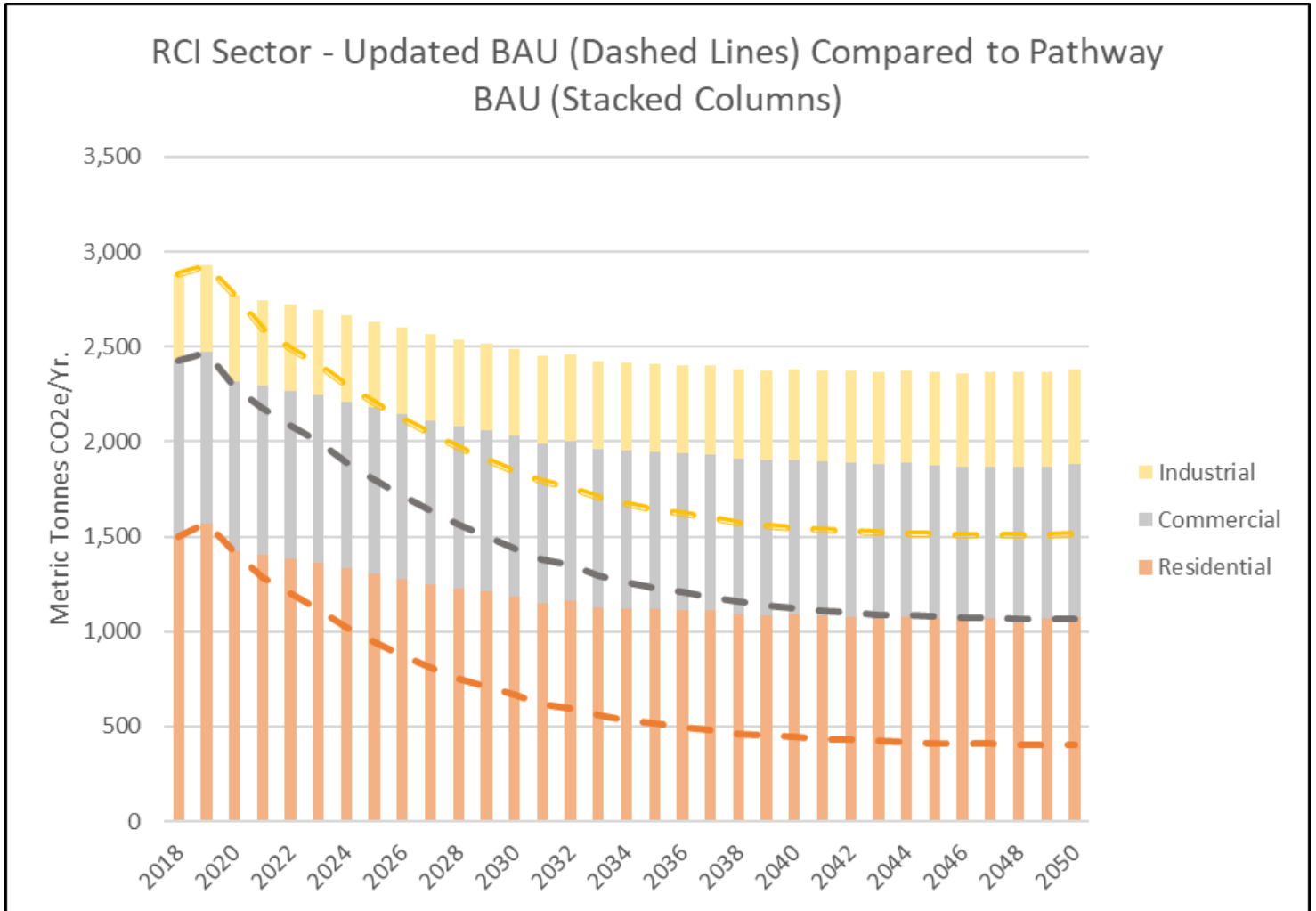
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# Overview of Scenarios

- **Scenario 1: Business-as-Usual**
- **Scenario 2: Meet Economy-Wide GHG Requirements by 2030.** Three policy sets included are analyzed under this scenario are 2. Expanding existing programs; 2b. Clean heat standard; and 2c. GHG emissions cap and investment
- **Scenario 3: Meet RCI Proportional Requirements by 2030.** Emissions reductions from the RCI sectors meet their proportional emission requirements. Three policy sets included are analyzed under this scenario are 3. Expanding existing programs; 3b. Clean heat standard; and 3c. GHG emissions cap and investment
- **Scenario 4: Regulatory Bundle to Meet Economy-Wide Requirements by 2030.** More reliance on reductions from commercial and industrial customers (and less from residential) because they are assumed to be easier to directly regulate.

# Key Findings

- Reaching Requirements Made Easier by Recent Federal and State Funding



# Key Findings

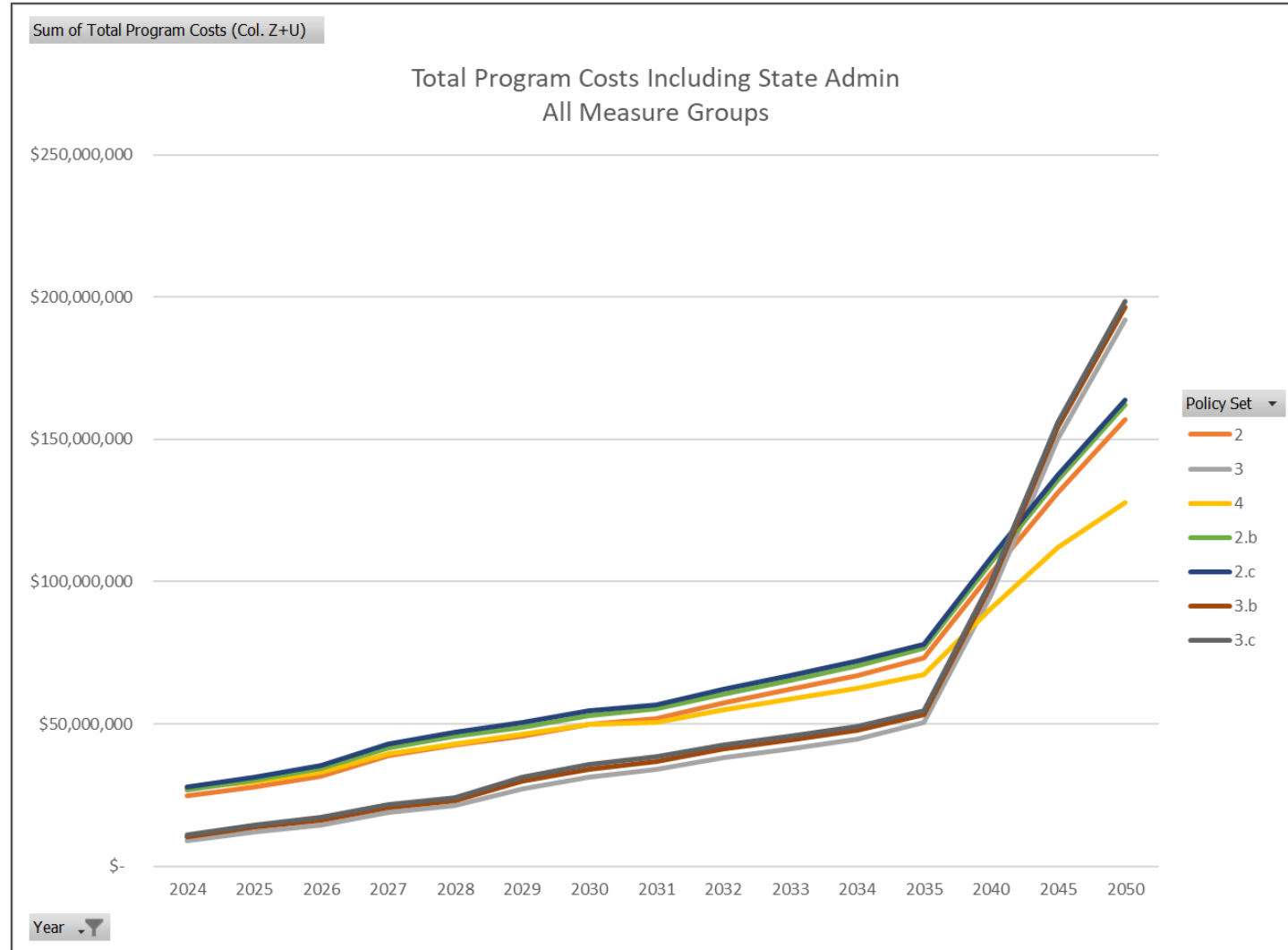
- The estimated net societal Costs of meeting GWSA requirements are a small fraction (0.9% to 2.36%) of energy spending over the study horizon.





## Key Findings

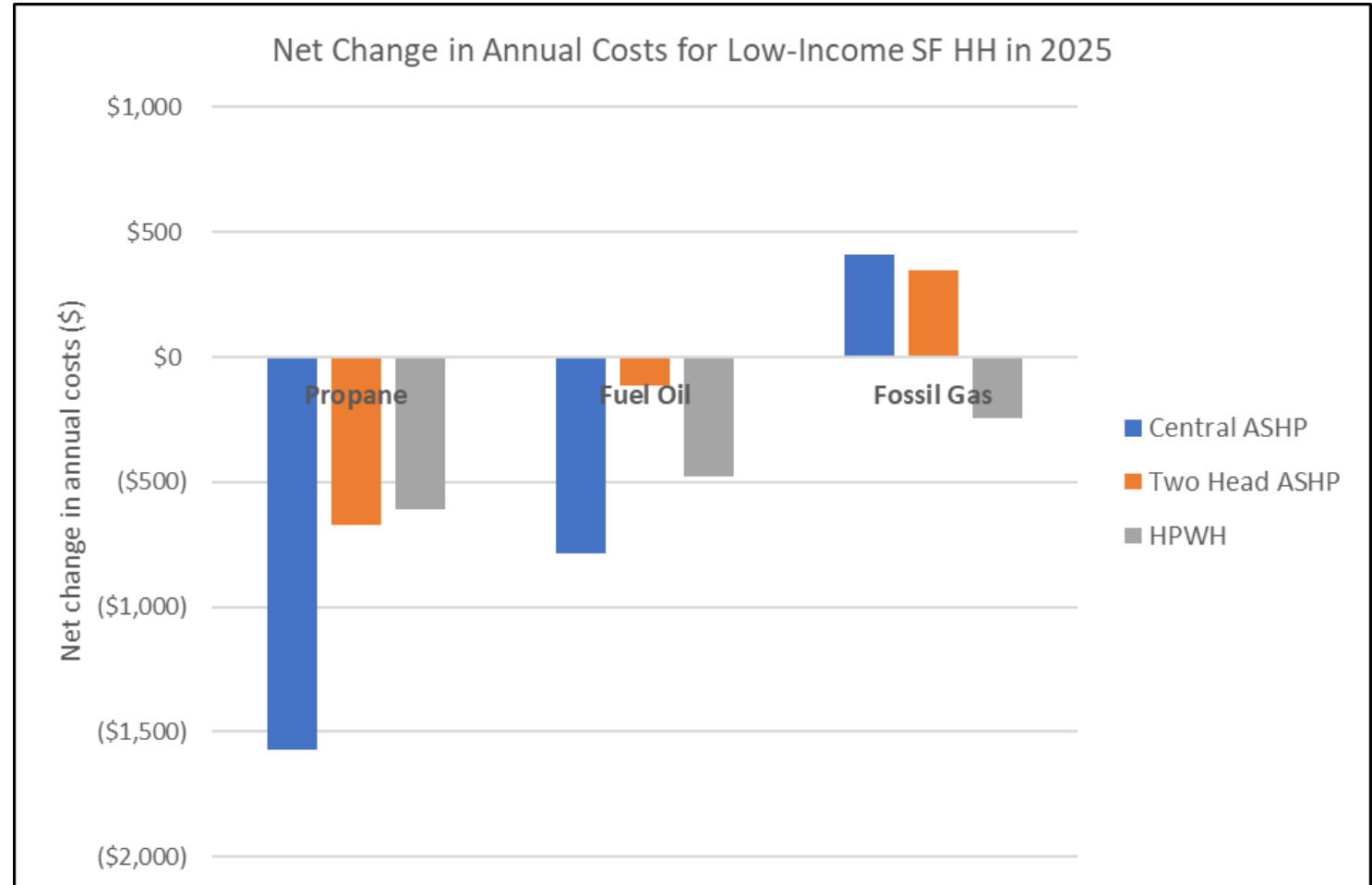
- Additional program initiatives beyond BAU are necessary to meet GWSA requirements.
- Increased programmatic expenditures range from \$11 to \$28 million above BAU in 2024, increasing to \$31 to \$51 million above BAU by 2030, and \$130 to \$200 million above BAU by 2050.





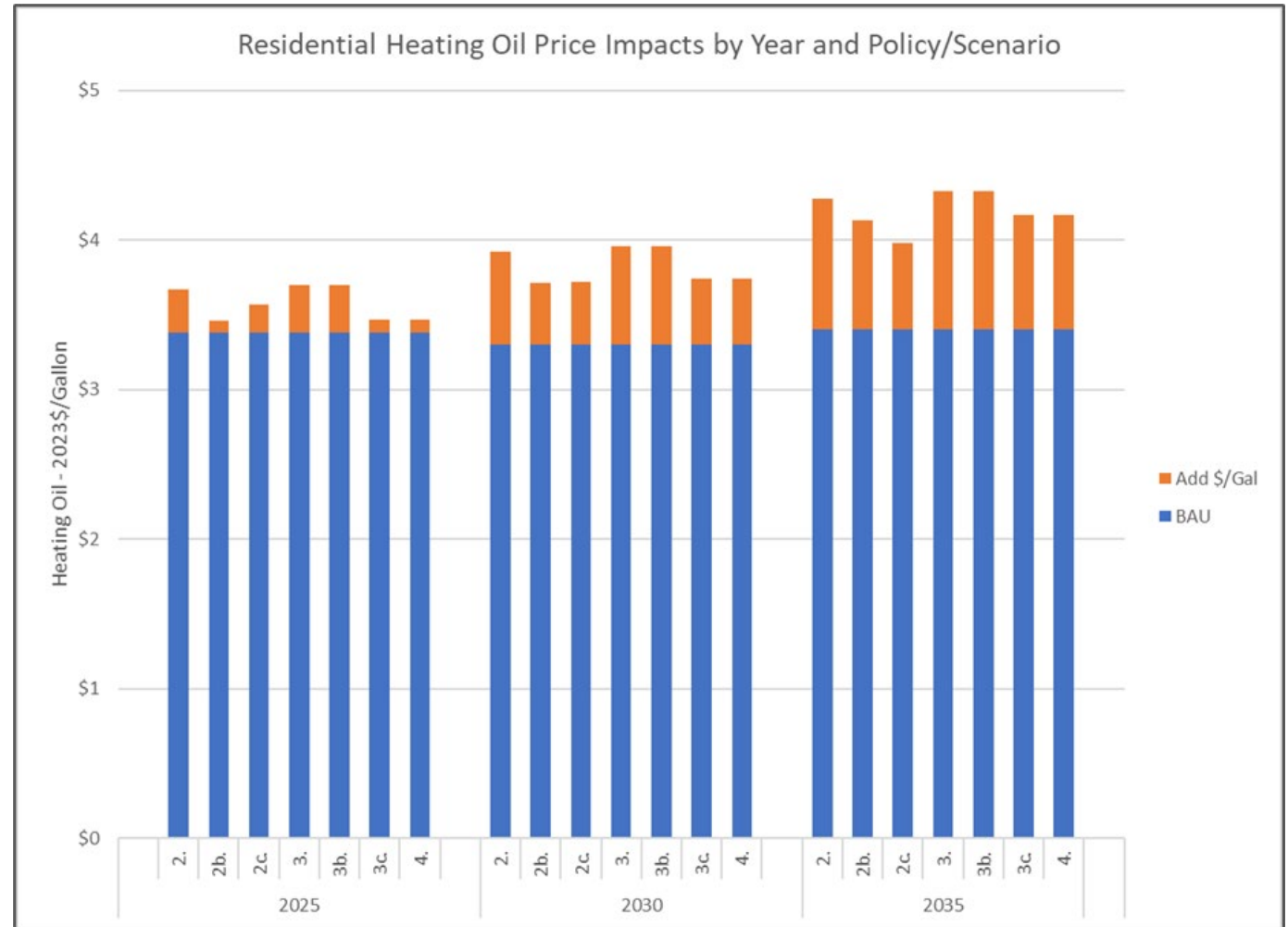
## Key Findings

- For many consumers adopting measures to reduce emissions will save money.
- Incentives cover 75% to 100% of transition costs for LMI households.



## Key Findings: Impact on Fuel Prices and Rates

- Fuel costs increase to recover program costs
- Natural gas has highest estimated increased rates of roughly 50% by 2034
- Propane and fuel oil prices estimated to increase in the 15%-17% range by 2034
- Electricity rates relatively steady as fixed costs recovered over higher volumes



## Summary Table of Key Findings

- Societal costs increase in the range of 0.9% to 2.36% of energy spending.
- Regulatory bundle has lowest societal costs with greater dependence on compliance and enforcement.

Scenario/Policy Set	<u>Societal Perspective</u>	<u>State and Program Costs</u>	<u>Customer Perspective</u>	
	Societal Net Present Value (2019-2050) 2% Discount Additional Net Costs - Million 2019 \$	2024 - 2030 Cumulative Program and Administrative Costs – Million 2019 \$	2025 Residential Fuel Oil Price Impact	2030 Residential Fuel Oil Price Impact
<b>Meets Economy Wide – 2030 Requirements</b>	\$1,331			
2. Expand Existing Programs		\$762.1	1.8%	8.5%
2b. Clean Heat Standard		\$822.0	0.3%	9.0%
2c. Cap and Invest		\$830.4	2.1%	9.0%
<b>Meets RCI Sector Proportional 2030 Requirements</b>	\$1,485			
3. Expand Existing Programs		\$331.3	2.2%	3.6%
3b. Clean Heat Standard		\$377.9	0.3%	3.6%
3c. Cap and Invest		\$384.4	0.3%	4.1%
<b>Regulatory Bundle Meets Economy Wide 2030 Requirements</b>	\$568			
4. Compliance and Enforcement Mechanisms		\$570.5	0.9%	4.3%



# Objectives and Approach

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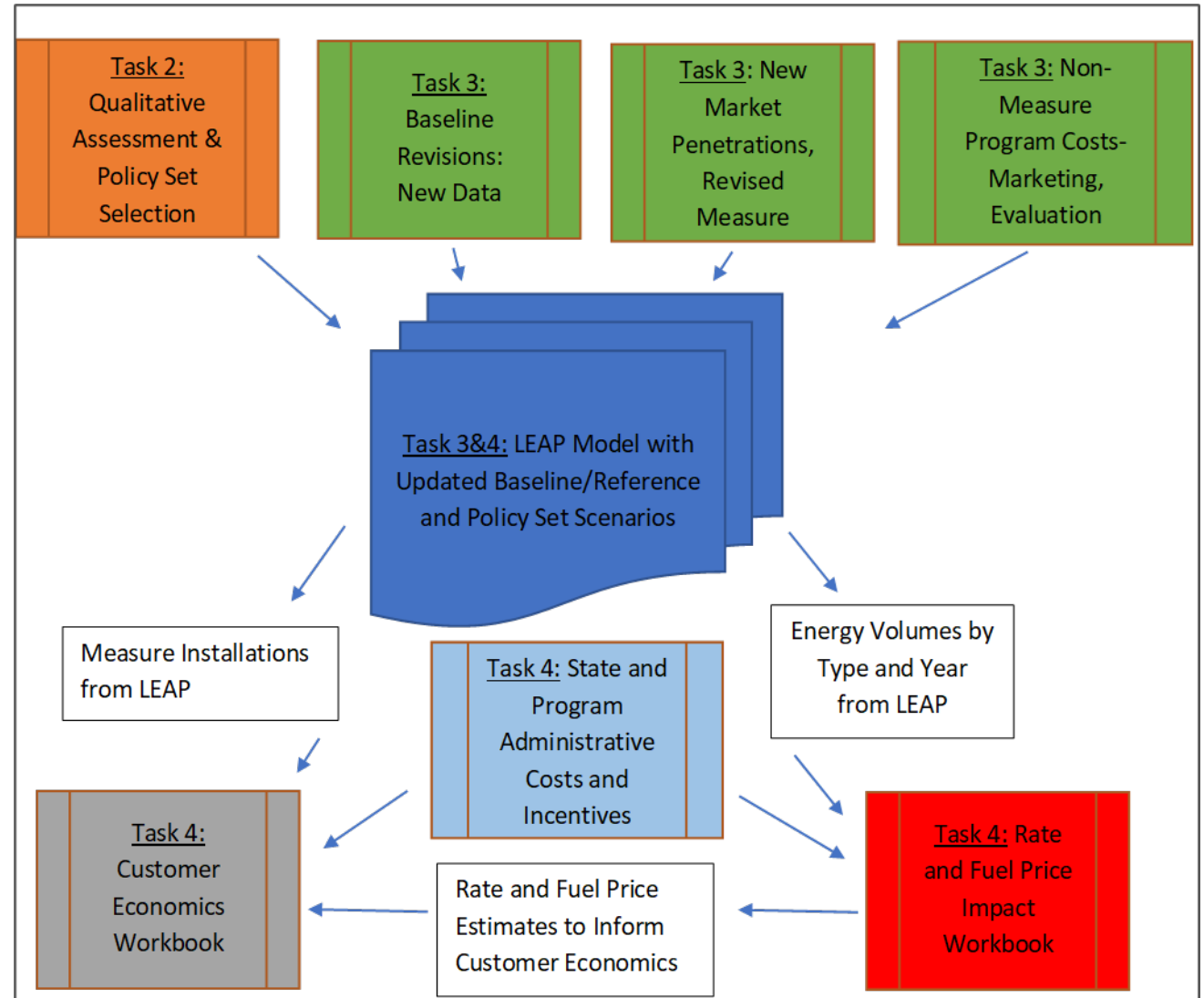
# Objectives of Study

- Provide an assessment of policy options available to Vermont to reduce emissions in the buildings/thermal energy sector necessary to meet the buildings sector's proportional share of the GHG emission reduction requirements of the GWSA.
- Intended to inform decision making at the State to guide future policy decisions.
- Assessment of the relative costs, benefits, and impacts of emissions reduction policy options across multiple criteria and from several perspectives.
- The analysis considers the social, programmatic, and administrative costs of the policies relative to a business-as-usual reference case.
- The analysis also includes an assessment of the impact on Vermont households, with consideration of the impact on low- and moderate- income (LMI) households, as well as contributions and impacts from federal support.



# Approach: Overview

1. Qualitative Assessment & Policy Set Creation
2. Update BAU Scenario
3. Quantitative Modeling
  - a. LEAP Modeling
  - b. Program and State Administrative Cost Workbook
  - c. Customer Economics Workbook
  - d. Rate, Bill, and Fuel Price Impacts

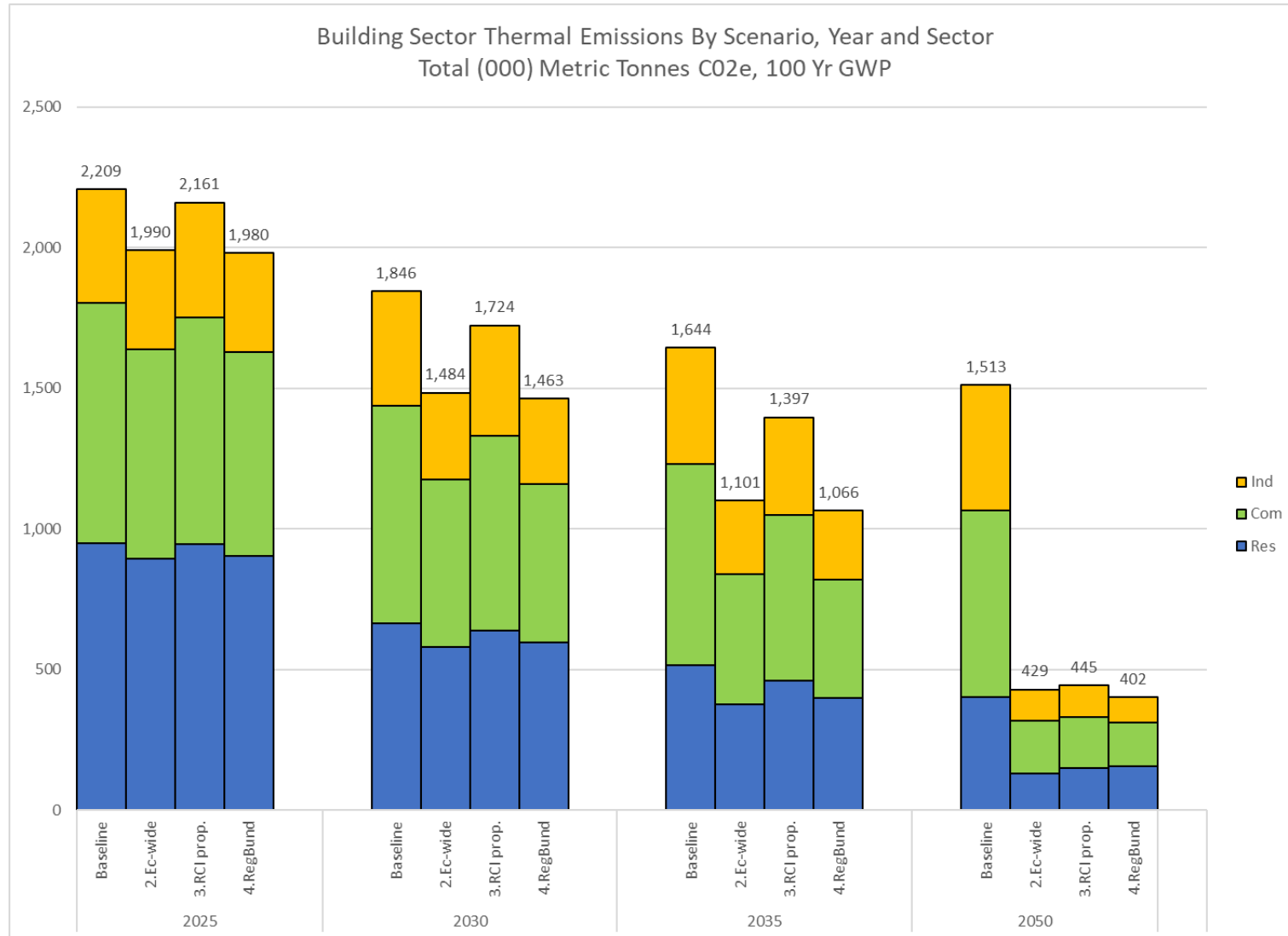




# Emissions Results

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# RCI Emissions by Scenario, Year, and Sub-Sector





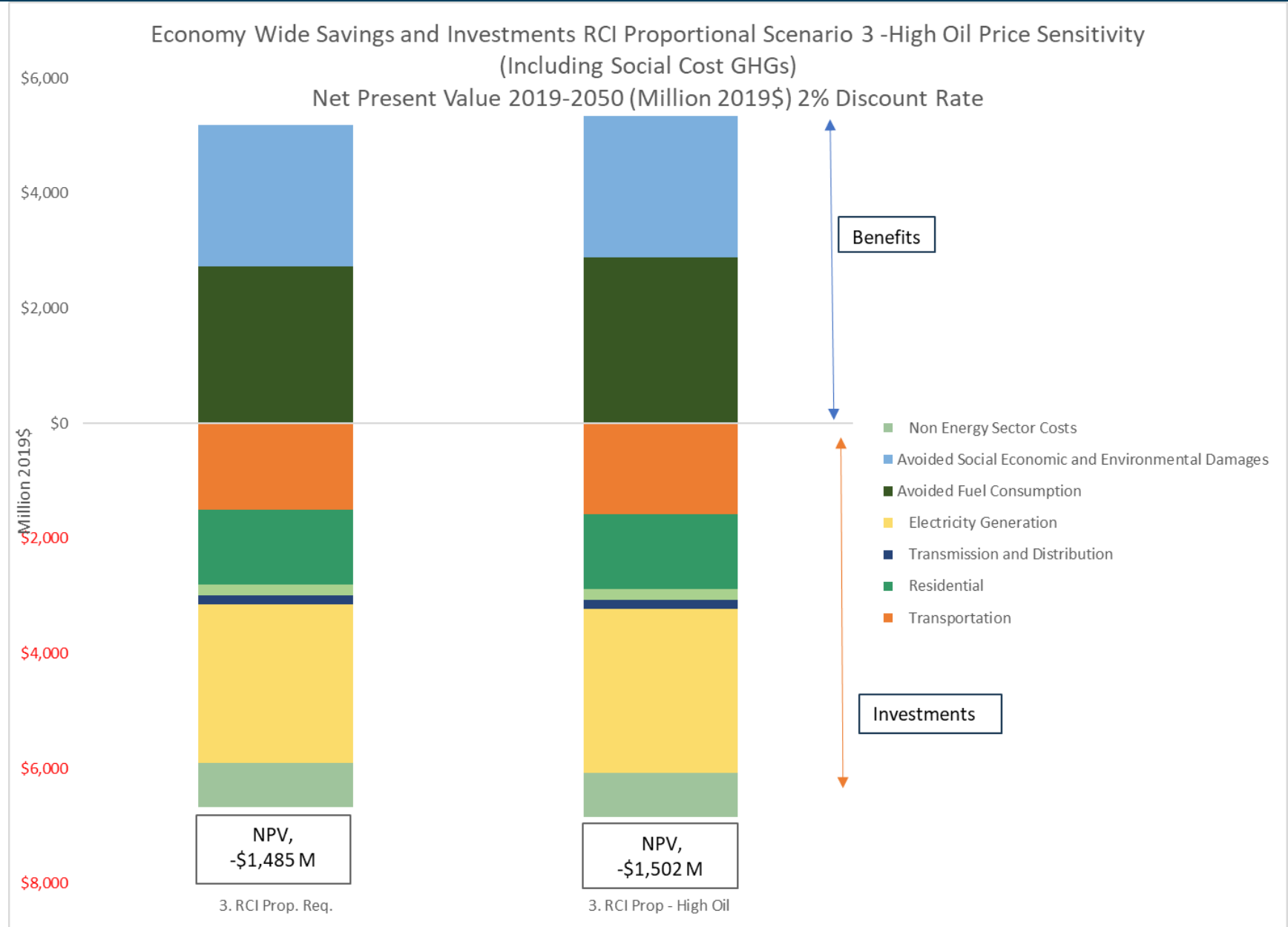
# Societal Benefits and Costs

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# High Oil Price Sensitivity, Scenario 3, RCI Proportional Reductions





# Complementary Models

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# Customer Economics Workbook: Objectives and Takeaways

## Objectives:

- Compare the costs of implementing decarbonization measures to the costs of using fossil fuels in each policy scenario for individual Vermont customers
  - Decarbonization measures: electrification, biofuels, or weatherization
- Incentives are aligned with the program and admin costs workbook. Rates and fuel prices are aligned with the rate and fuel prices impacts workbook

## Key Takeaways:

- The incentives for LMI households allow LMI households to implement a decarbonization measure and immediately realize reduced household energy costs.
- The switch from propane or fuel oil to a decarbonization measure is often economical for customers.
- Market rate incentives to switch from fossil gas to a decarbonization measure may need to be higher than those for propane and fuel oil to encourage the switch from fossil gas.

# Customer Economics Workbook: Results

Change in Annual Costs in Clean Heat Standard Scenario (3b).

	Electrification Measures								
	Furnace Full Displacement (Central Air Source Heat Pump)			Boiler Partial Displacement (Two Head Air Source Heat Pump)			Water Heater (Heat Pump Water Heater)		
	(Time-of-Replacement)			(Retrofit)			(Time-of-Replacement)		
	Propane	Fuel Oil	Fossil Gas	Propane	Fuel Oil	Fossil Gas	Propane	Fuel Oil	Fossil Gas
Net Change in Annual Costs for Low-Income	(\$1,573)	(\$784)	\$410	(\$671)	(\$115)	\$350	(\$608)	(\$477)	(\$244)
Net Change in Annual Costs for Moderate-Income	(\$1,391)	(\$602)	\$592	(\$502)	\$53	\$519	(\$553)	(\$422)	(\$189)
Net Change in Annual Costs for Market Rate	(\$1,126)	(\$337)	\$857	(\$246)	\$309	\$775	(\$482)	(\$350)	(\$118)

	Advanced Wood Heat Measures							Weatherization			
	Biofuels Blend	RNG Blend	HE Wood Stoves			HE Pellet Boilers			Weatherization		
	Retrofit	Retrofit	Time of Replacement			Time of Replacement			Retrofit (from furnace)		
	Fuel Oil	Fossil Gas	Propane	Fuel Oil	Fossil Gas	Propane	Fuel Oil	Fossil Gas	Propane	Fuel Oil	Fossil Gas
Net Change in Annual Costs for Low-Income	\$64	(\$32)	(\$844)	(\$591)	(\$51)	(\$1,448)	(\$531)	\$535	(\$621)	(\$405)	(\$225)
Net Change in Annual Costs for Moderate-Income	\$64	(\$32)	(\$773)	(\$520)	\$20	(\$1,046)	(\$130)	\$936	(\$466)	(\$250)	(\$69)
Net Change in Annual Costs for Market Rate	\$64	(\$32)	(\$657)	(\$404)	\$136	(\$581)	\$336	\$1,402	(\$331)	(\$116)	\$65

# Customer Economics Workbook: Results

- Lifetime Costs in CI 2035 Clean Heat Standard Scenario (3b)

	Electrification Measures								
	Furnace Full Displacement (Central Air Source Heat Pump)			Boiler Partial Displacement (Two Head Air Source Heat Pump)			Water Heater (Heat Pump Water Heater)		
	(Time-of-Replacement)			(Retrofit)			(Time-of-Replacement)		
	Propane	Fuel Oil	Fossil Gas	Propane	Fuel Oil	Fossil Gas	Propane	Fuel Oil	Fossil Gas
Lifetime Costs (NPV) Low-Income	(\$18,383)	(\$9,159)	\$4,793	(\$6,965)	(\$1,198)	\$3,633	(\$5,715)	(\$4,480)	(\$2,296)
Lifetime Costs (NPV) Moderate-Income	(\$16,258)	(\$7,034)	\$6,918	(\$5,215)	\$552	\$5,383	(\$5,196)	(\$3,961)	(\$1,778)
Lifetime Costs (NPV) Market Rate	(\$13,158)	(\$3,934)	\$10,018	(\$2,555)	\$3,212	\$8,043	(\$4,524)	(\$3,289)	(\$1,105)

	Advanced Wood Heat Measures							Weatherization			
	Biofuels Blend	RNG Blend	HE Wood Stoves			HE Pellet Boilers			Weatherization		
	Retrofit	Retrofit	Time of Replacement			Time of Replacement			Retrofit (from furnace)		
	Fuel Oil	Fossil Gas	Propane	Fuel Oil	Fossil Gas	Propane	Fuel Oil	Fossil Gas	Propane	Fuel Oil	Fossil Gas
Lifetime Costs (NPV) Low-Income	\$61	(\$30)	(\$9,864)	(\$6,910)	(\$594)	(\$18,040)	(\$6,616)	\$6,668	(\$8,754)	(\$5,713)	(\$3,165)
Lifetime Costs (NPV) Moderate-Income	\$61	(\$30)	(\$9,034)	(\$6,080)	\$236	(\$13,040)	(\$1,616)	\$11,668	(\$6,568)	(\$3,527)	(\$980)
Lifetime Costs (NPV) Market Rate	\$61	(\$30)	(\$7,678)	(\$4,724)	\$1,592	(\$7,236)	\$4,188	\$17,472	(\$4,671)	(\$1,630)	\$918



# Program and Administrative Cost Model

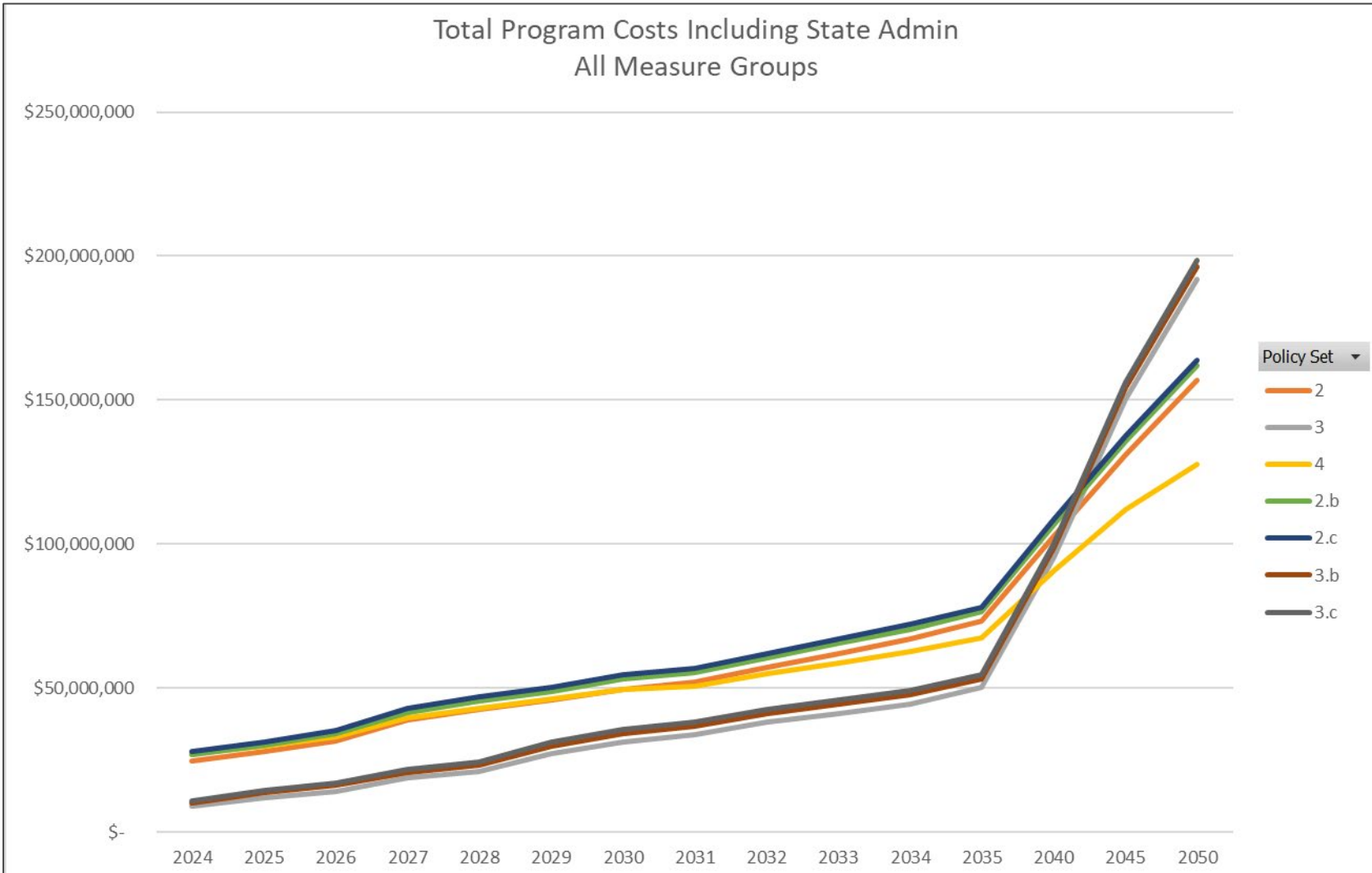
## Objectives:

- Estimate the measure and non-measure program and administrative costs for meeting GWSA requirement by policy set
- Adoption profiles and costs by measure and measure group

## Key Takeaways:

- Programmatic and/or market initiatives to support adoption above BAU levels are required
- Incentive support for LMI represents a significant share of the estimated program costs across the policy sets
- Delivery of services will expand on strong foundation in Vermont
- Program and administrative costs continue to rise to meet 2050 requirements

# Program and Administrative Cost Workbook Outputs



## Scenario 2: Meet Economy-Wide GHG Requirements by 2030

- 2: Expanding existing programs
- 2b: Clean heat standard
- 2c: GHG emissions cap and investment

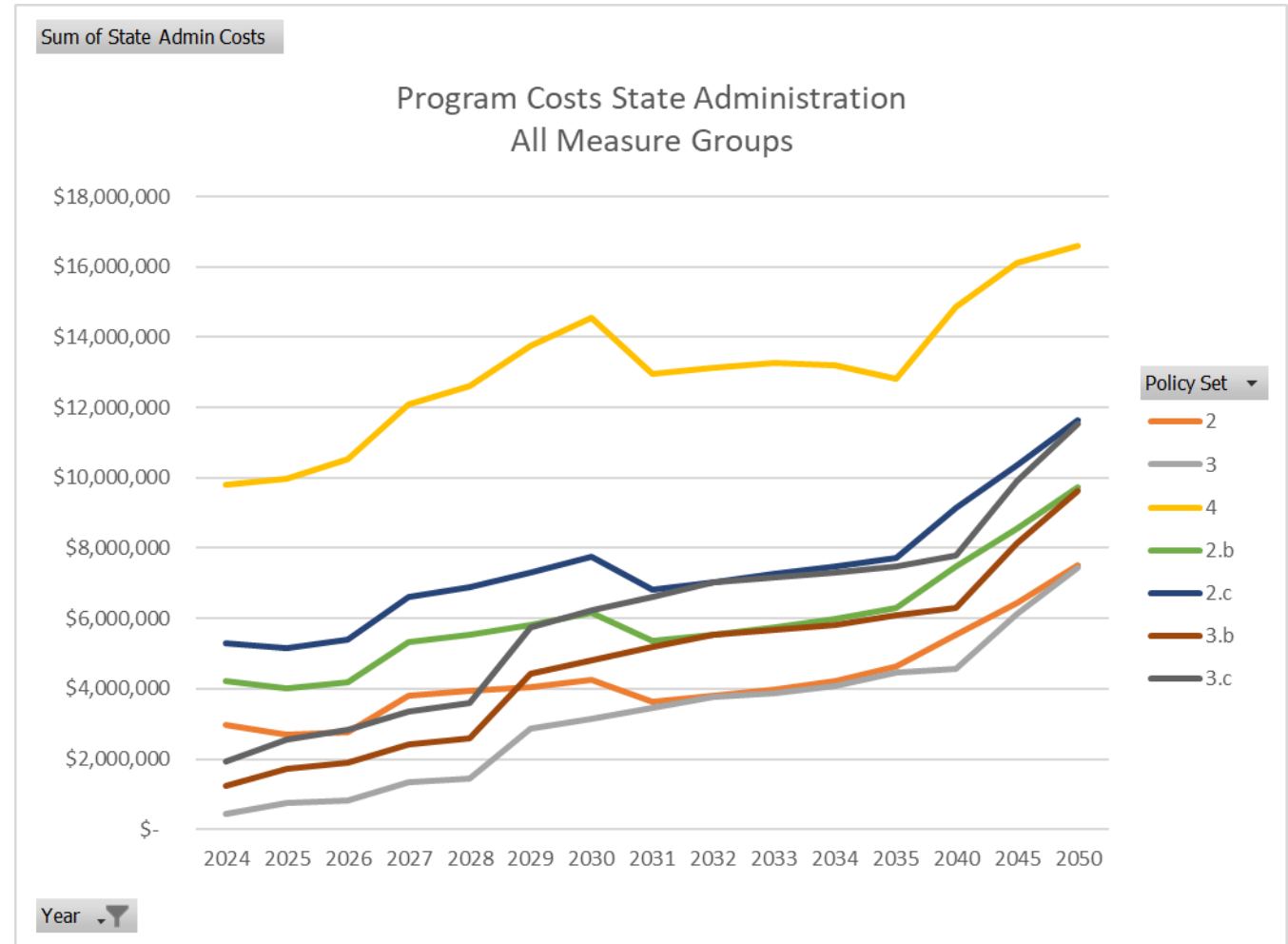
## Scenario 3: RCI Proportional Requirements by 2030

- 2: Expanding existing programs
- 2b: Clean heat standard
- 2c: GHG emissions cap and investment

## Scenario 4: Regulatory Bundle to Meet Economy-Wide Requirements by 2030

# State Administrative Costs

- Regulatory Bundle has higher compliance and enforcement costs than other scenarios
- Consideration of feasibility of stick versus carrot approach to facilitating transition



# Rate and Fuel Price Workbook

## Objectives:

- Compare impacts on fuel prices, electric and gas rates, and customer bills for policy sets
- Estimate changes to utility revenue requirement and rate base
- Reflect program costs to be recovered through rates or surcharges
- Changes in rate base or alternative fuel usage from electrification
- Fixed recoverable costs and variable generation and fuel costs

## Key Takeaways:

- By 2034 gas prices increase by ~50%
- By 2034 propane and heating oil increase by 15% - 17%.
- Electric rates show little to no impacts
- Price impacts for oil and propane are within historic volatility

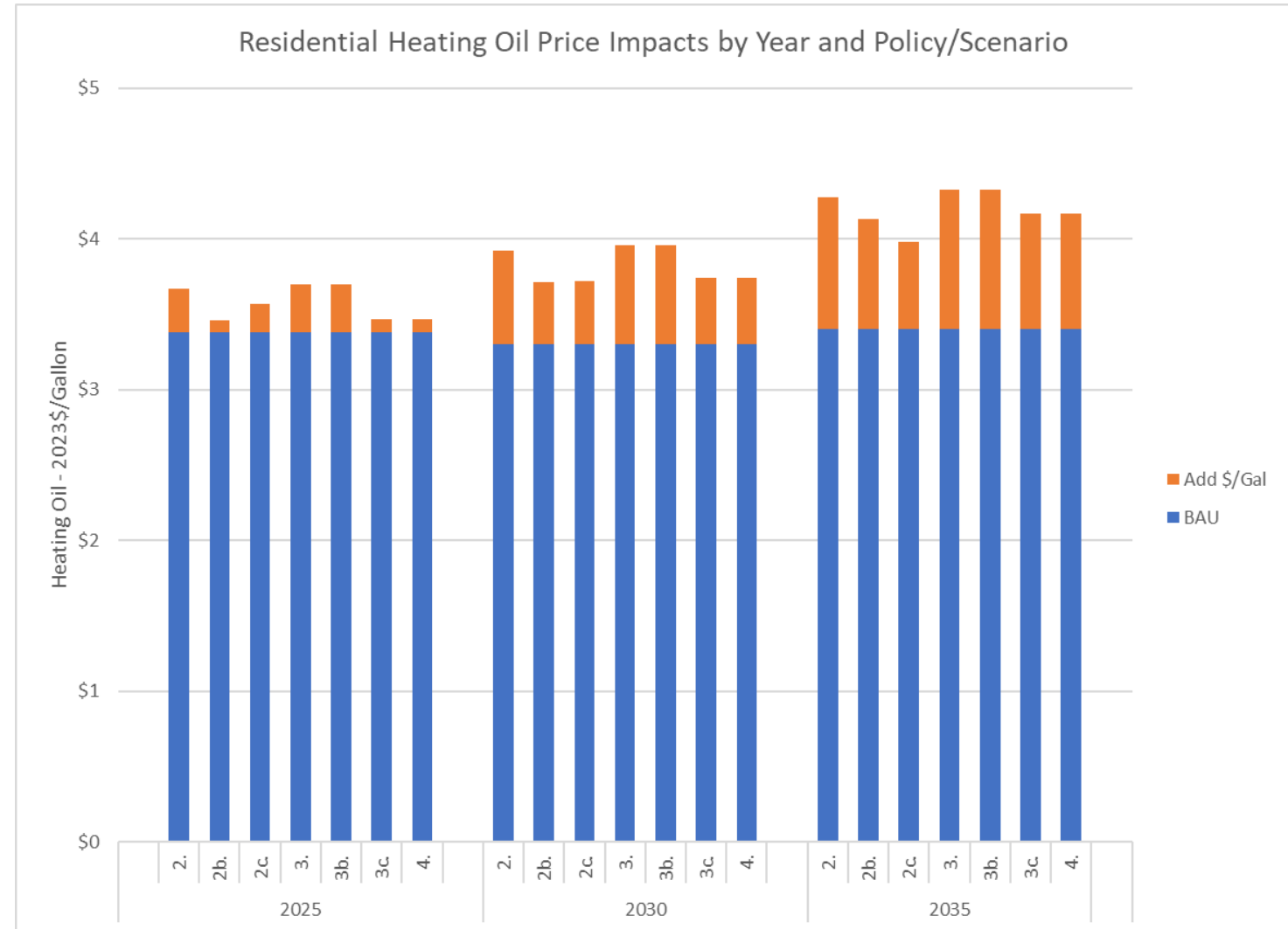
# Rate and Fuel Price Workbook: Results

- Impacts for Natural Gas reflect highest rate increases (51% by 2034) due to fixed cost recovery over declining volumes.
- Propane and Fuel Oil without fixed cost recovery have lower impacts in the range of 15% to 17% by 2034.

Sector	Year	Fuel	Units	BAU Scenario Average Rate	Average Change in Rates		
					2. 2030 Economy-Wide	3. RCI Proportional	4. Regulatory Bundle
Residential	2023	Natural Gas	\$/MCF	\$14.70	\$0.23	-\$0.02	\$0.21
Residential	2024	Natural Gas	\$/MCF	\$13.90	\$0.72	\$0.04	\$0.43
Residential	2025	Natural Gas	\$/MCF	\$13.92	\$1.03	\$0.08	\$0.63
Residential	2026	Natural Gas	\$/MCF	\$14.11	\$1.38	\$0.11	\$0.82
Residential	2027	Natural Gas	\$/MCF	\$14.29	\$1.90	\$0.34	\$1.19
Residential	2028	Natural Gas	\$/MCF	\$14.53	\$2.40	\$0.39	\$1.51
Residential	2029	Natural Gas	\$/MCF	\$14.88	\$2.95	\$0.75	\$1.86
Residential	2030	Natural Gas	\$/MCF	\$15.31	\$3.70	\$1.26	\$2.37
Residential	2031	Natural Gas	\$/MCF	\$15.64	\$4.69	\$1.65	\$3.08
Residential	2032	Natural Gas	\$/MCF	\$15.93	\$5.84	\$2.22	\$3.94
Residential	2033	Natural Gas	\$/MCF	\$16.46	\$7.18	\$2.87	\$4.94
Residential	2034	Natural Gas	\$/MCF	\$16.80	\$8.57	\$3.64	\$5.95
Residential	2035	Natural Gas	\$/MCF	\$17.11	\$2.26	\$1.02	\$1.76
Residential	2040	Natural Gas	\$/MCF	\$18.44	\$4.71	\$2.45	\$3.35
Residential	2045	Natural Gas	\$/MCF	\$19.37	\$8.29	\$4.72	\$5.30
Residential	2050	Natural Gas	\$/MCF	\$19.67	\$12.86	\$8.40	\$7.13

# Residential Heating Oil Impacts

- Fuel price impacts grow over time for each scenario.
- The BAU forecast is considerably lower than prices in the most recent Vermont winter of 2022-2023 during which the average residential fuel oil price was \$4.73 per gallon and the average propane price was \$3.46 per gallon.





# Conclusions

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## Support for Decision Makers

- This study indicates multiple policy options can meet GWSA requirements.
- Within each policy, multiple adoption profiles can meet requirements.
- The modeling and results are not prescriptive or predictive.
- For each of the policy sets there are other possible mixes of measures and measure adoption rates that can meet the GWSA requirements.



## Conclusions

- Economy-wide, the GWSA compliant scenarios entail additional net social costs of \$568 million to \$1.485 billion over the study horizon. This is a small increase of 0.9% to 2.36% of the present value of annual energy expenditures.
- The study highlights many common implementation, design, and delivery challenges related to the scale and pace of development required to meet the GWSA. This holds true regardless of the policy choice.
- The design of policies and programmatic initiatives to meet the GWSA is a historic opportunity to address equity impacts of energy use
- Without enabling participation from LMI households, attaining the GWSA requirements will be difficult if not impossible, and would not address important equity and justice policy objectives.



# Questions and Discussion

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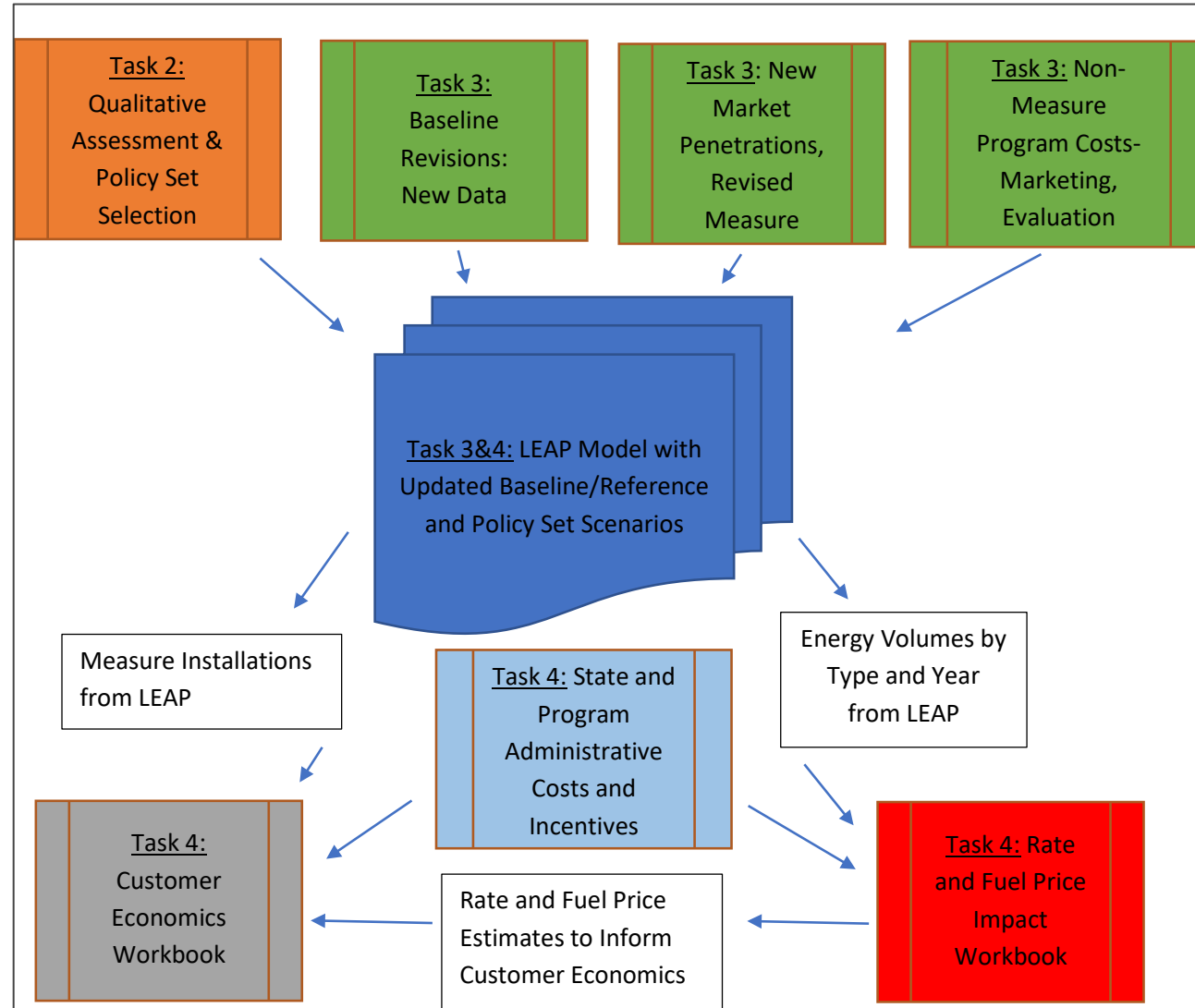
# Appendix

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## Background

- In 2020, the Vermont Legislature passed the Global Warming Solutions Act (GWSA)
  - GWSA codifies legally binding emissions reduction requirements, including emissions reductions of 26% below 2005 levels by 2025; 40% below 1990 levels by 2030; and 80% below 1990 levels by 2050.
- In 2023, the Affordable Heat Act (which establishes a Clean Heat Standard) became law. The Public Utility Commission (PUC) has opened proceedings to begin the process of designing the rules and regulations for a Clean Heat Standard.
- An initial analysis completed during development of the CAP, the Vermont Pathways Report, included an overall assessment of the costs and benefits for meeting the GWSA requirements.

# Approach: Overview



# Approach: Description of policy sets

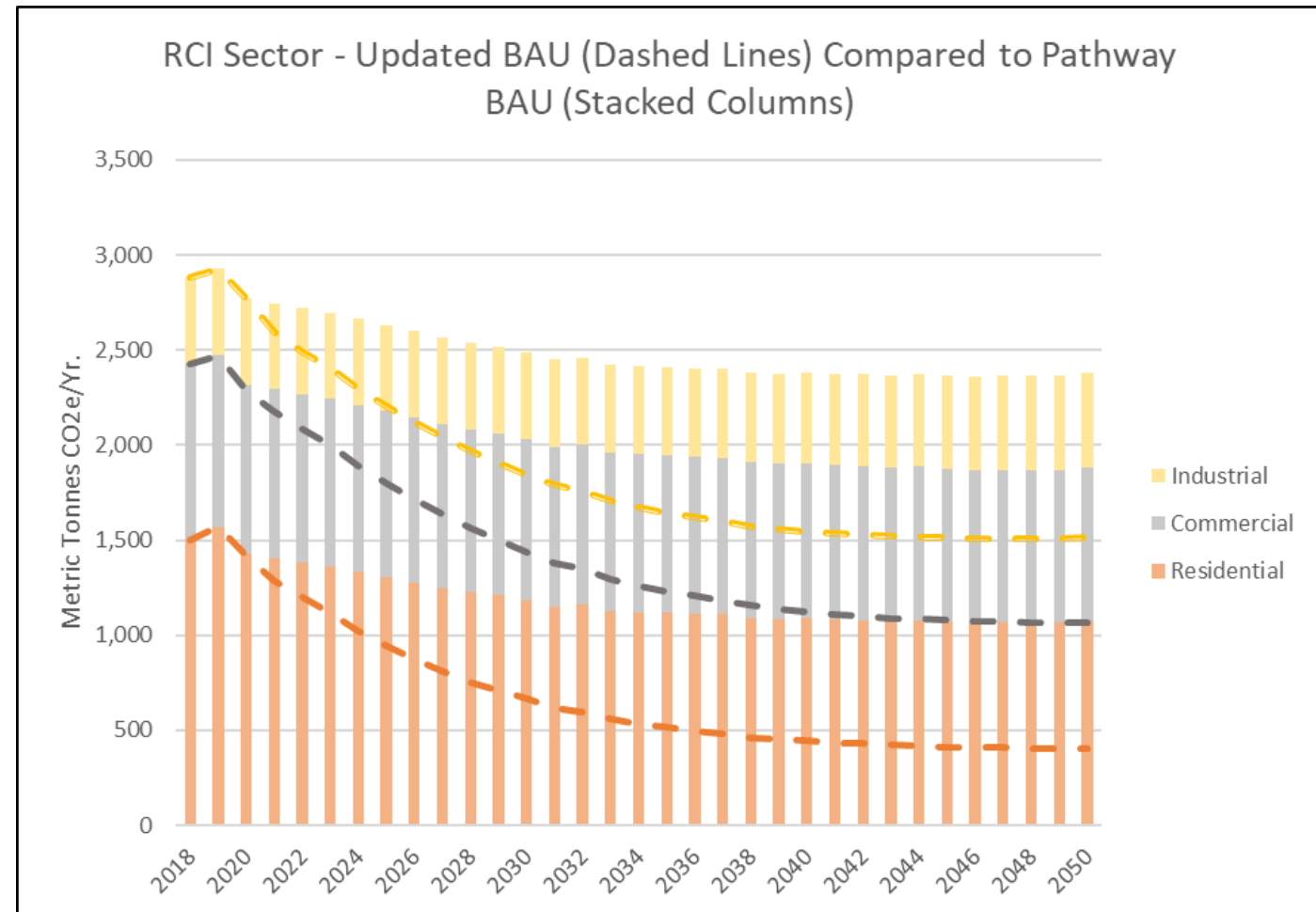
- **Scenario 1: Business-as-Usual.** This is a forecast of energy system costs and emissions absent any new state climate policies. Reflects new federal and state investments.
- **Scenario 2: Meet Economy-Wide GHG Requirements by 2030.** Under this scenario, emission reductions from the residential, commercial, and industrial (RCI) sectors are greater than their proportional share to compensate for shortfalls in other sectors. Three different sets of policies are analyzed under this scenario:
  - 2: Expanding existing programs,
  - 2b: Clean heat standard, and
  - 2c: GHG emissions cap and investment
- **Scenario 3: Meet Economy-Wide GHG Requirements by 2035.** Under this scenario, the emission reductions from the RCI sectors meet their proportional share of reductions necessary to meet the state's 2030 goals, but because of shortfalls in other sectors the state's 2030 goals are not met until 2035. As with Scenario 2, three different sets of policies are analyzed under this scenario:
  - 3: Expanding existing programs,
  - 3b: Clean heat standard, and
  - 3c: GHG emissions cap and investment
- **Scenario 4: Regulatory Bundle to Meet Economy-Wide Requirements by 2030.** As with Scenario 2, the state's 2030 emission reduction goals are met with the RCI sectors collectively achieving more than their proportional share of reductions to compensate for other sectors achieving less than their proportional shares. However, the mix of emission reduction measures is different from Scenario 2, with more reliance on reductions from commercial and industrial customers (and less from residential) because they are assumed to be easier to directly regulate.

# Business as Usual (BAU) Updates

1. Updates to current or historical data
  - Latest adoption levels for heating, water heating technologies, weatherization retrofits
  - Adoption of EVs and PHEVs, vehicle-miles traveled
  - Calibration to latest statewide energy consumption statistics
  - Latest available fuel prices
2. Updates to technology assumptions
  - Refinements to costs of heating technologies, retrofits, etc.
  - Improved assumptions on the impact of heat pumps on household heating needs
3. Updates to projections based on updated trends
  - Revised fuel price forecasts
  - Revised projections for total numbers of households, commercial floorspace
4. Updates to projections based on impacts from new policies and programs
  - Heating oil blending in line with New York Senate Bill
  - Federal Inflation Reduction Act
  - Federal Infrastructure and Jobs Act
  - Vermont Weatherization Act 185
  - Multi-State Advanced Clean Cars II
  - Multi-State Advanced Clean Trucks

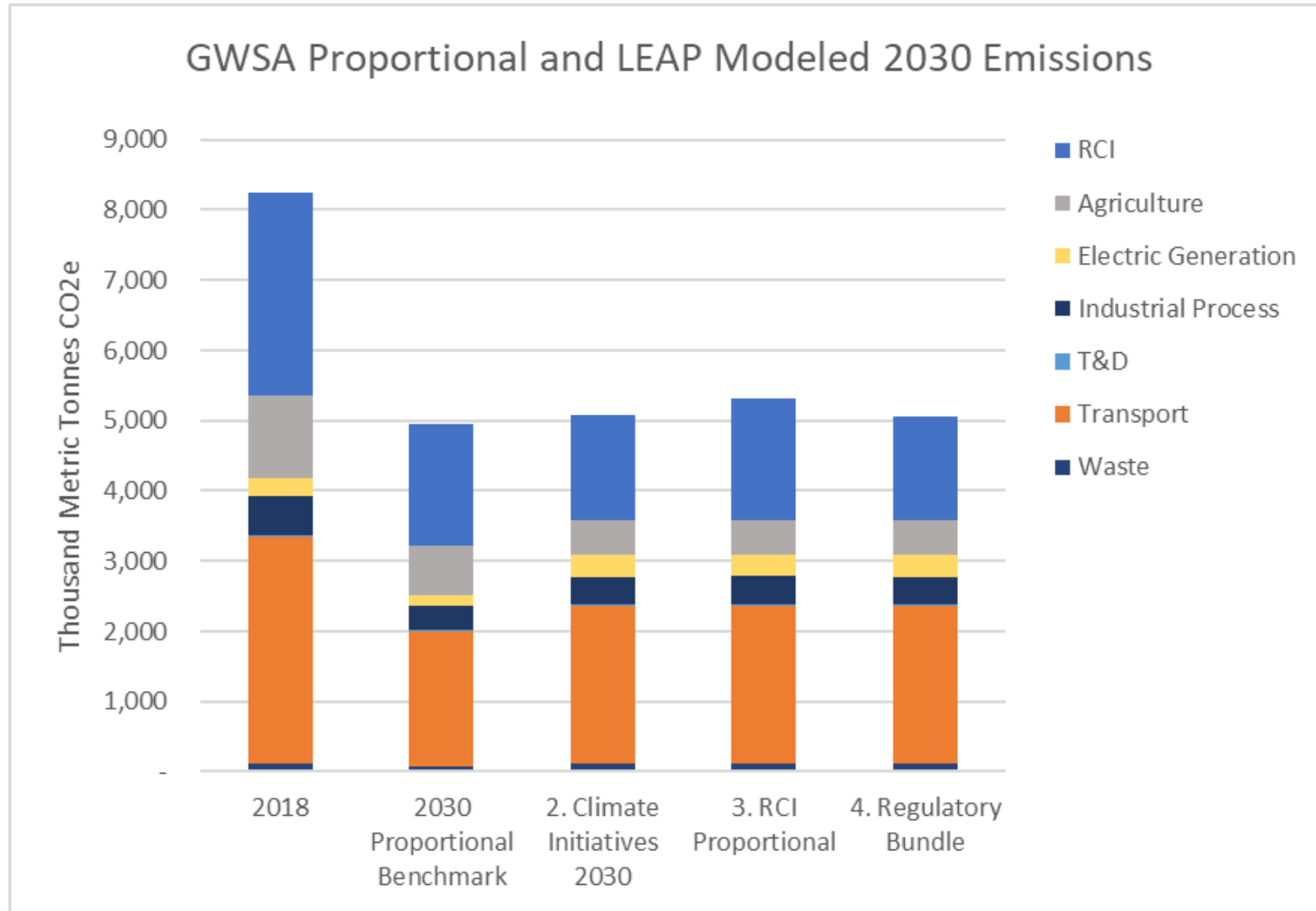
# BAU Update

- Updates to BAU reduces estimated emissions for the RCI sector relative to the previous BAU from the 2022 Pathways Report

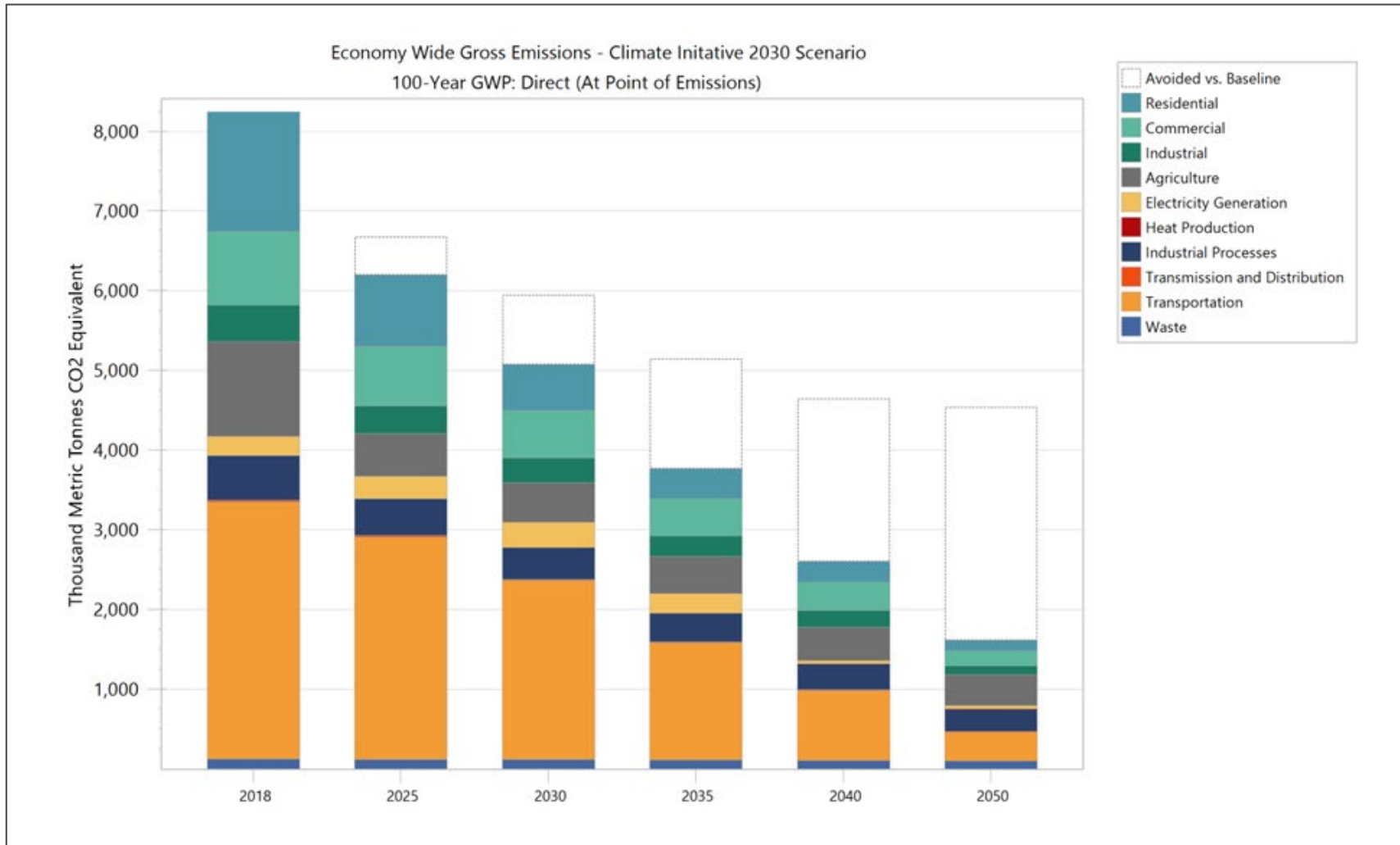




# GWSA Proportional and LEAP Modeled 2030 Emissions



# Climate Initiatives 2030 Economy-Wide Emissions



# Customer Economics Workbook: Inputs and Assumptions

## Key measures included:

- Electrification Measures
  - Furnace
  - Boiler
  - Water heater
- Biofuel measures
  - B20
  - Renewable natural gas
  - HE wood stoves
  - HE pellet boilers
- Weatherization

## Assumptions:

- Electric rate and fossil fuel rates consistent with rate and fuel price impacts workbook
- Data on capital costs and measure life consistent with LEAP model inputs
- Real discount rate is 5%
- Policy/program incentive levels consistent with program and admin costs workbook

# Customer Economics Workbook: Results

- Non-Participant Costs in CI 2035 Clean Heat Standard Scenario (3b) in 2025 and 2030

2025	Single Family						Multi-Family					
	Space Heating			Water Heating			Space Heating			Water Heating		
	Propane	Fuel Oil	Fossil Gas	Propane	Fuel Oil	Fossil Gas	Propane	Fuel Oil	Fossil Gas	Propane	Fuel Oil	Fossil Gas
Btus	82.8	82.8	82.8	15.2	15.2	15.2	38.9	38.9	38.9	15.2	15.2	15.2
Gallons/ therms	905	598	828	166	110	152	425	281	389	166	110	152
No policy fuel price	\$ 3.42	\$ 3.38	\$ 1.34	\$ 3.42	\$ 3.38	\$ 1.34	\$ 3.42	\$ 3.38	\$ 1.34	\$ 3.42	\$ 3.38	\$ 1.34
Policy fuel price	\$ 3.43	\$ 3.39	\$ 1.36	\$ 3.43	\$ 3.39	\$ 1.36	\$ 3.43	\$ 3.39	\$ 1.36	\$ 3.43	\$ 3.39	\$ 1.36
Annual cost w/o policy	\$ 3,096	\$ 2,021	\$ 1,113	\$ 568	\$ 371	\$ 204	\$ 3,096	\$ 2,021	\$ 1,113	\$ 568	\$ 371	\$ 204
Annual cost w/policy	\$ 3,105	\$ 2,027	\$ 1,123	\$ 570	\$ 372	\$ 206	\$ 3,105	\$ 2,027	\$ 1,123	\$ 570	\$ 372	\$ 206
Change in annual cost	\$ 9	\$ 6	\$ 10	\$ 2	\$ 1	\$ 2	\$ 9	\$ 6	\$ 10	\$ 2	\$ 1	\$ 2
% change in cost	0%	0%	1%	0%	0%	1%	0%	0%	1%	0%	0%	1%

2030	Single Family						Multi-Family					
	Space Heating			Water Heating			Space Heating			Water Heating		
	Propane	Fuel Oil	Fossil Gas	Propane	Fuel Oil	Fossil Gas	Propane	Fuel Oil	Fossil Gas	Propane	Fuel Oil	Fossil Gas
Btus	82.8	82.8	82.8	15.2	15.2	15.2	38.9	38.9	38.9	15.2	15.2	15.2
Gallons/ therms	905	598	828	166	110	152	425	281	389	166	110	152
No policy fuel price	\$ 3.79	\$ 3.30	\$ 1.48	\$ 3.79	\$ 3.30	\$ 1.48	\$ 3.79	\$ 3.30	\$ 1.48	\$ 3.79	\$ 3.30	\$ 1.48
Policy fuel price	\$ 3.91	\$ 3.42	\$ 1.63	\$ 3.91	\$ 3.42	\$ 1.63	\$ 3.91	\$ 3.42	\$ 1.63	\$ 3.91	\$ 3.42	\$ 1.63
Annual cost w/o policy	\$ 3,431	\$ 1,973	\$ 1,224	\$ 630	\$ 362	\$ 225	\$ 3,431	\$ 1,973	\$ 1,224	\$ 630	\$ 362	\$ 225
Annual cost w/policy	\$ 3,540	\$ 2,045	\$ 1,349	\$ 650	\$ 375	\$ 248	\$ 3,540	\$ 2,045	\$ 1,349	\$ 650	\$ 375	\$ 248
Change in annual cost	\$ 109	\$ 72	\$ 125	\$ 20	\$ 13	\$ 23	\$ 109	\$ 72	\$ 125	\$ 20	\$ 13	\$ 23
% change in cost	3%	4%	10%	3%	4%	10%	3%	4%	10%	3%	4%	10%

## Program and Administrative Costs: Overview

- Programmatic and policy initiatives are necessary to meet the GWSA requirements.
- While the updated BAU scenario narrows the gap between projected emissions reductions and those required by the GWSA, without additional program and policy support compliance with GWSA requirements is unlikely.
- Program costs include customer incentives, marketing and other administrative costs incurred by the state and/or Vermont fossil fuel companies
- Program costs influence customer economics, and fuel costs
  - Customer incentives have direct impact on the customer economics
    - Including differences between incentives for income-qualified and market rate participants
  - Total “program” spending by fossil fuel companies affects rates/prices for the fuel they sell

# Program and Administrative Cost Model: Structure

- Adoption of measures in the RCI sector by year – derived from Activity Levels in LEAP model.
- Incentives – 100% incentive for households with <80% Median Income, 75% for HH with 80%-120%, and market rate for HHs with Income > 120%.
- Administration and Delivery Costs for state and program administrators.

Measures				
Residential	Heating Equipment	SF ASHP 2 Head	Units	SF 2 Head Ductless HP
		MF ASHP 2 Head	Units	MF 2 Head Ductless HP
		SF ASHP Central	Units	SF Centrally-Ducted Cold Climate Heat Pump
		MF ASHP Central	Units	MF Centrally-Ducted Cold Climate Heat Pump
		SF ASHP HE	Units	SF Ductless Heat Pump
		MF ASHP HE	Units	MF Ductless Heat Pump
		SF GSHP HE	Units	SF Ground Source Heat Pump
		MF GSHP HE	Units	MF Ground Source Heat Pump
		SF ATW HP	Units	SF Air to Water Heat Pump
		APB	Units	Advanced Pellet Boilers
		PSt HE	Units	Pellet Stoves High Efficiency
		PSt Ty	Units	Pellet Stove Typical
		WS HE	Units	Wood Stove High Efficiency
		WS Ty	Units	Wood Stove Typical
	Wx	SF Wx	Units	SF Weatherization
		MF Wx 2-4	Units	MF Weatherization 2-4 units
		MF Wx 5+	Units	MF Weatherization 5+ units
		MH Wx	Units	Mobile Home Weatherization
	H2O	HPWH HE	Units	Heat Pump Water Heater High Efficiency
		HPWH Ty	Units	Heat Pump Water Heater Typical
Cooking	ECook	Units	Electric Cooking	
RE Fuels	RNG	MMBtus	RNG	
	BioD	MMBtus	Biodiesel	
	BioCHPDH	MMBtus	Bio CHP/District Heat	
Comm.	Reductions	Com Red	MTCO2e	
Ind.	Reductions	Ind Red	MTCO2e	

# Program and Administrative Cost Workbook Outputs

<u>Result</u>	<u>Description</u>	<u>Notes</u>
<b>Low- and Moderate -Income (LMI) Incentive Costs</b>	Total for households with income <= 80% of State median income receiving 100% incentive, plus a 75% of installed cost incentive for households with income between 80% and 120% of state median income.	Design assumption to support equity and ability to transition for LMI households.
<b>Market Incentive Costs</b>	Total incentives for measures installed by non-LI households, commercial sector and industry. Percent of measure cost, varies by year and technology.	Appendix F Table 28 provides measure incentive cost by year and technology.
<b>Total Incentive Costs</b>	Sum of LI and Market Incentives	Total program rebates or financial incentives estimated to be necessary to achieve emission reduction targets.
<b>Resource Acquisition Costs</b>	Resource acquisition costs include direct incentives, technical assistance, and other direct program delivery costs	Resource Acquisition and Program Administration will be borne by existing providers, obligated entities, or default providers.
<b>Program Administration Costs</b>	Direct support services for program delivery including IT, Legal, HR.	Clean Heat Standard and Cap and Invest Policies estimated to have increased program administrative costs based on new tracking verification and reporting.
<b>Total Program Costs</b>	Sum of Resource Acquisition Costs and Program Administration Costs.	The program costs for measures with greater than one year life is amortized over the measure life using a 5% real cost of capital. Each year's program costs are then calculated based on cumulative amortized costs plus annual expense for measures with one year life.
<b>State Administration Costs</b>	Monitoring, oversight, evaluation and reporting of program activities.	Estimated as share of Program Administrative Costs – cross referenced with estimates of start-up and operating costs for cap and invest and building performance standards from other jurisdictions.
<b>Tax Incentives</b>	Estimate of Federal Tax Incentives for measures, varies by measure type.	Reduces costs to Vermont consumers and economy. Share of measures claiming tax incentives estimated at 40% see Appendix F Table 27 Row 2 Notes.

# Rate and Fuel Price Workbook: Structure

- Separate sheets for rate/price impacts and bill impacts
- Rate/price impacts
  - Calculate change in revenue requirement and rate base for electric and natural gas rates
  - Calculate price forecasts for heating oil and propane based on changes in usage for each policy bundle
  - Separate calculations for customer sectors (residential and nonresidential), fuel type (electricity, natural gas, propane, heating oil)
- Bill impacts
  - Compare annual customer bills in baseline scenario against projected bills under each policy bundle
    - New annual usage \* new price compared to baseline usage \* baseline price



# Rate and Fuel Price Workbook: Inputs and Assumptions

## Key Inputs:

- Utility rate data
  - Base rates & revenue requirement
  - VELCO Customer and sales forecasts
- AEO/EIA price forecasts
  - Propane & heating oil
  - Current natural gas prices
- NMR baseline study heating fuel shares
  - MF
  - SF new & existing
- LEAP model outputs
  - Usage forecasts for each policy bundle

## Assumptions:

- Fuel price/rate escalators
- T&D vs fuel/generation rates
  - To estimate cost recovery and apply avoided costs
- Annual bill amounts for:
  - Affordable vs market rate renters
  - SF vs MF
- Share of policy/program costs included in revenue requirement
- Real discount rate is 5%

# Key Questions: Equity and Just Transitions

Low and Moderate Income Incentives as Share of Total Program Incentives by Year																
2030 Initiatives		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040	2045	2050
	2. Expansion w Surcharge	70%	67%	64%	65%	64%	63%	62%	59%	58%	58%	58%	59%	57%	55%	54%
	2.b Clean Heat Standard	70%	67%	64%	65%	64%	63%	62%	59%	58%	58%	58%	59%	57%	55%	54%
	2.c Cap and Invest	70%	67%	64%	65%	64%	63%	62%	59%	58%	58%	58%	59%	57%	55%	54%
	4. Regulatory Bundle	69%	66%	64%	66%	65%	64%	63%	58%	59%	58%	58%	60%	60%	58%	59%
2035 Initiatives		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040	2045	2050
	3. Expansion w Surcharge	39%	48%	46%	57%	55%	63%	62%	62%	63%	63%	63%	63%	54%	52%	50%
	3.b Clean Heat Standard	39%	48%	46%	57%	55%	63%	62%	62%	63%	63%	63%	63%	54%	52%	50%
	3.c Cap and Invest	39%	48%	46%	57%	55%	63%	62%	62%	63%	63%	63%	63%	54%	52%	50%

# Conclusions

- Societal benefit cost results indicate economy-wide the GWSA compliant scenarios entail additional net social costs of \$568 million to \$1.485 billion over the study horizon. This is a small increase of 0.9% to 2.36% of the present value of annual energy expenditures.
- The regulatory bundle has the lowest net societal cost of \$568 million. The regulatory bundle scenario relies more on compliance enforcement and less on incentives to catalyze transitions. It has higher state administrative costs and lower program and incentive costs. It also obtains greater emission reductions from the C/I sectors and fewer from the residential sector.
- The practicality and acceptability of relying on more of a compliance and enforcement-based approach in comparison to incentive driven approaches is an important qualitative factor to consider.

## Conclusions

- The study highlights many common implementation, design, and delivery challenges related to the scale and pace of development required to meet the GWSA. This holds true regardless of the policy choice.
- The expansion of existing programs and initiatives are estimated to have lower program and administrative costs than a clean heat standard and the cap and invest initiative.
- The variation between the program and administrative costs for these initiatives is relatively small in comparison to the overall investments and benefits.

## Conclusions

- The design of policies and programmatic initiatives to meet the GWSA is a historic opportunity to address equity impacts of energy use. For this study, our analysis assumes incentive levels for low- and moderate-income households cover 75% to 100% of the measure costs.
- Without enabling participation from low- and moderate-income households, attaining the GWSA requirements will be difficult if not impossible, and would not address the important equity and justice policy objectives.