



STATE OF RHODE ISLAND

ENERGY EFFICIENCY & RESOURCE MANAGEMENT COUNCIL

CONSULTANT TEAM

Strategic Electrification in the Thermal Sector

Presented By:

EERMC Consultant Team

Rhode Island Office of Energy Resources

Date: November 8, 2021





Agenda

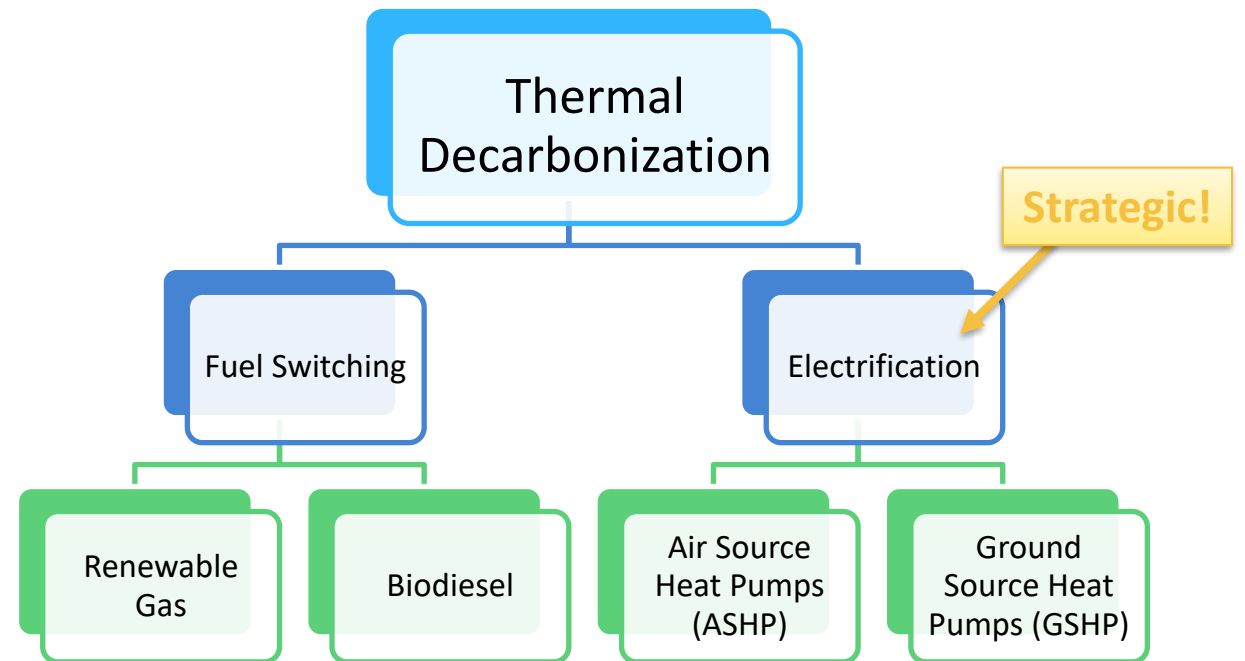
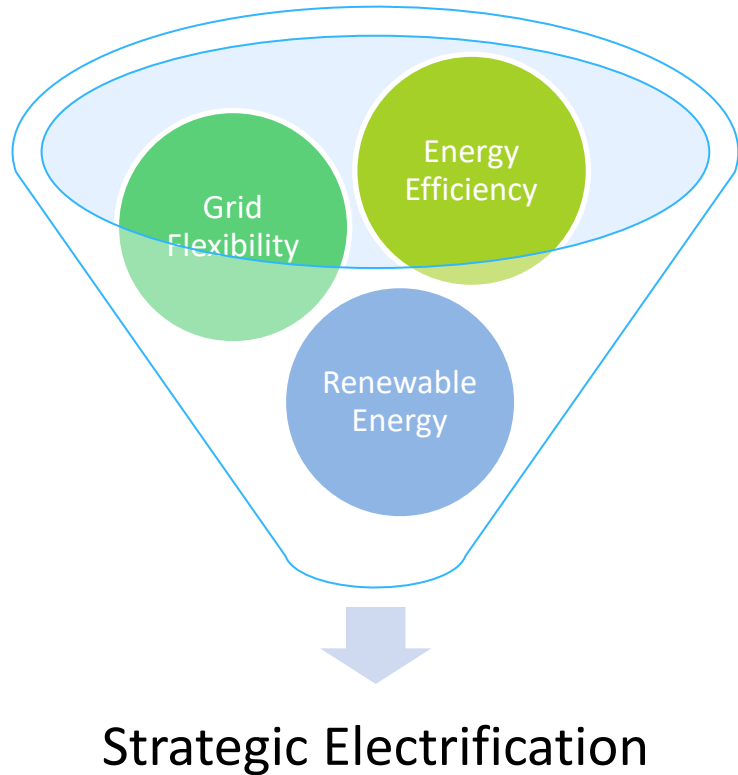
Context – 2021 Act on Climate & Heating Sector Transformation Report

Strategic Electrification in Other Jurisdictions

Looking Ahead – Thermal Electrification

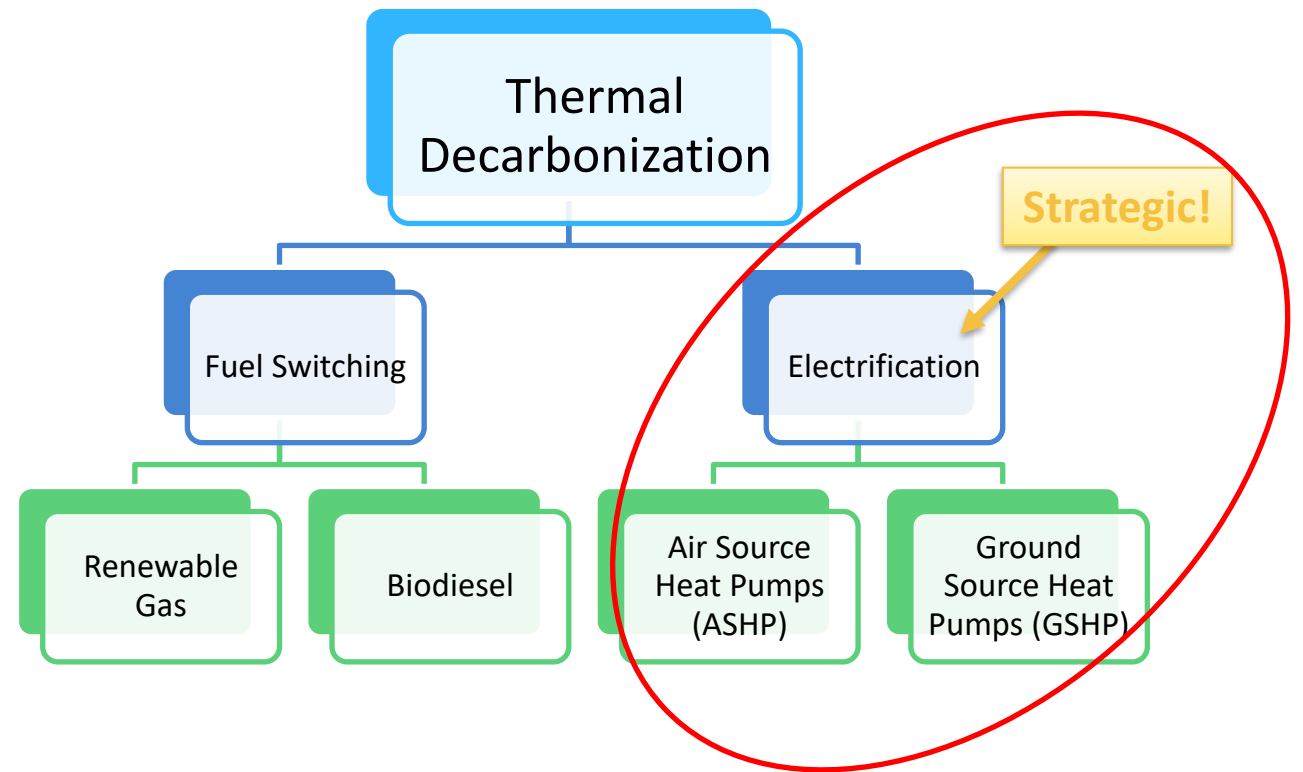
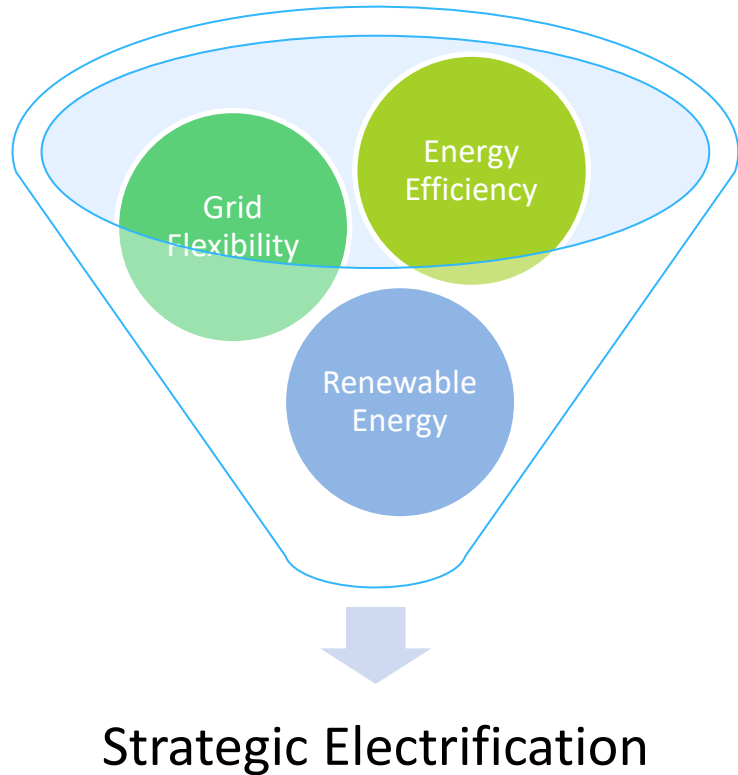


Terminology





Terminology





2021 Act on Climate

CONTEXT

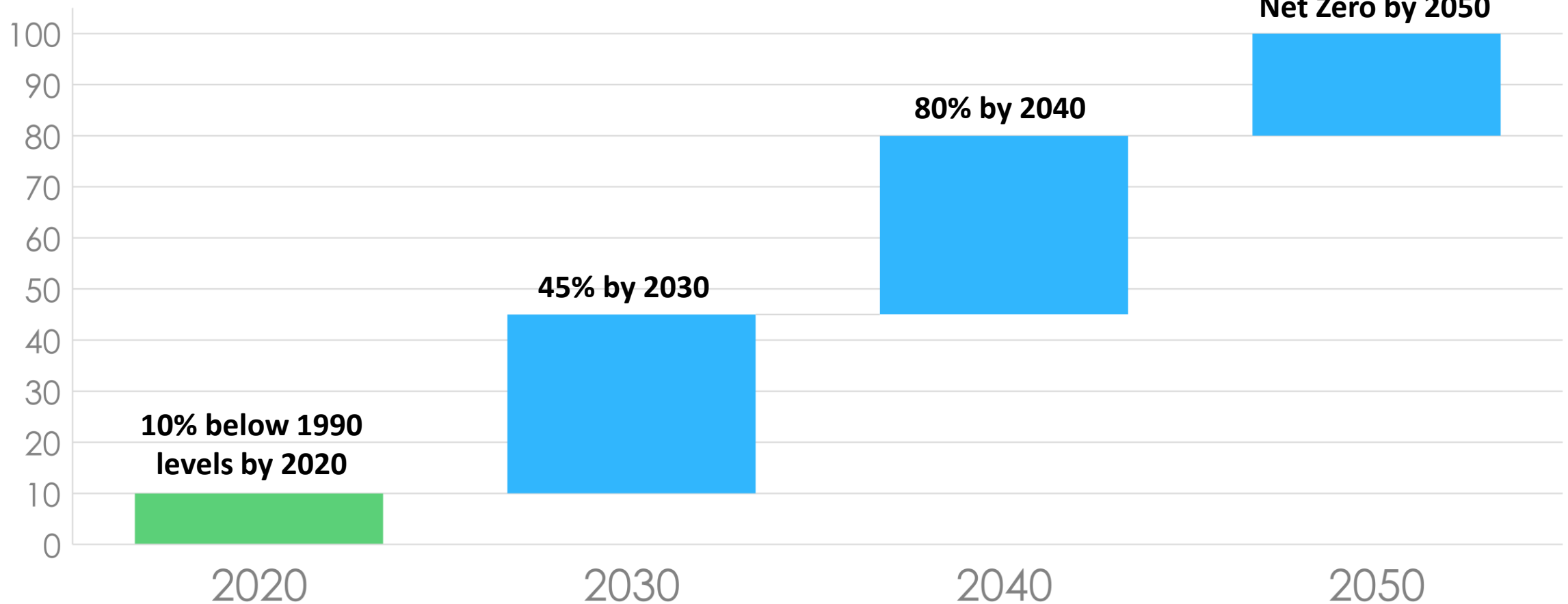




2021 Act on Climate

S-0078A, H-5445A

Targets





Heating Sector Transformation Report

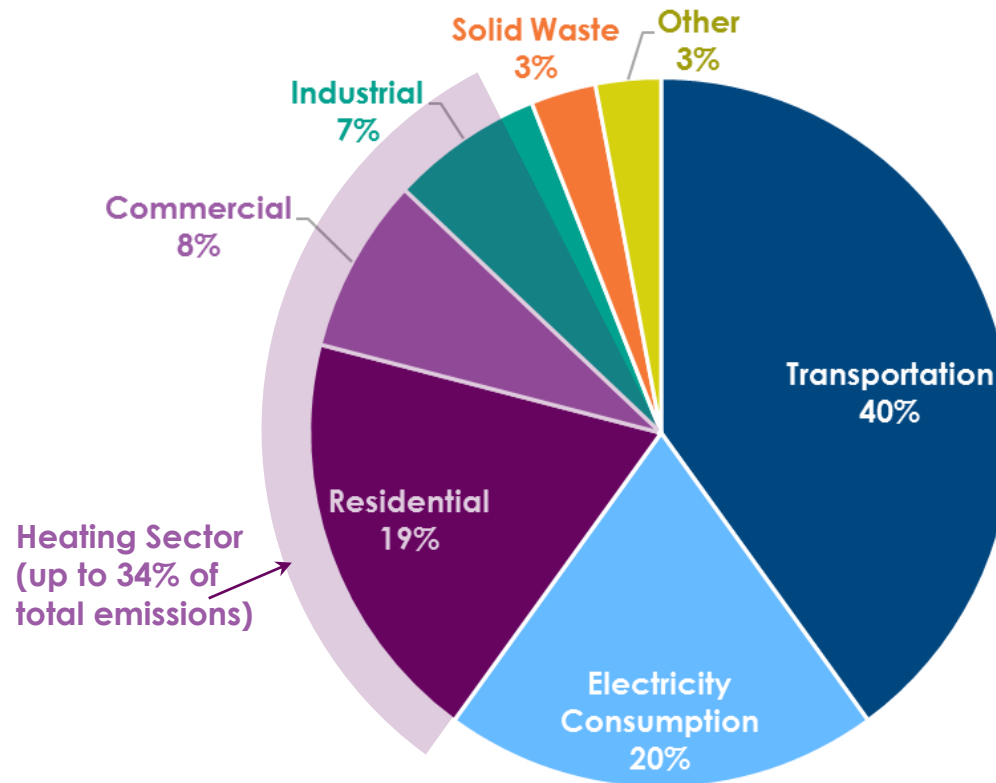
CONTEXT





Heating: 1/3 of RI Emissions

Rhode Island GHG Emissions by Sector (2015)

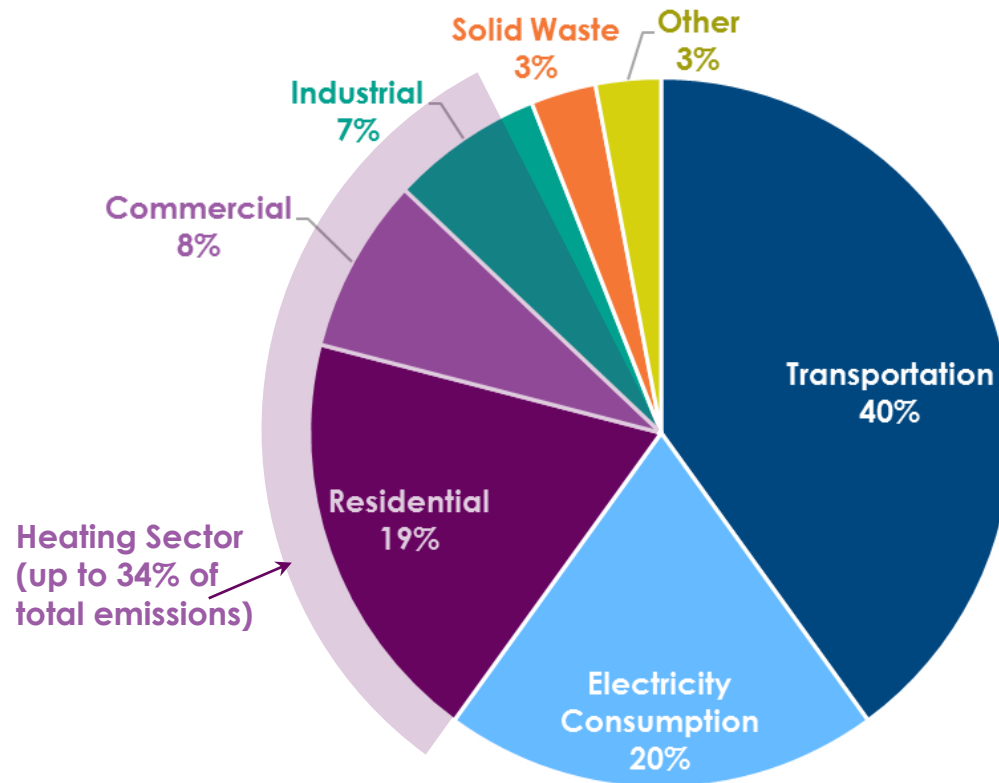


Note: Most but not all industrial GHG is related to heat generation, often for process heat.

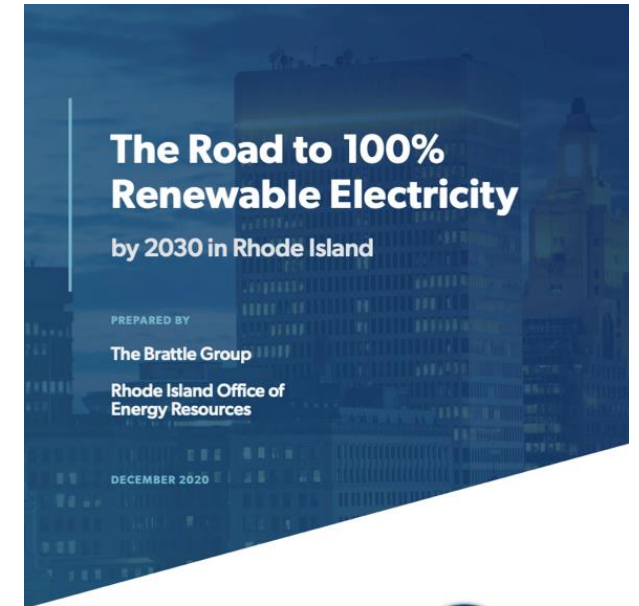


Heating: 1/3 of RI Emissions

Rhode Island GHG Emissions by Sector (2015)




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Primary Options

| | | |
|---|---|---|
| Space and water heat <i>Several primary options feasible across many applications/buildings</i> | Decarbonized Fuel <i>Limited supply from less-costly sources</i> | Renewable gas/power-to-gas (P2G) for gas customers – Landfill gas, anaerobic digesters, gasification, synthetic gas |
| | | Biofuel or power-to-liquids (P2L) for most other customers – Biodiesel, ethanol, synthetic fuels |
| | Heat Pumps | Air source heat pump (ASHP) |
| |  | Ground source heat pump (GSHP) – Including GeoMicroDistrict |
| Industrial heat | – <i>May be more specialized (e.g., high-temp)</i> – <i>Possibly requires (decarbonized) fuel including hydrogen</i> | |



Rhode Island, Massachusetts, Maine, and Vermont

STRATEGIC ELECTRIFICATION IN OTHER JURISDICTIONS





Strategic Electrification in Other Jurisdictions

| State | Legislation | Greenhouse Gas (GHG) Reduction Goal |
|---------------|--|---|
| Rhode Island | 2021 Act on Climate | Achieve net-zero GHG emissions by 2050 |
| Massachusetts | An Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy | Reduce GHG emissions to 50% below 1990 levels by 2030, and achieve net-zero GHG emissions by 2050 |
| Maine | An Act to Promote Clean Energy Jobs and to Establish the Maine Climate Council | Reduce GHG emissions to 45% below 1990 levels by 2030 and 80% below 1990 levels by 2050 |
| Vermont | An Act Relating to Addressing Climate Change | Reduce GHG emissions to 40% below 1990 levels by 2030 and 80% below 1990 levels by 2050 |



Strategic Electrification – Rhode Island

- Program Design
 - Prescriptive rebates for Res and Small Biz customers
 - Central or Ducted Minisplit HP: \$350 per ton
 - Ductless Minisplit HP: \$350 per ton
 - MSHP Displacing Elec. Resistance Heat: \$1,250 per ton
 - Oil/Propane customers eligible for additional \$650 per ton through OER/Regional GHG Initiative (RGGI), so up to \$1,000 per ton
 - Avg. RI home size = 1,700 square ft., 30 Btu of heating output per square foot, 12,000 Btu per ton -> **about 4 tons of HP capacity for average RI home**
- Funding Sources
 - Ratepayer EE charges (SBC, FCM revenues, RGGI)
 - Fuel switching not incentivized using ratepayer funding



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Strategic Electrification – Massachusetts

- Program Design
 - **Prescriptive rebates** for Res and Small Biz customers (\$250 per ton, \$1,250 per ton for Oil/Propane/Elec. Resistance customers)
 - Increasing incentives for 2022-2024 Three-Year Plan
- Funding Sources
 - **Ratepayer EE charges** (SBC, FCM revenues, RGGI)
 - \$800 million investment in electrification for 2022-2024 Plan (about **20% of total Mass Save spending**)
- Eligible Equipment
 - ASHPs, GSHPs, Variable Refrigerant Flow (VRF) systems
 - Exploring co-delivery model for **weatherization** (Wx) and HPs to properly size HP systems
 - Custom offerings for Large C&I and Multifamily
- Degree of Impact
 - 2022-2024 Plan will save 845,000 **mtCO₂e** that will count toward 2030 emissions reduction goal
 - Nearly **70,000 planned HP/HP Water Heater (HPWH)** installations for 2022-2024, about 23,000 HP/HPWHs annually

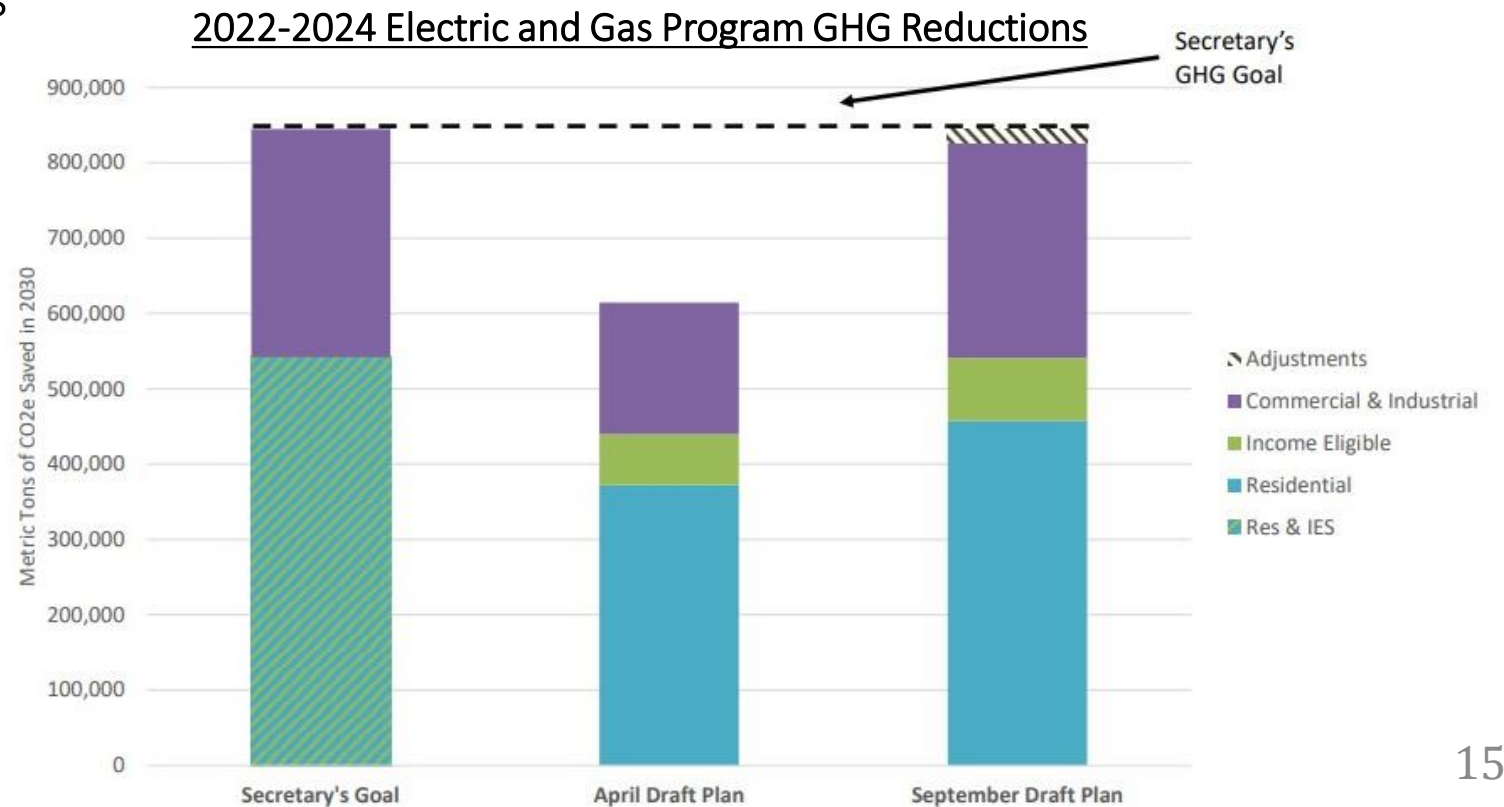
Weatherization: building shell insulation and air sealing to improve energy efficiency and weather resistance

mtCO₂e: Metric tons of carbon dioxide equivalent



Strategic Electrification – Massachusetts

- Integration w/Other Programs
 - Cape and Vineyard Electrification Offering – pairing of HPs, solar, storage, and Wx for low- and moderate-income customers
 - First comprehensive offering for HPs, solar/storage, and Wx for low-income customers
 - Also includes enhanced moderate-income incentives
- MA considering non-ratepayer funding sources to support electrification while mitigating adverse bill impacts





Strategic Electrification – Maine

Cumulative Efficiency Maine Heat Pump Installations (through 2025)



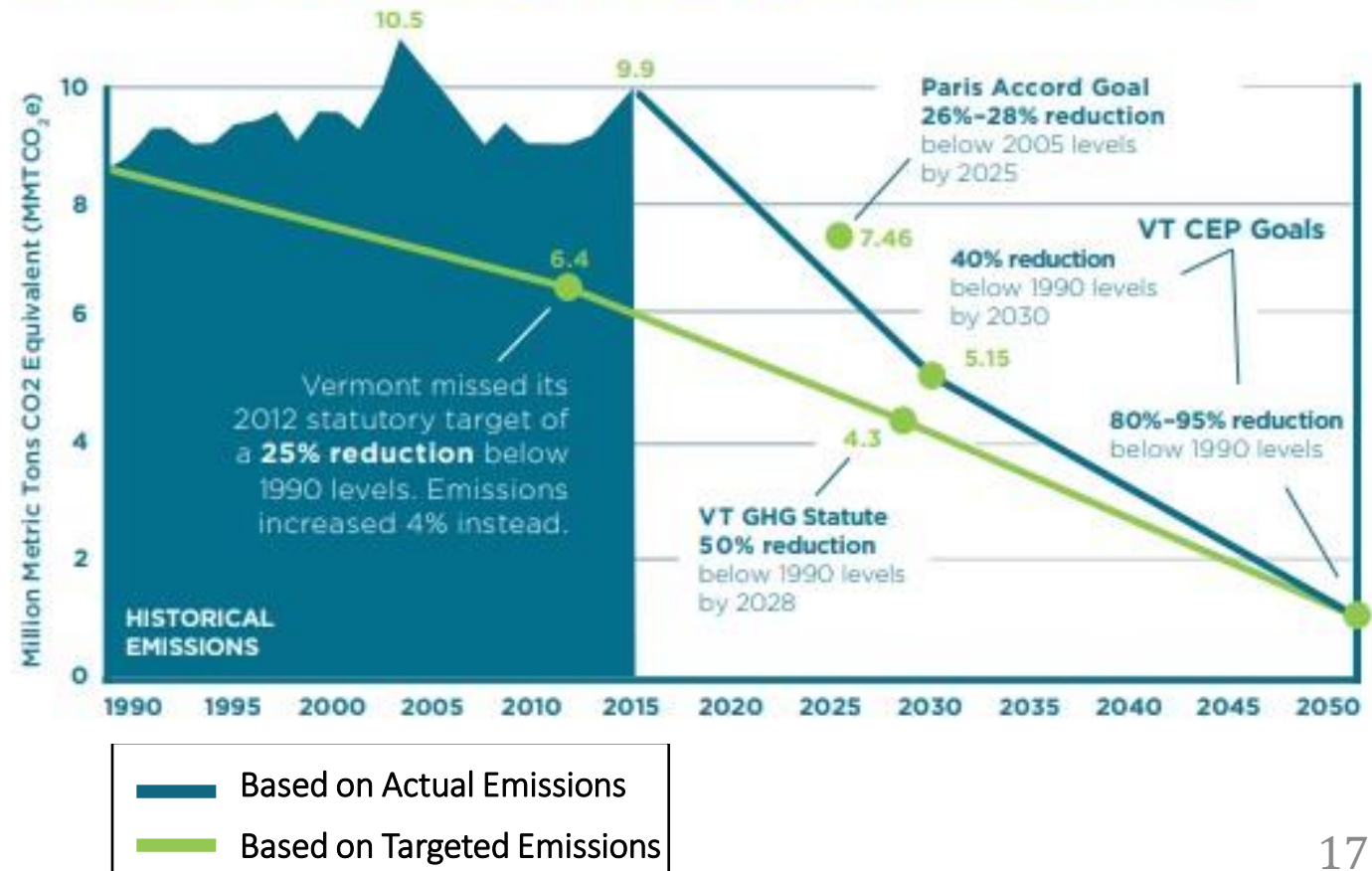
- Program Design
 - Prescriptive rebates
 - Res - \$400 per Tier 1 HP, \$800 per Tier 2 HP
 - IES - \$2,000 per HP, \$400 for second HP
 - Small Biz - \$1,600 per single-zone system, up to \$4,800
- Funding Sources
 - Ratepayer EE charges, RGGI, RPS compliance payments, federal grants
- Degree of Impact
 - Governor set goal to install **100,000 heat pumps** between FY 2019-2025
 - Equivalent to about 1,240 HPs per 100k residents per year for 6 years
 - Workforce development priority



Strategic Electrification – Vermont

- Program Design
 - Prescriptive rebates (Res/Small Biz)
 - Ductless HPs - \$350-\$450 per HP, size-dependent
 - Ducted HPs - \$1,000-\$2,000 per HP, size-dependent
 - IES: Bonus rebate, ~\$200-\$800
- Funding Sources
 - Ratepayer EE charges, RGGI, FCM Revenues
- Degree of Impact
 - About 237,000 HPs (roughly 7,100 HPs annually from 2019-2050) needed to meet 2050 GHG reduction target of 90% below 1990 GHG emissions levels, in addition to other EE measures

What will it take to meet our commitments?





Thermal Electrification
LOOKING AHEAD





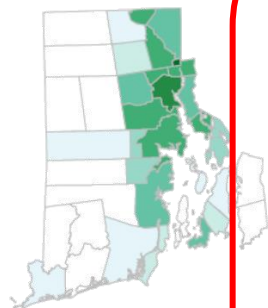
Thermal Electrification

- Thermal Electrification → heat pumps for both heating & cooling
- Most developed clean heating technology in RI
- When electricity is decarbonized, so is heating

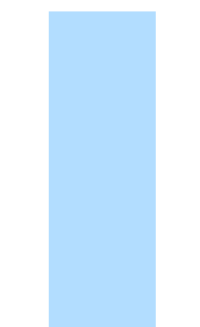


Initial Targets

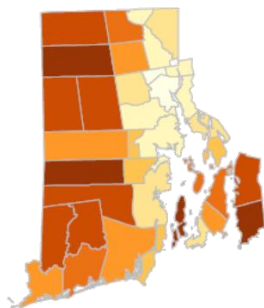
Utility Gas



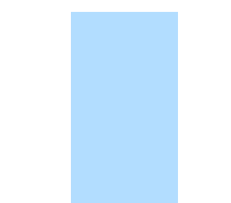
54%



Delivered Fuel



33%



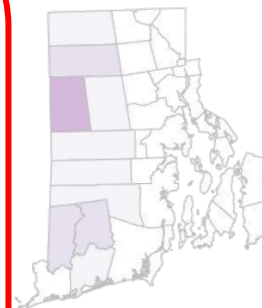
Electricity



9%



Wood/Other



4%



- Source: *Rhode Island Renewable Thermal Market Development Strategy*, prepared by Meister Consultants Group for Rhode Island Office of Energy Resources, January 2017.
Notes: "Other" includes propane, kerosene, solar, and no heat.



Current Perspective

Areas of Focus

- Improving energy efficiency
 - Weatherization
 - Most efficient technologies
- Providing utility-based incentives to consumers
- Increasing education and awareness
- Identifying needs and gaps

Challenges

- Streamlining process for consumers
- Securing stable incentive funding
- Ensuring all needs are met throughout entire *strategic* process
 - Weatherized
 - Proper sizing
 - Proper usage
- Equity
 - Involving those with limited resources
 - Non-homeowners



Additional Resources

- [Heating Sector Transformation Report](#)
- [National Grid Heat Pump Incentives](#)
- [Massachusetts GHG Reduction Goals](#)
- [Massachusetts 2022-2024 Plan Update Presentation](#)
- [Cape Light Cape and Vineyard Electrification Offering – Bundled ASHP, Wx, Solar PV, and Storage](#)
- [Efficiency Maine Heat Pump Incentives](#)
- [Efficiency Maine Cumulative Program Results 2021 Testimony](#)
- [Efficiency Vermont Heat Pump Incentives](#)
- [Energy Action Network Vermont – 2018 Annual Climate Change Progress Report](#)



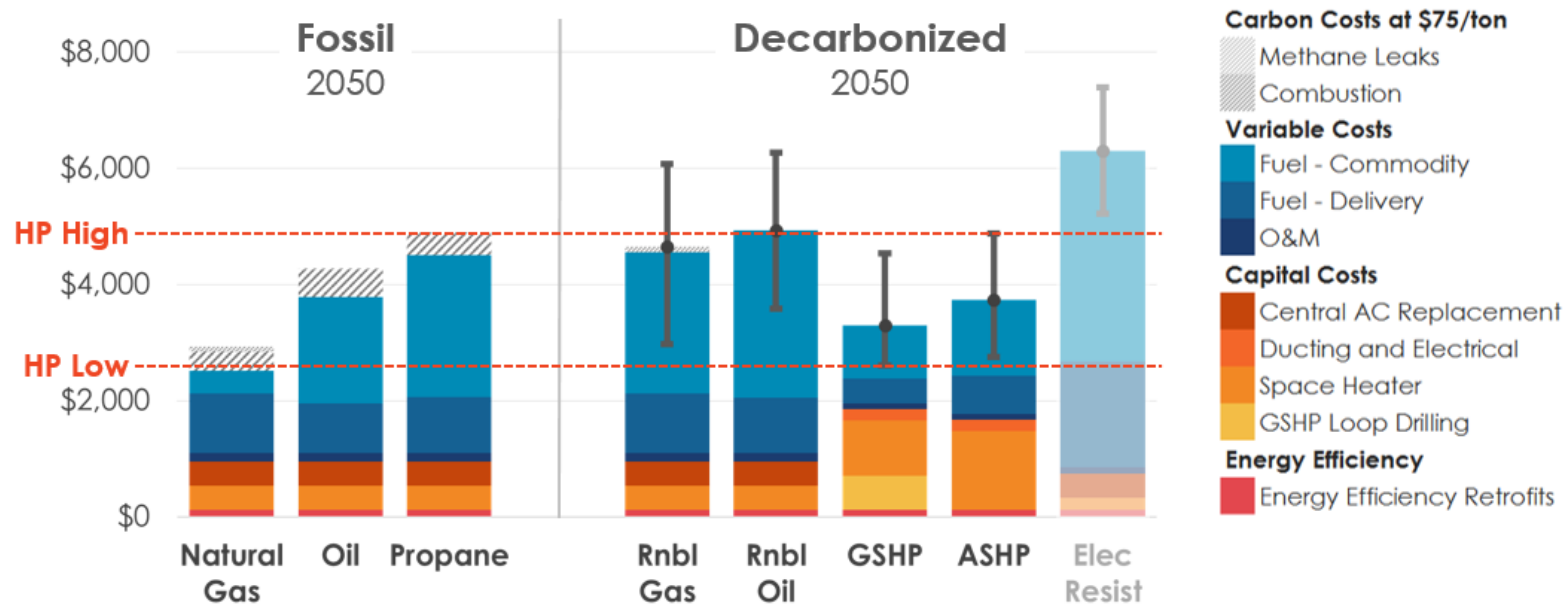
Cost comparison futures of decarbonized vs. fossil fuel heating

APPENDIX



Economics for representative single family home with bookend scenario show no one “best solution”

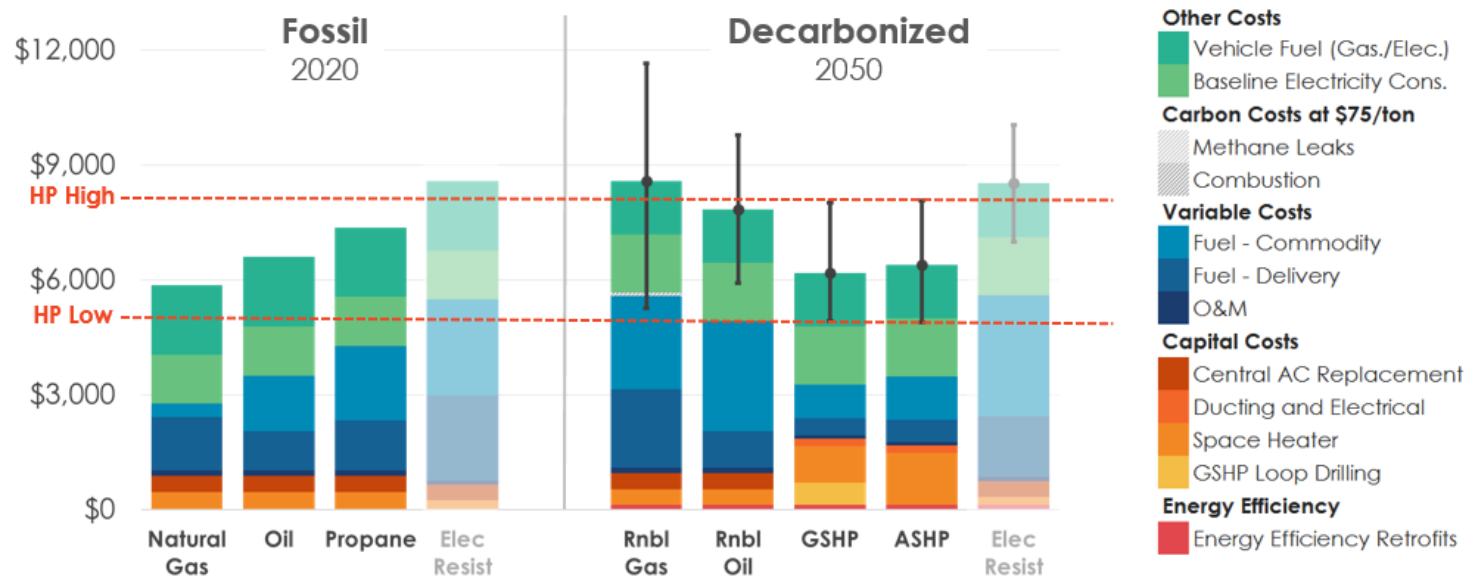
Space Heat Economics – Average Annual Cost (2018 \$/yr)



- Bookend scenario assumes current fossil shares are retained (Rnbl Gas, Rnbl Oil), or that all heat is provided by GSHPs or ASHPs
 - ASHP bookend has higher electric peak and prices, natural gas volume unchanged
- **Broadly similar costs when recognizing large uncertainty ranges**
 - “Central” projections are quite uncertain; ranges likely more reliable
 - Annualized costs of decarbonized heating comparable to oil or propane, more than gas

Typical energy spending will likely be comparable to today (except perhaps for current gas customers)

Average Annual Total Energy Cost(2018 \$/yr)
 Current (2020) Fossil vs Projected 2050 Decarbonized (Mixed Scenario Example)



Total energy wallet likely comparable to today for typical consumer (within uncertainty range)

- May be slightly higher for customers now using fossil gas heat (which is at historic lows)
- **EV charging is likely cheaper** than current motor fuel, offsetting other energy costs
- Not everyone is “typical” – **must recognize and mitigate impacts on disadvantaged consumers**



HST Report –Future Considerations

- **Feasibility in 30 years** – Weatherization/heat pump installations pose significant implementation challenges, given >400,000 residential/commercial buildings
- **Work force** requirements, especially for widespread heat pump deployment
 - Also workforce transition issue in fuel industries
- **Customer preferences**
 - Reluctance to give up gas for cooking, to endure disruption, etc.
- **Existing codes, standards, zoning rules etc.** may inhibit some technologies
- **Long life of heating infrastructure** creates challenges for altering it
- **High up-front cost and cost uncertainties** of heat pumps
 - The need for financing creates a barrier to adoption
- **Geology** may limit GSHP implementation
- To decarbonize heating, heat pumps **require decarbonized electricity**
- **Air quality** impacts of fuel burning (indoor from gas cooking; outdoor from gas and especially oil)
- **Safety concerns** of any gaseous fuel



BREAK



15 minutes

