Rhode Island Renewable Thermal Market Strategy: The Impacts of Getting to 5 Percent Penetration

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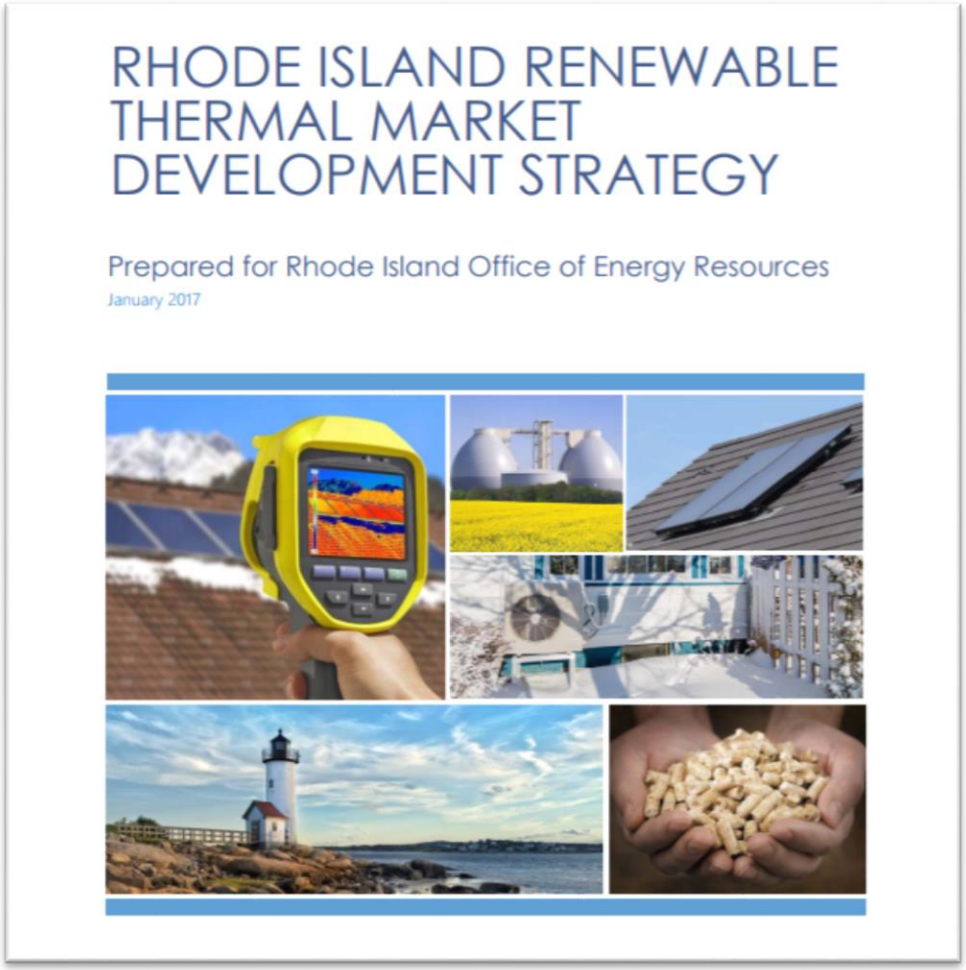
Report for Rhode Island Office of Energy Resources



Available at http://www.energy.ri.gov/reports-publications/past-projects/ri-renewable-thermal-market-development-strategy.php

Key Findings

- The 5% RE Thermal (RT) scenario is cost-effective
  - Cost-effectiveness varies greatly by technology
  - Our sensitivity analysis show possible improvements in cost-effectiveness

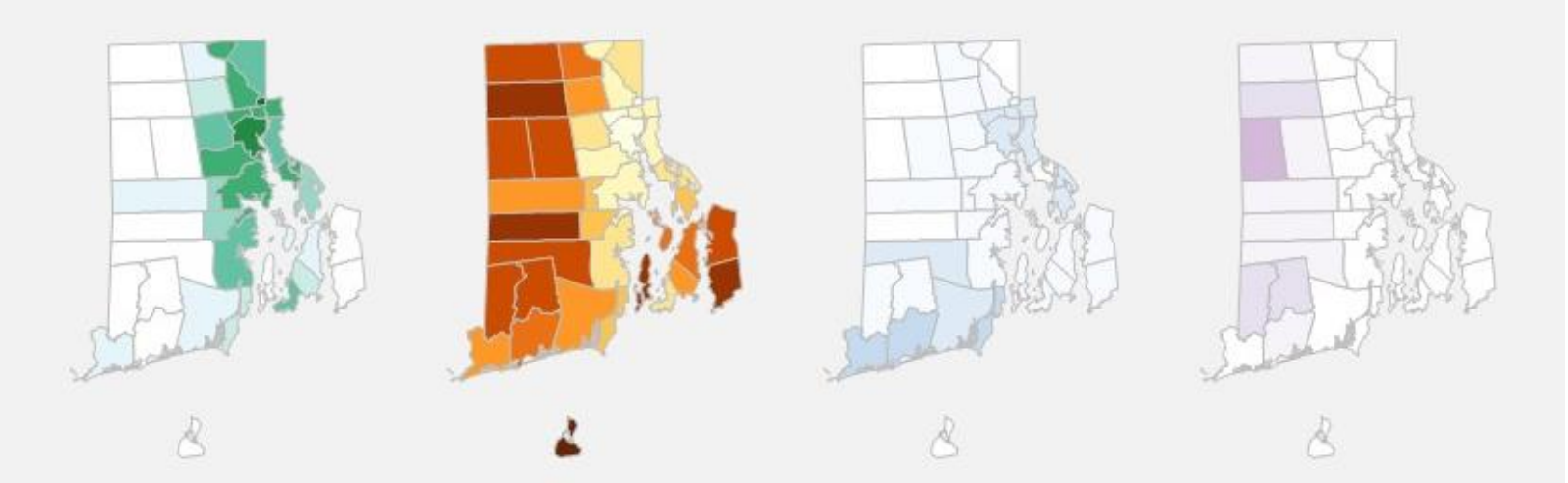
- In addition, the RT scenario:
  - Results in negligible rate and bill impacts
  - Produces net jobs for the state
  - Saves CO_2 emissions

Why Renewable Thermal?

Thermal Fuel Use in Rhode Island

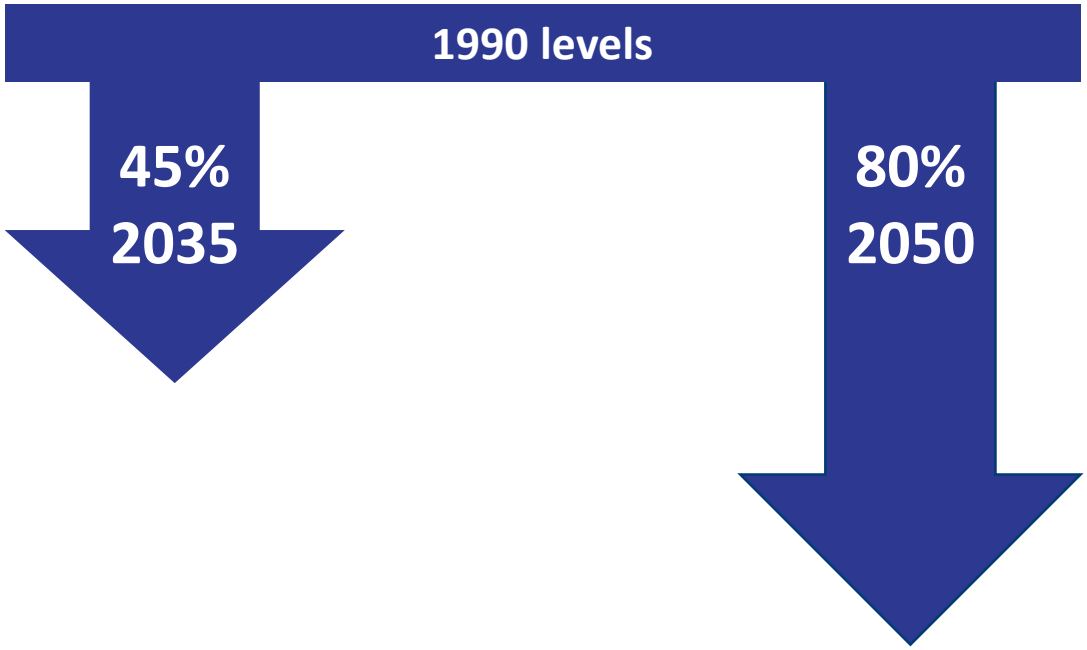
1/3 Total Energy Use | 1/3 GHG Emissions

Household Fuel Use



Utility Gas	Delivered Fuel	Electricity	Wood/Other
54%	33%	9%	4%

The Resilient Rhode Island Act of 2014



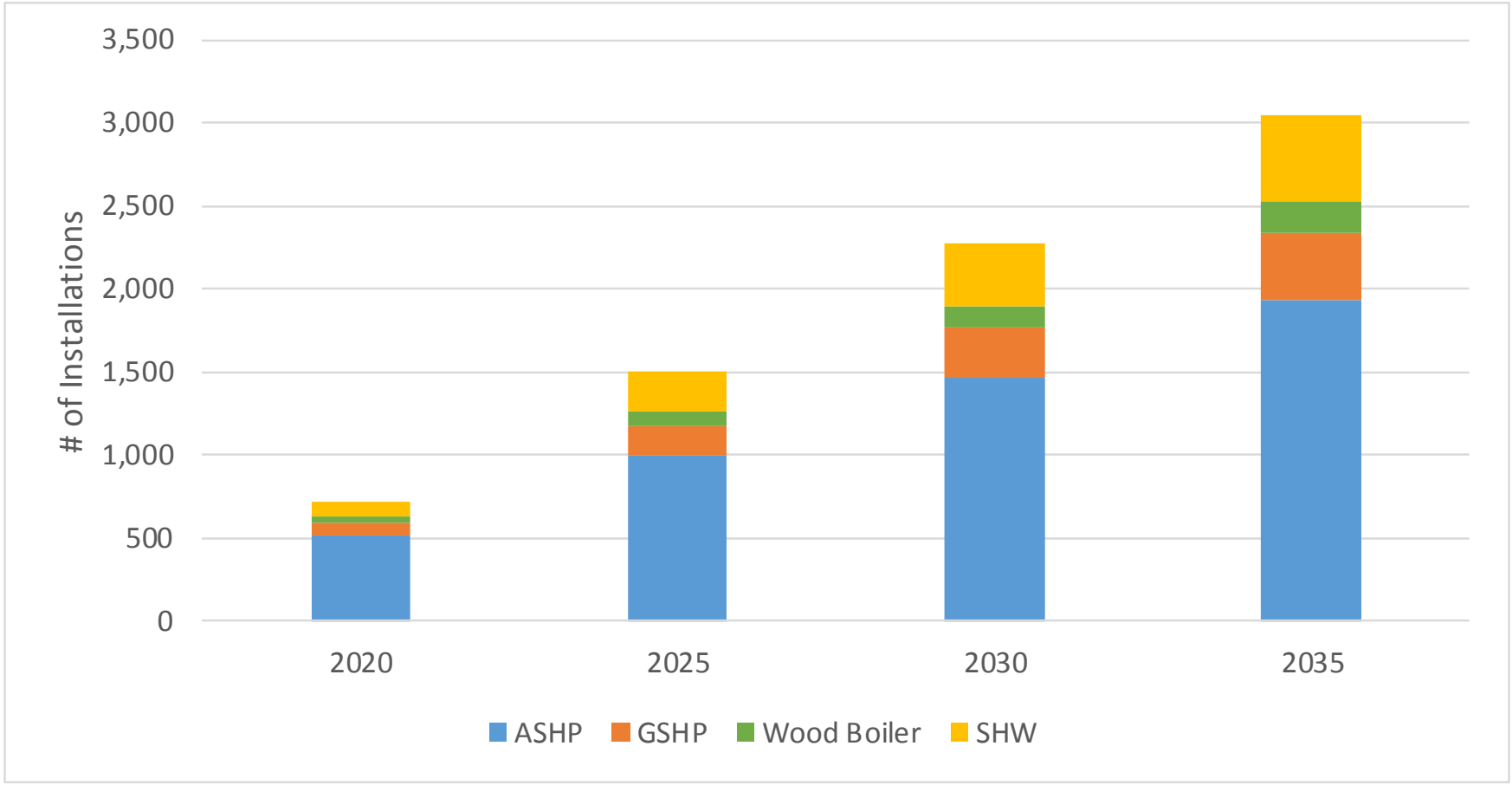
New opportunities with Renewable Thermal: Rhode Island can help meet its GHG emission reduction goals and reap substantial economic benefits by changing heating fuel sources to "renewable thermal" sources.

Scenario

- **Target**: Achieve 5 percent renewable thermal energy penetration by 2035 by providing technical support and financial incentives to RT technologies.
- **Sector**: residential single-family, multi-family, and small commercial customers (less than 20,000 sf).
- **RE Technologies**: ASHP, GSHP, wood boilers, and solar hot water (SHW) systems.
  - Due to the economics of different technologies and the size of current markets, we assumed that ASHP would be the prevailing RI technology deployed in this scenario.

Key Assumptions

RT Installation by Technology



RE Thermal Applications and Costs

- **GSHP and Wood boilers**:
  - Serves 100% of building heating needs
  - Installed instead of a standard system
  - The incremental cost beyond the cost of a standard system is used.
- **SHW and ASHP**:
  - Serve 70 % of building heating needs
  - Residents and businesses would keep their existing heating equipment as a backup or a supplemental heating source.
- Other possible technology configurations where ASHPs are used to serve the full heating load were considered but excluded due to wide degree of variability in these installations.

Key Assumptions

Category		Data	Sources
RE Thermal Costs	Single family	See the paper	Program data in MA and CT
	Multi-family	See the paper	Assumed certain economies of scale on SF projects
	Commercial	See the paper	2012 MA DOER Heating and Cooling report except SHW
Building	Thermal load	See the paper	EIA RECS and CBECS
Program cost	Incentive amonts	Incentive levels in MA	MA CEC
	Administrative cost	Ngrid EE program data	2016 Ngrid EE plan
Performance	ASHP	11 HSFP	NEEP
	GSHP	4 COP	ENERGY STAR standard
	Solar	SRCC 13.7	Mass CEC average
	Wood boilers	80 - 85 AFUE	Stakeholder feedback
Energy Avoided Cost	Electricity supply	AESC 2015 values	AESC 2015
	Natural gas supply	AESC 2015 values	AESC 2015
	Electricity and gas distribution costs	Ngrid current tariff with an escalation rate for future costs	Ngrid tariffs
	Fuel oil	RI OER based values	RI OER
	Wood	Stakeholder feedback with AESC fuel escalation factor	Stakeholder feedback and AESC 2015

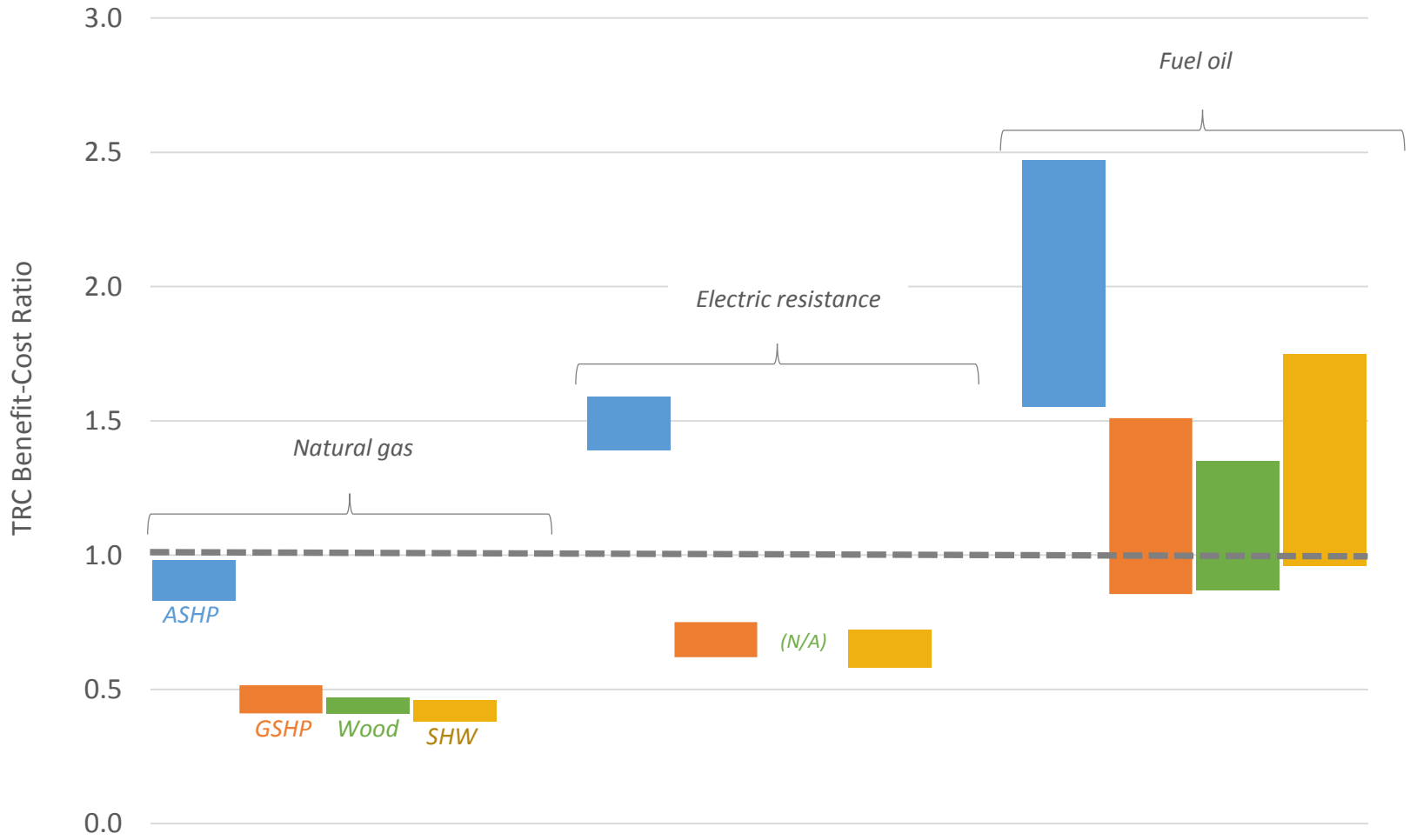
Cost-Effectiveness Analysis

Rhode Island Total Resource Cost Test

Benefits	Costs
Avoided costs of fossil fuel use	Incremental cost of installed RT equipment (where appropriate),
Environmental compliance costs	Administrative costs of managing an RT incentive program
Market price effects	Added fuel and electricity costs of RT technologies
Non-energy benefits (improved home comfort and increased property values)	Market price effects associated with the added electricity costs

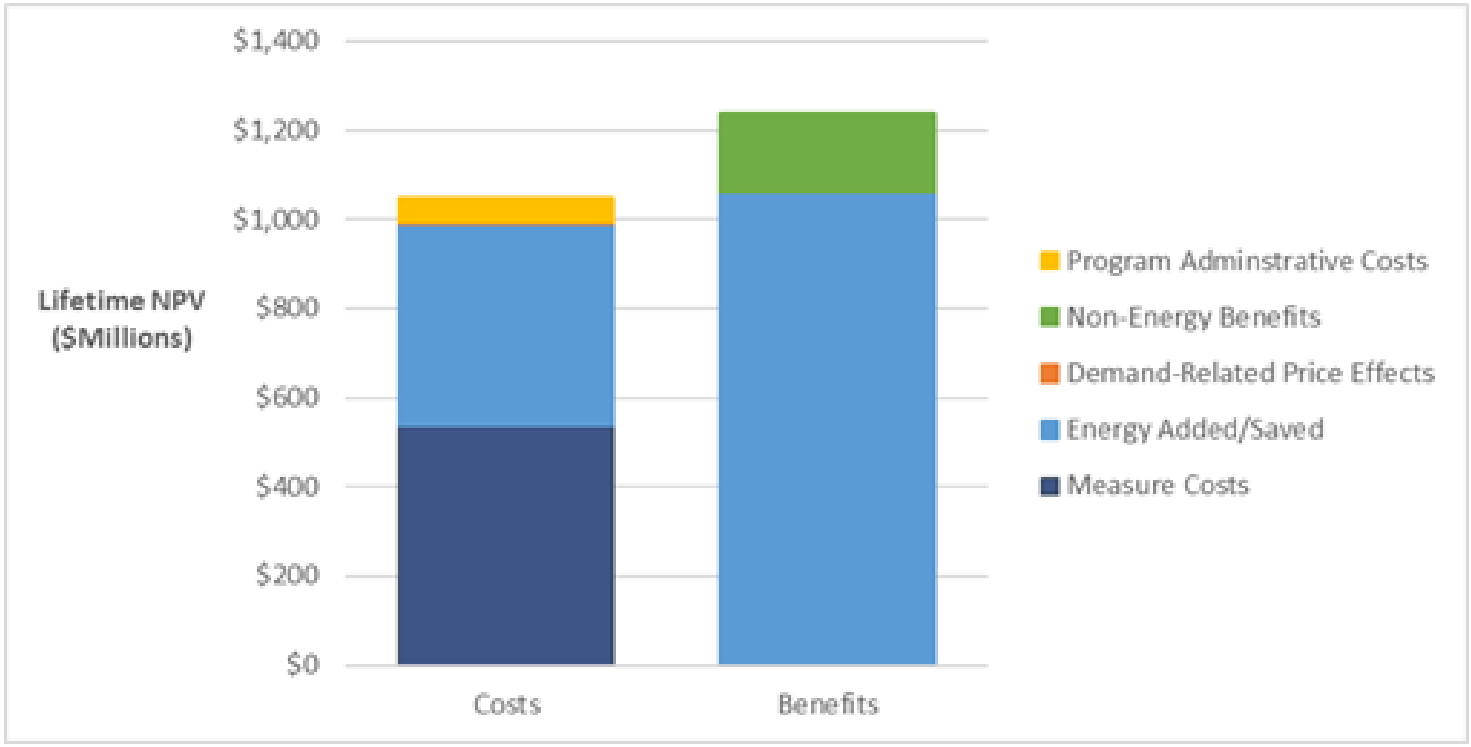
Benefits/costs: A score of 1 or greater is cost-effective. Less than 1 is not cost-effective.

Single Family Projects – TRC Results



Portfolio Level TRC Results

Sensitivity Scenario	Base Case	2013 Fossil Fuel Prices	Reduced RT Costs	Interaction of Effects
TRC Ratio	1.18	1.6	1.34	1.8



Rate and Bill Impact Analysis

Rate and Bill Impact Analyses

Program cost recovery: a system benefit charge (SBC) or similar charge is used to recover program costs. The same surcharge rate is assumed for the RES and COM sectors.

Rate impact

- RT annual energy rates =

$$\frac{RT\ annual\ revenues}{RT\ annual\ sales}$$

Where,

RT annual revenues = BAU revenues +/- expected system cost changes due to RT

RT annual sales = Adjusted sales due to RT

Bill impact

- Considers both changes in rates and changes in customers' consumption
- Better indication of a new policy's impact on customers.

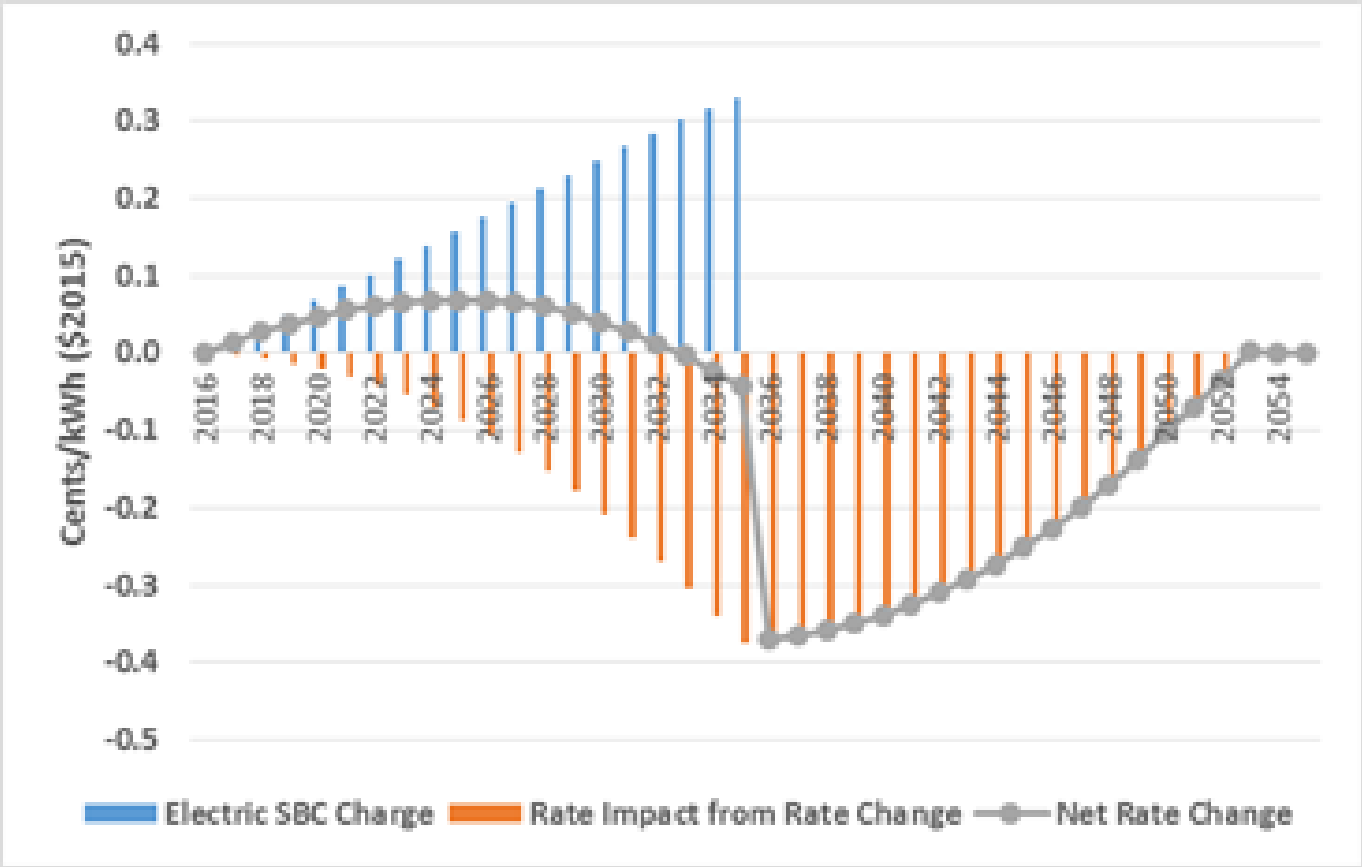
Rate Impact Results

- Both electric and natural gas rate impacts from the RT program are negligible.

	Natural Gas	Electricity
Residential	0.5%	-0.3%
Commercial	0.1%	0.2%

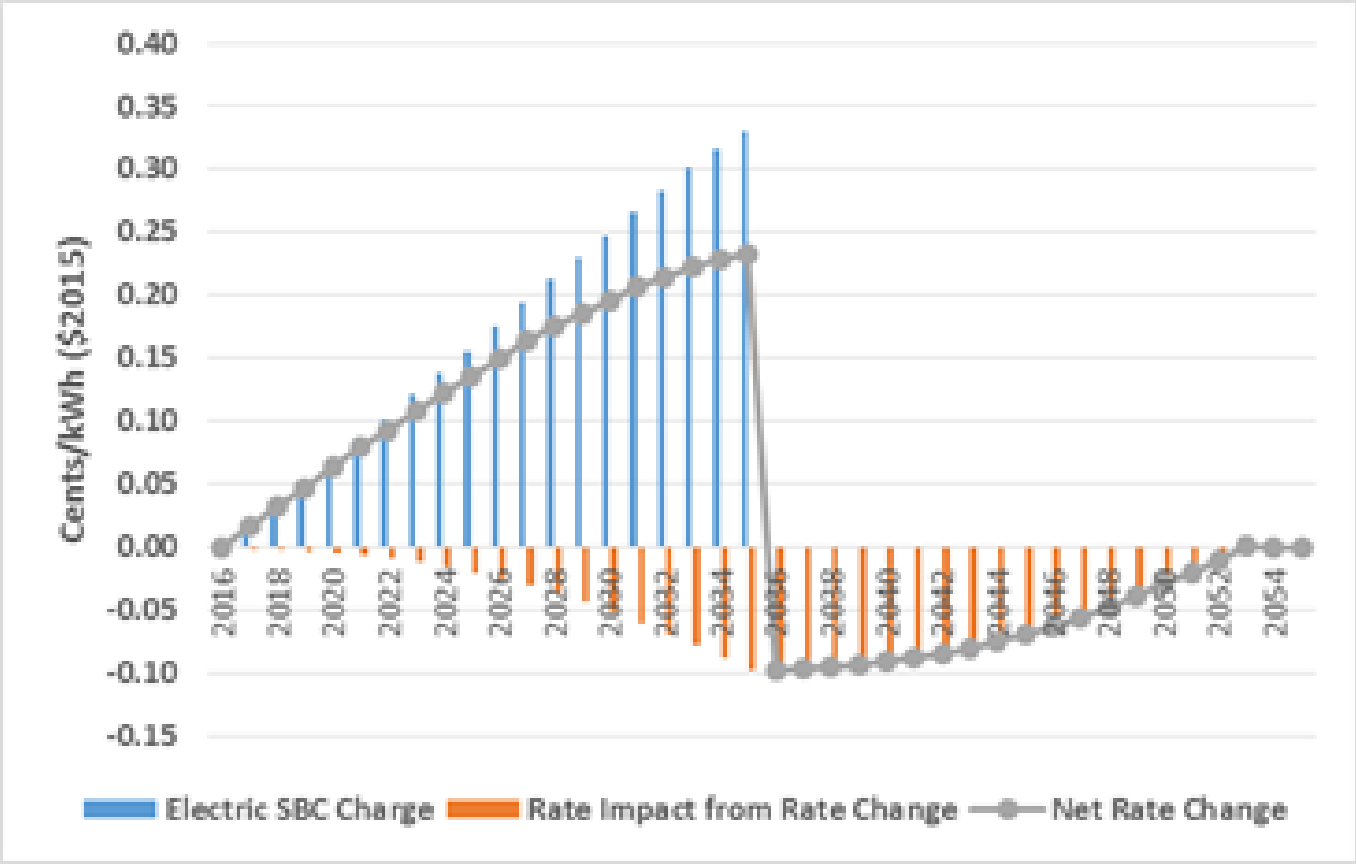
Electricity Rate Impact: Residential

Residential electric rate impact results



Electricity Rate Impact: Commercial

Commercial electric rate impact results



Bill Impact

Non-participant bill impact

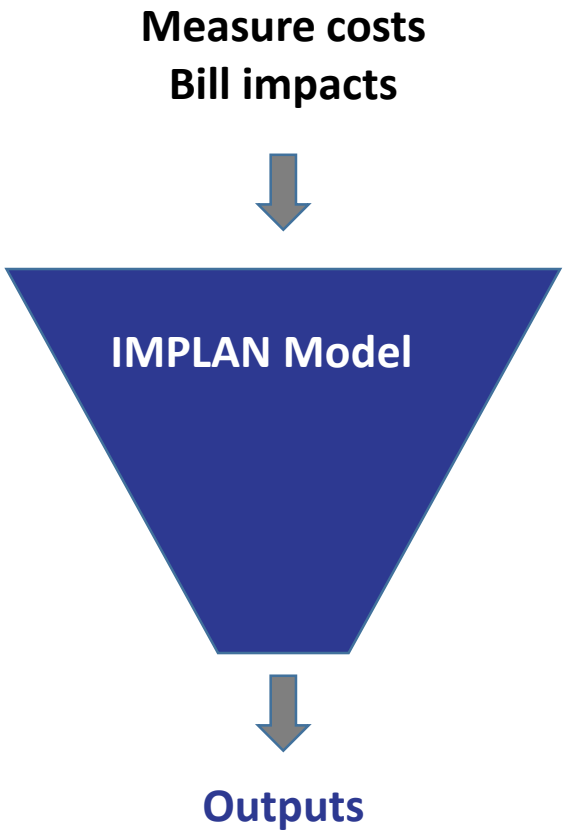
	Natural Gas Bill		Electricity Bill		Combined Bill	
	%	$ per year	%	$ per year	%	$ per year
Residential	0.5%	$7	0.0%	-$4	0.1%	$3
Commercial	0.1%	$4	0.2%	$24	0.2%	$28

Employment Impact Analysis

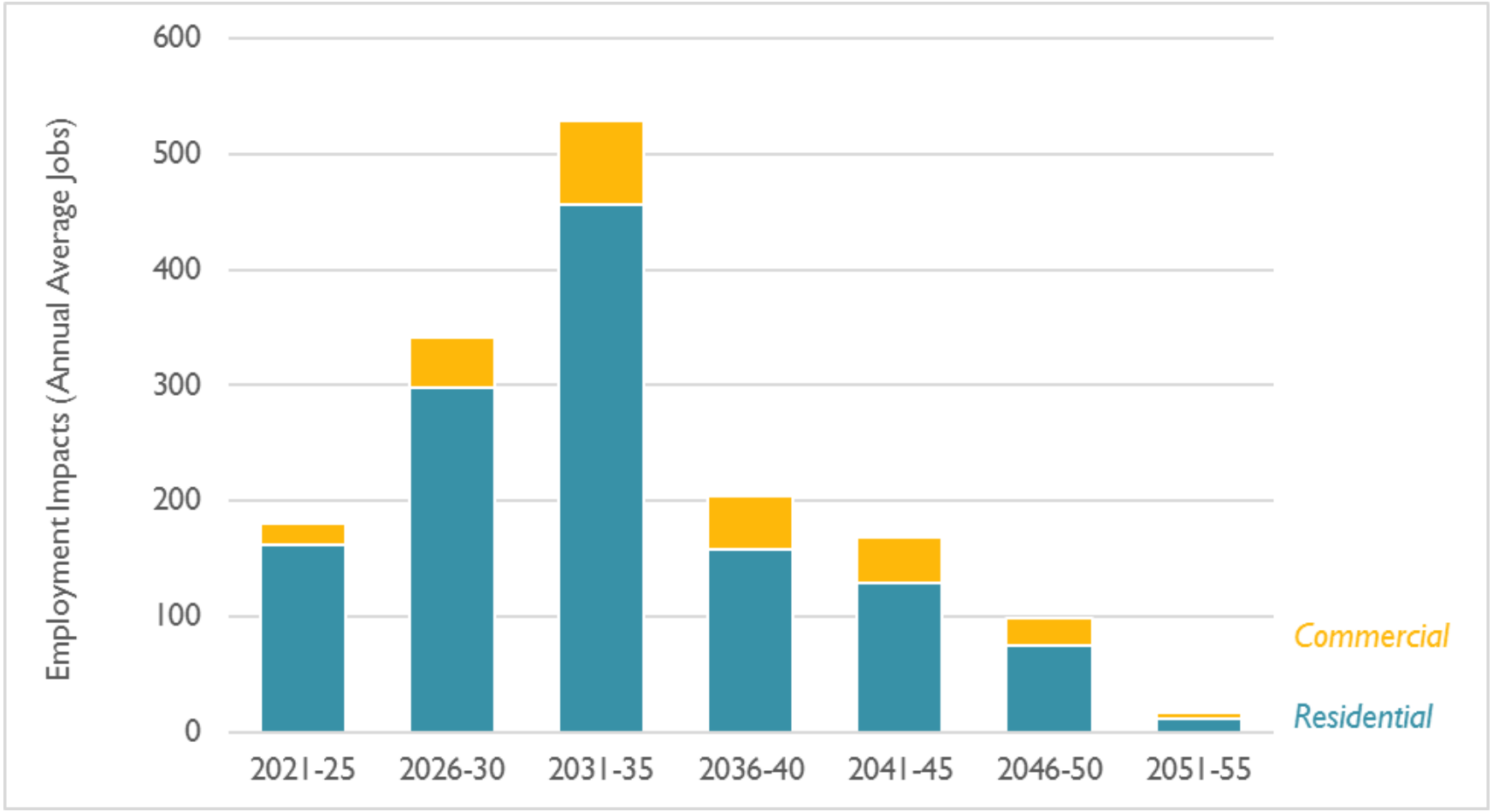
Analysis Approach

Outputs: increased labor from installing RT minus the reduction in labor from standard measures not installed as a result of the RT program.

- **Direct impacts:** installation labors
- **Indirect impacts:** equipment and services to support the HVAC installation
- **Induced impacts:** increased spending by workers and households



Local Job Impact Results

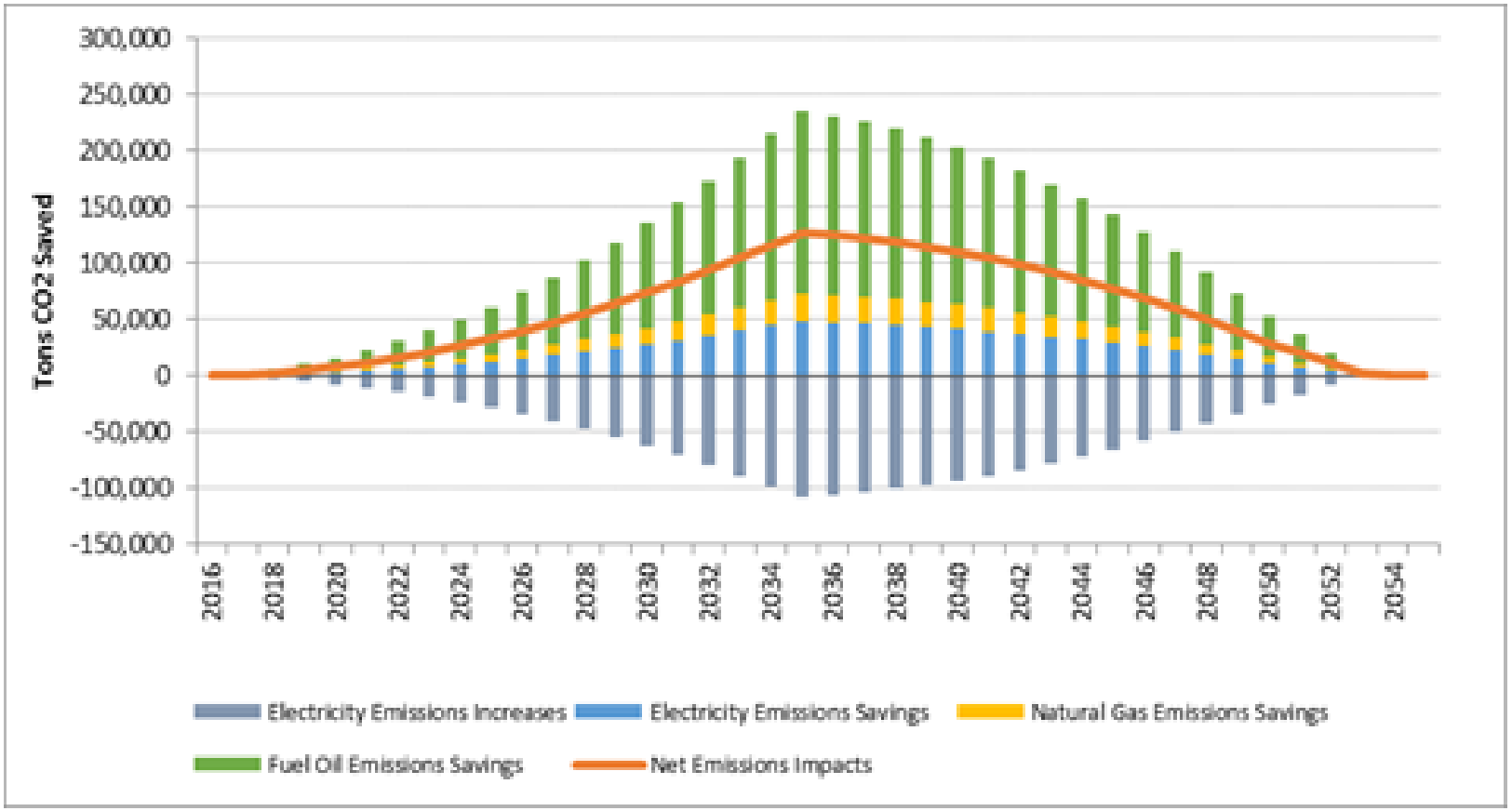


Emission Impact Analysis

Emission Impact Approach

- **Scope**:
  - Modeling of net CO_2 emission increases from increased electricity use (due to installation of ASHPs and GSHPs) and CO_2 reductions from decreased fossil fuel use (due to RT installations).
  - CO_2 impacts from wood boilers are not modeled.
- **Emissions from electricity**:
  - U.S. EPA's Avoided Emissions and Generation Tool (AVERT)
  - AVERT developed by Synapse for U.S. EPA can estimate hourly emissions impacts for CO_2, SO_2, NO_X, and $PM_{2.5}$ from reduced electricity loads due to clean energy programs.
- **Emissions from natural gas and fuel oil**:
  - Emission factors from U.S. Energy Information Administration

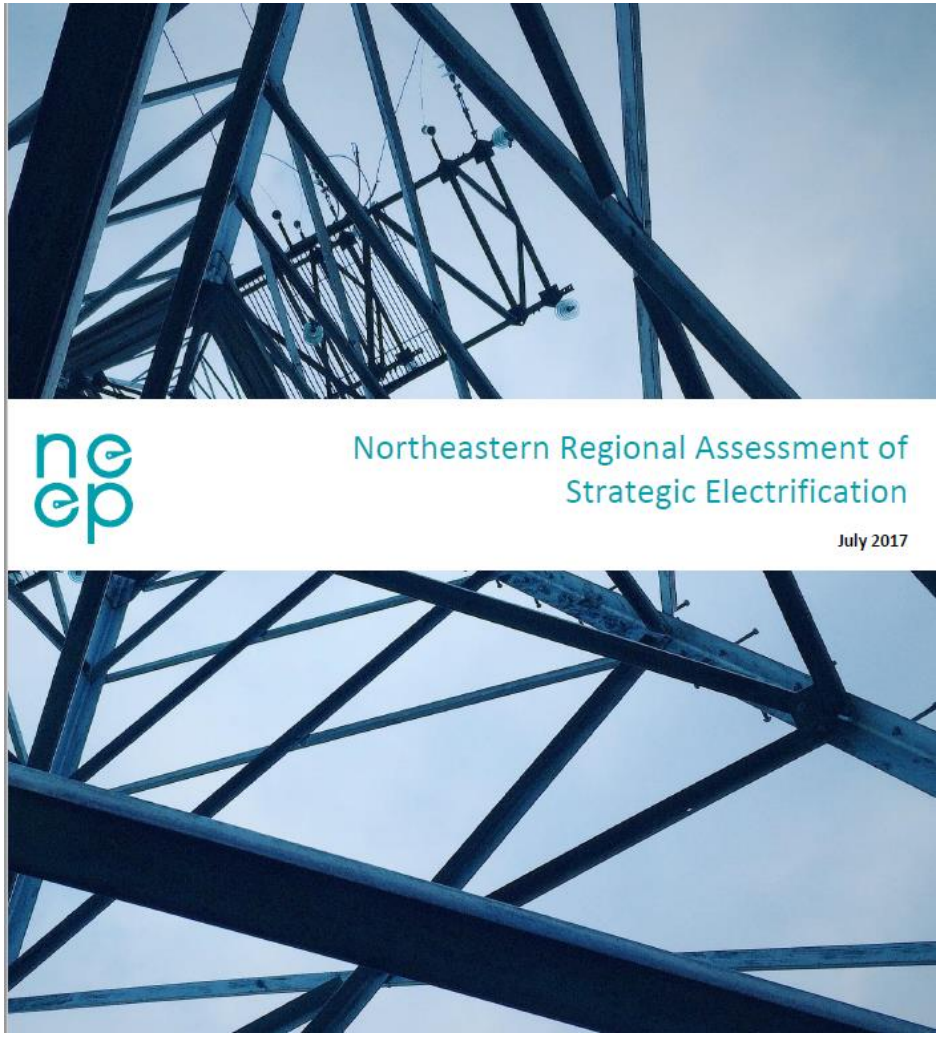
Annual Emissions Impacts (Short Tons)



Further Research Topics

a) Model new construction and major renovation for ASHP
b) Update the cost assumptions
c) Research potential cost improvements especially for ASHP and GSHP (See NYSERDA's RE Heating and Cooling Policy Framework report)
d) Model large commercial buildings and include variable refrigerant flow (VRF) heat pump systems
e) Model a larger-scale RT scenario that can really help achieve the state's GHG targets in 2035 and 2050 along with other policies (See NEEP Strategic Electrification report)

NEEP Strategic Electrification Report



Available at http://www.neep.org/strategic-electrification-regional-assessment

Thank you!

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