STATE OF RHODE ISLAND
Department of Environmental Management

PRIORITY CLIMATE ACTION PLAN

This project has been funded wholly or in part by the United States Environmental Protection Agency (EPA) under assistance agreement 00A00854 to the Rhode Island Department of Environmental Management. The contents of this document do not necessarily reflect the views and policies of the EPA, nor does the EPA endorse trade names or recommend the use of commercial products mentioned in this document.

March 1, 2024

Contacts:

Elizabeth Stone (elizabeth.stone@dem.ri.gov) and Rachel Calabro (rachel.calabro@dem.ri.gov)

Table of Contents

Table of Contents ii
Introduction 1
Greenhouse Gas Emissions Inventory 2
- Transportation 14
- Buildings 32
- Electricity 44
- Waste and Working Lands 50

Benefits Analysis 54
Low-Income and Disadvantaged Community Analysis 54
Review of Authority 63
Intersection with Other Funding Availability 63
Coordination and Outreach 63
Conclusion 65

Tables

Table 1. Rhode Island GHG emissions in MMT CO_2e by Sector 3
Table 2. Rhode Island GHG emissions in MMT CO_2e by Gas 5
Table 3. Rhode Island PCAP Priority Measures Summary 13

Figures

Figure 1. Rhode Island Greenhouse Gas Emissions Quick Facts
Figure 2. 2020 Greenhouse Gas Emissions by Economic Sector
Figure 3. Rhode Island Environmental Justice focus areas
Figure 4. Average annual temperatures in Rhode Island, 1895-2023
Figure 5. Temperatures measured in CAPA Heat Watch campaign
Figure 6: Benzene Concentrations in Rhode Island Ambient Air
Figure 7. Current asthma rates as compared to national average from EJScreen
Figure 8. Annual Precipitation in Rhode Island, 1895-2023

Appendices

Appendix 1. LIDAC
Appendix 2. Technical Appendix

Introduction

On April 14, 2021, Rhode Island Governor Dan McKee signed into law the 2021 Act on Climate, which set mandatory, enforceable climate emissions reduction goals culminating in net-zero emissions by 2050.

- 10% below 1990 levels by 2020
- 45% below 1990 levels by 2030
- 80% below 1990 levels by 2040
- Net-zero emissions by 2050

This legislation updated the previous 2014 Resilient Rhode Island Act, positioning the state to boldly address climate change and prepare for a global economy that will be shifting to adapt to clean technology.

The Act on Climate required that the Executive Climate Change Coordinating Council (RIEC4) deliver an updated climate plan to the Governor and General Assembly by December 31, 2022 (referred to as the '2022 Update'). After a fourteen-month process involving substantial stakeholder engagement, research, and compilation and coordination among the 13 state agencies of the RIEC4, the 2022 Update was completed and serves as a benchmark and updated foundation for Rhode Island's future climate work.

The RIEC4 then turned its attention to the 2025 Climate Strategy, which will include a set of "strategies, programs, and actions to meet economy-wide enforceable targets for greenhouse gas emissions" due by December 31, 2025. The 2025 Climate Strategy will be developed via a robust stakeholder process modelled closely on the process used for the 2022 Update and will address areas such as environmental injustices, public health inequities, and a fair employment transition as fossil-fuel jobs are transitioned into green energy jobs. The 2025 Climate Strategy will be a comprehensive working document that will be updated every five years thereafter.

Rhode Island intends to closely align the development of the 2025 Climate Strategy with the priorities identified in this PCAP and the larger CCAP (due later in 2025). Robust stakeholder engagement and explicit consideration of equity and justice will be critical to the success of each process.

The measures contained herein should be construed as broadly available to any entity in the state eligible for receiving funding under the EPA's Climate Pollution Reduction Implementation Grants (CPRG) and other funding streams, as applicable. Rhode Island has prioritized GHG reductions measures that maximize emission reductions, deliver benefits to low-income and disadvantaged communities, and leverage existing programs, policies, programs, and related federal funding sources to advance the state's climate priorities via cost-effective measures.

RIDEM would like to extend its gratitude to the Northeast States for Coordinated Air Use Management (NESCAUM) team and sub-contractors for assisting with many of the technical aspects of this plan.

Greenhouse Gas Emissions Inventory

The Rhode Island Department of Environmental Management has developed a statewide inventory of major sources of GHG emissions within Rhode Island. This inventory was prepared using the following data resource(s):

- State-level GHG inventories prepared by the EPA;[1]
- EPA's State Inventory Tool (SIT);[2]
- Data reported to the EPA's Greenhouse Gas Reporting Program;[3]
- EPA's Motor Vehicle Emissions Simulator (MOVES);[4] and,
- Rhode Island Electricity Consumption Emissions Methodology[5]

Detailed methodology and quality assurance procedures for preparation of this inventory are located in the '*RI Climate Pollution Reduction Grants Program Quality Assurance Project Plan 11/22/23*' as approved by USEAP in Nov. 2023. This report can be found online at https://dem.ri.gov/data-maps/data.php#quapps

[1] https://www.epa.gov/ghgemissions/state-ghg-emissions-and-removals
[2] https://www.epa.gov/statelocalenergy/state-inventory-and-projection-tool
[3] https://www.epa.gov/ghgreporting/data-sets
[4] https://www.epa.gov/moves
[5] https://dem.ri.gov/sites/g/files/xkgbur861/files/2022-11/Updates%20to%20Electricity%20Sector%20GHG%20Accounting.pdf

The Rhode Island inventory includes the following sectors and gases:

Sectors	***Greenhouse Gases (across all sectors)***
Transportation	Carbon Dioxide (CO_2),
Electricity consumption	Methane (CH_4),
Residential Heating	Nitrous Oxide (N_2O),
Commercial Heating	Fluorinated gases (F-gases), including
Industry	Hydrofluorocarbons (HFCs), Perfluorocarbons
Natural Gas Distribution	(PFCs), Sulfur Hexafluoride (SF_6), and Nitrogen
Waste	Trifluoride (NF_3)
Agriculture	
Land Use, Land Use Change, and Forestry	

Table 1 details GHG emissions in million metric tons (MMT) of carbon dioxide equivalents (CO_2e) for all economic sectors. The Rhode Island Inventory equates emissions of GHGs using the global warming potential metric from the Intergovernmental Panel on Climate Change's Fifth Assessment Report[6]. Table 2 details emissions of specific GHGs across all sectors.

Table 1. *Rhode Island GHG emissions in MMTCO$_2$e by Sector*[1,2,3,4,5]

Sector/Source	**1990**	**2020**
Transportation	**4.65**	**3.77**
Aviation	0.33	0.06
Highway Vehicles	3.98	3.34
On-Road Gasoline	*3.39*	*2.44*
On-Road Diesel	*0.59*	*0.89*
Liquified Petroleum Gas	+	+
Natural Gas	+	*0.01*
Non-Road Sources	0.35	0.37
Marine	*0.13*	*0.06*
Rail	*0.01*	*0.01*
Other Utility Equipment	*0.21*	*0.29*
Electricity Consumption	**2.82**	**2.04**
Electricity Consumed from Biogenic Sources[7]	N/A	0.32
Electricity Consumed from Non-Biogenic Sources	2.82	2.04
Residential Heating	**2.38**	**1.91**

[6] https://www.ipcc.ch/report/ar5/syr/

[7] Biogenic CO_2 emissions from electricity consumption are reported for informational purposes only.

"N/A" indicates breakout not available

Symbols:

"-" indicates that the value is not applicable

"+" indicates that the value does not exceed 0.005 MMT CO_2e

Coal	+	-
Petroleum	1.38	0.90
Natural Gas	0.97	1.00
Wood	0.03	0.01
Commercial Heating	**1.13**	**0.80**
Coal	0.01	-
Petroleum	0.67	0.21
Natural Gas	0.44	0.59
Wood	+	+
Industry	**0.69**	**0.98**
Industrial Heating	0.61	0.57
Coal	-	-
Petroleum	*0.38*	*0.16*
Natural Gas	*0.22*	*0.42*
Wood	+	+
Industrial Processes	0.08	0.40
Electric Power Transmission & Distribution	*0.06*	+
Iron & Steel Manufacturing	-	-
Ozone Depleting Substance Substitutes	+	*0.40*
Limestone & Dolomite Use	-	-
Soda Ash	*0.01*	*0.01*
Urea Consumption	+	+
Semiconductor Manufacturing	*0.01*	-
Natural Gas Distribution	**0.33**	**0.26**
Pipeline Mains	0.21	0.15
Pipeline Services	0.12	0.12
Waste	**0.34**	**0.12**
Municipal Solid Waste	0.24	0.02
Potential Methane Emissions	*0.85*	*N/A*
Methane Emissions Avoided from Flaring & LG2E	*-0.61*	*N/A*
Wastewater	0.10	0.10
Municipal Wastewater Treatment	*0.10*	*0.10*
Industrial Wastewater Treatment	-	+
Agriculture	**0.05**	**0.03**
Livestock	0.02	0.01
Manure Management	+	+
Enteric Fermentation	*0.02*	*0.01*
Soil Management	0.03	0.02
Urea Fertilization	+	+
Soil Management Practices	*0.03*	*0.02*
Land Use, Land Use Change, & Forestry (LULUCF)	**-0.81**	**-0.68**
Forest Land	-0.60	-0.54
Forest Land Remaining Forest Land	*-0.53*	*-0.47*
Land Converted to Forest Land	*-0.07*	*-0.07*

Croplands	0.02	0.03
Cropland Remaining Cropland	*0.01*	*0.02*
Land Converted to Cropland	*0.02*	*0.02*
Grasslands	+	+
Grasslands Remaining Grasslands	+	+
Land Converted to Grasslands	+	+
Wetlands	-0.02	-0.02
Coastal Wetlands Remaining Coastal Wetlands	*-0.02*	*-0.02*
Land Converted to Wetlands	+	+
Settlement Lands	-0.20	-0.15
Settlements Remaining Settlements	*-0.31*	*-0.26*
Land Converted to Settlements	*0.11*	*0.12*
Total (Sources) Emissions[8]	**12.37**	**9.92**
Total Net (Sources and Sinks) Emissions[9]	**11.56**	**9.24**

Table 2. Rhode Island GHG emissions in MMT CO_2e by Gas

Gas/Source	**1990**	**2020**
CO_2	**10.58**	**8.37**
Transportation	4.50	3.74
Aviation	*0.33*	*0.06*
Highway Vehicles	*3.84*	*3.32*
Non-Road Sources	*0.34*	*0.35*
Electricity Consumption	2.82	2.04
Residential Heating	2.34	1.89
Coal	+	-
Petroleum	1.38	0.89
Natural Gas	0.96	1.00
Wood	-	-
Commercial Heating	1.12	0.80
Coal	0.01	-
Petroleum	0.67	0.21
Natural Gas	0.44	0.59
Wood	-	-
Industry	0.61	0.58
Industrial Heating	*0.60*	*0.57*
Coal	-	-

[8] Total emissions presented without LULUCF; column totals may not agree with grand total due to rounding.
[9] Net emissions include LULUCF; column totals may not agree with grand total due to rounding.

Petroleum	0.38	0.16
Natural Gas	0.22	0.42
Wood	-	-
Industrial Processes	*0.01*	*0.01*
Limestone & Dolomite Use	-	-
Soda Ash	0.01	0.01
Iron & Steel Manufacturing	-	-
Urea Consumption	+	+
Agriculture	+	+
Urea Fertilization	+	+
Land Use, Land Use Change, & Forestry (LULUCF)	-0.81	-0.68
Forest Land	*-0.60*	*-0.54*
Croplands	*0.02*	*0.03*
Grasslands	+	+
Wetlands	*-0.02*	*-0.02*
Settlement Lands	*-0.20*	*-0.15*
CH_4	**0.72**	**0.40**
Transportation	0.02	0.01
Aviation	+	+
Highway Vehicles	0.02	+
Non-Road Sources	+	+
Electricity Consumption	N/A	N/A
Residential Heating	0.03	0.02
Coal	+	-
Petroleum	0.01	+
Natural Gas	+	+
Wood	0.02	0.01
Commercial Heating	0.01	+
Coal	+	-
Petroleum	+	+
Natural Gas	+	+
Wood	+	+
Industry	+	+
Industrial Heating	+	+
Coal	-	+
Petroleum	+	+
Natural Gas	+	+
Wood	+	+
Natural Gas Distribution	0.33	0.26
Pipeline Mains	*0.21*	*0.15*
Pipeline Services	*0.12*	*0.12*
Waste	0.31	0.09

Municipal Solid Waste	*0.24*	*0.02*
Wastewater	*0.07*	*0.07*
Agriculture	0.02	0.01
Livestock	*0.02*	*0.01*
Land Use, Land Use Change, & Forestry (LULUCF)	+	+
Forest Land (Wildfires)	+	+
N_2O	**0.19**	**0.08**
Transportation	0.13	0.03
Aviation	+	+
Highway Vehicles	*0.12*	*0.02*
Non-Road Sources	*0.01*	*0.01*
Electricity Consumption	N/A	N/A
Residential Heating	0.01	+
Coal	+	+
Petroleum	+	+
Natural Gas	+	+
Wood	+	+
Commercial Heating	+	+
Coal	+	+
Petroleum	+	+
Natural Gas	+	+
Wood	+	+
Industry	+	+
Industrial Heating	+	+
Coal	+	+
Petroleum	+	+
Natural Gas	+	+
Wood	+	+
Waste	0.03	0.03
Wastewater	*0.03*	*0.03*
Agriculture	0.03	0.02
Manure Management	+	+
Soil Management	*0.03*	*0.02*
Land Use, Land Use Change, & Forestry (LULUCF)	+	+
Forest Land (Wildfires)	+	+
HFCs, PFCs, and NF_3	**0.01**	**0.40**
Industry	0.01	0.40
Ozone Depleting Substance Substitutes	+	*0.40*
Semiconductor Manufacturing	*0.01*	-

SF_6	**0.06**	**+**
Industry	0.06	+
Electric Power Transmission & Distribution	*0.06*	+
Total (Sources) Emissions[8]	**12.37**	**9.92**
Total Net (Sources and Sinks) Emissions[9]	**11.56**	**9.24**

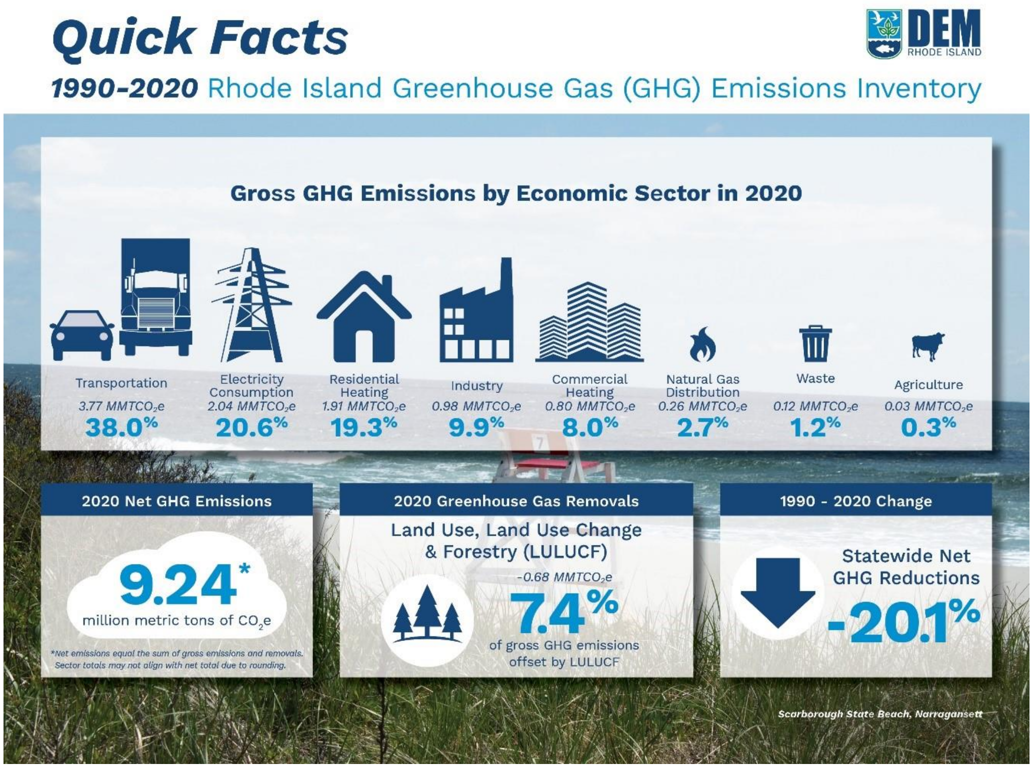


Figure 1. Rhode Island Greenhouse Gas Emissions Quick Facts

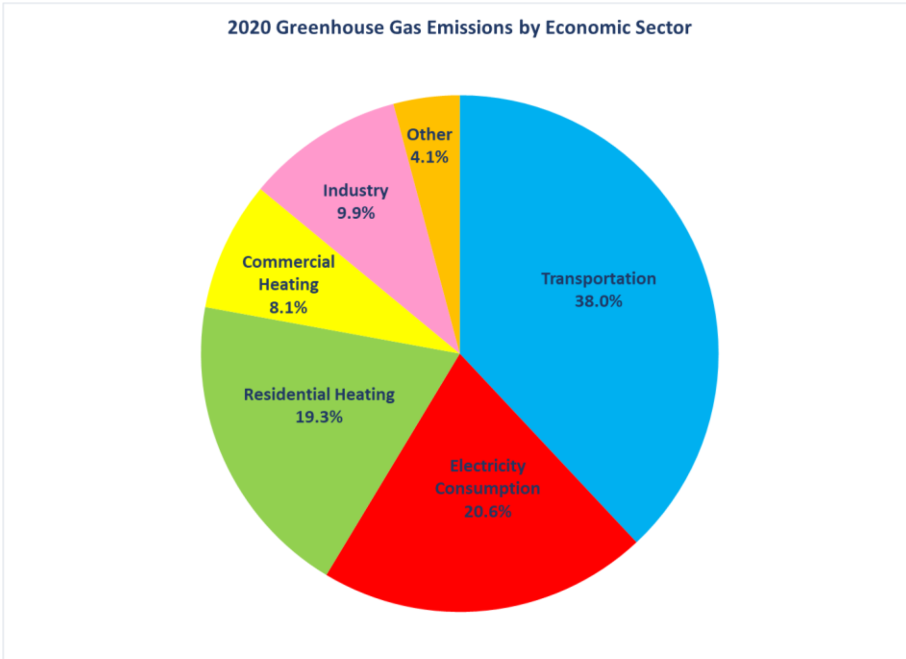


Figure 2. 2020 Greenhouse Gas Emissions by Economic Sector

Priority Measures

The measures in this section have been identified as “priority measures” for the purposes of this PCAP. This list is not exhaustive of the Rhode Island’s priorities. Instead, the selected priority measures included in this PCAP meet the following criteria:

- The measure can be completed in the near term, meaning that all funds will be expended, and the project completed, within the five-year performance period for the CPRG implementation grants.
- The measure advances the following state priorities: reducing Rhode Island’s GHG emissions in accordance with the Act on Climate (RIGL 42-6.2), helping Rhode Island become more resilient to the growing impacts of climate change, advancing economic opportunities in the fight against climate change, and promoting equity across all of Rhode Island’s climate policies/programs.

For each priority measure, both the measure description and an appendix to this PCAP provide details about the following information:

- An estimate of the cumulative GHG emission reductions from 2025-2030
- An estimate of the cumulative GHG emission reductions from 2025-2050
- Criteria pollutant reduction estimates if available
- Methods and assumptions
- Implementation schedule and milestones
- Implementing agency
- Review of authority to implement
- Geographic scope
- Metrics to track progress
- Intersection with other funding availability
- LIDAC/Benefits Analysis

Table 3. Rhode Island PCAP Priority Measures

Priority Measure	Cumulative GHG emission reductions ($MT\ CO_2e$)		Implementing Agency or Agencies	Geographic Scope	Technical Appendix
	2025–2030	2025–2050			
Transportation					
Electrify Rhode Island: Invest in EV charging infrastructure at RI workplaces, multi-unit dwellings	122,532	787,213	Office of Energy Resources	Statewide	2.A
Vehicle Electrification: Increase funding for EV rebates through Drive EV program with an emphasis on increasing the low-income rebate and adding a section for small commercial vans	95,380	144,105	Office of Energy Resources	Statewide	2.B
Green the Fleet: Adopt EVs for state and municipal fleets and add EV charging infrastructure	18,418	47,959	Office of Energy Resources	Statewide	2.C
Medium and Heavy-Duty Truck Incentives: Provide rebates for EV trucks and charging infrastructure	180,871	989,937	Department of Environmental Management	Statewide	2.D
Electric Equipment: Provide incentives for adoption of electric lawn and garden equipment	1,591	2,688	Department of Environmental Management	Statewide	2.E
Bus Shelter Improvements: Improve bus shelters to increase RIPTA ridership	90.6	245.6	RI Public Transit Authority	Statewide	2.F
Transit Subsidy: Incentivizing Mode Shift via Transit Fare Subsidies	179	179	RI Public Transit Authority	Statewide	2.G
Micro-transit Service: Funds pilot projects for local shared mobility van service	36.35	179.80	RI Division of Statewide Planning	Statewide	2.H

Rhody Express: Support for Rhody Express train project	332.61	901.81	RI Dept. Of Transportation	Wickford – Providence	2.I
Buildings					
Increase Residential and Commercial Heat Pump Adoption: Support heat pump adoption through education and incentives and add to subsidy for pre-weatherization electrical work	2,049	18,069	Office of Energy Resources	Statewide	2.J
Retrofit State Buildings: Add heat pumps and efficiency measures to state facilities	2,722	14,392	Office of Energy Resources	Statewide	2.K
Municipal Renewable Energy, Efficiency, and Electrification: Solar carports with EV charging, rooftop solar, LED streetlights, heat pumps, and municipal energy managers	14,324	83,421	Rhode Island Infrastructure Bank	Statewide	2.L
Pre-Weatherization Support for Electricity Customers: Would provide funds for pre-weatherization work on eligible properties as part of the state energy efficiency program	3,978	14,728	Rhode Island Energy/Office of Energy Resources	Statewide	2.M
Electricity					
Demand Response for Grid Resilience: Incentivize battery storage for residential and commercial customers for peak shaving through demand response	1,634	1,634	Rhode Island Energy	Statewide	2.N
Microgrids and Local Energy Resilience: Add solar and batteries as resilience and demand response on municipal buildings	10,151	50,755	Rhode Island Infrastructure Bank	Statewide	

Incentive Adders for Solar on Preferred Sites: Would preserve forests by incentivizing solar on previously disturbed and commercial sites	139,856	757,144	Rhode Island Energy	Statewide	2.O
Waste and Working Lands					
Food Waste Diversion: Promote municipal action	240,618	1,603,228	Department of Environmental Management	Statewide	2.P
Build Greater Capacity for Urban Forest Management: Invest in urban trees to help sequester carbon	81,800 pounds of sequestered CO2	841,000 pounds of sequestered CO2	Department of Environmental Management	Statewide	2.Q

Transportation

Electrify Rhode Island – EV Charging Infrastructure

Measure Description: Rhode Island will support deployment of electric vehicle charging by reinstating the Electrify Rhode Island rebate program. This popular program ran out of funds in 2022. This program will be available to workplaces, multi-unit dwellings, and state and local government for rebates on EV charging infrastructure.

Near-term cumulative GHG emission reductions (2025 - 2030): 122,532 MT
Long-term cumulative GHG emission reductions (2025 - 2050): 787,213 MT

Criteria Emissions Reductions (metric tons)			
	NOx	**VOC**	**PM2.5**
Annual Emissions Reductions 2025-2030	20.59	56.95	(1.5)
Annual Emissions Reductions 2025-2050	52.52	209.26	1.4

Methods and Assumptions The following key assumptions about measure implementation were used to quantify emissions reductions for this measure: Calculations assume 200 additional LDV chargers are installed between 2025 and 2030 and that they are operating through 2050. Level 2 chargers are assumed to cost $6,000. *See Appendix 2 for additional methods and assumptions*.

Implementing agency: Office of Energy Resources

Review of authority to implement. The implementing agency has the existing authority necessary to implement this measure.

Implementation schedule and milestones. Tentative program schedule:

Task #	Task Description	Anticipated Milestone Dates	Assumptions
1	OER accepts funds	December 2024	EPA provides funding by October 2024
2	Community engagement around program design specifics	December 2024 – March 2025	Outreach to building owners and agencies
3	Educate stakeholders and communities about program and open for project applications	March 2025	Three months following completion and publication of the program guide and promotional materials

4	Review applications, select projects, and enter into agreements with project proponents on a rolling basis	Begin June 2025	One month to evaluate and select successful applications and two months to enter into agreements with project proponents
5	Disburse funds to project proponents	Begin July 2025	As established in the agreements with project sponsors

Geographic Location: Statewide implementation.

Intersection with other funding availability. This measure will be implemented through the Office of Energy Resources and will be complementary to the National Electric Vehicle Infrastructure (NEVI) program. NEVI funds are restricted to infrastructure providing 24/7 access to charging stations and are subject to location restrictions, requiring them to be within 5 miles of an alternative fuel corridor. These limitations may impact the eligibility of certain entities. The Electrify Rhode Island program, on the other hand, offers greater flexibility and fills gaps left by the NEVI program, ensuring broader accessibility to electric vehicle charging infrastructure across various locations in Rhode Island.

Metrics to Track Progress. For this measure, the state intends to use the following metrics to track progress: number of facilities installing chargers by facility type, location of charger based on LIDAC community, electricity dispensed from electric vehicle chargers, and estimated ICE VMT displaced by electric vehicle chargers.

LIDAC Benefits/Analysis. The Electrify RI program would be accessible to all communities in the state and funding could be prioritized to LIDAC areas. Charging station availability limitations present a significant barrier to residents of LIDAC communities who seek to purchase electric vehicles (EVs) but lack access to residential chargers. This measure aims to address this barrier by expanding charging infrastructure, thereby facilitating EV adoption among LIDAC residents and promoting equity in access to sustainable transportation options.

LIDAC residents will experience air quality benefits from the replacement of Internal Combustion Engine vehicles with EVs. A 2019 RIDEM Community-Scale Air Toxics Monitoring Study found elevated levels of a range of air pollutants, including black carbon, ultrafine particles, and the carcinogens benzene and 1,3-butadiene at sensitive receptors in neighborhoods near I-95 when those sites were downwind of the highway. Air quality was also adversely affected by operation of ICE vehicles on city streets. 126 of the census block groups in the RI LIDAC tracts had an EJScreen subindex for traffic proximity greater than the 90% trigger, a signal that the 160,800 people who live in those block groups are exposed to elevated levels of vehicle related pollutants. Replacement of ICE vehicles with EVs will reduce those exposures. The increase in electricity demand to support EV charging may increase emissions of GHG and co-pollutants from power plants, impacting nearby residents. Decarbonization of the grid and adoption of measures that conserve energy are important to offset those increases.

Charging infrastructure is associated with a variety of job opportunities. In a 2024 report on EV charging infrastructure,[1] the International Council for Clean Transportation (ICCT) projects creation of 157,200 full-time equivalent jobs related to light-duty and medium- to heavy-duty vehicle charging infrastructure in the US by 2032. ICCT's per charger employment projections for light-duty chargers by job type are shown below.

Person-day jobs per charger for light-duty vehicle public, workplace, and home chargers for each type of jobs, ordered by the job projections in 2032.

Job Type	Public		Workplace	Multifamily Residential
	DC Fast	Level 2	Level 2	Level 2
Electrical installation	10.00	4.20	4.20	4.20
Electrical maintenance and repair	0.65	0.65	0.65	0.65
Charger assembly	4.00	1.00	1.00	1.00
General construction labor	2.98	2.31	2.31	2.31
Software maintenance and repair	1.00	1.00	1.00	1.00
Planning and design	3.98	3.70	3.70	3.70
Administration and legal	1.54	1.08	1.08	1.08

Vehicle Electrification – Rhode Island DRIVE-EV program

Measure Description: Rhode Island will support deployment of electric vehicles by enhancing the existing DRIVE-EV rebate program. This popular program is anticipated to run out of funds during 2024. Specifically, these funds will be used to increase the rebate for low-income individuals and introduce a new category covering small commercial vans.

Near-term cumulative GHG emission reductions (2025 - 2030): 95,380 MT
Long-term cumulative GHG emission reductions (2025 - 2050): 144,10 MT

Criteria Emissions Reductions (lbs)			
	NOx	**VOC**	**PM2.5**
Annual Emissions Reductions 2025-2023	27	49	1

Methods and Assumptions The following key assumptions about measure implementation were used to quantify emissions reductions for this measure: Calculations are for every $1M spent on the program. A 15-year lifespan is assumed for introduced ZEVs. Assumes a per-vehicle $1,500 incentive. *See Appendix 2 for more on methods and assumptions.*

Implementing agency: Office of Energy Resources

Review of authority to implement. The implementing agency has the existing authority necessary to implement this measure.

Implementation schedule and milestones. Tentative program schedule:

Task #	Task Description	Anticipated Milestone Dates	Assumptions
1	OER Receives funds and develops new program guidance for vans	December 2024	EPA grant funding is provided by October 2024
2	Additional funds become available	January 2025	Outreach to businesses and consumers
3	Disburse funds for rebates	Starting March 2025	

Geographic Location: Statewide implementation.

Intersection with other funding availability. This measure will be implemented through the Office of Energy Resources and will help to extend the life of Rhode Island's popular Drive EV program.

Metrics to Track Progress. For this measure, the state intends to use the following metrics to track progress: Number of vehicle rebates, number of vehicle rebates to low-income customers, number of rebates for commercial vans, and ICE VMT miles replaced by ZEVs.

LIDAC Benefits/Analysis. RI's Drive EV program offers rebates of up to $1,500 to individuals who purchase or lease a new or used EV or a new plug-in hybrid vehicle, reducing disparities between upfront costs for those vehicles and internal combustion engine (ICE) vehicles. An additional rebate of up to $1,500 is available through the Drive+ program based on income eligibility to further reduce the financial barriers to purchase of EVs by lower income households. Small businesses, nonprofits and public sector entities are also qualified for a rebate of up to $1,500 per vehicle, with an additional $500 per vehicle available for applicants located in high-asthma municipalities, which are identified as Central Falls, Cranston, East Providence, Pawtucket, and Providence. Note that 71 of the LIDAC census tracts are in those communities.

Operation and maintenance costs for EVs tend to be lower than for ICE vehicles. A recent Consumer Reports study determined that lifetime maintenance and repair costs for ZEVs are less than 50% of those of average ICE vehicles, resulting in a lower total lifecycle cost for the purchase, operation, and maintenace of a ZEV relative to the average ICE vehicle. Transitioning to EVs in the near term may also protect lower-income residents from future carbon taxes on fuel or additional charges for owning ICE vehicles. Charging can also present a challenge for low-income households, so it is important that the proposed measures that would increase access to public charging stations and support upgrades to home electrical systems to support residential charging be adopted in conjunction with this measure.

LIDAC residents will benefit from measures that reduce the operation of ICE vehicles even if they do not purchase an EV immediately. A 2019 RIDEM Community-Scale Air Toxics Monitoring Study found elevated levels of a range of air pollutants, including black carbon, ultrafine particles, and the carcinogens benzene and 1,3-butadiene at sensitive receptors in neighborhoods near I-95 when those sites were downwind of the highway. Air quality was also adversely affected by operation of ICE vehicles on city streets. 126 of the census block groups in the RI LIDAC tracts had an EJScreen subindex for traffic proximity greater than the 90% trigger, a signal that the 160,800 people who live in those block groups are exposed to elevated levels of vehicle related pollutants. Replacement of ICE vehicles with EVs will reduce those exposures.

The increase in electricity demand to support EVs may lead to higher emissions of GHG and co-pollutants from power plants, potentially affecting nearby residents. Therefore, decarbonization of the grid and adoption of measures that reduce energy use are crucial to offsetting those increases. While the shift towards EVs may create new job opportunities in car sales, EV maintenance, and repairs, it may also result in job losses for dealerships specializing in ICE vehicles and gas stations. The extent of these impacts will depend on the rate of EV adoption.

Green the Fleet: Adopt EVs for State and Municipal Fleets

Measure Description: Rhode Island will fund the incremental cost of purchasing state and municipal electric light-duty vehicles, including cars, lights trucks, and SUVs. Additionally, this measure will also fund the purchase and installation of electric vehicle supply equipment (EVSE) for municipal fleets and state agencies. This measure would be open to all municipalities, school districts, state agencies, and public universities and colleges.

Near-term cumulative GHG emission reductions (2025 - 2030): 18,418 MT
Long-term cumulative GHG emission reductions (2025 - 2050): 47,959 MT

Criteria Emissions Reductions relative to Business as Usual (metric tons)			
	NOx	**VOC**	**PM2.5**
Annual Emissions Reductions 2025-2030	5	9	0
Annual Emissions Reductions 2025-2050	7	18	0

Methods and Assumptions The following key assumptions about measure implementation were used to quantify emissions reductions for this measure: Calculations are based on spending $1M for 100 vehicles and $1M for EV chargers. A 15-year lifespan is assumed for introduced ZEVs. A per-vehicle incremental cost of $10,000 was assumed, for a total of 100 vehicles per $1M spent. *See Appendix 2 for additional methods and assumptions*.

Implementing agency: Office of Energy Resources

Review of authority to implement. The implementing agency has the existing authority necessary to implement this measure.

Implementation schedule and milestones. Tentative program schedule:

Task #	Task Description	Anticipated Milestone Dates	Assumptions
1	OER Receives funds and opens the program to state agencies and municipalities	December 2024	OER can make direct payments to municipalities and state agencies to support vehicle purchase
2	Community engagement around program specifics	December 2024 – June 2025	Outreach to municipalities through various channels
3	Review applications, select projects, and enter into agreements with project proponents on a rolling basis	Begin July 2025	One month to evaluate and select successful applications and two months to enter into agreements with project proponents
4	Disburse funds to project proponents	Begin September 2025 until funds are spent	As established in the agreements with project proponents

Geographic Location: Statewide implementation.

Intersection with other funding availability. This measure will be implemented through the Office of Energy Resources. There is currently no funding available for this measure.

Metrics to Track Progress. For this measure, the state intends to use the following metrics to track progress: Number of vehicles put into service, estimated ICE VMT displaced by those vehicles, number of facilities installing chargers by facility type, location of charger based on LIDAC community, electricity dispensed from electric vehicle chargers, and estimated ICE VMT displaced by electric vehicle chargers.

LIDAC Benefits/Analysis. This program would be accessible to all communities in the state, with funding potentially prioritized to LIDAC areas. In addition, this initiative will provide state and municipal employees, including those who reside in LIDAC communities, with the opportunity to interact with EVs at their workplace, reducing barriers associated with adoption of unknown technologies.

LIDAC residents will experience air quality benefits from the replacement of Internal Combustion Engine vehicles with EVs. A 2019 RIDEM Community-Scale Air Toxics Monitoring Study found elevated levels of a range of air pollutants, including black carbon, ultrafine particles, and the carcinogens benzene and 1,3-butadiene at sensitive receptors in neighborhoods near I-95 when those sites were downwind of the highway. Air quality was also adversely affected by operation of ICE vehicles on city streets. 126 of the census block groups in the RI LIDAC tracts had an EJScreen subindex for traffic proximity greater than the 90% trigger, a signal that the 160,800 people who live in those block groups are exposed to elevated levels of vehicle related pollutants. Replacement of ICE vehicles with EVs will reduce those exposures. The increase in electricity demand to support EV charging may increase emissions of GHG and co-pollutants from power plants, impacting nearby residents. Decarbonization of the grid and adoption of measures that conserve energy are important to offset those increases.

Charging infrastructure is associated with a variety of job opportunities. In a 2024 report on EV charging infrastructure,[1] the International Council for Clean Transportation (ICCT) projects creation of 157,200 full-time equivalent jobs related to light-duty and medium- to heavy-duty vehicle charging infrastructure in the US by 2032. ICCT's per charger employment projections for light-duty chargers by job type are shown below.

Person-day jobs per charger for light-duty vehicle public, workplace, and home chargers for each type of jobs, ordered by the job projections in 2032.

Job Type	Public		Workplace	Multifamily Residential
	DC Fast	Level 2	Level 2	Level 2
Electrical installation	10.00	4.20	4.20	4.20
Electrical maintenance and repair	0.65	0.65	0.65	0.65
Charger assembly	4.00	1.00	1.00	1.00
General construction labor	2.98	2.31	2.31	2.31
Software maintenance and repair	1.00	1.00	1.00	1.00
Planning and design	3.98	3.70	3.70	3.70
Administration and legal	1.54	1.08	1.08	1.08

Electrify Medium- and Heavy-Duty (MHD) Vehicles & Infrastructure

Measure Description: Rhode Island will support the transition to electric medium- and heavy-duty (MHD) vehicles through vehicle purchase incentives for vehicle purchase and charging infrastructure. MHD vehicles are a significant piece of RI's GHG emissions and a major source of nitrogen oxides (NOX), particulate matter (PM), and hazardous air pollutants that harm public health. Widespread electrification of MHD vehicles is needed to reduce the state's GHG emissions and improve air quality and health outcomes.

In December 2023, RIDEM adopted Advanced Clean Cars II (ACCII) and Advanced Clean Trucks (ACT) regulations. Incentivizing a growing number of MHD electrified trucks (and associated charging infrastructure) will help Rhode Island achieve its requirements pursuant to the ACT rule.
This program will be available to a wide variety of users including businesses, non-profits organizations and state/local governmental organizations.

Near-term cumulative GHG emission reductions (2025 - 2030): 180,871 metric tons
Long-term cumulative GHG emission reductions (2025 - 2050): 989,937 metric tons

Criteria Emissions Reductions			
	NOx (lbs)	**VOC (lbs)**	**PM2.5 (lbs)**
Annual Emissions Reductions 2025-2030	170.49	61.19	4.38
Annual Emissions Reductions 2025-2050	520.49	245.86	12.18

Methods and Assumptions The following key assumptions about measure implementation were used to quantify emissions reductions for this measure. Calculations assume:

- Medium-duty and heavy-duty vehicles are large pickup trucks, box vans/delivery vehicles all the way up to large class 7/8 trucks.
- MD/HD vehicle incentives will be established – 67% of incentive to MD, 33% to HD
- Install 350 kW chargers state-wide for MD and HD trucks.
- Install 1 MW electric truck chargers at a location on I-95 in Rhode Island – this will allow for corridor charging of class 8 tractor trailers and other heavy-duty electric trucks and will facilitate a transition to electric trucks.
- $1M is spent on corridor highway 1 MW chargers; $1M is spent on MHD ZEV incentives; and $1M on MHD state-wide chargers, for a total of $3M dollars.

See Appendix 2 for additional details about methods and assumptions.

Implementing agency: RI Department of Environmental Management

Review of authority to implement. The implementing agency has the existing authority necessary to implement this measure. Regulations may need to be promulgated to administer the rebate program.

Implementation schedule and milestones. Tentative program schedule:

Task #	Task Description	Anticipated Milestone Dates	Assumptions
1	Community engagement around program design specifics	December 2024 – June 2025	Program funds are awarded by December 2024
2	Promulgate incentive/rebate program regulations (either new regulations or an amendment of existing regulations)	June 2025 - April 2026	
3	Preparation of a program guide, application, and promotional materials	May 2026 – July 2026	
4	Rebate Program Round #1	August 2026 – May 2027	
5	Rebate Program Round #2	August 2027 – May 2028	
6	Rebate Program Round #3	August 2028 – May 2029	Round 3 may not be needed if program funds have been fully expended in Rounds 1 & 2,

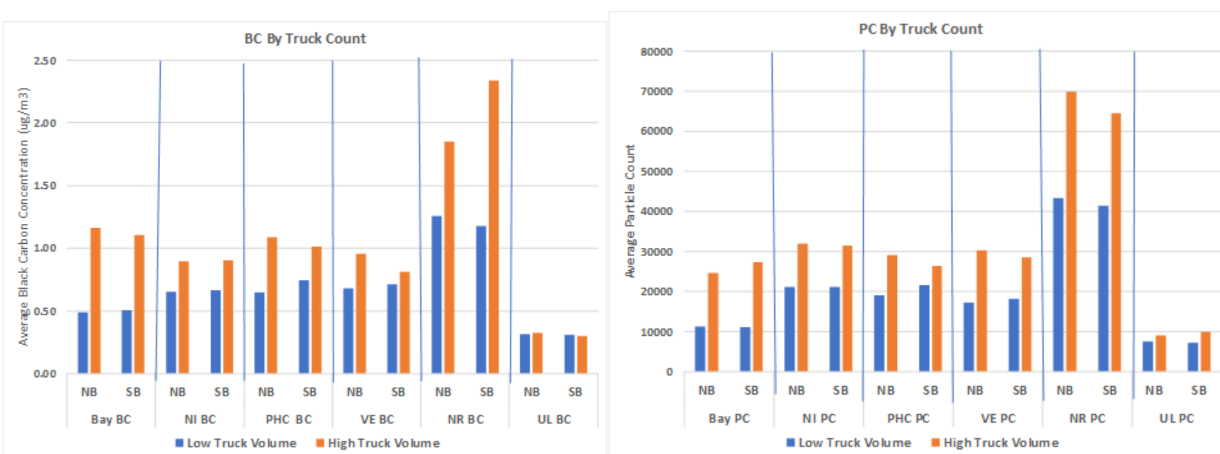
Geographic Location: Statewide implementation.

Intersection with other funding availability. This measure will be implemented through RIDEM and will be complementary to Diesel Emissions Reduction Act (DERA) funding and federal funding to electrify school buses.

Metrics to Track Progress. For this measure, the state intends to use the following metrics to track progress: number of facilities installing chargers by facility type, location of charger based on LIDAC community, electricity dispensed from MHD vehicle chargers and estimated ICE VMT displaced by electric vehicle chargers.

LIDAC Benefits/Analysis. Diesel vehicle emissions contribute significantly to ambient levels of a variety of pollutants, including PM, NOx, hydrocarbons, CO, and other hazardous air pollutants. LIDAC areas are particularly subject to those impacts, due to the proximity of those areas to highways and busy roadways. The EJScreen subindex for traffic proximity for 126 of the census block groups is greater than the 90% trigger, indicating that the 160,800 people who live in those block groups are exposed to elevated levels of vehicle related pollutants.

A 2019 RIDEM Community-Scale Air Toxics Monitoring Study found elevated levels of a range of air pollutants, including black carbon, ultrafine particles, and the carcinogens benzene and 1,3-butadiene at sensitive receptors in neighborhoods near I-95 when those sites were downwind of the highway. As shown in Figure 1, levels of black carbon (BC) and ultrafine particulate matter (measured as particle count (PC) were significantly elevated at all sites near the highway in hours with high truck traffic counts on the highway.



Average black carbon (BC) and particle count (PC) concentrations in daytime hours with high (upper 25th percentile) and low truck traffic on I-95 northbound (NB) and southbound (SB). The Bay, Niagrara (NI), Providence Health Center (PHC), and Vernon (CE) sites are located at sensitive receptors near the highway. The near-road (NR) site is adjacent to the highway near downtown Providence, and the Urban League (UL) site is in an urban area of Providence that is not immediately impacted by I-95.

The study also demonstrated impacts of diesel trucks on city streets on neighborhood air quality. Replacement of diesel vehicles with EVs would reduce impacts from both highway and city vehicles on those neighborhoods, which LIDAC designated census tracts. The increase in electricity demand to support EV charging may increase emissions of GHG and co-pollutants from power plants, impacting nearby residents. Decarbonization of the grid and adoption of measures that conserve energy are important to offset those increases.

Charging infrastructure is associated with a variety of job opportunities. In a 2024 report on EV charging infrastructure, the International Council for Clean Transportation (ICCT) projects creation of 157,200 full-time equivalent jobs related to light-duty and medium- to heavy-duty vehicle charging infrastructure in the US by 2032. *(Source: International Council for Clean Transportation (2024). Charging Up America: The growth of United States electric vehicle charging infrastructure jobs. Available at: https://theicct.org/wp-content/uploads/2024/01/ID-28-%E2%80%93-U.S.-infra-jobs-report-letter-70112-ALT-v6.pdf)*

Incentivize the Adoption of Electric Lawn and Garden Equipment

Measure Description: This measure will provide incentives for the replacement of gasoline-powered 2-stroke engines (lawn and garden equipment) with zero-emission battery operated equipment. It is estimated that over 400 pieces of gasoline-powered lawn and garden equipment will be replaced in public facilities (state and local) around Rhode Island. In addition, this measure will allow the state to partner with RI lawn and garden trade organizations to introduce battery operated equipment and portable charging stations into the private sector so companies can begin to "lead by example". Chainsaws, pole saws, leaf blowers, weed trimmers, hedge trimmers, push lawn mowers and zero turn mowers will be replaced.

Near-term cumulative GHG emission reductions (2025 - 2030): 1,591 metrics tons
Long-term cumulative GHG emission reductions (2025 - 2050): 2,688 metric tons

Criteria Emissions Reductions			
	NOx (tons)	**VOC (tons)**	**PM2.5 (tons)**
Annual Emissions Reductions 2025-2030	2.74	30.89	2.89
Annual Emissions Reductions 2025-2050	4.58	51.50	4.81

Methods and Assumptions The following key assumptions about measure implementation were used to quantify emissions reductions for this measure. Calculations assume:

- Approximately 1,035 gallons of gasoline use will be reduced each month as a result of the measure and 12,420 gallons per year.
- Emissions for nine types of gasoline powered nonroad lawn and garden equipment, including chain saws, lawn mowers, leaf blowers, weed trimmers, and other types was obtained from EPA's MOVES model. Emission factors were multiplied by estimated activity (hours of use) for

each type of equipment. Upstream emissions were estimated for well to pump emissions from gasoline equipment and for grid-related emissions for electricity use.

- EPA's MOVES4 model and the DOE GREET model were utilized.
- 1/6th of the 400+ pieces of equipment are purchased each year between 2025 and 2030; by 2030, all 400+ pieces of gasoline equipment have been replaced by the electric equipment and all 400+ pieces of gasoline equipment are retired; the assumed capital cost is approximately $435,000, and; it is assumed that the electric equipment will have lower operating and maintenance costs than the gasoline equipment it replaces.

See Appendix 2 for additional details about methods and assumptions.

Implementing agency: RI Department of Environmental Management

Review of authority to implement. The implementing agency has the existing authority necessary to implement this measure. Regulations may need to be promulgated to administer the incentive program for non-state/municipal participants.

Implementation schedule and milestones. Tentative program schedule:

Task #	Task Description	Anticipated Milestone Dates	Assumptions
1	State agency final identification of specific equipment needs	January 2025-June 2025	Program funds are awarded by December 2024
2	Commencement of equipment procurement (by state partners)	June 2025-December 2025; continues into 2026 and 2027	
3	Program design and implementation for participating municipal entities	January 2025-June 2025	
4	Commencement of equipment procurement (by municipal partners)	June 2025-December 2025; continues into 2026 and 2027	
5	Program design and implementation with engaged lawn and garden trade organizations	January 2025-September 2025	
6	Commencement of equipment procurement (with engaged lawn and garden trade organizations)	September 2025 – February 2026; continues into 2027 and 2028	

Geographic Location: Statewide implementation.

Intersection with other funding availability. Currently, there is no other funding available at this time.

Metrics to Track Progress. For this measure, the following metrics will be used to track progress: number of pieces of electric equipment purchased, number of gasoline equipment retired, hours of use of electric equipment annually, and fuel saved from retirement of gasoline equipment.

LIDAC Benefits/Analysis. This measure would reduce statewide emissions of GHG and co-pollutants, reducing risks associated with air pollution and climate change throughout the State. Those benefits are particularly important in LIDAC communities, which tend to be more vulnerable due to socioeconomic factors. LIDAC communities would also benefit from localized air quality improvements when the replacement equipment is used in those neighborhoods. For instance, the Providence Parks Department has requested electric ride-on mowers. The Parks Department maintains 120 parks throughout the city, including many that are located in LIDAC census tracts. Training to ensure proper use of equipment will be considered as part of this measure.

RIPTA Bus Shelter Improvements

Measure Description: Support RIPTA bus shelter improvements with the intention of enhancing rider comfort and sense of security, increasing ridership, and supporting mode shift. RIPTA is RI's primary public transportation service provider and provides public transportation, primarily buses, across the state.

Providing existing and potential riders better transit stops is a key recommendation of Transit Forward RI 2040, the statewide Transit Master Plan, as adopted by the State Planning Council (serving as the sole MPO for Rhode Island) back in 2020. Offering riders safe, comfortable, and accessible stops will help to achieve significant ridership gains, fulfill state GHG emission reduction goals and improve mobility, public health, and quality of life, especially in environmental justice communities.

Near-term cumulative GHG emission reductions (2025 - 2030): 90.6 metric tons
Long-term cumulative GHG emission reductions (2025 - 2050): 245.6 metric tons

Criteria Emissions Reductions			
	NOx (lbs)	**VOC (lbs)**	**PM2.5 (lbs)**
Annual Emissions Reductions 2025-2030	49.96	91.30	1.94
Annual Emissions Reductions 2025-2050	85.97	225.86	5.19

Methods and Assumptions The following key assumptions about measure implementation were used to quantify emissions reductions for this measure. Calculations assume:

- Assumes a 3.5% ridership increase for the impacted route after bus stop improvements.

- Estimates of VMT reductions were developed by Cambridge Systematics, Inc. Emission rates (grams per mile) were applied to VMT reductions to estimate emission reductions. Emission rates were developed and applied using the U.S. EPA MOVES4 model.
- Example modeled: Bus stop improvements, including new shelters, implemented along RIPTA Route 1 (Eddy/Hope/Benefit). Calendar Year ridership on this route was 721,000.
- he estimation method for this measure used a spreadsheet to perform calculations to estimate VMT reductions using data gathered from various sources.
- On average, 30 percent of new riders would have otherwise traveled by motorized vehicle.
- The average trip length for a Rhode Island transit rider is 4.4 miles (National Transit Database, 2019, as analyzed by Cambridge Systematics).
- The average annual automobile VMT displaced is therefore 25,200 trips * 4.4 miles per trip * 30% auto mode share = 33,300 VMT reduced.

See Appendix 2 for additional details about methods and assumptions.

Implementing agency: RI Public Transit Authority (RIPTA)

Review of authority to implement. The implementing agency has the existing authority necessary to implement this measure.

Implementation schedule and milestones. Tentative program schedule:

Task #	Task Description	Anticipated Milestone Dates	Assumptions
1	Permitting and site approvals	Late 2024 and early 2025	Program funds are awarded by December 2024
2	Finalize contractual services	Late 2024 and early 2025	
3	Site preparation and installation of shelter improvements	Late 2025 through 2028	

Geographic Location: Statewide implementation. Focus on LIDAC areas in RI.

Intersection with other funding availability. This measure will complement RIPTA's Bus Stop Improvement Program request for 2024 RAISE capital funding. In addition, RIPTA has a small amount of formula funding set aside for a small number of shelter upgrades (FTA 5307 funds).

Metrics to Track Progress. For this measure, the state intends to use the following metrics to track progress: increase in route ridership after improvements and share of pass holders who would have taken an automobile if they did not ride transit for the trips taken.

LIDAC Benefits/Analysis. RIPTA provided a list of the top 100 stops that they have identified for improvement. Of the 100 stops, 98 are located in LIDAC areas in Providence, East Providence, Central Falls, Cranston, Pawtucket, and Woonsocket. The proposed shelters would improve the safety and quality of life of residents of those areas that use RIPTA, as well as encouraging increased ridership. Any reductions in car use as a result of increased ridership would benefit air quality in those neighborhoods.

Incentivizing Mode Shift via Transit Fare Subsidies

Measure Description: This measure will provide support RI Public Transit Authority (RIPTA) to encourage employers to provide transit benefits to employees (Wave to Work Program) and provide continued fare-free transit services to very low-income individuals in need to transportation assistance (Low-Income Partnership Program). More than 130,000 transit trips have been taken through the Low-Income Partnership Program (as of late 2023), greatly reducing the need for participants to rely on automobiles that they can scarcely afford. Wave to Work is a re-launch of an earlier, successful transit program run by RIPTA focusing on the needs of the workforce and employers. We assume the subsidies will begin in 2025 and continue through 2029. Encouraging mode shift from private vehicles to public transportation continues to be a key part of Rhode Island's climate priorities in the transportation sector.

Near-term cumulative GHG emission reductions (2025 - 2030): 179 metric tons
Long-term cumulative GHG emission reductions (2025 - 2050): 179 metric tons

Since the service subsidies will end in 2030, the cumulative amount of GHGs reduced is the same between 2025-2030 and 2025-2050.

Criteria Emissions Reductions			
	NOx (tons)	**VOC (tons)**	**PM2.5 (tons)**
Annual Emissions Reductions 2025-2030	92.50	176.92	3.83
Annual Emissions Reductions 2025-2050	92.50	176.92	3.83

Methods and Assumptions The following key assumptions about measure implementation were used to quantify emissions reductions for this measure. Calculations assume:

- The estimation method for this measure used a spreadsheet to perform calculations to estimate VMT reductions using data gathered from various sources. The spreadsheet estimate of VMT reductions was developed by Cambridge Systematics, Inc. Emission rates (grams per mile) were applied to VMT reductions to estimate emission reductions. Emission rates were developed and applied by NESCAUM using the U.S. EPA MOVES4 model.
- $600,000 in subsidies is provided for free transit passes or fares for commuters. Between 2025 and 2029, a total of $600,000 is provided riders - each year from 2025 to 2029, 1/5th of the funds or $120,000 in subsidies are provided to riders.
- These subsidies are provided beginning in 2025 and continue through 2029.
- On average, 30 percent of new riders would have otherwise traveled by motorized vehicle.

- The average trip length for a Rhode Island transit rider is 4.4 miles (National Transit Database, 2019, as analyzed by Cambridge Systematics).
- The average annual automobile VMT displaced is therefore 60,000 trips * 4.4 miles per trip * 30% auto mode share = 79,200 VMT reduced.

See Appendix 2 for additional details about methods and assumptions.

Implementing agency: RI Public Transit Authority

Review of authority to implement. The implementing agency has the existing authority necessary to implement this measure.

Implementation schedule and milestones. Tentative program schedule:

Task #	Task Description	Anticipated Milestone Dates	Assumptions
1	Subsidies for the Low-Income Partnership Program can be utilized immediately – the funding is being inserted into existing program operations.	January 2025	Program funds are awarded by December 2024
2	Wave to Work commencing in 2025; funding can immediately be utilized to support subsidies.	June 2025 (estimated)	

Geographic Location: Statewide implementation.

Intersection with other funding availability. No other funding has been identified. Supporting this measure would allow for RIPTA revenue funds to be utilized for other programs that promote a variety of transit options for Rhode Islanders.

Metrics to Track Progress. For this measure, the following metrics will be used to track progress: number of passes provided, number of transit trips taken annually by new pass holders and share of pass holders who would have taken an automobile if they did not ride transit for the trips taken.

LIDAC Benefits/Analysis. The Wave to Work program allows employers to subsidize all or part of their employees' public transportation costs. It is not income dependent but will benefit low-income employees at participating companies. The Low-Income Partnership provides free unlimited access to RIPTA's fixed-route network for a fixed number of people who have incomes at or below 200% of the federal poverty level and do not qualify for other transit programs. These programs will clearly allow residents of LIDAC areas better access to jobs, stores, and other important services. As with other programs that encourage the use of public transportation instead of private vehicles, these programs reduce traffic-related air pollutant impacts, especially in high traffic areas, including LIDAC neighborhoods that abut highways or busy roadways.

Incentivizing Micro-transit Service: Fund Pilot Projects for Local Shared Mobility Van Service

Measure Description: This measure will provide support for the creation of one or more fare-free shuttles operating on a fixed loop (estimated to be about 5-7 miles) in one or more RI municipalities. Customers can board at either ending station, or at any of the stops in between, and rides are free. Deploying 4-6 vehicles, it is expected that multiple partners may collaborate to uplift the pilots.

The use of micro mobility projects can aid in reduction in traffic jams, greenhouse gases as well as noise pollution in the targeted community.

Near-term cumulative GHG emission reductions (2025 - 2030): 36.35 metric tons
Long-term cumulative GHG emission reductions (2025 - 2050): 179.80 metric tons

Criteria Emissions Reductions			
	NOx (tons)	**VOC (tons)**	**PM2.5 (tons)**
Annual Emissions Reductions 2025-2030	(7.93)	72.25	(5.94)
Annual Emissions Reductions 2025-2050	11.45	205.04	(4.96)

Methods and Assumptions The following key assumptions about measure implementation were used to quantify emissions reductions for this measure. Calculations assume:

- The estimation method for this measure used a spreadsheet to perform calculations to estimate VMT reductions using data gathered from various sources.
- The spreadsheet estimate of VMT reductions was developed by Cambridge Systematics, Inc. Emission rates (grams per mile) were applied to VMT reductions to estimate emission reductions. Emission rates were developed and applied by NESCAUM using the U.S. EPA MOVES4 model.
- Provision of new van shuttle service using electric vans running on a 5-mile continuous loop.
- The service is provided beginning in 2025 and continuing through 2041.
- Annual ridership is similar to the "Little Roady" microtransit service that was piloted with an electric autonomous vehicle between May 2019 and June 2020 in Providence, RI.

See Appendix 2 for additional details about methods and assumptions.

Implementing agency: RI Division of Statewide Planning (RI's MPO)

Review of authority to implement. The implementing agency has the existing authority necessary to implement this measure.

Implementation schedule and milestones. Tentative program schedule:

Task #	Task Description	Anticipated Milestone Dates	Assumptions
1	Programming planning and community engagement	January 2025 – September 2025	Program funds are awarded by December 2024
2	Educate stakeholders and communities about pilot opportunity and solicit applications for project(s)	November 2025	
3	Review applications, select project(s), and enter into agreements with project sponsor(s)	February 2026	
4	Disburse funds to project sponsor(s)	April 2026	

Geographic Location: Statewide implementation.

Intersection with other funding availability. Currently no other funding is identified to support these pilots.

Metrics to Track Progress. For this measure, the following metrics will be used to track progress: ridership on new service, vehicle utilization rates, and share of riders who would have taken an automobile if they did not ride transit for the trips taken.

LIDAC Benefits/Analysis. This program will provide riders with improved, non-polluting access to stores and services in metropolitan areas and will serve as an economic agent for participating communities. While not targeted to LIDAC areas, it will be particularly useful to people with limited access to cars or other issues that limit mobility.

Supporting ‘Rhody Express’ Train Service Between Providence Station, TF Green Airport and Wickford Junction

Measure Description: Support the development of RI Department of Transportation’s proposed “Rhody Express”, a commuter rail pilot program with the Massachusetts Bay Transit Authority (MBTA) which would provide free access to rail service linking Wickford Junction, T.F. Green Airport, and Providence Station. This program will help alleviate congestion on Interstate 95 south of Providence during a large number of bridge replacement projects slated to begin the next few years.

Rhody Express will provide enhanced service frequency over existing schedules, which will provide underserved communities with a zero-cost method for reaching both Downtown Providence and City Centre Warwick by rail, two of the largest job centers and freight hubs in the state. It will bring approximately 15 additional daily trips between Wickford Junction and Providence Station to encourage modal shift, decrease carbon emissions, and reduce congestion on Interstate 95. This service expansion will offer commuters a free, reliable, high-frequency transit alternative during bridge construction, which will improve congestion and reduce travel times for commuters.

Near-term cumulative GHG emission reductions (2025 - 2030): 332.61 metric tons
Long-term cumulative GHG emission reductions (2025 - 2050): 901.81 metric tons

Criteria Emissions Reductions			
	NOx (lbs)	**VOC (lbs)**	**PM2.5 (lbs)**
Annual Emissions Reductions 2025-2030	183.42	335.21	7.13
Annual Emissions Reductions 2025-2050	315.61	829.22	19.04

Methods and Assumptions The following key assumptions about measure implementation were used to quantify emissions reductions for this measure. Calculations assume:

- Assumes a $4.5M investment in Rhody Express.
- The estimation method for this measure used a spreadsheet to perform calculations to estimate VMT reductions using data gathered from various sources.
- The spreadsheet estimate of VMT reductions was developed by Cambridge Systematics, Inc. Emission rates (grams per mile) were applied to VMT reductions to estimate emission reductions. Emission rates were developed and applied by NESCAUM using the U.S. EPA MOVES4 model.
- Baseline ridership is 221 daily riders, or 66,300 annual riders.
- On average, 75 percent of new riders would have otherwise traveled by motorized vehicle.
- Average displaced automobile trip length of riders is 13.1 miles.
- The average annual automobile VMT displaced is therefore 66,300 trips * 13.1 miles per trip * 75% auto mode share = 130,000 VMT reduced.

See Appendix 2 for additional details about methods and assumptions.

Implementing agency: RI Department of Transportation

Review of authority to implement. The implementing agency has the existing authority necessary to implement this measure.

Implementation schedule and milestones. Tentative program schedule:

Task #	Task Description	Anticipated Milestone Dates	Assumptions
1	Finalize negotiations with service provider (MBTA)	January – July 2025	Program funds are awarded by December 2024

2	Project ramp up and rollout	Summer 2025	
3	Rhody Express commences operation	Fall 2025	

Geographic Location: Statewide implementation.

Intersection with other funding availability. $8.9 M carbon funds in the STIP

Metrics to Track Progress. For this measure, the state intends to use the following metrics to track progress: number of subsidized fares provided, change in rail ridership before and after fare subsidy, and share of riders who would have taken an automobile if they did not ride transit for the trips taken.

LIDAC Benefits/Analysis. The Wickford and TF Green stations are not located in LIDAC areas, and it is likely that many of the riders that will use this program will not be residents of LIDAC communities. However, it is very important to note that use of the train in place of cars for commuting to and from Providence would reduce traffic on I-95, resulting in reduced air quality impacts in LIDAC neighborhoods in Cranston and Providence that abut I-95. As discussed in other measures, RIDEM air monitoring studies have documented elevated concentrations of a range of vehicle emission-related pollutants at sensitive receptors in LIDAC neighborhoods near I-95. Those receptors include residences, schools, and health care facilities.

Buildings

Increase Residential and Commercial Heat Pump Adoption

Measure Description: Rhode Island will support deployment of residential and commercial air and ground-source heat pumps and heat pump water heaters by making installation easy and accessible for contractors and consumers, deploying distributor incentives and workforce development to address key market barriers, and informing long-term building decarbonization measures through public data and analysis. This project would also add funding to the Clean Heat RI program for additional pre-weatherization work by increasing the cap on pre-weatherization costs to $7,500 for low-income customers. Pre-weatherization work would include panel upgrades and knob and tube wiring.

Near-term cumulative GHG emission reductions (2025 - 2030): 2,049 MT
Long-term cumulative GHG emission reductions (2025 - 2050): 18,069 MT

Criteria Emissions Reductions (metric tons)			
	NOx	**VOC**	**PM2.5**
Annual Emissions Reductions 2025-2030	2.2	(.2)	.2
Annual Emissions Reductions 2025-2050	15.2	.3	1.5

Methods and Assumptions The following key assumptions about measure implementation were used to quantify emissions reductions for this measure: This measure assumes $1M spent on Clean Heat RI. It also assumes buildings in the program would not have upgraded without it.

Implementing agency: Office of Energy Resources

Review of authority to implement. The implementing agency has the existing authority necessary to implement this measure.

Implementation schedule and milestones. Tentative program schedule:

Task #	Task Description	Anticipated Milestone Dates	Assumptions
1	OER accepts funds	December 2024	Award from EPA is made by October 2024
2	Agency engagement around program specifics and additional program offerings	December 2024 - January 2025	Concurrent with program development
3	Funds are added to Clean Heat RI program	March 2025	
4	Promotional materials and community engagement about program offerings	Starting March 2025	Following program guide and promotional materials
5	Funds fully dispersed	September 2029	

Geographic Location: Statewide implementation.

Intersection with other funding availability. This measure will be implemented through the Office of Energy Resources and will be complementary to the Clean Heat RI program (CHRI). Currently, (CHRI) offers eligible low-income participants no-cost heat pump installations, including heat pump water heaters, along with a maximum adder of $3000 for electric panel upgrades. While generous, the adder cannot be applied to knob-and-tube wiring removal, which excludes a significant number of low-income households from program participation. Knob-and-tube removal also excludes households from free weatherization services; foam insulation cannot be "blown in" over active knob-and-tube wiring, as it presents a fire hazard. Funding would provide a double-benefit to low-income households: free weatherization services followed by free heat pump installations.

According to an analysis from home-energy assessment provider, RISE Engineering, roughly 30% of homes (3,500) from January 2023-June 2023, were deferred from receiving weatherization services due to the presence of knob-and-tube wiring. RISE reported the median cost for removal was $7500. Rhode Island's Community Action Partnerships echo RISE's finding, reporting that knob-and-tube mitigation is a primary reason for deferral from the Weatherization Assistance Programs (WAP).

Metrics to Track Progress. For this measure, the state intends to use the following metrics to track progress: number of heat pumps installed, number of contractors involved in programming, workforce training.

LIDAC Benefits/Analysis. Low-income households in all LIDACs in the state are eligible to benefit from this measure. Electrical upgrades needed before weatherization or installation of more efficient space and water heating equipment can occur are often cost prohibitive for low-income households. The increased subsidies will reduce this hurdle, allowing low-income homeowners and renters to benefit from the cost savings associated with improvements in energy efficiency. A 2021 Rewiring America report estimates that "99% of households in Rhode Island — 407 thousand — could save $164 million a year on energy bills if they were using modern, electrified furnaces and water heaters instead of their current machines."[1] The RI Office of Energy Resources will continue to provide outreach to low-income households about the benefits of the Clean Heat RI program.

In addition to the reductions in emissions of GHG and co-pollutants quantified above, replacement or reduced operation of fossil fuel space and hot water heating equipment may improve indoor air quality. Fossil fuel combustion in home appliances are linked to higher levels indoor air levels of NOx and other pollutants that cause or exacerbate asthma and other respiratory disease, as well as air toxics like the carcinogen benzene. Those effects are of particular concern to LIDAC residents, who may be at increased risk from those effects due to underlying health conditions and other factors.

Programs that promote electrical upgrades also create jobs. The Rewiring America reports estimates that replacing fossil fired appliances in Rode Island with heat pumps would create 800 installation jobs in the State. [2]

This measure will reduce emissions of NOx, PM2.5, SO2, and VOCs from power plants in Rhode Island, as quantified above, by reducing the electricity demand associated with lighting Middletown's streets. According to EPA's Power Plants and Neighboring Communities tool, five power plants generate 95% of annual net electricity in Rhode Island. Four of those plants are not located near LIDACs, but the Manchester Street Station in Providence is located in or within one mile of six LIDAC census tracts: 44007000600, 44007000700, 44007000800, 44007003601, 44007003602, and 44007003700. Those census tracts are also disproportionately impacted by air pollutant emissions from highway and local road traffic, activity at the Port of Providence, and other industrial emissions. In addition, residents of LIDAC communities are more likely to be vulnerable to the effects of air pollution and climate change due to a variety of socioeconomic factors.

Retrofit State Buildings with Heat Pumps and Efficiency Measures

Measure Description: Rhode Island will retrofit state owned buildings through weatherization, efficiency, and heat pump installations. This work would include electrical upgrades, HVAC system upgrades, and installation of air-sourced heat pumps and heat pump water heaters.

Near-term cumulative GHG emission reductions (2025 - 2030): 2,722 MT
Long-term cumulative GHG emission reductions (2025 - 2050): 14,392 MT

Criteria Emissions Reductions (kg)

	NOx	VOC	PM2.5
Annual Emissions Reductions 2025-2023	1758	36	128
Annual Emissions Reductions 2025-2050	9114	13	169

The breakdown of greenhouse gas reductions expected for the 3 building typologies included in this measure is displayed below.

Timeline and building		**CO2e (MT)**	**NOx (kg)**	**PM2.5 (kg)**	**VOC (kg)**
Baseline through 2030	DOA	7044	3730	403	839
	Trudeau	1297	653	77	187
	10 x SFH	1353	793	70	86
Reductions through 2030	DOA	2080	1273	104	102
	Trudeau	252	154	13	10
	10 x SFH	390	331	11	-76.2
Total reductions through 2030		**2722**	**1758**	**128**	**36**
Baseline through 2050	DOA	16666	9638	880	1185
	Trudeau	2598	1410	146	276
	10 x SFH	5070	3064	256	230
Reductions through 2050	DOA	9690	6110	470	326
	Trudeau	1068	654	53	40
	10 x SFH	3634	2350	169	13
Total reductions through 2050		**14392**	**9114**	**692**	**379**

Methods and Assumptions The following key assumptions about measure implementation were used to quantify emissions reductions for this measure: To calculate this measure, we modeled three potential building types and projects. The portfolio of buildings includes the Department of Administration (DOA) at 1 Capitol Hill (250,708 sq. ft.); a large day use facility represented by the Trudeau Center building at 3445 Post Rd, Warwick, RI 02886 (32,809 sq. ft.); and 10 single-family homes (10-SFH) represented by the group home located at 50 Cedar Ave., East Greenwich, RI 02818 (10 × 3,132 sq. ft.).

Compared to the baseline scenario of continued natural-gas combustion, converting to air source heat will provide large reductions in greenhouse gas emissions for all three building types, even without further greening of the electrical grid. These reductions are because of the high efficiency of heat-pump heating and cooling relative to on-site combustion and current stand-alone air conditioning. Of course, these emissions reductions will be magnified by the increased percentage of non-emitting sources on the RI electricity grid, which is mandated by law to be 100% renewable by 2033. As heat pumps combine both high efficiency and the capacity to leverage increasingly clean electricity, the percentage cumulative emissions reductions through 2050 for the buildings in question range from 58-72%. For the complete portfolio of buildings, the CO_2e emissions through 2050 are reduced 59%, avoiding 14,400 tons of CO_2e.

The cost to implement this measure has been estimated in two ways: 1) as an incremental expense compared to replacing the existing systems in kind, and 2) as a total cost for the new systems. For the office buildings (DOA and Trudeau), the incremental costs (per square foot) are estimated to be $0.92 and $3.10, respectively. For 10-SFH, the estimate is $3.20. For the portfolio, we estimate a combined incremental cost of $430,000, or a cost of emissions reductions of ~$30/MT CO_2e. The total costs (per square foot) of the conversions for DOA and Trudeau are estimated at $11.90; for 10-SFH the estimate is $7.20. Using the total costs, rather than the incremental costs, the combined portfolio will cost $3.6M, or $250/MT CO_2e. *See Appendix 2 for additional details about methods and assumptions*.

Implementing agency: Office of Energy Resources

Review of authority to implement. The implementing agency has the existing authority necessary to implement this measure.

Implementation schedule and milestones. Tentative program schedule:

Task #	Task Description	Anticipated Milestone Dates	Assumptions
1	OER accepts funds	December 2024	Award from EPA is made by October 2024
2	Agency engagement around program specifics and project identification	December 2024 – June 2025	Concurrent with project development
3	Solicit applications from state agencies	July 2025 – September 2025	Three months following project identification
4	Select projects and enter into agreements with DCAM or other agencies on a rolling basis	Starting September 2025	One month to evaluate and select projects and two months to enter into agreements with DCAM
5	Funds fully dispersed	September 2029	

Geographic Location: Statewide implementation.

Intersection with other funding availability. This measure will be implemented through the Office of Energy Resources and will be leveraged with their existing Lead by Example program as well as energy efficiency incentives provided by the utility, Rhode Island Energy.

Metrics to Track Progress. For this measure, the state intends to use the following metrics to track progress: number of heat pumps installed, amount of anticipated energy savings per building and overall.

LIDAC Benefits/Analysis. This project would take place across the state. Implementation of this measure will reduce government energy costs. Implementing this measure will reduce emissions of pollutants from power plants, resulting in improved health outcomes. Because LIDAC communities frequently bear a disproportionate burden of environmental harms and adverse health outcomes from pollution, such communities will receive the greatest health benefits from implementation of this measure.

This measure will reduce emissions of NOx, PM2.5, SO2, and VOCs from power plants in Rhode Island, as quantified above. According to EPA's Power Plants and Neighboring Communities tool, five power plants generate 95% of annual net electricity in Rhode Island. Four of those plants are not located near LIDACs, but the Manchester Street Station in Providence is located in or within one mile of six LIDAC census tracts: 44007000600, 44007000700, 44007000800, 44007003601, 44007003602, and 44007003700. Those census tracts are also disproportionately impacted by air pollutant emissions from highway and local road traffic, activity at the Port of Providence, and other industrial emissions. In addition, residents of LIDAC communities are more likely to be vulnerable to the effects of air pollution and climate change due to a variety of socioeconomic factors.

Municipal Energy Efficiency and Electrification

Measure Description: Rhode Island will support deployment of renewable energy, heat pumps, and EV charging, and other efficiency measures across municipalities. We will select projects through the Rhode Island Infrastructure Bank's existing programs that support municipal energy transition. This measure could be utilized by any sub-state government actor, including without limitation cities and school districts within Rhode Island. This measure would also create a network of energy assistance coordinators to assist cities and towns with the transition to clean power, clean transportation, and clean heat.

Near-term cumulative GHG emission reductions (2025 - 2030): 31,248 MT
Long-term cumulative GHG emission reductions (2025 - 2050): 151,633 MT

The table below shows the GHG reductions in metric tons that can be reduced if a grant of $3 million is provided for municipal technical assistance and GHG reduction measures. The table shows the three different types of GHG reduction measures assumed for the municipal program. We assume each municipality receives $1 million for heat pump installation, $1 million for electric vehicle chargers, $1 million for solar panel installation and each municipality receives $20,000 in technical assistance from a consultant.

Time Period	Heat Pumps GHG Reduced (tons)	EV Chargers GHG Reduced (tons)	Solar Panels GHG Reduced (tons)
2025-2030	645	12,275	816
2025-2050	2735	78,860	1,061

The municipal technical assistance measure will reduce 4,489 metric tons of CO2e annually per $1 million spent on the program.

Criteria Emissions Reductions (tons)			
	NOx	**VOC**	**PM2.5**
Annual Emissions Reductions 2025-2030	8,412	16,425	(185)
Annual Emissions Reductions 2025-2050	13,061	37,832	160

Methods and Assumptions The following key assumptions about measure implementation were used to quantify emissions reductions for this measure: The above calculations assume that three municipalities are funded through the municipal technical assistance program and that each municipality receives technical support to install solar panels, install electric vehicle chargers, and convert buildings from fossil fuels to heat pump hot water heat and space heating. The measure lifetime is 26 years – the solar panels and chargers are assumed to operate for 26 years (from 2025 to 2050).

Solar panel assumptions	$1 million for solar panels = 333 kw installed and 449,637 kWh per year production
EV charger assumptions	$1 million for level 2 and level 3 150 kW
Assumed cost of network of energy assistance coordinators	$cost of Cadmus contract ($60,000)
Heat pump assumptions	$1 million for heat pumps

In addition, we modeled the following projects as examples. The reductions from these projects were added to the totals above.

- A 69 kW solar array was assumed to be installed on the Narragansett Library and generate 81,000 kWh of electricity each year.
- A 180 kW solar array was assumed to be installed at the Narragansett Bay Commission which would generate 243,480 kWh of electricity each year
- An additional $1M is spent on solar panels with 333 kW installed and 449,637 kWh production.
- 14 Level 2 chargers were assumed to be installed at two facilities at a cost of $6,000 per charger.

See Appendix 2 for additional details about methods and assumptions.

Implementing agency: Rhode Island Infrastructure Bank

Review of authority to implement. The implementing agency has the existing authority necessary to implement this measure.

Implementation schedule and milestones. Tentative program schedule:

Task #	Task Description	Anticipated Milestone Dates	Assumptions

1	RIIB accepts funds	December 2024	Award from EPA is made by October 2024
2	Community engagement around program design specifics	December 2024 – March 2025	Concurrent with program development
3	Educate stakeholders and communities about program and solicit applications for projects	April 2025 – September 2025	Three months following completion and publication of the program guide and promotional materials
4	Review applications, select projects, and enter into agreements with project sponsors on a rolling basis	Starting September 2025	One month to evaluate and select successful applications and two months to enter into agreements with project sponsors
5	Provide technical assistance to project sponsors for duration of the project	Starting September 2025	Based on contract with technical assistance vendor
6	Continued community engagement during and following project implementation	Starting September 2025	Based on agreed upon project duration with project sponsors
7	Disburse funds to project sponsors	Rolling basis starting November 2025	As established in the agreements with project sponsors

Geographic Location: Statewide implementation.

Intersection with other funding availability. This measure will be implemented through the Rhode Island Infrastructure Bank and will be complementary to the Energy Efficiency and Conservation Block Grants and other existing programs administered by the Infrastructure Bank and other Rhode Island agencies. The Infrastructure Bank currently operates the Efficient Buildings Fund in coordination with the Rhode Island Office of Energy Resources. Since 2016, the Efficient Buildings Fund has provided long-term, one-third below market rate loans to dozens of communities and quasi-public agencies in Rhode Island. This includes energy efficiency and renewable energy upgrades to public facilities that conserve energy or produce clean energy for Rhode Island stakeholders. This program holds a consistently high subscription rate and a Fitch AA credit rating (October 2023).

Additionally, the Infrastructure Bank is currently in the process of refining the Clean Energy Fund for operations this year, which additionally provides energy efficiency and renewable energy grants and loans for public, quasi-public, private, and nonprofit entities. This program complements the existing Efficient Buildings Fund program and widens the scope of potential energy upgrades by the Infrastructure Bank to cover all emissions-producing project areas. The Clean Energy Fund expects an allocation of $5 million from the Rhode Island General Assembly for grant and loan activities.

Energy programs at the Infrastructure Bank will be further supported by the Greenhouse Gas Reduction Fund (GGRF) awards, including funding from the Clean Communities Investment Accelerator, the National Clean Investment Fund, and the Solar For All grant competitions. If awarded, these GGRF awards will expand upon RIIB's abilities to provide subsidized renewable energy and energy efficiency grants and loans to Rhode Island communities and entities. Additionally, all GGRF awards are subject to Justice40 requirements, with 100% of investments using Solar For All funds targeting low-income disadvantaged communities. Measures proposed for GGRF funding include community solar projects, landfill capping and solar programs, microgrid programs, and networked geothermal heat pump projects.

In addition, this measure intends to leverage the complementary funding available through elective pay (sometimes called direct pay) of certain clean energy tax credits (§45Y, §48E). In addition to directly supporting projects through technical assistance and deployment of renewable energy and storage systems, this measure will also serve to educate local governments on the available tax credits and provide technical assistance to local governments in designing such systems. As a result, this measure will catalyze widespread adoption of renewable energy and storage systems by local governments.

Metrics to Track Progress. For this measure, the state intends to use the following metrics to track progress: number of facilities installing projects, number of kilowatts of installed renewable energy, electricity production from solar arrays, expected energy savings from efficiency measures, the expected lifespan of projects, and number of performance years to quantify lifetime pollution reductions.

- Electricity dispensed from electric vehicle chargers.
- Estimated ICE VMT displaced by electric vehicle chargers.

LIDAC Benefits/Analysis. Municipal energy efficiency, renewable energy, and electrification project grants would be open to all communities in the state and funding could be prioritized to LIDAC areas. Implementation of this measure will reduce local government energy costs allowing these agencies to divert funding they were spending on energy to provide additional services to communities. Implementing this measure will reduce emissions of pollutants from power plants, resulting in improved health outcomes. Because LIDAC communities frequently bear a disproportionate burden of environmental harms and adverse health outcomes from pollution, such communities will receive the greatest health benefits from implementation of this measure.

This measure has the dual benefits of providing Level 2 EV chargers, which will reduce hurdles for use of EVs, while generating energy with rooftop and parking lot canopy solar arrays that will help to offset the additional electrical demands associated with those chargers. Additional energy produced by the arrays will reduce the facilities' monthly energy bills and supply zero GHG electricity to the grid.

This measure will reduce emissions of NOx, PM2.5, SO2, and VOCs from power plants in Rhode Island, as quantified above. According to EPA's Power Plants and Neighboring Communities tool, five power plants generate 95% of annual net electricity in Rhode Island. Four of those plants are not located near LIDACs, but the Manchester Street Station in Providence is located in or within one mile of six LIDAC census tracts: 44007000600, 44007000700, 44007000800, 44007003601, 44007003602, and 44007003700. Those census tracts are also disproportionately impacted by air pollutant emissions from highway and local road traffic, activity at the Port of Providence, and other industrial emissions. In addition, residents of LIDAC communities are more likely to be vulnerable to the effects of air pollution and climate change due to a variety of socioeconomic factors.

Addressing Pre-Weatherization Barriers

Measure Description: Rhode Island will address the problem of pre-weatherization barriers for residential and income-eligible electricity customers. Federal funding will be used to help customers resolve these issues and proceed with weatherization services through the utility energy efficiency program or other state and local agency pre-weatherization programs. Rhode Island Energy currently manages a utility energy efficiency program and proposes using the funds for pre-weatherization (PreWx) work for income eligible customers, and some of the funds for pre-weatherization for EnergyWise customers (those who do not qualify for income eligible services). The funding would be available to all customers and could receive targeted marketing in environmental justice communities. In addition, other state agencies that administer federal weatherization and efficiency programs could utilize funding for their programming with Community Action Programs (CAPs).

Near-term cumulative GHG emission reductions (2025 - 2030): MT
Long-term cumulative GHG emission reductions (2025 - 2050): 14,728 MT

Methods and Assumptions The following key assumptions about measure implementation were used to quantify emissions reductions for this measure: This measure assumes $10M spent on this program with an allocation of 65% to the income-eligible single-family program and the remainder to the EnergyWise single family program. It assumes a 5% administrative cost and that 1/3 of homes would be completed each year from 2025 to 2027. *See Appendix 2 for additional details about methods and assumptions*.

Implementing agency: Rhode Island Energy, Rhode Island's predominant electric distribution utility, is the implementor of the utility sponsored program, through which federal funding would flow to participants. Rhode Island Energy and its programs undergo thorough stakeholder and regulatory oversight from the Rhode Island Public Utilities Commission, Division of Public Utilities and Carriers, Office of Energy Resources, and Energy Efficiency Council. Rhode Island Energy would partner with Rhode Island Department of Environmental Management to report on actual performance, including GHG emissions reductions. Key implementation partners would be RISE energy, CLEAResult, and the Community Action Programs (CAPs). In addition, the Office of Energy Resources and the RI Department of Human Services, which runs the federal weatherization and LIHEAP programs could take federal funds and utilize them directly through the CAP agencies.

Review of authority to implement. The implementing agencies have the existing authority necessary to implement this measure.

Implementation schedule and milestones. Tentative program schedule:

Task #	Task Description	Anticipated Milestone Dates	Assumptions
1	Rhode Island Energy or other agency accepts funds	December 2024	Award from EPA is made by October 2024
2	Rhode Island Energy or other agency puts funds into 2025 energy efficiency program and utilizes it annually until funds are dispersed	December 2024 - January 2027	Concurrent with program development

Geographic Location: Statewide implementation.

Intersection with other funding availability. This measure will be utilized as part of the Rhode Island energy efficiency program which is delivered through a system benefit charge on electricity bills. It will also complement other federal funds through the state's weatherization assistance program. There is currently no specific program in Rhode Island that addresses whole-home retrofits or pre-weatherization barriers.

Metrics to Track Progress. For this measure, the state intends to use the following metrics to track progress: number of homes provided with pre-weatherization upgrades by town or zip code, and energy saved. Project progress will be tracked on an annual basis at the conclusion of each program year. The 2024-2026 program goals will be reviewed and compared to program performance and growth realization after each season.

LIDAC Benefits/Analysis.
Weatherization (insulation and air-sealing) plays an important role as Rhode Islanders electrify their heating systems and appliances. Weatherization services offered through Rhode Island Energy's EnergyWise energy efficiency program and Income Eligible Services energy efficiency program help improve the comfort of homes for occupants, save money for residents and building owners, and reduce energy consumption. Pre-weatherization barriers (PWBs), which includes presence of asbestos, knob-and-tube wiring, mold, mildew, and vermiculite, can prevent weatherization projects from moving forward and are particularly prominent health and safety issues in Rhode Island, which has one of the oldest housing stocks in the nation.

Addressing pre-weatherization barriers and providing weatherization services has a myriad of benefits:

- It **reduces energy use** (regardless of a home's current or future HVAC system).
- It **reduces emissions** of greenhouse gases.
- It makes homes more **climate resilient**; by improving the building's envelope, the building can retain heat (and cool) better and stay warmer (cooler) longer in the event of a winter (summer) power outage.
- It **improves the health and safety** of the home by dealing with issues such as knob and tube wiring, mold and mildew, asbestos, unsafe combustion, etc.
- It makes a home **more comfortable** for occupants by reducing drafts and making temperature more consistent and stable.
- It **saves money** for the homeowner through lowering the cost of their utility bills
- It **creates jobs** in the local economy through the work of energy auditors and contractors who perform the PreWx and Wx work.
- It **keeps money in the local economy** through the creation of jobs, the revenue of local businesses performing the work and the reduction of utility bills for the homeowners
- It **stays with the home** regardless of a change in ownership.

- It **advances heat pumps** since a home ideally receives both PreWx and Wx improvements before heat pumps are sized and installed.

Pre-weatherization barriers are a pervasive issue across Rhode Island's housing stock, impacting customers across categories such as both Market Rate (EnergyWise) and Income Eligible. In a recent analysis, approximately 55% of homes audited that had Wx opportunities had barriers that would need to be resolved before the Wx work could occur. 74% of those homes with barriers had the issues go unresolved, often due to the costs associated with remediation.

This project would provide many benefits to Low Income and Disadvantaged Communities (LIDAC). The Company does not foresee any disbenefits to LIDAC through this project. The benefits of PreWx and Wx work listed above would accrue to LIDAC when executed in those areas. However, this program would produce outsized results for LIDAC because our analysis suggests low-income customers often do not have the resources to address pre-weatherization barriers, which prevents them from receiving critical weatherization services.

Data collected during a previous assessment done by Rhode Island Energy shows that low-income customers receive three times more home energy assessments than market rate customers as a percentage of customers in that rate class (calculated by the number of assessments/electric customers in that rate class, see below). However, the percentage of customers that move from assessment to weatherization is 17% lower for low-income customers (28% for low-income versus 45% for market rate).

2022 Program Results	Audits	Wx	Conversion from audit to Wx	Electric customer by Rate Class	% of audits to eligible customers	% of Wx/ to eligible customers
EnergyWise Single Family	9,251	4,143	45%	408,268 (A-16)	2.3%	1.0%
Income-Eligible Single Family	2,679	758	28%	39,042 (A-60)	6.9%	1.9%

Comparison of services between market rate and income eligible single-family programs

Electricity

Demand Response for Grid Resilience – Incentivize Battery Storage for Residential and Commercial Customers for Peak Shaving Through Demand Response

Measure Description: This measure will incentivize the climate mitigation and resilience benefits that battery energy storage at homes and businesses can provide. Batteries are capable of charging from renewable energy systems or the electric grid, storing that power, and then discharging when called on. By encouraging batteries to discharge during "peak events," when RI uses use the most electricity and that electricity is generated by the most emission-intensive sources, we can reduce greenhouse gas (GHG) emissions while avoiding costly infrastructure investments. Batteries can also provide back-up power for homes and businesses in the event of a power outage. As the state electrifies its transportation and heating, building infrastructure, resilience to power outages will become increasingly important. This measure will leverage the local distribution utility's existing demand response program (branded "ConnectedSolutions") delivery structure by layering on incremental incentives for battery participation.

Near-term cumulative GHG emission reductions (2025 - 2030): 1,633.5 metric tons
Long-term cumulative GHG emission reductions (2025 - 2050): 1,633.5 metric tons

(Note: RIE modeled GHG benefits for the period 2024-2029 due to the limited battery landscape currently in Rhode Island, as well as the limited ability to forecast battery development beyond 2029.)

Methods and Assumptions The following key assumptions about measure implementation were used to quantify emissions reductions for this measure. Calculations assume:

RI Energy determined additional funding layer for residential and small business (RSB) battery participants; it then determined the avoided emissions and generation as a result of RSB Battery program participation; it them calculated the funding required to realize this level of program participation and emission reductions.

To determine the amount of solar capacity participating in the RSB Battery program load shed analysis forecasts from Schedule 2 of PUC Docket No. 24-06, as well as an internally run report regarding solar PV capacity paired with battery storage for RSB customers were utilized to estimate program growth with the proposed increase in incentive level.

EPA's AVERT web version tool was utilized to estimate annual GHG emissions in New England. The tool was also utilized to determine avoided CO_2 emissions during the ConnectedSolutions season (June-September). One key assumption made was to exclude C&I Daily Dispatch battery participants from the avoided GHG emissions calculations. $9.7M federal funding with estimated $25M program funding for battery participation over 2024-2029, resulting in total anticipated expenditures of $34.7M.

See Appendix 2 for very specific information about methodology and assumptions as provided by Rhode Island Energy.

Implementing agency: Rhode Island Energy will implement this measure.

Review of authority to implement. The implementing entity has the existing authority necessary to implement this measure.

Implementation schedule and milestones. Since Rhode Island Energy already has an existing program in place, many of the implementation events listed below and assumptions made will be completed prior to disbursement of awarded funds (represented by light gray boxes in the below). This measure will layer incentives for customers with batteries paired with renewable energy systems and associated administrative costs for batteries to participate in ConnectedSolutions.

Task #	Implementation Event	Anticipated Milestone Dates	Assumptions
1.	Preliminary draft SRP Investment Proposal circulated for external review and feedback	September 6, 2023	Completed by program season start date
2.	Communication and stakeholder engagement	September 2023 – February 2024	
3.	Revised SRP Investment Proposal circulated for external review and feedback	January 19, 2024	
4.	Discussion at EERMC meeting	January 25, 2024	
5.	SRP Investment Proposal filed with the Commission	February 9, 2024	
6.	Submit Implementation Grant Proposal to RIDEM	March 1, 2024	
7.	Submit Funding Application to RIDEM	April 1, 2024	
8.	Receive ConnectedSolutions Regulatory Approval Decision from PUC	April, 2024	
9.	Community engagement for program participation	April 1, 2024 – June 1, 2024	
10.	Seek input, prepare, and release Program Guidance documents, FAQs, and promotional materials based on stakeholder engagement.	February 1 – May 15, 2024	
11.	Continued community engagement, marketing, outreach during and following ConnectedSolutions season.	January 1st – December 31st	Conducted Annually
12.	ConnectedSolutions season start	June 1st	Annually
13.	ConnectedSolutions season end	September 30th	Annually
14.	All participant performance incentive payments due	December 31st	Completed Annually
15.	Selection of program administrator for 2025-2026 ConnectedSolutions seasons	January 1, 2025 – April 1, 2025	Competitive procurement procedure to select

			program administrator for 2025-2026 seasons
16.	Revise guides, promotional materials, as needed in response to RFP.	January 1, 2025 – May 15, 2025	Completed Annually
17.	Repeat steps 11 – 14 as needed	January 2025 – December 2026	
18.	Repeat all steps for 2027-2029 program years	January 2027 – December 2029	

Geographic Location: The geographic scope of the Rhode Island Energy ConnectedSolutions program is statewide for Rhode Island Energy customers (corresponds to roughly 37.5 of Rhode Island's 39 municipalities).

Intersection with other funding availability. Federal funding for this measure will be paired with state program funding. In this proposal, Rhode Island Energy would layer approximately $9.7M in federal funding with estimated $25M program funding for battery participation over 2024-2029, resulting in total anticipated expenditures of $34.7M and reduction of 1633.5 MTCO2e.

Metrics to Track Progress. Due to the nature of the incentive payment structure, progress from the ConnectedSolutions program will be tracked very closely. Rhode Island Energy will track the number of public communications with all Rhode Island customers such as email sends, social media posts, and other forms of customer engagement. Rhode Island Energy's ConnectedSolutions implementation vendor assists in the tracking of program marketing, participation, events, performances, and end of season incentive payments. Project progress will be tracked on an annual basis at the conclusion of each ConnectedSolutions season. The 2024-2026 program goals, outlined in Schedule 2 of RI PUC Docket No. 24-06, will be reviewed and compared to program performance and growth realization after each season.

LIDAC Benefits/Analysis. This proposed measure would provide the following benefits to all Rhode Islanders, a portion of which would accrue to Rhode Islanders in Environmental Justice Focus Areas:

- Lower electric bills of the ConnectedSolutions' program in its entirety (including the other non-battery pathways) All Rhode Island Energy residential electric customers will see an estimated annual decrease of 0.15% in their electric bill costs by 2026.
- Increased number of Residential and Small Business ("RSB") battery assets.
- Large Commercial and Industrial ("C&I") solar storage and batteries encourages green spaces, reduces co-pollutants, and increases distribution system reliability during extreme weather events.
- Approximately 10% of currently enrolled RSB Battery Pathway participants are located within a LIDAC or RI EJ Focus Area. Via this measure, RI expects an additional 30 participants to be in LIDACs or RI EJ Focus Areas.

Over the five-year period of performance, Rhode Island Energy anticipates holding a minimum of 10 Customer Assistance Expos, 60 Technical Working Group meetings, and 10 stakeholder forums through the Rhode Island Energy Efficiency Council and other public platform means.

Microgrids and Local Energy Resilience

Measure Description: Rhode Island will support deployment of renewable energy and storage systems for local government buildings to reduce energy costs and provide resilience in case of an electric grid outage. Any funding awarded will also complement newly available “direct pay” options for local governments to receive energy tax credits and technical assistance. We will select projects through the Rhode Island Infrastructure Bank’s existing programs that support municipal energy transition. This measure could be utilized by any sub-state government actor, including without limitation cities, towns, and school districts within Rhode Island.

Near-term cumulative GHG emission reductions (2025 - 2030): 10,151 MT
Long-term cumulative GHG emission reductions (2025 - 2050): 50,755 MT

Criteria Emissions Reductions (metric tons)			
	NOx	**SO_2**	**PM2.5**
Annual Emissions Reductions	2.08	2.08	0.12

Methods and Assumptions. The emissions reduction estimates are based on a case evaluation using the National Renewable Energy Lab’s PVWatts and ReOpt Tools. For the evaluated case, a 387 kW rooftop solar installation with 60 kW battery power and 153 kWH battery capacity were assumed. The formula for GHG emissions is: 0.7*(funding allocated to measure excluding administrative/817,154)*237*5> mt CO_2e (2025-2030) and 0.7*(funding allocated to measure excluding administrative /817,154)*237*25> mt CO_2e (2025-2050). The above calculations are based on spending $10m on project grants.

Implementing agency: Rhode Island Infrastructure Bank

Review of authority to implement. The implementing agency has the existing authority necessary to implement this measure.

Implementation schedule and milestones. Tentative program schedule:

Task #	Task Description	Anticipated Milestone Dates	Assumptions
1	RIIB accepts funds	December 2024	EPA funding is awarded in fall 2024
2	Local governments apply for and receive funding on a rolling basis	December 2024 – June 2025	Outreach to municipalities through various channels
3	Review applications, select projects, and enter into agreements with project proponents on a rolling basis	Begin July 2025	One month to evaluate and select successful applications and two months to enter into agreements with project proponents

4	Disburse funds to project proponents	Begin September 2025 until funds are spent	As established in the agreements with project proponents

Geographic Location: Statewide implementation.

Intersection with other funding availability. This measure intends to leverage the complementary funding available through elective pay (sometimes called direct pay) of certain clean energy tax credits (§45Y, §48E). These tax credits only cover up to 30% of the projects contemplated under this measure, which may be insufficient for some local government buildings to achieve a return on investment through cost-savings from energy bills. In addition to directly supporting projects through technical assistance and deployment of renewable energy and storage systems, this measure will also serve to educate local governments on the available tax credits and provide technical assistance to local governments in designing such systems. As a result, this measure will catalyze widespread adoption of renewable energy and storage systems by local governments. The following additional funding sources were identified as available for the purpose of installing solar plus storage projects but are not believed to be duplicative due to different program foci: Department of Energy "Energy Efficiency and Conservation Block Grant", EPA "Greenhouse Gas Reduction Fund", and Federal Emergency Management Agency "Building Resilient Infrastructure and Communities."

Metrics to Track Progress. For this measure, the state intends to use the following metrics to track progress: number of facilities installing renewable energy and storage, number of kilowatts of installed renewable energy, number of kilowatts of battery power installed, number of kilowatt hours battery capacity installed, the expected lifespan of projects, and number of performance years to quantify lifetime pollution reductions.

LIDAC Benefits/Analysis. A local resilient energy program would be open to all communities in the state and funding could be prioritized to LIDAC areas in the state. Implementation of this measure will reduce local government energy costs allowing these agencies to divert funding they were spending on energy to provide additional services to communities. Implementing this measure will reduce emissions of pollutants from power plants, resulting in improved health outcomes. Because LIDAC communities frequently bear a disproportionate burden of environmental harms and adverse health outcomes from pollution, such communities will receive the greatest health benefits from implementation of this measure.

Preserving Carbon Sinks through Renewable Energy Siting Incentives

Measure Description: Renewable energy systems reduce greenhouse gas emissions of the electric sector, but many communities are concerned about the apparent contradiction of cutting carbon sink forests to promote carbon-free electricity. Rhode Island's Renewable Energy Growth feed-in-tariff program was recently amended to consider incentive-adders for siting in pre-disturbed and commercially zoned spaces, which serves to discourage otherwise lower-cost siting in forested areas. This measure would support the preservation of carbon sinks by encouraging renewable energy systems to be sited outside of forests. Funding would be directed through Rhode Island Energy's (RI's largest gas and electric utility) existing program delivery channels.

Near-term cumulative GHG emission reductions (2025 - 2030): 139,856 metric tons

Long-term cumulative GHG emission reductions (2025 - 2050): 757,144 metric tons

Methods and Assumptions The following key assumptions about measure implementation were used to quantify emissions reductions for this measure. Calculations assume:

- Assumes a ~$0.04/kWh incentive adder for five years of compensation for renewable electricity generated by newly developed solar PV systems located on preferred sites that require remediation (a total request of $6,471,666 to be spent over a five-year period of performance).
- It is anticipated that 110 MW of solar PV will be eligible for this incentive adder through the end of the period of performance in 2029.

Emissions Reductions Method: Initial step is to determine the anticipated scale of solar PV development during the five-year period of performance. Estimate annual renewable electricity generation from eligible projects. Estimate the greenhouse gas emissions avoided from the scale of renewable electricity generation. Estimate the greenhouse gas emissions sequestration achieved by not developing in forested areas. Add the greenhouse gas emissions from previous two steps to get total greenhouse gas emissions benefit.

- Data and summary statistics derived by state agencies and available in the public record to estimate greenhouse gas emissions benefits of this measure.
- It is assumed that the level of the incentive adder as proposed will be approved by the Rhode Island Public Utilities Commission and therefore implemented.

See Appendix 2 for additional details about methods and assumptions.

Implementing agency: Rhode Island Energy will implement this measure through the pre-existing Renewable Energy Growth program. Rhode Island Energy already administers this program, so all administrative structure is already in place. Rhode Island Office of Energy Resources and the DG Board determine the proposed compensation levels, which are then reviewed and approved by the Rhode Island Public Utilities Commission.

Review of authority to implement. The implementing entity has the existing authority necessary to implement this measure.

Implementation schedule and milestones. The implementation schedule for this measure is simple and immediate. The proposed program plan for 2024 through 2026 is currently under review by the Rhode Island Public Utilities Commission, with the Commission's final order anticipated by April 30, 2024. Once approved, the incentive adder will go into effect. Rhode Island Energy anticipates eligible solar PV systems to be constructed and operational by 2027, with added systems (capacity) through 2029.

Geographic Location: The geographic scope of the Renewable Energy Growth program is Rhode Island Energy's electric distribution territory, covering about 37.5 out of Rhode Island's 39 municipalities. This measure is anticipated to result in 110 MW of new solar PV nameplate capacity across ten to twenty distinct solar PV projects across the State of Rhode Island.

Intersection with other funding availability. The incentive adder layers on top of existing program funding sourced from customers via a charge on electric bills.

Metrics to Track Progress. Rhode Island Energy will track progress based on the following metrics:

- Number of MW of installed, operational solar PV nameplate capacity.
- Locations and nature of remediation that have occurred in preparation for solar PV development.
- Number of acres of eligible solar PV as a proxy for number of acres of forested land preserved.
- Actual generation (MWh) and total incentive-adder compensation ($) paid out.

LIDAC Benefits/Analysis. Rhode Island Department of Environmental Management recognizes Low-Income and Disadvantaged Communities (LIDACs) within its Environmental Justice Focus Areas across Rhode Island. This proposed measure would provide the following benefits to all Rhode Islanders, a portion of which would accrue to Rhode Islanders in Environmental Justice Focus Areas:

- Lower electric bills by roughly $6.5M in aggregate over the five-year period of performance.
- Preserve over 400 acres of forested land.
- Reduce greenhouse gas emissions by more than 755,000 metric tons of carbon dioxide through 2050.

Waste and Working Lands

Promote Food Waste Diversion in Rhode Island Municipalities

Measure Description: Rhode Island will support municipal efforts to divert food waste from RI's primary Central Landfill. In this measure, we propose that approximately 20 tons per month, or 240 tons per year of food scraps will be diverted from landfills to anaerobic digestion and composting facilities. Anaerobic digesters convert food waste into useful products such as biogas. In addition, composting of food scraps will be assumed. The measure will fund municipalities to establish food scrap collection programs. By recycling food scraps, landfilling of waste material will be avoided.

Near-term cumulative GHG emission reductions (2025 - 2030): 240,618 metric tons
Long-term cumulative GHG emission reductions (2025 - 2050): 1,603,228 metric tons

Methods and Assumptions The following key assumptions about measure implementation were used to quantify emissions reductions for this measure. Calculations assume:

- The Environmental Protection Agency's (EPA) Solid Waste Emissions Estimation Tool (SWEET) is an Excel-based tool to estimate project or source level emissions from the solid waste sector and compare alternative waste treatment scenarios. It is valuable for municipal solid waste officials to

establish a baseline of air pollutant and short-lived climate pollutants, and to identify mitigation options.
- Assumes 50 percent of food scraps are anaerobically digested and 50 percent are composted.
- Using information from the City of Providence (also a SWIFR recipient) as an example for purposes of modeling.

See Appendix 2 for additional details about methods and assumptions.

Implementing agency: RI Department of Environmental Management

Review of authority to implement. The implementing agency has the existing authority necessary to implement this measure. Regulations may need to be promulgated to administer the assistance program.

Implementation schedule and milestones. Tentative program schedule:

Task #	Task Description	Anticipated Milestone Dates	Assumptions
1	Community engagement around program design specifics	December 2024 – June 2025	EPA program funds are awarded by December 2024
2	Identify final municipal/program partners	June 2025 – December 2025	
3	Assist municipalities with outreach	January 2026 – July 2026	
4	Monitor diversion rates/progress with municipal partners	August 2026 – September 2029	

Geographic Location: Statewide implementation.

Intersection with other funding availability. This measure will be implemented through RIDEM and will be complementary to the Bipartisan Infrastructure Law Solid Waste Infrastructure for Recycling (SWIFR) Grants received by RIDEM.

Metrics to Track Progress. For this measure, the state intends to use the following metrics to track progress: tons of food waste diverted to composting (annually), tons for food waste diverted to anaerobic digestion (annually), percentage of food waste diverted (per municipality), program participation rates (per municipality), and number of participating municipalities.

LIDAC Benefits/Analysis. Climate-related benefits from GHG emissions reductions associated with diverting food waste from the Central Landfill are particularly critical for LIDAC areas. 45 of Rhode Island's LIDAC census tracts are classified as high risk according to CDC Social Vulnerability Index, which considers a range of socioeconomic factors, including poverty, lack of vehicle access, and crowded housing. (Source: CDC/ATSDR SVI Fact Sheet. Available at https://www.atsdr.cdc.gov/placeandhealth/svi/fact_sheet/fact_sheet.html

This measure may also generate employment opportunities. A 2013 study by the Institute for Self-Reliance (ILSR) on composing in Maryland determined that, on a per-ton or per-dollar capital investment basis, composting facilities in that state sustain twice as many employees as landfilling. Further jobs are created when the compost is used in “green infrastructure” and for stormwater and sediment control creates even more jobs.

Build Greater Capacity for Urban Forest Management

Measure Description: Allow the RI Division of Forest Environment (within RIDEM) and partners to work with additional municipalities across RI to build greater capacity for urban forest management, tree preservation and expand tree canopy.

Targeted municipalities will have their canopy cover mapped to identify baseline conditions for existing tree canopy, including the equitable distribution of canopy across a jurisdiction, identify potential planting areas for new tree plantings, quantify ecosystem service benefits the canopy provides with regards to carbon, air pollutants, stormwater and urban heat island, an audit of tree-related codes and ordinances to ensure adequate preservation and conservation of existing tree canopy, and work with disadvantaged communities to identify opportunities for new tree plantings and greenspaces in their neighborhoods. Some tree plantings will require removal of hardscapes, soil conditioning and structural cells to improve planting areas and increase soil volume which will increase tree longevity. Communities will be trained on proper tree care and stewardship (watering, pruning, etc.) to ensure that new planted trees are cared for over the long-term and survive into maturity to maximize carbon sequestration and storage.

The RI Division of Forest Environment is already partnering with a handful of RI municipalities on this specific type of work. Providing additional funding will allow additional partnership across more municipalities.

Near-term cumulative GHG emission reductions (2025 - 2030): 81,800 pounds of sequestered CO2
Long-term cumulative GHG emission reductions (2025 - 2050): 841,000 pounds of sequestered CO2

Sequestration of the following common air pollutants (in pounds): *Carbon monoxide, nitrogen dioxide, ground level ozone, particulate matter at 10 microns and 2.5 microns, and sulfur dioxide.*	
Annual Emissions Reductions 2025-2030	196 pounds of sequestered air pollutants
Annual Emissions Reductions 2025-2050	1,960 pounds of sequestered air pollutants

Methods and Assumptions The following key assumptions about measure implementation were used to quantify emissions reductions for this measure. Calculations assume:

- The values for quantifying carbon and the six common air pollutants sequestered from new tree plantings were calculated using *iTree*, a software suite of tools developed by the U.S. Forest Service and Davey Trees to quantify the ecosystem service benefits trees provide.
- Since participating municipalities have not been identified or their canopy mapped at this point, we are providing example estimates for two different common municipal scenarios for the state of Rhode Island. These communities' tree canopy and carbon were mapped and quantified. One represents a high-density built urban city landscape and the other represents a smaller suburban town.
- Implementation measure assumptions include the availability of the nursery stock sizes to be planted, the tree species selected for planting, specific locations and available planting spaces within the neighborhoods and long-term stewardship (watering, pruning, fertilizing, etc.).
- Tree planting estimates assume that the trees survive to maturity. A 15% mortality factor was calculated to conservatively estimate tree survival since it is unlikely that all trees will survive to maturity.

See Appendix 2 for additional details about methods and assumptions.

Implementing agency: RI Department of Environmental Management

Review of authority to implement. The implementing agency has the existing authority necessary to implement this measure.

Implementation schedule and milestones. Tentative schedule:

Task #	Task Description	Anticipated Milestone Dates	Assumptions
1	Recruit new municipalities for urban forest mapping and planning	Year 1	Assumes funding is awarded by end of 2024.
2	Map and assess communities	Year 2 & 3	
3	Organize and engage with local stakeholders on urban forest issues. Assess opportunities for tree plantings in disadvantaged neighborhoods with local committees.	Year 2 & 3	
4	Tree establishment and stewardship of new plantings	Year 2,3 & 4	

Geographic Location: Statewide implementation.

Intersection with other funding availability. This measure will be implemented through RIDEM and will be complementary to IRA FFY2023 funding in support of Community Capacity Building for Urban Forestry in Rhode Island; BIL increase to base funding.

Metrics to Track Progress. For this measure, the state intends to use the following metrics to track progress: number of municipalities receiving assistance, number of community engagement events, number of volunteer hours, number of trees planted, number of impervious surfaces reduced, and number of new greenspaces created or restored.

LIDAC Benefits/Analysis. Improved public health resulting from reductions in co-pollutants (ozone, PM2.5 and hazardous air pollutants) such as reductions in new asthma cases and reductions in hospital admissions and emergency department visits. Increased resilience to climate change from GHG reduction measures that have both GHG benefits and climate adaptation benefits (e.g. heat island strategies help reduce GHG emissions by reducing energy demand and help reduce health impacts due to extreme heat.) Enhanced community engagement, increased public awareness of projects and results, and community capacity building. New green space and/or community beautification.

Benefits Analysis

The implementation of the measures included in this PCAP is anticipated to have a broad range of benefits. Please see a discussion of benefits and dis-benefits along with an analysis of co-pollutant emission changes in each measure description.

Low-Income and Disadvantaged Community Analysis

Implementation of the measures included in this PCAP will significantly benefit low-income and disadvantaged communities (LIDACs). This section identifies LIDACs within the jurisdiction covered by this PCAP, and how Rhode Island meaningfully engages with LIDACs for our work on climate change. We also present a climate vulnerability analysis to highlight the challenges that currently burden these communities. Measures in this PCAP intend to lower these burdens. Specific benefits and disbenefits along with co-pollutant reductions are outlined in each measure description.

Identification of and Engagement with LIDACs

In 2023, the Rhode Island Department of Environmental Management (RIDEM) developed an environmental justice (EJ) policy to guide all programs in the Department in operating in accordance with RIDEM's commitment to equity and justice. The policy "represents DEM's ongoing commitment and dedication to a clean, healthy Ocean State and represents DEM's commitment to the health of all people who live and work within its communities, especially for those who often experience the disproportionate and adverse human health impacts of environmental burdens."[10]

The EJ policy states that RIDEM's "ongoing obligation is to incorporate EJ considerations into all the Department's programs, policies, and activities, and elevate important environmental issues that have a significant impact on EJ focus areas." The policy defines EJ focus areas as census tracts that meet one or more of the following criteria:

(i) Annual median household income is not more that sixty-five percent (65%) of the statewide annual median household income;
(ii) Minority population is equal to or greater than forty percent (40%) of the population;
(iii) Twenty-five percent (25%) or more of the households lack English language proficiency; or
(iv) Minorities comprise twenty-five percent (25%) or more of the population and the annual median household income of the municipality in the proposed area does not exceed one hundred fifty percent (150%) of the statewide annual median household income.

To be consistent with Department policy, RIDEM used the EJ focus area criteria to identify 98 of the 244 census tracts in Rhode Island as LIDAC areas. According to the 2020 census, the 418,964 people that reside in those census tracts constitute 38% of the total population of the State. A comparison of the LIDAC census tracts identified using the State criteria with the Disadvantaged Areas in the State identified by EPA's Climate and Economic Justice Screening Tool (CEJST) is attached as Appendix 1. All but one of the 61 census tracts identified by CEJST as Disadvantaged Areas meet the RIDEM EJ focus area definition.

EPA also recommends considering the Supplemental Indexes in the Environmental Justice Screening and Mapping Tool (EJScreen) when identifying LIDACs. To be consistent with the State EJ policy, RIDEM did not use the Supplemental Indexes to identify LIDAC areas. However, EJScreen results are included in the discussions of environmental and health burdens in LIDAC communities in the State. As shown in Appendix 1, all but 16 of the 98 RIDEM EJ focus areas are also CEJST Disadvantaged Areas or include census block groups that trigger EPA's recommended EJScreen subindex criteria or both. [11]

RIDEM EJ focus areas are shown in Figure 3. Note that three census tracts initially identified using the criteria in the policy are not shown in this map and were not included in this analysis because of additional information available to RIDEM about those areas. For example, the median income for

---

[10] RIDEM Environmental Justice Policy, Version 1.3,September 25, 2023 . Available at: https://dem.ri.gov/sites/g/files/xkgbur861/files/2023-09/ridem-environmental-justice-policy.pdf

[11] [2] EPA's *Climate Pollution Reduction Grants Program: Technical Reference Document for States, Municipalities and Air Pollution Control Agencies Benefits Analyses: Low-Income and Disadvantaged Communities* (April 2023) recommends using CJEST Disadvantaged census tract designations and/or census block groups that are at or above the 90th percentile for any of EJScreen's Supplemental Indexes when compared to the nation or state, as well as tribal and indigenous lands to identify LIDAC areas.

census tract 44009051400 is skewed by the inclusion of students at the nearby University of Rhode Island in that statistic.

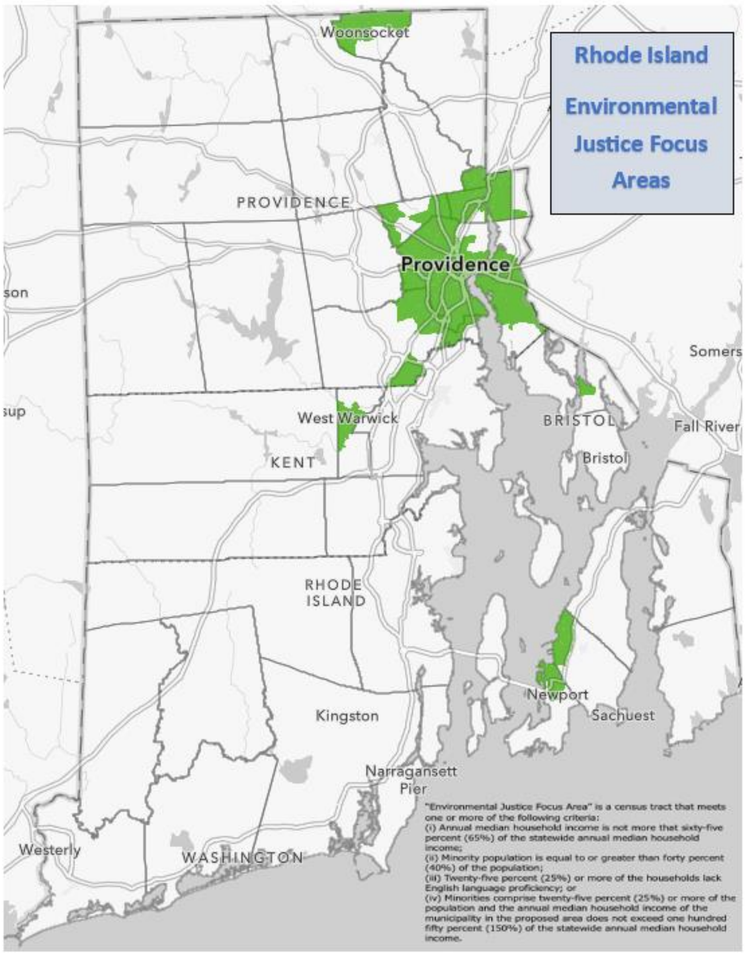


Figure 3. Rhode Island Environmental Justice focus areas. Interactive map is available at: https://dem.ri.gov/environmental-protection-bureau/initiatives/environmental-justice

Rhode Island DEM engaged with LIDAC communities during the preparation of our PCAP and will continue to provide opportunities to engage throughout the CPRG process. We hosted an online listening session in January and provided an online comment portal for community members to comment on draft PCAP measures. We have highlighted our climate planning efforts in our EC4 newsletter, and on our website.

RIDEM actively engages its recently hired Climate Justice Specialist in the CPRG process to help ensure the work is transparent, represents the voices of low-income and disadvantaged communities, and is communicated effectively to populations most vulnerable to the impacts of climate change. Ongoing 'Climate Justice Hours' will provide an avenue to share information and solicit feedback from low-income and disadvantaged community members. RIDEM will continue to look to engage with the members of the Providence Racial and Environmental Justice Committee (REJC) about the PCAP and how it can work to implement some of the recommendations outlined in the Providence Climate Justice

Plan (https://www.providenceri.gov/sustainability/climate-justice-action-plan-providence/) as adopted in 2019. This outreach and coordination will continue past March 2024 when RIDEM turns its attention to the development of the CCAP.

We have also provided grants to six community organizations that will lead community engagement activities through workshops, educational opportunities, and discussions with specific stakeholders. This work will continue through the development of our CCAP and 2025 Climate Action Strategy.

- CPRG webpage
- CPRG Comment Portal

Climate Change Vulnerability Analysis

According to the National Oceanic and Atmospheric Administration (NOAA), Rhode Island has warmed by more than 4°F in the past century. Both mean and extreme precipitation have also increased. NOAA data shows a sea level rise of more than 9 inches since 1930 in Newport, Rhode Island, which exceeds the global average.[12] Rhode Island has a population density second only to New Jersey of the 50 states[13] and a 384-mile shoreline along its 40-mile coast[14], making the State's residents, environment, and economy vulnerable to climate impacts.

LIDAC communities are particularly affected by climate impacts due to disproportionate environmental exposures and health and socioeconomic factors that increase the vulnerability of residents. Most of the Rhode Island LIDAC communities are in densely populated urban areas. Residents of those areas are less likely to be able to prepare for and respond to climate effects due to limited resources and lack of control over rented living spaces.

Climate change is associated with a range of effects, including temperature, air quality, and coastal and indoor flooding impacts. The impact of those climate related effects on LIDAC communities in Rhode Island are described further below.

---

12 [3] NOAA National Centers for Environmental Information/State Summaries 150-RI. Available at: https://statesummaries.ncics.org/downloads/RhodeIsland-StateClimateSummary2022.pdf

13 [4] US Census Bureau Population Density of the 50 States, the District of Columbia, and Puerto Rico: 1910 to 2020. Available at: https://www2.census.gov/programs-surveys/decennial/2020/data/apportionment/population-density-data-table.pdf

14 [5] RI.gov webpage. Available at: https://www.ri.gov/facts/history.php#:~:text=For%20a%20state%20that%20is,Ocean%20runs%20for%20400%20miles.

Extreme temperature impacts

The average temperature in Rhode Island in 2023 was 4.1ºF higher than the 20th century mean, consistent with a warming trend in recent years, as shown in Figure 2.[15] A NOAA analysis determined that the number of hot days (maximum temperature above 90°F) and warm nights (minimum temperature above 70°F) were highest in the most recent 5-year period analyzed, 2015–2020. NOAA predicts that historically unprecedented warming will continue through this century. Under a higher emissions scenario, NOAA predicts average temperatures 10°F warmer than the hottest year in the historical record. Exposure to extreme temperature causes increases in health-related illness and mortality and can exacerbate pre-existing conditions, including cerebral, respiratory, and cardiovascular diseases.[16]

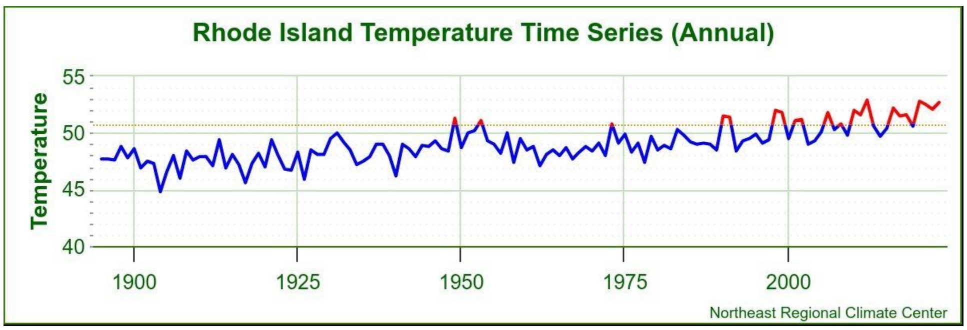


Figure 4. Average annual temperatures in Rhode Island, 1895-2023. This figure and additional climate data are available at the [Cornell University Northeast Regional Climate Center website](https://www.nrcc.cornell.edu/regional/tables/tables.html).

Temperatures are not uniform throughout the state. On July 29-30, 2020, the CAPA Heat Watch campaign collected 62,084 temperature measurements in Providence, East Providence, Pawtucket, and Central Falls, Rhode Island. As shown in Figure 5, afternoon temperatures were as much as 12.6º higher (94.6º versus 82.0º) in residential areas with little shade than in areas with more tree cover.[17] Those heat island locations are largely in LIDAC areas.

---

[15] [6] Cornell University Northeast Regional Climate Center website. Available at: https://www.nrcc.cornell.edu/regional/tables/tables.html

[16] S EPA (2021) *Climate Change and Social Vulnerability in the United States Report, pg. 32.* Available at: https://www.epa.gov/system/files/documents/2021-09/climate-vulnerability_september-2021_508.pdf

[17] [8] CAPA Strategies, LLC (2020), *Heat Watch Report:, Providence, East Providence, Pawtucket, and Central Falls, Rhode Island.* Available at: https://osf.io/jr9b7?view_only=1b5c811777f546bdb808088bfa24735b

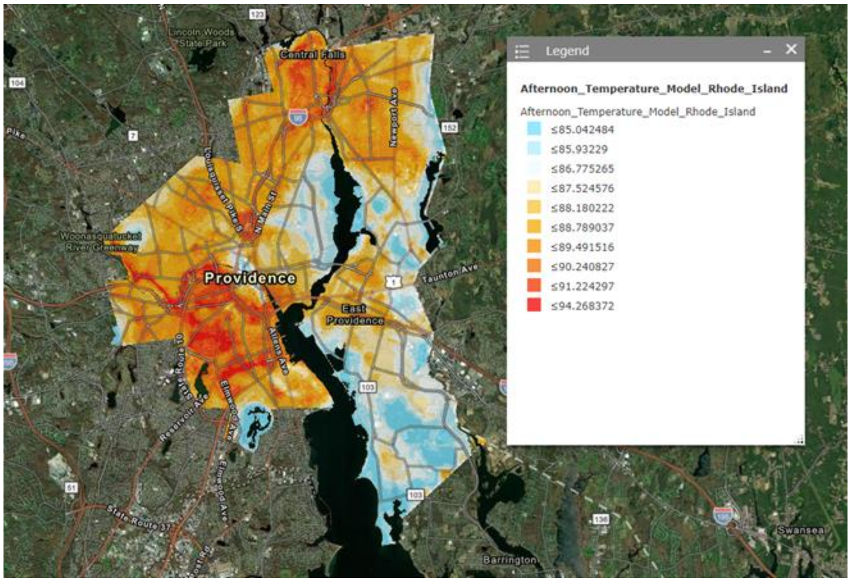


Figure 5. Temperatures measured in CAPA Heat Watch campaign, 3:00-4:00 pm. More information on that campaign is available at: [*https://osf.io/jr9b7?view_only=1b5c811777f546bdb808088bfa24735b*](https://osf.io/jr9b7?view_only=1b5c811777f546bdb808088bfa24735b)

The Federal Emergency Management Agency's (FEMA's) National Risk Index ranks 20 of the Rhode Island LIDAC identified census tracts as at relatively high risk from heat waves.[18] A range of socioeconomic factors contribute to vulnerability to heat effects. The FEMA data include a Social Vulnerability Index (SVI) calculated by the Centers for Disease Control/Agency for Toxic Substances and Disease Registry (CDC/ASTDR) using US Census data, which considers 16 socioeconomic factors, including poverty, lack of vehicle access, and crowded housing.[19] 45 of the Rhode Island LIDAC tracts are ranked as high risk for social vulnerability according to that index.

Air quality impacts

EPA's *Climate Change and Social Vulnerability* report states that changes in chemical and physical interactions that create, remove, and transport air pollution will cause increased levels of fine particulate matter (PM2.5) and ground-level ozone that are likely to have significant respiratory and cardiovascular health effects. EPA also notes that "climate change-driven increases in wildfires and windblown dust events also result in higher PM2.5 concentrations."[20] That document estimates that, in the Northeastern region of the United Staes, increased air pollution exposures associated with global warming of 2°C will cause 400 additional premature deaths in people aged 65 and above and 450

---

[18] [9] FEMA National Risk Index for Natural Hazards. Available at: https://hazards.fema.gov/nri/

[19] [10] CDC/ATSDR SVI Fact Sheet. Available at: https://www.atsdr.cdc.gov/placeandhealth/svi/fact_sheet/fact_sheet.html

[20] [11] USEPA (2021), page 20.

additional asthma diagnoses in children each year. A 4° increase would cause 1,200 deaths in seniors and 1,400 additional childhood asthma diagnoses.

People living in LIDAC areas in Rhode Island are already exposed to elevated levels of air pollutants, due to the density of mobile and stationary emissions sources in urban areas. Figure 6 shows annual average ambient levels of the known human carcinogen benzene measured in the RIDEM monitoring network over the past twenty years, Benzene is a constituent of gasoline and other petroleum products and is a component of combustion emissions. Although benzene concentrations have decreased over that period at all sites, considerable discrepancies remain between the concentrations measured at the sites, with levels highest at a site adjacent to Interstate Route 95 (I-95) in Pawtucket and lowest at a rural site in West Greenwich.

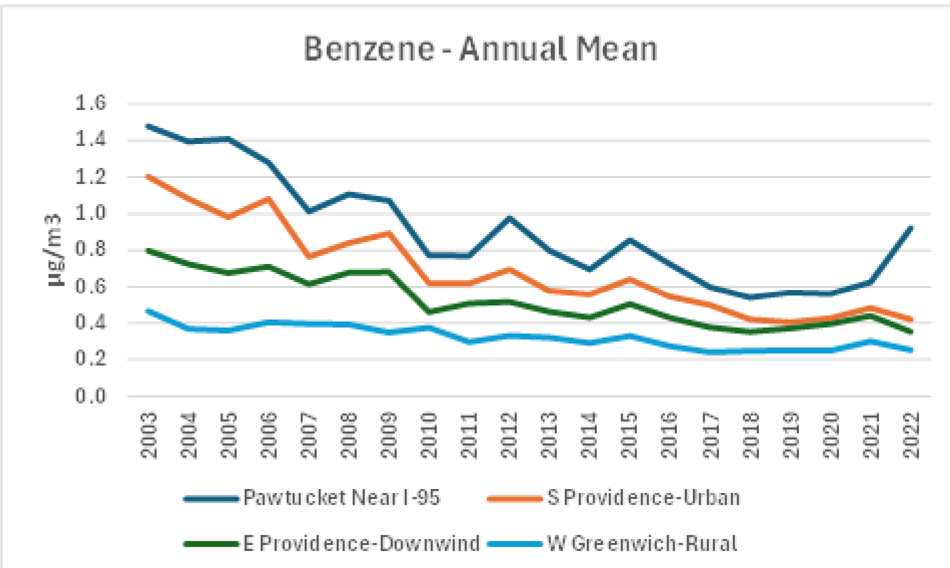


Figure 6: Benzene Concentrations in Rhode Island Ambient Air

As part of an EPA-funded Community-Scale Air Toxics study in 2017-2018, RIDEM measured black carbon, an indicator of diesel exhaust, and particle count, an indicator of emissions of ultrafine particles from vehicles and other combustion sources, at neighborhood sites in LIDAC areas near I-95 in Providence. Both of those pollutants were elevated during hours with high total and truck traffic counts.[21] In a 2021-2022 RIDEM Community Scale study, RIDEM measured air quality in LIDAC areas near

---

[21] [12] RIDEM (2019). Community-Scale Air Toxics Monitoring Grant: Evaluation of the Impact of On-Road Mobile Source Air Toxics on Air Quality at Sensitive Receptors Adjacent to Interstate Route 95 in the Providence Metropolitan Area. Available at: https://dem.ri.gov/sites/g/files/xkgbur861/files/programs/air/documents/air-mobile95-report.pdf

the Port of Providence; that study found elevated levels of air toxics at those sites relative to those measured at a site in the same area that is more distant from the Port.[22]

As with excessive heat, LIDAC communities are particularly vulnerable to health effects associated with air pollutant exposure due to the socioeconomic factors that contribute to the high Social Vulnerability Index in those areas. Residents in those areas also experience among the highest asthma rates in the State, as shown in Figure 7, and, therefore, are more likely to have serious health consequences as a results of air pollutant exposures.

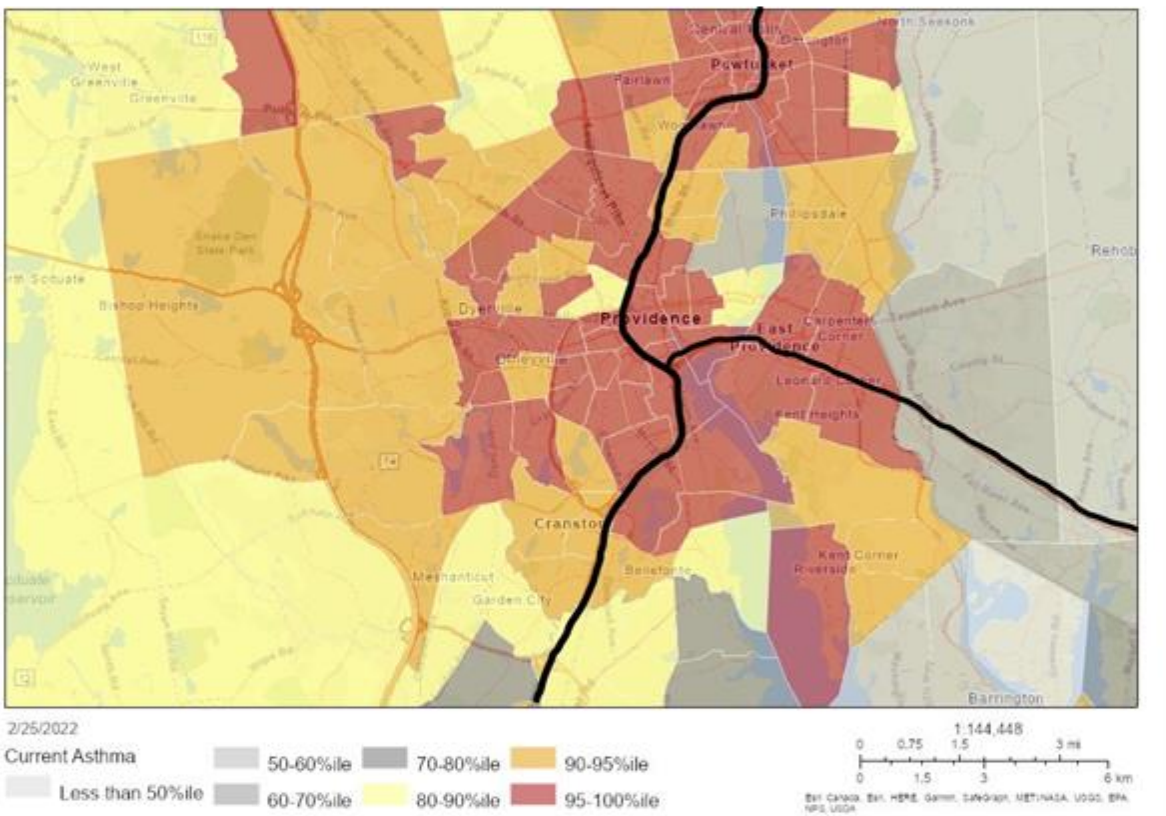


Figure 7. Current asthma rates as compared to national average from EJScreen. Black line indicates highways (I-95 and I-195). More information available at: https://ejscreen.epa.gov/mapper/

Coastal and Inland Flooding

According to NOAA, both mean and extreme precipitation have increased during the last century, with the highest number of extreme events in recent years. Further, NOAA reports that sea level at Newport, RI has risen more than 9 inches since 1930. NOAA projects continued increases in frequency and intensity of extreme precipitation events and an additional rise sea level rise of 1 to 4 feet by 2100.

---

[22] [13] Final Report will be posted at RIDEM's *Community Scale Air Toxics Monitoring Project – Port of Providence and Surrounding Communities* webpage. Available at: https://dem.ri.gov/environmental-protection-bureau/air-resources/air-toxics-monitoring-port-providence

Higher sea levels are associated with increased risk of coastal flooding and erosion during winter storms and hurricanes. The trend in annual precipitation in the State is shown in Figure 8.

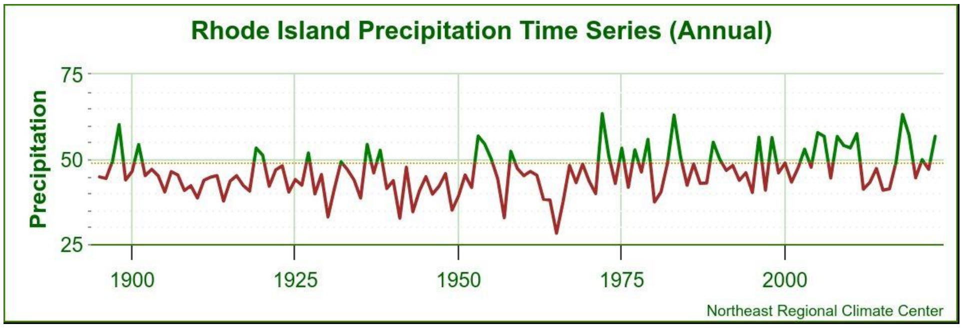


Figure 8. Annual Precipitation in Rhode Island, 1895-2023. This figure and additional climate data are available at the [Cornell University Northeast Regional Climate Center website]

Extreme weather events, including heavy rain and windstorms, result in flash floods, property damage, and disruption of essential services in the State. A Major Disaster Declaration was issued on January 7, 2024 for destruction caused by severe storms, flooding, and tornadoes in the State between September 10 and September 13, 2023.[23]

Coastal and inland flooding from sea level rise and increased precipitation leads to financial losses and displacement for businesses and residents in the State. FEMA ranks 93 of Rhode Island's census tracts as at relatively high or relatively moderate risk for coastal and/or riverine flooding. Twenty-seven of those areas are LIDAC census tracts in Warren, West Warwick, Providence, East Providence, Central Falls, North Providence, Cranston, Pawtucket, and Woonsocket.[24]

Low-income households living in poor-quality structures or floodplains are more likely to be adversely impacted from property damage or loss of property from floods. Coastal flooding also impacts roads and can lead to traffic delays, significantly affecting lower income workers who are paid on an hourly basis.[25] As discussed above, the high Social Vulnerability rating of the Rhode Island LIDAC communities indicates that those communities will be more to those effects.

---

[23] FEMA Disasters and Assistance- Rhode Island webpage. Available at: https://www.fema.gov/locations/rhode%20island#declared-disasters

[24] [15] FEMA National Risk Index for Natural Hazards. Available at: https://hazards.fema.gov/nri/

[25] [16] USEPA (2021), page 46.

Review of Authority

Rhode Island DEM has determined that there is existing authority to implement all the measures in this plan. Additional details are included in each measure description.

Intersection with Other Funding Availability

Many of the priority measures included in this PCAP expand upon or complement existing programs. Within each measure description is a discussion of both federal and non-federal funding sources related to implementation of that measure. Without additional funding, many of the measures and existing programs will either run out of funds or will not be able to be created as described.

Coordination and Outreach

Rhode Island DEM conducted extensive intergovernmental coordination and stakeholder outreach in the development of this PCAP. The following coordinating entities were involved in the development of this plan.

- The RI Executive Climate Change Coordinating Council, or RIEC4, (as Chaired by RIDEM Director Terry Gray) comprised of 13 member agencies as follows: RI Coastal Resources Management Council, RI Department of Administration, RI Department of Environmental Management, RI Department of Health, RI Department of Transportation, RI Division of Planning, RI Emergency Management Agency, RI Executive Office of Health & Human Services, RI Infrastructure Bank, RI Office of Energy Resources, RI Public Transit Authority, RI Division of Public Utilities and Carriers, and the Rhode Island Commerce Corporation.
- The 9-member RIEC4 Science and Technology Advisory Board (STAB)
- The 13-member RIEC4 Advisory Board
- RIDEM's Climate Justice Specialist and the RI Office of Energy Resources Energy Justice Manager
- The RI Department of Labor & Training (including the Governor's Workforce Board)
- Cities and towns across Rhode Island with targeted outreach and engagement
- Institutions of higher education located within Rhode Island (e.g., Brown University, University of Rhode Island)
- Environment Council of Rhode Island (ECRI) and member organizations
- The Northeast States for Coordinated Air Use Management (NESCAUM)
- Southeastern Regional Planning and Economic Development District (lead on the Providence/Warwick MSA PCAP)

Interagency and Intergovernmental Coordination
Interagency coordination on climate change is one of the core elements of RI's success to-date on mitigation measures and climate planning. RIDEM climate policy staff interact on a very regular basis with staff from the other 12 RIEC4 agencies (listed above). This staff-level coordinating network is critical to the success of both the PCAP and the CCAP. Agency directors meet 6-times a year at RIEC4 Council meetings, and it is anticipated that all key deliverables of this process over the next 4 years will be discussed and vetted though both RIEC4 staff and agency directors/staff. Because Rhode Island's Division of Statewide Planning serves as our state's only MPO, we rely on their staff to help engage with cities and towns regarding local plans and requirements. We also interact frequently with the Rhode

Island League of Cities and Towns. The Rhode Island Infrastructure Bank is also a critical partner in developing funding analysis and mechanisms to direct federal funds to cities and towns.

The RIEC4 has existed for nearly 10 years and is very adept at communicating about such large projects and deliverables. In order to bring in the voices of RI's 39 cities and towns into this process, RIDEM worked with the Southeastern Regional Planning and Economic Development District (SRPEDDD) to engage municipal leaders to solicit input and align our two PCAPs. In addition, monthly RIEC4 Advisory Board meetings and bi-monthly RIEC4 STAB meetings are utilized to advance interagency and municipal coordination. The RI climate change website (online at https://climatechange.ri.gov/) will continue to be utilized as the primary repository for sharing materials and announcing meetings/events via its online calendar feature. SmartComment (web-based software for public comments and engagement campaigns) will continue to be used for capturing, organizing, and analyzing online feedback from stakeholders. Similarly, RI's climate listserv will be utilized to push out interim deliverables, engage stakeholders, and the final PCAP (to inform the development of implementation grant applications by RI cities/towns, tribes, etc.).

PCAP Public and Stakeholder Engagement

The members of the RIEC4 Advisory Board and RIEC4 STAB represent a wide variety of organizations/interests including, but not limited to, the Audubon Society of RI, TNC, RI AFL-CIO, RI Coastal Resources Center, Brown University, the University of Rhode Island, the Narragansett Bay National Estuarine Research Reserve, builders, affordable housing, architects, and private business. With the RIEC4 Advisory Board meeting monthly and the RIEC4 STAB meeting bi-monthly, board meetings were used to provide direct input into the development of the PCAP and solicit public feedback (all meetings include opportunity for public comment).

RIDEM has created maps of environmental justice focus areas that overlap with those identified by CEJST. The maps, along with our environmental justice policy, guide our benefits analysis and our outreach to specific areas of the state. Because of Rhode Island's small size, we are intimately familiar with the areas that we consider environmental justice focus areas. In much of our planning, we work on a watershed scale and include adjacent neighborhoods as well. There are several state-designated watershed councils that are actively engaged in citizen science and advocacy within our EJ communities, and they are all organized under the umbrella of the Rhode Island Rivers Council which is a quasi-public body. In addition to these tools, we will utilize existing structures such as the Department of Health's Health Equity Zones and neighborhood associations to reach into the community. Ongoing 'Climate Justice Hours' will provide an avenue to share information and solicit feedback from low-income and disadvantaged community members. Direct stakeholder feedback was solicited through an online listening event in January. This outreach and coordination will continue past March 2024 when RIDEM turns its attention to the development of the CCAP.

In order to better communicate with the public and stakeholder groups about the PCAP, CCAP and related climate activities (e.g., the 2025 Climate Strategy due to be completed in late 2025), RIDEM anticipates utilizing contractual services to develop an online metric-based climate and emissions reduction dashboard. It will be developed as an easy to use/understand tool so residents of RI can track how fast RI is moving the needle on specific climate metrics (e.g., EV adoption, installation of EVSE, heat pump deployment, progress towards renewable energy standard goals, or MWs of renewable energy contracted for use in RI). This dashboard will be integrated into our https://climatechange.ri.gov/ website which hosts all of our meeting minutes, resources, and links to reports and policies.

Conclusion

This PCAP is the first major deliverable under the CPRG planning grant awarded to Rhode Island from the Environmental Protection Agency. RIDEM and its partners will continue planning, engagement, and action through the development of our 2025 Climate Action Strategy in compliance with the Act on Climate. The 2025 Climate Action Strategy will also form the basis of our comprehensive climate action plan for EPA's CPRG grant. These plans will establish equitable and sustainable economic development strategies that reduce emissions across all sectors. The CCAP and 2025 Climate Action Strategy will include near- and long-term emissions projections, a suite of emission reduction measures, a robust analysis of measure benefits, plans to leverage federal funding, and a workforce planning analysis. In 2027, RIDEM will publish a status report that details implementation progress for measures included in the PCAP and CCAP, any relevant updates to PCAP and CCAP analyses, and next steps and future budget and staffing needs to continue implementation of CCAP measures.

Appendix 1: LIDAC Area Analysis

GEOID	Municipality	County	RI EJ	CEJST DA	EJSCreen >=1 CB >=90% Fed	EJScreen >=1 Bl Grp >= 90% St	EJScreen >=1 Bl Grp >= 90% St or Fed
44001030500	Warren	Bristol	X	X	X	X	X
44003020200	West Warwick	Kent	X				
44003020300	West Warwick	Kent	X	X	X	X	X
44003020400	West Warwick	Kent		X	X	X	X
44005040200	Middletown	Newport	X	X			
44005040303	Middletown	Newport	X			X	X
44005040500	Newport	Newport	X	X	X	X	X
44005040600	Newport	Newport	X		X	X	X
44005041200	Newport	Newport	X			X	X
44007000101	Providence	Providence	X	X	X	X	X
44007000102	Providence	Providence	X	X	X	X	X
44007000200	Providence	Providence	X	X	X	X	X
44007000300	Providence	Providence	X	X	X	X	X
44007000400	Providence	Providence	X	X	X	X	X
44007000500	Providence	Providence	X	X	X	X	X
44007000600	Providence	Providence	X	X	X	X	X
44007000700	Providence	Providence	X	X	X	X	X
44007000800	Providence	Providence	X	X	X	X	X
44007000900	Providence	Providence	X	X	X		X
44007001000	Providence	Providence	X	X	X	X	X
44007001100	Providence	Providence	X	X	X	X	X
44007001200	Providence	Providence	X	X	X	X	X
44007001300	Providence	Providence	X	X	X	X	X
44007001400	Providence	Providence	X	X	X	X	X
44007001500	Providence	Providence	X		X	X	X
44007001600	Providence	Providence	X	X	X	X	X
44007001700	Providence	Providence	X	X	X	X	X
44007001800	Providence	Providence	X	X	X	X	X
44007001900	Providence	Providence	X	X	X	X	X

44007002000	Providence	Providence	X	X	X	X	X
44007002101	Providence	Providence	X				
44007002102	Providence	Providence	X		X	X	X
44007002200	Providence	Providence	X	X	X	X	X
44007002300	Providence	Providence	X		X	X	X
44007002400	Providence	Providence	X		X		X
44007002500	Providence	Providence	X		X	X	X
44007002600	Providence	Providence	X	X	X	X	X
44007002700	Providence	Providence	X	X	X	X	X
44007002800	Providence	Providence	X	X	X	X	X
44007002900	Providence	Providence	X	X	X	X	X
44007003100	Providence	Providence	X	X	X	X	X
44007003200	Providence	Providence	X				
44007003500	Providence	Providence	X		X	X	X
44007003601	Providence	Providence	X		X	X	X
44007003602	Providence	Providence	X				
44007003700	Providence	Providence	X			X	X
44007010200	East Providence	Providence	X		X	X	X
44007010300	East Providence	Providence	X	X	X	X	X
44007010400	East Providence	Providence	X	X	X	X	X
44007010501	East Providence	Providence	X		X	X	X
44007010502	East Providence	Providence	X		X	X	X
44007010800	Central Falls	Providence	X	X	X	X	X
44007010900	Central Falls	Providence	X	X	X	X	X
44007011000	Central Falls	Providence	X	X	X	X	X
44007011100	Central Falls	Providence	X	X	X	X	X
44007011800	North Providence	Providence	X		X	X	X
44007011901	North Providence	Providence	X				
44007012102	North Providence	Providence	X				
44007012103	North Providence	Providence	X				

44007012104	North Providence	Providence	X				
44007013500	Cranston	Providence	X		X	X	X
44007013600	Cranston	Providence	X				
44007013701	Cranston	Providence	X				
44007013702	Cranston	Providence	X				
44007014000	Cranston	Providence	X				
44007014100	Cranston	Providence	X	X	X	X	X
44007014200	Cranston	Providence	X			X	X
44007014700	Cranston	Providence	X	X	X	X	X
44007015000	Pawtucket	Providence	X				
44007015100	Pawtucket	Providence	X	X	X	X	X
44007015200	Pawtucket	Providence	X	X	X	X	X
44007015300	Pawtucket	Providence	X	X	X	X	X
44007015400	Pawtucket	Providence	X	X	X	X	X
44007015500	Pawtucket	Providence	X		X	X	X
44007015600	Pawtucket	Providence	X				
44007015900	Pawtucket	Providence	X		X	X	X
44007016000	Pawtucket	Providence	X	X	X	X	X
44007016100	Pawtucket	Providence	X	X	X	X	X
44007016300	Pawtucket	Providence	X		X		X
44007016400	Pawtucket	Providence	X	X	X	X	X
44007016600	Pawtucket	Providence	X	X			
44007016700	Pawtucket	Providence	X	X	X	X	X
44007016800	Pawtucket	Providence	X				
44007017000	Pawtucket	Providence	X		X	X	X
44007017100	Pawtucket	Providence	X	X	X	X	X
44007017300	Woonsocket	Providence	X		X	X	X
44007017400	Woonsocket	Providence	X	X	X	X	X
44007017500	Woonsocket	Providence	X				
44007017600	Woonsocket	Providence	X	X	X	X	X
44007017800	Woonsocket	Providence	X	X	X	X	X
44007017900	Woonsocket	Providence	X	X	X	X	X
44007018000	Woonsocket	Providence	X	X	X	X	X
44007018100	Woonsocket	Providence	X	X	X	X	X
44007018200	Woonsocket	Providence	X	X	X	X	X

44007018300	Woonsocket	Providence	X	X	X	X	X
44007018400	Woonsocket	Providence	X	X	X	X	X
44009050103	N. Kingston-Quonset	Washington		X		X	X
44009050801	Westerly	Washington		X	X	X	X
44009051400	Kingston-URI	Washington		X		X	X
			95	**61**	**75**	**78**	**81**

Appendix 2: Technical information

This technical appendix explains the methodology and assumptions used for developing the estimated greenhouse gas (GHG) emissions (and co-pollutant emissions) reduced for each measure included in the PCAP.

2-A Measure: Electrify Rhode Island

Emission Reductions Estimate Method:

The MOVES4 model was used to develop emission inventories for light-duty vehicles specific to the State of Rhode Island for calendar years 2025-2050s. Emission factors for NOx, VOC, and PM2.5 emissions in grams/MMBtu for light-duty vehicles (classes 1-2a and defined as vehicles up to 8500 pounds Gross Vehicle Weight Rating (GVWR). It was assumed that 200 level 2 chargers would be installed as part of this measure in Rhode Island. Information on frequency of charging sessions per charger, power dispensed per charger per day, and other information was obtained from Electrify America for light-duty vehicles. Cost information from the International Council on Clean Transportation, ICF, and other sources was obtained to estimate the number of chargers that could be purchased for a given level of funding. Based on cost estimates for Level 2 light-duty chargers, the cost for installing 200 charging ports was estimated to be $1,240,000. Total power dispensed from the chargers was calculated and this power was converted to light-duty emissions using the MOVES4 emission rates expressed in terms of grams/million Btu of energy consumption for classes 1-2a. Emissions were summed for the periods 2025-2030 and 2025-2050.

Models/Tools Used:

EPA's Motor Vehicle Emission Simulator (MOVES) version 4 was used to estimate Rhode Island-specific light-duty vehicle emissions between 2025 and 2050. Sonoma Technology developed an Excel spreadsheet that included the MOVES4 emission factors for light-duty vehicles, charging sessions per day per charger, power dispensed per charger per day, and costs of Level 2 chargers. Based on a literature review and the MOVES4 modeling, the Excel spreadsheet calculates the emission reductions from the installation of different types of the chargers in the State of Rhode Island.

Grid emissions rates provided by RI DEM and USDOE's GREET model were used to calculate upstream utility emissions associated with electric vehicle charging. For light-duty vehicles, average power demand from existing chargers as documented in Electrify America's most recent quarterly report to the

California Air Resources Board was used. The net benefit was calculated by combining avoided vehicle emissions (from MOVES emissions rates) and the grid emissions associated with charging.

Measure Implementation Assumptions:

The following key assumptions about measure implementation were used to quantify emissions reductions for this measure:

- We assumed that 200 Level 2 would be installed.
- We assume a six-year phase-in for chargers between 2025 and 2030.
- Level 2 chargers were assumed to cost $6,000.

Emission Reduction Estimate Assumptions:

The following key assumptions about emission reductions were used to quantify emission reductions for this measure:

- MOVES emission rates for for CO2e, NOx, PM2.5, and VOC were used for light-duty vehicles.

Reference Case Scenario:

Absent this measure the CO2 emissions shown in the table above would not be avoided.

Measure-Specific Activity Data and Implementation Tracking Metrics:

- Total power dispensed from the chargers was calculated and this power was converted to light-duty VMT. VMT was converted to emissions using the MOVES4 emission rates for class 1-2a vehicles.
- We assume that chargers installed as part of this program remain in place through 2050.

2-B Measure: Vehicle Electrification

Emission Reductions Estimate Method:

The MOVES4 model was used to develop emission inventories for light-duty vehicles specific to the State of Rhode Island for calendar years 2025-2050s. Based on an assumed funding level of $1 million for light-duty ZEV incentives, the number of ZEVs purchases that could be incentivized through the program were calculated. Annual ZEV VMT was calculated for the incentivized ZEV purchased. Based on the estimation of new ZEV VMT that would occur as a result of the ZEV incentives, ICE vehicle VMT was reduced in each calendar year between 2025 and 2050. Emissions reductions were estimated by applying estimated ICE VMT reductions to the MOVES4 emissions estimates for CO2, NOx, VOC, and PM2.5. Emissions reductions were summed for 2025 to 2030 and 2025 to 2050. Grid emissions associated with charging these additional ZEVs were estimated using calculated estimates of the electricity demand from these vehicles along with emissions rates provided by DOE's GREET model and RI DEM. The overall emissions reductions represent a net value reflecting both the reduction in tailpipe emissions and the increase in grid emissions.

Models/Tools Used:

EPA's Motor Vehicle Emission Simulator (MOVES) model version 4 was used for this analysis. Using emission factors for class 1-2a vehicles, Sonoma Technology developed a calculator for ZEV purchase incentives. The calculator estimates the ICE vehicle VMT that will be displaced as a result of the ZEV purchase incentives.

Measure Implementation Assumptions:
The following key assumptions about measure implementation were used to quantify emissions reductions for this measure:

- A per vehicle $1,500 incentive was assumed.
- In each calendar year between 2025 and 2030, 1/6th or 16.7% of vehicles incentived as part of the program are assumed to be introduced into the fleet. Between 2025 and 2030, 100% of the vehicles are introduced into the fleet. This equals a total of 666 light-duty ZEVs are introduced as a result of this measure.
- Assumes $1,000,000 spent on the program
- Vehicle lifetime is 15 years, measure lifetime is from 2025 to 2045.

Emission Reduction Estimate Assumptions:
The following key assumptions about emission reductions were used to quantify emission reductions for this measure:

- Estimated VMT growth over time for vehicles was provided by the State of Rhode Island.
- Annual VMT estimates for light-duty ICE vehicles were taken from the MOVES model.
- Tailpipe emissions for ZEVs is assumed to be zero and emission factors from MOVES were used for ICE vehicles.

Reference Case Scenario:
Absent this measure, GHG emissions will equal the amounts shown in the report table.
Measure-Specific Activity Data and Implementation Tracking Metrics:

- A 15-year lifespan is assumed for the introduced ZEVs. Vehicles introduced in 2025 are assumed to leave the fleet (be retired) in 2040. Vehicles introduced in 2026 are assumed to leave the fleet in 2041 and so on. By 2050, no ZEVs introduced as part of this program are still assumed to be on the road.

2-C Measure: Green the Fleet

The MOVES4 model was used to develop emission inventories for light-duty vehicles specific to the State of Rhode Island for calendar years 2025-2050s. Based on an assumed funding level of $1 million for municipal light-duty ZEV purchases and an assumed incremental cost of $10,000 per electric vehicle (relative to the purchase price of an internal combustion engine vehicle), the number of ZEVs that could be purchased with the $1 million in funding was calculated. Annual ZEV VMT was calculated for the ZEVs purchased. Based on the estimation of new ZEV VMT that would occur as a result of the municipal ZEV purchases, ICE vehicle VMT was reduced in each calendar year between 2025 and 2050. Emissions reductions were estimated by applying estimated ICE VMT reductions to the MOVES4 emissions estimates for CO_2, NO_x, VOC, and PM2.5. Emissions reductions were summed for 2025 to 2030 and 2025 to 2050. Grid emissions associated with charging these additional ZEVs were estimated using calculated estimates of the electricity demand from these vehicles along with emissions rates provided by DOE's GREET model and RI DEM. The overall emissions reductions represent a net value reflecting both the reduction in tailpipe emissions and the increase in grid emissions.

For electric vehicle chargers, an assumed cost for Level 2 chargers and Level 3, 150 kW chargers was estimated. The number of electric vehicles charged per day per charger was estimated. This electricity usage was converted into ICE emissions using MOVES emission rates.

Models/Tools Used:
EPA's Motor Vehicle Emission Simulator (MOVES) model version 4 was used for this analysis. Using emission factors for class 1-2a vehicles, Sonoma Technology developed a calculator for ZEV purchases. The calculator estimates the ICE vehicle VMT that will be displaced as a result of the ZEV purchases.

Information on frequency of charging sessions per charger, power dispensed per charger per day, and other information was obtained from Electrify America for light-duty vehicles. Cost information from the International Council on Clean Transportation, ICF, and other sources was obtained to estimate the number of chargers that could be purchased for a given level of funding. Based on cost estimates for Level 2 and Level 3, 150 kW light-duty chargers, the number of chargers that could be installed for $1 million dollars was estimated. Total power dispensed from the chargers was calculated and this power was converted to light-duty emissions using the MOVES4 emission rates expressed in terms of grams/million Btu of energy consumption for classes 1-2a. Emissions were summed for the periods 2025-2030 and 2025-2050. The GREET model was used to estimated well to pump emissions for ICE vehicles.

Measure Implementation Assumptions:
The following key assumptions about measure implementation were used to quantify emissions reductions for this measure:

- A per vehicle incremental cost of $10,000 incentive was assumed, and $1 million to fund EV purchases or a total of 100 municipal EVs.
- In each calendar year between 2025 and 2030, 1/6th or 16.7% of vehicles incentive as part of the program are assumed to be introduced into the fleet. Between 2025 and 2030, 100% of the vehicles are introduced into the fleet.
- It is assumed that $1 million is spent on the municipal EV chargers.
- 90% of EV chargers are Level 2 and 10% are Level 3, 150 kW.
- Vehicle lifetime is 15 years, measure lifetime is from 2025 to 2045.

Emission Reduction Estimate Assumptions:
The following key assumptions about emission reductions were used to quantify emission reductions for this measure:

- Estimated VMT growth over time for vehicles was provided by the State of Rhode Island.
- Annual VMT estimates for light-duty ICE vehicles were taken from the MOVES model.
- Tailpipe emissions for ZEVs is assumed to be zero and emission factors from MOVES were used for ICE vehicles. Upstream emissions for the vehicles were calculated using Rhode Island provided grid emission factors and the U.S. DOE GREET model.

Reference Case Scenario:
Absent this measure, GHG emissions will equal the amounts shown in the table above.
Measure-Specific Activity Data and Implementation Tracking Metrics:

- A 15-year lifespan is assumed for the introduced ZEVs. Vehicles introduced in 2025 are assumed to leave the fleet (be retired) in 2040. Vehicles introduced in 2026 are assumed to leave the fleet in 2041 and so on. By 2050, no ZEVs introduced as part of this program are still assumed to be on the road.

2-D Measure: Electrify Medium- and Heavy-Duty (MHD) Vehicles & Infrastructure

Emission Reductions Estimate Method:

The MOVES4 model was run for the State of Rhode Island to estimate per mile CO2e, NOx, VOC, and PM2.5 emissions in grams/MMBtu for medium- and heavy-duty vehicles (classes 1-8). Medium-duty vehicles are vehicles between 8500 and 26,000 pounds GVWR, and heavy-duty vehicles are those above 26,000 pounds GVWR.) Medium- and heavy-duty vehicle charger power demand was calculated using the nominal capacity of the chargers and assumed utilization rates of 30% for medium-duty vehicles, which typically operate locally, and 15% for heavy-duty vehicles based on the ICCT report "Total Cost of Ownership of Alternative Technologies for Class 8 Trucks," tco-alt-powertrain-long-haul-trucks-us-apr23.pdf (theicct.org). Cost information from the International Council on Clean Transportation, ICF, and other sources was obtained to estimate the number of chargers that could be purchased for a given level of funding. Based on cost estimates for medium-, and heavy-duty chargers, and an estimated mix of charger power levels, an estimated total number of chargers was developed for an assumed funding level. Total power dispensed from the chargers was calculated and this power was converted to medium-, and heavy-duty emissions using the MOVES4 emission rates for each class of vehicle. Emissions were summed for the periods 2025-2030 and 2025-2050.

Models/Tools Used:

EPA's Motor Vehicle Emission Simulator (MOVES) version 4 was used to estimate Rhode Island-specific medium-, and heavy-duty vehicle emissions between 2025 and 2050. Sonoma Technology developed an Excel spreadsheet that included the MOVES4 emission factors for each vehicle class, assumptions about charger power levels, charging sessions per day per charger, power dispensed per charger per day, and cost of different types of chargers. Based on a literature review and the MOVES4 modeling, the Excel spreadsheet calculates the emission reductions from the installation of different types of chargers in the State of Rhode Island.

Grid emissions rates provided by RI DEM and USDOE's GREET model were used to calculate upstream utility emissions associated with electric vehicle charging. The capacity of the chargers and assumed utilization rates of 30% (MDVs) and 15% (HDVs) were used to calculate average power demand and associated grid emissions. The net benefit was calculated by combining avoided vehicle emissions (from MOVES emissions rates) and the grid emissions associated with charging.

Measure Implementation Assumptions:

The following key assumptions about measure implementation were used to quantify emissions reductions for this measure:

- Based on a review of costs in the literature we are assuming installation of four 350 kW M/HD chargers.
- We assume a six-year phase-in for chargers between 2025 and 2030.
- Level 3 350 kW chargers were assumed to cost 210,000;
- 1 MW chargers were assumed to be installed at one location along I-95. The cost for each charger is assumed to be $381,000, based on ICCT studies. For the 1 MW charger, costs exclude electrical upgrades. Thus, only the cost of the charger port is assumed.

Emission Reduction Estimate Assumptions:
The following key assumptions about emission reductions were used to quantify emission reductions for this measure:

- MOVES emission rates for CO2e, NOx, PM2.5, and VOC were used for medium-, and heavy-duty vehicles.

Reference Case Scenario:
Absent this measure the CO2 emissions shown in the table above would not be avoided.

Measure-Specific Activity Data and Implementation Tracking Metrics:

- Total power dispensed from the chargers was calculated and this power was converted to medium-, and heavy-duty VMT. VMT was converted to emissions using the MOVES4 emission rates for each class of vehicle. We assume that chargers installed as part of this program remain in place through 2050.

Specific Measure Vehicle Incentives Information:

Emission Reductions Estimate Method:

- The MOVES4 model was used to develop emission inventories for medium-, and heavy-duty vehicles specific to the State of Rhode Island for calendar years 2025-2050s. Based on an assumed funding level for medium-, and heavy-duty ZEV incentives, the number of ZEVs purchases that could be incentivized through the program were calculated. Annual ZEV VMT was calculated for the different classes of incentivized ZEV purchased. Based on the estimation of new ZEV VMT that would occur as a result of the ZEV incentives, ICE vehicle VMT was reduced in each calendar year between 2025 and 2050. Emissions reductions were estimated by applying estimated ICE VMT reductions to the MOVES4 emissions estimates for CO2, NOx, VOC, and PM2.5. Emissions reductions were summed for 2025 to 2030 and 2025 to 2050. reductions are multiplied by the emissions for CO2e, NOx, VOC, and PM2.5 to arrive at total CO2e and co-pollutants reduced for the measure years. Grid emissions associated with charging these additional ZEVs were estimated using calculated estimates of the electricity demand from these vehicles along with emissions rates provided by DOE's GREET model and RI DEM. The overall emissions reductions represent a net value reflecting both the reduction in tailpipe emissions and the increase in grid emissions.

Models/Tools Used:
EPA's Motor Vehicle Emission Simulator (MOVES) model version 4 was used for this analysis. Using emission factors for class 1-8 vehicles, Sonoma Technology developed a calculator for ZEV purchase incentives. The calculator estimates the ICE vehicle VMT that will be displaced as a result of the ZEV purchase incentives.

Measure Implementation Assumptions:
The following key assumptions about measure implementation were used to quantify emissions reductions for this measure:

- Funding was assumed to be allocated in the following way: 67% for MDV, and 33% for HDV ZEV incentives.
- In each calendar year between 2025 and 2030, 1/6th or 16.7% of vehicles incentives as part of the program are assumed to be introduced into the fleet. Between 2025 and 2030, 100% of the vehicles are introduced into the fleet.

- MD ZEV incentives are assumed to average $138,750 for MD ZEVs and $174,349 for HD ZEVs.
- $1 million is spent on corridor highway 1 MW chargers $1 million on MHD ZEV incentives; and $1 million on MHD state-wide chargers, for a total of $3 million dollars.

Emission Reduction Estimate Assumptions:
The following key assumptions about emission reductions were used to quantify emission reductions for this measure:

- Estimated VMT growth over time for vehicles was provided by the State of Rhode Island.
- Annual VMT estimates for medium-, and heavy-duty ICE vehicles were taken from the MOVES model.
- Tailpipe emissions for ZEVs is assumed to be zero and emission factors from MOVES were used for ICE vehicles.

Reference Case Scenario:
Absent this measure, GHG emissions will equal the amounts shown in the table above.

Measure-Specific Activity Data and Implementation Tracking Metrics:

- A 15-year lifespan is assumed for the introduced ZEVs. Vehicles introduced in 2025 are assumed to leave the fleet (be retired) in 2040. Vehicles introduced in 2026 are assumed to leave the fleet in 2041 and so on. By 2050, no ZEVs introduced as part of this program are still assumed to be on the road.

2-E Measure: Incentivize the Adoption of Electric Lawn and Garden Equipment

Emission Reductions Estimate Method:
Emissions for nine types of gasoline powered nonroad lawn and garden equipment, including chain saws, lawn mowers, leaf blowers, weed trimmers, and other types was obtained from EPA's MOVES model. Emission factors were multiplied by activity (hours of use) for each type of equipment. Upstream emissions were estimated for well to pump emissions from gasoline equipment and for grid-related emissions for electricity use.

Models/Tools Used:
EPA's MOVES4 model was used to estimate emissions for the gasoline powered lawn and garden equipment. For upstream emissions, the DOE GREET model was used to estimate well to pump emissions for gasoline equipment. Grid-related emissions were estimated from Rhode Island-specific electric generating unit emission factors.

Measure Implementation Assumptions:
The following key assumptions about measure implementation were used to quantify emissions reductions for this measure:

- 1/6th of the 414 pieces of equipment are purchased each year between 2025 and 2030.
- By 2030, all 414 pieces of gasoline equipment have been replaced by the electric equipment.

- All 414 pieces of gasoline equipment are retired.
- The assumed capital cost is approximately $435,000. (Note: in addition, this measure was modeled on a per $1M investment for future reference).
- It is assumed that the electric equipment will have lower operating and maintenance costs than the gasoline equipment it replaces.

Emission Reduction Estimate Assumptions:
The following key assumptions about emission reductions were used to quantify emission reductions for this measure:

- Emission rates for the gasoline nonroad lawn and garden equipment vary from 671 grams of CO_2 per day per piece of equipment to 7,081 grams per day per piece of equipment, depending on the horsepower of the equipment and the equipment type.
- Rates are based on MOVES activity for commercial lawn and garden equipment.
- Rates assume equipment is operated between May and October of each year.

Reference Case Scenario:
Absent funding for this measure, the avoided emissions described above would be emitted in the reference scenario.

Measure-Specific Activity Data and Implementation Tracking Metrics:

- Number of pieces of electric equipment purchased.
- Number of gasoline equipment retired.
- Hours of use of electric equipment annually.
- Fuel saved from retirement of gasoline equipment.

Approximately 1,035 gallons of gasoline use will be reduced each month as a result of the measure and 12,420 gallons per year.

2-F Measure: RIPTA Bus Shelter Improvements

Emission Reductions Estimate Method:
The estimation method for this measure used a spreadsheet to perform calculations to estimate VMT reductions using data gathered from various sources.

Models/Tools Used:
The spreadsheet estimate of VMT reductions was developed by Cambridge Systematics, Inc. Emission rates (grams per mile) were applied to VMT reductions to estimate emission reductions. Emission rates were developed and applied by NESCAUM using the U.S. EPA MOVES4 model.

Measure Implementation Assumptions:
The following key assumptions about measure implementation were used to quantify emissions reductions for this measure:

- Bus stop improvements, including new shelters, implemented along Route 1 (Eddy/Hope/Benefit). This route services TF Green Airport, RI Hospital, and the new Pawtucket/Central Falls train station.

Emission Reduction Estimate Assumptions:
The following key assumptions about emission reductions were used to quantify emission reductions for this measure:

- Calendar Year ridership on this route was 721,000.
- A 3.5% increase in ridership is assumed as a result of the improvements, based on discussion with RIPTA staff and literature reviewed, for a total of 25,200 annual new riders.
- On average, 30 percent of new riders would have otherwise traveled by motorized vehicle. Transit Cooperative Research Program (TCRP) Report 237 found that about 5 to 30 percent of new fare-free transit trips made by people switching from other motorized modes. (M. Kirschen, *et al*, 2023, "Fare-Free Transit Evaluation Framework," TCRP Report 237, National Academies Press.) An analysis for the Georgetown Climate Center developed an estimate of 47 percent of new urban bus riders previously being taken by automobile, using data from various sources. (Cambridge Systematics, 2021, Transportation Investment Strategy Tool Documentation, Prepared for Georgetown Climate Center.) An estimate of 30 percent "prior drive mode share" for new bus transit riders is used in this study.
- The average trip length for a Rhode Island transit rider is 4.4 miles (National Transit Database, 2019, as analyzed by Cambridge Systematics).
- The average annual automobile VMT displaced is therefore 25,200 trips * 4.4 miles per trip * 30% auto mode share = 33,300 VMT reduced.

Reference Case Scenario:
Absent this measure, annual average automobile VMT would be 33,300 higher each year between 2025 and 2041. GHG and co-pollutant emissions would be increased by the amount shown above in the summary of emissions reduced.

Measure-Specific Activity Data and Implementation Tracking Metrics:

- Increase in route ridership after improvements.
- Share of pass holders who would have taken an automobile if they did not ride transit for the trips taken.

2-G Measure: Incentivizing Mode Shift via Transit Fare Subsidies

Emission Reductions Estimate Method:
The estimation method for this measure used a spreadsheet to perform calculations to estimate VMT reductions using data gathered from various sources.

Models/Tools Used:
The spreadsheet estimate of VMT reductions was developed by Cambridge Systematics, Inc. Emission rates (grams per mile) were applied to VMT reductions to estimate emission reductions. Emission rates were developed and applied by NESCAUM using the U.S. EPA MOVES4 model.

Measure Implementation Assumptions:
The following key assumptions about measure implementation were used to quantify emissions reductions for this measure:

- $600,000 in subsidies is provided for free transit passes or fares for commuters using three programs: (Wave to Work), low-income persons enrolled in partner programs (Low Income Partnership), and residents of partner developments (Residential Partnership).
- These subsidies are provided beginning in 2025 and continue through 2029.
- Between 2025 and 2029, a total amount of $200,000 is provided to Wave to Work riders. Each year from 2025 to 2029, 1/5th of the funds or $40,000 in subsidies are provided to riders.
- Between 2025 and 2029, a total of $200,000 is provided to Low Income Partnership riders. Each year from 2025 to 2029, 1/5th of the funds or $40,000 in subsidies are provided to riders.
- Between 2025 and 2029, a total of $200,000 is provided to Residential Partnership riders. Each year from 2025 to 2029, 1/5th of the funds or $40,000 in subsidies are provided to riders.

Emission Reduction Estimate Assumptions:
The following key assumptions about emission reductions were used to quantify emission reductions for this measure:

- Subsidized fares/passes result in new transit riders. With an average RIPTA fare of $2.00 per trip, a total of 60,000 new trips are taken annually as a result of the expanded subsidy.
- On average, 30 percent of new riders would have otherwise traveled by motorized vehicle. Transit Cooperative Research Program (TCRP) Report 237 found that about 5 to 30 percent of new fare-free transit trips made by people switching from other motorized modes. (M. Kirschen, *et al*, 2023, "Fare-Free Transit Evaluation Framework," TCRP Report 237, National Academies Press.) An analysis for the Georgetown Climate Center developed an estimate of 47 percent of new urban bus riders previously being taken by automobile, using data from various sources. (Cambridge Systematics, 2021, Transportation Investment Strategy Tool Documentation, Prepared for Georgetown Climate Center.) An estimate of 30 percent "prior drive mode share" for bus transit riders is used in this study.
- The average trip length for a Rhode Island transit rider is 4.4 miles (National Transit Database, 2019, as analyzed by Cambridge Systematics).
- The average annual automobile VMT displaced is therefore 60,000 trips * 4.4 miles per trip * 30% auto mode share = 79,200 VMT reduced.

Reference Case Scenario:
Absent this measure, annual average automobile VMT would be 79,200 higher each year between 2025 and 2041. GHG and co-pollutant emissions would be increased by the amount shown above in the summary of emissions reduced.

Measure-Specific Activity Data and Implementation Tracking Metrics:

- Number of passes provided.
- Number of transit trips taken annually by new pass holders.
- Share of pass holders who would have taken an automobile if they did not ride transit for the trips taken.

2-H Measure: Incentivizing Micro-transit Service: Fund Pilot Projects for Local Shared Mobility Van Service

Emission Reductions Estimate Method:
The estimation method for this measure used a spreadsheet to perform calculations to estimate VMT reductions using data gathered from various sources.

Models/Tools Used:
The spreadsheet estimate of VMT reductions was developed by Cambridge Systematics, Inc. Emission rates (grams per mile) were applied to VMT reductions to estimate emission reductions. Emission rates were developed and applied by NESCAUM using the U.S. EPA MOVES4 model.

Measure Implementation Assumptions:
The following key assumptions about measure implementation were used to quantify emissions reductions for this measure:

- Provision of new van shuttle service using electric vans running on a 5-mile continuous loop. Assume 4 vans are needed to cover the 5-mile loop.
- The service is provided beginning in 2025 and continuing through 2041.

Emission Reduction Estimate Assumptions:
The following key assumptions about emission reductions were used to quantify emission reductions for this measure:

- Annual ridership is similar to the "Little Roady" microtransit service that was piloted with an electric autonomous vehicle between May 2019 and June 2020. This service operated along a 5.3-mile, 12-stop loop serving downtown Providence, the Amtrak Station, and nearby neighborhoods. Average ridership pre-COVID was about 3,840 per month (Marini, et al, Rhode TRIP: Lessons for the future of mobility from the Little Roady autonomous microtransit pilot. Rhode Island Department of Transprtation, RIDOT-RTD-SPR-235-2279, 2022.) This equates to 46,000 riders per year.
- Average trip length is 2.5 miles or ½ the route distance (Marina, et al found an average trip length of 2.8 miles for Little Roady riders).
- The new service operates an average vehicle-miles of 10,600 per month similar to Little Roady (Marina et al, 2022) or 127,000 VMT per year.
- On average, 30 percent of new riders would have otherwise traveled by motorized vehicle. Transit Cooperative Research Program (TCRP) Report 237 found that about 5 to 30 percent of new fare-free transit trips made by people switching from other motorized modes. (M. Kirschen, *et al*, 2023, "Fare-Free Transit Evaluation Framework," TCRP Report 237, National Academies Press.) An analysis for the Georgetown Climate Center developed an estimate of 47 percent of new urban bus riders previously being taken by automobile, using data from various sources. (Cambridge Systematics, 2021, Transportation Investment Strategy Tool Documentation, Prepared for Georgetown Climate Center.) An estimate of 30 percent "prior drive mode share" for van shuttle riders is used in this study.
- The average annual automobile VMT displaced is therefore 46,000 trips * 2.5 miles per trip * 30% auto mode share = 34,500 VMT reduced.

Reference Case Scenario:
Absent this measure, annual average automobile VMT would be 34,500 higher each year between 2025 and 2041. GHG and co-pollutant emissions would be increased by the amount shown above in the summary of emissions reduced.

Measure-Specific Activity Data and Implementation Tracking Metrics:

- Ridership on new service.
- Share of riders who would have taken an automobile if they did not ride transit for the trips taken.

2-I Measure: Supporting 'Rhody Express' Train Service Between Providence Station, TF Green Airport and Wickford Junction

Emission Reductions Estimate Method:
The estimation method for this measure used a spreadsheet to perform calculations to estimate VMT reductions using data gathered from various sources.

Models/Tools Used:
The spreadsheet estimate of VMT reductions was developed by Cambridge Systematics, Inc. Emission rates (grams per mile) were applied to VMT reductions to estimate emission reductions. Emission rates were developed and applied by NESCAUM using the U.S. EPA MOVES4 model.

Measure Implementation Assumptions:
The following key assumptions about measure implementation were used to quantify emissions reductions for this measure:

- Up to $4.5 million provided to subsidize fares on the "Rhody Express" MBTA commuter rail service extending from Providence, RI to T.F Green International Airport and Wickford Junction.
- These subsidies are provided beginning in 2025 and continuing through 2041.

Emission Reduction Estimate Assumptions:
The following key assumptions about emission reductions were used to quantify emission reductions for this measure:

- Baseline ridership is 221 daily riders, or 66,300 annual riders using an annualization factor of 300. Source of daily ridership: RIDOT Memorandum using the "mid" estimate assuming a 5% mode share for trips in the service area market.
- Baseline fare per trip is $3.50.
- Funding is sufficient to completely subsidize the fare (i.e., free fare).
- Elasticity of ridership with respect to change in fare cost is approximately –0.20 for commuter rail systems (Transit Cooperative Research Program Report 95, Chapter 12: "Transit Pricing and Fares", 2004).
- Change in annual new ridership is 66,300 * -100% * -0.20 = 13,300 new riders. (Note – with a total ridership of 79,600 this implies a total annual subsidy of $280,000 assuming all riders' fares are subsidized, which could maintain the subsidy for 16 years.)

- On average, 75 percent of new riders would have otherwise traveled by motorized vehicle. An analysis for the Georgetown Climate Center developed an estimate of 47 percent of new commuter rail riders previously being taken by automobile, using data from various sources. (Cambridge Systematics, 2021, Transportation Investment Strategy Tool Documentation, Prepared for Georgetown Climate Center.)
- Average displaced automobile trip length of riders is 13.1 miles. This is based on an average of driving distances measured using Google maps between the station origins (TF Green, Wickford Junct.) and destinations (Downtown/East Side) weighted based on ridership from McMahon memo.
- The average annual automobile VMT displaced is therefore 66,300 trips * 13.1 miles per trip * 75% auto mode share = 130,000 VMT reduced.

Reference Case Scenario:
Absent this measure, annual average automobile VMT would be 130,000 higher each year between 2025 and 2041. GHG and co-pollutant emissions would be increased by the amount shown above in the summary of emissions reduced.

Measure-Specific Activity Data and Implementation Tracking Metrics:
- Number of subsidized fares provided.
- Change in rail ridership before and after fare subsidy.
- Share of riders who would have taken an automobile if they did not ride transit for the trips taken.

2-J Measure: Increase Residential and Commercial Heat Pump Adoption

Models/Tools Used:
The emissions impacts of this measure were quantified with a Microsoft Excel spreadsheet developed to support the preparation of Rhode Island's PCAP. The Stockholm Environment Institute built the spreadsheet, and version 2 of the file was used to generate the emission projections reported here.
In outline, the spreadsheet calculates emissions impacts as follows.

- Based on user-provided inputs, the amount of additional funding proposed for Clean Heat RI (e.g., $1,000,000) is distributed over program implementation years and various types of projects covered by the program. Project types are segmented by the following characteristics:
    - Sector – residential or commercial
    - Energy end use – space heating or water heating
    - Construction status – retrofit or new construction (all new construction projects are residential; commercial new construction is not covered by Clean Heat RI)
    - Technology deployed – different types of heat pumps for space and water heating
    - Income eligibility – indicates whether residential households qualify for low-income incentives under Clean Heat RI; based on whether households are eligible for Supplemental Nutrition Assistance Program (SNAP) benefits
    - Space heating fuel displaced – fuel oil, propane, or natural gas
    - Disposition of original space heating system (retrofits only) – retained or retired
    - Electrical service upgrade (residential projects only) – included or not

- Amounts of funding by year and type of project are translated into numbers of projects. For the most part, this involves dividing the amount of funding for a year and type of project by the corresponding incentive amount under the Clean Heat RI program. However, a different approach is required for income-eligible residential retrofits, as the program meets 100% of the installation cost of heat pumps in this case (excluding electrical service upgrades, for which a separate incentive is capped at $7,500). For these projects, the annual funding amounts are divided by estimated heat pump installation costs taken from a recent report prepared for New York State, plus the electrical service upgrade incentive if applicable. Each residential project represents an upgrade of the space or water heating system in a residential dwelling unit; each commercial project represents an upgrade of the space heating system or one water heater in a commercial building.

- The annual energy impacts of each project are calculated.
    - The impacts are determined in comparison to a baseline that was elaborated with baseline data from the National Renewable Energy Laboratory's ResStock and ComStock tools. These data describe energy consumption in existing residential (ResStock) and commercial (ComStock) buildings in Rhode Island, and they were used to establish the consumption of typical, non-upgraded buildings for each type of Clean Heat RI project. For new construction, the baseline is predicated on energy use in buildings constructed since 2000 (i.e., the spreadsheet assumes that by default, new dwelling units have the same energy use characteristics as recently built dwelling units).
    - Except for commercial water heating, changes in energy use after installing heat pump space or water heating equipment are based on simulations of these upgrades in ResStock and ComStock. The simulations capture changes in energy demand for space heating, space cooling, and water heating, taking into account equipment use patterns, load status, ambient temperatures, and other factors.
    - Because no appropriate upgrade simulation was available in ComStock for water heating, the energy impacts of commercial water heating projects are computed using baseline energy demand for water heating, average performance characteristics of currently installed commercial water heaters, and performance requirements for heat pump water heaters (HPWH) from the Clean Heat RI program. The method assumes each new HPWH provides the same useful energy output as the legacy water heater it replaces, but at a different efficiency and relying on heat pump technology.

Annual energy impacts are figured separately for electricity, fuel oil, propane, and natural gas, and they are then summed by type of project.

- The energy impacts of each type of project are converted into emissions impacts by multiplying changes in energy consumption by appropriate emission factors. The emission factors for fuel oil, propane, and natural gas are taken from US Government sources, while the factors for electricity consumption come from a previous analysis conducted for Rhode Island. The spreadsheet includes factors and calculates emissions for carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), nitrogen oxides (NO_x), particulate matter < 2.5 micrometers in diameter ($PM_{2.5}$), volatile organic compounds (VOC), sulfur dioxide (SO_2), and carbon monoxide (CO). It also reports carbon dioxide equivalent emissions of CO_2, CH_4, and N2O using global warming potentials from the Intergovernmental Panel on Climate Change's *Fourth Assessment Report*.

Measure Implementation Assumptions:
The following key assumptions about measure implementation were used to quantify emissions reductions for this measure:

- Buildings upgraded through Clean Heat RI would not have upgraded without the program. Once upgraded space or water heating equipment is installed in a building, the building's owner replaces it with similar equipment at the end of the equipment's lifetime.
- Additional funding for the Clean Heat RI program: $1,000,000
- Starting year for implementation and use of the additional program funding: 2025
- Ending year for implementation and use of the additional program funding: 2028
- Share of program funding used for residential projects: 95%
- Share of residential funding used for space heating upgrades: 90%
- Share of residential space heating upgrades that require an electrical service upgrade: 30%
- Share of residential space heating upgrades in new construction: 7%
- Share of residential space heating retrofits in income-eligible dwellings: 40%
- Share of residential space heating retrofits in which the original heating system is retained as a back-up system: 65%
- Share of residential funding used for water heating upgrades: 10%
- Share of residential water heating upgrades that require an electrical service upgrade: 0%
- Share of residential water heating upgrades in income-eligible dwellings: 40%
- Share of program funding used for commercial projects: 5%
- Share of commercial funding used for space heating upgrades: 90%
- Share of commercial air source heat pump (ASHP) retrofits in which the original heating system is retained as a back-up system: 65%
- Share of commercial funding used for water heating upgrades: 10%
- Clean Heat RI program incentive amounts
  - Residential new construction space heating upgrade, ASHP: $750/ton cooling capacity
  - Residential non-income-eligible retrofit space heating upgrade, ASHP: $1,000/ton cooling capacity
  - Residential non-income-eligible retrofit water heating upgrade, HPWH: $750/dwelling unit
  - Residential income-eligible electrical service upgrade: $7,500/dwelling unit
  - Residential non-income-eligible electrical service upgrade: $500/dwelling unit
  - Commercial retrofit space heating upgrade, ASHP: $2,500/ton cooling capacity
  - Commercial retrofit space heating upgrade, variable refrigerant flow heat pump: $3,500/ton cooling capacity
  - Commercial retrofit water heating upgrade, HPWH with capacity ≤ 80 gallons: $1,000/building
  - Commercial retrofit water heating upgrade, HPWH with capacity > 80 gallons and ≤ 120 gallons: $2,200/building
- Installation costs for income-eligible residential retrofits
  - Space heating upgrade, ASHP in a single-family building: $16,930/dwelling unit

- Space heating upgrade, ASHP in a 2-19-unit multifamily building: $14,981/dwelling unit
- Space heating upgrade, ASHP in a 20+ unit multifamily building: $24,831/dwelling unit
- Water heating upgrade, HPWH in a single-family building: $2,514/dwelling unit
- Water heating upgrade, HPWH in a multifamily building: $2,360/dwelling unit

- Only costs incurred by the Clean Heat RI program are considered in the cost analysis. These consist of incentives paid for space and water heating upgrades (and associated electrical service upgrades), including total heat pump installation costs for income-eligible residential retrofits and predefined incentive amounts in other cases. The cost analysis does not include other costs borne by building owners, such as capital costs not covered by Clean Heat RI and operation, maintenance, and input fuel costs for space and water heating equipment.
- The measure implementation assumptions listed in this section were derived from data from the Clean Heat RI program and the sources footnoted above.

Emission Reduction Estimate Assumptions:
The following key assumptions about emission reductions were used to quantify emission reductions for this measure:

- Emission factors (g/kWh of energy consumed)
  - Fuel oil
    - NOx: 0.201
    - PM2.5: 0.0238
    - CH4: 0.0199
    - N2O: 0.0006
    - CO2: 253.1719
    - VOC: 0.0078
    - SO2: 0.0511
    - CO: 0.0558
  - Natural gas
    - NOx: 0.1412
    - PM2.5: 0.0114
    - CH4: 0.0035
    - N2O: 0.0033
    - CO2: 180.7073
    - VOC: 0.0083
    - SO2: 0.0009
    - CO: 0.0601
  - Propane
    - NOx: 0.239
    - PM2.5: 0.0167
    - CH4: 0.0037
    - N2O: 0.002
    - CO2: 214.7248
    - VOC: 0.0084
    - SO2: 0
    - CO: 0.1379

- Electricity: Consistent with Rhode Island policy, emission factors for electricity are assumed to decrease to 0 in 2035. Factors for 2025 are shown below.
    - NOx: 0.1565
    - PM2.5: 0.0208
    - CH4: 0.0061
    - N2O: 0.0008
    - CO2: 331.9469
    - VOC: 0.0587
    - SO2: 0.005
- Global warming potentials
  - CO2: 1
  - CH4: 25
  - N2O: 298
- The emission reduction estimate assumptions listed in this section were derived from the sources footnoted above.

Reference Case Scenario:
As discussed earlier, the analysis of this measure assumes a baseline where the upgrade projects enabled by Clean Heat RI's additional funding do not take place. Existing buildings that would have been upgraded continue to use their current space conditioning and water heating systems, and new residential buildings that would have been upgraded are constructed with the same types of systems found in residential buildings added since 2000. When space conditioning and water heating systems wear out in these buildings, they are replaced with the same technologies. The state's electricity supply becomes emission-free by 2035 as planned, and this affects emissions associated with electricity consumption. However, there are no changes in the patterns of electricity consumption in buildings that would have been upgraded due to the underlying technological stability.

Measure-Specific Activity Data and Implementation Tracking Metrics:
The primary activity data used in the analysis of this measure are the numbers of space and water heating upgrade projects of different types that are funded by Clean Heat RI. As explained above, these are based on the analysis spreadsheet's input assumptions, and they translate directly into changes in energy demand and emissions.

2-K Measure: Retrofit State Buildings with Heat Pumps and Efficiency Measures

Emission Reductions Estimate Method:
In order to understand the expected energy demand of RI homes and offices on an annual basis, we downloaded physics-based simulation results from the National Renewable Energy Laboratory's ResStock and ComStock databases. These datasets are built on public and private data sources and use statistical sampling and sub-hourly building simulations to estimate cooling and heating electricity and fuel demand for different types of structures in the lower 48 states (over 20 million simulations nationwide). ComStock documentation is available at this link. ResStock documentation is available at this link.

For the single-family home component, we aggregated all of the simulations (202) for RI single-family detached homes, with wood-frame construction dating to 1979 or earlier, that meet specified selection criteria --- that the baseline house has a ducted HVAC system with a natural-gas combustion furnace, and a natural-gas water heater. This residential building typology corresponds to the representative group home located at 50 Cedar Ave. The NREL ResStock 2022 TMY3 release 1.1 was used, which assumes a typical meteorological year and provides results for a baseline case and several upgrades. We examined Upgrades 3, 4, and 6. Upgrades 3 and 4 use air-source heat pumps for heating and cooling. Upgrade 4 considers high-efficiency heat pumps, which might require a cost premium, though what is considered “high efficiency” in the current ResStock analysis may well be the industry standard in a year or two (heat pumps have improved dramatically in the past decade and continue to improve). Upgrade six considers heat-pump water heaters. The relative standard deviations of the baseline simulation results in this sample of 202 buildings were 53% for electricity usage and 39% for natural gas usage.

For the larger group-home facility (Trudeau Center), we used a ComStock building typology consisting of outpatient facilities of greater than 25,000 sq. ft., that use packaged single-zone rooftop units for natural gas heating and electricity cooling. In the ComStock 2023 release 2 database (which uses the 2018 actual meteorological year), there were only 2 RI buildings of this type simulated. To provide greater confidence in the results, we aggregated additional buildings of this type in CT and MA, for a total of 9 buildings, still a small sample. To help further our understanding of the potential variation among buildings, we also examined an office building typology of greater than 25,000 sq. ft. This selection resulted in a total of 45 buildings in RI, CT, and MA. The difference in emissions reductions between the outpatient and office typologies is small, despite a significant difference in the cooling loads for these typologies. Nonetheless, we note that the relative standard deviations of the simulation results in this sample of 45 buildings were 30% for electricity usage and 47% for natural gas usage. We therefore analyzed both the mean and variance of electricity and natural gas uses.

For the DOA building, we used the office-building typology sample mentioned above. All of the office (and outpatient) buildings simulated use packaged single-zone rooftop units for natural gas heating and electricity cooling, and natural-gas water heaters. The NREL ComStock 2023 release provides results for a baseline case and several upgrades. We examined Upgrade 1, which replaces existing natural-gas heating coil rooftop units with air-source heat-pump rooftop units. In addition, we checked average results for a different baseline case (>250,000 sq. ft. buildings) for the entire climate zone 5A, as available on NREL’s public Tableau portal. This larger sample is comprised of 250 buildings and gave similar results to those from our smaller sample.

The small additional reductions in emissions that would be expected with heat-pump water heaters were not directly accessible in a single upgrade scenario. However, Upgrade 17 includes the combined effects of heat pump HVAC, heat pump water heaters, and LED lighting. Those results can be compared to Upgrade 10, which includes only LED lighting. The differences in energy consumption between Upgrade 17 and Upgrade 10 represent the reductions due to the combined effects of heat-pump HVAC and heat-pump water heaters, which is the measure of interest. In this case, an “inferred upgrade” can be estimated as the baseline case plus the differential of these two upgrade cases.

Models/Tools Used:

The NREL ComStock extracts described above were used to estimate the energy intensities (kWh per sq. ft.) for the building typologies. Custom Matlab / Octave functions were coded to perform the required aggregations and compute the energy-intensity statistics. Note that we reached out to NREL researchers with questions, and they reported that the natural-gas usage found in the ComStock simulations runs about 30% lower than the values observed in their calibration studies.[1] Quoting directly from their documentation:

The baseline ComStock model currently underestimates natural gas consumption by around 30% for the modeled buildings, as shown in Figure 193 of the technical report on calibration of ComStock [5]. The source of this error is unknown but may be attributable to some combination of underestimation of heating load, overestimation of primary combustion equipment efficiencies, or misrepresentation of inefficiencies in controlling or maintaining HVAC systems.

If the simulated natural gas annual usage is manually adjusted upwards by 30%, the value is closer to the observed natural gas usage in the years 2022 and 2023 for the DOA building. With this adjustment, both electricity and natural gas usage lie within about three-quarters of a standard deviation from the average simulation results. The relative standard deviations of the simulation results in this sample of 45 buildings were 30% for electricity usage and 47% for natural gas usage; the observed electricity and natural gas usage were within about 22% and 29% of the averaged simulations. No utility data were provided for the Trudeau Center or 50 Cedar Ave., so we cannot assess how our model results compare to those buildings' actual usage.

Measure Implementation Assumptions:
The following key assumptions about measure implementation were used to quantify emissions reductions for this measure:

1. Implementation: The state of RI will implement all of the measures described.
2. Grid emissions reductions: Our calculated emissions reductions are the result of two factors: 1) heat pumps are more efficient than combustion heating, even when accounting for current emissions from electricity generation and 2) the electricity grid in RI is, by law, required to reach zero emissions by 2033, so electric driven heat will allow increased energy and emissions savings as time goes on. In the calculations performed here, we are assuming that the emissions associated with electricity production will decline in the manner described by the emissions trajectory provided by the state (2023 ICCT/NESCAUM ACC II analysis).
3. Capital Costs: Cost estimates were not based on detailed examination of the buildings. They are based on literature surveys by the Rosen Consulting Group (RCG) done for New York State, on publicly available case studies from Buro Happold and Ecosystem Energy, and on the RMI assessment of single-family home retrofit costs in Providence, RI.[2] These costs are roughly in line with the known costs of a specific residential air-source heat pump conversion in Providence in 2014, adjusted for inflation. Where cost ranges are given, our estimates are the midpoints of the ranges given by the cited studies.
4. For the office building and outpatient facility typologies, we are relying on the RCG report, which references a study by the New York State Energy Research and Development Authority (NYSERDA, 2021). The retrofit costs are taken as the midpoint of the range they found, $11.50 per square foot. The incremental costs vs. a replacement natural gas HVAC system are estimated in this report at 7%, similar to the Buro Happold estimate of $0.92 per square foot, which is the estimate we have adopted. Note that we do not consider shell upgrades in this analysis. If shell upgrades are included, they would dominate the capital cost (increasing it to close to $9 per square foot incremental and $25 per square foot total, according to the RCG estimates).
5. The likelihood of needing electrical service upgrades in implementing these measures is estimated by considering the change in peak electricity demand. Based on the utility data provided, the electricity peak demand at 1 Capitol Hill was at most 344 kW during 2022 and 2023 (and occurred during summer cooling). The simulated peak demand increased about

22% in Upgrade 17 compared to Upgrade 10 and occurs during heating season. Without knowing what the existing electrical system entails, it's not possible to judge whether the heat-pump upgrade will trigger an electrical upgrade. If it does, the RCG report estimates $0.1 - $0.4 per square foot, or up to $100,000 for this building.

6. The situation is similar for Trudeau Center. The heat-pump upgrade causes an increase in peak electrical demand of about 77%. The estimated electrical upgrade cost is up to $13,000. Note that the asset inventory provided by RI lists the existing electrical switchgear in this building as having a remaining life expectancy of 7 years and a replacement cost of close to $200,000. If the heat-pump conversion is done at the same time that the electrical equipment is replaced, the upgrade potentially could be accomplished at little or no incremental cost.
7. From the typology simulations relevant for 50 Cedar Ave., the peak electricity demand is estimated to increase by about 51%. Again, electrical upgrades could be required, depending on the existing service capacity. For residential upgrades, on a per square foot basis, the published estimates range as high as $1 - $2 per square foot ($2,500 - $5,000 for a 2,500 square foot home). We estimate that the residential electrical upgrades would cost $0.80 per square foot, or about $25,000 for this component of the measure.
8. Operation and maintenance cost assumptions: none provided.

Emission Reduction Estimate Assumptions:
The following key assumptions about emission reductions were used to quantify emission reductions for this measure:

1. The emissions associated with natural gas combustion are taken from EPA's AP-42, Fifth Edition, Volume I, as found at this link. The electricity emissions factors are the Rhode Island grid emissions factors from the 2023 ICCT/NESCAUM ACC II analysis.
2. The ComStock and ResStock extracts are assumed to be representative of the building typologies that are the subject of this measure, in the sense explained in more detail below.

Reference Case Scenario:
For the DOA building, the reference case scenario is described by the actual usage data and compared to the baseline case of the ComStock simulations, representing continued use of natural gas combustion for space and water heating. However, for the simulations, we incorporate a 30% increase in natural gas consumption, consistent with the NREL observations referenced above. The annual usage data are shown in the following table:

DOA annual usage	ComStock	Adjusted ComStock	Actual
Total electricity (MWh)	2,920 ± 885	2,920 ± 885	2,292
Total natural gas (MWh)	1,254 ± 593	1,631 ± 771	2,110
Total MWh	4,174 ± 870	4,550 ± 941	4,402

The "adjusted ComStock" column can be used as a more realistic comparison with the observed consumption. The observed values lie within about 3/4 of a standard deviation from the adjusted ComStock values. Accordingly, we consider the adjusted ComStock results a roughly correct guide to how the observed consumption would be expected to change under the assumed upgrade. Specifically, the averaged percentage reductions in CO_2e and co-pollutants from the simulations are applied to the emissions expected from the actual consumption of electricity and natural gas observed (average of 2022 and 2023 data).

For the other buildings, the reference case scenario is described by the baseline case of the ResStock and ComStock simulations, representing continued use of natural gas combustion for space and water heating. No comparisons with actual energy usage were possible, since no data were provided for these buildings. As above, the projected greenhouse gas reductions in the NREL simulations are likely a lower bound and the reductions achieved in practice may be greater than estimated here.

Measure-Specific Activity Data and Implementation Tracking Metrics:
The validity of the underlying simulations used to estimate emission reductions is judged in comparison to the actual usage data (utility bills) for the building in its existing (baseline) condition. The number of building simulations used is much lower than recommended. Even so, the actual usage data are not too far off from the simulations (about half of a standard deviation).
We consider the actual natural gas usage (where available) the better estimate of the potential for emissions reductions from reductions in natural gas usage.

2-L Measure: Municipal Renewable Energy, Efficiency, and Electrification

Emission Reductions Estimate Method for Air Source Heat Pumps:
For this GHG reduction measure we calculated emissions benefits for each million dollars spent. We assumed, based on an existing contract with a company that provides municipal technical support on GHG mitigation, that $60,000 would be provided to each municipality for technical assistance. We assumed each municipality would receive $440,000 in funding for GHG reduction projects. We evaluated three approaches: the installation of solar panels, the installation of electric vehicle chargers, and the conversion of buildings from fossil fuel HVAC and hot water heating to heat pumps. We assumed the $440,000 is divided evenly between the three GHG reduction measures for the purposes of modeling emissions reductions.

To estimate the GHG reductions that result from the replacement of fossil fuel HVAC and hot water heating equipment with air source heat pumps, we used downloaded physics-based simulation results from the National Renewable Energy Laboratories' ComStock database. These datasets are built on public and private data sources and use statistical sampling and sub-hourly building simulations to estimate cooling and heating electricity and fuel demand for different types of structures in the lower 48 states (over 20 million simulations nationwide).

For air source heat pumps for space and water heating, we used a ComStock building typology consisting of outpatient facilities of greater than 25,000 sq. ft, that use packaged single-zone rooftop units for natural gas heating and electricity cooling. In the ComStock 2023 release 2 database (which uses the 2018 actual meteorological year), there were only 2 RI buildings of this type simulated. To provide greater confidence in the results, we aggregated additional buildings of this type in CT and MA, for a total of 13 buildings, still a small sample. For comparison, we also examined an office building typology of greater than 25,000 sq. ft., with a total of 69 buildings in RI, CT, and MA. The difference in emissions reduction between the outpatient and office typologies is small, despite a significant difference in the cooling loads for these typologies.

The NREL ResStock and ComStock extracts described above were used to estimate the energy intensities (kWh per sq. ft.) for the 2 building typologies. Custom Matlab / Octave functions were coded to perform the required aggregations and compute the energy-intensity statistics.

The emissions associated with natural gas combustion are taken from EPA's AP-42, Fifth Edition, Volume I, as found at this link. The electricity emissions factors are the Rhode Island grid emissions factors from the 2023 ICCT/NESCAUM ACC II analysis.

Emission Reductions Estimate Method for Electric Vehicle Chargers:
The MOVES4 model was used to develop emission inventories for light-duty vehicles specific to the State of Rhode Island for calendar years 2025-2050s. Emission factors for NOx, VOC, and PM2.5 emissions in grams/MMBtu for light-duty vehicles (classes 1-2a and defined as vehicles up to 8500 pounds Gross Vehicle Weight Rating (GVWR). It was assumed that 200 level 2 chargers would be installed as part of this measure in Rhode Island. Information on frequency of charging sessions per charger, power dispensed per charger per day, and other information was obtained from Electrify America for light-duty vehicles. Cost information from the International Council on Clean Transportation, ICF, and other sources was obtained to estimate the number of chargers that could be purchased for a given level of funding. Based on cost estimates for Level 2 light-duty chargers, the cost for installing 200 charging ports was estimated to be $1,240,000. Total power dispensed from the chargers was calculated and this power was converted to light-duty emissions using the MOVES4 emission rates expressed in terms of grams/million Btu of energy consumption for classes 1-2a. Emissions were summed for the periods 2025-2030 and 2025-2050.

EPA's Motor Vehicle Emission Simulator (MOVES) version 4 was used to estimate Rhode Island-specific light-duty vehicle emissions between 2025 and 2050. Sonoma Technology developed an Excel spreadsheet that included the MOVES4 emission factors for light-duty vehicles, charging sessions per day per charger, power dispensed per charger per day, and costs of Level 2 chargers. Based on a literature review and the MOVES4 modeling, the Excel spreadsheet calculates the emission reductions from the installation of different types of the chargers in the State of Rhode Island.

Grid emissions rates provided by RI DEM and USDOE's GREET model were used to calculate upstream utility emissions associated with electric vehicle charging. For light-duty vehicles, average power demand from existing chargers as documented in Electrify America's most recent quarterly report to the California Air Resources Board was used. The net benefit was calculated by combining avoided vehicle emissions (from MOVES emissions rates) and the grid emissions associated with charging.

Emission Reductions Estimate Method for Solar Panels:
To estimate the GHG and criteria pollutant reductions resulting from solar panel installations on municipal buildings, we used the U.S. Department of Energy National Renewable Laboratory PVWatts Tool (https://pvwatts.nrel.gov/pvwatts.php). Based on an assumed cost of $3,000 per installed kW of solar panels, NESCAUM estimated the number of solar panels and the kW of installed solar panels per million dollars of funding. We used PVWatts to estimate the amount of electricity that can be generated annually from the solar panels. We converted electricity generating emission factors from grams/mmbtu to grams per kWh. Grid-related emission factors were taken from a recent Sonoma Technology study of

Advanced Clean Cars program implementation for Rhode Island. We multiplied avoided annual electricity use (in kWh) by the grid emission factors for CO2e, NOx, PM2.5, and VOC to arrive at tons reduced per pollutant per year.

The U.S. Department of Energy National Renewable Energy Laboratory (NREL) PVWatts tool was used to estimate the size of the rooftop and carport solar arrays at the Narragansett Library and at the Narragansett Bay Commission. The estimated size of the arrays were determined in PVWatts and the tool provides the annual kWh reduced at each site. Emission factors for electricity production in Rhode Island were provided by the state. These were multiplied by the kWh reduced to estimate CO2e, NOx, PM2.5, and VOC emissions reduced from power plants. For the EV chargers, an assumed cost per Level 2 charger was taken from an International Council on Clean Transportation study and were assumed to be $6,200 per charger. Using Electrify America data on the daily usage of chargers, Sonoma Technology calculated the amount of electricity dispensed by each charger and then converted this into electric vehicle miles traveled. Conventional (ICE) VMT was then reduced by an equivalent amount and using MOVES4 modeling for the State of Rhode Island, avoided emissions from ICE vehicles was estimated.

Models/Tools Used:
NREL's PVWatts tool was used to estimate the kWh produced by the solar arrays on the two facilities. The annual electricity production from PVWatts was entered into an Excel spreadsheet with Rhode Island-specific grid emission factors for each year from 2025 to 2050. Electricity production was converted to mmbtu and then multiplied by grid emission factors in gm/mmbtu to estimate emissions reductions resulting from the solar PV installation. For the charging electric vehicle ports, an Excel spreadsheet was developed by Sonoma Technology to calculate avoided ICE vehicle emissions. Sonoma Technology ran the MOVES4 model to generate emission factors on a gram/mile basis for Rhode Island-specific light-duty vehicles. Avoided ICE VMT was multiplied by the MOVES4 emission factors to estimate avoided vehicle emissions.

Measure Implementation Assumptions:
The following key assumptions about measure implementation were used to quantify emissions reductions for this measure:

- A 69 kW array was assumed to be installed on the Narragansett Library and generate 81,000 kWh of electricity each year.
- An 180 kW array was assumed to be installed on the Narragansett Bay Commission and to generate 243,480 kWh of electricity each year
- 14 Level 2 chargers were assumed to be installed at the two faciliites at a cost of $6,000 per charger.
- The measure lifetime is 26 years – the solar panels and chargers are assumed to operate for 26 years (from 2025 to 2050).

Emission Reduction Estimate Assumptions:
The following key assumptions about emission reductions were used to quantify emission reductions for this measure:

- EPA MOES4 and DOE GREET model emission factors for CO2e, NOx, PM2.5, and VOC were used.
- Rhode Island-specific grid emission factors were used to estimate emissions from electricity generation.

Reference Case Scenario:
Absent this measure, the emissions listed above in the 2025-2030 and 2025 to 2050 avoided emissions section would be emitted.

Measure-Specific Activity Data and Implementation Tracking Metrics:

- Electricity production from the solar arrays at the Narragansett Library and the Narragansett Bay Commission.
- Electricity dispensed from the electric vehicle chargers.
- Estimated ICE VMT displaced by the electric vehicle chargers.

2-M Measure: Addressing Pre-Weatherization Barriers

RI Energy utilized various internal tools and files related to past and present EE programming activity. Some of the files and resources utilized include:

- Technical Reference Manual (TRM): This is a publicly available file that is vetted by numerous stakeholders and based on thorough EM&V processes.
- Benefit Cost Model: This file utilizes AESC 2021 for certain values and assumptions regarding GHG factors.
- Internal data gathered around PWB cost and frequency

These numbers are subject to change, but the following values, assumptions, and estimates were used to complete this project proposal.

We assumed a $10 million allocation for this project from DEM. We assumed an allocation of 65% to the Income-Eligible Single-Family program and the remainder to the EnergyWise Single Family program. We assumed a 5% administrative cost.

Income-Eligible Single Family (IE SF)
For IE SF, the average PreWx cost is $7,500 per home, and the average Wx cost is $5,500 per home. This brings the total cost per home to $13,650. At $6.5M this would enable 476 homes to receive PreWx and Wx services in the IE SF program. IE SF has four Wx measures that are based on fuel type. The average GHG factor of these four measures is 0.79 short tons per year. This equates to 376 short tons of GHG avoided per year per home. The estimated measure life of these Wx measures per the Technical Resource Manual is 20 years. Therefore, the lifetime avoided GHG is 7524 short tons. RIE assumes that if the money were delivered near the end of 2024, the program would start in 2025 and 1/3 of the money and homes would be executed each year starting in 2025. In table format, this looks like the following:

$7,500	Pre Wx costs
$5,500	Wx costs
$13,000	subtotal costs per home
1.05	admin fee
$13,650	total per home
65%	% budget allocation
$6,500,000	budget allocation
476	additional homes weatherized
0.79	GHG (short ton annual) per home avg across 4x IE SF wx measures

376	GHG per year
20	Wx measure EUL
7,524	lifetime GHG short ton

EnergyWise Single Family (EW SF)

For EW SF, the approach was very similar with a few differences. First, the two most common PWBs in EW SF are 1) knob and tube (K&T) wiring and 2) mold and mildew (M&M). We treated each of these two as their own PreWx measure. One unique difference between IE SF and EW SF is that in EW SF we are allocating money only for the full remediation of these PWBs, but no money for Wx. The assumption here being that our existing Wx incentives are adequate to move the market once a customer has had their PWBs removed and is thus enabled to proceed with their recommended Wx work.

EnergyWise Single Family: Knob and Tube

The process for calculating impact was very similar to what was described above. We used the following values:

$7,500	Pre Wx costs
$7,500	subtotal costs per home
1.05	admin fee
$7,875	total per home
30%	% budget allocation (of assumed $10M)
$3,000,000	budget allocation for this measure
381	additional homes weatherized total
0.69	GHG (short ton annual) per home (avg across the EW SF Wx measures)
263	GHG per year
20	Wx measure EUL
5,257	lifetime GHG short ton

Note that we are assuming the money comes in towards the end of 2024 and implementation begins in 2025, with 1/3 of the 381 homes being completed in each year starting in 2025 through 2027. 33% of 263 short tons per year is 87. (See GHG table below)

EnergyWise Single Family: Mold and Mildew

The process for calculating impact was very similar to what was described above. We used the following values:

$3,642	Pre Wx costs
$3,642	subtotal costs per home
1.05	admin fee
$3,824	total per home
5%	% budget allocation
$500,000	budget allocation
131	additional homes weatherized
0.69	GHG (short ton annual) per home (avg across the EW SF Wx measures)
90	GHG per year

20	Wx measure EUL
1,804	lifetime GHG short ton

Note that we are assuming the money comes in towards the end of 2024 and implementation begins in 2025, with 1/3 of the 131 homes being completed in each year starting in 2025 through 2027. 33% of 90 short tons per year is 30. (see GHG table below)

GHG Reductions by Year

The following table shows the GHG impact of the projects, assuming they are implemented evenly 1/3 each per year starting in 2025. The values are in short tons of GHG.

The net result would be approximately 14,439 short tons of lifetime GHG avoided.

		1st Tranche (1/3)			**2nd Tranche (2/3)**			**3rd Tranche (3/3)**			
Year #	**Year**	IE SF	EW SF KT	EW SF MM	IE SF	EW SF KT	EW SF MM	IE SF	EW SF KT	EW SF MM	**Totals**
1	2025	124	87	30							**241**
2	2026	124	87	30	124	87	30				**481**
3	2027	124	87	30	124	87	30	124	87	30	**722**
4	2028	124	87	30	124	87	30	124	87	30	**722**
5	2029	124	87	30	124	87	30	124	87	30	**722**
6	2030	124	87	30	124	87	30	124	87	30	**722**
7	2031	124	87	30	124	87	30	124	87	30	**722**
8	2032	124	87	30	124	87	30	124	87	30	**722**
9	2033	124	87	30	124	87	30	124	87	30	**722**
10	2034	124	87	30	124	87	30	124	87	30	**722**
11	2035	124	87	30	124	87	30	124	87	30	**722**
12	2036	124	87	30	124	87	30	124	87	30	**722**
13	2037	124	87	30	124	87	30	124	87	30	**722**
14	2038	124	87	30	124	87	30	124	87	30	**722**
15	2039	124	87	30	124	87	30	124	87	30	**722**
16	2040	124	87	30	124	87	30	124	87	30	**722**
17	2041	124	87	30	124	87	30	124	87	30	**722**
18	2042	124	87	30	124	87	30	124	87	30	**722**
19	2043	124	87	30	124	87	30	124	87	30	**722**
20	2044	124	87	30	124	87	30	124	87	30	**722**
21	2045				124	87	30	124	87	30	**481**
22	2046							124	87	30	**241**
23	2047										0
24	2048										0
25	2049										0
26	2050										0
	Totals	2,483	1,735	595	2,483	1,735	595	2,483	1,735	595	**14,439**

2-N Measure: Demand Response for Grid Resilience – Incentivize Battery Storage for Residential and Commercial Customers for Peak Shaving Through Demand Response

Emission Reductions Estimate Method:

Step 1: Determine additional funding layer for RSB Battery participants

Rhode Island Energy identified an additional incentive layer of $175/kW to be added to the received incentive rate for RSB Battery participants to adjust the total incentive for each participant to be $400/kW. From there, utilizing the data and analysis included in PUC Docket No. 24-06, the Company determined how the forecasted program participation would grow as a result of this increased incentive rate. The average load shed per battery per demand response event was determined to be 5.84 kW based on the 2023 ConnectedSolutions performance results. Utilizing these participation and performance forecasts, the solar PV participating in the program year over year was determined to be the same as the average load shed per battery. More information on this concluded assumption is detailed below in the "Emission Reduction Estimate Assumptions" section.

Step 2: Determine the avoided emissions and generation as a result of RSB Battery program participation.

The Company utilized the Environmental Protection Agency's ("EPA") Avoided Emissions and Generation ("AVERT") online tool to estimate the annual and seasonal (June-September) MWh of avoided GHG emissions in New England, as well as the seasonal avoided metric tons of CO^2 avoided as a result of RSB Battery participation.

Using forecasted participation and estimated load shed per battery + solar PV participant, the assumed MW participating in ConnectedSolutions was determined, as shown in Table 2. Within the AVERT tool, New England was selected for the region and the annual assumed MW participation was entered into the "Distributed (rooftop) solar PV total capacity" prompt within the tool. The values for displaced regional fossil fuel generation were determined for 2024-2029 as noted in Table 3. The results from the AVERT tool were further analyzed to determine the displaced regional fossil fuel generation accounted for during the ConnectedSolutions season (June-September) as well as the CO_2 emission reductions. These results were analyzed for the 2024-2029 program years, shown in the tables below.

Table 2: Assumed MW Participating in ConnectedSolutions (Cumulative per Year) in Rhode Island

Assumed MW Participating in ConnectedSolutions (Cumulative per Year) in Rhode Island						
Measure	2024	2025	2026	2027	2028	2029
RSB Batteries	5.03	5.91	6.79	7.66	8.54	9.41
Total:	**5.03**	**5.91**	**6.79**	**7.66**	**8.54**	**9.41**
*Assumptions for 2024-2026 completed during thorough analysis of historical participation and forecasted program growth in Docket 24-06. Assumptions for 2027-2029 RSB battery participation determined by estimated program growth between 2024-2026. Daily Dispatch year over year growth determined based on current participants and potential future participants that have reached out to the Company.						

Table 3: Estimated Annual MWh of Avoided GHG Emissions in New England

Estimated Annual MWh of Avoided GHG Emissions in New England							
Measure	2024	2025	2026	2027	2028	2029	Total
RSB Batteries Annual	8,000	10,000	11,000	13,000	14,000	16,000	72,000
Total:	**8,000**	**10,000**	**11,000**	**13,000**	**14,000**	**16,000**	**72,000**
*Utilizing United States Environmental Protection Agency's Avoided Emissions and Generation Tool AVERT calculator to determine annual displaced regional fossil fuel generation.							

Table 4: Estimated MWh of Avoided GHG Emissions in New England During ConnectedSolutions Season

Estimated MWh of Avoided GHG Emissions in New England During ConnectedSolutions Season							
Measure	2024	2025	2026	2027	2028	2029	Total
RSB Batteries Annual	2,667	3,333	3,667	4,333	4,667	5,333	24,000
Total:	**2,667**	**3,333**	**3,667**	**4,333**	**4,667**	**5,333**	**24,000**
*Utilizing United States Environmental Protection Agency's Avoided Emissions and Generation Tool AVERT calculator to determine annual displaced regional fossil fuel generation. Take annual MWh of avoided GHG emissions for the summer months only. Assumption that average avoided GHG emissions are equal or near equal during each month of the year. ConnectedSolutions season is from June 1 to September 30 each program year.							

Table 5: Estimated Metric Tons of CO2 Avoided from Renewable Energy Generation in Rhode Island During ConnectedSolutions Season

Estimated Metric Tons of CO2 Avoided from Renewable Energy Generation in Rhode Island During ConnectedSolutions Season							
Renewable Energy Class	2024	2025	2026	2027	2028	2029	Total
RSB Batteries	209.65	245.97	282.31	318.19	354.41	390.07	1,800.60
Total:	**209.65**	**245.97**	**282.31**	**318.19**	**354.41**	**390.07**	**1,800.60**
*Utilizing United States Environmental Protection Agency's Avoided Emissions and Generation Tool AVERT calculator to determine avoided CO2 emissions. Note that avoided emissions are considered for ConnectedSolutions program months only (June-September), rather than annual avoidance. ConnectedSolutions season is from June 1 to September 30 each program year.							

<u>Step 3: Calculate the funding required to realize this level of program participation and emission reductions.</u>

Utilizing Schedule 2 of PUC Docket No. 24-06, the estimated additional funding required to increase the RSB Battery incentive to $400/kW was determined. The incentive-payment adder cost was determined from the forecasted 2026-2029 battery participants. Table 6 notes the necessary additional administrative and participant expenses to run the program.

Models/Tools Used:

To determine the amount of solar capacity participating in the RSB Battery program load shed analysis forecasts from Schedule 2 of PUC Docket No. 24-06, as well as an internally run report regarding solar PV capacity paired with battery storage for RSB customers were utilized to estimate program growth with the proposed increase in incentive level.

The EPA's AVERT web version tool was utilized to estimate annual GHG emissions in New England[1]. The tool was also utilized to determine avoided CO2 emissions during the ConnectedSolutions season (June-September).

Measure Implementation Assumptions:

The following key assumptions about measure implementation were used to quantify emissions reductions for this measure:

One key assumption made was to exclude C&I Daily Dispatch battery participants from the avoided GHG emissions calculations. With the limited insight to the large battery pipeline, potential future C&I participants, and knowledge on how much solar would be paired with large batteries, the Company determined that the most accurate analysis of avoided GHG emissions would be an evaluation of RSB Battery participants only. With that assumption, Rhode Island Energy has concluded that the C&I Daily Dispatch pathway will further reduce GHG emissions, however, the Company is unable to accurately predict the effects at this stage in the program.

With the receival of the PCAP Grant funding, Rhode Island Energy will be able to increase the RSB Battery pathway incentive by $175/kW, to make the incentive rate $400/kW-summer. The Company assumed greater program participation growth under this new, higher incentive rate. The forecasted participation noted in Table 3 operates under the $400/kW incentive rate and assumed growth in participation.

Assumptions regarding implementation milestones are noted in Table 1. The measure lifetime for new and existing RSB battery participants is assumed to be at least through 2029. Any other additional capital, operation, and maintenance cost assumptions are noted in Table 6.

Emission Reduction Estimate Assumptions:
The following key assumptions about emission reductions were used to quantify emission reductions for this measure:
The reduction measure is calculated by using The Avoided Emissions and geneRation Tool (AVERT). In this analysis, we assume that participating batteries are charged via rooftop solar PV and make the simplifying assumption that this rooftop solar PV + paired battery would not be built within the five-year period of performance without the proposed incentive layer through this funding opportunity. Our estimates also do not distinguish between solar PV + battery meter configurations.
The avoided emission rates generated from AVERT analyze electric power sector impacts on an hour-by-hour basis, but it can also produce approximations of marginal emission rates for each AVERT region. We used AVERT to produce the marginal emission rates for the NE region, which used a weighted average for the nation across each year from 2007 to 2022. The AVERT Tool helped us quantify the emissions impact of the project's incremental capacity of distributed rooftop solar PV total capacity and its expected GHG emission reductions it is expected produce. An additional assumption that avoided generation is about equal month-over-month during the year to estimate the avoided fossil fuel generation specific to the ConnectedSolutions season.

Another key assumption made, because of a lack of insight into how many RSB Battery participants have paired their battery assets with solar PV, was that the average avoided distribution supply needed will closely match the average capacity discharged by each Residential battery system. On average, customers in the A-16 and C-06 rate classes who have solar PV paired with a battery asset, install about 8.44 kW-AC of solar PV. RSB Battery participants' performances averaged 5.84 kW of discharged capacity per demand response event in 2023. Once installed, lower energy costs and GHG emissions will be realized throughout the life of the asset.

Reference Case Scenario:
Absent the implementation of the "Peak Shaving and Resilience through Battery Energy Storage" measure and the incentive adder through the requested federal grant funding, about 1800 metric tons of CO_2 emissions would not be realized.

Measure-Specific Activity Data and Implementation Tracking Metrics:
Measure-specific activity data and implementation tracking metrics include battery enrollment, battery discharge data, average load shed during demand response events, and compensation (performance-based incentive, incentive adder). From this information, Rhode Island Energy can determine the amount of solar capacity participating in the program and the program's effectiveness at reducing GHG emissions throughout the peak load hours of the summer.

2-O Measure: Preserving Carbon Sinks through Renewable Energy Siting Incentives

Emission Reductions Estimate Method:
Step 1: Determine the anticipated scale of solar PV development during the five-year period of performance. Rhode Island Energy assumed that one project eligible for the Preferred Site Adder will be awarded and constructed in Large-Scale Solar I, in Large-Scale Solar II, and in Large-Scale Solar III pre-defined Renewable Energy Classes per year, for each of the three years in the DG Board and OER's December 20th, 2023, filing titled "Recommendations for the 2024-2026 Renewable Energy Growth Program Years" in RIPUC Docket No. 23-44-REG. Rhode Island Energy assumed that each project requires three years for construction and that projects built in Large-Scale Solar I, II, and III will be the maximum allowable size in each Renewable Energy Class. From the DG Board and OER's December 20th, 2023 filing titled "Recommendations for the 2024-2026 Renewable Energy Growth Program Years" in RIPUC Docket No. 23-44-REG, for Large-Scale Solar IV, the typical project is assumed to be 20 MW in size, based on Synapse Energy Economics' Solar Siting Opportunities for Rhode Island Report results, which suggests that a majority of preferred site parcels that can support solar development over 15 MW have about 20 MW of technical potential. Rhode Island Energy assumed that one Large-Scale Solar IV project eligible for the Preferred Site Adder will be awarded in 2026 and constructed by 2029.

Step 2: Estimate annual renewable electricity generation from eligible projects in Step 1. Rhode Island Energy used relevant assumptions from the DG Board and OER's December 20th, 2023, filing titled "Recommendations for the 2024-2026 Renewable Energy Growth Program Years" in RIPUC Docket No. 23-44-REG, SEA Schedule 5 Slide 26. The capacity factors of a Large-Scale Solar II project on a brownfield and on a landfill were averaged. This value is utilized to estimate the MWh of generation. 2028, 2032, 2036, 2040, 2044, and 2048 are leap years with 8784 hours assumed per year. The remainder of the years have 8760 hours assumed per year.

Step 3: Estimate the greenhouse gas emissions avoided from the scale of renewable electricity generation estimated in Step 2. Rhode Island Energy used the Avoided Energy Supply Component in New England study (AESC), vintage 2024, Appendix G, Marginal Emission Factor for CO2e lb/MWh to convert MWh to CO2e. This value varies over time annually.

Step 4: Estimate the greenhouse gas emissions sequestration achieved by not developing in forested areas. Rhode Island Energy used an estimate of 3.8 acres per MW of solar generation, in alignment with the DG Board and OER's December 20th, 2023, filing titled "Recommendations for the 2024-2026 Renewable Energy Growth Program Years" in RIPUC Docket No. 23-44-REG, Schedule 4, Slide 4. Rhode Island Energy assumes that the projects are sited on preferred sites requiring remediation instead of "oak / hickory" forests (which are the most common type of forest in Rhode Island), a sequestration factor of 1.46 metric tons of carbon per acre per year is estimated, from the Rhode Island 2020 Forest

Action Plan, by the Department of Environmental Management's Division of Forest Environment, Appendix C.

Step 5: Add the greenhouse gas emissions from Steps 3 and 4 to get total greenhouse gas emissions benefit. Please note that this methodology only accounts for the greenhouse gas emissions benefits of items (1) and (2) below, but does not account for items (3) and (4) below:

1. Renewable electricity is carbon-free
2. Siting in preferred locations preserves carbon-absorbing forested land
3. Siting on landfills that require remediation reduces methane leakage by encouraging uncapped landfills to be capped so that solar may be developed
4. Federal funding would reduce otherwise customer-sourced funding via an incremental charge incorporated into electric rates; lower electric rates will encourage electrification, which is a proven pathway to deep economy-wide decarbonization

Models/Tools Used:
Rhode Island Energy relied on data and summary statistics derived by state agencies and available in the public record to estimate greenhouse gas emissions benefits of this measure.

Measure Implementation Assumptions:
Please see assumptions included in the description of Step 1 in the methodology. Furthermore, Rhode Island Energy assumes the level of the incentive adder as proposed will be approved by the Rhode Island Public Utilities Commission and therefore implemented.

Emission Reduction Estimate Assumptions:
Please see the assumptions described in the description of Steps 3 and 4 in the methodology.

Reference Case Scenario:
The reference case scenario is a fictional scenario in which 110 MW of solar PV is not developed and roughly 400 acres of forested land are cleared. Rhode Island Energy uses this fictional reference scenario to separate out the impacts of the following ways in which an incentive adder will contribute to greenhouse gas emissions benefits:

1. Renewable electricity is carbon-free
2. Siting in preferred locations preserves carbon-absorbing forested land
3. Siting on landfills that require remediation reduces methane leakage by encouraging uncapped landfills to be capped so that solar may be developed
4. Federal funding would reduce otherwise customer-sourced funding via an incremental charge incorporated into electric rates; lower electric rates will encourage electrification, which is a proven pathway to deep economy-wide decarbonization

In the absence of federal funding, the counterfactual is most likely that the funding required for the incentive adder would be collected from electric customers, and therefore only benefits associated with item (4) above would be lost. Benefits associated with item (4) may be estimated using price elasticity of demand for electricity. Although the specific impact of a reduction in electricity prices relative to a counterfactual may be small, the overarching precedence of successfully leveraging non-customer funding to support climate policy objectives through utility-run, otherwise-customer-funded programs is significant and would demonstrate an impactful and repeatable model for driving decarbonization.

Measure-Specific Activity Data and Implementation Tracking Metrics:
Measure-specific activity data and implementation tracking metrics include application (MW applied, projects applied), selection (MW selected, projects selected, location of projects, land use classification of project sites, area of project sites), status (interconnection status, remediation status), generation (MWh generated, actual capacity factor), and compensation (performance-based incentive, incentive adder).

2-P Measure: Promote Food Waste Diversion in Rhode Island Municipalities

Emission Reductions Estimate Method:
The Environmental Protection Agency's (EPA) Solid Waste Emissions Estimation Tool (SWEET) is an Excel-based tool to estimate project or source level emissions from the solid waste sector and compare alternative waste treatment scenarios. It is valuable for municipal solid waste officials to establish a baseline of air pollutant and short-lived climate pollutants, and to identify mitigation options. SWEET offers specific climate-forcing pollutant estimates, including CO_2, NO_x, CH_4, Black Carbon, Organic Carbon, SO_x, $PM_{2.5}$ and PM_{10}.

Models/Tools Used: Environmental Protection Agency's (EPA) Solid Waste Emissions Estimation Tool (SWEET)

Measure Implementation Assumptions:
The following key assumptions about measure implementation were used to quantify emissions reductions for this measure:

Emission Reduction Estimate Assumptions:

Input	Value	Justification
Per capita waste generation rate inside formal collection zones	0.96 (kg/capita/day)	This value was calculated based on the total tonnage of waste reported by RI and the population of Providence, RI.
Average annual percent growth rate in the quantity of waste collected – historical and projected future	0 percent	It is assumed that the amount of solid waste collected over the past several years has remained constant and can be assumed to remain constant in the future.
Percentage of waste generated inside formal collection zones that is collected	100 percent	It is assumed that all waste generated within the state of RI is collected.

Default values for North America from the Intergovernmental Panel on Climate Change (IPCC) 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories were used for the average composition of collected waste.

Average Composition of Collected Waste	Percent
Food Waste	20.20%
Green	6.80%
Wood	4.10%

Paper/Cardboard	23.30%
Textiles	3.90%
Plastic	15.80%
Metal	6.40%
Glass	4.20%
Tires	1.60%
Other	14.00%

Reference Case Scenario: BAU and the food scrap diversion case emissions are shown below.

Year	BAU	100% AD	Change from BAU - 100% AD	50% AD, 50% Compost	Change from BAU - 50% AD, 50% Compost
2025	68,631	68,636	5	68,615	-16
2026	69,599	69,563	-37	27,538	-42,061
2027	70,524	70,456	-69	25,051	-45,473
2028	71,408	71,315	-93	22,943	-48,466
2029	72,253	72,140	-113	21,136	-51,116
2030	73,059	72,932	-127	19,573	-53,486
2031	73,830	73,691	-139	18,208	-55,621
2032	74,566	74,419	-147	17,005	-57,561
2033	75,269	75,115	-154	15,934	-59,336
2034	75,941	75,782	-159	14,973	-60,968
2035	76,584	76,420	-163	14,105	-62,479
2036	77,197	77,031	-166	13,315	-63,882
2037	77,784	77,615	-169	12,591	-65,193
2038	78,345	78,174	-171	11,925	-66,419
2039	78,881	78,709	-172	11,309	-67,572
2040	79,394	79,221	-173	10,737	-68,657
2041	79,884	79,710	-174	10,203	-69,681
2042	80,353	80,178	-175	9,704	-70,649
2043	80,802	80,627	-175	9,236	-71,566
2044	81,231	81,055	-175	8,796	-72,435
2045	81,642	81,466	-176	8,381	-73,260
2046	82,035	81,859	-176	7,990	-74,044
2047	82,411	82,235	-176	7,621	-74,790
2048	82,771	82,595	-176	7,271	-75,500
2049	83,116	82,940	-176	6,940	-76,176
2050	83,446	83,270	-176	6,626	-76,820
Total	**2,010,955**	**2,007,153**	**-3,802**	**407,727**	**-1,603,228**

Measure-Specific Activity Data and Implementation Tracking Metrics:

Input	Value	Notes
Tons of Waste Produced	73,359 tons	*Source: City of Providence - RIRRC Municipal Customer Monthly Summary: Providence - November 2023*
Tons of Waste Diverted – Composting	12 tons	
Tons of Waste Diverted – Anaerobic Digestion	96 tons	
Tons of Waste Disposed – Landfills	73,359 tons	

Input	Value	Source
Population in formal collection zones	189,563	US Census Population Estimates, July 1, 2022, (V2022)
Average annual precipitation	44 in.	RI DEM (2022)
Mean annual temperature	48 °F	RI DEM (2022)

2-Q Measure: Build Greater Capacity for Urban Forest Management

Emission Reductions Estimate Method:
The carbon storage, sequestration and co-pollutant reductions for the existing tree canopy will be calculated by remote sensing of the land cover for a jurisdiction. and totaling the acreage of tree canopy calculated by published multipliers for carbon and air pollutants by the U.S. Forest Service.
New tree plantings carbon storage, sequestration and co-pollutant reductions will be calculated using the U.S. Forest Service's iTree Design tool. Link: https://www.itreetools.org/
All trees planted will have their carbon sequestration and air pollutant reductions calculated for the two timeframes (2025-2030 and 2030-2050).

Models/Tools Used:
Preserving existing canopy – the existing tree canopy is mapped using remote sensing tools and high-resolution aerial photography provided by the U.S. Department of Agriculture at a 1-meter by 1-meter pixel. Using GIS, the number of acres of tree canopy can be calculated across the jurisdiction. The number of acres is multiplied using the U.S. Forest Service's Forest Inventory Analysis (FIA) county-level multipliers for carbon storage, sequestration and air pollution reduction. Spreadsheets of the multipliers for the U.S. is attached.

For new trees planted, i-Tree Design v7.0 (link: https://design.itreetools.org/) developed by the U.S. Forest Service and Davey Tree will be used to calculate cumulative reductions for both carbon and air pollutants. Proxy trees that are commonly planted in municipalities in Rhode Island (red maple and flowering dogwood) were used to estimate the emission and pollutant reductions since the actual species mix to be planted are unknown at this time.

Measure Implementation Assumptions:
Implementation measure assumptions include the availability of the nursery stock sizes to be planted, the tree species selected for planting, specific locations and available planting spaces within the neighborhoods and long-term stewardship (watering, pruning, fertilizing, etc.).

Cost assumptions include the cost and availability of the size nursery stock needed to plant in the communities. Site preparation (soil conditioning, impervious surface removal, access to the site, etc.) can add additional project costs.

Operation and maintenance cost assumptions are the ability to organize and train tree stewards in the community to help with long-term tree care and maintenance. Other assumptions include the municipality direct funding and resources to the long-term care and maintenance of trees with the rights-of-way and on public lands such as parks and city owned properties. Other stakeholders such as schools, churches and hospitals rely on adequate tree care and maintenance on their properties.

Emission Reduction Estimate Assumptions:
The model for estimating carbon sequestration for the existing tree canopy over the time period assumes no significant loss of urban forest cover. Potential tree canopy loss could include new development, storms, pests and disease and age of the trees. Long-term stewardship of the canopy relies on policies and programs that preserve, conserve or plant new trees by the wider community. Tree planting estimates assume that the trees survive to maturity. A 15% mortality factor was calculated to conservatively estimate tree survival since it is unlikely that all trees will survive to maturity.

Reference Case Scenario:
Without adequate investment in the tree canopy through maintenance and new tree plantings the tree canopy will decline over time as the existing trees age out or are impacted by storms, pests or new developments. Many communities in Rhode Island lack the infrastructure and programming for adequate tree maintenance and are not planting enough trees on an annual basis to sustain the tree canopy into the future. Furthermore, on average a local government only owns or manages 20% of the land base within its jurisdiction. The other 80% is in private ownership, which means that without active public engagement and programming on the urban forest, the local government can never alone sustain the tree canopy over time. These projects are meant to build long-term community capacity, interest and support for the management of the urban forest on both public and private property. The approach for the DFE IRA funding is to take a comprehensive view of urban forest management while providing intensive resources to help build local capacity for the long-term. Without further funding many Rhode Island communities will not have the resources, capacity or expertise to get urban forestry programs off the ground.

Other Assumptions:
Since participating municipalities have not been identified or their canopy mapped at this point, we are providing example estimates for two different common municipal scenarios for the state of Rhode Island. These communities' tree canopy and carbon were mapped and quantified under a previous grant funding source. One is the City of East Providence and represents a high-density built urban city landscape and the other is the Town of Bristol which represents a smaller suburban-rural town.

COVERING 2025-2030:
City of East Providence:

Tree canopy (2021) – 2,927 acres
Total carbon stored in the canopy – 150,155 metric tons
Annual carbon sequestered by tree canopy – 12,732 metric tons
The city's tree canopy between 2025 – 2030 will cumulatively sequester (assuming no significant loss in tree cover) 63,660 metric tons.

Town of Bristol:
Tree canopy (2021) – 2,717 acres
Total carbon stored in the canopy – 151,322 metric tons
Annual carbon sequestered by tree canopy – 10,708 metric tons
The town's tree canopy between 2025 – 2030 will cumulatively sequester (assuming no significant loss in tree cover) 53,540 metric tons.

Estimates for new tree plantings:
Assuming a mix of tree species with large form trees making up 55% of the total and small form trees the remaining 45% of newly planted trees. We used two species as representatives for calculating the carbon sequestration using iTree Design.

Large form tree representative means a tree with a height and spread at maturity on average 40 feet in crown diameter and height: Red Maple (Acer rubrum).
Small form tree representative means a tree with a height and spread at maturity on average 20 feet in crown diameter and height: Flowering dogwood (Cornus florida).

Using iTree Design a single 2-inch caliper red maple will sequester between 2025-2030:
118 pounds of CO_2
0.2 pounds cumulatively of the 6 air pollutants previously referenced
Using iTree Design a single 2-inch caliper flowering dogwood will sequester between 2025-2030:
83 pounds of CO_2
0.3 pounds cumulatively of the 6 air pollutants previously referenced

Extrapolating those values out using a 55%:45% mix of large and small trees, assuming 1000 new trees are planted and 80% tree survival rate yields the following estimated carbon sequestration for trees during the 2025-2030 time period.
(1000 X 0.55) = 550 large trees
550 large trees X 0.8 survivorship = 440
440 X 118 pounds = 51,920 pounds of sequestered CO_2
440 X 0.2 pounds = 88 pounds of sequestered air pollutants
(1000 X 0.45) = 450 small trees
450 large trees X 0.8 survivorship = 360
360 X 83 pounds = 29,880 pounds of sequestered CO_2
360 X 0.3 pounds = 108 pounds of sequestered air pollutants

Total for all trees:
81,800 pounds of sequestered CO_2
196 pounds of sequestered air pollutants

COVERING 2025-2050
City of East Providence:

The city’s tree canopy between 2030 – 2050 will cumulatively sequester (assuming no significant loss in tree cover) 254,640 metric tons.

Town of Bristol:
The town’s tree canopy between 2030 – 2050 will cumulatively sequester (assuming no significant loss in tree cover) 214,160 metric tons.

Using iTree Design a single 2-inch caliper red maple will sequester between 2030-2050:
1,292 pounds of CO_2
2 pounds cumulatively of the 6 air pollutants previously referenced

Using iTree Design a single 2-inch caliper flowering dogwood will sequester between 2030-2050:
757 pounds of CO_2
3 pounds cumulatively of the 6 air pollutants previously referenced

Extrapolating those values out using a 55%:45% mix of large:small trees, assuming 1000 new trees are planted and there is 80% survivorship of the trees will yield the following carbon sequestered for all trees during the 2030-2050 time period.
(1000 X 0.55) = 550 large trees
550 large trees X 0.8 survivorship = 440
440 X 1,292 pounds = 568,480 pounds of sequestered CO_2
440 X 2 pounds = 880 pounds of sequestered air pollutants

(1000 X 0.45) = 450 small trees
450 large trees X 0.8 survivorship = 360
360 X 757 pounds = 272,520 pounds of sequestered CO_2
360 X 3 pounds = 1,080 pounds of sequestered air pollutants

Total for all trees:
841,000 pounds of sequestered CO_2
1,960 pounds of sequestered air pollutants