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RHODE ISLAND 2022 CLIMATE UPDATE

RIEC[4]

This is a working draft and will change throughout the year. Only the final version will be formatted, and all formatting will happen in December; content will not be formatted prior to December.

Introductory Letter

TO BE REPLACED WITH A TRANSMITTAL LETTER (IN LATE DECEMBER)

Executive Summary

On April 14, 2021, 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. 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 (EC4) deliver an update to the *2016 Greenhouse Gas Emissions Reduction 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 in the EC4, this *2022 Update* has been prepared to serve as a benchmark and updated foundation for the work ahead.[1] We have reviewed the 2016 plan, reflected on the substantial work that has been done in Rhode Island over the past six years, and provided an interim path forward based on work being done across state government.

Looking back, in the 2016 Greenhouse Gas Reduction Plan the authors identified six key policy recommendations for moving forward in Rhode Island:

- Support further evaluation of the costs and benefits of GHG mitigation pathways, including macroeconomic, environmental, and health impact analyses.
- Develop a state-of-the-art 2018-2020 Three-Year Energy Efficiency Procurement Plan, with special focus on expanded access to delivered fuels (oil and propane) heating customers, opportunities to drive toward new demand response strategies, and expanded financing mechanisms to leverage capital toward the achievement of robust savings goals.
- Initiate an effort to escalate clean energy adoption in Rhode Island, elevating our state's position as an emerging leader in renewable energy and building off recent momentum from the nation's first offshore wind farm.
- Explore state and regional mechanisms for promoting clean transportation solutions consistent with addressing the state's largest GHG source sector.
- Craft a framework for addressing utility, rate, and regulatory modernization to position Rhode Island on the cutting-edge of power sector transformation activities and demonstrate our state as a proof-of-concept testbed for integrating clean energy, empowering customers, and improving the resiliency of our electric grid.
- Pursue regional approaches where they promise to enhance progress toward GHG goals, either through existing collaborations such as RGGI or through newly emerging ones.

Rhode Island has remained focused in these areas and has followed through on all of them. These have been the guiding principles for much of the work done by the EC4 over the time since they were published. The specifics of each are outlined in detail in this *2022 Update*. Former EC4 Chairperson

[1] The 13 official member agencies of the RIEC4 can be found listed at https://climatechange.ri.gov/state-actions/ri-executive-climate-change-coordinating-council-ec4 In addition, representatives from the RI Department of Labor and Training (RIDLT) have been participating in the meetings (non-voting).

Janet Coit was clear, however, in her letter submitting that report in 2016 that it was just a beginning, and much work and refinement had to follow if Rhode Island was to meet its emission reduction goals.

When the legislature passed the Act on Climate and it was signed by Governor McKee in April of 2021, the sense of urgency increased. Goals became enforceable mandates and clear priorities were set for equity, justice, and workforce development. These priorities were to be central to all our work on reducing emissions. Regular reporting, metrics, and dashboards, as well as strategic plans were required to ensure we stayed on track to meet our goals and clearly communicate status and progress. The *2022 Update* is the first of the plans required by the Act on Climate.

Beginning in September 2021, the EC4 initiated a comprehensive public involvement strategy to provide transparency and opportunities for engagement on the development of the *2022 Update*. The EC4 met more often – bimonthly versus quarterly – and held meetings throughout the state to allow more Rhode Islanders to participate in critical conversations about climate change. The EC4 held over 20 public listening sessions and workshops to gather public input for the *2022 Update*. The EC4 has worked closely with Governor McKee to make key appointments to both the EC4 Advisory Board and the Science and Technical Advisory Board, has begun work to create a Climate Justice Advisory Group, and OER and DEM have both onboarded additional staff to assist with the state's numerous climate programs, including staff members in both organizations focused on energy and climate justice.

Much has changed in the world, the country, the region, and Rhode Island with respect to attitudes, actions, and science related to climate change since 2016. Key changes since 2016 include new emissions reduction mandates directed by the 2021 Act on Climate; new learning from analyses, reports, progress on actions, and advances in science, technology, and business; emergency events leading to a renewed and stronger sense of urgency to act; and changing factors like new funding opportunities, renewable energy procurements, and changes in utility ownership.

Perhaps most importantly, the *2022 Update* builds the foundation for developing the *2025 Climate Strategy*. The *2022 Update* reflects on past progress and identifies our priority short-term actions needed to stay on the right path to meet our 2030 emissions mandate, in hope these priorities will be well established by 2025. The *2025 Climate Strategy* will then build out workplans for each sector to meet our mandates and set us on a viable path to reach net-zero emissions by 2050.

The development of the *2022 Update* was an opportunity to reconsider and confirm technical aspects of modeling, be action oriented, promote resilience and reliability, and emphasize the role of renewable energy resources. Updates of the modeling will be a significant component of the 2025 Climate Strategy.

The 2021 Act on Climate set forth a mandate to reach 'net-zero emissions by 2050'. However, the law did not define the terms 'net-zero' or 'emissions', leaving open questions of which emissions, how we net those emissions, and on what timeframe the netting occurs. Following public discussions held in three sharing sessions and supplemented by online comments, the *2022 Update* provides definitions and offers several critical caveats related to how our definitions may evolve over the next three decades.

During the dialogs with stakeholders, it became clear that the development of the *2022 Update* to the *2016 Greenhouse Gas Emissions Reduction Plan* was also an opportunity to reconsider and confirm technical aspects of modeling. Current emissions inventory processes, methodologies, and tools were reviewed in detail and, in many cases updated and modernized to use better local data. Two central principles governing how and when we update process, methodologies, and tools specifically related to the 1990 baseline and estimating emissions from the land use, land use change, and forestry (LULUCF) sector. We also include explicit actionable recommendations for additional analysis in support of the development of the *2025 Climate Strategy*, as well as recommendations for improving transparency of how Rhode Island will assess interim compliance with the 2021 Act on Climate

In terms of progress and where we stand, Rhode Island's 2019 gross greenhouse gas emissions – the most recent inventory on record – are estimated to be 10.82 MMTCO2e. This level of emissions is 1.8% below emissions in 2016. Since 2016, electric power consumption emissions decreased by 28.0%, residential heating emissions increased by 13.5%, commercial heating emissions increased 8.8%, transportation emissions increased 8.8%, industrial emissions decreased 9.2%, agricultural emissions increased 39.2%, and waste emissions increased 14.2%.

Rhode Island's Greenhouse Gas Emissions come from several sources. The transportation sector is the largest source (39.7%) of greenhouse gas emissions. The thermal sector (residential heating, commercial heating, industry, and natural gas distribution) accounts for 38.8% of emissions. The electricity consumption sector accounts for 18.9% of emissions. Agriculture and waste account for the other 2.6% of emissions. As we electrify more and more of our transportation and heating systems, those emissions will switch to the electricity consumption sector, which will then be eliminated by transition to renewable, zero-emission sources of electricity.

As of July 2022, the state has counted approximately 1,149 MW of clean energy generation capacity. . Of Rhode Island's current 1,149 MW total, 430 MW is offshore wind which is mostly under contract for the Revolution Wind facility scheduled to come online in 2026, 527 MW is solar, 148 MW is onshore wind, 35 MW is landfill gas/anaerobic digestion, and 9 MW is small hydroelectric power. Including the 400 MW Revolution Wind project, approximately 85 percent of Rhode Island's current clean energy portfolio is comprised of in-state renewables or projects scheduled for adjacent federal waters.

Key Studies and Legislation Since 2016

Since 2016, the State has conducted several in-depth studies deepening our understanding of decarbonization activities and enabling actions. The *2022 Update* includes a list and summary of over a dozen major studies that either directly authored by state agencies or state-commissioned subject matter experts. These studies contain numerous data-driven and stakeholder-informed recommendations for future action that should be continually referenced throughout strategic climate planning.

The list of studies in the *2022 Update* is not complete but is illustrative of the large and growing body of work we can rely on as we continue to reassess and refine our climate strategy. This list does not include state plans in which stakeholders and agencies prioritize and plan investments in state infrastructure nor does this list include retrospective evaluations of programs, though such evaluations are crucial to increasing the impacts of these programs. This list also omits studies conducted by federal agencies and non-governmental organizations that add to our understanding and depth of knowledge.

However, all these studies have advanced the specific knowledge of both decarbonization and resilience in Rhode Island.

Additionally, the Rhode Island General Assembly has debated and passed several bills addressing different aspects of our response to climate change. Probably the most significant legislation was the 2021 Act on Climate, which set statewide, economy-wide climate goals that are both mandatory and enforceable. The Act requires the state reduce greenhouse gas emissions by 45% below 1990 levels by 2030, 80% below 1990 levels by 2040, and reach net-zero emissions by 2050. The Act also requires the development of this update to the *2016 Greenhouse Gas Emissions Reduction Plan* in 2022 and a comprehensive climate strategy by 2025, to be updated every five years thereafter.

Critically, the Act deems addressing the impacts on climate change to be within the powers, duties, and obligations of all state departments, agencies, commissions, councils, and instrumentalities, including quasi-public agencies. The Act gives each agency the authority to promulgate rules and regulations necessary to meet the Act's greenhouse gas emission reduction mandates.

Also in 2021, legislation updated the Biodiesel Heating Oil Act of 2013 to phase in higher percentages of biodiesel or renewable hydrocarbon diesel blended into home heating oil. The new law that was signed by Governor McKee requires home heating oil to be 10% biodiesel or renewable hydrocarbon diesel in 2023, 20% in 2025 and 50% in 2030.

In January 2020, Executive Order 20-01 set a first-in-the-nation goal to meet 100% of Rhode Island's electricity demand with renewable energy by 2030. In 2022, the RI legislature passed a bill, subsequently signed by Governor McKee, to commit the state to 100% renewable energy by 2033.

Offshore wind-powered energy will play a major role in the reduction of greenhouse gasses. In 2016, Rhode Island became home to the first offshore wind project in the nation with the successful installation of the 30 MW Block Island Wind Farm. In 2019, another contract for the 400 MW Revolution Wind was approved. In 2022, the legislature authorized procurement of up to an additional 1000 MW of power generated from offshore wind.

Obviously, action is needed to meet the upcoming emission reduction mandates in the Act on Climate. While the details, modeling, and balancing of these actions across the sectors of our economy will be done as part of the 2025 Strategic Plan, the following actions are underway and must continue.

Turning our attention to priority actions in Rhode Island's three biggest source sectors – electric, transportation and thermal – this report identifies strategic actions the state needs to advance to meet mandates as outlined in the Act on Climate. Additional priority actions for land use and climate justice are identified further in the report.

Priority Actions for the Electric Sector

Implement the 100% Renewable Energy Standard

During the 2022 legislative session, a 100% Renewable Energy Standard (RES) was passed by the RI General Assembly and signed by Governor McKee. The RES ensures we decarbonize the electric sector with yearly targets. Rhode Island's RES is an existing statutory mechanism by which we can require electricity suppliers to meet an increasing percentage of retail electric sales from renewable energy resources. The RES also sets forth an accounting methodology and process to ensure compliance.

The schedule and yearly targets set forth in the 100% RES bill steadily increase over time starting with an additional four percent of retail electricity sales in 2023 and increases until an additional 9.5% of retail electricity sales are needed in years 2032 and 2033.

Modernize the Electric Grid

Our current electric grid is built for one-way flow of electricity from a few large power generators to many end customers. However, decarbonizing our electric grid necessitates a paradigm of two-way power flow between renewable energy systems of all sizes distributed throughout the electric grid to all customers. Safely, reliable, and affordably building out the electric grid will require electric distribution companies to make strategic investments in technologies for a twenty-first century electric grid.

Grid modernization technologies serve the purpose of managing power flow, protecting workers and customers, improving visibility into electricity consumption and grid conditions, building resilience from power outages, and giving customers more choice and control over their electricity use.

Deploy Advanced Meters

Meters that measure electric (and gas) consumption for utility accounts range in capability from simple counting and aggregation of energy use over a billing period to detailed accounting of consumption throughout minutes-long intervals and real-time communication with customers. Most meters in Rhode Island are more like the former – basic gadgets that report how much energy a customer uses over the course of a month – and they are reaching the ends of their useful and reliable lives.

Procure Offshore Wind

Offshore wind is a not only a vital renewable energy resource but a significant economic driver of growth and jobs in Rhode Island. As we move to implement the 100% Renewable Energy Standard, offshore wind will play a critical role in affordable meeting both our in-state renewable energy requirements as well as supporting the region.

On July 6, 2022, Governor McKee signed a bill into law adding up to 1,000 MW more megawatts of offshore wind to Rhode Island's clean energy portfolio. Rhode Island Energy, RI's new gas and electric utility as of 2022, then released a request for proposals for up to 1,000MW in the Fall of 2022 (proposals are due in March 2023). It is expected that any new offshore wind projects procured through the RFP would be operational during the first half of the 2030s.

Continue Energy Efficiency Work

Energy efficiency programming in Rhode Island helps residents and businesses adopt and install technologies that allow them to receive the same or better performance from their equipment, buildings, and appliances while using less energy to do so. Rhode Island's energy efficiency programs are offered through the state's utilities and from the Rhode Island Office of Energy Resources. These services can directly lower energy bills for participating consumers. reducing both emissions and energy costs for all consumers, which help support the local economy, and combat climate change. In 2021 Rhode Island's least cost procurement statute was extended to 2029, which ensures the energy efficiency programs for the next seven years.[2]

Complete RGGI Program Review and Implement Suggested Changes

The Regional Greenhouse Gas Initiative (RGGI) is a cooperative, market-based effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and Virginia to cap and reduce CO2 emissions from the power sector. It represents the first cap-and-invest regional initiative implemented in the United States. Rhode Island has continued to be an active participant in RGGI since 2009. A Third Program Review is currently underway throughout 2021-2023, which will inform RGGI program design for future years.

Priority Actions for the Transportation Sector

There are two ways to reduce emissions in the transportation sector: consume less fuel and consume lower-emissions fuel. To consume less fuel, we can discourage high-emissions driving and encourage low-emissions mobility solutions. To consume lower-emissions fuel, we need to encourage electric vehicles and expand electric vehicle charging infrastructure. Over the next five years, we can strengthen the groundwork for integrating climate into our investment decisions and take action to incentivize lower-emissions mobility.

[2] Least Cost Procurement: http://webserver.rilin.state.ri.us/Statutes/title39/39-1/39-1-27.7.HTM

Target 10% Penetration of Electric Vehicles by 2030

As of October 2022, Rhode Island has 6,275 *registered* electric vehicles, which is a 1,313% increase in EVs since 2015. If Rhode Island adopted Advanced Clean Cars II, 68% of all new passenger vehicles *sold* in the state would be electric in 2030. By having programs focused on Zero-Emission Vehicles, such as DRIVE EV, an electric vehicle rebate program available to Rhode Island residents and businesses, it will help increase the amount of registered electric vehicles on the road in Rhode Island as mandated by the 2021 Act on Climate, as well as paving the way for further expansion of EV penetration, post 2030.

As Resources are Available, look to the Transit Master Plan (TMP)and Bicycle Mobility Plan (BMP) as Well-vetted Strategies for Next Steps

RIDOT, RIPTA, and RIDSP have all developed planning work tasks to support mapping, evaluation, and implementation of projects and priority corridors which were recommended in the TMP or BMP respectively. These agencies continue to prioritize projects advancing better connections for both transit and bicycle/pedestrian modes as the state looks to identify funding for the TMP and BMP.

Reduce RIPTA's Carbon Footprint by decarbonizing Rhode Island's transit fleet.

The full cost of fleet decarbonization is currently unknown. RIPTA is preparing an Action Plan for Electrification and Service Growth which will provide estimated annual decarbonization infrastructure, vehicle, and energy costs. This plan will be complete in 2023.

Adopt Advanced Clean Trucks Rule

The federal Clean Air Act (CAA) grants the U.S. Environmental Protection Agency (EPA) original jurisdiction for establishing emission standards for new motor vehicles, including heavy-duty trucks.

Under CAA Section 177 (42 USC § 7507), states that choose to adopt vehicle emission standards that are more stringent than the federal standards for new vehicles may adopt standards that are identical to any standards adopted by California.

Rhode Island has previously adopted California's emissions standards for passenger cars and trucks and, through the state's rulemaking process, could further opt-in to California's standards by amending 250-RICR-120-05-37 to include new standards for medium- and heavy-duty vehicles. Rhode Island should continue to adopt new rules, including California's Advanced Clean Trucks (ACT), the Low NOx Heavy-Duty Omnibus (HD Omnibus), and Phase 2 Greenhouse Gas (Phase 2 GHG) emission standards for trucks and trailers, as well as the Advanced Clean Cars II regulation.

Incentivize Electric Mobility

In July 2022, OER launched an electric vehicle rebate program, DRIVE EV. Driving Rhode Island to Vehicle Electrification (DRIVE) is an electric vehicle (EV) and e-Bike rebate program administered by the Rhode Island Office of Energy Resources (OER) to support adoption of electric vehicles by Rhode Island residents, small-businesses, non-profits, and public sector entities. DRIVE EV also provides additional incentives for qualified Rhode Islanders who purchase or lease an eligible electric vehicle and meet certain income requirements or participate in a State or Federal Income-Qualifying Program. It works towards making EVs more affordable for more Rhode Islanders.

Model Climate Impacts of Transportation Demand

To understand how projects of regional significance in the State Transportation Improvement Program (STIP) contribute to GHG emissions and to assess future policy options and investment strategies towards the reduction of those emissions, Rhode Island Department of Transportation (RIDOT) is working with

other state partners to improve the modeling of GHG, establishing performance measures to help reduce emissions and creating a Carbon Reduction Plan per federal guidelines.

Investments in transportation capital projects are prioritized based on many factors, including asset management, readiness, risk levels, available funding, and opportunities for partnership. Due to changes in both state and federal regulations and guidelines, this data-driven process now will include another layer that determines how regionally significant projects impact carbon emissions in the state. The state planning process determines these priorities so that adequate investments are made based on the proper funding sources and uses, and to meet mandates such as performance measures.

Develop 'Complete Streets' State Plan Leveraging Federal Funding

USDOTs definition of "Complete Streets" as "Streets that are streets designed and operated to enable safe use and support mobility for all users. Those include people of all ages and abilities, regardless of whether they are travelling as drivers, pedestrians, bicyclists, or public transportation riders. The concept of Complete Streets encompasses many approaches to planning, designing, and operating roadways and rights of way with all users in mind to make the transportation network safer and more efficient. Complete Street policies are set at the state, regional, and local levels and are frequently supported by roadway design guidelines."

In Rhode Island, RIDOT and RIDSP have joined together to maximize the impact of that funding. RIDSP will lead a 2.5-year effort to invest more than $250,000 in combined planning funds into development of a Complete Streets Plan and Design Guidelines. This project has kicked off (fall 2022) with a draft RFP for consultant assistance, which RIDSP expects to complete and issue in spring 2023, in coordination with RIDOT and RIPTA. This project is included in the FY2023 Unified Planning Work Program (UPWP), which is the annual RIDSP program of projects under development.

Priority Actions for the Thermal Sector

The thermal sector consists of emissions from all thermal processes, including space heating and cooling, high-heat industrial processes, refrigeration, cooking, and household activities such as clothes drying. Fossil fuels, electricity, and bio-based materials are all used as energy sources for thermal processes in Rhode Island.

Continue Energy Efficiency Programs and Weatherization

Weatherization of buildings is key to ensuring a successful transition to decarbonized heating and cooling, because it helps to decrease our overall energy demand. While the utilities' efficiency programs support a number of weatherization programs and appliance efficiency standards, these should continue to be expanded

Target 15% Penetration of Energy Efficient Electric Heating by 2030

A conversion of 15% of Rhode Island's buildings from fossil fuel heat to efficient electric heating by 2030 is an aggressive, but attainable and necessary target. While the market for efficient electric heating—including a variety of heat pump technologies—is relatively nascent in Rhode Island, the next several years will be used to build a strong foundation for the market to expand at a quicker pace in the last two decades as we approach 2050. The priority actions below, will help us reach this 15% target and plan for further expansion, in tandem with other decarbonized thermal technologies, post 2030.

Efficient Heat Pump Incentives

There are several mechanisms for incentivizing efficient heat pumps that are expected to be used in the coming years. First, the Office of Energy Resources will be launching the High Efficiency Heat Pump Program (HHPP) in 2023, which will combine federal funding from the American Rescue Plan Act (ARPA) with existing incentives provided by Rhode Island Energy's energy efficiency programs. Second, the Inflation Reduction Act, recently passed by the U.S. Congress, will provide a suite of incentives including tax credits and rebate programs for heat pumps and other electric thermal appliances, such as induction stoves. The State will work diligently to ensure that the maximum benefits are easily accessible to Rhode Islanders and that federal incentives for heat pumps compliment State offerings.

Increase Biofuel Blending in Accordance with the 2021 Biofuel Heating Oil Act

The 2021 Biofuel Heating Oil Act requires that, by 2030, all No. 2 distillate heating oil sold in Rhode Island, "shall at a minimum meet the standards for B50 biodiesel blend and/or renewable hydrocarbon diesel." This means that by 2050 all heating oil in the state will contain at least 50% biodiesel, significantly decreasing the carbon intensity of home heating oil.

Continue to Abandon Leak-Prone Gas Pipes and Pursue Non-pipe Alternatives

Public Utilities Commission Docket No. 5210, "National Grid's FY 2023 Gas Infrastructure, Safety and Reliability (ISR) Plan," contains the Leak Prone Pipe Replacement Program which replaces leak-prone gas mains throughout the Rhode Island gas distribution network. Since the program's beginning in 2012, 537 miles of leak-prone pipe have been replaced and an additional 951 miles are expected to be completed by the program's end in 2035. Gas mains that are replaced through this program have an expected lifespan between 50-100 years, locking in gas infrastructure well beyond the target date for an emissions-free state. Therefore, in the coming years, more emphasis should be placed on non-pipes alternatives (NPA). NPA seeks alternative ways of providing thermal service to Rhode Islanders, rather than expanding and enforcing the fossil gas network.

Future of the Gas Distribution System

Just over half of Rhode Islanders are connected to the gas system for heating, cooking, and various other household appliances. Gas is also used for high-heat industrial processes. Pipelines and other gas infrastructure have been, and continue to be, built with decades to centuries-long time horizons.

In August 2022 the Rhode Island Public Utilities Commission (PUC) opened Docket 22-01-NG, "Investigation into the Future of the Regulated Gas Distribution Business in Rhode Island in Light of the Act on Climate." Commencing in 2023, this docket will serve as an important first step in beginning to plan for the gas system's transition to carbon neutrality.

Begin Developing a Renewable Thermal Standard

Like the recently enacted 100% Renewable Energy Standard, the state should begin to plan for a renewable thermal standard to phase thermal emissions down at intervals that align with the Act on Climate emission reduction mandates.

Looking Forward to 2025 and Beyond

The Act on Climate required that the Executive Climate Change Coordinating Council (EC4) deliver this update to the *2016 Greenhouse Gas Emissions Reduction Plan* to the Governor and General Assembly by December 31, 2022. After a fourteen-month process involving substantial stakeholder engagement, research, and compilation and coordination among the 13 state agencies in the EC4, this *2022 Update* has been prepared to serve as a benchmark and updated foundation for the work ahead.

With technical assistance funding from the US Climate Alliance, Rhode Island partnered with the Rocky Mountain Institute (RMI) and Acadia Center to undertake high-level greenhouse gas modeling focused on the near term 2030 reduction mandate (45% below 1990 levels). A high-level state decarbonization analysis was performed by the Acadia Center utilizing the RMI's *Energy Policy Simulator* (EPS). By modeling a short list of key policy scenarios as outlined in the report, it is projected that Rhode Island is not fully on track to meet the Act on Climate's 2030 reduction mandate of 45% by 0.5 $MMTCO_2e$. To put this in perspective, the emissions in 2030 are projected by the EPS to be 7.39 $MMTCO_2e$, as compared to the 1990 baseline of 12.48 $MMTCO_2e$. This is a very simple, preliminary model that verifies Rhode Island is moving in the right direction but is not at the point where we can be confident in our success. More refined modeling and development of specific strategies to increase that confidence will be the crux of the 2025 Strategic Plan.

On that note, the EC4 will immediately turn attention to the *2025 Climate Strategy*, which will include a set of "strategies, programs, and actions to meet economy-wide enforceable mandates for greenhouse gas emissions" due by December 31, 2025. The *2025 Climate Strategy* will be developed via a robust stakeholder process modeled 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.

The agencies in the EC4 will focus on implementation of the action items outlined above and throughout this report. The EC4 will continue to work with the Advisory Board, as well as the Science and Technical Advisory Board (STAB) and Climate Justice working group, to refine policies and develop metrics and the public dashboard called for in the Act. The metrics and dashboard will serve as an educational and communications toll to highlight progress and the status of our efforts.

Discussions of identifying and allocating resources to these efforts will continue. The decarbonization and transition of our economy must be done carefully, and deliberately, to meet the goals set forth in the statutes. This will require both internal and external expertise and support for all the agencies. In the near term, prospects for federal support in many areas looks strong, particularly from the federal Bi-Partisan Infrastructure Law and the Inflation Reduction Act. However, these federal funds will not provide complete support needed for our efforts and state funds will be needed. Effective community and stakeholder engagement will especially require financial and expert support so that the voices of all Rhode Islanders can be heard as we move forward.

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Introduction and Scope

On April 14, 2021, 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. 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 (EC4) deliver an update to the *2016 Greenhouse Gas Emissions Reduction Plan* to the Governor and General Assembly by December 31, 2022 (referred to as the '*2022 Update'*). The Act was clear that the *2022 Update* needed to be informed by public comment and stakeholder discussions. This 2022 update reflects the work of many people over the past fourteen months and is the first major milestone in implementing the Act on Climate.

Following the completion and submission of this report, our attention will turn to the strategies, actions, and modeling to meet the reduction targets in the law. The EC4 will develop a plan to incrementally reduce climate emissions to net-zero by 2050 to be delivered to the Governor and the General Assembly by December 31, 2025 (referred to as the '*2025 Climate Strategy'*). The *2025 Climate Strategy* will be developed via a robust stakeholder process 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. This, however, should not be viewed as the only opportunities or requirements for state agencies and offices pertaining to climate action (e.g. regulatory authority, mission, duties, etc. as called for in RIGL §42-6.2-8).

A note on terminology:

- ***2016 Plan*** refers to the *2016 Greenhouse Gas Emissions Reduction Plan* published in December 2016 in response to the 2014 Resilient Rhode Island Act
- ***2022 Update*** refers to the required update to the *2016 Greenhouse Gas Emissions Reduction Plan*, as mandated by the 2021 Act on Climate
- ***2025 Climate Strategy*** refers to the set of "strategies, programs, and actions to meet economy-wide enforceable targets for greenhouse gas emissions" due "no later than December 31, 2025, and every five (5) years thereafter", as mandated by the 2021 Act on Climate

The following scope and objectives of the *2022 Update* to the *2016 Greenhouse Gas Emissions Reduction Plan* were informed by discussions with stakeholders and the public during a November 2021 sharing session, as well as by comments received through the online public comment portal.

The 2022 Update should:

- ☐ *Be responsive to the 2021 Act on Climate*
- ☐ *Center equity and be developed using a meaningful public participation process*
- ☐ *Leverage lessons learned since 2016*
- ☐ *Build a foundation for the* 2025 *Climate Strategy*
- ☐ *Reconsider and confirm technical aspects of modeling, be action oriented, promote resilience and reliability, and emphasize the role of renewable energy resources*
- ☐ *Focus on near-term actions to achieve the 2021 Act on Climate's 2030 mandate*

First, the *2022 Update* must first and foremost be responsive to the 2021 Act on Climate. We are operating under the premise that the legislative intent and objective of the 2021 Act on Climate mandates

is to limit the worst impacts of climate change in alignment with the latest science.[3] We rely on the latest science and recommendations of the Intergovernmental Panel on Climate Change (IPCC).[4]

Second, developing the *2022 Update* should rely on robust and meaningful stakeholder engagement in order to appropriately center equity into the discussion. We welcomed feedback and suggestions from stakeholders throughout the development process, and relied on a combination of workshops, sharing sessions, and one-on-one conversations to strike a helpful balance of providing support, facilitating conversation, and making space to listen and learn.

Third, the *2022 Update* should recognize and leverage lessons learned since 2016 when the previous greenhouse gas emissions reduction plan was published. Key changes since 2016 include new emissions reduction targets directed by the 2021 Act on Climate; new learning from analyses, reports, progress on actions, and advances in science, technology, and business; emergency events leading to a renewed and stronger sense of urgency to act; and changing factors like new funding opportunities, renewable energy procurements, and changes in utility ownership.

Fourth, the *2022 Update* should build a foundation for developing the *2025 Climate Strategy*. These two documents should avoid duplicating each other and instead build on each other so that we place continued pressure on reducing our emissions. The *2022 Update* reflects on past progress and identifies our priority short-term actions needed to stay on the right path to meet our 2030 emissions mandate. The *2025 Climate Strategy* will then build out workplans for each major sector in order to meet our interim mandates and set us on a viable path to reach net-zero emissions by 2050.

Fifth, the development of the *2022 Update* is a ripe opportunity to reconsider and confirm technical aspects of modeling, be action oriented, promote resilience and reliability, and emphasize the role of renewable energy resources. Modeling will be a significant component of the 2025 Climate Strategy.

Finally, the *2022 Update* identifies a clear set of priority near-term action items that will keep Rhode Island on a compelling path to reach the 2021 Act on Climate's 2030 mandate of 45% emissions reduction below our 1990 baseline. Further accountability, roles, and responsibility are included for each priority action wherever possible.

Based on these objectives, we developed the following scope of the *2022 Update*, which informed both our workplan for developing the *2022 Update* and the outline reflected in this document.

Scope of the *2022 Update*

- Technical updates:
  - Update greenhouse gas emissions reduction targets to comply with the 2021 Act on Climate, and define the goal of reaching 'net zero emissions by 2050'
  - Review modeling to ensure the 1990 baseline is sound, data are defensible, and modeling assumptions are reasonable
- Update pathways, policy, and implementation strategies
  - Restructure pathways and policies from *2016 Plan* to coordinate with emissions sectors
  - Provide updates on progress for each policy and implementation strategy recommended in the *2016 Plan*

[3] See for example RIGL §42-6.2-3.9, which states state agencies shall "Develop plans, policies, and solutions based on the latest science to ensure the state continues to have a vibrant coastal economy, including protection of critical infrastructure, and a vibrant and resilient food system that can provide affordable access to healthy food for all Rhode Islanders" (emphasis added).

[4] Intergovernmental Panel on Climate Change

    - Add policy and implementation strategies recommended by more recent studies
    - Refine policy and implementation strategies based on lessons learned
    - Update policy and implementation strategies to identify priority actions to meet the 2030 mandate, clarify roles, and identify mechanisms for accountability
    - Consider new and forthcoming funding opportunities
- Review and update the entire *2016 Plan* with equity appropriately centered and integrated throughout
- Identify key stakeholders to engage (and engage them!)
- Design a climate dashboard that tracks progress on community-prioritized outcomes using clearly defined, transparent, and meaningful metrics
- Identify and address the prerequisite needs of the *2025 Climate Strategy* and preview the work ahead

Components of the *2016 Plan* that do not need to be updated include the model itself; the guiding objectives to build on state success, enable markets and communities, and leverage regional collaboration; and the process of RIDEM's triennial greenhouse gas reporting.

Defining Net-Zero Emissions by 2050

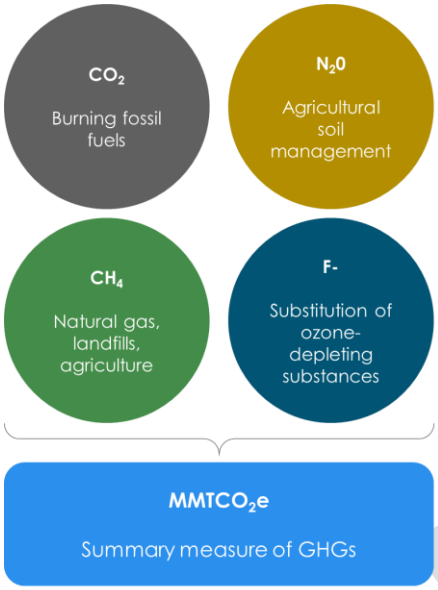
The 2021 Act on Climate sets forth a mandate to reach 'net-zero emissions by 2050' (RIGL 46-6.2). However, the law does not define the terms 'net-zero' or 'emissions', and therefore leaves open questions of which emissions, how we net those emissions, and on what timeframe the netting occurs. Following public discussions held in three sharing sessions and supplemented by online comments, we propose the following definitions and offer several critical caveats related to how our definitions may evolve over the next three decades.

> 'Emissions' refer collectively to the set of greenhouse gases that contribute to climate change. Based on current science, greenhouse gases include carbon dioxide, methane, nitrous oxide, and fluorinated gases. The greenhouse gases included in our definition of emissions may evolve over time if climate science uncovers additional gases contributing to climate change.
>
> 'Net-Zero' refers to the requirement that the summary measure of greenhouse gas emissions emitted over the course of a calendar year less the summary measure of greenhouse gas emissions absorbed or otherwise broken down over the course of a calendar year equals zero. All emissions can be summarized in a measure such as million metric tons carbon dioxide equivalent ($MMTCO_2e$) using global warming potential factors which adhere to international standards, including those of the IPCC[5] and UNFCCC[6], and are embedded within the US EPA's[7] greenhouse gas emissions inventory tools.

Which emissions?

Greenhouse gases are molecules that cause and exacerbate climate change. The IPCC and US EPA identify four types of greenhouse gases[8]:

[5] Intergovernmental Panel on Climate Change
[6] United Nations Framework Convention on Climate Change
[7] United States Environmental Protection Agency
[8] "Greenhouse gases (GHGs) - Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of radiation emitted by the Earth's surface, by the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapour (H2O), carbon dioxide (CO2), nitrous oxide (N2O), methane (CH4) and ozone (O3) are the primary GHGs in the Earth's atmosphere. Human-made GHGs include sulphur hexafluoride (SF6), hydrofluorocarbons (HFCs), chlorofluorocarbons (CFCs) and perfluorocarbons (PFCs); several of these are also O3-depleting (and are regulated under the Montreal Protocol). See also Well-mixed greenhouse gas" [IPCC Glossary] Note that IPCC, US EPA, and Rhode Island do not count water vapor or ozone in tracked emissions.



Carbon dioxide (CO2) is the most prevalent greenhouse gas. Its primary source is from the combustion of fossil fuels.

Nitrous Oxide (N2O) is a type of greenhouse gas that is emitted in part from certain agricultural soil management practices.

Methane (CH4) is released into the atmosphere from natural gas leakage, from landfills, and from some agriculture.

Fluorinated gases are a set of greenhouse gases containing hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3). While these gases are less common, they have a more substantial impact on climate change. These gases primarily stem from the substitution of ozone-depleting substances.

One legislative objective of the 2021 Act on Climate is to limit the worst impacts of climate change in alignment with the latest science.[9] We rely on the latest science and recommendations of the IPCC. Since all four types of greenhouse gases are recognized by the IPCC as contributors to climate change, all four must be included in our accounting of emissions generally and in our emissions reduction strategies specifically. If additional greenhouse gases are identified, then those greenhouse gases should also be accounted for.

> 'Emissions' refer collectively to the set of greenhouse gases that contribute to climate change. Based on current science, greenhouse gases include carbon dioxide, methane, nitrous oxide, and fluorinated gases. The greenhouse gases included in our definition of emissions may evolve over time if climate science uncovers additional gases contributing to climate change.

The IPCC regularly re-evaluates the relative contributions of these greenhouse gases to climate change. One key parameter used to describe these relative impacts is a greenhouse gas's 'global warming potential' (GWP). The GWP allows for comparisons of the global warming impact of different gases. Specifically, it is a measure of how much energy the emissions of 1 ton of a gas will absorb over a given period of time, relative to the emissions of 1 ton of carbon dioxide (CO_2). All global warming potentials are relative to the impact of carbon dioxide, whose GWP is equal to one (GWP = 1). The greater the GWP, the more a given gas warms the Earth compared to CO_2 over that time period. Other greenhouse gases, which have relatively more impact on causing climate change on a molecule-by-molecule basis, have global warming potentials greater than one.

Global warming potentials depend on both the impact of each molecule of the greenhouse gas and how long each molecule stays in the atmosphere. Greenhouse gases that tend to stay in the atmosphere longer have a longer timeframe over which they can cause climate change; on the other hand, molecules that are broken down or absorbed quickly have only a short time over which they can contribute to climate

[9] RIGL §42-6.2-3.9 states state agencies shall "Develop plans, policies, and solutions based on the latest science to ensure the state continues to have a vibrant coastal economy, including protection of critical infrastructure, and a vibrant and resilient food system that can provide affordable access to healthy food for all Rhode Islanders" (emphasis added).

change. Global warming potentials are continually studied by the IPCC and are subject to change over time depending on the most recent analyses.

In practice, we propose to use the global warming potentials embedded in the US EPA's greenhouse gas emissions inventory tools, which adhere to international standards, including the IPCC and UNFCCC. We additionally propose to include a qualitative or sensitivity analysis to describe how our current emissions levels may differentially contribute to climate change if global warming potentials are modified. For example, while our current inventory uses a 100-year timeframe for the global warming potential of methane (because this is the parameter embedded in the US EPA greenhouse gas inventory tool), we will also describe how our inventory might look different if we were to use a 20-year timeframe instead. A qualitative description may be included more frequently than an administratively intensive quantitative sensitivity analysis.

All emissions will be summarized in a metric called million metric tons carbon dioxide equivalent ($MMTCO_2e$). This metric accounts for both the amount of each greenhouse gas in our atmosphere *and* its relative impact on climate change. This is a common metric used across the climate science sector to summarize greenhouse gases.

Anthropogenic versus biogenic emissions sources

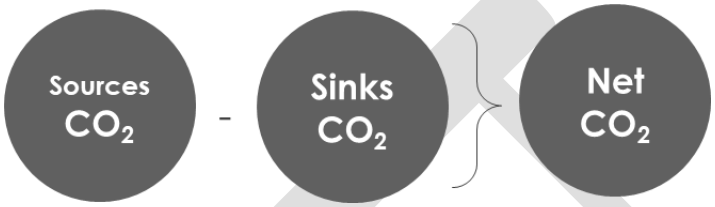
> *Biogenic emissions are emissions that come from natural sources.*[10] *In contrast, anthropogenic emissions are emissions that come from human activities.*[11] *Both types of emissions contribute to climate change, and both are accounted for in some manner by the US EPA's greenhouse gas inventory tools. However, our greenhouse gas inventory and emissions reduction strategies tend to focus more on anthropogenic emissions because these are the emissions within our control. We propose to include in our greenhouse gas inventory and definition of emissions whatever emissions sources – anthropogenic and/or biogenic – are recommended by the US EPA in alignment with IPCC guidance.*

There are a variety of methods that can be used to estimate the greenhouse gas emissions from the electric sector. Our current accounting method for the electric sector is consumption-based, rather than generation-based.[12] This means that we calculate emissions based on electricity used within Rhode Island, regardless of where the generation sources are located that provide the electricity.

The consumption-based approach reflects significant historical and ongoing change in the mix of fuels used to generate electricity in New England. When we consider consumption-based versus generation-based inventories, we have to consider how we can ensure that all emissions are accounted for by some state. Consider, for example, Rhode Island and Maine. Rhode Island's consumption-based inventory only accounts for emissions from an in-state fossil-based power plant if its output electricity is consumed in state. However, let's say Maine only has a production-based inventory but uses some of the electricity from the Rhode Island power plant. In this fictional example, the emissions produced in Rhode Island and consumed in Maine would incorrectly not be accounted for in either state's greenhouse gas emissions inventory. This would lead to too little climate mitigation action.

[10] US EPA
[11] IPCC Glossary
[12] In May 2016, the EC4 voted to officially adopt a consumption-based methodology; this memo summarizes those considerations.

Therefore, it is critical that we work with neighboring states and states in our region to understand the flow of emissions and ensure emissions are accounted for. This comprehensive accounting also requires consistency in how inventorying is done across state borders. In the absence of consistent methodology, we will need to caveat our greenhouse gas inventory with an additional description of which emissions may not be included.



How do we 'net' these emissions?

Netting is the process of accounting for both sources of emissions and 'sinks' that cause emissions to be absorbed, broken down, or otherwise rendered incapable of contributing to climate change. For example, tree growth is considered a carbon sink because trees absorb carbon from the atmosphere. There are two methods by which we can net emissions. Rhode Island's current greenhouse gas inventory first summarizes all greenhouse gas emissions sources as $MMTCO_2e$ and then subtracts all greenhouse gas emissions sinks as $MMTCO_2e$.[13] An alternative method is to require that each specific greenhouse gas reached net zero. For example, the total methane emitted by all sources minus the total methane absorbed by all sinks is required to equal zero in 2050, as is required for each type of greenhouse gas.

Given the legislative objective of the 2021 Act on Climate to align Rhode Island's greenhouse gas emissions with the latest science and recommendations to limit global warming and resulting climate change impacts, we propose continuing our current method of netting emissions because the summary measure of $MMTCO_2e$ already encapsulates the total impact of emissions on climate change. In other words, netting each type of greenhouse gas provides no incremental aid in reaching our objective to limit climate change impacts, and may actually be more difficult to achieve.

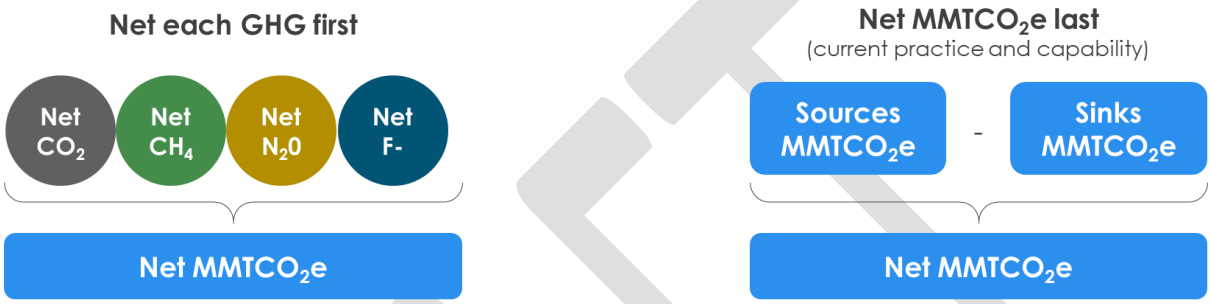
> 'Net-Zero' refers to the requirement that the summary measure of greenhouse gas emissions emitted over the course of a calendar year less the summary measure of greenhouse gas emissions absorbed or otherwise broken down over the course of a calendar year equal zero. All emissions can be summarized in a measure such as million metric tons carbon dioxide equivalent ($MMTCO_2e$) using global warming potential factors which adhere to international standards, including the IPCC and UNFCCC, and are embedded within the US EPA's greenhouse gas emissions inventory tools.

Rhode Island's current greenhouse gas emissions inventory methodology was updated for the 2019 inventory to account for emissions sinks. While the US EPA's greenhouse gas inventory tools do estimate emissions reductions from land use, land use change, and forestry (abbreviated LULUCF), these tools have known reliability issues and therefore are not included in previous years inventories. Rhode Island is moving ahead with utilizing state specific data to account for emissions reductions from LULUCF from 2019 and beyond.

[13] We refer interested readers to the most recent Greenhouse Gas Emissions Inventory (2019) for more information about the updated methodology for accounting for LULUCF. https://dem.ri.gov/environmental-protection-bureau/air-resources/greenhouse-gas-emissions-inventory

- As we progress toward 2050, we will continue to refine methods of accounting for emissions reductions due to land use, land use change, and forestry.

If future policy objectives arise, such that reaching net-zero for a particular type of greenhouse gas is a solution, then we should revisit our method of netting emissions. We may also consider estimating net emissions for each type of greenhouse gas if our capability evolves such that doing so is not too burdensome; doing so may provide additional insight about the efficacy of our emissions reduction strategies.



Another consideration is whether to net emissions economy-wide or require each sector within the economy reach net-zero emissions. Similar to the argument for netting $MMTCO_2e$ rather than each type of greenhouse gas, netting emissions economy-wide achieves the legislative objective of limiting the impacts of climate change; netting by sector provides no incremental benefit. However, estimating emissions by sector may provide insight into the efficacy of our greenhouse gas emissions reduction strategies if data and tools are available to do so.

Stakeholders raised two critical concerns about the net-zero emissions mandate. First, stakeholders feared that netting emissions may alleviate a sense of urgency to reduce emissions sources; folks may rely too heavily on as-yet-developed future technology to remove greenhouse gases from the atmosphere. Second, stakeholders emphasized that emissions in our atmosphere will contribute to climate change regardless of the accounting practices we use in our emissions inventory; therefore, we must prioritize actions to reduce emissions rather than dwelling on how to inventory them.

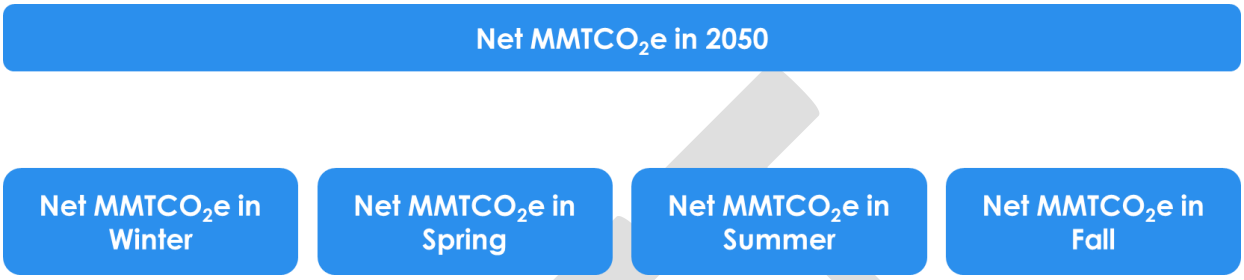
Both concerns are valid and must be addressed. We propose three immediate responses related to maintaining a sense of urgency, limiting our reliance on not-yet-developed technologies, and recognizing the shortfalls of accounting.

Regarding urgency: while this *2022 Update* defines our 2050 emissions reduction mandate, we also include priority actions needed to reach our interim 2030 emissions reduction target. Balancing the emphasis of short-term action with long-term understanding will help with identifying priorities now and developing the *2025 Climate Strategy* over the coming few years.

Regarding future technologies: the priority actions identified within this plan are all related to reducing sources of anthropogenic greenhouse gas emissions and we plan to continue to stress a ‘mitigate first – net as a last resort’ principle in the *2025 Climate Strategy* and subsequent updates.

Regarding accounting: our greenhouse gas emissions inventories allow us to track progress so that we can adjust course if our strategies are not working as needed. We propose to update our greenhouse gas emissions inventory alongside metrics within our climate dashboard with the objective of continual self-

evaluation and improvement. We also will rely on climate experts at the IPCC, US EPA, and at Rhode Island's institutes of higher education to provide technical guidance that underlies our development of strategic policies.



Over what timeframe should we net emissions?

The process of netting emissions sums up the net of all emissions remaining in the atmosphere over a particular timeframe. Current practice is the net emissions over an annual timeframe, in which case the net of all emissions released into the atmosphere between January 1 and December 31, 2050 is required to equal zero. On the other hand, we could require net emissions to equal zero for each season, each month, each day, or even each hour.

There are tradeoffs to a longer timeframe versus a shorter timeframe. A longer timeframe – netting emissions on an annual basis – may be the most appropriate for a complex and volatile system. While more frequent netting – netting emissions sub-annually – may provide insights about seasonal emissions patterns and related emissions reduction strategies, natural randomness and volatility in our behaviors, our economy, and our environment may lead to spurious results and false insights. However, there may be some particular sectors or industries for which sub-annual netting might be appropriate. For example, industries with a defined 'season' (for example, heating) or with relatively insensitive emissions profiles (for example, some manufacturing) might benefit from more frequent netting to obtain more real-time feedback on emissions reduction strategies.

Two additional key considerations are our capabilities and the administrative burden of inventorying greenhouse gas emissions. First and foremost, our capabilities are dependent on capabilities built into existing inventory tools. At this time, we do not have the capability to track emissions on a daily or hourly basis. As tools evolve to include additional flexibility, then our capabilities may evolve as well. Given these capabilities, we want to strike the right balance between getting feedback on our strategies with actually doing the work called for by our strategies; and, importantly, we want to make sure the administrative work we do to measure emissions provides incremental and actionable insights. We propose continuing annual netting at this time, but reassessing capabilities, resources, and benefits within the *2025 Climate Strategy* and each subsequent iteration.

Exogenous limitations

Rhode Island should continue to align with best practices for greenhouse gas inventorying. We do so by leveraging inventory tools developed and maintained by the US EPA, and we rely on the US EPA to update these tools to be consistent with the recommendations of the IPCC.[14] We do not envision Rhode

[14] Specifically, Rhode Island uses the US EPA SIT, the US EPA MOVES, and a method developed in-house based on methodology developed by Massachusetts and Connecticut to estimate emissions from the electric sector. We refer interested readers to the most recent Rhode Island Greenhouse Gas Emissions Inventory for additional technical detail.

Island developing its own tools, but we will strive to improve methods using the most specific data available for Rhode Island as well as the most recent science and coordinate accounting methodologies with the federal government and neighboring states. We can advocate for the US EPA to develop and enhance these key capabilities in future evolutions of their greenhouse gas inventory tools. Furthermore, our Triennial Greenhouse Gas Emissions Inventory provides insights beyond a single point estimate of greenhouse gases by including a discussion of how this point estimate may be sensitive to certain assumptions and therefore imprecise or biased.

Non-quantitative metrics and lived experience

While our climate mandates entail specific greenhouse gas emissions reductions, the 2021 Act on Climate also discusses the need for strategies regarding climate justice, community resilience, and improving public health. These objectives cannot be represented by a single value of $MMTCO_2e$, so we cannot lose sight of the importance of non-quantitative metrics and lived experience. While this chapter discusses technical accounting methodology for estimating our greenhouse gas emissions, we should also continue to provide opportunities to lift up voices from communities across Rhode Island to share their experiences and trust their expertise on priority actions and success (or failure) of our climate strategies.

Greenhouse Gas Emissions Inventory Process, Methodology, and Tools

Stakeholders suggested the development of the *2022 Update* to the *2016 Greenhouse Gas Emissions Reduction Plan* is a ripe opportunity to reconsider and confirm technical aspects of modeling. The objective of this chapter is to describe current emissions inventory processes, methodologies, and tools in order to highlight changes since 2016 and understand the status quo. Much of this content is adapted from the 2019 Rhode Island Greenhouse Gas Emissions Inventory. We refer interested readers to that report for more detail. [15]

We then describe two central principles governing how and when we update process, methodologies, and tools specifically related to the 1990 baseline and estimating emissions from the land use, land use change, and forestry (LULUCF) sector. We also include explicit actionable recommendations for additional analysis in support of the development of the *2025 Climate Strategy*, as well as recommendations for improving transparency of how Rhode Island will assess interim compliance with the 2021 Act on Climate.

Methodologies

The Rhode Island Department of Environmental Management (RIDEM) is the state agency responsible for estimating Rhode Island's greenhouse gas emissions. RIDEM's Office of Air Resources estimates emissions on a calendar-year basis. For example, the 2016 emissions inventory estimates emissions resulting from activities that occurred between January 1, 2016 through December 31, 2016, inclusive of the end dates. For all inventories, there is a three-year lag between the year of emissions and the year of the inventory. For example, Rhode Island's 2016 emissions inventory was estimated in 2019. Rhode Island's 2019 emissions inventory will be released in December 2022. Unless otherwise noted, the emissions inventory year (e.g., '2016 emissions inventory') corresponds to the year in which the emissions resulted, not the year in which estimation occurred. This lag time is caused by reliance on multiple federal and state agencies' dataset releases, and the time required to collect data and modify emissions inventory tools. Rhode Island must endure this lag time to access US Environmental Protection

[15] Available online at https://dem.ri.gov/environmental-protection-bureau/air-resources/greenhouse-gas-emissions-inventory

Agency's (EPA) emissions inventory tools, which are necessary to complete Rhode Island's emissions inventory.

- Rhode Island should coordinate with other states to request the US EPA shorten the lag time from three years to one year or less.

Like many other states that regularly preform economy-wide greenhouse gas emissions inventories, Rhode Island relies heavily on the US EPA's State Inventory Tool (SIT). The tool is an interactive top-down spreadsheet designed to help states develop GHG emissions inventories. The SIT consists of 11 modules which calculate sector-by-sector greenhouse gas emissions based on numerous state-level data sets, including energy-related data provided by the US Energy Information Administration (EIA). When state level data are likely to be more robust than the tool's default data, the US EPA recommends that states employ their own data.

The SIT estimates GHG emissions by applying pollutant-specific emission factors to Rhode Island activity data. The US EPA updates the SIT annually with the latest activity data. If needed, any updates to emission factors and/or parameters like global warming potentials are made as well. Greenhouse gas emissions are converted to a summary unit of measure called million metric tons of carbon dioxide equivalent ($MMTCO_2e$) based on their global warming potentials that allows for better comparison of the impact of different greenhouse gases. These conversions are completed within the SIT.

RIDEM releases annual greenhouse gas emissions inventories. Every three years, RIDEM publishes a "triennial summary" that coincides with the releases of the US EPA's triennial National Emissions Inventory.[16] Each National Emissions Inventory details emissions of criteria air pollutants, criteria precursors, and hazardous air pollutants. Triennial greenhouse gas emissions summaries provide a greater level of detail than annual emissions inventories. Table X below displays the history of default versus non-default model runs. All inventories since 2013 were non-default runs and RIDEM anticipates using non-default runs for all future emissions inventories. In these years, state-specific data was utilized to obtain the most robust emissions estimates. Inventory years 2011 and 2012 were default runs for which emissions were estimated using primarily default data in the SIT. This default data relies on top-down estimates rather than bottom-up primary data collection. Non-default model runs are considered more precise. Consistent methodologies – even with differently sourced data –still allows for comparisons of emissions estimates from year to year. However, caution should be applied when comparing emissions estimates year-over-year when we expect the results to be biased differently when using default versus non-default data. See the callout box on *The Role of Models* below for additional explanation.

Table X. Model Run Types by Emissions Inventory Year.

Rhode Island Greenhouse Gas Emissions Inventory											
	1990	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Triennial Summary Released	No	No	No	No	No	No	No	Yes	No	No	Yes
Model Run Type	Non-Default	Non-Default	Default	Default	Non-Default	Non-Default	Non-Default	Non-Default	Non-Default	Non-Default	Non-Default

[16] As described in the *2016 Greenhouse Gas Emissions Reduction Plan*, Monitoring, Page 26.

Some categories of emissions require other tools and methods instead of or in addition to the SIT. All of RIDEM's tools provide emissions estimates in $MMTCO_2e$ for each of the nine emissions categories: transportation, electricity, residential heating, commercial heating, industry, waste, natural gas distribution, agriculture, and land use, land use change, & forestry. We summarize these emissions estimated for 2019 below; these sectors – transportation, electricity, and thermal[17] – correspond to the following chapters that identify priority actions to reduce emissions.

NOTE: THE IMAGES BELOW WILL BE UPDATED ONCE THE 2019 GHG INVENTORY IS OFFICIALLY RELEASED AND NEW IMAGES HAVE BEEN FORMATTED.

Agriculture and waste account for the other 2.6% of emissions.

The thermal sector (residential heating, commercial heating, industry, and natural gas distribution) accounts for 38.8% of emissions

Source: RIDEM 2019 Greenhouse Gas Emissions Inventory. Please note that data are consistent, but in this document the Thermal Sector includes the following distinct sectors: residential heating, commercial heating, industry, and natural gas distribution.

The transportation sector is the largest source (39.7%) of greenhouse gas emissions

The electricity consumption sector accounts for 18.9% of emissions

Notes: The data used in the figure above and throughout this chapter are from Rhode Island's 2019 Greenhouse Gas Emissions Inventory. However, the grouping of emissions from natural gas distribution differs between the annual emissions inventories and this 2022 Update. In annual emissions inventories, emissions caused by methane leakage from the natural gas distribution system are aggregated with emissions from electricity consumption under the label 'emissions from the energy sector.' This is because Rhode Island's in-state power plants rely on natural gas to generate electricity. However, in this 2022 Update, we instead include emissions from natural gas distribution within emissions from the thermal sector. The purpose of this choice is to showcase natural gas's role in heating.

Rhode Island's first greenhouse gas emissions inventory was completed in 2013 with the support of experts from the Northeast States for Coordinated Air Use Management.[18] This first analysis estimated both a 1990 baseline and emissions inventory for 2010, the most recent year for which data was available

[17] Note that in the Annual Greenhouse Gas Emissions Inventory, emissions caused by methane leakage from the natural gas distribution system are aggregated with emissions from electricity consumption under the label 'emissions from the energy sector.' This is because Rhode Island's in-state power plants rely on natural gas to generate electricity. However, we do *not* include emissions caused by methane leakage from the natural gas distribution system within the electric sector and instead reference this source of emissions within the thermal sector. The purpose of this choice is to showcase natural gas's role in heating.

[18] Northeast States for Coordinated Air Use Management (NESCAUM) is a non-profit organization: https://www.nescaum.org/.

at the time. Since this first analysis, RIDEM has continued to complete annual emissions inventories. In the sections below, we provide a high-level summary of how emissions are estimated and highlight changes since the *2016 Plan* was developed.

In the spirit of focusing our efforts around the most impactful and immediate priority actions to reduce Rhode Island's emissions, we limit the discussion in this chapter to the emissions sources that have readily available solutions for decarbonization. Therefore, we provide in-depth descriptions and discussions of methodologies for the three largest contributors to Rhode Island's greenhouse gas emissions: transportation, electricity consumption, and residential heating. We do not provide in-depth discussions of how we estimate emissions from commercial heating, industry, natural gas distribution, waste, or agriculture – each of these sources, while critically important for reaching net-zero emissions, is small in comparison and has relatively limited or nascent solutions for decarbonization. We recommend further attention to these sectors in the development of the *2025 Climate Strategy*. We do, however, provide an in-depth discussion of methodology and considerations around estimating the emissions impacts of land use, land use change, and forestry (LULUCF).

The Role of Models

A model is a way to describe something that happens in the world around us. A model does not dictate what happens, nor does a 'right' model exist. Models are tools that we use to understand how one variable affects another. In this vein, it is important to understand the value of – and the limitations of – the models we employ.

A model should be as simple or complex as needed to attain the requisite levels of precision and accuracy given objectives and available resources. A simpler model typically needs fewer resources than a complex model because there is less data to be collected, less time used to run the model, etc. If a simple model is sufficiently precise and accurate for the user, then there is negligible value to making the model more complex.

Precision is the concept of how reproducible the results of the model are – a precise model consistently gives similar results. However, a precise model may give consistently *inaccurate* results. In statistics, we can estimate precision using established methods and tests. For example, an econometric model reports out what-are-called 'standard errors,' which help a user understand whether the model's results are the result of real underlying relationships or are spurious.[19] Precision is important to understand when we compare results because it would be inappropriate to attribute differences between imprecise results to a specific reason. You might hear terms like 'statistical significance', 'variability', and 'uncertainty' when discussing precision.

Accuracy is how close a model's results are to the truth, which may or may not be known. An accurate model may not be precise. If a model is expected to consistently underestimate or overestimate a result, then we say that result is 'biased'. In the models we use to estimate Rhode Island's emissions, it is the responsibility of the people doing the estimation to understand if and how results are biased.

[19] Precision is a concept that exists across disciplines. For example, engineers may be familiar with the concept of 'tolerances' to describe required precision of machining and manufacturing. Scientists have developed standardized methods for assessing precision of measurements, such as by completing multiple counts of the same sample or by taking multiple samples of the same population.

Results from any model should not live in isolation, and any isolated facts or figures should be considered incomplete results. Complete results must discuss precision and bias, and should include discussion of the validity of the model.

The methodology used to estimate Rhode Island's greenhouse gas emissions inventory does not report any measures of precision or imprecision. However, the SIT does provide some helpful insights into uncertainties in the default data provided. RIDEM assesses the validity of the data and the factors that influence emissions to inform their understanding of how precise our emissions results are, especially as we compare emissions year-over-year. Having some standardized guidance from the US EPA on the precision of their models' results would help Rhode Island (and other states) properly contextualize emissions inventory results.

- States should request the US EPA develop methods to assess precision to be integrated into their emissions inventory tools.

Transportation Sector Emissions

Emissions from the transportation sector include emissions from highway vehicles,[20] aviation, marine transportation, gas and diesel off-road vehicles, locomotives, and more.

Table X. Emissions from the Transportation Sector

Rhode Island Greenhouse Gas Emissions Inventory											
Updated November 15, 2022. All emissions reported in $MMTCO_2e$.											
	1990	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Transportation Total	**4.97**	**4.33**	**4.40**	**4.19**	**4.59**	**4.25**	**4.09**	**3.94**	**4.17**	**4.45**	**4.29**
Aviation	0.33	0.27	0.31	0.29	0.29	0.30	0.28	0.30	0.34	0.38	0.30
Highway Vehicles	4.38	3.70	3.76	3.62	4.10	3.62	3.66	3.62	3.57	3.85	3.61
Nonroad Sources	0.27	0.36	0.33	0.28	0.20	0.32	0.12	0.02	0.25	0.23	0.38

Bottom-Line Factors that Reduce Transportation-Sector Emissions

1. Reducing fuel use reduces emissions
2. Using lower-emissions fuels (like electricity) reduces emissions

Current Method

Several tools are available to calculate greenhouse gas emissions from the transportation sector. The US EPA recommends the SIT for the entire sector and the Motor Vehicle Emissions Simulator (MOVES) for highway vehicles only. The SIT and MOVES models vary in the amount of precision at the state level.

The SIT uses a top-down approach to calculate emissions from transportation, starting with fuel consumption and vehicle miles traveled. This approach uses data on fuel sales within each state as a proxy for fuel consumption. The major shortcoming of this method is a lack of detail; drivers do not always use their vehicles in the same state that they purchase fuel. As a result, fuel sales may provide an imprecise

[20] A highway vehicle is any type of on-road vehicle (e.g. passenger car, passenger truck, light commercial truck, heavy-duty trucks, etc.) that uses any fuel type.

estimate of fuel consumption at the state level. Data on fuel sales also do not provide information on different types of on-road vehicles.

MOVES is an all-in-one program that estimates emissions using a "bottom-up" approach. Vehicle miles traveled and vehicle data determine fuel consumption and emissions produced. The tool requires many user-supplied inputs and simplifies the analysis at different geographic levels. For the purpose of state emissions inventories, US EPA recommends county level inputs requiring the user to supply local, state, and county data. Inputs to MOVES include data on vehicle population, vehicle age, average speed distribution, meteorological data, inspection and maintenance program details, road type distribution, and vehicle miles traveled. The model simulates vehicle drive cycles for the defined time period and geographical area specified. Data from all five Rhode Island counties are summed to produce a transportation sector inventory.

Although MOVES provides the strongest and most current methods for analyzing the greenhouse gas emissions of on-road vehicles, the tool is not the best option for estimating emissions from non-road modes of transportation. Instead, the SIT is used to determine emissions from aviation and other non-road sources. Some examples of non-road sources are boats, locomotives, tractors, construction equipment, snowmobiles (gasoline only), and lubricants. For aviation related greenhouse emissions, the Rhode Island Airport Corporation (RIAC) provides RIDEM with an annual inventory of greenhouse gas pollutants associated with the State's primary airport, T.F. Green Airport.

Notable Changes

Rhode Island's emissions inventories for years 1990, 2010-2012, 2018, and 2019 used the SIT only; those inventories did not use MOVES to estimate emissions from highway vehicles. MOVES was used for years 2013-2017 to estimate emissions from the highway vehicle sub-sector. As such, transportation emission totals for years 1990, 2010-2012, 2018, and 2019 should be interpreted as being less precise than transportation emissions for years 2013-2017.

Notes on the 1990 Baseline

The 1990 baseline was estimated using only the SIT. Transportation emissions today relative to the existing 1990 baseline would not be an apples-to-apples comparison because the core methodology is different.

Limitations of the Model

The SIT distinguishes between alternative fuel vehicles and petroleum-powered vehicles. Categories of alternative fuel vehicles include methanol, compressed natural gas, liquified petroleum gas, and ethanol. Electric vehicles are not considered alternative fuel vehicles in the SIT. Emissions resulting from the electricity consumed in charging electric vehicles are also accounted for in the electricity consumption sector of Rhode Island's greenhouse gas emissions inventory. MOVES also does not distinguish between electric and non-electric vehicles, which results in overestimating emissions from electric vehicles in two ways.

First, because the tools cannot distinguish between electric and non-electric vehicle types, emissions from electric vehicles are assumed – incorrectly – to be equivalent to emissions from gas-powered vehicles. Fortunately, emissions from electric vehicles using electricity from the renewable- and fossil-based generators we have today are less than the emissions from gas-powered vehicles.

Second, the emissions from electric vehicles are double counted because they appear (incorrectly) in the transportation sector emissions estimates and (correctly) in the electric sector emissions estimate. Currently, this overestimation is negligible since electric vehicles comprise only a small portion of the

Rhode Island market (as of 2021, slightly less than one percent of vehicles registered were electric). This overestimation will grow as more and more Rhode Islanders adopt electric vehicles.

- States should request the US EPA amend the greenhouse gas emissions inventory tools to correctly account for emissions resulting from electric vehicles.

Electric Sector Emissions

Emissions from the electric sector result from electricity consumed[21] within Rhode Island. Rhode Island's increasing Renewable Energy Standard and continued energy savings from energy efficiency programs, both of which reduce emissions, have mitigated the magnitude of emissions increase that we would have seen absent those activities.

Table X. Emissions from the Electric Sector

Rhode Island Greenhouse Gas Emissions Inventory											
Updated November 15, 2022. All emissions reported in $MMTCO_2e$.											
	1990	2010	2011	2012	2013	2014	2015	2016	2017	2018*	2019
Electricity Consumption	2.82	2.29	3.38	3.38	3.52	3.25	3.21	2.84	3.31	2.33	2.05

** Revised 2018 electricity sector emissions*

Bottom-Line Factors that Reduce Electric Sector Emissions

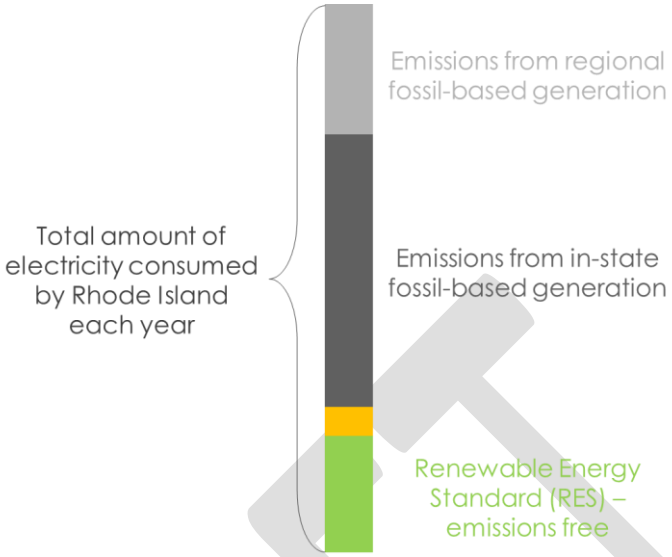
1. Reducing electricity consumption reduces emissions.
2. Producing electricity with renewable energy reduces emissions and appropriately crediting RIs investment in renewable energy in the inventory

Current Method

Rhode Island's current method for estimating emissions from the electric sector is based on annual state-wide electricity consumption. Both Massachusetts and Connecticut also rely on this method for their annual emissions inventory. The electric sector emissions inventory includes three primary components (illustrated in the figure below): compliance with the Renewable Energy Standard (RES),[22] emissions of in-state fossil-based electricity generation, and emissions of fossil-based electricity from our regional electric grid.

[21] Note that in the Annual Greenhouse Gas Emissions Inventory, emissions caused by methane leakage from the natural gas distribution system are aggregated with emissions from electricity consumption under the label 'emissions from the energy sector.' This is because Rhode Island's in-state power plants rely on natural gas to generate electricity. However, we do *not* include emissions caused by methane leakage from the natural gas distribution system in this section and instead reference this source of emissions within the section on emissions from the thermal sector. The purpose of this choice is to showcase natural gas's role in heating.

[22] RIGL 39-26



First, we account for emissions-free electricity in compliance with Rhode Island's RES, requires we meet an increasing portion of our electricity consumption with renewable energy. Electric distribution companies and non-regulated power producers comply with the RES by supplying an increasing percentage of their retail electric sales from renewable energy resources. Eligible renewable energy resources include solar, wind, wave, geothermal, small hydropower, biomass, and fuel cells.

RES compliance does not involve the physical delivery of electricity produced by renewable energy facilities. Instead, electricity providers meet the requirements of the RES mandate by purchasing renewable energy certificates (RECs), which each represent the environmental attributes associated with one megawatt-hour (1 MWh) of renewable energy generated and delivered to the electric grid at some point throughout the year.

RES compliance can also be demonstrated by making alternative compliance payments (ACPs) to the Rhode Island Commerce Corporation (Commerce RI) Renewable Energy Fund. The ACP functions as a price ceiling, allowing electricity providers to comply with the RES mandate if REC shortages occur. Commerce RI uses the Renewable Energy Fund (REF) to support the development of new renewable energy projects. In turn, these projects generate RECs, theoretically helping to ameliorate tightening of the REC market.

This portion of electricity consumed that resulted in ACPs rather than retiring RECs cannot be considered to be emissions-free. Rather, this portion of our electricity consumption has emissions proportional to the emissions resulting from our in-state and regional electric grids. Emissions from this portion of electricity consumption comprise Rhode Island's total electric sector emissions – as we increase the RES, all else equal, emissions will decrease. We estimate these emissions by first assuming all in-state fossil-based electricity generation is consumed in state, and then pro-rate emissions from regional fossil-based electricity generation required to be imported into the state to satisfy consumption. As other states enact RES-like mandates and as market dynamics evolve to favor lower-emissions generation, emissions will decrease, all else equal.

We can walk through this method using the 2018 emissions inventory as an illustrative example; these steps are also detailed in the figure below. In 2018, Rhode Island consumed approximately eight billion kilowatt-hours (kWh) of electricity.[23]

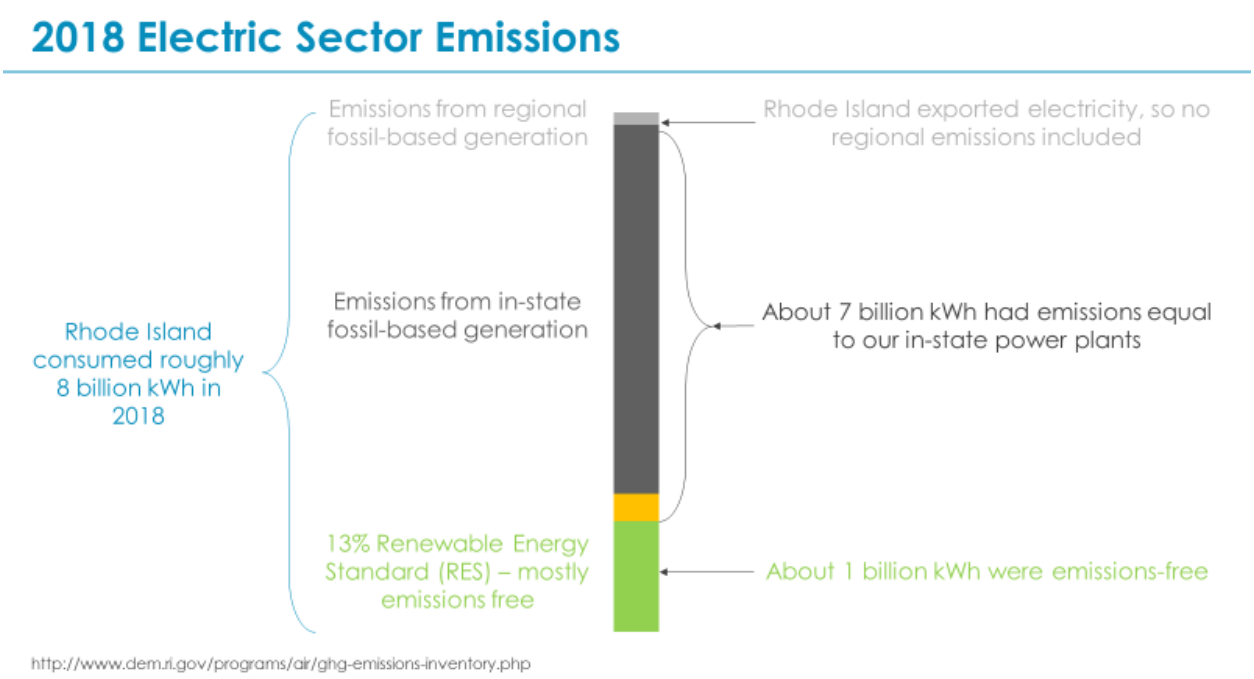
In 2018, the RES required 13% of electricity consumption be met with renewable energy. Of this 13%, nearly all was offset through the purchase (and retirement) of RECs. This portion of electricity consumed – equal to about 1 billion kWh – is deemed to have zero emissions.[24] The small portion of compliance through ACPs – roughly 30 million kWh – cannot be considered to be emissions-free.

In 2018, Rhode Island had six electricity generators, five of which used natural gas and one of which used landfill gas. These six generators produced a little more electricity than the total amount of electricity Rhode Island consumed in 2018. Therefore, emissions for roughly seven billion kilowatt-hours of emissions-intensive electricity consumed equaled the emissions produced by in-state fossil-based generators.[25] If those power plants had produced less than the equivalent of the amount of electricity consumed by Rhode Island, as was the case in 2016, the emissions from the remaining amount of electricity would be deemed to be proportional to emissions from the fossil-based fuel mix that supplies our regional electric grid.

[23] We present electricity consumption in units of kilowatt-hour (kWh) because readers may be familiar with this unit from electricity bills. We could present electricity consumption (or generally) equivalently as 8,000 gigawatt-hours (GWh) or 8 million megawatt-hours (MWh).

[24] Some readers may ask how our retail renewable energy programs fit in here – the answer is that it all depends on who retains ownership of the RECs generated and what they do with them. People who have renewable energy systems through the REG program (National Grid's feed-in-tariff program) sign over ownership of all RECs generated to the utility. The utility then retires those RECs to meet its own obligation under RES – in other words, those RECs count toward reducing Rhode Island's emissions. In contrast, people who own their own renewable energy systems that are net metered retain ownership of the RECs generated for those systems. In order to measure the RECs generated, these systems need additional technology that meets required specifications (i.e. a revenue-grade meter to measure renewable energy production). For residential systems, individuals usually don't install this technology. Therefore, the generation of these systems doesn't count toward Rhode Island's compliance with RES, but it does have the effect of reducing our statewide electricity consumption. From 2018, Rhode Island consumed eight billion kilowatt-hours of electricity *plus* the amount of emissions-free electricity generated by these direct-owned net metered systems. Net metered systems that are direct owned or owned by third parties, and that have the technology to measure REC generation (this is more common for commercial systems), may have their RECs sold to meet Rhode Island's RES *or* another state's RES. If the RECs are retired in Rhode Island, then they reduce our emissions. If the RECs are retired in another state, then they reduce that other state's emissions.

[25] Some readers may ask how Rhode Island's participation in the Regional Greenhouse Gas Initiative (RGGI) fits in – the short answer is that it helps us reduce our carbon dioxide emissions both regionally by encouraging carbon abatement measures and generating revenue to support emissions reductions. If our in-state fossil-based generators abate their emissions to comply with RGGI, then Rhode Island's emissions decrease. If those generators instead buy allowances to produce emissions, then we receive some portion of revenue that we then allocate to programs like energy efficiency and renewable energy incentives, which in turn reduce our emissions.



Annual versus Hourly Electric Sector Emissions

The emissions that result from consuming a unit of electricity on a hot, humid summer evening are different from the emissions that result from consuming the same unit of electricity on a pleasant fall day. This is because the systems that generate electricity differ based on time of day and how much electricity is needed.

On hot and humid summer evenings, when individuals are getting home from work and turning their air conditioners on, the region typically needs the most electricity out of the entire year (called 'peak electricity demand').[26] Our region's renewable energy sources tend to generate less electricity during summer evenings (when the wind calms down and the sun sets), so our electricity needs must be met by fossil-fueled electricity generators. To satisfy electricity demand during these peak hours, the New England electric grid relies on additional natural gas power plants and occasionally on oil- and coal-based power plants (less than one percent of the region's electricity comes from these highest-emitting sources). Therefore, emissions from overall electricity consumption and emissions *per unit of electricity consumed* both increase during times of peak electricity demand.

In contrast, on pleasant fall days we tend to leave our heating or air conditioning systems off, and since individuals tend to be at work, we aren't running appliances like dishwashers and washing machines. During these times, our renewable energy resources tend to have more output, too. The relatively small amount of additional electricity we need to satisfy our demand during these off-peak hours can be derived from our region's emissions-free nuclear power plants plus some natural gas power plants. Therefore, at certain times of the year, like pleasant fall days, our emissions are lower both because we consume less electricity and the little electricity we consume comes from sources with relatively low emissions.

[26] The timing of when peak electricity demand occurs is anticipated to shift to winter months as we electrify thermal and transportation sectors. For more information about peak demand, visit the US Energy Information Agency.

Rhode Island's current practice and capability is to estimate emissions on an annual basis, but this method does not distinguish between electricity used at times when resulting emissions are high and electricity used at times when resulting emissions are low. For example, electricity produced using renewable energy resources generates RECs which can be used to offset emissions from fossil-based electricity generated at any time of the year – the RECs are not specific to a single hour. Rhode Island and its regional partners should revisit the idea of more granular emissions accounting as technology and capabilities allow within the next decade.

Notable Changes

Prior to the 2016 emissions inventory, Rhode Island used the SIT to account for electric sector emissions. However, the SIT does not accurately account for emissions reductions from state policies like the RES. This change in methodology prevents robust comparison of electric sector emissions before and after 2016.

Notes on the 1990 Baseline

The 1990 baseline was originally estimated with the SIT. After the publication of the *2016 Plan*, the 1990 baseline's electric sector emissions were adjusted. Comparing electric sector emissions today relative to the existing 1990 baseline would not being comparing apples-to-apples because the underlying methods differ.

Limitations of the Methodology

This methodology does not account for the varying rates of emissions across hours of the year. Renewable energy systems generate more electricity during times when the marginal fossil-fueled power plant uses natural gas. However, peak electricity demand occurs when the marginal power plant uses a more emissions-intensive fuel. Since RECs produce by renewable energy are not time-stamped, those RECs may theoretically offset more emissions-intensive electricity consumption than the renewable energy resources actually did. Therefore, this methodology is likely to result in underestimating emissions from the electric sector. See the callout box on *Annual versus Hourly Emissions* for additional discussion. Methodology changes for the most recent inventory year, 2019, are discussed in the *2019 Rhode Island Greenhouse Gas Emissions Inventory*. We suggest consistent revisions to the electricity sector methodology as accounting capabilities and economic markets evolve.

Impacts of Strategic Electrification

Strategic electrification is one pathway to reducing greenhouse gas emissions. By transitioning transportation and heating away from technologies that require fossil fuels to those that use electricity – and then meeting our growing electricity needs with renewable energy resources – we will reduce emissions in the transportation and heating sectors. [27]

As we electrify heating and transportation, a growing proportion of heating and transportation emissions will be captured within the electric sector emissions inventory. This has two effects. First, to the extent our thermal sector and transportation sector emissions inventory tools account for electrification, the

[27] The GHG emissions from registered in Rhode Island (i.e. from charging) are counted in the electricity sector, not the transportation sector. When there are significantly more EVs registered in Rhode Island, their vehicle mile traveled (VMT) contribution will be omitted from the overall VMT. This will avoid double-counting their emissions between the transportation and electricity sectors. Since VMT from EVs would be omitted from the transportation sector, overall transportation sector emissions would DECREASE. The 2033 100% RES should mitigate additional emissions by EVs in the electricity sector. In theory, we could adopt as many EVs as we want and still have 0 MMTCO2e with the electric sector by 2033.

decreases we will see in emissions in transportation and heating sectors will be exaggerated because those emissions will be included in the electric sector emissions inventory. We will need to make sure we use caution when using sector-specific emissions to assess the efficacy of our climate strategies to avoid thinking we have made more progress than we actually have. Second, emissions in the electricity sector will grow as people electrify their vehicles and heating systems. This growth in electricity consumption – and, depending on timing of renewable energy deployment, of electric-sector emissions – may result in obscuring progress we are actually making with our climate strategies.

- For these reasons, among others, it is important for Rhode Island to track metrics beyond greenhouse gas emissions in order to evaluate progress accurately and clearly. Such metrics may include, but are not limited to, proportion of vehicles that are electric, census of heating system fuel types, prevalence of these technologies across communities, and others.

We also have to be increasingly careful with our terminology. 'Thermal sector emissions,' which is comprised of residential heating, commercial heating, industrial heating and processes, and natural gas distribution, may become an increasingly incomplete representation of all emissions from the thermal sector. 'Electricity sector emissions' as used in the emissions inventory will increasingly include more end uses than in the past and therefore may take on a broader interpretation than is used colloquially today.

- If, and until, we have tools that disaggregate state-level electricity consumption by end use, we must strive to be more precise in our choice of terminology. Instead of shortening to 'thermal sector emissions', we should strive to say 'emissions from combustible fuels used for heat'; instead of 'transportation sector emissions', say 'emissions from combustible fuels used for transportation.'

Residential Heating Emissions within the Thermal Sector

Emissions from the thermal sector result from the sub-sectors of residential heating, commercial heating, industrial processes that require heat, and natural gas distribution. [28] Residential and commercial heating include space heating, water heating, and cooking. The five sub-sectors are each estimated separately. Emissions resulting from heating, cooking, and heat processes that use electricity are captured in the electric sector emissions inventory and are not reflected in the thermal sector inventory. [29] Below, we describe the methodology used to estimate emissions from residential heating only.

[28] Note that in the Annual Greenhouse Gas Emissions Inventory, emissions caused by methane leakage from the natural gas distribution system are aggregated with emissions from electricity consumption under the label 'emissions from the energy sector.' This is because Rhode Island's in-state power plants rely on natural gas to generate electricity. However, we instead include this source of emissions within the thermal sector. The purpose of this choice is to showcase natural gas's role in heating.

[29] Since cooling relies on electricity, emissions resulting from cooling – residential, commercial, or other – are captured in the electric sector emissions inventory.

Table X. Emissions from the Thermal Sector

Rhode Island Greenhouse Gas Emissions Inventory											
Updated November 15, 2022. All emissions reported in $MMTCO_2e$.											
	1990	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Residential Heating	2.37	2.24	2.15	2.08	2.27	2.34	2.46	1.84	1.87	2.32	2.09
Commercial Heating	1.15	0.92	0.87	0.79	0.91	1.13	1.00	0.86	0.88	0.98	0.94
Industry	0.81	1.04	1.06	1.05	1.24	1.14	1.12	1.14	1.12	1.19	1.03
Industrial Heating	0.71	0.61	0.56	0.54	0.67	0.57	0.59	0.61	0.62	0.63	0.61
Industrial Processes	0.09	0.43	0.5	0.51	0.56	0.57	0.53	0.53	0.50	0.55	0.42
Natural Gas Distribution	0.3	0.15	0.15	0.15	0.17	0.17	0.16	0.15	0.15	0.14	0.14

Bottom-Line Factors that Reduce Thermal Sector Emissions

1. Reducing combustible fuel use (like natural gas, oil, and propane) reduces emissions.
2. Using lower-emissions fuels (like biodiesel or electricity) reduces emissions.

Current Method

Residential heating emissions are estimated using the SIT's Carbon Dioxide from Fossil Fuel Combustion (CO_2FFC) module and the Stationary Combustion module. The US Energy Information Administration (EIA) collects fuel consumption data throughout the United States by requiring mandatory surveys for all companies that deliver natural gas to consumers, usually through pipelines, or transport natural gas across state lines.

Distillate fuel, propane, and kerosene are examples of fuels that are usually trucked to Rhode Island homes that use them for heat. These are therefore called 'delivered fuels'. Consumption estimates for delivered fuels are estimated by the EIA. Fuel consumption data is a key component to estimate emissions.

Notable Changes

There have not been any appreciable changes to methodology for estimating emissions from residential heating.

Notes on 1990 Baseline

The 1990 baseline is fairly comparable to current emissions inventories; the methodology has not changed. However, there has been a change to a specific parameter used to account for the impact different types of emissions on climate change – this parameter is called global warming potential (GWP) and it is particularly important within estimating thermal sector emissions because of the types of greenhouse gases associated with thermal sector emissions. See the following section on When to Update the 1990 Baseline for more information. Rhode Island's 1990 baseline and 2010 emissions inventory used different GWPs than emissions inventories for 2011-2019. Comparing emissions from our 2019 emissions inventory to the 1990 baseline is not a direct comparison. However, the effect of this change in GWPs is likely to be small relative to total emissions.

Limitations of the Model

Rhode Island enacted and subsequently updated the Biodiesel Heating Oil Act to require the mixing of biodiesel in heating oil. Biodiesel is a renewable fuel made from plant or animal based materials or waste. Biofuel can be mixed with conventional heating oil to create different blends of oil. For example, a B5 blend contains 5% biodiesel and a B50 blend contains 50% biodiesel. In 2019, Rhode Island required a B5 blend. The Biodiesel Heating Oil Act requires Rhode Island to be at least a B50 blend by 2030.

Biodiesel reduces emissions because it burns cleaner than conventional oil. Currently, biodiesel is not included in the emissions inventory due to a lack of state-level data on biofuel consumption. Residential heating emissions are likely to be overestimated because this inventory's calculations do not include the use of blended biofuels, and this overestimation is likely to be exacerbated as we increase biofuel blending.

- We recommend modifying tools and methods to account for blending of biodiesel by 2025 (i.e. for the 2022 emissions inventory). Strategies to do so include joining with other states to request that the EPA modify their tools or developing an alternative methodology specific to Rhode Island's needs.

When to Normalize

One key driver of emissions from the thermal sector is the year-to-year variation in how cold our winters are. Due to larger-scale climate processes and natural stochasticity of weather, some winters are colder than others, which lead to using more fuel to heat, and therefore to higher emissions. The opposite is true, too – warmer winters mean less heating is required and therefore less fuel is burned, resulting in fewer emissions. Since each year is different, it makes it hard to feel like were comparing apples-to-apples across years.

One way to track progress over years is to 'normalize' emissions for weather conditions. 'Normalizing' is a common process in data analysis in which you factor out whatever exogenous variable might be preventing you from seeing clear trends. For example, we can measure how cold a winter is by calculating the number of what-are-called 'heating degree days.' Heating degree days provide useful information about the coldness or warmness of any particular winter. Heating degree days are calculated by subtracting the average daily temperatures from a baseline temperature of 65°F. 65°F is deemed to be the temperature at which neither air conditioning nor heating are required to maintain a comfortable indoor temperature. The concept of heating degree days is tricky because there can be multiple heating degree days in a 24-hour period.

There are various ways to normalize emissions for heating degree days, the simplest of which is to divide emissions by the number of heating degree days each year. If emissions per heating degree day decreases over time, then we can say with confidence that we are reducing our emissions from heating. Another factor we might consider normalizing emissions for might be population. As population grows in Rhode Island – something that is arguably uncontrollable – then we expect higher emissions. However, we will be more convinced that our strategies to reduce emissions are working if emissions per person decrease over time.

- We recommend including supplemental analyses like this at key intervals to gain better insight into the efficacy of our actions.

Land Use, Land Use Change, and Forestry

As discussed in the Defining Net-Zero Emissions by 2050 chapter, how we use our lands and preserve our forests impacts our greenhouse gas emissions. The land use, land use change, and forestry (LULUCF) sector of our emissions inventory captures this impact.

Bottom-Line Factors that Impact LULUCF Emissions

Further avoidance of forest loss helps steady Rhode Island's ability to sequester carbon.

Current Method and Limitations

Rhode Island's small and diverse landscape is inherently difficult to account for LULUCF. 1990's LULUCF sector was estimated through a one-time contract with the NESCAUM and is not replicable. Additionally, the 2010 LULUCF estimate was calculated through the Long-range Energy Alternatives Planning (LEAP) model used in the *2016 Plan* and is not replicable. Beginning with inventory year 2019, RIDEM now estimates LULUCF with in-house data from RIDEM's Division of Agriculture and Forest Environment (DAFE) and some data from the EPA's SIT.

Carbon sequestration from forest land and urban trees, or settlement trees, account for the lion's share of LULUCF. RIDEM estimates both with in-house data provided by DAFE. Data on forest fires in Rhode Island are also provided by DAFE. The remaining LULUCF subsectors (yard trimmings, settlement soils, and agricultural soils) are derived from the SIT and comprise less than 5% of the LULUCF sector. More information on the methodology used to estimate carbon sequestration can be found in the *2019 Rhode Island Greenhouse Gas Emissions Inventory*. 2019's LULUCF sector represents a **first step** towards reliably estimating carbon sequestration in Rhode Island. This methodology should not be compared with other state's carbon removal sectors.

- We recommend RIDEM continue to collaborate with its DAFE and the U.S. Climate Alliance to continuously improve the LULUCF sector. The methodology should be replicable, consistent, and conducted in-house.
- We recommend estimating emissions from LULUCF at least every year in which we assess compliance with the 2021 Act on Climate. If the administrative burden of estimating LULUCF emissions is low and the expected variation in LULUCF emissions is high, then we may choose to estimate LULUCF more frequently.

1990 Baseline

In 2016, LEAP modeling completed for the *2016 Plan* estimated that LULUCF in Rhode Island removed 0.29 $MMTCO_2e$ in 1990. This model failed to be replicable, so we cannot make accurate comparisons to 1990's LULUCF sector.

- We recommend further evaluation of using a replicable methodology for annual emissions inventories to re-estimate emissions from the 1990 baseline and subsequent years through 2018.

When to Update the 1990 Baseline

The 2021 Act on Climate sets forth greenhouse gas emissions reduction mandates relative to a 1990 baseline: reduce emissions by 45% below 1990 levels by 2030 and reduce emissions by 80% below 1990 levels by 2040. Therefore, the 1990 baseline is a critical piece of benchmarking Rhode Island's progress.

However, over time methods and models evolve to accommodate the best science. Preserving our original estimate of emissions in 1990 memorializes consistency, but results in inaccurate comparisons over time.

Updating the 1990 baseline can help us understand our emissions reductions on an apples-to-apples basis with our contemporaneous emissions inventory.

One notable example is the change to a specific parameter used to account for the impact different types of emissions on climate change – this parameter is called global warming potential (GWP). This parameter is updated routinely to reflect the most current and robust science (the impact of the emissions does not change over time, but our understanding of the impacts does). Table X shows how GWPs have changed over time.

Table X. Global Warming Potentials (GWPs)

Global Warming Potentials (GWPs)				
Type of Greenhouse Gas	IPCC Second Assessment Report (SAR)	IPCC 4th Assessment Report (2007)	IPCC 5th Assessment Report (2014)	IPCC 6th Assessment Report (2022)
Carbon dioxide (CO_2)	1	1	1	forthcoming
Methane (CH_4)	21	25	28	forthcoming
Nitrous oxide (N_2O)	310	298	265	forthcoming
Use in Rhode Island's GHG Emissions Inventories:	1990 baseline, 2010	2011-2019	N/A	N/A

Rhode Island's 1990 baseline and 2010 emissions inventory used different GWPs than emissions inventories for 2011-2019. Comparing emissions from our 2019 emissions inventory to the 1990 baseline is not a direct comparison. However, the effect of this change in GWPs is likely to be small relative to total emissions.

- We recommend further evaluation and discussion of updating the 1990 baseline if the best science suggests new and reasonable parameters or methods.

Assessing Compliance

The greenhouse gas emissions reduction mandates set forth in the 2021 Act on Climate are both mandatory and enforceable. Therefore, Rhode Island needs a clear, transparent, and comprehensive way to assess compliance with those mandates.

- We recommend RIDEM evaluate in 2023 the benefits of promulgating such regulations.

Since 2016

The 2021 Act on Climate requires this *2022 Update* to "submit to the Governor and the General Assembly an update to the greenhouse gas emission's reduction plan dated 'December 2016'." Since 2016, we've had six years of experience, progress, and lessons learned. We present this information in three different ways.

First, we review the metrics we've been tracking since 2016 – these metrics represent an outcome-oriented snapshot of how we've worked to reduce greenhouse gas emissions in Rhode Island.

Second, we inventory the numerous studies, programs, policies and pieces of legislation that have contributed to our experience with climate mitigation, resilience, and adaptation since 2016 – by doing so, we provide an easy reference for readers to connect to these resources and learnings.

Third, we directly describe progress made (or in some instances, not made) on each pathway from the 2016 Plan – these descriptions supplement the outcome-oriented metrics with a process-oriented narrative.

Some readers may find this chapter to feel repetitive – it is by design. We are attempting to describe our actions since 2016 in multiple ways, with each providing a different perspective, level of detail, and intention for use moving forward.

A Snapshot of Metrics Since 2016

For this section, we leverage the framework of metrics from the "RI Snapshot" climate dashboard maintained by the Rhode Island Department of Environmental Management.[30] The Executive Climate Change Coordinating Council (EC4) and its Advisory Board are developing a new climate dashboard throughout 2022, to be used beginning in 2023.

Greenhouse Gas Emissions

Rhode Island's 2019 gross greenhouse gas emissions – the most recent inventory on record[31] – are estimated to be 10.04 MMTCO2e. This level of emissions is 1.8% below emissions in 2016. Since 2016, electric power consumption emissions decreased by 28.0%, residential heating emissions increased by 13.5%, commercial heating emissions increased 8.8%, transportation emissions increased 8.8%, industrial emissions decreased 9.2%, agricultural emissions increased 39.2%, and waste emissions increased 14.2%.

Clean Energy

As of July 2022, the state has counted approximately 1,149 MW of clean energy generation capacity. Of Rhode Island's current 1,149 MW total, 430 MW is offshore wind which is mostly under contract for the Revolution Wind facility scheduled to come online in 2026, 527 MW is solar, 148 MW is onshore wind, 35 MW is landfill gas/anaerobic digestion, and 9 MW is small hydroelectric power. Including the 400 MW Revolution Wind project, approximately 85 percent of Rhode Island's current clean energy portfolio is comprised of in-state renewables or projects scheduled for adjacent federal waters. The Power Purchase Agreement for Revolution Wind was approved in 2019 with construction expected to commence in 2024.

[30] RI in the Fight Against Climate Change: A Snapshot

[31] There is a three-year lag between the release of Rhode Island's greenhouse gas emissions inventory and the year in which emissions occurred. See the 'Greenhouse Gases' chapter for more information about Rhode Island's greenhouse gas emissions inventory, methodology, and tools.

Energy Efficiency

Since 2016, energy savings from utility energy efficiency programs has been accumulating. Table X shows energy savings for both electric and gas efficiency programs. Annual savings are savings which occur in a single year. Lifetime savings are estimated over the expected duration of installed efficiency measures.

Table X. Energy Savings from Energy Efficiency Programs 2016-2021

	National Grid	Pascoag Utility District	Block Island Utility District[32]
Electric Annual Energy Savings Cumulative 2016-2021	1,128,943 MWh	671 MWh	10 MWh
Electric Energy Savings Cumulative over Expected Lifetimes of Measures Installed 2016-2021	10,166,520 MWh	3,980 MWh	59 MWh
Gas Annual Energy Savings Cumulative 2016-2021	2,468,022 MMBtu	Not Applicable[33]	
Gas Energy Savings Cumulative over Expected Lifetimes of Measures Installed 2016-2021	26,327,149 MMBtu		

Heating

Residential and commercial heating contribute 28% of Rhode Island's greenhouse gas emissions, and industrial heat processes contribute another 9.5%.[34] In 2017, roughly half of Rhode Island homes used natural gas for heating, a third used fuel oil, a tenth used electricity, and the remainder used another fuel like propane or wood.[35]

Green Jobs

In 2021, Rhode Island had 13,809 clean energy jobs.[36] The economic aftermath of COVID-19 resulted in the loss of roughly four years of clean energy job growth, sending Rhode Island's clean energy economy back to 2016 employment levels. Clean energy job losses represented about seven percent of all jobs lost in Rhode Island's overall labor market in 2020. This decline marks the first year of job losses since the state began tracking clean energy employment in 2014. Prior to COVID-19, Rhode Island's clean energy sector had experienced a 77% increase in jobs since 2014.

[32] Energy savings for Block Island Utility District are for November 2020 through December 2021; data do not do not include savings from the *Block Island Saves Pre-Pilot* (2015-2016) or *Full Pilot* (2016-2017). For more information about Block Island Saves, please see the Final Report.
[33] Neither Pascoag Utility District nor Block Island Utility District operate a gas distribution system or offer gas supply.
[34] 2019 Greenhouse Gas Emissions Inventory
[35] 2017 Rhode Island Renewable Thermal Market Development Study
[36] 2021 Clean Energy Industry Report

Impacts of COVID-19 – A 2020 Summary

While COVID-19 has severely disrupted life for all communities and businesses, the presence of COVID-10 does not lessen the urgency of climate change. That the 2021 Act on Climate passed in 2021 – amidst COVID-19 – is a testament to our need to mitigate the most severe impacts of climate change today and into the future. We have to be cognizant of pressures facing Rhode Islanders and consider these forces when developing future policies and programs, but climate mitigation and adaptation needs to continue to avoid overburdening communities with avoidable costs down the road.

Over the past couple years, we have felt the impacts of COVID-19 throughout our programs and our economy. We describe some but not all of the impacts here to provide some context for our progress. We discuss related impacts from supply chain distributions and real estate market dynamics elsewhere.

The economic aftermath of COVID-19 resulted in the loss of roughly four years of clean energy job growth, sending Rhode Island's clean energy economy back to 2016 employment levels. Employment across clean energy businesses declined by over 2,500 jobs (15.5%) between the last quarters of 2019 and 2020. By comparison, the overall statewide labor market declined by 7.4% during the same time. Clean energy job losses represented about seven percent of all jobs lost in Rhode Island's overall labor market in 2020. This decline marks the first year of job losses since the state began tracking clean energy employment in 2014 – prior to COVID-19, Rhode Island's clean energy sector had experienced a 77% increase in jobs since 2014.

Despite the unexpected shock of COVID-19, Rhode Island's clean energy labor market already appears to be bouncing back. Of surveyed clean energy firms in Rhode Island in the fourth quarter of 2020, four in ten indicated that they had laid off, furloughed, or reduced pay for their clean energy workers as a result of COVID-19. As of the end of 2020, three-quarters of these firms indicated that they had already brought back their laid off or furloughed clean energy staff. Job losses in 2020 were concentrated in March through May, with steady monthly job gains in June through December. With vaccinations on the rise and pandemic restrictions lifting, clean energy job gains are likely to continue throughout the remainder of the year. (UNDER REVIEW)

Administratively, COVID-19 made some work more difficult to move forward as facility access to implement projects was more limited in 2020 and much of the planning and stakeholder engagement moved from in-person to fully remote.

In response to COVID-19, energy efficiency programs began providing the option of a virtual home energy audit. Instead of having an energy specialist walk through a participant's home, the participant video conferences with the energy specialist and shares videos and photos of key appliances. Shifting to virtual energy audits has not only demonstrated the industry's ability to safely adapt to COVID-19 conditions, but has been shown to result in increased responsiveness, higher convenience for participants, and may improve equitable access to this resource.

COVID-19 has changed how the Bank's Municipal Resilience Program operates, switching workshops from in person to online events and delaying some municipalities' participation in the program. Despite these challenges, participation in the MRP has remained strong, and online workshop events have allowed for more attendees than typically attend these events.

While the transition to remote meetings happened abruptly (starting with public workshops related to our Heating Sector Transformation report), we do not see any loss in public

participation. On the contrary, attendance at remote events has increased and participation seems to be more robust. These insights have led to continued remote opportunities for stakeholder engagement, opportunities which reduce commute times and costs, obviate the need for some services to enable participation of some people, and are felt to provide comparative benefits like ease of seeing meeting materials and ability to participate either through oral comments or via written chat.

Even as COVID-19 restrictions ease, many are still suffering from economic and personal losses, and communities and businesses are still recovering. Our climate strategy does not exist in isolation – we must consider this ongoing context within our policies and programs. Climate action today should be designed to help communities and businesses recover by investing in our local economy, putting downward pressure on costs, and supporting improvements with simultaneous public health benefits, all while making real strides toward achieving our climate goals to mitigate the worst impacts of climate change.

Clean Cars

As of October 2022, there are 6,275 electric vehicles registered in Rhode Island. 2847 (45.4%) are Plug-in Hybrid Electric Vehicles (PHEVs), and 3,428 (54.6%) are Battery Electric Vehicles (BEVs). This represents an 1,313% increase in EVs since 2015.[37]

As of December 2022, there are 564 Level II (public and private) charging station ports, and 65 direct current fast charger (DCFC) ports. This represents a 636% increase in charging stations in RI since 2016.[38]

Protected Land

From 2010 through 2015 9,758 acres of land were protected by the state.[39] From 2016 to 2022 an additional 3,585 acres have been protected by the state [40]

Resilient Communities

As of 2022, 27 municipalities have participated in the Rhode Island Infrastructure Bank's Municipal Resilience Program (MRP). The MRP is a new program since 2019 and includes a robust stakeholder engagement approach to resilience planning. MRP workshops have hosted over 600 participants, including municipal staff and community leaders. 350+ potential resilience capital projects have been identified using this locally specialized approach.

As of 2022, 46 resilience projects have been funded through MRP Action Grants - a total of $7.5 million in assistance. 91% of projects funded by MRP Action Grants have incorporated green infrastructure and/or nature-based solutions. 93% of MRP Action Grants have incorporated green infrastructure and/or nature-based solutions. $7 million was allocated to the MRP through the 2021 Beach, Clean Water, and Green Economy Bond, and another $16 million was allocated to the MRP through the 2022 Green Economy Bond.

[37] Source: Rhode Island Division of Motor Vehicles
[38] Source: U.S. Department of Energy, Alternative Fuels Data Center
[39] Source: Rhode Island Department of Environmental Management, State Land Conservation Program, as of 12/31/2021
[40] RIDEM is currently collecting data on conservation projects completed at the local level by municipalities and land trusts and will add these numbers to this total by early 2023.

Lead-by-Example

The Rhode Island Lead-by-Example (LBE) program was initiated in 2015. Through the end of 2021, the State has achieved an 12.7% reduction in overall State facilities' energy consumption compared to a 2014 baseline. 95% of State Government electricity consumption is offset by renewables.

In 2021, OER developed the "School Lighting Accelerator Program." This program provides technical assistance and financial incentives to Rhode Island public schools to accelerate the transition to LED lighting with controls. Through the end of 2021, five public schools in Central Falls have been converted to LED with integrated controls saving annually 471,500 kWh or $78,500. Also, 31 communities have received support to convert their municipal streetlights to LEDs with controls, representing nearly 90% of the State, and driving $5.3 million in annual cost savings. 100% of State-owned streetlights have been converted to LED lighting with controls as well.

67% of all State buildings are already or in the process of being converted to LED lighting with controls (through the end of 2021). 120 electric vehicle charging ports have been installed across State properties (through the end of 2021) and 11 solar PV systems have been installed at State facilities. 62 light duty vehicles purchased or leased since December 2015 are zero-emission vehicles (through the end of 2021).

Focus on Equity

> *Disproportionate impacts of COVID-19 on communities of color and major national events illustrating social injustice catalyzed a sincere focus on centering equity throughout our work. Historical systemic inequities have continued into our world today, which result in overburdening under-resourced communities with higher energy costs, worse public health outcomes, lower access to programs and resources, and worse environmental quality – among other things – relative to others. Rhode Island's* 2022 Update, 2025 Climate Strategy, *and all future plans must address these inequities. A climate strategy that fails to address climate justice will not be the best strategy for Rhode Island's fight against climate change.*
>
> *Since 2016, we've seen immense growth in understanding about equity generally and climate justice specifically. This understanding should have already been in place, and our level of understanding today is still deficient. However, we are making some progress. While the 2016 Plan omits mention of equity or justice, we have centered these concepts in the recommendations stemming from our more recent studies and we will integrate explicit consideration of equity in the priority actions of this* 2022 Update *and throughout development of all future climate strategies.*

Studies, Programs, Policies, and Legislation

Since 2016, we have conducted over a dozen additional studies, gained six years of additional experience running programs, have enacted a number of important policies and passed a number of important laws. In this section, we review what we've done and what we've learned.

Key Studies Since 2016

Since 2016, the State has conducted a number of in-depth studies deepening our understanding of decarbonization activities and enabling actions. The following list contains major studies either directly authored by state agencies or state-commissioned subject matter experts. These studies contain numerous data-driven and stakeholder-informed recommendations for future action that should be continually referenced throughout strategic climate planning.

The following list of studies is not complete but is illustrative of the large and growing body of work we can rely on as we continue to reassess and refine our climate strategy. This list does not include state plans in which stakeholders and agencies prioritize and plan investments in state infrastructure[41] nor does this list include retrospective evaluations of programs, though such evaluations are crucial to increasing the impacts of these programs. This list also omits studies conducted by federal agencies and non-governmental organizations that add to our understanding and depth of knowledge.

100% Renewable Electricity by 2030 (2020)

http://www.energy.ri.gov/100percent/

In January 2020, Executive Order 20-01 set a first-in-the-nation goal to meet 100% of Rhode Island's electricity demand with renewable energy by 2030. In 2020, the Rhode Island Office of Energy Resources (OER) conducted an economic and energy market analysis, and developed policy and programmatic pathways, to meet this goal. *The Road to 100% Renewable Electricity by 2030 in Rhode Island* provides economic analysis of the key factors that will guide Rhode Island in the coming years as the state accelerates its adoption of carbon-free renewable resources.

The study considers available renewable energy technologies, including their feasibility, scalability, costs, generation patterns, market value, and local economic and employment impacts, as well as barriers that may hamper or slow their implementation. It identifies ways to leverage competition and market information to ensure reasonable ratepayer costs and manage energy price volatility, while taking advantage of economic development opportunities within the state. Utilizing this information, OER developed specific policy, programmatic, planning and equity-based actions that will support achieving the 100% renewable electricity goal.

Solar Siting Opportunities (2020)

http://www.energy.ri.gov/documents/renewable/Solar%20Siting%20Opportunities%20for%20Rhode%20Island.pdf

In an effort to assist with planning future solar photovoltaic (PV) development within the context of other land-use interests such as conservation, agriculture, and housing development, the Rhode Island Office of Energy Resources (OER) contracted Synapse Energy Economics to develop an estimate of the likely solar potential available within a number of solar siting categories. We conducted this statewide study using a granular bottom-up approach, primarily through the use of geospatial data and geographic information system (GIS) software.

Synapse examined and quantified solar potential for rooftop solar (including rooftops of residential single family, residential multifamily, commercial, industrial, municipal, and other building types); ground-mounted solar on landfills, gravel pits, brownfields, and commercial and industrial developed and undeveloped lots; and in parking lots. These categories were identified by OER as types of locations that could aid in policymakers' decisions for balancing future solar PV development with other land use interests such as conservation, farming/agriculture and housing development.

The report finds that in aggregate across all six categories analyzed, technical potential for solar is between 3,390 megawatts (MW) and 7,340 MW, or 13 to 30 times the amount of solar that is currently installed in Rhode Island. This translates into 5,560 gigawatt-hours (GWh) to 12,600 GWh of electricity

[41] Such plans include the Long-Range Transportation Plan, State Transportation Improvement Program, Forest Action Plan, Comprehensive Outdoor Recreation Plan, State Energy Plan, RIPTA's Sustainable Fleet Transition Plan, or local comprehensive planning. We refer interested readers to the State Guide Plan developed and maintained by the Division of Statewide Planning for more information.

able to be produced. Median estimated upfront prices for these categories range from about $3 to $5 per watt. If this entire technical potential were installed, we estimate that up to 7.65 million metric tons of carbon dioxide (MMTCO2) could be displaced, equal to about 70 percent of Rhode Island's total, current greenhouse gas emissions. However, the feasibility of this, especially in light of high costs, needs to be further examined.

Use of Operating Agreements and Energy Storage to Reduce Photovoltaic Interconnection Costs (2022)

Conceptual Framework: https://www.nrel.gov/docs/fy22osti/81960.pdf

Technical and Economic Analysis: https://www.nrel.gov/docs/fy22osti/80556.pdf

From 2019-2022, the Rhode Island Office of Energy Resources, National Grid, Rocky Mountain Institute, National Renewable Energy Lab, Lawrence Berkeley National Lab, and Clean Energy States Alliance partnered on a project supported by the Solar Energy Innovation Network. This 2022 report explores one integrated technical and process concept designed to manage interconnection costs and streamline interconnection timelines to support near-term renewable energy deployment. The report describes a new agreement between renewable energy developers and utilities, informed by a technical and economic analysis. The agreement defines the operational parameters for a renewable energy system, with the goal of reducing risk and cost to all parties. This work provides a foundation upon which states and utilities may build proof of concept.

Resilient Microgrids for Critical Services (2017)

http://www.energy.ri.gov/reports-publications/past-projects/resilient-microgrids-for-critical-services.php

The Rhode Island Office of Energy Resources commissioned the report Resilient Microgrids for Critical Services in 2017. In the wake of multi-day power outages due to severe weather events in recent years, OER sought consultant support for design of a program intended to enhance the energy assurance of critical infrastructure through deployment of distributed energy resources and other means. This effort draws from lessons learned in other states with similar programs. This report describes technologies, procurement strategies, and polices that can contribute to microgrid development.

Power Sector Transformation (2017)

http://www.energy.ri.gov/electric-gas/future-grid/

In November 2017, OER, along with the Division of Public Utilities and Carriers (DPUC) and Public Utilities Commission (PUC), issued a major report on how Rhode Island could develop a more dynamic regulatory framework to enable a cleaner, more affordable, and reliable energy system for the twenty-first century. Goals of transforming the power sector include controlling long-term costs of the electric system, giving customers more energy choices and information, and building a flexible grid to integrate more clean energy generation. This report describes recommendations for four workstreams: 1) utility business models, 2) grid connectivity and functionality, 3) distribution system planning, and 4) beneficial electrification. The recommendations in this report are based on significant stakeholder engagement, staff expertise, and consultation with national experts.

Docket 4600: Investigation into the Changing Electric Distribution System (2017)

http://www.ripuc.ri.gov/eventsactions/docket/4600page.html

From 2016-2017, the Public Utilities Commission investigated how a changing electric distribution system impacted their review of rate structures proposed in future proceedings. The resulting stakeholder report and order adopting the stakeholder report provide "a set of rate design principles and a benefit-cost framework to inform how rates could be set in a way to properly incent National Grid to meet state

policies." Importantly, this benefit-cost framework includes societal costs and benefits: greenhouse gas externality costs, criteria air pollutant and other environmental externality cost, and conservation and community benefits. Consideration of these factors provided a basis for which regulators can incorporate climate impacts into their decisions for certain applications.

Heating Sector Transformation (2020)

http://www.energy.ri.gov/HST/

The 2020 Heating Sector Transformation report identified and analyzed the state's potential pathways to thermal decarbonization. It was the result of an executive order from July 2019, issued by Gov. Raimondo. The study was led by the Office of Energy Resources (OER) and the Division of Public Utilities and Carriers (DPUC) and conducted by the Brattle Group.

The report identified several different decarbonization pathways, generally categorized into two types: electrification or decarbonized fuels. The findings suggest that several pathways exist that would enable RI to decarbonize the thermal sector by 2050, and also maintain similar overall energy expenses for households to those of present day. Due to a number of factors, including uncertainty around the future rate of technological development, the Report recommended that none of the potential decarbonization pathways be foreclosed on, but rather a suite of thermal decarbonization efforts be pursued in the coming years. Work in the coming years should focus on education and laying the groundwork to support several decarbonization avenues.

Electrifying Transportation: A Strategic Policy Guide for Improving Public Access to Electric Vehicle Charging Infrastructure in Rhode Island (2021)

http://www.energy.ri.gov/evplan/

In August 2021, the Rhode Island General Assembly passed bills H5031/S0994 directing the Department of Transportation (RIDOT), the Division of Motor Vehicles (DMV), and the Office of Energy Resources (OER) to "develop, no later than January 1, 2022, a plan for a statewide electric vehicle charging station infrastructure in order to make such electric vehicle charging stations more accessible to the public." In response, RIDOT, DMV, and OER, along with representatives from the Rhode Island Department of Environmental Management (RIDEM) and Rhode Island Department of Health (RIDOH) – collectively the Project Team – developed Electrifying Transportation: A Strategic Policy Guide for Improving Public Access to Electric Vehicle Charging Infrastructure in Rhode Island.

The intent of this Strategic Policy Guide is threefold: First, the Project Team reviews the status quo of electric vehicles and their charging infrastructure, as well as current and prior programming. The purpose of this review is to establish where Rhode Island is with vehicle electrification as we look ahead to 2022. Second, the Project Team distills needs and recommendations heard from three months of public comment, three public listening sessions, and two dozen one-on-one meetings with agencies and external stakeholder organizations. The purpose of this report is to prioritize what we heard as the most critical items to integrate into future policies and programs. Third, the Strategic Policy Guide will be a working document from which agencies – and stakeholders – can coalesce around priorities and coordinate action in the years to come.

Clean Transportation and Mobility Innovation Report (2021)

http://climatechange.ri.gov/documents/mwg-clean-trans-innovation-report.pdf

This 2021 report published by the Mobility Innovation Working Group provides a bold and ambitious vision for Rhode Island's transition to a cleaner and healthier transportation network. The scope of the report deals with short-and long-term trends that open opportunities for implementing new technologies

and strategies to build a more equitable and environmentally responsible transportation system. The transportation sector represents the largest share of Rhode Island's greenhouse gas emissions. In order to meet a net-zero future, bold initiatives are needed to electrify this sector while also encouraging infrastructure development and community design

Rhode Island's uniquely small land area creates an opportunity to integrate and coordinate transportation and land use policy. The state's single public transit agency, single statewide planning organization, and single major utility have the ability to streamline the framework for GHG emission reduction policies. Recommendations build off establishing Rhode Island as a national leader in transportation and climate commitments, unlocking economic opportunity and green job creation, while focusing on creating a healthier and more equitable environment for residents of our most overburdened and underserved communities.

Energy Efficiency Market Potential Study (2020)

https://rieermc.ri.gov/resources/

Commissioned in 2020 by the Energy Efficiency and Resource Management Council, this Market Potential Study covers the six-year period from January 1, 2021 to December 31, 2026 and estimates electricity, natural gas, oil, and propane energy savings; passive electric demand reduction savings and active demand response savings; and the costs and benefits associated with these savings.

Value of Forests (2019)

http://www.dem.ri.gov/programs/bnatres/forest/pdf/forest-value.pdf

This 2019 report discusses and identifies ways in which trees, plants, and vegetation are beneficial to Rhode Islanders and the Ocean State as a whole. The study uses data and visual depictions to convey the benefits and impacts of a healthy forest, good management practices, and engaged community members. Furthermore, the study frames areas for improvement and conservation growth with regards to air and water quality, climate change, human well-being, and wildlife. 56% of Rhode Island's land area is covered by vital forests and The Value of Rhode Island Forests focuses on how best to maintain, grow, and understand the state's vast forestry, open space, and conservation land. RIDEM developed this plan in conjunction with the US Forest Service and the Rhode Island Tree Council.

Resilient Rhody (2018) and Resilient Rhody 3-Year Impact Report (2021)

https://riib.org/solutions/initiatives/

To accelerate climate resilience actions and investments, Governor Raimondo signed an Executive Order on September 15, 2017 calling for the development of the state's first comprehensive climate preparedness strategy. Following nine months of collaborative work, the 2018 Resilient Rhody strategy lays the groundwork for collective action, involving state agencies, municipalities, and statewide business, academic, and nonprofit partners. The strategy responds to changing weather and environmental conditions in Rhode Island caused by climate change and proposes bold yet implementable actions to better prepare the state for these impacts. Building on the climate leadership of state government, municipalities, and organizations, Resilient Rhody leverages existing studies and reports to identify critical actions that move from planning to implementation.

Resilient Rhody identified priority actions the state could take to build statewide resilience, as well as a need to work collaboratively with and in support of municipalities across Rhode Island to build resilience at the local level. In response to this need, the Bank, in partnership with The Nature Conservancy, introduced the Municipal Resilience Program (MRP) in order to provide clearer pathways to implement the shared priorities of Resilient Rhody with participating municipalities. The purpose of the Municipal

Resilience Program is to help Rhode Island municipalities deepen their understanding of climate risk and adaptation approaches, as well as to assist municipalities to prioritize and implement local resilience actions, effectively increasing climate resilience across Rhode Island and advancing Resilient Rhody. In November 2021, the Bank released the 'Resilient Rhody 3-Year Impact Report' detailing progress that has been made by state agency and municipal partners in turning the original 2018 Resilient Rhody report's recommendations into concrete actions including infrastructure upgrades, coordinated planning, and financing of resilience projects.

Climate Change and Health Resiliency (2015)

https://health.ri.gov/publications/reports/ClimateChangeAndHealthResiliency.pdf

This 2015 report by the Rhode Island Department of Health warrants mention because of its thorough review of climate's impacts on health. The report discusses implications of extreme heat and rising temperatures, air quality, extreme weather, water quality, marine bacteria, and vector-borne disease. Importantly, this report also discusses climate change's implications for mental health. The report provides some next steps for action which continue to be relevant to our recommendations today.

Carbon Pricing Study (2020)

http://www.energy.ri.gov/documents/carbonstudy/final-rhode-island-carbon-price-study-report.pdf

In response to a 2017 directive from the Rhode Island General Assembly, OER and RIDEM in consultation with the RIDOT, contracted with the Cadmus Group and Synapse Energy Economics to investigate potential state and regional carbon pricing policy options to support Rhode Island in achieving the requirements laid out in the 2014 Resilient Rhode Island Act. This report provides an impartial assessment of the implementation considerations and potential impacts of illustrative carbon pricing policies.

The report outlines several key findings: A carbon price at the levels analyzed in this study would not achieve Rhode Island's 2050 greenhouse gas (GHG) reduction targets alone. Determining how to use revenue generated by the carbon price is a chief policy design step. Equity needs to be a conscious choice in both process and ultimate policy design. A carbon price has a small impact on electric vehicle (EV) adoption. A carbon price contributes, in a limited fashion, to increasing the adoption of air source heat pumps (ASHPs). A carbon price will create shifts in Rhode Island's economy, but aggregate economic impacts are expected to be negligible. A carbon price would generally have a limited aggregate impact on households. Wider geographic scope would lead to greater success.

Rhode Island Bicycle Mobility Plan (2020)

https://planning.ri.gov/sites/g/files/xkgbur826/files/documents/LRTP/Bicycle-Mobility-Plan.pdf

Approved in December 2020, The Rhode Island Bicycle Mobility Plan (BMP) is the first statewide initiative to expand the bicycle network strategically. The BMP takes a more detailed look at specific conditions, needs, and gaps surrounding bicycle infrastructure and operations in the State of Rhode Island and identifies supporting policies, strategies, and projects that will expand the network over the 20-year vision set out by the Long Range Transportation Plan. The plan seeks to safely and efficiently connect people and places so that riding a bicycle in Rhode Island is safe and fun for all ages. It also serves as a guide to assist municipalities at developing bicycle infrastructure at the local level.

Rhode Island Transit Master Plan (2020)

www.transitforwardri.com

Also approved in December 2020, The Transit Master Plan (TMP) performs a comprehensive analysis on the condition, needs, and future solutions to the transit network and works within the same 20-year horizon as the Long Range Transportation Plan and Bicycle Mobility Plan. The TMP sets out to achieve four major goals: Make transit attractive and compelling, connect people to life's activities, grow the economy and improve quality of life, and ensure financial and environmental sustainability. The plan hopes to guide investments to provide transit riders with faster services in dedicated lanes, investments in stops and regional hubs, and increased transit frequency. More information for this plan can be found at transitforwardri.com.

Clean Energy Industry Reports (2016-2021)

http://www.energy.ri.gov/cleanjobs/

The 2021 Clean Energy Industry Report is the seventh iteration in a series of reports conducted and written by BW Research Partnership, Inc. under commission by the Rhode Island Office of Energy Resources and the Renewable Energy Fund at Commerce RI. Findings in this report are based on data taken from comprehensive 2021 U.S. Energy and Employment Report (USEER). The 2021 USEER utilizes data from the Bureau of Labor Statistics Quarterly Census of Employment and Wages (BLS QCEW 2019 Q2) and Current Employment Statistics, as well as survey data. The survey was designed and implemented by BW Research Partnership. This series of reports provide crucial insight into trends in Rhode Island's clean energy workforce.

Select New Programs Since 2016

This section highlights some programs that have supported decarbonization strategies in Rhode Island, focusing on new programs since the *2016 Greenhouse Gas Emissions Reduction Plan* was released. The main takeaway from the programs described below is that we have gained a lot of experience with offering programs to support decarbonization. This experience should be leveraged to support progress toward our 2030 mandate and these programs provide an existing vehicle for deploying funding to support our climate goals.

This is not a comprehensive inventory of programs – to keep this section manageable, we exclude many impactful programs that began prior to 2016, are limited in term and funded by external grants, or are not administered directly by state agencies. We also omit many significant refinements to existing programs that have increased their impacts and benefited Rhode Islanders.

Expanding Energy Efficiency Programs

While National Grid has a long history of administering an energy efficiency program for its customers, Rhode Island's two municipal-owned utilities have made notable advances in their own energy efficiency programs. Since 2016, we can now say we have full statewide coverage to support energy efficiency.

Following an initial pilot program in 2015-2016, Block Island customers were offered an expanded energy efficiency pilot program called 'Block Island Saves' in 2016-2017. In 2021, Block Island Utility District launched a full-scale energy efficiency program for its customers.

Electric customers in Pascoag saw their long-running program substantially expanded beginning in 2019. The new program offers more incentives for more types of energy efficiency upgrades for both households and businesses.

Renewable Energy Fund

CommerceRI's Renewable Energy Fund (REF) provides grants for renewable energy projects. Since the program started in 2014, nearly 500 applicants received Renewable Energy Fund grants totaling $3.7 million for over 11 MW of grid-connected renewable energy.[42] Several notable program features have been added to the Renewable Energy Fund since 2016.

In 2017, the Renewable Energy Fund began incentivizing Community Renewables, including community solar. A community solar project is a large solar farm shared by more than one household. Its primary purpose is to allow members of a community the opportunity to share the benefits of solar power even if they cannot install solar panels on their roof or property.

In 2020, the Renewable Energy Fund began incentivizing the installation of solar projects located on brownfields. Brownfields are former industrial or commercial sites where future use is affected by environmental contamination and are often ideal locations for renewable energy projects. By incentivizing the installation of solar on already disturbed sites, this feature helps reduce pressures to develop open space, forests or farmland for solar projects.

In 2020, the Renewable Energy Fund began piloting an enhanced incentive for solar projects that are paired with battery energy storage systems. Energy storage can help match the timing of renewable electricity production with that electricity is consumed, which can reduce strain on our electric grid during critical times and provide other grid support. Energy storage can also provide backup power when the power is out.

Supply Chain Challenges

> *Supply Chain Shortages due to COVID-19 have had dramatic impacts on construction costs for clean energy systems. Spikes in steel prices, other raw materials, and transportation costs have led to higher costs and delays for renewable energy systems, electric transportation, and electric heat pumps. Rising costs and supply chain issues continue to create uncertainties in the clean energy industry, especially with respect to the reliability of future employment opportunities given the ongoing pandemic.*

Electric Transportation Programs

Since 2016, Rhode Island has offered several new programs to support electric transportation.[43] From 2016-2017, incentives for electric vehicles were available through a program called DRIVE. This program offered rebates up to $2,500, based upon vehicle battery capacity. Over 250 Rhode Island drivers received rebates, totaling the programs funding limit of $575,000. Electric vehicles using the DRIVE incentive were purchased at 15 different car dealerships across Rhode Island, generating over $300,000 in sales tax revenue for the state.

From 2017 to 2019, the Office of Energy Resources supported the installation of electric vehicle charging infrastructure at public locations through the ChargeUp! program. This program provided applicants with incentives to support the purchase and installation of electric vehicle charging stations (Level 2 or higher) at publicly accessible locations. In addition, applicants that installed at least one charging station through this program could also qualify for incentives to support the purchase or lease of a new electric vehicle as

[42] Data through 12/31/2021

[43] This section does include programs offered by third parties or federal agencies, but we recognize the importance of these programs.

part of their public sector fleet. ChargeUp! supported the installation of 49 dual charging stations and the purchase of 9 electric vehicles.

From 2019-2022, the Office of Energy Resources ran an incentive program for electric vehicle charging stations called Electrify RI, funding with $1.4 million from the Volkswagen Diesel Settlement. Incentives varied from $10,000 to $40,000 based on the type of charging station (Level 2, or DCFC) and sector (workplaces, multi-unit dwellings, state and local government, and publicly accessible locations). As of November 30, 2022, Electrify RI has supported the installation of 70 Level II charging stations, and 23 DC Fast Chargers throughout Rhode Island. In 2022, federal funding will be available to further expand electric vehicle charging infrastructure.

In July 2022, OER launched an electric vehicle rebate program, DRIVE EV. Driving Rhode Island to Vehicle Electrification (DRIVE) is an electric vehicle (EV) and e-Bike rebate program administered by the Rhode Island Office of Energy Resources (OER) to support adoption of electric vehicles by Rhode Island residents, small-businesses, non-profits, and public sector entities. DRIVE EV also provides additional incentives for qualified Rhode Islanders who purchase or lease an eligible electric vehicle and meet certain income requirements or participate in a State or Federal Income-Qualifying Program. It works towards making EVs more affordable for more Rhode Islanders.

Following recommendations from the 2017 Power Sector Transformation report, National Grid began its Electric Transportation Initiative. This suite of programs includes a pilot to encourage charging at certain times of the day to reduce strain on the electric grid, an incentive program to offset some costs of installing electric vehicle charging stations, and technical assistance to support converting fleets from gas to electric.[44]

Incentives for Heat Pumps

Converting heating systems to electric heat pumps is a key strategy to reduce emissions from heating. Incentives for installing heat pumps are new since 2016. These incentives have been offered by utility energy efficiency programs and by the Office of Energy Resources leveraging auction proceeds from the Regional Greenhouse Gas Initiative (RGGI). Since 2016, incentives have supported hundreds of households – in 2021 alone, over 500 households were supported. In 2022, the general assembly passed a budget article that allocated $25 million to the High-efficiency Heat Pump Program (HHPP) that will provide a broadened suite of heat pump incentives to Rhode Islanders. It is set to launch in early 2023.

Agricultural Energy Grant Program

The Rhode Island Department of Environmental Management and Office of Energy Resources partnered to offer a grant program specifically designed to support farmers. The Agricultural Energy Grant Program that provides grant awards of up to $20,000 for eligible energy efficiency and renewable energy projects at Rhode Island Farms. This funding helps local farmers "green" their operations and benefit from the related energy and cost savings through energy efficiency projects and by transitioning to renewable power. Funding for this program is made possible through the Regional Greenhouse Gas Initiative (RGGI). Since 2016, grants totaling over $894,000 have supported more than 50 projects.

Lead-by-Example

Signed in 2015, Executive Order 15-17 set forth specific goals for the State Administration to lead-by-example. Since then, the Office of Energy Resources has devoted staff resources to leading this body of work and has expanded support to other public entities. To tout progress being made, the Lead-by-

[44] The Electric Transportation Initiative also included a discount on demand charged for eligible customers installing fast charging; this discount is no longer offered.

Example Annual Awards recognize achievement of public sector entities in implementing clean energy projects.

Since 2016, several Master Price Agreements (MPAs) have been developed to streamline procurement for state agencies and other public entities who wish to follow state procurement law. An MPA is a list of pre-qualified vendors from whom a procurer may solicit quotes. This purchasing mechanism expedites decarbonization by clearly defining proposal requisition processes and providing access to a pool of prequalified energy services vendors. MPA 508 includes vendors to develop and install turnkey energy efficiency projects. MPA 509 includes vendors to develop and install electric vehicle charging stations. MPA 553/CR 44[45] includes firms that can provide turnkey solar installation and maintenance services for public entities.

OER has also coordinated several competitive procurements of gas and electricity supply. These procurements, in addition to covering all State accounts, have also been made available to other public sector entities, such as quasi-state agencies and municipalities. By aggregating demand and leveraging economies of scale through a competitive process, OER and the Department of Administration aim to reduce energy supply costs and reduce energy price volatility for all participating public entities. The current electric contract will deliver approximately $2.3 million in bill savings in 2021 compared to the default utility price and the current gas contract will deliver approximately $2.1 million in bill savings in 2020 compared to the default utility price.

OER is now the central clearinghouse for all utility billing for State accounts. By collating and providing greater oversight over State agency utility bills, OER has been able to improve energy usage and cost forecasting, decrease payment errors, and analyze progress toward Lead by Example goals. Importantly, OER has been simultaneously working to increase public and inter-governmental transparency into these important data sets.

In February 2018, Rhode Island's first voluntary Stretch Codes were made available to private and public building construction and renovation projects. The codes were developed with the assistance of subject matter experts and were vetted through a public comment process. Rhode Island's Stretch Codes are meant to be used on a voluntary basis to guide the construction and/or renovation of buildings that use less energy, have less negative impact on the environment, and achieve higher levels of occupant health and comfort.

In 2021, the LED School Lighting Accelerator Pilot was launched to support the conversion of public-school facilities to LEDs in Central Falls and Providence. Public schools, particularly in economically challenged school districts, have not had the funding, technical expertise, and bandwidth to implement many clean energy upgrades. By providing the technical, procurement, and financial support needed to implement these projects, OER is helping to improve the operations, efficiency and learning environment in public school facilities. After a successful pilot, OER scaled up efforts to support LED lighting projects in additional districts, expanding the reach of the program to 10 communities by the end of 2022.Clean Energy Internship

Created in 2019, the Clean Energy Internship Program is designed to help provide internship opportunities in clean energy careers, ranging across sectors (e.g. energy efficiency, solar) and job types (e.g. direct construction, engineering, research). This programs pairs students with host companies from Rhode Island. Student interns can develop professional skills under the mentorship of an industry partner

[45] CR-44 is a Continuous Recruitment procurement list. Similar to an MPA, a CR is a list of pre-qualified vendors. In contrast to an MPA, a vendor may apply to be included on a CR at any time through an open enrollment process.

to combat real world problems in energy and the environment. The Clean Energy Summer Internship program approved five interns providing a reimbursement to four clean energy host companies that totaled $16,871.85 in calendar year 2021.

Municipal Resilience

Resilient Rhody identified priority actions the state could take to build statewide resilience, as well as a need to work collaboratively with and in support of municipalities across Rhode Island to build resilience at the local level. In response to this need, the Bank, in partnership with The Nature Conservancy, introduced the Municipal Resilience Program to provide clearer pathways to implement the shared priorities of Resilient Rhody with participating municipalities. The purpose of the Municipal Resilience Program is to help Rhode Island municipalities deepen their understanding of climate risk and adaptation approaches, as well as to assist municipalities to prioritize and implement local resilience actions, effectively increasing climate resilience across Rhode Island and advancing Resilient Rhody.

As of 2022, 27 municipalities have participated in the Rhode Island Infrastructure Bank's Municipal Resilience Program (MRP). The MRP is a new program since 2019 and includes a robust stakeholder engagement approach to resilience planning. MRP workshops have hosted over 600+ participants, including municipal staff and community leaders. 350+ potential resilience capital projects have been identified using this locally specialized approach.

As of 2022, 46 resilience projects have been funded through MRP Action Grants - a total of $7.5 million in assistance. 91% of projects funded by MRP Action Grants have incorporated green infrastructure and/or nature-based solutions. 93% of MRP Action Grants have incorporated green infrastructure and/or nature-based solutions. $7 million was allocated to the MRP through the 2021 Beach, Clean Water, and Green Economy Bond, and another $16 million was allocated to the MRP through the 2022 Green Economy Bond. The Bank also developed two new programs in 2022 to support resilience. MRP workshops statewide have identified a need for local capacity building, as well as a need for regional approaches that can address resilience projects spanning municipal boundaries. Rhode Island Infrastructure Bank launched a pilot Regional Resilience Coordinator position at the Bank, within the MRP, to provide additional capacity for local resilience. The pilot position, a Regional Resilience Coordinator for Aquidneck Island, assists island municipalities to advance intra- and inter-municipal resilience efforts, and serves as a model for future Regional Resilience Coordinator positions at the Bank.

MRP municipalities have also expressed a need for increased design and engineering assistance, particularly for resilience projects implementing green infrastructure and nature-based solutions. In response, the Bank will launch a new initiative in 2023: 'Creating a Centralized Nature-Based Resilience Program for RI.' This upcoming initiative, funded by the National Fish and Wildlife Foundation and conducted by the Rhode Island Infrastructure Bank in partnership with Narragansett Bay National Estuarine Research Reserve, University of Rhode Island Coastal Resources Center / Sea Grant, Save the Bay, and The Nature Conservancy, will assist MRP municipalities to advance resilience project ideas to construction ready designs.

Climate Change and Health Program

Since the 2015 Climate Change and Health Resiliency report, RIDOH has continued to support community resilience and adaptation efforts focusing on extreme heat, flooding, emergency preparedness, and sea level rise. Resilience building efforts with the Health Equity Zones have resulted in grants for urban greening and tree planting, community education and youth activities, and efforts to support senior living facilities, schools, and municipal cooling centers.

During the summer of 2020, RIDOH collaborated with the RIDEM Division of Forest Environment and American Forests to measure ambient air temperatures across several Rhode Island municipalities and neighborhoods. This project resulted in a set of maps that identifies urban heat islands and heat disparities during different times of the day. Areas where overnight temperatures stay high and where daytime temperatures can be up to 12 degrees hotter than others are considered priority areas for heat mitigation using tree planting and other urban greening techniques.

In 2021, the RIDOH Climate Change and Health Program conducted a needs assessment with a small group of stakeholders. This assessment showed that we need to continue collaborating across state agencies to deepen our connection with the community and drive change through inclusion of a diversity of community voices. The Climate Change and Health Program sees its role as supporting community engagement, educating the public and other agencies about risks to human health, and building resilience and social cohesion. Additional resources are needed to continue this work at a meaningful level while integrating it into 2021 Act on Climate goals.

Climate & Youth

Climate change has contributed to extreme weather events, air pollution, and rising temperatures. As the impacts of climate change become more severe, the fear of uncertainty in our future grows. Our youth population is already facing challenges caused by climate change. We need to prepare and educate our youth on how policies can be used to regulate and slow down the anthropogenic activities that are causing climate change. This will allow the future generation to gain skills that will help them determine the best ways to fight against climate change. When it comes to youth and climate it is also important to recognize that young people are active participants in climate action and provide a valuable perspective that deserves to be heard by decision-makers, as we will be leaving the Earth to them.

Climate change education is critical because the impacts that climate change is having on humans goes beyond our physical health. It can also affect our mental health, especially in our youth. For example, natural disasters related to climate change, such as hurricanes and wildfires, may lead to high levels of anxiety and trauma. Long-term impacts of climate change can cause fear of not knowing what the future of our environment will be, leaving our youth feeling helpless. To help ease the anxieties of climate change in our youth, we need to educate them on the importance of climate policies and what they can do personally to help.

It is important that we ensure our youths voices are heard. Through climate-youth workshops, young Rhode Islanders can learn about our current climate change policies as well as be given an opportunity to share their ideas on climate's impact on our youth. It is critical that we focus not only on meeting our climate mandates but also ensuring health, safety, and comfort of our youth community.

Policies and Legislation

The following list highlights some policies and legislation that showcase substantial commitments toward our climate goals. This list is not exhaustive, and every piece of policy and legislation matters. Interested readers should contact their local legislators to learn more about considerations in the General Assembly.

2021 Act on Climate

The 2021 Act on Climate sets statewide, economy-wide climate goals that are both mandatory and enforceable. The Act requires the state reduce greenhouse gas emissions by 45% below 1990 levels by 2030, 80% below 1990 levels by 2040, and reach net-zero emissions by 2050. The Act also requires the development of this update to the *2016 Greenhouse Gas Emissions Reduction Plan* in 2022 and a comprehensive climate strategy by 2025, to be updated every five years thereafter.

Critically, the Act deems addressing the impacts on climate change to be within the powers, duties, and obligations of all state departments, agencies, commissions, councils, and instrumentalities, including quasi-public agencies. The Act gives each agency the authority to promulgate rules and regulations necessary to meet the Act's greenhouse gas emission reduction mandates.

COP26 (Signaling Promising Momentum) and COP27 (Loss & Damage Fund)

In November 2021, the United Nations Climate Change Conference (called COP26*) was held in Glasgow, Scotland. Many first-hand accounts of this remarkable meeting were shared afterwards, including from Rhode Island State Senator Dawn Euer at the December meeting of Rhode Island's Executive Climate Change Coordinating Council held in Newport.*

Bill Gates also shared his experiences and observations in a blog post. Mr. Gates noted three major areas of change that have happened since the last summit he attended in 2015; clean-energy innovation is higher on everyone's agenda, the private sector is now playing a major role alongside government agencies; and, there is much more public visibility and acceptance of climate adaptation.

The 27th Conference of the Parties (COP27) took place during the first two weeks of November 2022 in the Egyptian coastal city of Sharm el-Sheikh. More commonly referred to as COP27, this conference was touted as the "Africa COP" with a specific focus on implementation to help turn past pledges into real climate action. The conference closed on November 20th after all night negotiations. The highlight of the conference was an agreement to establish a "loss and damage" fund. The fund aims to provide financial assistance to nations most vulnerable to the adverse effects of climate change. However, key details, such as which countries will pay into the fund, have yet to be fully decided. While the creation of a "loss and damage" fund was historic, the lack of action on adaption and mitigation begs the question of whether the "loss and damage" fund will translate into action. Additionally, many countries did not bring updated nationally determined contributions to COP27 and therefore have not set more ambitious climate targets that are necessary to stay below the Paris Agreement goal of a 1.5°C. Finally, the most disappointing element of COP27 was the failure to commit to decisively phase out the use of fossil fuels.

Appliance Energy Efficiency Standards

In 2021, the General Assembly updated Rhode Island's energy and water efficiency standards for a number of common appliances.[46] The legislation sets minimum efficiency standards for 15 household and commercial products which will save energy, save money, and reduce greenhouse gas emissions. From 2023 to 2035, these standards are expected to reduce emissions by 256,000 metric tons.

[46] RIGL 39-27.1 Appliance and Equipment Energy and Water Efficiency Standards Act of 2021

Transportation and Climate Initiative

The Rhode Island Department of Environmental Management led Rhode Island's participation in the Transportation and Climate Initiative (TCI), a regional cap-and-invest policy proposal for the transportation sector. In December 2021, neighboring states Connecticut and Massachusetts paused their participation in this effort. As this effort depends upon the involvement of at least three jurisdictions, Rhode Island cannot move forward with TCI at this time. However, key insights about priorities for program design and revenue investment should be incorporated into future policies and programs.

Conversations about Solar Siting

Since 2016, increasing deployment of large solar PV systems in forested areas has raised concerns from stakeholders and the public about finding the right balance of renewable energy development amidst policy objectives like decarbonization and land conservation. These local conversations have informed studies (e.g. the Solar Siting Opportunities study, Value of Forests report), program design (e.g. REF Brownfields Program), and policies (e.g. municipal solar ordinances). These conversations should continue to inform our climate strategies, particularly related to decarbonizing our electric sector and preserving environmental benefits of Rhode Island's forests.

Increasing Biofuels

In 2021, legislation updated the Biodiesel Heating Oil Act of 2013 to phase in higher percentages of biodiesel or renewable hydrocarbon diesel blended into home heating oil. The new law requires home heating oil to be 10% biodiesel or renewable hydrocarbon diesel in 2023, 20% in 2025 and 50% in 2030. Biodiesel is a fuel made from plant or animal products or waste. It must meet standards and is blended with petroleum heating oil to burn cleaner and reduce greenhouse gas emissions. Rhode Island had previously required heating oil to be sold as a mix that contains 5 percent biodiesel, phased in between 2014 and 2017.

Offshore Wind

In 2016, Rhode Island became home to the first offshore wind project in the nation with the successful installation of the 30 MW Block Island Wind Farm. In 2019, another contract for the 400 MW Revolution Wind was approved. This new project is expected to reduce Rhode Island's greenhouse gas emissions by 11 MMTCO2e, in addition to providing substantial local economic benefits including more than 800 direct construction jobs, 50 permanent jobs, and hundreds more jobs supported indirectly as the region's burgeoning offshore wind industry takes off.

Land and Forest Conservation

In 2016, the RI General Assembly amended the laws of the state as they relate to the conservation and preservation restrictions on real property (RIGL §34-39-5). The amendment makes it more difficult remove land conservation restrictions. The result has been stronger land protection laws in Rhode Island.

Forests provide invaluable ecosystem services like carbon sequestration and storage that are essential to meeting the state's climate change goals. In recognition of this natural asset, the Rhode Island General Assembly passed the Forest Conservation Act in July 2021 (RIGL §2-27). The Act establishes a Forest Conservation Commission (FCC) to inventory the state's forestland, develop stronger tools and incentives for forest conservation, expand urban and community forestry, and grow the state's forest products industry. Led by RIDEM, the Forest Conservation Commission has been meeting regularly since mid-2022.

Pressures on Land Conservation Efforts

Land conservation efforts are significantly impacted by real estate market dynamics. Rhode Island's housing market has seen an unprecedented increase in value over the past several years. However, higher than ever development costs (i.e., roads, utilities, and home construction) have led to uneven expectations for the value of large land parcels, often leaving state land protection programs unable to match private market offers. Similarly, pressure for kilowatts of solar (renewable) energy has resulted a in large tracts of undeveloped property being converted to fields of solar panels. Finding the right balance between solar development and the need to protect working farms and forest land continues to be the subject of much discussion at the local level and in the General Assembly. Siting guidance and incentives that push solar development away from large forested and agricultural parcels can help to protect Rhode Island's remaining open space.

It is an ongoing challenge to protect interconnected land areas of sufficient size to support wildlife, biodiversity, and ecosystem services for future Rhode Island generations. Large, interconnected conservation lands are particularly important as a strategy for adapting to climate change because the distribution of animals and plants are likely to shift and continue shifting as temperatures, rainfall and the timing of seasons continue to morph over coming decades. Ensuring the state can be ready to match available funding with the opportunity to protect such critical land resources should be a priority resilience measure.

Rhode Island's 400 miles of coastline is particularly vulnerable to episodic storms, erosion, coastal flooding, inundation and storm surge. The National Oceanic and Atmospheric Administration's February 2022 report 'Global and Regional Sea Level Rise Scenarios for the United States' indicates that relative sea level along the contiguous US coastline is expected to rise on average as much over the next 30 years as it has over the last 100 years. Land conservation efforts that accommodate and proactively target areas to allow for the inland movement of coastal habitat, such as wetland migration, are increasingly being considered to help maintain natural storm surge buffers, wildlife habitat, wetland-dependent human activities, water filtration, and other ecosystem services coastal wetlands provide.

2021 Beach, Clean Water, and Green Economy Bond & 2022 Green Bond

The 2021 Beach, Clean Water, and Green Economy Bond dedicated $7 million to the Municipal Resilience Program matching grants to municipalities to restore and/or improve the resiliency of infrastructure, vulnerable coastal habitats, river and stream floodplains, and watersheds. The Bond passed with 78.3% support, allowing the Municipal Resilience program funds to further advance community resilience to the impacts of climate change.

In the pilot years of the Municipal Resilience Program, limited MRP Action Grant funds meant that the Bank could only offer Action Grants to municipalities who had completed their MRP workshop in the current award year. With the support of this State Green Bond, the Bank has been able to expand the call for MRP Action Grant proposals, allowing any community who completed a Municipal Resilience Program workshop in any year access to MRP Action Grant funds annually. With a successfully widened call for MRP Action Grant proposals in fall of 2021, the Bank seeks to continue offering annual MRP Action Grants to all MRP municipalities each year.

2022 saw the passage of the 2022 Green Bond which infused an additional $16 million into the Municipal Resilience Program. This has greatly increased the capacity of the Bank to support resilience priorities identified by a majority of communities across Rhode Island.

Progress on 2016 Pathways

The *2016 Greenhouse Gas Emissions Reduction Plan* organized its emissions mitigation strategies were organized as a set of pathways under three overarching objectives: build on state success, enable markets and communities, and leverage regional collaboration. We refer the reader to the 2016 Plan for the full description of each of these pathways. Here, we summarize the progress we've made since 2016 and comment on the progress we still need to make. For additional detail on specific items since 2016, we refer readers to the other sections within this chapter.

Build on State Success

The *2016 Greenhouse Gas Emissions Reduction Plan* noted that "Rhode Island has existing policies and proven models to address nearly all mitigation options, creating a strong foundation the State can build upon to reach our goals." Since 2016, Rhode Island has continued to be a leader in our climate efforts.

Energy Efficiency

Rhode Island has continued to invest in its energy efficiency programs. In 2021, the General Assembly extended the statutory obligation to offer energy efficiency through 2029.[47] Programs have also been initiated and enhanced for customers of Pascoag Utility District and Block Island Utility District.

One notable achievement of these energy efficiency programs is their influence on transforming the lighting market. Programs in previous years emphasized incentives that reduced the customer cost of energy efficient lighting, a very cost-effective low hanging fruit to reduce energy use. Thanks to these incentives and appliance efficiency standards, energy efficient LEDs are now the prominent type of lighting technology, rendering utility incentives for LEDs unnecessary in most applications. Today's energy efficiency programs are in the transition to incentivizing other efficient technologies like building automation, high-efficiency HVAC, and weatherization.

The 2016 Plan recommends "policymakers could address a critical gap in existing programs – limited energy efficiency services for delivered fuels (heating oil and propane) customers, a group comprising over one-third of all heating customers. A sustainable funding and/or financing solution is needed for these users to enjoy full and equal access to energy efficiency programs." Rhode Island continues to lack this sustainable funding solution for customers relying on delivered fuels for heating.[48] Short-term, limited funding has been proposed as a stop-gap solution, but we must come up with a permanent funding stream to achieve the level of heating decarbonization needed to meet our longer-term climate mandates.

The 2016 Plan recommends screening additional appliances to see whether enacting or updating energy efficiency standards may be warranted – in 2021, Rhode Island did indeed enact updated appliance efficiency standards.[49]

Last, the 2016 Plan recommends making energy costs of purchases visible to consumers including through building energy disclosure and labeling. While discussions have occurred, no such statewide policy has been enacted.

Vehicle Miles Traveled (VMT) Reductions

The 2016 Plan notes a number of considerations that may encourage the reduction of vehicle miles traveled, including increasing transit and mode share ridership targets, integrating transportation and land

[47] Least-Cost Procurement Statute
[48] Some funding is available to incentivize some efficiency measures for electric customers who heat with delivered fuels (e.g. weatherization).
[49] RIGL 39-27.1 Appliance and Equipment Energy and Water Efficiency Standards Act of 2021

use planning, using price signals to discourage solo driving, and investing in alternative modes of mobility.

In 2019, Rhode Island launched the Mobility Innovation Working Group, a 26-member panel of experts comprised of equal participation from the private and non-profit sectors as well as key state agency representatives. The two-year effort culminated in a thorough strategy for improving mobility broadly, including additional thinking around reducing vehicle miles traveled. To date, there has been no concerted action to expressly reduce vehicle miles traveled. On the contrary, all efforts have been based on strategies to improve the relative attractiveness (e.g. convenience, cost savings) of alternative forms of mobility (e.g. transit, biking, walking) and better connect residents with destinations (e.g. state and local comprehensive plans).

In 2021, the Rhode Island Turnpike and Bridge Authority completed installation of all-electronic tolling at their Jamestown Plaza serving drivers crossing the Newport Pell Bridge. While not explicitly reducing vehicle miles traveled, this project does reduce idling and congestion, which reduces localized air pollution and emissions.

Clean Energy

The 2016 Plan recommends aligning "in-state renewable energy policy and deployment targets to be consistent with the broader goal of a 99% clean regional grid by 2050. As part of this consideration, policymakers would need to weigh the comparative costs and benefits of different pathways (e.g., local versus regional renewables, the role of different technologies, and the need for incremental distribution or transmission investments)." Rhode Island's 100% Renewable Electricity by 2030 report analyzes the trade-offs between various technology pathways to meet all of Rhode Island's electricity demand with renewable energy resources. Among other important insights, this report recommends enacting an accounting mechanism to ensure Rhode Island either generates or offsets all its electricity consumption with renewable energy resources.

Electric Heat

The *2016 Plan* noted the importance of transitioning to energy efficient electric heat, and the 2021 Act on Climate's stronger emissions mandates will necessitate this strategy even more. To offset costs of transitioning to efficient electric heating, the *2016 Plan* suggests using existing energy efficiency programs which would require "further policy guidance is needed to allow electrification of heating to fully qualify as an activity under the State's energy efficiency program or another energy program." Regardless of programmatic avenue to deploy funding and assistance, sustainable funding is needed.

While there is a long-term funding source identified for upgrading inefficient electric heating systems (e.g. electric resistance) to efficient electric heating (e.g. heat pumps), this is not the case for supporting customers who would like to switch fuels. We have since employed short-term and limited funding sources as a stop gap measure to support fuel switching. Rhode Island has not yet identified a long-term source of funding that can support energy efficient heating electrification, particularly for customers who currently rely on delivered fuels, within our current statutory framework.

Biofuel Heat

In line with recommendations from the *2016 Plan* to increase the existing statewide bioblend standard, the General Assembly updated the Biodiesel Heating Oil Act in 2021. The strengthened Act now requires all home heating oil sold in Rhode Island to be 10% biodiesel or renewable hydrocarbon diesel in 2023, 20% in 2025, and 50% in 2030.

Electric Vehicles

The *2016 Plan* recommends "further initiatives to incentivize the adoption of electric vehicles and charging infrastructure would be needed to achieve the aggressive market penetration levels necessary to meet long-term GHG reduction targets." Accordingly, Rhode Island has deployed several incentive and assistance programs to support electric vehicle purchases and installation of charging infrastructure, with significant incentive programs and funding becoming available in 2022.

In line with recommendations, the Rhode Island Public Transit Authority is working to convert its entire fleet to electric or zero-emissions buses by developing an action plan in 2022 and the Department of Transportation is conducting a study to understand implications for gas tax revenues and resulting policy considerations to ensure sustainable funding for our transportation infrastructure. These commitments, along with many others by all state agencies represented on the Executive Climate Change Coordinating Council, are described in the report Electrifying Transportation.

The *2016 Plan* also recommends "future planning for the state's passenger and freight rail transportation system could also evaluate electrification as a strategy aligned with long-term greenhouse gas reduction targets." Electrification continues to be discussed and is considered in Transit Forward 2040, a collaboration between the Rhode Island Public Transit Authority, the Rhode Island Department of Transportation, and the Rhode Island Division of Statewide Planning.

More generally, the Rhode Island Department of Environmental Management (RIDEM) has enacted or is in the process of enacting two key regulations that will reduce emissions from vehicles since 2016. In 2019, RIDEM amended their existing Air Pollution Control Regulation to align with California's Low Emission Vehicle emissions standards for passenger cars and trucks.[50] By the end of 2022, RIDEM will further amend this regulation to adopt by reference California's Advanced Clean Truck (ACT) Rule and Heavy-Duty Engine and Vehicle Omnibus rules (HD Omnibus).[51] The ACT Rule will require medium- and heavy-duty vehicle manufacturers to sell zero-emission vehicles (ZEVs) as a certain percentage of sales in our state. Manufacturers must increase their zero-emission truck sales depending upon the class size of the truck. The HD Omnibus rules will require lower nitrogen oxides (NOx) and fine particulate matter (PM2.5) emission standards for new truck engines (both diesel and non-diesel engines), in addition to other requirements for these engines.

Transportation Biofuels

The *2016 Plan* suggests "Rhode Island could explore the feasibility of establishing a statewide bioblend standard" similar to bioblending for heating oil. Such a standard has not been enacted to date.

Land Use Conservation

The *2016 Plan* suggests considering "adoption of a 'no net-loss of forests' policy." While such a policy has not be enacted per se, recent policies have strengthened land and forest conservation (RIGL §34-39-5 and RIGL §2-27). Renewable energy programs have also been developed to nudge renewable energy development away from forested areas and onto previously disturbed sites.

Natural Gas Leaks

The *2016 Plan* recommends "continuation of National Grid's gas infrastructure repair and replacement program to address fugitive methane leaks in the state's gas distribution system." Indeed, this work has

[50] Part 37 of the Air Pollution Control Regulation, "Rhode Island's Low-Emission Vehicle Program" (250-RICR-120-05-37).
[51] Amendment to Part 37 of the Air Pollution Control Regulation, "Rhode Island's Low-Emission Vehicle Program" (250-RICR-120-05-37).

continued in collaboration with the Division of Public Utilities and Carriers and under the regulatory oversight of the Public Utilities Commission.[52] Approximately 500 miles of leak prone pipe has been replaced since 2016 –which reduces leaks from the pipeline gas system. However, leak prone pipe replacement may actually be counterproductive to meeting the Act on Climate, since pipes that are replaced have a 50–100-year lifespan. This topic will likely be analyzed the Public Utility Commission's upcoming Future of Gas docket.

Energy Storage

The *2016 Plan* recommends "pursuit of policies to promote energy storage, which can provide many types of system benefits, including integrating clean energy resources in a more cost-effective manner." Since 2016, two key programs have been deployed to encourage energy storage: payment for performance of energy storage systems during demand response events and incremental incentives for solar PV systems paired with energy storage. The report 100% Renewable Electricity by 2030 echoes the recommendation to build out a strategic role for energy storage as we increase renewable energy on our regional grid; this work has not yet begun. In addition to electric energy storage, there are thermal storage options that can help decarbonize the thermal sector. These have not yet been extensively explored, but should evaluated in the coming years.

Other

This section outlines three 'other' pathways described in the *2016 Greenhouse Gas Emissions Reduction Plan*. In addition to the updates below, in 2021, RIDEM also enacted a new Air Pollution Control Regulation to prohibit manufacturers from selling products (air conditioning and refrigeration equipment, aerosol propellants, and foam) that contain a certain particularly potent greenhouse gas.[53]

Battery Storage in Pascoag

The Pascoag Utility District (PUD) unveiled a new 3MW/9MWh stand-alone battery storage installation in August of 2022, which will provide needed grid-reliability and peak load reductions for the utility's 5,000 customers. This battery project, alongside a needed substation upgrade, helped PUD avoid nearly $12 million dollars in infrastructure investment that would have otherwise been required to continue reliably serving their customers during peak-load conditions in the summer months.

Through an innovative and collaborative partnership with the Office of Energy Resources, the Rhode Island Infrastructure Bank, and Agilitas Energy, PUD was able to provide the reliability and load management it needed, at a fraction of the cost to its customers. The implementation of this battery is a successful example of implementing a non-wires alternative to improve reliability at a lower cost.

A first of its kind project in Rhode Island, this stand-alone battery demonstrates the viability of storage technologies in not only delivering value for utility customers but also supporting the State's Act on Climate mandates to reduce GHG emissions. Using batteries to store energy and dispatch it later at times of peak demand helps balance supply and demand. It also supports the

[52] Plans for identifying and prioritizing the replacement of 'leak-prone pipe' are proposed in annual Infrastructure, Safety, and Reliability Plans. The most recent plan is included in Docket 5210.

[53] Part 53 of the Air Pollution Control Regulation, "Prohibition of Hydrofluorocarbons in Specific End Uses" (250-RICR-120-05-53) prohibits manufacturers from selling products that contain high global warming potential hydrofluorocarbons.

transition to clean energy by allowing better integration of the increasing amount of renewable energy coming onto the electric grid.

Solid Waste

The *2016 Plan* recommends we put in place "strategies to reduce methane emissions from the Central Landfill." The RI Resource Recovery Corporation (RIRRC) continues to maintain a landfill gas (LFG) recovery system at the Central Landfill. LFG, which contains methane, is captured, converted, and used as a renewable energy resource. Using LFG helps to reduce odors and prevents methane from migrating into the atmosphere and directly contributing to climate change. Rhode Island's Central Landfill has one of the largest methane-to-energy plants in the country.

In 2015, RIRRC completed a waste characterization study that highlighted a significant opportunity to extend the life of its Central Landfill by further diverting organics from the municipal residential waste stream. Anaerobic decomposition of organic materials in landfills produces methane, a greenhouse gas with global warming potential many times higher than carbon dioxide. In 2018, RIRRC's Long Term Solid Waste Alternatives Study subsequently identified several means for processing this material. Then, in 2019, RIRRC identified 13 potentially viable collection scenarios that could be pursued for the technologies short-listed in the 2018 Alternatives Study. Recognizing that collection costs are a significant consideration of overall program delivery, RIRRC issued a request for proposals in 2020 to better understand the collection scenarios for organics that could be pursued in Rhode Island and what their associated costs may be – results of this analysis are expected in 2022. The co-benefit of reducing organics in the Central Landfill as a means to extend the life of the Central Landfill will be reduced methane emissions.

Enable Markets and Communities

The *2016 Greenhouse Gas Emissions Reduction Plan* noted that "Rhode Island's best resources are our people and communities – with the right support, we can remove barriers to clean energy market growth, consumer education and engagement, partnership of utilities, and public sector leadership." This strategy

of partnership and collaboration has not only been foundational for Rhode Island's leadership but has improved since 2016.

Grow Clean Economy Jobs

The *2016 Plan* provide three recommendations for state policymakers: "fostering nascent local clean energy industries, supporting innovation in clean energy, providing workforce training, and assisting incumbent fossil fuel industries (e.g., the delivered fuels industry) and disadvantaged communities with resources to excel in the burgeoning clean energy marketplace."

We point readers to the Office of Energy Resources annual Clean Energy Industry Report for more details about job growth and industry trends but note a few key items here. First, Rhode Island is working hard to position itself as a hub for the domestic offshore wind supply chain. For example, the 2019 contract for the 400 MW Revolution Wind offshore wind project includes $4.5 million in investments for Rhode Island's ports and offshore wind workforce.[54] Second, Rhode Island continues to support the local solar industry through programs that incentivize solar (e.g. RE Growth Program, Renewable Energy Fund) and partnerships for workforce development (e.g. Clean Energy Internship Program). Third, in 2022 the Department of Labor and Training is beginning an industry convening to assess workforce development needs for increasing consumer adoption of electric transportation (to launch in 2023). Fourth, the High-efficiency Heat Pump Program (HHPP) includes supporting workforce development as a key component.

Further strategic analysis needs to be conducted to recommend specific action items needed to support a just transition with living wages as part of the development of the *2025 Climate Strategy*, as required by the 2021 Act on Climate.

Empower Citizens and Communities

The *2016 Plan* lists barriers to consumer adoption of decarbonized technologies: "low customer awareness and confidence in previously unfamiliar products; access to and availability of financing solutions; soft costs related to permitting and regulatory hurdles; technical assistance for municipalities to implement solutions." These barriers are still present, but some work has attempted to mitigate them. This work includes consumer education and outreach campaigns (e.g. via Ocean State Clean Cities Coalition, via the Energy Efficiency and Resources Management Council), financing through energy efficiency programs and the Rhode Island Infrastructure Bank (e.g. HEAT Loan, on-bill repayment, Efficient Buildings Fund), and technical support for municipalities (e.g. via the Municipal Resilience Program, via OER's Shared Energy Manager pilot program). However, gaps remain and barriers are still present, which necessitates continued work to empower citizens and communities, and particularly low-income and vulnerable communities.

Foster a More Dynamic Regulatory Model

The *2016 Plan* states "state policymakers and utility regulators will continue initial efforts already underway to consider thoughtful changes to utility planning, business models, performance incentives, and rate design in order to enable a transition to the future grid that values, integrates, and plans for growth in clean energy and carbon-free resources, while maintaining a safe and reliable electric system." This statement alluded to the Power Sector Transformation initiative, which resulted in a stakeholder report in 2017. Resulting recommendations led to National Grid's programs related to electric transportation and proposals for both modernizing our electric grid and deploying advanced metering infrastructure. While these two proposals were filed in 2021, they were on hold while other regulatory proceedings were being resolved. In November 2022 Rhode Island Energy filed their Advanced Metering

[54] Press Release from April 2019

Functionality (AMF) Business Case to the Public Utilities Commission.[55] The Power Sector Transformation report also includes a number of recommendations that should continue to be considered.

Lead-by-Example

The *2016 Plan* advocates for the "state government to serve as an early adopter to demonstrate the benefits of greenhouse gas mitigation and clean energy solutions." In accordance with this recommendation, the Office of Energy Resources has supported state agencies across government leading by example with reducing energy use and cost, deploying renewable energy systems, transitioning fleets to electric, and installing electric vehicle charging infrastructure, among other accomplishments. These efforts to date will save Rhode Island nearly $100 million in energy costs over the lifetime of projects implemented.[56]

The *2016 Plan* extends leading by example to municipalities and communities: "at the local level, cities and towns can play an important role in achieving state greenhouse gas targets by integrating mitigation into community planning efforts, setting their own reduction goals, investing in clean energy projects, and directly engaging with diverse community voices." Programs like the Municipal Resilience Program and the Shared Energy Manager pilot program have supported these local efforts. Localities have also demonstrated their leadership in climate planning and community engagement. For example, the City of Providence has been widely recognized for their 2019 Climate Justice Plan and applauded for process of co-development between their Office of Sustainability and the Racial and Environmental Justice Committee of Providence.

Leverage Regional Collaboration

The *2016 Greenhouse Gas Emissions Reduction Plan* noted that "Rhode Island has a fruitful history of working cooperatively with neighbors to seek scalable, cost-effective solutions to mutual challenges; climate change mitigation is one such area that is ripe for strong regional partnerships." This strategy of regional collaboration has continued since 2016.

Regional Greenhouse Gas Initiative (RGGI)

The *2016 Plan* advocates for Rhode Island's continued participation in the Regional Greenhouse Gas Initiative (RGGI) and recommends advocating for program design elements that align RGGI emissions reductions with state climate mandates. Rhode Island has continued to be an active participant in RGGI since 2016. A program review is currently underway throughout 2021-2023, which will inform RGGI program design for future years.[57]

Transportation and Climate Initiative (TCI)

In accordance with *2016 Plan* recommendations to continue participation in the Transportation and Climate Initiative (TCI), Rhode Island continued to pursue TCI and consider legislation through 2021. However, in December 2021, neighboring states Connecticut and Massachusetts paused their participation in this effort. As this effort depends upon the involvement of at least three jurisdictions, Rhode Island cannot move forward with TCI at this time. However, key insights about priorities for program design and revenue investment should be considered in future policies and programs, and Rhode Island should leverage regional partnerships as opportunities arise.

[55] https://ripuc.ri.gov/Docket-22-49-EL
[56] Lead-by-Example 2020 Annual Report
[57] For more information about the RGGI Program Review and for opportunities to participate, visit https://www.rggi.org/.

New England Governors/Eastern Canadian Premiers

The *2016 Plan* supports Rhode Island's continued engagement with the New England Governors/Eastern Canadian Premiers (NEG/ECP). In 2018, NEG/ECP's Climate Change Steering Committee submitted the 2017 Update of the Regional Climate Change Action Plan and is currently working to execute this new report through various committees. Currently, there is a low level of activity in this regional organization.

Other Regional Work

The *2016 Plan* offers additional ideas for regional collaboration, including through renewable energy procurements and carbon pricing. Doing so is also a recommendation of the 100% Renewable Electricity by 2030 report. Regarding the *2016 Plan's* specific suggestions, Rhode Island leveraged a procurement by Massachusetts to contract for the 400 MW Revolution Wind offshore wind farm, and we conducted a study to examine the impacts of carbon pricing in 2020.

Also of note is a vision statement submitted in 2020 by the New England States Committee on Electricity (NESCOE, of which Rhode Island is a member) to ISO-NE, the organization that operates and maintains our region's transmission system. The NESCOE vision statement lays out three recommendations: First, wholesale markets need to be redesigned such that state-procured renewable energy systems are accounted for and properly valued. Second, transmission planning needs to account for substantial long-term deployment of renewable energy resources to meet states' decarbonization goals. Third, ISO-NE's governance needs to better reflect states voices and improve opportunities for public participation. Through NESCOE, New England states continue to work collaboratively to improve our regional transmission system.

In relation to transportation emissions: recognizing the urgent need for action, a diverse coalition of jurisdictions across the United States and Canada has committed, through the Multi-State Medium- and Heavy-Duty Zero Emission Vehicle (ZEV) Memorandum of Understanding (MOU), to work to reduce greenhouse gas emissions and harmful air pollution by accelerating the market for zero-emission trucks, vans, and buses. To achieve a timely transition and ensure near-term progress, the participating jurisdictions committed to strive to make at least 30 percent of sales of new medium- and heavy-duty vehicles ZEVs by 2030, and 100 percent of sales ZEVs by no later than 2050.

To translate commitment into action, the MOU directed the participating jurisdictions to develop a Multi-State Medium-and-Heavy-Duty (MHD) ZEV Action Plan to recommend policy options to foster a self-sustaining market. Released in July 2022, the Action Plan includes more than 65 recommendations for state policymakers to support the rapid, equitable, and widespread electrification of MHD ZEVs.

Meeting our 2030 Mandate

This section identifies recommendations for discrete priority actions by sector. Whereas the *2016 Greenhouse Gas Emissions Reduction Plan* offered "a broad framework to achieve the Resilient Rhode Island greenhouse gas reduction targets," this *2022 Update* recommends more granular actions needed in the short-term in order for Rhode Island to get on track to meet our 2030 emissions reduction mandate set forth by the 2021 Act on Climate. These priority actions are informed by all of our progress since 2016 – including studies, policies, and experience gained – as well as by stakeholder input.

The priority actions presented here are not comprehensive. We choose to focus on coordinated systems-level interventions that will either ensure or enable we meet our 2030 mandate. Instead of prescribing specifics for each action, we discuss the nuances of select factors that may be refined in order to advance policy co-objectives. Our intent is to elucidate the tradeoffs of certain refinements such that legislators, policy makers, and stakeholders can make decisions with the best understanding of impacts across the policy landscape.

In focusing on systems-level interventions, we de-emphasize priorities for individual action. This is not intended to downscale the importance of our individual decisions within our collective impact. Individual choices to reduce the greenhouse gas emissions within our control is fundamental and necessary for meeting Rhode Island's climate mandates. Indeed, we want to empower and encourage all Rhode Island households and businesses to reduce their own greenhouse gas emissions and prepare for impacts of a changing climate. Public administrations should lead by example here.

We also choose to focus on actions needed within the near future, when Rhode Island's comprehensive climate strategy is due and programs launching now will begin to take hold. The *2025 Climate Strategy* will include additional short-term and long-term actions to ensure Rhode Island meets is climate mandates through 2050.

Please also note that these actions have been restructured relative to the pathways identified in the *2016 Greenhouse Gas Emissions Reduction Plan.* This restructuring is intended to better align our strategic framework with how we think about our emissions inventory and the portfolio of analyses conducted since 2016. However, the pathways described in the *2016 Greenhouse Gas Emissions Reduction Plan's* broad framework comprise the foundation for the following short-term strategy.

Customized Emission Modeling Scenario for the 2022 Update

With technical assistance funding from the US Climate Alliance, Rhode Island partnered with RMI and Acadia Center to undertake high-level greenhouse gas modeling focused on the near term 2030 reduction mandate (45% below 1990 levels). A high-level state decarbonization analysis was performed by Acadia Center utilizing the *Energy Policy Simulator* (EPS) developed by Energy Innovation and RMI. By modeling a short list of key policy scenarios as outlined below, it is projected that Rhode Island slightly misses the Act on Climate's 2030 reduction mandate of 45% by 0.5 $MMTCO_2e$. To put this in perspective, the emissions in 2030 are projected by the EPS to be approximately 7.39$MMTCO_2e$, as compared to the 1990 baseline of 12.48 $MMTCO_2e$.

The EPS created a '2030 Climate Plan' scenario for Rhode Island using a number of realistic, actionable policies the state could adopt in the next decade.

Transportation

The EPS created a '2030 Climate Plan' for Rhode Island using various transportation policies the state is likely to adopt in the next decade. Clean transportation-related policies provide the greatest greenhouse gas emission reductions. The following transportation policies help Rhode Island move towards the Act on Climate's 2030 GHG emission reduction mandate of 45% below 1990 levels.

1. **Increase Adoption of Electric Passenger Vehicles**

    - Rhode Island can adopt California's *Advanced Clean Cars II* regulation as a Section 177 state. *(See Transportation Priority Actions for definition of a Section 177 state).*
    - If Rhode Island adopted *Advanced Clean Cars II*, **68% of all new passenger vehicles sold** in the state would be electric in 2030.
    - Adoption of the *Advanced Clean Cars II* helps Rhode Island **avoid approximately 0.29 MMTCO$_2$e emitted** in 2030.
    - Of the clean transportation-related policies, an estimated 88.5% of emissions reductions are attributed to switching to electric passenger vehicles.
    - In addition, an estimated 10.2% of all GHG emission reductions modeled in the EPS are attributed to adopting more electric passenger vehicles.

2. **Increase Adoption of Electric Trucks & Buses**

    - Rhode Island can also adopt California's *Advanced Clean Truck* and *Medium-and-Heavy-Duty Omnibus* regulation to decarbonize large trucks and buses.
    - If Rhode Island adopted these regulations, **36% of all large trucks and buses sold** in the state would be electric in 2030.
    - Adoption of more electric trucks and buses helps Rhode Island **avoid approximately 0.04 MMTCO$_2$e emitted** in 2030.
    - Of the clean transportation-related policies, 11% of emissions reductions are attributed to switching to electric heavy-duty trucks and buses.
    - Also, 1.3% of all GHG emission reductions modeled in the EPS are attributed to increased adoption of electric trucks and buses.

3. **Increase Decarbonization of RIPTA's Bus Fleet**

    - Another policy to reduce transportation-related greenhouse gas emissions is RIPTA's Zero Emissions Fleet Transition Program.
    - The EPS modeled the emission reductions if **electric buses account for 17.7% of total miles travelled by the RIPTA bus fleet** in 2030.
    - An estimated **0.0004 MMTCO$_2$e** of GHG emissions would be avoided in 2030 with RIPTA's Zero Emissions Fleet Transition Program.
    - Of the clean transportation-related policies, 0.1% of all transportation emission reductions are attributed to RIPTA's Zero Emissions Fleet Transition Program.
    - Additionally, 0.01% of all GHG emission reductions modeled are attributed to the increased decarbonization of RIPTA's bus fleet.

4. **Expand RIPTA Ridership to Reduce Light Duty VMT**

    - Another powerful policy to reduce GHG emissions is known as "mode shifting".
    - Under this scenario, the EPS modeled the emissions reductions of a **4.8% reduction in vehicle miles travelled by single occupancy vehicles** below 2020 levels by 2030.

- Mode shifting reduces vehicle miles traveled (VMT), which takes more vehicles off the road and reduces traffic congestion.
- Through this scenario, Rhode Island **avoids approximately 0.23 MMTCO$_2$e** of GHG emissions in 2030.
- 7.9% of all GHG emission reductions modeled in the EPS are attributed to mode shifting.

Altogether, clean transportation-related policies modeled in the EPS help Rhode Island avoid 0.56 MMTCO2e of GHG emissions in 2030.

Thermal - Energy Code

1. **Strengthen RI's Building Energy Code**

- More efficient building codes are vital to eliminate wasted energy, lower energy bills, and reduce carbon emissions that cause climate change.
- Under this scenario, the EPS modeled continuous adoption of the most recent IEEC model energy code for residential buildings and the most recent ASHRAE Standard 90.1 for commercial buildings for all code cycles falling between 2021 and 2030.
- Improvements to energy code efficiency requirements combined with an estimated rate of new construction in the state over the next decade results in an estimated **1.3% reduction in total building energy use in the state by 2030** relative to the BAU scenario.
- Through this scenario, Rhode Island **avoids 0.04 MMTCO$_2$e** of GHG emissions in 2030.
- 1.5% of all GHG emission reductions modeled in the EPS are attributed to strengthening energy codes.

Thermal - Electrification

1. **Increase Efficient Electrification of Building Space and Water Heating**

- The persistent reliance on fossil fuels makes buildings one of the largest sources of GHG emissions.
- Under this scenario, the EPS modeled an **aspirational target of 15% of space and water heating demand in all buildings** being provided by efficient electric appliances (e.g., heat pumps and heat pump water heaters) by 2030.
- The EPS analysis shows that 22% of sales of new non-electric space heating equipment and 8% of the sales of new non-electric water heating equipment are replaced with the sale of efficient electric equipment from 2021 to 2030.
- Through this scenario, Rhode Island **avoids approximately 0.19 MMTCO$_2$e** of GHG emissions in 2030.
- 6.7% of all GHG emission reductions modeled in the EPS are attributed the efficient electrification of building space and water heating.

Land Use

1. **Adopt a No Net Loss Forest Policy**

- Trees and vegetation absorb and store carbon dioxide. If forests are cleared, or even disturbed, they release greenhouse gases. Forest loss and damage cause rising GHG emissions.

- Under this scenario, the EPS modeled the adoption of a statewide policy that results in maintaining the existing amount of total forested land (~361,000 acres) in Rhode Island through 2030.
- A no-net loss forest policy through 2030 does not further reduce carbon emissions, but helps limit increases in carbon emissions.
- Further avoidance of forest loss helps steady Rhode Island's ability to sequester carbon.

Please take note of the following key issues which are further explained in the technical appendix attached to this report.

- The EPS uses 2020 as a starting point for Rhode Island when undertaking its modeling for 2030. Note that it is a *projected* estimate (RIDEM has yet to complete a full inventory for 2020).
- The EPS utilizes a generation-based approach for the electric sector that also incorporates RIs renewable energy standard. RIDEM's GHG inventory uses a consumption-based methodology that also incorporates RI's RES. This is an important fact that needs to be acknowledged.
- Rhode Island's recently enacted Renewable Energy Standard and Biodiesel Heating Oil Act (RIGL § 23-23.7) adopted in 2013 and amended in 2021 are directly incorporated into the EPS and accounted for in the '*Business as Usual*' scenario because they have already been adopted into law. Please note that in accordance with the Biodiesel Heating Oil Act, the percent of heating oil composed of bioproduct is assumed to achieve the following blend rates: 2020 (5%), 2024 (15%), 2025 (20%), and 2030 (50%).
- RI's leak prone pipe replacement program was not examined as part of this analysis because the level of uncertainty surrounding EPA's per mile emission factors is too high. We propose that this issue be examined in greater detail for the 2025 Climate Strategy as informed by the Public Utility Commission's (PUC) Future of Gas docket (commencing in 2023).
- The scenarios modeled in the EPS primarily focused on policies considered for adoption between 2020 and 2030.

The most important takeaways from this high-level analysis are:

- Electrifying the transportation sector and installing efficient electric appliances for space and water heating (e.g., heat pumps) combined have the most significant impact on GHG reductions in RI between 2020 and 2030.
- Adoption of all the scenarios previously discussed result in a 40.8% reduction in GHG emissions by 2030.
- Although the model indicates RI is projected to be 6.6% away from the Act on Climate's 45% reduction mandate in 2030, adoption of the highlighted policies is critical to putting the state on the correct path for large-scale emission reductions.

Please refer to the technical appendix for further details and explanation of the EPS methodology and policy assumptions used.

Climate Change: Local Action for a Global Issue

The following is an excerpt from the EC4 Event: A Conversation with Senator Whitehouse, hosted on February 11, 2022.

Question: How do you respond to people who say, "Hey it's just little Rhode Island, it's not going to make any difference?" What do you think the value is of the work that we're doing, in terms of leading by example, or just trying to set the stage for bigger things?

Senator Whitehouse:

> *It was little Rhode Island that created the first conservation-based electric rates in the country back in the late 80s when it was still Narragansett Electric and now you see those everywhere. It was an entirely new way of thinking about regulation and how you compensate utilities, not for selling more electricity, but for actually reducing how much they create and burn.*
>
> *So Little Rhode Island has had some big, big leadership that plays out still across the country and, frankly, across the world, so, you know everything has to start somewhere, but was it Margaret Mead that said "never doubt that a small group of committed individuals can change the world - in fact, it's the only thing that ever has". We can be that small group of determined people in a lot of ways, and then good ideas take on a life of their own.*

Priority Actions for the Electric Sector

There are two ways to reduce emissions from the electric sector: consume less electricity and meet electricity needs using decarbonized energy resources. The Rhode Island General Assembly enacted a 100% Renewable Energy Standard that must be met by 2033. The 100% Renewable Energy Standard is expected to grow demand for renewable energy resources; this, in turn, will require strategic investments in our electric grid to enable timely and efficient integration of these resources, as well as bolstering cost-effective renewable energy within Rhode Island's portfolio through procurement of offshore wind. All actions must be considered within the larger fabric of policy objectives, and should be refined to improve affordability, equity, land use, and other policy objectives. The following table summarizes priority actions, which are described in more detail below. We additionally summarize recommendations from key recent and relevant studies in recognition that action must happen across the board.

Table X. Summary of Priority Actions in the Electric Sector

Action	**Impact**	**Lead(s)**	**Select Considerations**
Implement the 100% Renewable Energy Standard	100% reduction in greenhouse gas emissions when 100% target is achieved through REC retirement	Public Utilities Commission	Track schedule of increasing requirement yearly through 2033
Modernize the electric grid	Enables the electric grid to more readily integrate distributed energy resources and improve customer energy management	Electric distribution utilities propose investments Public Utilities Commission regulates	Timing of investments, scale of investments, use of technologies
Deploy advanced metering	Enables time-varying utility rate designs; allows customers to better	Electric distribution utilities propose investments	Interaction with grid modernization proposal, timing of deployment,

	manage their energy use; provides additional visibility into the electric grid	Public Utilities Commission regulates	subsequent rate design considerations
Procure offshore wind	Expands renewable energy generation portfolio	Electric Distribution Utility Public Utilities Commission regulates	Local economic development, scale and timing, contract structure
Continue Energy Efficiency Work	Continue and further evolve programs to capture additional energy savings	Utilities	Effective investments
Complete RGGI Program Review and implement suggested changes	Supports regional decarbonization	RIDEM	Equitable investments

Implement the 100% Renewable Energy Standard

During the 2022 legislative session, a 100% Renewable Energy Standard (RES) was passed by the RI General Assembly and signed by Governor McKee. The RES ensures we decarbonize the electric sector with yearly targets. Rhode Island's Renewable Energy Standard is an existing statutory mechanism by which we can require electricity suppliers to meet an increasing percentage of retail electric sales from renewable energy resources. The Renewable Energy Standard also sets forth an accounting methodology and process to ensure compliance.

The newly passed Renewable Energy Standard, initially enacted in 2004 and subsequently revised in 2022, sets a statewide target of 100% renewable energy by 2033. Electric distribution companies and non-regulated power producers must comply with the mandate by supplying an increasing percentage of their retail electric sales from renewable energy resources through the purchase and retirement of Renewable Energy Certificates (RECs).[1]

The impact of a 100% RES is that the emissions reduction may be as large as fully eliminating emissions from the electric sector, as it relates to electricity as an end-use. In 2019, emissions from electricity consumption were estimated to account for 18.9% of total economy-wide emissions. If the 100% Renewable Energy Standard were met in whole by the purchase of Renewable Energy Certificates, then Rhode Island would reduce its greenhouse gas emissions by 18.93%.[2, 3, 4, 5]

The schedule and yearly targets set forth in the 100% RES mandate steadily increase over time starting with an additional four percent of retail electricity sales in 2023 and increases until an additional 9.5% of retail electricity sales are needed in years 2032 and 2033. Additionally, the law requires municipalities participating in municipal aggregation to possibly include voluntary renewable energy products to be counted toward the annual targets.

Any impact to electricity costs should be considered within a larger macroeconomic context. For instance, the war in Ukraine has and will continue to result in increased fuel prices, which in turn increase electricity supply costs. Communities continue to struggle with the economic downturn from the COVID-19 pandemic. Supply chain challenges are not only delaying shipments necessary to our energy landscape but are causing cost increases as well for commonplace technologies. However, implementing the 100% Renewable Energy Standard is one of the most important steps Rhode Island has taken towards statewide, economywide decarbonization.

Modernize the Electric Grid

The current electric grid is built for one-way flow of electricity from a few large power generators to many end-use customers. However, decarbonizing the electric grid necessitates a paradigm of two-way power flow between renewable energy systems of all sizes distributed throughout the electric grid to all customers. Safely, reliably, and affordably building out the electric grid will require electric distribution companies to make strategic investments in technologies for a twenty-first century electric grid.

Grid modernization technologies serve the purpose of managing power flow, protecting workers and customers, improving visibility into electricity consumption and grid conditions, building resilience from power outages, and giving customers more choice and control over their electricity use.

Deploy Advanced Meters

Meters that measure electric (and gas) consumption for utility accounts range in capability from simple counting and aggregation of energy use over a billing period to detailed accounting of consumption throughout minutes-long intervals and real-time communication with customers. Most meters in Rhode Island are more like the former – conventional meters that report how much energy a customer uses over the course of a month – and the majority of those meters are reaching the ends of their useful lives.

As Rhode Island considers how to replace its legacy meter system, advanced meters may be the more cost-effective option that also supports progress toward our climate mandates. The granularity of data and method of data communication that advanced meters use allows for innovative rate designs that deliver appropriate signals about the true cost of electricity use throughout the day and year, enables customers to better understand and control their electricity use, and provides important visibility into the electric grid that allows us to make the most use of our infrastructure.

Procure Offshore Wind

Offshore wind is a not only a vital renewable energy resource but a significant economic driver of growth and jobs in Rhode Island. As we move to implement the 100% Renewable Energy Standard, offshore wind will play a critical role in affordably meeting both our in-state renewable energy requirements as well as supporting the region as a whole.

On July 6, 2022, Governor Dan McKee signed a bill into law adding 600 to 1,000 additional megawatts of offshore wind to Rhode Island's clean energy portfolio. Rhode Island Energy released a request for proposals for public comment through the Public Utilities Commission in the Fall of 2022. RIE formally released the RFP in October and responses by interested bidders are expected in early 2023. A final decision on the winning projects will occur later in the year, and contract(s) with developers will be reviewed and approved Public Utilities Commission. It is expected that any new offshore wind projects procured through the RFP would be operational during the first half of the 2030's.

Continue Energy Efficiency Work

Energy efficiency programs in Rhode Island helps residents and businesses adopt and install technologies that allow them to receive the same or better performance from their equipment, buildings, and appliances while using less energy. Rhode Island's energy efficiency programs are offered through the state's utilities and from the Rhode Island Office of Energy Resources. These services can directly lower energy bills for participating consumers, reducing both emissions and energy costs for all consumers, which help support the local economy, and combat climate change. Since 2005, ratepayer-funded energy efficiency programs have saved Rhode Island consumers about 15,400 GWhs of electricity. The impact of these savings means that Rhode Island's electric load is 9% lower than it was in 2005. Since 2009, Rhode Island's ratepayer funded energy efficiency programs have provided over $4.5 billion in realized benefits. This compares to total program costs of about $1.6 billion, resulting in a cumulative benefit-cost ratio of 2.8.[58] In 2021, Rhode Island's least cost procurement statute was extended to 2029, which ensures the energy efficiency programs for the next seven years.[59]

Complete RGGI Program Review and implement suggested changes

The Regional Greenhouse Gas Initiative (RGGI) is a cooperative, market-based effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and Virginia to cap and reduce CO2 emissions from the power sector. It represents the first cap-and-invest regional initiative implemented in the United States. Rhode Island has continued to be an active participant in RGGI since 2009. A Third Program Review is currently underway throughout 2021-2023, which will inform RGGI program design for future years. Once the ongoing Third Program Review is completed, Rhode Island can examine adopting new program design elements aimed at continued reduction in greenhouse gas emissions in Rhode Island and the region. The 2025 Climate Strategy should be informed by and responsive to the recommendations of the RGGI Third Program Review.

Table X. Summary of Remaining Recommendations for the Electric Sector from Select Recent and Relevant Studies

Report Title	
Status	Recommendation
100% Renewable Energy by 2030	
Complete[6]	We must ensure we meet our clean energy goals by advancing a 100% Renewable Energy Standard.
Complete[7]	Continued efforts to decrease energy consumption necessitate extension of Least-Cost Procurement and Nation-Leading Energy Efficiency Programs.
Underway[8]	Maintain continued support for in-state renewable energy development, while supporting programmatic evolution to deliver more affordable and sustainable outcomes.

[58] Rhode Island Energy Efficiency and Resource Management Council 2022 Annual Report
[59] Least Cost Procurement: http://webserver.rilin.state.ri.us/Statutes/title39/39-1/39-1-27.7.HTM

Underway[9]	Optimize the electric grid through integrated grid planning.
Priority action[10]	Facilitate integration of distributed energy resources by deploying Advanced Metering Functionality and Grid Modernization technologies.
On the horizon[11]	Build out a strategic role for energy storage technologies.
Underway[12]	Continue regional collaboration on wholesale markets and interstate transmission.
Needs more work	Partner with trusted community organizations to listen, learn, support, and establish foundational definitions. Based on foundational definitions, develop equity metrics with the community to track and monitor progress towards equitable outcomes. Improve outcomes identified and prioritized by communities through rate design, program adjustments, and policy.
Power Sector Transformation	
Implemented[13]	Create a multi-year rate plan and budget with a revenue cap to incentivize cost savings.
Ongoing[14]	Shift to a pay-for-performance model by developing performance incentive mechanisms for system efficiency, distributed energy resources, and customer and network support.
Ongoing[15]	Develop new value streams from the distribution grid to generate third-party revenue and reduce burden on ratepayers.
Ongoing[69, 71]	Update service quality metrics to address today's priorities, including power outage prevention, cyber-resiliency, and customer engagement.
Needs more work	Assess the existing split treatment of capital and operating expenses.
Priority action	Deploy advanced meters.
Ongoing[69, 71]	Plan for third-party access and innovation.
Ongoing[69, 71]	Share the cost burden of advanced metering through partnerships.
Ongoing[69, 71]	Focus on capabilities to avoid technological obsolescence.
Ongoing[69]	Proactively manage cyber-resilience.
Implemented[16]	Synchronize filings related to distribution system planning.
Ongoing	Improve forecasting.
Ongoing[69, 71]	Establish customer and third-party data access plans.
Ongoing[17]	Compensate locational value.
Ongoing and on the horizon[18]	Design rates to increase system efficiency.

Ongoing[69, 71]	Establish outcome-based metrics.
Needs more work	Beneficial heating proposals should be consistent with principles outlined in the Commission white paper on beneficial electrification.
Solar Siting Opportunities	
Ongoing	This report estimated viability of solar in preferred locations. Considerations are embedded throughout the report,
Docket 4600	
Ongoing	This report included a number of next steps for the Public Utilities Commission to consider, some of which fed into the Power Sector Transformation report and subsequent work to develop a grid modernization plan and advanced metering functionality business case in collaboration with National Grid's Power Sector Transformation Advisory Group.
Energy Efficiency Market Potential Study	
Ongoing	There is significant opportunity to expand DR programs in RI in a cost-effective manner, both through growing the market for existing programs, and introducing new measures and programs.
Ongoing	C&I lighting remains by far the largest opportunity, both in terms of annual and lifetime savings.

Building an Integrated Portfolio of Action

Framing our emissions reduction journey by the largest emissions categories— thermal, transportation, and electric—provides a clear starting point for assessing our baseline and organizing our actions. As we move along in the process, however, it becomes clear that we cannot draw clear lines between these sectors. So many systems, both big and small, overlap and these overlaps will only continue to change, as we adjust the way we do things to decrease our emissions.

For example, our food systems produce emissions through agricultural practices, processing, distribution, refrigeration, cooking, and waste. This one supply chain includes emissions from the electric sector, the transportation sector, and the thermal sector. Another example is heating. We currently use a mix of fuels and technologies to heat our buildings, and as we decarbonize, that mix will continue to change, overlap, and have greater implications on other sectors. When we begin to look at the ways in which different areas of our energy usage are integrated with each other, we can find additional priority actions that more strategically reduce emissions across the board.

As policymakers, we often rely on benefit-cost assessments to understand the potential impacts of choosing different options. When we conduct benefit-cost assessments on single actions, or sets of siloed actions, we lose sight of the integrated and indirect benefits and costs that ripple throughout the entire system. Looking at the big picture, can change how we interpret the benefits and costs in a small part of it.

For example, if we prioritize only the low-hanging fruit—actions with the biggest benefits and the lowest costs—then we may find ourselves in a place where our remaining actions are no longer cost-effective. We also run the risk of not seeing the full scale of benefits across our holistic set of policy objectives. Looking at the collective benefits and costs of an entire portfolio of actions, can help us see the full effect of our actions.

It is for this reason that, in this report, we not only organize our priority actions by sector (electric, transportation, thermal, land use, etc.) but we also include these integrated callouts on health, food systems, buildings, and youth. Discussing these integrated systems helps us understand additional priority actions that we must take, not only to meet our climate mandates, but also to improve things like the health, comfort, safety, affordability, resilience, equity, and the vibrancy of our Rhode Island communities.

Regional Greenhouse Gas Initiative (RGGI)

The Regional Greenhouse Gas Initiative (RGGI) is a multi-state, market-based program to cap and reduce carbon dioxide (CO_2) emissions from electricity generating power plants. Through independent regulations (based on the RGGI "Model Rule"), twelve Eastern states currently participate in this cooperative effort. Launched in 2009, RGGI was the first mandatory greenhouse gas "cap-and- invest" program in the United States. The regional cap on CO_2 emissions is set by the RGGI states. Together, the RGGI states' individual emissions caps (or CO_2 budgets) are equal to shares of the regionwide cap. This cap sets a limit on the emissions from regulated power plants in the RGGI states' and declines over time in a planned and predictable way.

Since its conception, RGGI emissions have been reduced by more than 50% RGGI-wide and the RGGI program has contributed to the decarbonization of the electric sector. Fossil fuel-fired power plants with a capacity of 25 megawatts or greater must acquire enough RGGI allowances to cover their CO_2 emissions. Electric generation facilities in the RGGI states obtain allowances primarily through quarterly auctions. The RGGI states receive the proceeds from selling RGGI allowances and each state has discretion over how best to use their proceeds. Over $5 billion has been raised RGGI-wide from the allowance auctions. Generally, the proceeds have been invested by states back into their communities including funding of energy efficiency, clean energy programs, renewable energy deployment and direct rate relief for low-income consumers. As of September 2022, RI's proceeds from all auctions total approximately $116 million.

The RI Office of Energy Resources (OER) with guidance from RIDEM determines the allocation and distribution of RI's RGGI auction proceeds. In 2022, RI auction revenue supported numerous programs including the RI Commerce Corporation's Renewable Energy Fund (REF), LED lighting in public schools, air-source heat pump incentives, RIDEM Energy-Savings Trees Program and RI Agricultural Energy Grant Program. Two programs directed towards low- and moderate- income (LMI) customers; the Affordable Solar Access Pathways Program (ASAP) and the Zero Energy for the Ocean State (ZEOS) were also funded by RGGI auction proceeds. In addition, approximately 5 million in electric bill credits to low-income customers were also supported by RGGI revenues.

Priority Actions for the Transportation Sector

There are two ways to reduce emissions in the transportation sector: consume less fuel and consume lower-emissions fuel. To consume less fuel, we can discourage high-emissions driving and encourage low-emissions mobility solutions. To consume lower-emissions fuel, we need to encourage electric vehicles and expand electric vehicle charging infrastructure. Over the next five years, we can strengthen the groundwork for integrating climate into our investment decisions and take action to incentivize lower-emissions mobility.

Table X. Summary of Priority Actions for the Transportation Sector

Action	Impact	Lead(s)	Select Considerations
Increase light-duty ZEV penetration to at least 10% by 2030.	The GHG emission impacts of this action will be modeled as part of the 2025 Climate Strategy.	Administration (RIDOT, RIDEM, OER, DMV, Commerce, RIIB)	Incentive programs, interaction with electric vehicle charging infrastructure. State fleet transportation Lead by Example.
Implement Transit Forward RI 2040, Rhode Island's Transit Master Plan, to grow transit ridership from 53,000 to 87,000 daily passenger trips. Look to the Transit Master Plan and Bicycle Mobility Plan for next steps and consider committing resources to key projects.	The GHG emission impacts of this action will be modeled as part of the 2025 Climate Strategy.	RIPTA, Division of Statewide Planning, RIDOT	This will mitigate 231,000 MTCO2e. [60] Projects in the TMP and BMP are planned on a conceptual level. The next step is to evaluate needs and connections.
Reduce RIPTA's carbon footprint by decarbonizing Rhode Island's transit fleet.	The GHG emission impacts of this action will be modeled as part of the 2025 Climate Strategy.	RIPTA	This will mitigate 14,122 MTCO2e. [61]
Maintain increasing fuel economy and low-and zero-emission vehicle standards.	The GHG emission impacts of this action will be modeled as part of the 2025 Climate Strategy.	RIDEM	Maintain adherence to Corporate Average Fuel Economy and GHG emission standards. Maintain adherence to California low-emission and zero-emission vehicle requirements. Includes amending existing rules to incorporate Advanced Clean

[60] Estimates are from the TCRP Land Use Benefit Calculator as provided by RIPTA.
[61] Estimates are from the TCRP Land Use Benefit Calculator as provided by RIPTA.

			Cars II. Adopt New Rules: California's Advanced Clean Trucks (ACT), the Low NOx Heavy-Duty Omnibus (HD Omnibus), and Phase 2 Greenhouse Gas (Phase 2 GHG) emission standards for trucks and trailers.
Incentivize electric mobility	Enables switch to electric vehicles	Office of Energy Resources	New and used, personal and fleet, BEV, PHEV and MHD, future expansion of incentives to e-bikes. Utilize Diesel Emissions Reduction Act (DERA) funds to provide incentives to RI entities to replace older diesel engines and vehicles with cleaner and zero-emission alternatives.
Model climate impacts of transportation demand (in Unified Planning Work Program)	Allows weighing climate impacts of transportation investment decisions among policy objectives	Division of Statewide Planning, RIDOT and RIDEM	This is not an issue only at the state level, but nationally and regionally. RIDOT and RIDSP will work together with other federal, state and regional partners to improve the GHG modeling capacities as this is a FHWA requirement for transportation capital projects and establish a model for decision-making.
Develop 'complete streets' state plan leveraging federal funding	Reduces fuel consumed through decrease in vehicle miles traveled and encourages lower-emissions mobility	Division of Statewide Planning, RIDOT and RIPTA	The IIJA resulted in specific formula funding set-asides for developing a Complete Streets plan and implementation strategy: RIDSP will be the lead but work closely with a robust group of partners and stakeholders. Anticipated completion in 2025.

Target 10% penetration of electric vehicles by 2030

In the latest Rhode Island Greenhouse Gas (GHG) Emissions Inventory report, the Transportation sector was responsible for the highest gross greenhouse gas emissions (39.7%) by economic sector in 2019.

Emerging technologies in the transportation sector, such as electric vehicles, are paving the way for alternative fuels to be used as a solution for reducing GHG emissions. Clean transportation will also deliver substantial energy security and economic benefits as cleaner electricity derived from renewable energy and other low-carbon sources replaces imported gasoline and diesel as transportation fuels.

As of October 2022, Rhode Island has 6,275 registered electric vehicles, which is a 1,313% increase in EVs since 2015. In order for the transportation sector to meet its 2030 emissions reduction, Rhode Island will need to have roughly 43,000[62] registered EVs on the road. By having programs focused on Zero-Emission Vehicles, such as DRIVE EV, an electric vehicle rebate program available to Rhode Island residents and businesses, it will help increase the amount of registered electric vehicles on the road in Rhode Island as mandated by the 2021 Act on Climate, as well as paving the way for further expansion of EV penetration, post 2030.

Implement Transit Forward RI 2040

Implementing the plan will require an approximate average annual capital investment of $100-160M over 20 years. Operating costs will increase roughly $150M annually, from $130M (2020) to $280M). This action is estimated to grow transit ridership from 53,000 to 87,000 daily passenger trips and to mitigate 231,000 MTCO2e,

As resources are available, look to the Transit Master Plan (TMP) and Bicycle Mobility Plan (BMP) as well-vetted strategies for next steps

RIDOT, RIPTA, and RIDSP have all developed planning work tasks to support mapping, evaluation, and implementation of projects and priority corridors which were recommended in the TMP or BMP respectively. These agencies continue to prioritize projects advancing better connections for both transit and bicycle/pedestrian modes as the state looks to identify funding for the TMP and BMP.Some of the projects related to these steps include funding for long-range planning studies that take conceptual proposals and prepare design and cost details. In addition, staff resources are used to map the projects in the BMP and TMP to show where overlap may occur with existing planned projects, allowing incorporation of bike, pedestrian, and transit components into projects already programmed in the STIP.

Reduce RIPTA's carbon footprint by decarbonizing Rhode Island's transit fleet.

The full cost of fleet decarbonization is currently unknown. RIPTA is preparing an Action Plan for Electrification and Service Growth which will provide estimated annual decarbonization infrastructure, vehicle, and energy costs. This plan will be complete by June of 2023.

Adopt Advanced Clean Trucks rule

The federal Clean Air Act (CAA) grants the U.S. Environmental Protection Agency (EPA) original jurisdiction for establishing emission standards for new motor vehicles, including heavy-duty trucks. Section 209(a) of the federal Clean Air Act (42 USC § 7543) prohibits states (except California) or other political sub-divisions, such as local or regional governments, from establishing emission standards for new motor vehicles.

Under CAA Section 177 (42 USC § 7507), however, states that choose to adopt vehicle emission standards that are more stringent than the federal standards for new vehicles may adopt standards that are identical to any standards adopted by California.

[62] This estimate is based on an internal scatter model used by Rhode Island Energy (RIE).

Rhode Island has previously adopted California's emissions standards for passenger cars and trucks and, through the state's rulemaking process, could further opt-in to California's standards by amending 250-RICR-120-05-37 to include new standards for medium- and heavy-duty vehicles.

Reducing emissions from the vehicles on our road is an important part of Rhode Islands' programs to meet and maintain the health-based National Ambient Air Quality Standards (NAAQS), reduce the risk of exposure to toxic diesel particulate matter, and reduce the GHG emissions that contribute to climate change. The adoption of California's emissions standards is an imperative piece of the puzzle to Rhode Island's response and action on climate change.

Adopt New Rules: California's Advanced Clean Trucks (ACT), the Low NOx Heavy-Duty Omnibus (HD Omnibus), and Phase 2 Greenhouse Gas (Phase 2 GHG) emission standards for trucks and trailers.

- ACT: The purpose of the ACT Rule is to accelerate the widespread adoption of ZEVs in the medium-and heavy-duty truck sector and reduce the amount of harmful emissions generated from on-road trucks. The ACT Rule applies to manufacturers of medium- and heavy-duty vehicles over 8,500 pounds gross vehicle weight rating (GVWR)8 which includes passenger vans, buses, pickups, vocational trucks, box trucks, and tractor trailer combinations used locally and for long-haul applications. The ACT Rule requires manufacturers to sell ZEV trucks as an increasing percentage of their annual sales from model years 2026 to 2035. (**MY26 or MY27 pending if we move forward in 2022 or 2023).

- HD Omnibus: The Heavy-Duty Engine and Vehicle Omnibus (HD Omnibus) Rule and associated amendments require NOx emissions reductions from new on road heavy-duty engines and vehicles and ensure emission reductions are maintained as those engines and vehicles are operated.12 The HD Omnibus Rule requires a 90% reduction in NOx emission from model year 2027 engines.

- Phase 2 GHG: The Phase 2 GHG Rule sets standards to reduce GHG emissions associated with medium- and heavy-duty engines, vocational vehicles, heavy-duty pick-up trucks and vans (PUVs), and applicable tractors and trailers. The Phase 2 GHG Rule requires manufacturers to improve existing technologies or develop new technologies to meet the GHG emission standards. It also amends requirements for glider vehicles, glider engines, and glider kits. The Phase 2 GHG requirements would apply to model year 2026 and newer Class 2b to 8 medium- and heavy-duty vehicles with greater than 8,500 pounds GVWR and the engines that power them, except for medium-duty passenger vehicles already covered in the light-duty regulations. (**MY26 or MY27 pending if we move forward in 2022 or 2023).

Avoided Medium- and Heavy-Duty Emissions, 2020-2040		
NOx (short tons)	PM2.5 (short tons)	CO2e (million metric tons)
4,740	25	1.96
Avoided Medium- and Heavy-Duty Emissions, 2020-2050		
13,080	76	5.59

Table: Cumulative emissions avoided with 2025 implementation of ACT, HD Omnibus, and Phase 2 GHG rules. [63]

Amend Existing Rules to incorporate California's Advanced Clean Cars II:

- Rhode Island Department of Environmental Management will also have the ability to amend our existing Advanced Clean Cars program to adopt California's Advanced Clean Cars II (ACCII). The ACCII ZEV regulation requires that all passenger car and light-duty truck vehicles delivered by manufacturers for sale in Rhode Island by 2035 meet the definition of zero-emission vehicle (ZEV). The ACCII regulation will reduce NOx, PM2.5, and GHG emissions. (**GHG reduction analysis pending)

Incentivize electric mobility

Rhode Island has a history of impactful planning and programming related to clean transportation programs. In the past, the Office of Energy Resources has successfully administered programs incentivizing electric mobility.

Program	Targeted Technology	Program Duration	% Increase
DRIVE	Electric Vehicles	January 2016 – July 2017	20-35% (254 EVs)
Electrify RI	Electric Vehicle Charging Stations	October 2019 – July 2021	83 Operational Charging Stations and 14 Pending Activation (as of August 24, 2022).

The success of the programs implemented in the table above provided several best-practices and mechanisms used to incentivize electric mobility. On July 7, 2022, OER launched an electric vehicle rebate program, DRIVE EV. Driving Rhode Island to Vehicle Electrification (DRIVE) is an electric vehicle (EV) rebate program administered by the Rhode Island Office of Energy Resources (OER) to support adoption of electric vehicles by Rhode Island residents, small-businesses, non-profits, and public sector entities. DRIVE EV also provides additional incentives for qualified Rhode Islanders who purchase or lease an eligible electric vehicle and meet certain income requirements or participate in a State or Federal Income-Qualifying Program.

In the coming years, there will be opportunities to identify long-term, sustainable fundings sources to continue incentivizing electric vehicle adoption. An increased focus on providing additional incentives aimed at reducing the barrier-to-entry costs related to electric vehicles, as well as providing programs aimed at providing electric vehicle charging stations for non-homeowners, and those that live at multi-unit dwellings, as well as businesses looking to transition their fleet.

There are now programs, and incentive opportunities, available for e-bikes. The current DRIVE EV rebate program gives rebates for light-duty electric vehicles, and recently OER expanded the scope to include rebates for e-bikes.

Model climate impacts of transportation demand

Transportation accounts for the largest share of Greenhouse Gas (GHG) emissions in Rhode Island, with passenger vehicles being the largest contributor to pollution caused by transportation related emissions[64].

[63] Source: ICCT Report "Benefits of state level adoption of MHDV Regulations" https://theicct.org/
[64] Per Transportation Emissions Dashboard | Rhode Island Department of Environmental Management (ri.gov)

RIDOT and the Rhode Island MPO must adopt long-range transportation plans that reduce GHGs to set reduction levels. Current air quality measurements and travel-demand models do not specify GHG levels as they pertain to transportation projects in the STIP, so a new model is needed.

To understand how projects of regional significance in the State Transportation Improvement Program (STIP) contribute to GHG emissions and to assess future policy options and investment strategies towards the reduction of those emissions, Rhode Island Department of Transportation (RIDOT) is working with other state partners to improve the modeling of GHG, establishing performance measures to help reduce emissions and creating a Carbon Reduction Plan per federal guidelines.

Investments in transportation capital projects are prioritized based on many factors, including asset management, readiness, risk levels, available funding and opportunities for partnership. Due to changes in both state and federal regulations and guidelines, this data-driven process now will include another layer that determines how regionally significant projects impact carbon emissions in the state. The state planning process determines these priorities so that adequate investments are made based on the proper funding sources and uses, and to meet mandates such as performance measures.

In addition, the Rhode Island Division of Statewide Planning (RIDSP) hosts and maintains the State's Travel Demand Model.

Develop 'complete streets' state plan leveraging federal funding

In addition to the state requirements around complete streets, Complete Streets law: http://webserver.rilin.state.ri.us/Statutes/TITLE24/24-16/24-16-1.HTM there is a federal requirement to develop a complete streets plan and design guidance. In December 2021, USDOT sent a letter to all state and regional offices to highlight new Planning Emphasis Areas (PEAs), which included Complete Streets as a focus for planning-level funds and projects. The IIJA requires that states and metropolitan planning organizations set aside 2.5 percent of their highway planning funding for designing "complete streets" projects and policies that will improve safety and accessibility for all users of the road.

USDOTs definition of "Complete Streets" as "Streets that are streets designed and operated to enable safe use and support mobility for all users. Those include people of all ages and abilities, regardless of whether they are travelling as drivers, pedestrians, bicyclists, or public transportation riders. The concept of Complete Streets encompasses many approaches to planning, designing, and operating roadways and rights of way with all users in mind to make the transportation network safer and more efficient. Complete Street policies are set at the state, regional, and local levels and are frequently supported by roadway design guidelines."

In Rhode Island, RIDOT and RIDSP have joined together to maximize the impact of that funding. RIDSP will lead a 2.5-year effort to invest more than $250,000 in combined planning funds into development of a Complete Streets Plan and Design Guidelines. This project has kicked off (fall 2022) with a draft RFP for consultant assistance, which RIDSP expects to complete and issue in spring 2023, in coordination with RIDOT and RIPTA. This project is included in the FY2023 Unified Planning Work Program (UPWP), is the annual RIDSP program of projects under development .

Electrifying Transportation Strategic Policy Guide [65]

In December 2021, '*Electrifying Transportation: A Strategic Policy Guide for Improving Public Access to Electric Vehicle Charging Infrastructure in Rhode Island'* was released in response to S-0994 and H-5031, which directed numerous agencies to develop a coordinated plan to improve access to electric vehicle charging stations across the state. The policy guide highlighted the following key priorities for Rhode Island in the coming years:

- Reinvest in incentive programs for electric vehicles and charging infrastructure;
- Refine electric vehicle and charging infrastructure programs to align with priorities and to center equity such that benefits accrue to underserved and overburdened communities;
- Demonstrate progress in electrifying transit, school buses, and medium- and heavy-duty vehicles in order to reduce harmful emissions and improve public health;
- Conduct an analysis to understand transportation revenue impacts and develop recommendations for future action to ensure sustainable funding streams;
- Support a 100% Renewable Energy Standard to ensure electric transportation is truly decarbonized;
- Develop a clean transportation dashboard to track progress; and
- Demonstrate action through state agency commitments and accountability.

A number of these priorities have already been accomplished or are underway. A specific meaningful action item for all agencies represented by EC4 was included in the final guide. The EC4 should continue to track progress on all the agency specific action items and coordinate implementation across agencies to maximize impact. Looking ahead, the 2025 Climate Strategy will be able to revisit both the priorities outlined above and the agency specific action items and recommend changes as needed.

Climate and Buildings

Buildings are a significant source of greenhouse gas emissions and contributors to climate change. According to the American Council for an Energy-Efficient Economy (ACEEE), "residential and commercial buildings are responsible for approximately 40% of U.S. energy consumption and GHG emissions."[1] We live, work, and play inside buildings and the operations required to keep the lights on, operate our electronics and appliances, and keep our spaces comfortably heated or cooled require a lot of energy. Buildings also contribute to climate change through the construction process and the manufacturing of the materials necessary for construction. We create buildings to have very long lifespans, which means that how we choose to build or renovate them can have large impacts on the lifetime emissions of those buildings. Altogether, our built environment is both one of our largest contributors to climate change and one of our greatest opportunities for reducing our emissions.

Resilient buildings are important because buildings affect our climate, but our buildings are also impacted by our changing climate. In our coastal areas, flooding will become more common as sea levels rise. Across the state, storms will become more severe, and the number of high heat days that we have in the summer will increase. All of these changes mean that our buildings must also be constructed to be resilient in order to withstand these more intense impacts, and to keep the interiors of our buildings comfortable in more extreme weather conditions.

[65] Please see the Electrifying Transportation Strategic Policy Guide for additional recommendations throughout the entire text of the report.

Decarbonizing the built environment is one way we can reduce GHG emissions of buildings. There are numerous considerations for decarbonizing the built environment that intersect across different sectors. For example, we typically use fossil fuels to heat our buildings, and we use electricity to power an increasingly wide range of appliances. One of the greatest uses of energy in buildings is for space heating and cooling. Switching to renewable sources for energy, heating and cooling our buildings can help to reduce the impact the built environment has on the climate. Key considerations for the thermal sector and decarbonizing the thermal needs of buildings are issues addressed throughout this report.

We have a variety of tools available to us in Rhode Island to both reduce the emissions that come from our built environment and to strengthen the resilience and adaptability of our buildings.

Strengthen building energy codes

Building codes are one of the tools available for improving our buildings. Building codes provide a baseline set of rules that all new construction projects must comply with to ensure the safety and energy efficiency of buildings. The State's building codes are generally updated every three years through a public process to raise the bar on the minimum standards of safety and efficiency. The State also has a stretch code in place, which is a more ambitious building code that developers can choose to comply with in order to build more efficient buildings. Building codes can help the State set the trajectory for net-zero green building standards, prepare our new buildings to be EV- and solar-ready, and prepare our buildings to be completely electrified.

Implement the updated Green Buildings Act legislation and continue to assess and recommend opportunities for improvement

The Green Buildings Act was signed into law in 2009 to require public agencies to design and construct projects and renovations to meet a LEED-certified of equivalent high performance green building standard. In 2022, the Green Buildings Act was amended to specify that these requirements apply to all new construction projects and renovations of 10,000 square feet or larger. The Green Buildings Act is administered by a Green Buildings Advisory Committee comprised of State agency representatives and members of the public. The Committee will continue to assess and evaluate the implementation practices of the Green Buildings Act, including conducting studies as needed, to provide recommendations for achieving the State's goals related to public facility emissions. By ensuring improved compliance with the Green Buildings Act, the State can help reduce emissions from public buildings and facilities throughout the state.

Coordinate climate considerations with new housing and school investments that use public money

There are many efforts being made to use public funds to reduce harmful climate impacts in the state, including with new housing and school investments. One program is the Zero Energy for the Ocean State (ZEOS) program, which is a partnership between the Office of Energy Resources and RI Housing. This program provides Regional Greenhouse Gas Initiative (RGGI) funding to affordable housing developments to create net-zero energy housing for low- and moderate-income residents. The State's School Building Authority is also able to leverage its funding to ensure that school construction projects are built to high energy and environmental standards. School districts looking to renovate existing buildings or construct new facilities can receive 30 to 98 percent in funding reimbursements for those projects, if the projects are constructed to meet the New England Collaborative for High Performance Schools criteria (NE-CHPS). State agencies continue to seek additional opportunities to leverage federal funding for reducing

emissions from Rhode Island's built environment. These efforts will allow new building stock to advance climate mandates and deliver non-energy benefits to all.

Priority Actions for the Thermal Sector

The thermal sector consists of emissions from all thermal processes, including space heating and cooling, high-heat industrial processes, refrigeration, cooking, and household activities such as clothes drying. Fossil fuels, electricity, and bio-based materials are all used as energy sources for thermal processes in Rhode Island. Because of the variety of energy sources, emissions accounting for the thermal sector is spread across different categories in the state's greenhouse gas reporting. Over the next decades, the fuel sources we use for the thermal sector will begin to shift as we transition to lower emissions fuels.

At a high level, the two primary ways to reduce emissions from the thermal sector are to, 1) consume less fuel, and 2) to consume lower emissions fuels. Consuming less fuel means optimizing efficiency and reducing wasted fuel or heat that does not get used for its primary purpose or providing heating or cooling to Rhode Islanders. The ways we can use lower emissions fuels are summarized in Figure X and generally involve two over-arching pathways: strategic electrification and decarbonized fuels.

Thermal Processes	**Strategic electrification**	**Air Source Heat Pumps (ASHPs)** -e.g., air to air, air to water heat pumps
		Ground Source Heat Pumps (GSHPs) -e.g., ground to air, water to air heat pumps, and geothermal district systems
		Thermal Energy Storage -e.g., heat batteries
	Decarbonized Fuel	**Renewable Liquid Fuels** -e.g., biodiesel, ethanol
		Renewable Gases -e.g., renewable natural gas, hydrogen

Figure X. Thermal Decarbonization Pathways (adapted from the Heating Sector Transformation Report)

Table X summarizes priority actions for decarbonizing the thermal sector. The priority actions focus on consuming less fuel, consuming lower emissions fuel, or a combination of both.

Table X. Summary of Priority Actions in the Thermal Sector

Action	Impact	Lead(s)	Select Considerations
Energy Efficiency			
Continue Energy Efficiency and Weatherization	Efficiency standards can continue to be improved for heating equipment, and weatherization incentives and programs can further be enhanced by the utilities and the state.	Utilities and State Agencies	Extensive federal funding for electrification is expected in coming years; weatherization programs should ramp up to use funding effectively
Strategic Electrification			
Target 15% penetration of energy efficient electric heating by 2030	≈ 0.19MMTCO2e reduction in greenhouse gas emissions (in 2030)	OER and RIE	Workforce training, consumer education, utility coordination
Pursue district geothermal	Pilot most efficient electric thermal system	OER and RIE	Utility coordination, community involvement, integrated systems and planning
Incentivize efficient electric heating technologies	Increases affordability of technologies and spurs market growth	State and federal government	Funding streams and associated limitations, consumer and contractor trust and awareness
Decarbonized Fuels			
Increase biofuel blending in accordance with the 2021 Biofuel Heating Oil Act	The GHG emission impacts of this action will be modeled as part of the 2025 Climate Strategy.	Industry	Equipment compatibility, cost and quantity of supply, life cycle carbon intensity and environmental impact
Continue to abandon leak-prone gas pipes and pursue non-pipe alternatives	The GHG emission impacts of this action will be modeled as part of the 2025 Climate Strategy.	RIE DPUC + PUC	Evaluate whether replacement is consistent with climate mandates
Pursue hydrogen demonstration projects in coordination with the Northeast Regional Hydrogen Hub	Creates opportunities for decarbonization of hard to electrify areas, such as high-heat industrial processes	State of RI, led by OER; Northeast Hydrogen Hub state and private sector partners	Technology research and development, workforce development, zoning, codes, safety regulations
Continue to pursue solutions to reduce emissions from solid waste	Lowers direct emissions from waste, creates source of renewable methane	OER in coordination with relevant waste facilities	Overlap with biofuels and biogas planning, ideally solid waste amounts decrease in future, consider

			implications on renewable gas supply
Future of the gas distribution system	Enables cost-effective decarbonization, planning, and aligning utility business model	PUC	Trimming branches of the distribution system where we can electrify, strengthening branches where we can't electrify
Begin developing a renewable thermal standard	Progressive scale down of thermal sector emissions	Legislature	Interplay of all different decarbonization technologies, cost effectiveness, jobs impacts, rethinking role of the utility

Prioritize Efficiency to Decrease Fuel Usage

The first way to reduce emissions from the thermal sector is to improve energy efficiency, so we use less fuel. This can be done by improving the efficiency of appliances and by improving the weatherization of buildings.

Continue Energy Efficiency Programs and Weatherization

Weatherization of buildings is key to ensuring a successful transition to decarbonized heating and cooling, because it helps to decrease our overall energy demand. While the utilities' efficiency programs support a number of weatherization programs and appliance efficiency standards, these should continue to be expanded.

Strategic Electrification

One pathway to thermal decarbonization is through strategic electrification. Converting thermal processes from fossil fuel power to energy efficient electric appliances can reduce emissions immediately. Air source heat pumps, for example, are three times more efficient at providing heat than fossil fuel heating systems, resulting in an immediate increase in fuel efficiency. The emissions of electric appliances for thermal processes will continue to decrease to zero, as we move toward the state's 100% Renewable Energy Standard by 2033.

Converting fossil fuel technologies to electric power will pose new challenges for our electric grid. According to the Heating Sector Transformation Report, 100% electrification of the thermal sector is not only unlikely, but also not cost effective.[66] Electrification is not appropriate for certain components of the thermal sector, such as high-heat industrial processes. Additionally, we must be cognizant of the impacts heat pump conversions will have on our electric distribution system. As we design incentives and other mechanisms to support the market for electrification, we need to remain strategic in how we plan for necessary changes to the electric system and simultaneously support other decarbonization technologies to reach our emissions reductions targets.

Target 15% penetration of energy efficient electric heating by 2030

A conversion of 15% of Rhode Island's buildings from fossil fuel heat to efficient electric heating by 2030 is an aggressive, but attainable and necessary target. This rate of conversion will reduce thermal

[66] https://energy.ri.gov/heating-cooling/heating-sector-transformation

sector emissions by an estimated 0.19MMTCO$_2$e[67]. While the market for efficient electric heating—including a variety of heat pump technologies—is relatively nascent in Rhode Island, the next several years will be used to build a strong foundation for the market to expand at a quicker pace in the last two decades as we approach 2050. The priority actions below, will help us reach this 15% target and plan for further expansion, in tandem with other decarbonized thermal technologies, post 2030.

Efficient heat pump incentives

There are several mechanisms for incentivizing efficient heat pumps that are expected to be used in the coming years. First, the Office of Energy Resources will be launching the High Efficiency Heat Pump Program (HHPP)[68] in 2023, which will combine federal funding from the American Rescue Plan Act (ARPA) with existing incentives provided by Rhode Island Energy's energy efficiency programs. The aim of the program is to create a robust incentive program, extending greater financial incentives to more Rhode Islanders who want to convert to efficient heat pumps. The program will also emphasize education and workforce development to build a sold market for this efficient, and ultimately emissions-free, thermal technology.

Second, the Inflation Reduction Act, recently passed by the U.S. Congress, will provide a suite of incentives including tax credits and rebate programs for heat pumps and other electric thermal appliances, such as induction stoves. The State will work diligently to ensure that the maximum benefits are easily accessible to Rhode Islanders and that federal incentives for heat pumps compliment State offerings.

Third, in the coming years, there will likely be opportunities through policy and regulation to identify long-term, sustainable funding sources for efficient electric heat that go beyond one-time federal stimulus funding. While federal funding can provide a very solid basis for standing up efficient electric heating programs, there may be a need to craft novel funding mechanisms that can carry electrification efforts well into the future.

Pursue district geothermal

District geothermal systems are being piloted in neighboring states as a solution for providing extremely efficient electric-powered heating and cooling that is delivered by a thermal utility company. Traditionally, gas utilities have delivered fossil fuel to customers connected to the gas distribution system to fuel heating appliances. Geothermal systems (a.k.a. ground source heat pumps) use the least amount of energy to deliver space heating and cooling, of all the electric thermal technologies currently available. Drawbacks to geothermal include high upfront costs, and disruptive installation practices, which involve drilling, and/or laying pipe in the ground or a body of water. Once geothermal systems are installed though, they have an extremely long lifespan and very low operating costs—providing clean, affordable, and reliable heating and cooling to customers.

The challenges with geothermal systems make it difficult for many homeowners to install these systems themselves; gas utilities, however, are uniquely well-positioned to carry the high upfront costs and engineering challenges given their experience with large scale infrastructure projects. In the next 1-3 years, OER will work together with the utility to assess the opportunities for district geothermal.

[67] Please see "Meeting our 2030 Mandate" and Acadia Center's Technical Appendix at the conclusion of this report for additional details.
[68] https://energy.ri.gov/heating-cooling/high-efficiency-heat-pump-program

Decarbonized Fuels

Priority actions in this category mainly focus on using lower emissions fuels and using them more efficiently, but also contain actions to consume less fuel, by avoiding emissions caused by wasted fuel.

Increase biofuel blending in accordance with the 2021 Biofuel Heating Oil Act

The 2021 Biofuel Heating Oil Act requires that, by 2030, all No. 2 distillate heating oil sold in Rhode Island, "shall at a minimum meet the standards for B50 biodiesel blend and/or renewable hydrocarbon diesel."[69] This means that by 2050 all heating oil in the state will contain at least 50% biodiesel, significantly decreasing the carbon intensity of home heating oil.

As the state moves incrementally toward the 2030 biofuel mandate, it will be necessary to consider the impacts on customers, heating oil companies, and emissions. In the next two to three years, as biodiesel blending mandates increase, it will be important to anticipate and monitor potential implications of using higher biodiesel blends with existing heating equipment. Generally, biodiesel is considered a "like-for-like" swap with heating oil, because it can be used with existing oil boilers and furnaces. There are, however, concerns that higher biodiesel blends can wear on existing heating systems and may require retrofits.

Additionally, in the next two to three years, compliance plans for the mandate should be made. Currently, there is no robust system for monitoring compliance with the blending mandate, nor are there requirements for biodiesel feedstocks and sourcing, both of which greatly impact the emissions profile of biodiesel. At this time, there is a very limited supply of bio-based fuels and in the context of significantly increasing global demand, future biodiesel prices are a concern. Therefore, we must consider strategies for mitigating the impacts of supply-side cost increases on local business.

While biodiesel has fewer greenhouse gas emissions than fossil diesel, using biodiesel and other bio-based fuels for heating still results in emissions. Biodiesel and other biofuels have a wide range of potential feedstocks, and numerous additional supply chain factors impact the emissions intensity of biodiesel. In order to effectively track our state's emissions, it will be necessary to understand the different emissions profiles of biodiesel and require biodiesel blending with the lowest emissions. Beyond the 2030 biodiesel blending mandate, there will need to be solutions for fully decarbonizing oil heating by 2050.

Continue to abandon leak-prone gas pipes and pursue non-pipe alternatives

Public Utilities Commission Docket No. 5210, "National Grid's FY 2023 Gas Infrastructure, Safety and Reliability (ISR) Plan," contains the Leak Prone Pipe Replacement Program which replaces leak-prone gas mains throughout the Rhode Island gas distribution network. Since the program's beginning in 2012, 537 miles of leak-prone pipe have been replaced and an additional 951 miles are expected to be completed by the program's end in 2035.

While the avoidance of methane leaks along the gas system is extremely important to reducing our state's emissions, the efficacy of the Leak Prone Pipe Replacement Program, in light of the goals of the Act on Climate, needs to be evaluated. Gas mains that are replaced through this program have an expected lifespan between 50-100 years, locking in gas infrastructure well beyond the target date for an emissions-free state. Currently, there are extremely limited supplies of decarbonized gases, and the ratepayer cost impacts of future decarbonized gas supplies must be considered. It would be imprudent to continue to reinforce and expand gas infrastructure that could not be easily and affordably decarbonized by 2050. Therefore, in the coming years, more emphasis should be placed on non-pipes alternatives (NPA). NPA

[69] http://webserver.rilin.state.ri.us/BillText/BillText21/HouseText21/H5132A.pdf p. 3

seeks alternative ways of providing thermal service to Rhode Islanders, rather than expanding and enforcing the fossil gas network. The gas utility has already formed a working group to discuss developments in NPA.

Continue to pursue solutions to reduce emissions from solid waste

Waste streams, such as landfills and water treatment facilities, produce highly penetrative greenhouse gases that result from the breakdown of biological material. If not captured, these greenhouse gases are released directly into the atmosphere and contribute to global warming. One method of decreasing direct emissions from waste is to capture these gases and use them as a source of renewable gas.

The future of the state's solid waste streams should be considered in the context of thermal decarbonization opportunities as well. There are numerous technologies that could be explored, but the climate and environment impacts must also be critically examined.

Future of the gas distribution system

Just over half of Rhode Islanders are connected to the gas system for heating, cooking, and various other household appliances. Gas is also used for high-heat industrial processes. At this time, Rhode Island is supplied with fossil gas that, while cleaner than other fossil fuels like oil and coal, still emits greenhouse gases and contributes substantially to climate change. The gas system in Rhode Island relies on extensive physical infrastructure in the form of pipelines and supporting facilities. Pipelines and other gas infrastructure have been, and continue to be, built with decades to centuries-long time horizons. There is an urgent need to reconsider the existing gas infrastructure and planning in our state to avoid burdening consumers with the cost of stranded fossil gas assets, as the state transitions to carbon neutrality.

In August 2022 the Rhode Island Public Utilities Commission (PUC) opened Docket 22-01-NG, "Investigation into the Future of the Regulated Gas Distribution Business in Rhode Island in Light of the Act on Climate."[70] This docket will serve as an important first step in beginning to plan for the gas system's transition to carbon neutrality. There are many options for decarbonizing the thermal sector, and as the HST Report notes, it is unlikely that one single technology will prevail. Instead, to optimize costs and emissions reductions, a mix of solutions will need to be pursued. Other states are looking to transform their gas systems to work cohesively with a mix of decarbonized thermal technologies. In light of the Act on Climate, it will be important to engage in a very robust planning process that ensures a viable future for the thermal sector with a mix of different technologies. The utility company is uniquely positioned to tackle large decarbonization challenges and substantially help move the state toward our emissions reduction goals.

Begin developing a renewable thermal standard

Similar to the recently enacted 100% Renewable Energy Standard, the state should begin to plan for a renewable thermal standard to phase thermal emissions down at intervals that align with the Act on Climate Mandates. The results of Docket 22-01-NG "The Future of Gas" may provide a good foundation to begin planning for such a standard. Additionally, other states with drafted renewable thermal standards could be looked to for best practices and guidance.

[70] https://ripuc.ri.gov/Docket-22-01-NG

Table X. Summary of Remaining Recommendations for the Thermal Sector from Select Recent and Relevant Studies

Report Title	
Status	Recommendation
Heating Sector Transformation Report	
Priority action[71]	Ensure: Increase efficiency and reduce carbon content of all fuels to zero over time – ensures progress no matter which technologies are used
Priority actions[72]	Learn: Data collection, R&D, pilot projects to understand technologies, infrastructure, and customers
Underway[73]	Inform: Educate stakeholders – customers, installers, policy-makers – about pros and cons of options, system interactions, etc.
Priority Action[74]	Enable: Facilitate deployment with incentives; target natural investment opportunities; align regulation, rules, codes; expand workforce
Priority Action[75]	Plan: Expand planning horizon; develop long-term, high-level contingency plans now (don't commit yet) and use to guide near-term policy
Energy Efficiency Market Potential Study	
Underway[76]	Electrifying oil and propane-based systems offers the bulk of the economic opportunity for heating electrification.

Climate and Food Systems

A food system represents the interconnected parts of the food supply chain such as production, consumption, distribution, processing, consumption and disposal, all of which creates greenhouse gas emissions and significantly impacts water resources and biodiversity. Globally, the food and agriculture sector are responsible for one-third of greenhouse gas emissions [77] 70% of water withdrawals and 60% of biodiversity loss. At the same time, climate change threatens our long-term food security due to greater frequency of extreme and erratic weather events which impact crop yield, disrupt natural ecosystems and weaken national and global food supply chains.

The majority of food-related GHG emissions comes from agriculture and land-use such as methane from cattle production, nitrous oxide from fertilizers on crop production and carbon dioxide from clear-cutting for food production as well as refrigeration and management of food waste. Despite all of those impacts and high emissions, according to the EPA, one-third of food produced in the United States is never eaten and, food waste is the single most common material in landfills. When food is wasted all the resources, land, fertilizer, capital and energy that went

[71] Our priority action to begin the development of a renewable thermal standards is responsive to this recommendation.
[72] Two priority actions are responsive to this recommendation: pursue district geothermal, and pursue hydrogen demonstration projects in coordination with the Northeast Regional Hydrogen Hub.
[73] This recommendation is central to all new and upcoming thermal policies led by OER. For example, the High-efficiency Heat Pump Program will have a consumer and workforce education component.
[74] Priority actions to incentivize heat pumps, the future of gas docket, and planning for the renewable thermal standard are responsive to this recommendation.
[75] Future of gas docket and planning for the renewable thermal standard are priority actions responsive to this recommendation.
[76] Current and upcoming heat pump incentive programs sponsored by OER and RIE incentivize the switch from oil and propane heating to efficient electric heat pumps.
[77] Cippa, Solazzo et al. *Nature* (2021)

into producing it is wasted, too. In RI, 20% of waste that goes to the Central Landfill is food and organics waste [78] (2017).

Fortunately, food systems and agriculture hold potential to sequester greenhouse gas emissions while regenerating biodiversity and ecological systems. In fact, according to "Project Drawdown" scientists and policymakers estimate that the top two solutions to staying below the critical 2 degrees Celsius necessary for survival are reducing food waste and eating plant-rich diets [79].

In order to better understand the impacts of climate change on our food systems, the following actions should be considered:

1. Establish metrics to set a baseline of GHG emissions derived from the food system throughout the value-chain from agriculture/aquaculture to manufacturing, processing, consumption and food waste disposal. The EPA's GHG emissions by economic sector fails to capture the complexity of food systems-related emissions which is why it is imperative that we better align climate, land-use, transportation, and food systems planning and policies in Rhode Island. Most of the emissions related to food consumption are derived from activities outside of the state because we import some 95% of the food we consume. However, these Scope 3 emissions[80] will provide the greatest opportunity to drawdown emissions and should be considered as part of the Act on Climate mandates (ex: emissions related to the food purchased by State agencies for corrections and K-12 school meals could be quantified and goals could be set to shift menus towards more climate-friendly, nature positive foods for a healthy planet and healthy people)

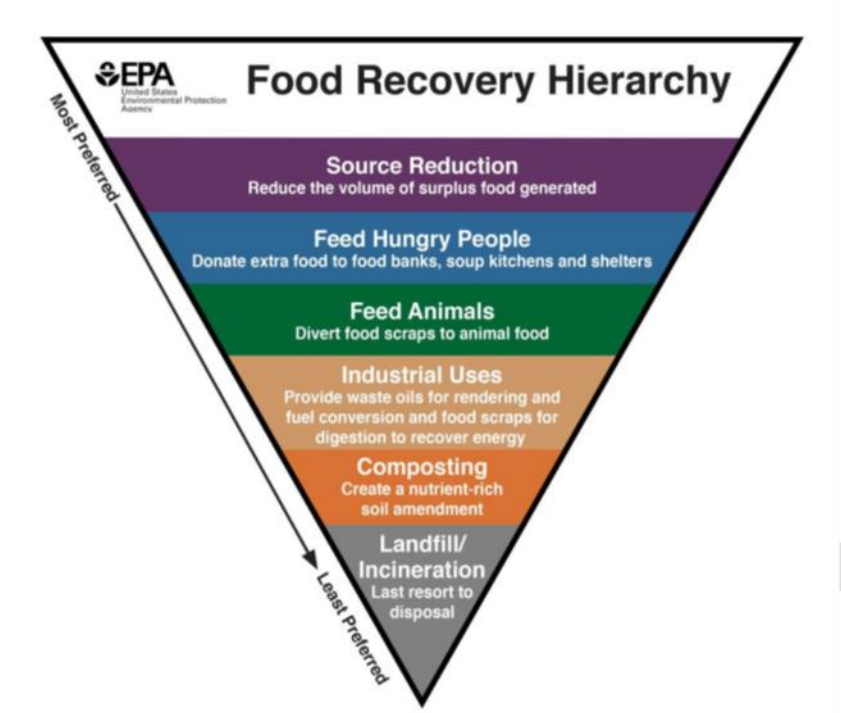
2. Quantify the current and potential carbon sequestration of our working lands and waters (e.g. agricultural lands, coastal areas zoned for aquaculture, etc.)

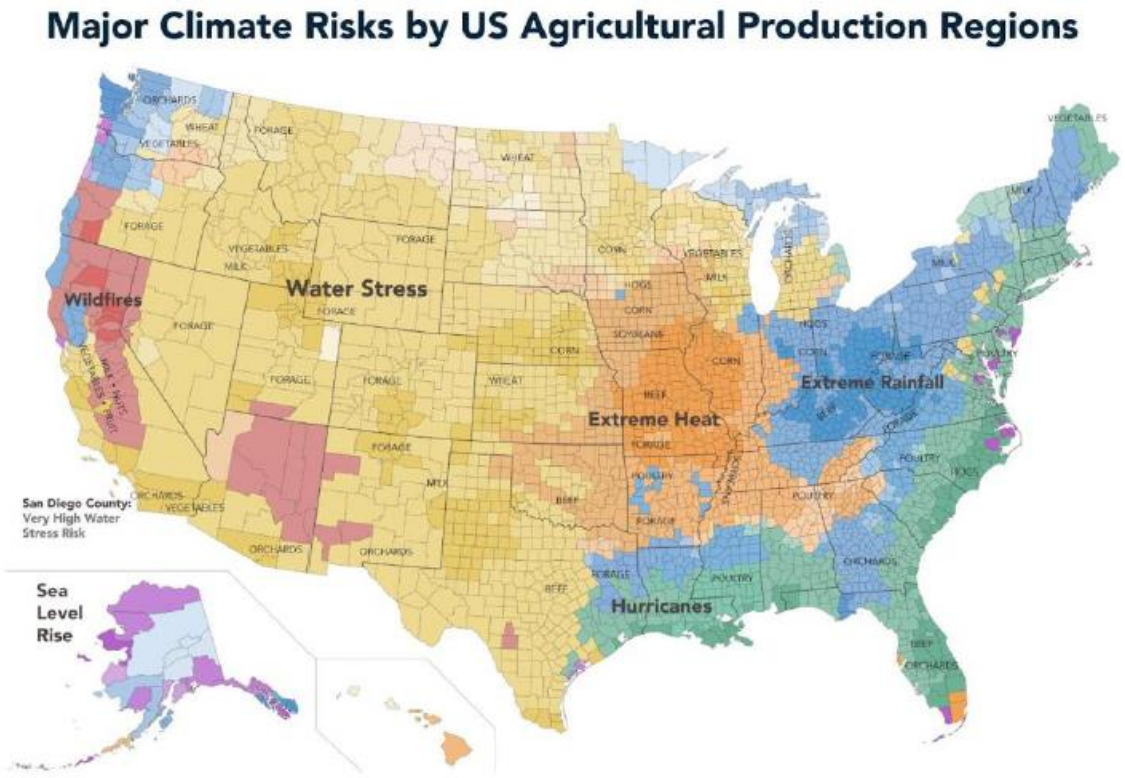
3. Evaluate policies for increasing food waste diversion and food recovery including more supports to help commercial waste generators comply with the 2017 "Food Waste Ban" and support municipalities with residential food/compost collection.

4. Support the development of the state's update to the 2017 food strategy "Relish Rhody" in order to strengthen regional food supply chains to better combat climate change disruptions to food producing and regions outside of New England

5. Explore alternative pathways to decarbonization which minimize trade-offs between renewable energy production and regional food production and harvesting.

[78] RI Food Policy Council (2017)
[79] Project Drawdown (2022)
[80] Scope 3 emissions are defined by the USEPA: "Scope 3 emissions are the result of activities from assets not owned or controlled by the reporting organization, but that the organization indirectly impacts in its value chain. Scope 3 emissions include all sources not within an organization's scope 1 and 2 boundary. The scope 3 emissions for one organization are the scope 1 and 2 emissions of another organization. Scope 3 emissions, also referred to as value chain emissions, often represent the majority of an organization's total GHG emissions.





Source: *Every Country Has Its Own Climate Risks. What's Yours?* https://www.nytimes.com/interactive/2021/01/28/opinion/climate-change-risks-by-country.html (2021)

Priority Actions to Address Climate Justice

As highlighted earlier in this report, since 2016, we've collectively seen vast growth in understanding about equity generally and climate justice specifically. This understanding should have already been a priority, and our level of understanding today is still deficient. However, we are making some progress. While the 2016 Plan omits mention of equity or justice, we have centered these concepts in the recommendations stemming from our more recent studies and we will integrate explicit consideration of equity and justice not only in this report, but throughout development of all future climate strategies and activities of the EC4.

In direct response to needs and calls for accountability, RIDEM and OER onboarded new staff in the fall of 2022 who will assist each respective organization to better understand and incorporate the needs of overburdened and underserved populations across the state. Bringing these voices to the front of the many conversations happening about mitigation and resilience will help to address community needs, build trust and incorporate new perspectives into Rhode Island's fight against climate change. This work began in 2022 with an inaugural 'Climate Justice Hour' in November 2022 with additional sessions planned in 2023 and beyond.

TABLE X: Summary of Priority Actions for Centering Climate Justice

Action	Impact
Create space for meaningful conversation – continue climate justice conversations in communities and with a new climate justice advisory board	Raises up new voices about climate justice and community needs into the EC4 and future climate plans, programs and policies
Better align work of RI's Health Equity Zones (HEZs) with the resilience and mitigation work being undertaken by EC4 agencies	Strengthens the efforts of the various HEZs to serve its members and provide tangible community benefits on issues related to climate change
Better coordinate state and local investments in urban tree programs	Provides health, social and environmental benefits for urban communities; increased tree canopies in RI's urban core
Provide technical assistance to communities for climate related issues	Allows communities to better address the climate/environmental/energy issues they have defined as priorities
Promote research into the impacts of climate change on overburdened and underserved communities	Provides a clearer understanding of direct impacts; better alignment of funding to address climate impacts and improve community resilience

Priority Actions Related to Land Use

Plants on our lands and in our oceans can absorb carbon dioxide, acting as a sink for emissions. However, removing natural elements of our land to develop our built environment (for roads, renewable energy resources and other uses) can take away the land's ability to sequester carbon dioxide. Beyond impacts on emissions – or climate change *mitigation* – how we use our lands is of critical importance in relation to climate change *adaptation* – our ability to reduce damages from and recover from the impacts of climate change like intense storms, extreme heat, and flooding.

These critical issues are being debated in RI, regionally in many states' climate plans and internationally. The Intergovernmental Panel on Climate Change (IPCC) published its Special Report on Climate Change

and Land in August 2019[81]. It analyzes the existing science to date on how greenhouse gases are released and absorbed by land-based ecosystems, and the science on land use and sustainable land management in relation to climate change adaptation and mitigation, desertification, land degradation and food security. The findings are of great importance to decision-makers across the US and the world.

In terms of climate justice and equity, the way we use our lands will have a much bigger impact on the quality of life of Rhode Islanders than most other emission reduction strategies. Land use policies that increase access to open public spaces and encourage the development of healthy communities while promoting the development of renewable energy resources is a balancing act RI must continue to explore in future legislation, regulation and policies.

TABLE X: Summary of Priority Actions for Land Use

Action	Impact
Explore improvements to siting guidance and incentives that push solar development away from forests and agricultural lands towards previously disturbed sites	Streamline support for investments in renewable projects that minimize impacts on forest and agricultural lands
Identify a more stable and predictable funding stream for land conservation	Allow the state/municipalities/land trusts to develop longer-term land use protection strategies
Coordinate state and local investments in urban tree programs	Health, social and environmental benefits for urban communities
Expand existing programs that promote local agriculture	Increased local food security; reduce the carbon intensity of food
Promote research and policies that invest in regenerative agriculture practices	Allows agricultural lands to store more carbon to help mitigate the effects of climate change

Climate and Health

Climate change, health, and equity are inherently intertwined. Climate change acts as a risk multiplier, meaning vulnerable populations face more of its effects. Many of the environmental and social determinants of health, such as housing, proximity to traffic, tree canopy cover, and vulnerability to flooding, are related to climate. For this reason, improving community resilience is a key strategy to help keep a focus on equity and environmental justice. As incidences of heat-waves and flooding increase, we must address immediate health impacts and build resilience among Rhode Islanders.

Climate Change worsens the health effects from urban heat, flooding, severe weather and sea level rise, food and water borne diseases, vector-borne diseases, and poor air quality. Our efforts to cut greenhouse gasses, plant trees, reduce air pollution, build green infrastructure, and support healthy food systems will create huge gains in public health across the state. When we focus this work with equity and justice in mind, we will see the biggest gains among our most vulnerable populations. We should also use our decarbonization efforts to undo past harms and

[81] IPCC Report on Climate Change and Land Use (2019) https://www.ipcc.ch/srccl/

ensure that our youth are poised to take on the challenges of the work we know we need to do in our communities.

Extreme Heat

Extreme heat is an increasing threat across Rhode Island as the average temperature has already risen three degrees in the last century. Since 1980, there has been an average of 10 days above 90 degrees in the Providence area each summer, but already in the last several years, we have seen closer to 20 days. Extreme heat is the leading cause of weather-related injury and can lead to health harms such as cardiovascular events and dehydration. In the Providence area, studies have shown that some neighborhoods can be up to 12 degrees warmer on hot summer days. These neighborhoods also tend to stay warmer at night. In the last several years, the Department of Health (DOH) and the Department of Environmental Management (DEM) have teamed up to support urban forestry and better understand urban tree canopy across our cities.

Air Quality

Air quality also degrades when it is hot. Ozone is formed from air pollution and sunlight on hot days. While DEM measures air pollution and issues air quality alerts on high ozone days, it is the very localized, everyday emissions that we also must consider. For example, many schools and neighborhoods are close to heavy traffic and truck routes putting residents and children at a higher risk. Schools also lack proper air filtration and air conditioning creating poor indoor air quality. As spring and fall warms, learning suffers in hot classrooms. Asthma is also a large driver of school absenteeism and can affect learning. As we remove fossil-fuel burning appliances from homes and provide efficient air conditioning to urban families, the health of children will greatly improve as will their success in school.

Emergencies

During emergencies, people who are already vulnerable suffer the most. RIDOH has worked with senior living facilities to make sure they have shelter-in-place plans for their residents and adequate supplies during events. The Rhode Island Special Needs Registry allows those who need additional help to make sure they are prioritized during a storm. Restoration of power for those who need electricity for medical reasons is prioritized, but more can be done to help folks with assistance for back-up power and batteries for their medical devices. RIDOH is also working on supporting cooling shelters and community spaces that can serve as information centers and gathering places.

Mental Health

Mental health is affected by climate change in multiple ways. People who are taking certain medications are more prone to heat stroke and have a hard time regulating body temperature. Heat can also increase anxiety and levels of violence and can affect sleep and mental functioning. Extreme weather events also increase anxiety and can lead to post-traumatic stress when lives are disrupted. Working with communities on building social cohesion and supporting a local resilient economy can help people bounce back from disturbances faster. Working with youth on climate solutions lowers their sense of anxiety and gives them a place to be part of the conversation.

Health Care

The health care system should be an important part of implementing climate change solutions. Doctors and other health care providers are becoming more attuned to the effects of climate change on their patients. Medical students are asking to have climate change taught in medical school. Many health care systems are focusing on social determinants of health, the environment being one of them. The medical system also produces a large amount of waste and uses a large amount of energy. Hospitals should be part of the conversation about electrification and decarbonization as they provide critical community services. Sustainability efforts at hospitals are being supported more and more by medical professionals and should be part of state-wide efforts.

Looking ahead to the *2025 Climate Strategy*

When the legislature passed the Act on Climate and it was signed by Governor McKee in April of 2021, the sense of urgency for the State's response to climate change increased dramatically. Goals became enforceable mandates and clear priorities were set for equity, justice, and workforce development. These priorities were to be central to all our work on reducing emissions. Regular reporting, metrics, and dashboards, as well as strategic plans were required to ensure we stayed on track to meet our goals and clearly communicate status and progress. The 2022 Update is the first of the plans required by the Act on Climate.

Beginning in September 2021, the EC4 initiated a comprehensive public involvement strategy to provide transparency and opportunities for engagement on the development of the 2022 Update. The EC4 met more often – bimonthly versus quarterly – and held meetings across the state to allow more Rhode Islanders to participate in critical conversations about climate change. The EC4 held over 20 public listening sessions and workshops to gather public input for the 2022 Update. The EC4 also worked closely with Governor McKee to make appointments to both the EC4 Advisory Board and the Science and Technical Advisory Board, started work to create a Climate Justice Advisory Group, and OER and DEM have both onboarded additional staff to assist with the state's numerous climate programs, including staff members in both agencies focused on climate justice. This 2022 Update has been prepared to serve as a benchmark and updated foundation for the work ahead. We have reviewed the 2016 plan, reflected on the substantial work that has been done in Rhode Island over the past six years, and provided an interim path forward based on work being done across state government.

Much has changed in the world, the country, the region, and Rhode Island with respect to attitudes, actions, and science related to climate change since 2016. Key changes since 2016 include new emissions reduction targets directed by the 2021 Act on Climate; new learning from analyses, reports, progress on actions, and advances in science, technology, and business; emergency events leading to a renewed and stronger sense of urgency to act; and changing factors like new funding opportunities, renewable energy procurements, and changes in utility ownership.

The 2022 Update reflects on past progress and identifies our priority short-term actions needed to stay on the right path to meet our 2030 emissions mandate, in hope these priorities will be well established by 2025. The 2025 Climate Strategy will then build out workplans for each sector to meet our mandates and set us on a viable path to reach net-zero emissions by 2050.

During the dialogs with stakeholders, it became clear that the development of the 2022 Update was also an opportunity to reconsider and confirm technical aspects of modeling. Current emissions inventory processes, methodologies, and tools were reviewed in detail and, in many cases updated and modernized to use better local data. We also include explicit actionable recommendations for additional analysis in support of the development of the 2025 Climate Strategy.

In terms of progress and where we stand, Rhode Island's 2019 gross greenhouse gas emissions – the most recent inventory on record – are estimated to be 10.04 MMTCO2e. This level of emissions is 1.8% below emissions in 2016. Since 2016, electric power consumption emissions decreased by 28.0%, residential heating emissions increased by 13.5%, commercial heating emissions increased 8.8%, transportation emissions increased 8.8%, industrial emissions decreased 9.2%, agricultural emissions increased 39.2%, and waste emissions increased 14.2%.

Since 2016, the State has conducted several in-depth studies deepening our understanding of decarbonization activities and enabling actions. The 2022 Update includes a list and summary of over a dozen major studies that either directly authored by state agencies or state-commissioned subject matter experts. These studies contain numerous data-driven and stakeholder-informed recommendations for future action that should be continually referenced throughout strategic climate planning. The list of studies in the 2022 Update is not complete but is illustrative of the large and growing body of work we can rely on as we continue to reassess and refine our climate strategy.

Additionally, the Rhode Island General Assembly has debated and passed several bills addressing different aspects of our response to climate change. The most significant legislation was the 2021 Act on Climate, which set statewide, economy-wide climate goals that are both mandatory and enforceable.

In 2021, legislation updated the Biodiesel Heating Oil Act of 2013 to phase in higher percentages of biodiesel or renewable hydrocarbon diesel blended into home heating oil.

In January 2020, Executive Order 20-01 set a first-in-the-nation goal to meet 100% of Rhode Island's electricity demand with renewable energy by 2030. In 2022, the RI legislature passed a bill, subsequently signed by Governor McKee, to commit the state to 100% renewable energy by 2033.

In 2016, Rhode Island became home to the first offshore wind project in the nation with the successful installation of the 30 MW Block Island Wind Farm. In 2019, another contract for the 400 MW Revolution Wind was approved. In 2022, the legislature authorized procurement of up to an additional 1000 MW of power generated from offshore wind.

Obviously, action is needed to meet the upcoming emission reduction targets that are now enacted in Rhode Island law. While the details, modeling, and balancing of these actions across the sectors of our economy will be done as part of the 2025 Strategic Plan, many actions are underway by several agencies, funded by both federal grants and state investments, and they must continue.

In the electric sector, we must take action to both consume less electricity and meet electricity needs using decarbonized energy resources. Critical to this will be meeting the 100% Renewable Energy Standard by 2033. The 100% Renewable Energy Standard is expected to grow demand for renewable energy resources; this, in turn, will require strategic investments in our electric grid to enable timely and efficient integration of these resources, as well as bolstering cost effective renewable energy within Rhode Island's portfolio through procurement of offshore

wind. All actions must be considered within the larger fabric of policy objectives, and should be refined to improve affordability, equity, land use, and other policy objectives. This report outlines seven priority policies and actions for the electric sector to meet our goals and more detailed options, plans, and metrics will be developed as part of the 2025 Strategic Plan. Upcoming discussions on the use of smart meters and modernization of our electric grid will be critical to formulate state policies and investments moving forward.

In the transportation sector, priority actions must be taken to both consume less fuel and consume lower-emissions fuel. To consume less fuel, we can discourage high-emissions driving and encourage low-emissions mobility solutions. To consume lower-emissions fuel, we need to encourage electric vehicles and expand electric vehicle charging infrastructure. Critical to all this is the development and construction of a convenient and robust charging infrastructure across Rhode Island and pushing the adoption of more and more low-emission and zero-emission electric vehicles. Strategies outlined in the 2022 Update those focusing on passenger vehicles, public transportation, and school bus transportation. More work is needed to develop a plan for commercial fleet conversion. Over the next five years, we can strengthen the groundwork for integrating climate into our investment decisions in transportation infrastructure and take action to incentivize lower-emissions mobility. The modeling to done in support of the 2025 Strategic plan will balance these options and provide us with the degree of implementation and penetration needed to meet our goals.

The thermal sector consists of emissions from all thermal processes, including space heating and cooling, high-heat industrial processes, refrigeration, cooking, and household activities such as clothes drying. Fossil fuels, electricity, and bio-based materials are all used as energy sources for thermal processes in Rhode Island. Our initial action on this will be a large state investment supporting the conversion of heating systems to heat pumps, moving from fossil-fuel based heating to electricity. An upcoming discussion on the future of natural gas in Rhode Island will also be very important to inform our strategies and plans for the building and heating sector. As Rhode Island makes significant investments in both housing and school construction, climate considerations must be incorporated into those design and construction plans.

With technical assistance funding from the US Climate Alliance, Rhode Island partnered with the Rocky Mountain Institute (RMI) and Acadia Center to undertake high-level greenhouse gas modeling focused on the near term 2030 reduction mandate (45% below 1990 levels). A high-level state decarbonization analysis was performed by the Acadia Center utilizing the RMI's Energy Policy Simulator (EPS). By modeling a short list of key policy scenarios as outlined in the report, it is projected that Rhode Island slightly misses the Act on Climate's 2030 reduction mandate. This is a very simple, preliminary model that verifies Rhode Island is moving in the right direction but is not quite at the point where we can be confident in our success. More scenarios must be considered, with input from a wide variety or experts and stakeholders, and the modeling needs to be further refined to develop and balance different implementation strategies to increase that confidence. That will be the crux of the 2025 Strategic Plan.

On that note, the EC4 will immediately turn 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.

The public involvement strategies for the 2022 Update were generally well received and effective in soliciting comments and feedback from a broad range of stakeholders. Thank you to everyone who participated in the listening sessions, attending our EC4 meetings, and for providing comment through the online portal. A huge change from 2016 is the degree of public engagement and interest, and it is clear that people want more - both in terms of more opportunities to participate and more action. Looking forward to starting the next process on developing the 2025 Strategic Plan, we will continue some of the best practices from this effort with a specific eye towards bringing in more voices to the conversation. In particular, our engagement with disadvantaged and underserved communities has just begun and there is much more work necessary to ensure that those voices are heard in our policy and program discussions. Similarly, we need to develop systems to effectively engage with municipalities and Rhode Island's business communities. Their voices and contributions will also be critical to meeting our greenhouse gas emission reduction goals. Concurrently with these additional outreach efforts, we must expand our communications channels to effectively tell our story and get broader engagement across the State.

The agencies in the EC4 will focus on implementation of the action items outlined in this report. The EC4 will continue to work with the Advisory Board, as well as the Science and Technical Advisory Board and Climate Justice working group, to refine policies and develop metrics and the public dashboard called for in the Act. The metrics and dashboard will show the progress made and the status of our efforts.

Discussions of identifying and allocating resources to these efforts will continue. The decarbonization and transition of our economy must be done carefully, and deliberately, to meet the goals set forth in the statutes. This will require both internal and external expertise and support for all the agencies. In the near term, prospects for federal support in many areas looks strong, particularly from the federal Bi-Partisan Infrastructure Law and the Inflation Reduction Act. However, these federal funds will not provide complete support needed for our efforts and state funds will be needed.

We look forward with enthusiasm to working with all partners as we chart our path forward to implementing solutions and achieving the goals of the Act on Climate.

Appendix: Stakeholder Engagement

Summary

A goal from the outset of the development of this report was to prioritize stakeholder involvement to inform the priorities and actions outlined for next steps to meet the goals of the Act on Climate. Over the course of 12-months between November 2021 and November 2022, over 20 listening sessions and workshops addressed the following topics, and in many instances multiple sessions were hosted for each topic:

1. Scoping the 2022 Update
2. How to Define Net-Zero Emissions by 2050
3. Understanding RI's Greenhouse Gas Inventory Process
4. Priority Actions for the Electric Sector
5. Priority Actions for the Transportation Sector
6. Priority Actions for the Thermal Sector
7. Priority Actions for Land Use
8. Health & Climate
9. Buildings & Climate
10. Food Systems & Climate
11. Climate Justice

The first seven sessions listed above are further summarized in the following pages of this appendix. We highlight issues heard from participants and actions identified to help the state meet its near-term climate goals.

In addition, we further highlight the issues of health and climate, buildings and climate, food systems and climate, and climate justice in special sections in the report. A copy of the slides from these sessions can be found online at: https://climatechange.ri.gov/act-climate/attend-event [82]

Throughout the development of this report, the EC4 utilized an online comment portal called Smart Comment to collect and review additional comments submitted by interested parties. Over 390 sets of comments were received from November 2021 through early December 2022. The vast majority were submitted on behalf of individuals, with additional sets of comments submitted on behalf of local/regional organizations active in RI's climate change conversation. Additional public comments were offered verbally at EC4 meetings between December 2021 and December 2022.

[82] Note: The November 'Climate Justice Hour' did not utilize slides. It was intended to be a conversational session. Additional 'Climate Justice Hours' will be held in 2023 and beyond to ensure continued conversations with communities disproportionately impacted by environmental and climate burdens.

Scoping the 2022 Update Sharing Session (#1) Stakeholder Appendix

The 1st series of public sharing sessions was held in November 2021 and discussed the scope of the *2022 Update to the 2016 Greenhouse Gas Emissions Reduction Plan*. During this first public sharing session, 89 people participated from a range of stakeholders including interested individuals, environmental advocates, policymakers, and representatives of the clean energy industry.

The goal of the discussion was to reach consensus on the scope of the *2022 Update* and was framed by four discussion points to generate participation and input from all groups represented.

The first discussion point was for each attendee to describe their objectives for the update. After attendees expressed their opinions on the matter, the following objectives were recorded: be responsive to the 2021 Act on Climate, center equity and be developed using a meaningful public participation process, leverage lessons learned since 2016, build a foundation for the *2025 Climate Strategy*, reconsider and confirm technical aspects of modeling while promoting reliance and being action oriented, and focus on near-term actions to achieve the 2021 Act on Climate's 2030 mandate.

The next discussion point was focused on the major changes and lessons learned since the last Greenhouse Gas Emissions Reduction Plan was published in 2016. Some of the changes that were highlighted include new learning from analyses, reports, progress on actions, and advances in science, technology, and business over the last few years. There was also a mention of lessons learned from intense weather events that renewed a sense of urgency to act on the issues posed by the changing climate.

Given these objectives and changing conditions, attendees collaborated with one another to come up with updates to specific components of the *2016 Greenhouse Gas Emissions Reduction Plan*. This scope includes technical updates, updates to pathways, policy, and implementation strategies, as well as specific action items. The technical updates include modernizing the greenhouse gas emissions reduction targets to comply with the 2021 Act on Climate, defining the goal of reaching net zero emissions by 2050, and review modeling to ensure the 1990 baseline is sound and the data and modeling assumptions are reasonable. Under the update pathways, policy and implementation strategies, there were a few more recommendations. This included providing progress updates, as well as coordinating emissions sectors with policies from the *2016 Plan*, adding and refining policy and implementation strategies from more recent studies that also comply with the 2030 mandate, and consider new funding opportunities. There were also recommendations to review the entire *2016 plan* with equity appropriately centered, identify and engage key stakeholders, develop a climate dashboard that tracks progress on community-prioritized outcomes, and identify and address the prerequisite needs or the *2021 Climate Strategy* and preview the work ahead.

The last discussion point was centered around which stakeholder groups should be included in future conversations, and attendees were encouraged to help connect the project team to their contacts within these groups and to continue to recommend stakeholders with whom to engage.

A copy of the slides from this session can be found online at: https://climatechange.ri.gov/act-climate/attend-event

Defining 'Net-Zero Emissions by 2050' Sharing Session (#2) Stakeholder Appendix

The 2nd series of public sharing sessions was held in January 2022 and discussed how the 2021 Act on Climate's ultimate mandate of 'net-zero emissions by 2050' should be defined. Over the span of two identical sessions, held on January 11th and 13th, 102 people participated from a range of stakeholders including, interested individuals, environmental advocates, policymakers, and representatives of the clean energy industry.

The scope of the discussion was framed by three different prompts whose aim was to increase understanding surrounding considerations and preferences for how we define 'net-zero by 2050'. This was facilitated through a brief background information discussion before diving into the prompts.

The first prompt asked attendees which emissions should be included when defining the term 'net-zero emissions by 2050'. Attendees generally supported continuing to track the same four greenhouse gases already tracked by the IPCC and US EPA, which include Carbon dioxide, Methane, Nitrous oxide, and Fluorinated gases. A few concerns were raised including timeframes regarding global warming potentials, biogenic versus anthropogenic emissions, tracking for methane leakage from pipelines, considerations for land use changes, emissions from biodiesel and bioheat, the importance of consistency throughout states and with the IPCC, the role of education and messaging, developing mitigation strategies tailored for each type of emission, and prioritizing action.

The second prompt was centered around how we should net emissions. There were two net options given, one was net each greenhouse gas first and the second was to net MMTCO2e last by subtracting the sinks from the sources of MMTCO2e. Attendees were a bit more divided in this discussion, but the overall preference was towards netting MMTCO2e last, which is the current practice and capability. Some considerations that were raised included but were not limited to understanding the consequences of offsets versus sinks, the role of transparency regarding climate dashboards, and definitions to account for changes in technology and science.

The third and final prompt encouraged attendees to discuss the timeframe over which emissions should be netted. The current practice is to net emissions over an annual timescale, but attendees debated over whether annual or sub annual time frames would be more beneficial. It was roughly split 50/50 with slightly more attendees supporting the current annual timeframe but made sure to raise important points regarding the potential value in supplementing annual netting with sub-annual netting and considering the best timeframe for each type of sector. Other considerations included prioritizing action, focusing on reaching short term mandates, prioritize mitigating sources, highlighting success stories in conjunction with quantitative metrics, and identifying impactful near-term actions.

A copy of the slides from this session can be found online at: https://climatechange.ri.gov/act-climate/attend-event

Greenhouse Gas Inventory Methods and Tools Sharing Session (#3) Stakeholder Appendix

The 3rd series of public sharing sessions was held in March 2022 and discussed the different greenhouse gas inventory methods and tools. During the session, 76 people participated from a range of stakeholders including, interested individuals, environmental advocates, policymakers, several state administration representatives, and representatives of the clean energy industry.

There were three objectives of the discussion: (1) provide a tutorial to improve understanding of how we inventory greenhouse gas emissions, (2) understand considerations and preferences for how / when we re-estimate greenhouse gas emissions changes due to land use, land use change, and forestry, and (3) understanding preferences for comparing apples-to-apples across years versus maintain an unchanging baseline against which to compare contemporary emissions.

The sharing session began with RIDEM expert Allision Archambault presenting a brief overview of how RIDEM inventories greenhouse gas emissions. After the overview, a facilitated discussion took place, using two discussion prompts that were meant to help attendees understand considerations and preferences for updating greenhouse gas emissions accounting.

The first prompt asked attendees what considerations they saw for how frequently Rhode Island estimates emissions reductions due to land use, land use change, and forestry (LULUCF). Attendees generally supported estimating emissions from LULUCF every five years, which is in line with Rhode Island's Comprehensive Climate Strategy beginning in 2025. There were some suggestions, including working to better understand trends and changes in LULUCF emissions and accounting methodologies. In doing this, we might strategically estimate emissions from LULUCF when certain indicators are met. The second prompt encouraged attendees to discuss considerations for how frequently we update the 1990 baseline. Three considerations were given: the first was to never change the baseline, the second was to update somewhere in between / strategically, and the third was anytime updated science is available. The attendees generally recommended that re-estimation should occur whenever major updates to climate science occur, such as those identified in IPCC Assessment Reports. Another recommendation made includes consideration of administration burden and costs when determining the frequency of update estimations.

Finally, attendees had an opportunity to voice other considerations for greenhouse gas emissions inventorying. The first included reiterating the importance of accurate accounting of and reduction of methane emissions, specially from the gas pipeline system. The second consideration was whether and how we track 'Scope 3' emissions, which are the emissions that result from activities from assets not owned or controlled by the reporting organization, but that the organization indirectly impacts in its value chain.

A copy of the slides from this session can be found online at: https://climatechange.ri.gov/act-climate/attend-event

Priority Actions for the Electric Sector Sharing Session (#4) Stakeholder Appendix

The 4th series of public sharing sessions was held in April 2022 and discussed the priority actions for the Electric Sector with regards to the *2022 Update* to the *2016 Greenhouse Gas Emissions Reduction Plan*. Over the span of three identical sessions, 58 people participated from a range of stakeholders including interested individuals, environmental advocates, policymakers, and representatives of the electric sector.

There were three objectives of the discussion: (1) provide a refresher on key recommendations from the 2016 Plan and update with the most relevant recent reports, (2) brainstorm actions needed over the next 1-3 years to set Rhode Island on a path to meet the 2030 mandate, and (3) understand preferences and considerations to inform how actions are prioritized.

Dr. Gill provided significant background information Rhode Island's electric sector emissions and how emissions would change if Rhode Island went 100% renewable. Some progress that was described included the extension of Rhode Island's Least-Cost Procurement statute, expansion of appliance and equipment energy and water efficiency standards, costs versus benefits measurement of pathways to decarbonize the electric sector in *The Road to 100% Renewable Electricity by 2030 in Rhode Island*, and two programs offered through the Renewable Energy Fund called ConnectedSolutions and Solar+Storage Adder Pilot Program that support the development of energy storage systems. Following the background information, several policy and programmatic recommendations were made, as well as planning, enabling, and equity recommendations.

The attendees then participated in a facilitated discussion, which allowed them to express their opinions on priority actions needed over the next 1-3 years within the electric sector to aid Rhode Island in meeting its goals for the 2030 emissions reduction mandate. The framework that was used in this segment fell under three categories: ensure decarbonization, enable decarbonization, and refining our actions. One clear priority action is to pass a 100% Renewable Energy Standard, and attendees also recommended bolstering energy efficiency and demand response programs, encouraging, and educating renewable energy practices in preferred locations, continuing to improve building standards and codes, modernizing the electric grid, and deploying smart meters. Some refining actions that were suggested by the attendees include improving affordability, improving equitable access to programs and public participation in program design, balancing land use priorities, and ensuring equitable investments in communities. Actions that would enable this include building relationships between customers and utilities, programmatic and process evolution, building community partnerships through regional collaboration, and systematic planning for energy storage.

A copy of the slides from this session can be found online at: https://climatechange.ri.gov/act-climate/attend-event

Priority Actions for the Transportation Sector Sharing Session (#5) Stakeholder Appendix

The 5th series of public sharing sessions was held in May 2022 and discussed priority actions for the transportation Sector with regards to the *2022 Update* to the *2016 Greenhouse Gas Emissions Reduction Plan*. Over the span of three identical sessions, 54 people participated from a range of stakeholders including interested individuals, environmental advocates, policymakers, and representatives of the transportation sector.

There were three objectives of the discussion: (1) provide a refresher on key recommendations from the 2016 Plan and update with the most relevant recent reports, (2) brainstorm actions needed over the next 1-3 years to set Rhode Island on a path to meet the 2030 mandate, and (3) understand preferences and considerations to inform how actions are prioritized.

Dr. Gill provided background information on the greenhouse gas emissions from the transportation sector and said that most of the emissions come from on-road vehicles, which was one of the main focuses of the discussion. She also noted that there is an overall reduction in the transportation sector when (1) we consume less fuel and (2) we consume lower-emissions fuels. These pathways are what framed the facilitated discussion later in the presentation. Dr. Gill also reviewed Rhode Island's efforts to decrease carbon emissions in the transportation sector and named a few key areas of progress: encouragement of electric vehicle use in the state, electrification of the public transport buses, and enacting more stringent air regulations. In relation to decarbonizing the transportation sector, Dr. Gill highlighted two key studies conducted since 2016 that provide meaningful templates and information for states to use. The *Clean Transportation and Mobility Innovation Report* and the more recent *Electrifying Transportation Report* both provided significant information on recommendations for creating a healthier environment through more updated an efficient transportation use.

The attendees then participated in a facilitated discussion, which allowed them to express their opinions on priority actions needed over the next 1-3 years within the transportation sector to aid Rhode Island in meeting its goals for the 2030 emissions reduction mandate. The framework that was used in this segment was split into two conversations consistent with the two pathways we must reduce emissions from the transportation sector: reducing fuel consumed, and consuming lower-emissions fuel. The priority actions included reducing high-emissions driving, increase low-emissions mobility, and refining our actions. To reduce high-emissions driving, attendees suggested making driving less attractive while making transit more attractive, consider lower-emissions biofuels, and enact stricter emissions regulations on vehicles. As a suggestion to increase low-emissions mobility, attendees recommended making active mobility more attractive, such as support for the Bicycle Master Plan. In terms of refining our actions, attendees suggested learning from others, as well as balancing climate impacts of transportation investments among other policy objectives such as safety. The second conversation prompted attendees to suggest priority actions to encourage electric vehicle usage as well as charging infrastructure availability. In terms of actions to encourage people to switch to electric vehicles, attendees suggested incentive programs with sustainable and substantial funding streams, as well as broadening incentive programs to include other modes or transportation such as e-bikes. Attendees also discussed requiring maintenance strategies and standards for charging stations for actions to expand electric vehicle charging. Finally, under the section titled "refining our actions" attendees recommended tailoring strategies based on use cases and needs, as well as integrating equity into program design.

A copy of the slides from this session can be found online at: https://climatechange.ri.gov/act-climate/attend-event

Priority Actions for the Thermal Sector Sharing Session (#6) Stakeholder Appendix

The 6th series of public sharing sessions was held in June 2022 and discussed emissions reductions in the thermal sector. Over the span of three sessions, 47 people participated from a range of stakeholder groups including, interested individuals, environmental advocates, fuel sector advocates, policymakers, and representatives of the utility company. The scope of the discussion was framed by two guiding emissions reductions principles: to reduce our thermal sector emissions, we can, 1) consume less fuel, and 2) consume lower emissions fuel.

Throughout the three sharing sessions, stakeholders had a range of comments, including numerous ideas to both enhance existing mechanisms for thermal decarbonization and to push beyond current structures which would enable novel approaches to decarbonizing our thermal sector. Ideas for thermal decarbonization also loosely formed a timeline of when to pursue certain measures, starting with low-hanging fruit while simultaneously planning for larger-scale and more complex projects that are not yet feasible in the short term.

Building codes, workforce development, and the implications of various decarbonization pathways and regulatory frameworks on energy costs, were some of the most highly discussed topics. Numerous stakeholders see building codes as a powerful lever for lowering the carbon intensity of heating and cooling in buildings. Stakeholders would like to see stronger, more enforceable energy codes that require buildings to lower the amount of energy needed for heating and cooling, and to require technologies that will be carbon-free. Ensuring that Rhode Island has the labor force needed to construct and install technologies in buildings that meet ambitions efficiency standards and decarbonization standards is essential. Furthermore, stakeholders see a need to start planning for the emissions and price impacts of various decarbonization pathways that could be pursued. Several stakeholders argued that a mix of centralized and decentralized approaches will likely be needed to meet the Act on Climate mandates, and given the scale of these potential project ideas, and the significant potential impacts on costs to consumers, it is urgent to think about how to manage these scenarios.

A copy of the slides from this session can be found online at: https://climatechange.ri.gov/act-climate/attend-event

Priority Actions for the Land Use Sharing Session (#7) Stakeholder Appendix

The 7th series of public sharing sessions was held in July 2022 and discussed how natural vegetation can absorb greenhouse gasses, resulting in lowering emissions, and how we use our land can also help adapt to a changing climate and build community resilience. Over the span of three sessions, 43 people participated from a range of stakeholder groups including, interested individuals, environmental advocates, land use advocates, policymakers and renewable energy. The scope of the discussion was framed by two guiding questions: what do we need to do to decrease emissions resulting from how we use and develop land? and; what do we need to do to increase the amount of carbon our land can sequester?

Throughout the three sharing sessions, stakeholders had numerous comments, including clarifying what policies are in place to reduce solar development of forests and agricultural land (e.g. redirecting solar development to previously disturbed sites), promoting transit-oriented development, adopting a no-net loss of forests policy, prioritizing forest management to increase sequestration, promoting reforestation, increasing available state funds for land protection (including agricultural lands), prioritizing urban trees, and the need for a broader state discussion to address competing land uses.

Solar development, no net-loss policies, agricultural land protection (including healthy sols), and forest conservation (both urban and rural) were some of the most highly discussed topics. Numerous stakeholders see the competition between renewable energy development and land conservation as one of the most pressing on-going discussions in Rhode Island related to climate change. Stakeholders would like to see more regulations and policies in place to prevent future forest loss. Several stakeholders argued that issues related to food security and organics diversion need to be considered as well.

A copy of the slides from this session can be found online at: https://climatechange.ri.gov/act-climate/attend-event

Technical Appendix: Energy Policy Simulator GHG Emissions Avoided Modeling Analysis

Technical analysis conducted by Acadia Center, in collaboration with RIDEM, was used to inform the estimates of avoided greenhouse gas (GHG) emissions associated with individual actions and the collective suite of actions described in previous sections of this report. Specifically, Acadia Center leveraged the Rhode Island Energy Policy Simulator (EPS) model developed by Energy Innovation and RMI. The EPS was originally designed at a national scale with the intention of discovering the most effective policies to decarbonize America's economy at the lowest cost and empower decision makers to find the best course toward a low-carbon U.S. economy. In recent years, state-level versions of the EPS have been publicly released in select states. The version that has been customized for Rhode Island, referred to as the Rhode Island EPS (RI EPS), is scheduled to be released in early 2023 and will serve as a free, open-source, peer-reviewed model that allows users to estimate climate and energy policy impacts through 2050 on emissions, the economy, jobs, and public health using publicly available data. Technical documentation associated the EPS, detailing the specifics of how the model works, can be found at: https://us.energypolicy.solutions/docs/.

The RI EPS uses a "base year" starting point of 2020 and then projects emissions out to 2050 under a pre-loaded "Business as Usual" (BAU) scenario that incorporates existing policy, scheduled power plant retirements, some improvement in building and transportation efficiency, and economic adoption of electric vehicles (EVs). It's important to note that, due to some methodological differences, the base year 2020 GHG emissions in the RI EPS likely will not match the 2020 Rhode Island GHG emissions inventory (to be released in December 2023). For this reason, the RI EPS is not intended to provide precise projections of how a specific suite of actions will impact future emissions in Rhode Island as measured by the state's official GHG accounting standards, but rather is intended to provide high-level insight by estimating approximate GHG emissions reductions trajectories for the state.

Actions that have already been formally adopted in state legislation – including Rhode Island's Renewable Energy Standard and Biofuel Heating Oil Act – are included in this BAU Scenario. Building off of this BAU scenario, Acadia Center leveraged input and data from various Rhode Island state agencies to develop a customized emission modeling scenario for the 2022 Update with the intent of developing high-level, preliminary estimates of the GHG emissions avoided by 2030 from both 1) Individual actions in this draft plan and 2) The collective suite of actions in this draft plan. Evaluating multiple policies simultaneously through the RI EPS captures the interactive effects of these policies. Ultimately, the 2022 Draft Climate Plan Update Scenario details how actions outlined in this plan would reduce Rhode Island's GHG emissions in 2030 beyond the reductions already captured in the BAU Scenario.

The table below provides a list of the actions analyzed for GHG emissions reduction potential by Acadia Center using the RI EPS and briefly describes the analysis approach for each action. In some instances, the analysis approach is "bottom up": For example, estimating vehicle miles travelled (VMT) avoided in the year 2030 as a result of the collective suite of actions and programs outlined in Transit Forward RI 2040 to reduce VMT in the state. In other instances, the analysis approach is "top down": For example, setting an aspirational target of 15% of space and water heating demand in all buildings served by efficient electric appliances by 2030. For "top down" measures, the specifics of the policies and programs needed to achieve these aspirational targets will require further detailed conversation and analysis.

Table X: List of Actions Analyzed in the Rhode Island Energy Policy Simulator "Customized Emission Modeling Scenario for the 2022 Update" & Analysis Approach by Action

Action	Analysis Approach
Enact a 100% Renewable Energy Standard	In accordance with the Renewable Energy Standard, assumes 72% of total electricity generated to be from qualifying renewable energy sources by 2030 (on course for 100% by 2033). This action was incorporated into the RI EPS BAU projections as the policy is already formally adopted in legislation.
Increase Adoption of Electric Vehicles (Light Duty)	Assumes state adopts Advanced Clean Cars II Regulations, taking effect starting model year 2027.
Increase Adoption of Electric Vehicles (Trucks)	Assumes state adopts Advanced Clean Trucks and Phase 2 GHG regulations, taking effect starting model year 2027.
Increase Decarbonization of RIPTA's Bus Fleet	Assumes 17.7% of total RIPTA bus fleet miles are driven by EVs by 2030 based on estimated projections from RIPTA staff assuming 1) Three pilot Proterra buses in service; 2) R Line electrification; 3) Electrification of five Newport routes; and 4) Route 78 service electrification.
Expand RIPTA Ridership to Reduce Light Duty VMT	Assumes a 4.8% reduction in statewide single occupancy vehicle miles travelled (VMT) below 2020 levels by 2030 based on estimated projections from RIPTA staff assuming 1) Full funding for TMP implementation; 2) Sufficient labor resources (drivers, mechanics, etc.) to implement at recommended service levels; 3) Timely implementation of all new routes and span/frequency recommendations; 4) Ridership growth at estimated rates; and 5) Land use changes consistent with TCRP calculator assumptions.
Strengthen Building Energy Codes	Assumes continuous adoption of the most recent International Energy Conservation Code (IEEC) model energy code for residential buildings and continuous adoption of the most recent American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 90.1 for commercial buildings for all code cycles falling between 2021 and 2030.
Increase Efficient Electrification of Building Space and Water Heating	Assumes achievement of 15% of space and water heating demand in all buildings, both residential and commercial, in the state being provided by efficient electric appliances (e.g., heat pumps) by 2030.
Increase Biofuel Blending in Heating Oil	In accordance with the 2021 Biofuel Heating Oil Act, assumes that a percentage of biofuel is blended into the heating oil supply at rates of 15% by 2024, 20% by 2025, and 50% by 2030. In accordance with the current RI GHG emissions inventory lifecycle emissions associated with biofuel production and biofuel combustion were not assumed to result in GHG emissions attributable to Rhode Island. This action was incorporated into the RI EPS BAU projections as the policy is already formally adopted in legislation.
Maintain Current Amount of Forested Land	Assumes that Rhode Island adopts a policy or set of policies that results in maintaining the existing amount of total forested land currently in the state (approximately 361,000 acres) through the year 2030. This is an increase in amount of forested land in 2030 in comparison to the BAU Scenario which assumes a 2.3% decline in 2030 levels of forested land relative to 2020 levels of forested land based on analysis conducted by RIDEM.

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