DRAFT

2022 Update* to the *2016 Greenhouse Gas Emissions Reduction Plan

Working Draft

Version: April 2022
Due: December 2022

This document is intended to be drafted section by section as we complete sharing sessions and in line with the deliverables scheduled in our workplan. 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. All feedback, questions, and comments can be submitted online at www.climatechange.ri.gov/aoc/.

Commented [GC(1]: Question for reviewers: Would you like to see quotes from stakeholders throughout the report (akin to the Electrifying Transportation report) or will quotes feel too distracting?

Front Matter – due in November
- Introductory Letter
- Executive Summary
- Table of Contents

Introduction and Scope – due in December – drafted
Defining net-zero emissions by 2050 – due in February – drafted
Greenhouse Gases – drafted
- How we inventory
- 1990 baseline
- 2018 greenhouse gas inventory
- Projections, modeling, review of key assumptions

Since 2016 – due in March – drafted
- Greenhouse gas reductions, other metrics
- Studies, programs, policies
- Progress on 2016 pathways
- Restructured strategy by sector
    - Electricity
    - Transportation
    - Thermal
    - Land Use
    - Climate Justice

Meeting our 2030 Mandate – due in August

Commented [GC(2]: Reviewers: please note change in workplan.

- Electric
- Transportation
- Thermal
- Land use
- Climate justice – due in September
- Agency actions – due in October
- Considerations for the General Assembly – due in October

Looking ahead to the *2025 Climate Strategy* – due in November
Appendix: Stakeholder Engagement – drafted throughout
- Summary – due in November
- November Sharing Session on Scope of *2022 Update* – drafted
- January Sharing Sessions on 'Defining Net-Zero by 2050' – drafted
- March Sharing Session on Rhode Island's Greenhouse Gas Emissions Inventory Methodology – drafted

- April Sharing Sessions on Priority Actions for the Electric Sector – drafted

Introductory Letter

[To be added in November]

Executive Summary

[To be added in November]

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Introduction and Scope

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

As required by law, the Executive Climate Change Coordinating Council (EC4) will 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 *2022 Update* will be informed by public comment and stakeholder discussions.

Subsequently, 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.

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 objectives of the *2022 Update* to the *2016 Greenhouse Gas Emissions Reduction Plan* were informed by discussions with stakeholders and the public during the 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.[1] We rely on the latest science and recommendations of the Intergovernmental Panel on Climate Change (IPCC).[2]

Second, developing the *2022 Update* should rely on robust and meaningful stakeholder engagement in order to appropriately center equity into the discussion. We welcome feedback and suggestions from stakeholders throughout the development process, and intend to rely 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 potential 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. We envision the *2022 Update* to reflect on past progress and identify our priority short-term actions needed to get on the right path to meet our 2030 emissions mandate, in hope these priorities will be complete by 2025. The *2025 Climate Strategy* will then build out workplans for each 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.

Finally, the *2022 Update* must identify a clear set of priority near-term action items that will set 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 should be included for each priority action.

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

[1] 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).

[2] Intergovernmental Panel on Climate Change

  - Provide updates on progress for each policy and implementation strategy recommended in the *2016 Plan*
  - 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!)
- Develop 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.

[Brief summary of *2022 Update* findings to be added in November]

Defining Net-Zero Emissions by 2050

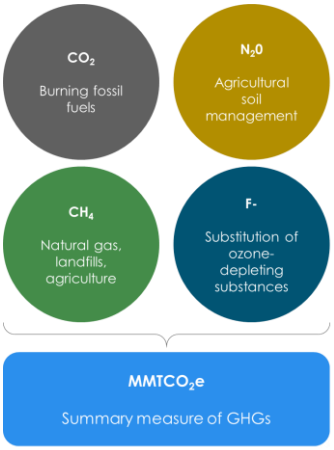
The 2021 Act on Climate sets forth a mandate to reach 'net-zero emissions by 2050' (RIGL 46-6.2). However, the law does not define the terms 'net-zero' or 'emissions', and therefore leaves open questions of which emissions, how we net those emissions, and on what timeframe the netting occurs. Following 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[3] and UNFCCC[4], and are embedded within the US EPA's[5] 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[6]:

[3] Intergovernmental Panel on Climate Change
[4] United Nations Framework Convention on Climate Change
[5] United States Environmental Protection Agency
[6] "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.[7] 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 that 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

[7] 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.[8] In contrast, anthropogenic emissions are emissions that come from human activities.[9] 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.[10] 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.

[8] US EPA
[9] IPCC Glossary
[10] 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 $MMTCO_2e$.[11] 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 does not officially include any 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. We refer interested readers to the most recent Greenhouse Gas Emissions

[11] Technically, zero sinks are included in Rhode Island's current annual emissions inventory. While the US EPA's greenhouse gas inventory tools do estimate emissions reductions due to land use, land use change, and forestry (abbreviated LULUCF), these tools have known reliability issues and therefore are not included. We refer interested readers to the most recent Greenhouse Gas Emissions Inventory for more information

Inventory for more information about current practice and limitations.[12] Our 1990 baseline accounts for land use, land use change, and forestry, but uses a proprietary model – please see the chapter on the 1990 baseline for more information (forthcoming).

- As we progress toward 2050, we will need to develop a replicable and reliable method 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.

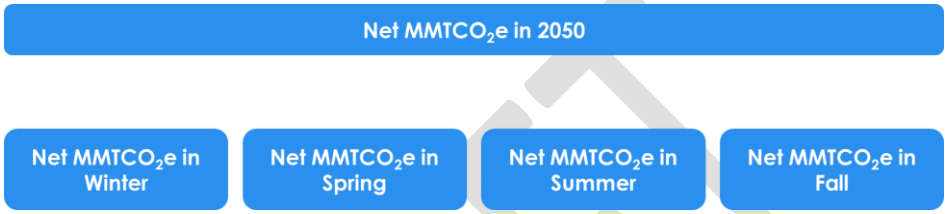
Both concerns are valid and must be addressed. We propose three immediate responses related to maintaining a sense of urgency, limiting our reliance on not-yet-developed technologies, and recognizing the shortfalls of accounting.

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.

[12] http://www.dem.ri.gov/programs/air/ghg-emissions-inventory.php

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.[13] We do not envision Rhode Island developing its own tools, but we will strive to improve methods using 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 should provide 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 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.

[13] Specifically, Rhode Island uses the US EPA SIT tool, the US EPA MOVES tool, and a method developed in-house based on methodology developed by Massachusetts 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.

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 *2016 Rhode Island Green House Gas Emissions Inventory* report produced in 2019 – we refer interested readers to that report for more detail.

We then describe two central principles governing how and when we update process, methodology, and tools specifically related to the 1990 baseline and estimating emissions from land use, land use change, and forestry (LULUCF) activities. 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 generally 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 is expected to be estimated by 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 EPA's 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 model 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 issues a "triennial summary" that coincides with the releases of the US EPA's triennial National Emissions

Inventories.[14] Each National Emissions Inventory details emissions of criteria air pollutants, criteria precursors, and hazardous air pollutants. Triennial greenhouse gas emissions summary provides a greater level of detail on certain sectors relative to annual emissions inventories. Table X below shows the history of default versus non-default model runs. Inventory years 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, we should be cautious 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.

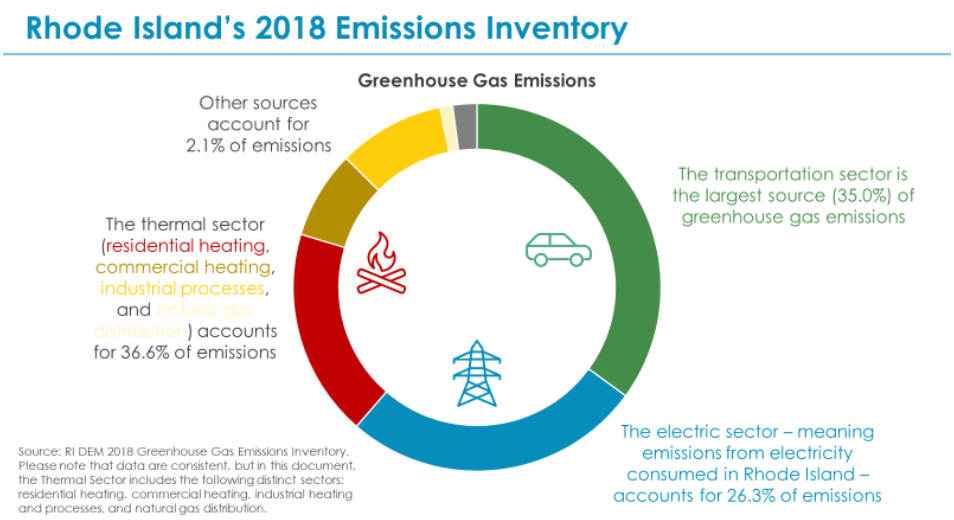
Table X. Model Run Types by Emissions Inventory Year.

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

Some categories of emissions require other tools and methods instead of or in addition to the SIT. The 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 2018 below; these sectors – transportation, electricity, and thermal[15] – correspond to the following chapters that identify priority actions to reduce emissions.

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

[15] 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.



Notes: The data used in the figure above and throughout this chapter are from Rhode Island's 2018 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 Northeast States for Coordinated Air Use Management.[16] This first analysis estimated both a 1990 baseline and emissions inventory for 2010, the most recent year for which data was available 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,

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

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.[17] 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.

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.

[17] 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.

Transportation Sector Emissions

Emissions from the transportation sector include emissions from highway vehicles,[18] 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 April 1, 2022, all emissions reported in $MMTCO_2e$										
	1990	2010	2011	2012	2013	2014	2015	2016	2017	2018
Transportation Total	**4.97**	**4.33**	**4.4**	**4.19**	**4.59**	**4.25**	**4.09**	**3.94**	**4.17**	**4.45**
Aviation	0.33	0.27	0.31	0.29	0.29	0.30	0.28	0.3	0.34	0.38
Highway Vehicles	4.38	3.70	3.76	3.62	4.10	3.62	3.66	3.62	3.57	3.85
Nonroad Sources	0.27	0.36	0.33	0.28	0.20	0.32	0.12	0.02	0.25	0.23

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 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 simplifiesthe 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

[18] 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.

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, as required by the Permanent Air Quality Monitoring Act,[19] 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, and 2018 used the SIT tool 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, and 2018 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 tool. 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 switch to 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[20] within Rhode Island. While electric sector emissions appear to be increasing since 1990, changes in methodology prevent robust comparison

[19] RIGL §1-7-1: Long-term air-quality-monitoring program

[20] 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

of emissions prior to and since the 2016 emissions inventory. Since 2016, we estimate that emissions have increased. Increases in in-state electricity generation due to shifts in relative economics in the regional electricity supply market have been the dominant driver of increasing emissions. 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 April 1, 2022, all emissions reported in $MMTCO_2e$										
	1990	2010	2011	2012	2013	2014	2015	2016	2017	2018
Electricity Consumption	2.82	2.29	3.38	3.38	3.52	3.25	3.21	2.84	3.31	3.34

Bottom-Line Factors that Reduce Electric Sector Emissions

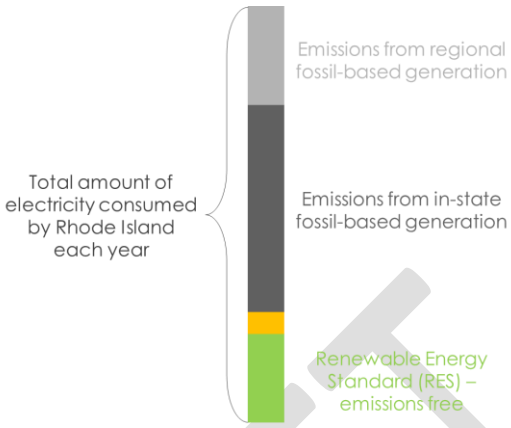
1. Reducing electricity consumption reduces emissions.
2. Producing electricity with renewable energy reduces emissions.

Current Method

Rhode Island's current method for estimating emissions from the electric sector is based on annual state-wide electricity consumption. This method is consistent with the method used by neighbors Massachusetts and Connecticut. The electric sector emissions inventory includes three primary components (illustrated in the figure below): compliance with the Renewable Energy Standard (RES),[21] emissions of in-state fossil-based electricity generation, and emissions of fossil-based electricity from our regional electric grid.

'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.

[21] 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.[22]

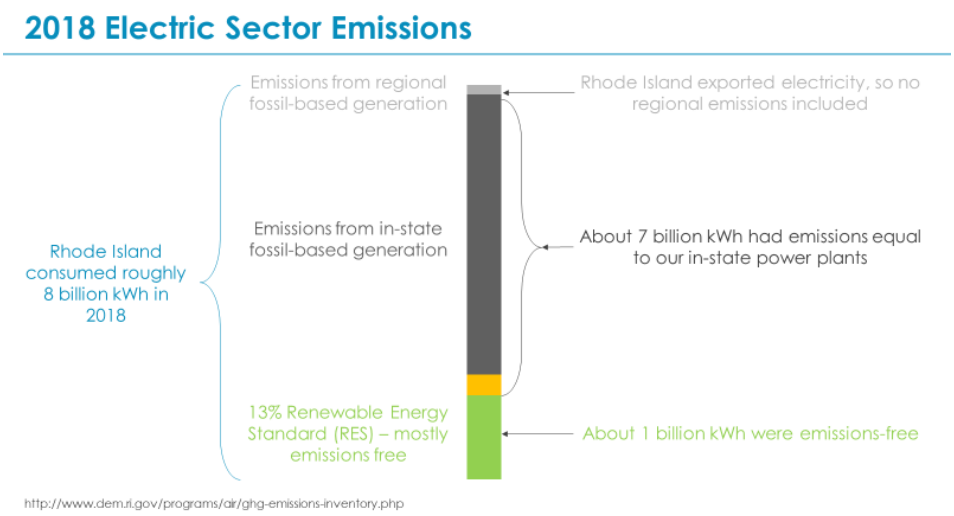
In 2018, the RES required 13% of electricity consumption be met with renewable energy. Of this 13%, nearly all was offset through the purchase (and retirement) of RECs. This portion of electricity consumed – equal to about 1 billion kWh – is deemed to have zero emissions.[23] The small portion of compliance 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.[24] 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.

[22] 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).

[23] 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.

[24] 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').[25] 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.

[25] 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.

There are emerging markets for what's-called 24/7 clean energy – essentially each hour's electricity consumption is generated by emissions-free renewable energy resources, 24 hours a day, 7 days a week, throughout the entire year. As influential companies such as Google and Microsoft move toward an hourly granularity of emissions accounting,[26] we are likely to see our emissions inventory tools build in capability to account for hourly emissions from contemporaneous electricity consumption. Indeed, this level of accounting is probably necessary to truly meet net-zero emissions as we advance toward our 2050 climate mandate. Rhode Island should revisit the idea of 24/7 clean energy in the coming decade, and should lay the groundwork for regional collaboration at the end of this 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 reductions in emissions resulting 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 estimated using the SIT tool. 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. We do not recommend any changes in methodology at this time due to limitations of available data and tools, but do suggest revisiting methodology at the end of this decade as capabilities and 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.

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 decreases we will see in emissions in transportation and heating sectors will be exaggerated because those

[26] See, for example, the explanation in this article or the discussion in this report.

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 electric 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 accurately and clearly evaluate progress. 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. 'Electric 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.[27] 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.[28] Below, we describe the methodology used to estimate emissions from residential heating only.

Table X. Emissions from the Thermal Sector

Rhode Island Greenhouse Gas Emissions Inventory										
Updated April 1, 2022, all emissions reported in $MMTCO_2e$										
	1990	2010	2011	2012	2013	2014	2015	2016	2017	2018
Residential Heating	2.37	2.24	2.15	2.08	2.27	2.34	2.46	1.84	1.87	2.32
Commercial Heating	1.15	0.92	0.87	0.79	0.91	1.13	1.00	0.86	0.88	0.98
Industry	0.81	1.04	1.06	1.05	1.24	1.14	1.12	1.14	1.12	1.19

[27] 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.

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

Industrial Heating	0.71	0.61	0.56	0.54	0.67	0.57	0.59	0.61	0.62	0.63
Industrial Processes	0.09	0.43	0.5	0.51	0.56	0.57	0.53	0.53	0.50	0.55
Natural Gas Distribution	0.3	0.15	0.15	0.15	0.17	0.17	0.16	0.15	0.15	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 Agency (US EIA) collects fuel consumption data throughout the United States by requiring mandatory surveys for all companies that deliver natural gas to consumers or transport natural gas across state lines.

Distillate fuel, propane, and kerosene are examples of fuels used to heat homes in Rhode Island. These are called 'delivered fuels' because they must be delivered to your house for use. Consumption estimates for delivered fuels are estimated by the US 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 2011-2018. Comparing emissions from our 2018 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 waste such as plant oils, cooking oils, and animal fats. 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 2018, 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 US 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 can impact 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

1. Preserving more land (like forests) reduces emissions.

Current Method and Limitations

The US EPA does have a module within the SIT that can estimate emissions impacts from LULUCF; however, Rhode Island and other states have agreed that this model is too imprecise and inaccurate to be reliable. Rhode Island currently does not account for emissions from LULUCF.

- We recommend developing a new method to estimate emissions impacts of LULUCF prior to 2025 that is replicable, consistent, can be conducted in-house after development.
- 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, with the support of modeling experts at the Northeast States for Coordinated Air Use Management (NESCAUM), Rhode Island estimated that LULUCF reduced our emissions by 0.29 $MMTCO_2e$ in 1990. However, this model failed to be replicable, so we cannot make comparisons to emissions from LULUCF in 1990 because we do not have estimates of emissions from LULUCF in subsequent years.

- We recommend using a replicable methodology for annual emissions inventories to re-estimate emissions from the 1990 baseline.

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 our past thinking, but results in inconsistent 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 Emissions Inventories:	1990 baseline, 2010	2011-2018	N/A	N/A

Rhode Island's 1990 baseline and 2010 emissions inventory used different GWPs than emissions inventories for 2011-2018. Comparing emissions from our 2018 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 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 promulgate policies or regulations to describe how compliance will be assessed before the release of the 2020 emissions inventory.

Since 2016

Commented [GC(3]: Throughout this section we provide the most recent metrics available. As we prepare the final report at the end of this year, we will thoroughly review and update metrics if new ones are available.

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 five 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.[29] 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 2018 greenhouse gas emissions – the most recent inventory on record[30] – are estimated to be 12.70 MMTCO2e. This level of emissions is 15.26% above emissions in 2016, representing increases across all sectors. Since 2016, electric power consumption emissions increased by 17.70%, residential heating emissions increased by 26.23%, commercial heating emissions increased 14.00%, transportation emissions increased 13.04%, industrial processes emissions increased 4.10%, agricultural emissions increased 32.36%, and waste emissions increased 8.61%.

Clean Energy

As of September 31, 2021, the state has counted approximately 1,017 MW of clean energy generation capacity. This represents a 792 MW increase in under 5 years, or a 78% increase since 2016.[31]

Of Rhode Island's current 1,017 MW total, 430 MW is offshore wind, 399 MW is solar, 144 MW is onshore wind, 35 MW is landfill gas/anaerobic digestion, and 9 MW is small hydroelectric power.

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

[30] 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.

[31] As of June 2017, the state had counted only 225MW of energy generation capacity. Of that 225MW, 30MW was offshore wind, 104MW was onshore wind, 35MW is landfill gas/anaerobic digestion, and 11MW was 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.

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 25% of Rhode Island's greenhouse gas emissions, and industrial heat processes contribute another 10%.[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

[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] 2017 Greenhouse Gas Emissions Inventory
[35] 2017 Rhode Island Renewable Thermal Market Development Study
[36] 2021 Clean Energy Industry Report

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.

Impacts of COVID-19

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.

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 February 13, 2022, there are 4,896 electric vehicles registered in Rhode Island. 2,294 (47%) are Plug-in Hybrid Electric Vehicles (PHEVs), and 2,575 (53%) are Battery Electric Vehicles (BEVs). This represents an 734% increase in EVs since 2015.[37]

As of February 25, 2022, there are 535 Level II (public and private) charging station ports, and 38 direct current fast charger (DCFC) ports. This represents a 625% increase in charging stations in RI since 2016.[38]

Protected Land

Since 2010, 9,758 acres have been protected by the state.[39] From 2016 to 2022, an additional 3,585 acres have been protected by the state, representing nearly a 60% increase in conserved acreage since 2016.[40]

Resilient Communities

As of 2021, 20 municipalities have participated in the Rhode Island Infrastructure Bank's Municipal Resilience Program (MRP). The MRP is a new program since 2016 and includes a robust stakeholder engagement approach to resilience planning. MRP workshops have hosted over 400+ participants, including municipal staff and community leaders. 400 potential resilience capital projects have been identified using this locally specialized approach.

As of 2021, 22 resilience projects have been funded through MRP Action Grants - a total of $2.5 million in assistance. 95% of projects funded through MRP Action Grants to date have incorporated green

[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] DEM 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 summer of 2022.

infrastructure and/or nature-based solutions. $7 million was allocated to the MRP through the 2021 Beach, Clean Water, and Green Economy Bond.

Lead-by-Example

The Rhode Island Lead-by-Example (LBE) program was initiated in 2017. Through the end of 2020, the State has achieved an 11.3% reduction in overall State facilities' energy consumption compared to a 2014 baseline. 95% of State Government electricity consumption is offset by renewables. Through the end of 2020, LBE investments saved $98 million in lifetime electric and gas utility costs and reduced electricity consumption equivalent to that used by 6,010 homes annually.[41]

60% of all State buildings are already or in the process of being converted to LED lighting with controls (through the end of 2020). 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.

120 electric vehicle charging ports have been installed across State properties (through the end of 2020) and 10 solar PV systems have been installed at State facilities. 14.4% (54 vehicles) of light duty vehicles purchased or leased since December 2015 are zero-emission vehicles (through the end of 2020). This LBE work has supported 466 clean energy jobs.

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 been built into our world today, which result in overburdening communities of color with higher energy burdens, 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.*

Commented [GC(4]: Please note we will have a series of public sharing sessions specifically on Climate Justice this summer! Please reach out to us with suggestions for running these sessions or conducting outreach for these sessions. Please also reach out to us if you'd like to have a one-on-one discussion about climate justice. We will be happy to visit your community or attend an already-scheduled meeting for your community group.

Studies, Programs, Policies, and Legislation

Since 2016, we have conducted over a dozen additional studies, gained five 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

[41] Rhode Island Office of Energy Resources Lead-by-Example Energy Initiative 2020 Annual Report

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[42] 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.

[42] 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.

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 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.

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 (2017)

http://climatechange.ri.gov/documents/resilientrhody18.pdf

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, RIIB 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.

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, the Rhode Island Office of Energy Resources (OER) and the Rhode Island Department of Environmental Management (DEM), in consultation with the Rhode Island Department of Transportation (DOT), 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.

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.[43] 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.

[43] Data through 12/31/2021

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.[44] 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. In 2022, an incentive program for electric vehicles will be re-launched.

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 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 February 25, 2022, Electrify RI supported the installation of 66 Level 2 charging stations with 132 ports, and 15 DCFC charging stations throughout Rhode Island. In 2022, federal funding will be available to further expand electric vehicle charging infrastructure.

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.[45]

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 350 households were supported.

[44] This section does include programs offered by third parties or federal agencies, but we recognize the importance of these programs.
[45] The Electric Transportation Initiative also included a discount on demand charged for eligible customers installing fast charging; this discount is no longer offered.

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 $770,000 have supported more than 40 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-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[46] 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.

[46] 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.

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. Should the pilot prove successful, the program will be scaled up to support additional districts.

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 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, Rhode Island Infrastructure Bank 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 2021, 20 municipalities have participated in the Municipal Resilience Program and the program's workshops have hosted over 400 participants, including municipal staff and community leaders. 400 potential resilience capital projects have been identified using this locally specialized approach. As of 2021, 22 resilience projects have been funded through MRP Action Grants totaling $2.5 million in assistance. 95% of projects funded through MRP Action Grants to date have incorporated green infrastructure and/or nature-based solutions.

The Rhode Island Infrastructure Bank is also developing 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 is preparing to launch 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, will assist island municipalities to advance intra- and inter-municipal resilience efforts, and will serve 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, Rhode Island Infrastructure Bank will launch a new initiative in 2022: '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 daytimes 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.

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

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.

Here in Rhode Island, all three of these areas have also evolved over that timeline. Innovation continues in our blooming offshore wind industry and is quickly developing in our transportation and heating sectors. The private sector is actively engaged in the climate dialog and the Chambers of Commerce, along with industry organizations like the Partnership for Rhode Island and the Ceres Group are consistently at the table. Also, organized labor has partnered with environmental groups to show the potential job opportunities and workforce development inherent in our response to climate change. Finally, the Municipal Resilience Program created by the Rhode Island Infrastructure Bank in partnership with The Nature Conservancy is amazing work that has extended the conversation on preparing Rhode Island cities and towns for the future.

We have a come a long way since 2016. Innovation, engagement with the private sector, and adaptation are three examples highlighted by Mr. Gates on a global scale, and all efforts in all three of these areas are major elements of our efforts here.

Appliance Energy Efficiency Standards

In 2021, the General Assembly updated Rhode Island's energy and water efficiency standards for a number of common appliances.[47] 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.

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 vegetable oils such as used cooking oil and soy byproducts. It must meet

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

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. There have been calls in 2021 and 2022 to develop additional offshore wind resources to further decarbonize Rhode Island's electric sector and match the pace of offshore wind development regionally.

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.

Land Conservation and Real Estate

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 large pieces of undeveloped property 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

The 2021 Beach, Clean Water, and Green Economy Bond dedicated $7 million to 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.

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.[48] 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

[48] Least-Cost Procurement Statute

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.[49] 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.[50]

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 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

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

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. Accordingly, legislation has been proposed in 2021 and 2022 that would strengthen Rhode Island's Renewable Energy Standard to 100% over the coming decade.[51] Furthermore, while continued work has been done to refine our in-state renewable energy programs and increase their impact, the 100% Renewable Electricity by 2030 report recommends further discussions to find and realize an optimal balance between program costs and benefits across our entire portfolio of programs.

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.

[51] There are two ways for electric distribution companies and non-regulated power producers to comply with the Renewable Energy Standard (RES): either they can purchase renewable energy certificates (RECs), which represent 1 MWh of renewable energy generated and delivered to the electric grid or they can make alternative compliance payments (ACPs) to the Renewable Energy Fund managed by Commerce RI. Within Rhode Island's accounting methodology for electric sector emissions, if full RES compliance is met through the purchase of RECs, then electric sector emissions will drop to zero. However, if a portion of compliance is met through alternative compliance payments, then that proportion of electric sector emissions will be equal to emissions from the regional fuel mix. 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 and influencing the economics of renewable energy systems on the regional electricity supply market.

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 alleviate 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.[52] 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).[53] 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.

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.[54]

[52] Part 37 of the Air Pollution Control Regulation, "Rhode Island's Low-Emission Vehicle Program" (250-RICR-120-05-37).
[53] Amendment to Part 37 of the Air Pollution Control Regulation, "Rhode Island's Low-Emission Vehicle Program" (250-RICR-120-05-37).
[54] 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.

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 continued in collaboration with the Division of Public Utilities and Carriers and under the regulatory oversight of the Public Utilities Commission.[55] Approximately 300 miles of leak prone pipe has been abandoned since 2016 along with approximately 15,000 leak prone services – all of which reduces leaks from the pipeline gas system.

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.

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 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.

[55] 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.

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.[56] 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 leading an industry convening to assess workforce development needs for increasing consumer adoption of electric transportation. Fourth, the proposed electric heating program (if approved by the General Assembly, to be funded through the American Rescue Plan Act) 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 adopt 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 have been on hold while other regulatory proceedings are resolving. The Power Sector Transformation report also includes a number of recommendations that should continue to be considered.

[56] Press Release from April 2019

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.[57]

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.[58]

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.

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

[57] Lead-by-Example 2020 Annual Report
[58] For more information about the RGGI Program Review and for opportunities to participate, visit https://www.rggi.org/.

2017 Update of the Regional Climate Change Action Plan and is currently working to execute this new report through various committees.

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 18 jurisdictions in 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. Participating jurisdictions include the states of California, Colorado, Connecticut, Hawaii, Maine, Maryland, Massachusetts, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Rhode Island, Vermont, Virginia, and Washington, the District of Columbia, and the province of Quebec. 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.

Meeting our 2030 Mandate
[To be added in August]

Climate Change: Local Action for a Global Issue

Priority Actions for the Electric Sector

Building an Integrated Portfolio of Action

Priority Actions for the Transportation Sector

Climate and Food Systems

Priority Actions for the Thermal Sector

Priority Actions Related to Land use

Climate and Health

Priority Actions to Address Climate justice
[To be added in September]

Priority Actions for State Agencies
[To be added in October]

Considerations for the General Assembly
[To be added in October]

Looking ahead to the *2025 Climate Strategy*

[To be added in November]

Appendix: Stakeholder Engagement

Summary

[To be added in November]

November Sharing Session on Scope of *2022 Update*

On November 16, 2021, the EC4 held a public sharing session to help scope the *2022 Update* to the *2016 Greenhouse Gas Emissions Reduction Plan*. This session was held via Zoom and a project webpage was first updated with notice of the session on October 28. The project team, which is comprised of staff and leadership from the Office of Energy Resources and Department of Environmental Management with guidance and input from the remaining EC4 agencies/offices, conducted outreach for the sharing session beginning November 2, with emailed announcements distributed to OER's and EC4's distribution lists, and announcements made at the Energy Efficiency and Resource Management Council's public meeting on November 8 and the Green Buildings Advisory Committee's public meeting on November 16.

At the sharing session, RIDEM Acting Director Gray and State Energy Commissioner Ucci provided introductory remarks and summarized the directives of the 2021 Act on Climate. Liz Stone, EC4 Coordinator for DEM, reviewed the development and contents of the *2016 Greenhouse Gas Emissions Reduction Plan*. Dr. Carrie Gill, Chief Economic and Policy Analyst for OER, led participants in a facilitated discussion. Finally, Ms. Stone concluded the sharing session with next steps. The slide deck used for this session was made available on www.climatechange.ri.gov/aoc on November 17.

The sharing session was attended by 89 people including Senator Anderson, Representative Carson, Representative Cortvriend, and Senator Valverde, and Karen Bradbury on behalf of Senator Whitehouse, as well as EC4 members RIDEM Acting Director Gray, State Energy Commissioner Ucci, and DPUC Administrator George. State Administration representatives also included staff from OER, DEM, DOT, DSP, DPUC, RIPTA, DOA, and Commerce. Several stakeholder groups were represented as well, including Acadia Center, Green Energy Consumers Alliance, Audubon Society, Conservation Law Foundation, The Nature Conservancy, Environmental Council of Rhode Island, National Grid, Brown University, and members of the clean energy industry.

Attendees were asked to complete surveys before and after the sharing session. Twenty-four (24) attendees (27%) completed the pre-session survey – while the response rate is typical, the low number of completions should only be interpreted as being suggestive of general trends. According to the pre-session survey, 29% of respondents represented state government and 29% of respondents represented environmental organizations. Most respondents (84%) were already familiar with the *2016 Greenhouse Gas Emissions Reduction Plan*. The demographics of respondents skewed white, non-hispanic/latinx, and female. While these data should not be interpreted as conclusive trends in participation, they do suggest likely underrepresentation of several communities across Rhode Island, including indigenous communities and people of color, as well as Rhode Islanders not already familiar with state climate efforts.

- Recommendation for continuous improvement: Partner with community groups to attend existing group meetings and hold sharing sessions directly within communities – Status: Developing coordination and outreach plan for implementation in Summer 2022

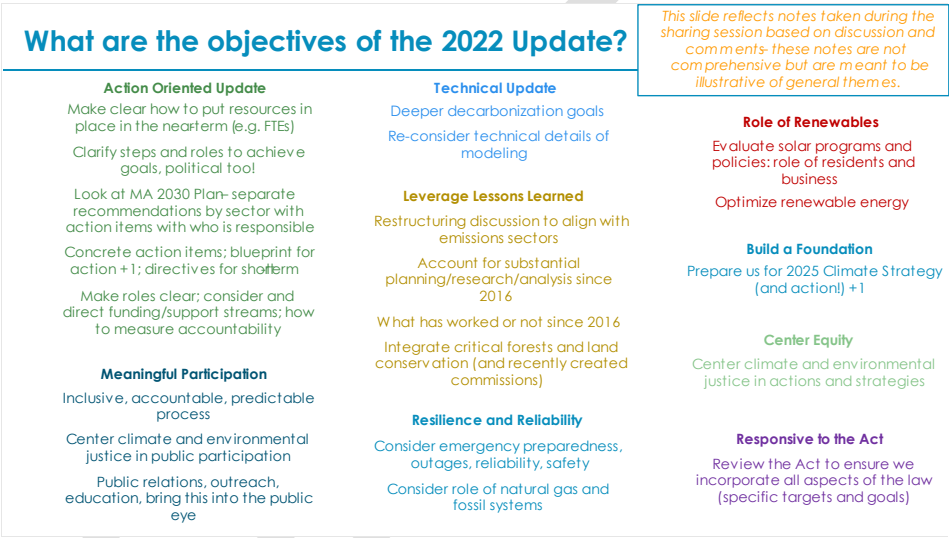
The facilitated discussion walked through four discussion prompts, all with the aim of reaching consensus on the scope of the *2022 Update*.

First, attendees were asked to describe their objectives for this update. Attendees suggested over twenty objectives and engaged in lively discussion both orally and in Zoom's chat feature. Notes describing suggested objectives were taken in real time on the screen. Following the brainstorming session, objectives were grouped into similar themes to produce the following set of objectives.

Objectives of the *2022 Update* to the *2016 Greenhouse Gas Emissions Reduction Plan*

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



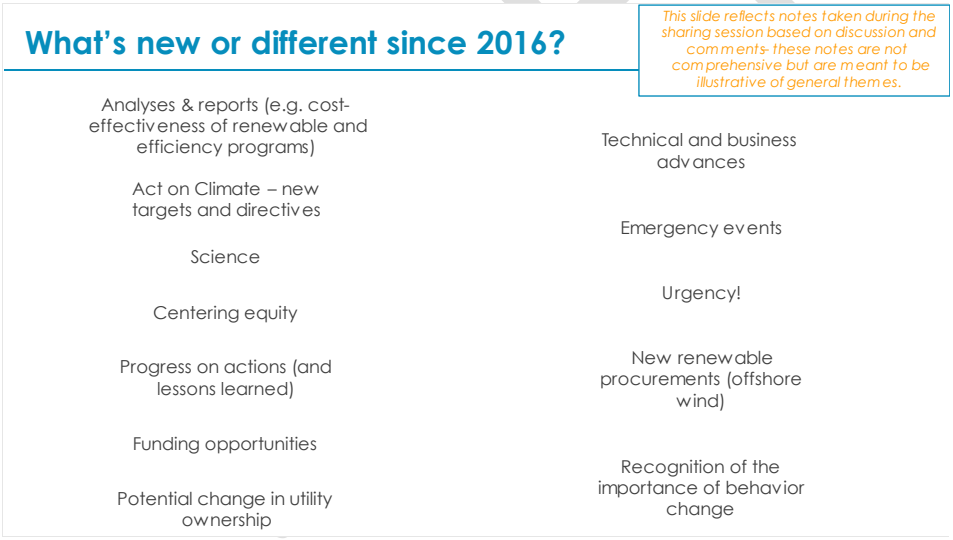
Next, attendees noted major changes and lessons learned since 2016 when the last Greenhouse Gas Emissions Reduction Plan was published. Attendees noted new emissions reduction targets directed by the 2021 Act on Climate; new learning from analyses, reports, progress on actions, and advances in science, 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 potential changes in utility ownership.

Given objectives and changing conditions, attendees strategized what specific components of the *2016 Greenhouse Gas Emissions Reduction Plan* warranted an update – these components constitute the scope of the *2022 Update*. Specifically, the following updates were suggested:

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*
  - 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!)
- Develop 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 GHG 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 DEM's triennial greenhouse gas reporting.

Finally, attendees brainstormed stakeholder groups that should be included in future conversations. These groups are listed in the sharing session slides and should be considered a working list. 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.

Who needs to be at the table?

This slide reflects notes taken during the sharing session based on discussion and comments- these notes are not comprehensive but are meant to be illustrative of general themes.

Update Topic (from previous slide)	Stakeholder/Group
• GHG targets • Revisit modeling • Data	• Municipalities and schools • RI Building and Construction Trades • Labor, frontline workers • Transportation organizations, RIDOT and leadership, RIPTA and RIBTA • Health Equity Zones, health organizations, American Lung Association • Business representation, minority and women-owned businesses, businesses from environmental justice and frontline communities, businesses that may need to transition • South Providence Neighborhood Association • SURJ RI • Communities • Washington Park Association • People's Port Authority • Narragansett Nation • NAACP • Urban League • Young people
• Leverage analyses/reports • Center equity	
• Restructure around sectors • Update progress • Actions, roles, accountability • Center equity • Funding considerations	
• Center equity • Climate dashboard • Metrics	
• Centering equity • Key stakeholders • Prepare for 2025 Climate Strategy	
General/Other	

Few attendees (7 attendees, 8%) completed the post-session survey. Of those who did, respondents expressed general preference for afternoon meetings (46%). All respondents (100%) stated there was a sufficient opportunity to share their thoughts and found the sharing session to be at least moderately helpful.

January Sharing Sessions on Defining 'Net-Zero Emissions by 2050'

On January 11 and 13, 2022, the EC4 held three public sharing sessions to understand how the 2021 Act on Climate's ultimate mandate of 'net-zero emissions by 2050' should be defined. This session was held via Zoom and a project webpage was first updated with notice of the sessions on December 20, 2022. The sessions were also noticed on the Secretary of State's website on January 5, 2022.

The project team, which is comprised of staff and leadership from the Office of Energy Resources (OER) and Department of Environmental Management (DEM) with guidance and input from the remaining EC4 agencies/offices, conducted outreach for the sharing session beginning January 5, 2022, with emailed announcements distributed to OER's and EC4's distribution lists, and announcements made at the Green Buildings Advisory Committee's public meeting on December 14.

Each session was run identically. Liz Stone, EC4 Coordinator for DEM, reviewed the 2021 Act on Climate's mandates related to the *2022 Update* to the *2016 Greenhouse Gas Emissions Reduction Plan* and reviewed guidelines and ground rules for participation. Dr. Carrie Gill, Chief Economic and Policy Analyst for OER, led participants in a facilitated discussion. Finally, Ms. Stone concluded the sharing session with next steps. The slide deck used for this session was made available on www.climatechange.ri.gov/aoc on February 4, 2022.

The sharing session was attended by 102 people including Representative Carson and Karen Bradbury on behalf of Senator Whitehouse, as well as EC4 members RIDEM Acting Director Gray, State Energy Commissioner Ucci, and Rhode Island Infrastructure Bank Executive Director and CEO Jeff Diehl. State Administration representatives also included staff from OER, DEM, DOT, DOH, DSP, RIPTA, and Commerce. Several stakeholder groups were represented as well, including Acadia Center, Green Energy Consumers Alliance, Audubon Society, The Nature Conservancy, Environmental Council of Rhode Island, National Grid, Brown University, New England Convenience Store & Energy Marketers Association (NECSEMA), Climate Jobs RI, land trusts, and members of the clean energy industry.

Attendees were asked to complete surveys before and after the sharing session. Forty-nine (49) attendees (48%) completed the pre-session survey – while this response rate is higher than the response rate from the November sharing session, we continue to suggest the low number of completions should only be interpreted as being suggestive of general trends. According to the pre-session survey, 15% of respondents represented state government and 33% of respondents represented environmental organizations. While all respondents considered themselves at least familiar with what greenhouse gases are, 22% of respondents reported not being at all familiar with how greenhouse gases are inventoried.

- Recommendation: hold a workshop to provide an introductory overview of how greenhouse gas emissions are inventoried – Status: Completed in March 2022

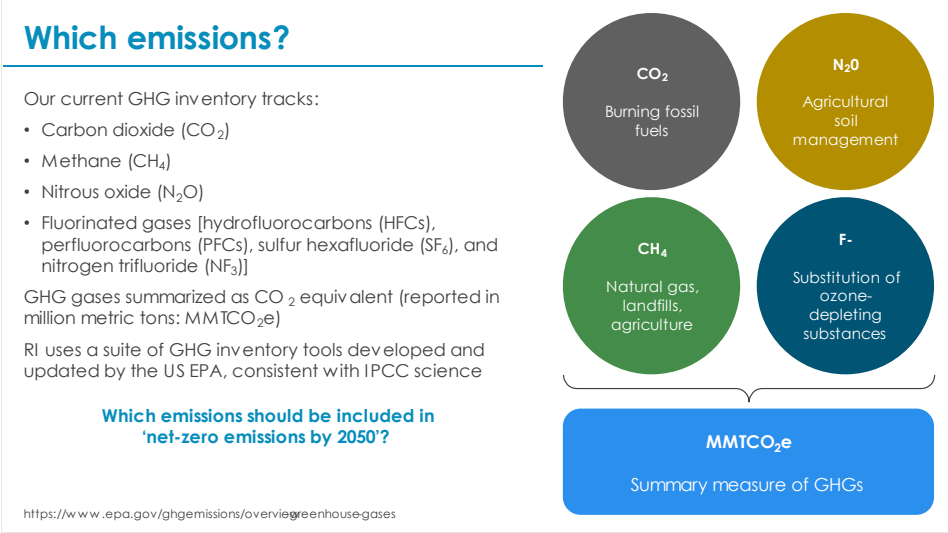
The majority of respondents learned about these sharing sessions from an EC4 newsletter or email, but some respondents reported new outreach channels, including through a Climate Action RI meeting. Seeing new outreach channels is encouraging because it suggests increased awareness of 2021 Act on Climate and EC4 events, which may lead to increased and more diverse participation.

- Recommendation: continue to ask about and monitor outreach channels used – Status: Ongoing through April

The demographics of respondents skewed white and non-Hispanic/latinx. While these data should not be interpreted as conclusive trends in participation, they do suggest likely underrepresentation of several communities across Rhode Island, including indigenous communities and people of color.

The facilitated discussion walked through three discussion prompts, all with the aim of understanding considerations and preferences for how we define 'net-zero by 2050'. Each prompt began with a brief overview of background information needed to support discussion. Notes on comments were taken in real-time directly on shared slides; these slides were made available as notes online and on the Secretary of State's website on February 4, 2022.

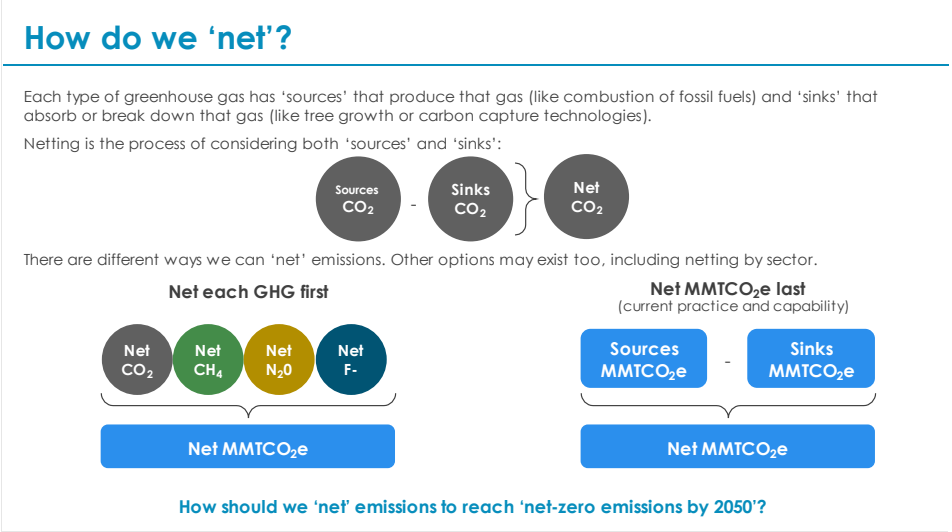
First, attendees were asked which emissions should be included when defining the term 'net-zero emissions by 2050'. Dr. Gill explained the four main types of greenhouse gas emissions identified and tracked by the IPCC and US EPA and noted that Rhode Island currently uses a tool developed and maintained by the US EPA that tracks all four types of greenhouse gases.



Attendees generally supported continuing to track all four types of greenhouse gases. Indeed, of the 18 respondents to the post-session survey, 94% suggested we include all four types of greenhouse gases in our definition. Concerns and considerations raised included timeframes used to calculate global warming potentials, biogenic versus anthropogenic emissions, assumptions and tracking for methane leakage from pipelines, how to best consider land use and land use changes, emissions from biodiesel and bioheat, the importance of consistency across state borders, importance of consistency with IPCC, the role of education and messaging, developing mitigation strategies tailored for each type of emission, and prioritizing action over accounting.

Second, attendees discussed how we should net emissions. Dr. Gill explained the concept of emissions sources and sinks, and how netting is the process of considering both sources and sinks. Dr. Gill provided

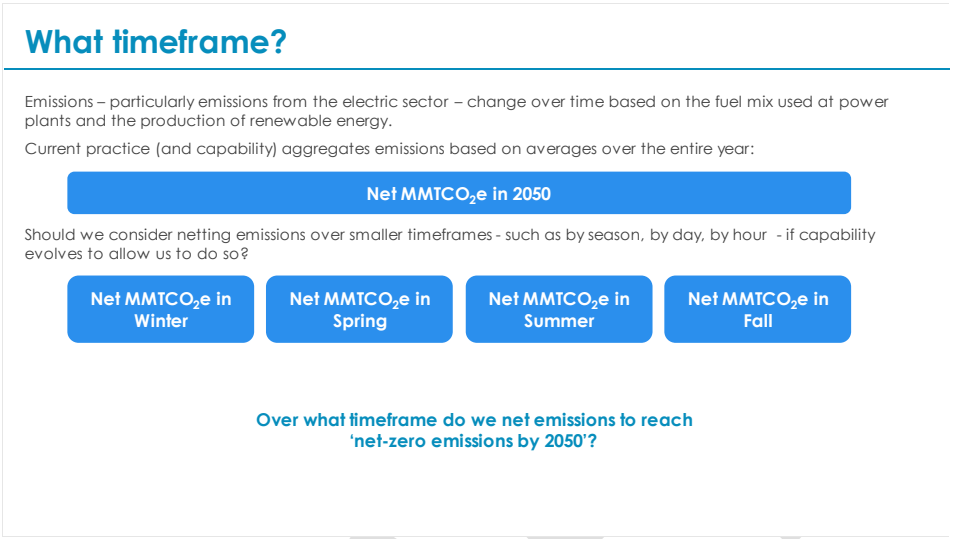
examples of two different methods for netting and noted other methods may be considered as well, before opening discussion for attendees.



Attendees were more split in their preferences between netting each greenhouse gas first versus netting the summary measure $MMTCO_2e$ last. While the overall preference seemed to be for netting $MMTCO_2e$ last – Rhode Island's current practice and capability, as determined by tools developed and maintained by the US EPA – there was insightful discussion about the potential role of considering net emissions of each type of greenhouse gas and for all greenhouse gases by sector. Of 16 post-survey respondents, 44% preferred netting $MMTCO_2e$ last, 31% preferred netting each greenhouse gas first, and 25% suggested hybrid, mixed, or alternative methods of measure progress toward net-zero emissions.

Other considerations raised included the importance of action to mitigation emissions from all sources, the concern of over-reliance of as-yet-unproven emissions capture technology, the need for appropriate education and communications, understanding the difference between and consequences of offsets versus sinks, a preference for being overly conservative in our accounting, the role of transparency and climate dashboards, the need to ensure comprehensive accounting across state borders, and building flexibility into our methods, tools, and definitions to account for changes in technology and science, among others.

Third, attendees discussed the timeframe over which emissions should be netted. Dr. Gill described Rhode Island's current practice of estimating emissions on an annual timescale, meaning all sources of emissions throughout the year are estimated, from which all reductions in emissions from sinks over the course of the year are subtracted. Emissions may also be netted on smaller timeframes, such as seasonal, daily, or hourly, but Rhode Island doesn't currently have the capability to do so. If we were to consider smaller timeframes, that would require reaching net-zero emissions for each timeframe (e.g. reaching net-zero emissions in each season in 2050).



Attendees engaged in really robust discussion about the tradeoffs between annual and sub-annual timeframes. Of the 15 post-session survey responses, roughly half of respondents supported using an annual timeframe (53%) and roughly half supported using a sub-annual or other timeframe (47%). There seemed to be an inclination across the three sharing sessions to maintain the annual timeframe, but attendees raised important considerations about the potential value in supplementing annual netting with sub-annual netting, weighing the incremental insights of more frequent netting with the costs of administration, being intentional about which sub-annual timeframe to use if appropriate, and considering the best timeframe for each type of greenhouse gas or sector.

Attendees were also given an opportunity to voice any other considerations about how we should define 'net-zero emissions by 2050'. Attendees stressed the need to prioritize action over accounting, focus on reaching short-term interim mandates, prioritize mitigating sources over pursuing sinks or offsets, considering non-quantitative metrics alongside emissions – including social and mental health impacts, highlighting case studies and success stories alongside quantitative metrics, and identifying the most impactful near-term actions.

Eighteen (18) attendees completed the post-session survey. Of those who did, respondents expressed general preference for afternoon meetings (33%). All respondents (100%) stated there was a sufficient opportunity to share their thoughts and 94% found the sharing session to be at least moderately helpful.

March Sharing Session on Greenhouse Gas Inventory Methods and Tools

On March 16, 2022, the EC4 held a public sharing session with the three objectives of (1) providing a tutorial to improve understanding of how we inventory greenhouse gas emissions, (2) understanding considerations and preferences for how/when we re-estimate greenhouse gas emissions changes due to land use, land use change, and forestry (LULUCF), and (3) understanding preferences for comparing apples-to-apples across years versus maintaining an unchanging baseline against which to compare contemporary emissions.

This session was held via Zoom and a project webpage was first updated with notice of the sessions on February 3, 2022. The session was also noticed on the Secretary of State's website on March 10, 2022. Because of the technical nature of this sharing session, we extended the length of the session to 90 minutes.

The project team, which is comprised of staff and leadership from the Office of Energy Resources (OER) and Department of Environmental Management (DEM) with guidance and input from the remaining EC4 agencies/offices, conducted outreach for the sharing session beginning March 7, 2022, with emailed announcements distributed to OER's and EC4's distribution lists, and announcements made at the Green Buildings Advisory Committee's public meeting on March 15.

Liz Stone, EC4 Coordinator for DEM, reviewed the 2021 Act on Climate's mandates related to the *2022 Update* to the *2016 Greenhouse Gas Emissions Reduction Plan* and reviewed guidelines and ground rules for participation. Dr. Carrie Gill, Chief Economic and Policy Analyst for OER, led participants in a facilitated discussion. Finally, Ms. Stone concluded the sharing session with next steps. The slide deck used for this session was made available on www.climatechange.ri.gov/aoc on March 21, 2022.

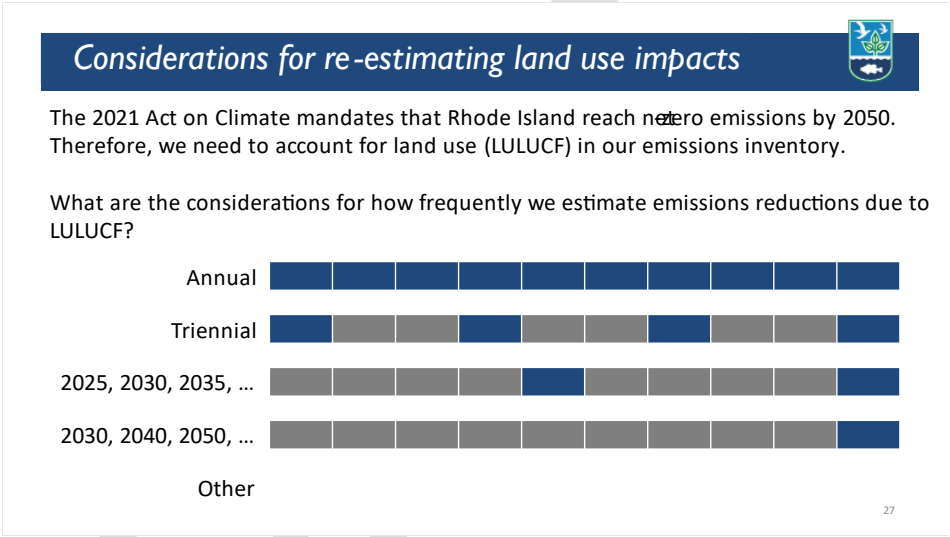
The sharing session was attended by 76 people including Representative Cortvriend, EC4 Chair and RIDEM Acting Director Gray, EC4 Advisory Board member Rubinoff, and Energy Efficiency and Resource Management Council members Case and Verrengia. State Administration representatives also included staff from OER, DEM, DOT, DOH, DSP, DPUC, PUC, CRMC and Commerce. Several stakeholder groups were represented as well, including Acadia Center, Green Energy Consumers Alliance, Audubon Society, Environmental Council of Rhode Island, and National Grid.

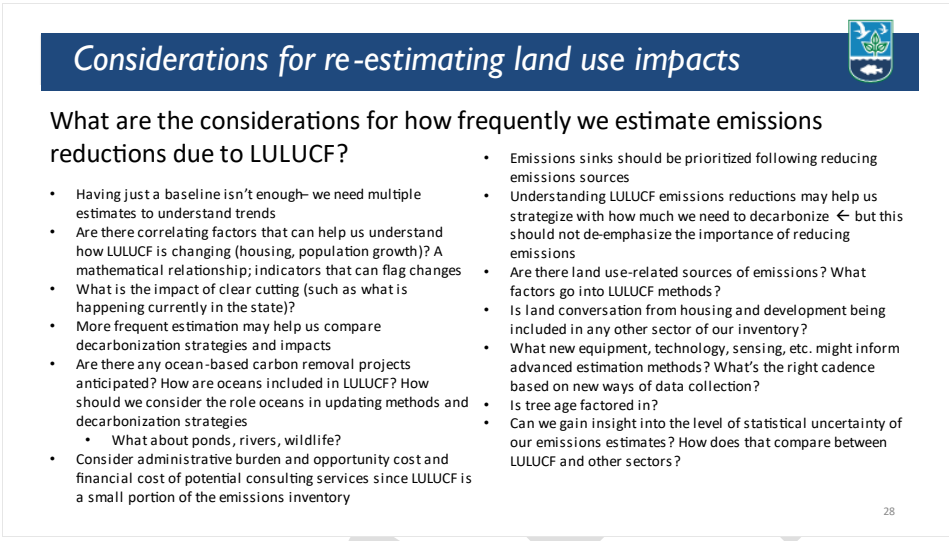
Attendees were asked to complete surveys before and after the sharing session. Twenty-two (22) attendees (29%) completed the pre-session survey – we continue to suggest the low number of completions should only be interpreted as being suggestive of general trends. According to the pre-session survey, 32% of respondents represented state government, 27% of respondents represented environmental organizations, and 18% represented industry. While all respondents considered themselves at least familiar with what greenhouse gases are, 32% of respondents reported not being at all familiar with how greenhouse gases are inventoried and 59% stated they had not been involved in prior conversations related to past years' greenhouse gas emissions inventories – these statistics echo those from the January sharing sessions. Following the recommendation from the January sharing session, this March sharing session began with an introductory overview of how greenhouse gas emissions are inventoried.

The majority of respondents learned about these sharing sessions from an EC4 newsletter or email. The demographics of respondents skewed white and non-Hispanic/latinx. While these data should not be interpreted as conclusive trends in participation, they do suggest likely underrepresentation of several communities across Rhode Island, including indigenous communities and people of color.

During first half of the sharing session, RIDEM expert Allison Archambault presented an introductory overview of how RIDEM inventories greenhouse gas emissions. The second half of the sharing session was a facilitated discussion using two discussion prompts, both with the aim of understanding consideration and preferences for updating greenhouse gas emissions accounting. Each prompt began with a brief overview of background information needed to support discussion. Notes on comments were taken in real-time directly on shared slides; these slides were made available as notes online and on the Secretary of State's website on March 18, 2022.

First, attendees were asked what considerations they saw for how frequently Rhode Island estimates emissions reductions due to land use, land use change, and forestry (LULUCF). Following background remarks from Ms. Archambault, Dr. Gill gave four examples of potential frequencies for estimating emissions from LULUCF.





Attendees generally supported estimating emissions from LULUCF every five years, in line with Rhode Island's Comprehensive Climate Strategy beginning in 2025. Indeed, of the 7 respondents to the post-session survey, 71% suggested we conduct this estimation every five years (2025, 2030, …). The frequency of estimation will help inform these climate strategies and will align with the 2021 Act on Climate's decarbonization mandates for 2030, 2040, and 2050. Echoing priorities voiced in prior sharing sessions, attendees advocated for prioritizing actions that reduce emission sources rather than increasing emissions sinks; this priority is one factor that motivated a less frequent cadence of estimation. Attendees also suggested that we work to better understand trends and changes in LULUCF emissions and accounting methodologies; by understanding these trends and changes, we might strategically estimate emissions from LULUCF when certain indicators are met.

Second, attendees discussed considerations for how frequently we update the 1990 baseline. Following an overview from Ms. Archambault, Dr. Gill suggested that attendees might consider how often we update the baseline to be on a spectrum. At one extreme, attendees might suggest we update the baseline every time we estimate Rhode Island's emissions inventory. At the other extreme, attendees might suggest we never update the baseline. In between, attendees might suggest a strategy for when to update the baseline based on their considerations and priorities.

Considerations for updating the 1990 baseline

Science is always evolving. The greenhouse gas inventory tools are updated periodically to reflect the best science.Updates may include updated global warming potentials in response to Assessment Reports, reestimating emissions impacts from the land use sector, or other asyet unforeseen updates to methodology.

What are the considerations with how frequently we update the 1990 baseline?

Never: Don't change what we have

Somewhere in between / strategically

Anytime updated science is available

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Considerations for updating the 1990 baseline

What are the considerations with how frequently we update the baseline?

- Major updates to science occur when major assessment reports are release (about once every seven years), so updating the baseline when ARs are released may not be too burdensome
- 20 versus 100 year warming potential
- Should strive to update our understanding and resulting policies as frequently as possible, since we have limited time to mitigate the worst impacts of climate change
- Our decisions today have longterm ramifications, so we need to be using the most updated science now to inform policy choices
- Is there an opportunity for collaboration with communities, schools, etc. to support this work?
- Do we anticipate substantial changes to the baseline? Afterall, the accounting is just accounting and what matters is the emissions in the atmosphere and our actions to reduce them
- However, there is value in comparing apples to apples so that we can get feedback on our strategies

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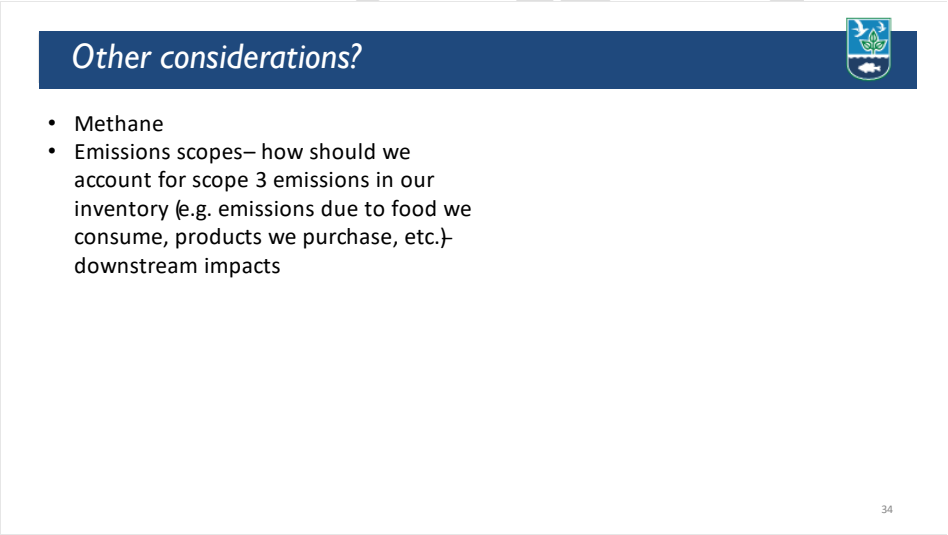
Attendees generally recommended we re-estimate Rhode Island's baseline whenever major updates to climate science occur, such as those identified in IPCC Assessment Reports every seven years or so. The principle behind this recommendation is comparing apples-to-apples to understand our greenhouse gas emissions reductions. The 2021 Act on Climate makes this principle salient by mandating interim emissions reductions relative to the 1990 baseline in percentage terms (i.e. 45% below 1990 levels by 2030 and 80% below 1990 levels by 2040). Conducting such a comparison requires the contemporaneous emissions and the baseline emissions to be estimating using consistent methodologies and assumptions.

Regarding both discussion prompts, attendees generally agreed that administration burden and costs should be considered when determining how frequently to conduct and update estimations. Echoing priorities from prior sharing sessions, the most critical actions are those that reduce greenhouse gas emissions rather than actions to account for those reductions. That said, where accounting provides insight into the efficacy of our actions, then undertaking those accounting exercises are critical for refining our climate strategies in order to meet the 2021 Act on Climate mandates.

Lastly, attendees had an opportunity to voice other considerations for greenhouse gas emissions inventorying. Two considerations were noted. First, attendees reiterated the importance of accurate accounting of and reduction of methane emissions, especially from the gas pipeline system. Second, attendees raised the question of whether and how we should track what are called 'Scope 3' emissions. For background, emissions can be categorized within three scopes. According to the US EPA[59] "Scope 1 emissions are direct greenhouse (GHG) emissions that occur from sources that are controlled or owned by an organization (e.g., emissions associated with fuel combustion in boilers, furnaces, vehicles). Scope 2 emissions are indirect GHG emissions associated with the purchase of electricity, steam, heat, or cooling. 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." Attendees raised their concerns about reducing and accurately tracking Rhode Island's Scope 3 emissions.



Few attendees completed the post-session survey. Of those who did, respondents expressed general preference for afternoon weekday meetings (36%). All respondents (N=6) stated there was a sufficient opportunity to share their thoughts and all respondents (N=7) found the sharing session to be at least moderately helpful. One respondent (N=6) stated their question was not answered sufficiently.

Commented [GC(5]: If this was you – we apologize! Please feel free to reach back out to us so we can try to better respond to your question or connect you with more resources. DOA.ClimateChangeRI@DOA.RI.gov

[59] For more information, visit the US EPA's webpage on emissions scopes.

April Sharing Session on Priority Actions for the Electric Sector

On April 19-21, 2022, the EC4 held three public sharing sessions with the objectives of (1) providing a refresher on key recommendations from the 2016 Plan and update with the most relevant recent reports, (2) brainstorming actions needed over the next 1-3 years in order to set Rhode Island on a path to meet the 2030 mandate, and (3) understanding preferences and considerations to inform how actions are prioritized.

These 60-minute sessions were held via Zoom and a project webpage was first updated with notice of the sessions on April 7, 2022 (registration links added April 11, 2022). These sessions was also noticed on the Secretary of State's website on April 11, 2022.

The project team, which is comprised of staff and leadership from the Office of Energy Resources (OER) and Department of Environmental Management (DEM) with guidance and input from the remaining EC4 agencies/offices, conducted outreach for the sharing session beginning April 11, 2022, with emailed announcements distributed to OER's and EC4's distribution lists, and announcements made at the Green Buildings Advisory Committee's public meeting on April 19, 2022.

Liz Stone, EC4 Coordinator for DEM, reviewed the 2021 Act on Climate's mandates related to the *2022 Update* to the *2016 Greenhouse Gas Emissions Reduction Plan* and reviewed guidelines and ground rules for participation. Dr. Carrie Gill, Chief Economic and Policy Analyst for OER, led participants in a facilitated discussion. Finally, Ms. Stone concluded the sharing session with next steps. The slide deck used for this session was made available on www.climatechange.ri.gov/aoc on May 5, 2022.

The sharing sessions were attended by 58 people. State Administration representatives included staff from OER, DEM, RIDE, and DPUC. Several stakeholder groups were represented as well, including Acadia Center, Green Energy Consumers Alliance, Audubon Society, RI Farmers for Climate Action, National Grid, and Pascoag Utility District.

Attendees were asked to complete surveys before and after the sharing session. Thirteen (13) attendees (22%) completed the pre-session survey and three attendees (5%) completed the post-session survey – we continue to suggest the low number of completions should only be interpreted as being suggestive of general trends. Both the pre-session and post-session survey response rates have decreased steadily since January despite efforts to reiterate the importance of responding to these surveys during each session.

- The project team should re-evaluate the surveys and survey request strategy to improve survey response rates for the May sharing sessions.

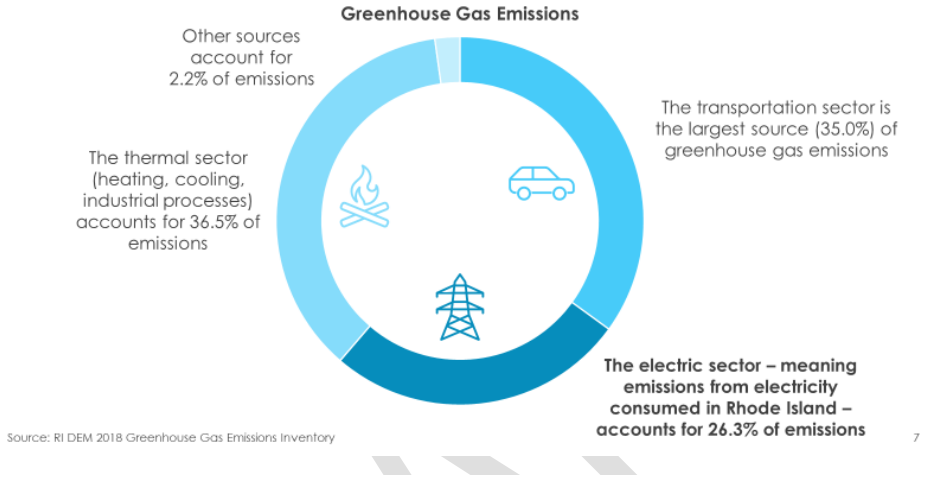
According to the pre-session survey, 23% of respondents represented state government, 23% of respondents represented environmental organizations, and 15% represented industry. While all respondents considered themselves at least familiar with what greenhouse gases are, 8% of respondents reported not being at all familiar with what causes greenhouse gas emissions in the electric sector.

The majority of respondents learned about these sharing sessions from an EC4 newsletter or email. The demographics of respondents skewed white and non-Hispanic/latinx. While these data should not be interpreted as conclusive trends in participation, they do suggest likely underrepresentation of several communities across Rhode Island, including indigenous communities and people of color.

Dr. Gill prefaced the facilitated discussion with some background information to ensure attendees all had a base understanding. She reviewed the overall methodology for estimating emissions from Rhode Island's electric sector, including examples of estimated emissions from Rhode Island's 2018 Greenhouse

Gas Emissions Inventory and illustrating how emissions may change if Rhode Island were to enact a 100% Renewable Energy Standard (slides below).

Over a Quarter of Total Emissions



Source: RI DEM 2018 Greenhouse Gas Emissions Inventory

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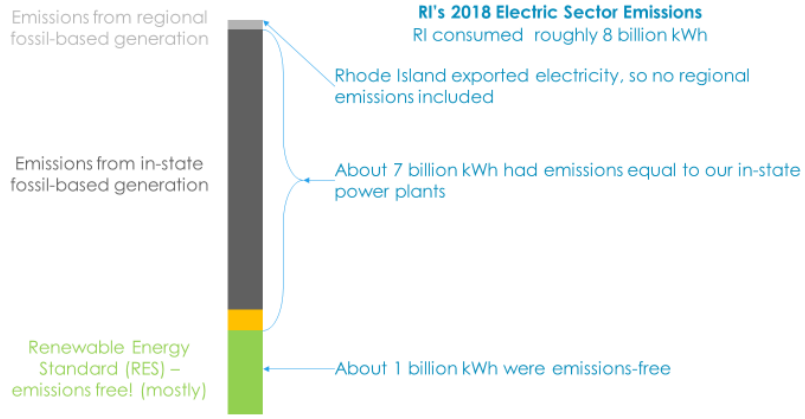
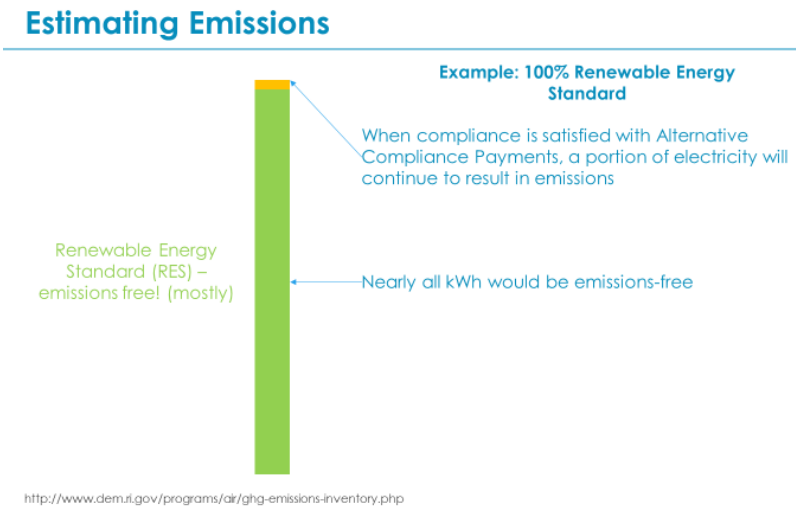
Estimating Emissions



http://www.dem.ri.gov/programs/air/ghg-emissions-inventory.php

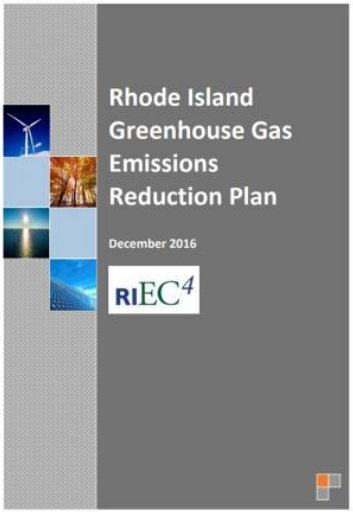


Dr. Gill then reviewed efforts since 2016 in relation to the pathways to decarbonization described in the *2016 Greenhouse Gas Emissions Reduction Plan*. Dr. Gill noted progress on several pathways. In particular, Rhode Island's Least-Cost Procurement statute, which authorizes energy efficiency programs, was extended through 2028 in 2021; appliance and equipment energy and water efficiency standards were expanded and strengthened in 2021; the 2020 report *The Road to 100% Renewable Electricity by 2030 in Rhode Island* weighs costs and benefits of pathways to decarbonize the electric sector; and two notable programs, ConnectedSolutions demand response program offered through National Grid and the Solar+Storage Adder Pilot Program offered through the Renewable Energy Fund, both now provide additional financial support to encourage the deployment of energy storage systems.

Pathways from the 2016 Plan

- **Energy Efficiency**
  - ✓ Extend energy efficiency programs
  - ✓ Update appliance standards
  - Energy disclosure and labeling
- **Clean Energy**
  - ✓ Weigh costs and benefits of comparative pathways
- **Energy Storage**
  - ✓ Policies and programs to promote energy storage
- **Other Pathways – See 'Since 2016' for more info**
  - Grow Clean Economy Jobs
  - Empower Citizens and Communities
  - Foster a More Dynamic Regulatory Model
  - Regional Greenhouse Gas Initiative (RGGI)
  - Other Regional Work

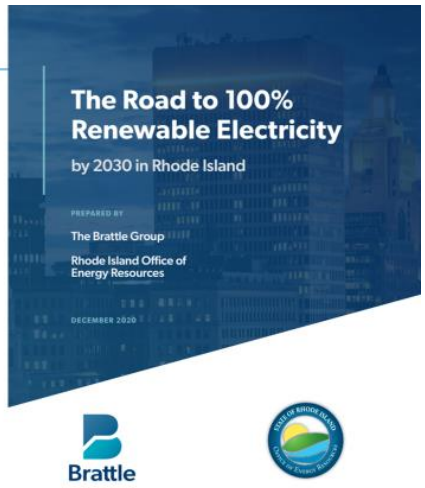
http://climatechange.ri.gov/aoc/index.php#working-draft



Dr. Gill then highlighted select key studies conducted since 2016 that relate to decarbonizing the electric sector. Dr. Gill focused on still-relevant recommendations from the 2020 study *The Road to 100% Renewable Electricity by 2030 in Rhode Island*, which provided 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 (slides below).

Select Key Studies

- **100% Renewable Electricity by 2030 ← Today's focus**
- Solar Siting Opportunities
- Power Sector Transformation
- Docket 4600: Investigation into the Changing Electric Distribution System
- Energy Efficiency 2021-2026 Market Potential Study
- Others



http://climatechange.ri.gov/aoc/index.php#working-draft

Policy and Programmatic Recommendations

Study insights inform three categories of recommendations:

Policy

Recommendations for defining, achieving, and procuring 100% renewable electricity.

Planning & Enabling

Recommendations on ways to reduce risk, increase flexibility, and optimize renewable energy integration.

Equity

Recommendations on ways to foster equitable outcomes developed in partnership with frontline communities.

Policy Recommendations

Policy is needed to establish a strong, statewide framework and reach our goals in ways that align with our foundational principles.

We must ensure we meet our clean energy goals by advancing a **100% Renewable Energy Standard.**

Continued efforts to decrease energy consumption necessitate extension of **Least-Cost Procurement and Nation-Leading Energy Efficiency Programs.**

Maintaining continued support for in-state development, while supporting **programmatic evolution** to deliver more affordable and sustainable outcomes.

Planning and Enabling Recommendations

We need to advance innovative, integrated, and collaborative **planning** to **enable** interconnection of clean energy onto the grid while minimizing costs and optimizing land use.

Optimize the electric grid through collborative, **integrated grid planning**.

Facilitate integration of distributed energy resources by advancing **Power Sector Transformation** and **Grid Modernization**.

Build out a strategic role for **energy storage** technologies.

Continue **regional collaboration** on wholesale markets and interstate transmission.

http://www.energy.ri.gov/100percent/ 19

Equity Recommendations

We must center **equity** and include community engagement in program design to improve access to clean energy benefits for all Rhode Islanders. Throughout this effort, we will identify and address systemic racism and historic inequities.

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 commuities through rate design, program adjustments, and policy.

http://www.energy.ri.gov/100percent/ 20

The scope of the facilitated discussion was limited to priority actions needed over the next 1-3 years within the electric sector to set Rhode Island on the path to meeting its 2030 emissions reduction mandate. Attendees were instructed that actions related to strategic electrification of transportation and thermal technologies should be reserved for those upcoming sharing sessions in May and June, respectively. Attendees were also given an example framework with which to consider type of actions: actions that directly ensure we decarbonize, actions that enable us to decarbonize, and policy

considerations that allow us to refine our actions. The slide below summarizes scope and this example framework:

Scope

- Actions required over next 1-3 years
- Limited to reducing emissions from the electric sector
- Consider 2030 Mandate (45% emissions reduction)

- Some principles to consider
  - Prioritize low-hanging fruit – biggest impact with lowest cost
  - Prioritize actions we can control
  - Prioritize actions that balance and advance multiple policy objectives, like affordability, reliability, equity
  - Others?

- **Types of actions**

Ensure decarbonization
(ex: Renewable Energy Standard)

Enable decarbonization
(ex: grid modernization, energy storage, regional collaboration)

Refining our actions
(ex: energy efficiency, evolving renewable energy programs, centering equity)

The following three slides include notes taken in real-time based on attendee discussion over the three sharing sessions. Themes are summarized afterwards:

Priority Actions – 4/19

Ensure decarbonization

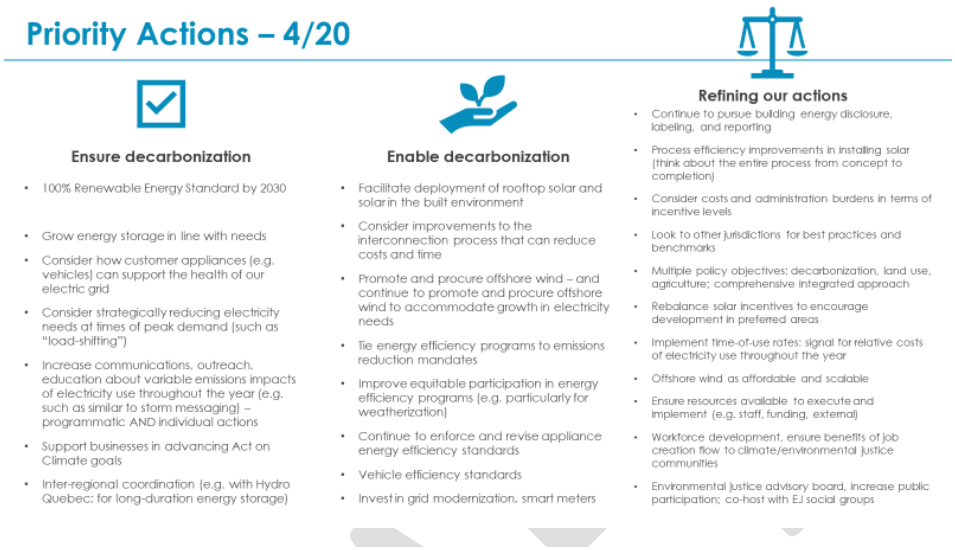
- Pass/advocate for 100% Renewable Energy Standard
- Renewable energy cluster; climate/energy cluster at CommerceRI
- Public and stakeholder collaboration to understand perspectives and inform how to achieve climate mandates
- Energy efficiency – see recommendations from 100% renewable electricity by 2030 report: how can we align energy efficiency programs with climate mandates
- Improve visibility and control of the electric grid; enable smart investments in renewable and EVSE investment

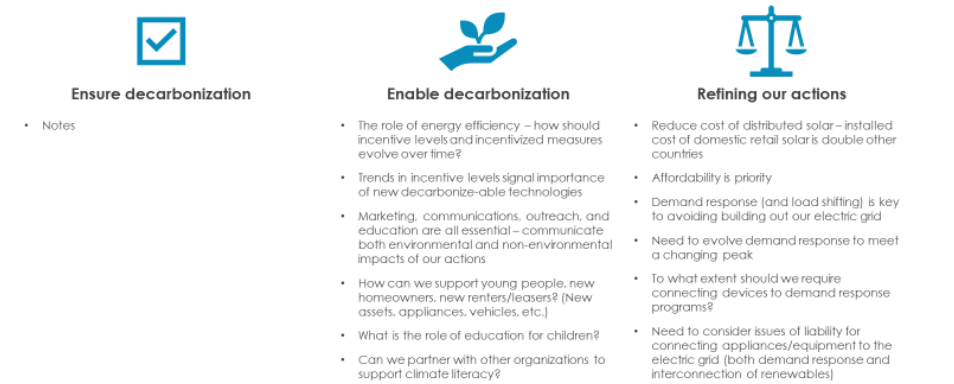
Enable decarbonization

- Encourage solar carport development (brings clean energy and reduces heat island effect)
- Prioritize development of renewable energy in priority areas (e.g. incentivize solar on rooftops)
- Allow for sizing rooftop solar to generate more electricity than consumed
- Allow for sharing solar between neighbors
- Energy storage solutions: How much do we need? What types do we need? Where do we need these resources? How do these needs change as we increase renewables? = Systematic Planning
- Improve accessibility and transparency in regulatory processes, utility procurements, etc.

Refining our actions

- Discourage tree cutting, such as by: incentivizing development in locations that are already cleared (incentives may include financial incentives, programs, etc.)
- Refine energy efficiency programs and measures to improve equity, reduce energy burden, deliver additional benefits; analysis to determine the extent to which energy efficiency programs are serving those who need it most
- Importance of weatherization
- Remove 'silos' of energy efficiency programming to optimize energy delivery and energy efficiency delivery
- Opportunity to broaden perspectives





One clear priority action to ensure Rhode Island's electric sector is decarbonized is to pass a 100% Renewable Electricity Standard. In order to enable decarbonized energy generation systems to come online, attendees recommended bolstering energy efficiency and demand response programs, encouraging renewable energy development in preferred locations, conducting education and outreach, continuing to revise and strengthen appliance efficiency standards and building codes, enacting building energy disclosure and labeling, leading by example, modernizing the electric grid, and deploying of smart meters.

Attendees suggested refining actions based on principles of improving affordability, improving equitable access to programs and public participation in program and policy design, balancing land use priorities, and ensuring equitable investments in communities. These principles may be achieved through actions like examining and building relationships between customers and utilities, programmatic and process evolution, building community and organizational partnerships, regional collaboration, workforce development, interagency coordination, and systematic planning for energy storage.

Of the three responses to the post-session survey, all three respondents indicated their questions were answered sufficiently, the sharing sessions were moderately or very helpful, and there was sufficient opportunity to share their thoughts.