R. I. Greenhouse Gas Process

Rhode Island
Greenhouse Gas Action Plan

Final Phase I Report
Appendices

Developed by
The Rhode Island Greenhouse Gas Stakeholder Process

Convened by
Rhode Island Department of Environmental Management
Rhode Island State Energy Office

Project Manager/Facilitator
Raab Associates, Ltd.

Technical/Policy Consultant
Tellus Institute

July 15, 2002

Appendix A:
Rhode Island Greenhouse Gas Process
Final Ground Rules
As amended 3/22/02

Stakeholder Group:

Membership

1. Each member organization of the Stakeholder Group will designate a lead representative, and, at their discretion, an alternate or alternates.

2. Only the lead representative, or the alternate in the case of the representative's absence, will participate in formal decision-making.

3. The Stakeholder Group meetings are public meetings open to anyone interested in attending.

4. Stakeholder Group members can participate in all discussions and deliberations. Other members of the public who are not from Stakeholder Group member organizations will also be given a chance to express their opinions and make suggestions at appropriate junctures, as determined by the Stakeholder Group and the facilitator.

Members' Roles and Responsibilities

5. Stakeholder Group members will make every attempt to attend all Stakeholder Group meetings, to be on-time, and to review all documents disseminated prior to the meeting. Members who can not make a meeting should let the Facilitator know prior to the meeting (by voice or e-mail).

6. Stakeholder Group members will be expected to participate in good faith negotiations including being truthful and communicative. Members also agree to act respectfully toward each other.

7. It is the responsibility of the Stakeholder Group members to keep their organizations and constituencies up to speed on developments in the Stakeholder Group process.

8. Stakeholder Group members will not speak on behalf of the Stakeholder Group or its members without the Stakeholder Group's permission.

9. Stakeholder Group members may confer with each other and with the Facilitator in between meetings.

Decisionmaking

10. The goal of the process will be to make major substantive decisions by consensus of the Stakeholder representatives (excluding ex officio representation), where consensus shall mean that everyone is at least willing to live with a decision and chooses not to dissent. If unable to consent, a representative will be expected to explain why and to try and offer a positive alternative. Representatives are responsible for voicing their objections and concerns, and silence or absence will be considered consent.

11. The Group's Report at the end of the Phase I and Final Report at the end of Phase II will include all areas of consensus, and a description of the alternative approaches preferred by Group members in areas where consensus was not reached, if any. For non-consensus issues, the Stakeholder Group members supporting each alternative approach will be listed under each alternative.

12. Stakeholder Group members will be listed in the Reports (with actual signatures--time and logistics permitting) along with their organizational affiliations. Members should seek the endorsement of each Report from their respective organizations.

Working Groups:

Membership

13. Working Group representatives can be members of the Stakeholder Group, others from Stakeholder organizations, or individuals nominated by Stakeholder representatives. Working Group membership is subject to approval by the Stakeholder Group.

14. The Working Group meetings are public meetings open to anyone interested in attending.

15. Working Group members can participate in all discussions and deliberations. Other members of the public will also be given a chance to express their opinions and make suggestions at appropriate junctures, as determined by the Working Group and the facilitator.

Members' Roles and Responsibilities

16. Working Group members will make every attempt to attend all workgroup meetings, to be on time, and to review all documents disseminated prior to the meeting. Members who can not make a meeting should let the Facilitator know prior to the meeting (by voice or e-mail).

17. Working Group members will be expected to participate in good faith negotiations

including being truthful and communicative. Members also agree to act respectfully toward each other.

18. It is the responsibility of the Working Group members to keep their organizations and constituencies up to speed on developments in the Working Group process.

19. Working Group members will not speak on behalf of the Working Group or its members without the Working Groups' permission.

20. Working Group members may confer with each other and with the Facilitator in between meetings

.

Decisionmaking

21. The goal of the Working Groups is to analyze options with the assistance of the Technical Consultants and Facilitator in a collaborative fashion, and prepare recommendations for the Stakeholder Group's consideration.

22. Each Working Group's recommendations to the Stakeholder Group will include all areas of consensus, and a description of the alternative options or approaches preferred by Group members in areas where consensus was not reached, if any. Consensus shall mean that everyone is at least willing to live with a decision and chooses not to dissent. Representatives are responsible for voicing their objections and concerns, and silence or absence will be considered consent.

Facilitator's and Consultant's Roles and Responsibilities

23. Facilitator will facilitate all meetings of the Stakeholder Group and the Working Groups.

23. The Facilitator will draft all agendas and meeting summaries and distribute to Stakeholders in a timely fashion. Facilitator will also distribute documents prepared by Consultants. All documents will be distributed once via email, and will then be available on a web site maintained by the Facilitator for the duration of the process.

24. Consultants will prepare all memos, documents, modeling runs, and reports in a timely manner and for distribution by the Facilitator prior to meetings.

25. Facilitator will act in a non-partisan manner, and will treat confidential discussions with parties confidentially.

Appendix B:
New England/Eastern Canada Regional GHG Reduction Target

"While there is a recognition that emissions of greenhouse gases are a global problem that ultimately require a global solution, New England states and Eastern Canadian provinces are well positioned to play a leadership role in addressing the issue of climate change. Therefore, our region is establishing a short-term goal to demonstrate its commitment for action over the next decade.

There are a number of precedents that illustrate that a clearly articulated, ambitious policy goal is necessary to spur advancement in relevant technologies. The intent is for the mid-term goal to signal a promising future for energy-efficient and greenhouse gas reducing technologies, and to encourage the growth of related industries in the region. Furthermore, the region will undertake a planning process every five years, beginning in 2005, to ensure that the mid-term reduction target is as aggressive as possible for the year 2015, ten years ahead. This review will be based on findings of new efficiency technologies, changes in the resources available and estimated economic and energy impacts.

The ultimate goal mirrors that of the United Nations Framework Convention on Climate Change, to which both the United States and Canada are signatories. Over the long term, anthropogenic GHG emissions must be reduced to levels that no longer pose a dangerous threat to the climate. The best science available at present indicates that attaining this goal will require reductions in GHG emissions of approximately 75–85% below current levels. The long-term goal will be modified as the understanding of climate science advances.

It is important to note that the goals and results outlined in this plan are for the New England and Eastern Canada region in aggregate and may not be achieved in equal measure by each jurisdiction. It is recognized that differences in emissions characteristics and inventories, social and political systems, economic profiles (including transportation/utility/industrial infrastructures), and resources will lead to varying approaches among the jurisdictions in contributing to the regional goals. However, each jurisdiction in the region commits to participate in the achievement of the regional goals and work with the other states and provinces in the region on this important effort.

Short-term Goal: Reduce regional GHG emissions to 1990 emissions by 2010.

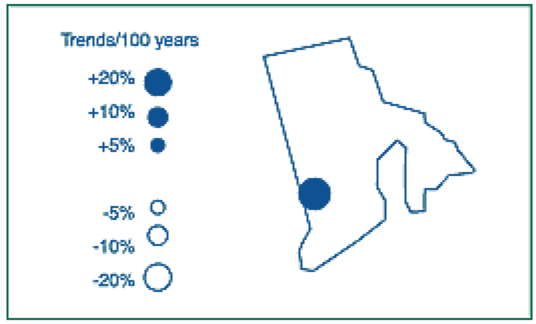
Mid-term Goal: Reduce regional GHG emissions by at least 10% below 1990 emissions by 2020, and establish an iterative five-year process, commencing in 2005, to adjust the goals if necessary and set future emissions reduction goals.

Long-term Goal: Reduce regional GHG emissions sufficiently to eliminate any dangerous threat to the climate; current science suggests this will require reductions of 75–85% below current levels."

New England Governors/Eastern Canadian Premiers,* Climate Change Action Plan*, August 2001, pp.6-7

Appendix C:
EPA Report: Climate Change and Rhode Island

Local Climate Changes



Source: Karl et al. (1996)

Over the last century, the average temperature in Providence, Rhode Island, has increased 3.3°F, and precipitation has increased by up to 20% in many parts of the state. These past trends may or may not continue into the future.

Over the next century, Rhode Island's climate may change even more. For example, based on projections made by the Intergovernmental Panel on Climate Change and results from the United Kingdom Hadley Centre climate model (HadCM2), a model that accounts for both greenhouse gases and aerosols, by 2100 temperatures in Rhode Island could increase by 4°F (with a range of 1-8°F) in winter and spring and by 5°F (with a range of 2-10°F) in summer and fall. Precipitation is projected to increase by 10% in spring and summer (with a range of 5-15%), 15% in fall (with a range of 5-30%), and 25% in winter (with a range of 10-50%). Other climate models may show different results, especially regarding estimated changes in precipitation. The impacts described in the sections that follow take into account estimates from different models. The amount of precipitation on extreme wet or snowy days in winter is likely to increase. The frequency of extreme hot days in summer would increase because of the general warming trend. Although it is not clear how the severity of storms such as hurricanes might be affected, an increase in the frequency and intensity of winter storms is possible.

Human Health

Higher temperatures and increased frequency of heat waves may increase the number of heat-related deaths and the incidence of heat-related illnesses. Rhode Island, with its irregular, intense heat waves, could be susceptible. One study projects that a warming of 3-4°F could increase heat-related deaths during a typical summer in Providence by 50% from the current 50 to near 75 (although increased air conditioning use may not have been fully accounted for). This study also shows that winter-related deaths in Providence could rise by 25% given a 2°F warming. However, the exact reasons for this increase are unknown. The elderly, especially those living alone, are at greatest risk.

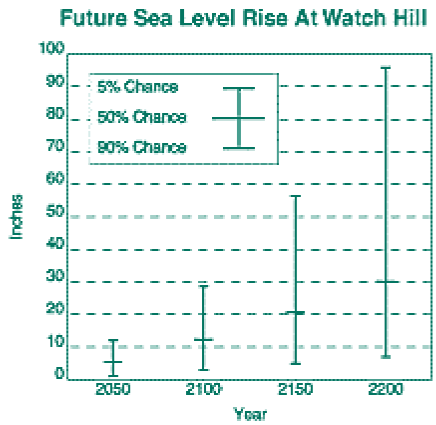
Climate change could increase concentrations of ground-level ozone. For example, high temperatures, strong sunlight, and stable air masses tend to increase urban ozone levels. Based on projections for New York City, a 4°F warming could increase concentrations of ozone, a major component of smog, by 4%. Currently, ground-level concentrations exceed the national ozone health standard throughout the state. All of Rhode Island is classified as a serious nonattainment area for ozone. Ground-level ozone is associated with respiratory illnesses such as asthma, reduced lung function, and respiratory inflammation. Air pollution also is made worse by increases in natural hydrocarbon emissions such as emissions of terpenes by trees and shrubs during hot weather. If a warmed climate causes increased use of air conditioners, air pollutant emissions from power plants also will increase.

Warmer temperatures could increase the incidence of Lyme disease and other tick-borne diseases in Rhode Island, because populations of ticks, and their rodent hosts, could increase under warmer temperatures and increased vegetation. Respiratory and eye allergies increase in warm, humid conditions.

Warmer winters, warmer temperatures, and heavy precipitation also can increase harmful algal blooms, that is, red tides; reduce water quality; and increase outbreaks of cryptosporidiosis and giardia. In addition, warmer seas could contribute to the intensity, duration, and extent of harmful algal blooms in the coastal waters of Rhode Island. These blooms damage habitat and shellfish nurseries and can be toxic to humans. Developed countries such as the United States should be able to minimize the impacts of these diseases through existing disease prevention and control methods.

Coastal Areas

Sea level rise could lead to flooding of low-lying property, loss of coastal wetlands, erosion of beaches, saltwater contamination of drinking water, and decreased longevity of low-lying roads, causeways, and bridges. In addition, sea level rise could increase the vulnerability of coastal areas to storms and associated flooding.



Source: EPA (1995)

Rhode Island is endowed with over 400 miles of densely populated, tidally influenced shoreline, consisting of both sandy and gravel barrier beaches, and rocky cliffs. Block Island and Narragansett Bay contain relatively undisturbed salt marshes, tidal flats, rocky shores, and small islands. The beaches along the Rhode Island coast are highly developed and heavily used by hundreds of thousands residents and out-of-state visitors each year. These beaches have suffered severe damage during hurricanes and storm surges. In general, erosion is most severe at the barrier beaches on the south shore of Rhode Island and bluff areas on Block Island; these areas are likely to erode most if sea level rises. The northern shore of Narragansett Bay, including Cranston, Providence, and Pawtucket, is heavily armored with seawalls and other erosion control devices.

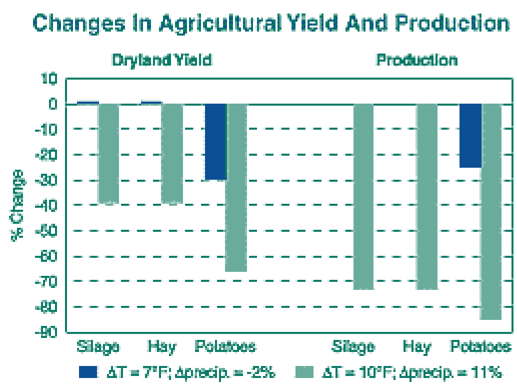
At Watch Hill, sea level already is rising by 2 inches per century, and it is likely to rise another 12.4 inches by 2100. Possible responses to sea level rise include building walls to hold back the sea, allowing the sea to advance and adapting to it, and raising the land (e.g., by replenishing beach sand, elevating houses and infrastructure). Each of these responses will be costly, either in out-of-pocket costs or in lost land and structures. For example, the cumulative cost of sand replenishment to protect Rhode Island's coastline from a 20-inch sea level rise by 2100 is estimated at $90-$530 million. However, sand replenishment may not be cost-effective for all coastal areas in the state and, therefore, some savings could be possible.

Water Resources

The principal rivers in Rhode Island are the Blackstone, the Pawtuxet, and the Pawcatuch, which drain toward Narragansett Bay and Block Island Sound. Water resources in Rhode Island are currently abundant and well developed. Most of the freshwater used in the state comes from reservoirs, lakes, and rivers. Sciture Reservoir, in southern Providence County, serves nearly one-half of the state's population. Winter snow accumulation and spring snowmelt strongly affect the state's rivers. A warmer climate would lead to an earlier snowmelt, resulting in higher streamflows in winter and spring. Without increases in precipitation, higher temperatures and increased evaporation would lower streamflows, lake levels, and groundwater levels in the summer and fall. This could aggravate water supply problems, particularly in the southern part of the state, where water demand is highest. Groundwater sources, recently developed to meet growing demand in the state, also could be reduced by lower spring and summer recharge. Lower summer streamflows and warmer temperatures also could increase water quality problems by concentrating pollutant levels, particularly in parts of rivers where effluent from municipal wastewater treatment facilities and industries is dumped. Increases in rainfall could mitigate these effects. Higher rainfall, however, could contribute to localized flooding, increased levels of pesticides and fertilizers from agricultural runoff, and increased pollution from urban runoff. During periods of high flow, the water quality in northern Narragansett Bay is particularly susceptible to pollution from sewer overflows and stormwater runoff from the highly urbanized area around Providence.

Agriculture

The mix of crop and livestock production in a state is influenced by climatic conditions and water availability. As climate warms, production patterns could shift northward. Increases in climate variability could make adaptation by farmers more difficult. Warmer climates and less soil moisture due to increased evaporation may increase the need for irrigation. However, these same conditions could decrease water supplies, which also may be needed by natural ecosystems, urban populations, industry, and other users.



Sources: Mendelsohn and Neumann (in press); McCarl (personal communication)

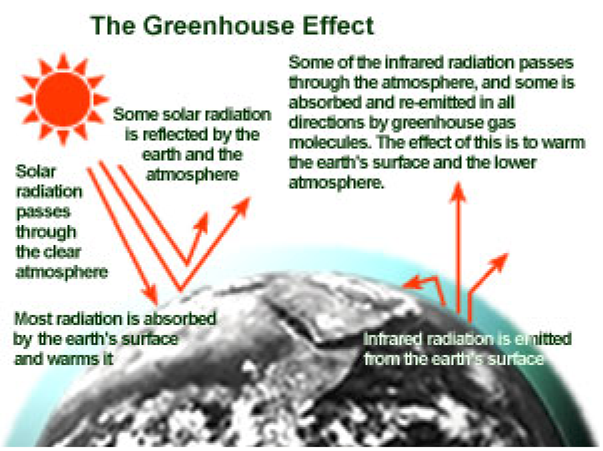
Understandably, most studies have not fully accounted for changes in climate variability, water availability, crop pests, changes in air pollution such as ozone, and adaptation by farmers to changing climate. Including these factors could change modeling results substantially. Analyses that assume changes in average climate and effective adaptation by farmers suggest that aggregate U.S. food production would not be harmed, although there may be significant regional changes.

In Rhode Island, production agriculture is a $78 million annual industry, three-fourths of which comes from crops. Very few of the farmed acres are irrigated. The major crops in the state are silage, potatoes, and hay. Climate change could reduce potato yields by 30-66%. Silage, hay, and pasture yields could fall as much as 39% as temperatures rise beyond the tolerance level of the crop. Farmed acres may remain constant or could fall by as much as 14%. Estimated changes in yield vary, depending on whether land is irrigated.

Forests

Trees and forests are adapted to specific climate conditions, and as climate warms, forests will change. These changes could include changes in species composition, geographic range, and health and productivity. If conditions also become drier, the current range and density of forests could be reduced and replaced by grasslands and pasture. Even a warmer and wetter climate could lead to changes; trees that are better adapted to these conditions, such as oaks and pines, would thrive. Under these conditions, forests could become more dense. These changes could occur during the lifetimes of today's children, particularly if the change is accelerated by other stresses such as fire, pests, and diseases. Some of these stresses would themselves be worsened by a warmer and drier climate.

Although the extent of forested areas in Rhode Island could change little because of climate change, a warmer climate could change the character of those forests. Maple-dominated hardwood forests could give way to forests dominated by oaks and conifers, species more tolerant of higher temperatures. This change would diminish the brilliant autumn foliage as the contribution of maples declines. Across the state, as much as 30-60% of the hardwood forests could be replaced by warmer-climate forests with a mix of pines and hardwoods.



Ecosystems

The smallest state in the country, Rhode Island is almost entirely a coastal area. Its marshes, estuaries, and salt ponds are critical habitats for waterfowl and other migratory birds, as well as for many terrestrial animals. The many streams and rivers that enter Narragansett Bay provide important spawning habitat for shad, herring, and Atlantic salmon. Barrier reef islands such as Block Island in Narragansett Bay are important as refuges for a number of rare and endangered species, including the grasshopper sparrow, savannah sparrow, northern harrier hawk, and American burying beetle. These islands are also key stopover points for migratory songbirds.

The fragile coastal ecosystems of Rhode Island are particularly susceptible to destruction as sea level rises and barrier reef islands are inundated, and if the frequency and severity of storms increase. Such losses would reduce coastal habitat that supports diverse sea life and migratory waterfowl.

This document is from the EPA’s Climate Change website, which is located at: http://www.epa.gov/globalwarming/impacts/stateimp/rhodeisland/index.html

Appendix D
Rhode Island Greenhouse Gas Baseline Scenario: Summary Figures and Tables

Final Version

Prepared for

The Rhode Island Greenhouse Gas Policy Stakeholder Group

Prepared by

Alison Bailie, Steve Bernow, Rachel Cleetus,

Bill Dougherty, Charlie Heaps and Chella Rajan

Tellus Institute
11 Arlington Street
Boston, MA 02116
Tel: 617-266-540

7/15/2002

Table of Figures

Overview

Tellus Institute developed a Baseline forecast of Rhode Island's GHG emissions for the 2002-2020 period, based largely on projections of the State's energy use, as well as its solid waste and agriculture and forestry practices. The figures that follow show, in order of increasing levels of detail, the 1990-1999 history and Tellus' 1999-2020 Baseline forecast of Rhode Island's GHG emissions. It begins from the most -general information (totals and sectoral splits) and moves towards more specific information (sub-sector and fuel use levels). All historic data and forecast assumptions and results are contained in the Tellus ***LEAP*** model. A description of the LEAP model can be found at (http://www.tellus.org/seib/leap).

GHG Emissions Figures

The thirteen (13) figures display Rhode Island's GHG emissions in relatively aggregate form. Note that in the baseline scenario, the total annual GHG emissions grow by 41 percent between 1990 and 2020.

The first three figures show (1) the total GHG emissions (2) total GHG emissions broken out into methane and forest emissions plus energy related emissions and (3) the total broken out into non-energy, energy supply (electricity and steam production) and energy demand (fossil fuel combustion in buildings, industry and transport).

Figure 4 the emissions baseline, shows each sector that either consumes fossil fuels and emits GHGs, produces energy (electricity and steam) and emits GHGs, or emits GHGs from non-energy sources (solid waste and forests).

Figure 5 shows emissions from the energy related GHG emissions regrouped into the end user sectors – residential, commercial, industry and transport. It includes electricity in the sector totals insofar as they consume electricity. Figure 6 breaks this up further into the fossil fuel and electricity contributions to emissions from each sector's demand.

Figures 7 through 12, give the breakdown for each sector, into its sub-sectoral or end-use contributions – residential end-uses, commercial building types, transportation modes, industrial sub-sectors, electricity generation technologies.

The 13th figure compares the projected baseline forecast to Rhode Island's proportional share of the New England Governors' and Eastern Canadian Premiers' regional greenhouse gas reduction targets. This figure shows that meeting these targets would require a 22% reduction from the projected baseline in 2010 and a 36% reduction by 2020.

Energy End User Projections
Following the thirteen GHG figures, we show five (5) figures (14-18) summarizing the energy demand projections up which modeling of the GHG emissions are based – for Residential (by sub-sector), Commercial (by sub-sector), Industrial (by sub-sector) Transportation (by fuel), and electricity generation (by generation supply type).

These, in turn, are followed by projections of the nitrogen oxides (NO_x), sulphur dioxide (SO_2), volatile organic compounds (VOCs) and fine particulates emissions from Rhode Island's energy use over the study period, also modeled in LEAP. See Figures 19-22.

The Baseline model was developed using the U.S. Department of Energy (DOE) energy-use information for Rhode Island, plus its latest regional energy forecasts. The model takes account of economic, demographic, energy demand and purchase, technology, and energy price information and relationships, based upon DOE's integrated energy supply and demand model (the National Energy Modeling System -- *NEMS*), and economic and demographic conditions and projections and climate data for Rhode Island.

The figures in this appendix are the summary GHG results of the Tellus Baseline forecast analysis. The more detailed energy demand and supply projections upon which these summary results are based, are at http://righg.raabassociates.org/Articles/RI_revised_baseline_study_expanded.doc, along with the methodology description and the detailed structure of the LEAP modeling exercise.

Summary Results

Figure D1: Baseline Greenhouse Gas Emissions for Rhode Island: Total (Carbon Equivalent)

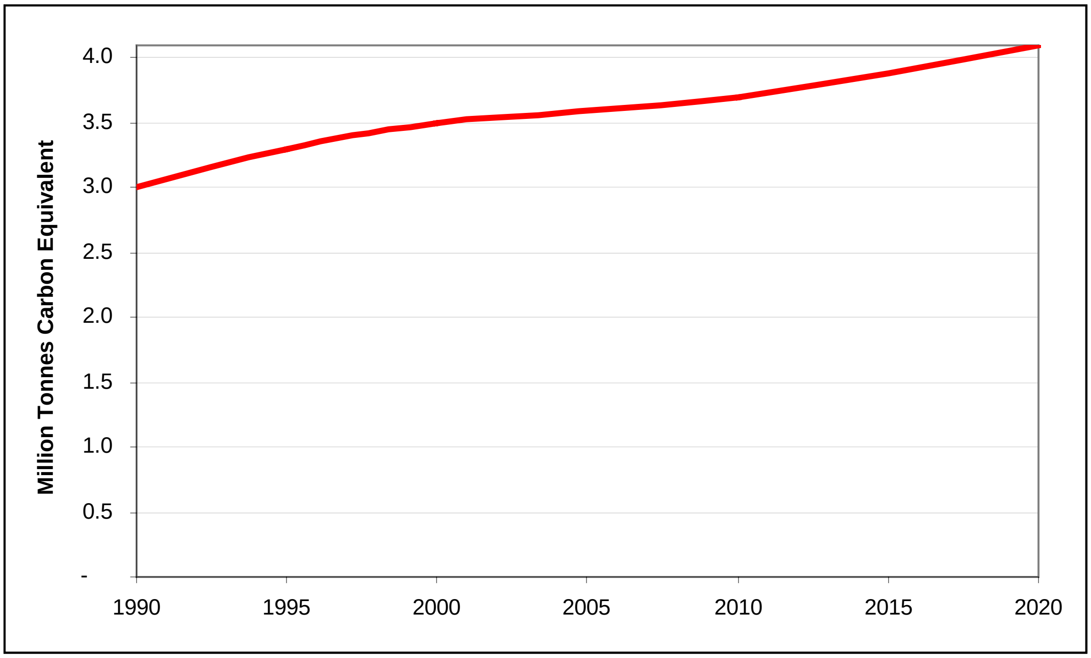


Figure D2: Baseline Greenhouse Gas Emissions for Rhode Island: By Pollutant (Carbon Equivalent)

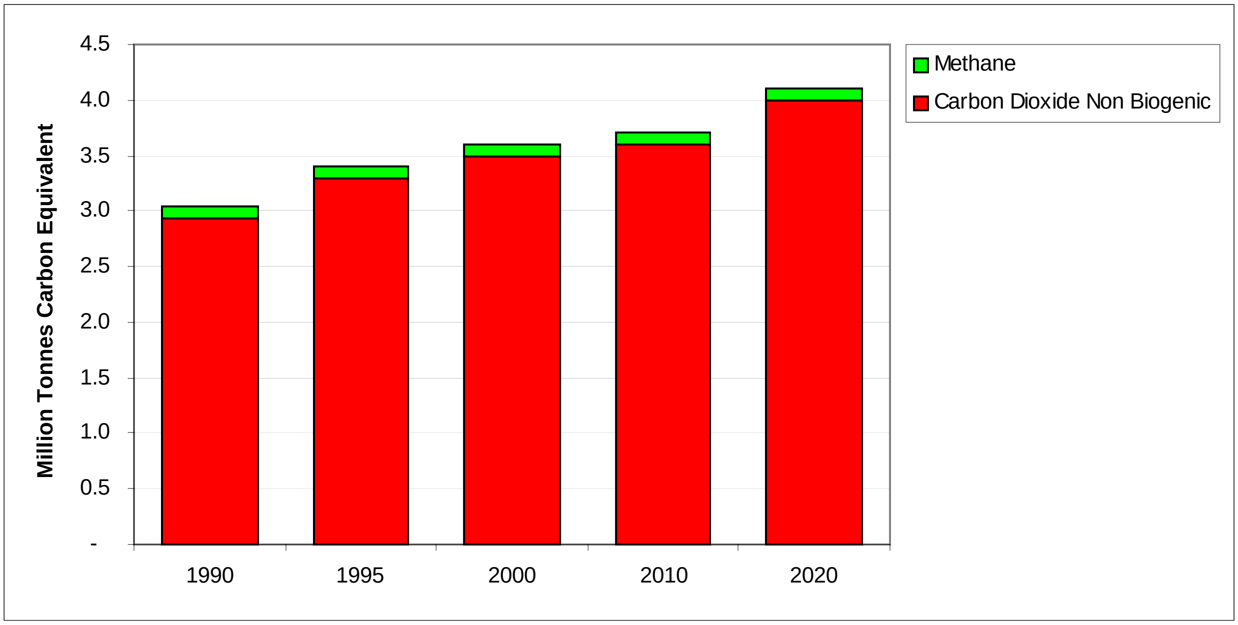
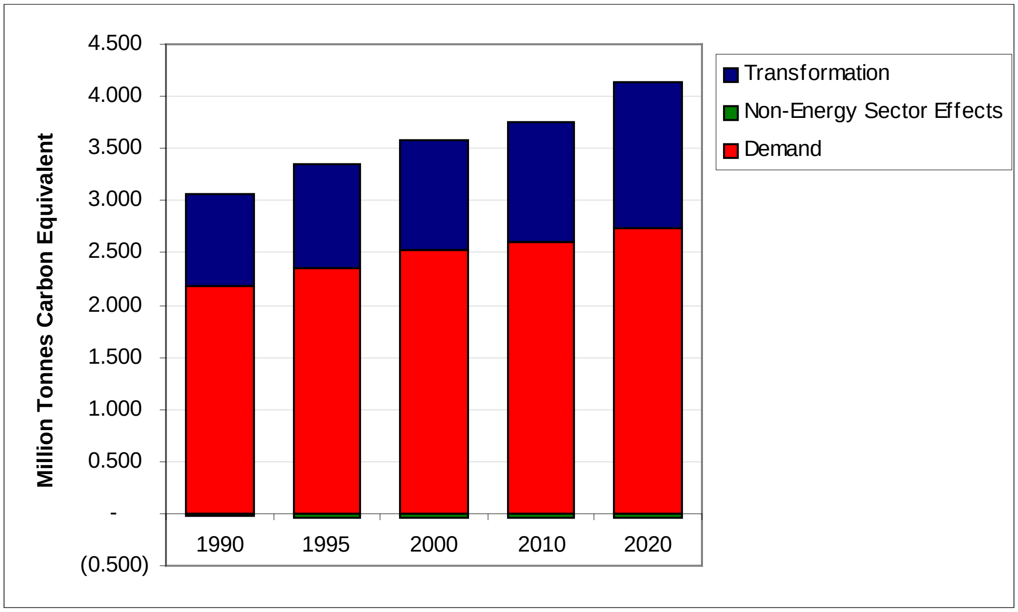


Figure D3: Baseline Greenhouse Gas Emissions by Sector for Rhode Island (Carbon Equivalent)



Notes: The chart shows how total greenhouse gas emissions are likely to continue growing if current trends continue. Emissions from fossil fuel combustion in the energy **demand** sectors (industrial, transport, commercial, and residential) are the largest contributor, followed by emissions from "**Transformation**" (primarily electric generation). **Non-energy sector effects** (e.g., GHG emissions from solid waste, forestry and agriculture) are negligible. NB: all emissions are shown in metric tons of Carbon (C) equivalent. To convert from C to CO_2 multiply by 44/12.

Figure D4: Baseline Greenhouse Gas Emissions by Sector for Rhode Island (Carbon Equivalent)

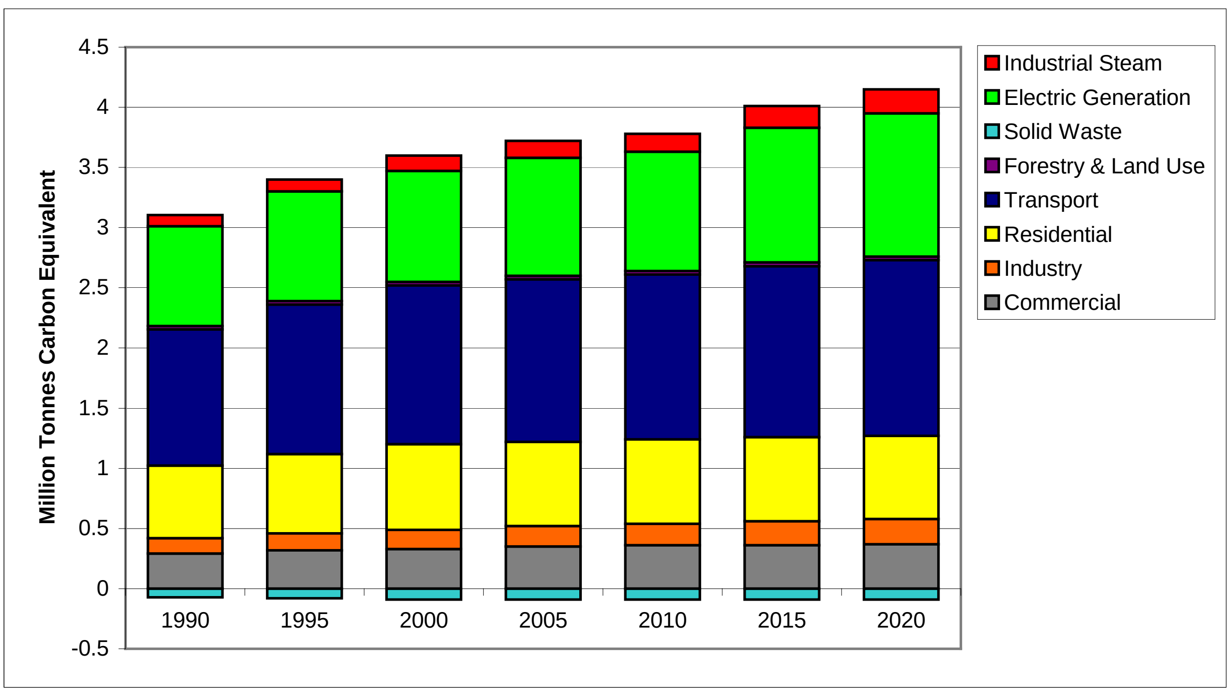
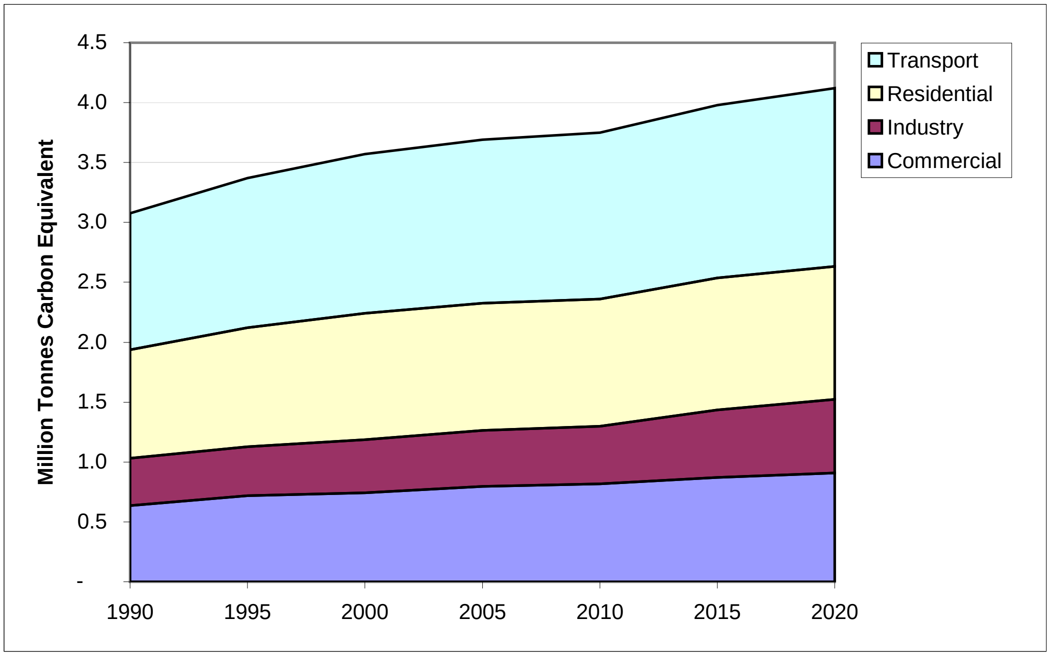


Figure D5: Baseline Energy Sector Greenhouse Gas Emissions by Sector for Rhode Island (Carbon Equivalent)



Notes: This chart shows energy sector emissions with emissions from electric generation allocated among the four tertiary sectors (industry, transport, commerce and residential) based on the electricity consumed in those sectors. Figure 3 below breaks these emissions out to show sectoral emissions from electricity and fossil fuel consumption separately for each sector

Figure D6: Baseline Electric/Fossil Greenhouse Gas Emissions by Sector (Carbon Equivalent)

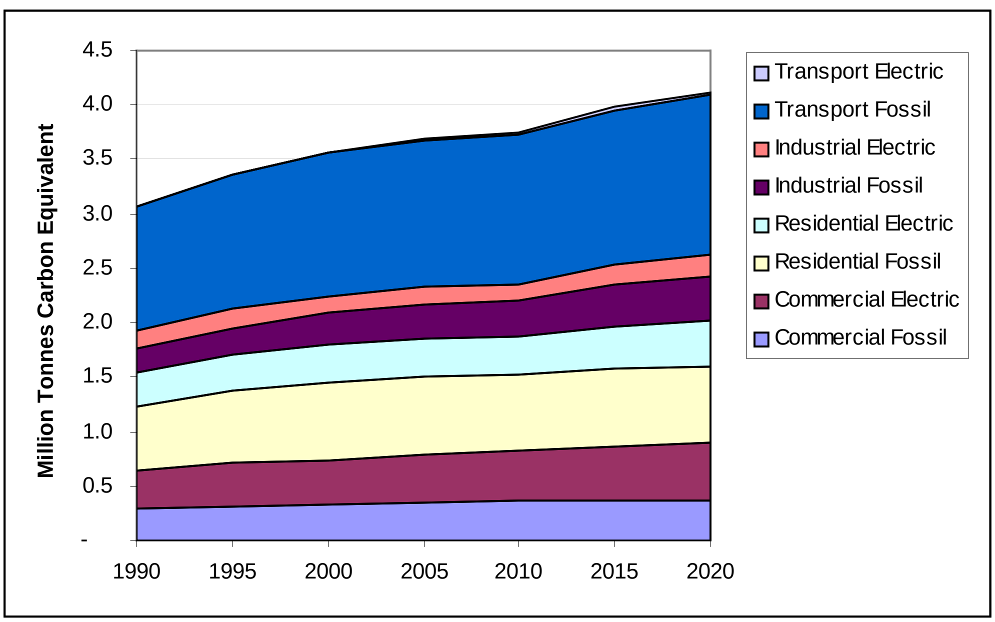


Figure D7: Residential Sector GHG Emissions By End Use (Carbon Equivalent)

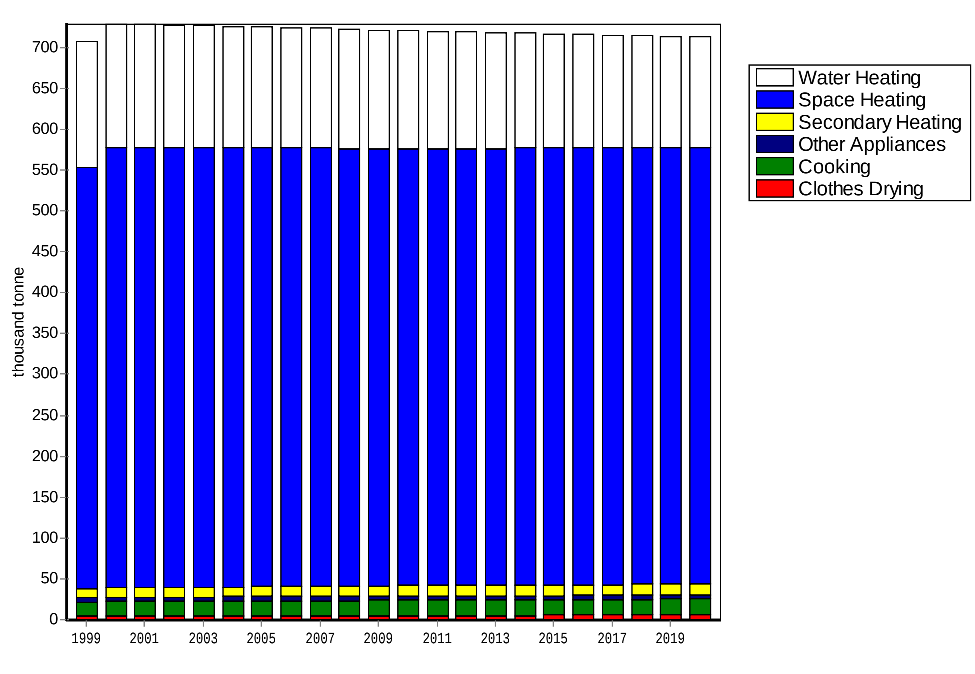


Figure D8: Commercial Sector GHG Emissions By Building Type (Carbon Equivalent)

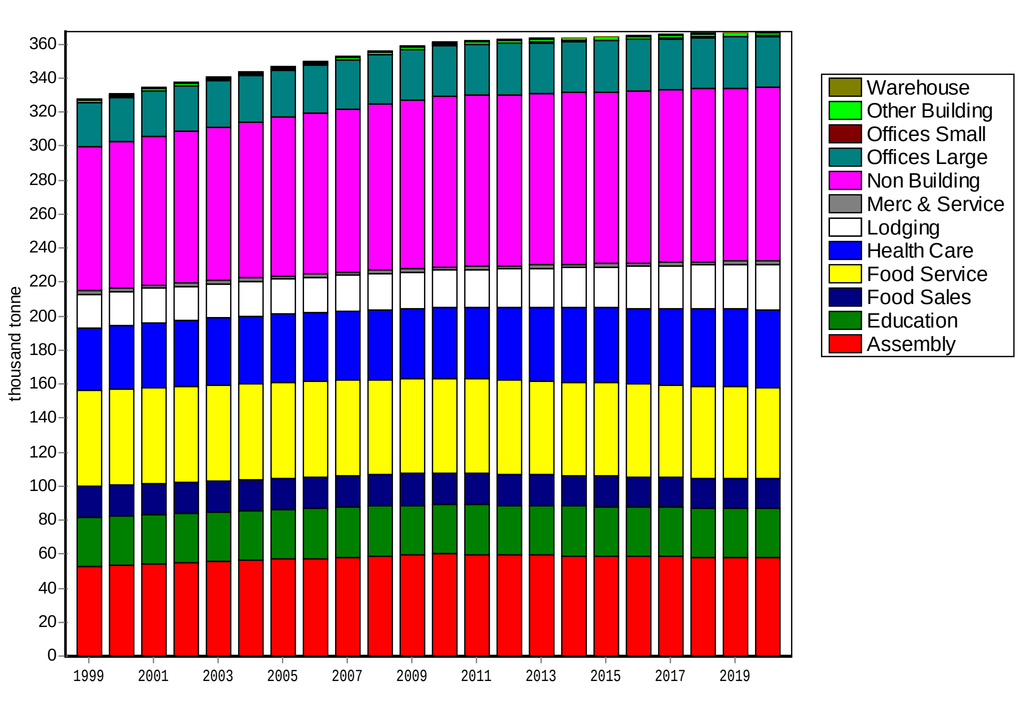


Figure D9: Transport Sector GHG Emissions: Passenger and Freight (Carbon Equivalent)

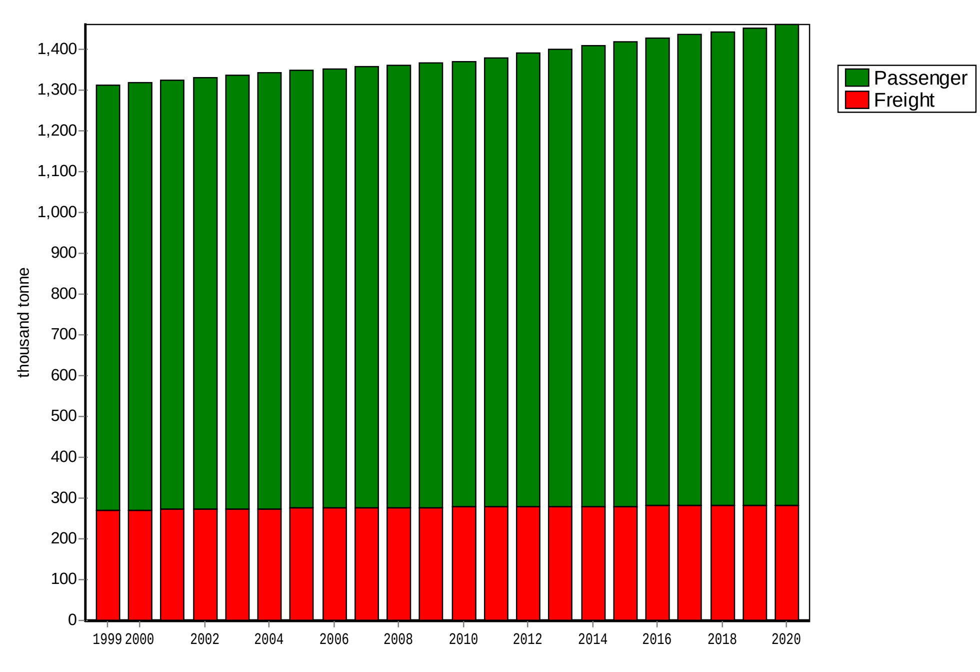


Figure D10: Passenger Transport GHG Emissions by Mode (Carbon Equivalent)

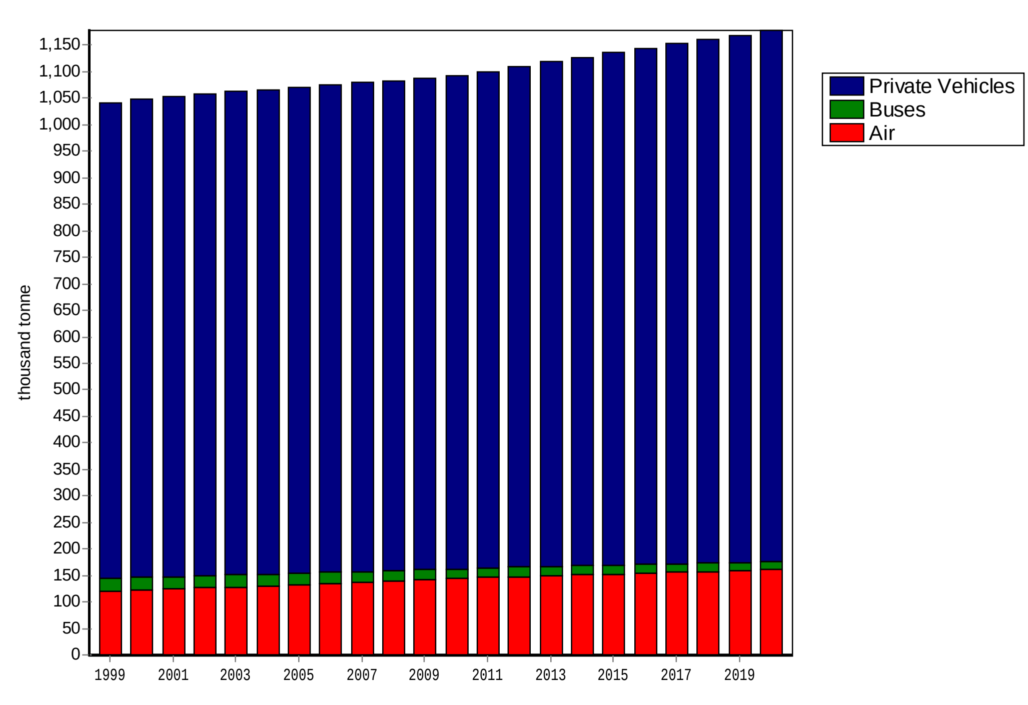


Figure D11: Industrial Sector GHG Emissions by Subsector (Carbon Equivalent)

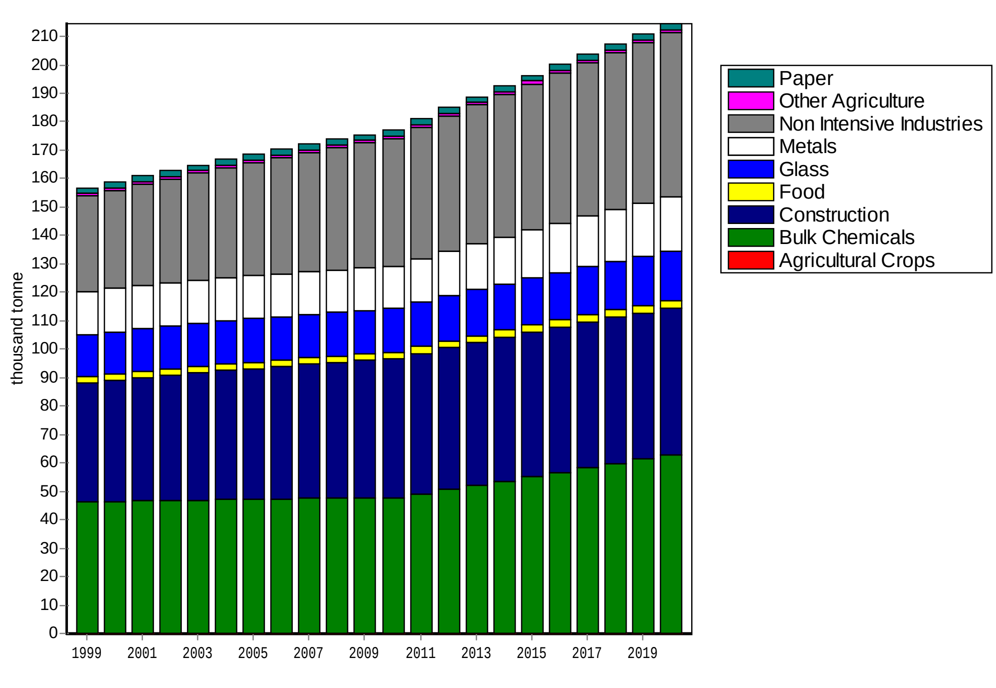


Figure D12: Electric Sector Energy GHG Emissions by Technology (Carbon Equivalent)

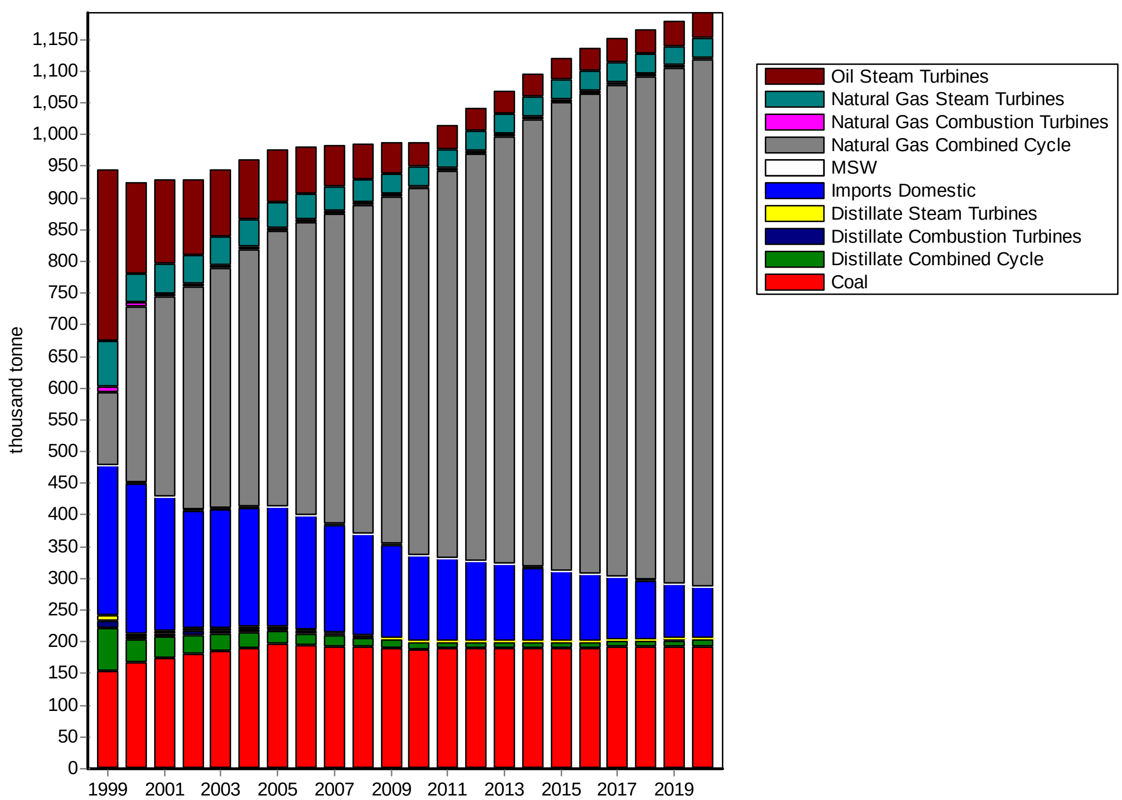
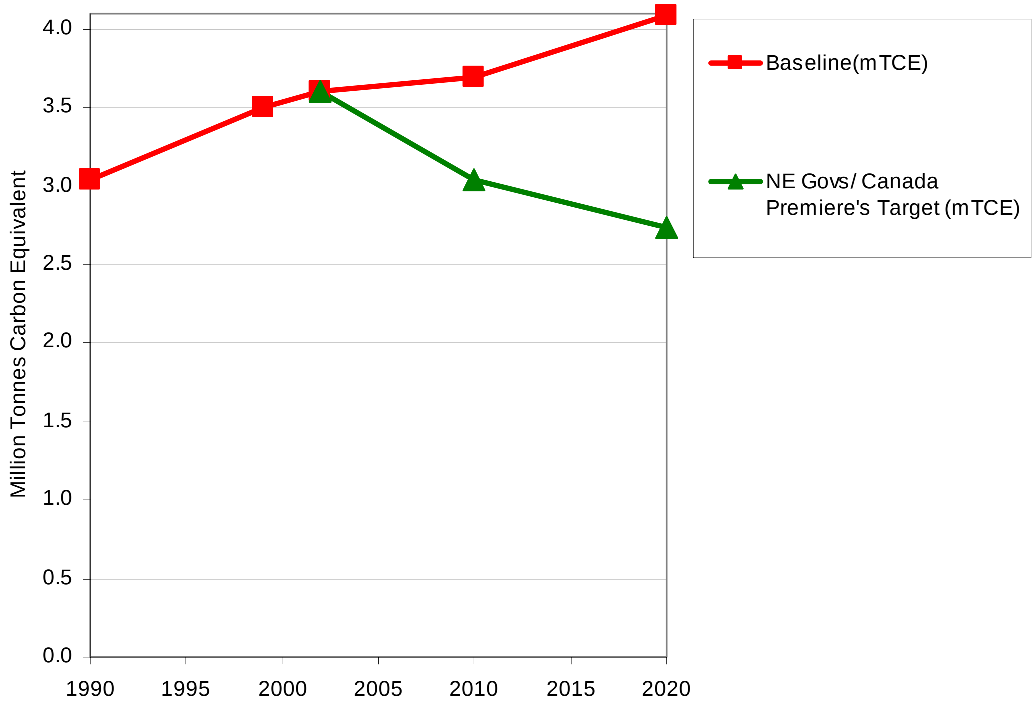


Figure D13: Rhode Island Baseline GHG Emissions Compared to the New England Governors'/ Canadian Premier's Target



	1990	1999	2002	2010	2020
Baseline(mTCE)	3.04	3.50	3.60	3.70	4.10
NE Govs/ Canada Premier's Target (mTCE)			3.60	3.04	2.74
Percent Reduction Required (in year)	-	-	-	18%	33%

Figure D14: Residential Sector Energy Consumption by End-Use (Final Energy Units)

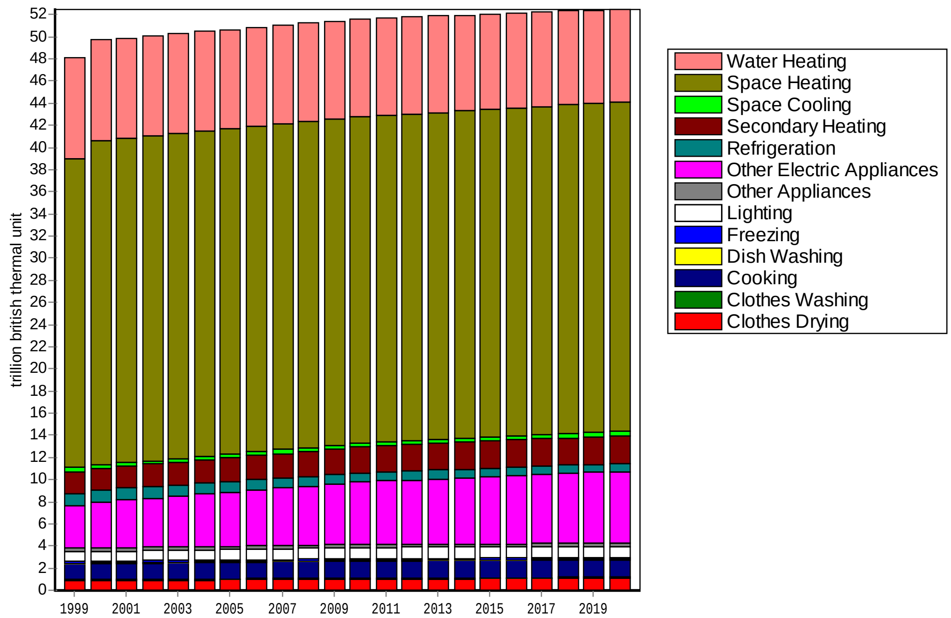


Figure D15: Commercial Sector Energy Consumption by End-Use (Final Energy Units)

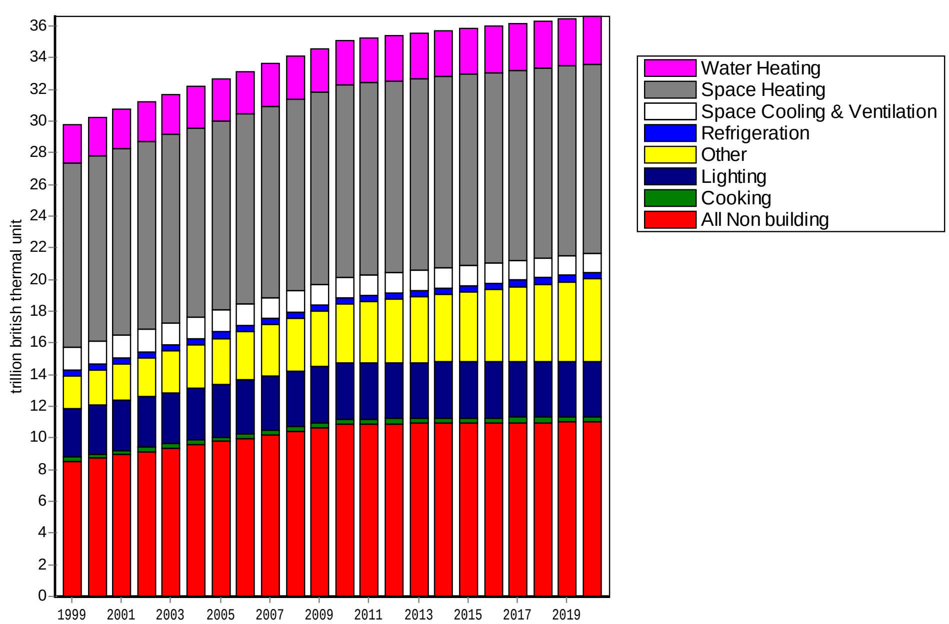


Figure D16: Industrial Sector Energy Consumption by Subsector (Final Energy Units)

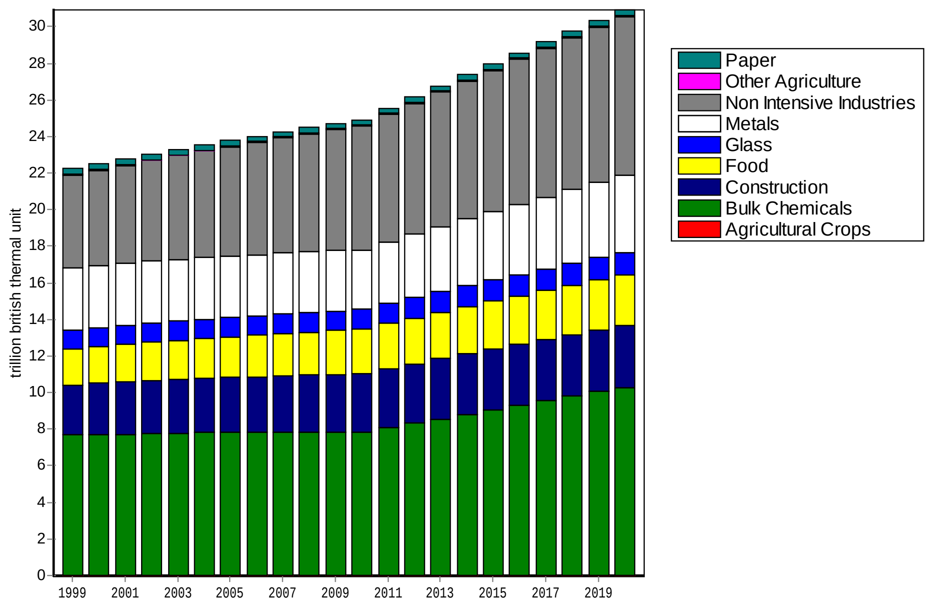


Figure D17: Transport Sector Energy Demand by Fuel

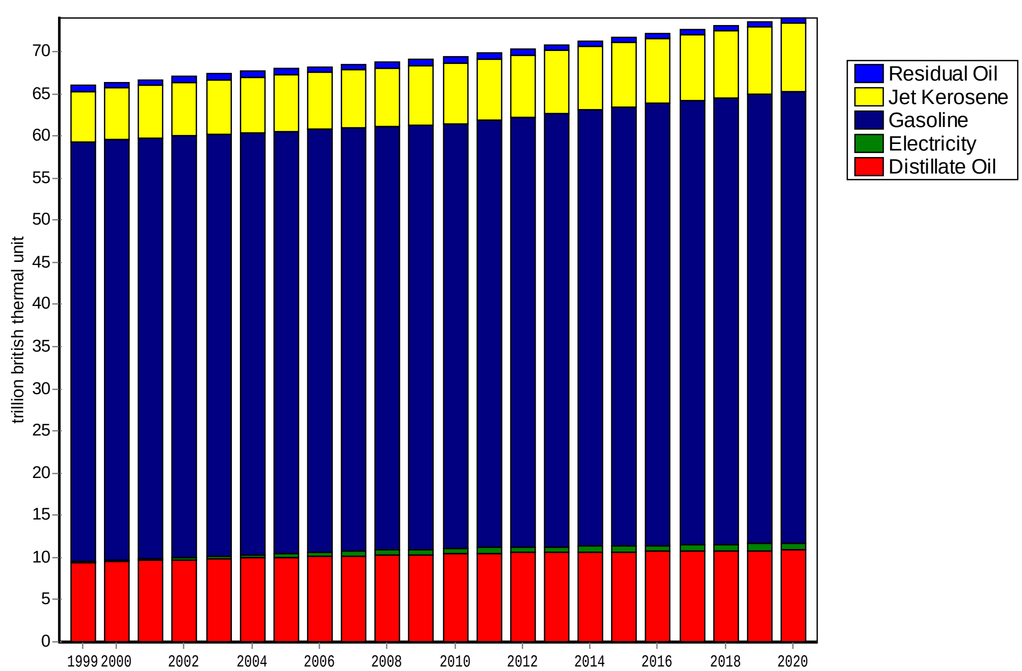


Figure D18: Electric Sector Generation (GWhr)

The generation mix to meet Rhode Island electricity demands is its proportional share of the New England mix.

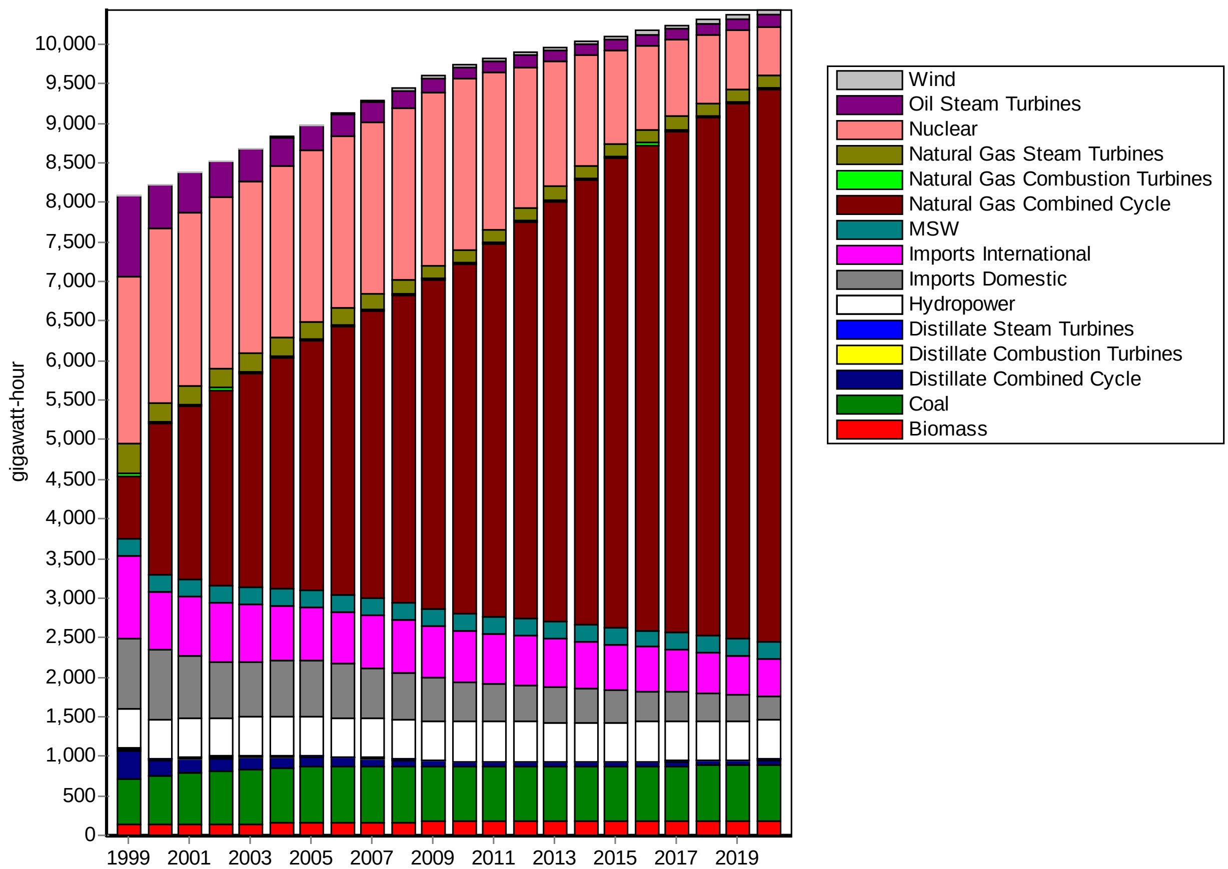


Figure D19: Nitrogen Oxide Emissions by Sector

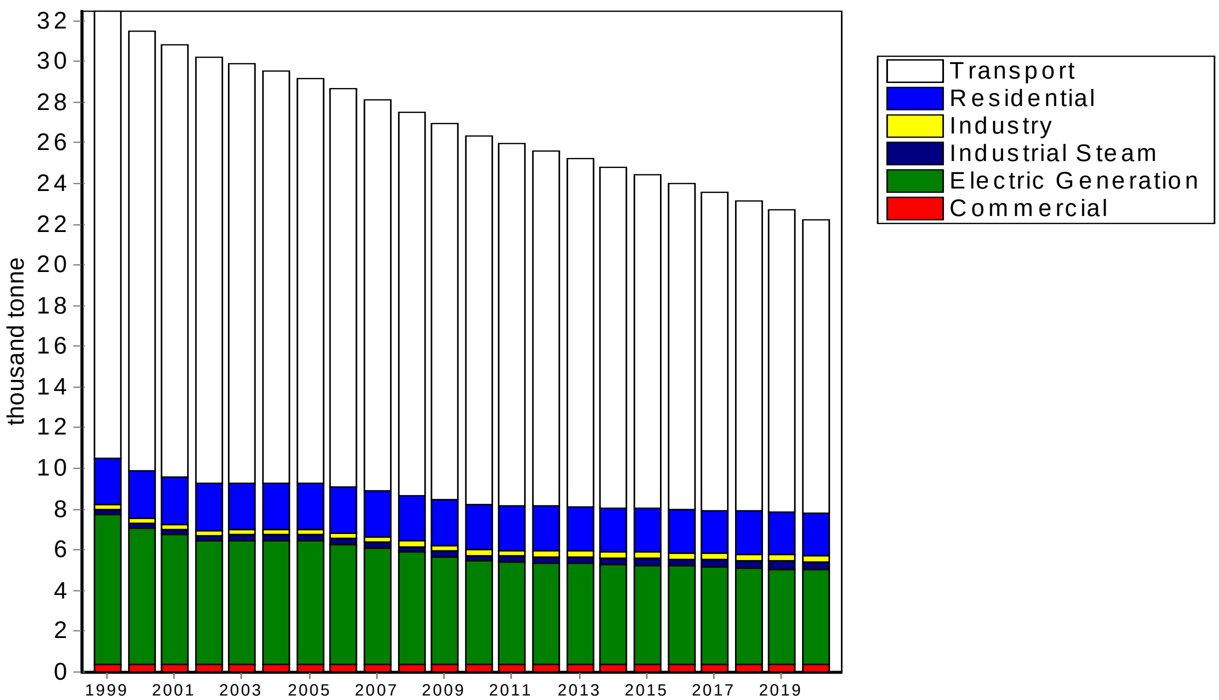


Figure D20: Sulfur Dioxide Emissions by Sector

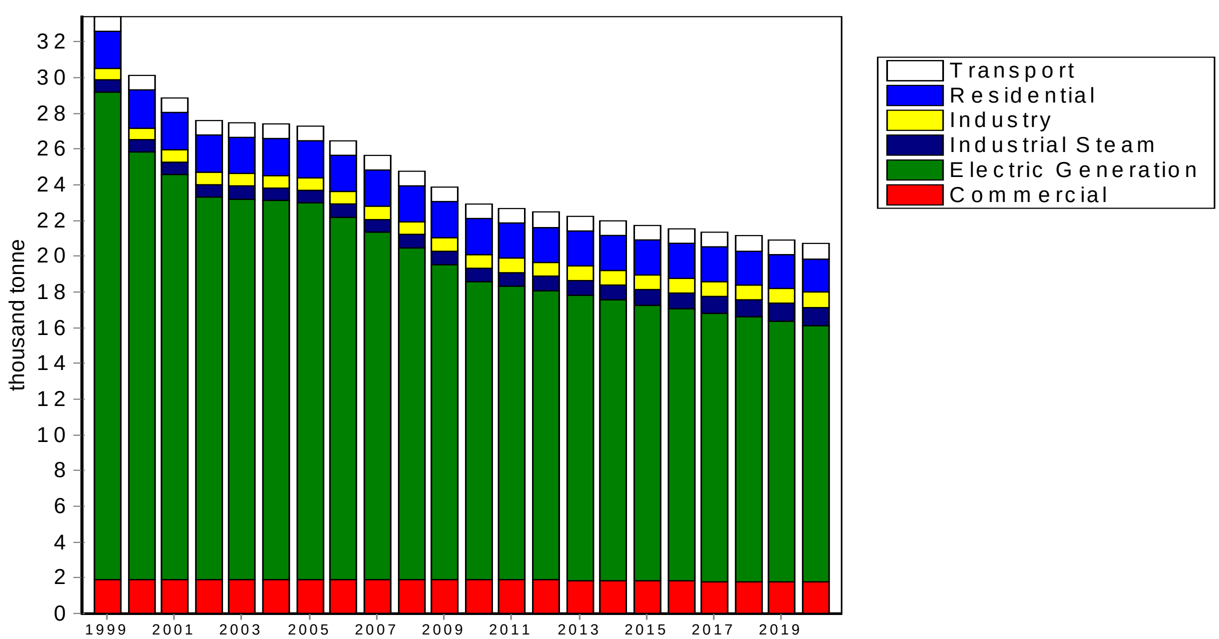


Figure D21: VOC Emissions by Sector

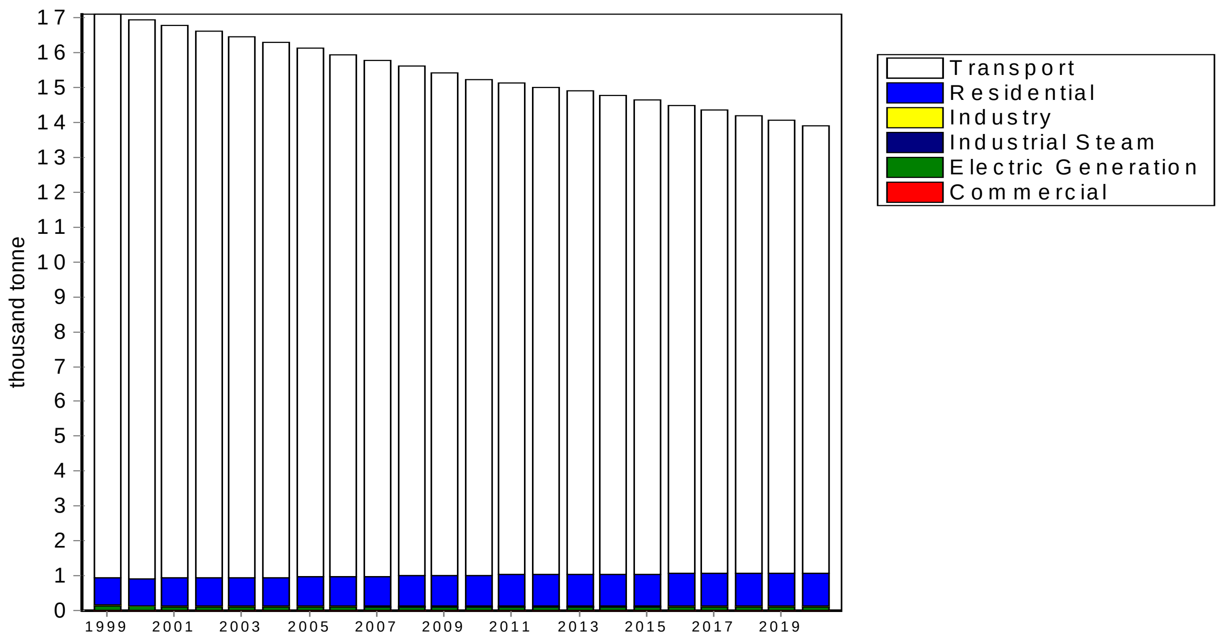
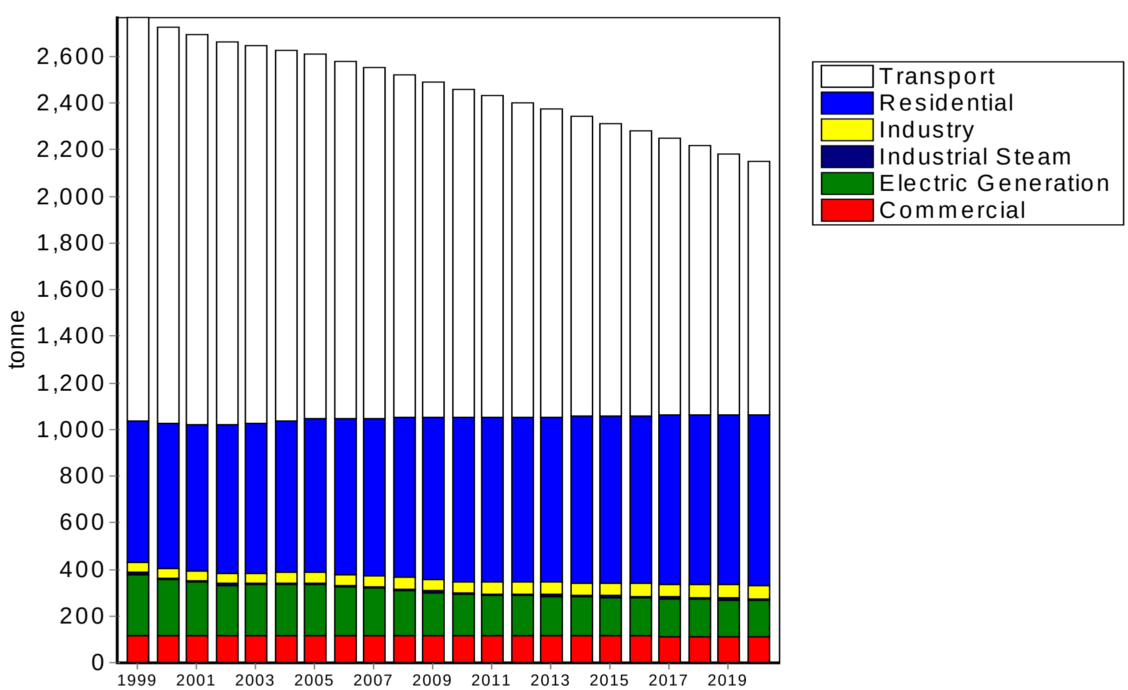


Figure D22: Particulate (PM10) Emissions by Sector



Appendix E:
Scenario Modeling Methods

Tellus Institute developed a series of scenarios that describe the evolution of end-use energy consumption in Rhode Island, associated energy production and greenhouse gas (GHG) and air pollutant emissions, and GHG emissions from other activities in the State, over the period 1990-2020. A first scenario, the "Baseline" scenario describes the evolution of these indicators in a future reflecting current projections of trends in major economic and demographic variables (population, economic output, etc.), consumer choices of energy technologies and associated fuel prices, in the absence of any new Rhode Island, regional or national actions to reduce greenhouse gas emissions. It is based upon the U.S. Department of Energy's 2002 Annual Energy Outlook (AEO 2002).

Tellus also prepared a series of policy scenarios, which examined the potential reductions in GHGs from the Baseline that could be achieved in Rhode Island between 2002 and 2020. Tellus described the technical details (costs, energy demand reductions, savings, GHG reductions and co-benefits) for each set of mitigation measures in the scoping paper reports to each of the three Working Groups. Based on the information in the scoping papers and recommendation memos from each Working Group, the Stakeholder Group assembled the various options into three different sets or policy scenarios. The main focus of these options was on actions that could be undertaken within the State. However, the Stakeholders also considered options that would require national or regional actions. In particular, they considered the effect of improved national CAFÉ (fuel economy) standards for vehicles, national appliance efficiency standards, and a national system for capping and trading carbon emissions from power plants. The final "binning" of options was based on a wide set of criteria, including the costs, savings and GHG reductions of each measure and its practicality and relevance to Rhode Island, as determined by the Stakeholder process with inputs from the Working Groups and the scoping papers.

The Stakeholders' final binning of options was used as the basis for the series of policy scenarios analyzed by Tellus. Three final scenario sets were created:

- **In-State Consensus Options**
- **In-State Consensus plus Non-Consensus Options**
- **In-State Consensus plus Non-Consensus Options, plus National/Regional Options** (those requiring action beyond the State)

Baseline Scenario Methodology

The Baseline scenario describes the likely evolution of greenhouse gas emissions (GHGs) and criteria air pollutants (CAPs) from Rhode Island, based on historical energy use and emissions levels over the period 1990-2000 and projecting forward until 2020, based on assumptions and modeling of how overall macroeconomic and demographic factors, energy supplies, demands and prices, technologies and emission factors are likely to evolve in the future.

Rhode Island-specific data and projections were supplemented by other information owing to the limited information available on the detailed structure of energy consumption in the State. The analysis was therefore based on an existing energy modeling study that includes the Northeastern United States undertaken by the U.S. Department of Energy's Energy Information Administration (DOE-EIA) using the National Energy Modeling System (NEMS[1]). The NEMS analyses were then coupled with RI-specific data and estimates of activity levels in each major sector of the Rhode Island economy, as follows:

- **For the residential sector,** New England-specific energy intensities (Btu or kWh per household) from EIA for the various different end-uses (cooking, heating, lighting space cooling, etc.) differentiated by household type (single family, multi-family and mobile home dwellings) were coupled with RI-specific data for the number of households (from the U.S Census Bureau). Future fuel shares and energy intensities were taken from NEMS results for New England, while future population growth rates were taken from runs of the REMI model for Rhode Island. Fossil fuel emission factors (e.g., grams per Btu) were based on data in the EPA's National Air Quality and Emissions Trends Report 1999, and were assumed to remain constant in the future.

- **For the commercial sector,** we used New England energy intensities (Btu or kWh per dollar value added) for the various end uses in each major building type (offices, hospitals, warehouses, non-building energy use, etc.) for 1999 from EIA coupled with RI-specific estimates of floor space for each major commercial sub sector. Future energy intensities, and fuel share trends after 1999 were all taken from NEMS results for New England, while estimates of growth in each sector were taken from the REMI model for Rhode Island. Fossil fuel emission factors were based on data in the EPA's National Air Quality and Emissions Trends Report 1999, and were assumed to remain constant in the future.

- **For the industrial sector,** we coupled Northeastern energy intensities (Btu or kWh per dollar value added) for fuel use in each major sector (chemicals, construction, food processing, non-intensive industries, etc.) with RI-specific estimates of value of output from each sector (U.S. census bureau). Future energy intensities, and fuel share trends after 1999 were taken from NEMS results for the Northeast, while the growth in value of output for each sector was taken from the REMI model for Rhode Island. Fossil fuel emission factors were based on data in the EPA's National Air Quality and Emissions Trends Report 1999, and were assumed to remain constant in the future.

- **For the transport sector,** we started with 1999 energy data for Rhode Island taken from the EIA. Total fuel use was allocated to the various transportation modes using data from the Federal Highway Authority and the EIA (AEO2001). Energy intensities (fuel economy) were based on data from the EIA and Oak Ridge National Laboratory. Estimates of vehicle miles traveled (VMTs) in 1999 for each mode were calculated based on total energy use and fuel economy. Finally, VMTs were translated into passenger and freight transport service requirements (passenger-miles and ton-miles), which are a better

[1] NEMS is the Federal Government's official energy forecasting model and is used primarily to produce the EIA's Annual energy outlook publication, which forecasts energy demand and supply over a 20 year period.

overall indicator of overall transportation service requirements, using load factor data for each technology developed for a recent Tellus study. Future light duty vehicle VMTs were assumed to grow in line with overall population growth (taken from the State's use of the REMI model for Rhode Island). VMT growth in other modes was assumed to equal to overall growth in Gross State Product (GSP), also taken from the State's REMI runs. Load factors were assumed to remain constant. Fuel economy improvements and vehicle purchase shifts (e.g. from cars to SUVs) are assumed to be in-line with EIA projections. Transport sector emission factors are based on current and future emissions regulations and characteristics in the transport sector.

- **Emissions from electricity consumption** were derived from the electricity consumption calculated across each demand sector. Rather than model the power plants physically located in RI, a better approach is to assume that electricity demands are met by the New England generating pool as a whole. Hence, electricity generation was modeled by allocating a fraction of the overall capacity of New England to RI. The fraction was RI's share of total New England electricity sales (about 6% in 1999). Information on the current and future mix of power plants in the New England pool was taken from NEMS, as were future levels of transmission and distribution losses. Emission factors for 1999 were based on data in the EPA's National Air Quality and Emissions Trends Report 1999, and were assumed to remain constant in the future. Future power plant efficiencies, capacity factors and other technical information were also taken from NEMS results for the New England power pool. Emissions from electricity imports into New England were modeled by assuming that domestic imports are generated from coal-fired plants, and international imports are from hydropower.

- **Non-energy sector emissions** are small compared to those in the energy sector. Our analysis assumed the same level of non-energy sector emissions calculated for the recent Brown University Inventory of Greenhouse Gas Emissions for 1996. Future emissions levels are assumed to remain constant.

In a final step, the base year energy consumption patterns for each fuel and in each sector (in 1999) calculated using the above methods were calibrated to match Rhode Island's energy consumption statistics by sector and fuel contained in the EIA's State Energy Data Report (SEDR). The above calculations were calibrated by adjusting the energy intensity values from NEMS for the base year and all future years. This calibration is intended to reflect differences in the fuels and technologies used in a given sub sector between Rhode Island and New England, but may also reflect differences in data definition, differences in the structure of production and consumption in each sub sector. For additional detail on the baseline analysis see Appendix B.

Policy Scenarios

As noted above, Tellus modeled three final scenario sets: (1) Consensus, (2) Consensus and Non-Consensus, and (3) Consensus, Non-Consensus and National/Regional. Each of the scenarios was modeled within the Tellus LEAP system as deviations from the detailed Baseline scenario. For each measure, Tellus entered the following additional information into LEAP for the years 2002 through 2020, based on the information developed for the scoping papers:

- Energy and/or GHG savings potential of the measure versus the Baseline scenario
- Unit costs (Incremental capital and operations and maintenance costs) of saved energy of demand-side options
- Capital and operating and maintenance costs of electric generation technologies
- Unit prices of the various fuels consumed in Rhode Island.

Tellus then used the LEAP system to combine the options into the three policy scenarios and to compare and contrast these scenarios. Each scenario results in significant reductions in electricity demand and thus generation requirements. Moreover, each of the scenarios includes a Renewable Portfolio Standard (RPS), which specifies that non-hydro renewables should ramp up to 20% of electricity generation by 2020. To model these situations, we used NEMS to examine what types of power plants and what generation mix will be avoided in New England in future scenarios with lower electric demand growth. NEMS simulates that virtually all of the reductions in generation will be due to avoided natural gas combined cycle power plants. The corollary of this is that none of the scenarios show significant differences in emissions from coal and oil-fired generation. We also used NEMS to examine what types of power plants are likely to be used to meet the RPS. The types of plants used vary over time as electricity from wind and biomass technologies become more economic and as landfill gas becomes more fully utilized. By 2020, the RPS is generated from approximately 43% biomass, 33% Wind and 25% landfill gas. The results of the analysis in NEMS were entered into LEAP, which was then used to examine the overall costs, and emissions implications of each integrated scenario.

Appendix F:
LEAP Modeling Software

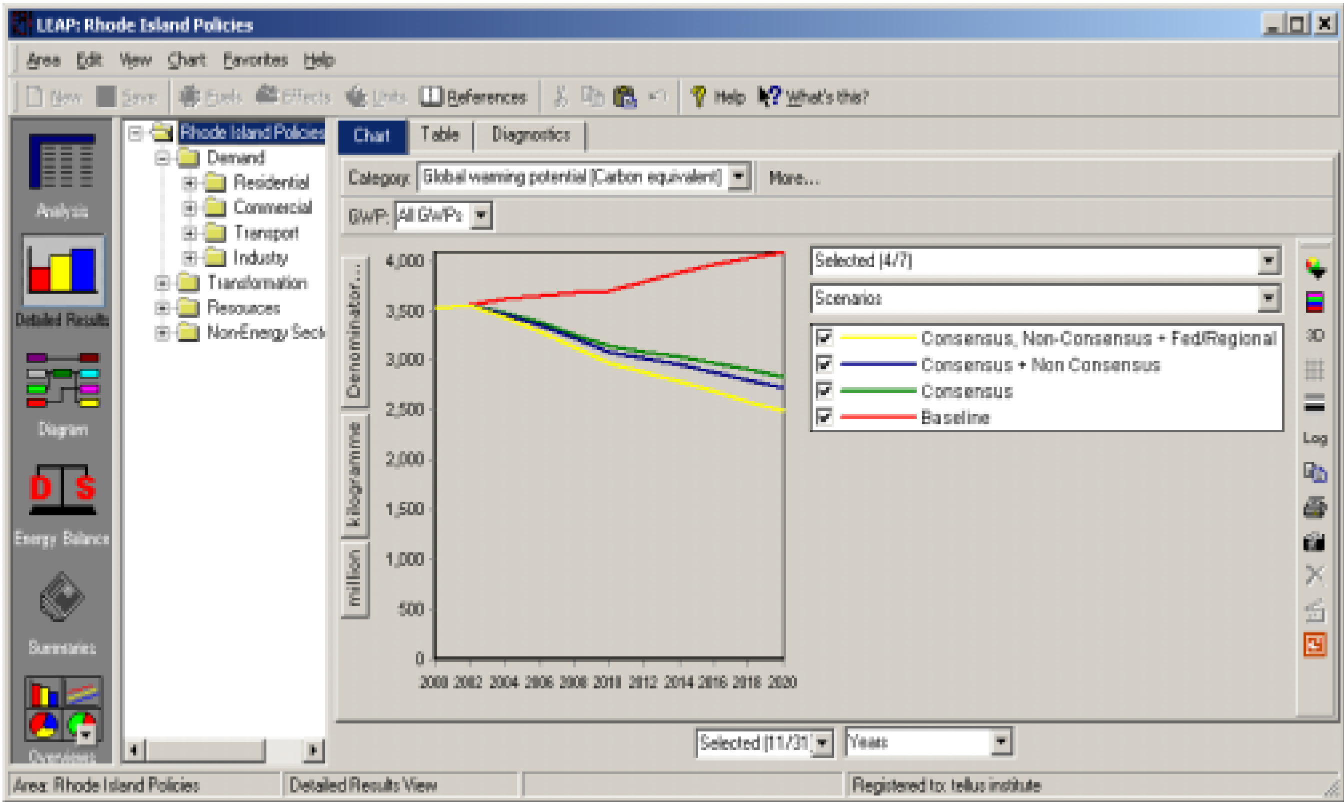
Tellus Institute used its LEAP software system as the main organizing framework and modeling tool for the RI GHG analysis. LEAP, the Long-range Energy Alternatives Planning system, is an advanced software tool for energy-environment modeling, such as integrated greenhouse gas mitigation with pollutant reduction co-benefits, and economic costs and savings. It is a flexible tool, capable of being programmed to analyze (at desired levels of detail) energy consumption and production and the emissions of greenhouse gases and criteria air pollutants from all sectors of the economy including the households, services, industry, transport, agriculture and all energy conversion sectors including electric generation, oil refining and mining. It can also be used to examine emissions from non-energy sectors including those from solid waste, agriculture and land-use change. LEAP is capable of detailed analysis and comprehensive tracking of all costs associated with a GHG mitigation action plan, including capital, operating and maintenance, and fuel costs. It can also optionally track the externality co-benefits arising from the avoided emissions of criteria pollutants. Tellus used these capabilities to assess the economic costs and benefits of each scenario analyzed.

LEAP has a number of key characteristics that make it ideal for application to the Rhode Island GHG Action Plan:

- **Modeling Approach:** LEAP's overall modeling approach was well suited to the requirements of the Rhode Island analysis. We wanted a system that could be used to readily organize, adapt and combine intermediate results from other studies. For example, Tellus took energy intensities developed from the U.S. DOE's NEMS model and combined them with economic indicators from the REMI model and emission factors based on EPA and other sources of data. The relatively simple "accounting framework" approach and the flexible data structures in LEAP were well suited to this task. Moreover, the simple accounting calculations in LEAP, made it very easy for Stakeholders to understand the approach we used in the analysis.

- **Intuitive Reporting of Quantitative Results:** The project also called for quick turnarounds of results and intuitive presentation of quantitative information. LEAP's fast calculation speeds and powerful charting and exporting capabilities were well suited to meet this need (see example below).

Figure F1: LEAP Program Interface



- **Scenario Management:** LEAP's scenario management system was used to examine options both individually and in various different overall scenario combinations. This made it easy to quickly create a wide variety of overall scenarios as requested by Stakeholders.

Additional information on LEAP is available at the Tellus Institute web site (http://www.tellus.org/seib/leap). The site gives full access to an online version of the LEAP User Guide, and also provides the ability to download an evaluation version of LEAP.

Appendix G: Detailed Option Descriptions

Table of Contents

Non-Consensus In-State Options

Regional/National Consensus Options

Consensus Priority Study Options

Introduction

The project team developed and characterized a set of GHG mitigation options for consideration by the Stakeholders. These were refined and augmented through discussions with the three Working Groups. However, the Stakeholder Group made the final decisions on which options to include in this GHG Action plan as well as each option's priority.

The GHG mitigation options are designed to change technologies and practices in ways that reduce the emission of GHGs to the atmosphere. Options represent actions that combine two elements: (1) new or enhanced policies, programs, or projects, and (2) changes in technologies and/or the ways in which people use them. Both the changes in technologies and practices and the policy or programmatic components they entail are characterized by using representative technologies and the main outlines of initiatives to affect technology use. Thus, each option sets out a key strategy that would need to be refined and specified further at the level of state implementation. Some policy approaches may be rather broad, affecting many processes and technologies, while other may be more process and technology-specific. While specific technology assumptions are used to estimate the impacts of the options, it is classes of technologies not specific ones that these calculations aim to represent.

The Baseline forecast of Rhode Island's use of energy and emissions of GHGs (see Appendix D) embodies expected trends in economic growth, technical innovation, and existing policies that are relatively fixed from a state perspective. Therefore, some improvements in how Rhode Islanders use energy-related technologies over time are included in the baseline forecast. Thus the options presented here reflect the incremental impacts of new policies and programs as well as the expansion and extension of some existing ones, relative to the Baseline forecast.

The 52 options included below are arranged in the same order as in Section III: Options. They begin with the higher priority in-state consensus options, followed by the lower priority in-state options, the non-consensus in-state options, the priority study options, and finally the consensus regional/national options.

The characterization of each option contains a number of key numeric measures or indicators:

- **The cost of saved/supplied energy (CSE) for each option.** Energy efficiency saves energy while alternative energy resources supply energy, both avoiding energy and emissions from the conventional (in this case GHG-intensive) resources that they displace. For efficiency, the CSE measures the increase in costs required to install an energy-savings measure, e.g., the extra costs of more efficient equipment, divided by its lifetime energy savings. It is calculated by converting the additional cost of the more efficient equipment into a series of annual payments over the lifetime of the equipment[2] and dividing this annual cost by annual energy savings. For energy supplies, the CSE is computed the same way, except that the cost numerator is the full cost per kWh (or Btu) of supplying the alternative energy – annualized capital, fuel and O&M costs. Both are

[2] The annualization calculation is based on an interest rate (discount rate) of 5% and the lifetime of the equipment. For example, an additional $635 cost for a more efficient furnace with an 11-year estimated life converts to about $76 per year. We use the same discount rate but varying lifetimes for the estimates in this project.

gross costs, which do not reflect the savings in energy supply costs (i.e., the avoided costs) that they achieve. [3]

- **The amount of energy saved in 2020**. This is the total amount of energy estimated to be saved by an efficiency measure or displaced by an alternative energy supply measure in the year 2020 as a result of all implementations of the measure from 2002 (or later) and on through 2020.

- **The benefit to cost (B/C) ratio.** The B/C ratio measures value of the direct economic benefits of a program, relative to the incremental costs of a program. This is called total resource cost perspective. B/C ratios are the CSE divided by the avoided cost. The avoided costs are assumed to be:

    - The electric avoided cost of $.04/kWh is based on a new natural gas combined cycle unit.
    - Gas and oil avoided costs are based on projections of retail rates, averaging $8.70/MMBtu (residential) and $6.00/MMBtu (commercial).

- **The reduction in emission of carbon to the atmosphere in 2020**. As with energy savings, this is a total impact in 2020 as a result of all implementations of the measure from 2002 (or later) and on through 2020.

The cost of saved carbon (CSC) is the *net cost* of the option (cost of saved energy minus avoided costs) divided by the carbon reductions for the option. The costs and carbon reductions are computed through a discounted cash flow and "carbon flow" analysis over the 20-year period. There are many options (largely energy efficiency and demand reduction in buildings and facilities and transportation) that result in net savings (i.e., avoided costs are greater than the cost of saved/supplied energy; thus the CSE can be negative – a win-win option that reduces carbon emissions and saves money.

Each option has additional benefits besides saving energy, reducing energy costs and decreasing carbon emissions, particularly reductions in air pollutants. Electric generation from fossil fueled power plants produces a number of emissions to the atmosphere that are directly or indirectly harmful to human health. These include particulate matter, sulfur dioxide, and nitrogen oxide. Reductions in electricity required from the power grid reduce fossil fuel use in electricity production and translate to reductions in such air emissions. Savings in on-site combustion of fossil fuels like gas, oil, and coal also reduce these other air emissions. These air pollution "co-benefits" associated with each option are quantified in terms of emissions reductions and in monetary terms represented in dollars per unit of saved carbon (so that they could be combined with the CSC if desired). Other co-benefits and side effects more difficult to quantify are described qualitatively.

[3] For the avoided costs of electricity savings or of alternative supplies we used the capital, fuel and O&M costs of a new natural gas combined cycle plant. For transportation vehicle efficiency, driving reduction or alternative fuels or the avoided costs were largely the costs of reduced gasoline consumption. For efficiency in furnaces, hot water and process heating facilities the avoided costs were largely the costs of reduced fossil fuel consumption

Higher Priority Consensus In-State Options

OPTION 1 -- Commercial/Industrial Fossil Fuel Retrofit Initiative

This option is similar to option 5, “Energy Initiative” but would focus on saving fossil fuels such as oil and gas. This new initiative might be a distinct new program or it might be “piggy-backed” on the existing “Energy Initiative” program. Either way, non-SBC sources of funding -- for example new gas utility DSM, Energy Office monies, or other sources -- would need to support the expanded marketing and program implementation in fossil-heated facilities. Besides DSM, another approach would be to establish a commercial/industrial loan program to help businesses finance retrofit projects in their facilities. For example, monies from New York’s systems benefits charge are used to write down the interest on loans to businesses for energy efficiency projects. Another lending program approach would be to set up a revolving loan fund. Whatever programmatic approach is taken, some source of capital is required to launch and sustain the program.

New England Gas Co. has a DSM program that helps commercial/industrial customers pay for gas equipment, but it is designed to build load, not conserve energy.[4] This new option would thus differ substantially from any existing program.

The program would focus on larger commercial and industrial customers and could include rebates or financing subsidies for efficient boilers for space, water, and process heating, steam system optimization, and other measures. Table 2.6 shows impacts from a new fossil-fuel oriented DSM program.

[4] There could be some GHG savings to the extent the existing gas DSM program displaces the use of electricity or oil.

OPTION 1 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Commercial/Industrial Fossil Fuel Retrofit Initiative
Sector and market	All existing nonresidential buildings and facilities; retrofit-oriented.
Technical elements	Space, water, and process heating, and other measures.
Policy/program elements	Technical and financial assistance (incentives and financing).
Existing policy/program	This option represents a new DSM component to realize fossil fuel savings, implemented in 2002 and continuing until 2020.
Rationale	Encourage replacement of inefficient equipment among all existing non-residential buildings and facilities.
Energy saved in 2020	2,850,000 MMBtu gas; 1,800,000 MMBtu oil and coal.
CSE	$6/MMBtu
B/C	1.0
Carbon saved in 2020	100,000 tonnes.
CSC	-$200/tonne.

OPTION 2 -- Compact Residential Appliances Initiative

The average size of several domestic appliances grew in past decades: refrigerators, freezers, clothes washers, dishwashers, televisions, and other appliances. Smaller units may better match the average load and equipment size, reducing energy use. This initiative would encourage households to systematically select the smallest reasonable appliance for any job.

Like option 4, this initiative would be innovatively different from other existing state and national efforts to improve the efficiency of energy use. Organization of the initiative would depend on groups and agencies with an interest in minimizing the energy, and environmental impacts of development coming together to create a long-term strategy and program. Pursuit of options 4 and 8 on a joint basis would enhance the likelihood of raising public consciousness. Since option 8 can affect appliance choice for both existing and new buildings, it has a potentially larger impact.

Our calculations assume that 20% of new purchases are for smaller appliances that use 10% less energy. Whatever costs might be incurred in organizing a compact appliance initiative would be more than offset by reduced capital and operating costs.

OPTION 2 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Compact Residential Appliances Initiative
Sector and market	Residential appliances other than heating & cooling.
Technical elements	Smaller appliances more closely matched to average user requirements.
Policy/program elements	Organization of a movement for visioning, education, and technical assistance.
Existing policy/program	None.
Rationale	Begin to address the “life style” elements of the challenge of sustainable development.
Energy saved in 2020	231,000 MWh; 360,000 MMBtu of fossil fuel.
CSE	n/a.
B/C	n/a.
Carbon saved in 2020	80,000 tonnes.
CSC	-$550/tonne.

OPTION 3 -- Energy Efficiency Targeting Initiative (Industrial)

There is a nascent trend in several industrial sectors to set explicit energy efficiency targets for production areas and processes. Despite a number of interesting case studies and the development of computerized monitoring and targeting systems, overall progress has been slow. Substantial acceleration of this trend within the R.I. industrial sector could yield benefits to manufacturing productivity and costs.

OPTION 3 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Energy Efficiency Targeting Initiative (Industrial)
Sector and market	All R.I. industries.
Technical elements	Monitoring and targeting for energy use by process or product.
Policy/program elements	Industry-driven program to support state-of-art targeting approaches and technologies.
Existing policy/program	Existing DSM programs have relatively little impact on this approach.
Rationale	Systematize energy monitoring and integrate it into industry management and accounting.
Energy saved in 2020	22,500 MWh electricity; 3,688,000 MMBtu gas; 1,363,000 MMBtu oil.
CSE	$0.018/kWh electricity; $1.50/MMBtu fossil fuel.
B/C	2.2 electricity; 2.7 fossil fuel.
Carbon saved in 2020	40,000 tonnes.
CSC	-$180/tonne.

OPTION 4 -- Combined Heat & Power (CHP) Initiative (Industrial)

CHP systems, also known as co-generation systems, make use of heat that would be wasted in conventional electric generating plants. Electricity is generated and the heat that would otherwise be wasted is used for process heating requirements, water heating, or other fairly continuous thermal loads. There is relatively little CHP in the State. Considered here are CHP systems that are sized to meet electricity requirements at their host facilities. Several technologies are available for possible application in industries in the State: combustion turbine (CT) type systems and internal combustion engines (ICEs) at different size configurations, likely all fueled by gas.

This option would require funding for some mix of technical studies, program marketing, and financial incentives. Financial support would need to come from existing or expanded SBC funds, gas DSM funds, Energy Office funds, etc.

Additionally, utility regulations may need to be changed to encourage CHP. At the current time, there is a back-up power rate that expires in 2004. It may be useful for the Commission to begin to review back-up rate issues in advance of its expiration, to ensure that they do not unduly discourage CHP. Utility buyback rates for excess generation are another issue that may require attention. While net metering would not be appropriate for CHP, it is important to properly value any available output from on-site CHP facilities.

OPTION 4 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Combined Heat & Power (CHP) Initiative (Industrial)
Sector and market	Industrial facilities that use electricity and process heat.
Technical elements	Installation of combined boiler/generator systems.
Policy/program elements	State or DSM funding plus technical assistance.
Existing policy/program	PUC interconnection and rate policies.
Rationale	Encourage distributed generation that increases overall energy efficiency.
Energy saved in 2020	554,000 MWh of electricity from the grid, while gas use is increased by 1,011,000 MMBtu.
CSE	$0.033/kWh.
B/C	1.2
Carbon saved in 2020	35,000 tonnes.
CSC	-$70/tonne (2000$)

OPTION 5 -- Electric Energy Efficiency Retrofit in Non-Residential Buildings and Facilities

A major DSM program operated by Narragansett to promote installation of energy-efficiency measures in existing non-residential buildings, this program includes rebates for qualifying lighting, heating, air conditioning, refrigeration, electric motors and motor drive, transformers, industrial process and process cooling, and other measures. The program provides a range of technical assistance services. A range of financial incentives is available, as is a financing program to assist participants to pay for their share of project costs. The program focuses on larger commercial and industrial customers.

This option assumes that this SBC funded program continues throughout the analysis period. The same incremental annual impact on electricity usage as planned for 2001 is continued in each of the years from 2002 through 2020.

OPTION 5 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Electric Energy Efficiency Retrofit in Non-Residential Buildings and Facilities
Sector and market	All existing nonresidential buildings and facilities; retrofit-oriented.
Technical elements	lighting, controls, thermostats, chillers, premium motors, variable speed drives (fan, pump, and others systems), transformers, refrigeration measures, etc.
Policy/program elements	Technical and financial assistance (incentives and financing).
Existing policy/program	This option represents continuation of an existing SBC funded DSM program through 2020.
Rationale	Encourage replacement of inefficient equipment among all existing non-residential buildings and facilities.
Energy saved in 2020	330,000 MWh
CSE	$0.02/kWh
B/C	1.9
Carbon saved in 2020	30,000 tonnes.
CSC	-$200/tonne.

OPTION 6 -- Efficient Residential Fossil Fuel Heating Initiative

Home heating systems using fossil fuel rely on furnaces to heat air or boilers to make steam or hot water. The most efficient models of furnaces and boilers use far less energy than those which dominate today's market. This option would promote home heating equipment that is Energy Star rated and better.

For example, gas heating systems often rely on furnaces, as well as fans and ductwork, to distribute heated air throughout a living space. Most gas furnaces installed in new construction or in fuel conversion or heating system replacement applications are mid-efficiency units, which are required due to federal minimum efficiency standards for gas furnaces. The market penetration of high-efficiency, condensing-type gas furnaces remains low in Rhode Island. Yet their annual fuel utilization efficiency, at 93-97 percent substantially exceeds that of mid-efficiency furnaces, whose AFUEs range upward from the minimum efficiency of 78 percent.

Similarly, the most efficient gas boilers, oil boilers, and oil furnaces available in today's market are far more efficient than standard efficiency equipment.

High-efficiency furnaces and boilers cost more than mid-efficiency furnaces.[5] While there is a capital cost premium for high-efficiency equipment, it has lower annual operating costs than standard equipment.

In 2001-2 the State's major gas utility, New England Gas Co., provides financing for new natural gas heating equipment. This financing is not conditioned on the efficiency level of the equipment installed, and the utility does not have a DSM program that promotes high-efficiency gas heating systems. Thus, consideration could be given to a DSM initiative that does specifically promote high-efficiency heating systems.

From a program perspective, this option assumes use of (1) gas utility DSM funds or other public benefit funding to provide substantial incentives for the installation of high-AFUE gas furnaces when documentation of proper sizing and installation is provided, and (2) public benefit funding to incent acquisition of the higher-efficiency oil-fired equipment. The programs would be marketed to consumers, appliance dealers, and HVAC contractors.

[5] In new construction, it is possible to save on chimney construction costs when installing a high-efficiency furnace of the "condensing" type. This offset does not apply to existing houses, and is not included here.

OPTION 6 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Efficient Residential Fossil Fuel Heating Initiative
Sector and market	New residences and residences in which existing heating equipment is being replaced.
Technical elements	Condensing-type gas furnaces, and high-efficiency oil furnaces and boilers, properly sized and installed.
Policy/program elements	Gas DSM funding and oil overcharge or other funding for: incentives for hi-AFUE equipment, contractor training, program marketing.
Existing policy/program	New England Gas Co.'s existing DSM program promotes this equipment, but only for customers who are switching to gas heat. There is no general DSM program for homes heated with gas or oil
Rationale	Relative to mid-efficiency equipment, over ten percent of the fossil fuel consumed and carbon emitted can be saved if high-efficiency equipment is installed instead.
Energy saved in 2020	586,000 MMBtu (gas); 675,000 MMBtu (oil).
CSE	$7.50/MMBtu.
B/C	1.0 (1.05 oil, 0.95 gas).
Carbon saved in 2020	25,000 tonnes.
CSC	$10/tonne (2000$).

OPTION 7 -- Tax Credits For Energy Efficiency

Rhode Island has a number of tax credits to promote renewable energy. Development of a tax credit program to promote energy efficiency could potentially apply to a wide range of equipment purchases. If tax credits were extensive and substantial, they might entail increases in the overall levels of the relevant taxes in anticipation of the decrease of revenue from the credits program.

The impacts for this option are based on national work on federal energy tax credits by Tellus and the ACEEE. The impacts have been scaled to Rhode Island and then halved to reflect the fact that relying only on state taxes yields smaller incentives.

OPTION 7 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Tax Credits For Energy Efficiency
Sector and market	All.
Technical elements	Broad range of highest-efficiency equipment.
Policy/program elements	State tax credit program requiring legislation.
Existing policy/program	State tax credits focus on renewable energy and do not extend to energy efficiency.
Rationale	Promote a wide range of commercial and residential efficiency investments.
Energy saved in 2020	Residential: 66,900 MWh electricity; 635,000 MMBtu fossil fuel. Commercial: 58,000 MWh electricity; 283,000 MMBtu fossil fuel.
CSE	Residential: $0.031/kWh electricity; $13/MMBtu gas. Commercial: $0.034/kWh electricity; $7.50/MMBtu gas.
B/C	Residential: 1.3 electricity, 0.7 fossil fuel. Commercial: 1.2 electricity, 0.8 fossil fuel.
Carbon saved in 2020	15,000 tonnes.
CSC	-$150/tonne.

OPTION 8 -- Combined Heat & Power (CHP) Initiative (Non-Industrial)

While there is some CHP in the State, the untapped potential is significant. Considered here are CHP systems that are sized to meet electricity requirements at their host facilities. Multi-building campuses are especially promising potential sites.

This option would require funding for some mix of technical studies, program marketing, and financial incentives. Financial support would need to come from existing or expanded SBC funds, gas DSM funds, Energy Office funds, etc.

As pointed out in the discussion of option 4, utility regulations may need changing to encourage CHP. Developers often perceive electric utility standby power rates as a barrier to CHP. Utility buyback rates for excess generation are another issue.

The option is evaluated using a 1000 KW system. This is a mid-range size for a non-industrial facility. Note that capital costs of installed CHP have been projected to decrease regularly between 2000 and 2020.[6] We have conservatively used year 2000 costs here.

OPTION 8 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Combined Heat & Power (CHP) Initiative (Non-Industrial)
Sector and market	Buildings that require substantial quantities of electricity and process heat.
Technical elements	Installation of combined boiler/generator systems.
Policy/program elements	State or DSM funding plus technical assistance.
Existing policy/program	PUC interconnection and rate policies.
Rationale	Encourage distributed generation that increases overall energy efficiency.
Energy saved in 2020	1,165,000 MWh of electricity from the grid, while gas use is increased by 7,080,000 MMBtu.
CSE	$0.31/kWh.
B/C	1.3
Carbon saved in 2020	15,000 tonnes.
CSC	-$90/tonne (2000$)

[6] ONSITE SYCOM Energy Corporation, *The Market and Technical Potential for Combined Heat and Power in the Commercial/Institutional Sector*, prepared for the U.S. DOE, January 2000.

OPTION 9 -- Efficient Residential Electric Cooling Initiative

Central air conditioning systems (CACs) rely on packaged air conditioning units as well as fans and ductwork to distribute cooled air throughout a living space. The penetration of CACs in Rhode Island has been steadily growing, especially in new homes.

Efficient CAC units are those whose seasonal energy efficiency ratio (SEER) is substantially above the federally established minimum of SEER 10.0. But the current market penetration of such high-efficiency units is very low.

A general practice over-sizing tCACs has been documented in the heating, ventilation, and air-conditioning (HVAC) industry. While there is no survey of installation practices in Rhode Island, it is reasonable to assume that typical practice prevails here. Better sizing of AC units can materially reduce the electric energy used by CACs to deliver cooling.

Installation practices influence the operating efficiency of CACs. For instance, if the refrigerant is not properly charged the unit may operate poorly. Ductwork must be properly balanced and free of leaks if cooled air is to be efficiently distributed. Some programs that just seal ductwork of existing systems have found that electricity for cooling can be reduced by 5-10 percent.

From a technical perspective, this option assumes that while ductwork is generally properly installed with minimal leakage, improved practices can be implemented for the other elements described above: increased SEER plus proper sizing and installation. The annual kWh savings per measure implemented (per efficient CACs installed) is the result of including all three of these technical elements in the program design.

From a program perspective, this option assumes that SBC funds or other public benefit funding is used to provide substantial incentives for the installation of high-SEER CACs when documentation of proper sizing and installation is provided. Additionally, the program is marketed to consumers, appliance dealers, and HVAC contractors. Further, training on proper installation to qualify for the program is provided to HVAC contractors.

OPTION 9 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Efficient Residential Electric Cooling Initiative
Sector and market	Residences with central air conditioning systems (CACs) or installing CACs.
Technical elements	(1) CACs at SEER 13.5+, (2) proper sizing and (3) installation of CACs, and possibly (4) duct sealing.
Policy/program elements	SBC support for: incentives for hi-SEER CACs, contractor training, program marketing.
Existing policy/program	Federal minimum SEER likely to increase from 10.0 to 12.0 in mid-2005. Narragansett Electric incents efficient new homes (but not CACs per se) in its Energy Star program which penetrates only few % of RI market. No DSM programs in the replacement CAC market.
Rationale	No R.I. electric distribution co. has recently done an appliance saturation survey. Nonetheless there is an impression of increasing penetration of CACs in existing and (especially) new homes. The market penetration of high-SEER, properly installed CACs is likely rather low. Existing R.I. programs that may encourage additional efficiency in CACs have a limited impact. This option works in N.J., elsewhere.
Energy saved in 2020	96,000 MWh.
CSE	$0.06/kWh.
B/C	ι1.0.[7]
Carbon saved in 2020	10,000 tonnes.
CSC	ι$0/tonne[3]

[7] Assumes higher preliminary avoided costs than for other options, based on peak period savings.

OPTION 10 -- Retrofit Program For Electrically Heated Residences

Narragansett's "EnergyWise" DSM program delivers in-home energy efficiency services to improve the energy efficiency of existing dwelling units. A number of program services are provided -- an initial "audit" of energy using patterns and opportunities for improvement; information to customers on their electricity usage patterns; and financial incentives for cost-effective measures such as insulation, windows, and thermostats. The program provides energy use surveys and limited assistance in installing weatherization measures in existing homes. Eliminating windows from this program may improve the benefit/cost ratio for this program for some houses. This would lead to a modest improvement in cost-effectiveness but would decrease the carbon savings.

Initially limited to mid and high use electricity customers, from 2001 this DSM program is available to any residential customer. Moreover, the low-interest financing option in the program may be used to install weatherization.

This option consists of a continuation of the residential retrofit program from 2002 through 2020.

OPTION 10 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Retrofit Program For Electrically Heated Residences
Sector and market	Existing dwelling units.
Technical elements	Audit, insulation, windows, weatherization.
Policy/program elements	Information and financial incentives funded through SBC.
Existing policy/program	Narragansett's "EnergyWise" program.
Rationale	Continuation of EnergyWise will facilitate reaching existing households throughout the analysis period.
Energy saved in 2020	87,500 MWh
CSE	$0.039/kWh.
B/C	1.0 (electric)
Carbon saved in 2020	9,000 tonnes.
CSC	-$7/tonne overall.

OPTION 11 -- Retrofit Initiative For Fossil Heated Residences

Option 11 is a new DSM program targeted to homes heated with natural gas and oil. As with “EnergyWise” (option 10), the program would deliver in-home energy efficiency services to improve the energy efficiency of existing dwelling units. A number of program services could be provided -- an initial “audit” of energy using patterns and opportunities for improvement; information to customers on their electricity usage patterns; and financial incentives for cost-effective measures such as insulation, replacement of older oil burners, adjustment of older oil nozzles, installation of setback thermostats, reduction of boiler temperatures, windows , etc. This option could potentially be piggy-backed on the current program structure (option 10), or delivered through separate programs. Eliminating windows from this program may improve the benefit/cost ratio for this program for some houses. This would lead to a modest improvement in cost-effectiveness but would decrease the carbon savings.

The estimates below consider the combined effect of (a) current programs and (b) an expanded program focusing on non-electrically heated homes. Non-SBC sources of funding, for example gas utility DSM, are needed to support the expanded marketing and program implementation in fossil-heated homes.

Another potential option is annual inspection and maintenance of fossil heating systems. Such a practice has safety benefits as well as energy benefits. Its energy saving benefits would be modest but could be 1-2% in homes with older oil heating systems.

OPTION 11 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Retrofit Initiative For Fossil Heated Residences
Sector and market	Existing oil- and gas-heated dwelling units.
Technical elements	Audit, insulation, weatherization, thermostats, heating system improvements
Policy/program elements	Information and financial incentives funded through gas utility DSM and a new funding source for oil conservation.
Existing policy/program	Narragansett's "EnergyWise" program treats electrically heated homes and the State's WAP program treats income-eligible homes independent of fuel source.
Rationale	New non-SBC DSM program for fossil heated homes, will facilitate reaching existing households from 2002 to 2020.
Energy saved in 2020	210,000 MMBtu (gas); and 140,000 MMBtu (oil).
CSE	$11/MMBtu
B/C	0.8
Carbon saved in 2020	6,000 tonnes.
CSC	-$7/tonne

OPTION 12 -- Electric Equipment Retrofit Program (Small Commercial & Industrial)

This energy efficiency program is targeted to commercial & industrial customers whose electricity usage is relatively small (less than 100 kW demand). A distinctive feature of this program is direct installation whereby Narragansett arranges the equipment purchase and installation of efficiency measures. The focus is on efficient lighting (fluorescent lamps and ballasts, fixtures, and hard-wired CFLs; high intensity discharge systems; occupancy sensors), plus refrigeration and other measures.

The program uses rebate incentives plus interest-free financing for the remaining portion of the installed cost of the measures to attract participation. This option assumes continued operation of the program through 2010, at which point it will have been conducted for 20 years. Electricity savings impacts are based on levels planned for 2001.

OPTION 12 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Electric Equipment Retrofit Program (Small Commercial & Industrial)
Sector and market	Existing nonresidential buildings with moderate electricity usage levels; retrofit-oriented.
Technical elements	Lighting, refrigeration, and other measures.
Policy/program elements	Company arranged measure installation; rebates and interest free financing.
Existing policy/program	This options represents continuation of an existing SBC funded DSM program through 2010.
Rationale	Continue to encourage replacement of inefficient equipment among existing non-residential buildings.
Energy saved in 2020	48,600 MWh.
CSE	$0.024/kWh.
B/C	1.6.
Carbon saved in 2020	5,000 tonnes.
CSC	-$150/tonne.

OPTION 13 -- Public Facilities Efficiency Initiative

Option 13 is a public facilities clean buildings initiative. There are a number of specific programs to promote energy efficiency in state and local public facilities. For example, the State Energy Office manages a revolving loan fund which totals some $1.2 million and has resulted in an estimated 1200 GWh/year of savings from energy efficiency in state facilities. On the other hand some programs have ended, such as the Institutional Conservation Program, which supported projects in schools and hospitals.

Option 13 consists of a comprehensive effort to minimize energy-related GHG emissions in public facilities through such measures as best technology in all new construction, maximum use of day-lighting and lighting controls, comprehensive retrofitting, and using lower carbon fossil fuels for space heat. The option may entail changes in legislation or regulations governing leasing and financing by schools and other facilities, as well as additional funding for retrofit measures and program coordination.

The achievable impacts from a suite of initiatives is estimated in an indicative fashion by taking an amount equal to 3% of options 1, 5, 15, and 17, to represent efficient new construction, plus energy efficiency in existing facilities, including some fuel switching from oil.

New resources or mandates would be needed to realize these benefits. With respect to resources, some states have larger revolving loan funds for public facilities, relative to energy use, than does Rhode Island. With respect to mandates, the state could evaluate adoption of explicit standards to be applied to new state buildings -- for example, requiring a silver rating.[8] Further, some states mandate that school financings require the highest feasible levels of energy efficiency in new construction.

[8] Silver is the second of four increasingly eco-efficient levels, developed by the US Green Building council's LEED™ standards program.

OPTION 13 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Public Facilities Efficiency Initiative
Sector and market	New and existing public facilities
Technical elements	Efficiency measures in new construction and renovation; major equipment retrofit opportunities.
Policy/program elements	Multiple.
Existing policy/program	Several.
Rationale	State has opportunity and leverage to lead in energy efficiency and GHG reduction in its own facilities.
Energy saved in 2020	12,849 MWh electricity; 139,500 MMBtu fossil fuel.
CSE	$0.02/kWh electric; $6./MMBtu fossil.
B/C	1.95 electric; 1.0 fossil.
Carbon saved in 2020	5,000 tonnes.
CSC	-$160/tonne.

OPTION 14 -- Efficient Residential Lighting and Appliances Programs

Three kinds of lighting technologies which can reduce electricity use in households are compact fluorescent lamps (CFLs), CFL fixtures, and fluorescent torchieres. The first is the oldest technology, but there have been significant improvements in the performance characteristics of CFLs over the years. The CFL fixture and fluorescent torchiere technologies are somewhat newer.

The US Environmental Protection Agency "Energy Star" program identifies more efficient appliances and equipment in several markets. Energy Star rates CFLs and CFL fixtures. Household appliances that are Energy Star rated include refrigerators, room air conditioners, clothes washers, and dish washers.

The SBC-funded DSM programs administered by Narragansett Electric Company's DSM include *two* current DSM programs in this area, promoting (1) the lighting and technologies described above, and (2) the appliance technologies. Narragansett works with the Northeast Energy Efficiency Project and other regional utilities to promote Energy Star products. These efforts entail general product promotion through advertising, liaising with manufacturers and retailers, and a variety of rebates targeted to either dealers or customers.

This option combined two different related DSM programs for convenience, and assumes that these DSM efforts and SBC funding for them are renewed and continued. The projection of costs is based on lighting technology costs developed by the *Clean Energy Futures* study (lighting) and work by the American Council for an Energy-Efficient Economy (for other appliances). The impacts are based on continuing DSM efforts at current levels for 2002 through 2007. Based on equipment lifetimes, the total cumulative impact is effective through 2020.

Efforts to increase the mandatory minimum energy efficiency of major appliances overlap with this DSM program. Option 30 captures the effects of success in improving appliance efficiency standards. If appliance standards are not upgraded, or if they are upgraded but still lag best available technology, then revision and extension of these DSM programs beyond 2007is an alternative option.

OPTION 14 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Efficient Residential Lighting and Appliances Programs
Sector and market	All residences and market delivery channels for the covered technologies.
Technical elements	Energy Star CFLs, CFL fixtures, fluorescent torchieres, refrigerators, room air conditioners, clothes washers, and dish washers.
Policy/program elements	SBC support applied to: information and education; liaising with US DOE, US EPA, NEEP, and other utilities; marketing efforts with manufacturers, dealer, retailers, and customers; and a variety of rebate incentives to customers or dealers.
Existing policy/program	This option represents renewal and continuation of two existing SBC based programs.
Rationale	Promote market penetration of more efficient equipment (while simultaneously working to increase equipment efficiency per option 3.1, appliance efficiency standards initiative).
Energy saved in 2020	46,000 Mwh.
CSE (cost of saved energy)	$0.018/kWh.
B/C benefit-cost ratio	2.2.
Carbon saved in 2020	5,000 tonnes.
CSC (cost of saved CO_2)	-$226/tonne (2000$).

OPTION 15 -- Efficient Non-Residential Construction

A DSM program operated by Narragansett "encourages energy efficiency in new construction, renovations, and replacement of failed equipment through financial incentives and technical assistance to developers, customers, and design professionals."[9]

A range of technical assistance services is available, which may include identifying measures, monitoring or metering equipment, design and construction assistance, detailed energy efficiency studies, and "commissioning," or engineering review of completed projects to assure that they are installed and operating as designed. The range of potential efficiency measures addressed by the program is broad, including building shell, lighting, HVAC and chiller systems, motors and variable speed drives, refrigeration, and process heating and cooling. A range of financial incentives is available. Though the incentives cover from most to all of the incremental cost of efficiency measures, a financing program is also available to assist participants to pay for their share of project costs.

The program focuses on electricity savings. It may have significant co-benefits in other resources savings such as fossil fuel or water requirements, but these have not been quantified. The program is funded from SBC.

This option assumes that the program continues for eight years from 2002. The assumption is that by then, the impacts from option 48 (appliance efficiency standards) and options 45 & 46 (upgrade building codes) would supersede the program. If options 30 and 45/46 are not implemented, or are not at sufficiently aggressive levels, then another option would be to extend this program throughout the analysis period. Note that option 5, a similar non-residential program that is more oriented to retrofit applications, is assumed to continue throughout the analysis period.

[9] *Stipulation of Parties for The Narragansett Electric Company 2001 DSM and Renewable Energy Program*s, State of Rhode Island and Providence Plantations Public Utilities Commission, Docket No. 1939, November 30, 2000, page 15.

OPTION 15 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Efficient Non-Residential Construction
Sector and market	Nonresidential new construction and renovation; major equipment replacement opportunities.
Technical elements	A wide variety of building and equipment system measures.
Policy/program elements	Technical and financial assistance (incentives and financing).
Existing policy/program	This options represents continuation of an existing SBC funded DSM program through 2009.
Rationale	A strong program aimed at new construction and at equipment replacement cycles that are potential “lost opportunities” can help to transform building practices and equipment markets.
Energy saved in 2020	98,300 MWh.
CSE	$0.02/kWh.
B/C	2.0.
Carbon saved in 2020	5,000 tonnes.
CSC	-$200/tonne.

OPTION 16 -- Energy Star Home Construction Program

Energy Star Homes is one of the national efficiency initiatives developed by the U.S. Environmental Protection Agency and the Department of Energy. Several utilities operate residential new construction DSM programs as Energy Star partners. In Rhode Island, Pascoag Fire District as well as Narragansett sponsor the program. Its aim is to promote energy efficiency in the construction of new houses, so that they are 30% more efficient than required by Rhode Island's current Model Energy Code (MEC) standards for cooling, heating, lighting, and appliance operation.

The current program design includes: a customer application fee, refundable on certification of the house as Energy Star; measurement of building shell characteristics as well as heating and cooling equipment during the construction process; a Home Energy Rating certification; and depending on the rating attained, up to five free Energy Star lighting fixtures and up to $500 in rebates toward Energy Star appliances. The program is marketed to builders and contractors, realtors, and buyers.

The market penetration of the existing program has been modest, a few percent of the potential market annually. This option is based on more intensive marketing which doubles the market penetration and impact on electricity use, for the years 2002 through 2009. Only electricity costs and impacts are calculated here, though this program does save fossil fuel as well as electricity.

The assumption is that by then, the impacts from options 45 & 46, enhanced building codes, would supersede those from this program. If enhanced building codes are not substantially better than MEC-95 (see option 48/49), then another option would be to extend this program throughout the analysis period.

OPTION 16 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Energy Star Home Construction Program
Sector and market	Residential new construction.
Technical elements	Multiple building shell and equipment measures to attain an energy efficiency level 30% better than MEC.
Policy/program elements	Measurement, monitoring, marketing, and limited rebates.
Existing policy/program	This option represents renewal and expansion of the existing SBC based program.
Rationale	The program encourages better building practices until a more energy-efficient building code can be implemented.
Energy saved in 2020	2,256 MWh.
CSE	$0.04/kWh.
B/C	1.0.
Carbon saved in 2020	1,000 tonnes.
CSC	$0/tonne.

OPTION 17 – Use of Lower Carbon Fossil Fuels

This option replaced a prior option titled Switching from Oil to Natural Gas. The Group agreed that we should encourage use of lower carbon fossil fuels (where fossil fuels are in use) when such fuels are available and cost effective, and Rhode Island should continue to look for those opportunities, so this new option was created and the Group agreed that it should be a higher priority. However, this option was not included in the Scoping Papers and the option will need to be further developed and analyzed.

OPTION 18 – Local Fuel Economy Improvements (Feebate) Initiative

Even if national standards are not raised, Rhode Island or New England/Northeast Region could adopt their own efforts to encourage fuel efficiency. These could take the form of tax incentives to vehicle owners to purchase vehicles with higher than average fuel economy[10]. Our preliminary assumption, in the absence of more rigorous research, is that these measures would result in roughly 10% of the fuel savings of altered national CAFE standards[11].

Feebates are a financial incentive to encourage purchasers of cars and light duty trucks to take more account of either the energy efficiency or emissions of their motor vehicles. A feebate system is typically designed to combine elements of both a fee and a rebate for different categories of passenger vehicles. Purchasers who choose vehicles with poor fuel economy or high emissions would have to pay a fee that would be added on to the purchase price, whereas those who choose more efficient, cleaner cars would be rewarded with a rebate. The addition to or subtraction from purchase price would be calculated on a sliding scale, depending on how far a vehicle's performance diverges from a pre-determined average ideal. The system can also be designed to be revenue-neutral[12], and should be designed to change as national fuel economy and tailpipe emissions standards change.

Several states – California, Massachusetts, Maryland, Arizona, Maine, South Dakota, Rhode Island and Iowa – are considering feebate plans. A national-level policy would be necessary to ensure maximum impact through inducing changes in the average fuel economy of the nationwide vehicle fleet. But state-level plans can serve the important purpose of public education, informing consumers about the characteristics of different vehicles and their pollution consequences, and thus possibly affecting their buying patterns. Also, if enough states adopt such plans, it might provide an impetus to car manufacturers to develop a cleaner line of vehicles.

A combination of *fee* and *rebate*, the concept applies a sliding scale cost that is either add

---

[10] More stringent enforcement of speed limit could be another state-level strategy to improve efficiency. Vehicle fuel economy decreases markedly above speeds of about 50 mph. (David Greene, 1996: *Transportation and Energy*, Eno Transportation Foundation, p. 229). The National Research Council (1984) concluded that, despite imperfect compliance, the imposition of the 55 mph speed limit in 1974 reduced fuel consumption by around 2.2% (Greene, 1996.p 230*)*

[11] This assumption was based on the following considerations. Davis et al. (1993) show that a national feebate policy would improve fuel economy of *new* vehicles by about 15-18% in 15 years, as opposed to no change in policy. Note, however, that Davis et al (1993) indicated that nearly all the savings are due to manufacturers' response, rather than consumers' response. If we assume that a state or regional feebate policy would produce substantially lower response from manufacturers than a national policy (as opposed to consumers), then we could expect less than a 10% improvement from a feebate policy. Other policies, like speed-limit enforcement, are expected to yield a few additional percent in overall efficiency. Davis, William B. et al. (1993): "Feebates: Estimated Impacts on Vehicle Fuel Economy, Fuel Consumption, CO2 Emissions, and Consumer Surplus," LBL-34408, August 1993, Lawrence Berkeley Laboratory, Berkeley, CA; Greene (1996).

[12] That is, all revenues generated in fees would be distributed back in the form of rebates. In practice, this can only be done approximately since it is impossible to predict the precise composition of vehicle purchases in a given year. An annual or bi-annual review of the actual design may be necessary to ensure rough revenue neutrality in subsequent years.

There are several possible approaches to feebate design. The table below shows examples from two countries where a feebate system is already in place:

Measure	Where in Operation	Reference
Zero-point (fixed tax rate at 32%) for 29 mpg vehicles, and varying non-linearly (with vehicle price and changes in mpg)	Austria	OECD (1997): http://193.51.65.78/env/docs/cc/gd9769.pdf
Linear, but not revenue neutral. Fee between $55-$3300 for vehicles<39 mpg, otherwise, US $75 rebate	Ontario, Canada	OECD (1997); Barg et al. (2000): Economic Instruments for Environmental Policymaking in Ontario, IISD, Ontario.

Feebate legislation in Rhode Island would be a way to for the state to address both local pollution and climate change through a market mechanism. Feebates produce incentives to both purchasers and manufacturers. Since they reduce the cost of efficient and low polluting vehicles, feebates provide a strong and immediate market signal for consumers to buy more of these vehicles, thereby shifting the sales mix. The presence of a feebate system provides manufacturers with a long-term incentive to incorporate more fuel-efficient and pollution control technologies, thereby gradually affecting the product mix available to the consumer. Although a feebate in Rhode Island per se would not affect the auto industry, a coordinated regional policy could create a significant market force to cause the industry to be encouraged to develop a niche for more fuel-efficient vehicles[13]. Moreover, if combined with the following option, government procurement of more efficient and less polluting vehicles, the impacts of the feebate incentive system on consumer vehicle choices could be enhanced by the demonstration and educational impacts of that complementary policy.

Feebate proposals have sometimes been criticized on the grounds that they would unfairly penalize purchasers of vehicles who require larger cargo size to meet personal or work-related needs. One way to mitigate this concern is by designing feebates within size classes. A better option is to design them around functionally equivalent vehicles; for instance, many wagons have the same or better internal volume, and significantly higher fuel economy, than sport-utility vehicles. An annually or biennually adjusted feebate program could also be designed to be approximately revenue neutral, to ensure that state revenues for other programs are not adversely affected[14].

[13] Another reason to consider a coordinated feebate structure across, say, New England states, is to provide a disincentive against people importing vehicles from other states in the region simply because they may not be subject to higher sales taxes.

[14] A related option that is sometimes proposed is to introduce programs to purchase old vehicles. However, such programs, which have had limited success for criteria air pollutant reduction strategies, are fraught with equity

The Rhode Island legislature may take up a bill during the current session that includes fuel efficiency based feebate for new vehicles. Vehicles with an average fuel economy greater than 25 mpg would receive a rebate, while those below that level would pay a surcharge on their sales tax. This bill will likely be returned to a study commission this year so that further analysis can be completed before the bill is taken up again.

OPTION 18 -- SUMMARY TABLE

Parameter	Value
Working group	Transportation and Land-Use.
Option name	Local Fuel Economy Improvements (Feebate) Initiative
Sector and market	All light-duty vehicles
Technical elements	Improved materials, engine efficiency, advanced technology, including hybrids
Buydown program elements	None
Existing policy/program	Sales tax incentives for purchasing high efficiency vehicles – revenue neutral feebates
Rationale	Reduce carbon emissions as well as oil dependence.
Energy saved in 2020	1.3 trillion BTU (10.3 million gallons) in gasoline savings
CSE (cost of saved energy)	$1.84/MMBTU ($0.21/gallon)
Carbon saved in 2020	125,000 tonnes
Certainty of savings if option is adopted	Medium
CSC (cost of saved CO_2)	-$300/tonne (2000$)

concerns (old cars are typically owned by the poor, who may not be able to make the switch to newer cars even if compensated at a slight premium over the market price of their vehicles), are likely to produce new market distortions, and do not even lead to a substantial reduction in GHG emissions, since fuel economy standards have remained roughly the same since 1985.

OPTION 19 – Transit Oriented Development And Enhancing Transit Options And Operations Initiative

Transit Oriented Development (TOD), "Traditional Neighborhood Design" (TND), and other "Smart Growth" initiatives all focus on urban design to maximize walkable communities, mixed use environments, and transit access . TOD and similar land use strategies can reduce automobile use and associated pollution, increase access, create socially and physically more attractive neighborhoods, and increase productivity[15]. Examples of successful TOD include King County (www.metrokc.gov/kcdot/alts/tod/todindex.htm) in Washington state and Maplewood, New Jersey (www.stationfoundation.org). Smart Growth initiatives include legislated programs in the State of Maryland, and the Portland, OR metropolitan region.

Smart Growth initiatives in Rhode Island include the Governor's Growth Planning Council (http://www.planning.state.ri.us/GPC/Annual%20report.pdf); recommendations of a number of the State Guide Plan's elements, as well as private efforts like Grow Smart Rhode Island (www.growsmartri.com).

The State Land Use Policies and Plan[16], and the Ground Transportation Plan[17] both provide strong policy support for "smart growth" initiatives. The Land Use Plan recommends a compact development pattern and the preservation and enhancement of existing cities, villages, and other densely settled areas. The Ground Transportation Plan calls for a strong correlation of land use and transportation, and emphasizes modal diversification to reduce reliance upon private auto travel.

One TOD/Smart Growth initiative being studied by the Growth Planning Council in Rhode Island would include designation by municipalities of compact, higher density areas as locations for concentrating future growth and development. It would be critical that this be reinforced by state incentives and policies that direct public investments to designated areas, once approved. Design and designation criteria would ensure that existing city neighborhoods, villages, and other densely developed areas which have adequate infrastructure (including transit services) are preserved and enhanced and that any new growth areas that are developed are walkable, resource –efficient, environmentally-sustainable, and transit-supportive.

The city of Providence has been trying to encourage people to move back downtown since the early 1990s, by promoting walkability, allowing mixed-use zoning, and increasing transit access. The city is undertaking a major neighborhood revitalization effort in the Olneyville neighborhood, with special emphasis on transit and inter-modal facilities. Similarly, the City of

---

[15] John Holtzclaw, *Using Residential Patterns and Transit to Decrease Auto Dependence and Costs*, National Resources Defense Council (San Francisco; www.nrdc.org), 1994; Transit Oriented Development Website (www.transittown.org). Porter, D. R. (1997), Transit-Focused Development: A Synthesis of Research and Experience. *TRCP Report* No. 20. National Academy Press.

[16] R.I. Statewide Planning Program. Land Use 2010: State Land Use Policies and Plan. Providence, RI 1989.
[17] R.I. Statewide Planning Program. Transportation 2020: Ground Transportation Plan—August 2001 Update. Providence, RI. 2001.

Warwick is planning a major new, higher density center connecting TF Green Airport to a planned new rail station. The TOD option would extend the planning concepts used in Olneyville and Warwick to other communities with compact, mixed-use developments situated at or around transit stops and location-efficient development. Such developments would comprise housing, office, neighborhood retail, and civic uses, and be built to become pedestrian-friendly, human-scale communities.

In the near term, benefits could be realized from this option through concerted efforts to maximize the use of existing (RIPTA) bus transit system via realignment of routes, introduction of flexible services, and local land management and design requirements which support the integration of transit services with higher densities and ensure safe and convenient pedestrian access to and within new developments. Longer range TOD strategies could involve the development of growth centers along rail transit routes (MBTA service), including extensions currently being planned and studied. In more rural parts of the state, village centers could also serve as focal points for connecting flexible local transit services with regional busways or corridor routes. This level of implementation would require not only investment in rail/bus infrastructure and services, but also a re-assessment of local land management regimes to ensure that growth is properly channeled to promote neighborhood revitalization, and develop walkable, mixed-use environments respecting compact growth and corridor preservation initiatives of the State Guide Plan and Smart Growth objectives[18].

While TOD has traditionally focused on adapting urban design to meet transit needs, it is also important to think about adapting transit services to existing land-use design. Known sometimes as Development-Oriented Transit (DOT), this approach would call for the innovative use of technology to make transit systems more flexible and reduce waiting times for transfers. The adoption of smart technologies, like automatic vehicle locators for para-transit modes like shuttle vans, jitneys and microbuses and signal priority systems and headway-based schedulers (to mimic dedicated lanes) for Bus Rapid Transit, can provide more effective travel choices[19]. Other transit adaptive options include the promotion of small neighborhood vehicles within the "footprint" of golf carts for local travel on low speed-limit roads, with easy access to parking facilities at bus and rail transit stations.[20]

Improvements in commuter rail trunk service can improve the quality of trips into the Providence Central Business District (CBD) as well as non-CBD trips, if integrated with feeder bus service through a properly timed transfer system. Additionally, it is important to bear in mind that a hybrid system will offer much better service to the poor, disadvantaged and minority riders than an infrequent peak-hour commuter rail system.[21]

[18] The extension of the Boston commuter line to the planned intermodal Airport facility in Warwick and other investments in commuter rail will provide new opportunities for focusing on TOD around stations.

[19] Robert Cervero (1998): *The Transit Metropolis: A Global Inquiry*, Island Press, Washington, DC; http://www.fta.dot.gov/brt/.

[20] Sperling, D., "Toward a Neighborhood Vehicle Vision," Procs., *Conference on The Future of Urban Travel*, 11th Entretiens Jacques Cartier, Lyon, France, December 7, 1998.

[21] John Pucher, "Socioeconomic Characteristics of Transit Riders: Some Recent Evidence." *Traffic Quarterly* July, 1981: 466-476.

A total saving of 75,000 tonnes of carbon was computed for all the Land-Use and VMT strategies taken together. Since this was hard to disaggregate further, we have indicated in the summary tables below that each individual option would save a "fraction of 75,000 tonnes."

OPTION 19 -- SUMMARY TABLE

Parameter	Value
Working group	Transportation and Land-Use.
Option name	Transit Oriented Development And Enhancing Transit Options And Operations Initiative
Sector and market	Urban zoning, transit operators
Technical elements	Primarily integrated land-use zoning and transit planning
Policy/program elements	Coordinated support of local governments, private developers and transit agencies
Existing policy/program	Extension of existing Rhode Island programs, with Smart Growth elements
Rationale	Increase access, increase energy security, reduce GHGs, sprawl, congestion and local air pollution
Energy saved in 2020	Fraction of 31 million gallons (3.6 trillion BTU)
CSE	Not computed
Certainty of savings if option is adopted	Medium
Carbon saved in 2020	Fraction of 75,000 tonnes
CSC	-$500/tonne (2000$).

OPTION 20 – Bicycle and Pedestrian Infrastructures Initiative

In this option, we consider expanding bicycle and pedestrian infrastructures through improved paths and bike lanes, taking measures to address specific roadway hazards (potholes, cracks, narrow lanes, etc.) and improve security for cyclists and pedestrians, providing a better connected street network and clustered development, imposing speed and vehicle restrictions for motorized modes (traffic calming), and providing safety education to all road users[22].

Examples of communities making serious efforts to expand bicycle and pedestrian infrastructures include Copenhagen (www.cios.com), Portland, OR (www.trans.ci.portland.or.us/traffic_management/bicycle_program/BikeMasterPlan/Default.htm), and New York (www.ci.nyc.ny.us/html/dcp/html/bndprods.html#b and www.transalt.org/blueprint).

The Greenspace and Greenways Element[23] of Rhode Island's State Guide Plan includes a goal for creating an interconnected greenway network for the state by 2020. Included within this network of protected open space is to be a 200+ mile bikeway system of on and off-road bicycle routes. The R.I Greenways Council was established in 1995 to coordinate state agency and local efforts to promote greenways in the state. The Rhode Island Department of Transportation and DEM have a Bicycle/Pedestrian Program that plans, designs, and constructs bicycle paths and walking trails; designates on-road bicycle lanes and routes through signing and striping; and distributes educational and other materials.

Currently completed segments in the bike path system include the 14.5 mile East Bay Bike Path, connecting five communities, and portions of the Blackstone, South County, and Washington Secondary bike paths, and Ten Mile River Greenway. Community-wide bicycle route systems are under development in Providence, Cranston, Warwick, and East Greenwich. On-road bicycle lanes have been designated on state roads in a number of communities, including Cranston, Coventry, Narragansett, Providence, and West Greenwich.

In 2000, the DEM and DOT began building an additional 3.5 miles of the Blackstone River Bikeway and designed 7 more miles, and work continued in 2001 on this segment of the project. DOT/DEM are also building roadside rest areas on 295 with links to the Blackstone Path. When completed, the 17.1 mile Blackstone River Bikeway will stretch from Pawtucket to Woonsocket, and eventually to Worcester, Massachusetts. It is being constructed by the Department of Transportation (DOT) and managed by DEM. The Department also began design for a ten-mile bikeway to connect Providence and Cranston to the Connecticut border through Coventry. This bikeway will be part of the East Coast Greenway, a planned 2,500 mile connection linking East Coast Cities from Maine to Florida. The State Greenways Plan, cited above, recommended that

[22] ADONIS (1999), *Best Practice to Promote Cycling and Walking* and *How to Substitute Short Car Trips by Cycling and Walking*, ADONIS Transport RTD Program, European Union (www.cordis.lu/transport/src/adonisrep.htm). See also the report *Collection of Cycle Concepts* by the Danish Road Directorate, in particular, http://www.vd.dk/pdf/cykelrapport/131-162Chapter13.pdf

[23] R.I. Statewide Planning Program, A Greener Path…Greenspace and Greenways for Rhode Island's Future, Providence, RI, 1994.

Rhode Island be the first state to complete its section of the East Coast Greenway, and the state is on track to meet this goal by 2006.

Feasibility or design studies are underway for additional bikepaths, including the Woonasqutucket River Greenway/ Northwest Bikepath, a path along the Newport Secondary rail line on Aquidneck Island, and in Tiverton, and the Trestle Trail segment of the Washington Secondary bikepath in western Coventry. RIPTA has outfitted all its buses with bicycle racks to promote intermodal travel, and reduce auto trips. RIDOT publishes a statewide bicycle system route map to promote cycling, and the Greenways Council has produced a statewide map of all greenways, including bike paths.

The state recently announced plans to link Providence with the East Bay Bike Path via the Washington Bridge. The state bikeway program could be enhanced and expanded through continued integration of bikes with transit; continued investments in expansion of bicycle paths and lanes; in support of the State Greenways Plan, and policies to encourage bike and pedestrian use in central business districts through traffic calming and vehicle restrictions; development of “Bike Stations” providing trip-end services for cyclists, and the innovative use of human-scale street furniture and design (including benches, green traffic islands, street lights, etc.). The Ground Transportation Element of the State Guide Plan recommends a number of these and other measures designed to improve conditions for bicyclists and pedestrians. Other policies could include incentives to employers to provide mileage credits to bicyclists, building of bike racks and lockers at bus stations, and information campaigns to highlight the positive health effects of bike riding.

OPTION 20 -- SUMMARY TABLE

Parameter	Value
Working group	Transportation and Land-Use.
Option name	Bicycle and Pedestrian Infrastructures Initiative
Sector and market	Urban zoning
Technical elements	Minimal – primarily integrated land-use zoning, roadway and sidewalk improvements, and bikeways where feasible and desirable
Policy/program elements	Coordinated support of local governments, private developers and transit agencies
Existing policy/program	Extension of state DOT program, with Smart Growth elements
Rationale	Increase access, increase energy security, reduce GHGs congestion and local air pollution
Energy saved in 2020	Fraction of 31 million gallons (3.6 trillion BTU)
CSE	Not computed
Carbon saved in 2020	Fraction of 75,000 tonnes
Certainty of savings if option is adopted	Medium
CSC	-$500/tonne (2000$).

OPTION 21 – Commuting Efficiency Program

This option considers a number of incentives to improve the efficiency of commuting trips, through special High Occupant Vehicle (HOV) facilities, transit subsidies/vouchers, Park-and-Ride lots, and Guaranteed Ride Home programs to provide an occasional subsidized ride home to commuters who use alternative modes[24]

HOV facilities can be implemented by adding new road capacity designated for HOVs. They include highway and arterial lanes, High Occupancy Toll (HOT) lanes, preferred parking spaces or parking fee discounts provided to rideshare vehicles. Rhode Island may not have capacity for adding HOV-only lanes. Moreover, such lanes could have negative equity impacts if low-income and self-employed commuters are not able to participate in employer-sponsored carpools and vanpools.

Examples of programs to improve commuting efficiency include the King County METRO Commute Partnership Program (http://transit.metrokc.gov), Puget Sound HOV expressways (http://www.wsdot.wa.gov/regions/northwest/hovpage/hovmain.htm), and the New Zealand Bus Priority System (www.akcity.govt.nz/around/transport/transport_strategies/buses_first)

RIPTA currently provides incentives for HOVs such as preferred parking, Guaranteed Ride Home programs, and limited HOV lanes. RIPTA, DEM and DOT have also jointly developed a program to provide free bus service on days when high levels of ozone are likely. Further expansion of these programs would include policies that provide for transit subsidies and parking cash-outs[25], and encourage vanpools. RIPTA has also recently supported legislation for offering group ridership rates for employees in state agencies.

Another potential way to improve commuting efficiency is to introduce policies to encourage station cars, which is a particular form of car sharing, where several individuals have “shares” in a single car and are charged only on the basis of how much they use it[26]. For instance, commuters who might otherwise drive long distances to work would have incentives to drive to nearby transit stations and take station cars at the other end to their workplaces. Station cars may be electric vehicles and require charging facilities near their parking spaces and intelligent electronics for managing reservations, access, user accounts, queues, and station car fleets.

[24] Richard H. Pratt (1999), “HOV Facilities,” *Traveler Response to Transportation System Changes, Interim Handbook*, TCRP Web Document 12 (www4.nationalacademies.org/trb/crp.nsf/all+projects/tcrp+b-12), DOT-FH-11-9579.

[25] In a cashout program, a company essentially pays employees to not drive; the rationale is that since car parking is an expensive commodity, those who use it less than others deserve additional compensation. Employers may also encourage the use of smaller vehicles by providing special spaces for small cars, and even paying employees partial cash-outs for their use.

[26] http://www.stncar.com.

OPTION 21 -- SUMMARY TABLE

Parameter	Value
Working group	Transportation and Land-Use.
Option name	Commuting Efficiency Program
Sector and market	Transportation
Technical elements	HOV facilities and scheduling/monitoring systems, charging infrastructure and intelligent electronics for station car/shared cars
Policy/program elements	Coordinated support of state and federal DOT, local governments, transit agencies
Existing policy/program	Extension of RIPTA, with Smart Growth elements
Rationale	Increase access and energy security, reduce GHGs, congestion and local air pollution
Energy saved in 2020	Fraction of 31 million gallons (3.6 trillion BTU)
CSE	Not computed
Carbon saved in 2020	Fraction of 75,000 tonnes
Certainty of savings if option is adopted	Medium
CSC	-$500/tonne (2000$).

OPTION 22 – Commuting Trip Reduction Initiative

This option differs from Option 21 in that it provides incentives to reduce vehicular trips through telecommunications, telecommuting (including employer-shared local centers) and internet commerce, all of which can substitute for physical travel[27].

Arizona is one of several states that have implemented a telecommuting program at the state level, with the goal of having 15% of government employees in Maricopa County actively participating (http://www.teleworkarizona.com).

Telecommuting is one of several options included in the Rhode Island State Guide Plan (in both the transportation and energy elements). State government policies to encourage flex-time and tele-working could help prime similar efforts in the private sector.

OPTION 22 -- SUMMARY TABLE

Parameter	Value
Working group	Transportation and Land-Use.
Option name	Commuting Trip Reduction Initiative
Sector and market	Industrial and Commercial facilities where telecommunications can partially or fully substitute for employee trips
Technical elements	Remote tele-working facilities, high-speed connectivity
Policy/program elements	Coordinated support of governments, businesses, employers, employees and labor organizations
Existing policy/program	No state policy, but private initiatives that could benefit from state support
Rationale	Reduce dependence on gasoline, reduce GHGs, congestion and local air pollution, increase energy security
Energy saved in 2020	Fraction of 31 million gallons (3.6 trillion BTU)
CSE	Not computed
Carbon saved in 2020	Fraction of 75,000 tonnes
Certainty of savings if option is adopted	Medium
CSC	-$500/tonne (2000$).

[27] See, for instance, *International Telework Association* (www.telecommute.org), and Telecommunications and Travel Research Program http://www.engr.ucdavis.edu/~its/telecom/

OPTION 23 – Government Owned And Private Fleet-Vehicle Efficiency Initiative

Local governments as well as the state can adopt "green fleet" policies, including optimizing efficiency of use, purchasing cleaner vehicles, promoting alternative fuels, etc. Such policies are in effect in many cities around the United States, including Denver, Madison, Los Angeles, and San Francisco[28].

Section 507(o) of the federal Energy Policy Act (EPACT) mandates that state government fleets acquire an increasing percentage of new alternatively fueled vehicles (AFVs), but does not include municipal fleets. EPACT may actually hurt green fleet programs, because more than 75% of federally mandated purchases are AFVs, which tend to be CNG vehicles of higher than average weight. However, municipal and private fleets may provide some limited opportunities for "greening" through the introduction of hybrids and other high efficiency vehicles.

OPTION 23 -- SUMMARY TABLE

Parameter	Value
Working group	Transportation and Land-Use.
Option name	Government Owned And Private Fleet-Vehicle Efficiency Initiative
Sector and market	Fleet vehicles in local and state governments and private enterprises
Technical elements	Procurement specifications
Policy/program elements	Stakeholder processes, commitments
Existing policy/program	EPACT 507(o) for state fleets, none at the local level
Rationale	Fleets provide opportunities to develop a market for more fuel efficient vehicles, to reduce GHGs, air pollution and increase energy security
Energy saved in 2020	0.1 trillion BTU (~1million gallons) in gasoline savings
CSE (cost of saved energy)	$1.84/MMBTU ($0.21/gallon)
Carbon saved in 2020	>2,500 tonnes[29]
Certainty of savings if option is adopted	Low
CSC (cost of saved CO_2)	-$300/tonne (2000$)

[28] See http://www.greenfleets.org/greenfleets_us.html, http://www.ccities.doe.gov/fleet.shtml
[29] Difficult to estimate without additional information about fleet inventories.

OPTION 24 - Urban/Suburban Forestry Program

Given that about 30% of Rhode Island land is already developed, managing and enhancing its tree cover is a natural carbon sequestration strategy with multiple benefits and broad popular appeal. Urban and community trees can remove both conventional pollutants and carbon dioxide from the air.[30] They provide shading that is not only aesthetic but also practical, reducing urban heat island effects, and producing real improvements in summer comfort levels and savings in air conditioning bills of 10-50% (STAAPA/ALAPCO, 1999). They can also reduce winter heat loss by lowering low-level wind speeds. In general, these energy savings produce considerably more GHG benefit (through avoided use of fossil fuels for air conditioning and heat) than the carbon sequestered through growth each year.

The US Forest Service provides grants and support to urban and rural tree planting and landscape improvements through its America the Beautiful Program, the Urban and Community Forestry Advisory Council, the Forest Stewardship Program, and Stewardship Incentive Program. In addition, there are numerous non-profit, private, and community based programs and foundations that support tree planting activities throughout the state. The RI DEM's Division of Forest Environment's Urban and Community Forestry Program is charged with coordination, and works with the R.I. Tree Council, and other community groups to promote enhancement of tree resources in urbanized areas. RIDEM—Division of Forest Environment, the RI Tree Council, and the RI Statewide Planning Program cooperated in development of the Rhode Island Urban and Community Forest Plan, which was adopted in May, 1999 as an element of the State Guide Plan.

According to the Plan, "Rhode Island's urban and community forests face a variety of challenges. Among the key issues are lack of knowledge of the value of trees, insufficient data on tree resources, little or no legal protection for tree resources, insufficient investment in tree resources, and lack of foresight and planning for protection of tree resources in concert with new development."

To tackle these challenges, the Plan has laid out a set of targets and strategies, among them, strengthened legal protection for tree resources. For example, only one quarter of Rhode Island municipalities have tree ordinances, which require that significant tree resources be identified, maintained, and replaced if damaged or removed. Municipalities in some parts of the US are now extending these ordinances to include trees on private lands. The plan suggests several enhancements to ordinances, legislation, and zoning to enhance the urban and community tree resource.

Rhode Island and its communities should seek to manage the state's urban and community forests as follows:

- the state as an entirety should seek to maintain forest land cover at approximately 55 percent of total land area through the year 2020.

[30] Trees can increase levels of volatile organic carbon, which can contribute to troposphere ozone formation, but the benefits of trees in reducing urban heat islands and energy usage far outweigh the risks of increasing local VOC levels.

- communities having 50 percent or higher forest land cover in the 1995 land use survey, should seek to avoid a more than 2 percent decrease below their 1995 baseline of forest land cover through the year 2020.
- communities having 20-49 percent forest land cover in the 1995 land use survey, should seek to increase their forest land cover by 4 percent over the 1995 baseline by the year 2010, and by 8 percent over the 1995 baseline by 2020.
- communities having less than 20 percent forest land cover in the 1995 land use survey, should seek to increase their forest land cover by 2 percent over the 1995 baseline by 2010, and by 5 percent over the 1995 baseline by 2020.

Overall, the plan is to enhance tree canopy by 5-8% by 2020 in 24 urban/suburban communities. The Urban and Community Forestry Plan targets limiting canopy loss to 2% in 15 rural communities. But equally important will be implementation of the State Guide Plan's policies to encourage "urban infill" and revitalization of Rhode Island's core cities. As pointed out in the Grow Smart Rhode Island report, The Costs of Suburban Sprawl and Decay in Rhode Island, *"Rhode Island can solve its suburban sprawl problem only if it solves its urban decay problem."*

OPTION 24 – SUMMARY TABLE

Parameter	Value
Working group	Transportation and Land Use
Option name	Urban/Suburban Forestry Program
Sector and market	Urban and Community Forestry
Technical elements	Tree planting; enhanced protection and management of existing trees and forests
Policy/program elements	Raise awareness to decision makers; provide increased legal protections for trees and forests; develop urban design guidelines, etc.
Existing policy/program	RI Urban and Community Forestry Plan; existing tree ordinances
Rationale	Carbon sequestration, aesthetic amenity, community and air quality benefits
Carbon saved in 2020	30-120,000 tonnes C[31]
Certainty of savings if option is adopted	Low
CSC (cost of saved C)	Possible net benefit (societal perspective)

[31] According to STAAPA/ALAPCO (1999), a 10yr program to increase residential canopy cover by 10% and other urban cover by 5-20% could sequester 3-9 million tC/yr, while yielding 7-29 million tC/yr in heating and cooling savings. Rough estimates shown are scaled to RI population.

OPTION 25 – Open Space Protection Program

The loss of open space in Rhode Island, through conversion to residential as well as commercial development, has been a cause for public concern in terms of reduced recreation, buffer zone, and visual amenity. Residential acreage climbed from 89,000 acres to almost 140,000 acres between 1970 and 1995. The state lost 20,000 acres of forest 1985-1998.

These shifts have also meant significant reductions in carbon storage. According to the RI inventory, the loss of forestlands translates to 85,000 tonnes C per year in net emissions.

Open space protection is therefore not only land use policy, but also one with potentially potent carbon mitigation benefits. Indeed, open space protection is a featured element of climate action plan in New Jersey, a state that faces similar pressures from expanding suburban residential development. (NJ DEP, 1999). RI has a distinguished history of land protection and public park creation which reaches back to the Metropolitan Park Commission plan of 1903. Beginning in the 1960s with the Green Acres Program, Rhode Island has continuously pursued protection of critical resource lands via a succession of recreational, open space, fisheries and wildlife, natural heritage, and agricultural land preservation initiatives, By the early 1990s, state, local, and private efforts had protected approximately 13 percent of the state's land area. Land protection in recent years has been significantly boosted by private foundation support and the involvement of private conservation groups such as The Nature Conservancy, Trust for Public Land, and the creation of numerous local land trusts, both private and municipal, throughout the state.

The Greenspace and Greenways Element of the State Guide Plan, approved by the State Planning Council in 1994, challenged the state to create a statewide greenspace network protecting fully one-third of the state's land area over time. A specific goal of protecting 35,000 acres by 2020 via public acquisition and creative development practices was established by the plan. Under a recent initiative by Governor Almond and the General Assembly, this land protection goal was accelerated to 2010 via passage of a $34 million Open Space bond issue in 2000. In 2001, through the combined efforts of many governmental and non-governmental entities, Rhode Islanders protected over 3,400 acres of important resource lands[32].

Continuation of policies to create an integrated statewide greenspace network protecting Rhode Island's critical environmental resources could support strategies to reduce greenhouse gases, not only via sequestration of carbon, but via indirect support of option 19, which advocates a more compact pattern of development. Protection of resource lands is a necessary complement to policies encouraging more compact development patterns. Sustainable funding sources to underwrite state and local open space protection efforts would help insure the attainment of the carbon savings potential of this option.

[32] R.I. Department of Environmental Management, Land Acquisition Program Report for Fiscal Year 2001. Providence, RI. 2001.

OPTION 25 – SUMMARY TABLE

Parameter	Value
Working group	Transportation and Land Use
Option name	Open Space Protection Program
Sector and market	Land use planning
Technical elements	Reducing sprawl; denser development; land use protections and zoning
Policy/program elements	Raise awareness to decision makers; zoning and land use planning and ordinances; incentives for urban densification, etc.
Existing policy/program	RI Urban and Community Forestry Plan
Rationale	Carbon sequestration, cultural/historical/aesthetic benefits, buffer zone
Carbon saved in 2020	60,000 tonnes C [33] (may include some overlap with urban and community forestry targets above)
Certainty of savings if option is adopted	Low
CSC (cost of saved C)	Hard to quantify, driven by co-benefits

[33] RI lost about 1450 acres/year of forest, 1985-1998. The average biomass is (9,350,000 tons C tree + 4,500,000 tC forest floor + 280,000 tC understory + 19,800.00 soil tC)/393,000 acres or 86 tons/acre, or 79 metric tC/acre. At that rate of forest loss, RI loses about 114,000 tC per year to forest conversion. The rough estimate shown assumes that about half the loss could be stemmed through better land use planning, higher-density development, etc. This deserves closer analysis as to what is achievable, as well as the reliability of forest loss and soil carbon loss estimates. It is estimated that continuation of current policies will be more than adequate to meet this target.

OPTION 26 -- Renewable Portfolio Standards

A Renewable Portfolio Standard (RPS) is a market-oriented policy for accelerating the introduction of renewable resources and technologies into the electric sector. An RPS sets a schedule for establishing a minimum amount of renewable electricity as a fraction of total generation, and requires each supplier that sells electricity to meet the minimum either by producing that amount of renewable electricity in its mix or acquiring credits from generators that exceed the minimum.

The market determines the portfolio of technologies and geographic distribution of facilities that meet the RPS target at least cost– i.e., the lowest difference between the renewable and its avoided generation - subject to the RPS's eligibility requirements. Thirteen states – Arizona, Connecticut, Hawaii, Iowa, Maine, Massachusetts, Minnesota, Nevada, New Jersey, New Mexico, Pennsylvania, Texas, and Wisconsin – already have established RPSs or similar measures.

A bill was proposed in the RI legislature for an RPS.[i] This bill would have required that at least 3% of the electricity provided by any electricity supplier (as a percentage of energy) in the state be generated using renewable energy sources by January 1, 2005, and 20% of the electricity supplied be generated using new renewable energy sources by December 31, 2020. Moreover, several pieces of proposed Federal energy legislation have included a national RPS provision, including a bill introduced by Senator Jeffords in the 106th Congress (S. 1369) to establish a national RPS target of 20% non-hydro renewables by 2020.

Regarding the characteristics of an RPS, several dimensions need to be addressed, as follows:[ii]

- Eligibility: type of generation, as well as vintage (new versus existing resources).

- Geographic scope: an appropriate geographic scope for an RPS policy is the New England region, which is well interconnected and has a tightly-run Power Pool. A Rhode Island RPS to encourage developers anywhere in New England to meet a specified renewable generation target level would result in carbon reductions attributed to the State. ISO New England established a Generation Information System (G.I.S.) supporting a tradable certificate market within New England to facilitate low-transaction cost compliance and verification for RPS and other state mandates in the region.

- Renewable generation target: the magnitude of the potential carbon savings depends on the target. In the Table below, a 20% target by 2020 for ISO New England is assumed, consistent with the Jefford's Bill target for the nation as a whole. In interpreting/projecting RPS benefits, one needs to examine incremental reductions. An RPS for which existing renewables are eligible cannot be said to have unambiguously lead to 20% increase in renewables. On the other hand, without the RPS, many existing renewables may cease to operate. It is practically very difficult, if not impossible, to determine what proportion of generation is truly above what would have happened in lieu of the RPS.

Several recent studies have been conducted to assess the costs of an RPS at the national level.[iii] There have also been recent studies to assess the costs and other potential effects of an RPS in the State of Massachusetts.[iv]

The MA RPS and the RPS recently introduced into the RI Legislature are similar. However, they differ with respect to the level of renewable generation required, as summarized in the table below.

Table 1.3.1 Comparison of renewable energy target levels in the MA RPS and the Proposed RI RPS

Year	RI Proposed RPS (% of energy provided)	MA RPS (% of sales)
2003	NA	1.0%
2004	NA	1.5%
2005	3%	2.0%
2006	Increment as per RI PUC	2.5%
2007	Increment as per RI PUC	3.0%
2008	Increment as per RI PUC	3.5%
2009	Increment as per RI PUC	4.0%
2010-2019	Increment as per RI PUC	+1.0%/year until suspended
2020	20.0%	by the Division of Energy
Post-2020	+1.0%/year	Resources (maximum of 14% by 2020 at this rate)

The cost, price and emissions impacts an RPS just in RI have not been determined. However, Table 1.3.2 summarizes the impacts of an RPS applied at the national level and at the state level in MA.[v] Annex C to the ESW Scoping Paper provides a discussion of the cost impact of the RPS at the national and state level, as determined in two recent studies.

It is important to note the following:

- The national and MA analyses can not be directly compared due to the fact that they are driven by different target assumptions and different analysis methodologies;
- The results of the national-level RPS analysis represent the incremental impacts of a national RPS after efficiency and other emissions policies are in place
- For the MA RPS it is likely the cost of saved carbon, if averaged over a period extending to 2020 would be higher.

For scoping purposes, we recommend that both the lower and upper estimates for the cost impact of the RPS be considered as upper bounds. It is important to stress that, as discussed in Annex 1 of this Appendix, that the cost impact of an RPS could be negative depending on a range of factors that affect costs (e.g., supply feedback effects).

We assess the potential cost and impact of an RPS as follows. Assuming a target of 20% non-hydro renewable generation by 2020 for ISO New England, and a marginal ISO NEW ENGLAND carbon intensity of 0.101 tC/MWh, the annual carbon reductions would be about 140,600 tC, at a cost of between $46/tonne and $230/tC avoided, assuming all renewables are incremental. This is summarized in the Option Summary Table.

Table 1.3.2 Estimated Impacts of an RPS policy

Category	Parameter	National	MA
Target	*Level achieved*	20%	4%
	Year achieved	2020	2009
Cost Impacts	*Costs (NPV, billions 1999$)*	19	NA
	Renewable energy credit trading price (c/kWh)	2.7	NA
Change in Average Electricity price	*Average (1999 cents/kWh)*	0.57	NA
	Minimum (2003) (2000 cents/kWh)	NA	0.02
	Maximum (2009) (2000 cents/kWh)	NA	0.10
	Natural gas price ($/MMBTU) [vi]	-0.11	NA
Emission Reductions (2020 for National; 2009 for MA)	*Carbon (million tones of carbon equivalent)*	81	0.7
	Carbon Monoxide (thousand tons)	26	NA
	Nitrogen oxides (thousand tons)	468	1.25
	Sulfur dioxide (thousand tons)	1,708	8
	VOCs (thousand tons)	4	NA
	PM-10 (thousand tons)	38	NA
Cost of saved carbon ($ per Mt C)		46	230

OPTION 26 -- SUMMARY TABLE

Parameter	Value
Working group	Electric Supply and Solid Waste
Option name	Renewable Portfolio Standards
Sector and market	Electric supply
Technical elements	Renewable energy technology installations
Program elements	Market renewable credit trading regime to meet a 20% target in 2020
Existing policy/program	None.
Rationale	Reduce carbon emissions
Energy saved in 2020	1,392,400 MWh (or 20% of Baseline total electricity generation).
CSE (cost of saved energy)	Estimate 2 – 4 ¢/kWh above commodity, corresponding to approximately 5.5 – 7.5¢/kWh
Carbon saved in 2020	140,600 tC
CSC (cost of saved C)	$46/tonne (National RPS)[vii] and $230/tonne (MA RPS)

OPTION 27 -- Resource Management (RM) Contracting Initiative

A Resource Management (RM) option consists of contracting for non-residential waste service with incentives for service providers to foster waste diversion. An overview of RM contracting – how it could be implemented, what the benefits are to generators and contractors – is provided in Annex A.

RM contracting typically reduces non-residential waste generation by up to 20 percent and increases the "recycling rate" by up to 14 percentage points. In general, commercial solid waste management contracts do not cover recycling and do not include any incentives to recycle, where PAYT does.

One can expect an average range of 0.62 to 0.99 tC-equivalent avoided for each tonne of non-residential solid waste avoided through Resource Management strategies.[viii] Assuming current commercial/industrial solid waste generation in Rhode Island is 510,000 tons and assuming a 50% efficacy of the policy (i.e., 17%), one could expect to avoid 86,700 tons of solid waste and between 53,750 tC to 85,800 tC from the implementation of a RM policy.

One can expect an average range of between 25 and 48 Mmbtu avoided for each tonne of non-residential solid waste avoided through Resource Management strategies. The basis for this estimate is a document prepared for the USEPA.[ix]
A summary of this policy is shown in the table below.

OPTION 27 -- SUMMARY TABLE

Parameter	Value
Working group	Electric Supply and Solid Waste
Option name	Resource Management (RM) Contracting Initiative
Sector and market	Waste Management Services
Technical elements	Waste Prevention, Recycling and Composting
Program elements	RM Contracting
Existing policy/program	Not known
Rationale	Reduce carbon emissions
Energy saved in 2020	Not Available
CSE (cost of saved energy)	Not Available
B/C benefit-cost ratio	RM reduces the cost of solid waste services, saves landfill space, reduces energy use and related pollutant emissions
Carbon saved in 2020	53,750 tC - 85,800 tC
CSC (cost of saved C)	Because the cost of waste services are reduced the cost will be negative[x]

OPTION 28 – Pay-As-You-Throw (PAYT) Initiative

Typically, households pay for waste collection through either property taxes or some form of fixed fee. These payments are made regardless of the quantity of waste that is generated. In contrast, under a PAYT policy, households pay a variable rate depending on the amount of the commodity they use. Communities that have a PAYT system in place either charge residents a fee for each bag or can of waste they generate, or charge residents based on the weight of their trash. In either case, the less waste that households generate, the less they pay.

Communities in Rhode Island that have some type of pay-as-you-throw system in place for solid waste include Westerly/Hopkinton, Richmond, New Shoreham, North Kingstown and South Kingstown/Narragansett. In addition, Pawtucket and Barrington have conducted feasibility studies utilizing grants from DEM.

Adopting Pay-As-You-Throw (PAYT) pricing for residential waste services could be widely implemented by municipalities in Rhode Island. Under most PAYT systems, recycling services are "free" to the household, with recycling costs recovered as part of the fee for waste disposal. Recycling costs would be recovered as part of the fee for disposal. This policy will contribute to both reductions in waste generation and increases in recycling. The carbon saved depends on the extent of the diversion projected in Rhode Island. PAYT decreases residential waste generation by up to 14 percent and increases recycling rates by up to 13 percentage points. One can expect an average range of between 0.62 and 0.99 tC-equivalent avoided for each tonne of solid waste avoided.[xi] Assuming current residential solid waste generation in Rhode Island is about 510,000 tons, and assuming a 50% efficacy of the policy (i.e., 13.5%), one could expect to avoid 68,850 tons of residential waste and between 42,700 tC to 68,200 tC from the implementation of a PAYT policy. A summary of this policy is shown in the table below.

OPTION 28 -- SUMMARY TABLE

Parameter	Value
Working group	Electric Supply and Solid Waste
Option name	Pay-As-You-Throw (PAYT) Initiative
Sector and market	Waste Management Services
Technical elements	Waste Prevention, Recycling and Composting
Program elements	PAYT Pricing
Existing policy/program	Not known
Rationale	Reduce carbon emissions
Energy saved in 2020	Not Available
CSE (cost of saved energy)	Not Available
B/C benefit-cost ratio	PAYT reduces the cost of solid waste services and provides ancillary societal benefits
Carbon saved in 2020	42,700 - 68,200 Tc
CSC (cost of saved C)	Because the cost of waste services are reduced the cost will be negative – Net Savings[xii]

OPTION 29 – State Facilities Renewable Purchase Requirement

A State renewable purchase requirement is similar in concept to an RPS. It stipulates a date and level by which a portion of total electricity consumption by state agencies is met by renewable energy sources.

New York, Maryland, and New Jersey have adopted this approach. In New York, Executive Order 111 called for state agencies to obtain 10% of their electricity needs from renewable sources, such as wind, solar, biomass, geothermal, and fuel cells by 2005, with the percentage increasing to 20% by 2010. The order applies to state buildings and those of quasi-independent organizations. The order also calls for state agencies to implement energy efficient practices, increase purchases of energy efficient products, and follow green building standards for new construction and renovation projects. In New Jersey, the current renewable purchase level is 152,000 MWhs or 15% of the bid state contract for electricity which was estimated to be 85% of the state facilities electric use. Rhode Island could establish a similar purchase requirement.

We assess the potential cost and impact of a purchase requirement as follows. Assuming a funding level of $1 m distributed over a 10-year period, and an average renewable premium of $0.025/kWh, the average annual generation from this direct investment is about 4,000 MWh per year. At a marginal ISO NEW ENGLAND carbon intensity of 0.101 tC/MWh, the annual carbon reductions would be about 400 tC. This is summarized in the Table below.

OPTION 29 -- SUMMARY TABLE

Parameter	Value
Working group	Electric Supply and Solid Waste
Option name	State Facilities Renewable Purchase Requirement
Sector and market	Electric supply
Technical elements	Expenditures on electricity from renewable energy
Program elements	Establish targets
Existing policy/program	None.
Rationale	Reduce carbon emissions
Energy saved in 2020	4,000
CSE (cost of saved energy)	Estimate 2.5 ¢/kWh above commodity, corresponding to approximately 6 ¢/kWh
Carbon saved in 2020	400 tC
CSC (cost of saved C)	$250/tonne [xiii]

Lower Priority Consensus In-State Options

OPTION 30 -- Compact Floorspace Initiative

Many of the options set forth in this Plan imply little change in end-use services received from energy use. Each option is largely a “technical fix” that produces or uses energy in a way that yields lower GHG emissions. The working group may also wish to consider options that reduce GHG emissions through modifications to current and expected life styles.

The long-term trend in new buildings has been toward continually increasing floorspace in relation to the use of the building. A “compact floor space” option would aim to reverse this trend. It would be a voluntary initiative to encourage residential and commercial facilities to reduce their floorspace in the future. Reduction in floorspace per resident or employee will in turn reduce energy use and GHG emissions.

This initiative would be innovatively different from other existing state and national efforts to improve the efficiency of energy use. It is somewhat related to the stirrings of interest in reducing “sprawl” in recent years. Organization of the initiative would depend on groups and agencies with an interest in minimizing the land, energy, and environmental impacts of development coming together to create a long-term strategy and program.

From a societal viewpoint, there would be some costs to organizing a compact floorspace initiative, which would be more than offset by reduced construction and operating costs. While no costs are calculated for this option, reductions in energy use are based on energy consumption for heating and cooling in the National Energy Modeling System. Our calculations assume that the option is targeted to the residential sector, and that 10% of new houses reduce their floor space by 25%.

One complementary initiative might be to promote greater density of land use in residential construction. For example, state policies to promote greater density in local zoning could be explored. As the main GHG benefits of increased density would arise from transportation-related energy savings, this option is addressed in the Scoping Paper for the Transportation Working Group.

OPTION 30 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Compact Floorspace Initiative
Sector and market	New and renovated residential buildings.
Technical elements	Design changes for more compact floor space.
Policy/program elements	Organization of a movement for visioning, education, and technical assistance.
Existing policy/program	None.
Rationale	Begin to address the “life style” elements of the challenge of environmentally sustainable development.
Energy saved in 2020	6,800 MWh; 240,000 MMBtu of fossil fuel.
CSE	n/a.
B/C	n/a.
Carbon saved in 2020	5,000 tonnes.
CSC	-$400/tonne.

OPTION 31 -- Switching From Electricity To Fossil Fuel Heating

A small amount of residential housing in Rhode Island is heated by electricity. This new option would promote the choice of gas or oil heat rather than electricity for full-sized houses (non-recreational), in order to realize the lower carbon emissions from heating with fossil fuels. Electric space heating systems tend to have lower capital costs but higher operating costs than fossil fuel systems. The life-cycle cost of fossil fuel heating is slightly lower. However, including the cost of converting an electrically heated house to fossil fuel heating is significant and leads to an overall cost for this option. A non-economic benefit of promoting switching to fossil heating systems is the reduction in air emissions, including carbon. The carbon intensity of fossil fuels for space heating is lower than that of electricity.

OPTION 31 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Switching From Electricity To Fossil Fuel Heating
Sector and market	New or replacement applications where electric heat would have been chosen.
Technical elements	Install gas or oil furnaces.
Policy/program elements	To be developed.
Existing policy/program	No existing program promotes fuel conversion.
Rationale	Fossil fuels are less carbon intensive than electricity.
Energy saved in 2020	54,000 MWh electricity, increased consumption of 135,000 MMBTU gas and 90,000 MMBTU oil.
CSE	0.
B/C	0.
Carbon saved in 2020	1,300 tonnes.
CSC	$170/tonne (2000$).

EXISTING DSM OPTION 32 -- Solar Photovoltaic (PV) Buydown Program

Solar photovoltaic cells systems (PVs) convert sunlight into electricity. The cells are usually made of silicon. Individual cells are wired together to make modules. PV cells produce direct current electricity, which is converted to alternating current by a conditioner that forms part of the PV system. Various controls form the balance of the system. There are no carbon emissions from PVs.

Though the capital costs of PV systems have been declining, on a $/kW basis they remain substantially higher than many other renewable resources. For this reason, many states have implemented policies or programs to promote further market penetration of PVs.

More broadly, a number of measures have been implemented across the U.S. to promote greater use of several renewable energy resources so that the technology learning curve may be shifted due to increased installations of them. In Rhode Island, renewable resources are promoted by several underlying State policies as well as by programs based on systems benefit charge (SBC) funding. Only customer-side SBC-based programs are considered an option here, as they constitute DSM. Other state policies on renewables are either reflected in the baseline forecast or are treated in the electricity supply option area.

The major existing "non-DSM" policies or programs are as follows:

- Tax policies relating to renewable technologies: new direct solar thermal water and space heating systems, solar thermal electricity, wind power, and solar PVs. The policies are: (1) rebate of all sales tax, (2) a credit on personal income tax, which declines year to year, and (3) local property tax is capped at the cost of a conventional energy system. All three end after 2004; prospects for further tax policies are unknown.
- A net metering rule was created by the Public Utilities Commission in 1985 and is expected to continue. Renewable generation is netted against the customer's retail electric rate, with excess annual generation purchased at utility avoided costs. PV is eligible.
- Energy Office grants for renewable energy projects on Block Island. There are some PV projects, most of which are grid-connected and net metered.
- Some supply side renewable programs funded through the SBC, as discussed in the electricity supply/ solid waste area scoping paper.

The major existing DSM program in place that affects PVs is the PV and small wind rebate program designed by the multi-party Rhode Island Renewable Energy Collaborative. The program makes available a buy-down of $3 per Watt to residences or businesses, up to 50% of the total installed cost of the system. Approved vendors must be used. A buy-down of $1.50 per Watt is also available for small wind power systems of less than 10 kW total capacity. In addition, a grant from SBC funds promotes installation of PV systems on the rooftops of school buildings.

This option assumes that the PV/small wind program and SBC funding for it are renewed and continued, along with grants to schools or other facilities for rooftop PVs, at levels in the year 2001 Narragansett DSM and Renewables budget. The projection of impacts is based upon PV installations caused by these programs during 2002-2012. Based on PV lifetimes, the total cumulative impact is effective through and after 2020. (After 2012, the costs from PVs may have come down sufficiently that they are effectively promoted by broader renewable resource policies.

OPTION 32 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Solar Photovoltaic (PV) Buydown Program
Sector and market	All buildings and facilities
Technical elements	Customer-side on-site PVs installed by approved vendors.
Buydown program elements	SBC support for up to 50% of installed PV system cost, at $3/Watt.
Existing policy/program	This option represents renewal and continuation of the existing SBC based program.
Rationale	Reduce carbon emissions while contributing to the “learning curve” for this technology.
Energy saved in 2020	2100 Mwh. This is energy generated by PVs and thus saved from the grid.
CSE (cost of saved energy)	$0.15/kWh.
B/C benefit-cost ratio	0.3.
Carbon saved in 2020	1,000 tonnes.
CSC (cost of saved CO_2)	$1,200/tonne (2000$).

OPTION 33 -- Active Solar Hot Water Heating Initiative

Active solar water heating systems collect and store thermal energy from the sun in order to heat water for domestic and small commercial use. Like PVs, they are usually installed on roofs. A number of the underlying renewable energy policies notes in the description of option 35, the PV buydown program, apply to active solar water heating systems. To provide backup, a conventional water heater must be installed along with the SWH. The cost of active solar water heating is quite high, about $3500 installed. This cost has severely limited its market penetration.

Option 6 is creation of a DSM-type program to provide additional support for solar water heating. Our calculations assume that an active solar DSM program operated throughout the analysis period leads to limited replacement of gas water heating and electric water heating Funding would come from gas or electric DSM or from State Energy Office sources.

R.I. law (§ 34-40) provides for solar easements, which protect access to sunlight when solar systems are installed. Granting of easements is voluntary under present law. Strengthening of solar access rights could increase the feasibility of offering this DSM option successfully,

OPTION 33 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Active Solar Hot Water Heating Initiative
Sector and market	New or existing residences.
Technical elements	Active solar water heating (SWH) systems.
Policy/program elements	Funding to market and incent SWH based on DSM or Energy Office funding.
Existing policy/program	No existing DSM program promotes this equipment.
Rationale	Though tax credits are available for active SWH, very few are installed in the State at the present time.
Energy saved in 2020	22,000 MMBtu gas, 4,700 MWh electricity.
CSE	$23/MMBtu gas, $0.10/kWh electricity.
B/C	0.4.
Carbon saved in 2020	800 tonnes.
CSC	$1,100/tonne (2000$).

OPTION 34 -- Non-Residential Natural Gas Air Conditioning Initiative

While gas air conditioning could be promoted under New England Gas Co.'s existing DSM program, that program does not specifically target this option. It may be desirable to target gas AC in particular because it can help to reduce electric loads during summer peak periods when aggregate electric system demand and GHG emission rates are high.

We have assumed a targeted gas DSM initiative focusing on the applications with the most favorable customer economics for gas AC, namely, where the gas system can replace electric cooling and water heating on a combined basis. This is a limited application but it is the set-up with the most favorable economics.

OPTION 34 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Non-Residential Natural Gas Air Conditioning Initiative
Sector and market	All existing nonresidential buildings and facilities.
Technical elements	In lieu of electric centrifugal chiller and electric water heating, installing gas-fired engine-driven commercial chiller systems that recover heat in the form of hot water (replacing the electric boiler)
Policy/program elements	Technical and financial assistance (incentives and financing).
Existing policy/program	This option represents a new DSM component implemented in 2002 and continuing until 2020.
Rationale	Increase use of gas cooling during periods of peak electricity use, to lower electricity costs and to reduce air pollution and GHG emissions.
Energy saved in 2020	1087 MWh, increased gas consumption 4,517 MMBTU
CSE	$0.052/kWh
B/C	0.76
Carbon saved in 2020	40 tonnes
CSC	$309/tonneC

OPTION 35 – Fleet Fuel GHG Content Mandate

This option considers policies at the national and state level that would reduce the GHG content of fuels. Some fuels, such as ethanol blends, are in limited use nationally. Others, such as ethanol made from biomass, will require new production technologies, minor changes in vehicles and engines, and new fuelling infrastructures.

In Rhode Island, $4.5 million in Congestion Mitigation and Air Quality Improvement Plan (CMAQ) funds have been awarded to the Ocean State Clean Cities Coalition, locally-based government/based partnership, to build or upgrade Compressed Natural Gas (CNG) stations to support buses and state fleet vehicles[34]. The coalition will also use the CMAQ money to fund the incremental cost of 250 Alternative Fuel Vehicles (AFVs) and to support training and public outreach activities. In addition, the Rhode Island AFV Incentives Act of 1997 provides tax incentives for using alternative fuels.

We consider in this option further incentives aimed specifically to reduce GHG fuel content by displacing 7% of gasoline use in the state with ethanol by 2020.

OPTION 35 -- SUMMARY TABLE

Parameter	Value
Working group	Transportation and Land-Use.
Option name	Fleet Fuel GHG Content Mandate
Sector and market	All light-duty vehicles
Technical elements	AFVs, Re-fueling Infrastructure for AFVs
Policy/program elements	Stakeholder processes, commitments, public outreach
Existing policy/program	AFV Incentives Act, and extension of state CMAQ Plan to cover cellulosic ethanol[35] with supplementary EPACT support. Additional outreach and incentives for private vehicles.
Rationale	Reduce dependence on gasoline, reduce GHGs, reduce local air pollution, increase energy security
Energy saved in 2020	16.5 million gallons (1.9 trillion BTU)
CSE	Not computed
Carbon saved in 2020	40,000 tonnes
Certainty of savings if option is adopted	High
CSC	$100/tonne (2000$)

[34] http://www.osccc.state.ri.us/
[35] Note that increased use of cellulosic ethanol, in particular, has GHG reduction benefits due to reduction of refinery power and fuel use and reduction of GHG emissions in gasoline. However, there may be a slight reduction in fuel economy in ethanol-gasoline blends.

OPTION 36 – Conversion of Marginal Cropland to Forest Initiative

In Rhode Island, as throughout the US, there are marginal farmlands, land that is either unsuitable or unprofitable for farming in today's market. There are competing viewpoints on how to manage these lands from a public policy perspective, given that farms, even if not actively managed, provide cultural, aesthetic and open space benefits. At the same time, converting such lands to permanent cover, such as grasses, trees, or wetlands, can reduce farm fuel and chemical use and the emissions associated with their manufacture and use, as well as non-point source pollution and soil erosion. Conversion of marginal farmlands to forest can increase soil and above ground carbon levels by 1 to 3 tonnes of C per acre per year, depending on the ultimate land cover[36]. A recent report by the Coalition of Northeastern Governors (CONEG) cites a figure of 19,400 acres for marginal cropland and pasture in Rhode Island. If all this land were converted to forest over the next 20 years, 19,000-58,000 tonnes of C per year could be removed by 2020[37].

The potential costs and feasibility of conversion depend in part on the policies used to compensate farmers, and the on tax treatment and financial viability of the avoided farming. Policies and programs to retire marginal farmland are well established, with the long history of programs such as the Soil Bank and the Conservation Reserve Program to draw upon. The CRP, for instance, provides cost-sharing for land preparation and planting as well as land rentals that average $50/acre-yr. Assuming similar payments were required in Rhode Island, the resulting cost would be about $25/tC.

OPTION 36 – SUMMARY TABLE

Parameter	Value
Working group	Transportation and Land Use
Option name	Conversion of Marginal Cropland to Forest Initiative
Sector and market	Agriculture
Technical elements	Tree planting; site restoration; rental payments or other arrangements with farmers
Policy/program elements	Financial incentives to farmers
Existing policy/program	National Conservation Reserve Program
Rationale	Carbon sequestration
Carbon saved in 2020	40,000 tonnes C
Certainty of savings if option is adopted	Low
CSC (cost of saved C)	$25/tonne (rental payments only)

[36] STAAPA/ALAPCO. 1999. *Reducing Greenhouse Gases and Air Pollution : A Menu of Harmonized Options.* Washington, DC.
[37] Irland, Lloyd C. and Mike Cline, February 20, 1999. *Role of Northeastern Forests and Wood Products in Carbon Sequestration*: Report to Northeast Regional Biomass Program CONEG Policy Research Center, Inc., New York State Energy Research and Development Administration, College of Environmental Science and Forestry, SUNY, New York.

OPTION 37 – Conversion of Marginal Cropland to Wetlands Initiative

Conversion of cropland to wetland can result in gains of 0.06 to 0.14 tonnes C/acre-yr. (STAAPA/ALAPCO, 1999). However, wetlands also can create anaerobic conditions that result in methane emissions, which can ultimately offset any gains from carbon sequestration on a net GWP basis. While the creation of new – or restoration of original – wetlands could provide many ecological benefits, we do not suggest that this option be considered a GHG mitigation option until the further research is done to establish the net GHG balance (carbon sequestration net of potential methane emissions) from newly created Rhode Island wetlands. Site-specific research would be required to establish this balance and is thus beyond the scope of this effort[38].

OPTION 37 – SUMMARY TABLE

Parameter	Value
Working group	Transportation and Land Use
Option name	Conversion of Marginal Cropland to Wetlands Initiative
Sector and market	Agriculture and Forestry
Technical elements	Wetland restoration; rental payments or other arrangements with farmers
Policy/program elements	Financial incentives to farmers
Existing policy/program	National Conservation Reserve Program
Rationale	Carbon sequestration, wetland restoration
Carbon saved in 2020	<1500 tonnes C (assuming no offsets from methane emissions)
Certainty of savings if option is adopted	Low
CSC (cost of saved C)	$25/tonne (assuming rental payments only)

[38] Restoration of coastal and freshwater wetlands is already an active policy of the state. Agencies are proceeding as they are able to raise funds, but they are seeking legislative approval for a defined source of funding to systematically restore wetlands and other degraded habitat. Baseline and post-restoration data could be collected from these sites for further investigation.

OPTION 38 – Low Input Agriculture and Improved Cropping Systems Initiative

Low input farming techniques, such as integrated pest management and organic farming, have been discussed as a GHG mitigation options (e.g., STAAPA/ALAPCO, 1999). However, there are little data from which to base the amount of possible reductions, which might result from the reduced application of nitrogen fertilizers (lower N_2O emissions) and the incorporation and retention of more organic matter in the soil (C sequestration). STAAPA/ALAPCO (1999) estimates that other improved cropping techniques such as cover crops and increased fertility could remove about 0.02-0.06 tC/acre-yr.

OPTION 38 – SUMMARY TABLE

Parameter	Value
Working group	Transportation and Land Use
Option name	Low Input Agriculture and Improved Cropping Systems Initiative
Sector and market	Agriculture and Forestry
Technical elements	Minimal
Policy/program elements	Education and outreach
Existing policy/program	None?
Rationale	Carbon sequestration
Carbon saved in 2020	<400 tonnes C (assuming no more than 10,000 acres at 0.02-0.06 tC/acre)
Certainty of savings if option is adopted	Low
CSC (cost of saved C)	Net economic benefit from a social perspective. Conservation tillage credits are selling in ERC market for about $2-$6/tonne[39].

[39] Personal communication, JP Moscarella, Econergy, based on Iowa Farm Bureau.

OPTION 39 – Forest Management Initiative

Forest management is an often-promoted mechanism for sequestering carbon. Changing forest management practices can help forests grow faster or retain more biomass above or within the soil layer. Longer rotations, species selection, optimum stocking, low-impact harvesting, safeguarding regeneration (e.g. from pests and fire), fertilization, and weed control are among the specific techniques that can be used. In fact, many of these methods are already in wide use today, and are an important reason that US forests are sequestering nearly 288 million tonnes C per year, an amount equal to about 20% of national carbon emissions from fossil fuel combustion. Some estimates have pegged the role of forest management activities themselves at about 100-200 million tonnes C per year, more than 5% of US current net GHG emissions[40]. The large magnitude of these figures, and the fact that many forest management techniques are already "business-as-usual" practices -- or that they should be for reasons intrinsic to sound forest stewardship -- have led many to question whether they should be considered valid mitigation measures in the context of the Kyoto Protocol or local emissions targets.

Compared with the US as a whole, forest management has a more limited role and potential in the Northeast, and specifically within Rhode Island. Northeast forests have been storing carbon annually through their net growth. The Rhode Island inventory estimates that growth in existing forests increases the stock of carbon by 56,000 tonnes C per year, only 0.02% of the total annual sequestration in the US[41]. Moreover, some suggest that this rate of accumulation cannot be increased very much (Irland and Cline, 1999). Only 2% of Northeast forests are cut each year, leaving limited opportunity to improve tree selection and harvest techniques, implement longer rotations, or effect other changes in management practice. Furthermore, total forest area has been declining steadily due to urban and suburban development. Nonetheless, there are still opportunities for boosting stand growth rates, and carbon storage in existing forests, especially given the fact that forests still account for 45% of Rhode Island's total acreage. (Reducing forest loss and urban forestry are discussed separately below). Options include:

- Establishing new plantings, forests or plantations (for fuel or fiber). Rhode Island is one of the states with programs underway to establish streamside and other riparian plantings in order to provide multiple environmental benefits, including reduced silting and erosion. Abandoned farmland can also be planted for short or long-rotation woody crops, either for biomass energy, pulp and lumber mill feedstocks, often using fast-growing species. These efforts can be supported by state policy, and possibly by federal farm funding.

---

[40] The extent to which these figures may be additional to existing activity is not precisely clear.
See Gurney, K.(2000). Carbon Sequestration Potential in the United States, Canada, and Russia under Article 3.4 of the Kyoto Protocol. Colorado State University, May 4, 2000;.

[41] RI lost about 1450 acres/year of forest, 1985-1998. The average biomass is (9,350,000 tons C tree + 4,500,000 tons C forest floor + 280,000 tons C understory + 19,800.00 soil tonsC)/393,000 acres or 86 tons/acre, or 79 metric tC/acre. At that rate of forest loss, RI loses about 114,000 tC per year to forest conversion. The rough estimate shown assumes that about half the loss could be stemmed through better land use planning, higher-density development, etc. This deserves closer analysis as to what is achievable, as well as the reliability of forest loss and soil carbon loss estimates.

- Increasing biomass in existing forests. Forest practice regulations could be modified to require prompter re-vegetation of cut areas, or restricting harvest in riparian areas. The overall potential and policy priority of such changes is considered to be relatively minor. (Irland and Cline, 1999)

We have yet to find site-specific analyses on which to base estimates for potentials and costs for these measures in Rhode Island. The general carbon sequestration literature suggests that forest management projects cost from near zero to over $40/tC, depending on method, forest type, and growth assumptions[42].

OPTION 39 – SUMMARY TABLE

Parameter	Value
Working group	Transportation and Land Use
Option name	Forest Management Initiative
Sector and market	Forestry
Technical elements	Improved practices adopted by landowners and users; Establishment of new forests and plantings
Policy/program elements	Forest management regulations to support greater biomass retention; support for local landowners
Existing policy/program	State and federal conservation programs
Rationale	Carbon sequestration
Carbon saved in 2020	No estimate
CSC (cost of saved C)	Near zero to over $40/tonne

[42] Missfeldt, Fanny and Haites, Eric, 2001, "The Potential Contribution of Sinks to Meeting the Kyoto Protocol Commitments", submitted for publication to *Climate Policy*.

OPTION 40 - Promote New Renewable Electricity Supply Using System Benefit Charge Funds

OPTION 41 – Promote Green Power Purchases Using System Benefit Charge Funds

The system benefit charge (SBC) is a fee placed on customers' electricity bills. Almost every state that has passed electric industry restructuring legislation has used an SBC to support renewable energy, energy efficiency, low-income customer programs, or other functions that the competitive market is unlikely to provide on its own. The SBC is designed to be "non-bypassable," meaning that every customer pays the charge regardless of who sells the electricity. It is also designed not to place the entity charged with collecting the fee at a competitive disadvantage. It is usually, but not always, assessed as a fee per kilowatt-hour (kWh). SBCs accumulate in a fund and are distributed relative to RFP responses or programs implemented.

- The SBC programs in Rhode Island, which are funded through the end of 2006, cover renewable energy projects and energy efficiency programs. Use of the SBC to fund energy efficiency is discussed in the Buildings and Facilities Working Scoping Paper while.[xiv] This Scoping Paper focuses on the use of the SBC for funding renewable energy for two major strategies as follows: Provide subsidies to generators of new renewable electric supply. New renewable capacity anywhere in New England would be eligible as long as it supplies Rhode Island customers
- Provide subsidies to Rhode Island customers who buy green power i.e. power generated from renewable energy sources, such as wind and solar power, geothermal, hydropower and various forms of biomass.

Regarding the current structure of the SBC, several funding options are possible, as follows:

- Approach 1: Increase the level of the SBC between now and 2006. Of the approximately $20 million raised each year to support renewable energy and energy efficiency programs, $2-4 million is allocated to renewable energy programs. If this level were increased, the impact could be more renewable generation within the program period. However, the ability to effectively distribute funds is an important issue that should be carefully considered before deciding on this approach (see “efficacy” issue below).
- Approach 2: Extend the SBC beyond 2006 at the same level. Assuming the same funding level was implemented, this would have the effect of meeting a higher renewable target, but in a more gradual transition than the above approach. This approach may be preferable, as the Collaborative is having trouble spending the SBC funds already allocated to renewables, due to the state of the market. A gradual increase as market demand is developed and supply premiums decrease with scale and technological advance seems more likely to succeed.
- Approach 3: Increase the level of the SBC between now and 2006 and extend the SBC beyond 2006. This represents the most aggressive of the three approaches. However, the same caveats associated with Approach 1 apply.

There are several fundamental issues that require careful attention, as indicated below.

- Efficacy: It is not clear whether a more aggressive SBC would result in the development of more renewable capacity. The Rhode Island Renewable Energy Collaborative (RIREC) has received fewer applications for renewable projects support than it could fund (likely stemming from the immature state of the market).
- Penetration: The scale of the impact from higher SBC funding levels is difficult to assess. It is a question of finding the level of incentive to residential, small business, large customers, and Independent Power Producers that would motivate them to pay a price premium for renewables.
- Credit: Only green power purchases or renewable capacity from new SBC funding would obtain credit to carbon reductions in a Rhode Island Action Plan.

There are several additional issues of secondary importance that should be considered as follows:

- Quantifying GHG benefits of subsidizing green power purchases is challenging because the effect is so diffuse and it is so difficult to identify free rider-ship. Ideally, the existing programs would encourage long-term purchases that would continue after funding is discontinued – so investments might be amortized over additional sales (ignoring this is conservative). But given the challenges, it may be better to concentrate on supply side programs for GHG planning;
- The greatest advantage of subsidizing green power purchase over other options is that it can, in theory, leverage contributions from customers who would not otherwise pay the full incremental cost of green power.
- The demand side for green power is limited by saturating penetration (i.e., reaching a point where there are few or no customers for to be installed); supply side is limited by potential supply within the region and its cost, but could be expanded at slightly increasing incremental cost over a wide range of budgets and impacts; and
- If green power purchases level off, additional cost incentives would be required to induce more green power purchases. If a green power purchase subsidy program is layered on top of existing programs that are generous but under-subscribed (due to lack of viable competitive market conditions or saturation), it would suggest a greater cost-share is necessary to induce green power purchases by consumers. .
- Double counting: Since Rhode Island is operating within a larger power pool system, it is important to avoid ascribing to the Rhode Island SBC what is being accounted for elsewhere in similar SBC systems in other states, and vice versa. Also, it will be important to distinguish between what the SBC leads to and what would have happened anyway (i.e., free Rhode Island ridership). For example, a national Renewable Portfolio Standard would impose renewables requirements on electricity sales in Rhode Island, which might be either duplicative or additive to Rhode Island's SBC reductions.

We assess the potential cost and impact of more aggressive SBC support for renewables by category as follows:

- Subsidize the generation of new renewable electric supply:

  - SBC funds could be used in a production incentive auction. To make sure the auction is for incremental renewable generation only, the SBC program could acquire and retire the associated certificates in exchange for the incentive. This would eliminate the possibility of double counting or free riders. The amount of carbon emissions avoided depends on the budget, but we are assuming that every $1m spent on an average production incentive of $0.025/kWh over a 10-year period would result in about 4,000 MWh saved in each year for the life of the project. Using a carbon intensity of 0.101 tC/MWh, this corresponds to 400 tC avoided per year, or an aggregate 4,000 tC avoided for each $1m spent (with reductions spread over time).
  - SBC funds could be used in combination with a Renewable Portfolio Standard (RPS) (see discussion under Option 26) to promote the investment in renewable energy technologies which are far from competitive at present, and so contribute to accelerating the reduction in their capital costs through scale economies and learning by doing.[xv] Assuming a suitable mix (i.e., wind, solar, biomass) of renewable electric supply options, the cost of saved carbon is about $200/tC.[xvi] This will be discussed in the section on renewable portfolio standard that follows.

- Subsidize green power purchases: SBC funds could be used to offset a portion of the price premium associated with green power purchases. Assuming an average green power price premium of 3 cents/kWh in New England for new/incremental renewable power, a 50% incentive of the green power price premium is sufficient to attract customers,[xvii] a carbon intensity of 0.101 tC/MWh,[xviii] and an incremental annual funding level of $2 million, the annual carbon reductions would be about 13,333 tC, at a cost of about $300/tC avoided cost (full societal cost). This is summarized in the Table below.

OPTION 40/41 -- SUMMARY TABLE

Parameter	Value
Working group	Electric Supply and Solid Waste
Option name	Promote New Renewable Electricity Supply Using System Benefit Charge Funds, and Promote Green Power Purchases Using System Benefit Charge Funds
Sector and market	Electric supply and demand side green power purchases
Technical elements	Renewable energy supply technology installations and green power purchase
Program elements	Supply: SBC support for full incremental costs (i.e., just the additional cost of renewables) of new renewable capacity via a production incentive auction or similar mechanism; Demand: SBC support for up to 50% of renewable price premium, or 1.25 cents/kWh
Existing policy/program	This option represents renewal of the existing SBC based program.
Rationale	Reduce emissions of carbon and other air pollutants; increase security of energy supply.
Energy saved in 2020	Supply: 80,000 MWh (relative to a production incentive auction of $2 million); Demand: 133,333 MWh (equivalent to green power purchases relative to a $2 million funding level @ 3 c/kWh average price premium, and a 50% incentive; 1.2% of Baseline total electricity consumption). This is assumed to be natural gas-fired electricity saved from the grid.
CSE (cost of supplied energy)	Estimate 3¢/kWh above commodity, corresponding to approximately 5.5 – 7.5¢/kWh
Carbon saved in 2020	Supply: 8,000 tonnes Demand: 13,333 tonnes
CSC (cost of saved C)	Supply: $250/ton[xix] Demand: $300/ton[xx]

OPTION 42 – Incentive Package

This initiative would build upon existing Rhode Island programs to provide a package of incentives that complement the RPS and SBC to promote use of renewable technologies. This package includes four options:

- Production tax credit
- Investment tax credit
- Net metering
- Back-up rates

PART 1 – Production Tax Credit

A production tax credit (PTC) is an incentive for the development of renewable energy. At the Federal level, it exists as an incentive originally introduced through the Energy Policy Act of 1992, granting 1.5¢ per kilowatt-hour (1992 dollars escalating with inflation) to developers for the first ten years of operation to wind plants brought on line before expiration. This Federal PTC has been extended on two occasions from its original June 30, 1999 expiration date, but has once again expired as of December 31, 2001. There is broad bilateral support for another 1-2 year extension, which is anticipated to be passed by Congress in the spring of 2002; draft bills being deliberated contemplate expanding eligibility to include a range of biomass sources. To fully take advantage of a PTC, the owner of the generator must have a sufficiently large tax obligation so that it can be reduced each year by the amount of the PTC.[xxi]

Several fundamental issues that would need to be resolved regarding a state production tax credit are highlighted below.

- Will the production tax credit be designed to be revenue neutral? A revenue neutral tax would conceivably require a countervailing tax penalty on another electricity production source
- If the production tax credit is not designed to be revenue neutral, where will the tax loss be raised?
- If the Federal PTC is extended, due to "no double dipping" provisions of the Federal PTC, the amount of the PTC may be reduced to reflect the State PTC, thereby undermining the ability of the State PTC to increase the amount of generation. For this reason, the State PTC may be more suitable as a replacement of an expired Federal PTC, or for eligibility expansion of an extended Federal PTC.
- It would require that the equity investor have a substantial enough Rhode Island state "tax appetite' to make use of the tax credits. This may prove a limiting factor on potential investors (as noted above, this requirement severely limits the equity investors able to fully utilize Federal PTCs).

Some additional issues to consider are briefly outlined below:

- Since the PTC covers a 10-year stream and not the life of the project, it equates to a lesser subsidy applied over the full life on a levelized annual basis;
- There are tax feedback benefits. Lower cost means lower income tax. While this is substantial for the Federal PTC, it would likely be a small effect for a state PTC; and
- A state PTC would only be fully incremental if it is not double-counted with other program impacts, other benefits, or with baseline activities (e.g. if this PTC provides subsidized power to supply customers under existing green power demand incentives).

We assess the potential cost and impact of a production tax credit as follows. Every $1m in production tax credits over a 10-year period would result in about 2,400 MWh saved in each year for the life of the project. Using a carbon intensity of 0.101 tC/MWh, this corresponds to 240 tC avoided per year, or an aggregate 2,400 tC avoided for each $1m spent (with reductions spread over time).

The summary table below outlines the costs and benefits of Option 1.2 -- Production Tax Credit, assuming that a PTC is applied over a 10-year stream of the project activities.

OPTION 42 PART 1 – SUMMARY TABLE

Parameter	Value
Working group	Electric Supply and Solid Waste
Option name	Production Tax Credit
Sector and market	Electric supply
Technical elements	Renewable energy technology installations
Program elements	State tax credit of 1.25 cents per kWh produced for the first 10 years of production.
Existing policy/program	NA (only investment tax credits currently in place)
Rationale	Reduce emissions of carbon and other air pollutants; increase security of energy supply
Energy saved in 2020	24,000 MWh (relative to a total production tax credit of $1 million)
CSE (cost of saved energy)	1.5 ¢/kWh above commodity, corresponding to approximately 5.0¢/kWh
Carbon saved in 2020	2,400 tC
CSC (cost of saved C)	$417/tonne[xxii]

OPTION 42 PART 2 – Investment Tax Credit

There are many State-level examples of tax incentive programs to encourage renewable energy. In contrast to the *production* tax credit described above, they are designed to reduce the costs for the purchase, installation, or manufacture of renewable energy systems, equipment, and facilities, rather than defray the costs of producing electricity using renewable resources. These programs reward *investment* with tax credits, deductions, and allowances for their support of renewable energy sources. Typically, available tax incentives include income, corporate, property, and sales tax incentives.

Rhode Island offers two types of tax credit incentives (Rhode Island General Laws 44-56-1) for renewable energy procurement:

- Renewable Energy Personal Income Tax Credit. Eligible technologies for Rhode Island's personal renewable energy tax credit include solar and wind systems. Biomass systems are not eligible. The tax credit declines over time as follows: 25% of the cost of the system for systems claimed in year 2000; 20% in 2001; 15% in 2002; 10% in 2003; 5% in 2004. Applicability is restricted to residential and commercial installations only.
- Renewable Energy Sales Tax Credit: Rhode Island division of taxation offers a full refund for the sales tax of qualifying renewable energy systems. Eligible technologies include solar and wind systems. Biomass systems are not eligible. The law does not specify an expiration date for the tax credit. Applicability is open to residential, commercial, and industrial installations.

Restructure RI Personal Tax Credit. RI could change the structure of the renewable energy personal tax credit so that it is constant over time. That is, the tax credit could be set at 25% of the cost of a renewable energy system for systems claimed in years 2000 and thereafter.

We assess the potential cost and impact of a restructured renewable energy personal tax credit assuming that investor perception of a 25% tax credit is equivalent to that of a production tax credit.[xxiii] Therefore, as with the estimate above, every $1m in energy personal tax credits would result in about 24,000 MWh saved. Using a carbon intensity of 0.101 tC/MWh, this corresponds to 2,400 tC avoided for each $1m spent, or about $417/tC.

The summary table below outlines the costs and benefits of Option 1.3 -- Tax Incentives, assuming that a incentive is applied over a 10-year stream of the project activities.

OPTION 42 PART 2 – SUMMARY TABLE

Parameter	Value
Working group	Electric Supply and Solid Waste
Option name	Investment Tax Credit
Sector and market	Electric supply
Technical elements	Renewable energy technology installations
Program elements	State personal income tax credit of 25% of the cost of a renewable energy system for systems claimed in years 2000 and thereafter.
Existing policy/program	This option represents restructuring of the existing State investment tax credit program from a declining percentage to a straight 25 % credit.
Rationale	Reduce carbon emissions
Energy saved in 2020	24,000 MWh (relative to a total production tax credit of $1 million)
CSE (cost of saved energy)	1.5 ¢/kWh above commodity, corresponding to approximately 5.0¢/kWh
Carbon saved in 2020	2,400 tC
CSC (cost of saved C)	$417/tonne[xxiv]

OPTION 42 PART 3 – Net Metering

Rhode Island's net metering ruling originally created in 1985 by the Public Utility Commission (PUC) and supplemented in 2000 by PUC Order 15705, applies to renewable energy generating facilities and cogeneration.[xxv] The ruling was originally created to encourage small wind generation facilities, but all renewables are eligible.[xxvi] In addition, fuel cells are also eligible for net metering. Applicable sectors include commercial, industrial, residential, and utilities. There is no expiration date envisioned.

Net excess generation is returned to the distribution grid at the utility's retail sale price for the generation energy. This price includes costs that can't be avoided (e.g., transmission and distribution, stranded costs) and those than can be avoided (i.e., generation). The maximum allowable capacity depends on the utility. Customers may have generating units of up to 25 kW in size.

Since the ruling was made in 1985, only a few small wind-generating and solar PV facilities have participated in net metering. PUC Order 15705 caps at 1 MW reverse metering for the Narragansett Electric Company.

An important point to consider in the expansion of the net metering program is the effect that net metering has on shifting transmission and distribution costs to other customers. That is, by allowing customers to displace their own usage at the full retail rate, the total costs of providing Transmission and Distribution services are distributed across a smaller pool of customers. This effect is considered to be small in the short run, but would need to be reconsidered if the program were expanded beyond the current cap.

We assess the potential cost and impact of net metering on the basis of the following assumptions:

- Under a continuation of the current net metering program, future GHG reductions are likely to be negligible.
- Expanding the maximum allowable capacity could increase participation in the program, especially among industrial facilities, while still remaining below the 1 MW cap.
- Doubling of the maximum capacity (i.e., to 50 kW)
- This capacity doubling could result in an additional 45 MWh[xxvii] and allow more cost-effective wind generators.
- The full 1 MW cap, this would result in carbon reductions of about 180 tC.
- The cost of saved carbon for this option should be determined using the same methodological basis as the costs for all other options. That is, it should reflect a reasonable estimate of the societal cost associated with the expected resources that would be introduced. Therefore:
    - The CSC should not be established using the most expensive technology;
    - Neither should the CSC be established based on a specific, predetermined technology cost;

- Finally, even though this option may function like a shadow tax that one could liken to a transfer payment borne by other ratepayers (i.e., tax), it needs to still be evaluated to assess its societal cost.

Therefore, a range of 2 – 4 ¢/kWh above commodity for electricity produced under net metering was assumed. A central value of 3 ¢/kWh above commodity was used to develop the estimate of the cost of saved carbon.

OPTION 42 PART 3—SUMMARY TABLE

Parameter	Value
Working group	Electric Supply and Solid Waste
Option name	Net Metering
Sector and market	Electric supply
Technical elements	Renewable energy technology installations
Program elements	Increase net metering capacity threshold
Existing policy/program	Net metering allowed for facilities less than or equal to 50 Kw
Rationale	Reduce carbon emissions
Energy saved in 2020	1,762 MWh (assuming net metering at 1 MW cap)
CSE (cost of saved energy)	3.0 cents/kWh (central value of incremental renewable cost)
Carbon saved in 2020	180 tC
CSC (cost of saved C)	$294/tonne[xxviii]

OPTION 42 PART 4 — Backup Rates

The Group agreed that any backup rate or net metering proposals should evaluate and appropriately address potential adverse rate impacts and lost revenue to the utility. However, no additional work on backup rates was done for inclusion in the Scoping Papers.

OPTION 43 -- Direct Government Investments Or Expenditures in Renewable Energy

Direct investments or expenditures by state or municipal government range from the purchase of renewable energy facilities in Rhode Island using low-cost financing, to the purchase of renewable energy credits, to the purchase of CO_2 emission reduction credits.

An advantage to this approach is the potential to bring tax advantaged finance, combined with leverage available from using 100% debt, to dramatically reduce the cost premium associated with renewable energy. Direct government investment in renewable energy projects is particularly important because they are so capital intensive. There is one Federal incentive – the renewable energy production incentive (REPI) available only to publicly owned entities and available to wind and landfill gas projects built prior to 9/30/2003. It should be noted that California has formed an entity – the California Consumer Power and Conservation Financing Authority – to take advantage of this financial leverage.

A recent Lawrence Berkeley National Lab study suggests that, depending on the availability of PTC, REPI, and other state incentives, under some circumstances there might be significant cost reductions to renewables through public ownership, perhaps in the 0.5 to 1.5¢/kWh range.[xxix]

We assess the potential cost and impact of direct investment or expenditures as follows. Assuming a funding level of $1 m distributed over a 10-year period, and a cost reduction of 0.5 c/kWh relative to an average renewable premium of $0.025/kWh, the average annual generation from this direct investment is about 5,000 MWh per year. At a marginal ISO NEW ENGLAND carbon intensity of 0.101 tC/MWh, the annual carbon reductions would be about 500 tC. This is summarized in the Table below.

OPTION 43 -- SUMMARY TABLE

Parameter	Value
Working group	Electric Supply and Solid Waste
Option name	Direct Government Investments Or Expenditures in Renewable Energy
Sector and market	Electric supply
Technical elements	Expenditures on electricity from renewable energy
Program elements	Establish targets
Existing policy/program	None.
Rationale	Reduce carbon emissions
Energy saved in 2020	5,000 MWh
CSE (cost of saved energy)	Estimate 2 ¢/kWh above commodity, corresponding to approximately 5.5 ¢/kWh
Carbon saved in 2020	500 tC
CSC (cost of saved C)	$200/tonne[xxx]

OPTION 44 -- Deposit Bottle System ("Bottle Bill")

Bottle bills are a common method of capturing beverage bottles and cans for recycling. The refund value of the container (usually 5 or 10 cents) provides a monetary incentive to return the container for recycling.

Unlike its neighboring states, Rhode Island does not allow for the redemption of bottles and cans for a cash refund. This may be an issue that needs to be revisited, although it is unclear that it would have a significant waste management impact as Rhode Island is already capturing a great deal of material that would be included in a bottle bill. The municipal recycling infrastructure (truck capacity, MRF design) has been designed to accommodate these materials.

While a bottle bill could be implemented, it is a policy that is expected to generate little in the way of carbon reduction benefits relative to other solid waste strategies. Nationally, bottles represent a small portion of the current waste stream -- 14.6 million tons out of a total 230 million tons, or 6%.[xxxi] Assuming Rhode Island accounts for 2% of the national bottle waste stream, and the bottle bill affects 10% (assumption) of the waste stream, and a weighted average of about 0.65 tC avoided per ton recycled, the total reduction amount to 19,000 tC.

OPTION 44 -- SUMMARY TABLE

Parameter	Value
Working group	Electric Supply and Solid Waste
Option name	Deposit Bottle System ("Bottle Bill")
Sector and market	Waste Management Services
Technical elements	Waste Prevention, Recycling and Composting
Program elements	Bottle deposit
Existing policy/program	
Rationale	Reduce carbon emissions
Energy saved in 2020	Not Available
CSE (cost of saved energy)	Not Available
B/C benefit-cost ratio	A bottle bill increases the cost of solid waste services
Carbon saved in 2020	19,000 tC
CSC (cost of saved C)	Because the cost of waste services are increased the cost will be positive[xxxii]

Non-Consensus In-State Options

OPTION 45 -- Upgrade New Residential Construction Building Code
OPTION 46 -- Upgrade New Commercial Construction Building Code

The amount of energy consumed in new or substantially renovated buildings is affected by the State's existing building codes. Both the residential and the non-residential building code have requirements affecting the level of energy used in new buildings. Requirements affect the rate at which heat may be transmitted through the building envelope (roofs, walls, floor, slab, or other solid elements, as well as windows and doors) and the rate of air change. Non-residential code requirements affect these elements plus the intensity of lighting and the efficiency of mechanical equipment

California, Oregon, and Minnesota have shown that it is possible to evolve a building standards programs resulting in new buildings that use 20-30% less energy than homes built to the levels of the 1995 Model Energy Code (residential) or the new ASHRAE 90.1 standard 90.1-1999 (all buildings except low-rise residential). One option is for Rhode Island to promulgate and apply higher energy-efficiency standards than are reflected in current State building codes.

A weaker option (in terms of its impact on energy use) would be to promote a voluntary standards program, for example by continuing and enhancing the existing DSM programs in this area indefinitely (see options 15 and 16, Design 2000 Plus AND Energy Star Homes).

Our estimates for this option assume substantial upgrade of the state building codes. A process to upgrade building codes would need to bring together different stakeholder interests, and would entail some funding requirements for standards evaluation and development, implementing revised codes, and perhaps training for contractors or inspectors. The cost and impact estimates for options 45/46, upgraded residential and non-residential building codes, are based on national work by ACEEE which evaluates the phase-in of new residential and commercial codes. National data are scaled to Rhode Island based on the state's baseline electricity and fossil fuel consumption.

OPTION 45 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Upgrade New Residential Construction Building Code
Sector and market	All new construction and major renovation.
Technical elements	Develop new standards, rewrite codes and supporting materials.
Policy/program elements	Convene code upgrade process including state building code officials. Legislation may be required.
Existing policy/program	Existing R.I. building codes.
Rationale	Build in higher efficiency levels at the point of construction to realize lower energy operating costs and reduced carbon emissions.
Energy saved in 2020	Residential: 66,800 MWh; 393,000MMBtu gas; 352,000 MMBtu oil.
CSE	Residential: $0.06/kWh electric; $7.00/MMBtu fossil fuel.
B/C	Residential: 0.5 electricity; 1.14 fossil fuel.
Carbon saved in 2020	20,000 tonnes.
CSC	-$20/tonne (2000$).

OPTION 46 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Upgrade New Commercial Construction Building Code
Sector and market	All new construction and major renovation.
Technical elements	Develop new standards, rewrite codes and supporting materials.
Policy/program elements	Convene code upgrade process including state building code officials. Legislation may be required.
Existing policy/program	Existing R.I. building codes.
Rationale	Build in higher efficiency levels at the point of construction to realize lower energy operating costs and reduced carbon emissions.
Energy saved in 2020	Commercial: 191,000 MWh; 931,000 MMBtu gas; 350,000 MMBtu oil.
CSE	Commercial: $0.02/kWh electric; $2.00/MMBtu fossil.
B/C	Commercial: 2.0 electricity; 3.0 fossil fuel.
Carbon saved in 2020	40,000 tonnes.
CSC	-$300/tonne (2000$).

OPTION 47 – Increase The Gasoline Tax

Gasoline taxes provide an important price signal to road-users to factor in the true costs of driving, including environmental and social costs. Depending on the level of the tax, they could provide sufficient incentive to users to adopt more fuel-efficient vehicles or be more judicious in their travel and mode choices.

In several European countries, gasoline taxes are more than eight to ten times the levels in the United States, where in real terms, state and federal taxes have actually declined steadily since 1962.[43] Part of the reason for the decline is public resistance to taxes, under the false perception that gasoline taxes are more "painful" than taxes on any capital goods, including vehicles. In fact, however, average gasoline expenditures in the US amount to less than about 2% of median household income, and even a tripling in gasoline prices would actually cause little or no dent in non-gasoline household consumption patterns.[44] Furthermore, although gasoline taxes are typically treated as being regressive, there is evidence that "low-expenditure households devote a smaller share of their budget to gasoline than do their counterparts in the middle of the expenditure distribution[45]."

Although gasoline taxes in Rhode Island are among the highest in the country, a policy to increase gasoline taxes by $0.50/gallon to address greenhouse gases would likely result in significant savings in carbon. These taxes could be *implicitly* revenue neutral if the revenues could be used to fund policies in several of the other options, thereby complementing and amplifying the direct impact of the tax itself. Alternatively, the tax could be made *explicitly* revenue-neutral through income tax reductions. In economic terms, the cost of the additional tax would be *zero* if the revenues are used to correct for the otherwise uncompensated externalities of the transportation system, particularly by reducing emissions.

[43] http://www.chevron.com/about/currentissues/gasoline/apiprice/gasoline_price_trends.shtm

[44] When asked to choose hypothetically between a 3% tax on new vehicles and a 25 cent/gallon tax on gasoline to address global warming, 70% chose the former but only 17% preferred the latter, even though the total expenditure in present value terms would have been around the same. Opinion Research Corp. for NREL phone survey 2/98, cited in http://www.ott.doe.gov/pdfs/patterson.pdf

[45] James Poterba (1991): "Is the Gasoline Tax Regressive?", *Tax Policy and the Economy*, MIT Press. See also Todd Litman (1999): "Evaluating Transportation Equity" http://www.vtpi.org/equity.pdf

OPTION 47-- SUMMARY TABLE

Parameter	Value
Working group	Transportation and Land-Use.
Option name	Increase The Gasoline Tax
Sector and market	All light-duty vehicles
Technical elements	None
Policy/program elements	Stakeholder processes, commitments, public outreach
Existing policy/program	No existing program, but could be tied to Option 1.1b
Rationale	Reduce GHGs and air pollution, increase energy security
Energy saved in 2020	16.5 million gallons (1.9 trillion BTU)
CSE	$0.0/MMBTU ($0./gallon)[46]
Carbon saved in 2020	160,000 tonnes[47]
Certainty of savings if option is adopted	High
CSC	$0.00 (2000$)

[46] A tax level of $0.50/gallon amounts to an average increase of around $0.02/mile, compared to conservatively estimated external costs and hidden subsidies of about $0.07/mile (see, for instance, J. Murphy and M. DeLucchi, A review of the literature on the Social Cost of Motor Vehicle Use in the United States, *Journal Of Transportation and Statistics,* vol 1, no. 1, 1998, pp. 16-42.

[47] We have assumed a relatively conservative long-run price elasticity of –0.4 for gasoline based on the literature (Phil Goodwin, 1992:"Review of New Demand Elasticities," *Journal of Transport Economics*, May; John DeCicco and Deborah Gordon, *Steering with Prices: Fuel and Vehicle Taxation and Market Incentives for Higher Fuel Economy*, American Council for an Energy Efficient Economy (Washington DC; www.aceee.org), Dec. 1993; .http://www.mackinac.org/1247

Regional/National Consensus Options

OPTION 48 -- Upgrade And Extend Appliance Efficiency Standards

At the current time, the minimum efficiency level of a wide range of energy-related appliances and equipment is established through U.S. DOE regulations. Under the DOE program, regulations are periodically evaluated to determine whether a further increase in efficiency levels is economically justified. Because appliance efficiency regulations apply at the point of manufacture, they affect the entire market and are a powerful tool for affecting levels of energy consumption.

Federal law precludes individual states from establishing independent appliance efficiency standards, except for integrally built-in equipment that is covered under a state building code, unless they obtain a waiver from the DOE. Thus, states could (a) regulate the efficiency of appliances that are not covered by federal regulations, and/or (b) develop proposed efficiency standards that are higher than DOE levels and request a waiver to implement them.

Option 3.1, appliance standards, consists of an initiative to increase appliance efficiency standards. The new standards would exceed existing federal efficiency standards, or apply to equipment not subject to federal efficiency standards. Some public and private R.I. stakeholders are already supporting a Northeast regional effort for states to propose or adopt energy efficiency standards for fifteen types of equipment. This is the “Northeast Equipment Standards Project,” organized by Northeast Energy Efficiency Partnership. Continued or expanded support for this initiative, or other efforts to increase standards, could lead to Rhode Island being one of the regional states adopting new standards.

The cost and impact estimates for option 30 are based on national work by ACEEE which evaluates the phase-in over 2002 to 2008 of higher efficiency levels across a wide range of technologies. National data are scaled to Rhode Island based on the state’s baseline electricity and fossil fuel consumption.

The impacts from this option would accumulate gradually as new buildings are built, or as existing equipment is retired and replacement equipment is acquired. It is interesting to note that, with regard to existing equipment, Germany has adopted a policy requiring phase-out of older (and thus less efficient) fossil-fired heating equipment within a few years. Such a policy would amplify the impacts of the option described here.

OPTION 48 -- SUMMARY TABLE

Parameter	Value
Working group	Buildings and facilities.
Option name	Upgrade And Extend Appliance Efficiency Standards
Sector and market	New residential and nonresidential equipment sold in the state.
Technical elements	15-30 equipment types using both electricity and fossil fuel.
Policy/program elements	Analyze and develop information on target technologies; disseminate to policymakers and advocates.
Existing policy/program	This option would extend existing appliance standards.
Rationale	Reduce the operating costs and carbon impacts from energy using equipment in homes and businesses.
Energy saved in 2020	Residential: 543,000 MWh; 989,000MMBtu gas; 885,000 MMBtu oil. Commercial: 146,000 MWh; 195,000 MMBtu gas; 73,000 MMBtu oil.
CSE	Weighted averages: $0.019/kWh electric; $2.00/MMBtu fossil fuel.
B/C	2.1 electricity; 3.0 fossil.
Carbon saved in 2020	100,000 tonnes.
CSC	-$50/tonne (2000$).

OPTION 49 – National Fuel Efficiency Standards For Cars And Light Trucks

We assume the emergence of new CAFE legislation that would require the fuel economy of new light-duty vehicles to improve by around 100 percent by 2020.[48] Political support from local and state governments (including coordinated support from New England states) for such federal action can play an important role in breaking the current deadlock in raising national CAFE standards.

An alternative to raising national CAFE standards, which is not analyzed here, is for the New England states to set coordinated regional fuel economy standards, including the creation of a regional mandate for zero-emitting vehicles (ZEVs). This could, for instance, follow recent legislative action in California (AB 1058), which directs the state Air Resources Board to adopt regulations by 2004 that achieve the "maximum feasible and cost-effective reduction" of CO2 emissions from cars and light trucks while granting automobile manufacturers flexibility "to the maximum extent feasible."[49].

OPTION 49 -- SUMMARY TABLE

Parameter	Value
Working group	Transportation and Land-Use.
Option name	National Fuel Efficiency Standards For Cars And Light Trucks
Sector and market	All light-duty vehicles
Technical elements	Improved materials, engine efficiency, advanced technology, including hybrids
Buydown program elements	None
Existing policy/program	National level CAFE legislation
Rationale	Reduce carbon emissions as well as oil dependence.
Energy saved in 2020	13 trillion BTU (103 million gallons) in gasoline savings
CSE (cost of saved energy)	$1.84/MMBTU ($0.21/gallon)
Carbon saved in 2020	250,000 tonnes
CSC (cost of saved CO_2)	-$300/tonne (2000$)
Certainty of savings if option is adopted	High

[48] Assumed to improve by 1.4 miles per gallon each year from 2003.
[49] "Assembly Bill Targets Global Warming Trend," *Los Angeles Times,* A1, January 26, 2002.

OPTION 50 – Carbon (And Multi-Pollutant) Cap And Permit Trade System For The Power Sector

A carbon cap and trade would work by setting a cap on total carbon emissions, auction or allocate allowances to emit carbon dioxide to energy producers, and then permit them to trade these allowances among themselves. A cap-and-trade is generally viewed as a more cost-effective way of reducing total emissions than a straight limit or a tax on carbon-based fuels.

A carbon cap could be implemented to indirectly promote renewable energy (although there are other ways to achieve the same result). For this to happen, it would be necessary to ensure that the CO_2 emissions trading scheme contain a cap that is tight enough to stimulate markets for renewable energy resources and that, in setting emission caps, lowers the tonnage allowed from fossil fuel generators by an amount based on projected electric power generation from renewables.

It is essential that renewables receive a set-aside and receive allowances or credits which can then be sold or retired. Otherwise there is no mechanism for renewables to get any benefit, and no mechanism for operators of facilities subject to CO_2 caps to use renewables for compliance. One approach would be to issue allowances to renewables for displaced CO_2, and to reduce the overall quantity of allowances available (auctioned or allocated) to emitters in subsequent years accordingly. This would lead to real reductions.

A major challenge for instituting a CO_2 cap and trade in only part of a regional electricity market is that due to the nature of the regional electricity market, CO_2 may not be reduced: if Rhode Island generators are marginally more expensive to operate than those in neighboring states due to the Rhode Island requirement, Rhode Island plants may simply be less competitive and thereby reduce output, with plants in neighboring states picking up the slack and increasing their output accordingly. Without a mechanism to link or scale the allowances to production, the CO_2 cap would be ineffective. Therefore, if applied, the scope of this option should be regional. One could also allow credits for energy efficiency

Assuming a cap of 80% of baseline carbon emissions in 2020, the carbon savings and costs would be similar to that of a RPS with a 20% target. Assuming a marginal ISO NEW ENGLAND carbon intensity of 0.101 tC/MWh, the annual carbon reductions would be about 140,600 tC, at a cost of about $250/tC avoided.[xxxiii] This is summarized in the Table below.

OPTION 50 -- SUMMARY TABLE

Parameter	Value
Working group	Electric Supply and Solid Waste
Option name	Carbon (And Multi-Pollutant) Cap And Permit Trade System For The Power Sector
Sector and market	Electric supply
Technical elements	Expenditures on electricity from renewable energy
Program elements	Establish targets
Existing policy/program	None.
Rationale	Reduce carbon emissions
Energy saved in 2020	1,392,400 MWh (or 20% of Baseline total electricity generation).
CSE (cost of saved energy)	Estimate 2 – 4 ¢/kWh above commodity, corresponding to approximately 5.5 – 7.5¢/kWh
Carbon saved in 2020	140,600 tC
CSC (cost of saved C)	$250/tonne[xxxiv]

Consensus Priority Study Options

OPTION 51 – Vehicle Miles Traveled (VMT)-Based Insurance Premium Structures

Pay-As-You-Drive (PAYD) Insurance provides drivers an incentive to reduce their annual vehicle miles traveled, and could thereby help reduce fuel use and emissions. It is also economically efficient because it indicates to drivers the true costs of driving. It is more equitable than current systems because it imposes premium costs based on the level of driving, and is progressive because it is likely to lower costs for lower income drivers who tend to use their vehicles less than the median driver does[50].

PAYD premiums can be collected either for every gallon of gasoline purchased (pay at the pump insurance) or for every vehicle-mile driven (odometer-based registration fees). In either case, they help transfer a portion of insurance costs from fixed to variable costs, and give an economic disincentive to consumers to drive. Examples of VMT-Based Insurance include legislation in Oregon (HB 3871: www.leg.state.or.us/01reg/measures/hb3800.dir/hb3871.intro.html) and Texas (HB 45: www.capitol.state.tx.us).

OPTION 51 -- SUMMARY TABLE

Parameter	Value
Working group	Transportation and Land-Use.
Option name	Vehicle Miles Traveled (VMT)-Based Insurance Premium Structures
Sector and market	All light-duty vehicles
Technical elements	None
Policy/program elements	Consultation with all stakeholders, including insurance companies, insurance regulators, state or provincial legislators, transportation agencies, motorists, transportation professionals, public safety officials, environmentalists, consumer groups and organizations concerned with poverty.
Existing policy/program	No existing program in RI, but support may be forthcoming from the Federal Highway Administration's Value Pricing Pilot Program
Rationale	Reduce GHGs and air pollution, increase energy security
Energy saved in 2020	47 million gallons (5.4 trillion BTU)
CSE	Not computed
Carbon saved in 2020	110,000 tonnes C

[50] See *National Organization For Women Insurance Project* (www.now.org/issues/economic/insurance), Todd Litman (2001), *Distance-Based Vehicle Insurance Feasibility, Benefits and Costs*, VTPI (http://www.vtpi.org/dbvi.pdf). The previous reference indicates that a 10% reduction in VMT can be brought about through VMT-based insurance. Note that many insurance companies offer discounts for reduced mileage accumulation, but the associated price signals are relatively weak to induce changes in driving behavior.

Certainty of savings if option is adopted	High
CSC	<0

OPTION 52 – Transportation Infrastructure Planning

(Note: This options was not originally included in the Scoping Papers and so there is only the following outline of topics that would need to be studied.)

- Impact of commuter rail/light rail and its potential electrification
- Role of barging in the transportation system
- Study the carbon impact of reallocating transportation resources from new lane miles to preserving and enhancing the transportation infrastructure

Annex 1: Discussion of the Cost Impact of the Renewable Portfolio Standard

Renewable resources and technologies for generating electricity -- principally solar, wind, biomass and geothermal power plants -- have multiple benefits.[xxxv] They decrease requirements for fossil fuels, thereby helping to keep electricity costs down, and they reduce the vulnerability of electricity consumers to large and unexpected fuel price hikes or rapid price escalation. They decrease emissions of air pollutants and greenhouse gases, thus improving local health and environment while avoiding high costs of compliance with potentially tighter emissions regulations. They also can provide a new basis for economic development and income for states that have renewable resources.

What is a Renewable Portfolio Standard (RPS)?

New England's renewable resource potential, as well as that of neighboring regions, could be tapped by introducing a Renewable Portfolio Standard with annual targets for renewable generation as fraction of total sales. A resource portfolio requirement is a market-based mechanism, which requires that a pre-determined level of renewable electricity generation be included in the overall electricity generation mix of a retail electricity supplier. A key element to making such portfolio requirements practical is to establish a credit trading market to meet the portfolio obligations. A system that allowed suppliers to comply through trading of renewable energy credits within the New England region or beyond would help the suppliers meet this target at the lowest possible cost. Such trading flexibility would obviate the need for each electricity supplier to develop renewable energy resources, provided the region wide portfolio standard is met. It would also provide a number of other benefits: lower transaction costs, visible spot-market prices, enhanced liquidity, simpler and more reliable compliance verification, and ability for buyers to procure just what they need.

An RPS policy has the advantage of supporting new technology with many environmental benefits. By setting some guarantee of demand for renewable energy technologies in the future, the RPS provides support for renewable-based generation, just as fossil-based generation has been supported in the past. Supporting new technology can lead to benefits of "learning by doing" that lead to both decreased costs for renewable generation technologies over time (i.e., economies of scale and scope, technological advance, etc) and local expertise in an industry with great potential growth.

How Would Renewable Credits be Traded under an RPS?

Each supplier could develop their own generation, purchase energy and credits from a renewable generator, or acquire only the credits from a renewable generator. A credit is a certificate of proof that one kWh of renewable electricity has been generated, and an instrument for the transfer of title to the attributes of that generator. An RPS would require that retail electricity suppliers demonstrate that they have supported an amount of renewable energy generation equivalent to some percentage of their total annual kWh sales through ownership of credits. A trading scheme allows retail suppliers to buy what they require for compliance while focusing on their core business objectives in retail sales and serving end-users. Generators can compete against each other to provide credits to retail suppliers at lowest cost. The result is a market-based mechanism to meet the region wide renewable portfolio target at the lowest cost to the region.

What is the Role of State Government under a State-Specific RPS?

For an RPS at the state level, the role of state Government would be focused on four areas. First, RPS rules must be established. The state must confer upon some agency with necessary jurisdiction the authority to implement an RPS. This is almost always done through legislation, although in a few states the Public Utilities Commissions have interpreted their legislative authority to allow them to establish such purchase mandate. Second, the state would have a role in the certification of renewable credits generated. This would involve the implementation of a scheme to legally credit producers who have generated renewable-based electricity, either by the state authority, or by delegation. Third, there would be a state role in the assessment of the level of compliance with the legislature-specified target. This would involve a monitoring system to assess compliance by each retail electricity supplier for possession of the correct number of renewable credits at the end of the year. In New England, the New England Power Pool will be operating a Generation Information System that will perform the certification and accounting functions.

Finally, the state would have a role in, if necessary, imposing sanctions for noncompliance. This would involve levying a penalty of some kind for each required renewable credit that the generator lacks, or suspending the supplier's license to sell at retail.

How Many States Have Proposed or Adopted an RPS?

Including the recent RI legislative proposal, there are a total of 17 states that have proposed or adopted an RPS policy,[51] and additional states are starting to consider similar mandates. In New England, Connecticut's 1998 electric utility restructuring bill (HB 5005) created an RPS with a target ramping up to 6% of "Class 1" resources (solar, wind, landfill gas, sustainably-managed biomass, and fuel cells) by 2009, as well as a stable requirement for hydroelectric, waste-to-energy and other biomass. The Maine RPS became effective in November 1999 and requires electric providers to supply at least 30% of their total retail electric sales in Maine with electricity from eligible resources (which included renewables and fossil cogeneration). The recently finalized Massachusetts RPS is as described in the main body of this Scoping Paper.

Does an RPS have Cost Impacts?

The answer to this question depends on several major factors. As indicated in the body of this Scoping Paper, there have been several published analyses that provide estimates of the cost impacts of an RPS. The range in cost impacts associated with these analyses differ widely depending on how each study dealt with a number of key assumptions, as outlined in below:

- *Scale of the analysis.* A national RPS would apply nation-wide, but also allow generation anywhere in the nation to be used for compliance. A state RPS, on the

[51] Database of State Incentives for Renewable Energy, last updated 12/18/01. http://www.dsireusa.org/

other hand, will have specific limits to eligibility that directly or indirectly limit the geographic scale over which renewable generators can realistically contribute. A larger region implies both more options for renewable energy resources and a larger pool of entities that require ownership of renewable energy credits -- thereby lowering the costs of meeting a given target.

- *Geographic location of the analysis.* The cost of an RPS with a given target depends upon the availability and cost of renewables in that state/region and the cost of the displaced generation (the marginal generation of the existing generation mix and the new generation that would otherwise be built and operated). A state or region could have low-to-high cost renewables and low-to-high avoided generation costs. Low cost renewables with high avoided costs would result in low costs to achieve the target, while high cost renewables and low avoided costs would result in high costs to meet the target. For the cost of saved carbon, the emissions factor of avoided generation will also play a role -- the higher the emissions factor the lower the CSC all else equal.
- *RPS target.* The higher the target the higher the cost and the higher the CSC all else equal, since reaching the target would entail climbing the cost curve, i.e., going to more costly locations and technologies.
- *Assumed effect of lower fossil demand on fuel price.* Some studies model the feedback on fuel price to all economic sectors from a reduction in demand for fossil fuels (notably lower prices for natural gas) caused by the RPS, since the renewables would displace fossil generation. This could result in savings in all sectors that use this fossil fuel, not just the electricity sector. This is important because some studies with a strong renewables target could show enough of a feedback effect to result in a net benefit (i.e., the multi-sectoral fuel savings exceeding the incremental electricity generation costs) from the RPS.
- *The incorporation of other policies in the analysis.* This refers to whether the RPS is considered on its own, or whether other policies such as energy efficiency are also included. This is important because the presence of other policies -- demand side policies in particular -- defer the need to build new electric capacity and thus can change the marginal generation, costs and emissions that are displaced by the RPS.
- *Modeling assumptions.* This refers to several issues. Perhaps the most important of these is the modeling sequence assumption when an RPS is one of several policies analyzed. It refers to the order in which the RPS is considered in a suite of policies. It also affects how far up the cost curve the RPS needs to go to meet its target. If there is already a lot of energy efficiency, loads are lower and thus a given target will require less renewables and thus not have to resort to the more costly ones. This is important because the order of the analysis directly affects the manner in which the costs are distributed across the policies.

What are the Cost Impacts of the National RPS?

The cost impact (i.e., CSC) associated with the national RPS, ramping up top 20% by 2020, cited in the body of this Scoping Paper. (i.e., Bernow, et al, 2001) is $46/tC avoided. This study assumed the following:

- *National scale.* Because it was at this scale, renewable credit trading can occur with areas that have greatest resource potential and the smallest difference between renewable and commodity electricity generation costs. Hence, entities in such a policy context can take advantage of lower cost renewable energy credits.
- *Assumed no effect of lower fossil demand on fuel price in demand sectors.* The CSC of $46/tC was determined ignoring any potential supply feedback effect to the residential, commercial, and industrial sectors resulting from decreased fossil usage. This is a conservative result as depressed demand for fossil fuel in the electric supply can be expected to lower the rate of growth in fuel prices. A sensitivity case was conducted in which the price feedback effects assumed by the US Department of Energy were incorporated into the analysis. The result of this effect showed that the CSC becomes negative.
- *The RPS was modeled last in the sequence of policies* An aggressive set of energy efficiency policies was included in the RPS. The costs associated with the RPS were calculated as the difference in costs between the results with all policies considered (i.e., RPS plus energy efficiency) and the results with only the energy efficiency policies considered. Hence, the CSC of $46/tC can be viewed as the incremental cost of the 20% RPS when it is part of an integrated policy package. Furthermore, the analysis included cost reduction assumptions for the capital costs of renewables associated with an R&D policy; and
- *Other policies were included in the analysis.* The effect of this assumption is that there is a lower level of new electric capacity and electric generation required during the years when a renewable target exists. Because the RPS is defined relative to a percentage of total generation, rather than an absolute amount, this means that meeting the RPS targets will need to mobilize less renewable resources.

What are the Cost Impacts of the Massachusetts RPS?

The cost impact in terms of a CSC associated with the Massachusetts RPS cited in the body of this Scoping Paper has not been calculated directly by the authors of the report for the MA RPS (i.e., Smith, et al, 2000). However, it can be calculated in a straightforward manner for any year, or across the period 2003-2012, from the cost information provided in the source document. The method shown below represents the methodology used for calculating the cost of saved carbon from the MA RPS Cost Analysis Study. It incorporates a correction the earlier estimate provided to the Working Group.[xxxvi] Where applicable, the page numbers from where these inputs are taken are provided in parentheses.

- Choose year. The year 2012 is chosen for illustrative purposes;
- Identify generation mix: In 2012, the types of resources include wind, Landfill gas, biomass, biomass co-firing (gas and coal), photovoltaics, and fuel cells (page 30);
- Renewable demand: The total New England renewable demand is 8,276 GWh (page 30);
- Average incremental renewable generation cost: The incremental cost associated with the mix of technologies to meet the New England demand in 2012 is 2.32 c/kWh (2000 $) (page 32);
- Displaced NE marginal generation is from natural gas combined cycle units in the long-term (page 27);

- Total cost of incremental renewables is equal to the incremental cost multiplied by the total demand (i.e., 2.32 c/kWh * 8,276 GWh / 100 = $192 million (calculated for this Scoping Paper);
- Total carbon avoided by renewable generation is equal to the carbon intensity of the displaced demand multiplied by the renewable demand less emissions from emitting renewable technologies. It is assumed that all technologies under the MA RPS are zero-emitting. Therefore, the total carbon avoided is equal to 0.101 tC/MWh * 8,276,000 MWh = 835,876 tC (calculated);
- Cost of saved carbon is = ($192,000,000) / (835,876) = $230/tC (calculated).

The study for the MA RPS assumed the following:

- *Regional scale.* Renewable credit trading can take advantage of regional generation only;
- *Assumed no effect of lower fossil demand on fuel price.* The CSC of $230/tC was determined based on the absence of any supply feedback effect.
- *No other policies were included in the analysis.* The RPS was analyzed in isolation. Hence, the CSC of $230/tC is higher than what it would be if it had been combined with a suite of energy efficiency measures; and
- *The RPS was the first and only policy modeled.* The effect of the sequencing issue is not applicable to the MA RPDS analysis.
- *A renewable generation target of 4% by 2009.*
-

The analysis of the Massachusetts RPS was carried out at a regional scale and may therefore be a better indicator of the costs that would be associated with a Rhode Island RPS.

What Does the Difference in the Cost Impact Mean?

The difference in the cost impact simply reflects the differing bases and assumptions used in the modeling of the two RPS policies. One can view the national RPS as a conservative estimate of the CSC (i.e., upper bound) in a policy context where energy efficiency measures, environmental quality, and climate change are key drivers. It is conservative because, if the feedback effects were explicitly considered, the CSC would be negative. One can view the MA RPS as a conservative estimate of the CSC (i.e., upper bound) in a policy context where diversification of the fuel mix is the driving factor. It is conservative due to the fact that if supply feedback effects were explicitly considered, the effect would be to lower the CSC. Modeling would be needed to confirm the magnitude of this effect.

Other studies show that an RPS may have nominal price impacts. An analysis by Tom Wind[xxxvii] for the state of Iowa showed that while there would likely be small near-term increases in cost, there would also likely be long-term savings. The analysis focused exclusively on wind power in a region where substantial wind resources exist, so it would be important to carefully assess that and other local factors before drawing strong conclusions for the applicability of the study to Rhode Island.

Lastly, implementation of an RPS could reduce the clearing price for natural gas and other fossil fuels in New England which, if accounted for in the analysis, would further reduce the cost of saved carbon for an RPS in Rhode Island.

What Implications Would an RPS have for Block Island?

At several points, the Working Groups has raised the issue of what may be the potential implications of a policy option such as an RPS for Block Island. Block Island is isolated from the U.S. mainland, relying diesel generators for its electric power, and has a large summer peak load mostly driven by tourism. In the past few years, Block Island has installed air pollution control equipment on its fleet of diesel generators to be in compliance with a consent decree filed by the USEPA.

Some of the benefits achieved by the pollution control equipment could have been achieved by the introduction of renewables, or by the introduction of energy efficiency. A preliminary study by David Kline of the National Renewable Energy Laboratory[xxxviii] concludes that a majority of Block Island need for energy services could be supplied by a mix of wind, solar PV, commercial/residential cogeneration, and demand side measures (i.e., high efficiency lighting and refrigeration). Some diesel generator power would still be required for backup and emergency peaking power. It is important to note that the NREL analysis is an initial scoping analysis rather than a detailed feasibility study. More sophisticated analysis (i.e., costs, resources, matching of load shapes, etc) would be needed to validate its conclusions. However, at the minimum it would suggest that an RPS is a relevant policy option for the Island.

[i] H 7237 “An Act Relating to Renewable Energy Content” introduced by Representatives Moura, Ginaitt, Palumbo, Ajello, and Slater on February 05, 2002

[ii] In addition, care needs to be taken to not double count the impact of other generation-based programs (as opposed to consumption based renewable programs such as green power purchases) such as supply side SBC funding or other RPS systems. However, the other RPS programs should not be an issue here. The ISO New England GIS is being established to assure such double counting between state RPSs cannot happen. If a Federal RPS is adopted, and if the Rhode Island RPS is left ambiguous, then there exists a risk of double counting. In this event, the Rhode Island RPS could simply mandate a percentage above and beyond any Federal RPS requirement, and eliminate a double-counting threat.

[iii] I.e., Bernow et al, 2001, *American Way to the Kyoto Protoco*), Clemmer, S. and Donavan, D., 2001. *Clean Energy Blueprint*, Geller H., Nadel, S. 2001. *Smart Energy Policies* (ACEEE 2001), and the *Clean Energy Futures Study* by the 5 National Laboratories.

[iv] Available at http://www.state.ma.us/doer/rps/#public

[v] The results of the MA analysis are taken from: Smith, D. Cory, K., Grace, R., and Wiser, R., 2000. *Massachusetts Renewable Portfolio Standard Cost Analysis Report*, December Available at http://www.state.ma.us/doer/programs/renew/rps-docs/fca.pdf

[vi] There is a side benefit in that the RPS reduces demand for natural gas in the electricity sector and thus the price of natural gas generally. By 2010, the price of natural gas is reduced about $.07/MMBtu and by 2020 it is reduced about $0.11/MMBtu. This reduces the cost of NG used in the residential, commercial and industrial sectors. Note, however, that this natural gas price benefit occurs with a *national* RPS. In theory, sustained reductions in natural gas consumption due to an aggressive RPS in Rhode Island alone should result in lower regional natural gas prices and hence reduce the cost of saved carbon of a RI RPS. It is not clear, absent a modeling effort, what the answer the question of whether Perhaps (given the Govs and Premiers GHG commitment), a regional RPS which might have a price feedback effect, could be explored in a later stage of the Working Group activities.

[vii] The lower bound in this table, i.e., $46/tC based on national results, is not the lower bound for the national RPS. As mentioned in a previous endnote, if natural gas price feedback effects were included, the cost of a national RPS could be negative. The upper bound in this table, i.e., $230/tC based on extracting MA results from Smith, D., et al, 2000 as described in Annex C is not necessarily an upper bound for the MA RPS The cost assumptions used to calculate the incremental cost of renewable generation are central values.

[viii] Source: EPA, 1998. *Greenhouse Gas Emissions from Management of Selected Materials in Municipal Solid Waste*, EPA530-R-98-013, Exhibit ES-6

[ix] Cotter, A, and Stutz, J., 2001. *Memo to Scott Palmer of the USEPA RE Resource Conservation Benefits of 2000 Source Reduction and Recycling.*

[x] It is impossible to report with any degree of confidence how negative the cost of saved carbon would be. This is because this option is highly dependent upon local conditions. As a result, there is no “central” estimate. Costs can range between 5% to 100%.

[xi] Source: EPA, 1998. *Greenhouse Gas Emissions from Management of Selected Materials in Municipal Solid Waste*, EPA530-R-98-013, Exhibit ES-6

[xii] It is impossible to report with any degree of confidence how negative the cost of saved carbon would be. This is because this option is highly dependent upon local conditions. As a result, there is no “central” estimate. Costs can range between 5% to 100%.

[xiii] Calculated as $1m divided by 4000 tC = $250/tC

[xiv] It is important to note that the SBC already requires fairly aggressive demand side management. Further aligning local distribution company (LDC) incentives is unlikely to yield additional cheap and plentiful carbon reductions. Therefore, options to break the link between LDC sales and profitability are not discussed further.

[xv] Since Rhode Island consumption is small, its contribution to substantially impact scale economies or renewables that are far from competitive at present would also likely be small.

[xvi] The basis for this value is as discussed in Tellus Institute, 2001. *Development Of Options: Scoping Paper For The Working Group On Buildings and Facilities,* presented on 26 November as Part of Phase I: Developing A GHG Reduction Framework for Rhode Island’s Greenhouse Gas Action Plan

[xvii] It is, of course, debatable whether this would successfully attract incremental customers relative to existing programs. Without viable retail choice, the existing programs are unlikely to be able to spend a funding level less than envisioned here. Hence, the projected penetration can be considered an aggressive upper bound.

[xviii] The carbon intensity of 0.101 tC/MWh corresponds to an NGCC and is derived using the following assumptions: carbon emission factor = 32.7 lb C/mmBtu; NGCC heat rate = 6,800 Btu/kWh.
[xix] Calculated as $1m divided by 4000 tC = $250/tC
[xx] Calculated as $2m divided by (50% incentive x 13,3333 tC saved) = $300/tC
[xxi] For the Federal PTC, it can be challenging for developers to find equity investors with sufficient tax credit appetite to fully monetize the PTC benefits.
[xxii] Calculated as $1m divided by 2,400 tC = $417/tC
[xxiii] This is a conservative assumption (i.e., implies a higher costs of saved carbon) given the investor time preference of for immediate savings from a tax credit on equipment purchase rather than savings spread out over time from a production tax credit.
[xxiv] Calculated as $1m divided by 2,400 tC = $417/tC
[xxv] A minimum efficiency standard for cogeneration has been proposed in some jurisdictions. For example, in California, an overall minimum efficiency determination is calculated relative to process heat and electricity generation. For process heat requirements, the minimum process heat requirements (Btu/hr) are used and do not include thermal energy from supplemental fuel firing. For electricity generation, average electrical generation (after converting to Btu/hr using 3,414 btu/kWh) is used. For fuel input (Btu/hr), supplemental fuel firing is not included. Minimum efficiency is then calculated as: [electricity production + process heat]/[fuel energy input].
[xxvi] Eligible technologies include solar thermal electric, photovoltaics, wind, biomass, hydro, renewable transportation fuels, geothermal electric, waste, and cogeneration.
[xxvii] Assuming an average capacity factor of about 20%.
[xxviii] Calculated as follows: (3.0 c/kWh) * (annual generation of 1,762 MWh (i.e., 1 MW @ 20% capacity factor)) divided by 180 tonnes of carbon avoided (i.e., 1,762 MWh at 0.101 tC/MWh)) = $294/tC
[xxix] Bolinger, Mark, R. Wiser and W. Golove, 2001. *Revisiting the "Buy versus Build" Decision for Publicly Owned Utilities in California Considering Wind and Geothermal Resources*, October.
[xxx] Calculated as follows: $1 m divided by (500 tC/year x 10years) = $200/tC
[xxxi] EPA, 2001. *Municipal Solid Waste in the United States: 1999 Facts and Figures*, EPA530-R-01-014, Table 18 on page 68
[xxxii] It is impossible to report with any degree of confidence how positive the cost of saved carbon would be. This is because firstly, bottle bills are organized in very different ways and the costs can differ dramatically (i.e., by an order of magnitude). Secondly, the entity (e.g., consumer, state agency) who gets the deposit is a matter of state policy, which can differ significantly.
[xxxiii] Based on a projected baseline generation in Rhode Island of 6,962 GWh in 2020.
[xxxiv] Assumed cost is same as for an RPS
[xxxv] Large scale hydropower is not usually considered in RPS formulation due to its land and other impacts.
[xxxvi] The earlier estimate of the cost of saved carbon, i.e., $351/tC, contained an error in a conversion factor. The methodology described in this Annex calculates, for illustrative purposes, the CSC for the last year (i.e., 2012) of the MA RPS, as opposed to a levelized cost for the 2003-2012 period. The CSC over the entire period, taking into account variations in cost premiums and renewable demand is slightly lower, i.e., $222/tC, due to the lower renewable costs in the earlier years of the period.
[xxxvii] Wind, T., 2000. The Electric Price Impact of an RPS in Iowa, presented at Windpower 2000, May

[xxxviii] Kline, D., 1998. *Renewable and Energy Efficiency Options for Block Island Power*, National Renewable Energy Laboratory.