12-1-2004

A Climate Action Plan for Maine 2004 : A Report to the Joint Standing Committee on Natural Resources, Vol 1

Maine Department of Environmental Protection

A CLIMATE ACTION PLAN FOR MAINE 2004

A Report to the Joint Standing Committee on Natural Resources
of the Maine Legislature Pursuant to PL 2003 Chapter 237

Department of Environmental Protection December 1, 2004

ACKNOWLEDGEMENTS

The Department of Environmental Protection gratefully acknowledges the following organizations for their financial support of the Climate Action Plan project:

- The United States Environmental Protection Agency, for a facilitation grant to develop the stakeholder process;
- The Energy Foundation, for funds to support modeling and analytic activities;
- The Kendall Foundation, for funds to support modeling and analytic activities;
- The Maine Department of Transportation, for a grant to further the work of the Transportation and Land Use Working Group;
- The Governor's Office of Energy independence and Security, for funds to support modeling in the energy sector.

Several organizations represented in the stakeholder process were gracious in making their facilities available for meetings of the Stakeholder Advisory Group and Working Groups:

- The Natural Resources Council of Maine
- The Maine Pulp and Paper Association
- The Maine Motor Transport Association
- The Chewonki Foundation

The preparation of this report was assisted by the Muskie School of Public Service at the University of Southern Maine under the Cooperative Agreement with the Maine Department of Environmental Protection.

The Department expresses its particular thanks to Jonathan Raab and Peter Wortsman, of Raab Associates, for their tireless efforts and many useful suggestions, without which this *Plan* would not have come to fruition.

TABLE OF CONTENTS

* * * * *

VOLUME 2: APPENDICES

OVERVIEW

A 2003 Maine law (PL 237) required the Department of Environmental Protection (DEP) to develop and submit a *Climate Action Plan* (*CAP* or *Plan*) for Maine. The goals of the *CAP* are to reduce greenhouse gas (GHG) emissions to1990 levels by 2010, 10% below those levels in 2020, and by a sufficient amount to avert the threat of global warming over the longer term, which could be as much as 75%. This law was built on a New England Governors and Eastern Canadian Premiers resolution calling for similar reductions. Several New England states have adopted or are in the process of drafting their own plans. The law also directed the DEP to undertake "Lead by Example" initiatives, including conducting emissions inventories for state facilities and programs; obtaining voluntary carbon reduction agreements with private sector businesses and non-profit organizations; participating in a regional GHG registry; and establishing an annual statewide GHG emissions inventory.

For the past year and a half, the Department has worked with approximately 100 stakeholders to develop the Plan. In addition to a core group of 30 stakeholders comprising the Stakeholder Advisory Group (SAG), four different Working Groups (Transportation and Land Use; Buildings, Facilities, and Manufacturing; Energy and Solid Waste; and Agriculture and Forestry segments) consisting of approximately 100 individuals, met to identify measures, develop baselines, analyze pros and cons, and draft recommendations to the Stakeholder Advisory Group, and ultimately, the Department.

The first task was to establish a baseline of Maine's actual (1990) GHG emissions, and forecast numbers to 2020. The forecast is based largely on projections of Maine's economic growth and energy use (including both overall consumption and fuel mix), as well as Maine's solid waste, forestry, and agricultural practices. A particular effort was made to assure stakeholder consensus on the assumptions to be used for baseline and reduction calculations so that the *CAP* would be as Maine-specific as possible. The results show that, under a business as usual scenario, Maine's emissions in 2020 are projected to be 9,238,000 metric tons, or 34 percent, higher than the goal of the GHG legislation.

After a year of development, and based on the work of stakeholders, the Department is recommending fifty-four actions that will be needed to fill the gap between the baseline and the legislative targets. The Department's decision to include these options was based primarily on the assessment of saved carbon, and accompanying costs. Almost half of the options either reduce carbon at a negative cost (*i.e.,* "save" money over the program life) or cost very little. The recommended actions would, if taken together and implemented, make significant progress toward the statutory emission reduction targets, and may even meet them.

There are multiple actions for each of the four sectors. The report presents the actions in a variety of ways: by the amount of greenhouse gases saved; by cost-effectiveness; and grouped by sector. The Report also indicates next steps to implement the actions. Some actions require further legislation, while others can be implemented through executive order, rulemaking, or voluntary activity. Some will need further discussions and development before implementation.

A number of the included actions are initiatives that are already well under way. Maine's 2001 "Clean Government" initiative requires state agencies to incorporate environmentally sustainable practices into their planning, operations and regulatory functions. Many of the actions address GHG mitigation options, particularly in areas such as energy efficiency, building standards, and transportation fleet upgrades.

Maine's Office of Energy Independence and Security has calculated Maine State Government's GHG emissions for FY 02, 03 and 04. Over that time period the Government has reduced its own GHG emissions by 8%, through increased purchase of renewable power and fuels, and increased focus on energy conservation and efficiency in the transportation and building sectors.

To date, other state agencies have taken such actions as converting traffic lights at intersections to more efficient light-emitting diode (LED) lighting; administering a program whose focus is to increase electrical energy efficiency throughout the Maine economy; and requiring Maine's retail electricity suppliers

to have 30% of all power coming from renewable sources. This is the highest such “renewable portfolio standard” in the United States.

Every effort was made to reach consensus on the actions. Many actions achieved consensus and for the few that did not, a number achieved consensus as “principled goals”: that is, stakeholders agreed on the numerical target for the amount of carbon to be saved for that option. For the few that did not achieve consensus, the Report describes the pros and cons expressed by stakeholders.

The stakeholders paid careful attention to using the best available data for modeling and calculation. It was necessary, though, to choose certain values for key variables (such as economic growth), which are sensitive over the relevant time period (2005 to 2020) to relatively small initial differences in assumptions, or to subsequent changes. While the Department is confident that the data and assumptions used to calculate the forecast carbon savings and cost information are as refined as possible at this point, we are also aware that additional information, or more sophisticated analysis, is likely to change specific numbers. In addition, the final policy design and implementation strategy for each option may require changes to the projected carbon savings and cost estimates. Since we view the CAP as a continuing and living document, we will expect to modify the specifics as better information becomes available. The Legislature clearly had this in mind in the enabling legislation, which calls on the Department to evaluate the State’s progress toward meeting the reduction goals specified and amend the action plan as necessary by January 1, 2006, and every two years thereafter. Beginning in 2008, the DEP may recommend that the reduction goals be increased or decreased.

The Plan contemplates public education and outreach efforts. There is an Education and Public Awareness Working Group to assist the Department to offer public sessions at which this Climate Action Plan can be presented to wider audiences. The Department, along with other agencies of this administration, will work with the legislature to refine and implement the Plan, a leadership role that Maine frequently takes.

HIGHLIGHTS

Forestry Benefits. One of the more interesting and groundbreaking issues involves the forestry sector, which presents significant opportunities for carbon savings through sequestration. Extensive analysis of data from Federal and State sources, combined with careful exploration of assumptions about, for example, the role of forest soils in the carbon cycle, brought the Working Group to conclude that certain forms of active management already well-understood by the forest industry were capable of producing real carbon savings at very low or negligible cost. The options, voluntary in nature, would improve silviculture to produce more and higher-quality wood as an important co-benefit. It will be important to develop incentives needed to increase markets of this wood. The modeling of the carbon savings and costs suggest the likelihood that, taken together, these options would be close to cost-neutral, and could produce new landowner revenue streams and/or cost savings over time. Since Maine's is the first Climate Action Plan in the United States to fully consider the forest carbon cycle and active management options as a significant part of the overall GHG mitigation effort, further research and modeling will be necessary as part of implementation planning.

Efficiency Rewards. By establishing a baseline based on an earlier period, the Plan allows for higher production through economic efficiency. Industry is rewarded for both GHG reductions and more efficient production methods.

Trade Possibilities. The Plan gives Maine a competitive advantage by establishing a GHG baseline and registry. As more states develop GHG plans, along with the many countries with existing or contemplated plans, Maine may be in a position to "trade" carbon allowances if aggressive policies are pursued.

Co-benefits. Most of the recommended actions are expected to produce significant co-benefits in addition to saving carbon. Of particular significance are those will have a positive impact on human health, will save consumers money through energy conservation and efficiency, will reduce our dependence on foreign oil and gas, will create jobs, and/or can be expected to promote economic growth and development. Many of these occur in the realm of air quality affect-

ing human health, since lessening the emission of carbon dioxide from combustion of fossil fuels for electricity or transportation will also lead to reductions in other air pollutants. These include smog-producing sulfur and nitrogen oxide, and those fine particulates implicated in asthma and other respiratory diseases. Other co-benefits are expected to arise from the development of new technologies, particularly in the forestry sector, which in turn will produce additional economic benefits.

Energy Efficiency. Many of the electricity demand management options, such as energy efficiency measures, will save Maine people and businesses significant dollars, while contributing to Maine's energy security. Finally, a number of the options would work hand-in-hand with existing State policy goals such as forest and farmland protection.

GLOSSARY

AF	Agriculture and Forestry Working Group
BFM	Buildings, Facilities, and Manufacturing Working Group
CAP	Climate Action Plan 2004
CHP	Combined Heat and Power
CO2	Carbon Dioxide
ESW	Energy and Solid Waste Working Group
GHG	Greenhouse Gas
HFC	Hydro-fluorocarbon compounds
IPCC	Intergovernmental Panel on Climate Change
KmtCO2	Thousand(s) of metric tons (tonnes) of carbon dioxide equivalent
LEED	Leadership in Energy and Environmental Design
LEV	Low Emission Vehicle
NEG/ECP	Conference of New England Governors and Eastern Canadian Premiers
PUC	Public Utilities Commission
PV	Photo-voltaic
RPS	Renewable Portfolio Standard
SAG	Stakeholder Advisory Group
SBC	System Benefit Charge
SPO	State Planning Office
TLU	Transportation and Land Use Working Group
VMT	Vehicle Miles Traveled
WG	Working Group
ZEV	Zero emission vehicle

A CLIMATE ACTION PLAN FOR MAINE:
THE PROPOSAL

Background

In order to meet the requirements of the 121st Maine State Legislature's L.D. 845, "An Act to Provide Leadership in Addressing the Threat of Climate Change," the Maine Department of Environmental Protection convened a group of over thirty stakeholders representing business, industry, environmental groups, and other government agencies in the autumn of 2003. The purpose was to develop a Climate Action Plan (CAP) for Maine.[1] Maine's CAP development process builds on the 2001 agreement among the governors of New England states, and premiers of Eastern Canadian provinces to reduce greenhouse gases in the region. The goals are to reduce emissions to 1990 levels by 2010, 10% below those levels in 2020, and by as much as 75% over the longer term.[2] Under the terms of the legislation, the Department must submit a Plan recommending steps needed to meet these reduction targets to the legislature's Natural Resources Committee. The present document is intended to meet that obligation.

During the course of the stakeholder process, the core group (known as the Stakeholder Advisory Group (SAG) met on five occasions to set overall direction, review recommendations, and advise the Commissioner. SAG members served with other stakeholders on five different Working Groups (Transportation and Land Use; Buildings, Facilities, and Manufacturing; Energy and Solid Waste; Agriculture and Forestry; Education and Public Outreach) that each met on four occasions. The Working Groups (WG) were charged with discussing multiple GHG reduction initiatives, programs, and policy options in consultation with technical advisors representing a number of different disciplines. They were also charged with making recommendations to the SAG and DEP. Their work forms the central core of this Plan.[3]

Establishing the Baseline

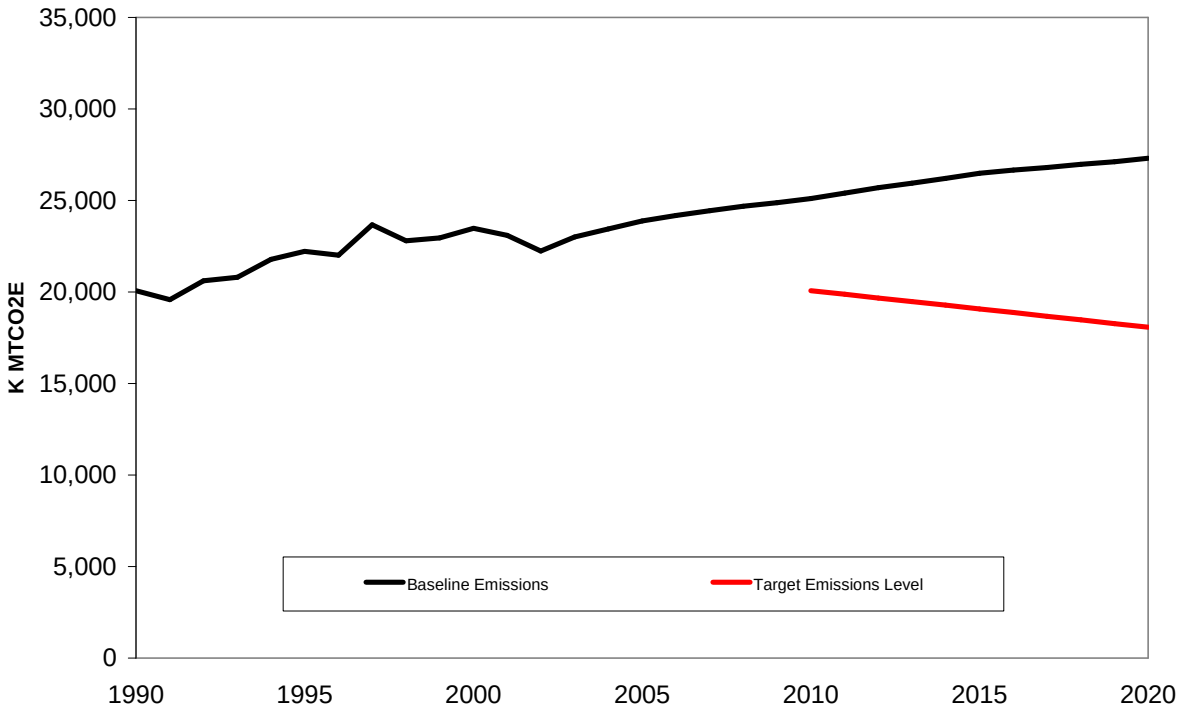
Much of the initial effort on the part of the Department and stakeholders centered on the establishment of a "Baseline" of Maine's actual (to 2002) and forecast (to 2020) GHG emissions. The baseline establishes the framework for planning the reductions needed to meet the mandated goals.

---

[1] See below, pp. 29 ff., for a description of the stakeholder process.
[2] See below, pp. 23-4.
[3] The entire *CAP*, together with all materials associated with the stakeholder process, is found at http://maineghg.raabassociates.org/

Figure 1 shows the baseline path for Maine's greenhouse gas emissions: that is, the expected growth in GHG emissions absent new initiatives. It also shows the path needed to meet the 2010 and 2020 targets. The gap between these paths must be filled by the initiatives, programs, and policies detailed in the following pages.

Figure 1: Emissions Baseline and Target



Calculation of Maine's baseline forecast was developed by Maine DEP and the Tellus Institute, a consulting firm engaged to provide modeling services on technical issues. The forecast is based largely on projections of Maine's energy use, as well as Maine's solid waste, forestry, and agricultural practices. The developers utilized U.S. Department of Energy energy-use information for Maine, supplemented by Maine-specific calculations based on information supplied by stakeholders representing the forest industry, the Public Utilities Commission, etc. Each stakeholder had multiple opportunities to provide data, which were reviewed by the technical consultants and Working Groups. A particular effort was made to assure stakeholder consensus on the assumptions to be used for baseline and reduction calculations so that the CAP would be as Maine-specific as possible. Further details on the assumptions underlying the develop-

ment of the baseline, the modeling approach used by Tellus, etc., may be found in Appendix 2.2. Additional baseline graphs may be viewed below, pp. 98-9.

Recommendations

Based on the work of stakeholders in both the Working Groups and SAG processes, the Department is recommending the following fifty-four actions as necessary to fill the gap between the baseline and the targets.[4] Items in the table are ranked based on expected GHG emission savings in the year 2020. The number in the first column, which indicates the option's position in the rank ordering of 2020 carbon savings, is also used to identify the option elsewhere in the document. This is followed by the short title of the option. In the third and fourth columns, the estimated annual savings to be realized by 2010 and 2020, respectively, are presented in terms of "KmtCO_2," or "thousands of metric tons of carbon dioxide equivalent," a metric which allows other GHGs such as methane to be presented in terms equivalent to CO_2. The 2020 savings number is then applied to the costs (or savings) that the option entails, measured in dollars *per* unit of saved CO_2 equivalent. In this column, numbers less than –"$0"- indicate measures that, if implemented, would save more than they cost over time. Finally, the Working Group identification number is given to allow easy reference to the working group reports found in the Appendices. These present information about assumptions and calculations, as well as fuller descriptions than are found in the Detailed Option Descriptions on pp. 37 to 92.[5]

TABLE 1: CONSOLIDATED OPTIONS RANKED BY CO_2 SAVINGS

GW #	Measure (Sector)	KmtCO2 saved in 2010	KmtCO2 saved in 2020	Cost per ton CO2	Workgroup ID
1	Offset Requirements	**365.0**	**1022.0**	10	ESW 1.12
2	Implement Tailpipe GHG Emissions Standards	**137.5**	**933.6**	-48	TLU 1.1a
3	Regional Cap and Trade	**376.0**	**755.0**	-90	ESW 1.9b
4	Clean Diesel/Black Carbon	**383.8**	**740.0**	14	TLU 8.1
5	Renewable System Benefit Charge	**334.0**	**689.0**	30	ESW 1.2

[4] Original option #12 has been removed; see below, p. 50 for a complete explanation.

[5] Several of the options listed above are essentially alternative paths toward the same goal. Each is listed separately here for purposes of comparison; however, the carbon savings in 2020 have been adjusted when compiled to produce Figure 1 to avoid double counting. For example, as described in the option summaries, Options 5 (System Benefit Charge) and 11 (Renewable Portfolio Standard) each seek to support the development of renewables. Similarly, the desired outcomes of Options 1 and 7 (Offset Requirements; Emission Standards) would be partially met if Option 3 (Regional Cap and Trade) were implemented.

6	Set a Low GHG Fuel Standard	**63.5**	**639.5**	34	TLU 3.1
7	Emission Standards	**484.0**	**609.0**	23	ESW 1.10
8	Biomass Generation: Existing Units	**574.0**	**574.0**	15	ESW 1.5a
9	Landfill Gas Management: Energy Production	**210.0**	**550.0**	NE	ESW 2.1a
10	Increased Stocking With Faster Growing Trees	**531.7**	**531.7**	1	F 2.0 (A 8.0)
11	Renewable Portfolio Standards	**247.0**	**527.0**	10	ESW 1.1
13	Pay as You Drive Insurance	**6.9**	**379.0**		TLU 2.4d
14	Forestland Protection	**376.0**	**376.0**	-6	F 1.0 (A7.0)
15	Recycling/ Source Reduction	**168.0**	**374.0**	0	ESW 2.3
16	Early Commercial Thin	**331.7**	**331.7**	1	F 3 (A5.2a)
17	Slowing VMT Growth (TLU 2.2, TLU 2.3, unquantified measures in TLU 2.4)	**87.5**	**286.4**		TLU 2.0
18	Biomass Restart Nonoperating Units	**269.0**	**269.0**	15	ESW 1.5a
19	Improve Electricial Efficiency:Commercial / Institu-tional	**181.9**	**250.8**	-139	BFM 3.8
20	Timber Harvest to Capture Anticipated Mortality	**239.5**	**239.5**	4	F 7 (A5.2b)
21	Biomass Electricity Feedstocks	**228.4**	**228.4**	0	F 5.0 (A 6.1)
22	Electrical Efficiency Measures: Manufacturing	**156.5**	**207.2**	-30	BFM 4.1
23	Fossil Fuel Efficiency Measures	**76.6**	**204.4**	-34	BFM 5.5
24	Low-GHG Fuel for State Fleets	**19.1**	**157.5**	10	TLU 3.2
25	Expanded Use Of Wood Products	**129.8**	**129.8**	3	F 6 (A5.5)
26	Appliance Standards	**84.3**	**128.7**	-134	BFM 1.1
27	Landfill Gas Management: Flaring	**109.0**	**109.0**	2	ESW 2.1b
28	Active Softwood Increase	**73.2**	**73.2**	3	F 4 (A5.2e)
29	Increase Public Expenditures for Electrical Efficiency	**25.0**	**71.1**	-55	BFM 5.2
30	Improve Residential Building Energy Codes	**24.7**	**64.1**	-35	BFM 2.1
31	Voluntary Partnerships and Recognition Programs	**34.5**	**57.5**	0	BFM 5.9
32	Add ZEV Mandate to LEV II Standards	**0.0**	**53.0**	0	TLU 1.1b
33	Local Grown Produce	**34.9**	**52.1**	TBD	A 6.0
34	State Green Power Purchases	**31.0**	**45.0**	28	ESW 1.3
35	Efficient Use of Oil and Gas: Home Heating	**29.3**	**39.1**	-6	BFM 2.6
36	Combined Heat and Power Incentive Policy	**86.0**	**38.0**	-185	ESW 1.8
37	Enforce Commercial Building Energy Code	**12.0**	**33.6**	-61	BFM 3.7
38	Solar Hot Water Heater Program	**12.0**	**33.1**	16	BFM 5.7
39	Soil Carbon Buildup	**15.4**	**31.0**	28	A 2.0
40	Green Campus Initiatives	**11.0**	**29.8**	-18	BFM 3.6
41	Encourage Anti-Idling Measures: Freight	**12.0**	**29.7**		TLU 4.2d
42	Voluntary Green Building Design Standards	**23.5**	**28.0**	-45	BFM 2.3
43	Waste-to-Energy	**24.0**	**24.0**	9	ESW 2.2
44	Agricultural Land Protection	**15.9**	**22.7**	13	A 5.0
45	Energy Savings in State Buildings	**7.9**	**21.0**	-37	BFM 3.3
46	GHG Feebates (state or regional)	**3.8**	**18.8**	0	TLU 1.3b
47	Procurement Preference for Concrete Containing Slag	**18.0**	**18.0**	0	BFM 3.9

48	Promote energy efficiency buildings	**4.3**	**11.3**	-19	BFM 3.2
49	Specification C150 Portland Cement	**9.0**	**9.0**	0	BFM 4.8
50	Reduce HFC Leaks from Refrigeration	**1.2**	**9.0**	1	BFM 5.10
51	Increase Organic Farming	**4.4**	**8.9**	28	A 3.0
52	Maine Biodiesel	**5.5**	**5.5**	40	A 1.0
53	Low-GHG Fuel Infrastructure (CNG, LPG)	**0.4**	**2.0**	1,482	TLU 3.3
54	Nutrient Management	**1.8**	**1.8**	0	A 4.0
55	PV Buy Down Program	**0.1**	**0.2**	NE	BFM 5.6

The Department's decision to include these options was based primarily on the assessment of saved carbon, and accompanying costs. The recommended actions would, if all taken together and implemented, make significant progress toward the statutory 2010 emission reduction targets and would meet them by 2020. However, each one of them will require a separate plan of implementation, ranging from legislative action, rule-making or executive order, to encouraging voluntary activity on the part of Maine people, organizations, and businesses. Some options are presented in a manner that clearly identifies a specific approach to implementation, such as the adoption of a certain standard for construction materials.[6] Others will require additional study and planning to arrive at a robust, cost-effective, and publicly acceptable means to put in place the action(s) necessary to reduce emissions.

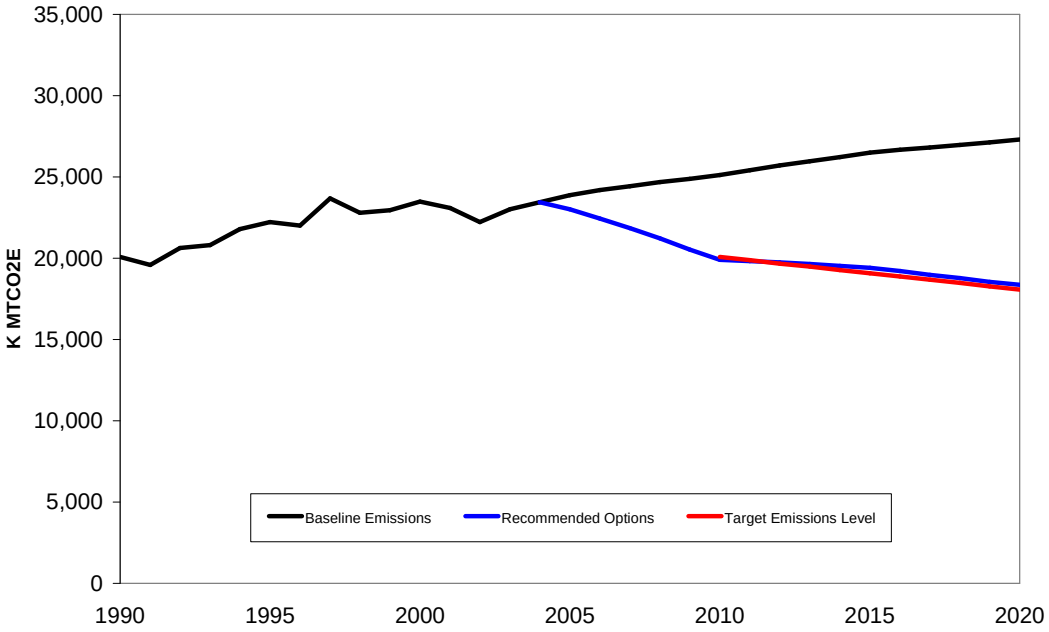
The stakeholder process of reviewing and recommending these options (and removing others from an original list) was carried out in a way that identified whether an action received consensus approval or not. At the June 30, 2004 meeting, Commissioner Gallagher concluded that all the options presented here, even when taken together, might not reach the statutory target. The Commissioner then determined that all should be preserved and presented here regardless of whether they achieved consensus.[7] When there was a lack of consensus at the Working Group or Stakeholder Advisory Group level, the detailed Option Descriptions on pp. 37 to 92 indicate that and delineate the reasons put forward by those who could and could not support the option. The complete Working Group reports in Appendix 5 identify more specifically those organizations unable to support a given recommendation.

When the 54 recommended options are summed, and compared to the forecast baseline and targets in Figure 1, the results are as follows:

[6] See Option 49.

In figure 2, the projected carbon savings are presented without considering the baseline

Figure 2: Emissions Baseline and Target without Black Carbon

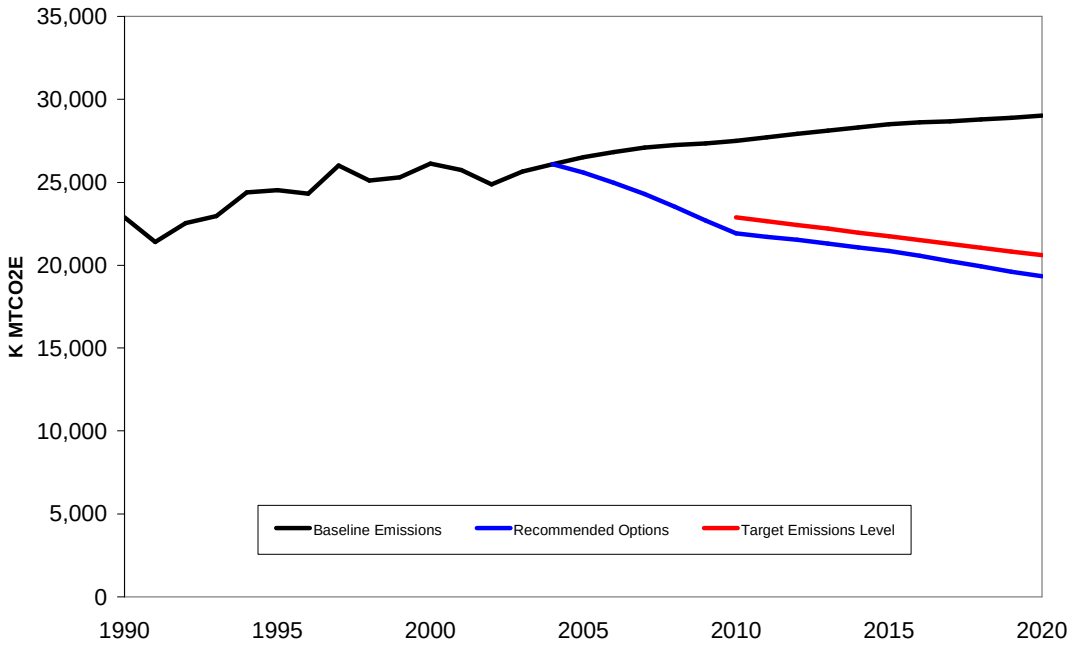


forecast of the factor "black carbon."[8] In figure 3, the original baseline, as shown in figure 1, begins and ends at a higher point to account for this factor; correspondingly, the recommended options include mitigation Option #4, "Clean Diesel / Black Carbon," which would address this.

[7] Several additional forestry options, as well as the overall methodology for estimating GHG savings from the forestry sector resulting in additional GHG savings to help Maine meet the targets, were finalized subsequent to that Stakeholder meeting.

[8] Impact of Black Carbon has not been fully modeled for this reason information is presented with and without this factor. The impact of Black Carbon understood in the transportation sector is well understood, but has not been fully modeled in the other sectors. See Appendix 3.1, for a complete description of this factor.

Figure 3: Emissions Baseline and Target with Black Carbon



As can be seen above, carbon savings sufficient to meet the statutory goals can be attained if all these options are implemented. The savings exceed the goal by approximately 5% in the first calculation; and by approximately 12.5% if black carbon and its corresponding mitigation options are included. Moreover, the continuing trend downward approaching 2020 indicates that continuation of these options would produce additional reductions in subsequent years.[9] However, several cautionary notes are in order:

- The stakeholders' and DEP paid careful attention to using the best available data for modeling and calculation, but the data are subject to change. For instance, it was necessary to choose certain values for key variables such as economic growth which are sensitive over time (2005 to 2020, for example) to relatively small initial differences in assumptions, or to subsequent changes.
- Each of the recommended options contains assumptions about the "best case" for speed of implementation: that is, the option would be put in place and begin to save emissions as soon as possible given the technical requirements of the option. Each year of delay in implementing an option, for whatever reason, slows its impact. Since a number of the most important options are already expected to

[9] At present, the data are not sufficient to determine whether this downward slope would meet the eventual goal of eliminating danger to the climate.

take longer to implement than others, and several would require an extended period of time before their effects were fully realized, the actual timetable for implementation will have a direct effect on whether or not the projected carbon savings are realized by 2010 and 2020.

- Several of the options are presented as "principled goals": that is, stakeholders agreed on the numerical target for saved carbon for an option, without agreement as to appropriate implementation.[10] Forms of implementation different from those modeled are likely to produce different results.
- The CAP is a living document. The implementation plans for some options will need to identify appropriate measures, and how to gather the data needed for measurement. Since the statute specifies that the DEP shall report to the Legislature bi-annually on progress beginning in 2006,[11] the Department can identify and modify, if needed, measurement and savings data.

With these considerations in mind, particularly given the possibility that the options, either individually or in combination with others, may not save as much carbon as projected, *the Department is forwarding this Plan in the expectation that all the recommended mitigation options*, as well as others for which the analysis is not yet complete, *will be needed over time to meet the statutory targets.* As will be noted, several of the most significant recommendations depend on regional agreement and action, while others could be negatively affected by actions on the federal level or decisions made in other states.[12] As a consequence, we believe that adopting and implementing a combination of actions that exceeds the minimum statutory requirements is both prudent and desirable.

[10] For example, there was strong stakeholder support for the goals of Option #11, "Renewable Portfolio Standards" in terms to fostering growth in renewable energy production, but no consensus on whether or not this should be implemented by increasing the current RPS standard.
[11] 38 MRSA §578.
[12] See, *e.g.,* Options 2, 3, 6.

DISCUSSION

Overview: Cost Considerations

The enabling legislation calls for the *CAP* to "address reduction *in each sector* (emphasis added) in cost-effective ways…."[13] However, comparison with similar plans generated in other states, and discussion with the consultants, identified that these particular sectors do not lend themselves to discrete analysis for purposes of calculating carbon savings. Instead, the Stakeholder Advisory Group re-aligned the sectors into Energy and Solid Waste; Transportation and Land Use; Buildings, Facilities, and Manufacturing; and Agriculture and Forestry, with Working Groups for each. The resulting recommended Options do, however, identify which of the NEG/ECP sectors will be affected by implementation.

In Table 2, the 54 recommended Options are presented in order of cost effectiveness, beginning with those forecast to produce the highest cost savings. The "cost of saved carbon" is the *net* cost of the option: that is, cost of implementing the option minus avoided costs or offsetting gains.[14] In general, where the modeling or other analysis produced a range of potential costs dependent on a number of variables, the cost number in Table 2, and in the individual option descriptions, is the more *conservative* value: that is, the higher cost (or lower negative cost).

TABLE 2: OPTIONS RANKED BY COST

GW #	Measure (Sector)	KmtCO2 saved in 2010	KmtCO2 saved in 2020	Cost $/tCO2	Workgroup ID
36	Combined Heat and Power Incentive Policy	**86.0**	**38.0**	-185	ESW 1.8
19	Improve Electricial Efficiency:Commercial / Institutional	**181.9**	**250.8**	-139	BFM 3.8
26	Appliance Standards	**84.3**	**128.7**	-134	BFM 1.1
3	Regional Cap and Trade	**376.0**	**755.0**	-90	ESW 1.9b
37	Enforce Commercial Building Energy Code	**12.0**	**33.6**	-61	BFM 3.7
29	Increase Public Expenditures for Electrical Efficiency	**25.0**	**71.1**	-55	BFM 5.2
2	Implement Tailpipe GHG Emissions Standards	**137.5**	**933.6**	-48	TLU 1.1a
42	Voluntary Green Building Design Standards	**23.5**	**28.0**	-45	BFM 2.3
45	Energy Savings in State Buildings	**7.9**	**21.0**	-37	BFM 3.3
23	Fossil Fuel Efficiency Measures	**76.6**	**204.4**	-34	BFM 5.5
22	Electrical Efficiency Measures: Manufacturing	**156.5**	**207.2**	-30	BFM 4.1

[13] 38 MRSA §577, referencing the sectors in §574.2 identified by the NEG/ECP plan: transportation, industrial, commercial, institutional, and residential.

[14] For instance, the cost of implementing forestry management options that sequester carbon can be offset by revenues from sales of removed biomass.

48	Promote energy efficiency buildings	**4.3**	**11.3**	-19	BFM 3.2
40	Green Campus Initiatives	**11.0**	**29.8**	-18	BFM 3.6
35	Efficient Use of Oil and Gas: Home Heating	**29.3**	**39.1**	-6	BFM 2.6
14	Forestland Protection	**376.0**	**376.0**	-6	F 1.0 (A7.0)
32	Add ZEV Mandate to LEV II Standards	**0.0**	**53.0**	0	TLU 1.1b
47	Procurement Preference for Concrete Containing Slag	**18.0**	**18.0**	0	BFM 3.9
49	Specification C150 Portland Cement	**9.0**	**9.0**	0	BFM 4.8
54	Nutrient Management	**1.8**	**1.8**	0	A 4.0
21	Biomass Electricity Feedstocks	**228.4**	**228.4**	0	F 5.0 (A 6.1)
15	Recycling/ Source Reduction	**168.0**	**374.0**	0	ESW 2.3
31	Voluntary Partnerships and Recognition Programs	**34.5**	**57.5**	0	BFM 5.9
46	GHG Feebates (state or regional)	**3.8**	**18.8**	0	TLU 1.3b
16	Early Commercial Thin	**331.7**	**331.7**	1	F 3 (A5.2a)
10	Increased Stocking With Faster Growing Trees	**531.7**	**531.7**	1	F 2.0 (A 8.0)
50	Reduce HFC Leaks from Refrigeration	**1.2**	**9.0**	1	BFM 5.10
27	Landfill Gas Management: Flaring	**109.0**	**109.0**	2	ESW 2.1b
28	Active Softwood Increase	**73.2**	**73.2**	3	F 4 (A5.2e)
25	Expanded Use Of Wood Products	**129.8**	**129.8**	3	F 6 (A5.5)
20	Timber Harvest to Capture Anticipated Mortality	**239.5**	**239.5**	4	F 7 (A5.2b)
43	Waste-to-Energy	**24.0**	**24.0**	9	ESW 2.2
1	Offset Requirements	**365.0**	**1022.0**	10	ESW 1.12
11	Renewable Portfolio Standards	**247.0**	**527.0**	10	ESW 1.1
24	Low-GHG Fuel for State Fleets	**19.1**	**157.5**	10	TLU 3.2
44	Agricultural Land Protection	**15.9**	**22.7**	13	A 5.0
4	Clean Diesel/Black Carbon	**383.8**	**740.0**	14	TLU 8.1
8	Biomass Generation: Existing Units	**574.0**	**574.0**	15	ESW 1.5a
18	Biomass Restart Nonoperating Units	**269.0**	**269.0**	15	ESW 1.5a
38	Solar Hot Water Heater Program	**12.0**	**33.1**	16	BFM 5.7
7	Emission Standards	**484.0**	**609.0**	23	ESW 1.10
34	State Green Power Purchases	**31.0**	**45.0**	28	ESW 1.3
39	Soil Carbon Buildup	**15.4**	**31.0**	28	A 2.0
51	Increase Organic Farming	**4.4**	**8.9**	28	A 3.0
5	Renewable System Benefit Charge	**334.0**	**689.0**	30	ESW 1.2
6	Set a Low GHG Fuel Standard	**63.5**	**639.5**	34	TLU 3.1
30	Improve Residential Building Energy Codes	**24.7**	**64.1**	35	BFM 2.1
52	Maine Biodiesel	**5.5**	**5.5**	40	A 1.0
53	Low-GHG Fuel Infrastructure (CNG, LPG)	**0.4**	**2.0**	1,482	TLU 3.3
9	Landfill Gas Management: Energy Production	**210.0**	**550.0**	NE	ESW 2.1a
55	PV Buy Down Program	**0.1**	**0.2**	NE	BFM 5.6
33	Local Grown Produce	**34.9**	**52.1**	TBD	A 6.0
13	Pay as You Drive Insurance	**6.9**	**379.0**		TLU 2.4d
17	Slowing VMT Growth (TLU 2.2, TLU 2.3, unquantified measures in TLU 2.4)	**87.5**	**286.4**		TLU 2.0
41	Encourage Anti-Idling Measures: Freight	**12.0**	**29.7**		TLU 4.2d

Based on the current underlying assumptions, including those relating to economic growth and energy prices, it appears reasonable to estimate is that we can accomplish the 2020 goals at a net negative cost. *That is, if all the recommended options*

were implemented, the aggregate overall cost per unit of saved carbon would be less than zero. It should be noted that these data, including cost estimates, are inherently uncertain, and depend on many variables such as population and economic growth projections, discount rates, etc. The data represent the best possible estimate of these uncertainties at the time the inventory is completed. The inventory will be reviewed, and modified when necessary, on a regular basis, so that the carbon and cost numbers are part of a living document. Any changes to these assumptions that emerge in the future will have the effect of altering either the projected carbon savings, or the cost characteristics of saved carbon, or both. The complete presentation and discussion of the assumptions which produced cost/savings numbers is found in the final reports of the Working Groups in Appendix 5.

Overview: Options by Working Group Sector

Energy and Solid Waste Options

These options focus on actions to be taken in the areas of electrical energy supply (generation) and solid waste management. The workgroup felt that whenever possible Maine specific data would be preferred. These were essential in two areas: 1) forecasting future electrical supply and demand; and 2) moving towards a consumption-based accounting system. The Stakeholder Advisory Group determined that the median economic forecast provided by Professor Charles Colgan should be used, although some stakeholders were concerned that the projected economic growth rates were too high.[15]

The discussion of the production/consumption issue concerned which methodology best represents Maine's electrical demand for greenhouse gas planning purposes. Although the workgroup favored a consumption-based approach it became clear that this could not easily be modeled. Two major problems are that 1) without a regional approach the possibility of leakage or double counting exists; and 2) that the current methods of collecting consumption data needed to be updated to serve this need. As discussed in Appendix 2.3, the CAP relies on a modified version of the production method, one using instate production figures, adjusted to reflect import and export trends during the period of the modeling. Over the longer term, the Workgroup and SAG believe it is in Maine's best interest to have a regional consumption-based approach adopted for future GHG accounting.

[15] See Appendix 2.1 for a complete description.

Buildings, Facilities, and Manufacturing Options

These options focus on actions to be taken in the commercial, residential and industrial building management and operation area; and in manufacturing processes. The workgroup concentrated on developing an inventory and baseline for residential, commercial, and industrial buildings and facilities that fairly represented the sectors. Workgroup members supplied facility numbers and other sources of data that replaced the initial baseline results with Maine-specific data to the greatest possible extent. The resulting options achieved a very high degree of consensus. The workgroup identified several areas of concern or modification as the CAP moves forward:

- Allowing facilities to use carbon intensity targets, which would allow them to increase production as long as the pollution *per* unit of production was reduced from current levels. The difficulty with this approach in the context of this *Plan* is that the legislative goal is based on absolute reduction targets. Since measured levels of GHGs could increase using this approach, the legislative dictate would potentially need to be changed.
- The discount rate for payback on investment was left unresolved. The workgroup thought that the discount rate should be different for each sector. While in the industrial sector a discount rate of less than one year is often expected, a 5 to 7 year payback is probably acceptable in the residential sector.
- Mechanisms to implement some of the options in this area are not specifified, or would depend on funds for initial capital investment which are not presently identified. The Working Group recommends that the entities responsible for implementing these options take into account the pros and cons of each of the following mechanisms, including the effectiveness and political viability of each:
    1. Education;
    2. Recognition Programs;
    3. Financial Incentives;
4. Mandatory Programs.

Transportation and Land Use Options

The interactive relationship between land use (siting of residential and commercial areas; managing growth, etc.) and transportation (vehicle use) suggested that these options be analyzed by the same Working Group. This sector represents the largest source of GHG pollution in Maine. The recommended options address actions to be taken by individual consumers, such as a Zero Emission Vehicle mandate and Feebates (Options 32 and 46) on the one hand; and land use strategies to reduce VMT growth on the other. As was true in the other workgroups, Maine-specific data were provided by the stakeholders to assure the truest possible picture of Maine's situation.

Workgroup members were concerned that any transportation option take market fairness into consideration. This fairness could be reached by making sure a regional approach was used to implement options, like Tailpipe Standards (Option 2) or Feebates. A regional approach would address issues such as boundary issues with close proximity states and special products for a relatively small market.

The transportation group discussed "black carbon" because current work on the subject will affect the diesel transportation segment. The group was concerned about making recommendations in this area without considering all black carbon-producing combustion sources and thus requested the Departments of Environmental Protection and Transportation to study the matter further.

Agriculture and Forestry Options

Because they were thought to represent management of natural resource areas, particularly as directed toward increasing carbon sequestration,[16] representatives of these interests shared the same Working Group. As time went on, however, it became clear that significantly different options applied to each. As a result, the Options are divided between five Agricultural options, and seven Forestry options.

As seen in Table 1, the forest sector presents significant opportunities for carbon savings through sequestration. Early in its analysis, the Agriculture and Forestry Working Group was surprised to discover that Maine's forests were currently emitting more carbon than was being taken up. Extensive analysis of data from Federal and State sources, combined with careful exploration of assumptions about, for example, the role of forest soils in the carbon cycle, brought the WG to the conclusion that certain forms of

[16] §577, "The action plan…must allow sustainably managed forestry, agricultural and other natrual resource activities to be used to sequester greenhouse gas emissions."

active management already well-understood by the forest industry were capable of producing real carbon savings at very low or negligible cost.

Information about the carbon savings and costs for the Forestry options differs from all the others. The 2010 / 2020 template for setting carbon emission reductions, required by the statute and mirroring the NEG/ECP regional *Plan*, does not accurately account for the reality of a living system, Maine's forests. Thus, for example, a forestry management option to increase the sequestration of carbon that is put in place in 2005 might actually *increase* GHG emissions for the first ten years, but result in substantial carbon savings over the lifetime of the forest. After considering and comparing the calculations for carbon savings and costs over a 15-year span (2005-2020), and then a 95-year span (through 2100), the Working Group adopted a 58-year time horizon as best representing the life-span of a typical managed forest. In order to report data comparable with that for the non-forest options, the projected carbon savings were then "levelized": that is, total carbon savings over 58 years were averaged to an equal annual number for purposes of modeling. The Working Group and its technical advisors recognize that this is an artificial construct, but were agreed that it best represents the contribution of the forest sector to the long-term reduction of GHG emissions in Maine.[17]

Six of the recommended Forest sector options (10, 16, 20, 21, 25, 28) constitute an interactive package of forest management practices which primarily apply to Maine's large industrial and other actively managed woodlands. The options would improve silviculture to produce more and higher-quality wood as an important co-benefit. As can be seen, implementation of the options would depend primarily on voluntary actions by landowners, all of which would depend on a variety of incentives needed to increase markets. The modeling of the carbon savings and costs suggest the likelihood that, taken together, these options would be close to cost-neutral, and could produce new landowner revenue streams and/or cost savings over time. Since Maine's is the first Climate Action Plan in the United States to fully consider the forest carbon cycle and active management options as a significant part of the overall GHG mitigation effort, further research and modeling will be necessary as part of implementation planning.[18]

[17] For a fuller discussion of the process by which this standard was adopted, and its implications for the calculation of carbon savings and costs, see the Working Group report in Appendix 5.4.
[18] In 2004, the Maine Forest Service received a Federal grant to explore management options more fully, in order to identify which measures hold the greatest promise. An initial report is expected early in 2005.

Overview: Carbon Savings / Costs

As an aid to comparing the carbon savings and costs of the recommended actions, the following matrix may be helpful:

TABLE 3: DECISION / IMPLEMENTATION MATRIX

Number in ( ) is estimated $ per tonne of saved carbon

	> 200 KMT Carbon saved	**< 200 KMT Carbon saved**
Options costing less than -$20 per ton (saves money)	19: Commercial/institutional energy efficiency [BFM 3.8] **(-139)** 3: Regional Cap and Trade [ESW 1.9b] **(-90)** 2: Tailpipe GHG [TLU 1.1a] **(-48)** 23: Fossil fuel efficiency measures BFM 5.5] **(-34)** 22: Mfg. electrical efficiency [BFM 4.1] **(-30)**	36: CHP incentive policy [ESW 1.8] **(-185)** 26: Appliance standards [BFM1.1] **(-134)** 37: Commercial building energy code [BFM 3.7] **(-61)** 42: Voluntary green building standards [BFM 2.3] **(-45)** 29: Public expenditure elec. efficiency [BFM 5.2] **(-55)** 45: State buildings energy savings [BFM 3.3] **(-37)** 30: Residential building energy codes [BFM 2.1] **(-35)**
Options costing between -$20 and $0 per ton (saves money)	14: Forestland Protection [F 1.0] **(-6)** 21: Biomass electricity stocks [F 5.0] (**0**) 15: Recycling / source reduction ESW 2.3] **(0)**	48: Promote energy efficient buildings [BFM 3.2] **(-19)** 40: Green campus [BFM 3.6] **(-18)** 35: Home heating efficiency [BFM 2.6] **(-6)** 47: Slag concrete procurement preference [BFM3.9] **(0)** 49: Portland cement ASTM specification [BFM 4.8] **(0)** 54: Agriculture nutrient management [A 4.0] **(0)** 31: Voluntary partnerships [BFM 5.9] **(0)** 32: ZEV Mandate [TLU 1.1b] **(0)** 46: GHG vehicle feebates [TLU1.3b] **(0)**
Options costing more than $0 and less than $20 per ton	16: Early commercial thinning [F. 3.0] **(0 - 1)** 10: Increased stocking fast growth [F 2.0] **(1)** 20: Timber Harvesting [F 7.0] **(3.5)** 4: Clean diesel [TLU 8.1] **(6-14)** 1: Offset requirements [ESW 1.12] **(10)** 11: RPS [ESW 1.1] **(10)** 8, 18: Bio-mass re-start, subsidy [ESW 1.5a] **(15)**	41: Encourage freight anti-idling [TLU 4.2d] **(>0)** 50: Reduce HFC refrigeration leaks [BFM 5.10] **(1)** 27: Landfill methane flaring [ESW 2.1b] **(2)** 25: Expand wood products use [F 6.0] **(3)** 28: Softwood increase [F 4.0] **(3)** 43: Waste to energy [ESW 2.2] **(9)** 24: State fleet low GHG fuel [TLU 3.2] **(10)** 44: Agricultural land protectoin (**13**) 38: Solar hot water heater [BFM 5.7] **(16)**
Options costing more than $20 per ton	7: Emissions standards [ESW 1.10] **(23)** 5: System Benefit Charge [ESW 1.2] **(30)** 6: Low GHG fuel [TLU 3.1] **(34)**	39: Soil carbon buildup [A 2.0] **(28)** 51: Organic farming [A 3.0] **(28)** 34: State green power purchase [ESW 1.3] **(28)** 52: Promote Maine bio-diesel [A 1.0] **(40)** 53: Low GHG fuel infrastructure **(1482)**

Overview: Co-Benefits

Most of the recommended actions are expected to produce significant co-benefits *in addition to saving carbon*. Of particular significance are those will have a positive impact on human health, are likely to reward efficiency, and/or can be expected to promote economic growth and development. Many of these occur in the realm of air quality affecting human health, since lessening the emission of CO_2 from combustion of fossil fuels for electricity or transportation will also lead to reductions in other air pollutants. These include smog-producing sulfur and nitrogen oxide, and those fine particulates implicated in asthma and other respiratory diseases. Other co-benefits are expected to arise from the development of new technologies, particularly in the forestry sector, which in turn will produce additional economic benefits. Many of the electricity demand management options, such as energy efficiency measures, will save Maine people and businesses significant dollars, while contributing to Maine's energy security. Finally, a number of the options would work hand-in-hand with existing State policy goals such as forest and farmland protection. The Options are presented here in several categories of co-benefits:

TABLE 4: GHG OPTIONS SORTED BY CO-BENEFIT

Reduce Other Air Emissions: multiple benefits, especially human health	Economic Development, including new technologies, new markets for existing products, increase value of resources, etc.	Consumer, Business, Institutional, and/or Municipal Savings
2: Tailpipe GHG standards	1: Offset requirements	2: Tailpipe GHG standards
3: Regional cap & trade	5: Renewable SBC	12: Energy efficiency measures
4: Clean Diesel	6: Low GHG fuel standard	15: Recycling/ source reduction
6: Low GHG fuel standard	8: Biomass generation	19: Electrical efficiency of commercial buildings
7: Emission standards	10: Forest stocking increase	22: Mfg. Electrical efficiency
13: Pay as you drive insurance	11: Renewable portfolio	26: Appliance standards
17: Slowing VMT growth	16: Early forest thinning	30: Residential building codes
32: ZEV standards	20: Light forest harvest	35: Efficient home heat
41: Freight anti-idling	21: Biomass feedstocks	37: Commercial codes
46: GHG vehicle feebates	23: Fossil fuel efficiency	40: Green campus
53: Low GHG fuel infrastructure	25: Wood products use	41: Freight anti-idling
	28: Active softwood incr.	42: Green buildings
	38: Solar water rebate	45: State buildings
	42: Green building standards	47: Concrete with slag
	52: Bio-diesel	48: Energy efficient buildings
		49: Cement standards
		50: Reduce HFC leaks

Energy Security	Other
1: Offset requirements	9: Landfill methane: avoided landfill site odors
5: Renewable SBC	14: Forestland protection: habitat protection, sprawl reduction
11: Renewable portfolio standard	20: Regular light harvest: improved forest health
17: Slowing VMT growth	21: Biomass feedstocks
29: Electrical Efficiency invest.	33: Locally grown produce
34: Green power purchase	44: Agricultural land protection
52: Bio-diesel	51: Organic farming

Information about, and discussion of, co-benefits is presented qualitatively, since only some of them can be quantified. This is unfortunate, because in many cases the real cost savings to the economy are significant. Using one of the examples above, for instance, public health organizations point to significant savings in avoided health care costs and lost work time consequent on lessening the number of chronic health problems associated with air pollutants.

NEXT STEPS

In presenting this *Climate Action Plan,* the Department is aware that even if all the options are approved in principle by the Legislature and stakeholders, implementation will not be immediate or uniform. As previously noted, each of the options will have its own associated implementation steps. The different anticipated implementation approaches are summarized in Table 5.

TABLE 5: GHG OPTIONS BY TYPE OF IMPLEMENTATION

Legislation	Executive Order	Rule	Voluntary Action[19]
1, Offset Req. 6, Low GHG fuel 8, Biomass subsidy 11, RPS 26, Appliance standards 30, Residential building codes 37, Comm. energy codes 38, Solar water heat rebate 46, GHG feebates	24, Low GHG fuel, state fleets 34, State green power purchase 45, State buildings energy savings 47, Concrete procurement	2, Tailpipe GHG[20] 7, Emission Standard 9, 27 Landfill CH_4 32, ZEV 36, CHP incentives 49, Cement standards	9, 27 Landfill CH_4 10, Forest Stocking 13, PAYD Insurance 16, Early Comm. Thin 20, Forest Harvest 28, Softwood increase 31, Partnerships and recognition programs 39, Soil carbon 41, Anti-idling 42, Green building design 43, Waste to energy 48, Energy efficient buildings 50, HFC leaks

Regional or Federal Participation	Multi-part[21]	Enhance Existing Program
2, Tailpipe GHG 3, Cap and Trade 6, Low GHG fuels 24, Low GHG state fleet fuels 46, Feebates 49, Cement standards	4, Diesel/Carbon 5, SBC 14, Forest Protection 15, Recycling 17, Slow VMT growth 21, Biomass stocks 22, Manufacturing Energy Effic. 23, Fossil Fuel Efficiency 25, Wood products 33, Local produce 44, Farmland protection 51, Organic farming 52, Bio-diesel 53, Fuel infrastructure	19, Commercial / Institutional Energy Efficiency 29, Increase Electricity Efficiency Measures 35, Home heating 40, Green campus 54, Nutrient management 55, Solar PV

[19] "Voluntary Action" is assumed to require some combination of support activities such as educational programs; training; public outreach, etc. These activities may be eligible for offsets, market-based incentives, or use of SBC-type funding.
[20] Could be seen as a "major substantive" rule, requiring legislative action.
[21] Some combination of preceding approaches, including development of an implementation plan. May include incentive programs for which specific funding was not identified by SAG.

The implementation process overall will require several additional considerations. First, while the Department is confident that the data and assumptions used to calculate the forecast carbon savings and cost information are as refined as possible at this point, we are also aware that additional information, or more sophisticated analysis, is likely to change specific numbers. In addition, the final policy design and implementation strategy for each option may require changes to the projected carbon savings and cost estimates. Since we view the *CAP* as a continuing and living document, we will expect to modify the specifics as better information becomes available. The Legislature clearly had this in mind in the enabling legislation, which calls on the Department to "evaluate the State's progress toward meeting the reduction goals specified…and amend the action plan as necessary" by January 1, 2006, and every two years thereafter.[22] Beginning in 2008, the DEP may recommend that the reduction goals be increased or decreased. In order to meet this standard, some of the recommended options will need further determination of performance measures, and accompanying data gathering and analysis activities, as part of implementation.

Since many of the recommended options would have, when implemented, direct effects on individual citizens, institutions, organizations, and businesses in Maine, further efforts will be needed in the area of public education and outreach. Many of these options already identify key groups to engage in implementation, but the *Plan* as a whole must also be presented to the people of Maine. The Commissioner has asked the Education and Public Awareness Working Group to continue its work, in particular by planning and assisting the Department to offer one or more public sessions at which this *Climate Action Plan* can be presented to wider audiences. Maine citizens must be invited to join the effort to reduce Maine's GHG emissions through their individual choices and actions if Maine is to be successful in meeting the challenging goals set by statute.

As has been noted, Maine's actions will be taken, and should be understood, in the broader context of regional, national, and international activity. A number of the options that are most significant (in terms of potential for carbon reduction) either depend upon, or have effects that would be enhanced by, the actions of other jurisdictions.[23] The implementation and effectiveness of several others, particularly those involving the

[22] §578, "Progress evaluation."
[23] Chief among these are Options 2 (Tailpipe GHG Standards); 3 (Regional Cap and Trade); 4 (Clean Diesel/Black Carbon); 6 (Low GHG Fuel Standards); and 1 (Offsets) and 7 (Emission Standards) to the extent that these interact with Regional Cap and Trade.

development of, and demand for, renewable electricity supplies, will be affected by similar actions taking place in other New England states. Finally, the NEG/ECP jurisdictions have yet to agree on important items related to the long-term counting and crediting of emission reductions, particularly in the electricity sector, where agreed common assumptions would allow more accurate calculation of carbon savings and costs. It will be important for Maine to continue to lead these efforts.

The Report, as required by law, will be delivered to the Natural Resources committee of the Maine Legislature. The Department will bring to the attention of the legislature those proposed actions that require further legislative activity. While many of these would come under the jurisdiction of the Natural Resources committee, there are others that would likely be directed to other committees such as Utilities and Energy, or Transportation. The Department expects to ask the leadership of the 122nd Legislature, and the House and Senate chairs of the relevant committees, to appoint a group of legislators representing the committees. This group could be charged with reviewing the *CAP* and determining which of the recommended actions may require additional legislative action. It could then coordinate the process of moving the measures through the legislative process. It would also be asked to oversee implementation of aspects of the *CAP*, including the establishment of priorities for action.

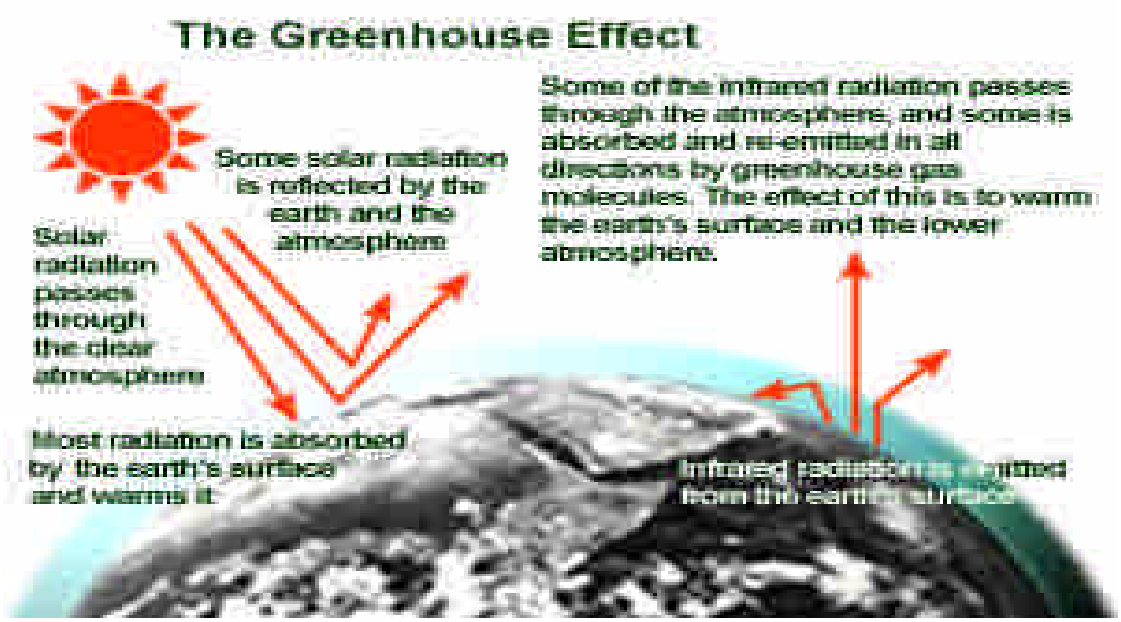
The *Plan* will also be delivered to the Office of the Governor. Some of the recommended actions, such as state purchases of renewable energy, are currently under way in the executive branch. The Department, or other appropriate agency, will continue to implement these measures. The Department will begin implementation of other actions for which it currently has authority. The Department will work with other executive branch agencies to implement recommended actions in their purview.

There are additional issues that may require additional work by the Department over the course of the next year. For example, the carbon status of biomass for purposes of the recommended actions is an issue that needs further clarification and definition before moving forward. The Department expects that the legislative group chosen to oversee the implementation of the *CAP* will provide input on how the legislature would like to see issues of this sort dealt with.

GREENHOUSE GASES AND THE PROBLEM OF GLOBAL CLIMATE CHANGE

The global climate system that produces local weather and seasonal change is a highly complex entity. It is by its nature highly variable: that is, small changes in factors such as Earth's orbital track around the sun or natural variation in the sun's intensity can have large consequences, including the advance and retreat of ice ages. Thus, until recently, studies of climate change focused primarily on natural causes and cycles.

Among the physical causes of climate change is the prevalence in the atmosphere of so-called "greenhouse gases (GHG)." These include naturally occurring components of terrestrial life such as water vapor, carbon dioxide, and methane; and human-made compounds such as SF_6.[24] As solar radiation passes through the clear atmosphere, most of it is absorbed by Earth's surface and warms it. Some is reflected by the earth and the atmosphere, and this infrared radiation passes back through the atmosphere. As it does so, a portion is absorbed and re-emitted in all directions by GHG molecules, just as the glass of a greenhouse maintains the heat created by the warming of the inside when the sun's rays pass through. The effect is further to warm the Earth's surface and lower atmosphere.[25]



[24] Sulfur hexaflouride, commonly used as an insulating compound in the electrical distribution system.

[25] Current understandings of climate science cannot easily be summarized in a *Report* such as this. A convenient website with the most comprehensive international reports on the causes and consequences of climate change is that of the Intergovernmental Panel on Climate Change, http://www.ipcc.ch.

While natural phenomena such as volcanic explosions can add significantly to the GHG in the atmosphere, the burning of fossil fuels, the clearing of forests, and other human interventions appear to be destabilizing the global climatic system which has been gradually changing (in this case, warming) since the end of the last Ice Age, about 12,000 years ago. This has been exacerbated in recent times, so that the United Nations Intergovernmental Panel on Climate Change (IPCC) concluded in its *Third Assessment Report* that "(t)here is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities."[26] To cite one of the most commonly used measures of change, atmospheric concentration of carbon dioxide (CO_2) has increased from a pre-industrial level of 280 parts *per* million (ppm) to the current level of 360 ppm, 31 *per cent* higher than the pre-industrial levels. Unless steps are taken to lessen further releases of GHGs, these levels are projected to increase to 450 ppm by 2025, and 550 ppm by 2050. The current level of CO_2 in the atmosphere has not been exceeded in the past 420,000 years, and probably not in the past 20 million years.[27]

Since CO_2 molecules persist in the atmosphere for more than a century, their effect on climate cannot be quickly halted or reversed. However, long-term climatic changes are difficult to predict with certainty because of the complexity of the climate system. The IPCC's increasingly sophisticated modeling results suggest that by 2100, the effects of climate change could include increased global average surface temperature of 2.5 to 10.4° F. This and other changes will not be evenly distributed over time or geography, and may include rapid and unexpected changes in temperature and water cycles.[28]

If no action is taken, the IPCC identifies as likely consequences some or all of the following:

- Increase in the incidence and severity of extreme weather events such as storms, droughts, floods, and heat waves;
- Rise in global sea level, including stresses on estuaries, bays, and wetlands;
- Changes in precipitation rates impacting water supplies and food production;
- Shifts in and/or expansion of certain disease and pest vectors; and
- Further stress on already vulnerable species and eco-systems.

[26] *Climate Change 2001: The Scientific Basis.* Report of Working Group I: Summary for Policy Makers. Cambridge, 2001: 10.
[27] *IPCC 2001*: 12.

All of these effects would be potentially profound for Maine's, and the Northeast's, natural resources in the areas of agriculture, forestry, and fisheries, as well as for human infrastructure, particularly in coastal regions.[29]

The anticipated human health effects of global climate change are profound, if less easy to quantify. Both the IPCC and World Health Organization have agreed that significant effects are likely. These include temperature-related illnesses and death; health effects related to extreme weather events; air pollution-related health problems; water- and food-borne diseases; and insect-borne diseases such as malaria, dengue, Lyme disease, and encephalitis.

In Maine, there is not yet evidence of significant warming, for reasons that are thus far unclear. However, there are already measurable changes in seasonal variation, and in patterns of precipitation, with particular impacts on groundwater, which can reasonably be associated with climate change.

Even in the face of uncertainties regarding the precise consequences to be expected from increasing levels of atmospheric CO_2, there has been increasing world-wide interest in taking steps to reverse the trend.[30] In 1992, the United States and other parties (187 countries to date) to the United Nations Framework Convention on Climate Change agreed to adopt the long-term goal of stabilizing GHG concentrations at a level that would prevent "dangerous anthropogenic interference" with the climate system. While the United States has thus far not ratified the 1997 Kyoto Protocol, which sets targets for the total quantity of GHGs that industrialized countries would be allowed to emit, a number of states and local jurisdictions have developed climate action plans centered on steps to be taken to lessen GHG emissions.[31]

In July 2000, the Conference of New England Governors and Eastern Canadian Premiers (NEG/ECP) adopted Resolution 25-9 on global warming and its impacts on the environment. The Conference recognized that global warming, given its harmful consequences to the environment and the economy, is a joint concern for which a regional ap-

---

[28] *IPCC 2001*: 10.

[29] For an older but still useful summary of possible effects for Maine, see the 1998 EPA evaluation at http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/SHSU5BUT6R/$File/me_impct.pdf

[30] For a summary of these uncertainties, and associated policy implications, see David G. Victor, *Climate Change: Debating America's Policy Options* (NY: Council on Foreign Relations), 2004: 12-16.

proach to strategic action is required. Its Committee on the Environment was charged with presenting a summary of findings and a recommended action plan to the 2001 annual meeting of the NEG/ECP. The resulting NEG/ECPClimate Change Action Plan was subsequently ratified by each of the governors and premiers. Governor Angus King was a signatory to the Plan, and Maine's participation was subsequently endorsed by Governor John Baldacci. The plan

> (p)resents a set of near-term options for our region that would help protect the climate, reduce GHG emissions and other pollutants, cut energy demands, and promote future job growth by harnessing sustainable energy resources and advanced technologies. … By focusing on a set of concrete, achievable, near-term opportunities, we hope to demonstrate leadership and build a foundation from which more dramatic progress can be realized.[32]

The NEG/ECP *Plan* commits each member jurisdiction to participate in the achievement of regional goals which mirror those proposed in the UN Framework Convention and Kyoto Protocol, namely

- Reduce regional GHG emissions to 1990 levels by 2010;
- Reduce regional GHG emissions to at least 10% below 1990 levels by 2020; and
- Reduce regional GHG emissions sufficiently "to eliminate any dangerous threat to the climate" as a long-term goal, date unspecified.

Under the terms of the agreement, there will be varying approaches among the jurisdictions to achieving the regional goals, and an understanding that the targets might not be reached in equal measure by each jurisdiction.[33]

---

[31] See Barry G. Rabe, *Statehouse and Greenhouse: The Emerging Politics of American Climate Change Policy* (Washington, D.C.: Brookings Institution), 2004.
[32] NEG/ECP *Climate Change Action Plan 2001*: 2.
[33] NEG/ECP *Plan*: 6-7.

MAINE'S POLICY RESPONSE TO THE CHALLENGE OF CLIMATE CHANGE

The Department of Environmental Protection issued its first report on GHGs in the *Maine's Greenhouse Gas Emissions Inventory for 1990.* The inventory, which was updated in 2000, is a "current, comprehensive listing, by source, of air pollutant emissions."[34] Such an inventory is necessary to establish baselines from which emissions reductions such as those called for in the subsequent legislation can be calculated. The Department has subsequently revised its Emission Statement Regulation (DEP Chapter 137) to include the reporting of GHGs for inclusion in the Emissions Inventory, making Maine the first jurisdiction in the region to mandate the reporting of GHG emissions.
In June 1998, the State Planning Office (SPO) released a draft report*, Responding to Global Climate Change and Achieving Greenhouse Gas Emission Reductions in Maine: Roles for Industry, Business, and Citizens*. The following April, a non-governmental organization, Maine Global Climate Change Inc., sponsored a two-day conference, "Global Climate Change in Maine – The Risks and Opportunities." Partly as a result of the conference, SPO then issued (January 2000) a State of Maine Climate Change Action Plan, which provided a menu of options for reducing the state's GHG emissions, but did not commit the State to specific actions. A number of the options in the SPO Climate Change Action Plan are, however, mirrored in the commitments and options for action in the NEG/ECP Plan.

The 2001 "Clean Government" initiative created a legislative mandate requiring, among other things, that state agencies incorporate environmentally sustainable practices into their planning, operations and regulatory functions. Many of the actions subsequently planned and adopted within Maine State Government directly or indirectly address GHG mitigation options, particularly in areas such as energy efficiency, building standards, and transportation fleet upgrades. This initiative precisely matches one of the action items set out in the NEG/ECP *Plan,* "Lead by Example," which commits the jurisdictions to meeting the goal of "reduc(ing) end-use emissions of GHGs through improved energy efficiency and lower carbon fuels within the public sector by 25% by 2012,…."
By statute,[35] a similar target has been mandated for state buildings. To meet the re-

[34] *On the Development of a Greenhouse Gas Emissions Inventory & Registry*. Report of the Joint Standing Committee on Natural Resources, Maine Legislature, January, 2002:1
[35] 5 MRSA § 1770, "Energy Conservation of Buildings," sets a goal of a 25% reduction in energy consumption relative to a 1998 baseline by 2010.

quirements of the Clean Government Initiative mandate, executive orders have been issued to all state government entities requiring:

- adherence to LEED building standards for all construction and renovation projects;
- procurement of fuel efficient and hybrid technology vehicles: and
- procurement of environmentally friendly goods and services.

Governors King and Baldacci have used their office to further these goals. In 2003, Governor King formally directed state agencies to pursue the purchase of low emission and more fuel-efficient vehicles. Governor Baldacci, by his March 17, 2004, Executive Order, built on his predecessor's action, ordering that state agencies:

- track state vehicle fleet fuel economy;
- track and develop plans to reduce state employee vehicle miles traveled (VMT);
- purchase and use cleaner and/or renewable fuels in state vehicles; and
- measure the GHG emissions from the state transportation sector.

To date, other state agencies have also been active in measures to reduce energy use, and thus, greenhouse gas emissions. The Department of Transportation has converted traffic lights at intersections in its span of control from conventional to LED (light emitting diode) lamps, and has made funds available to municipalities to promote similar conversion.

The Public Utilities Commission (PUC) has primary responsibility for managing state-led energy efficiency programs. The PUC's Energy Programs Division administers the State Energy Program, a United States Department of Energy funded effort whose goal is to promote energy efficiency and renewable energy. The PUC's Energy Programs Division also administers the Efficiency Maine program whose focus is to increase electrical energy efficiency throughout the Maine economy. Efficiency Maine was created to implement the legislature's Conservation Act and is funded through electric utility rates.

In the area of renewable electrical generation, Maine has been a significant national leader. Since 2000, Maine electricity producers have been required to meet a standard of 30% of all power coming from renewable sources. This is the highest such "renewable portfolio standard" in the United States.[36]

[36] See below, Option 11 for further discussion. Recent efforts to increase over time the percentage of renewable energy in the RPS have been unsuccessful. For comparison with other states' efforts, see Rabe 2004: 53.

The 2003 State Legislature enacted L.D. 845, "An Act to Provide Leadership in Addressing the Threat of Climate Change," signed by Governor Baldacci on May 21 of that year.[37] It established State GHG emission goals identical to those of the NEG/ECP *Plan*, and directed the DEP to undertake two specific actions toward that end:

1. A group of "Lead by Example" initiatives, including:
   - emissions inventory for state facilities and programs;
   - voluntary carbon reduction agreements with private sector businesses and non-profit organizations;
   - participation in a regional GHG registry; and
   - establishment of an annual statewide GHG emissions inventory.
2. Adopt a state climate action plan "with input from stakeholders" to meet the reduction goals.

The present document is intended to meet that requirement.

The Department believes that the Climate Action Plan for Maine (proposed herein) builds on the foundation of the earlier SPO document and offers a comprehensive group of cost-effective actions needed to meet the statutory requirements. The 54 options create a solid policy basis on which to proceed toward the long-term reduction targets. This *Plan* also identifies significant co-benefits to mandated GHG emission reductions, including many that would promote innovation and economic development for Maine, support Maine's energy independence, have a positive impact on the health of Maine citizens, or all three.

The Department also believes that the title of the enabling legislation is particularly instructive. Since actual GHG emissions from Maine sources constitute a very small portion even of US national emissions, so that Maine ranks 43rd among the states,[38] actions taken within the state will have little direct impact on the global problem of GHG build-up in the atmosphere and resultant climate change. Instead, as suggested by "An Act to Provide *Leadership* …", the legislature recognized that in the absence, thus far, of Federal actions to address the threat of climate change, Maine's initiative, in company with those of other states and Canadian provinces in the region, would signal others as to the importance Maine people place on a healthy and sustainable environment.[39] From a policy point of view, this is acting on a "clean hands" basis: that Maine

[37] 38 MRSA §§ 574-578. See Appendix 1 for complete text.
[38] Rabe 2004: 2, citing USEPA inventories.
[39] This belief was affirmed in a lecture by Professor David Victor in Augusta on September 13, 2004. Victor pointed out in particular that Maine's leadership can provide powerful leverage on

cannot ask other states and nations to reduce GHG emissions until we have taken these steps ourselves.

both the Federal government, and the private sector, in developing long-term strategies and offering incentives for market-driven innovations to address climate change.

CLIMATE ACTION PLAN STAKEHOLDER PROCESS

As specified in the Legislation, the Department of Environmental Protection was charged with developing a *Climate Action Plan* (*CAP*) "with input from stakeholders." To that end, Commissioner Gallagher convened an informal advisory committee, the Climate Action Plan Convenors' group, to assist her in developing the stakeholder process. The group met for the first time on July 24, 2003.[40]

During the same period, the Department explored various options for assuring the technical and process expertise necessary to staff *CAP* development. After review of the parallel GHG/Climate plan processes in Rhode Island and Connecticut, and consultation with leaders in other states, the DEP entered into contracts (though the Muskie School of Public Service at the University of Southern Maine) with Raab Associates, Ltd., Boston, MA, for overall process coordination and facilitation; and with the Center for Clean Air Policy, Washington, D.C., and with Thomas D. Peterson, LLC, for technical consultation.[41] Raab Associates also developed a Web site dedicated to Maine's *CAP* process, on which background and working papers, *agendae* and meeting summaries, etc. were made available to stakeholders and the public.[42] All written materials developed during the process, or submitted by stakeholders for consideration, will be maintained on this site for the immediate future, since limitations of space precluded them from being included in the written *Appendix* to this report.

Using funds provided by the US Environmental Protection Agency, Raab Associates worked with the Convenors' Group and the DEP to design a stake-holder process which would produce the *CAP* called for by the Legislature. Commissioner Gallagher solicited interested participants through direct mail and an open invitation on the Web site. Ultimately, it was agreed that the process would best be served by a relatively small (30-35) group of "core" stakeholders representing the public sector, the private sector, and advocacy groups.[43]

---

[40] Members included Rep. Ted Koffman; Wendy Porter, Interface Fabrics Group; Chris Hall, Maine Chamber and Business Alliance; Sue Jones, NRCM; and Pam Person, Coalition for Sensible Energy.

[41] Additional process facilitators Ann Gosline, Jonathan Reitman (Gosline, Reitman) and Jack Kartez (USM) were hired to support the Working Groups. CCAP sub-contracted modeling work, particularly in the electricity sector, to the Tellus Institute. Steve Winkelman, Karen Lawson and Matt Ogonowski of CCAP were the principal, and much-appreciated, technical consultants.

[42] http://maineghg.raabassociates.org/

[43] For lists of organizations and their representatives, see Appendix 5.2.

TABLE 6: STAKEHOLDER ADVISORY GROUP MEMBERSHIP

Government	Industry	NGO
Department of Agriculture	Dragon Products	The Chewonki Foundation
Department of Economic and Community Development	Florida Power and Light	Coalition for Sensible Energy
Department of Environmental Protection	Interface Fabrics Group	Environment Northeast
Department of Human Services: Bureau of Health	Industrial Energy Consumers Group	Maine Organic Farmers and Gardeners Association
Department of Conservation: Maine Forest Service	Independent Energy Producers of Maine	Maine Center for Economic Policy
Department of Transportation	J.D. Irving Corporation	Maine Lung Association
Office of Energy Independence and Security	Maine Automobile Dealers Association	Maine Public Health Association
Public Utilities Commission	Maine Better Transportation Association	Natural Resources Council of Maine
The University of Maine	Maine Chamber & Business Alliance	Maine Council of Churches
Androscoggin Valley Council of Governments	Maine Farm Bureau	The Nature Conservancy
Legislators *ex officio* 1. Sen. Tom Sawyer 2. Rep. Bob Daigle 3. Sen. Chris Hall 4. Rep. Ted Koffman	Maine Oil Dealers Association	Prof. Robert Kates, resource panel Co-chair, *ex officio*
	Maine Pulp & Paper Association	Karl Braithwaite, Dean, Muskie School, resource panel Co-chair, *ex officio*

Four representatives of the State Legislature were invited to serve *ex officio.* This group, named the Stakeholder Advisory Group (SAG), would assist the DEP to set general direction and review recommendations for mitigation options. Members of the SAG, supplemented by additional stakeholder representatives, also served on Working Groups charged with closer investigation of options in each of four general areas:

1. Transportation and Land Use;
2. Buildings, Facilities, and Manufacturing;
3. Energy and Solid Waste; and

4. Agriculture and Forestry.[44]

A fifth Working Group, Outreach and Public Awareness, was convened later in the process.

Commissioner Gallagher also invited distinguished representatives of Maine's academic community to serve on a technical and scientific advisory panel, co-convened by Dr. Robert Kates, a member of the Intergovernmental Panel on Climate Change, and Dean Karl Braithwaite of the Muskie School. Members of the group were to be available on an as-needed basis to provide second-party review of economic, scientific, technical or policy issues. While a number of members did contribute in this way, special note should be made of the participation of: Professors Charles Colgan, Muskie School, USM, and Tom Tietenberg, Colby College, who were particularly helpful in providing economic forecast data needed in order to model emissions over time; Jonathan Rubin, University of Maine, on the Transportation and Land Use Working Group; and Mark Battle, Bowdoin College, and Ivan Fernandez, University of Maine, for their service on the Agriculture and Forestry Working Group;. In addition, Jim Smith of the U.S. Forest Service provided invaluable assistance during the modeling of the forestry sector options.

In preparation for an initial meeting of the SAG, Raab Associates conducted interviews with a number of potential participants to identify key issues to be considered in designing the process. The Convenors' Group also assisted in drafting ground rules that would guide subsequent activities.[45]

The Stakeholder Advisory Group met for the first time on November 6, 2003, at the Chewonki Foundation in Wiscasset, where Governor John E. Baldacci gave it an initial charge. Commissioner Gallagher made clear that the stakeholders' primary mission was to advise the Department in identifying a suite of mitigation options which, taken together, would meet the 2010 and 2020 GHG emission reduction targets. The Department retained ultimate decision-making responsibility for the *CAP* and its recommendations. The SAG first reviewed the goals, missions and objectives of the process, and held an initial discussion of the forecast emissions baseline for Maine GHG emissions. They also agreed on the ground rules governing their activities. At a second

[44] Final reports from each Working Group, together with attendance lists and select working papers, may be found in Appendix 5.

meeting, in December, the SAG reviewed an extensive list of possible options gathered from a wide range of sources, and identified those it thought worthy of further consideration to be forwarded to the Working Groups. The SAG met on three further occasions, concluding its work on September 29, 2004 with a final review of the draft proposed *CAP.*

The four primary Working Groups each met for three or four day-long meetings (supplemented with conference calls and sub-committee work) to identify options in specific areas, working with consultants to assure that basic assumptions governing each option were agreed in advance. Some of the options in each group were based on existing activities or programs in Maine, while others were completely new. For each option, the Working Groups were presented with information describing the action to be taken, the GHG reductions associated with the option's impact, and the option's overall costs, savings, and potential co-benefits where available. Each option was then modeled for its behavior over time. The working Groups presented the options to the SAG in the form of reports identifying the extent of agreement / consensus in recommending a given option, together with additional thoughts and concerns regarding each. It should be noted that there was no requirement that an option reach consensus or majority approval in order to be passed on to the SAG, although in most cases, options not receiving at least majority approval were dropped from the list, or deferred for further study. In a number of cases, sub-committees and individuals within the Working Groups prepared white papers on specific topics; several of these are included in the Appendices.

Beginning in May 2004, an additional Working Group, "Education and Public Awareness," met on several occasions to identify a strategy for making the *CAP* accessible to the legislature and the general public. They also evaluated the individual mitigation options in terms of their impact on affected groups, likely co-benefits, and public components. Their analysis is included in the description of each mitigation option. The Department expects that this group may be re-convened during 2004-2005 to assist in public outreach efforts associated with the implementation of this *Plan.*

[45] The Ground Rules, together with other documents related to the work of the SAG, may be found in Appendix 4.1.

This Page is intentionally left blank

PART 2: DETAILED OPTION DESCRIPTIONS

Introduction

Based on consideration of a list of potential GHG mitigation options originally presented to the Stakeholder Advisory Group in December, 2003, each of the four Working Groups (Transportation and Land Use; Buildings, Facilities, and Manufacturing; Energy and Solid Waste; Agriculture and Forestry) worked with the technical consultants to identify and refine those options which appeared to have the greatest potential for cost-effective carbon savings. Each of those recommended by DEP for possible adoption, or suggested for additional study and modeling, is summarized in the following pages. More extensive information about the assumptions underlying the calculations of cost, carbon benefit, etc., may be found in the Appendix volume, where the complete final reports of the Working Groups are printed.

The GHG mitigation options are designed to change technologies and practices in ways that reduce the emission of GHGs to the atmosphere. 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 are broad, affecting many processes and technologies, while others are more specific.

The 54 (options included in Group I below are arranged in the same order as found in Table 1 ("Summary Table of Recommended Options") on page ##; that is, from highest to lowest in terms of estimated 2020 carbon savings. While the Working Group and Stakeholder Advisory Group processes identified some options as having reached consensus (defined as unanimous support), and others for which consensus was not reached, Commissioner Gallagher determined at the June 30, 2003, meeting that since all the modeled options taken together were not at that time projected to reach the legislative targets, the Department's *CAP* would include these without distinction.[46]

Even if all options taken together met the targets, it would be imprudent not to pursue most or all of them. Some benefits come after 2020 (especially for some of the Forestry options); the assumptions behind the expected reductions are likely to change when and if each option's design is finalized and it is implemented; and most impor-

[46] Each option summary includes identification of consensus or its absence. Where a summary is silent, consensus is assumed. The complete Working Group reports in Appendix 5 identify more specifically the organizations that did not agree with a particular recommendation, as required by the agreed Groundrules.

tantly, there will likely be many unexpected delays causing the options to be implemented later than planned.

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

- **The reduction in emission of carbon to the atmosphere in 2020.** This indicates the total impact in 2020 as a result of implementing all the measures from 2005 (or later) and on through 2020, expressed in thousands of metric tons of carbon dioxide equivalent.

- **The cost *per* unit of saved carbon** is the *net cost* of the option (cost of saved carbon 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 15-year time period.[47] There are many options (largely energy efficiency and demand reduction in buildings, facilities, and transportation) that result in *net savings* (*i.e.*, avoided costs from saved energy or other resources are greater than the cost of implementing the measure). Thus, this cost can be a negative number, indicating a very promising option that reduces carbon emissions and saves money.

- **Performance measures** are quantitative or qualitative metrics that can be used to monitor the effectiveness of the option once implemented.

- **Implementation method(s)** vary widely among options. If implementing an option would require legislative or regulatory action, or State Executive order, it is indicated here.

- **Co-benefits** are defined as the results from implementing an option which produce a benefit in addition to reducing carbon emissions. For instance, many of the recommended actions would also decrease emission of other air pollutants with significant human health effects such as fine particulate matter and air toxics. Other co-benefits and side effects, such as the potential for economic development, are more difficult to quantify and are here described qualitatively.

For many of the options, additional notes below the summary provide general background and further details about the option, including information on specific comments made by Stakeholders in working group or SAG meetings.

The 54 options in Group 1 constitute the core of the DEP's recommendations to meet the 2010 and 2020 emissions mitigation goal, *i.e.,* a level of Maine GHG emissions

[47] As explained in further detail in the Forestry Working Group report (Appendix x), the carbon savings and costs for the forestry options have been calculated using a 58-year time horizon (approximately through 2063) instead of the 15-year time period utilized for all other options. The Working Group agreed on this approach as better representing the real life cycle of the forest.

no greater than 10% below those emitted in 1990.[48] As noted above, not all of these are proposed on the basis of consensus by the Stakeholders to the *CAP*. They have in common that the technical consultants and Stakeholders were generally agreed on the assumptions underlying the calculation of carbon to be saved if the option were to be implemented as described, and these calculations have produced a "saved carbon" number. If all of them were implemented, they would, taken together, produce 11,332,617 metric tons of projected carbon savings, slightly exceeding the reductions needed to meet the statutory target.

A few options, most notably that related to so-called "black carbon" (4), clearly require a greater depth of understanding of both technical and policy implications than could be achieved in time for complete stakeholder review. Others (5, 11) are noted as having been approved in principle by stakeholders, but which there were differences of opinion about the details of implementation. These will require additional research, technical modeling and policy consideration. The Department will make every effort, within resource constraints, to complete the evaluation of these options in consultation with stakeholders.

Some options (2, 3, 6, 46, 49) would either require a regional or multi-jurisdictional approach to be implemented, or at least would be most effective if implemented in a broader context.

The 40+ options in Group 2 ("Non-quantified Options") are briefly identified as those potential emissions mitigation actions which seemed particularly promising to the stakeholders and the DEP, but for which at the moment the data, particularly the calculation of amounts of saved carbon and/or cost of saved carbon, are incomplete. Others in this group identify actions to educate and inform specific groups and the public at large about greenhouse gas issues. These options will be studied further in the immediate future, and included in updates to the present *CAP*. In cases where the Department would be able to begin implementation of such an option on its own authority, it would be likely to do so. This group also includes additional options that have been presented by stakeholders, or identified by the Department, since the June 30, 2003 SAG meeting at which a final list was presented. Since these have not been subjected to the same analysis and review process as those in Group1, the Commissioner did not wish to include them in the list of primary recommendations.

[48] Unless otherwise specified, the calculation of carbon savings assumes that a given option is implemented in 2005. In many cases, time is allowed for the effects of an activity to be fully real-

Several of the non-quantified options identify state actions necessary to the implementation of the Group 1 options. These items would not by themselves produce carbon savings, so they are not included in Table 1. However, they were identified by stakeholders as part of the critical path forward. Briefly, they are

- *Inter-connection Rules and Transmission Barriers* (ESW 1.11);[49]
- *GHG Registry* (ESW 1.13);[50]
- *Public Education* (ESW 1.14); and
- *Improve GHG Data Collection* (TLU 7.2).

The table of Additional Options provides additional information about each of these.

For each of the Group I options, the title is followed by an indication of the option's comparative ranking with others in two categories: anticipated carbon savings, and cost effectiveness. These indicators are derived from the information in Table 2, where options are grouped in a 4x2 matrix. This information is presented as follows:

Carbon Savings Potential

High = expected carbon savings of more than 200 KMT annually in 2020;
Moderate = expected carbon savings between 25 and 200 KMT in 2020.
Low = expected annual carbon savings less than 25 KMT in 2020.

Savings / Costs

High Savings = cost savings of $20 or more *per* KMT saved in 2020;
Low Savings = cost savings of $0 to $20 *per* KMT saved in 2020.
Neutral = no identifiable costs or cost savings
Lower Costs = costs of $0 - $20 *per* KMT saved in 2020; and
Higher Costs = costs of $20 or more *per* KMT saved in 2020.

---

ized, and for cumulative effects.

[49] This Option would directly influence the implementation of Options 9, 18, 27, and 36.

[50] Participation in a New England regional registry is called for in §575.3 of the statute.

OPTION #1-- Offset Requirements

Carbon Savings Potential: High

Costs / savings: Low cost

Category	Description
Working group	Electricity and Solid Waste 1.12
Option name	Offset Requirements
Sector(s)	Electricity
Policy / program elements	Requirement to offset a given percentage of CO_2 emissions through projects that reduce emissions indirectly, such as forest management practices in Options 16, 20 *et al.*; new renewable energy projects, or incremental energy efficiency projects.[51]
Rationale	Provides a way to ensure no net increase in emissions from new generation sources. May also provide a means for existing sources to offset emissions in addition to savings achieved through regional cap and trade (Option 3).
Existing policy/program	None
Significant co-benefits	Provides opportunities for increasing development or market penetration of renewable capacity.
Carbon saved 2020	1022.0 (without Option #3) (549.3 in conjunction with Option#3)
Cost *per* unit saved carbon	10[52]
Performance measure	
Implementation method(s)	Could require legislative action.
Implementation / outreach considerations	May be used in conjunction with a GHG cap and trade program or an emission standard (see 3 and 7). The utility of this option for the state could be affected by the potential adoption of a regional or national GHG reduction program in the future. Under such a plan, the state might not receive credit for offsets required by the state government.

Most Stakeholders agreed that Emission Standards and Offset Requirements should be included in the plan if they are not duplicative with the Regional Greenhouse Gas Initiative (RGGI), or if RGGI does not happen. Others could not support these two options without more information or wanted the numbers re-analyzed to ensure they were actually incremental to RGGI. These could be applied to non-electricity generation facilities, but stakeholders noted concerns over market fairness issues.
As noted above in Figure 1,[53] the consolidated options calculations only include the incremental difference between what RGGI would accomplish, and the additional savings from this and Option #7.

[51] The types of renewable generation ultimately utilized could change the costs *per* unit of saved carbon.
[52] This number was calculated on the assumption that the option would be implemented in its entirety. Should Option 3 be implemented, it's not presently known whether the cost of achieving the marginal difference would be higher or lower.
[53] Above, p. 3.

OPTION #2 -- Tailpipe GHG Emissions Standards

Carbon Savings Potential: High *Costs / savings: High savings*

Category	Description
Working group	Transportation and Land Use 1.1a
Option name	*Implement Tailpipe GHG Emissions Standards*
Sector(s)	Transportation: Vehicle Technologies
Policy / program elements	Adopt California GHG tailpipe standards for passenger vehicles. [54]
Rationale	Advances in vehicle technology offer significant opportunities to reduce GHG emissions from motor vehicles.
Existing policy/program	None at present
Significant co-benefits	Improved vehicle GHG performance is matched by reductions in other pollutant emissions, and reduces consumer fuel expenditures.
Carbon saved 2020	933.6
Cost *per* unit saved carbon	-48
Performance measure	Numbers of vehicles meeting the standard sold in Maine.
Implementation method(s)	Maine could propose amending Chapter 127 to include the new CARB regulation.
Implementation / outreach considerations	California GHG tailpipe standards are likely to face legal challenge from automakers on the basis that vehicle CO_2 regulation is preempted by federal fuel economy regulation. New York, Massachusetts, Connecticut and Rhode Island have indicated an interest in implementing the California motor vehicle GHG standards once finalized.

It is important to reduce vehicle GHG emissions rates in the short term because significant vehicle-fleet turnover and associated GHG savings can take a decade or more. This measure serves as a crucial complement to VMT reduction measures (see 17). This measure would follow California's lead on regulating emissions from new light-duty vehicles, which, according to the Clean Air Act, Maine can do. The measure produces cost savings based on the assumption that any vehicle meeting the emission standard would be significantly more fuel efficient than other vehicles, thus saving money for consumers over the operating life of the vehicle.

The Working Group was divided over this measure. Supporters noted that Maine would join other states, New York, Massachusetts and Connecticut, in the region that have in-

[54] On September 24, 2004, the California Air Resources Board (CARB) unanimously voted to direct automakers to reduce automobile CO_2 emissions starting with 2009 models of cars and light trucks and large trucks and minivans. The rule requires a 30% reduction in CO_2 by 2016. If there are no legislative changes, the regulation will take effect in 2006.

dicated interest in adopting CA GHG standards, once finalized.[55] Opponents expressed concerns that Maine's market share is too small to influence the market, about competitiveness impacts in Maine, and about potential legal exposure for the State, and were unable to support the measure in the SAG.

At the June 30 meeting of the Stakeholder Advisory Group, there was significant support to "wait and see" how the CA standards are defined and the outcome of the likely lawsuit in CA. All SAG members except one supported one of the alternatives explored, *viz.*, a "trigger" mechanism where Maine would adopt the standards after a certain number of other states in the northeast region did.

[55] In addition to Maine, New York, Massachusetts, and Vermont, three additional states, Connecticut, Rhode Island, and New Jersey, have recently adopted the LEV 2 tailpipe emission standards.

OPTION # 3-- Regional Cap and Trade

Carbon Savings Potential: High Costs / savings: High savings

Category	Description
Working group	Electricity and Solid Waste 1.9
Option name	Regional Cap and Trade
Sector(s)	Electricity
Policy / program elements	Set a mandatory cap on the amount of CO_2 emitted by the electricity generation sector. Reductions in emissions below cap levels result in tradable credits. Entities polluting at levels higher than permitted by the cap are required to purchase these emission credits. This option shows the impact of a cap and trade program in New York and six New England states. The regional CO2 emission cap was set at 25% below 1990 levels for New York in 2010, plus 1990 levels for New England in 2010.
Rationale	Market based emission reduction strategy
Existing policy/program	SO_2 and NOx trading programs
Significant co-benefits	Avoids other pollutant emission
Carbon saved 2020	755.0
Cost *per* unit saved carbon	-90
Performance measure	NA
Implementation method(s)	Regional RGGI Initiative
Implementation / outreach considerations	If implemented, would displace the need for some of the savings proposed in Options 1 and 7.

Cap and Trade is a market based policy tool for protecting human health and the environment. A cap and trade program first sets a cap, or maximum limit, on emissions. Sources covered by the program then receive authorizations to emit in the form of emissions allowances, with the total amount of allowances limited by the cap. Each source can design its own compliance strategy to meet the overall reduction requirement, including sale or purchase of allowances, installation of pollution controls, implementation of efficiently measures, among other options. Individual control requirements are not specified under a cap and trade program, but each emissions source must surrender allowances equal to its actual emissions in order to comply. Sources must also completely and accurately measure and report all emissions in a timely manner to guarantee that the overall cap is achieved.

Maine is currently involved in a Regional Greenhouse Gas Initiative (RGGI) with six New England States, NY, NJ, and Delaware. Model design and projected savings and costs should be available in 2005. Previous modeling of six New England states plus NY showed significant potential savings.

Carbon reductions and the cost estimates in this document will change based on the final design of the RGGI program. ICF Consulting's IPM model was used to estimate the impact of a cap and trade program in New York and six New England states. The regional CO_2 emission cap was set at 25% below 1990 levels for New York in 2010, plus 1990 levels for New England in 2010.

OPTION # 4-- Clean Diesel Technologies to Reduce Black Carbon

Carbon Savings Potential: High Costs / Savings: Low cost

Category	Description
Working group	Transportation and Land Use 8.1
Option name	Clean Diesel Technologies to Reduce Black Carbon
Sector(s)	Transportation
Policy / program elements	This program would accelerate the use of lower sulfur diesel and provide incentives to accelerate adoption of engine improvements and tailpipe control technology to reduce emissions of black carbon.
Rationale	Scientists have identified black carbon, a component of diesel particulate matter (PM), as having a large and fast-acting warming impact on the atmosphere.[56, 57] While there is still significant uncertainty on the exact climate impacts of black carbon emissions, the Working Group decided that the issue is worth serious consideration given the magnitude of the potential impact.
Existing policy/program	Clean School Bus USA Grant is funding diesel oxidation catalysts retrofits for 266 Maine school buses.
Significant co-benefits	Air quality improvements (particulate and toxics reductions), resulting in positive health effects.
Carbon saved 2020	740.0
Cost per unit saved carbon	14
Performance measure	Currently set for further study
Implementation method(s)	Would require definition of Best Available Control Technology (BACT) by vehicle type, vintage, duty cycle to promote appropriate use of fuels and new or retrofitted engines. Needs further study to identify a mixture of potential actions. Would likely require legislative action to establish standards, timelines, etc.
Implementation / outreach considerations	Dependent on availability of support funding for fleets to retrofit or replace. Maine's largest diesel fleet is the school buses, second largest is Maine DOT. For these sources the added expense would be a significant burden unless it could be supported by an offsets/trading funding mechanism.

Diesel engines emit roughly half of the black carbon in the United States. This option was recommended for further study by the working group, a position endorsed by the

[56] James Hansen and Larissa Nazarenko, "Soot climate forcing via snow and ice albedos," *Proceedings of the National Academy of Sciences*, vol. 101, no. 2, 423-428, January 2004.
[57] Mark Z. Jacobson, "Control of fossil-fuel particulate black carbon and organic matter, possibly the most effective method of slowing global warming," *Journal of Geophysical Research*, Vol.107, No.D19, p. ACH 16, 1-22, 2002.

SAG. There was consensus to approve the option if it was modified to include only the following:

- Gather statewide data on heavy-duty mobile diesel engines and emissions;
- Establish working group to analyze: data, fuel issues, emission control technologies, costs, benefits, opportunities, case studies, pilot projects;
- Develop recommendations for a Maine Clean Diesel Program;
- Regional initiatives – Recommend to the NEG-ECP that bi-national black carbon emissions be studied and considered for inclusion in the GHG inventories and baselines.
- Federal initiatives – Work with its federal delegation and EPA to increase funding for diesel retrofit programs, with particular focus on trans-boundary and international diesel sources (marine, interstate trucking).

The Working Group was divided on how to implement this option, and what incentives should be provided, which will affect cost and carbon savings. The Department has included this in the list of recommended options because of the large potential GHG savings associated with it. DEP understands that further effort will be required to develop implementation approaches, particularly because the exact impacts of black carbon remain the subject of ongoing research and analysis.

OPTION #5 – Renewable Energy System Benefit Charge (SBC)

Carbon Savings Potential: High *Costs / savings: Higher costs*

Category	Description
Working group	Electricity and Solid Waste 1.2
Option name	*Renewable Energy System Benefit Charge (SBC)*
Sector(s)	Electricity supply and demand side green power purchases
Policy / program elements	Under a system benefit charge program, the state would collect funding as a charge on electricity rates or as a lump-sum payment from utilities, and then redistribute the money to projects such as wind farms, fuel cell deployment programs, and solar energy systems.[58]
Rationale	Reduce emissions of carbon and other air pollutants by promoting increased use of renewables.
Existing policy/program	Consumers may make voluntary contributions to an R&D fund for renewable resources when paying their electric bills
Significant co-benefits	Increase security of state's energy supply; economic development impetus for emerging technologies which could be eligible for funding.
Carbon saved 2020	689.0
Cost *per* unit saved carbon	30[59]
Performance measure	
Implementation method(s)	
Implementation / outreach considerations	An SBC funds the same categories of units as the RPS, or it can be structured to fund other categories of renewables that would not overlap with an RPS, or both. For purposes of this analysis it has been modeled to fund the same renewables as the RPS, but only the reductions from the RPS itself have been included in the reduction totals to avoid overlap.

No specific mechanism for funding an SBC was proposed by the Working Group or Stakeholder Advisory Group.

Some Stakeholders suggested that the SBC may not necessary if it is redundant with the RPS, but no one disagreed with the Working Group recommendations to estimate the range of GHG savings and cost of saved carbon for using the SBC to support an RPS or to support emerging technologies not covered by the RPS.

[58] The present modeling assumes annual funding for each category is allocated at the following levels:

Wind: 45% of total funding

Landfill Gas: 45% of total funding

Solar: 10% of total funding

[59] System benefit charge set at $0.0005 / kWh, based on Massachusetts level.

OPTION # 6-- Set a Low-GHG Fuel Standard

Carbon Savings Potential: High Costs / savings: Higher costs

Category	Description
Working group	Transportation and Land Use 3.1
Option name	*Set a Low-GHG Fuel Standard*
Sector(s)	Transportation
Policy / program elements	Require minimum low-GHG fuel content in all fuel sold in the state
Rationale	Reduce dependence on gasoline, reduce GHG emissions
Existing policy/program	None at present
Significant co-benefits	Reduce local air pollution; increase energy security. Some economic development may ensue as resources move to the ethanol/bio-diesel infrastructure, particularly feedstock from Aroostook county and other agriculture / waste wood areas.
Carbon saved 2020	639.5
Cost *per* unit saved carbon	34
Performance measure	Sales of substitute fuels
Implementation method(s)	Requires legislative authority. Likely to be part of a larger regional effort.
Implementation / outreach considerations	There are significant infrastructure changes to be considered as part of this measure. There is the potential for a border issue with New Hampshire if a regional approach is not adopted

This measure would mandate the substitution of E-10 (ethanol) for a progressively increasing volume of gasoline; and a comparable substitution of B-5 (bio-diesel) for diesel fuel. The goal would be 100% of all fuels by 2020.

Opinions on this option were divided. Some stakeholders preferred passage of a Federal renewable fuel standard, or at least as part of a regional approach initiated through the Northeast States Consolidated Air Use Management organization. Several state agencies noted that they did not have explicit authority to support this measure. Opponents expressed concerns about supply, distribution and price volatility.

All representatives to the SAG could support this measure if adopted regionally, but were not in agreement if implementation was limited to Maine. The SAG also unanimously supported federal renewable fuel standards.

OPTION 7 -- ESW 1.10 Emission Standards

Carbon Savings Potential: High *Costs / savings: Higher cost*

Category	Description
Working group	Electricity and Solid Waste 1.10
Option name	*Emission Standards for Electricity Generation*
Sector(s)	Electricity
Policy / program elements	Output-based emission standard (emission limit) for CO_2 is applied to all fossil-fired plants in Maine (both new and existing units) beginning in 2008.
Rationale	Sets specific limits on GHG emissions.
Existing policy/program	None at present.
Significant co-benefits	Health and eco-system benefits associated with overall lessening of air emissions.
Carbon saved 2020	609.0 (without Option #3) (326.7 in conjunction with Option#3)
Cost *per* unit saved carbon	23
Performance measure	
Implementation method(s)	Change in licensing standard with authority that already exists with DEP.
Implementation / outreach considerations	Note that an emission standard may be used in conjunction with a program to offset the CO_2 emissions (see Option 1) through investment in afforestation / reforestation or new renewable energy projects. This limit could be met by averaging emissions across all fossil-fired units online in each year, so not every unit would be required to meet the standard. This is equivalent to a policy that allows entities to meet standards by purchasing and selling emission credits.

A CO_2 emission standard often limits the tons of CO_2 per kWh produced. A generation performance standard, or GPS, is an emission standard covering several pollutants in one policy / regulation, and can include CO_2. Emission standards may allow generators to meet all or part of the emission limit through purchases of offsets; the carbon sequestered or reduced is then deducted from the actual CO_2 emissions from the plant to help meet the standard. The standards could be placed on the consumer, or on the generator, with different results in either case. Emission standards were assumed to be 900 lb. CO_2/MWh in modeling the option.

Most Stakeholders agreed that Emission Standards and Offset Requirements should be included in the plan if they are not duplicative with the Regional Greenhouse Gas Initiative (Option 3), or if RGGI does not happen. Others could not support these two options without more information or wanted the numbers re-analyzed to ensure they were actually incremental to RGGI. One Stakeholder asked that Emission Standards be better defined.

As noted above in Option #1, the consolidated options calculations only include the incremental difference between what RGGI would accomplish, and the additional savings from this and Option #1.

OPTIONS #8, 18 -- Biomass Generation

Carbon Savings Potential: High *Costs / savings: Low costs*

Category	Description
Working group	Electricity and Solid Waste 1.5a
Option name	*Biomass Generation: Existing Units*
Sector(s)	Electricity
Policy / program elements	Two related options are combined here.[60] In the first scenario, three existing biomass-fired plants that are currently not in operation are restarted and then subsidized with a production tax credit. In the second scenario, six existing biomass-fired plants are subsidized with a production tax credit to enable them to continue operating.
Rationale	Electricity generation from biomass-fired plants can reduce greenhouse gas and other emissions.
Existing policy/program	None.
Significant co-benefits	Enables fuller utilization of existing biomass feedstock; may provide incentive to develop additional feedstocks from forests and farms.
Carbon saved 2020[61]	Scenario 1 - 269.0 Scenario 2 – 574.0
Cost *per* unit saved carbon	Scenario 1 - 15 -17 Scenario 2 – 15
Performance measure	Operating plant generation numbers.
Implementation method(s)	Production tax credit. Would require legislative action. Biomass subsidy assumed to be $10 per MWh based on information in Maine PUC Report
Implementation / outreach considerations	Full implementation would also depend on Non-quantified Option ESW 1.11, "Barriers to Interconnection." The Working Group noted that some non-operating plants may be restarting and some existing plants may become economical because of other states' RPS policies and increasing gas prices. Therefore a targeted program may not be necessary.

The Working Group supports these options if a subsidy is needed, and recommends that if state funds are used to subsidize existing units, a competitive bidding process should be explored (*e.g.,* evaluating bids' costs and benefits, or on a needs basis). As modeled here, this Option does aim to increase available renewable energy sources, but stands alone by using a different mechanism than that in Options 5 and 11 (SBC; RPS). As a result, the carbon savings are not double-counted.

[60] The carbon savings are entered separately in Table 1.

[61] Biomass is not inherently carbon neutral, since different fuels have different carbon emissions; and there has been some debate in the Working Group and SAG on this matter. For modeling purposes, biomass has been assumed to be carbon neutral. For further discussion, see Appendix 3.2.

For purposes of this Option, qualifying biomass fuel needs to be clearly defined so as to include clean biomass only (e.g., wooden debris) originating from sustainable managed forests.

OPTIONS #9, 27-- Landfill Gas Management

Carbon Savings Potential: High *Costs / savings: Low cost*

Category	Description
Working group	Electricity and Solid Waste 2.1a, 2.1b
Option name	*Landfill Gas Management*
Sector(s)	Waste Management
Policy / program elements	Landfills naturally create methane gas (CH_4, a GHG) as a by-product. Rather than being released into the air, methane can be captured and utilized as a fuel to produce energy or burned off (flared). Element 1 - *Small electric generating units (total potential 16 MW) are installed at four large landfill which currently flare their methane.* Element 2 – *Eight smaller landfills are required to flare their methane emissions.*
Rationale	Methane is 22 times more potent a GHG than CO_2. Both program elements reduce this to CO_2
Existing policy/program	Flaring is occurring at the larger active landfill sites, and studies/planning are underway toward active utilization.
Significant co-benefits	Avoided landfill site odors.
Carbon saved 2020[62]	Element 1 – 550.0 Element 2 - 109.0 Total: 659.0
Cost *per* unit saved carbon	Element 1 – NA Element 2 - 2
Performance measure	Calculated volumes of gas collected and either flared or converted to electricity.
Implementation method(s)	Element 1 is voluntary on the part of landfill operators. Element 2 would require additional regulations under the DEP's existing rule-making authority.
Implementation / outreach considerations	Both scenarios require capital investment. There may also be barriers in Scenario 1 to making resulting electricity available to the grid,[63] either because of transmission constraints, or "net metering" issues.

Some landfills are already required to manage methane emissions, principally to avoid local odors. In the first scenario, the state's largest landfill sites would continue to install gas collection systems, convert the gas to electricity, and either utilize the electric power locally, or sell it into the power grid. This option thus not only avoids intense GHG emissions, but generates renewable power. The second element focuses only on avoided

[62] Listed separately in Table 1.
[63] See Non-quantified Option ESW 1.11.

emissions, since collection and flaring does not produce electricity, but does reduce carbon emissions.

OPTION #10 – Increased Stocking with Faster Growing Trees

Carbon Savings Potential: High *Costs / savings: Low cost*

Category	Description
Working group	Agriculture / Forestry: Forestry 2.0
Option name	*Increased Stocking Of Poorly Stocked Forest Stands With Faster Growing Trees*
Sector(s)	Forestry
Policy / program elements	Manage and promote 25,000 acres per year from the Poorly Stocked Class (10-34% stocked) to Moderately Stocked Class (35-64% stocked) stands over the next 15 years through the use of select faster-growing nursery stock.
Rationale	Increasing coverage in existing stands increases active carbon storage in both standing timber and forest soils.
Existing policy/program	Public and private reforestation is required on many lands and practiced routinely in the state, but does not always result in full stocking of all stands.
Significant co-benefits	Harvest value of increased stocking.
Carbon saved 2020	531.7[64]
Cost *per* unit saved carbon	1
Performance measure	MFS annual forest inventory.
Implementation method(s)	Specific projects for enrichment and inter-planting; education and outreach; cost sharing.
Implementation / outreach considerations	All landowner groups can participate. May be a good candidate for pilot project funding support for planning and evaluation.

For this and a number of following options in the Forestry area (14, 16, 20, 21, 25, 28), the Working Group reached consensus in recommending them according to the following standard:

1. There is a carbon benefit gained over the long-term in actual on-ground implementation;
2. There is no adverse impact on bio-diversity and sustainability;
3. There is ongoing research and adaptive management conducted to determine the appropriate site specifications and realized Carbon benefits of the mitigation technique.
4. The mitigation technique is economically feasible for forest landowners.[65]

For this option in particular, some stakeholders raised concerns about the possible effects of introducing genetically-altered species.

[64] See above, p. 14, for the methodology used to calculate carbon savings for this and the other Forestry options.

[65] At the 9/29 SAG meeting, there was some discussion of whether the above standard should include other issues discussed at WG meetings, *e.g.*, introduction of "non-native" species. However, the minutes as approved by the stakeholders include only the four items above.

OPTION #11 -- Renewable Portfolio Standard (RPS)

Carbon Savings Potential: High Costs / savings: Low cost

Category	Description
Working group	Electricity and Solid Waste 1.1
Option name	*Renewable Portfolio Standard (RPS)*
Sector(s)	Electricity
Policy / program elements	An incremental increase in the current RPS of at least 5% by 2010, and 10% by 2020.
Rationale	Reduce carbon emissions by substituting renewable fuel sources.
Existing policy/program	Currently, at least 30% of total kWh sales from each competitive electricity provider in Maine must come from eligible renewable sources. Latter may include municipal solid waste plants, and combined heat and power units regardless of fuel type.[66]
Significant co-benefits	Reduced dependence on out-of-state and non-domestic electrical energy resources (fuel and transmission). Increased economic development in Maine to provide this alternative energy.
Carbon saved 2020	527.0
Cost *per* unit saved carbon	10
Performance measure	Compliance with mandated standard.
Implementation method(s)	Would require legislative increase in existing RPS.[67]
Implementation / outreach considerations	At the 6/30 meeting of the Stakeholder Advisory Group, several members stated that while they supported the overall goal of promoting increased renewable generation, they did not agree that increasing the RPS was necessarily the appropriate mechanism.

A Renewable Portfolio Standard (RPS) is a market-oriented policy for accelerating the installation of new renewable resources and technologies into the electricity sector. Renewable portfolio standards mandate a certain minimum percentage of annual electricity production or sales come from new renewable energy sources. Sources of qualifying renewable energy are delineated in the legislation, as are increased percentage requirements over time. RPS policies typically include wind and solar, and may include biomass, hydrogen (produced with renewable energy), tidal and small hydroelectric generation. At present in Maine, wind technologies seem likely to offer the greatest potential.

The Working Group agreed that higher levels should be modeled and explored further; and costs to consumers should be fully analyzed. Renewable Standards are currently in place in most other New England States, and New York mandated a 25% RPS by 2013 in September 2004.

[66] Fossil-fuel co-generation would not be eligible for the incremental RPS under the terms of proposed legislation.

[67] Legislation to increase Maine RPS in stages was introduced in 2004, but did not come to a vote. For the PUC *Report and Recommendations on the Promotion of Renewable Resources* (12/31/03), see http://www.state.me.us/mpuc/2004legislation/2004reports.htm.

OPTION #12 -- BFM Energy Efficiency

This item has been removed from the list of options and calculations because it originally summarized the savings counted in other BFM options. It represented the impact of the implementation of all demand-side energy efficiency measures considered in the Buildings, Facilities and Manufacturing (BFM) working group. It was included in the ESW sector because the NEMS model calculates the saving in this sector. However, treating it as a separate item created confusion as to whether the carbon savings were a separate addition to the total, which they were not. Thus, it was eliminated to avoid the appearance of "double counting."

OPTION #13 -- Pay As You Drive Insurance

Carbon Savings Potential: High Costs / savings: Not yet modeled

Category	Description
Working group	Transportation and Land Use 2.4d
Option name	*Allow Maine Car Insurance Companies to Experiment with Voluntary PAYD Pricing Programs*
Sector(s)	Transportation: Slowing VMT growth
Policy / program elements	Pay-As-You-Drive Insurance (also called Distance-Based Vehicle Insurance, Mileage-Based Insurance, Per-Mile Premiums and Insurance Variabilization) means that a vehicle's insurance premiums are based directly on how much it is driven.
Rationale	Provides a direct cost-savings incentive to consumers to lessen vehicle miles traveled.
Existing policy/program	Insurers typically reduce a premium for low-mileage customers, but a pay-as-you drive scheme ties the premium to actual, measured VMT, either through odometer readings or GPS.
Significant co-benefits	Other benefits associated with lessening VMT
Carbon saved 2020	379.0
Cost *per* unit saved carbon	Not yet modeled. Cost figures will be added after additional study.
Performance measure	Industry reports on market penetration.
Implementation method(s)	Pilot project with a recruited volunteer insurance provider.
Implementation / outreach considerations	The stakeholder advisory group expressed some skepticism regarding the market penetration assumptions. Some specific vehicle user groups might need an adjusted approach.

This assumes a market penetration rate of 1% of Maine vehicles in 2010 (pilot program) and 50% in 2020. There was near consensus in the working group to recommend this measure, with some objections related to specific hardships that might be associated with, *e.g.*, agricultural and commercial vehicle users. Several representatives to the SAG could not support this option, in particular because the modeling assumptions were inconsistent with existing underwriting criteria. Pilot programs for this option are currently under way in Oregon, and by several insurance providers.

OPTION #14 -- Forestland Protection

Carbon Savings Potential: High **Costs / savings: Low costs**

Category	Description
Working group	Agriculture/Forestry: Forestry 1.0
Option name	*Protection of Forestland from Conversion to Non-forested Land Uses*
Sector(s)	Forest; Land Use Planning
Policy / program elements	Reduce ten percent of forestland conversion by 2010, and 20 percent by 2020 (against a baseline rate of 141,600 acres projected loss from 2005-2020).
Rationale	Protection of forestland cover from conversion to developed uses significantly reduces the atmospheric conversion of carbon stored in biomass and soils on undeveloped lands.
Existing policy/program	Large number of existing programs, including Land for Maine's Future[68]; USDA Forest Legacy Program; Tree Growth Tax Law; etc.
Significant co-benefits	More efficient growth patterns: it may have the effect of directing growth to more efficient locations and reducing transportation emissions. Future opportunities for production and use of biomass for energy and wood products are also protected. Habitat protection. Supports Maine's forest-based economy.
Carbon saved 2020	376
Cost *per* unit saved carbon	-6
Performance measure	Documented accounting of land protected from loss.
Implementation method(s)	A number of potential implementation mechanisms exist, including regulatory and market-based land use standards and goals; direct incentive payments (easements and acquisitions); cluster zoning requirements or incentives (also known as conservation design or low impact development); revised transportation infrastructure investments; improvements to forest management profitability; and education.
Implementation / outreach considerations	Would need further state agency and stakeholder planning to adopt a comprehensive approach.

Implementation of this option would translate into protection of 2832 acres of natural forest cover *per* year that otherwise would have been lost to development. The Working Group did not recommend a specific implementation approach.

According to recent calculations by Thomas D. Peterson, the total volume of carbon lost from forestland conversion to non-forest uses in Maine from 1990-2000 was 18.53 MMTC compared to growth in emissions from all sectors of about 22 MMTC during the same period. In other words, the carbon emitted from forestland conversion was almost

[68] Currently not funded.

as large as that off all other sectors combined. Fortunately, some of this was mitigated through afforestation and stand recovery, but the flow of carbon from forestland conversion appears to be significant.

Calculation of cost savings is based on the assumption of savings from the costs of public infrastructure and services not expended away from urban centers. See Appendix 5.4 for further discussion.

OPTION #15 -- Increase Recycling/Source Reduction

Carbon Savings Potential: High Costs / savings: Low to moderate savings

Category	Description
Working group	Electricity and Solid Waste 2.3
Option name	*Expand and Increase Recycling/Source Reduction Efforts*
Sector(s)	Waste Management
Policy / program elements	Create programs to reduce the amount of waste being put in landfills and/or waste-to-energy facilities, thereby reducing the amount of methane and CO_2 generated.
Rationale	Avoid / reduce direct carbon emissions; increase carbon sequestration opportunities.
Existing policy/program	The Maine Legislature has established a goal of recycling 50% of the state's municipal solid waste by 2003. Maine residents and businesses achieved a 37.3% statewide recycling rate in 2001.[69]
Significant co-benefits	Cost savings for consumers and municipalities through reduction in waste volume requiring disposal; reducing burden on limited disposal capacity; the providing of 'raw materials' for the secondary materials market. Can reduce the need for petroleum-derived materials. Can reduce source emissions by reducing the need for virgin materials.
Carbon saved 2020	374.0
Cost *per* unit saved carbon	0
Performance measure	Volume of waste tipped at waste-to-energy facilities or landfills; tonnage of recovered, recycled and/or composted discards; tons of GHG reduced/avoided.
Implementation method(s)	Utilization of existing public & private recycling and composting programs; increased effort, assisted by grants, to assist in developing additional capture/processing capabilities; developing markets for collected recyclables 'closer to home' (which encourages recycling and decreases transportation necessary for the recycling of the materials.
Implementation / outreach considerations	Increase public information / education campaign on value of recycling, both from environmental as well as economic sides; target public audiences as well as the commercial sector, both with broad topics as well as targeted messages for specific commercial operations.

"Pay-as-you-throw" pricing for residential waste services has proven to be successful as a recycling incentive program in Maine. Mandatory recycling programs are also being used or developed in some areas, as well as backyard composting of food waste (in the residential sector). Pay-as-you-throw is now used in130 Maine communities. Food waste composting, as a commercial sized venture, is being promoted and implemented in several regions in Maine.

[69] See also Non-quantified Option BFM 4.5 for information about beneficial use and recycling of solid waste.

OPTION #16-- EARLY COMMERCIAL THINNING

Carbon Savings Potential: High Costs / savings: Very low costs

Category	Description
Working group	Agriculture / Forestry: Forestry 3.0
Option name	*Early Commercial Thinning*
Sector(s)	Forestry
Policy / program elements	Intentional thinning takes advantage of anticipated mortality, and concentrates growth on the better remaining timber. Treat 50% of available acreage to this practice over next 5 years.
Rationale	Carbon sequestration, with remainder used as a renewable energy source, or as building materials that displace higher emissions alternatives (steel and concrete).
Existing policy/program	A number of existing programs support improved management of private non-industrial forests in Maine.
Significant co-benefits	Enhanced value of longer-standing timber. Reduction in dead and dying timber through improved overall forest management. Expanded economic development options in rural economies.
Carbon saved 2020	331.7
Cost *per* unit saved carbon	1
Performance measure	
Implementation method(s)	Voluntary, supported by education and outreach. Market development needed.
Implementation / outreach considerations	Federal cost share programs support the development of forest and harvest management plans for Maine woodlot owners on acreage of 10-999 acres include) the Forest Land Enhancement Program (FLEP); and Forest Stewardship Assistance Program (FSA).

By definition this option meets market criteria and does not involve new costs to producers beyond planning and evaluation. Based on estimated Forest Product Output, products of thinning are directed to 20% durable wood products; 60% pulp/OSB (oriented strand board), and 20% biomass energy.

This and other forest management options may be linked to the development of emerging markets for sequestration as described in Options 1, 3, and 7. See Option 10 for the standard for implementation recommended by the Forestry Working Group.

OPTION #17 -- Slowing VMT Growth

Carbon Savings Potential: High Costs / savings: Not yet modeled

Category	Description
Working group	Transportation and Land Use 2.0
Option name	*Slowing Growth in Vehicle Miles Traveled* (combines TLU 2.1 *Develop Policy Packages to Slow VMT Growth*; 2.*2 Land Use & Location Efficiency*; 2.3 *Increase Low-GHG Travel Options*
Sector(s)	Transportation; land use
Policy / program elements	Develop policy packages to slow vehicle miles traveled (VMT) growth and increase the availability of low-GHG travel choices, such as transit (rail and bus), vanpools, walking, and biking. Included in the packages are a number of complementary land-use and location efficiency policies, and transit-based incentives to improve the attractiveness of low-GHG travel choices.
Rationale	Reduce dependence on gasoline; reduce GHGs, congestion, and local air pollution.
Existing policy/program	Executive Order 11, 3/17/04 calls for reductions in VMT by State employees, promotion of carpools, vanpools, teleconferencing, and study of telecommuting. A variety of existing DOT initiatives, including the State Transportation Plan, support these options.
Significant co-benefits	Reduction in time spent in travel between different locations; reduced human-hours lost to congestion; cost savings from reducing need for additional road capacity; reduction in non-point source pollution from impervious surface growth; preservation of open space/wildlife habitat (from compact growth); improved health of citizens with access to transit-served walking communities.
Carbon saved 2020	286.4
Cost *per* unit saved carbon	See more complete discussion in Appendix 5.1.
Performance measures	Transit ridership; quantity of open space lost; air and water quality; rate of growth of VMT.
Implementation method(s)	Requires establishment of a multi-agency and stakeholder working group to identify the best combination of options for Maine. Could be chartered by legislative resolve.
Implementation / outreach considerations	Must be approached from a regional perspective. State or regional planning agency involvement in land use/transit planning, water and sewer infrastructure investment is essential. Transit option must be made attractive and be adequately promoted. Compact growth may require publicly-funded incentives.

Given the interactive natural of land use and transportation measures it is difficult to estimate impacts of many of these policies on their own. So-called “smart growth” studies and projects in other parts of the country consistently show potential regional and statewide VMT reductions ranging from around 3-10 percent (below business-as-usual projections) for actions of this sort. The VMT savings are a result of a combination of transit improvements, land use modifications (Transportation Oriented Development; infill, etc.) and complementary policies such as open space protection and Travel Demand Management.

OPTION #19 -- Improve Electrical Efficiency in Commercial and Institutional Buildings

Carbon Savings Potential: High Costs / savings: High savings

Category	Description
Working group	Buildings, Facilities and Manufacturing 3.8
Option name	*Improve Electrical Efficiency in Commercial and Institutional Buildings*
Sector(s)	Commercial
Policy / program elements	Technical and financial assistance to encourage replacement of inefficient equipment
Rationale	Improving electrical efficiency in commercial and institutional buildings provides large carbon savings while working with a small set of facilities.
Existing policy/program	"Efficiency Maine" C&I Program, available to businesses with > 50 FTEs, includes three components: (1) business practices training, (2) information and end-use training opportunities, and (3) financial grants to assist in the purchase of EE equipment.
Significant co-benefits	Improves productivity of commercial buildings, which may translate into incentives for maintaining or establishing business in Maine
Carbon saved 2020	250.8
Cost *per* unit saved carbon	-139
Performance measure	Specific goal of saving 124K mwH in 2005, probably based on PUC measurement
Implementation method(s)	With Options 22, 29, and 37, builds on and expands current "Efficiency Maine" C&I Program
Implementation / outreach considerations	Funding may be available from savings in Option 29. Targeted audience: owners of commercial buildings. Outreach through identification of bellwether property owners and property management groups. Some form of "leadership excellence" awards / gubernatorial proclamation may be useful. Formal marketing effort may be required.

Included in this measure, which is based on the Office of Public Advocate *Optimal Energy Study*[70], are items such as efficient appliances, lighting and air conditioning; building system controls; high efficiency motors and variable frequency drives, etc.

[70] "The Achievable Potential for Electric Efficiency Savings in Maine" , Optimal Energy Full report: http://www.state.me.us/meopa/02-162%20Optimal.pdf
Report summary by the PUC: http://www.efficiencymaine.com/orders-documents/2002-162%20EE%20Pot%20Sum%20V5%202.htm

OPTION #20 – Timber Harvesting to Capture More Anticipated Mortality

Carbon Savings Potential: High *Costs / savings: Low costs*

Category	Description
Working group	Agriculture/Forestry: Forest 7.0
Option name	*Timber Harvesting to Capture More Anticipated Mortality*
Sector(s)	Forestry
Policy / program elements	Remove standing biomass with minimal impact on forest floor and soils. Goal: within 15 years capture 50% of tree biomass that otherwise is lost to natural mortality and decays on forest floors. Apply to all forest types and all landowner classes on 1,700,000 total acres over a 15-year period (113,333 acres per year).
Rationale	Reducing volume of decaying wood enhances carbon sequestration. Increased use of forest biomass for energy generation, paper production, and building materials displaces fossil based energy use of conventional alternatives.
Existing policy/program	Some support from federal cost-share programs
Significant co-benefits	Use of forest biomass to displace non-renewable energy and material sources. Improved forest management and health. Expanded economic development opportunities.
Carbon saved 2020	239.5
Cost *per* unit saved carbon	3.5
Performance measure	MFS forest sustainability benchmarking (Criterion 3, Timber Supply and Quality)
Implementation method(s)	This program potentially will require new administration and program costs associated with education and technical assistance to landowners, managers, and businesses, and identification or expansion of markets for low quality wood.. Program costs include the need for planning, implementation, and evaluation of programs and, potentially, individual projects.
Implementation / outreach considerations	By definition this option meets market criteria and likely will not involve new costs to landowners and managers. Timber harvests will remove anticipated mortality if it is more profitable than alternative management options.

This option is intended to support timber harvesting that removes anticipated mortality from the forest with minimal impact to the forest floor and soils, and to use the harvested wood for energy generation, paper and solid wood production to reduce carbon dioxide emissions from energy generation and materials production.

See Option 10 for the standard for implementation recommended by the Forestry Working Group.

OPTION #21 -- Biomass Electricity Feedstocks

Carbon Savings Potential: High Costs / savings: Neutral

Category	Description
Working group	Agriculture / Forestry: Forestry 5.0
Option name	*Biomass Electricity Feedstocks*
Sector(s)	Forestry; Electricity
Policy / program elements	Measured by simple addition of biomass energy sub-options from other forestry management options in-cluding: early commercial thinning (16), more lighter harvests (20), and active management of stands for softwood re-establishment (28).
Rationale	Incentives to make greater use forest products or for-est waste as a fuel (in solid or gas form) or for co-firing with fossil fuels may reduce net emissions from power supply if it replaces higher emissions supply sources.
Existing policy/program	Presently biomass is used for about 24 percent of the state's power generation, and is also a significant source of combined heat and power for wood products' manufacturing facilities. Biomass is heavily used for home heating with wood stoves.
Significant co-benefits	Removals of overstocked, unhealthy, or otherwise un-marketable trees may improve forest health and re-duce emissions from dead and dying trees. Supports Maine's forest-based economy.
Carbon saved 2020	228.4
Cost *per* unit saved carbon	-0-
Performance measure	
Implementation method(s)	
Implementation / outreach considerations	Biomass energy under current capacity and technology is marketable, but new capacity and new technology (biomass gasification and combined cycle) may require market intervention. Stakeholders identified a currently increasing demand for biomass in the market, which could produce a shortage in the intermediate future.

See Option 10 for the standard for implementation recommended by the Forestry Work-ing Group.

OPTION #22 -- Manufacturing Electrical Efficiency Measures

Carbon Savings Potential: High *Costs / savings: High savings*

Category	Description
Working group	Buildings, Facilities and Manufacturing 4.1
Option name	*Promote Electrical Efficiency Measures for Manufacturing in Maine*
Sector(s)	Industrial
Policy / program elements	Offer financial incentive/rebates for EE improvements for manufacturing in Maine.
Rationale	Continue to encourage replacement of energy inefficient equipment
Existing policy/program	"Efficiency Maine" has established a new Commercial and Industrial Program for Maine businesses that provides a combination of services, including energy efficiency information and training, business practice assistance, and direct financial incentives in the form of grants. The components of the program are designed to encourage businesses to adopt energy efficient business practices, to include consideration of energy costs and energy efficiency in their business decisions, and to purchase and install energy efficient products.
Significant co-benefits	Very high cost effectiveness, with rapid payback on investment to achieve significant operational savings
Carbon saved 2020	207.2
Cost *per* unit saved carbon	-30
Performance measure	Analysis of "Efficiency Maine" data.
Implementation method(s)	Can include: • Tax incentives, such as Investment Tax Credit or shortened depreciation periods for installation of energy efficient systems and equipment • Creative financing mechanisms • Rebates and grants • Technical assistance and training • Interruptible power programs • Real time pricing
Implementation / outreach considerations	May be able to take advantage of existing programs such as Building Operator Certification program.

Potential areas for energy efficiency improvement include

- ♦ Efficient Lighting
- ♦ Efficient Ventilation and Cooling
- ♦ Efficient Process Controls
- ♦ Building System Controls
- ♦ Variable Frequency Drives
- ♦ High Efficiency Air Compressors

While the Work Group reached consensus in recommending this option, it did not reach agreement on a specific funding mechanism or level.

OPTION #23 -- Fossil Fuel Efficiency Measures

Carbon Savings Potential: High

Costs / savings: High savings

Category	Description
Working group	Buildings, Facilities and Manufacturing 5.5
Option name	*Increase Public Expenditures for Fossil Fuel Efficiency Measures*
Sector(s)	Residential, Commercial, Industrial
Policy / program elements	Develop mechanisms to raise public funding for fossil fuel efficiency measures. Enhance existing programs to promote weatherization and insulation measures.
Rationale	Encourage replacement of energy inefficient equipment providing space, water, and process heating.
Existing policy/program	None
Significant co-benefits	Funds could support research and development for new energy technologies with wider applications in Maine.
Carbon saved 2020	204
Cost *per* unit saved carbon	- 34
Performance measure(s)	Would require an evaluation program to measure funds collected and expended, efficiency mechanisms installed, ease of implementation, user end point savings, number of participants etc.
Implementation method(s)	To be determined.
Implementation / outreach considerations	Involvement of key stakeholders in developing of specific mechanisms is particularly important. Probably a good candidate for pilot programs.

Could include actions such as rebates or financing subsidies for efficient boilers for space, water, and process heating, steam system optimization, etc. Could also be funded from a commercial/industrial loan program to help businesses retrofit projects in their facilities. For example, monies from New York's system benefits charge (SBC) are used to write down the interest on loans to businesses for energy efficiency projects. Revolving loan funds are also an option.

Option 35, *Efficient Use of Oil and Gas: Home Heating*, is a specific example of this approach which is listed and modeled separately.

Some members of the working group and the SAG were not in agreement with this option because no definition of "public expenditures" was presented, and/or because potential funding mechanisms were not specified.

OPTION #24 -- Low GHG Fuel for State Fleets

Carbon Savings Potential: Medium Costs / savings: Low costs

Category	Description
Working group	Transportation and Land Use 3.2
Option name	*Low GHG Fuel for State Fleets*
Sector(s)	Transportation
Policy / program elements	Maximize use of non-petroleum, renewable fuel or other low GHG-fuels for State Fleets where feasible.
Rationale	Fleets provide opportunities to develop a market for more fuel-efficient vehicles to reduce GHGs and air pollution.
Existing policy/program	In 2003 the 121st Maine Legislature passed a *Resolve* requesting the Maine Departments of Environmental Protection and Transportation to conduct a comprehensive study of the costs and benefits of various alternative energy sources for state government actions (S.P. 388 - L.D. 1184). MDOT has begun a trial program utilizing bio-diesel in one facility. The Department of Administrative and Financial Services (DAFS) was charged with developing recommendations for fuel efficiency and emissions standards for heavier duty vehicles by January 1, 2004, and agencies are directed to promote the procurement of dedicated alternative fuel vehicles, dual-fuel vehicles and fueling infrastructures to support such vehicles. DAFS was also given until January 15, 2003 to ensure that these policies are reflected in the procurement policies of the State.
Significant co-benefits	Similar to others in transportation sectors.
Carbon saved 2020	157.5
Cost *per* unit saved carbon	10
Performance measure	Measured volume of alternative fuel used.
Implementation method(s)	Executive order.
Implementation / outreach considerations	May require installation of additional local fuel storage tanks.

Similar policies are already in effect in many cities around the US. Stakeholders were not unanimous in endorsing this option, citing potential difficulties in the marketing of diesel light vehicles, but almost all the stakeholders could support the option if it was adopted in a regional approach through the New England Governors and Eastern Canadian Premiers.

OPTION #25 – Expanded Use of Wood Products

Carbon Savings Potential: Medium Costs / savings: Low costs

Category	Description
Working group	Agriculture / Forestry: Forestry 6.0
Option name	*Increase Wood Products Use*
Sector(s)	Forestry
Policy / program elements	This option is the simple addition of biomass to wood products sub-options evaluated under forest management options, including: early commercial thinning (16), more lighter harvests (20), and active management of stands for softwood reestablishment (25).
Rationale	Durable wood products in construction of furnishings and buildings can sequester carbon for long periods of time depending on the type of harvesting practices and end use of the wood products. The substitution of wood products building materials for steel and concrete reduces embedded energy and carbon dioxide emissions.
Existing policy/program	None at present.
Significant co-benefits	Wood products are often less energy-intensive in production and use than other materials. Supports Maine's forest products-based economy.
Carbon saved 2020	129.8
Cost *per* unit saved carbon	3
Performance measure	
Implementation method(s)	
Implementation / outreach considerations	The carbon savings associated with this option may be increased if additional technologies and markets for wood products come into active use.

The policy options that contribute to expanded wood products use assume marketable harvests of biomass and no additional costs of market penetration. The only additional costs are those associated with stewardship and harvest planning by landowners.

See Option 10 for the standard for implementation recommended by the Forestry Working Group.

OPTION #26-- Energy Efficiency Appliance Standards

Carbon Savings Potential: Medium *Costs / savings: High savings*

Category	Description
Working group	Buildings, Facilities, and Manufacturing 1.1
Option name	*Energy Efficiency Appliance Standards*
Sector(s)	Residential, Commercial
Policy / program elements	Legislation proposed, never passed.
Rationale	For appliances not covered under federal standards, the state may set minimum efficiency standards for appliances to reduce power consumption
Existing policy/program	Federal "Energy Star" program identifies some affected products. LED (Light-emitting Diode) kits for traffic signals have been purchased for replacement traffic lights in Maine, funded in part through existing PUC and DOT programs.
Significant co-benefits	Consumer, municipality, and commercial business cost savings.
Carbon saved 2020	128.7
Cost *per* unit saved carbon	-134
Performance measure	Number of energy efficient appliances purchased
Implementation method(s)	Will require legislative mandate.[71]
Implementation / outreach considerations	Demonstrable life-of-products cost savings will be a major incentive.

The working group has identified a group of appliances not currently subject to Federal efficiency standards. These are:

Dry type transformers
Commercial refrigerators & freezers
Exit signs
Traffic signals
Torchiere lamps
Set-Top boxes
Unit heaters (therm savings)
Commercial Clothes Washers

The impacts from this option would accumulate gradually as existing equipment is retired and replacements acquired, and as new buildings are built.

[71] The PUC has reported (2004) to the Legislature on cost effectiveness, and is engaged in further analysis on different mechanisms (including standards) for accelerating the adoption of more efficient technologies. A report is expected in January, 2005.

OPTION #28 -- Active Softwood Increase

Carbon Savings Potential: Medium Costs / savings: Low costs

Category	Description
Working group	Agriculture / Forestry: Forestry 4.0
Option name	*Maintain and Increase the Softwood Component of Forest Stands*
Sector(s)	Forest
Policy / program elements	Structured conversion from lands currently classified as hardwood to softwood to increase soil sequestration values. Goal: transition 33,333 acres per year over 15 years currently classified as a hardwood forest type on native softwood sites to a softwood forest type by 2020.
Rationale	Softwood stands provide higher merchantable biomass use rates and can reduce greenhouse gas emissions by increasing biomass use rates for energy generation and building materials. Biomass removals can also reduce emissions from decay of dead and dying timber.
Existing policy/program	Non-industrial forests: various MFS, etc., technical and financial assistance programs to promote better forest management practices; Tree Growth tax law
Significant co-benefits	Generation of additional bio-mass for wood products or energy; mitigate forest health risks as a result of improved forest management practices. Supports Maine's forest-based economy.
Carbon saved 2020	73.2
Cost *per* unit saved carbon	3[72]
Performance measure	Acres converted from hardwood to softwood classification: MFS annual inventory
Implementation method(s)	Implementation of appropriate practices by large industrial forest managers; utilization of existing non-industrial forest initiatives (see above)
Implementation / outreach considerations	By definition this option meets market criteria for the acreage involved in biomass harvest, and does not involve new costs to producers.

Significant percentages of Maine's original softwood forests have shifted to hardwoods as a result of forest practices. With long-term forest succession they are likely to return to softwoods in the very long term, but this process can be accelerated with practices that remove hardwood stocks by thinning or harvest and replace them with longer-lived softwoods.

See Option 10 for the standard for implementation recommended by the Forestry Working Group. There were significant differences of opinion in the Working Group as to the efficacy of this Option, particularly due to the possibility of herbicide use.

[72] This option also includes application of herbicides to 3,000 acres of hardwood to promote natural stand release and regeneration of softwoods. Costs here ($200/acre est.) would increase the cost per unit of carbon saved, but are not included in the above calculation since they would be incurred whether or not saving carbon is a goal.

OPTION #29 -- Increase Public Expenditures for Electrical Efficiency Measures

Carbon Savings Potential: Moderate *Costs / savings: High savings*

Category	Description
Working group	Buildings, Facilities and Manufacturing 5.2
Option name	*Increase Public Expenditures for Electrical Efficiency Measures*
Sector(s)	Residential, Commercial, Industrial
Policy / program elements	Develop mechanism(s) to raise public funding for electrical EE measures. This proposed measure would support several other options (19, 22, 37).
Rationale	Electrical efficiency measures frequently require initial investments in new or replacement equipment which cannot always be borne by property owners, even though the payback period is relatively short. Public funding bridges this gap.
Existing policy/program	Efficiency Maine is funded by electricity consumers and administered by the Maine Public Utilities Commission (current funding level ~$16 million per year); no sunset date.
Significant co-benefits	Direct and indirect electrical energy savings provides either additional capacity for development, or displacement of marginal (costly and environmentally less-preferred) energy production.
Carbon saved 2020	71.1
Cost *per* unit saved carbon	-55
Performance measure	Utilization of additional funds.
Implementation method(s)	No particular method suggested by stakeholder group.
Implementation / outreach considerations	Current program is funded by consumers. There will likely be opposition to increasing the current rate.

Estimates reflect the savings associated with putting $15 million into this effort beyond business-as-usual. It does not specify a funding mechanism.

OPTION #30 -- Improved Residential Building Energy Codes

Carbon Savings Potential: Moderate *Costs / savings: High savings*

Category	Description
Working group	Building and Facilities 2.1
Option name	*Improved Residential Building Energy Codes*
Sector(s)	Residential
Policy / program elements	Require new buildings or substantial reconstruction to meet the most recent energy code efficiency/ performance standards established by the International Code Council and ASHRAE 6.2 ventilation standards,
Rationale	More energy efficient residential buildings save both money and energy.
Existing policy/program	Residential: State-developed code, less stringent than 1992 MEC, mandatory statewide; Voluntary IECC 2000. The PUC has initiated model energy code rule-making (9/04) to require ASHRAE 62.2-2003.
Significant co-benefits	Significant cost savings over life of building; improved air quality.
Carbon saved 2020	64.1
Cost *per* unit saved carbon	-35
Performance measure	Number of new/reconstructed buildings using the new requirements.
Implementation method(s)	Legislative mandate, followed by outreach to building contractors, local code enforcement officers/ building inspectors, etc.
Implementation / outreach considerations	Would require compliance records and effective enforcement, as recommended through the PUC process. Some increase in initial price for buildings or improvement. Over time, energy efficiency certification can become a value-added aspect of home sales.

OPTION #31 -- Voluntary Partnerships and Recognition Programs

Carbon Savings Potential: Moderate *Costs / savings: High savings*

Category	Description
Working group	Buildings, Facilities and Manufacturing 5.9
Option name	*Participate in Voluntary Partnerships and Recognition Programs*
Sector(s)	Comprehensive
Policy / program elements	Recognize voluntary programs and reward actions for GHG reduction in the appropriate sectors.
Rationale	Developing additional programs in Maine increases the range of voluntary participation in saving energy and reducing emissions, and heightens public awareness.
Existing policy/program	Several programs already exist at the national level: EPA Climate Leaders, DOE Industries of the Future (Maine Industries of the Future currently includes pulp and paper, secondary wood, and metals industry), EPA Energy Star Benchmarking Program, Climate Vision, DOE Rebuild America; Maine STEP-UP program, Carbon Challenge
Significant co-benefits	
Carbon saved 2020	57.5
Cost *per* unit saved carbon	0
Performance measure	Number of new companies, institutions, etc., participating in formal agreement programs.
Implementation method(s)	Formal voluntary agreements; Memoranda of Understanding/Agreement with businesses, industries, institutions, etc.
Implementation / outreach considerations	Energy audit program sponsored by the PUC may provide a baseline for participants.

Existing voluntary programs such as those identified above have already generated agreements to significantly reduce GHG emissions and/or save energy. The success of these programs could be increased by broadening participation.

The Department of Energy identified the following possibilities for expanding Maine's participation in "Industries of the Future":

- Include agriculture and plastics and potentially welding;
- Additional publicity;
- The Maine legislature might consider creating a mini state grant program that could provide funds to Maine businesses for feasibility studies to determine whether to adopt new energy-efficient technologies;
- Discuss energy and EE technologies as part of technology cluster project.

The carbon savings quantified above assume that companies representing 10% of GHG emissions voluntarily reduce these by 15% by 2010, and 25% in 2020.

OPTION #32 -- Adopt Advanced Technology Component (Formerly ZEV) of LEV II Standards

Carbon Savings Potential: Moderate *Costs / savings: Neutral*

Category	Description
Working group	Transportation and Land Use 1.1b
Option name	*Adopt Advanced Technology Component (formerly ZEV) of LEV II Standards*
Sector(s)	Transportation
Policy / program elements	Adopt Advanced Technology component of California LEV II Standards
Rationale	Maine already has LEV II but opted (2000) not to include ZEV mandate because of concerns over limited number of non-electric vehicles that complied with zero-emission standard. New alternative path allows ZEV requirement to be met with current hybrid technology.
Existing policy/program	Maine adopted CA LEVII for criteria pollutant emissions, without ZEV.
Significant co-benefits	Reduction in other pollutants, especially hazardous air pollutants like benzene.
Carbon saved 2020	53.0
Cost per unit saved carbon	0
Performance measure	Increase in number of hybrids available for purchase in Maine
Implementation method(s)	Rulemaking
Implementation / outreach considerations	In late 2004, the Board of Environmental Protection held a Public Hearing on re-instituting the ZEV requirement as a revision to Chapter 127 of the Department's rules. This is expected to be considered by the Legislature, with earliest possible implementation affecting model year 2009 vehicles.

The ZEV program was designed to catalyze the commercialization of advanced-technology vehicles that would not have any tailpipe or evaporative emissions. Originally, the ZEV program required that 2 percent of new vehicles produced for sale in1998 and10 percent of new vehicles produced for sale in 2003 would be zero emission vehicles. The automakers convinced the California Air Resources Board (CARB) that they could not meet the 1998 deadline, and full implementation of the program was delayed until 2003. In 2002, automakers sued the state over the program and were granted a preliminary injunction barring its implementation pending a final court ruling. California has adopted a revision to its ZEV program, with the aim of restoring it by 2005.
In the Working Group and SAG, a few stakeholders mentioned the following considerations:

1) Dealers being forced to stock vehicles that would be difficult to sell;
2) Minimal CO_2 benefit of the option;
3) If not part of this program limited availability of hybrid vehicles.

OPTION # 33 Support Purchase of Locally Grown Produce

Carbon Savings Potential: Moderate *Costs / savings: Low or no Costs*

Category	Description
Working group	Agriculture / Forestry Agriculture 6.0
Option name	Support Purchase of Locally Grown Produce
Sectors	Agricultural; Transportation
Policy / program elements	Increase availability and purchase of locally produced agricultural products by shifting production location and transportation demand.
Rationale	Lower transportation emissions
Existing policy/program	Current Dept. of Agriculture "Buy Real – Buy Maine" and similar programs; also NGO programs to promote local production/consumption. Existing state and federal programs could assist in this effort, including the USDA Resource Conservation and Development (RC&D) program and recently promulgated organic food standards by USDA.
Significant co-benefits	Encourages local farming; prevents loss of farmland.
Carbon saved 2020	52.1
Cost *per* unit saved carbon	To be determined: probably > 0
Performance measure	Surrogate: Sales numbers of specific products, based on household surveys/
Implementation method(s)	Identify likely high-value product shifts; target specific marketing at producers and consumers. Good candidate for pilot program.
Implementation / outreach considerations	Further study to identify differential production costs of specific food categories. Likely to be perceived positively by general public. Food distribution and retail sector would need to be involved, and potentially provided with incentives.

Organic farming techniques can build up soil carbon levels in farmed acreage. Consistent with the broader policy option to increase soil carbon, the working group did not formulate an implementation mechanism for increased acreage in organic farming, and instead suggested simple acreage goals. About 20,000 acres of farmland in Maine are presently in organic farming out of 155,000 acres of total cultivated cropland. The Maine Organic Farming Association expects this to grow to 30,000 acres by 2010 and then cease to increase. They believe that aggressive public policy could increase this acreage level to 70,000 acres by 2020 (a 40,000 acre increase).

There is currently no inventory of existing market share of locally grown food in Maine for a baseline. The goal of 10% of every food dollar was derived from an Iowa study. The Working Group proposes to increase to this to 15% by 2020.

OPTION #34 -- State Green Power Purchases

Carbon Savings Potential: Moderate *Costs / savings: High costs*

Category	Description
Working group	Electricity and Solid Waste 1.3
Option name	*State Green Power Purchases*
Sector(s)	Electricity
Policy / program elements	A requirement that State government and universities meet a minimum percent of their power needs with renewable energy. The renewable energy percentage may be set to increase over time.
Rationale	Reduce carbon emissions from electrical generation, using a "lead by example" approach.
Existing policy/program	Governor of Maine has set a goal for the State government to purchase 50% of its electricity from renewable sources.
Significant co-benefits	Increased incentive for the development of renewable resources.
Carbon saved 2020	45.0
Cost *per* unit saved carbon	28
Performance measure	Direct reporting of State facilities energy portfolio mixture.
Implementation method(s)	Executive order.
Implementation / outreach considerations	Has the potential to add to State government costs at a time of increased budget stringency.

Implementation of this option would aim to increase state government purchase level to 50% in 2010 and 60% in 2020, all from 100% renewable sources. A policy of purchasing green tags from renewable energy providers that feed the New England Power Pool could serve as an additional means of increasing future renewable energy procurement. New York, Maryland and New Jersey have already adopted this approach.

OPTION # 35-- Efficient Use of Oil and Gas: Home Heating

Carbon Savings Potential: Moderate *Costs / savings: Moderate savings*

Category	Description
Working group	Buildings, Facilities and Manufacturing 2.6
Option name	*Efficient Use of Oil and Gas: Home Heating*
Sector(s)	Residential
Policy / program elements	Develop energy efficiency programs for heating and hot water systems of all fuel types. Replace inefficient boilers/furnaces with Energy Star rated.
Rationale	Relative to mid-efficiency equipment, over 10% of the fossil fuel consumed and carbon emitted can be saved if high-efficiency equipment is installed instead.
Existing policy/program	LIHEAP, WAP, REACH Central Heating Improvement (CHIP) Programs for low-income residents. (Energy Advisors, LLC, 2003)
Significant co-benefits	Long-term operating cost savings.
Carbon saved 2020	39.1
Cost *per* unit saved carbon	-6
Performance measure	Would require an evaluation program to measure funds collected and expended, efficiency mechanisms installed, ease of implementation, user end point savings, number of participants etc.
Implementation method(s)	Could be included in actions taken to implement Option 23.
Implementation / outreach considerations	Maine should review market and regulatory barriers to identify best opportunities for increasing installation of cost-effective efficiency measures, and review potential incentives for implementing these measures. This option provides good opportunities to utilize pilot projects.

The most efficient furnaces and boilers for home heating use far less energy than those which current dominate the market. High-efficiency products have a higher capital cost, but lower annual operating costs. Further, there are changes that can be made to existing systems (*e.g.*, pipe insulation, nozzle reduction) to achieve significant savings without full system replacement.

22 states have natural gas conservation programs. In the Northeast, NH, VT, MA, NY, NJ, PA, MD and WV have natural gas conservation programs. ME, RI, CT and DE do not. Vermont's natural gas conservation program has saved 1,000 cubic feet/year (typically lasting 20 years) for every $29 spent.
Programs include:

- ✓ promoting ENERGY STAR heating equipment;
- ✓ promoting ENERGY STAR-rated water heaters;
- ✓ promoting ENERGY STAR-rated programmable thermostats;
- ✓ increasing the efficiency of residential new construction.

OPTION # 36-- Combined Heat and Power (CHP) Incentive Policy

Carbon Savings Potential: Moderate Costs / savings: High savings

Category	Description
Working group	Electricity and Solid Waste 1.8
Option name	*Combined Heat and Power (CHP) Incentive Policy*
Sector(s)	Electricity
Policy / program elements	Reduce barriers and implement programs to increase clean CHP in the state. CHP is a high efficiency method of distributed generation that utilizes both the steam and electricity produced by the electricity generating process, rather than just the electricity
Rationale	Increases overall energy generation efficiency.
Existing policy/program	CHP units are included as eligible renewable sources under the state Renewable Resource Portfolio Requirement. See full option description for efforts currently underway.
Significant co-benefits	
Carbon saved 2020	38.0
Cost *per* unit saved carbon	-185
Performance measure	Direct reporting of CHP facility output.
Implementation method(s)	Developing uniform and consistent interconnection standards can allow units to be connected to the electricity grid faster and reduce the cost of interconnection.
Implementation / outreach considerations	Utility regulations may need to be changed to encourage CHP; however, this could have the effect of transferring costs to other ratepayers.

CHP systems, also known as co-generation systems, make use of heat that would be wasted in conventional electric generating plants.

The Working Group agreed that this option should be pursued by exploring the barriers to CHP, including inter-connection standards,[73] environmental standards, and back-up rates. Any back-up rate proceedings should look at impacts and benefits on CHP owners and other ratepayers.

There may be more opportunities in the institutional and commercial sectors than modeled above and should be further explored. For instance, USM and Eastern ME Medical are currently installing CHP.

In addition to the implementation methods above, other methods include:

- awarding of emission reduction credits to CHP units for emission reductions realized as a result of their high efficiency;
- consumer choice, which allows electricity customers to purchase CHP-generated electricity; and
- direct subsidies, provided to CHP units on a per unit, efficiency or energy production basis, which can improve the depreciation allowance for CHP equipment.

[73] See NQ Option ESW 1.11 for further discussion of inter-connection rules and transmissions barriers.

OPTION #37 -- Improve Enforcement of Commercial Energy Codes

Carbon Savings Potential: Moderate Costs / savings: High savings

Category	Description
Working group	Buildings, Facilities and Manufacturing 3.7
Option name	*Improve Enforcement of Commercial Energy Codes*
Sector(s)	Commercial
Policy / program elements	Improve enforcement of the requirement that new construction and substantial renovations of commercial buildings meet the most recent energy code efficiency/performance standards established by the International Code Council.
Rationale	Build in higher efficiency levels at the point of construction to realize lower energy operating costs and reduced carbon emissions.
Existing policy/program	Commercial: ASHRAE/IESNA 90.1-2001, mandatory statewide (includes all institutional buildings such as schools and hospitals).
Significant co-benefits	Operating cost savings for commercial businesses that utilize lower-energy construction methods.
Carbon saved 2020	33.6
Cost *per* unit saved carbon	-61
Performance measure	Reports from local building inspectors.
Implementation method(s)	Legislature must pass "housekeeping legislation" whenever the State wants to update to the most recent building energy codes.[74] Requires training for building inspectors. #29, *Increase Public Benefit Fund,* supports this option.
Implementation / outreach considerations	There may be a need to avoid conflict with existing rehabilitation codes. A well-publicized “Leadership Excellence” program for the commercial sector could be utilized for this and other sector options.

Current building codes have requirements affecting the level of energy used in new and renovated buildings.

Any process to upgrade enforcement of building codes would entail some funding requirements for standards evaluation and development, implementing code revisions as these occur, training for contractors and inspectors, etc.

[74] 10 MRSA c. 214, §1415-D: Mandatory standards for commercial and institutional construction.

OPTION #38 -- Solar Water Heat Rebate

Carbon Savings Potential: Moderate *Costs / savings: Moderate savings*

Category	Description
Working group	Buildings, Facilities and Manufacturing 5.7
Option name	Solar Water Heater Program
Sector(s)	Residential, institutional, commercial: new or existing buildings.
Policy / program elements	Funding for SWH systems incentives and marketing
Rationale	To promote the use of renewable energy through the installation of solar water heating systems.
Existing policy/program	No current program.
Significant co-benefits	Support of local businesses for purchase and installation
Carbon saved 2020	33.1
Cost *per* unit saved carbon	16
Performance measure	Number of installed systems
Implementation method(s)	Legislative action to establish tax credit or revolving loan fund. Specific approach to be determined.
Implementation / outreach considerations	Relatively high up-front costs may discourage potential adopters. Rebate system might need to be scaled to income.

Active solar water heating systems collect and store thermal energy from the sun in order to heat water for domestic and small commercial / institutional use. They are usually installed on roofs. To provide backup, a conventional water heater must be installed along with the SWH. Under this proposal, the state would promote through education, rebates, tax credits, etc. the procurement and installation of solar water heating systems for residential applications. To qualify, the system owner must have an inspector confirm the conservation measure is an efficiency upgrade.

The modeled carbon savings assume a 0.5% market penetration by 2020.

OPTION # 39-- Build Up of Soil Organic Carbon

Carbon Savings Potential: Moderate Costs / savings: Moderate cost

Category	Description
Working group	Agriculture / Forestry Agriculture 2.0
Option name	*Buildup of Soil Organic Carbon (Agriculture)*
Sector(s)	Agriculture
Policy / program elements	Conservation tillage and related cropland soil management toward improving *per* acre soil carbon storage rate. Goal: Bring 140,000 existing acres of cropland into new management practices.
Rationale	Practices that result in less disruption of the soil or increase organic content through carbon deposition can increase the carbon content (stock) of soil or reduce its rate of loss (flow) to the atmosphere.
Existing policy/program	A variety of support / incentive programs exist to encourage conservation tillage or no till agriculture through installation of best management practices.
Significant co-benefits	Soil conservation maintains land productivity, reduces water quality impairment, and loss of wildlife habitat.
Carbon saved 2020	31
Cost *per* unit saved carbon	28
Performance measure	Acreage brought into new management practice yielding per acre soil carbon storage rate improvements from1.5 percent to 3.5 percent over a 10 year time period.
Implementation method(s)	Development and deployment of Best Management Practices.
Implementation / outreach considerations	

OPTION #40 -- Green Campus Initiatives

Carbon Savings Potential: Moderate *Costs / savings: Moderate savings*

Category	Description
Working group	Buildings, Facilities and Manufacturing 3.6
Option name	***Green Campus Initiatives***
Sector(s)	Institutional
Policy / program elements	Promote a "Green Campus" initiative with all Maine colleges, universities, private/secondary schools to minimize environmental impact
Rationale	Educational institutions are discrete entities in which energy and GHG usage can be measured, monitored, and effected more easily than in other parts of the sector.
Existing policy/program	Currently underway on college campuses (USM, Other Campuses)
Significant co-benefits	Institutional cost reduction
Carbon saved 2020	29.8
Cost *per* unit saved carbon	-18
Performance measure	Typical energy saving indicators
Implementation method(s)	Further promotion of existing programs, including special attention to active support by senior administrators. Can be integrated with environmental management systems already being developed on some campuses.
Implementation / outreach considerations	Existing programs already well underway, with significant connections to the educational mission.

"Green campus" initiatives are well underway throughout the region. At present, these primarily involve post-secondary institutions, where both administrators and student action groups are promoting a wide range of environmentally-preferable activities. The above carbon savings and cost numbers are limited to colleges and universities.

Transferring these efforts to the public school group has not yet begun. Here, the active agents will change, to include not only school administrators and students, but also local school boards and the state Department of Education.

OPTION #41 -- Encourage Anti-Idling Measures: Freight

Carbon Savings Potential: Moderate *Costs / savings: Low cost*

Category	Description
Working group	Transportation and Land Use 4.2d
Option name	*Encourage Anti-Idling Measures: Freight*
Sector(s)	Transportation -- Freight
Policy / program elements	Support programs to fund infrastructure or develop incentives to reduce truck, locomotive, and marine engine idling through electrification and other technologies, enforcement, and congestion management.
Rationale	Lessening idle time reduces emissions directly.
Existing policy/program	Maine DOT Intelligent Transportation System Commercial Vehicle Operation work group is working on a system for pre-clearance at scale houses.
Significant co-benefits	Fuel cost savings (lowered consumption). Lessened emissions of fine particulate matter: direct human health benefits (asthma).
Carbon saved 2020	29.7
Cost *per* unit saved carbon	> 0
Performance measure	Surrogate: estimates of diesel consumption
Implementation method(s)	Installation of technology; education to promote best practices, inform truckers of alternative routes, etc.
Implementation / outreach considerations	Further information needed to identify potential for Truck Stop Electrification (~30% GHG emissions reductions) and list of freight rail commodities in Maine that could be shifting to TSE (refrigerated goods, etc). Good candidate for pilot project, either with specific firms or in partnership with other states for particular routes.

Vehicles at idle are performing no useful work, but are nonetheless consuming fossil fuels, and emitting both GHG and other substances associated with ground-level air pollution. The rationale for such idling frequently relates to the importance of maintaining heat in diesel engines; maintaining electric power to support ancillary motors (refrigeration, *e.g.*); and cab comfort.

Changes in diesel technology, and the availability of alternate power sources (so-called "truck stop electrification"), both act to reduce idling. Non-quantified Option TLU 8.2, "Highway Weight Limits," could have a positive effect on implementing this option.

OPTION #42 -- Voluntary Green Building Design Standards

Carbon Savings Potential: Moderate Costs / savings: High Savings

Category	Description
Working group	Buildings, Facilities and Manufacturing 2.3
Option name	Voluntary Green Building Design Standards
Sector(s)	Residential
Policy / program elements	Promote voluntary high efficiency and sustainable building standards that builders can follow (*e.g.,* Energy Star, LEED residential building standard as it becomes available, Built Green™). In addition to an energy efficiency requirement, require procurement standard for concrete containing up to 20% recovered mineral component (see #47).
Rationale	This program encourages better building practices, which have a high cost/benefit return for homeowners while saving energy in both construction and operation.
Existing policy/program	None
Significant co-benefits	Economic development related to increased use of energy efficient products; lessened use of toxic materials.
Carbon saved 2020	28.0
Cost *per* unit saved carbon	-45
Performance measure	Possible reporting through local CEO, building permits, etc.
Implementation method(s)	Voluntary change, requiring education and outreach; could be linked to state procurement requirements. Builder/constructor associations are the first clients.
Implementation / outreach considerations	Availability of specialized materials, and training of builders/contractors in sustainable construction: special license or certification may be needed. May be linked to special mortgage rates for meeting the standard. Will take time to implement. Excellent candidate for pilot programs.

Owning (*i.e.,* mortgage amortization) and operating (*e.g.,* utility bills) an Energy Star-labeled home costs less than owning and operating a non-Energy Star labeled home. Energy-saving measures are not recommended unless the amortized cost of implementing those measures is less than the utility bill savings resulting from them.

OPTION #43 -- Waste to Energy

Carbon Savings Potential: Moderate

Costs / savings: Moderate - High

Category	Description
Working group	Electricity and Solid Waste 2.2
Option name	*Waste to Energy*
Sector(s)	Waste Management
Policy / program elements	Increase capacity factor at waste-to-energy facilities.
Rationale	Burning waste instead of landfilling can reduce the amount of methane generated from waste and can create a source of energy that avoids emissions from other energy sources.
Existing policy/program	Electric generating plants fired by municipal solid waste (MSW) are included as eligible renewable sources under Maine's Renewable Resource Portfolio requirement (see Option 11).
Significant co-benefits	
Carbon saved 2020	24.0
Cost *per* unit saved carbon	9
Performance measure	Volume of waste being utilized for energy production.
Implementation method(s)	Voluntary action by existing plan owners.
Implementation / outreach considerations	Expansion of existing facilities is likely to generate local opposition that would have to be overcome.

Current status of MSW incineration in Maine indicates that construction of new plants is unlikely due to environmental concerns and local opposition. Plant operators have indicated that potential increases in generation at existing plants may be possible through upgrades. Total cost of upgrading plants assumed to be about $2 million, based on information provided by plants. Costs were annualized over the 2005-2020 time period, assuming a 7% interest rate.

The Working Group had concerns about increasing capacity of waste to energy facilities if it would reduce potential for recycling, source reduction, and landfill gas development.

OPTION # 44—Agricultural Land Protection

Carbon Savings Potential: Moderate Costs / savings: Moderate cost

Category	Description
Working group	Agriculture / Forestry: Agriculture 5.0
Option name	*Agricultural Land Protection*
Sector(s)	Agriculture
Policy / program elements	A goal of saving ten percent of projected farmland loss by 2010, and 20 percent by 2020 (950 acres *per* year over 15 years).
Rationale	Maintains soil from disruption that releases carbon to the atmosphere.
Existing policy/program	A variety of programs exist that potentially affect land conversion rates, including Land for Maine's Future program[75]; USDA Farm and Ranchland Protection Program; *etc.*
Significant co-benefits	May also reduce transportation emissions by directing growth to more efficient locations.
Carbon saved 2020	22.7, including a portion allocated to VMT reduction effects
Cost *per* unit saved carbon	13
Performance measure	
Implementation method(s)	Regulatory and market-based land use standards and goals; direct incentive payments (easements and acquisitions); cluster zoning requirements or incentives (also known as conservation design or low impact development); revised transportation infrastructure investments; improvements to farm profitability; and education.
Implementation / outreach considerations	Requires some form of proactive "smart growth" program.

[75] Currently unfunded.

OPTION #45 -- Energy Savings in State Buildings

Carbon Savings Potential: Moderate *Costs / savings: High Savings*

Category	Description
Working group	Buildings and Facilities 3.3
Option name	*Implement the Most Cost-effective Energy Savings in State Buildings*
Sector(s)	Institutional (Government)
Policy / program elements	Implement cost-effective savings in state buildings at a level of 1% per year above the existing legislative mandate. Specifically, implement the most cost-effective Harriman study recommendations such as appropriately adjusting building temperatures and turning off unneeded lights. Further evaluate emerging technology, such as the pilot program for bio-diesel.
Rationale	State has the opportunity and leverage to led in energy efficiency and GHG reduction in its own facilities. This is aligned with the NEG/ECP "Lead by Example" theme, and supported by current "Clean Government" initiative in Maine.
Existing policy/program	25% energy reduction goal by 2010 (relative to 1998 baseline) added to Energy Conservation Building Act for Public Buildings. This legislation established a pilot program to achieve that level of energy savings in ten facilities of over 40,000 square feet. Under the pilot program, energy savings are to be achieved through performance contracts with energy service companies. However, existing mechanisms have not been fully implemented.
Significant co-benefits	Healthier work environment for employees and public visitors; operating cost savings. Very cost effective.
Carbon saved 2020	21.0
Cost *per* unit saved carbon	-37
Performance measure	Energy use tracking by State Bureau of General Services
Implementation method(s)	May require additional mandates and resources.
Implementation / outreach considerations	Excellent opportunity for public education and outreach, through branding visible to the public, etc.

This option involves a comprehensive effort to minimize energy-related GHG emissions in public facilities through measures such as best technology in new construction; comprehensive retro-fitting, and using lower carbon fossil fuels for space heat.

OPTION #46 -- GHG Feebates

Carbon Savings Potential: Low

Costs / savings: Neutral

Category	Description
Working group	Transportation and Land Use 1.3b
Option name	*GHG Feebates (state or regional)*
Sector(s)	Transportation
Policy / program elements	Under a GHG Feebate system, consumers would be charged a fee on purchases of relatively high-emitting (more CO_2 *per* mile) vehicles and would receive a rebate on the purchase of relatively low-emitting, higher-efficiency vehicles. The program is intended to apply to all light-duty vehicles.
Rationale	Reduce carbon emissions as well as oil dependence.
Existing policy/program	The Cleaner Cars for Maine Program is a consumer-labeling and financial incentive/disincentive program that enables individuals seeking to purchase an automobile to easily identify the cleanest vehicles on dealer lots.
Significant co-benefits	Reduction in other vehicle fuel emissions.
Carbon saved 2020	18.8[76]
Cost *per* unit saved carbon	0
Performance measure	Comparisons of number of vehicles in each classification sold.
Implementation method(s)	Requires legislation.
Implementation / outreach considerations	Administering the Feebates at the time of registration would avoid any potential "leakage" (*i.e.,* if Maine residents were to buy high-GHG vehicles in another state to avoid paying the fee, or if out-of-state residents were to buy low-GHG vehicles in Maine in order to get the rebate).

Both in the Working Group, and the SAG, supporters noted that this program will help "market transformation" toward more fuel efficient, lower GHG cars, and that the measure should be crafted so as to be revenue neutral. It is part of the Action Plan for the GHG plans in Massachusetts, Rhode Island, Connecticut, and New York. Opponents noted that this program is a "tax," which hits working people hardest and would be politically unpopular. There was no consensus on recommending this option.

Savings could be significantly higher in a multi-state or national program, since a larger market would enhance the effect of price signals. However, a state- or regional-level plan can serve the important purpose of informing consumers about the characteristics of different vehicles and their pollution consequences.

[76] This calculation is based on Costs and savings schedule shown in Appendix 5.1, p.12, Table 1.3.b, a sample feebate schedule. Savings based on \$40/$MMTCO_2$. Many stakeholders believe that, depending on program design, this option could be much more aggressive in reducing carbon emissions and producing larger CO_2 savings.

OPTION #47 -- Procurement Preference for Concrete Containing Slag

Carbon Savings Potential: Low

Costs / savings: Neutral

Category	Description
Working group	Buildings, Facilities and Manufacturing 3.9
Option name	*Procurement Preference for Concrete Containing Slag*
Sector(s)	All
Policy / program elements	Specify procurement preference for concrete and concrete products that contain a minimum of 20% of ground granulated blast furnace slag for publicly funded projects, as long as this is cost-effective.
Rationale	Avoid a portion of direct emissions associated with cement manufacture.
Existing policy/program	ASTM specifies standards for the inclusion of slag to concrete. MDOT specifications allow for the inclusion of slag in concrete.
Significant co-benefits	
Carbon saved 2020	18.0
Cost *per* unit saved carbon	0
Performance measure	Slag sales, combined with construction industry activity reports.
Implementation method(s)	Executive order for state procurement.
Implementation / outreach considerations	

Slag is derived from a by-product of the steel industry. It is processed and grounds to meet strict specifications and sold as a cementitious (cement-like) product. Slag has cementitious properties and can be used to offset a portion of the cement used in concrete mixtures.[77] How much can be offset is dependent on season (winter/summer), set requirements and other factors.

[77] Although fly ash is another concrete admixture that wold lower the carbon intensity of concrete, it was not included as part of this Option due to concerns expressed by several Working Group members as to the nature of fly ash.

OPTION #48 -- Promote Energy Efficient Buildings

Carbon Savings Potential: Low

Costs / savings: Moderate Savings

Category	Description
Working group	Buildings, Facilities, and Manufacturing 3.2
Option name	*Promote Energy Efficient Buildings*
Sector(s)	Commercial and Institutional
Policy / program elements	Encourage privately financed new construction and renovation to be high performance buildings by certifying to 20% above existing code. Voluntary program; no public funds intended.
Rationale	New construction and renovation present a strong opportunity to transform building practices and influence equipment markets.
Existing policy/program	No current program.
Significant co-benefits	Long-term operational energy savings offset initial capital cost.
Carbon saved 2020	11.3
Cost *per* unit saved carbon	-19
Performance measure	Information from building inspectors, etc.; voluntary registration program.
Implementation method(s)	Development of a voluntary sign-on or registration program, including educational and technical materials, technical assistance, etc.
Implementation / outreach considerations	Adds $3-$5 *per* sq. ft. to construction costs. Builders and architects who follow "green" guidelines could be recognized with some sort of state designation, included in a directory through Efficiency Maine for customers wishing to find builders/architects if they want to build green.

This program addresses both electrical energy use/savings, and fossil fuel (heat) combustion. The range of potential efficiency measures is broad, including building shell, lighting, HVAC and chiller systems, motors, refrigeration, and process heating and cooling.

This measure could be enhanced through development of a financing program to assist participants, and/or through direct subsidies in the form of tax credits, loan funds, etc. Such measures have not been included in the calculation of saved carbon or cost.

OPTION # 49-- Portland Cement Specifications

Carbon Savings Potential: Low

Costs / savings: Low Costs

Category	Description
Working group	Buildings, Facilities and Manufacturing 4.8
Option name	*Accept ASTM Specification C150 for Portland Cement*
Sector(s)	Manufacturing
Policy / program elements	Specify ASTM (American Society for Testing and Materials) specification C150 for Portland cement rather than AASHTO (American Association of State Highway Officials).
Rationale	The amended specification lowers the overall carbon intensity of Portland cement through direct reduction of emissions from cement production.
Existing policy/program	N/A
Significant co-benefits	
Carbon saved 2020	9.0
Cost *per* unit saved carbon	0
Performance measure	Production information from manufacturers.
Implementation method(s)	Department of Transportation rule amendment.
Implementation / outreach considerations	Estimates of avoided CO_2 emissions would need to be adjusted regularly on the basis of recorded production. Maine would need to work with MA, NH to harmonize across the region so all cement companies could begin to implement.

ASTM is the American Society for Testing and Materials, the largest voluntary standard development system in the world. The manufacturing of portland cement is outlined in ASTM standard C150. ASTM C 150 was recently amended to allow for the inter-grinding of up to 5% limestone in Portland cement while maintaining all performance specifications. This standard is consistent with standards already in place in Mexico and Canada. US EPA supports this revised standard due to the potential for CO_2 reductions.

OPTION #50 -- Reduce HFC Leaks from Refrigeration

Carbon Savings Potential: Low

Costs / savings: Low Costs

Category	Description
Working group	Buildings, Facilities and Manufacturing 5.10
Option name	*Reduce HFC Leaks from Refrigeration*
Sector(s)	Commercial and Industrial
Policy / program elements	Reduce HFC leaks from refrigeration
Rationale	Leaking hydrofluorocarbons have many times the global warming value of carbon dioxide.
Existing policy/program	None.
Significant co-benefits	More efficient use of existing refrigeration equipment in commercial and industrial applications. Lower cost of use.
Carbon saved 2020	9.0
Cost *per* unit saved carbon	1
Performance measure	Reduction in reported emissions
Implementation method(s)	Maine Greenhouse Gas reporting requirement in Chapter 137.
Implementation / outreach considerations	Outreach to commercial and industrial users to promote voluntary inspection/servicing.

Hydroflourocarbons (HFCs) are primarily used in refrigeration and air-conditioning units to effect heat transfer. When these gases leak from faulty or inadequately serviced equipment, they ascend into the atmosphere. They carry with them a CO_2 equivalent value; for example, CFC-12 has a Global Warming Potential (GWP) of 10,600 and HCFC-22 has a GWP of 1,700. In other words, these compounds have 10,600 and 1,700 times the global radiative forcing impact of CO_2.

OPTION #51 -- Organic Farming

Carbon Savings Potential: Low *Costs / savings: Moderate Cost*

Category	Description
Working group	Agriculture / Forestry Agriculture 3.0
Option name	*Increase Maine's organically Farmed Acreage*
Sector(s)	Agriculture
Policy / program elements	Programs to increase acreage in organic cultivation relative to current expected growth
Rationale	Organic farming techniques can build up soil carbon levels in farmed acreage.
Existing policy/program	Some existing state and federal programs could assist in this effort, including the USDA Resource Conservation and Development (RC&D) program and recently promulgated organic food standards by USDA.
Significant co-benefits	Farmland protection
Carbon saved 2020	8.9
Cost *per* unit saved carbon	28
Performance measure	New acreage brought into organic cultivation
Implementation method(s)	To be determined.
Implementation / outreach considerations	

The Working Group did not suggest any particular implementation methods.

OPTION #52 -- Maine Bio-diesel

Carbon Savings Potential: Low

Costs / savings: High Cost

Category	Description
Working group	Agriculture / Forestry Agriculture 1.0
Option name	*Maine Bio-diesel*
Sector(s)	Agriculture; Transportation
Policy / program elements	The working group did not develop a detailed policy proposal for this potential action, and instead suggested a general proposal that assumed expanded use of bio-diesel in farm equipment and off-road diesel vehicles.
Rationale	Substitution of renewable vehicle fuel for petroleum.
Existing policy/program	Pilot production programs; some business fleet use.
Significant co-benefits	Economic development in both agriculture and fuel processing industries; lessen dependency on imported vehicle fuels; renewable and bio-degradable product; lessen criteria pollutant emissions.
Carbon saved 2020	5.5
Cost *per* unit saved carbon	40
Performance measure	Volume of state and regional production; volume of consumer use.
Implementation method(s)	Expand pilot projects to target vehicle fleets. Expand distribution network for product.
Implementation / outreach considerations	Some bio-diesel already available in Maine. Encouragement of domestic renewable fuel production likely to be positively received by public. Some existing barriers: fuel performance, current price premium, public confidence in fuel properties.

Adoption of this option would assist expansion of in-state and regional production capacity, including development of bio-fuel feed stocks (direct growth; agricultural by-product; wood waste).

OPTION #53 -- Low-GHG Fuel Infrastructure (CNG, LPG)

Carbon Savings Potential: Low *Costs / savings: Very High Costs*

Category	Description
Working group	Transportation and Land Use 3.3
Option name	*Low-GHG Fuel Infrastructure (CNG, LPG*)
Sector(s)	Transportation
Policy / program elements	Expand infrastructure for compressed natural gas, propane, and other low GHG fuels.
Rationale	The complex inter-relationship among supply, infrastructure, and purchase/use of alternative fuel vehicles requires some investment in infrastructure as an incentive.
Existing policy/program	Pilot project Portland area Council of Governments
Significant co-benefits	See other transportation measures.
Carbon saved 2020	2.0
Cost *per* unit saved carbon	1482[78]
Performance measure	
Implementation method(s)	See below.
Implementation / outreach considerations	Due to the high cost of implementation, identification of funding sources is necessary before action can be taken.

The measures included focus on investing in and providing incentives for fueling infrastructure for low-GHG fuels (biodiesel, ethanol, CNG, LPG) such as:

- Establishing CNG infrastructure in other metropolitan areas and along the Turnpike;
- Taking advantage of existing propane fueling infrastructure;
- Expanding incentives for in-State production of biofuels;
- Providing incentives for the sale of low-GHG fuels;
- Providing incentives for the purchase of low-GHG vehicles (E85, CNG);
- Considering use of CNG vehicles at any LNG port.

[78] Cost numbers used to calculate include both CNG and LNG. CNG costs account for roughly 90%, because the initial investment costs of a CNG infrastructure are extremely high. Thus, cost *per* unit would be significantly lower if implementation focused on LNG.

OPTION #54 -- Nutrient Management

Carbon Savings Potential: Low

Costs / savings: Neutral

Category	Description
Working group	Agriculture / Forestry Agriculture 4.0
Option name	*Nutrient Management*
Sector(s)	Agriculture
Policy / program elements	Improve efficiency of fertilizer application by reducing over-application resulting from incorrect timing. Substitute organic fertilizer (primarily manure) for synthetic fertilizer, by altering the timing of applications, by altering cover crops and rotational schemes, or by increasing soil testing to improve efficiency (and reduce unnecessary applications). Specific proposal for potato fertilization: bring 25% of current acreage into new application practice.
Rationale	A portion of nitrogen applied to the soil and not incorporated into plants and soil organic material is emitted as N_2O (a GHG); therefore, a reduction in the quantity of fertilizer applied or measures that improve uptake can reduce N_2O emissions.
Existing policy/program	Nutrient Management Law in 1998 (7 M.R.S.A. Chapter 747, Nutrient Management Act); various state and Federal support programs.
Significant co-benefits	Reduces threats to water quality.
Carbon saved 2020	1.8
Cost *per* unit saved carbon	-0-
Performance measure	Number of acres brought into new practice.
Implementation method(s)	Utilize existing programs to encourage voluntary adoption of preferred methods. Would require development of a specific education/outreach program.
Implementation / outreach considerations	

Since this process does not reduce the net amount of fertilizer applied, but increases use in the crop and soil organic layer versus over-application in one large dose, the result is a savings of 40 pounds per acre of fertilizer. This will be fully incorporated by crops and not applied in excess (660,000 pounds nitrogen saved).

OPTION #55 -- Solar Photovoltaic Buy Down Program

Carbon Savings Potential: Low *Costs / savings: Not estimated*

Category	Description
Working group	Buildings, Facilities, and Manufacturing 5.6
Option name	*Solar Photovoltaic (PV) Buy Down Program*
Sector(s)	Residential, Commercial, and Industrial
Policy / program elements	Create a "Maine PV Buydown" program
Rationale	To promote and encourage the use of renewable energy through the installation of photovoltaic (PV) systems by offering a rebate, or "buying down," the high up-front cost of PV systems.
Existing policy/program	None.
Significant co-benefits	Contributes to the "learning curve" for this technology. Support of local business for purchase and installation.
Carbon saved 2020	0.2
Cost *per* unit saved carbon	Not estimated
Performance measure	Identified number of installed units; calculation of displaced non-renewable electricity.
Implementation method(s)	Will need a new vehicle, not yet identified.
Implementation / outreach considerations	A good candidate for pilot program implementation, especially in business and institutional (campus; healthcare facility) settings.

Solar photovoltaic cells systems (PVs) convert sunlight into electricity, producing direct current which is then converted to alternating. Since such systems continue to be relatively expensive *per* kW, many states have implemented policies to promote further market penetration of this renewable approach to electrical generation.

ADDITIONAL GHG MITIGATION OPTIONS NOT YET QUANTIFIED OR DEFERRED FOR FURTHER STUDY

Work Group Identifier	Title	Description	Further Action Needed
ESW 1.4	Carbon Capture and Sequestration	Several technologies allow carbon dioxide to be removed from flue gases for storage in geologic formations or in the ocean. May be a more long-term measure	Based on discussions with Maine DEP, it is proposed that this option be transferred from immediate to long-term consideration for ongoing monitoring and future analysis.
ESW 1.5b	Biomass Gassification	Pressurizing agricultural and forestry biomass to produce a synthesis gas for combustion.	Based on discussions with Maine DEP, it is proposed that this option be transferred from immediate to long-term consideration for ongoing monitoring and future analysis.
ESW1.6	Repowering Old Generating Plants	Converting old plants to natural gas combined cycle (NGCC) or coal integrated gasification combined cycle (IGCC) technology. Both technologies have the potential to provide efficiency improvements and lower emissions per kWh.	The chief plant considered for repowering was the oil-fired William Wyman facility, which accounted for 37% of emissions from electric power in 2000. However, subsequent research has indicated that the plant is likely a poor candidate for repowering due to the fact that it operates as a peaking unit with a low capacity factor and the high potential costs involved. Other potential fossil facilities in Maine are either closed or used for peaking only, making repowering impractical.
ESW 1.7	Hydrogen	Hydrogen is a clean burning fuel that may be produced by IGCC and other power sources and can be used to generate electricity. The magnitude of the resulting emission reductions depends on how the hydrogen is produced.	Based on discussions with Maine DEP, it is proposed that this option be transferred from immediate to long-term consideration for ongoing monitoring and future analysis.
ESW 1.11	Inter-connection Rules and Transmission Barriers	Standardized rules to enable clean, distributed generation to receive authorization to connect to the local grid. Transmission pricing and technical issues are often barriers to renewable and other clean distributed generation (DG), as well as power from independent power producers (IPPs).	Information on potential costs and emission benefits for this option are not readily available. This option is discussed further in the discussion of the Combined Heat and Power (CHP) incentive policy.
ESW 1.13	Registry	Encourage further research and development of regional systems for reporting and tracking of GHG emissions. This would cover electricity and other sectors. Voluntary GHG emissions registry that requires participating entities to separately report direct and indirect emissions or emission reductions. Registries may be used to provide public recognition, baseline protection, and support future emissions trading regimes.	A GHG registry can be an important component of the supporting infrastructure in the Maine GHG Initiative. Current DEP policy is to work with a regional effort headed by NESCAUM.

ADDITIONAL GHG MITIGATION OPTIONS NOT YET QUANTIFIED OR DEFERRED FOR FURTHER STUDY

Work Group Identifier	Title	Description	Further Action Needed
ESW 1.14	Public Education	Any of a variety of methods, including public service announcements and education in schools, that make the public aware of the GHG emissions that come from fossil-fueled electricity generation and the actions people can take to reduce GHG emissions.	This option was referred to the Education Working Group.
ESW 1.15	Hydroelectric Power Development	Three areas were explored: the addition of capacity to existing hydroelectric units; the development of new hydroelectric units at existing dams; and development at undeveloped sites.	Based on discussions with Maine DEP, it is proposed that the third area under this option be transferred from immediate to long-term consideration for ongoing monitoring and future analysis.
BFM 2.7	Fuel Switching	Study opportunities in Maine to switch from electric heat and/or electric hot water systems to lower greenhouse gas alternatives using high efficiency oil or natural gas fired systems.	It was the workgroup's feeling that this matter needed further researched.
BFM 3.5	Load Management Techniques	Maine should fully examine the usefulness of TOU electric meters, rates, and related technologies to allow consumers to respond to price signals and to shift consumption.	Need to see if there is a CO2 benefit to option.
BFM 4.4	Substitution for High GWP Gases	State should explore the use of high GWP (Global Warming Potential) gases. These gases are used as replacements for OSD (Ozone Depleting Substances) mainly used in refrigeration.	Further study of the cost/benefit of this option is needed to evaluate its merits.
BFM 4.5	Industrial Ecology	Beneficial Use in Maine's Industrial Ecology program and is regulated under Chapter 418. Agronomic Use of waste materials is a similar program and is not discussed here. DEP convened a multi-year stakeholder process with the task of reviewing issues related to beneficial use with the overall goal of increasing beneficial use in Maine. The stakeholders' group funded a pilot project through the University of Maine to compile data related to beneficial use of certain materials.	Proposed bill developed by the Maine Beneficial Use Stakeholder Group was intended to promote and encourage beneficial use and recycling of solid waste by providing liability protection under relevant State laws to persons who engage in such activities in accordance with a permit or exemption:
BFM 4.6	Negotiated Agreements	Include GHG reduction projects as acceptable Supplemental Environmental Project (SEP). A SEP is an environmentally beneficial project that a company performs in exchange for a reduction in penalty associated with violation of an environmental regulation or statute, but it is in addition to the actions necessary to bring the company into compliance.	LD845 Climate Change: This bill requires new sources of greenhouse gases to be reported to the Department of Environmental Protection. The bill also requires the department to enter into carbon emission reduction agreements with nonprofit organizations and businesses.
BFM 5.4	Incentives for Green Power Purchases	Study the potential of promoting green power purchasing beyond State owned and operated buildings.	The BFM workgroup thought that there may be merit in expanding #34, State Green Power Purchases, to included residential and commercial consumers.

ADDITIONAL GHG MITIGATION OPTIONS NOT YET QUANTIFIED OR DEFERRED FOR FURTHER STUDY

Work Group Identifier	Title	Description	Further Action Needed
BFM 5.8	REC Purchase Program	To help reduce the cost of renewable energy by brokering the renewable energy credits (RECs) purchased from commercial and residential owners of renewable energy systems. The State will offer owners of renewable energy systems the opportunity to sell their renewable energy credits (RECs) to the State, which can then broker these RECs on the open market. The amount of the payments depends on the current market demand for the type of renewable energy technology, the amount of electricity produced by the system, and the length of the contract period.	Not determined at this time.
BFM 5.11	Natural Gas Leak Reduction	Study the potential for the reduction from leaks from LNG systems. Existing federal program – EPA Natural Gas Star Program - aims to reduce methane leaks from natural gas pipelines	Needs more study to analyze CO2 benefits and cost to implement.
TLU 1.1d	Add-on Technology (Low Friction Tires / Low Friction Oil)	Support technologies that improve efficiency in vehicles	Voluntary program with education effort to inform consumers on the benefits of technologies.
TLU 1.2b	Vehicle Maintenance / Driver Training	Encourage more energy efficient driving habits and increase awareness of maintenance issues that cause an increase in vehicle operating cost and increase pollution.	Not determined at this time.
TLU 1.2c	Transportation System Management	Use Technology, signage and other measures to mitigate traffic congestion	Not determined at this time.
TLU 1.3d	Provide Tax Credits for Efficient Vehicles	Offer tax credits for car buyers to purchase a low-GHG emitting car.	Not determined at this time.
TLU 2.4a	Commuter Choice	Promoting employer-based commuter incentives for transit and carpooling (includes transit benefits, parking cash-out, telecommuting, vanpools, preferential parking)	Workgroup needed more time to identify cost of individual options and CO2 benefits. But recommend this option as a voluntary program.
TLU 2.4b	VMT Tax	Tax on the number of miles driven per year per vehicle with revenues targeted towards low-GHG travel alternatives	Workgroup dropped this from the initial list of options because of time constraints.
TLU 2.4c	Fuel Tax with targeted use of revenues	A fuel targeted to a low-GHG option such as funding transit, hybrid vehicles, etc with revenues targeted towards low-GHG travel alternatives.	Workgroup dropped this from the initial list of options because of time constraints.
TLU 2.4e	Road Pricing	Toll pricing to encourage multi-occupant vehicles and travel during lower congestion periods	Not determined at this time due to time constraints.

ADDITIONAL GHG MITIGATION OPTIONS NOT YET QUANTIFIED OR DEFERRED FOR FURTHER STUDY

Work Group Identifier	Title	Description	Further Action Needed
TLU 2.4f	Location Efficient Mortgage	Location-Efficient Mortgages (LEM) – is a discounted mortgage that recognizes the savings available to people who live in location efficient communities, mixed-use communities near public transportation.	Workgroup dropped this from the initial list of options because of time constrains. Was also referred to BFM workgroup.
TLU 2.4j	VMT Offset Requirements from large developments	Require developer to offset automobile emissions attributed to their development (e.g., through transportation infrastructure changes, incentives for low-GHG modes, building efficiency improvements, tree planting, purchases of emission credits, etc.)	Workgroup dropped this from the initial list of options because of time constrains.
TLU 3.4	Hydrogen Infrastructure	Support research on low-GHG hydrogen vehicle technology and infrastructure. This could include such components as: fuel cells, how best to facilitate the development of alternative fuel infrastructure and refueling networks, pilot projects and R&D and /or incentives.	Workgroup was interested in this option as a future technology option, but felt it is too new an option.
TLU 5.3	Aircraft Emission	More efficient operation of aircraft	Not determined at this time.
TLU 5.4	Airport Emissions	Use of low GHG airport equipment and better runway management	Not determined at this time.
TLU 6.4	Incentives to purchase low GHG recreation vehicle alternatives	Offer tax breaks or rebates for purchase of low GHG recreation vehicles. (4 stroke vs. 2 stroke)	Not determined at this time due to time constraints of process.
TLU 7.2	Improve GHG Data Collection	Make available local data sets to replace regional and national data. The closer to the source the better the data and the more accessible that data is.	Coordinate data collection efforts and make recommendations to state agencies to supply better data for evaluating GHG performance measures.
F 8.0	Increased Age of Forest Stands	Over the next 15 years, identify hardwood stands under relatively short pulpwood rotations that can be shifted to significantly longer saw timber rotations.	Support development of durable wood products markets targeted to hardwood saw timber. Identify marginal economic sites for all stands that can be removed from production and maintained in permanent forest cover, particularly in areas with high environmental attributes. Focus forest preservation programs on mature timber stands to reverse the disproportionate clearing of this land, and reduce disease and pest risks as possible to maintain continuous growth of existing stands.

ADDITIONAL GHG MITIGATION OPTIONS NOT YET QUANTIFIED OR DEFERRED FOR FURTHER STUDY
OPTIONS FOR FUTURE CONSIDERATION ADDED BY STAKEHOLDERS OR DEP AFTER 6/30 STAKEHOLDER MEETING

Work Group Identifier	Title	Description	Further Action Needed
BFM 6.1 (new)	Educate and encourage landscaping practices that reduce energy use	Educate homeowners and landscaping professional on methods that well planned and maintained landscape can help reduce energy use	Not determined at this time.
BFM 6.2 (new)	Educate homeowners on energy saving options and cost saving	Provide information to homeowners on options that reduce energy use when retrofitting, renovating and new construction.	Not determined at this time.
BFM 6.3 (new)	Tax credits or rebates to purchase low energy alternative appliances	When purchasing a new appliance offer incentives to making a low energy appliance purchase.	Not determined at this time.
BFM 6.4 (new)	Energy Audits	Offer an energy audit program to all sectors (residential, commercial and industry) effective energy savings options.	Not determined at this time.
TLU 8.2 (new)	Highway Weight Limits	Increase the current weight limit on state highways to reduce VMT by heavy diesel vehicles	Not determined at this time. Suggested as an adjunct to Option #41, but not modeled.
TLU 9.0 (new)	CAFÉ	Support federal efforts to increase CAFÉ standard.	Provide support for the Maine delegation and work with of interested parties in requesting an increase in the national CAFÉ standard.
F 9.0	Short Rotation Woody Cropping	Over the next 15 years, explore the use of short rotation woody crops using hybrid willow or poplar species on non forested sites, including cropland, riparian zones, eroded lands, rights of ways, and pasture. Manage crops for wood products and bioenergy to displace fossil energy emissions. Use waste manure where possible for fertilization to minimize nitrous oxide emissions from synthetic fertilizers.	Additional research and development and commercialization programs may be needed. Costs of producing carbon credits have not yet been estimated for Maine, although preliminary investigation in New Brunswick suggests use of hybrid poplars sequesters 30-75 metric tons of CO_2 *per* acre-year at a cost of $2-3 *per* tonne. This Option could be utilized with the following one (F 10.0, Afforestation).
F 10.0	Afforestation	This option calls for establishment of forests on underutilized or abandoned cropland and pastureland.	The Maine Woods WISE program estimates tree planting costs for afforestation at $170 per acre.[79] Total future carbon sequestration from increased stocking of faster growing trees on poorly stocked sites is estimated at 26.90 MT carbon per acre. This translates into a cost of saved carbon equal to $6.31 per ton carbon, or $1.72 per ton CO2 saved.

[79] Guidelines and data from the Woods Wise program to support private forestland owners are available at: http://www.maine.gov/doc/mfs/woodswise/steward.html

ADDITIONAL BASELINE GRAPHS

Figures 4 and 5 present the emissions baseline based on the proportionate share of Maine emissions associated with each of four sectors: Transportation; Buildings, Facilities, and Manufacturing; Energy and Solid Waste; and Agriculture and Forestry. It should be pointed out, however, that there was no legislative requirement or Departmental intent that the recommended mitigation options exactly correspond to each sectors' emissions. Rather, the emphasis has been on identifying a suite of options sufficient to meet the *overall* emissions reduction target.

Figure 4: All-Sector Emissions Baseline without Black Carbon

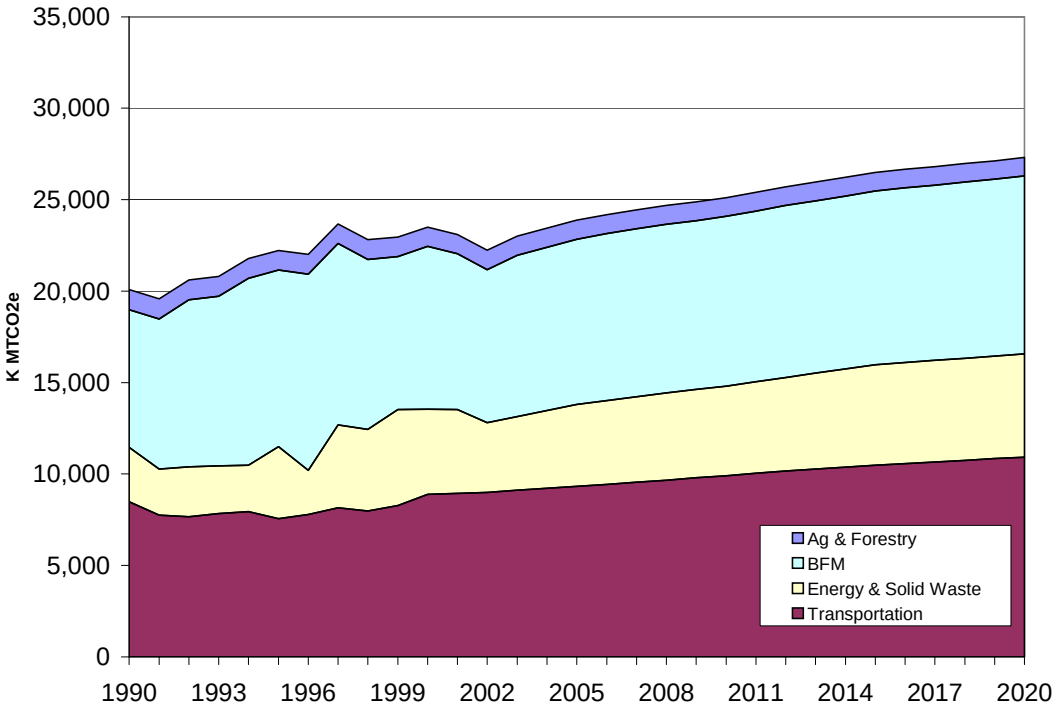


Figure 5: All-Sector Emissions Baseline with Black Carbon