FINAL REPORT

Date: April 30, 2010
To: Climate Protection and Green Economy Advisory Committee
From: Paula Fields, Eastern Research Group (ERG)
Re: Initial Estimates of Emissions Reductions from Existing Policies Related to Reducing Greenhouse Gas Emissions
cc: Bruce Biewald, Synapse Energy Economics; Chris Porter, Cambridge Systematics; Jason Veysey, ERG

INTRODUCTION

As part of its implementation of the Global Warming Solutions Act of 2008, the Secretary of the Massachusetts Executive Office of Energy and Environmental Affairs (EEA) is required to set a greenhouse gas (GHG) emissions reduction target for 2020 that is 10 to 25 percent below 1990 levels. In order to set this target and develop an associated climate plan, an early task was to understand the estimated GHG emissions reductions from already ***existing*** Massachusetts and federal GHG policies.

The consulting team of Eastern Research Group (ERG), Synapse Energy Economics (Synapse), and Cambridge Systematics (Cambridge) has built on the state's assessments by reviewing and reanalyzing Massachusetts and federal GHG policies in place prior to 2007, as well as new policies put into place beginning in 2007. The research team determined the impact of post-2007 policies by comparing them to a Business-as-Usual (BAU) scenario that incorporates the emissions impacts of pre-2007 policies (such as energy efficiency programs that began in 1998). This BAU scenario was published by the Massachusetts Department of Environmental Protection (MassDEP) in July 2009, and it estimated that statewide emissions of GHGs would remain relatively flat through 2020, as they were from 1990 to 2005.[1]

This report provides a preliminary estimate of the impact of all significant post-2007 state and federal GHG reduction policies on Massachusetts' GHG emissions by 2020, compared to the 1990 baseline. The policies included in this analysis consist of:

- Massachusetts programs and policies that are "on the books" and already being implemented (such as new energy-efficiency programs that are required under the Green Communities Act of 2008).

- Measures supported by the Patrick-Murray Administration and moving toward implementation, although not yet fully in place (such as adoption of a regional low-carbon fuel standard [LCFS]).

[1] See "Statewide Greenhouse Gas Emissions Level: 1990 Baseline and 2020 Business As Usual Projection," http://www.mass.gov/dep/air/climate/1990_2020_final.pdf.

- Regional efforts with a high probability of being implemented (such as new transmission lines from Canada that will import non-fossil electricity).

- Federal policies (such as the Obama Administration's new CAFE/GHG standards for fuel efficient vehicles).

In this report, we have not included any contribution from a prospective broad-based federal policy to reduce GHG emissions, such as the cap-and-trade bills that have been introduced into Congress and remain under consideration. Passage of such legislation could significantly improve the 2020 emissions picture in Massachusetts, but at this time the prospects are too uncertain for us to account for it. In addition, it is possible that the impacts of new federal legislation would overlap with existing in-state policies in ways that cannot be determined now.

Note also that the Regional Greenhouse Gas Initiative (RGGI), one the state's major GHG policies, is not shown in Table 1. The reason is that RGGI mandates a reduction in emissions from electricity generation, but Massachusetts' policies for both electrical energy efficiency and renewable electricity (see sections below), in combination, are expected to yield greater emissions reductions than RGGI. To include RGGI in our figures, along with both efficiency and renewables, would lead to double-counting the likely reductions.

SUMMARY OF RESULTS

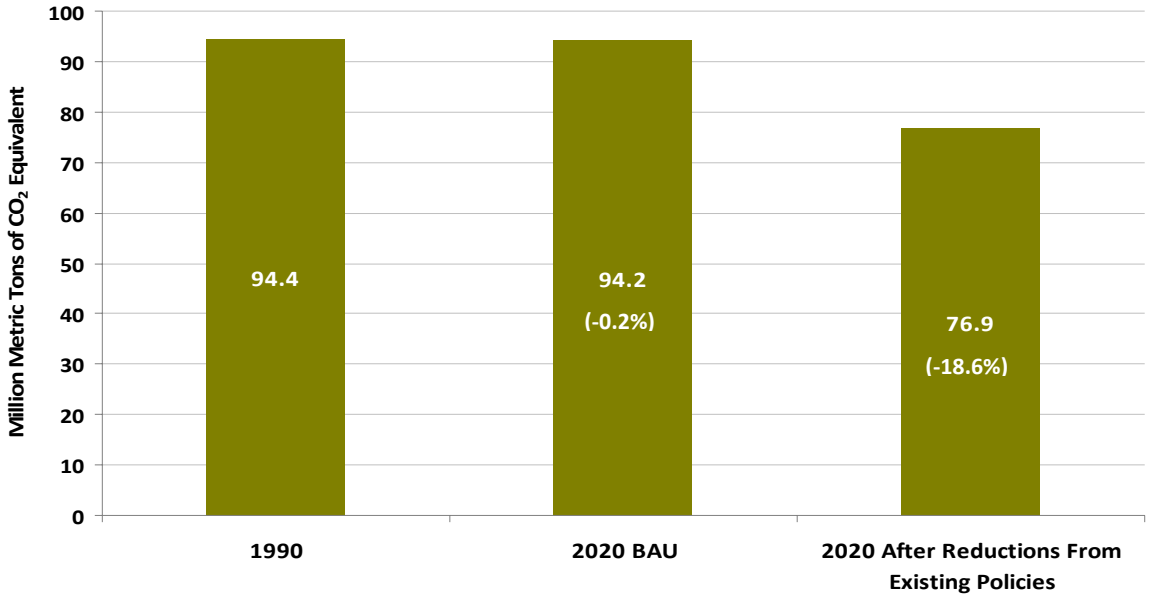
The post 2007 policies are estimated to yield approximately an 18.6 percent reduction of GHG emissions below 1990 levels, resulting in annual emissions of 76.9 million metric tons of carbon dioxide equivalent (CO_2e) in 2020, compared to approximately 94 million metric tons in 1990.

Figure 1 depicts Massachusetts' 1990 baseline GHG emissions, projected 2020 BAU emissions, and preliminary estimated 2020 emissions taking into account existing policies.

Table 1 shows the list of policies analyzed and the estimated GHG reduction in million metric tons reduced and percent reduction compared to the 1990 baseline. These estimates are preliminary and, as described later in this report, subject to important limitations and uncertainties. Because they result from discrete, policy-specific assessments, they do not reflect all possible interactions among policies. Nevertheless, they are reasonable estimates of the policies' 2020 effects, in the consulting team's judgment. As work on Massachusetts' climate planning proceeds, the estimates of these existing policies' impacts will be refined.

Figure 2 depicts the estimated reductions below 1990 levels for the major categories of existing policies.

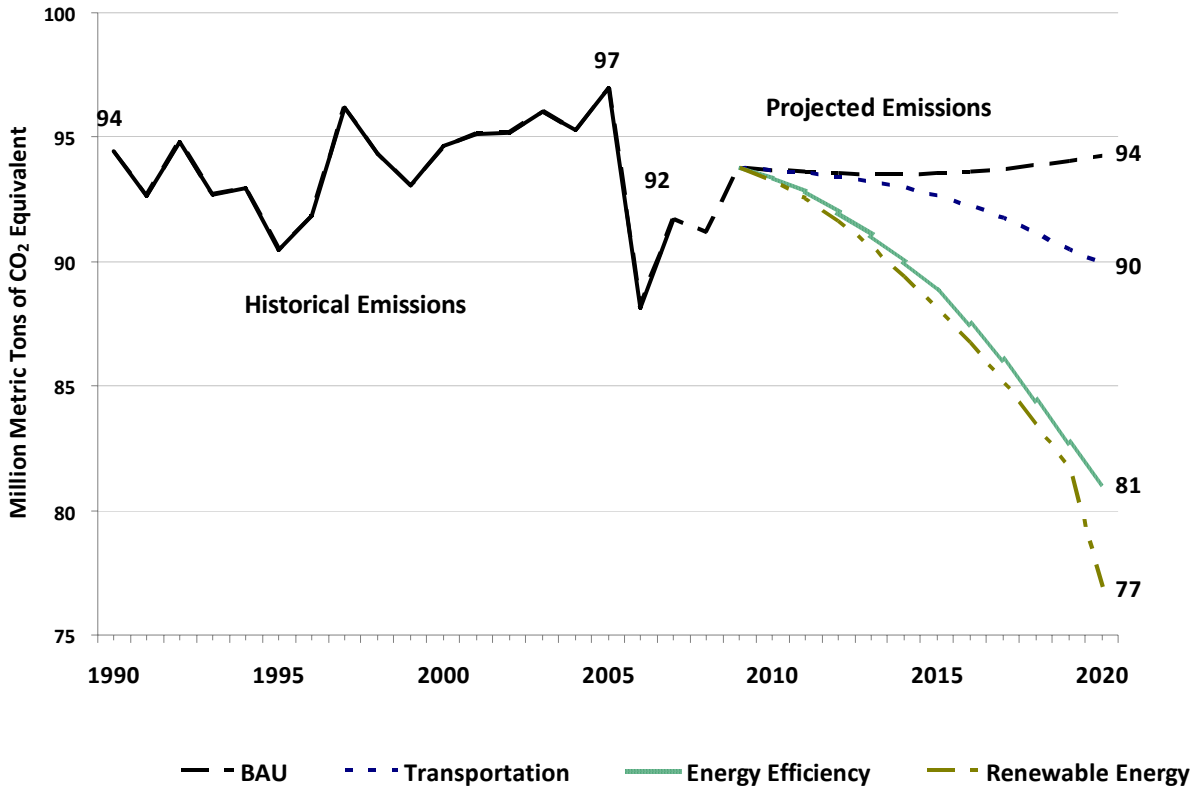
Figure 1: Initial Estimates of Emissions Reductions—Statewide Emissions



	Million Metric Tons of CO_2 Equivalent	% Change from 1990

1990	94.4	
2020 Business as Usual (BAU)	94.2	-0.2%
Transportation		
Federal and CA Vehicle Standards	-2.4	-2.6%
Federal RFS and Regional LCFS (including heating oil)	-1.8	-1.9%
Land Use / Smart Growth/GHG Criteria for Planning	-0.1	-0.1%
Energy Efficiency		
Energy Efficiency – Electricity	-4.7	-5.0%
Energy Efficiency – Natural Gas and Oil	-2.0	-2.1%
Building Codes (Residential Heating)	-1.5	-1.6%
Appliance/Product Standards	-0.5	-0.6%
Mass. Environmental Policy Act	-0.1	-0.1%
Renewable Energy		
Renewable Portfolio Standard	-1.1	-1.2%
Additional Low-Carbon Electricity Imports	-3.1	-3.2%
2020 After Reductions from Existing Policies	76.9	-18.6%

Figure 2: Estimated Impacts of Post-2007 State and Federal GHG Policies



Due to state and federal policies, expected emissions in 2020 fall from 94 to 77 million metric tons of CO_2e. Transportation policies account for about 4 million tons of the drop, shown as the difference between 94 and 90. Energy efficiency accounts for 9 million tons, or the difference between 90 and 81; and renewable energy accounts for another 4 million tons.

The remainder of this report describes each existing (post-2007) policy analyzed, the approach used to estimate preliminary GHG emissions reductions for the policy, limitations and uncertainties inherent in the estimation, and recommendations for additional research to reduce the limitations and uncertainties.

TRANSPORTATION POLICIES

Federal and California Vehicle Standards

The U.S. Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA) have proposed a harmonized set of rules that would limit GHG emissions from and increase the fuel efficiency of the light-duty vehicle fleet. California developed a policy (Pavley) similar to EPA's that would have limited GHG emissions from the light-duty vehicle fleets of those states that adopted the Pavley standards. California and the other Pavley states reached an agreement with EPA under which those states will accept the EPA standards through 2016. California is expected to propose its own standards for 2017 and beyond, and to request a waiver from EPA to implement the standards. Under Massachusetts law, if the California standards yield greater emissions reductions than those from EPA, and California receives its waiver, Massachusetts will adopt the new California standards.

Approach. Cambridge used the VISION model, developed by the Argonne National Laboratory for the U.S. Department of Energy (DOE), to create two analysis cases: the baseline case, which includes no GHG standards and fuel economy standards adopted before 2007, and the scenario case, which includes EPA and NHTSA standards from 2011–2016 and California's Pavley standards from 2017–2020. VISION is a spreadsheet model that estimates annual energy use, oil use, and lifecycle carbon emission impacts of light-duty highway vehicles and alternative fuels based on projections of the fleet vehicle mix, fleet turnover, new vehicle fuel economy standards, vehicle miles traveled (VMT), and new technology market penetration. The percent GHG reduction is applied to Massachusetts' BAU forecast for the transportation sector, assuming the policy affects only light-duty vehicles (59.3 percent of U.S. transportation GHG emissions, according to EPA's Inventory of U.S. GHG Emissions and Sinks: 1990–2007).

Limitations and Uncertainties in the Analysis. VISION is designed to account for all major drivers of on-road transportation GHG emissions. However, there are several uncertainties in the analysis. One set of uncertainties involves the use of national defaults instead of state-specific data for a number of parameters, including the vehicle fleet (VMT mix and age distribution) and VMT growth rates as assumed in the VISION model, and the percentage of transportation GHG emissions attributable to light-duty vehicles. It is also not entirely clear how the Pavley regulations relate to EPA's proposed GHG regulations. EPA intended to harmonize their standards with Pavley, but there are some disparities between the EPA and Pavley standards, as well as claims by the California Air Resources Board (CARB) that EPA's standards would be less effective than their own in those states that have adopted Pavley (while leading to large emission reductions nationwide).[2]

2 **Recommendations for Further Analysis of Federal and California Vehicle Standards.** These include: Comparing the Massachusetts vehicle fleet to the national fleet used in VISION and substituting Massachusetts fleet details if there is a significant difference in age distribution or VMT mix; investigating VMT growth projections in Massachusetts based on the statewide travel demand model and adjusting the VISION model accordingly; explicitly identifying light-duty vehicle GHG emissions relative to total transportation GHG emissions in Massachusetts, if a data source exists; further investigating and clarifying the relationship between Pavley and EPA GHG regulations; and estimating the potential impact of additional GHG regulations and the likelihood that California will receive a waiver in 2017 to implement these regulations.

Federal Renewable Fuel Standard (RFS) and Regional Low-Carbon Fuel Standard (LCFS)

Massachusetts law, Chapter 206 of the Acts of 2008, "An Act Relative to Clean Energy Biofuels," Section 6, requires that the state seek to create a LCFS with the other states that are part of RGGI. The Commonwealth has signed a Memorandum of Understanding (MOU) with 10 other governors of northeastern and mid-Atlantic states, in which they agree to develop the structure for and study the impacts of a regional LCFS. The MOU indicates that the LCFS will apply to transportation fuels and that the states will also consider including heating oil in the program. In 2007, EPA adopted an RFS (RFS-1), which sets requirements for production of transportation fuels from renewable sources meeting GHG reduction criteria.

Approach. For this analysis, Cambridge assumed that the LCFS will apply to fuel consumed by light-, medium-, and heavy-duty on-road vehicles only. According to EPA's Inventory of U.S. GHG Emissions and Sinks 1990–2007, these subsectors account for 59.3 and 19.6 percent, respectively, of total transportation GHG emissions in the United States, and our analysis assumed the same percentages for Massachusetts. In addition, based on discussion with state agency staff, it was assumed that the LCFS will reduce the carbon content of fuel for light- and heavy-duty vehicles (and heating oil) by 0.5 percent by 2014, increasing over time until a 5 percent level is reached in 2020. Further, we assume that the renewable fuels meeting the federal RFS requirements assist in reaching this level.

Limitations and Uncertainties in the Analysis. The LCFS has not been finalized by the RGGI states; therefore, one uncertainty is the specific transportation subsectors that will be affected by a regional LCFS. The 2020 reduction target also has not been finalized. Another uncertainty is technological (i.e., how likely it is that fuel and vehicle manufacturers will be able to meet a given low-carbon fuel target). California's LCFS calls for a 10-percent reduction in carbon intensity by 2020, while the current analysis conservatively assumes that a 5-percent reduction is achieved for Massachusetts. Finally, relative contributions of light- and heavy-duty vehicles to total transportation emissions may differ for Massachusetts vs. the United States as a whole.[3]

Land Use/Smart Growth/GHG Criteria for Planning

A number of initiatives to promote smart growth and non-motorized transportation are underway in Massachusetts. The Commonwealth's Sustainable Development Principles call for concentrating development and mixing uses. Chapter 40R of the Massachusetts General Laws encourages cities and towns to establish new overlay zoning districts to promote housing production and, more generally, smart growth development, including financial incentives to communities that adopt new

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3 **Recommendations for Further Analysis of Federal RFS and Regional LCFS.** We recommend following the regional LCFS effort to monitor the specific transportation subsectors that will be affected by the regulation, and the annual compliance targets for the regulation. Also, EPA has finalized a rulemaking for an RFS-2 regulation. We recommend investigating whether this might affect the magnitude of potential benefits from low-carbon fuels.

smart growth zoning districts. The Metropolitan Area Planning Council has led a transportation and land-use visioning initiative for the greater Boston region, known as MetroFuture, to encourage the adoption of smart growth plans at a local level. The 2009 Transportation Reform Act (An Act Modernizing the Transportation Systems of the Commonwealth) directs the Office of Transportation Planning to undertake research and planning in support of the implementation of the Global Warming Solutions Act of 2008, including collaborating with other state agencies to reduce GHG emissions.

Approach. For this analysis, Cambridge used information on the potential impacts of land use and non-motorized strategies from the *Moving Cooler* report, which was a nationwide examination of the potential GHG reductions from 49 transportation strategies. Percent reductions in on-road GHG in 2020 for "combined land use," "pedestrian," and "bicycle" strategies were taken from Table D.3 for the "expanded best practices" scenario. (The reductions were 0.06 percent, 0.12 percent, and 0.05 percent, respectively.) This is the least aggressive of three scenarios analyzed in *Moving Cooler* and therefore represents a conservative assessment of future GHG reduction potential, appropriate to the current state of development of Massachusetts' specific policies in these areas. The strategies can be briefly described as:

- *Land use* – Metropolitan areas collectively develop regional plans that provide for at least 60 percent of new development in attached or small-lot detached units, in pedestrian- and bicycle-friendly neighborhoods with mixed-use commercial districts and high-quality transit; the majority (nearly three-quarters) of communities adopts zoning and planning standards consistent with these plans.

- *Pedestrian* – All new developments include pedestrian access/amenities; new or fully reconstructed streets in denser neighborhoods (>4,000 persons/sq mi and business districts) incorporate traffic-calming measures; "complete streets" policies adopted by state and local transportation agencies.

- *Bicycle* – Citywide or regional plans developed and implemented for on-street bicycle accommodations to create a continuous network of routes (bicycle lanes or other facilities) at approximately ½-mile spacing in urban areas; bicycle parking provided at commercial destinations; new large commercial buildings include bicycle amenities; bikes accommodated on transit; safe cycling curricula in schools.

Since *Moving Cooler* assumed that strategy implementation began in 2015, allowing five years for implementation by 2020, this analysis assumes that the Commonwealth has already begun implementation of these strategies and therefore doubles the results to allow for a 10-year implementation period.

Limitations and Uncertainties in the Analysis. The results are taken from a national-level analysis reflecting average nationwide conditions. The land-use results in particular may vary from state to state, depending on relative population growth and redevelopment rates (e.g., faster growth rates provide more opportunity for reshaping land use). Percentage reductions in Massachusetts may also

differ from national levels according to the vehicle mix (light-duty vs. heavy-duty VMT) and percent rural vs. urban VMT. (*Moving Cooler* assumed 62 percent urban, and only urban VMT is affected).[4]

ENERGY EFFICIENCY POLICIES

Energy Efficiency – Electricity

The Green Communities Act greatly expands the opportunities for savings from utility-run efficiency programs by 1) providing the utilities with additional funds (i.e., at least 80 percent of funds generated through the RGGI auctions are dedicated to efficiency programs), and 2) mandating that utilities invest in all cost-effective efficiency and demand-side resources (with "cost-effective" defined as costing less per unit of energy saved than supplying more electricity or natural gas).

Approach. Synapse reviewed the energy-efficiency programs filed by the program administrators (PAs) and the future target savings levels in those programs, which will ramp up to 2.4 percent savings levels by 2013. There is evidence, however, that this savings level can be exceeded, and that implementation of all cost-effective energy efficiency would amount to a somewhat higher level of annual savings, including those from the expansion of combined heat and power (CHP) systems. For example, economies of scale associated with demand side management program delivery have yet to be realized. A July 9, 2009, report authored by consultants to the Energy Efficiency Advisory Council (EEAC), titled "Assessment of All Available Cost-Effective Electric and Gas Savings," suggests that 3.0 percent savings are possible for the electric sector. Here, we assume that savings ramp up from the 2.4 percent savings level in 2013 to 2.9 percent by 2018.

Because the utility-funded energy efficiency programs were in existence (although at lower levels) during the historical period that was used to develop the BAU trend for GHG emissions, it is very likely that the effects of those earlier years are included in that forecast. Therefore, in calculating the additional reductions from energy-efficiency programs, Synapse assumed a baseline trend of 0.8 percent, determined from the average of those earlier years, and reduced the net future year savings by that amount.

The general approach for all GHG reductions from electricity programs is to first calculate the electric energy savings and then apply the marginal GHG emission rate of 1,030 lbs of CO_2 per megawatt hour (MWh) of load, which was developed from detailed New England electric system modeling for the 2009 Avoided Energy Supply Cost (AESC) study. This emission rate is also equivalent to natural gas resources that represent the bulk of the marginal generation in New England.

4 **Recommendations for Further Analysis Land Use/Smart Growth/GHG Criteria for Planning.** Revise the analysis considering Massachusetts-specific conditions, including population growth, amount of new development that may be expected in "smart growth" vs. other areas, urban vs. rural population, light-duty vs. heavy-duty VMT, and baseline VMT per capita.

Limitations and Uncertainties in the Analysis. The greatest uncertainty lies with the BAU forecast for several reasons: 1) future electricity load growth, 2) future generation mix and GHG emission rates, and 3) the historical data used to develop the forecast trend. A more structural analysis of the factors affecting GHG emissions from electricity should be carried out in the next stage of this study. There is less uncertainty regarding the future savings levels, because these levels are reasonable targets based on extensive analyses, and because mechanisms exist for monitoring and adjusting the programs to achieve those targets.[5]

Energy Efficiency – Natural Gas and Oil

The Green Communities Act mandated that electric and natural gas utilities engage in all cost-effective energy efficiency. In addition, although there is no mandate on the fuel oil industry to provide funding for efficiency, it is well-recognized that a large portion of the efficiency opportunities for the residential sector are in space and water heating. This clearly includes oil-heated homes, and as a result, the state's electric utilities currently provide efficiency services to such homes. Under the new efficiency plans, in which the electric and gas utility programs are being fully integrated, homeowners should be able to access the same programs regardless of their heat source.

Approach. Consultants to the EEAC conducted a study of the potential for efficiency savings from electricity and natural gas, "Assessment of All Available Cost-Effective Electric and Gas Savings: Energy Efficiency and CHP," July 9, 2009. This study estimates that gas efficiency has the potential to achieve a savings of 2.0 percent per year from each year's programs (which will then have a cumulative impact over time). The state's gas utilities agreed to a savings target of 1.15 percent for 2012 and submitted this target to the Massachusetts Department of Public Utilities (DPU). We have used this figure, and on the basis of the EEAC potential study, have increased the target by 0.15 percent per year through 2017, reaching 1.9 percent per year, and then held that level constant to 2020. In addition, since the gas utilities have had (relatively small) programs in the past, we assumed that 25 percent of future gas efficiency gains are in the BAU trend line.

With respect to heating oil efficiency, the joint efficiency plans of the electric utilities (pages 98 to 101 in their submission to the DPU) include targets for distillate oil savings. We used the actual mmBTU savings shown for 2012 and assumed that these rise by 5 percent per year through 2020. This seems reasonable because the oil efficiency programs, similarly to the gas programs, are less developed than the electricity programs and therefore have room to expand. To check the reasonableness of the 5 percent, we also projected residential fuel oil sales out to 2020, based on recent data showing that they have been falling by 3.9 percent per year. Based on this, by 2020, efficiency savings from the current year's programs would be 1.5 percent of total sales, which seems

5 **Recommendations for Further Analysis for Energy Efficiency – Electricity.** We recommend a bottom-up, end-use-based analysis of electricity demand and a detailed structural analysis of the electric supply system to better identify the various factors driving GHG emissions from electricity use. It would also make sense to break out CHP in a manner that explicitly represents the CHP assumptions and policies to ensure consistency with the estimated impacts of utility programs and other trends and policies.

within reason. Although we do not have a potential study for homes heated with fuel oil, it is reasonable to expect that the potential would be similar to that for gas heated homes, as discussed above.

Limitations and Uncertainties in the Analysis. At this point, the utilities have committed only to efficiency targets through 2012, and we are relying on the potential study for years beyond then. Because the efficiency programs are now in the process of ramping up quickly in light of their new goals, we do not know how difficult it will be to achieve these goals or whether they can be maintained and further expanded over time.[6]

Appliance/Product Standards

New federal standards for appliances and other products will be implemented between 2009 and 2013. These will improve the baseline efficiency of most appliances and thus reduce electricity use and the associated GHG emissions.

Approach. The Appliance Standards Awareness Project (ASAP) has analyzed the effects of these new standards at the level of the individual states. We have used these savings as the starting point for our calculations. Overall, ASAP's study predicts 2,079 gigawatt hours (GWh) of Massachusetts savings in 2020 (about 3 percent of the unadjusted sales). However, the historical period used to develop the BAU trend also included some improved appliance efficiency standards as well. Some standards-driven appliance savings are therefore built into the BAU trend. While fairly detailed analysis would be necessary to unravel the precise amounts included in that trend, for the purpose of this analysis we assumed that half of these savings from the future standards are incremental to the trend, and thus take net credit for half of the savings predicted by ASAP.

Limitations and Uncertainties in the Analysis. The two sources of uncertainty are the baseline levels and the program effects. The baseline levels depend on assumptions about existing appliances, their usage levels, and their replacement rates. The program effect calculations include the same assumptions and also the net savings from the new appliances. Because we are dealing with infrastructure issues, the uncertainty is not likely to be large.[7]

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6 **Recommendations for Further Analysis of Energy Efficiency – Natural Gas and Oil.** Continuing research should be conducted on the future potential for efficiency savings in the use of natural gas and fuel oil, including learning from the experience of the efficiency program administrators as the programs are expanded.

7 **Recommendations for Further Analysis of Appliance/Product Standards.** The savings estimate used here relies extensively on the ASAP report and its underlying analysis. We have reviewed those calculations, and they appear generally reasonable, but we would recommend developing a state-specific calculation that accounts for Massachusetts' equipment stock turnover from the ground up, and that it be coordinated with the BAU projection and with estimates of the savings from other policies in order to ensure consistency.

Building Codes (Residential Heating)

This policy addresses the requirement under the Green Communities Act that Massachusetts adopt the International Energy Conservation Code (IECC), which is updated every three years, within one year of its publication. This affects energy consumption from new residential and commercial buildings, and additions to and major renovations of existing buildings.

Approach. ERG reviewed modeling methodologies and assumptions previously used by the state agencies and conducted research to fill gaps in residential heating data. In particular, ERG focused on finding additional data on existing housing units by residential heating fuel type and information that verifies/improves the initial assumption that the number of remodeling projects is 2 percent of the stock of existing homes each year.

ERG's review of the modeling methodologies and assumptions did not identify any major issues related to new homes or renovations to existing homes. However, based on data from the Joint Center for Housing Studies at Harvard University, ERG updated the "number of remodeling projects as a percent of the existing housing stock" assumption in the existing analysis from 2 percent to 3 percent. Also, ERG recommends that the analysis vary the relative percentages of new homes heated by gas and oil annually, if possible, but did not make any changes to the analysis due to lack of data. With respect to existing housing units by residential heating fuel type data, ERG updated the analysis with 2002–2008 data from the U.S. Census Bureau's American Community Survey. The previous analysis contained data for the years 1990 and 2000 only.

Limitations and Uncertainties in the Analysis. Data from the Joint Center for Housing Studies at Harvard University comes from the American Housing Survey (AHS). These data are available in two-year increments and are aggregated at the national level, with the limitation that the data do not contain Massachusetts-specific data. To develop the 3-percent estimate for the number of remodeling projects as a percentage of existing housing stock, ERG used AHS data from 1995–2007. The data indicate the total number of homeowners and the total number of remodeling projects for each two-year period between 1995 and 2007. In addition, the data show the number of remodeling projects by type. Several of the remodeling types affect residential heating; however, homeowners may report more than one type of renovation project completed, so it is not possible to aggregate all of the remodeling projects that might affect residential heating. Because of this limitation, ERG used the remodeling type, "HVAC," as a proxy for the percent of remodeling projects that affect residential heating. The two main limitations to this assumption are 1) that the residential heating energy savings from HVAC remodels may overlap significantly with emissions savings attributed to improved appliance standards and/or utility-administered energy efficiency programs, and 2), that the average percentage of energy savings from these remodeling projects is unknown. Of the list of remodeling options outlined in the AHS data, HVAC remodels have the greatest impact on residential heating energy. Another drawback is that the total number of homeowners listed in the tables is not broken out by existing vs. new housing stock built in that year.

With respect to existing housing units by residential heating fuel type, ERG was able to augment the existing analysis with additional data, but the analysis still relies on interpolation/extrapolation of data, which results in data uncertainty for those years estimated. The analysis of commercial and

industrial buildings relative to code improvements has not yet been completed; however, there are similar issues in parsing reductions between the complementary policies of energy-efficiency programs, improved energy codes, increased appliance standards, and carbon-content requirements for fuels.[8]

Renewable Portfolio Standard (RPS)

Created by the Electricity Restructuring Act of 1997, the Massachusetts RPS requires retail electricity suppliers (regulated distribution utilities and competitive suppliers) to obtain a percentage of electricity from sources that qualify as New Renewable Generation Units (i.e., post-1998) for their retail customers, with compliance achieved by purchasing Renewable Energy Credits.

The RPS began with an obligation of 1 percent in 2003 and increased by 0.5 percent annually since then, reaching 4 percent in 2009. Pursuant to the Green Communities Act, the RPS annual increase will double to 1 percent annually after 2009. Consequently, by 2020, 15 percent of the supply for nonexempt retail sales is forecast to be from new, renewable resources that are net carbon-neutral.

Approach. The starting point for the savings is the RPS target levels based on the nonexempt sales, after the effects of federal appliance standards and Massachusetts energy efficiency programs.

Because the program was in existence (although at lower levels) during the historical period used to develop the BAU trend for GHG emissions, it is very likely that the effects of those earlier years are included in that forecast. Thus, in calculating the additional reductions from the RPS programs, we have assumed a baseline trend of 0.5 percent per year. Therefore, the net effect of the RPS program in 2020 after accounting for the trends embedded in the BAU GHG forecast is 5.5 percent of the nonexempt sales.

Limitations and Uncertainties in the Analysis. The greatest uncertainty lies with the BAU forecast for several reasons: 1) future electricity-load growth, 2) future generation mix and GHG emission rates, and 3) the historical data that was used to develop the forecast trend.[9] A second uncertainty results from a carbon accounting assumption that, until recently, maintained that biomass fuel, which to date has been the largest contributor to meeting RPS requirements, is carbon neutral. However, issues have been raised as to whether, in fact, the use of wood-based biomass is carbon neutral, especially over short timeframes. As a result, the state's Department of Energy Resources (DOER)

8 **Recommendations for Further Analysis of Building Codes.** Analysis is needed of code impacts on the heating and cooling of commercial and industrial buildings, to the extent that these can be delineated separately from the existing energy-efficiency and appliance standards policy impacts. Within the residential heating sector, ERG recommends that the extrapolation/interpolation of existing housing by fuel-type data be reviewed, as well as the per-household GHG emissions for oil and natural gas homes from 2008–2020 to determine if the projections are acceptable. We also recommend updating the analysis with more accurate projections of the relative percentages of new homes heated by gas and oil annually if data can be found.

9 **Recommendations for Further Analysis of RPS.** A more structural analysis of the factors affecting GHG emissions from electricity use should be carried out in the next stage of this study. Particular attention should be focused on consistency of RPS savings with BAU projections, and consistency with other policies.

commissioned a comprehensive study of issues related to biomass sustainability and carbon accounting, led by the Manomet Center for Conservation Sciences. Due to be completed in May or June 2010, the study will guide DOER in proposing sustainability/carbon criteria that biomass facilities must meet to qualify for the RPS. Another substantial contributor to the RPS is the use of landfill gas as a fuel to generate power. Given that the methane in landfill gas has about 21 times the global warming potential per pound as the CO_2 that is emitted from burning it as fuel, there is great value in preventing direct release of such gas. Nevertheless, the net carbon balance from using landfill gas to generate power, in comparison to alternatives that might become available for handling the gas, is a subject that deserves further research.

Additional Low-Carbon Electricity Imports

Several proposals have been advanced for large additions to the electricity import capability for New England. The most developed proposal is the project proposed by Northeast Utilities and NSTAR to purchase power from Quebec. It is reasonably likely that one or more projects will be completed by 2020.

Approach. Based on advice from EEA and DPU staff, we assume one 1,500-MW transmission project delivering new baseload-purchased power into the region by 2020. Seeing that there are multiple projects proposed and possible by 2020 (for significantly more than 1500 MW), assuming only one project is a conservative estimate and a simple way of discounting the likelihood of multiple projects. We allocate half of this energy to Massachusetts. This is a fraction somewhat greater than the Massachusetts *pro rata* share of the regional load but is justified because the project proponents are mainly Massachusetts utilities.

The energy purchased over the new transmission line (or lines) is assumed to be zero carbon, and it is displacing the regional marginal generation, which is primarily natural gas generation. The annual CO_2 emissions reduction amounts to 3,068 thousand tons of CO_2 in 2020.

Limitations and Uncertainties in the Analysis. The development of new transmission projects faces a number of regulatory challenges, including federal, state, and provincial approvals. In this case, a long-term power contract would likely be a necessary part of the package. The carbon emissions benefits depend on the source of generation, which might be specified by requirement of the New England Governors or by terms of regional solicitation.[10]

10 **Recommendations for Further Analysis of Additional Low-Carbon Electricity Imports.** The calculations here are based on broad brush assumptions about the scale and timing of the transmission additions, and the source of generation (and therefore the CO_2 emissions implications). More detailed analyses should examine the specific intertie proposals and assess their timing and probability of completion, as well as the associated quantities of power and generation mix that would be delivered to New England generally and to Massachusetts' customers in particular. The potential overlap with other policies, particularly the RPS, should be examined and addressed.

Massachusetts Environmental Policy Act (MEPA)

MEPA requires that large new developments (commercial, residential, industrial) must try to mitigate their environmental impacts if they meet certain thresholds (e.g., needing certain state permits, having a certain number of expected vehicle trips/day). Amendments to MEPA now require that GHG impacts must be examined and mitigation attempted.

Approach. We looked at the average mitigation numbers from the MEPA projects that have been subjected to this requirement to date and extrapolated those reductions to the average number of projects that have gone through MEPA each year in recent years. This yielded significant reductions in GHG annually, though small relative to the economy wide total.

Limitations and Uncertainties in the Analysis. We have data to date on less than 20 projects that have completed the MEPA process under the GHG requirement, and it is not clear how representative these are compared to an "average" set of projects. The number and types of projects vary greatly each year, so it is difficult to know what average numbers will be in the future. In addition, there may be some double-counting with the savings achieved through the utility-operated efficiency programs. Also, future improvements in the state's building code may reduce the opportunities for mitigation via MEPA.[11]

11 **Recommendations for Further Analysis of MEPA.** As more projects complete MEPA review and submit final mitigation expectations, they should be added to the database and the averages recalculated. In addition, overlap with the utility efficiency standards should be examined.