The RGGI Opportunity

RGGI as the Electric Sector Compliance Tool to Achieve 2030 State Climate Targets

Sierra Club, Pace Energy and Climate Center, and Chesapeake Climate Action Network

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EDITOR'S NOTE

In the January 20, 2016 release of this report, there was a typographical error on page ii, paragraph 1 and on page 1, footnote 1. These errors have been corrected in this release.

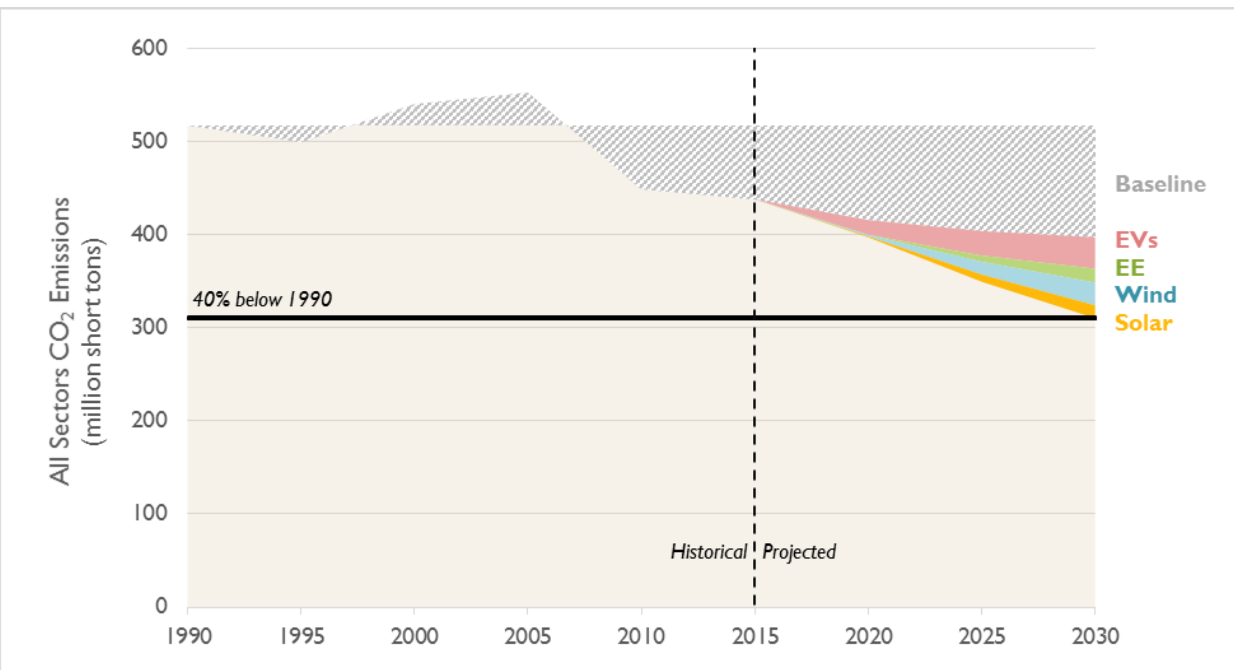
EXECUTIVE SUMMARY

For the past seven years, nine northeastern states have led the country in addressing greenhouse gas emissions from the electric sector. Working together under the Regional Greenhouse Gas Initiative (RGGI), Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont have already cut electric-sector carbon dioxide (CO_2) emissions by 45 percent compared to their 1990 levels and have created a framework to drive deeper electric sector reductions in the future. RGGI's electric sector carbon cap is complemented by individual state renewable portfolio standards (RPS) and energy efficiency resource standards (EERS) that are further helping to transform power generation in the region. The nine RGGI states have also led the country in establishing longer-term economy-wide climate goals, clustering around a 40 percent reduction from 1990 levels by 2030 and an 80 percent reduction by 2050.

Synapse evaluated the most cost-effective approaches for states to meet their 2030 climate goals, while avoiding investments during this time frame that would hinder compliance with states' longer-term 2050 goals. This least-cost strategy achieves a 40 percent CO_2 emission reduction in the nine states by 2030 by lowering the RGGI cap on electric sector emissions from 78 million short tons in 2020 to 19 million short tons in 2030, and adding a new emission reduction measure in the transportation sector.

In Figure ES-1, the grey area labeled "Baseline" shows the emission reductions expected without any additional policy measures: 20 percent below 1990 levels by 2030.

Figure ES-1. Emission reductions required to meet 40 percent target in RGGI states



The least-cost strategies modeled by Synapse to achieve an all-sector 40 percent emission reductions in the RGGI region by 2030 include converting one-third of gasoline-powered light-duty vehicles to electric vehicles, achieving the level of Massachusetts' electric efficiency savings in all nine states, investing in new wind generation up to its economic potential, and investing in smaller additions of new solar generation. Achieving a 40 percent reduction using these strategies yields $5.2 billion in total savings from 2016 through 2030 and 50,000 new jobs each year in the RGGI region. Asking more from RGGI than its original targets is a win-win for consumers, workers, and the environment.

Achieving a 40 percent CO_2 emission reduction will be driven by reductions in multiple sectors.

While the electric sector will continue to carry nearly 70 percent of the emission reductions through 2030, reductions from the transportation sector are also critical to achieving RGGI states' 2030 climate goals. Synapse's analysis examined both the electric and transportation sectors for the least-cost emission reduction combination, and left today's natural gas generating capacity in operation during the transition to renewables. With the 40 percent emission reduction, natural gas generation only runs when it is economic and necessary. In this way it continues to support electric service reliability and plays a role in smoothing out any mismatches between renewable generation and predominantly night-time charging of electric vehicles.

Increased adoption of electric vehicles saves money for consumers.

The cost savings of switching from gasoline to electricity to power a car more than make up for electric vehicles' higher purchase price. Our assessment of which emission reduction measures have lower and higher costs includes a value for the climate impacts avoided by lowering CO_2 emissions. But even ignoring the benefits of avoiding damage from climate change, electric vehicles save households money.

Robust investment in energy efficiency lowers overall electric sales despite the significant increase in electric vehicles.

In 2030, efficiency measures save 81,000 gigawatt-hours of electricity in the 40 percent emission reduction scenario. Converting one-third of all light-duty vehicles to run on electricity only adds 16,000 gigawatt-hours.

Efficiency measures will continue to lower consumers' bills.

Applying Massachusetts' expected electric energy efficiency savings in terms of percent of sales—based on their current three-year plan—to all RGGI states lowers electric sales by 11 percent by 2030. These efficiency savings have been determined to be cost effective in Massachusetts.

A more stringent RGGI cap works together with state RPS and EERS.

The RGGI allowance auction sets a price signal that is responded to, in part, by state RPS and EERS programs. Together, RGGI and state portfolios are what make emission reductions possible, both today and in the future. Without RPS and EERS programs the RGGI cap could be achieved by importing an increasing share of the Northeast's electricity from fossil-fuel generators outside of the region.

New RGGI policy generates nearly 50,000 jobs per year.

On average from 2016 through 2030, achieving a 40 percent emission reduction creates nearly 50,000 jobs per year. The new policy generates 27,600 jobs in 2020, 72,500 jobs in 2025, and 70,500 jobs in 2030.

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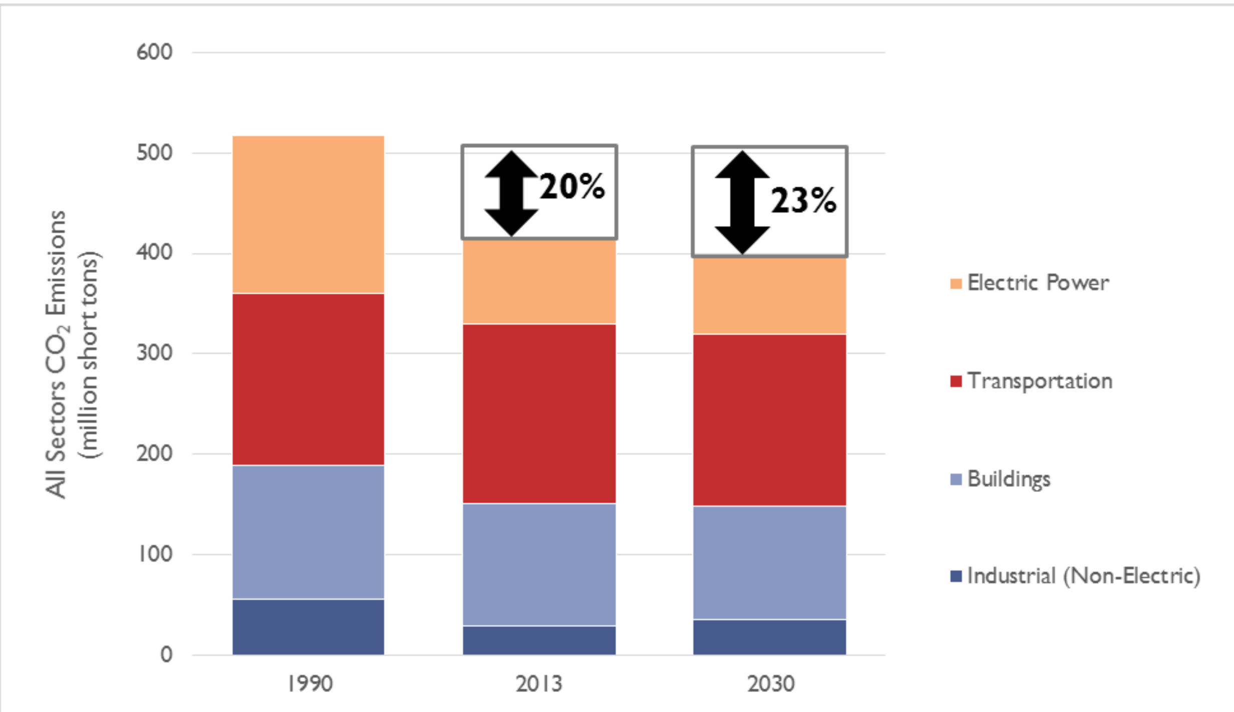
1. THE RGGI PROGRAM

For the past seven years, Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont have worked together to limit the emission of carbon dioxide (CO_2) from their electric sector. The Northeast's Regional Greenhouse Gas Initiative (RGGI) auctions certificates representing states' allowable CO_2 emissions to power generators: For each ton of CO_2 emitted, fossil fuel generators must purchase an allowance. The revenue from these auctions is returned to states and is typically spent on renewable energy and efficiency programs.

RGGI—working in concert with a changing market for fossil fuels, state renewable portfolio standards (RPS) and energy efficiency resource standards (EERS), and other state and federal environmental policies—has lowered total energy-related CO_2 emissions from the nine states 20 percent below 1990 levels (see Figure 1).[1] The RGGI electric-sector emissions cap shrinks from 91 million short tons in 2014 down to 78 million short tons in 2020, and stays constant thereafter. With this lower cap in place—and business-as-usual assumptions that include all current state and federal environment regulations—Synapse estimates that the nine states will achieve an additional 3 percentage point reduction in all sector emissions by 2030.

Figure 1. All-sector CO_2 emission reductions in the RGGI baseline scenario



Source: Synapse Energy Economics based on RGGI data.

[1] By 2013, emissions from all sectors had decreased by 20 percent compared to 1990 levels. In the electric sector, emissions decreased by 45 percent.

The U.S. Environmental Protection Agency's (EPA) recently released Clean Power Plan limits CO_2 emissions from electric generators nationwide. However, the combined Clean Power Plan target for Northeast states for 2030 is less stringent (allows higher levels of emissions) than the RGGI cap for 2020: 80 million short tons compared to 78 million short tons of CO_2.[2] With no further electric sector emission reductions between 2020 and 2030, the Northeast states' RGGI agreement already achieves Clean Power Plan compliance for the nine states.

Individual RGGI states have set greenhouse gas emission reduction targets for 2030 that range from 35 to 45 percent, centered around a 40 percent reduction from 1990 levels (see Table 1).

Table 1. State greenhouse gas emission reduction targets, 2030 and 2050

State	2030 Target	2050 Target
Connecticut	35-45% below 1990	80% below 2001
Delaware	36% below 1990*	No target
Maine	35-45% below 1990	75-80% below 2003
Maryland	35% below 1990**	Up to 90% below 2006
Massachusetts	35-45% below 1990	80% below 1990
New Hampshire	35-45% below 1990	80% below 1990
New York	40% below 1990	80% below 1990
Rhode Island	35-45% below 1990	80% below 1990
Vermont	35-45% below 1990	75% below 1990

Note: See Appendix E for citations to state climate statutes.

** Delaware's 2030 target is a non-binding goal recommended in the state's Climate Framework of 30 percent below 2008.*

*** Maryland's 2030 target is framed as 40 percent below 2006.*

To achieve these targets, deeper emission reductions will be needed both within the electric sector, which continues to offer cost-effective emission reductions, and in the rest of the economy. This report compares a "baseline" business-as-usual RGGI scenario to a future in which RGGI states' all-sector energy-related CO_2 emissions are 40 percent lower than their 1990 levels by 2030. The examples of additional emission reductions shown here take place in the electric and transportation sectors, although the buildings and industrial sectors also have the potential to lower emissions.

[2] All RGGI states' individual Clean Power Plan mass-based targets with new source complement are higher than their RGGI allocation in 2030 with the exception of Maine and Maryland.

2. GETTING TO 40 PERCENT EMISSION REDUCTIONS IN 2030

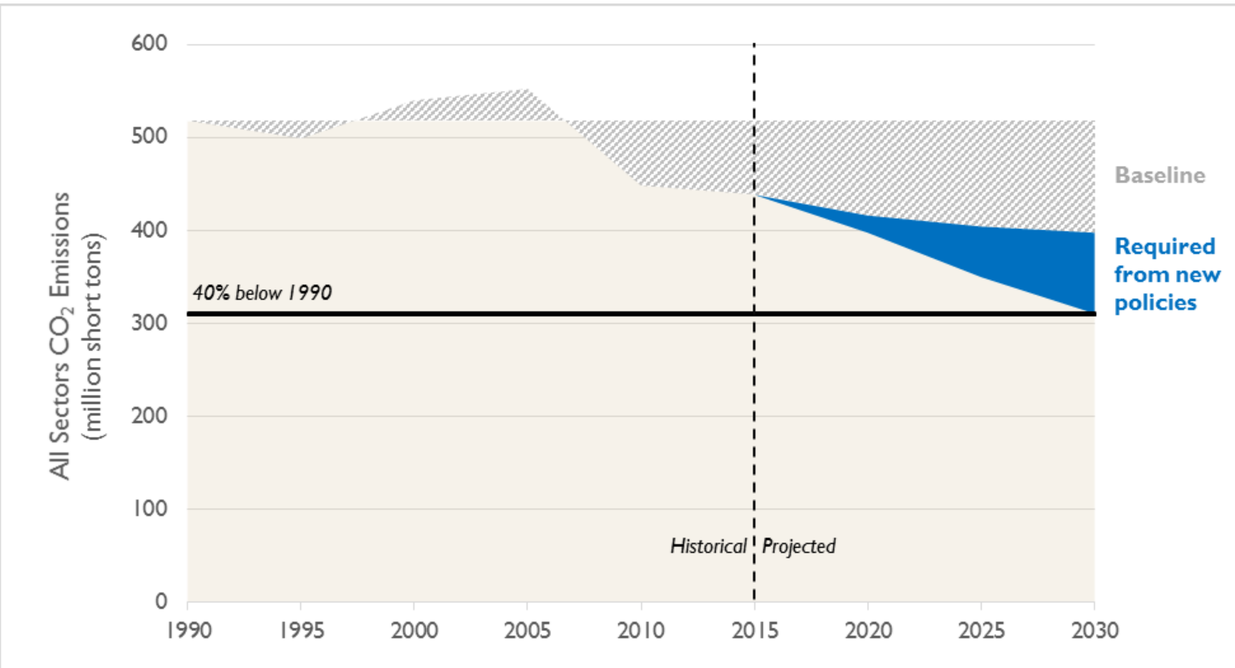
Deeper emission reductions will require efforts in multiple sectors. While there are many potentially successful policies to reduce emissions in all sectors, this analysis focuses on four well-researched, cost-effective emission reduction measures: energy efficiency, wind and solar generation in the electric sector, and conversion from gas to electric light-duty vehicles in the transportation sector.

Synapse's analysis applies the least-cost combination of these measures to detailed energy sector models, taking into consideration dynamic interrelations between electric supply and demand, new electric demand for transportation, and each state's power generation and transmission resources.[3] The result is a scenario of the Northeast's future use of energy resources that not only lowers region-wide CO_2 emissions by 40 percent in all sectors by 2030 but also reduces costs to consumers by $5.2 billion over the 2016 to 2030 period.

2.1. 2030 Baseline Emissions are 23 Percent Lower than 1990 Levels

In 2030, all-sector CO_2 emissions in the baseline RGGI scenario are 23 percent lower than 1990 emissions (see Figure 2).

Figure 2. Additional emission reductions required to meet 40 percent target in RGGI states



[3] See the appendices to this report for a detailed description of models and assumptions.

Source: Synapse Energy Economics.

This baseline emission reduction is due not only to RGGI, but also to lower natural gas fuel prices, efficiency gains in the transportation and building sectors, and state and federal environmental policies.

In the RGGI baseline, all-sector emissions are 397 million short tons of CO_2 in 2030 (120 million short tons lower than 1990 levels). A further 87 million short ton reduction is needed to bring all-sector emissions 40 percent below 1990 levels. The RGGI baseline includes the nine states' compliance with the RGGI caps as well as all U.S. states' compliance with state RPS, EERS, and federal Clean Power Plan mass-based CO_2 emission caps (including the new source complement).

2.2. Big Ticket Measures to Reduce Transportation and Electric Emissions

Synapse applied four selected "big ticket" emission reduction measures to the RGGI baseline scenario by modeling impacts on the electric and other energy sectors (see Table 2).[4] Three of the four selected measures have net negative costs (that is, benefits) for each ton of emission reductions. These net cost estimates include both economic costs and benefits that impact household budgets as well as the benefit of avoiding climate damages estimated as the U.S. federal government's social cost of carbon.[5] Note that this cost-benefit analysis does not include other non-energy benefits, such as improved air and health associated with reducing CO_2 co-pollutants.

[4] See Appendix C for a more detailed account of emission-reduction measure assumptions and the marginal abatement cost curve methodology used to select these measures. Note that because only part of the solar measure is applied in the 40 percent emission reduction policy scenario, the 2030 emissions reduction potential for solar exceeds the emissions reduction used in this analysis.

[5] U.S. EPA. 2015. "Technical Support Documents: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866." Revised July 2015 by the Interagency Working Group on Social Cost of Carbon. Available at: https://www.whitehouse.gov/sites/default/files/omb/inforeg/scc-tsd-final-july-2015.pdf. Summary also available at: http://www3.epa.gov/climatechange/EPAactivities/economics/scc.html.

Table 2. Selected emission reduction measures

	Net cost per ton (2014 $ / short ton)	2030 emissions reduction potential (million short tons)	2030 actual emissions reduction used in this analysis (million short tons)
Electric vehicles: Convert one-third of all light-duty vehicles from gas to electric[6]	-$300	28	28
Energy efficiency: Achieve Massachusetts' level of efficiency savings in all RGGI states	-$202	17	17
Wind: Invest in onshore wind generation up to the economically achievable potential	-$23	27	27
Solar: Limited investments in utility-scale solar installations	$10	616	15

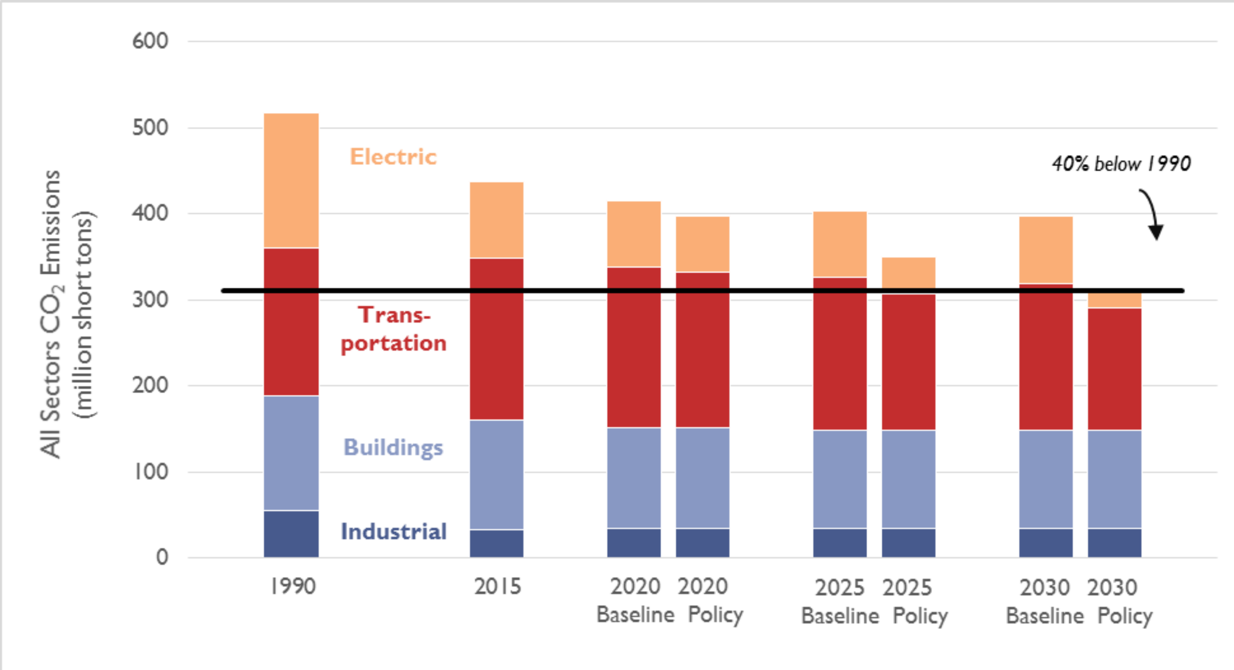
Source: Synapse Energy Economics analysis.

Performing detailed electric-sector modeling allows this analysis to take into consideration time of day, time of year, changes in generation by resource type over time, changes in generation technologies themselves over time, federal environmental requirements, and complex interactions of electric supply and demand across state lines.

Figure 3 compares emissions in the RGGI baseline and 40 percent emission reduction policy scenarios. While emissions in buildings and industrial sectors are the same in the two scenarios, electric sector and light-duty vehicle emissions fall as a result of the additional emission reduction measures.

[6] This measure does not include potential emission reductions as a result of plug-in hybrid vehicles or other types of plug-in vehicles.

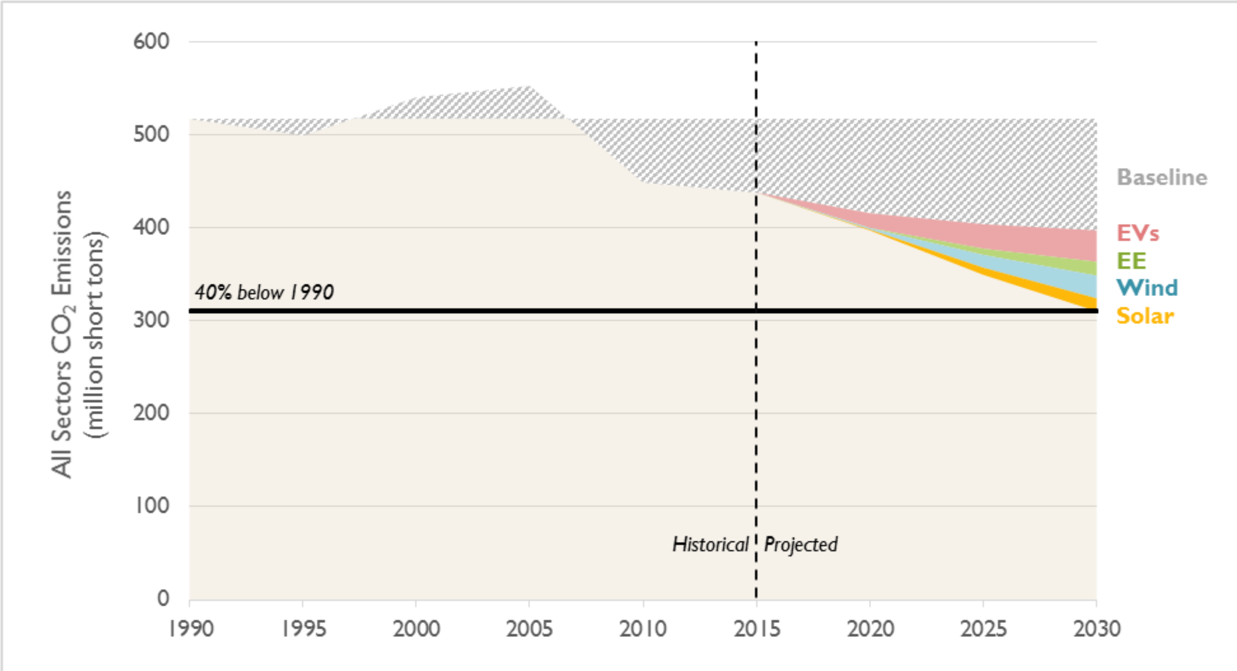
Figure 3. RGGI states' all-sector emissions in the baseline ("Baseline") and 40 percent emission reduction policy ("Policy") scenarios



Source: Synapse Energy Economics.

Figure 4 displays the estimated emission reductions achieved by each measure. Note that this is an approximation—the measures' actual emissions reductions are highly interrelated. The conversion to electric vehicles accounts for 32 percent of total emissions reductions from all four emission reduction measures applied to the RGGI baseline; electric energy efficiency, 19 percent; additions of wind, 31 percent; and additions of solar, 18 percent.

Figure 4. Additional emission reductions required to meet 40 percent target in RGGI states, by measure



Source: Synapse Energy Economics.

2.3. Emissions Do Not Leak from the RGGI Region

If RGGI states reduced emissions by importing fossil-fuel-fired generation, the result would be "emissions leakage": The Northeast's emissions would fall, but emissions in other states would rise. Our modeling demonstrates that this does not occur; emissions leakage is avoided under the scenario examined in this analysis. Our modeling assumptions restrict RGGI states' trading of Clean Power Plan allowances to remain within the RGGI group. This avoids leakage of emission allowances (and emissions) out of the region by (1) restricting RGGI states allowance trading to be within the RGGI region only, and (2) insuring that most new renewable resources are built within the region (instead of importing renewable energy credits and electricity from outside of the region).[7] As a result, RGGI states' electric-sector emissions are lower in the 40 percent emission reduction scenario than in the RGGI baseline. Emissions in the rest of the United States, however, meet Clean Power Plan mass-based targets exactly under both scenarios.

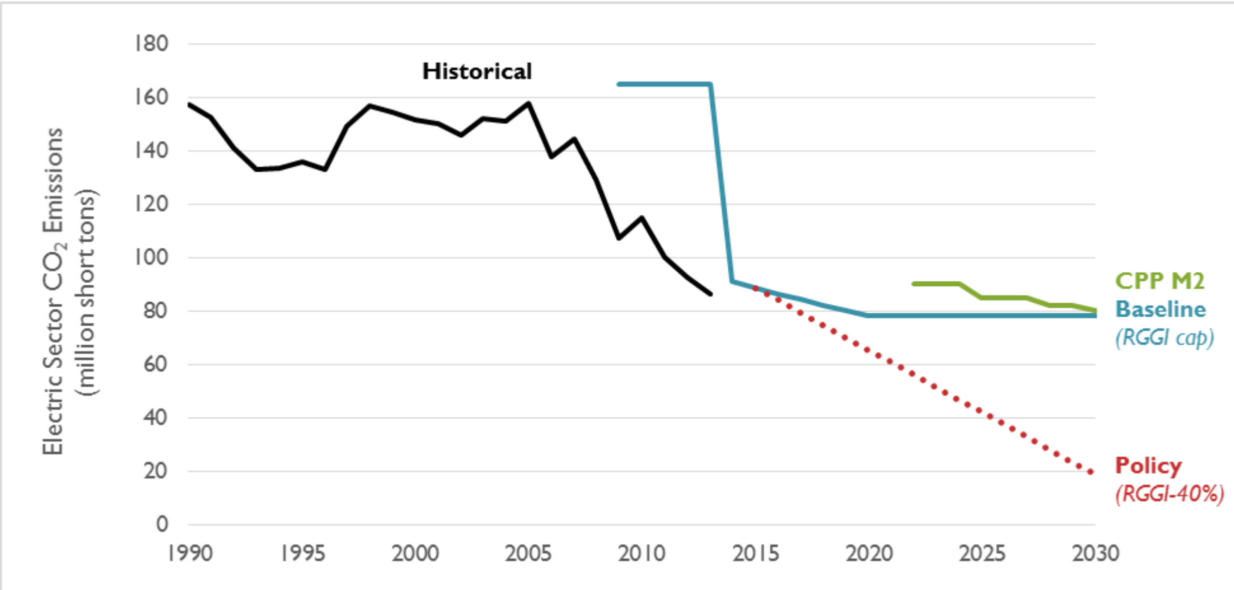
2.4. Two-Thirds of Emission Reductions Come from the Electric Sector

Electric-sector efficiency and renewables are responsible for over two-thirds of the total 40 percent reduction target in 2030. Figure 5 presents emission reductions in the electric sector for the baseline and 40 percent emission reduction policy scenarios. The RGGI baseline emission caps are themselves 11

[7] See Appendix B for further discussion.

percent lower than Clean Power Plan mass-based targets (with the new source complement) for the RGGI states in 2030.

Figure 5. RGGI states' electric-sector emission caps in the baseline and 40 percent emission reduction policy scenarios, relative to historical emissions and requirements in the Clean Power Plan

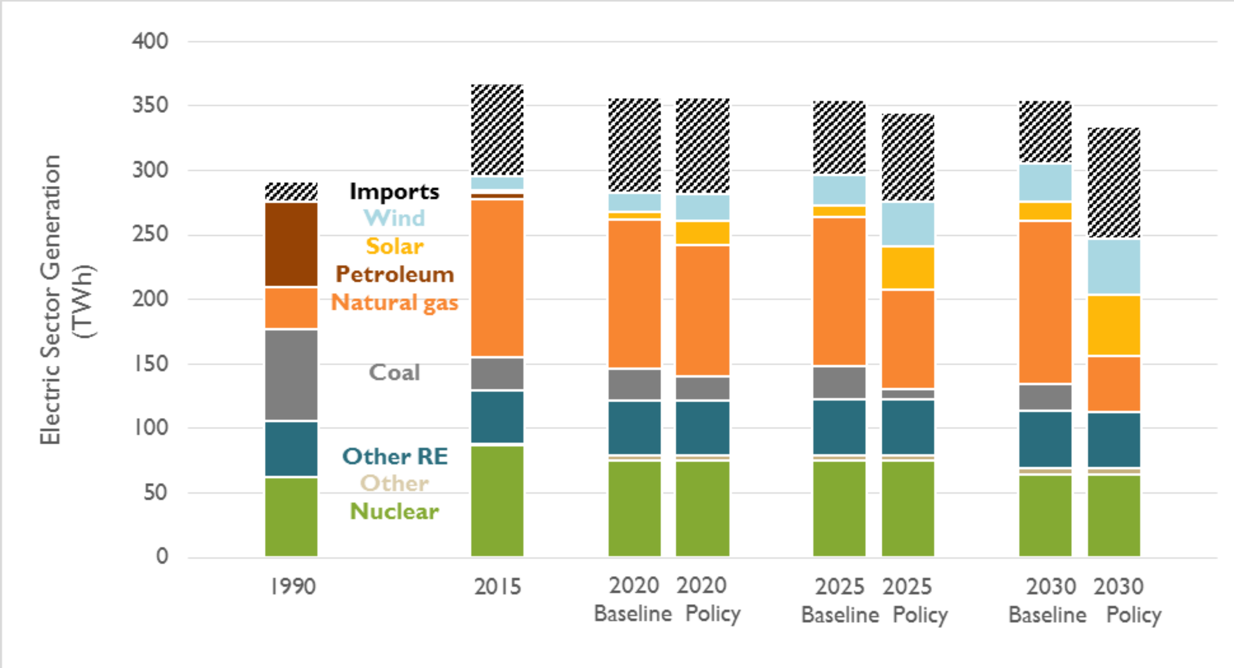


Source: Synapse Energy Economics.

2.5. Efficiency, Wind, and Solar Drive Down Electric-Sector Emissions

Under the 40 percent emission reduction scenario new, lower RGGI caps drive deeper, more wide-spread changes in the RGGI states' electric system. Figure 6 reports the impact of these measures in terms of generation by resource. Coal, oil, and some natural gas-fired generation are replaced by efficiency and renewables. Note that electric sector generation is lower in the 40 percent emission reduction scenario than in the RGGI baseline even though substantial generation is needed to power electric vehicles: savings from energy efficiency outweigh additional electricity sold to owners of electric vehicles.

Figure 6. RGGI states' electric generation by resource type in the baseline ("Baseline") and 40 percent emission reduction policy ("Policy") scenarios



Source: Synapse Energy Economics.

Table 3 below shows a summary of the increase in wind and solar capacity in the 40 percent emission reduction scenario compared to the baseline scenario. Total capacity values for all resources in the 40 percent emission reduction scenario are provided in Appendix F.

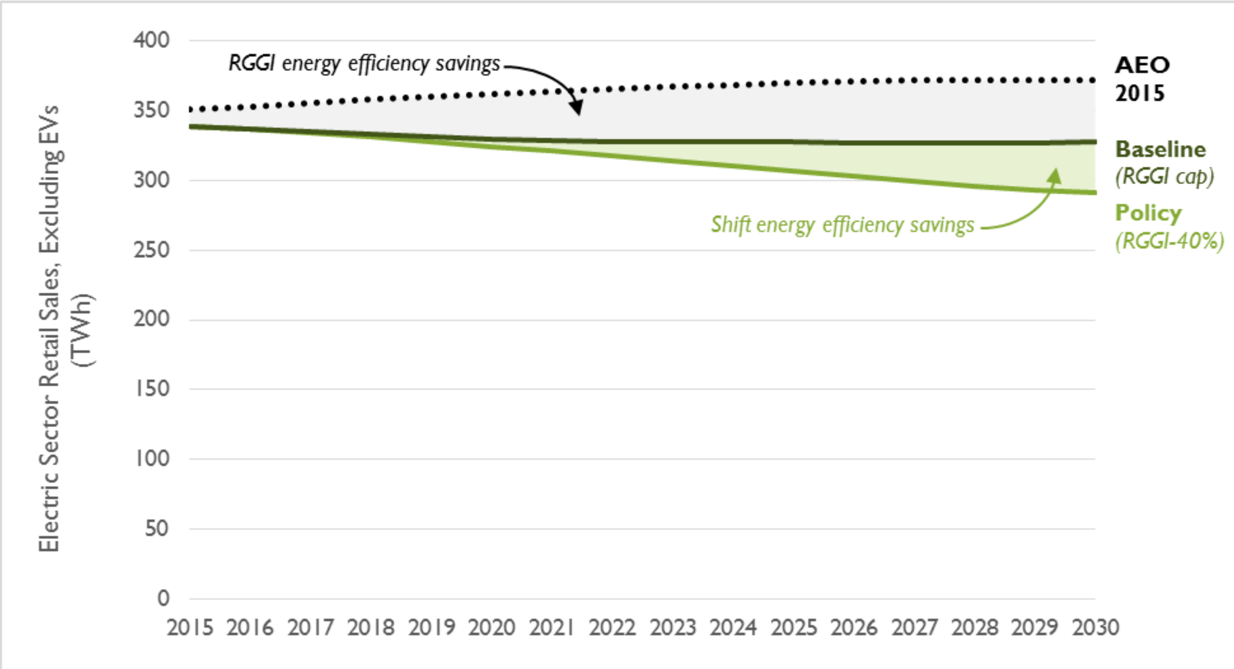
Table 3. 2030 increase in capacity in the 40 percent emission reduction policy scenario compared to the baseline scenario (GW)

	CT	DE	MA	MD	ME	NH	NY	RI	VT	Total
Wind	0.2	0.0	0.3	0.8	0.4	1.1	5.3	0.0	2.2	10.4
Solar	2.8	2.8	4.1	2.8	5.8	2.3	7.4	1.1	1.3	30.3

2.6. Electric Efficiency Savings Are One-Fifth of Total Emission Reductions

Efficiency savings in the electric sector contribute 19 percent of RGGI states' 2030 all-sector emission reductions. As shown in Figure 7, baseline RGGI efficiency savings avoid 12 percent of RGGI states' retail sales in 2030 (compared to the AEO 2015 scenario with no new efficiency measures added after 2012) while the efficiency measures in the 40 percent emission reduction scenario provide an additional 10 percentage points in avoided electric sales in 2030.

Figure 7. RGGI states' sales in AEO 2015 and in the baseline and 40 percent emission reduction policy scenarios



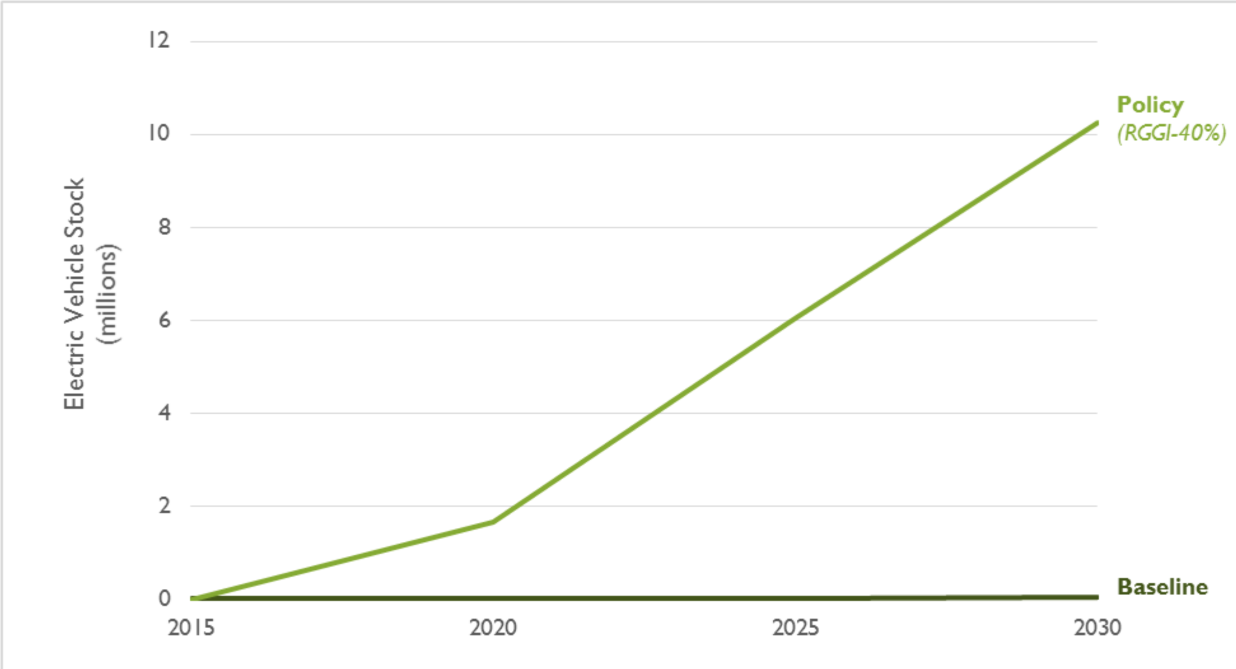
Source: Synapse Energy Economics.

2.7. Ten Million Electric Vehicles Offset 28 Million Short Tons of CO_2

The 40 percent emission reduction scenario adds 10 million battery electric vehicles in the nine RGGI states by 2030, above what is currently in place and expected in the baseline forecast (see Figure 8).[8] The stock of electric vehicles in the RGGI baseline is based on the Energy Information Administration's 2015 projections and reaches 46,000 vehicles in the RGGI region in 2030. In contrast, Synapse's 40 percent emission reduction scenario assumes that one-third of the RGGI region's light-duty vehicles run on electricity by 2030 based on the Federal Highway Administration's projection of the potential for electric vehicle adoption.

[8] This scenario does not include potential emission reductions as a result of plug-in hybrid vehicles or other types of plug-in vehicles.

Figure 8. Total electric vehicle stock in the RGGI states, 2030



Source: Synapse Energy Economics.

2.8. Forty Percent Emission Reduction Policy Saves Customers $5.2 billion

The 40 percent emission reduction scenario reduces costs to customers by $4.6 billion in 2030. This savings represents the net effect between the RGGI baseline and 40 percent emission reduction scenario of spending on the electric system, customer out-of-pocket costs for energy efficiency measures, new subsidies for electric vehicles, and avoided gasoline consumption.

However, there are additional benefits to the 40 percent emission reduction scenario beyond just economic costs and benefits. Table 4 and Figure 9 detail not only the out-of-pocket costs and benefits of this change, but also the additional co-benefit of avoiding climate damages (estimated here using the U.S. federal government's social cost of carbon).[9,10] When the avoided social cost of carbon is included, savings from the 40 percent emission reduction scenario increases to $9.1 billion in 2030.

[9] U.S. EPA. 2015. "Technical Support Documents: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866." Revised July 2015 by the Interagency Working Group on Social Cost of Carbon. Available at: https://www.whitehouse.gov/sites/default/files/omb/inforeg/scc-tsd-final-july-2015.pdf.

[10] Note that "RGGI revenue" is less in the 40 percent emission reduction case than in the RGGI baseline. This is because there is less fossil fuel generation in the policy case, and therefore less revenue is collected.

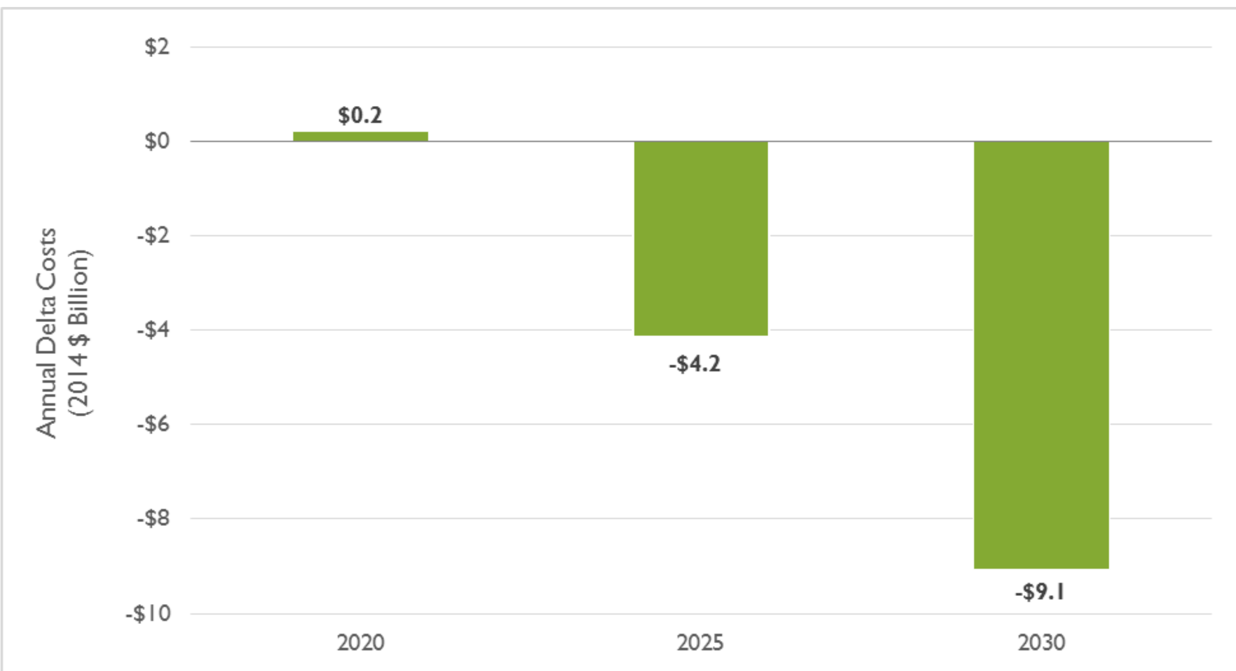
Table 4. Cost and benefits by cost type in the 40 percent emission reduction scenario (billions)

	2020	2025	2030
Electric system net costs	$1.0	-$1.6	-$4.6
Social cost of carbon	-$0.8	-$2.5	-$4.4
Total	**$0.2**	**-$4.2**	**-$9.1**

Note: Positive numbers represent increased costs in the 40 percent emission reduction scenario. Negative numbers represent savings in the 40 percent reduction scenario. Source: Synapse Energy Economics.

In the early years of the new 40 percent emission reduction policy, additional costs to the electric system and electric vehicle subsidies lead to net costs (see 2020 in Figure 9). However, as more electric vehicles are introduced over time, the savings from avoided gasoline overwhelms the incremental costs experienced in other sectors. Altogether, the discounted change in costs for 2016 through 2030 results in a net present value of $5.2 billion in savings to electric customers before the inclusion of the social cost of carbon, and a net present value of $20 billion in savings to all customers once the social cost of carbon is included.[11]

Figure 9: Annual changes in net costs in the 40 percent emission reduction scenario (billions)



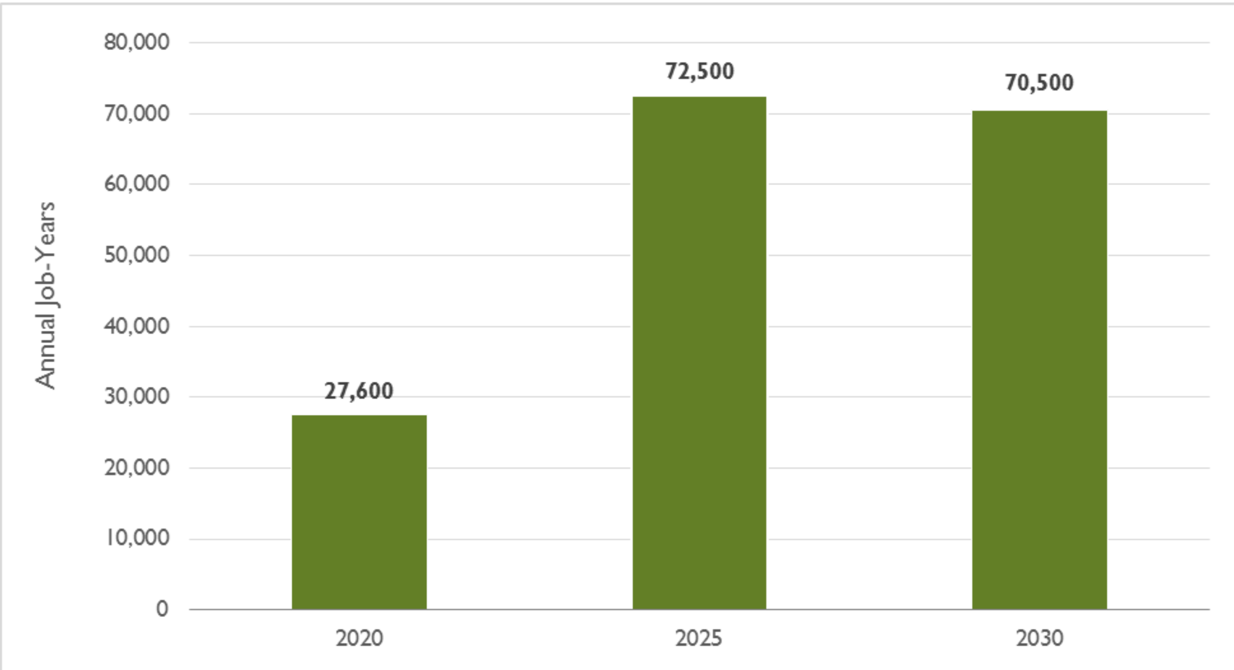
Note: Positive numbers represent increased costs in the 40 percent emission reduction scenario compared to the RGGI baseline. Negative numbers represent savings in the 40 percent reduction scenario. Source: Synapse Energy Economics.

[11] Net present value calculated using a discount rate of 3 percent and are reported in 2014 dollars.

2.9. Emission Reductions Generate Nearly 50,000 Jobs per Year

On average from 2016 through 2030, the 40 percent emission reduction scenario creates nearly 50,000 "job-years", or jobs per year (see Figure 10). The new policy generates 27,600 jobs in 2020, 72,500 jobs in 2025, and 70,500 jobs in 2030.

Figure 10: Annual job impacts in the 40 percent emission reduction scenario



Source: Synapse Energy Economics.

The employment impacts show the "net" economic effect from the 40 percent emission reduction scenario; that is, the jobs created by the policy less the jobs created in the RGGI baseline scenario. For the electric sector, the net jobs depend on the differences in capital and operating costs between scenarios. Additional jobs are created when new resources are installed under the 40 percent emission reduction policy, and fewer jobs are identified when the resources only exist in the RGGI baseline. Similarly, electric vehicles generate job impacts resulting from new electric service and charging infrastructure but also include losses from reduced gasoline usage.

Table 5 shows the breakdown of jobs by the source of impact through 2030. The largest gain in jobs comes from renewable energy resources (almost 25,000 average jobs per year) and energy efficiency (nearly 20,000 jobs per year). The only sectors that would have fewer jobs under the baseline than in the 40 percent emission reduction scenario are coal, natural gas, and biomass. "Re-spending" impacts refer to households and businesses spending savings from the new 40 percent emission reduction policy relative to the RGGI baseline. For instance, if households are financially better off from purchasing the combination of an electric vehicle and more electricity for battery charging (as opposed to a conventional gas-powered car and gasoline) then they can spend that savings elsewhere in the regional economy.

Table 5: Annual and cumulative job-year impacts by resource in the 40 percent emission reduction scenario

Resource	2020	2025	2030	Average Annual Jobs	Cumulative Jobs through 2030
Coal	-500	-1,600	-2,300	-1,200	-17,700
Biomass	0	-100	-400	-100	-1,700
Natural Gas	-2,400	-6,900	-21,300	-6,800	-101,300
Energy Efficiency	13,500	26,900	28,900	19,400	291,100
Renewable	21,100	32,500	9,700	24,600	369,600
Nuclear	0	0	0	0	0
Hydro	0	0	100	0	0
Transmission	900	1,300	10,400	2,400	35,700
Transportation	-100	200	-200	100	1,800
Re-spending	-5,000	20,200	45,600	10,400	156,300
Total	**27,600**	**72,500**	**70,500**	**48,900**	**733,800**

Note: Columns may not sum to total due to rounding. Values represent differences between single-year "job-years" in different hypothetical futures and do not necessarily show gains or losses from existing jobs. Source: Synapse Energy Economics.

The result that the 40 percent emission reduction scenario creates new jobs is not surprising. Renewable energy and energy efficiency typically create more jobs for the same amount of capacity provided by coal and natural gas generation. More of the cost of clean energy sources is spent on labor than on capital and fuel. The electrification of transportation also displaces fossil fuels. Compounding this effect, fossil fuels consumed by the RGGI states come almost entirely from outside the region. Thus the 40 percent emission reduction scenario leads to a shift from spending on extractive industries outside the region to more labor-intensive industries inside the region.

3. Key Policy Take-Aways

Both lowering the RGGI cap in the electric sector and expanding electric vehicle policies are critical to Northeast states achieving their state greenhouse gas emission reduction targets. To achieve 40 percent CO_2 emission reductions in RGGI states by 2030, Synapse made a few critical modeling assumptions that point to important policy considerations for a new, expanded RGGI policy.

Achieving a 40 percent CO_2 emission reduction will be driven by reductions in multiple sectors.

While the electric sector will continue to carry nearly 70 percent of the emission reductions through 2030, reductions from the transportation sector are also critical to achieving RGGI states' 2030 climate goals. Synapse's analysis examined both the electric and transportation sectors for the least-cost emission reduction combination, and left today's natural gas generating capacity in operation during the transition to renewables. With the 40 percent emission reduction, natural gas generation only runs when it is economic and necessary. In this way it continues to support electric service reliability and plays a role in smoothing out any mismatches between renewable generation and predominantly night-time charging of electric vehicles.

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In 2030, efficiency measures save 81,000 gigawatt-hours of electricity in the 40 percent emission reduction scenario. Converting one-third of all light-duty vehicles to run on electricity only adds 16,000 gigawatt-hours.

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The RGGI allowance auction sets a price signal that is responded to, in part, by state RPS and EERS programs. Together, RGGI and state portfolios are what make emission reductions possible, both today and in the future. Without RPS and EERS programs the RGGI cap could be achieved by importing an increasing share of the Northeast's electricity from fossil-fuel generators outside of the region.

New RGGI policy generates nearly 50,000 jobs per year.

On average from 2016 through 2030, achieving a 40 percent emission reduction creates nearly 50,000 jobs per year. The new policy generates 27,600 jobs in 2020, 72,500 jobs in 2025, and 70,500 jobs in 2030.

APPENDIX A: ENERGY SECTOR MODELS

Synapse's purpose-built Excel-based model of the nine RGGI states' electric, transportation, buildings, and industrial sectors estimates emission and cost differences between the RGGI baseline and the 40 percent reduction policy scenarios. The baseline and the 40 percent emission reduction policy scenario capacity, generation, emissions and costs for the electric sector are modeled in Synapse's adapted version of the National Renewable Energy Laboratory's (NREL) Regional Energy Deployment System (ReEDS) model. The results are then imported into the Excel-based model.[12]

Purpose-built Excel-based energy sector model

Synapse's customized, dynamic, spreadsheet-based model of emissions in the RGGI states includes the electric, transportation, building, and industrial sectors. For the electric and transportation sectors, energy use and its associate emissions differ between the RGGI baseline and 40 percent reduction policy scenarios. The buildings and industrial sectors are identical in the two scenarios.

Electric sector ReEDs model

ReEDS is a long-term capacity expansion and dispatch model of the electric power system in the lower 48 states. Synapse has adapted its in-house version of the ReEDS model to allow for more detailed outputs by state and sector, and to permit differentiation of energy efficiency expectations by state.

Compliance with the Clean Power Plan is modeled as achieving the state-level mass-based targets that include estimated emissions from new sources (the "new source complement") on a biennial basis. We assume that emission allowances are traded both within and across state borders among two separate groups of states: the nine RGGI states, and all other states modeled. The price of allowances is set endogenously within the model as a shadow price. For the RGGI states, Clean Power Plan emission caps are replaced with more stringent (lower) RGGI caps in both scenarios.

Temporal scope

The time period of this analysis is 2015-2030. ReEDS modeling is performed at two-year intervals starting in 2014. Historical data through 1990 has been included in the spreadsheet model to serve as a point of comparison for future emissions. The Excel-based model projects emissions and costs at five-year intervals for the years 2015, 2020, 2025 and 2030.

[12] ReEDS version used is ReEDS_v2015.2(r25). More information is available at: http://www.nrel.gov/analysis/reeds.

Geographic scope

The nine RGGI states are modeled both independently and as a group. In the ReEDS model, all states in the continental United States are represented. ReEDS divides the United States into 134 power control areas that are consistent with state boundaries and can be aggregated to model state impacts. Each power control area is modeled as having a single aggregated "unit" of each resource type, the size of which is equal to the sum of the capacities of the actual units in that territory. For this analysis, Synapse modeled the country as a whole to capture interactions between states.

APPENDIX B: BASELINE SCENARIO

The RGGI baseline scenario is a business-as-usual case in which (a) the currently mandated RGGI caps for each year are in place (staying constant at the 2020 level in years thereafter), (b) state's comply with their RPS and EERS requirements, and (c) states outside of RGGI comply with their mass-based Clean Power Plan targets, including the new source complement. States' RGGI emission caps are more stringent (lower) than their Clean Power Plan mass-based targets. For this reason, only the RGGI caps (and not the Clean Power Plan targets) apply to RGGI states and—to avoid emission leakage out of the RGGI region—we have restricted RGGI states to only trade allowances among themselves while remaining states may trade throughout the non-RGGI region.

Baseline state-specific emissions data

Historical years, 1990 to 2013

State-specific baseline energy consumption is based on the U.S. Energy Information Administration's (EIA) State Energy Data System (SEDS). SEDS contains historical time series of state-level estimates of energy production, consumption, prices, and expenditures by source and sector.[13] State-specific emissions are based on EIA's State Carbon Dioxide Emissions database.[14] These energy-related data does not include agriculture, land-use change, or upstream (life-cycle) emissions.

Future years, 2015-2030

Synapse based projections for the transportation, buildings, and industrial sectors on regional sector-specific growth rates derived from the EIA's Annual Energy Outlook (AEO) 2015 Reference case.[15] Electric-sector projections were based on detailed ReEDS modeling runs. ReEDS modeling assumptions specific to the RGGI baseline scenario are discussed in more detail in the subsequent sub-sections.

Sales and energy efficiency

Annual retail electric sales for the nine RGGI states are projected by applying regional growth rates from the AEO 2015 Reference case to state-specific EIA historical data. On average, the AEO 2015 Reference case assumes an annual growth rate of about 0.5 percent per year for the nine RGGI states. From this we "back out" the AEO representation of ongoing savings—estimated at 0.29 percent of 2012 sales—

[13] U.S. Energy Information Administration (EIA). 2015. "About SEDS." Available at: http://www.eia.gov/state/seds/.

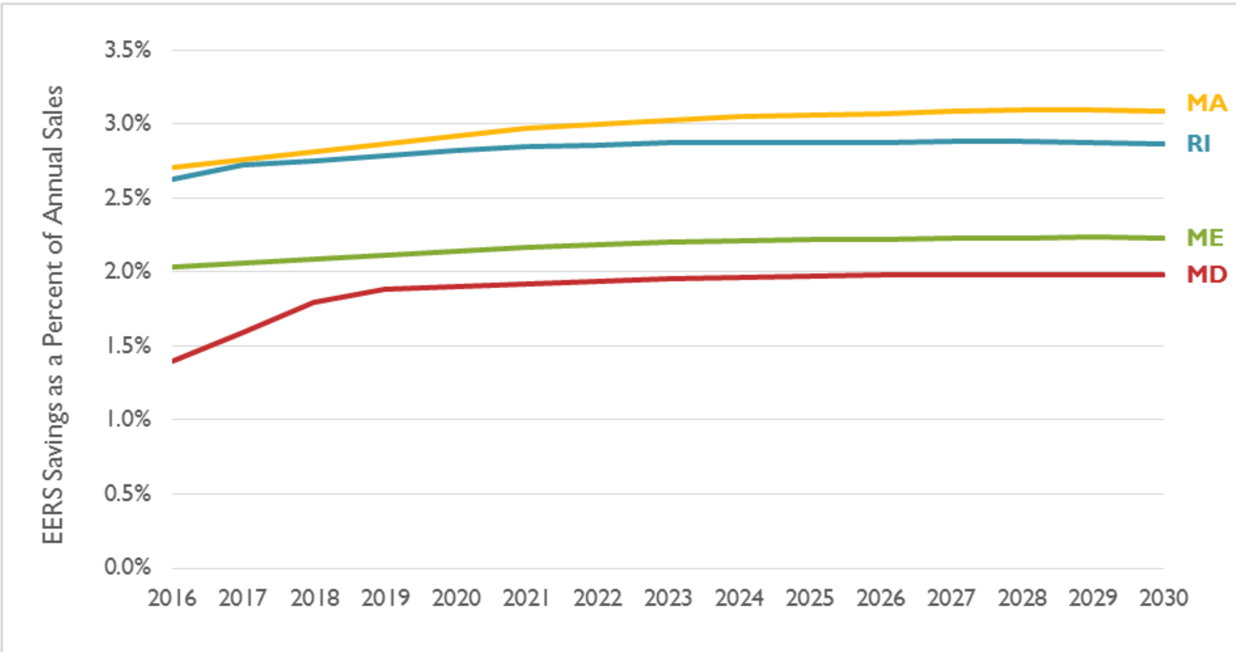
[14] EIA. 2015. "State Carbon Dioxide Emissions." Available at: http://www.eia.gov/environment/emissions/state/.

[15] EIA. 2015. "Annual Energy Outlook 2015." Available at: http://www.eia.gov/forecasts/aeo/index.cfm.

from new energy efficiency measures and replace it with more detailed forecasts.[16] Overall, energy efficiency in the RGGI baseline replaces 10.5 percent of regional sales in 2030.

Four of the nine RGGI states (Massachusetts, Maryland, Maine, and Rhode Island) have energy efficiency resource standards (EERS) that require utilities to meet a state-specific share of retail sales through energy efficiency measures. The RGGI states' EERS requirements are summarized in Figure 11.

Figure 11. RGGI states' EERS requirements



Note: EERS levels are modeled based on state and utility filings of projected energy efficiency, rather than on percentage-based state statutes.

For states without EERS policies, Synapse estimates future baseline energy efficiency savings according to state-specific program plans and utility- or state-specific integrated resource planning documents (see Figure 12). Where data is otherwise unavailable, we assume that the savings level in the last year of each individual forecast continues through 2030.

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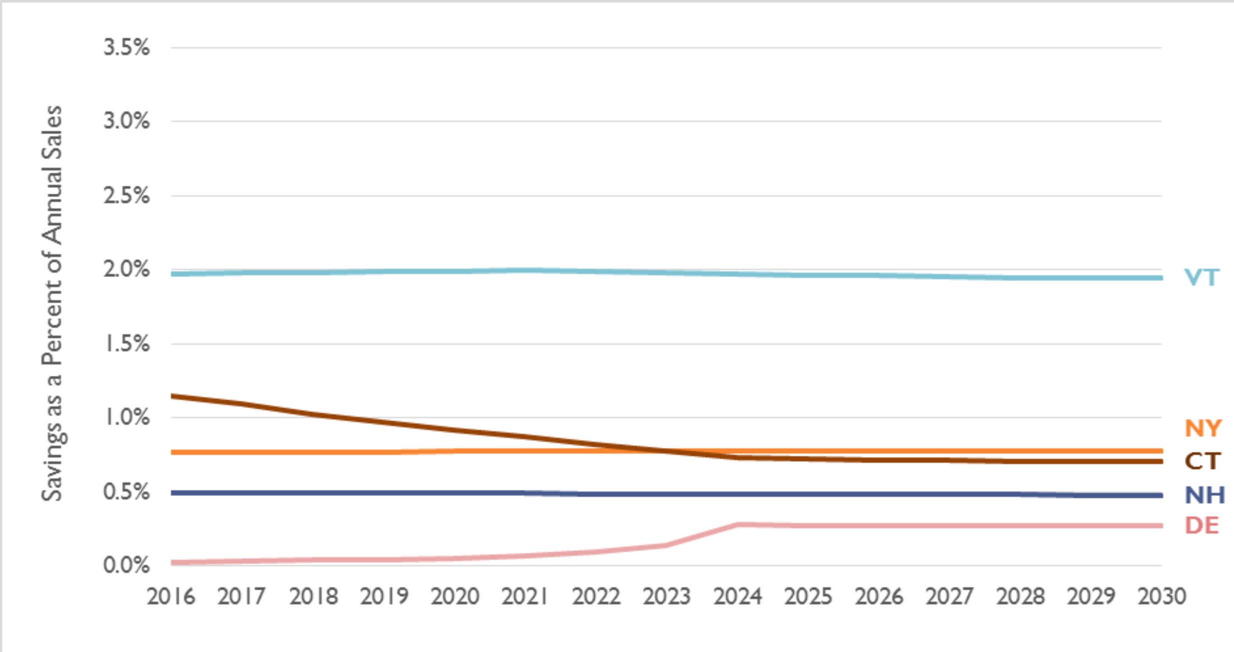
[16] White, D., et al. "State Energy Efficiency Embedded in Annual Energy Outlook Forecasts." 2013 Update. Available at http://synapse-energy.com/sites/default/files/SynapseReport.2013-11.0.EE-in-AEO-2013.12-094-Update_0.pdf.

Figure 12. Efficiency savings assumptions for RGGI states' without EERS requirements

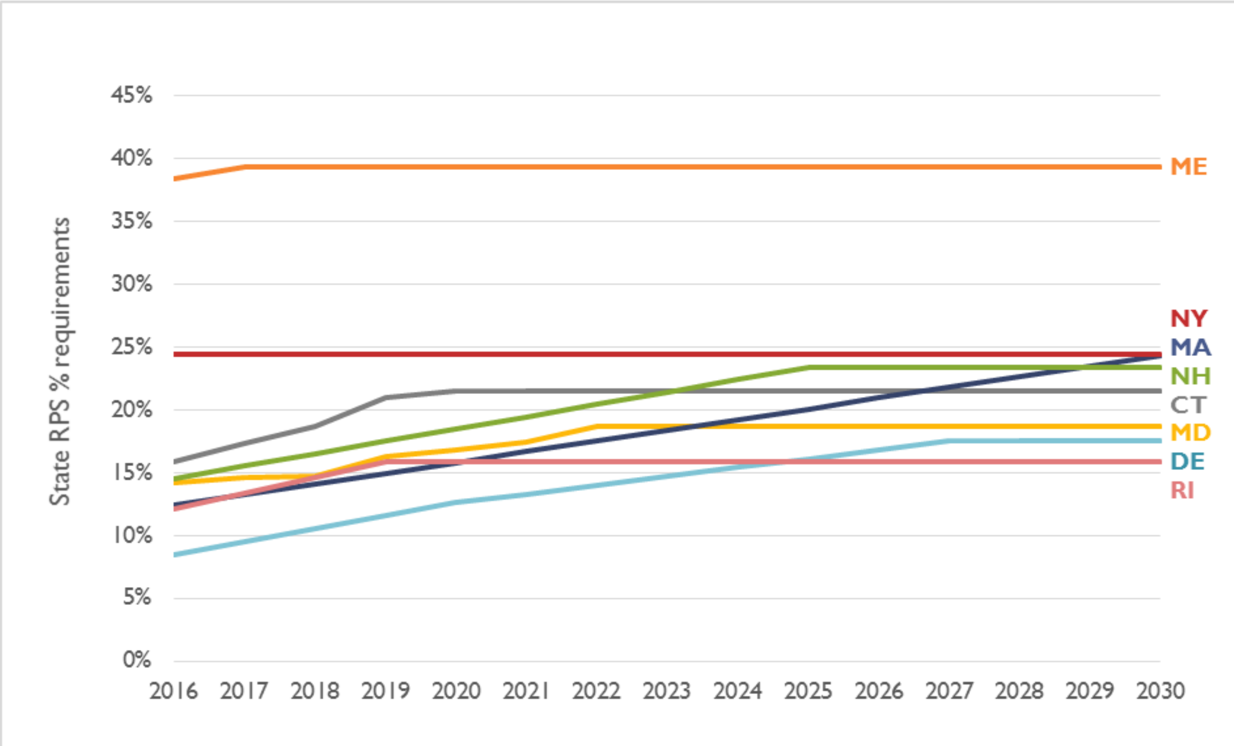


Sources: Connecticut Department of Energy and Environmental Protection's 2014 Integrated Resource Plan; Delmarva Power & Light Company's 2014 Integrated Resource Plan; 2016 New Hampshire Statewide Core Energy Efficiency Plan from NH Public Utilities Commission Docket DE14-216; 2014 NY incremental savings from EIA Form 861; Vermont Energy Investment Corporation's 2015-2017 Triennial Plan, prepared for the Vermont Public Service Board.

Renewable energy

All nine RGGI states have RPS policies that require utilities to procure a percentage of their electric retail sales in qualified forms of renewable generation. The share of renewables required and types of resources acceptable for classification as renewable varies from state to state. The RGGI states' total RPS requirements for all renewable resource types are summarized in Figure 13. Overall, renewable energy (including from existing generators) will account for 24 percent of baseline sales from the RGGI region by 2030.

Figure 13. RGGI states' RPS requirements



Notes: This figure displays total RPS-required share of sales for each state after adjusting for the sales in each state unaffected by the RPS requirement. For example, Massachusetts utilities' 2030 RPS requirement is 25 percent but affected utilities represent only 97 percent of the Commonwealth's retail sales. In this table, the RPS share of sales for Massachusetts as a whole is 24 percent in 2030. The trends shown in this figure do not account for any existing renewables already constructed. Vermont's RPS of 55 percent in 2017 and 75 percent in 2032 is assumed to be primarily met with existing energy supplied from Hydro Québec, and is not shown on this figure.

For New York, in addition to modeling the existing RPS (approximately 24 percent of retail electric sales by 2015), we modeled an additional 3,000 MW of utility PV added by 2023 and an additional 1,600 MW of wind added by 2029, in line with the New York State Energy Research and Development Authority's (NYSERDA) projections for capacity that will come online as a result of the it's *NY-Sun* and *Large-Scale Renewables* programs.[17,18]

Natural gas prices

Projected natural gas prices were derived from the AEO 2015 Reference case for the New England, Middle Atlantic, and South Atlantic regions. Figure 14 presents the projected price of natural gas in this

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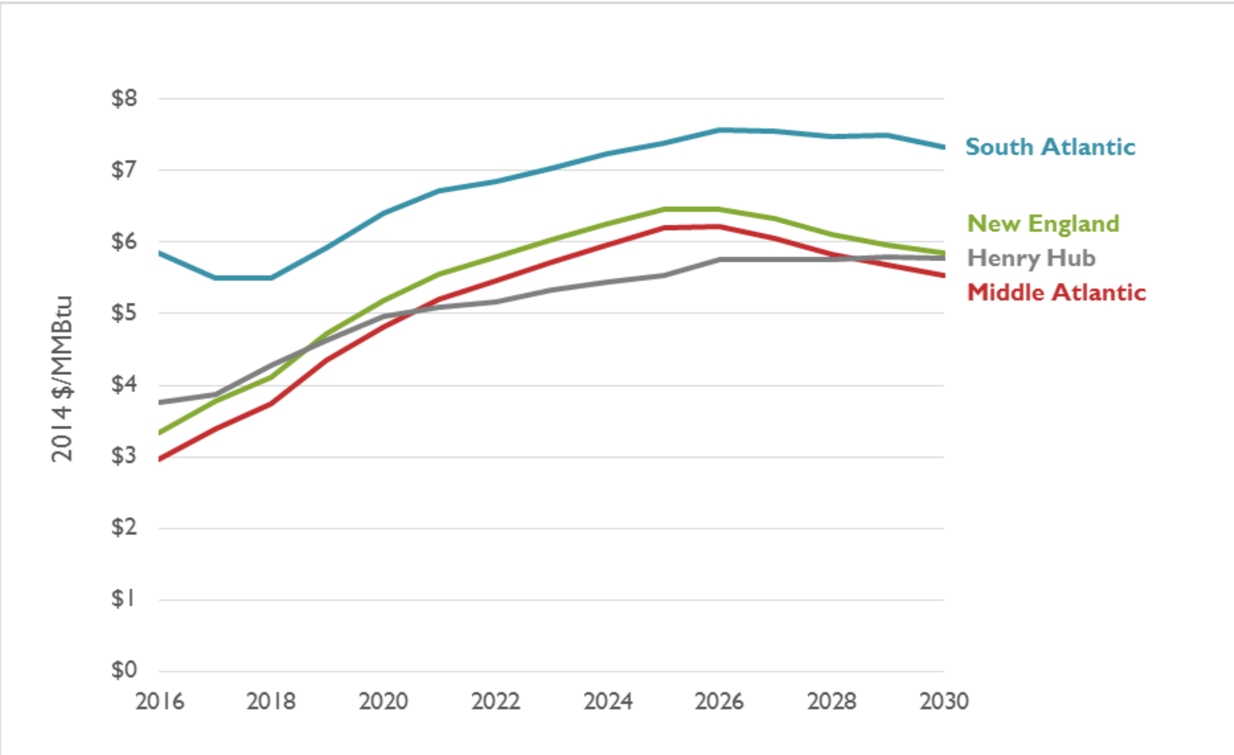
[17] New York State Energy Planning Board. 2015. *2015 New York State Energy Plan*. Available at: http://energyplan.ny.gov/-/media/nysenergyplan/2015-state-energy-plan.pdf.

[18] New York State Energy Research and Development Authority. 2015. *Large-Scale Renewable Energy Development in New York: Options and Assessment*. Available at: http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={26BD68A2-48DA-4FE2-87B1-687BEC1C629D}.

region out to 2030 and, for comparison, the projected Henry Hub spot-price from the same source. Note that ReEDS uses natural gas prices based on an endogenous supply-curve formulation, in which cost is a function of the quantity demanded with underlying supply curves calibrated to AEO Reference case forecasts.

Figure 14. Natural gas prices for the RGGI state regions



Source: Synapse Energy Economics, based on AEO 2015, Tables 3.1, 3.2, and 3.5.

Unit additions

A number of new natural gas units have been announced for the nine RGGI states. Table 6 presents a summary that includes: the state in which the units are coming online; the associated plant and utility; and each unit's capacity, anticipated in-service year, and generation technology. This list was developed by Sierra Club, Pace Energy and Climate Center, and Chesapeake Climate Action Network using sources that included the following:

- Unit additions reported in the 2014 edition of the EIA 860 database of generators currently under construction.
- Natural gas generators listed as currently under construction in the PJM Interconnection Queue. Where possible, data for these units was cross-checked with the EIA 860 2014 (even in cases where those generators have not yet begun construction, according to that dataset).

- New generators that have obligations in the New England capacity market for the periods of 2016-2017, 2017-2018, and 2018-2019.
- Generators that have completed the Class Year Facilities Study according to the 2015 NYISO Gold Book.
- Estimated incremental solar and wind capacity according to the 2015 NY State Energy Plan (NY-Sun initiative) and the 2015 NYSERDA Large-scale Renewables Report (LSR-incentivized wind).

Table 6. RGGI states' assumed unit additions

State	Plant	Utility	Nameplate Capacity (MW)	First Year of Operation	Fuel Type	Prime Mover	Unit Type
CT	Bridgeport Energy 1	Unknown	22	2018	Gas	GT	ISO-NE FCM
CT	CPV_Towantic	Unknown	725	2018	Gas	CC	ISO-NE FCM
CT	Subase Microgrid Project	CT Muni Electric Energy Coop	2	2016	Petroleum	IC	EIA 860
CT	Subase Microgrid Project	CT Muni Electric Energy Coop	2	2016	Petroleum	IC	EIA 860
CT	Subase Microgrid Project	CT Muni Electric Energy Coop	2	2016	Petroleum	IC	EIA 860
CT	Subase Microgrid Project	CT Muni Electric Energy Coop	2	2016	Petroleum	IC	EIA 860
CT	Wallingford 6 and 7	Unknown	90	2018	Gas	GT	ISO-NE FCM
DE	Garrison Energy Center	Garrison Energy Center	126	2015	Gas	CA	EIA 860
DE	Garrison Energy Center	Garrison Energy Center	235	2015	Gas	CT	EIA 860
MA	Belchertown SEd	Unknown	1	2018	Solar	PV	ISO-NE FCM
MA	Dartmouth Solar	Unknown	1	2018	Solar	PV	ISO-NE FCM
MA	East Bridgewater Solar Energy Project	Unknown	1	2016	Solar	PV	ISO-NE FCM
MA	Fisher Road Solar I	Unknown	2	2018	Solar	PV	ISO-NE FCM
MA	Harrington Street PV Project	Unknown	1	2016	Solar	PV	ISO-NE FCM
MA	Holliston	Unknown	0	2018	Solar	PV	ISO-NE FCM

State	Plant	Utility	Nameplate Capacity (MW)	First Year of Operation	Fuel Type	Prime Mover	Unit Type
MA	Indian Orchard Photovoltaic Facility	Unknown	1	2018	Solar	PV	ISO-NE FCM
MA	Indian Orchard Solar PV	Unknown	1	2016	Solar	PV	ISO-NE FCM
MA	Indian River Power Supply# LLC	Unknown	0	2018	Hydro	HY	ISO-NE FCM
MA	Landcraft	Unknown	1	2018	Solar	PV	ISO-NE FCM
MA	LSRHS	Unknown	0	2018	Solar	PV	ISO-NE FCM
MA	MAT-2 (MATEP Combined Cycle)	Unknown	14	2017	Gas	CC	ISO-NE FCM
MA	Medway Peaker – SEMARI	Unknown	195	2018	Gas	GT	ISO-NE FCM
MA	N/A	TerraForm Solar XVII	2	2015	Solar	PV	EIA 860
MA	N/A	TerraForm Solar XVII	3	2015	Solar	PV	EIA 860
MA	NFM Solar Power, LLC	Unknown	1	2016	Solar	PV	ISO-NE FCM
MA	Northfield Mountain 1	Unknown	12	2016	Hydro	PS	ISO-NE FCM
MA	Northfield Mountain 2	Unknown	12	2016	Hydro	PS	ISO-NE FCM
MA	Northfield Mountain 3	Unknown	12	2016	Hydro	PS	ISO-NE FCM
MA	Northfield Mountain 4	Unknown	12	2016	Hydro	PS	ISO-NE FCM
MA	Plymouth	Unknown	2	2018	Solar	PV	ISO-NE FCM
MA	Salem Harbor	NAES Salem Harbor	340	2017	Gas	CC	EIA 860
MA	Salem Harbor	NAES Salem Harbor	340	2017	Gas	CC	EIA 860
MA	Silver Lake Photovoltaic Facility	Unknown	0	2018	Solar	PV	ISO-NE FCM
MA	Southbridge Landfill Gas to Energy 17-18	Unknown	1	2017	Landfill Gas	IC	ISO-NE FCM
MA	Southbridge Landfill Gas to Energy 17-18	Unknown	1	2018	Landfill Gas	IC	ISO-NE FCM

State	Plant	Utility	Nameplate Capacity (MW)	First Year of Operation	Fuel Type	Prime Mover	Unit Type
MA	Treasure Valley- SE	Unknown	2	2018	Solar	PV	ISO-NE FCM
MA	Uxbridge	Unknown	1	2018	Solar	PV	ISO-NE FCM
MA	West Brookfield Solar	Unknown	0	2016	Solar	PV	ISO-NE FCM
MA	Westford Solar	Unknown	2	2018	Solar	PV	ISO-NE FCM
MA	WMA Chester Solar 1	Unknown	2	2018	Solar	PV	ISO-NE FCM
MD	Baltimore Ravens Facility	Baltimore Ravens	1	2015	Gas	IC	PJM Queue
MD	CNE at Cambridge MD	Constellation Solar Maryland	3	2015	Solar	PV	EIA 860
MD	CPV St Charles Energy Center	CPV Maryland LLC	215	2017	Gas	CT	PJM, EIA 860
MD	CPV St Charles Energy Center	CPV Maryland LLC	215	2017	Gas	CT	PJM, EIA 860
MD	CPV St Charles Energy Center	CPV Maryland LLC	316	2017	Gas	CA	PJM, EIA 860
MD	Keys Energy System	Genesis Power	736	2018	Gas	CC	PJM Queue
MD	Keys Energy System	Genesis Power	65	2018	Gas	GT	PJM Queue
MD	Mattawoman Energy Center	Mattawoman Energy, LLC	286	2018	Gas	CC	PJM, EIA 860
MD	Mattawoman Energy Center	Mattawoman Energy, LLC	286	2018	Gas	CC	PJM, EIA 860
MD	Mattawoman Energy Center	Mattawoman Energy, LLC	436	2018	Gas	CC	PJM, EIA 860
MD	Perryman	Constellation Power Source Generation	141	2015	Gas	GT	EIA 860
MD	Rockfish Solar	Rockfish Solar	10	2016	Solar	PV	EIA 860
MD	Wildcat Point Generation Facility	Old Dominion Electric Coop	310	2017	Gas	CT	PJM, EIA 860
MD	Wildcat Point Generation Facility	Old Dominion Electric Coop	310	2017	Gas	CT	PJM, EIA 860
MD	Wildcat Point Generation Facility	Old Dominion Electric Coop	493	2017	Gas	CA	PJM, EIA 860

State	Plant	Utility	Nameplate Capacity (MW)	First Year of Operation	Fuel Type	Prime Mover	Unit Type
ME	Saddleback Ridge Wind	Unknown	6	2017	Wind	WT	ISO-NE FCM
NH	Berlin Biopower	Unknown	7	2017	Biomass	ST	ISO-NE FCM
NH	Jericho Power	Jericho Power	14	2015	Wind	WT	EIA 860
NY	Berrians GT	NRG Energy	200	2017	Gas	CC	NY Gold Book
NY	Berrians GT II	NRG Energy, Inc.	79	2017	Gas	CC	NY Gold Book
NY	Berrians GT III	NRG Energy, Inc.	279	2019	Gas	CC	NY Gold Book
NY	CPV Valley Energy Center	CPV Valley, LLC	820	2016	Gas	CC	NY Gold Book
NY	Millbrook School	SolarCity Corporation	1	2015	Solar	PV	EIA 860
NY	Roaring Brook Wind	PPM Roaring Brook, LLC / PPM	78	2015	Wind	WT	NY Gold Book
NY	Taylor Biomass	Taylor Biomass Energy Mont., LLC	21	2017	MSW	Unk	NY Gold Book
NY	NY-Sun Initiative I	None	1,500	2020	Solar	PV	NY SEP
NY	NY-Sun Initiative I	None	1,500	2023	Solar	PV	NY SEP
NY	Wind-LSR I	None	800	2024	Wind	WT	NYSERDA
NY	Wind-LSR II	None	800	2029	Wind	WT	NYSERDA
RI	Central Power Plant	State of Rhode Island	2	2015	Gas	IC	EIA 860
RI	Johnston Solar	Half Moon Ventures	1	2015	Solar	PV	EIA 860
RI	Tiverton Power	Unknown	11	2018	Gas	GT	ISO-NE FCM

Sources: 2014 Form EIA-860 data, schedule 3, 'Generator Data' (Proposed, under construction units); PJM Interconnection Queue, accessed November 2015; ISO-NE Forward Capacity Market obligations 2016-2019; 2015 NYISO Gold Book; NY 2015 State Energy Plan; 2015 NYSERDA Large-scale Renewables Report.

Unit retirements and environmental retrofits

Table 7 on the following pages lists all announced unit retirements for the nine RGGI states. Retirement data is based on the 2014 edition of EIA's Form 860, supplemented by ongoing Synapse research. This table also indicates control technologies projected to be required at coal generators that will continue to operate through the study period. The cost of control technologies that will be installed at coal plants under existing federal environmental regulations other than the Clean Power Plan were estimated using the Synapse Coal Asset Valuation Tool (CAVT) (see Table 8 on the following page).[19] These expected new retrofits are only added in years in which specific units have not yet been retired. Note that all retirements and retrofits are assumed as inputs to both the baseline and the 40 percent reduction policy scenario scenarios.

[19] For more information, see also: Knight, P. and J. Daniel. 2015. "Forecasting Coal Unit Competitiveness – 2015 Update." Synapse Energy Economics. Available at: http://www.synapse-energy.com/sites/default/files/Forecasting-Coal-Unit-Competitiveness-14-021.pdf. CAVT is available at http://synapse-energy.com/tools/coal-asset-valuation-tool-cavt.

Table 7. RGGI states' anticipated unit retirements.

State	Plant Name	Nameplate Capacity (MW)	Fuel Type	2014 Capacity Factor	Retiring?	Moth-balling?	Re-powering?	Dry FGD	SCR	Baghouse	ACI	Cooling	CCR	Effluent
CT	Bridgeport Station 2	163	Coal	0%	2014									
CT	Bridgeport Station 3	400	Coal	24%								2019		
CT	Bridgeport Station 4	19	Oil	1%	2017									
CT	CJTS Energy Center UNIT1	0.2	Gas	23%	2014									
CT	CJTS Energy Center UNIT2	0	Gas	23%	2014									
CT	CJTS Energy Center UNIT3	0.2	Gas	23%	2014									
CT	CJTS Energy Center UNIT5	0	Gas	23%	2014									
CT	Covanta Wallingford Energy GEN1	11	Other	41%	2015									
CT	New Milford Gas Recovery GEN4	1	Other	50%	2015									
CT	South Norwalk Electric 6	1	Oil	0%	2014									
CT	Versailles Mill NO1	20	Gas	0%	2014									

State	Plant Name	Nameplate Capacity (MW)	Fuel Type	2014 Capacity Factor	Retiring?	Moth-balling?	Re-powering?	Dry FGD	SCR	Baghouse	ACI	Cooling	CCR	Effluent
DE	Indian River Generating Station 3	176.8	Coal	0%	2014									
DE	Indian River Generating Station 4	446	Coal	22%								2015	2019	2019
DE	McKee Run 1	18.8	Gas	0%	2017									
DE	McKee Run 2	19	Gas	0%	2017									
MA	Brayton Point 1	241	Coal	30%	2017									
MA	Brayton Point 2	241	Coal	35%	2017									
MA	Brayton Point 3	642.6	Coal	22%	2017									
MA	Brayton Point 4	476	Gas	2%	2017									
MA	Harris Energy Realty ALBA	0.3	Hydro	0%	2015									
MA	Harris Energy Realty ALBD	1	Hydro	0%	2015									
MA	Harris Energy Realty NONO	0.5	Hydro	0%	2015									
MA	Mass Inst Tech Cntrl Utilities/Cogen Plt CTG1	21	Gas	71%	2019									

State	Plant Name	Nameplate Capacity (MW)	Fuel Type	2014 Capacity Factor	Retiring?	Moth-balling?	Re-powering?	Dry FGD	SCR	Baghouse	ACI	Cooling	CCR	Effluent
MA	Mount Tom 1	136	Coal	0%	2014									
MA	Pilgrim Nuclear Power Station 1	670	Nuclear	98%	2019									
MA	Salem Harbor 1	81.9	Coal	0%	2014									
MA	Salem Harbor 2	82	Coal	0%	2014									
MA	Salem Harbor 3	165.7	Coal	15%	2014									
MA	Salem Harbor 4	476	Oil	1%	2014									
MD	Brandon Shores 1	685	Coal	42%									2019	2019
MD	Brandon Shores 2	685	Coal	37%									2019	2019
MD	C P Crane 1	190.4	Coal	11%	2020									
MD	C P Crane 2	209	Coal	17%	2020									
MD	Chalk Point LLC ST1	364	Coal	36%	2019									
MD	Chalk Point LLC ST2	364	Coal	43%	2019									

State	Plant Name	Nameplate Capacity (MW)	Fuel Type	2014 Capacity Factor	Retiring?	Moth-balling?	Re-powering?	Dry FGD	SCR	Baghouse	ACI	Cooling	CCR	Effluent
MD	Dickerson 2	196	Coal	23%	2019									
MD	Dickerson 3	196	Coal	23%	2019									
MD	Dickerson ST1	196	Coal	23%	2019									
MD	Goddard Steam Plant 1	6	Coal	19%	2014									
MD	Goddard Steam Plant 2	6.2	Coal	26%	2014									
MD	Herbert A Wagner 2	136	Coal	19%	2020									
MD	Herbert A Wagner 3	359	Coal	33%								2019	2019	2019
MD	Morgantown Generating Plant ST1	626	Coal	55%								2019	2019	2019
MD	Morgantown Generating Plant ST2	626	Coal	57%								2019	2019	2019
MD	Riverside 4	72	Gas	0%	2016									
MD	Riverside GT6	135	Gas	0%	2014									
ME	Bar Harbor 2	2	Oil	0%	2014									

State	Plant Name	Nameplate Capacity (MW)	Fuel Type	2014 Capacity Factor	Retiring?	Moth-balling?	Re-powering?	Dry FGD	SCR	Baghouse	ACI	Cooling	CCR	Effluent
ME	Bar Harbor 4	2	Oil	0%	2014									
ME	Medway IC1	2	Oil	0%	2015									
ME	Medway IC2	2	Oil	0%	2015									
ME	Medway IC3	2	Oil	0%	2015									
ME	Medway IC4	2	Oil	0%	2015									
NH	Merrimack 1	114	Coal	34%								2019		
NH	Merrimack 2	345.6	Coal	27%								2019		
NH	Nashua Plant UNT1	2	Other	20%	2014									
NH	Schiller 4	50	Coal	22%								2019		2019
NH	Schiller 5	50	Coal	71%								2019		2019
NH	Schiller 6	50	Coal	21%								2019		2019
NY	Al Turi 3010	1	Other	47%	2017									

State	Plant Name	Nameplate Capacity (MW)	Fuel Type	2014 Capacity Factor	Retiring?	Moth-balling?	Re-powering?	Dry FGD	SCR	Baghouse	ACI	Cooling	CCR	Effluent
NY	Auburn LFG Energy Facility 2	1.1	Other	35%	2014									
NY	C R Huntley Generating Station 67	200	Coal	29%	2016									
NY	C R Huntley Generating Station S68	200	Coal	40%	2016									
NY	Cayuga Operating Company 1	155	Coal	30%								2019	2019	2019
NY	Cayuga Operating Company 2	167.2	Coal	35%			2018		2018					
NY	Danskammer Generating Station 3	147	Coal	0%			2014							
NY	Danskammer Generating Station 4	239.4	Coal	0%			2014							
NY	Dunkirk Generating Plant 1	96	Coal	0%				2020			2016	2019	2019	2019
NY	Dunkirk Generating Plant 2	96	Coal	44%		2015								
NY	Dunkirk Generating Plant 3	218	Coal	0%		2015								
NY	Dunkirk Generating Plant ST4	217.6	Coal	0%		2015								
NY	Entenmanns Energy Center 1	1	Gas	15%	2014									

State	Plant Name	Nameplate Capacity (MW)	Fuel Type	2014 Capacity Factor	Retiring?	Moth-balling?	Re-powering?	Dry FGD	SCR	Baghouse	ACI	Cooling	CCR	Effluent
NY	Entenmanns Energy Center 2	1.3	Gas	15%	2014									
NY	Entenmanns Energy Center 3	1	Gas	15%	2014									
NY	Entenmanns Energy Center 4	1.3	Oil	15%	2014									
NY	Hawkeye Energy Greenport LLC U-01	54	Oil	3%	2018									
NY	James A Fitzpatrick 1	882	Nuclear	75%	2017									
NY	Monroe Livingston Gas Recovery GEN2	1	Other	61%	2016									
NY	Oceanside Energy OS3	0.7	Other	32%	2015									
NY	Rochester 9 2	19	Gas	0%	2014									
NY	S A Carlson 5	24.5	Coal	2%										
NY	S A Carlson 6	25	Coal	21%										
NY	Somerset Operating Co LLC 1	655.1	Coal	31%								2019	2019	2019
NY	WPS Power Niagara GEN1	56	Coal	18%				2020			2016		2019	2019
VT	Gilman Mill GEN5	4	Biomass	0%	2014									
VT	Vermont Yankee 1	563	Nuclear	103%	2014									

Note: Some capacity factors may exceed 100 percent based on discrepancies in utility reporting to EIA. Source: Synapse Energy Economics, based on EIA Form 860 data.

Appendix C: The RGGI 40 Percent Emission Reduction Policy Scenario

To design a policy scenario that would achieve 2030 all-sector energy-related CO_2 emissions that are 40 percent lower than 1990 levels, Synapse examined a discrete set of emission reduction measures for which previous research has demonstrated a potential for significant emission reduction and are known to be among the most cost-effective strategies for achieving remission reductions . For each measure, Synapse estimated its net costs per ton of CO_2 reduction in 2030 and its potential for emission reductions in tons in 2030. From these measures were chosen—in order of cost—just enough to achieve the target emission reductions.

After accounting for expected emission reductions in the transportation sector, ReEDS was programmed to achieve the remaining reductions in the electric sector by (1) setting new, more stringent (lower) RGGI caps, and (2) setting minimum additions (with respect to 2015) of onshore wind and utility PV that ReEDS must build within the RGGI states. This second constraint—together with the limitation in both scenarios that RGGI states may only trade emissions allowances within their group—avoids leakage of emissions out of RGGI region. Note that these two constraints, taken together, interact in the same way that current day RGGI caps work together with state RPS and EERS policies to achieve emission reductions.

Building and industrial sector emissions, and all assumptions not mentioned here, are the same in both scenarios.

Shift measures

To determine the lowest-cost emission reduction to achieve the incremental 87 million short tons of reductions needed beyond the RGGI baseline, Synapse used a supply—or "marginal abatement"—curve methodology. A supply curve analysis sets out potential emission reduction measures—or "shifts"—in order according to each measure's cost-per-ton of avoided CO_2. Shift measures are then selected for inclusion in the 40 percent reduction policy scenario in order of their costs, from least to most expensive, until their potential emission reductions are sufficient to meet the target. The per-ton cost of each shift measure includes both the costs of achieving the new measure and the costs avoided by not taking the same actions as in the RGGI baseline. (For example, the cost of a shift to electric vehicles is offset by savings from gasoline not purchased.) The per-ton costs of each shift also include a value of avoided climate damages equal to the federal social cost of carbon: $51 per short ton in 2030.[20]

[20] U.S. EPA. 2015. "Technical Support Documents: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866." Revised July 2015 by the Interagency Working Group on Social Cost of Carbon. Available at https://www.whitehouse.gov/sites/default/files/omb/inforeg/scc-tsd-final-july-2015.pdf.

Synapse researched five potential shift measures for use in this analysis, and ultimately brought four of these measures into our supply curve:

- **Electric vehicles:** By 2030, 35 percent of existing light-duty vehicle trips under 100 miles are assumed to be replaced with trips taken in plug-in battery electric vehicles.[21] Emissions are reduced by avoiding gasoline consumption. Electric vehicles are assumed to be powered by additions of new utility photovoltaic (PV) generation; for each new kWh shifted from the transportation sector to the electric sector, an incremental kWh of utility PV generation is also added. One-hundred percent of this shift's emission reduction potential was applied to the 40 percent emissions reduction policy scenario, providing 28 million short tons of emission reductions. This shift follows Scenario 8 from the Federal Highway Administration's EV project and includes an assumed 80 percent of charging occurring at home and gas tax revenues remaining unaffected.[22] For comparison, a recent Georgetown University study of potential electric vehicle adoption in 12 Northeast states found transportation emission reductions of 29-40 percent by 2030 and consumer savings of $3.6-18 billion over 15 years.[23]
    - **Costs:** Incremental electricity consumption at the AEO 2015 wholesale price of energy,[24] state-level subsidies associated with direct incentives for electric vehicles at the level of current RGGI states are phased out by 2020, state-level subsidies associated with spurring public charging stations at the level of current RGGI states are continued through 2030 [25]
    - **Avoided Costs:** Gasoline purchases,[26] social cost of carbon[27]
- **Energy efficiency:** Electric savings in MWh from energy efficiency programs and measures reduce emissions by making the same amount of MWh of fossil fuel-fired generation unnecessary. Energy efficiency savings in the 40 percent emission reduction policy scenario are assumed to be equal to each RGGI state achieving the savings

[21] This shift measure does not include potential emission reductions as a result of plug-in hybrid vehicles or other types of plug-in vehicles.

[22] U.S. Federal Highway Administration. 2015. "Feasibility and Implications of Electric Vehicle (EV) Deployment and Infrastructure Development." Available at: http://www.fhwa.dot.gov/environment/climate_change/mitigation/publications_and_tools/ev_deployment/es.cfm.

[23] Pacyniak, G., K. Zyla, V. Arroyo, M. Goetz, C. Porter, and D. Jackson. 2015. "Reducing Greenhouse Gas Emissions from Transportation: Opportunities in the Northeast and Mid-Atlantic." Georgetown Climate Center with Cambridge Systematics. Available at: http://www.georgetownclimate.org/five-northeast-states-and-dc-announce-they-will-work-together-to-develop-potential-market-based-poli.

[24] AEO 2015. Tables 3.1, 3.2, and 3.5. Available at: http://www.eia.gov/forecasts/aeo/.

[25] Additional information on current EV subsidies is available from the International Council on Clean Transporation at http://www.theicct.org/sites/default/files/publications/SupportEVsUScities_201510.pdf.

[26] AEO 2015. Tables 3.1, 3.2, and 3.5. Available at: http://www.eia.gov/forecasts/aeo/.

[27] "Technical Support Documents: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866." Revised July 2015. Interagency Working Group on Social Cost of Carbon, United States Government. Available at https://www.whitehouse.gov/sites/default/files/omb/inforeg/scc-tsd-final-july-2015.pdf.

assumed for Massachusetts in the RGGI baseline,[28] or a region-wide average of 3 percent annual incremental savings by 2030. Emissions are assumed to be avoided at the emission rate of the marginal generator. One-hundred percent of this shift's emission reduction potential (or 36 TWh by 2030) was applied to the 40 percent emission reduction policy scenario, providing an estimated 17 million short tons of emission reductions.

  - **Costs:** Utility-side energy efficiency program costs (including costs covering administration, marketing, incentives, and other utility-side costs)[29]
  - **Avoided Costs:** Social cost of carbon, avoided capacity, transmission, and distribution per AESC 2015[30]

- **Onshore wind:** Electric generation from economically achievable onshore wind displaces generation from existing fossil resources. Emissions are assumed to be avoided at the emission rate of the marginal generator. One-hundred percent of this shift's emission reduction potential (or 60 TWh) was applied to the 40 percent emission reduction policy scenario, providing an estimated 27 million short tons of emission reductions. This shift is based on costs and generation potential included in NREL's July 2015 study "Estimating Renewable Energy Economic Potential in the United States: Methodology and Initial Results."[31]
  - **Costs:** Levelized production cost of onshore wind generation
  - **Avoided Costs:** Social cost of carbon; avoided energy, capacity, transmission, and distribution per AESC 2015
- **Utility-scale PV:** Electric generation from economically achievable utility-scale PV units displaces generation from existing fossil resources. Emissions are assumed to be avoided at the emission rate of the marginal generator. Less than 3 percent of this shift's emission reduction potential (or 34 TWh) was applied to the 40 percent emission reduction policy scenario, providing an estimated 15 million short tons of emission reductions. An additional 1.3 percent (or 18 TWh) of utility-scale PV potential was included in the 40 percent emission reduction policy scenario to support new demand for electricity to power electric vehicles. This shift is based on costs and generation potential included in NREL's July 2015 study "Estimating Renewable Energy Economic Potential in the United States: Methodology and Initial Results."

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[28] MassSave. 2015. "2016-2020 Massachusetts Joint Statewide Three-Year Electric and Gas Energy Efficiency Plan." Massachusetts Energy Efficiency Advisory Council. Available at http://ma-eeac.org/wordpress/wp-content/uploads/Exhibit-1-Gas-and-Electric-PAs-Plan-2016-2018-with-App-except-App-U.pdf.

[29] Program costs are $0.40 per kilowatt-hour based on the average program cost for RGGI states historically.

[30] Hornby, R. et al. 2015. "Avoided Energy Supply Costs in New England: 2015 Report - Revised." Avoided Energy Supply Component Study Group. Available at: http://www.ct.gov/deep/lib/deep/energy/aescinnewengland2015.pdf.

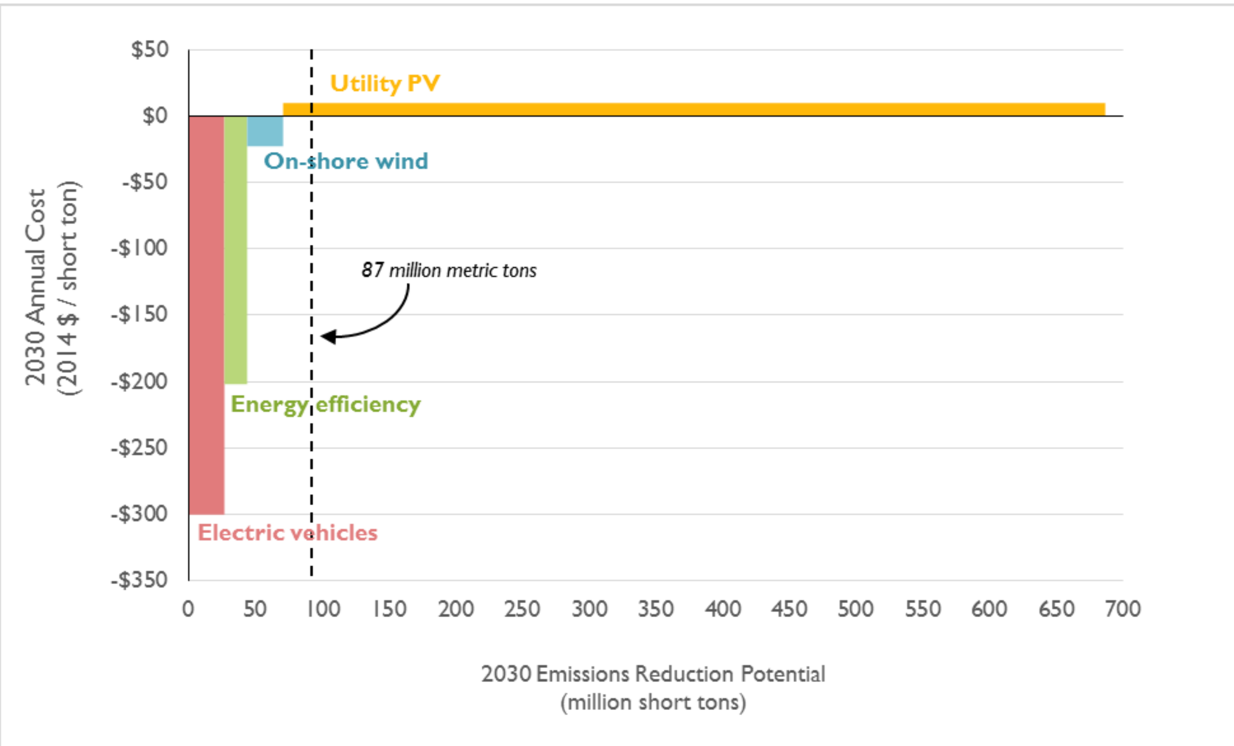
[31] Brown A. et al. 2015. "Estimating Renewable Energy Economic Potential in the United States: Methodology and Initial Results." National Renewable Energy Laboratory (NREL). Available at: http://www.nrel.gov/docs/fy15osti/64503.pdf.

- **Costs:** Levelized production cost of utility-scale solar generation
- **Avoided Costs:** Social cost of carbon; avoided energy, capacity, transmission, and distribution per AESC 2015

- **Increased long-distance rail usage:** By 2030, 14.4 million miles of long-distance light-duty vehicle trips have the potential to be replaced by trips taken on Amtrak's Northeast Corridor. This shift's cost was several orders of magnitude higher than the other potential shifts and was not included in the supply curve analysis. This shift is based on Alternative I in the November 2015 "NEC Futures" report.[32]

Figure 15 presents the supply curve used to compare these shift measures in terms of relative costs per ton and relative emission reduction potentials. Note that three of the shifts (electric vehicles, energy efficiency, and onshore wind) have negative net costs. Even after accounting for the construction and operation of these new low-carbon technologies, their benefits outweigh their costs.

Figure 15. Supply curve of emission reduction shift measures in 2030



Source: Synapse Energy Economics.

[32] U.S. Department of Transportation Federal Railroad Administration. 2015. "NEC Future: Tier 1 Draft Environmental Impact Statement." Available at: http://www.necfuture.com/tier1_eis/deis/.

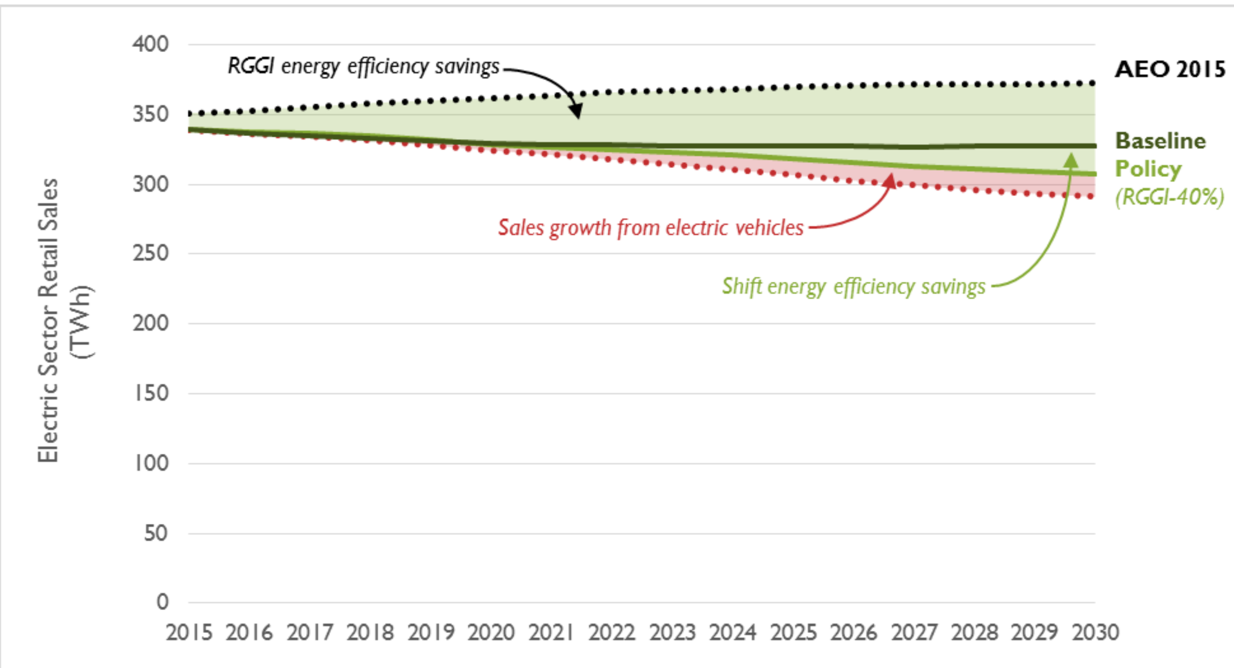
Changes to ReEDS assumptions

ReEDS modeling of the 40 percent emission reduction policy scenario begins with the RGGI baseline scenario in ReEDS and makes just a few changes to it in order to achieve the emission reduction goal. Note that ReEDS' build out of new renewables and emission impacts differs from that presented in the supply curve analysis. The supply curve analysis is a rough approximation. The ReEDS analysis is more complex and detailed, considering economic dispatch of electric generators and interaction among state both within and outside of the RGGI region.

ReEDS modeling inputs to the 40 percent emission reduction policy scenario are identical to the RGGI baseline scenario with three exceptions:

1. Retail electric sales are lower throughout the modeling period (see Figure 16). In 2030, the combination of energy efficiency savings (reducing sales) and new electric demand to power light-duty vehicles (increasing sales) lowers retails sales in the 40 percent emission reduction policy scenario by 6 percent, compared to the RGGI baseline.

Figure 16. Retail electric sales in the RGGI baseline and 40 percent emission reduction policy scenario



2. The model is instructed to build additional new renewables in RGGI states. These inputs are minimum additions of onshore wind and utility PV in the 40 percent emission reduction policy case with respect to 2015. Table 8 displays the combined effect of inputs determined by our supply curve analysis and the model's dynamic additions of capacity based on the economics of each resources' expected costs. The ReEDS model chooses a build out of new resources that is both consistent with the constraints entered by the modeler and provides the lowest system costs.

Table 8. 2030 total renewable capacity in the 40 percent emission reduction policy scenario (GW)

	CT	DE	MA	MD	ME	NH	NY	RI	VT	Total
Wind	0.2	0.0	0.4	0.9	0.6	1.3	7.1	0.0	2.4	12.8
Solar	2.9	2.8	4.7	3.0	5.8	2.3	7.8	1.2	1.3	31.8

Source: Synapse Energy Economics.

3. RGGI electric sector emission caps are more stringent (lower) than in the RGGI baseline. RGGI caps in the 40 percent emission reduction policy scenario are gauged to meet the all-sector 2030 reduction target of 40 percent, after taking into consideration the emission reductions achieved in the transportation sector from the transition to electric vehicles.

Appendix D: Economic and Employment Model

We estimated the job impacts using IMPLAN for each RGGI state and the region as a whole.[33] For each state, this modeling captures the impacts from spending in state and on the rest of the region. The assumed spending in each RGGI state comes from following activities:

- Construction of generating resources, transmission, energy efficiency installations, and new electric vehicle charging infrastructure
- Operations of energy resources
- Avoided gas station activity displaced by electric vehicles
- Consumer and business re-spending of electricity and transportation cost savings

For the electric sector, we developed customized inputs for the IMPLAN model relying in part on NREL's JEDI model.[34] For each resource, we estimated the portion of the investment spent on materials versus labor. Impacts from household spending and gas stations were more straightforward since these industries directly correspond to IMPLAN sectors. The analysis results in impacts of the following types:

- **Direct impacts** include jobs for contractors, construction workers, plant operators and automobile manufacturers. We developed these estimates using the amount of investment, the share of that investment spent on labor for each resource, and industry-specific wages.

- **Indirect impacts** include jobs that support the direct activities. For instance, an investment in a new wind farm not only creates jobs at the wind farm, but also down the supply chain, increasing jobs for turbine and other component manufacturers. We adjusted the IMPLAN model's base resource spending allocation assumptions for the entire electric industry based on NREL data on requirements for each individual resource.

- **Induced impacts** result from employees in newly created direct and indirect jobs spending their paychecks locally on restaurants, car repairs, and countless other consumer goods and services. Induced impacts also come from customer savings on energy spending, which are spent on the same broad range of goods and services.

[33] IMPLAN is a commercial model developed by IMPLAN Group PLC. Information on IMPLAN is available at: http://implan.com/

[34] NREL. *Jobs and Economic Development Impact (JEDI) Models.* Last accessed December 16, 2015. Available at: http://www.nrel.gov/analysis/jedi/about_jedi.html.

APPENDIX E: STATE EMISSION REDUCTION TARGETS

Table 9. State greenhouse gas emission reduction targets with citations, 2030 and 2050

State	2030 Target	2050 Target	Sources
Connecticut	35-45% below 1990	80% below 2001	2030: Conf. of New England Govs. Resolution 39-1 2050: C.G.S. 22a-200a (enacted by H.B. 5600) (https://www.cga.ct.gov/2008/ACT/PA/2008PA-00098-R00HB-05600-PA.htm)
Delaware	30% below 2008*	No target	*Recommended target. See Climate Framework for Delaware (Dec. 31, 2014) (http://www.dnrec.delaware.gov/energy/Documents/The%20Climate%20Framework%20for%20Delaware.pdf)
Maine	35-45% below 1990	75-80% below 2003	2030: Conf. of New England Govs. Resolution 39-1 "Long-term" target; date not specified: Maine Rev. Stat. ch. 3-A § 576(3) (enacted by PC 2003, C. 237) (http://legislature.maine.gov/statutes/38/title38sec576.html).
Maryland	40% below 2006	Up to 90% below 2006	2030: Recommendation of the Maryland Commission on Climate Change (Oct. 29, 2015) 2050: Md. Env. Code § 2-1201 (2009) (http://law.justia.com/codes/maryland/2013/article-gen/section-2-1201/)
Massachusetts	35-45% below 1990	80% below 1990	2030: Conf. of New England Govs. Resolution 39-1 2050: Mass.Gen.L. ch. 21N § 3(b) (https://malegislature.gov/Laws/GeneralLaws/PartI/TitleII/Chapter21N/Section3)
New Hampshire	35-45% below 1990	80% below 1990	2030: Conf. of New England Govs. Resolution 39-1 2050: 2009 New Hampshire Climate Action Plan (http://des.nh.gov/organization/divisions/air/tsb/tps/climate/action_plan/documents/nhcap_final.pdf)
New York	40% below 1990[b]	80% below 1990	2030: 2015 New York State Energy Plan (http://energyplan.ny.gov/Plans/2015). "Energy Sector" only—excludes agriculture 2050: Executive Order No. 24 (2009) (http://www.dec.ny.gov/energy/71394.html)
Rhode Island	35-45% below 1990	80% below 1990	2030: Conf. of New England Govs. Resolution 39-1 2050: Resilient Rhode Island Act of 2014, Sec. 42-6.2-2 (http://webserver.rilin.state.ri.us/Statutes/TITLE42/42-6.2/42-6.2-2.HTM)
Vermont	35-45% below 1990	75% below 1990	2030: Conf. of New England Govs. Resolution 39-1 2050: 10 V.S.A. § 578 (enacted by S. 259) (http://www.leg.state.vt.us/docs/legdoc.cfm?URL=/docs/2006/acts/ACT168.HTM)

APPENDIX F: DETAILED RESULT TABLES

Table 10. Difference in job-years by state and resource between the 40 percent emission reduction policy and baseline scenarios

2020	CT	DE	MA	MD	ME	NH	NY	RI	VT	Total
Coal	0	-29	0	-478	0	0	-41	0	0	-549
Biomass	0	0	0	0	0	0	0	0	-16	-16
Natural Gas	-499	3	-433	-116	-307	-234	-671	-93	-8	-2,358
Energy Efficiency	2,196	563	213	1,060	593	708	7,760	77	316	13,486
Renewables	2,560	2,841	4,886	1,205	7,218	3,479	-5,555	1,113	3,397	21,143
Nuclear	0	0	0	0	0	0	0	0	0	0
Hydro	0	0	0	0	0	0	0	0	0	0
Transmission	22	0	9	121	0	0	399	0	370	920
Transportation	-2	-3	-12	-6	-3	-4	-34	-2	-1	-67
Savings	173	-1,522	151	2,246	-1,955	-1,662	-697	-244	-1,447	-4,956
Total	4,450	1,854	4,814	4,031	5,546	2,287	1,159	851	2,612	27,604

2025	CT	DE	MA	MD	ME	NH	NY	RI	VT	Total
Coal	0	-219	0	-1,091	0	-1	-283	0	0	-1,595
Biomass	-63	0	0	0	-22	0	0	0	-30	-115
Natural Gas	-920	-28	-1,106	-628	-532	-473	-2,893	-304	-1	-6,885
Energy Efficiency	4,312	1,069	-42	3,143	537	1,443	15,995	45	357	26,859
Renewables	2,611	2,202	4,616	2,191	5,650	2,236	9,284	976	2,750	32,515
Nuclear	0	0	0	0	0	0	0	0	0	0
Hydro	0	0	0	0	0	0	0	0	-30	-30
Transmission	0	0	31	0	0	359	31	0	923	1,345
Transportation	46	4	50	79	20	12	-4	2	7	216
Savings	2,127	-1,639	6,898	9,518	-2,374	-1,254	9,743	593	-3,417	20,194
Total	8,112	1,389	10,446	13,212	3,279	2,323	31,872	1,312	559	72,504

2030	CT	DE	MA	MD	ME	NH	NY	RI	VT	Total
Coal	0	-210	0	-1,809	0	-3	-299	0	0	-2,322
Biomass	-21	0	0	-261	-118	0	0	0	-14	-414
Natural Gas	-1,586	95	-1,350	-321	-524	-1,434	-15,648	-276	-236	-21,281
Energy Efficiency	4,114	1,614	61	2,728	498	1,846	17,670	60	345	28,937
Renewables	2,270	2,031	3,216	-13,400	5,590	2,442	4,121	903	2,539	9,712
Nuclear	0	0	0	0	0	0	0	0	0	0
Hydro	0	0	0	0	0	0	44	-10	28	62
Transmission	487	0	3,547	1	-12	0	6,028	0	343	10,393
Transportation	11	-9	-30	14	-6	-11	-139	-6	-3	-179
Savings	4,711	-2,441	12,420	19,913	-3,204	-61	17,307	988	-4,038	45,594
Total	9,986	1,079	17,864	6,864	2,224	2,779	29,082	1,658	-1,036	70,502

Source: Synapse Energy Economics.

Table 11. Difference in million short tons CO_2 emissions by state and resource between the 40 percent emission reduction policy and baseline scenarios

2020	CT	DE	MA	MD	ME	NH	NY	RI	VT	Total
Coal	0	0	0	-6	0	0	-1	0	0	-7
Natural Gas	-1	0	-1	0	-1	-1	-2	0	0	-6
Petroleum	0	0	0	0	0	0	0	0	0	0
Other Electric	0	0	0	0	0	0	0	0	0	0
Transportation	-1	0	-1	-1	0	0	-2	0	0	-6
Buildings	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0
Total	-1	-1	-2	-7	-1	-1	-5	0	0	-19

2025	CT	DE	MA	MD	ME	NH	NY	RI	VT	Total
Coal	0	-2	0	-13	0	0	-3	0	0	-18
Natural Gas	-2	0	-3	-2	-1	-1	-8	-1	0	-18
Petroleum	0	0	0	0	0	0	0	0	0	0
Other Electric	0	0	0	0	0	0	0	0	0	0
Transportation	-2	-1	-3	-4	-1	-1	-6	0	0	-18
Buildings	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0
Total	-3	-3	-6	-18	-2	-2	-18	-1	0	-54

2030	CT	DE	MA	MD	ME	NH	NY	RI	VT	Total
Coal	0	-2	0	-17	0	0	-2	0	0	-21
Natural Gas	-4	0	-4	-4	-1	-3	-21	-1	0	-38
Petroleum	0	0	0	0	0	0	0	0	0	0
Other Electric	0	0	0	0	0	0	0	0	0	0
Transportation	-3	-1	-5	-6	-1	-1	-9	-1	-1	-28
Buildings	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0
Total	-6	-2	-9	-28	-3	-4	-32	-2	-1	-87

Source: Synapse Energy Economics.

Table 12. Difference in total costs (2014 $ million) by region and resource between the 40 percent emission reduction policy and baseline scenarios.

2020	New England	New York	DE + MD	Total
Coal	$0	-$14	-$165	-$179
Biomass	-$1	$0	$0	-$1
Natural Gas	-$527	-$216	-$166	-$909
Energy Efficiency	$93	$152	$26	$271
Renewables	$1,606	$421	$373	$2,401
Nuclear	$0	$0	$0	$0
Hydro	$0	$0	$0	$0
Transmission	$7	$8	$2	$17
Electric system subtotal	$1,178	$351	$71	$1,600
Transportation	-$351	-$281	-$170	-$803
RGGI collections	-$15	-$23	$3	-$35
EE participant spending	$74	$141	$21	$236
Total	$885	$190	-$76	$999

2025	New England	New York	DE + MD	Total
Coal	$0	-$96	-$426	-$522
Biomass	-$7	$0	$0	-$7
Natural Gas	-$1,066	-$929	-$428	-$2,423
Energy Efficiency	$294	$580	$142	$1,016
Renewables	$3,307	$672	$740	$4,718
Nuclear	$0	$0	$0	$0
Hydro	-$2	$0	$0	-$2
Transmission	$85	-$2	$2	$85
Electric system subtotal	$2,611	$224	$30	$2,866
Transportation	-$2,471	-$2,009	-$1,351	-$5,832
RGGI collections	$40	$102	$214	$356
EE participant spending	$241	$586	$145	$973
Total	$421	-$1,096	-$962	-$1,637

2030	New England	New York	DE + MD	Total
Coal	$0	-$101	-$655	-$757
Biomass	-$17	$0	-$18	-$35
Natural Gas	-$1,577	-$2,449	-$628	-$4,655
Energy Efficiency	$392	$1,051	$256	$1,699
Renewables	$4,428	$1,407	$540	$6,375
Nuclear	$0	$0	$0	$0
Hydro	-$1	$0	$0	-$1
Transmission	$212	$109	$2	$323
Electric system subtotal	$3,436	$16	-$502	$2,950
Transportation	-$4,117	-$3,335	-$2,377	-$9,829
RGGI collections	-$41	$243	$331	$533
EE participant spending	$381	$1,064	$258	$1,703
Total	-$342	-$2,012	-$2,290	-$4,643

Note: Negative values indicate net savings in the 40 percent emission reduction policy scenario
Source: Synapse Energy Economics.

Table 13. Total electric generating capacity in gigawatts by state and resource in the 40 percent emission reduction policy scenario

2020	CT	DE	MA	MD	ME	NH	NY	RI	VT	Total
Coal	0.4	0.4	0.0	3.0	0.0	0.5	0.8	0.0	0.0	5.2
Natural Gas	4.7	1.9	6.5	6.4	1.4	1.3	13.8	1.7	0.1	37.8
Nuclear	2.1	0.0	0.0	1.7	0.0	1.2	4.4	0.0	0.0	9.4
Other	2.1	0.9	4.4	3.3	1.9	1.3	13.9	0.0	0.4	28.2
Solar	1.0	1.2	2.0	1.1	2.3	0.9	2.1	0.4	0.5	11.4
Wind	0.1	0.0	0.2	0.7	0.6	0.8	3.0	0.0	0.7	6.2
Total	10.4	4.4	13.1	16.2	6.1	6.0	37.9	2.2	1.8	98.2

2025	CT	DE	MA	MD	ME	NH	NY	RI	VT	Total
Coal	0.0	0.1	0.0	3.0	0.0	0.0	0.7	0.0	0.0	3.8
Natural Gas	4.5	1.9	6.4	6.0	1.4	1.2	12.8	1.7	0.1	35.9
Nuclear	2.1	0.0	0.0	1.7	0.0	1.2	4.4	0.0	0.0	9.4
Other	2.0	0.7	4.2	3.2	1.9	1.3	13.4	0.2	0.4	27.2
Solar	1.9	2.0	3.5	2.0	4.1	1.6	5.0	0.8	1.0	21.9
Wind	0.2	0.0	0.4	0.9	0.6	1.3	5.2	0.0	1.7	10.3
Total	10.7	4.7	14.4	16.9	7.9	6.6	41.5	2.8	3.2	108.6

2030	CT	DE	MA	MD	ME	NH	NY	RI	VT	Total
Coal	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0
Natural Gas	4.4	1.8	6.3	5.7	1.4	1.2	11.2	1.7	0.0	33.7
Nuclear	2.1	0.0	0.0	1.7	0.0	1.2	3.1	0.0	0.0	8.1
Other	1.0	0.2	3.7	2.5	1.9	0.9	10.7	0.2	0.5	21.4
Solar	2.9	2.8	4.7	3.0	5.8	2.3	7.8	1.2	1.3	31.8
Wind	0.2	0.0	0.4	0.9	0.6	1.3	7.1	0.0	2.4	12.8
Total	10.6	4.9	15.1	14.7	9.6	6.8	39.9	3.1	4.1	108.8

Source: Synapse Energy Economics.