Report on:

Economic Impacts of Proposed Northeast Regional Greenhouse Gas Initiative

Prepared for:

The Staff Working Group of the
Northeast Regional Greenhouse Gas Initiative

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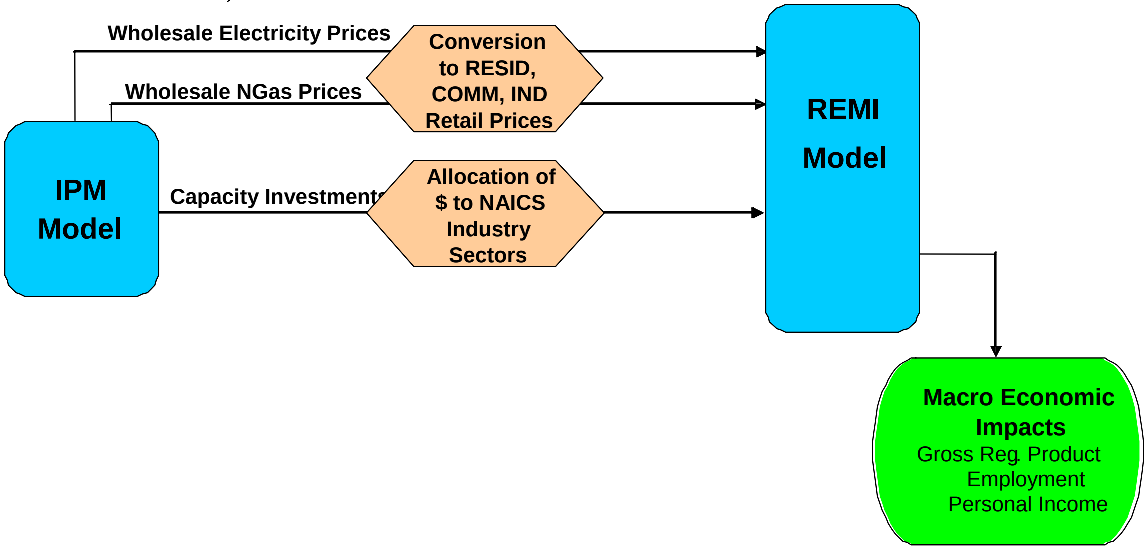
1 INTRODUCTION

Overview

Consideration of proposed regional greenhouse gas emission policies on electric generators 250 MW or larger for the 9-state *RGGI* region [comprised of the six New England states *plus* New York, New Jersey and Delaware] involved a study of the economic impacts that would result from policy-induced changes on the electricity supply market. The economic impact analysis that is documented in this report is built upon *predictions* of how the electricity supply market will respond over the period 2008 – 2035 under various carbon-cap policies, information which was derived from the ICF Consulting IPM Model (documented in a separate report), and an economic simulation forecasting model, developed by REMI.

Each of the modeling tools had a unique and crucial role in the overall policy evaluation. The IPM Model was enlisted for the primary analysis of each proposed carbon-cap policy, as well as for the base case outlook(s) in the regional energy market. Of particular relevance to the economic impact modeling, the IPM model predicted the resulting wholesale prices for electricity, natural gas, and oil for three broad customer segments - residential, commercial and industrial energy customers; resulting investment mix for traditional and renewable energy generation technologies; investment in energy efficiency measures and the associated savings. These results were then mapped appropriately as changes into the economic forecasting framework. The REMI model was then used to predict changes in key economic indicators, such as *gross-state product*, *aggregate personal income*, and *jobs* for the 9-state RGGI region (based on results for the individual states).



Role of the Economic Analysis

The objective of the comprehensive analysis of proposed RGGI carbon-cap policies was to help refine those policies and ultimately inform the decision-making process. The primary goal was to achieve desirable GGH emission targets without a noticeable economic burden on any of the participating states. The REMI impact modeling was undertaken to illustrate how electric customers (households and businesses) would be affected by increased prices, which states and industries benefit as suppliers of capital goods and services for the altered generation mix, and how energy-efficiency investments, savings and associated costs to promote efficiency affect energy consumers. As the member states are of different size and economic composition, as well as parts of various electricity markets, we do not expect them to be equally impacted.

Clearly another component of evaluating air-quality policies from an economic perspective pertains to changes in health outcomes. A different type of model is needed to trace out how changes in air chemistry – the result of the local initiative combined with regional air shed dynamics – alter illnesses and deaths. Once identified these health impacts can eventually be monetized and introduced into an economic model such as the REMI model. This aspect of the RGGI policies was not part of the final analysis.

Organization of the Report

This report presents an introduction into the REMI model used (Ch.2); a discussion of select IPM model outputs and how they are translated into REMI model inputs (Ch.3); a description of the baseline forecast re-calibration in the REMI model, the policy scenarios, sensitivity cases for both the baseline and policy settings, and results for the new REMI baseline forecasts (Ch.4); a presentation of the REMI impacts on the 9-state RGGI region for the policy scenarios and narrative on individual state's responses (Ch.5); and concluding discussion (Ch.6). Three appendices are included that address the state-specific baseline economic forecasts (A1), the state-specific model inputs (A2) and the state-specific REMI impacts (A3).

2 THE ECONOMIC IMPACT FRAMEWORK

Requirements of Modeling Tool

An economic forecasting system capable of simulating the RGGI policy scenarios over the policy horizon 2008 to 2025 was needed. The modeling system should be also be capable of representing each of the participating states as a stand-alone economy but with a suitable level of economic feed-back between these states as goods and services cross state boundaries in B-2-B transactions as well as households as commuters. The model should have appropriate *logic* in how it forecasts the economy of a state that is sensitive to the types of changes a carbon-cap policy facing electric generators would likely bring about (i.e. the results of the IPM electric supply modeling). The model should have an ample policy lever set to allow the analysts to introduce the RGGI policy changes (from the IPM model) on top of the accepted REMI baseline, as accurately as possible. Lastly, the model should be capable of identifying the *year-by-year* impacts of a proposed policy change – that is how employment, income or business sales differ in 2015 when the policy is in effect relative to the baseline.

After consideration of several factors a *multi-regional* REMI Policy Insight model was leased from Regional Economic Models, Inc. of Amherst, MA for use by analysts at the Massachusetts DOER, part of the RGGI Staff Working Group – Economic Impact Analysis Subgroup. This subgroup retained EDR Group, Inc. of Boston, MA to provide consulting support in their use of the model and to develop and make presentations at key meetings to the public and staff working group throughout the study period.

The REMI RGGI Model

A REMI 12-Region model (vers. 6.0) was leased for this study. This system was built with historical data through 2001, and classified business activity into 70 industries using the North American Industrial Classification System (NAICS). Nine of the twelve regions correspond to the RGGI participating states: New Hampshire, Vermont, Maine, Rhode Island, Massachusetts, Connecticut, New York, New Jersey and Delaware. The three additional non-participating regions configured in the model were Pennsylvania (significant for coal-fired generation, emissions target performance in the regional air-shed, and potential for greater electricity exports into the RGGI states), Maryland, and the District of Columbia.

Background on the REMI Model

The REMI model was selected for the analysis because it is a widely used and widely accepted approach for forecasting dynamic economic impacts of proposed policies and projects in the United States.[1] Connecticut, Vermont, New Hampshire, Maine, Massachusetts, and New York have had experience with a REMI model in either one or several state-level agencies, or utility entities. NESCAUM has used a REMI model in the past for evaluations of air-quality regulations.

The REMI software system allows the user to fine-tune aspects of the calibration using local expertise and available data. The model can be used to predict, for each year in the future, the impact of the proposed project or policy change on employment and business output for each of 70 industry categories and 94 detailed occupational categories. The model also can be used to predict other variables such as changes in regional personal income, population, business competitiveness, industry wage rates, and industry value added.

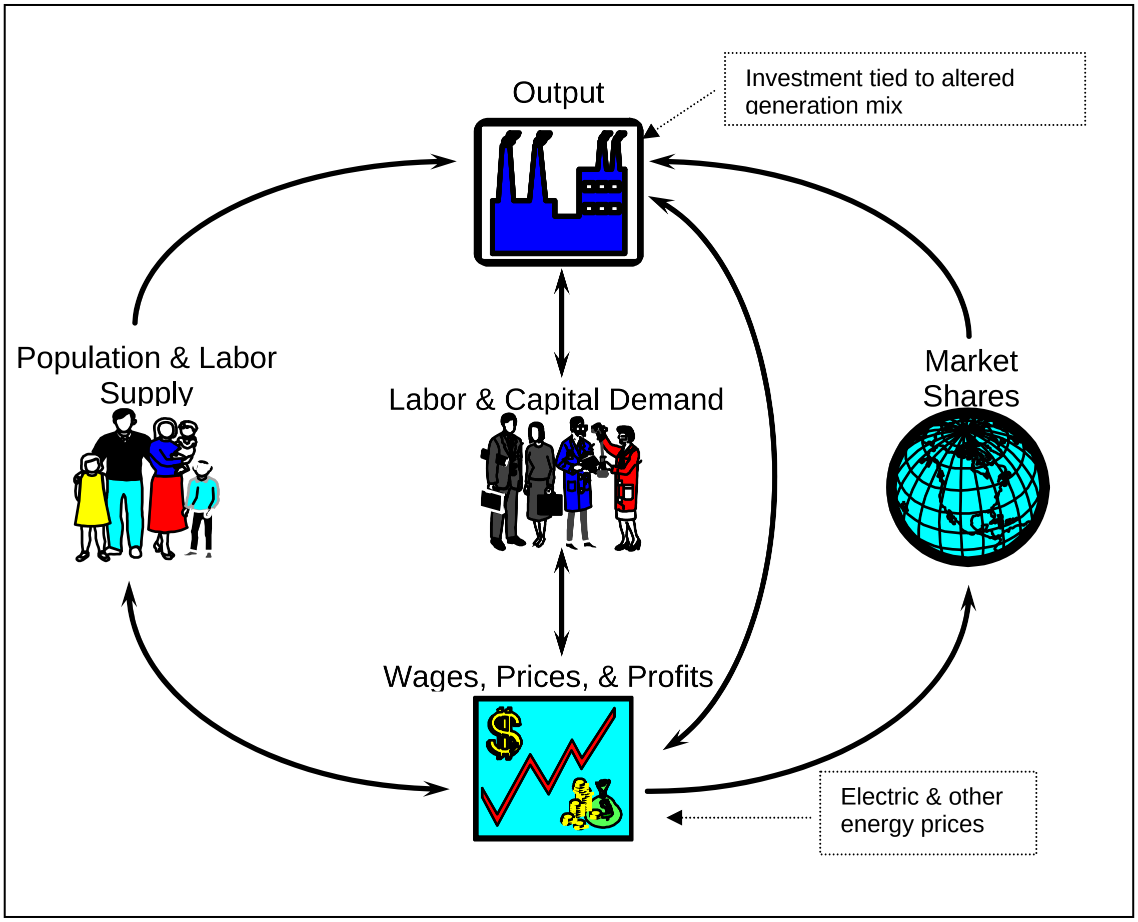
The REMI model effectively combines four components:

- *General economic forecast*, which projects changes in population, employment, business sales, and profits for the multi-region over the 2002-2050 time period;
- *Policy impact*, which estimates how public policy and facilities investment changes business revenues and operating costs in each industry in the region, and the effect of these changes on the product prices, the region's competitive position and share of national growth;
- *Population trend*, which estimates changes in the migration of working age segment of the region's population in response to changes in demand for labor, wage levels and living costs; and,
- *Input-output analysis*, which accounts for the inter-industry flows of dollars, and the associated indirect and induced economic effects.

These four functions are combined into one integrated model system, which simulates the effects of public or private projects or policy programs on the economy. In operation, the REMI economic simulation model of the regional economy can be broken down into five key economic arenas, illustrated in Figure 2-1 below: (1) output, (2) labor and capital demand, (3) population and labor supply, (4) wage, price and profit, and (5) market shares.

[1] The capabilities of the REMI model have been published in national academic journals such as the *American Economic Review*, The *Review of Economic Statistics*, and *International Regional Science Review*.

Figure 2-1: Simplified Structure of the REMI Model Feedbacks

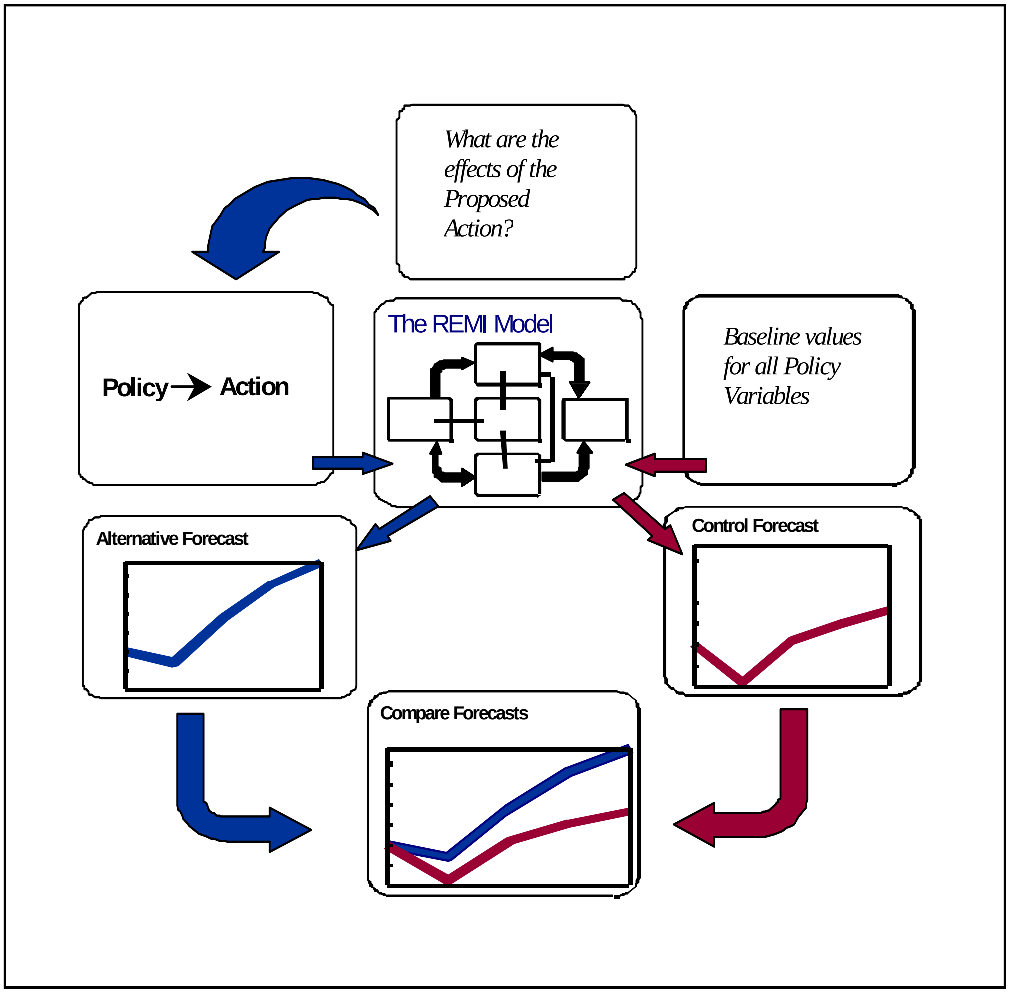


As the figure depicts, the REMI model creates a forecast (under a baseline setting or a policy scenario) of a region's economy and its demographics by simultaneously solving many equations that represent critical aspects of region's economy.

The *Output* block is where the model predicts economic *output* (business sales) or its value-added aspect *gross regional product*. It also solves for the underlying regional *demands* that trigger local production – such as *consumer spending*, *investment spending*, and *government spending*. The *labor and capital demand* block balances the use of regional labor and capital depending on how their relative costs (e.g. wages and the cost of capital – determined in the *wages*, *prices*, *profits* block) are changing in the model. Labor productivity for each industry is also solved for in this part of the model. The prices that price-setting industries charge are largely influenced by labor and capital costs. The profits of industries serving non-local markets are also predominantly influenced by those two costs as well. Both the price and profit signal will determine how regional industry can garner market share – in local or export markets. As the market share response is felt ultimately economic output in the top block adjusts. The model also reflects that wages are influenced by the size of the labor force which is determined by population changes – explained by cohort processes and economic migration. The size of the population will affect government spending. Consumer spending is determined by aspects of several blocks – the number employed, at specific nominal wage rates, the consumer price index, and taxes.

This structure is flexibly suited to trace out a forecast for a region under numerous *what-ifs*. The comparison of the region's baseline forecast expectation to one under a specific policy is how the *impact* of the policy is measured. Figure 2-2 below shows this comparison for the REMI model.

Figure 2-2: Impact Analysis in a Model



To identify economic impacts requires first developing an acceptable baseline forecast, followed by another run of the model whereby the analyst enters specific data about the policy (see the box in the above figure called **Policy Action**). Earlier in figure 2-1 you can see where the analyst would introduce two of the key results from the IPM electric supply sector modeling of a RGGI scenario. Additional documentation and bibliography on the REMI Model can be obtained by visiting www.remi.com .

3 ECONOMIC MODEL INPUT DEVELOPMENT

The analysis of the economic impact of RGGI follows from the impacts on the energy sector projected by the IPM model and presented by ICF Consulting. The impacts are evaluated as changes between a Reference Run and Policy Scenario Run. The reference run(s) and scenarios will be defined in the next chapter. The key results from the IPM model that are used for the evaluation of economic impacts are:

- Changes in wholesale electricity prices, as well as natural gas and oil prices
- Incremental investment in new power plant capacity
- Spending on energy efficiency measures and ensuing energy savings

This chapter presents a discussion of how these three key results from the IPM modeling are introduced into the economic modeling framework – both in concept and model input development.

REMI Policy *Levers*

The information describing a carbon-cap policy scenario is introduced into the REMI model as the *change from the baseline value* of the specific economic variable. The following table provides a translation or *mapping* of the energy supply modeling concept into a REMI economic variable. This mapping accomplishes the analyst's choice of policy levers that are used to introduce the policy's *changes* into the forecasting system, as realistically as possible.

Table 3-1: Mapping IPM Results into REMI's Economic Structure

IPM Result	REMI Input
Wholesale electric, natural gas prices	
Businesses	Rel. Retail Electric (N. Gas) Price – Commercial –or- Industrial User (% change)
Households	Consumer Price Index (*weighted change)*
Investment ($) in generation technologies (traditional & renewable)	New *demand* for goods & services from industries that supply energy generating capital; New *sales* for local Construction
Energy Efficiency (EE)	
Energy Customer Savings	
Businesses	Rel. Retail Electric Expenditures – Commercial –or- Industrial User ($ change)
Households	Increase purchasing power of household sector
Energy Customer Outlay on EE Goods	
Businesses	Increase in the *cost-of-doing business* (%)
Households	Decrease purchasing power of household sector
Paying for the EE Program (SBC charge)	
Businesses	Rel. Retail Electric Expenditures – Commercial –or- Industrial User ($ change)
Households	Decrease purchasing power of household sector
EE Program Budget	New local *sales* in marketing, energy auditing services & utility administration
Investment on EE Technologies	New *demand* for goods & services from industries that supply energy efficient capital

The following section discusses the assumptions used to convert the IPM results into the designated REMI policy lever concepts.

Assumptions Guiding Input Development

In most instances, the results from the IPM energy supply modeling required some additional calculations to present the implied policy changes in a manner compatible with the REMI model variable denoted above in Table 3-1. This undertaking required (a) an understanding of the concepts output form the IPM model and what implicitly is taken into account by that model, and (b) decisions by the SWG and the economic modeling subgroup on methods to fully translate data for the REMI framework.

Handling Energy Prices in REMI

The REMI model takes into account explicit retail prices for *electric, natural gas,* and *residual oil* for Commercial and Industrial customers. Furthermore, these retail prices concepts are stated *relative to the U.S. average price* for the specific energy type. Household energy prices are reflected implicitly in REMI's Consumer Expenditure Price Index (CPI).

The IPM model derives *wholesale* firm-power prices – this reflects the cost of generation alone (transmission and distribution costs are not included). These wholesale prices are estimated for each of the RGGI participating states as well as a U.S. average. The following methodology was developed to enable the economic modeling team to convert the IPM wholesale price concept into *relative retail energy prices* for re-calibrating the REMI Reference runs, as well as to appropriately weight IPM's wholesale price changes for REMI scenario runs. For the latter, the inverse of the retail conversion factor was multiplied by the change in relative wholesale price between a scenario and its associated reference run.

The methodology creates a conversion based on End-use Energy Prices by Sector & Source, *(http://www.eia.doe.gov/oiaf/aeo/supplement, Tables 11,12, 20)* from published forecast data from the Energy Information Administration. For each ISO (New England, New York, and PJM) in the EMM region, an annual projected series of retail factors is computed as the ratio of the published retail price_t, class_ j : published generation price_ t, where **t** = year and **j** = Residential, Industrial, or Commercial. Appendix D contains the time-series of retail conversion factors by customer class by ISO for electric, oil, and natural gas.

Entering energy prices changes for the household sector in REMI requires one additional adjustment, which is to reflect the share of electricity/natural gas expenditures in the consumer basket. REMI embeds household purchases of electricity and natural gas under the *Household Operations* commodity along with the purchase of water utilities, telephone, sanitary services, and domestic services. The energy portion accounts for approximately 33% of expenditures on this commodity.[2] REMI also estimates that *Household Operation* spending represents approximately 5.0% of all consumer spending annually. Therefore electric and natural gas expenditures by households reflects approximately 1.65% of annual consumer spending.

Handling Investments for Generation in REMI

The SWG economic modeling subgroup used information based on analysis in Massachusetts[3] that would correlate groups of industries (based on SIC's) to specific types of electric generation technologies, including renewable technologies. The IPM model provides investment in *new capacity* for generation and pollution control for each scenario for each state. It can not however inform the analyst how much of the capital goods and services are sold by in-state industries. The REMI model comes equipped with default *regional purchase coefficients* (RPC) for each industry which can then determine how much *of the **X** dollars of investment for turbine manufacturing* can be fulfilled in-state. The only exception made to relying on the REMI model's default RPC's pertained to the share of new capacity investment in a state that was mapped to *Construction* activities. Here a decision was made to award 100 percent of the construction dollars to in-state contractors. This of course may not always be the case, especially with smaller states, but over the 9-state RGGI region is likely a reasonable approximation of where those contractors would be based.

A full description of the methodology and data used for handling investments in generation is included in Appendix B.

Handling Investments for Energy Efficient Goods in REMI

A full description of the methodology and data used for handling investments in energy efficiency is included in Appendix B.

Other Aspects of the RGGI Energy Efficiency Program

User Energy Efficiency Savings

The IPM model predicts the state-specific annual GWh averted by a given level of energy efficiency adoption by households and businesses. The load averted allocates as follows per the IPM model: 42 % from Residential users, 46 % from the Commercial users and 12% from Industrial customers. The monetary savings

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[2] See REMI User Documentation, based on U.S. BLS- Consumer Expenditure Data by Major Region.
[3] Analysis performed by the Massachusetts Division of Energy Resources, based on direct communications with industry representatives.

are identified by calculating the prevailing customer class-specific retail electric prices from the IPM wholesale electric price forecast. The residential sector savings will *increase purchasing power* of households, and the Commercial and Industrial electric savings decrease the electricity expenditures of businesses.

User Outlay on Energy Efficient Goods

The IPM model identified the user's outlay on specific energy efficient measures. An annual total for each of the three customer classes is what is needed to inform the REMI model about increased costs to be borne by the household (a decrease in purchasing power) and businesses (an increase in the cost-of-doing business) in the state.

Financing the Energy Efficiency Program with a SBC Charge

One option for funding energy efficiency is through a systems benefit charge (SBC). For this evaluation it is assumed that the SBC would be levied across the three customer classes in the same proportion as the efficiency savings are allocated. Households incur a decrease in purchasing power and commercial and industrial sectors incur an increase their electric expenditures.

Spending the Energy Efficiency Program Budget

The program cost developed by ACEEE / IPM *net* of the subsidizing investment in efficiency measures to be adopted by households and businesses, is allocated over the sectors that help run such a program. Using a recent program from Massachusetts[4] approximately 15 % of the applicable budget is spent on *marketing*, 46 % on energy auditing and installation services, and 39 % on *administration* by the utilities. These are assumed to be entirely locally provided.

[4] 2002 Energy Efficiency Activities Report, Massachusetts Division of Energy Resources, available at http://www.mass.gov/doer/pub_info/ee02-long.pdf.

4 DEFINING THE RGGI-RELATED ENERGY FORECASTS

Overview

The IPM model crafted a default baseline energy forecast – termed the *Reference Run*, as well as a *High-Emissions Reference* for sensitivity analysis. For each of these base cases, several RGGI policy scenario forecasts were also developed and then subsequently examined in the REMI model. Table 4-1 lists the scenarios that were examined off of each reference case. All of these forecasts were developed and refined through the SWG and Stakeholder processes.

Table 4-1: RGGI Scenarios Examined

Default Reference	High-Emissions Reference
RGGI Package	***RGGI Package***
RGGI Package + CN – Federal Policies	***RGGI Package + CN – Federal Policies***
RGGI Package + 2 x Efficiency	-

A brief definition on each of these reference and policy settings is useful to understanding the economic impact results that will follow in Ch. 5.[5]

Reference (default) – includes existing state air quality regulations, federal 3P regulation, Renewable Portfolio Standards (RPS), mid- to long-term gas prices (2010-2024) averaging 7.5% growth

High-Emissions Reference – allowance of coal builds in RGGI region

Package - refers to the carbon–cap target of 35 % resulting in 2020 emission levels 10% below 1990 levels; off-sets mechanism and energy efficiency.

Energy efficiency - Technology costs, load shapes, load factors, and potential supply by sector are based on data provided by ACEEE. Program costs to implement measures are based on average of RGGI states' actual expenditures through 2004 to implement public benefit programs. The Package Scenario

[5] For further information on the RGGI scenarios modeled, see the documentation on the IPM modeling at the RGGI website (www.rggi.org).

assumes that current levels of annual state expenditures for public benefit programs continue through 2025. Approximately 1/3rd of the projected load growth is assumed to be averted by these measures.

Canadian Policy - assumes stabilization at projected 2008 levels starting in 2008.

Federal Policy - assumes stabilization at projected 2015 levels starting in 2015

2 *x* Efficiency - a two-fold participation in energy efficiency adoption described above.

Summary of Key IPM Results for Reference & Scenario Forecasts

This brief summary of the key policy indicators to influence the REMI modeling helps in understanding the economic impact results in Ch.5.

Table 4-1: RGGI Region Cumulative Investment in Pollution Control and New Plants ($ Millions, 2003)

	Reference Case	
Technology	Default	Hi-Emissions
Biomass Cofiring	408.35	207.99
Nuclear Uprate	432.51	432.51
Pollution Control	1,701.95	1,651.64
New CC	12,445.43	4,894.22
New CT	2,027.02	161.24
New IGCC	164.03	28,014.98
New Nuclear	0.00	0.00
New Scrubbed Coal	0.00	0.00
New Biomass	0.00	0.00
New Hydro	189.84	189.84
New Wind	8,114.24	10,761.31
New LFG	778.90	778.90
New Solar PV	1,178.80	1,178.80
New Fuel Cell	97.37	97.37
Total	27,538.43	48,368.80

The High-Emissions reference case represents an additional $20 billion of investment across the 9-state region over the 2008-2025 interval when compared to the default reference case. Note that the mix of generating capacity shifts as well when coal builds are allowed in the region.

Table 4-2: Comparison of Wholesale Electric Prices for Reference Cases

Hi-emissions Case - Default Reference ($/MWh)						
	Model Run Year					
	2009	2012	2015	2018	2021	2024
MA	$ 11.49	$ 11.22	$ 13.36	$ 12.72	$ 11.71	$ 9.80
CT	$ 13.56	$ 9.65	$ 9.49	$ 8.08	$ 7.10	$ 5.42
ME	$ 11.21	$ 10.66	$ 11.99	$ 11.14	$ 9.72	$ 7.64
NH	$ 11.19	$ 11.13	$ 13.11	$ 12.44	$ 11.09	$ 8.89
RI	$ 12.02	$ 11.15	$ 13.21	$ 12.52	$ 11.23	$ 9.03
VT	$ 12.07	$ 10.95	$ 12.91	$ 11.88	$ 10.62	$ 8.27
NY	$ 11.50	$ 7.58	$ 8.60	$ 8.04	$ 7.04	$ 6.23
DE	$ 8.93	$ 5.71	$ 4.85	$ 2.26	$ 1.00	$ (0.45)
NJ	$ 8.39	$ 6.12	$ 5.89	$ 3.16	$ 1.94	$ 0.46
PA	$ 7.34	$ 7.06	$ 5.22	$ 2.17	$ 1.62	$ 1.19
MD	$ 7.71	$ 6.67	$ 5.23	$ 2.59	$ 1.53	$ 0.30
US Average	$ 10.94	$ 7.77	$ 7.82	$ 5.94	$ 4.85	$ 3.60

The High-Emissions reference case is associated with both higher wholesale electric prices and slightly higher delivered natural gas prices as Table 4-2 and 4-3 show.

Table 4-3: Comparison of Delivered Natural Gas Prices for Reference Cases

Hi-emissions Case - Default Reference ($/MMBtu)						
	Model Run Year					
	2009	2012	2015	2018	2021	2024
MA	$ 1.60	$ 1.81	$ 2.22	$ 2.24	$ 2.23	$ 2.17
CT	$ 1.60	$ 1.83	$ 2.20	$ 2.22	$ 2.22	$ 2.17
ME	$ 1.59	$ 1.82	$ 2.22	$ 2.28	$ 2.25	$ 2.18
NH	$ 1.64	$ 1.81	$ 2.22	$ 2.24	$ 2.23	$ 2.16
RI	$ 1.61	$ 1.80	$ 2.21	$ 2.24	$ 2.24	$ 2.17
VT	N/A	N/A	N/A	N/A	N/A	N/A
NY	$ 1.62	$ 1.89	$ 2.27	$ 2.34	$ 2.36	$ 2.30
DE	$ 1.61	$ 1.81	$ 2.21	$ 2.24	$ 2.24	$ 2.17
NJ	$ 1.61	$ 1.81	$ 2.21	$ 2.24	$ 2.24	$ 2.17
PA	$ 1.61	$ 1.81	$ 2.21	$ 2.24	$ 2.24	$ 2.17
MD	$ 1.61	$ 1.81	$ 2.21	$ 2.24	$ 2.24	$ 2.17
US Average	$ 1.64	$ 1.82	$ 2.25	$ 2.29	$ 2.31	$ 2.25

Forecasts of the Reference Cases using REMI

Establishing the desired reference case and associated sensitivity cases is most important for developing the subsequent impact evaluation of any scenario that *originates* from that reference case –baseline-*do-nothing* setting. Here we present the resulting forecasted economic levels for the 9-state RGGI region (see Appendix A for individual state forecasts) under the default Reference assumptions and the High-Emissions Reference assumptions. These become the underlying values to which all associated scenario forecasts are compared.

Table 4-4. Economic Forecasts of Reference Cases, Select Years

9-State RGGI Region		2009	2015	2021
Default REF Forecast	Total GRP (Bil Fixed 96$)	$2,135.3	$2,426.6	$2,698.4
	Real Pers Inc (Bil Fixed 96$)	$1,702.6	$1,948.7	$2,203.6
	Private Sector Jobs (thous.)	22,302	23,369	24,060
High-Emissions Forecast	Total GRP (Bil Fixed 96$)	$2,137.0	$2,427.3	$2,697.3
	Real Pers Inc (Bil Fixed 96$)	$1,705.0	$1,949.5	$2,202.5
	Private Sector Jobs (thous.)	22,323	23,374	24,048

A brief discussion of these juxtaposed results might be helpful. Tables 4-1 through 4-3 describe the nature of the energy market assumptions that underpin each of these reference cases. Namely that under a *high-emissions* expectation the RGGI region will have higher levels of investment for new generating capacity, including coal facilities, and noticeably higher electric generation costs (wholesale prices). Natural gas prices will also be higher than under the *default* reference expectation.

In Table 4-4 the results of REMI modeling of these reference cases produce almost identical economic activity here depicted as the level of *gross regional product (GRP), real personal income(aggregate)* and *private-sector jobs*. After 2015 the level of economic activity in the 9-state region under the Hi-Emissions reference is slightly less than in the *default* reference. This can be explained as follows: up until 2015 the High-Emissions reference is buoyed by greater investment in new capacity despite the prevailing higher energy prices. However the pattern of those investments in front-loaded thus the stimulus to the economy tapers off and as higher energy prices make their effects felt over time (competitiveness effects in the REMI model) all three economic indicators in Table 4.4 are surpassed by the values in the *default* reference case by 2021.

Highlights of Policies compared to their Reference Case

The following tables present the differences between each policy and its associated reference case for the key IPM results that will drive the REMI impact analysis.

Table 4-5: RGGI Region Cumulative Investment in Pollution Control and New Plants ($ Millions, 2003)

	2005 -2025	*Differential Investment_New Capacity* Scenario		
Technology	Default Ref. Run (mil. $)	PCKG	PCKG+CN-FED	PCKG + 2xEE
Biomass Cofiring	$408	$4	$46	$4
Nuclear Uprate	$433	$0	$0	$0
Pollution Control	$1,702	-$71	-$335	-$65
New CC	$12,445	-$3,818	-$1,610	-$5,642
New CT	$2,027	$388	-$1,461	-$73
New IGCC	$164	-$55	-$74	$0
New Nuclear	$0	$0	$505	$0
New Scrubbed Coal	$0	$0	$0	$0
New Biomass	$0	$0	$0	$0
New Hydro	$190	$0	$0	-$16
New Wind	$8,114	-$123	$3,679	-$646
New LFG	$779	$0	$0	$0
New Solar PV	$1,179	-$45	-$45	-$90
New Fuel Cell	$97	$0	$0	$0
Efficiency*	$0	$7,014	$7,014	$14,027
Total	$27,538	$3,293	$7,718	$7,500

***** excludes 40 percent of budget used for program administration***

Implementation of a 35 % carbon-cap along with energy efficiency (PCKG) alters the mix of technology from the Reference case for new capacity additions (few combined cycle plants to be built) as energy efficiency averts some of the demand growth for electricity. Overall the PCKG policy reflects an additional $3 billion of investment over the policy interval when compared to the do-nothing case. The introduction of Canadian policy in 2008 and an eventual Federal policy in 2015 causes some reduction in traditional generation investments within the 9-state RGGI region, and an increase in Wind Generated facilities. The PCKG+CN-FED scenario represents almost $8 billion of additional investment in the RGGI region over the policy interval when compared to the do-nothing case. Last, an energy efficiency program that is double the program embedded in the PCKG scenario mitigates electric demand growth even more and reduces investment for combined cycle plants in the RGGI region. This scenario (PCKG + 2 x EE) holds $7.5 billion of additional investment in the RGGI region over the policy interval when compared to the do-nothing case.

Table 4-6: Electric Retail Price Changes, 2015 – Scenarios Compared to Default Reference

	Residential			Commercial			Industrial		
	PCKG	PCKG +CN-FED	PCKG + 2 X EFF	PCKG	PCKG +CN-FED	PCKG + 2 X EFF	PCKG	PCKG +CN-FED	PCKG + 2 X EFF
MA	0.43%	5.47%	0.06%	0.56%	7.13%	0.08%	0.70%	8.97%	0.10%
CT	0.00%	5.03%	-0.37%	0.00%	6.56%	-0.48%	0.00%	8.25%	-0.60%
ME	0.44%	5.45%	0.14%	0.57%	7.11%	0.18%	0.72%	8.95%	0.23%
NH	0.37%	5.41%	0.08%	0.48%	7.05%	0.11%	0.61%	8.87%	0.13%
RI	0.43%	5.39%	0.03%	0.56%	7.03%	0.05%	0.70%	8.84%	0.06%
VT	0.30%	5.76%	0.02%	0.39%	7.51%	0.03%	0.50%	9.44%	0.04%
NY	0.21%	4.88%	-0.02%	0.27%	6.40%	-0.02%	0.46%	10.70%	-0.04%
DE	0.56%	7.80%	0.36%	0.67%	9.34%	0.43%	0.82%	11.50%	0.53%
NJ	0.52%	7.83%	0.45%	0.63%	9.38%	0.54%	0.77%	11.54%	0.66%
PA	-0.09%	9.35%	-0.11%	-0.11%	11.20%	-0.13%	-0.14%	13.78%	-0.16%
MD	0.16%	8.63%	0.15%	0.20%	10.34%	0.18%	0.24%	12.73%	0.22%
US Average	0.03%	9.36%	-0.01%	0.03%	10.64%	-0.01%	0.04%	16.25%	-0.01%

Table 4.6 shows the customer-class specific retail price change implications of each scenario analyzed relative to the *default* Reference case. The price changes shown are for 2015. The IPM model predicted *wholesale* price changes for each policy setting and the reference case. These retail price changes are the result of the change in the wholesale price *weighted* by the inverse of the retail conversion scalar discussed earlier (also documented in Appendix D). The state-level values in Table 4.6 go one-step additional step before being entered into the REMI model. Since the REMI model is gauging how a region's competitiveness is changing, the model bases many of its economic costs as *relative to the U.S. prevailing cost*. The IPM model also tracked how the RGGI policies would effect U.S. wholesale energy prices (see the last row in Table 4.6). Therefore the REMI model inputs are expressed as the change in the *relative retail electric (natural gas) prices* between the policy and the reference. The two shaded rows in the table designate non-participating states that were part of the REMI analysis.

What we can understand from Table 4.6 is that the PCKG will create slightly higher retail electric prices for each of the RGGI states and that increase will be mitigated when a two-fold energy efficiency program helps avert load growth further than under the PCKG. The implementation of a Canadian policy in 2008 and eventual federal policy in 2015 closes off opportunities for the RGGI region for *leakage* (less costly energy imports generated outside the region) and more dramatic retail price increases occur. Keep in mind however that generators in the rest of U.S. (and Canada) are also complying with carbon cap policies and U.S. average electric prices are expected to increase more than the increase in the RGGI states. Therefore in terms of relative electric prices, the REMI model will manifest a different price dynamic played out under this policy than under the PCKG or PCKG w/2 *x* Efficiency.

Table 4-7: Natural Gas Retail Price Changes, 2015 – Scenarios Compared to Default Reference

	Residential			Commercial			Industrial		
	PCKG	PCKG +CN-FED	PCKG + 2 X EFF	PCKG	PCKG +CN-FED	PCKG + 2 X EFF	PCKG	PCKG +CN-FED	PCKG + 2 X EFF
MA	-0.01%	2.21%	-0.01%	-0.01%	2.76%	-0.01%	-0.01%	4.14%	-0.01%
CT	0.00%	2.22%	0.00%	0.00%	2.78%	0.00%	0.01%	4.17%	0.01%
ME	0.00%	2.22%	0.00%	0.00%	2.78%	0.00%	0.00%	4.17%	0.00%
NH	-0.09%	2.12%	-0.09%	-0.12%	2.65%	-0.12%	-0.17%	3.97%	-0.17%
RI	0.09%	2.22%	0.09%	0.12%	2.77%	0.12%	0.17%	4.16%	0.17%
VT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NY	0.06%	2.19%	0.06%	0.08%	2.74%	0.08%	0.11%	3.67%	0.11%
DE	0.00%	2.35%	0.00%	0.00%	2.94%	0.00%	0.00%	3.94%	0.00%
NJ	-0.10%	2.35%	0.00%	-0.12%	2.94%	0.00%	-0.16%	3.94%	0.00%
PA	0.00%	2.33%	0.00%	0.00%	2.92%	0.00%	0.00%	3.91%	0.00%
MD	0.00%	2.25%	0.00%	0.00%	2.82%	0.00%	0.00%	3.77%	0.00%
US Average	-0.04%	2.86%	-0.07%	-0.04%	3.24%	-0.07%	-0.07%	4.93%	-0.11%

The discussion for the results in Table 4.6 is appropriate to understanding much of the natural gas price changes stated for each state and the U.S. market. One noticeable difference is that natural gas prices under the PCKG and PCKG w/ 2*x* Efficiency scenarios show either no change from the *default* reference case or typically very small reductions in price. The only exception is New York state for these two scenarios.

Yet again, when the RGGI PCKG is implemented with Canadian and eventual federal emission policies, the backdrop of pronounced electric price increases seen in Table 4.6 affects the U.S. natural gas market more noticeably. While the RGGI states will faces gas price increases the extent of increases are not as large as those occurring elsewhere in the U.S. This will provide some mitigating effect to each state's economy despite a higher priced electric market.

Table 4-8: High-Emissions Reference Differentials in RGGI Region Cumulative Investment in Pollution Control and New Plants ($ Millions, 2003)

	2005 -2025	*Differential Investment_New Capacity* Scenario	
Technology	Hi-Emissions Ref. Run (mil. $)	PCKG	PCKG+CN-FED
Biomass Cofiring	$208	$31	$200
Nuclear Uprate	$433	$0	-$4
Pollution Control	$1,652	-$71	-$242
New CC	$4,894	-$1,215	-$1,272
New CT	$161	$98	$436
New IGCC	$28,015	-$12,827	-$8,639
New Nuclear	$0	$0	$0
New Scrubbed Coal	$0	$0	$0
New Biomass	$0	$0	$0
New Hydro	$190	$0	$6
New Wind	$10,761	$1,970	$2,128
New LFG	$779	$0	$0
New Solar PV	$1,179	-$45	-$45
New Fuel Cell	$97	$0	$0
Efficiency*	$0	$7,014	$7,014
Total	$48,369	-$5,046	-$416

excludes 40 percent of budget used for program administration

Under a High-Emissions expectation for the reference, the implementation of a 35% carbon-cap and energy efficiency adoption (PCKG), the RGGI region will require less investment in traditional generating capacity (fewer IGCC plants would be built)as energy efficient investments avert load growth, and investment in Wind generating facilities would increase by another almost $2 billion. The total effect however is the RGGI region would be investing $5 billion less than under the do-nothing case. However with Canadian and Federal policies also being introduced (2008 and 2015 respectively) investments shift among energy regions and the RGGI region will be investing almost the same amount (99 %) as under the do-nothing case albeit with a different generation mix.

Table 4-9: Electric Retail Prices, 2015 – Scenarios Compared to High-Emission Reference

	Residential		Commercial		Industrial	
	PCKG	PCKG +CN-FED	PCKG	PCKG +CN-FED	PCKG	PCKG +CN-FED
MA	1.31%	2.48%	1.71%	3.23%	2.14%	4.06%
CT	3.64%	5.13%	4.74%	6.69%	5.96%	8.41%
ME	2.59%	3.52%	3.38%	4.58%	4.25%	5.77%
NH	1.58%	2.73%	2.06%	3.56%	2.59%	4.48%
RI	1.57%	2.73%	2.05%	3.55%	2.58%	4.47%
VT	1.40%	2.71%	1.83%	3.53%	2.30%	4.44%
NY	2.60%	3.74%	3.41%	4.91%	5.70%	8.20%
DE	1.37%	6.81%	1.64%	8.16%	2.02%	10.04%
NJ	0.96%	6.58%	1.15%	7.88%	1.42%	9.70%
PA	0.27%	7.38%	0.32%	8.84%	0.39%	10.88%
MD	0.20%	6.86%	0.24%	8.22%	0.29%	10.11%
US Average	0.39%	7.02%	0.44%	7.98%	0.68%	12.19%

When the pre-policy expectation embodies higher emission inventories the costs associated with the PCKG implementation results in greater increases in electric prices than we saw in Table 4.6. These price increases grow under the PCKG + CN-FED but the New England states and New York do not grow as much as seen in Table 4.6. Again, the same discussion applies to understanding the relative price changes, particularly under the PCKG +CN-FED scenario. Price increase in the rest of the U.S. will outpace the price increases of the RGGI states since the RGGI states had for 7 years prior been making adjustments through the voluntary policy.

Table 4-10: Natural Gas Retail Prices, 2015 – Scenarios Compared to High-Emission Reference

	Residential		Commercial		Industrial	
	PCKG	PCKG +CN-FED	PCKG	PCKG +CN-FED	PCKG	PCKG +CN-FED
MA	0.38%	1.25%	0.48%	1.56%	0.72%	2.34%
CT	0.45%	1.36%	0.57%	1.71%	0.85%	2.56%
ME	0.45%	1.36%	0.57%	1.70%	0.85%	2.56%
NH	0.39%	1.29%	0.48%	1.62%	0.73%	2.42%
RI	0.39%	1.30%	0.49%	1.62%	0.73%	2.43%
VT	N/A	N/A	N/A	N/A	N/A	N/A
NY	0.54%	1.45%	0.68%	1.81%	0.91%	2.43%
DE	0.27%	1.29%	0.34%	1.61%	0.46%	2.16%
NJ	0.34%	1.36%	0.42%	1.70%	0.57%	2.28%
PA	0.41%	1.31%	0.51%	1.64%	0.69%	2.19%
MD	0.41%	1.36%	0.51%	1.70%	0.68%	2.28%
US Average	0.52%	1.31%	0.59%	1.48%	0.90%	2.25%

Under the PCKG scenario with a high-emissions reference case the RGGI states will experience more definite natural gas price increases (compared to what was seen in Table 4.7). Under the PCKG+CN-FED scenario the price increase for natural gas in the RGGI states (like that for electricity) does not rise as much in the same policy under the *default* reference setting.

The Energy Efficiency Aspect to Compliment RGGI

A single program was designed for energy efficiency adoption in the future by ACEEE and feedback from the SWG. This program in is invariant regardless of the reference case, and is included in all variants of the PCKG scenarios. The only aspect of the set of energy efficiency effects that will vary is *bill savings*. This is the result of using scenario specific electric price forecasts to *value* the fixed forecast of averted load growth (in GWh) as it is allocated over the three customer classes. The following tables describe key aspects of the program that are important to introducing into the impact analysis in the REMI model.

Table 4-11a: Energy Efficiency – Program Cost[1] (User SBC Charges), Mil.$, 2003

Customer Class	2009	2012	2015	2018	2021	2024	Total
Residential	646.00	646.00	646.00	646.00	646.00	646.00	3,876.0
Commercial	710.60	710.60	710.60	710.60	710.60	710.60	4,263.6
Industrial	181.50	181.50	181.50	181.50	181.50	181.50	1,089.0
Total	1,538.10	1,538.10	1,538.10	1,538.10	1,538.10	1,538.10	9,228.6

[1] Values reported reflect a three-year cost around the *model run* year reported by IPM. Total reflects 2008 through 2025 costs.

Table 4-11b: Consumer Outlay[1] on Energy Efficient Goods, Mil.$, 2003

Customer Class	2009	2012	2015	2018	2021	2024	Total
Residential	103.36	103.36	103.36	103.36	103.36	103.36	620.2
Commercial	113.70	113.70	113.70	113.70	113.70	113.70	682.2
Industrial	29.04	29.04	29.04	29.04	29.04	29.04	174.2
All Classes	246.10	246.10	246.10	246.10	246.10	246.10	1,476.6

[1] Values reported reflect a three-year outlay around the *model run* year reported by IPM. Total reflects 2008 through 2025 outlay.

Energy consumers will experience a *net* savings over time by investing in energy efficient measures. Table 4.11a shows that the $9.2 billion program cost over the 18 year interval will be borne as a SBC charge. In addition energy consumers will incur added expenditures towards energy efficient goods as shown in Table 4-11b. The$1.5 billion expended is a portion of the total investment required – the balance is assumed in the program spending shown in Table 4-13, which ultimately comes back to the energy consumer as long as a SBC charge is used to pay for the program. Adding the totals from table 4-11a and 4-11b amounts to $10.7 billion over the18 years fro energy consumers. Table 4-12 shows the total savings for the same interval under the *default* PCKG amounts to $19.7 billion. The *net* savings is approximately $9.0 billion.

Table 4.12: Energy Efficiency – User Savings, Mil.$, 2003

			Savings 2008-2025
DEFAULT REF	PCKG	Residential	$9,777,607,038
		Commercial	$8,381,675,875
		Industrial	$1,563,360,521
	PCKG+CN-FED	Residential	$10,970,812,086
		Commercial	$9,409,570,288
		Industrial	$1,755,680,464
Hi-Emission REF	PCKG	Residential	$11,932,260,595
		Commercial	$10,219,190,629
		Industrial	$1,903,512,112
	PCKG+CN-FED	Residential	$12,608,384,555
		Commercial	$10,799,131,684
		Industrial	$2,017,383,936

Table 4-13: Energy Efficiency Program Budget 2008 through 2025 , Mil. $2003

Administration	$1,443.4
Marketing	$561.1
Auditing & Installation	$1,687.0
Total Program Implementation	$3,691.4
Subsidies toward EE technology	$5,537.2
Total	$9,228.6

5

REMI IMPACT RESULTS

This chapter presents the economic impacts resulting from the RGGI policy changes discussed in the preceding chapter. Impacts to be addressed include *gross regional product (GRP)*, *real personal income*, and *private-sector job changes*. Each of the values reported should be understood as *"X number of jobs –or $ of income different (more/less) than would have occurred in year _ t, without the policy"*. The discussion and tabular results are for the 9-State aggregate RGGI region. Appendix C presents similarly formatted results for each of the states and a discussion of any notable differences from the results at the aggregate region level.

Default Reference Scenario Impacts

Table 5-1a: RGGI Region Impacts Compared to *Default* Reference

Impacts on 9-State Region		2009	2015	2021
Package	Total GRP (Bil Fixed 96$)	**0.17**	**0.25**	**0.21**
	Real Pers Inc (Bil Fixed 96$)	**-0.05**	**0.25**	**0.43**
	Private Sector Jobs (thous.)	**2.59**	**4.18**	**4.29**
Package w/ 2 x *Efficiency*	Total GRP (Bil Fixed 96$)	**0.85**	**1.26**	**1.58**
	Real Pers Inc (Bil Fixed 96$)	**0.18**	**0.99**	**1.90**
	Private Sector Jobs (thous.)	**10.61**	**15.00**	**18.02**
Package + CN-FED Policies	Total GRP (Bil Fixed 96$)	**-0.78**	**1.64**	**2.28**
	Real Pers Inc (Bil Fixed 96$)	**-1.21**	**2.33**	**2.91**
	Private Sector Jobs (thous.)	**-8.52**	**22.31**	**22.39**

The PCKG scenario shows modest positive economic impacts for the select years (initial, mid-interval, proximate to end year), other than for *real* personal income in 2009 (one expects *nominal* income to increase with GRP and job increases but there is also an initial increase in the consumer price index that erodes nominal income gains). Despite higher electric prices, consumers paying for an energy efficiency program and their buying efficient goods, the combined effects of generating technology investments (traditional, renewable and energy efficient) and bill savings eventually out weigh the effect of higher electric prices. There is little role exerted by natural gas price changes under this scenario. As a result gross regional product in 2015 is approximately $0.25 billion higher than it would be without the policy. This activity adds an additional 4,180 jobs in the private-sector for the 9-state region.

The PCKG w/ 2 *x* Efficiency scenario produces larger positive impacts relative to the *default* reference than the PCKG. This results from the combined effect of more than double an investment stimulus across all types of generating/load averting technologies than in the PCKG, amplified bill savings to households and businesses that adopt energy efficient measures, and dampened electric price increases due to heightened energy efficiency adoption.

The PCKG +CN-FED scenario initially shows negative impacts on the 9-state region. This is predominantly due to the fact that RGGI states face higher electric Prices than the rest of the U.S. until the broader electric market adjusts for the 2015 implementation of the federal carbon-cap policy. That adjustment brings more than double the investment stimulus into the RGGI region for generating capacity (conventional and renewable), energy efficiency has been accumulating bill savings to energy consumers, and most importantly, RGGI region electric and gas price differentials narrow dramatically with the onset of the federal policy. By 2015 onward, the 9-state economy shows the largest positive impacts relative to the *default* reference case from among the three scenarios considered.

Table 5.1b presents these impacts as percent changes of the reference case values shown earlier in Table 4.4. The implication is that any of the policies have very small economic reverberations on the 9-state region.

Table 5-1b: RGGI Region Impacts (%) Compared to *Default* Reference

Impacts on 9-State Region		2009	2015	2021
Package	Total GRP (Bil Fixed 96$)	0.01%	0.01%	0.01%
	Real Pers Inc (Bil Fixed 96$)	0.00%	0.01%	0.02%
	Private Sector Jobs	0.01%	0.02%	0.02%
Package w/ 2 x *Efficiency*	Total GRP (Bil Fixed 96$)	0.04%	0.05%	0.06%
	Real Pers Inc (Bil Fixed 96$)	0.01%	0.05%	0.09%
	Private Sector Jobs	0.05%	0.06%	0.08%
Package + CN-FED Policies	Total GRP (Bil Fixed 96$)	-0.04%	0.07%	0.08%
	Real Pers Inc (Bil Fixed 96$)	-0.07%	0.12%	0.13%
	Private Sector Jobs	-0.04%	0.10%	0.09%

High-Emission Scenario Impacts

Impacts are next presented for the two scenarios considered based on the *High-Emissions* Reference case.

Table 5-2a: RGGI Region Impacts Compared to *High-Emissions* Reference

Impacts on 9-State Region		2009	2015	2021
Package	Total GRP (Bil Fixed 96$)	**-0.28**	**-1.10**	**-1.77**
	Real Pers Inc (Bil Fixed 96$)	**-0.56**	**-1.19**	**-1.71**
	Private Sector Jobs (thous.)	**-2.34**	**-8.26**	**-10.72**
Package + CN-FED Policies	Total GRP (Bil Fixed 96$)	**-0.56**	**1.31**	**2.76**
	Real Pers Inc (Bil Fixed 96$)	**-0.87**	**1.98**	**3.22**
	Private Sector Jobs (thous.)	**-5.39**	**18.76**	**26.24**

The *High-Emissions* Reference circumscribes a different set of impact outcomes for two of the same policies considered under the *default* Reference. Negative economic outcomes persist for the 9-state region under the PCKG scenario. Keep in mind this scenario has same level of energy efficiency adoption as the PCKG under the *default* reference, however that benefit can not buoy the RGGI region while it faces (a) drastically lower investment ($5 billion) over the policy interval relative to its reference case (fewer New CC and IGCC plants), (b) markedly larger increases in electric prices and (c) increases in natural gas prices not seen for the same scenario under the *default* reference.

The PCKG +CN-FED scenario on the other hand shows a similar pattern of economic impacts to the same scenario shown in Table 5-1a. - initial negative impacts at the outset, and positive impacts at the mid – and end-policy years. The first two years reported show less dramatic impacts (either a *smaller* loss or gain) than this scenario under the *default* reference setting. The *high-emissions* expectation early on influences pricing for all energy type not only in the RGGI region but nationally, and this backdrop limits the *relative* price increases in electric and natural gas markets once the RGGI policy is implemented and the eventual federal policy later in 2015. The impacts reported for 2021 are a bit larger than this scenario produces under the *default* reference case. The reason for this is that U.S. electric prices increase at a greater rate than for the early-adopting RGGI states, making relative electric prices more competitive in the 9-state region.

Table 5.2b presents these impacts as percent changes of the *high-emissions* reference case values shown earlier in Table 4.4. The implication is that either of the policies will create a very small economic reverberation on the 9-state region.

Table 5-2b: RGGI Region Impacts (%) Compared to *High-Emissions* Reference

Impacts on 9-State Region		2009	2015	2021
Package	Total GRP (Bil Fixed 96$)	-0.01%	-0.05%	-0.07%
	Real Pers Inc (Bil Fixed 96$)	-0.03%	-0.06%	-0.08%
	Private Sector Jobs	-0.01%	-0.04%	-0.05%
Package + CN-FED Policies	Total GRP (Bil Fixed 96$)	-0.03%	0.05%	0.10%
	Real Pers Inc (Bil Fixed 96$)	-0.05%	0.10%	0.15%
	Private Sector Jobs	-0.02%	0.08%	0.11%

Appendix C presents the state-specific impact results and a narrative of on any departures from the above presentation of regional results.

APPENDIX A- STATE-SPECIFIC REMI RESULTS ON REFERENCE FORECASTS

The following tables present similar formatted results as shown in Table 4.4 in Chapter 4 for each of the RGGI states.

Default Reference Forecasts

MASSACHUSETTS			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	385.3	452.2	515.9
Real Pers Inc (Bil Fixed 96$)	275.5	315.4	360.3
Private-sector Jobs (thous.)	3872.1	4047.1	4207.1

Connecticut			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	182.1	204.5	227.4
Real Pers Inc (Bil Fixed 96$)	156.3	177.8	201.7
Private-sector Jobs (thous.)	1925.0	2008.5	2074.3

Maine			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	39.2	45.2	50.9
Real Pers Inc (Bil Fixed 96$)	37.9	44.4	51.5
Private-sector Jobs (thous.)	728.5	774.3	806.2

New Hampshire			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	59.6	74.0	86.4
Real Pers Inc (Bil Fixed 96$)	48.0	56.0	65.0
Private-sector Jobs (thous.)	760.0	805.3	840.7

Rhode Island			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	41.4	49.7	57.6
Real Pers Inc (Bil Fixed 96$)	36.8	42.5	49.1
Private-sector Jobs (thous.)	542.4	574.0	602.2

Vermont			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	23.9	30.2	35.2
Real Pers Inc (Bil Fixed 96$)	19.6	23.1	26.9
Private-sector Jobs (thous.)	374.7	401.2	419.1

New York			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	967.5	1084.1	1189.6
Real Pers Inc (Bil Fixed 96$)	739.6	846.6	950.7
Private-sector Jobs (thous.)	9350.2	9822.0	10075.9

Delaware/DELMARVA			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	38.8	43.0	47.3
Real Pers Inc (Bil Fixed 96$)	28.4	32.3	36.4
Private-sector Jobs (thous.)	450.9	466.6	473.9

New Jersey			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	401.8	451.4	498.4
Real Pers Inc (Bil Fixed 96$)	360.7	410.6	462.0
Private-sector Jobs (thous.)	4298.3	4470.3	4560.1

High-Emissions Reference Forecasts

MASSACHUSETTS			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	385.5	451.5	514.2
Real Pers Inc (Bil Fixed 96$)	275.8	314.6	358.5
Private-sector Jobs (thous.)	3874.6	4040.0	4193.0

CONNECTICUT			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	182.1	204.5	227.2
Real Pers Inc (Bil Fixed 96$)	156.4	177.9	201.7
Private-sector Jobs (thous.)	1925.1	2009.0	2073.2

MAINE			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	39.3	45.2	50.8
Real Pers Inc (Bil Fixed 96$)	37.9	44.3	51.4
Private-sector Jobs (thous.)	728.8	773.7	804.9

NEW HAMPSHIRE			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	59.6	73.9	86.2
Real Pers Inc (Bil Fixed 96$)	48.0	55.9	64.7
Private-sector Jobs (thous.)	760.5	803.8	838.1

RHODE ISLAND			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	37.1	42.1	47.2
Real Pers Inc (Bil Fixed 96$	36.8	42.4	48.9
Private-sector Jobs (thous.)	542.6	573.1	600.4

VERMONT			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	23.9	30.1	35.1
Real Pers Inc (Bil Fixed 96$	19.6	23.0	26.8
Private-sector Jobs (thous.)	374.9	400.7	418.2

NEW YORK			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	968.4	1084.9	1189.6
Real Pers Inc (Bil Fixed 96$	740.7	847.4	950.4
Private-sector Jobs (thous.)	9360.1	9828.5	10074.5

DELAWARE			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	38.9	43.1	47.4
Real Pers Inc (Bil Fixed 96$	28.4	32.5	36.6
Private-sector Jobs (thous.)	451.6	467.7	475.6

NEW JERSEY			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	402.3	452.1	499.6
Real Pers Inc (Bil Fixed 96$	361.4	411.5	463.5
Private-sector Jobs (thous.)	4304.7	4477.0	4570.3

APPENDIX B- HANDLING INVESTMENTS FOR GENERATION AND ENERGY EFFICIENCY

(This Appendix was prepared by the Massachusetts Division of Energy Resources)

Handling Investments for Generation in REMI

For this study, the REMI Model is used to estimate the regional economic impact on Northeastern States' industries from investing in new generating technologies. REMI is an economic model that works with input-output database, using North American Industry Classification System sectors (NAICS).

The economic evaluation is composed of two sections: the evaluation has been completed at the industry level and not at the generating technology level. The first section translates generating technology in IPM model to generating technology in various regional economic modeling such as IMPLAN. IMPLAN[6] is used to define some of IPM generating technologies**.** Other IPM generating technologies (see footnotes 6 through 10) are researched and defined by Energy Supply & Pricing[7] (ESP) group. The second section matches up generating technology in IMPLAN and ESP to industry sectors in NAICS[8] codes in order to allocate investment dollars spent on generating capacities to industries. NAICS sector codes can easily be synchronized with REMI industries[9]. REMI examines how costs from investments in new generating technology would be passed forward to customers: REMI uses the incremental costs (i.e. in percentage amount) of these new generating technologies as one of the inputs for each industry's expenditure.

The Table below describes IPM generating technologies and its equivalent to IMPLAN[10] and other economic models researched by ESP group (with further detail in the footnotes).

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[6] Minnesota IMPLAN Group, Inc., IMPLAN System (data and software), 1725 Tower Drive West, Suite 140, Stillwater, MN 55082. IMPLAN is an Input-Output economic assessment computer modeling system- IMPLAN data descriptions and classification can be found at www.implan.com. Original data descriptions are listed in IMPLAN user's manual.

[7] Energy Supply Group, Massachusetts Division of Energy Resources, 100 Cambridge Street, Suite 1020, Boston, MA 02115

[8] NAICS: North American Industry Classification systems are new approach to classify economic activity. It has larger number of sector and allows more flexibility in designating sub sectors than the Standard Industry Classification (SIC). For more information on the subject visit the website www.naics.com/info.

[9] Some of IPM capacities are converted to IMPLAN and the corresponding industries. Other IPM capacities have relied on ESP research team to identify the industries

[10] Eight of IPM- investments of new capacity are converted to IMPLAN investments

IPM Generating Technology	**IMPLAN & ESP Generating Technology**	**IMPLAN /ESP Conversion**	**IMPLAN/ESP Code Name**
Biomass Co-firing	Diesel, Manure Lagoon	IMPLAN	ES-CLM
New CC	Combined Cycle	IMPLAN	ES-CCCS
New CT	Combustion Turbine	IMPLAN	ES-CCT
New IGCC	New Pulverized Coal, w./FDG, coal	IMPLAN	ES-CPCS
New Scrubbed Coal	Pulverized Coal w/FGD Retrofit	IMPLAN	ES-CPCR
New Biomass	Boiler, wood	IMPLAN	ES-CWB
New Wind	Wind Turbine	IMPLAN	ES-CWT
New Solar PV	Photovoltaic	IMPLAN	ES-CPV
Pollution Control	Air Pollution Control[11]	ESP	ESP-PC
Fuel Cell	Fuel Cell[12]	ESP	ESP-FC
Nuclear Uprate	Nuclear Electricity[13]	ESP	ESP-NU
Hydro	New Hydro[14]	ESP	ESP-NH
Landfill	Landfill Gas[15]	ESP	ESP-LFG

Using IMPLAN energy supply model, IMPLAN generating technologies are represented by industries and by costs allocation per industry. The industry sectors are IMPLAN sectors and they can be matched to NAICS-sectors of 2-4 digit codes and then links NAICS codes to REMI-Policy Variables (PV). Both IMPLAN and REMI models have been used to estimate economic impacts on the northeastern regions: IMPLAN works with REMI using 2001 data with NAICS[16] sectors and 1987 data with SIC[17] sectors. REMI industries translate IMPLAN industry codes to policy variables using 2-4 digit NAICS codes. The Table below shows the detail of costs percentages of Biomass Co-firing, New CC, New CT, New IGCC, New Scrubbed Coal, and New Biomass, New Wind, and New Solar PV renewable technologies using IMPLAN-NAICS-REMI industry codes. ESP group uses IPM investment dollars by generating technology and IMPLAN cost allocation by industry to calculate the amount spent by REMI industry sectors[18].

[11] Source: CIC Research , Inc
[12] Source: http://wlapwww.gov.bc.ca/air
[13] Source: Canadian Energy Research Institute (CERI)
[14] Source: http://www.mfe.govt.nz/publications/water
[15] Source: CONEG Policy Research Center, Inc.
[16] Prior to 2001, IMPLAN data are SIC based. It is stated in IMPLAN User's manual that in order to get a clean conversion for 2000 and earlier IMPLAN data, we link IMPLAN to NAICS using SIC (i.e. the 2001 data is already NAICS based). The U.S. Census Bureau provides correspondence between 2002 NAICS Bridge and 1987 SIC bridge.
[17] SIC Standard Industry Classification.
[18] Amount of REMI policy variable are keyed in million of 2003 dollars

IMPLAN CODE	NAICS CODE	REMI-CODE	ES-CPCS	ES-CPCR	ES-CCCS	ES-CCT	ES-CWB	ES-CPV	ES-CWT	ES-CLM
50	22	6406	58.57%	42.81%	31.88%	61.27%	36.85%			
56	488	6438						22.64%	15.26%	28.34%
189	325	6428			3.77%					
219	326	6429								12.98%
220	326	6429								4.12%
249	3361	6415	0.04%							
258	331	6410					0.15%			
267	331	6410	0.10%		0.13%	0.37%				
281	331	6410					5.01%			
282	332	6411						7.59%	23.80%	
284	332	6411	14.24%		14.25%	5.87%	20.32%			
303	332	6411				1.15%	2.03%			
307	333	6412	7.98%		44.59%	23.93%	18.88%		56.61%	
311	333	6412					0.83%			
315	333	6412	3.10%	1.71%			2.07%			
316	333	6412	0.33%		0.22%					
332	333	6412	0.88%		1.41%		2.20%			
334	333	6412	11.18%	55.02%			5.73%			0.73%
338	333	6412								2.16%
349	333	6412	0.19%	0.17%	0.09%	1.89%	0.61%			
355	335	6414	0.87%		0.86%	2.44%				
356	335	6414	1.30%		1.02%	2.89%	1.67%	3.88%		
357	335	6414								33.74%
360	335	6414						19.63%		
372	331	6410	0.03%		0.19%					
377	331	6410						42.30%		
403	334	6413	0.94%		1.19%		3.22%			
433	487	6438	0.02%		0.003%		0.01%	0.01%		
435	487	6438	0.15%	0.17%	0.22%	0.09%	0.27%	0.11%	0.10%	0.15%
436	483	6434	0.04%	0.06%	0.01%	0.02%	0.06%			0.003%
437	481	6432	0.05%	0.06%	0.17%	0.08%	0.11%	0.08%	0.05%	0.11%
447	42	6430						3.72%	4.18%	2.07%
506	54	6449								15.6%
TOTAL			100%	100%	100%	100%	100%	100%	100%	100%

Source: IMPLAN- Energy Supply Model

In addition to generating technologies being identified by IMPLAN, an effort was made to identify generating technologies in IPM that can not be matched to IMPLAN. ESP group researched several types of models that used to measure generating technologies by industries and by cost function. The sector codes by generating technologies are ESP sectors and they are matched to NAICS codes. The Table below shows the cost allocation (in percentage) by industries[19]. It

[19] ESP group identified some of IPM generating technologies using various economic models of a specific group or company. The costs percentage by industries may not exact match other data published in other

describes the detail of the percentage cost allocation of Pollution Control, Fuel Cell, Nuclear Uprate, Hydro, and landfill Gas renewable technologies by NAICS and by REMI-Industry demand. ESP group uses IPM investment dollars by generating technology and various economic models that represent cost allocation by industry in order to measure the amount spent by REMI industry codes.

NAICS - CODE	**REMI-CODE**	**ESP-PC**	**ESP-NU**	**ESP-FC**	**ESP-NH**	**ESP-LFG**
23	6407				91%	13%
332	6411	22%		4%		
333	6412	30%		15%	3%	
334	6413	14%				
335	6414			9%	3%	15%
3361	6415			1%		
3364	6418			1%		
325	6428		14%			
326	6429			70%		
42	6430		7%			65%
516	6442		15%			
524	6446		7%			
54	6449	8%	38%		3.%	5%
561	6451	26%	13%			2%
811	6463		3%			
813	6465		3%			
TOTAL		100%	100%	100%	100%	100%

Source: ESP group

companies. However, ESP took in consideration the description of northeastern economy and the IPM definition of generating technologies.

As the Table below shows, all IPM generating technologies are in REMI industries that are represented by REMI codes and NAICS[20] codes. It is those industries that can best describe the economic impact of adding addition dollars to the northeastern region through investing in new generating technologies.

REMI-PV	Description	NAICS Codes
6406	Utilities	22
6438	Support activities for transportation	487
6428	Chemical manufacturing	325
6429	Plastic and rubber products manufacturing	326
6415	Motor vehicle manufacturing	3361
6410	Primary metal manufacturing	331
6413	Computer and electronic product manufacturing	334
6411	Fabricated metal product	332
6412	Machinery manufacturing	3336
6414	Electric equipment & appliance manufacturing	335
6434	Water transportation	483
6432	Air transportation	481
6430	Wholesale trade	42
6449	Professional and technical services	54
6407	Construction	23
6418	Miscellaneous manufacturing	339
6442	Information services: Data processing	51
6446	Finance and Insurance	52
6451	Administration and support service	561
6463	Repair maintenance	811
6465	Membership association organization	813

Source: ESP & REMI Policy Insights

Handling Investment for Energy Efficiency Goods in REMI

ESP group uses the REMI Model to measure the economic impacts of energy efficiency programs over time in the northeastern states. IPM provides total expenditures data on energy efficiency products &services by customer class from 2005 to 2025. The ESP group desegregates into IPM energy efficiency expenditures to REMI industry-specific expenditures. The difficulty lies into providing end use categories as a percentage of total IPM's expenditures and as an expenditure of REMI industry demand for every northeastern State.

In order to provide an accurate estimate and impact analysis of energy efficiency programs for every RGGI state, data should be collected from every state's utility companies by customer class (i.e. residential, commercial, and industrial) and by end use category (i.e. lighting, refrigeration, motors, etc.). It is important to understand that energy efficiency information may not be readily available: customer class data are easier to provide than end-use data. In order to use the REMI model, ESP group needs to determine how much each state spent on energy efficiency activities not only by customer class but also by end use.

[20] The level of NAICS varies from 2-4 digit codes.

Massachusetts provides the most detailed and comprehensive energy efficiency model[21]. Utility companies in Massachusetts submit data by end use and customer class[22]. Massachusetts' energy efficiency model provides consistent description of the state economy[23].
The simplest approach to accounting for end use rates by customer class and by State is to use the end use rates for Massachusetts and apply it as a proxy rate to all northeastern States[24].

The energy efficiency impact analysis entails two different sections: The analysis is accomplished by customer class and by end use. The first section defines rate proxy by end use for each customer class and applies those rates to each Northeastern State. The last section, ESP group assumes end-use rates for all RGGI States based on Massachusetts' energy efficiency data and calculates the breakdown of IPM expenditures by end use category, and then measures total energy efficiency expenditures by customer class and applies to REMI industry specifics. ESP group matches up IMPLAN cost applications by industry to NAICS codes. NAICS codes are translated to REMI industry demand.

The end-use categories by customer class are IMPLAN energy efficiency applications. ESP group multiplies the amount of customer class expenditures projected by IPM over time with end-use rates determined by ESP (see below). It is this calculated amount that the Table below shows end-use expenditures (in percentage) by the residential sector.

End-Use	**Residential ESP Rates**
Refrigeration	6%
Lamps	41%
Lighting Fixtures	4%
Water Heat Controls	0%
Water Heat Equipment	5%
Solar Water Heating	0%
Laundry Appliances	19%
Windows- HVAC Heating	0%
Windows- HVAC Cooling	0%
Insulation-HVAC Heating	3%
Insulation- HVAC Cooling	3%
HVAC-Controls-HVAC Heating	3%
HVAC-Controls-HVAC Cooling	5%
Heating &Cooling Equipment-HVAC Heating	4%
Heating& Cooling Equipment-HVAC Cooling	6%
Other Process measures	1%
Cooking Appliances	0%
Total Residential Expenditures (in percentage)	100%

[21] See DOER annual report on " energy efficiency Activities" for 1998 to present
[22] The current state of knowledge about end use rates for every state is limited to the extent that there are no data provided by other northeastern states. ESP has no knowledge as to whether or not northeastern states have developed energy efficiency models using REMI policy Insight. .
[23] For the state of Massachusetts, IMPLAN Energy efficiency Model was used to identify end use sectors by customer class. IMPLAN end use rates sectors were applied to calculate total energy efficiency expenditure by industry. The sector codes are IMPLAN sectors and they were matched to NAICS codes and then to REMI industry specific codes. Both IMPLAN and REMI models have been used to estimate economic impact of energy efficiency for the state of Massachusetts.
[24] ESP group consider any implication or attribute other than those above from any RGGI State. As ESP gets data updates, it can add them to the energy efficiency tables.

ESP group calculates end-use category by multiplying the total amount of residential expenditures projected by IPM over time with the residential end-use rates[25]. It is the total spending amount (in million of 2003 dollars) by end use that is used to allocate energy efficiency investment across industries.

The Table below shows rate proxy by end use and by Commercial & Industrial (C & I) class. ESP group applies the same calculations and assumptions as in residential rates by end use.

End-Use	**Commercial ESP Rates**	**Industrial ESP Rates**
Refrigeration	5%	4%
Lamps	2%	1%
Lighting Fixtures	37%	11%
Water Heat Controls	0%	0%
Water Heat Equipment	0%	0%
Solar Water Heating	0%	0%
Windows- HVAC Heating	0%	0%
Windows- HVAC Cooling	0%	0%
Insulation-HVAC Heating	0%	0%
Insulation- HVAC Cooling	0%	0%
HVAC-Controls-HVAC Heating	0%	0%
HVAC-Controls-HVAC Cooling	2%	0%
Heating &Cooling Equipment-HVAC Heating	1%	1%
Heating& Cooling Equipment-HVAC Cooling	13%	8%
HVAC Storage Cooling-Heating	0%	0%
HVAC storage Cooling-Cooling	0%	0%
Process Measures	0%	5%
Motors	5%	1%
Others	4%	0%
Total C & I Expenditures (in percentage)	69%	31%

The following Table translates end use rates by customer class to end use rates by REMI industry demand. The end use sector codes are NAICS sectors and they can be matched to REMI codes: IMPLAN energy efficiency model is used to determine the cost allocation per end use and per customer class with the dollars invested over time for each end use. IMPLAN industries match up with NAICS sectors.

[25] ESP suggests using the same residential rates over time across northeastern States. Even though, States may differ in their energy efficiency activities. Currently, there no state other than Massachusetts has provided data to ESP group. For now, ESP group assumed the same end use rate independently of any state's energy efficiency activities.

REMI-PV	Description	NAICS-Codes
6404	Mining	21
6409	Non metallic product manufacturing	327
6411	Fabricated metal products manufacturing	332
6412	Machinery manufacturing	333
6413	Computer and electronic product manufacturing	334
6414	Electrical equipment and appliance manufacturing	335
6429	Plastic & rubber products manufacturing	326
6430	Wholesale trade	42
6432	Air transportation	481
6433	Rail transportation	482
6435	Truck transportation	484
6438	Scenic &sightseeing transportation support activities	487
6449	Professional and technical services	54
6452	Waste management and remediation services	562

APPENDIX C- STATE-SPECIFIC REMI IMPACT RESULTS

Key to understanding the state-specific impacts that follow is that the *direct* policy effects that the IPM model estimates for each state largely determine the economic impacts exerted on each state. However, the REMI model considers how each state's economy is influenced not only by the policy changes experienced within its own borders but also those changes occurring in neighboring states. This influence is conveyed as goods and services are traded across state borders, and businesses (as well as working age households) consider location decisions as a result of policy induced changes.

Impacts stated as *differences* are presented to provide an understanding of the magnitude of job and monetary changes. A succinct discussion of these state-level results follows the presentation of each scenario's state-specific results in *%* change.

Scenarios Compared to ***Default*** **Reference Forecast**

Table C-1: State-level Impacts as Differences – PCKG

MASSACHUSETTS			
Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	0.07	0.07	0.16
Real Pers Inc (Bil Fixed 96$	0.00	0.06	0.19
Private-Sector Jobs (thous.)	0.87	0.99	1.85

CONNECTICUT			
Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	0.02	0.06	0.04
Real Pers Inc (Bil Fixed 96$	-0.01	0.07	0.08
Private-Sector Jobs (thous.)	0.30	0.78	0.64

MAINE			
Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	0.00	0.01	0.01
Real Pers Inc (Bil Fixed 96$	0.00	0.01	0.02
Private-Sector Jobs (thous.)	0.10	0.18	0.29

NEW HAMPSHIRE			
Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	0.01	0.01	0.01
Real Pers Inc (Bil Fixed 96$	0.00	0.01	0.02
Private-Sector Jobs (thous.)	0.13	0.18	0.21

RHODE ISLAND			
Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	0.01	0.01	0.01
Real Pers Inc (Bil Fixed 96$)	0.00	0.01	0.02
Private-Sector Jobs (thous.)	0.11	0.14	0.25

VERMONT			
Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	0.00	0.01	0.01
Real Pers Inc (Bil Fixed 96$)	0.00	0.01	0.02
Private-Sector Jobs (thous.)	0.10	0.19	0.26

New York			
Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	0.04	0.07	-0.03
Real Pers Inc (Bil Fixed 96$)	-0.01	0.12	0.09
Private-Sector Jobs (thous.)	0.71	1.42	0.70

NEW JERSEY			
Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	0.01	0.02	-0.01
Real Pers Inc (Bil Fixed 96$)	-0.03	-0.02	0.00
Private-Sector Jobs (thous.)	0.18	0.32	0.21

DELAWARE			
Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	0.01	0.00	-0.01
Real Pers Inc (Bil Fixed 96$)	0.00	-0.01	-0.02
Private-Sector Jobs (thous.)	0.09	-0.02	-0.12

Table C-2: State-level Impacts as Percent Change – PCKG

MASSACHUSETTS			
Variable	**2009**	**2015**	**2021**
Total GRP	0.02%	0.02%	0.03%
Real Pers Inc	0.00%	0.02%	0.05%
Private-Sector Jobs	0.02%	0.02%	0.04%

CONNECTICUT			
Variable	**2009**	**2015**	**2021**
Total GRP	0.01%	0.03%	0.02%
Real Pers Inc	-0.01%	0.04%	0.04%
Private-Sector Jobs	0.02%	0.04%	0.03%

MAINE			
Variable	**2009**	**2015**	**2021**
Total GRP	0.01%	0.02%	0.03%
Real Pers Inc	-0.01%	0.01%	0.04%
Private-Sector Jobs	0.01%	0.02%	0.04%

NEW HAMPSHIRE			
Variable	**2009**	**2015**	**2021**
Total GRP	0.01%	0.01%	0.01%
Real Pers Inc	0.00%	0.02%	0.03%
Private-Sector Jobs	0.02%	0.02%	0.03%

RHODE ISLAND			
Variable	**2009**	**2015**	**2021**
Total GRP	0.02%	0.02%	0.03%
Real Pers Inc	0.00%	0.02%	0.05%
Private-Sector Jobs	0.02%	0.03%	0.04%

VERMONT			
Variable	**2009**	**2015**	**2021**
Total GRP	0.01%	0.02%	0.03%
Real Pers Inc	-0.01%	0.05%	0.08%
Private-Sector Jobs	0.03%	0.05%	0.06%

New York			
Variable	**2009**	**2015**	**2021**
Total GRP	0.00%	0.01%	0.00%
Real Pers Inc	0.00%	0.01%	0.01%
Private-Sector Jobs	0.01%	0.01%	0.01%

NEW JERSEY			
Variable	**2009**	**2015**	**2021**
Total GRP	0.00%	0.00%	0.00%
Real Pers Inc	-0.01%	-0.01%	0.00%
Private-Sector Jobs	0.00%	0.01%	0.01%

DELAWARE			
Variable	**2009**	**2015**	**2021**
Total GRP	0.03%	0.00%	-0.02%
Real Pers Inc	0.01%	-0.02%	-0.05%
Private-Sector Jobs	0.02%	-0.01%	-0.03%

Typically all states show the same pattern of positive impacts on all three years as the aggregate RGGI region portrayed in Table 5.1b. The exception is in initial year results for some states (CT, VT, ME, NJ, and DE) with respect to impacts on *real* income. Nominal income increases with the reported GRP increases (hence job gains as well). However, the combined electric price increase, energy users' out-of-pocket for energy efficient purchases and the SBC charge on consumers to fund the energy efficiency program aggravate the consumer price index (CPI). When the percentage increase in the CPI exceeds the percent increase in nominal income, *real* income declines *temporarily*

As for the stimulus of energy efficiency investments the following is the allocation of dollars from largest to smallest: *NY (33%), MA (25%), NJ (17.5%), CT (13.6%), ME and RI (3% each),* and *NH and VT (2.5% each).* The pattern of investment in traditional generation technologies under this scenario is as follows relative to the default reference case: *NY (-$1,077m), MA (-$815m), NJ (-$921m), CT (-$355m), ME (no change), NH (+$46m), DE (-$470m)* and *VT (-$130m).* The combined investment dynamics between energy efficiency technologies and traditional generating capacity/pollution control/renewable investments will serve as a net stimulus on each state economy.

Table C-3: State-level Impacts as Differences – PCKG +CN-FED

MASSACHUSETTS

Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	-0.15	0.46	0.64
Real Pers Inc (Bil Fixed 96$)	-0.26	0.55	0.69
Private-Sector Jobs (thous.)	-1.68	5.54	5.63

CONNECTICUT

Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	-0.06	0.19	0.24
Real Pers Inc (Bil Fixed 96$)	-0.13	0.28	0.34
Private-Sector Jobs (thous.)	-0.70	2.48	2.40

MAINE

Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	-0.02	0.04	0.07
Real Pers Inc (Bil Fixed 96$)	-0.03	0.06	0.10
Private-Sector Jobs (thous.)	-0.33	0.94	1.15

NEW HAMPSHIRE

Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	-0.03	0.06	0.09
Real Pers Inc (Bil Fixed 96$)	-0.04	0.09	0.11
Private-Sector Jobs (thous.)	-0.39	1.03	1.03

RHODE ISLAND

Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	-0.02	0.04	0.06
Real Pers Inc (Bil Fixed 96$	-0.03	0.07	0.09
Private-Sector Jobs (thous.)	-0.23	0.75	0.78

VERMONT

Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	-0.01	0.02	0.04
Real Pers Inc (Bil Fixed 96$	-0.01	0.03	0.06
Private-Sector Jobs (thous.)	-0.09	0.50	0.68

New York

Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	-0.32	0.52	0.86
Real Pers Inc (Bil Fixed 96$	-0.44	0.85	1.14
Private-Sector Jobs (thous.)	-3.16	7.21	8.06

NEW JERSEY

Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	-0.14	0.25	0.27
Real Pers Inc (Bil Fixed 96$	-0.23	0.35	0.39
Private-Sector Jobs (thous.)	-1.52	3.17	2.64

DELAWARE

Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	-0.04	0.07	0.00
Real Pers Inc (Bil Fixed 96$	-0.02	0.04	0.01
Private-Sector Jobs (thous.)	-0.42	0.70	0.02

Table C-4: State-level Impacts as Percent Change – PCKG +CN-FED

MASSACHUSETTS			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.04%	0.10%	0.12%
Real Pers Inc	-0.09%	0.18%	0.19%
Private-Sector Jobs	-0.04%	0.14%	0.13%

RHODE ISLAND			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.04%	0.10%	0.12%
Real Pers Inc	-0.09%	0.16%	0.17%
Private-Sector Jobs	-0.04%	0.13%	0.13%

CONNECTICUT			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.03%	0.09%	0.11%
Real Pers Inc	-0.09%	0.16%	0.17%
Private-Sector Jobs	-0.04%	0.12%	0.12%

VERMONT			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.03%	0.07%	0.12%
Real Pers Inc	-0.07%	0.15%	0.22%
Private-Sector Jobs	-0.02%	0.13%	0.16%

MAINE			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.04%	0.09%	0.13%
Real Pers Inc	-0.09%	0.14%	0.19%
Private-Sector Jobs	-0.05%	0.12%	0.14%

New York			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.03%	0.05%	0.07%
Real Pers Inc	-0.06%	0.10%	0.12%
Private-Sector Jobs	-0.03%	0.07%	0.08%

NEW HAMPSHIRE			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.04%	0.08%	0.11%
Real Pers Inc	-0.09%	0.16%	0.16%
Private-Sector Jobs	-0.05%	0.13%	0.12%

NEW JERSEY			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.03%	0.06%	0.06%
Real Pers Inc	-0.06%	0.09%	0.09%
Private-Sector Jobs	-0.04%	0.07%	0.06%

DELAWARE			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.11%	0.17%	0.00%
Real Pers Inc	-0.07%	0.12%	0.02%
Private-Sector Jobs	-0.09%	0.15%	0.01%

All states show *negative* impacts in the initial year reported followed by *positive* impacts during the mid- and near end-policy years. The size of the GRP impact in 2009 for 8 of the 9 states is comparable to that reported for the aggregate RGGI-region in Table 5-1b. The state of Delaware is the exception through-out the policy interval. In the first two of three result years shown, Delaware exhibits the strongest impact in percentage terms (negative –or-positive). By 2021 this however changes and Delaware exhibits the smallest impact.

By 2015 the energy efficiency savings begin to accumulate and provide a benefit as well as parity being established in electric and natural gas markets (in terms of % price increases) for the rest of U.S. compared to the early-adopting RGGI states. This latter effect lessens the initial competitive disadvantage that a RGGI state experiences when compared to non-participating states outside of the RGGI region. As for the stimulus of energy efficiency investments the following is the allocation of dollars from largest to smallest: *NY (33%), MA (25%), NJ (17.5%), CT (13.6%), ME and RI (3% each),* and *NH and VT (2.5% each).* Under this scenario investment changes for traditional generating technologies over the interval is as follows relative to the default reference case: *NY (+$260m), MA (-$513m), NJ (-$75m), CT (-$477m), ME (+$830m, wind), NH (+$431m, wind),* *DE (-$411m), RI (no change)* and *VT (+$658m, wind)*. The combined investment dynamics between energy efficiency technologies and traditional generating capacity/pollution control/renewable investments will serve as a net stimulus on each state economy.

Table C-5: State-level Impacts as Differences – PCKG w/ 2 *x* Efficiency

MASSACHUSETTS

Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	0.30	0.41	0.58
Real Pers Inc (Bil Fixed 96$)	0.08	0.30	0.59
Private-Sector Jobs (thous.)	3.22	4.22	5.59

CONNECTICUT

Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	0.12	0.21	0.22
Real Pers Inc (Bil Fixed 96$)	0.03	0.19	0.28
Private-Sector Jobs (thous.)	1.45	2.35	2.40

MAINE

Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	0.01	0.03	0.05
Real Pers Inc (Bil Fixed 96$)	0.00	0.03	0.06
Private-Sector Jobs (thous.)	0.31	0.62	0.87

NEW HAMPSHIRE

Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	0.04	0.05	0.07
Real Pers Inc (Bil Fixed 96$)	0.02	0.04	0.07
Private-Sector Jobs (thous.)	0.54	0.68	0.84

RHODE ISLAND

Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	0.02	0.04	0.05
Real Pers Inc (Bil Fixed 96$	0.01	0.03	0.07
Private-Sector Jobs (thous.)	0.42	0.57	0.77

VERMONT

Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	0.01	0.02	0.04
Real Pers Inc (Bil Fixed 96$	0.00	0.03	0.05
Private-Sector Jobs (thous.)	0.32	0.52	0.69

New York

Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	0.24	0.34	0.41
Real Pers Inc (Bil Fixed 96$	0.06	0.29	0.59
Private-Sector Jobs (thous.)	3.03	4.20	5.00

NEW JERSEY

Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	0.10	0.16	0.17
Real Pers Inc (Bil Fixed 96$	-0.01	0.08	0.19
Private-Sector Jobs (thous.)	1.24	1.80	1.99

DELAWARE

Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	0.01	0.01	-0.01
Real Pers Inc (Bil Fixed 96$	0.00	0.00	-0.02
Private-Sector Jobs (thous.)	0.08	0.05	-0.13

Table C-6: State-level Impacts as Percent Change – PCKG w/ 2 x Efficiency

MASSACHUSETTS			
Variable	**2009**	**2015**	**2021**
Total GRP	0.08%	0.09%	0.11%
Real Pers Inc	0.03%	0.10%	0.16%
Private-Sector Jobs	0.08%	0.10%	0.13%

CONNECTICUT			
Variable	**2009**	**2015**	**2021**
Total GRP	0.07%	0.10%	0.10%
Real Pers Inc	0.02%	0.11%	0.14%
Private-Sector Jobs	0.08%	0.12%	0.12%

MAINE			
Variable	**2009**	**2015**	**2021**
Total GRP	0.04%	0.07%	0.09%
Real Pers Inc	-0.01%	0.06%	0.12%
Private-Sector Jobs	0.04%	0.08%	0.11%

NEW HAMPSHIRE			
Variable	**2009**	**2015**	**2021**
Total GRP	0.07%	0.07%	0.08%
Real Pers Inc	0.03%	0.07%	0.11%
Private-Sector Jobs	0.07%	0.08%	0.10%

RHODE ISLAND			
Variable	**2009**	**2015**	**2021**
Total GRP	0.07%	0.09%	0.11%
Real Pers Inc	0.02%	0.08%	0.14%
Private-Sector Jobs	0.08%	0.10%	0.13%

VERMONT			
Variable	**2009**	**2015**	**2021**
Total GRP	0.06%	0.08%	0.11%
Real Pers Inc	0.01%	0.12%	0.20%
Private-Sector Jobs	0.08%	0.13%	0.16%

New York			
Variable	**2009**	**2015**	**2021**
Total GRP	0.02%	0.03%	0.03%
Real Pers Inc	0.01%	0.03%	0.06%
Private-Sector Jobs	0.03%	0.04%	0.05%

NEW JERSEY			
Variable	**2009**	**2015**	**2021**
Total GRP	0.02%	0.04%	0.04%
Real Pers Inc	0.00%	0.02%	0.04%
Private-Sector Jobs	0.03%	0.04%	0.04%

DELAWARE			
Variable	**2009**	**2015**	**2021**
Total GRP	0.02%	0.02%	-0.03%
Real Pers Inc	0.01%	-0.01%	-0.05%
Private-Sector Jobs	0.02%	0.01%	-0.03%

These results are tied to a scenario similar to the PCKG scenario except the assumption for the role of energy efficiency is *doubled*. This does not mean the results from the IPM electric supply modeling are merely doubled in terms of how electric and natural gas prices are affected (see Tables 4.6 and 4.7). Natural gas prices changes are identical under the PCKG and the PCKG *w/ 2 x Efficiency*. The REMI economic impacts are positive as they are in Table C.2 but they are more than double those impacts. The exception is the state of Delaware which shows negative impacts of similar magnitude to the PCKG scenario.

Each state receives the same proportion of energy efficient investment activity as under all prior scenarios, except in levels it represents twice the amount and achieves a two-fold demand load averting effect, which changes the price determination of the IPM model. With a two-fold role for energy efficiency, this scenario implies the largest reductions in investment for traditional generating technologies relative to the default reference case.

Scenarios Compared to *High-Emissions* **Reference Forecast**

Table C-7: State-level Impacts as Differences – PCKG (under H-E backdrop)

MASSACHUSETTS			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	-0.05	-0.09	0.08
Real Pers Inc (Bil Fixed 96$)	-0.13	-0.03	0.17
Private-Sector Jobs (thous.)	-0.40	0.06	1.77

CONNECTICUT			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	-0.01	-0.16	-0.19
Real Pers Inc (Bil Fixed 96$)	-0.06	-0.20	-0.19
Private-Sector Jobs (thous.)	-0.05	-1.36	-1.17

MAINE			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	-0.01	-0.04	-0.01
Real Pers Inc (Bil Fixed 96$)	-0.02	-0.04	-0.01
Private-Sector Jobs (thous.)	-0.12	-0.54	0.10

NEW HAMPSHIRE			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	-0.01	-0.03	-0.02
Real Pers Inc (Bil Fixed 96$)	-0.02	-0.02	0.00
Private-Sector Jobs (thous.)	-0.15	-0.19	0.02

RHODE ISLAND			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	0.00	-0.01	0.00
Real Pers Inc (Bil Fixed 96$	-0.02	-0.01	0.01
Private-Sector Jobs (thous.)	-0.05	-0.04	0.16

VERMONT			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	0.00	0.00	0.00
Real Pers Inc (Bil Fixed 96$	0.00	0.00	0.02
Private-Sector Jobs (thous.)	0.04	0.07	0.19

New York			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	-0.11	-0.67	-0.75
Real Pers Inc (Bil Fixed 96$	-0.18	-0.74	-0.54
Private-Sector Jobs (thous.)	-0.73	-5.43	-4.09

NEW JERSEY			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	-0.06	-0.08	-0.85
Real Pers Inc (Bil Fixed 96$	-0.12	-0.13	-1.13
Private-Sector Jobs (thous.)	-0.50	-0.58	-7.38

DELAWARE			
Variable	**2009**	**2015**	**2021**
Total GRP (Bil Fixed 96$)	-0.04	-0.02	-0.03
Real Pers Inc (Bil Fixed 96$	-0.02	-0.02	-0.03
Private-Sector Jobs (thous.)	-0.38	-0.24	-0.32

Table C-8: State-level Impacts as Percent Change – PCKG (under H-E backdrop)

MASSACHUSETTS			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.01%	-0.02%	0.02%
Real Pers Inc	-0.05%	-0.01%	0.05%
Private-Sector Jobs	-0.01%	0.00%	0.04%

CONNECTICUT			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.01%	-0.08%	-0.09%
Real Pers Inc	-0.04%	-0.11%	-0.10%
Private-Sector Jobs	0.00%	-0.07%	-0.06%

MAINE			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.02%	-0.09%	-0.02%
Real Pers Inc	-0.05%	-0.10%	-0.01%
Private-Sector Jobs	-0.02%	-0.07%	0.01%

NEW HAMPSHIRE			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.02%	-0.04%	-0.03%
Real Pers Inc	-0.05%	-0.04%	-0.01%
Private-Sector Jobs	-0.02%	-0.02%	0.00%

RHODE ISLAND			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.01%	-0.02%	0.00%
Real Pers Inc	-0.05%	-0.02%	0.03%
Private-Sector Jobs	-0.01%	-0.01%	0.03%

VERMONT			
Variable	**2009**	**2015**	**2021**
Total GRP	0.00%	-0.02%	0.00%
Real Pers Inc	-0.03%	0.01%	0.06%
Private-Sector Jobs	0.01%	0.02%	0.05%

New York			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.01%	-0.06%	-0.06%
Real Pers Inc	-0.02%	-0.09%	-0.06%
Private-Sector Jobs	-0.01%	-0.06%	-0.04%

NEW JERSEY			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.01%	-0.02%	-0.17%
Real Pers Inc	-0.03%	-0.03%	-0.24%
Private-Sector Jobs	-0.01%	-0.01%	-0.16%

DELAWARE			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.10%	-0.04%	-0.06%
Real Pers Inc	-0.06%	-0.06%	-0.08%
Private-Sector Jobs	-0.08%	-0.05%	-0.07%

Under this scenario built upon a *high-emissions* reference case, *New York, Connecticut*, and *Maine* have noticeably higher electric price increases than the other RGGI states (see Table 4-9). In terms of natural gas price increases, *New York* experiences the highest increase from the IPM model.

Three states (*Massachusetts, Vermont, Rhode Island*) depart from the pattern of policy-induced impacts by 2021. These states show modest *positive* impacts while all other RGGI states exhibit persistent *negative* economic impacts. Vermont and Rhode Island's results are mitigated by investment stimulus relative to the high-emissions reference case in 2018. This provides relief from the prevailing higher energy costs and this stimulus has a persistent effect. While Massachusetts will experience lower levels of investment for traditional generation technologies/pollution control compared to the high-emissions reference, the state's energy efficiency savings are second largest (after New York) and grow considerably from 2018 onward. These savings combined with Massachusetts' share of energy efficiency investment dollars (second largest among RGGI states at 25%) are what turn prior *negative* economic impacts slightly *positive* for 2021.

Table C-9: State-level Impacts as Differences – PCKG + CN_FED (under H-E backdrop)

MASSACHUSETTS			
Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	-0.13	0.49	1.25
Real Pers Inc (Bil Fixed 96$)	-0.19	0.67	1.28
Private-Sector Jobs (thous.)	-1.20	5.91	10.50

CONNECTICUT			
Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	-0.02	0.09	0.21
Real Pers Inc (Bil Fixed 96$)	-0.08	0.16	0.29
Private-Sector Jobs (thous.)	-0.19	1.36	2.17

MAINE			
Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	-0.01	0.02	0.09
Real Pers Inc (Bil Fixed 96$)	-0.03	0.05	0.14
Private-Sector Jobs (thous.)	-0.25	0.61	1.65

NEW HAMPSHIRE			
Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	-0.02	0.06	0.16
Real Pers Inc (Bil Fixed 96$)	-0.03	0.09	0.19
Private-Sector Jobs (thous.)	-0.25	1.03	1.79

RHODE ISLAND			
Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	-0.01	0.04	0.10
Real Pers Inc (Bil Fixed 96$	-0.02	0.07	0.15
Private-Sector Jobs (thous.)	-0.10	0.71	1.33

VERMONT			
Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	0.00	0.03	0.06
Real Pers Inc (Bil Fixed 96$	-0.01	0.05	0.09
Private-Sector Jobs (thous.)	-0.02	0.61	0.94

New York			
Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	-0.24	0.35	0.92
Real Pers Inc (Bil Fixed 96$	-0.34	0.65	1.17
Private-Sector Jobs (thous.)	-2.16	5.35	8.48

NEW JERSEY			
Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	-0.09	0.18	-0.01
Real Pers Inc (Bil Fixed 96$	-0.15	0.20	-0.04
Private-Sector Jobs (thous.)	-0.87	2.25	-0.12

DELAWARE			
Variable	2009	2015	2021
Total GRP (Bil Fixed 96$)	-0.04	0.05	-0.03
Real Pers Inc (Bil Fixed 96$	-0.02	0.04	-0.03
Private-Sector Jobs (thous.)	-0.34	0.94	-0.50

Table C-10: State-level Impacts as Percent Change – PCKG + CN_FED (under H-E backdrop)

MASSACHUSETTS			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.03%	0.11%	0.24%
Real Pers Inc	-0.07%	0.21%	0.36%
Private-Sector Jobs	-0.03%	0.15%	0.25%

RHODE ISLAND			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.02%	0.10%	0.22%
Real Pers Inc	-0.06%	0.17%	0.30%
Private-Sector Jobs	-0.02%	0.13%	0.22%

CONNECTICUT			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.01%	0.04%	0.09%
Real Pers Inc	-0.05%	0.09%	0.14%
Private-Sector Jobs	-0.01%	0.07%	0.11%

VERMONT			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.02%	0.09%	0.18%
Real Pers Inc	-0.05%	0.20%	0.32%
Private-Sector Jobs	-0.01%	0.15%	0.22%

MAINE			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.04%	0.04%	0.18%
Real Pers Inc	-0.07%	0.10%	0.26%
Private-Sector Jobs	-0.03%	0.08%	0.21%

New York			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.03%	0.03%	0.08%
Real Pers Inc	-0.05%	0.08%	0.12%
Private-Sector Jobs	-0.02%	0.05%	0.08%

NEW HAMPSHIRE			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.03%	0.08%	0.19%
Real Pers Inc	-0.07%	0.17%	0.29%
Private-Sector Jobs	-0.03%	0.13%	0.21%

NEW JERSEY			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.02%	0.04%	0.00%
Real Pers Inc	-0.04%	0.05%	-0.01%
Private-Sector Jobs	-0.02%	0.05%	0.00%

DELAWARE			
Variable	**2009**	**2015**	**2021**
Total GRP	-0.09%	0.12%	-0.07%
Real Pers Inc	-0.07%	0.12%	-0.09%
Private-Sector Jobs	-0.08%	0.20%	-0.11%

All states show initial year *negative* impacts and most states show *positive* economic impacts by the mid-policy year and near-end policy year. Three states (*Delaware, New Jersey, Connecticut*) show markedly higher electric price increases than the remaining RGGI states (see Table 4-9). Natural Gas price changes are modest and uniform under this scenario. Recall that once the federal policy is implemented in 2015 there has already been some convergence in prices in the rest of U.S. market to the RGGI state price increases. In relative price terms, the RGGI states have already experienced the full effect of their state's electric price increases.

Connecticut is awarded the third largest share of energy efficiency savings and fourth largest share of energy efficiency investment dollars. Both of these effects combine to bolster the state's economy despite electric price increases. *Delaware* experiences lower investment levels in traditional generation technologies / pollution control after 2018 than in the high-emissions reference case, a modest share of energy efficiency investment dollars and only a small portion of the energy efficiency savings. As a result, in 2021 *negative* economic impacts occur for *Delaware*. *New Jersey's* impact turns *negative* in 2021 from the prior *positive* impacts even under higher electric prices, since investment for traditional generation technologies retracts in 2021 when compared to the high-emissions reference case.

APPENDIX D – EIA RETAIL ENERGY CONVERSION FACTORS

Electric

	NEW ENGLAND			NEW YORK			PJM		
	Resid. Ratio	**Comm. Ratio**	**Indstrl. Ratio**	**Resid. Ratio**	**Comm. Ratio**	**Indstrl. Ratio**	**Resid. Ratio**	**Comm. Ratio**	**Indstrl. Ratio**
2005	2.1	1.7	1.5	2.5	1.9	1.0	1.9	1.6	1.4
2006	2.2	1.8	1.5	2.7	2.0	1.0	2.0	1.6	1.4
2007	2.2	1.8	1.6	2.8	2.1	1.1	2.1	1.6	1.5
2008	2.3	1.8	1.6	2.9	2.2	1.2	2.1	1.7	1.5
2009	2.4	1.8	1.6	3.0	2.2	1.3	2.1	1.7	1.6
2010	2.3	1.8	1.6	2.9	2.1	1.2	2.0	1.6	1.5
2011	2.4	1.8	1.5	2.9	2.1	1.2	2.1	1.7	1.4
2012	2.4	1.8	1.4	2.8	2.1	1.2	2.0	1.6	1.3
2013	2.3	1.8	1.4	2.7	2.0	1.2	1.9	1.6	1.3
2014	2.3	1.7	1.4	2.6	2.0	1.2	1.9	1.6	1.3
2015	2.2	1.7	1.4	2.6	1.9	1.2	1.9	1.6	1.3
2016	2.2	1.7	1.4	2.5	1.9	1.2	1.8	1.5	1.3
2017	2.2	1.7	1.4	2.5	1.9	1.2	1.8	1.5	1.3
2018	2.2	1.7	1.4	2.5	1.9	1.2	1.8	1.5	1.3
2019	2.2	1.7	1.4	2.5	1.9	1.2	1.8	1.5	1.3
2020	2.2	1.7	1.4	2.5	1.9	1.2	1.8	1.5	1.3
2021	2.2	1.7	1.4	2.5	1.9	1.1	1.8	1.5	1.2
2022	2.2	1.7	1.3	2.4	1.9	1.1	1.8	1.5	1.2
2023	2.2	1.7	1.3	2.4	1.9	1.1	1.8	1.5	1.2
2024	2.2	1.7	1.4	2.4	1.9	1.1	1.8	1.5	1.3
2025	2.2	1.7	1.3	2.4	1.9	1.1	1.8	1.5	1.2

Natural Gas

	NEW ENGLAND			NEW YORK			PJM		
	Resid. Ratio	Comm. Ratio	Indstrl. Ratio	Resid. Ratio	Comm. Ratio	Indstrl. Ratio	Resid. Ratio	Comm. Ratio	Indstrl. Ratio
2005	2.5	2.0	1.2	2.4	1.9	1.3	2.4	1.9	1.3
2006	2.5	1.9	1.2	2.5	1.9	1.3	2.5	1.9	1.3
2007	2.4	1.9	1.1	2.4	1.9	1.3	2.4	1.9	1.3
2008	2.3	1.8	1.1	2.3	1.8	1.3	2.3	1.8	1.3
2009	2.3	1.8	1.1	2.3	1.8	1.3	2.3	1.8	1.3
2010	2.3	1.8	1.1	2.3	1.8	1.3	2.3	1.8	1.3
2011	2.2	1.8	1.1	2.2	1.8	1.3	2.2	1.8	1.3
2012	2.2	1.7	1.1	2.2	1.7	1.3	2.2	1.7	1.3
2013	2.1	1.7	1.1	2.1	1.7	1.2	2.1	1.7	1.2
2014	2.1	1.7	1.1	2.1	1.7	1.2	2.1	1.7	1.2
2015	2.1	1.7	1.1	2.0	1.6	1.2	2.0	1.6	1.2
2016	2.1	1.6	1.1	2.0	1.6	1.2	2.0	1.6	1.2
2017	2.0	1.6	1.1	2.0	1.6	1.2	2.0	1.6	1.2
2018	2.0	1.6	1.1	2.0	1.6	1.2	2.0	1.6	1.2
2019	2.0	1.6	1.1	2.0	1.6	1.2	2.0	1.6	1.2
2020	2.0	1.6	1.1	2.0	1.6	1.2	2.0	1.6	1.2
2021	2.0	1.6	1.1	2.0	1.6	1.2	2.0	1.6	1.2
2022	2.0	1.6	1.1	2.0	1.6	1.2	2.0	1.6	1.2
2023	2.0	1.6	1.1	2.0	1.6	1.2	2.0	1.6	1.2
2024	2.0	1.6	1.1	2.0	1.6	1.2	2.0	1.6	1.2
2025	2.0	1.6	1.1	2.0	1.6	1.2	2.0	1.6	1.2

Oil

	NEW ENGLAND			NEW YORK			PJM		
	Resid. Ratio	Comm. Ratio	Indstrl. Ratio	Resid. Ratio	Comm. Ratio	Indstrl. Ratio	Resid. Ratio	Comm. Ratio	Indstrl. Ratio
2005	1.5	1.2	1.2	1.6	1.1	1.2	1.6	1.1	1.2
2006	1.5	1.2	1.2	1.6	1.1	1.2	1.6	1.1	1.2
2007	1.5	1.2	1.2	1.6	1.1	1.2	1.6	1.1	1.2
2008	1.5	1.2	1.2	1.6	1.1	1.2	1.6	1.1	1.2
2009	1.5	1.2	1.2	1.6	1.1	1.2	1.6	1.1	1.2
2010	1.5	1.2	1.2	1.6	1.1	1.2	1.6	1.1	1.2
2011	1.5	1.2	1.2	1.6	1.1	1.2	1.6	1.1	1.2
2012	1.5	1.2	1.2	1.6	1.1	1.2	1.6	1.1	1.2
2013	1.5	1.2	1.2	1.6	1.1	1.2	1.6	1.1	1.2
2014	1.5	1.2	1.2	1.6	1.1	1.2	1.6	1.1	1.2
2015	1.5	1.2	1.2	1.6	1.1	1.2	1.6	1.1	1.2
2016	1.5	1.2	1.2	1.6	1.1	1.2	1.6	1.1	1.2
2017	1.5	1.2	1.2	1.6	1.1	1.2	1.6	1.1	1.2
2018	1.5	1.2	1.2	1.6	1.1	1.1	1.6	1.1	1.1
2019	1.5	1.2	1.2	1.6	1.1	1.1	1.6	1.1	1.1
2020	1.5	1.2	1.2	1.6	1.1	1.1	1.6	1.1	1.1
2021	1.5	1.2	1.2	1.6	1.1	1.1	1.6	1.1	1.1
2022	1.5	1.2	1.2	1.6	1.1	1.1	1.6	1.1	1.1
2023	1.5	1.2	1.2	1.6	1.1	1.1	1.6	1.1	1.1
2024	1.5	1.2	1.2	1.6	1.1	1.1	1.6	1.1	1.1
2025	1.5	1.2	1.2	1.6	1.1	1.1	1.6	1.1	1.1