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Macroeconomic Assessment of the Pennsylvania Climate Action Plan

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Abstract

The *Pennsylvania Climate Action Plan* (CAP) is the culmination of a formal stakeholder process to specify policies and measures to mitigate emissions of greenhouse gases (GHGs). The implementation of technical and behavioral mitigation options will require changes in the way businesses and government operate, and the way households conduct their daily lives. An important question is whether the sum of all of these microeconomic changes and their interactions will be stimulus to or a drain on the economy as whole. We apply the Regional Economic Models, Inc. Policy Insight Plus (REMI PI+) Model to analyze the impacts of major GHG mitigation options at the macroeconomic level in Pennsylvania for the policy horizon of 2009-2020. Our results indicate that the net impacts on the State's economy will be significantly positive. We also develop a reduced form model based on the results and subject it to rigorous statistical testing. This is the first time an independent test of this kind has been applied to the REMI Model.

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I. Introduction

The Pennsylvania Climate Change Act (Act 70) was signed into law in 2008. A Climate Change Advisory Committee (CCAC) was established immediately after the passage of the bill to facilitate the development of a plan to mitigate greenhouse gasses in cooperation with the Pennsylvania Department of Environment Protection (PA DEP).[1] The ensuing *Pennsylvania Climate Action Plan* (PA DEP, 2009) specified a broad set of mitigation options, and, in fact, identified several that result in net cost savings. For example, many electricity demand-side management practices translate into less electricity needed to produce a given outcome, such as running an assembly line or cooling a home, i.e., energy efficiency improvements. However, all of the cost estimates of mitigation work plans apply to the site of their application, or what are termed partial equilibrium economic impacts. They do not include broader general equilibrium or macroeconomic impacts. The many types of linkages in the economy and macroeconomic impacts are extensive and cannot be traced by a simple set of calculations. It requires the use of a sophisticated model that reflects the major structural features of an economy, the workings of its markets, and interactions between them.

The purpose of this paper is to evaluate the macroeconomic impacts of the *Pennsylvania Climate Action Plan* on the State's economy for the planning horizon 2009-2020. We use the Regional Economic Models, Inc. (REMI) Policy Insight Plus (PI^+) Model (REMI, 2009), the most widely applied state-level economic modeling software package in the U.S. The application involves the most extensive analysis of the linkages between individual mitigation options and the workings of a state economy to date. It is based on mitigation data carefully estimated by an extensive stakeholder process. To validate the results we developed a reduced form version of the macroeconomic analysis and tested it using regression methods.

Our results indicate that the net macroeconomic impacts on the Pennsylvania economy will be positive. While many mitigation activities have dampening effects or incur costs, as when electricity production is reduced or when new equipment that does not pay for itself is purchased, these are more than offset by shifts in spending out of energy savings and by the stimulus of business in the state that produce the necessary equipment.

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Although the analysis is based on the best estimation of the costs and savings of various mitigation work plans, these variables, as well as some conditions relating to their implementation, are not known with full certainty. They are highly dependent on assumptions regarding fuel prices, and the extent to which investment in new equipment will simply displace investment in other equipment in the state or will attract new capital from elsewhere. Accordingly, we performed sensitivity analyses to investigate these alternative conditions.

This paper is divided into 6 sections. Section 2 introduces the REMI Model. Section 3 presents an overview of how we translate the analysis of the CCAC Subcommittees' mitigation work plans into REMI simulation policy variables, as well as how the data are further refined and linked to key structural and policy variables in the Model. Section 4 presents the simulation results, including a sensitivity analysis and interpretation of results. Section 5 develops a reduced form of model that tests the REMI results using the regression approach. Section 6 provides a summary of the results.

II. REMI Model Analysis

Several modeling approaches can be used to estimate the total regional economic impacts of environmental policy, including both direct (on-site) effects and various types of indirect (off-site) effects. These include: input-output (I-O), computable generated equilibrium (CGE), mathematical programming (MP), and macroeconometric (ME) models. Each has its own strengths and weaknesses (see, e.g., Rose and Miernyk, 1989; Partridge and Rickman, 1998). The choice of which model to use depends on the purpose of the analysis and various considerations that can be considered as performance criteria, such as accuracy, transparency, manageability, and costs. After careful consideration of these criteria, we chose to use the REMI PI^+ model. The REMI Model is superior to the other reviewed in terms of its forecasting ability[2] and is comparable to CGE models in terms of analytical power and accuracy. With careful explanation of the model, its application, and its results, it can be made as transparent as any of the others.

The REMI Model has evolved over the course of 30 years of refinement (see, e.g., Treyz, 1993). It is a (packaged) program, but is built with a combination of national and region-specific. Government agencies in practically every state in the U.S. have used a REMI Model for a variety of purposes, including evaluating the impacts of the change in tax rates, the exit or entry of major businesses in particular or economic programs in general, and, more recently, the impacts of energy and/or environmental policy actions (see, e.g., Miller et al., 2010).

We simply provide a summary for general readers here. A macroeconometric forecasting model covers the entire economy, typically in a "top-down" manner, based on macroeconomic aggregate relationships such as consumption and investment. REMI differs somewhat in that it includes some key relationships, such as exports, in a bottom-up approach. In fact, it makes use of the finely-grained sectoring detail of an I-O model, i.e., in the version we used it divides the economy into 169 sectors, thereby allowing important differentials between them. This is especially important in a context of analyzing the impacts of GHG mitigation actions, where various options were fine-tuned to a given sector or where they directly affect several sectors somewhat differently.

The macroeconomic character of the model is able to analyze the interactions between sectors (ordinary multiplier effects) but with some refinement for price changes not found in I-O models. The REMI PI$^+$ Model also brings into play features of labor and capital markets, as well as trade with other states or countries, including changes in competitiveness.

The econometric feature of the model refers to two considerations. The first is that the model is based on inferential statistical estimation of key parameters based on pooled time series and regional (panel) data across all states of the U.S. (the other candidate models use "calibration," based on a single year's data).[3] This gives the REMI PI$^+$ model an additional capability of being better able to extrapolate[4] the future course of the economy, a capability the other models lack. The major limitation of the REMI PI$^+$ model versus the others is that it is pre-packaged and not readily adjustable to any unique features of the case in point. The other models, because they are based on less data and a less formal estimation procedure, can more readily accommodate data changes in technology that might be inferred, for example from engineering data. However, our assessment of the REMI PI$^+$ Model is that these adjustments were not needed for the purpose at hand.

The use of the REMI PI$^+$ Model involves the generation of a baseline forecast of the economy through 2020. Then simulations are run of the changes brought about through the implementation of the various GHG mitigation options. Again, this includes the direct effects in the sectors in which the options are implemented, and then the combination of multiplier (purely quantitative interactions) general equilibrium (price-quantity interactions) and macroeconomic (aggregate interactions) impacts. The differences between the baseline and the "counter-factual" simulation represent the total regional economic impacts of these policy options.

III. Input Data

A. Mitigation Options

Through the development of the *Pennsylvania Climate Change Action Plan*, over 100 GHG mitigation actions covering multiple economic sectors were reviewed by CCAC and PA DEP. Finally, 52 polices and measures, called "work plans" in the Pennsylvania process, were recommended and approved,[5] among which 42 work plans/measures were analyzed in a quantitative manner. Table 1 lists the micro level impacts (GHG reductions and cost-effectiveness) of implementing each quantified work plan. In total, they can generate \$8.6 billion net cost savings (NPV in 2007\$) and reduce GHG emissions of 570.9 million tons of carbon dioxide equivalent (MMtCO2e) during the 2009-2020 period. The weighted average cost-effectiveness (using GHG reduction potentials as weights) of the work plans is about -\$15 per ton of CO2e emissions removed. The negative sign means implementing the work plans on average would yield overall cost savings.

B. Modeling Assumptions

The major data sources of the analysis are the Subcommittees' quantification results or their best estimation of the cost/savings of various recommended work plans/policies. However, we supplement these with some additional data and assumptions in the REMI analysis in cases

Table 1. Estimated GHG Reductions and Costs/Savings of the 42 Quantified Mitigation/Sequestration Work Plans

Work Plan No.	Work Plan Recommendation	GHG Reductions (MMtCO2e) 2020	% of 2020 BAU Level	Total 2009-2020	Net Present Value 2009-2020 (Million $)	Cost-Effective-ness ($/tCO2e)
Ag-3	Management Intensive Grazing	0.6	0.21%	5.5	-$387.4	-$70.4
Ag-4b	Manure Digester Implementation Support--Swine	0.04	0.10%	0.23	$1.1	$4.9
Ag-5a	Regenerative Farming Practices	0.1	0.02%	0.3	$17.9	$59.5
Ag-5b	Carbon Sequestration from Continuous No-Till	0.4	0.15%	2.7	-$32.3	-$12.0
F-1	Forest Protection Initiative – Easement	0.2	0.06%	12.2	$70.9	$5.8
F-3	Forestland Protection and Avoided Conversion – Acquisition	2.1	0.72%	22.6	$620.4	$27.5
F-4	Reforestation, Afforestation, Regeneration	4.0	1.35%	25.9	$597.2	$23.1
F-7	Urban Forestry	3.0	1.01%	19.4	-$10,997.0	-$565.7
F-8	Wood to Electricity	0.3	0.09%	1.7	$3.0	$1.7
F-9a	Biomass Thermal Energy Initiatives--Combined Heat and Power	0.5	0.16%	3.0	-$159.0	-$53.0
F-9b	Biomass Thermal Energy Initiatives--Fuels for Schools	0.6	0.21%	4.0	-$258.8	-$64.9
E-3	Stabilized Load Growth	2.8	0.93%	8.2	-$254.7	-$31.1
E-5	Carbon Capture and Sequestration in 2014	5.0	1.70%	12.6	$391.1	$31.0
E-6	Improve Coal-Fired Power Plant Efficiency by 5%	5.4	1.83%	55.4	$101.9	$1.8
E-7	Sulfur Hexafluoride (SF6) Emission Reductions from the Electric Power Industry	0.1	0.03%	0.7	$0.3	$0.4
E-9	Promote Combined Heat and Power (CHP)	4.4	1.47%	23.2	$209.2	$9.0
E-10	Nuclear Capacity	14.7	4.96%	31.0	$693.0	$22.4
RC-5	Commission Buildings	1.5	0.51%	9.6	-$70.5	-$7.3
RC-6	Re-Light PA	12.9	4.35%	103.2	-$4,044.1	-$39.2
RC-7	Re-Roof PA	1.4	0.49%	4.3	$1,012.9	$235.6
RC-8	Appliance Standards	1.9	0.64%	12.4	-$290.8	-$23.5
RC-9	Geothermal Heating and Cooling	1.4	0.48%	8.0	$499.8	$62.5
RC-10	DSM - Natural Gas	7.3	2.48%	40.5	-$357.1	-$8.8
RC-11	DSM - Heating Oil and Biofuel for Heat	5.7	1.93%	35.8	$207.6	$5.8
RC-13	DSM - Water	0.1	0.04%	0.8	-$1,011.4	-$1,264.2
Ind-1	Coal Mine Methane (CMM) Recovery	0.6	0.19%	6.4	-$51.8	-$8.1
Ind-2	Industrial NG & Electricity Best Management Practices	5.1	1.74%	25.3	-$972.3	-$38.4
Ind-3	Reduce Lost and Unaccounted for Natural Gas	0.1	0.05%	0.9	-$47.6	-$52.9
W-1	Landfill Methane Displacement of Fossil Fuels	0.1	0.03%	0.6	-$10.3	-$17.1
W-2	Statewide Recycling Initiative	5.4	1.84%	34.4	-$258.4	-$7.5
W-4	Improved Efficiency at Wastewater Treatment Facilities	0.0	0.00%	0.0	-$3.4	-$148.1
W-5	Waste-to-Energy Digesters	0.1	0.03%	0.6	$7.0	$11.6
W-6	Waste-to-Energy MSW	0.2	0.08%	1.4	-$65.8	-$47.0
T-3	Low Rolling Resistance Tires	0.7	0.23%	4.1	-$818.3	-$199.6

Work Plan No.	Work Plan Recommendation	GHG Reductions (MMtCO2e) 2020	% of 2020 BAU Level	Total 2009-2020	Net Present Value 2009-2020 (Million $)	Cost-Effective-ness ($/tCO2e)
T-5a	Eco-Driving 5A PAYD Insurance	0.4	0.15%	1.8	-$665.1	-$369.5
T-5b	Eco-Driving 5B Feebates	0.4	0.14%	2.7	-$532.8	-$197.3
T-5c	Eco-Driving 5C Driver Training	0.6	0.21%	4.5	-$375.7	-$83.5
T-5d	Eco-Driving 5E Tire Inflation	0.1	0.03%	0.6	-$90.2	-$150.4
T-5e	Eco-Driving 5H Speed Limit Reduction	2.0	0.66%	23.0	$6,791.0	$295.3
T-6	Utilizing Existing Public Transportation Systems	0.1	0.02%	0.6	$2,157.5	$3,595.9
T-8	Cutting Emissions from Freight Transportation	1.0	0.34%	6.7	-$956.4	-$142.7
T-9	Increasing Federal Support for Efficient Transit and Freight Transport in PA	1.2	0.40%	12.9	$724.6	$56.2
Total		**94.7**	**32.06%**	**570.9**	**-$8,605.0**	**-$15.1**

Note: Some modifications and updates were made to the original quantifications of some work plans before we undertook the macroeconomic analysis. Thus, some numbers presented in this table may be different from the ones presented in the PA Action Plan.

where these costs and some conditions relating to the implementation of the work plans are not specified by the Subcommittees or are not known with certainty. Below is the list of major assumptions we adopted in the analysis:

1. Capital investment in power generation is split 60:40 between sectors that provide generating equipment and the construction sector for large power plants (such as coal-fired power plants), and 80:20 for smaller installations (mainly renewables).
2. In all the applicable analyses, we simulated a stimulus from only 50% of the capital investment requirements. This is based on the assumption that 50% of the investment in new equipment will simply displace other investment in the state and that 50% will be additive, stemming from a combination of attracting private investment funds from outside the state and from federal subsidies.
3. We assume that any increase in household spending on energy-efficient appliances will reduce the household spending on other commodity categories by the same dollar amount. Similarly, any energy bill savings will enable households to increase their spending on other commodities and services by the same dollar amount.
4. For some Electricity and Res/Com work plans, the energy consumers' participant costs of energy efficiency programs for the commercial sector and industrial sector are aggregated, respectively. In the REMI analysis, we distributed the total costs for the commercial and industrial sectors among the REMI 169 individual sectors based on the Pennsylvania Input-Output data provided in the REMI model in relation to the delivery of utility services to individual sectors.
5. The original analysis of Electricity 6 (5% Efficiency Improvement from Existing Coal-Fired Plant) only quantified the costs, but not the savings, associated with this work plan. In the REMI analysis, we estimated the savings as avoided fuel cost of coal resulted from the improved efficiency.

6. For the forestry work plans that include land acquisition, it is assumed that the program funding comes from the state government budget. It is also assumed that the increased government spending in these forestry programs will be offset by a decrease in the same amount of government spending on other goods and services.
7. For Forestry 7 (Urban Forestry), the non-energy benefits, such as aesthetic, storm water, and air quality benefits are not included in the REMI macroeconomic impacts analysis. Also, it is assumed that one-third of the program funding comes from the state government budget; the other two-thirds will be borne by the commercial sector and residential sector.
8. For Transportation 6 (Utilizing Existing Public Transportation Systems) and Transportation 9 (Increasing Federal Support for Efficient Transit and Freight Transport in PA), potential fuel savings were not counted in the quantification analysis of the work plans. Therefore, the macroeconomic stimulus from energy savings associated with these two work plans are not included in the macro study.
9. For Forestry 8 (Wood to Electricity), benefits from avoided fossil fuel use were not quantified for this work plan, since wood-to-electricity was likely to offset very little of the fossil fuel when used for electricity. Therefore, the macroeconomic impacts from the avoided fossil fuel are not included in the REMI analysis.

IV. Presentation of the Results

A. Basic Results

A summary of the basic results of the application of the REMI Model to determining the state-wide macroeconomic impacts of individual *Pennsylvania Climate Action Plan* mitigation work plans is presented in Tables 2 and 3. Table 2 includes the Gross State Product (GSP) impacts for each work plan for three selected years, as well as a net present value (NPV) calculation for the entire period of 2009 to 2020. Table 3 presents analogous results for employment impacts statewide, though, for reasons noted below, an NPV calculation of employment impacts is not appropriate.[6]

The NPV total GSP impact for the period 2009-2020 is about $5.05 billion (constant 2007 dollars) with the impacts being negative in 2010 and increasing steadily over the years to an annual high of $2.14 billion in 2020. In that year, the impacts represent an increase of 0.31% in GSP in the State.

Table 2 highlights several important points:

- The macroeconomic impacts of 27 of the 42 work plans are positive, which means implementing these work plans will bring about a positive stimulus to the Pennsylvania state economy by increasing the GSP and creating more jobs.
- Work plans Res/Com-5 (Commission Buildings) and Industry-2 (Industrial Natural Gas and Electricity Best Management Practices) yield the highest positive impacts on the economy—a total NPV of $4.94 billion; work plan Electricity-9 (Combined Heat and Power) results in the highest negative impacts to the economy—an NPV of -$3.24 billion.

- Mitigation work plans from the Residential and Commercial sector and the Industrial Sector would yield the highest positive impacts on the economy, followed by the work plans from the Agriculture sector and Waste Management sector.

Table 2. Gross State Product Impacts of the Pennsylvania Climate Action Plan

(Billions of Fixed 2007$)					
Scenario		**2010**	**2015**	**2020**	**Net Present Value**
	E3	$0.00	$0.00	$0.02	$0.01
	E5	$0.00	-$0.03	-$0.12	-$0.21
	E6	$0.04	$0.10	$0.13	$0.71
	E7	$0.00	$0.00	$0.00	$0.00
	E9	-$0.03	-$0.41	-$0.94	-$3.24
	E10	$0.00	-$0.01	-$0.18	-$0.14
Subtotal - Electricity		$0.00	-$0.35	-$1.10	-$2.88
	I1	$0.01	$0.01	$0.01	$0.06
	I2	$0.00	$0.25	$1.06	$2.47
	I3	$0.00	$0.02	$0.04	$0.12
Subtotal - Industrial		$0.01	$0.28	$1.11	$2.66
	RC5	$0.03	$0.31	$0.75	$2.47
	RC6	-$0.04	$0.28	$0.95	$1.98
	RC7	$0.00	-$0.04	-$0.31	-$0.57
	RC8	$0.00	-$0.02	-$0.02	-$0.10
	RC9	$0.01	$0.07	$0.18	$0.54
	RC10	$0.05	$0.28	$0.35	$1.85
	RC11	$0.13	$0.13	$0.09	$0.98
	RC13	$0.01	$0.05	$0.08	$0.35
Subtotal - Res/Com		$0.17	$1.06	$2.07	$7.50
	F1	-$0.02	$0.00	$0.00	-$0.07
	F3	-$0.01	-$0.02	-$0.03	-$0.16
	F4	-$0.08	-$0.10	-$0.12	-$0.86
	F7	$0.00	-$0.02	-$0.06	-$0.16
	F8	$0.00	$0.00	$0.00	$0.00
	F9a	$0.02	$0.12	$0.25	$0.92
	F9b	$0.00	$0.00	-$0.01	-$0.03
Subtotal - Forestry		-$0.10	-$0.02	$0.03	-$0.37
	Ag3	$0.00	$0.04	$0.07	$0.27
	Ag4b	$0.00	$0.00	$0.00	$0.00
	Ag5a	$0.00	$0.00	$0.00	-$0.01
	Ag5b	$0.00	$0.00	$0.00	$0.02
Subtotal - Ag		$0.00	$0.04	$0.07	$0.27
	W1	$0.00	$0.03	$0.06	$0.22
	W2	$0.00	$0.02	$0.02	$0.13
	W4	$0.00	$0.00	$0.00	$0.00
	W5	$0.00	$0.00	$0.00	$0.01
	W6	$0.00	$0.00	$0.01	$0.02
Subtotal - Waste		$0.01	$0.06	$0.09	$0.39
	T3	$0.00	$0.06	$0.13	$0.43
	T5a	-$0.01	-$0.06	-$0.34	-$0.84

(Billions of Fixed 2007$)					
Scenario		**2010**	**2015**	**2020**	**Net Present Value**
	T5b	-$0.01	$0.00	$0.01	$0.01
	T5c	-$0.10	-$0.10	-$0.09	-$0.77
	T5d	$0.00	$0.00	$0.01	$0.00
	T5e	-$0.58	-$0.11	-$0.11	-$1.91
	T6	-$0.11	-$0.12	-$0.13	-$0.93
	T8	$0.00	$0.07	$0.27	$0.65
	T9	$0.10	$0.11	$0.11	$0.84
Subtotal - TLU		-$0.72	-$0.14	-$0.14	-$2.52
Summation Total		**-$0.62**	**$0.92**	**$2.14**	**$5.05**
Simultaneous Total		**-$0.82**	**$0.69**	**$3.33**	**$5.08**

Note: A positive number in this table means a positive stimulus to the state economy, or an increase in the GSP; a negative number in this table means negative impacts to the state economy, or a decrease in the GSP.

Most of the work plans that generate positive impacts do so because they result in cost-savings, and thus lower production costs in their own operation and that of their customers. This raises business profits and the purchasing power of consumers in Pennsylvania, thus stimulating the economy. The cost-savings emanate both from direct reductions in fuel/electricity costs, by simply using existing resources more prudently, or through the payback on initial investment in more efficient technologies. Those work plans that result in negative macroeconomic impacts do so because, while they do reduce GHGs, the payback on investment from a purely economic perspective is negative, i.e., they don't pay for themselves in a narrow economic sense. This also raises the cost for production inputs or consumer goods to which they are related.[7]

The employment impacts are summarized in Table 3 and are qualitatively similar to those in Table 2. In this case, 28 of 42 work plans yield positive employment impacts. By the year 2020, for the simple summation results, these new jobs accumulate to the level of about 40 thousand full-time equivalent jobs generated directly and indirectly in the Pennsylvania economy by the Climate Action Plan. This represents an increase over baseline projections of 0.52%. The employment impacts in the REMI model are presented in terms of annual differences from the baseline scenario and as such cannot be summed across years to obtain cumulative results.[8]

The simulation results indicate that work plans in the Residential and Commercial, Forestry, and Industrial sectors would create more jobs than the mitigation work plans in other sectors.

The work plans in the Action Plan have the ability to lower the Pennsylvania Price Index by 0.36% from baseline by the Year 2020. This price decrease, of course, has a positive stimulus on GSP and employment.

The last row of Table 2 and Table 3 presents the simulation results of the GSP and employment impacts for the simultaneous run, in which we assume that all the work plans are implemented concurrently. The simultaneous simulation indicates a GSP impact in NPV terms of $5.08 billion for the period 2009-2020, with the impacts being negative in 2010 and then increasing steadily over the years to an annual high of $3.33 billion in 2020. This increase represents 0.48% of GSP in the State in that year. The cumulative new job creation in 2020 is about 53 thousand full-time equivalent jobs, an increase of about 0.71% from the baseline level.

Table 3. Employment Impacts of the Pennsylvania Climate Action Plan

(Thousands)				
Scenario		**2010**	**2015**	**2020**
	E3	0.0	0.1	0.8
	E5	0.0	-0.2	-0.9
	E6	0.4	0.9	1.0
	E7	0.0	0.0	0.0
	E9	-0.3	-3.8	-7.1
	E10	0.0	-0.1	-1.7
Subtotal - Electricity		0.1	-3.1	-7.9
	I1	0.1	0.1	0.1
	I2	0.0	2.8	9.5
	I3	0.0	0.2	0.3
Subtotal - Industrial		0.1	3.1	9.9
	RC5	0.4	3.9	7.8
	RC6	0.6	8.5	13.3
	RC7	0.0	-0.2	-1.7
	RC8	0.1	0.3	0.4
	RC9	0.0	0.2	0.7
	RC10	0.7	3.1	3.1
	RC11	1.9	1.6	1.0
	RC13	0.2	0.7	1.0
Subtotal - Res/Com		3.8	18.0	25.6
	F1	-0.3	0.0	0.0
	F3	-0.3	-0.3	-0.4
	F4	-1.2	-1.4	-1.6
	F7	3.0	9.8	15.5
	F8	0.0	0.0	0.0
	F9a	0.3	1.4	2.4
	F9b	0.0	-0.1	-0.1
Subtotal - Forestry		1.4	9.5	15.8
	Ag3	0.0	0.5	0.8
	Ag4b	0.0	0.0	0.0
	Ag5a	0.0	0.0	0.0
	Ag5b	0.0	0.0	0.1
Subtotal - Ag		0.0	0.5	0.9
	W1	0.0	0.3	0.5
	W2	0.1	0.4	0.4
	W4	0.0	0.0	0.0
	W5	0.0	0.0	0.0
	W6	0.0	0.1	0.2
Subtotal - Waste		0.1	0.8	1.2
	T3	0.1	0.6	1.2
	T5a	-0.2	-1.0	-5.0
	T5b	-0.2	0.0	0.2
	T5c	-1.7	-1.4	-1.2

(Thousands)				
Scenario		**2010**	**2015**	**2020**
	T5d	-0.1	0.0	0.1
	T5e	-8.4	-4.2	-5.9
	T6	0.5	0.3	0.3
	T8	0.0	0.7	2.1
	T9	1.9	1.8	1.7
Subtotal - TLU		-8.1	-3.2	-6.6
Summation Total		**-2.5**	**25.5**	**38.8**
Simultaneous Total		**-5.1**	**24.6**	**53.0**

Note: A positive number in this table means job creation in Pennsylvania; a negative number in this table means a reduction in the total employment of Pennsylvania.

A comparison between the simultaneous simulation and the summation of simulations of individual work plans shows that the former yields higher positive impacts to the economy—the GSP NPV is 0.8% higher and the job increase in 2020 is 36.6% higher. The overlaps between work plans have been accounted for in the microeconomic analysis and have been eliminated before performing the macroeconomic analysis. The difference between the simultaneous simulation and the ordinary sum can be explained by the non-linearity in the REMI model and synergies in economic actions it captures. In other words, the relationship between the model inputs and the results of REMI is not one of constant proportions. The higher positive impact from the simultaneous simulation is due to non-linearities and synergies in the model that reflect real world considerations. In actuality, few phenomena scale up in a purely proportional manner. For example, in REMI, labor market responses are highly non-linear, and a much larger scale stimulus sets off a significant shift from capital to labor. Given that the simulation results are magnitude-dependent and are not calculated through fixed multipliers, it is not surprising that when we model all the mitigation work plans together, the increased magnitude of the total stimulus to the economy causes wage, price, cost, and population adjustments to occur differently than if each work plan is run by itself.[9]

B. Sensitivity Analysis

In the sensitivity analysis, we first simulate the macroeconomic impacts of two recent state actions of the electricity sector. The first recent state action is Electricity-1 Act 129 of 2008, which aims to reduce carbon emissions associated with the reduction of electricity consumption and peak load use. The second recent state action plan is Electricity-4 Alternative Energy Portfolio (Act 213 of 2004) Tier I Standard, which requires that all electricity consumed in PA by 2021 be generated at least from 0.5% solar PV technology and 8% other renewable resources.[10] Table 4 shows the impacts on GSP and employment of these two recent state actions.

We also performed sensitivity tests on two parameters of the analysis for some of the work plans with large economic impacts. For example, for Electricity-9 (cogeneration) these parameters are: fuel prices and costs. In the sensitivity tests we assumed:

1. The prices of all types of fuel are 50% lower or 50% higher than the levels used in the base case analysis. These would first affect the fuel cost savings to all the commercial and industrial sectors (which are the product of the physical amount of displaced fuel use and the price of fuels). Meanwhile, change of fuel prices will also affect the gross fuel costs for the CHP systems, which are part of the increased production cost to the commercial and industrial sectors. Moreover, these would also affect the "exogenous final demand" for the outputs of the Natural Gas Distribution sector and Farm sector (in value terms).

Table 4. GSP and Employment Impacts of Electricity-1 and Electricity-4

	2010	2015	2020	NPV
Electricity-1 (Act 129)				
GSP (Billions of Fixed 2007$)	$0.00	$0.03	$0.13	$0.29
Employment (Thousands)	0.2	1.4	2.1	n.a.
Electricity-4 (AEPS)				
GSP (Billions of Fixed 2007$)	$0.06	$0.39	$1.00	$3.21
Employment (Thousands)	0.4	3.9	8.9	n.a.

2. The costs of the CHP systems are 50% lower or 50% higher than the levels used in the base case analysis. The costs of the CHP systems include three parts: annualized capital, fuel, and O&M costs. The sensitivity of the fuel costs is analyzed in #1. The O&M costs are very small compared with the capital cost. Thus, we confine the sensitivity tests to the capital cost. This translates into the demand for production for the Construction, Engine, Turbine, and Power Transmission Equipment Manufacturing sectors. Note also that this sensitivity test can implicitly also refer to whether the investment funds come from within the State, and thus displace other investment, or whether they flow into the State from the outside and therefore do not have a displacement effect.

We combined these two sensitivities into two cases:

<u>Upper-Bound case</u>--the two variations that result in the highest estimate[11]

<u>Lower-Bound case</u>--the two variations that result in the lowest estimate

The Upper-Bound case involves fuel costs that are 50% higher (the fuel cost savings, including electricity savings, of this work plan cannot offset the gross fuel costs increase for the CHP systems) plus CHP investment costs that are 50% higher. The Lower-Bound case includes the opposite combination. The sensitivity tests indicated that our results are relatively robust, i.e., varying the parameters does not change them in a major way.

In the base case simulation, we simulated impacts from only 50% of the capital investment and only a 50% change in the capital cost requirement in the utility sector or production sectors. The assumption is that 50% of the investment in new equipment will simply displace other investment in the state and that 50% will be additive, stemming from a combination of attracting private investment funds and from federal subsidies. Similarly, the utility and production sectors only need to increase their capital cost by 50% of the total mitigation program cost, since the other 50% will simply offset what would take place without the Action Plan. In a sensitivity test, we simulate the impacts of 100% capital investment / capital costs (no displacement effects). The GSP impacts in NPV reduce from $5.08 billion to $2.26 billion. The employment impacts in 2020 reduce from 53 thousands to 50 thousands. Therefore, the GSP impacts are sensitive to the assumption on the percentage of capital investment / capital cost simulated in the REMI model.

Our final sensitivity test relates to the 5% discount rate used in the base case analysis. When a 2% discount rate is used in the simultaneous run, the Base Case NPV increase in GSP climbs from $5.08 billion to $7.41 billion. When a 7% discount rate is used, the Base Case estimate drops to an increase of $3.93 billion. Changes in the discount rate do not affect the employment estimates.

Our overall results are similar to those of some recent studies. Roland-Holst (2009), in a recent study of the impacts of RPS Standards and energy efficiency improvements for the California economy, similar to those in the Pennsylvania case, projected a net increase of half a million jobs by 2050. If we adjust for the relative sizes of the two state economies, the results are very similar in percentage terms. Kammen (2007) estimated a large number of new jobs as well stemming from climate change legislation. Macroeconomic analyses of the climate action plans of Florida and Michigan yield similar positive impacts to the state economies (Rose and Wei, 2009; Miller et al., 2010). However, compared with Florida and Michigan, the Pennsylvania Action Plan yields relatively less favorable impacts to the state economy. One major reason is that Pennsylvania uses in-state produced coal to generate large quantities of electricity. Electricity consumption reduction due to various energy efficiency work plans would result in economic activity reductions in the power generating sector, as well as the coal mining sectors in PA. In contrast, nearly 100% of the coal used in the coal-fired electricity generation in Florida and Michigan is imported.

V. Regression Analysis

We next performed a regression analyses to examine the relationship between the microeconomic analysis results in the CAP and the macroeconomic impacts yielded by the REMI model. This is intended as a validation of the results.

The REMI result in terms of NPV of GSP has been chosen as the dependent variable. The first independent variable is the NPV of the direct net cost of a work plan. The other independent variables are dummy variables describing the characteristics of the work plans. The first four dummy variables pertain to the sector of a mitigation work plan: ES (stands for Energy Supply), RCI (Residential, Commercial, and Industrial), TLU (Transportation and Land Use), and AFW (Agriculture, Forestry, and Waste Management). The next two dummy variables are related to the capital investment of a work plan. The variable CONST indicates whether a work plan involves capital investment in structures (like building a new power plant). MFG represents whether a work plan has capital investment on equipment and appliances. The GS dummy variable indicates whether a work plan receives a state government subsidy. In the REMI simulation, it is assumed that if a work plan receives government funding, the government spending would decrease by the same amount elsewhere. The dummy variable CR indicates whether a work plan results in consumer consumption reallocation, such as reducing spending on electricity, gas, and other fuels, and increasing consumption in energy-efficient appliances and other consumption categories. The variable values are presented in Appendix Table B.

Before performing the analysis, the regression model assumptions are examined. We found that the original data without transformation fail to meet some of the model assumptions, such as constant error variances. Therefore, we transformed both the dependent variable and the one continuous independent variable (NPV of the direct net cost) by taking the cube root. After the transformation, the problem of heteroskedacity is not obvious any more. The following regression model is adopted in the analysis:

$$\sqrt[3]{Y} = \beta_1\sqrt[3]{X} * ES + \beta_2\sqrt[3]{X} * RCI + \beta_3\sqrt[3]{X} * TLU + \beta_4\sqrt[3]{X} * AFW + \beta_5 ES + \beta_6 RCI + \beta_7 TLU + \beta_8 CONST + \beta_9 MFG + \beta_{10} GS + \beta_{11} CR$$

where

Y: NPV of the GSP impacts of a policy or measure
X: NPV of the direct net cost of a policy or measure
ES: Energy Supply polices and measures
RCI: Residential, Commercial, Industrial policies and measures
TLU: Transportation and Land Use policies and measures
AFW: Agriculture, Forestry, and Waste Management policies and measures
CONST: Capital investment on building constructions, which has stimulus impacts to the local construction sector
MFG: Capital investment on equipment, which has stimulus impacts to the machinery and equipment manufacturing sectors
GS: Work plan/policy or measure that receives state government subsidy (assuming government spending decreases by the same amount elsewhere)
CR: Policy or measure that results in consumer consumption reallocation.

In the regression model, instead of including one X term, we include the interaction terms of X with the four different work plan sector dummies, based on the hypothesis that there are different slopes associated with work plans from different sectors.

The regression analysis results are shown in Table 5. The coefficient estimates of the four interaction terms are all negative. Except for the interaction term of AFW, the other three interaction terms show a statistical significance at the level of 0.05. As expected, the negative signs indicate that work plans with positive direct cost tend to have negative impacts on the GSP.

The estimated value of the coefficient of a dummy variable represents the mean difference in response (the dependent variable) between the chosen level and the reference level of the dummy variable, given all the other independent variables fixed. For example, the estimated coefficient of the dummy variable ES is -5.68. Since the reference level of the option sector is AFW (i.e., when the dummy variables of ES, RCI, TLU equal zero), the estimated value of the ES dummy variable can be interpreted as when the option type changes from AFW to ES,

Table 5. Output of the Regression Analysis

Determinants	Coefficient	Standard Error	T-Value	P-Value
$\sqrt[3]{X} \times TLU$	-0.440	0.155	-2.84	0.008
$\sqrt[3]{X} \times ES$	-1.551	0.331	-4.68	<.0001
$\sqrt[3]{X} \times RCI$	-0.581	0.196	-2.96	0.006
$\sqrt[3]{X} \times AFW$	-0.224	0.277	-0.81	0.426
ES	-5.682	2.241	-2.54	0.017
RCI	1.486	2.238	0.66	0.512
TLU	1.080	2.281	0.47	0.639
CONST	5.625	2.236	2.52	0.017
MFG	2.656	1.471	1.81	0.081
GS	-4.702	2.510	-1.87	0.071
CR	-2.438	1.907	-1.28	0.211

N=42; R^2 (0.72); F-statistic (7.29)

the expected value of Y (GSP) changes by -5.68 plus -1.33 (this is the difference between the ES and AFW respective interaction terms with $\sqrt[3]{X}$), equal to -7.01, holding all the other variables fixed. Among the three work plan sector dummy variables, only the ES variable shows a statistical significance at the level of 0.05.

The coefficient estimates of the two capital investment variables, the investment to the construction sector and the investment to the machinery and equipment manufacturing sector are both positive and statistically significant. Simulating capital investment change in REMI involves two aspects: the increase of the capital cost of the sectors that take the mitigation actions and the increase of the final demand in the construction and machinery and equipment manufacturing sectors. In general, the former yields negative impacts to the economy and the latter yields positive impacts. The positive signs of the two capital investment dummy variables indicate that the positive effects are expected to exceed the negative effects in PA.

The estimated coefficient of GS is -4.70. The negative sign indicates that, holding all the other variables fixed, if a work plan involves state government subsidies, its overall impact on GSP is expected to decrease by -4.70. In REMI, the state government subsidy is simulated in two aspects. The stimulus effects to the sectors that receive the government subsidy and the dampening effects due to the decrease of the same amount of government spending elsewhere. The negative sign of this variable indicates that in PA, it is expected that the stimulus effects of directing government subsidy to the mitigation work plans cannot offset the dampening effects associated with the decreased government spending in other areas.

The overall F-test for the regression model has a p-value less than 0.0001. The R-square indicates that 72% of the variance in the GSP impacts is explained. Thus, our reduced form model helps verify the results of our macroeconometric modeling analysis, and provides reliable insight into the factors that most influence the results.

VI. Conclusion

This paper summarizes the analysis of the impacts of the *Pennsylvania Climate Action Plan* on the State's economy. We used a state of the art macroeconometric model to perform this analysis, based on data derived through an in-depth, consensus-based technical assessment and stakeholder process. The results indicate that the majority of the greenhouse gas mitigation and sequestration work plans have positive impacts on the State's economy individually. On net, the combination of work plans increase the Net Present Value of GSP by about $5.08 billion and increase employment by 53 thousand full-time equivalent jobs by the Year 2020. The Commissioning and Retro-Commissioning buildings work plan and Industrial Natural Gas and Electricity Best Management Practices work plan contribute the highest GSP gains, which combined to account for about 33% of the total. Urban Forestry and Re-light PA contribute the highest employment gains, which combined to account for nearly 45% of the total job creation.

The economic gains stem primarily from the ability of mitigation work plans to lower the cost of production. This arises primarily from energy efficiency improvements and then lower production costs and higher consumer purchasing power. The results also stem from the stimulus of increased investment in plant and equipment.

Several tests were performed to determine the sensitivity of the results to major changes in key variables such as capital costs, fuel prices, and avoided costs of electricity generation. The tests indicate the results are robust, i.e., the overall results do not change much even when these variables are changed by plus and minus 50%. A regression analysis of a reduced form model further validated the results.

Note that the estimates of economic benefits to Pennsylvania represent a lower bound from a broader perspective. They do not include the avoidance of damage from the climate change that continued baseline GHG emissions would bring forth, the reduction in damage from the associated decrease in ordinary pollutants, the reduction in the use of natural resources, the reduction in traffic congestion, etc.

Endnotes

[1] Five Subcommittees: Energy Generation, Transmission, and Distribution; Residential and Commercial; Industry and Waste; Land Use and Transportation; and Agriculture and Forestry, were assigned by CCAC. The tasks of each subcommittee were to identify and provide technical analysis of potential GHG mitigation, sequestration, and offsetting policy actions in its respective sector.

[2] Statistically estimated time series models are best suited to forecasting, but were not among the candidates considered here because our emphasis was on policy analysis.

[3] REMI is the best of the models reviewed in terms of addressing the fact that many impacts take time to materialize and that the size of impacts changes over time as prices and wages adjust. In short, it better incorporates the actual dynamics of the economy.

[4] The model can be used alone for forecasting with some caveats, or used in conjunction with other forecast "drivers".

[5] Among the 52 work plans, 28 were approved by CCAC unanimously, 11 with only three or less objections, and 13 with eight or fewer objections or abstentions (PA DEP, 2009) (a more detailed description of a similar stakeholder process is presented in Rose et al., 2009).

[6] In contrast to the entries presented in Table 1, a positive number in Table 2 and Table 3 represents a positive stimulus to the economy (i.e., an increase in GSP or a creation of jobs). A negative number, on the contrary, means negative impacts to the state economy (i.e., a decrease in the GSP or a decline in total employment in PA).

[7] The results for Electricity-9 (cogeneration), for example, can be decomposed into negative and positive stimuli, with the net effects being negative. The negative economic stimuli of this work plan include the increased cost (including annualized capital costs, operating and maintenance costs, and fuel costs) to the commercial and industrial sectors due to the installation of the CHP systems; reduced final demand from the conventional electricity generation (which equals the sum of electricity output from the CHP plus avoided electricity use in boilers/space heaters/water heaters). The positive stimuli include various fuel cost savings (e.g., electricity, natural gas, oil, and other fuel cost savings) to the commercial and industrial sectors from displaced heating fuels for all kinds of CHP systems; increase in final demand to the Construction and Engine, Turbine, and Power Transmission Equipment Manufacturing sectors; and increase in final demand in Farm (biomass) and Natural Gas Distribution sectors due to the increased demand of fuels and feedstocks to supply the CHP facilities.

[8] For example, a new business opens its doors in 2009 and creates 100 new jobs. As long as the business is open, that area will have 100 more jobs than it would have had without the business. In other words, it will have 100 more jobs in 2009, 2010, 2011, etc. We cannot say that the total number of jobs created is 100 + 100 + 100 +… Every year it is the *same* 100 jobs that persist over time not an additional 100 jobs.

[9] Analysis on sectoral impacts shows that the impacts of the various mitigation work plans vary significantly by sector of the Pennsylvania Economy. One would expect producers of energy efficient equipment to benefit from increased demand for their products, as will most consumer goods and trade sectors because of increased demand stemming from increased purchasing power. The top five positively impacted sectors in terms of the NPV of GSP are, in descending order, Real Estate, Transit and Ground Passenger Transportation, Waste Collection; Waste Treatment and Disposal and Waste Management, Offices of Health Practitioners, and Monetary Authorities, Credit Intermediation.

One would expect Electric Utilities related to fossil fuels, to witness a decline. In fact, the Electric Power Generation, Transmission, and Distribution sector is expected to have the largest negative impact by far -- $7.38 billion (NPV). Other negatively affected sectors in descending order of impacts are Petroleum and Coal Products Manufacturing, Natural Gas Distribution, Coal Mining, Water, Sewage, and Other Systems, and Pipeline Transportation. However, none of these sectors is expected to have a decline of more than $0.4 billion.

[10] Act 129 of 2008 was signed into law on October 15, 2008. The Pennsylvania REMI model did not take this legislation into account in the model baseline condition. From personal contact with the REMI modelers, we also learned that, although the Alternative Energy Portfolio Standard was signed in November 24, 2004, since most of its effects would take place 10 or so years from its inception, REMI did not explicitly take the implications of this legislation into account in the Pennsylvania baseline forecast as well.

[11] Since the overall impacts of this work plan are negative, the highest estimate here means highest negative impacts.

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APPENDIX

A. REMI Model Input Development

Before undertaking any economic simulations, the key quantification results for each work plan conducted by the Subcommittees are translated to model inputs that can be utilized in the Model. This step involves the selection of appropriate policy levers in the REMI Model to simulate the policy's changes. The input data include sectoral spending and savings over the full time horizon (2009-2020) of the analysis. In Appendix Table A we choose one example work plan (DSM) to illustrate how we translate, or map, the Subcommittees' results into REMI economic variable inputs.

Using Res/Com-10 Demand-Side Management (DSM) (Natural Gas) as an example, the first two columns of Appendix Table A show the quantification analysis results of this mitigation work plan according to their applicability to business (commercial and industrial) sectors and the household (residential) sector provided by the Res/Com Subcommittee. The last column of Appendix Table A presents the corresponding economic variables in the REMI Model and their position within the Model.

DSM refers to programs implemented by the utilities aimed at reducing electricity consumptions in the business and household sectors. For both the commercial and household sectors, the selected REMI policy variables to represent energy savings are from the "Compensation, Prices, and Costs Block" and "Output and Demand Block" respectively. For the former, the energy savings are simulated as the decrease of "Natural Gas Fuel Cost for the Commercial Sector". For the latter, the energy savings are simulated as the "Consumer Spending" decrease of Gas.

The natural gas consumption reduction from this mitigation work plan would result in a decrease in demand from the Gas Distribution sector. This is simulated by reducing the "Exogenous Final Demand" from the Gas Distribution sector in REMI. This variable can be found in the "Output and Demand Block".

The costs of this work plan are the levelized cost of saved natural gas. For commercial sector, the costs would include improved HVAC equipment, controls and building shell measures, and efficient cooking equipment. The total costs are distributed among the individual commercial sectors based on the reference case natural gas sales to the corresponding sectors. This is simulated in REMI by increasing the value of the "Production Cost" variable of individual commercial sectors under the "Compensation, Prices, and Costs Block". For the residential sector, the costs would involve improvement in space heating efficiency (including adopting insulation measures of the home envelope and investing in more efficient heating and ventilation equipment and systems). These are simulated in REMI by increasing the "Consumer Spending" on "Owner-occupied Nonfarm Dwellings" and "Kitchen & Other Household Appliances" (and decrease in all the other consumptions correspondingly). The "Consumer Spending" variable can be found in the "Output and Demand Block" in the REMI model.

Appendix Table A. Mapping the Quantification Results of Res/Com-10 Demand-Side Management (Natural Gas) into REMI Inputs

Quantification Results		Policy Variable Selection in REMI
Natural Gas Savings of the Customers	Commercial Sectors	Compensation, Prices, and Costs Block→ Natural Gas (Commercial Sectors) Fuel Cost (amount) of All Commercial Sectors→Decrease
	Households (Residential Sector)	Output and Demand Block→Consumer Spending (amount)→Gas→Decrease Output and Demand Block →Consumption Reallocation (amount)→All Consumption Sectors →Increase
Natural Gas Demand Decrease from the NG Distribution Sector		Output and Demand Block →Exogenous Final Demand (amount) for Natural Gas Distribution sector→Decrease
NG Customer Outlay on Energy Efficiency (EE)	Commercial Sectors	Compensation, Prices, and Costs Block →Production Cost (amount)→Increase
	Households (Residential Sector)	Output and Demand Block→Consumer Spending (amount)→Kitchen & Other Household Appliances and Owner-occupied Nonfarm Dwellings →Increase Output and Demand Block →Consumption Reallocation (amount)→All Consumption Sectors →Decrease
Investment on EE Technologies		Output and Demand Block →Exogenous Final Demand (amount) for Construction sector and Ventilation, Heating, Air-conditioning, and Commercial Refrigeration Equipment Manufacturing sector→Increase

Finally, the DSM program would increase the demand for goods and services from the industries that supply energy-efficiency equipment and appliances and the construction sector. We simulated this in REMI by increasing the "Exogenous Final Demand" from the Ventilation, Heating, Air-conditioning, and Commercial Refrigeration Equipment Manufacturing sector and Construction sector.

B. Regression Input Table

Appendix Table B. Regression Data

Work Plans		REMI GSP Impacts NPV ($millions)	Direct Cost NPV ($millions)	TLU	ES	RCI	AFW	CONST	MFG	GS	CR
Ag-3	Management Intensive Grazing	267.76	-387.37	0	0	0	1	1	0	0	0
Ag-4	Manure Digester Implementation Support	0.94	1.13	0	0	0	1	0	0	0	0
Ag-5a	Regenerative Farming Practices Initiative--Regenerative Farming Practices/	-13.57	17.86	0	0	0	1	0	0	0	0
Ag-5b	Regenerative Farming Practices Initiative--Carbon Sequestration from Continuous No-Till	18.03	-32.30	0	0	0	1	0	1	0	0
F-1	Forest Protection Initiative -- Easement	-72.10	70.92	0	0	0	1	0	0	1	0
F-3	Forestland Protection and Avoided Conversion -- Acquisition	-163.42	620.43	0	0	0	1	0	0	1	0
F-4	Reforestation, Afforestation, Regeneration	-864.85	597.17	0	0	0	1	0	0	1	0
F-7	Urban Forestry	-159.30	1704.55	0	0	0	1	0	0	1	1
F-8	Wood to Electricity	-3.55	2.95	0	0	0	1	0	0	0	0
F-9a	Biomass Thermal Energy Initiatives--Combined Heat and Power	916.02	-159.05	0	0	0	1	1	1	0	0
F-9b	Biomass Thermal Energy Initiatives--Fuels for Schools	-29.15	48.28	0	0	0	1	0	1	0	0
W-1	Landfill Methane Displacement of Fossil Fuels	224.62	-10.26	0	0	0	1	0	1	0	0
W-2	Statewide Recycling Initiative	128.77	-258.38	0	0	0	1	0	1	0	1
W-4	Improved Efficiency at Wastewater Treatment Facilities	3.68	-3.41	0	0	0	1	0	0	0	0
W-5	Waste-to-Energy Digesters	7.86	6.97	0	0	0	1	0	1	0	0
W-6	Waste-to-Energy MSW	23.31	-65.79	0	0	0	1	0	1	0	0
E-3	Stabilized Load Growth	9.28	-254.68	0	1	0	0	0	1	0	1
E-5	House Bill 80: Carbon Capture and Sequestration in 2014	-214.93	391.08	0	1	0	0	1	1	0	0

E-6	Improve Coal-Fired Power Plant Efficiency by 5%	705.52	-822.53	0	1	0	0	0	0	0	0
E-7	Sulfur Hexafluoride (SF6) Emission Reductions from the Electric Power Industry	-0.47	0.29	0	1	0	0	0	0	0	0
E-9	Promote Combined Heat and Power (CHP)	-3237.97	209.20	0	1	0	0	1	1	0	0
E-10	Nuclear Capacity	-142.17	233.07	0	1	0	0	1	1	0	0
RC-5	Commission Buildings	2471.50	-70.53	0	0	1	0	1	0	0	0
RC-6	Re-Light PA	1978.00	-4044.07	0	0	1	0	1	1	0	1
RC-7	Re-Roof PA	-574.65	1012.88	0	0	1	0	1	0	0	0
RC-8	Appliance Standards	-102.03	-290.84	0	0	1	0	0	1	0	1
RC-9	Geothermal Heating and Cooling	538.49	499.75	0	0	1	0	1	1	0	0
RC-10	DSM - Natural Gas	1853.75	-357.12	0	0	1	0	1	1	0	1
RC-11	DSM - Heating Oil and Biofuel for Heat	981.47	207.57	0	0	1	0	1	1	0	1
RC-13	DSM - Water	350.37	-1011.38	0	0	1	0	0	0	0	1
Ind-1	Coal Mine Methane (CMM) Recovery	62.86	-51.80	0	0	1	0	0	0	0	0
Ind-2	Industrial Natural Gas and Electricity Best Management Practices	2475.00	-972.27	0	0	1	0	0	1	0	0
Ind-3	Reduce Lost and Unaccounted for Natural Gas	124.75	-47.57	0	0	1	0	0	0	0	1
T-3	Low Rolling Resistance Tires	432.12	-818.34	1	0	0	0	0	1	0	1
T-5a	Eco-Driving 5A PAYD Insurance	-844.94	-665.10	1	0	0	0	0	0	1	1
T-5b	Eco-Driving 5B Feebates	9.36	-532.83	1	0	0	0	0	0	1	1
T-5c	Eco-Driving 5C Driver Training	-771.72	-375.74	1	0	0	0	0	0	1	1
T-5d	Eco-Driving 5E Tire Inflation	1.87	-90.22	1	0	0	0	0	0	1	1
T-5e	Eco-Driving 5H Speed Limit Reduction	-1909.66	6790.96	1	0	0	0	0	0	0	1
T-6	Utilizing Existing Public Transportation Systems	-931.42	2157.51	1	0	0	0	0	0	1	0
T-8	Cutting Emissions from Freight Transportation	650.35	-956.35	1	0	0	0	0	1	0	0
T-9	Increasing Federal Support for Efficient Transit and Freight Transport in PA	842.76	724.64	1	0	0	0	1	1	0	0