THE ECONOMIC IMPACT OF THE FLORIDA ENERGY AND CLIMATE CHANGE ACTION PLAN ON THE STATE'S ECONOMY

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The Center for Climate Strategies (CCS) is a nonpartisan, nonprofit partnership organization that helps public officials, private stakeholders, and technical experts develop and implement strategies to reduce greenhouse gas pollution and adapt to a changing climate. Please contact Tom Peterson at tdp1@mac.com or Jeff Wennberg at wennberg.ccs@gmail.com with any questions about this paper, or the Florida Energy and Climate Action Plan.

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By

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EXECUTIVE SUMMARY

This report summarizes the analysis of the impacts of the *Florida Energy and Climate Change Action Plan* on the State's economy. By executive order in 2007, Governor Charlie Crist created the Florida Energy and Climate Change Planning Process and established state greenhouse gas (GHG) mitigation goals. The Florida Action Team on Energy and Climate Change final report, or Action Plan, contained 50 policy recommendations that were developed through a stakeholder-driven, consensus-based process. The Action Plan also addressed priority recommendations for adaptation to many of the affects of near-term climate change. The planning process was managed by the Florida Department of Environmental Protection and facilitated by the Center for Climate Strategies (CCS). In addition, CCS provided technical support and microeconomic analyses of most of the recommendations. The option by option aggregate analysis of the 28 quantified policy recommendations indicate that together they can generate $33.6 billion in net cost savings (2005 NPV) and reduce 1.9 billion tons of carbon dioxide-equivalent (CO_2e) GHG emissions between 2008-2025. This macroeconomic study completes the analysis of Action Team recommendations by projecting the state-wide individual and collective GSP, output, income, employment, and price impacts of the recommendations between 2008 and 2025.

The results indicate that the majority of the recommended greenhouse gas mitigation and sequestration policies individually have positive impacts on the State's economy. When combined, the Action Plan recommendations would, on a net present value basis, increase Gross State Product by about $37.9 billion and increase employment by 148 thousand full time equivalent jobs by the Year 2025. The Florida Renewable Portfolio Standard contributes the highest GSP gains, or nearly 50% of the total. Afforestation and Restoration of Non-Forested Lands and the Renewable Portfolio Standard contribute the highest employment gains, which combined account for nearly 60% of the total job creation. The economic gains arise primarily from the ability of mitigation options to lower the cost of production. This stems primarily from their ability to improve energy efficiency and thus lower production costs and higher consumer purchasing power. The results also stem from the stimulus of increased investment in plant and equipment. The table titled ES-1 summarizes the gross state product and employment impacts, including the simultaneous effects of interactive policies, for the State of Florida in the years 2010, 2015, 2020 and 2025.

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Table ES-1. Simultaneous Gross State Product and Employment Impacts of Enacting the Florida Energy and Climate Change Action Plan Recommendations

	2010	2015	2020	2025	Net Present Value
Gross State Product Impacts (billions of fixed 2000$)	$0.31	$2.73	$5.95	$11.06	$37.90
Employment Impacts (thousands of full time equivalent jobs)	11.380	57.720	100.400	148.300	n.a.

This analysis is based on data, methods and assumptions provided by six Florida Action Plan Technical Work Groups and the Florida Governor's Action Team on Energy and Climate Change that vetted policy recommendation data through an in-depth, consensus based, technical assessment and facilitated stakeholder process. Note that the estimates of economic benefits to Florida represent a lower bound from a broader perspective. They do not include benefits associated with the avoidance of damage that continued baseline GHG emissions would bring forth; the savings from the associated decrease in ordinary pollutants; the reduction in the use of natural resources; the reduction in traffic congestion, etc.

The econometric model used in this study is the REMI Policy Insight Model, a peer reviewed model that is the most widely used state level economic modeling software package in the United States. Government agencies in practically every state 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, increasingly, the impacts of energy and/or environmental policy actions.

I. INTRODUCTION

The *Florida Energy and Climate Change Action Plan* addresses a critical issue for the citizens of the State by designing policies and measures to mitigate emissions of greenhouse gases (GHGs). The implementation of technical and behavioral mitigation options requires changes in the way businesses and government operate and the way households (and visitors) conduct their daily lives. Some of those changes associated with the varied mitigation options will require minor adjustments, while some mitigation options will require major ones.

The Climate Action Plan (CAP) has endeavored to identify the least costly mitigation options, and, in fact, has identified a number 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. When this is accomplished at no cost at all or at a net cost-savings on an electricity bill, this is referred to as an energy efficiency improvement.[2] In other cases, as when new equipment must be purchased, the additional expense may exceed this cost savings in reducing GHGs.

All of the cost estimates of mitigation options in the CAP apply to the site of their application, or what are termed local economic impacts. It was beyond the scope of the CAP to evaluate broader economic impacts, which are often referred to as regional and national macroeconomic impacts. The mitigation options include the ripple effects of decreased or increased spending on mitigation, and the interaction of demand and supply in various markets. For example, reduction in consumer demand for

[2] This definition is widely used by economists and employed here; however the CAP may also include some positive cost demand-side management measures within the meaning of "energy efficiency."

electricity reduces the demand for generation by all sources, including both fossil energy and renewables. It therefore reduces the demand for fuel inputs such as coal and natural gas. Fortunately, this reduction takes place in other states, since little of these fuels are produced in Florida. At the same time, businesses and households whose electricity bills have decreased have more money to spend on other goods and services. If the households purchase more food or clothing, this stimulates the production of these goods, at least in part, within the state. Food processing and clothing manufactures in turn purchase more raw materials and hire more employees. Then more raw material suppliers in turn purchase more of the inputs they need, and the additional employees of all these firms in the supply chain purchase more goods and service from their wages and salaries. The sum total of these "indirect" impacts is some multiple of the original direct on site impact; hence this is often referred to as the multiplier effect, a key aspect of macroeconomic impacts. It applies to both increases and decreases in economic activity. It can be further stimulated by price decreases and muted by price increases.

The extent of the many types of linkages in the economy and macroeconomic impacts is 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 all of the interactions between them. In this study, we used the Regional Economic Models, Inc. (REMI) Policy Insight modeling software to be discussed below (REMI, 2007). This is the most widely used state level economic modeling software package in the U.S. and heavily peer reviewed. The REMI Model is used extensively to measure proposed legislative and other program and policy economic impacts across the private and public sectors by government agencies in nearly every state of the U.S. In Florida, it is used by the Florida Joint Legislative Management Committee, Division of Economic & Demographic Research, the Florida Department of Labor (Agency for Workforce Innovation), and other state and local government agencies. In addition, it is the chosen tool to measure these impacts by a number of university researchers and private research groups that evaluate economic impacts across a state and nation. The Florida version of the REMI Model was applied to the estimation of the macroeconomic impacts of the major GHG mitigation options on output, income, employment, and prices in the state for years 2008-2025 (i.e., 18 years).

Our results indicate that the net macroeconomic impacts on the Florida economy will be significantly positive. While many mitigation activities incur costs, as when electricity production is reduced or the cost of production is increased by the need to purchase new equipment, 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.

The analysis below is based on the best estimation of the cost of various mitigation options.[3] However, these costs and some conditions relating to the implementation of these options are not known with full certainty. Examples include the net cost or cost savings of the options themselves 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 report is divided into 6 sections. In Section 2 we summarize the workings of the REMI Model. Section 3 presents an overview of how we translate the CAP Technical Working Groups' (TWGs) analysis of mitigation options 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. In section 4, we summarize the set-up and process of policy simulation in REMI. Section 5 presents the simulation results, including a sensitivity analysis and interpretation of results. Section 6 provides a summary and some policy implications.

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[3] Data used for REMI inputs were provided by Governor's Climate Action Team Electricity Supply and Demand (ESD), Agriculture, Forestry and Waste (AFW), and Transportation and Land Use (TLU) Technical Work Groups (CAT TWGs), September 2008.

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.

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 a form of econometric model known as the REMI Policy Insight Model (REMI, 2007). The REMI Model is superior to all the others in terms of its forecasting ability and is comparable to CGE models in terms of analytical power and accuracy. The availability of this model for the state of Florida made it, along with an I-O model, the least costly. 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 data that is 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.

A detailed discussion of the major features of the REMI policy insight model is presented in appendix A. 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 in that it includes these key relationships but is based on a more bottom-up approach. In fact, it makes use of the finely-grained sectoring detail of an I-O model, i.e., it divides the economy into at least 70 sectors, thereby allowing important differentials between them. This is especially important in a context like the Florida Action Plan, 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 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 a time series (historical) data for Florida (the other candidate models use “calibration,” based on a single year’s data). This gives the REMI model an additional capability of being better able to extrapolate or forecast the future course of the economy, a capability the other models lack. The major limitation of the REMI 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 Model is that these adjustments were not needed for the purpose at hand.

The use of the REMI Model involves the generation of a baseline forecast of the economy through 2025. Then simulations are run of the changes brought about through the implementation of the various options included in the *Florida Energy and Climate Change Action Plan*. 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 the CAP.

III. INPUT DATA

A. *Florida Energy and Climate Change Action Plan*

The Florida Governor's Action Team on Energy and Climate Change was established at the Florida Summit "Serve to Preserve: A Florida Summit on Global Climate Change," hosted by Governor Charlie Crist on July 12 and 13, 2007. Phase 1 of the Governor's Action Team was completed on November 1, 2007, with 30 recommendations proposed to reduce greenhouse gas emissions in Florida (Florida Climate Action Team, 2008). Phase 2 of the planning process began in February of 2008. The Center for Climate Strategies (CCS) was asked to facilitate and provide technical support of this stakeholder-based, consensus-building process.

Six Technical Work Groups (TWGs): Energy Supply and Demand (ESD), Agriculture Forestry, and Waste (AFW), Transportation and Land Use (TLU), Adaptation (ADP), Cap and Trade (C&T), and Government Policy and Coordination (GP), were designated by the Action Team. The tasks of each TWG were to identify and provide technical analysis of potential GHG mitigation, sequestration, and offsetting policy options in its respective sector.

At the end of the process, the Action Team recommended 50 policy actions, among which 28 recommendations were quantified with emission reduction potentials and associated net costs/cost savings over the time period of 2008-2025. These 28 policy options were recommended from the AFW, ESD, and TLU TWGs. Table 1 lists the estimated impacts (reductions and costs/savings) of implementing each of the 28 quantified policy options. In total, the 28 policy options can generate $33.6 billion net cost savings (2005 NPV) and reduce 1.9 billion tons of carbon dioxide-equivalent (CO_2e) GHG emissions during the 2008-2025 period.

B. REMI Model Input Development

The quantification analysis of the costs/savings undertaken by the TWGs was limited to the direct effects of implementing the policy options. For example, the direct costs of an energy efficiency option include the ratepayers' payment for the program and the energy customers' expenditure on energy efficiency equipments and devices. The direct benefits of this policy option include the savings on energy bills of the customers.

All the analyses of the TWGs pertain to the direct (microeconomic or partial equilibrium) effects of policy implementation. It was beyond the scope of the TWGs to perform broader economic impacts analyses, which are often referred to as macroeconomic and general equilibrium impacts. To supplement the formal Florida Action Team analysis, the REMI Policy Insight Model was selected to evaluate macroeconomic impacts (such as gross state output, employment, and personal income) of various GHG emissions reduction strategies. In this study, the Florida REMI Model is based on Florida historical data through 2006.

Table 1. Estimated Reductions and Costs/Savings of the 28 Quantified Mitigation/Sequestration Options

Policy No.	Policy Recommendation	GHG Reductions ($MMtCO_2e$) 2017	% of 2017 BAU Level	2025	% of 2025 BAU Level	Total 2009-2025	Net Present Value 2009-2025 (Million $)	Cost-Effective-ness ($/tCO2e)
ESD-5	Promoting Renewable Electricity through Renewable Portfolio Standard (RPS), incentives and barrier removal (20% by 2020)	17	4.19%	34.5	7.45%	319	-$9,274	-$29
ESD-6	Nuclear Power	0	0.00%	7.3	1.58%	49.4	$1,782	$36
ESD-8	Combined Heat and Power (CHP) Systems	1.8	0.44%	2.2	0.47%	26.5	$126	$5
ESD-9	Power Plant Efficiency Improvements	8.4	2.07%	8.9	1.92%	111.4	-$1,541	-$14
ESD-11	Landfill Gas-To-Energy (LFGTE)	3.7	0.91%	8.7	1.88%	64.7	$79	$1
ESD-12	Demand-Side Management (DSM)/Energy Efficiency Programs, Funds, or Goals for Electricity	13	3.20%	21.8	4.71%	201.4	-$8,566	-$43
ESD-13a	Energy Efficiency in Existing Residential Buildings	3.4	0.84%	5.4	1.17%	50.4	-$1,432	-$28
ESD-14	Improved Building Codes for Energy Efficiency	0	0.00%	4.9	1.06%	9.9	-$265	-$27
ESD	Building Codes for Energy Efficiency (HB 697 and Executive Order 127)	8	1.97%	15.4	3.32%	136.5	-$4,082	-$30
TLU-1	Develop and Expand Low-GHG Fuels	6.2	1.53%	12.62	2.72%	106.41	-$15,161	-$142
TLU-2	Low Rolling Resistance Tires and Other Add-On Technologies	0.8	0.20%	1.84	0.40%	13.99	-$1,259	-$90
TLU-4	Improving Transportation System Management (TSM)	3.94	0.97%	6.98	1.51%	63.91	-$5,106	-$80
TLU-8	Increasing Freight Movement Efficiencies	0.59	0.15%	1.1	0.24%	11.52	$21	$2
AFW-1	Forest Retention—Reduced Conversion of Forested to Non-Forested Land Uses	0.5	0.12%	0.6	0.13%	7.2	$186	$26
AFW-2	Afforestation and Restoration of Non-Forested Lands							
	A1. Afforestation	1.6	0.39%	3.1	0.67%	28	$134	$5
	A2. Reforestation	6.1	1.50%	11.6	2.50%	104	$555	$5
	B. Urban Forestry	4.6	1.13%	8.7	1.88%	78	$759	$10
AFW-3	Forest Management for Carbon Sequestration							
	A. Pine Plantation Management	0.5	0.12%	0.9	0.19%	7.9	$84	$11
	B. Non-Federal Public Land Management	0.3	0.07%	0.4	0.09%	3.9	$41	$11
AFW-4	Expanded Use of Agriculture, Forestry, and Waste Management (AFW) Biomass Feedstocks for Electricity, Heat, and Steam Production	21	5.17%	40	8.63%	361	$7,432	$21

Policy No.	Policy Recommendation	GHG Reductions ($MMtCO_2e$) 2017	% of 2017 BAU Level	2025	% of 2025 BAU Level	Total 2009-2025	Net Present Value 2009-2025 (Million $)	Cost-Effective-ness ($/tCO2e)
AFW-5	Promotion of Farming Practices That Achieve GHG Benefits							
	A. Soil Carbon Management	0.5	0.12%	0.9	0.19%	8	-$74	-$9
	C. Nutrient Management	0.2	0.05%	0.3	0.06%	2.6	$68	$26
AFW-6	Reduce the Rate of Conversion of Agricultural Land and Open Green Space to Development	0.2	0.05%	0.5	0.11%	4.2	$394	$93
AFW-7	In-State Liquid/Gaseous Biofuels Production	4	0.98%	8.2	1.77%	68	-$532	-$8
AFW-8	Promotion of Advanced Municipal Solid Waste (MSW) Management Technologies (Including Bioreactor Technology)	1.9	0.47%	4.4	0.95%	34	$294	$9
AFW-9	Improved Commercialization of Biomass-to-Energy Conversion and Bio-Products Technologies							
	A. Manure Digestion/Other Waste Energy Utilization	0.04	0.01%	0.09	0.02%	0.8	-$13	-$17
	B. WWTP Biosolids Energy Production & Other Biomass Conversion Technologies	2.4	0.59%	5	1.08%	42	$1,848	$44
	C. Bio-Products Technologies and Use	0.2	0.05%	0.3	0.06%	2.6	-$161	-$62
Total*		110.9	27.29%	216.63	46.76%	1,917	-$33,633	

* Without adjusting for overlaps within sectors and among sectors.

Before undertaking any economic simulations, the key quantification results for each policy option conducted by the TWGs 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 (2008-2025) of the analysis. In Tables 2-4, we choose one example option from each of the ESD, AFW, and TLU sectors to illustrate how we translate, or map, the TWG results into REMI economic variable inputs.

Using ESD-12 Demand-Side Management (DSM) as an example, the first two columns of Table 2 show the quantification analysis results of this mitigation option according to their applicability to business (commercial and industrial) sectors and the household (residential) sector provided by the ESD TWG. The last column of Table 2 presents the corresponding economic variables in the REMI Model and their position within the Model (i.e., in which one of the five major blocks, as introduced in Appendix A, the policy variables can be found):

DSM refers to programs implemented by the utilities aimed at reducing electricity consumptions in the business and household sectors. The annual energy (electricity) savings resulting from the implementation of the DSM/energy efficiency programs are distributed among the commercial, industrial, and residential sectors based on the baseline electricity consumption of these sectors. For both the business and household sectors, the selected REMI policy variables to represent energy savings are from the "Wages, Prices, and Costs Block". For the former, the energy savings are simulated as the decrease of

"Electricity Fuel Cost for Individual Industry". For the latter, the energy savings are simulated as the "Consumer Price" decrease under the "Household Operation" category.[4]

Table 2. Mapping the TWGs Quantification Results of ESD-12 Demand-Side Management into REMI Inputs

TWGs Quantification Results		Policy Variable Selection in REMI
Energy Savings of the Customers	Businesses (Commercial and Industrial Sectors)	Wages, Prices, and Costs Block→Fuel Costs→Electricity Fuel Cost (amount) →Decrease
	Households (Residential Sector)	Wages, Prices, and Costs Block→Prices (housing and consumer)→Consumer Price (equivalent currency amount)→Household Operation→Decrease
Electricity Demand Decrease from the Utility Sector		Output Block→Industry Demand→Exogenous Final Demand (amount) for Utilities sector→Decrease
Energy Customer Outlay on Energy Efficiency (EE) Goods	Businesses (Commercial and Industrial Sectors)	Wages, Prices, and Costs Block→Production Cost (amount)→Increase
	Households (Residential Sector)	Output Block→Consumer Spending (amount) →Computers and Furniture→Increase Output Block→Consumption Reallocation (amount)→All Consumption Sectors →Decrease
Paying for the EE Program (Ratepayer Costs)	Businesses (Commercial and Industrial Sectors)	Wages, Prices, and Costs Block→Fuel Costs→Electricity Fuel Cost (amount) →Increase
	Households (Residential Sector)	Output Block→Consumer Spending (amount) →Household Operation→Increase Output Block→Consumption Reallocation (amount) →All Consumption Sectors →Decrease
Investment on EE Technologies		Output Block→Industry Demand→Exogenous Final Demand (amount) for Machinery Manufacturing, Computer & Electronic Product Manufacturing, and Electrical Equipment & Appliance Manufacturing sectors→Increase
EE Program Budget Spending		Output Block→Industry Demand→Exogenous Final Demand (amount) for Utilities and Professional & Technical Services sectors→Increase

[4] REMI includes household purchases of electricity, natural gas, as well as water utilities and other sanitary and domestic services, under the Household Operations commodity category.

Table 3. Mapping the TWGs Quantification Results of AFW-2 Afforestation and Restoration of Non-Forested Lands into REMI Inputs

TWGs Quantification Results	Policy Variable Selection in REMI
Fund Spending on Afforestation and Reforestation[a]	For public owned forest land:[b] Output Block→Industry Demand→Exogenous Final Demand (amount) for Agriculture sector→Increase For private owned forest land:[b] Output Block→Disposable Income→Transfer Payments (amount) to All Recipients→Increase
Fund Spending on Urban Forestry[a]	Output Block→Industry Demand→Exogenous Final Demand (amount) for Agriculture sector→Increase[c] Output Block→Government spending (amount) →State and Local→Increase[c] Output Block→Industry Demand→Exogenous Final Demand (amount) for Waste Management and Remediation Services sector→Increase[c]
Reduction of Government Spending Elsewhere[a]	Output Block→Government spending (amount) →State and Local→Decrease
Energy Savings (reduction in electricity consumption)	Wages, Prices, and Costs Block→Fuel Costs→Electricity Fuel Cost (amount) →Decrease
Electricity Demand Decrease from the Utility Sector	Output Block→Industry Demand→Exogenous Final Demand (amount) for Utilities sector→Decrease

[a] We assume that the program funding of this policy strategy comes from the Florida state government budget. Increasing government spending in this program will decrease the same amount of government spending elsewhere.

[b] The ownership of forest land in Florida is 30% public and 70% private (USDA, 2008).

[c] The total program spending of urban forestry includes tree planting and annual maintenance, program administration and waste disposal. In the REMI analysis, we simulate these as final demand increases distributed evenly among the following three sectors: Agriculture and Forestry Support Activities, State and Local Government, and Waste Management and Remediation Services.

Table 4. Mapping the TWGs Quantification Results of TLU-8 Increase Freight Movement Efficiencies into REMI Inputs

TWGs Quantification Results	Policy Variable Selection in REMI
Investment to Improve Rail Lines and Terminals	Output Block→Industry Demand→Exogenous Final Demand (amount) for the Construction sector→Increase
Investment to Advanced Equipment to be Installed in Trucks	Output Block→Industry Demand→Exogenous Final Demand (amount) for the Computer and Electronic Product Manufacturing sector→Increase
Fuel Savings from Rail Improvement	Wages, Prices, and Costs Block→Production Cost (amount) for the Rail Transportation Sector→Decrease
Fuel Savings from Truck Technology Improvement	Wages, Prices, and Costs Block→Production Cost (amount) for the Truck Transportation Sector→Decrease
Fuel Demand Decrease	Output Block→Industry Demand→Exogenous Final Demand (amount) for the Petroleum and Coal Products Manufacturing sector→Decrease
Costs on Rail Improvement	Wages, Prices, and Costs Block→Production Cost (amount) for the Rail Transportation sector→Increase
Costs of the Truck Technology Improvements	Wages, Prices, and Costs Block→Production Cost (amount) for the Truck Transportation sector→Increase

The electricity consumption reduction from this mitigation option would result in a decrease in demand from the electric utility sector. This is simulated by reducing the "Exogenous Final Demand" from the Utilities sector in REMI. This variable can be found in the "Output Block".

The total costs of this policy option are divided into two parts: the utility cost (or ratepayer cost) and the participant cost. The former is paid by the utilities, but would eventually be passed forward to all the customers through electricity rate increases. The latter is paid by those customers that participate in particular DSM/energy efficiency programs. The ratio between the ratepayer costs and the participant costs is assumed to be 60:40. Both costs are distributed among the commercial, industrial, and residential sectors based on the reference case electricity sales to the corresponding sectors. For the business sectors, the ratepayer costs are simulated by increasing the value of the "Electricity Fuel Cost" variable under the "Wages, Prices, and Costs Block"; the participant costs are simulated by increasing the value of the "Production Cost" variable under the "Output Block". For the residential sector, the ratepayer costs would result in the increase of consumer spending on household operation (and decrease in all the other consumptions correspondingly); the participant costs are simulated by increasing the "Consumer Spending" on Computers and Furniture (which is the household consumption category in REMI that includes energy efficient appliances) and decrease in all the other consumption categories.

Finally, the DSM program would increase the demand for goods and services from the industries that supply energy-efficiency equipment and appliances. We simulated this in REMI by increasing the "Exogenous Final Demand" from the Machinery Manufacturing, Computer & Electronic Manufacturing, and Electrical Equipment & Appliance Manufacturing sectors. The budget spending of the DSM program would also stimulate demand from local energy auditing services and utility administration. These are simulated by increasing the "Exogenous Final Demand" from the Professional & Technical Services and Utility sectors.

Please note the major data sources of the analysis below are the TWG quantification results or their best estimation of the cost/savings of various recommended policy options. However, we supplement this with some additional data and assumptions in the REMI analysis where these costs and some conditions relating to the implementation of the options are not specified by the TWGs 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. For some ESD options, the energy consumers' participant costs of energy efficiency programs are only computed for the entire commercial sectors and/or industrial sectors by the TWGs. In the REMI analysis, we distributed these costs among the 70 individual sectors based on the data in the Florida Input-Output table (MIG, 2008) in relation to the delivery of utility services to individual sectors.

3. For option ESD-8 Combined Heat and Power Systems, the total costs of installing the CHP systems are only computed for the commercial and industrial sectors as a whole by the ESD TWG. We used the data on Florida market potential for CHP in existing facilities of industrial, commercial, and institutional sectors to distribute the input costs among individual sectors in the REMI analysis (Elliott et al., 2007).

4. For option AFW-2, Afforestation and Restoration of Non-Forested Lands, potential future cost savings from forest products (e.g., merchantable timber or bioenergy feedstocks) are not taken into account, since these cost savings would most likely not be realized during the time frame of this analysis (Florida Climate Action Team, 2008).

5. For the forestry options, it is assumed that the program funding comes from the state government budget. It is also assumed that increasing the government spending in these forestry programs will be offset by a decrease in the same amount of government spending on other goods and services..

6. 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.

7. In all the applicable analyses, we assumed the Operation and Maintenance (O&M) cost spent on the new electricity generation would simply displace the O&M cost for the replaced generation. Thus, in the REMI model, we simulated zero net additional O&M cost.

8. For most ESD options, utility avoided cost is used for avoided costs for displaced electricity consumption. For option ESD-8 (Combined Heat and Power), avoided costs are based on fuel prices in the sector (commercial or industrial) that makes the capital investment on the CHP system.

IV. SIMULATION SET-UP IN REMI

Figure 1 shows how a policy simulation process is undertaken in the REMI model. First, a policy question is formulated (e.g., what would be the economic impacts of implementing RPS in the state). Second, external policy variables that would embody the effects of the policy are identified (take RPS as an example, relevant policy variables would include incremental costs and investment in renewable electricity generation; avoided generation of conventional electricity; and electricity price changes). Third, baseline values for all the policy variables are used to generate the control forecast (baseline forecast). In REMI, the baseline forecast uses the most recent data available (i.e., 2006 data) for the study region and the external policy variables are set equal to their baseline values. Fourth, an alternative forecast is generated by changing the values of the external policy variables. Usually, the changing values of these variables represent the direct effects of the simulated policy scenario. For example, in our analysis of the RPS option, the costs to the ratepayers, the investments to the renewable electricity generation, and the avoided investment to the conventional electricity generation were based on the technical assessment of implementing this mitigation option by the ESD technical work group of Florida. Fifth, the effects of the policy scenario are measured by comparing the baseline forecast and the alternative forecast. Sensitivity analysis can be undertaken by running a series of alternative forecasts with different assumptions on the values of the policy variables.

In this study, we first run the REMI model for each of the 28 recommended Florida mitigation policy options *individually* in a comparative static manner, i.e., one at a time, holding everything else constant. Next, we run a *simultaneous* simulation in which we assume that all the policy options are implemented together. Then the simple summation of the effects of individual options is compared to the simultaneous simulation results to determine whether the "whole" is different from the "sum" of the parts.

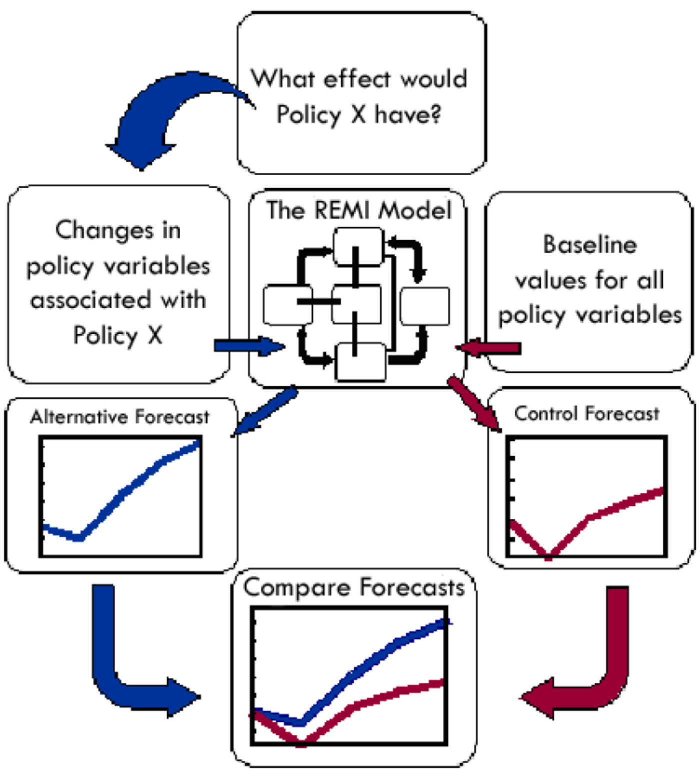

Figure 1. Process of Policy Simulation in REMI

Source: REMI Policy Insight 9.5 User Guide.

Differences can arise from non-linearities and/or synergies. The latter would stem from complex functional relationships in the REMI Model.

Before performing the simulations in REMI, overlaps between policy options are eliminated as much as possible. This process is conducted by applying “overlap factors” identified by the TWGs to both the costs and savings of the relevant policy options

V. 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 *Florida Energy and Climate Change Action Plan* mitigation options is presented in Tables 5 and 6. Table 5 includes the Gross State Product (GSP) impacts for each option for four selected years, as well as a net present value (NPV) calculation for the entire period of 2008 to 2025. Table 6 presents analogous results for employment impacts statewide, though, for reasons noted below, an NPV calculation of employment impacts is not appropriate. The reader is referred to Appendix B for detailed results for each year, as well as the impacts on other economic indicators, such as gross regional product and prices, for a representative set of options. Individual sectoral results are presented in Appendix C.

Table 5. Gross State Product Impacts of the Florida CAP

(billions of fixed 2000$)

Scenario		2010	2015	2020	2025	Net Present Value
	ESD 5	$0.17	$0.79	$2.62	$4.50	$16.22
	ESD 6	$0.00	$0.00	-$0.60	-$1.00	-$2.48
	ESD 8	-$0.06	-$0.29	-$0.60	-$0.99	-$4.21
	ESD 9	$0.00	$0.10	$0.30	$0.41	$1.70
	ESD 11	$0.00	$0.00	$0.01	$0.01	$0.04
	ESD 12	$0.00	$0.12	$0.38	$0.70	$2.40
	ESD 13a	$0.00	$0.15	$0.49	$0.92	$3.08
	ESD 14	$0.00	-$0.01	$0.03	$0.43	$0.46
Subtotal - ESD		$0.12	$0.88	$2.62	$4.97	$17.21
	AFW 1	$0.00	$0.00	$0.00	$0.00	$0.00
	AFW 2	$0.08	$0.56	$1.25	$2.04	$8.04
	AFW 3	$0.00	$0.00	$0.00	$0.00	-$0.01
	AFW 4	$0.00	-$0.05	-$0.12	-$0.17	-$0.71
	AFW 5	$0.00	$0.00	$0.01	$0.01	$0.05
	AFW 6	$0.00	$0.01	$0.04	$0.08	$0.26
	AFW 7	$0.00	$0.88	$0.77	$0.43	$4.07
	AFW 8	$0.00	$0.01	$0.04	$0.07	$0.23
	AFW 9	$0.01	$0.08	$0.19	$0.32	$1.22
Subtotal - AFW		$0.26	$1.50	$2.18	$2.78	$13.17
	TLU 1	$0.07	$0.26	$0.55	$0.86	$3.83
	TLU 2	$0.00	$0.01	$0.03	$0.03	$0.16
	TLU 4	-$0.01	-$0.12	-$0.28	-$0.53	-$1.87
	TLU 8	$0.04	$0.04	$0.09	$0.25	$0.81
Subtotal - TLU		$0.10	$0.19	$0.39	$0.63	$2.93
Summation Total		**$0.31**	**$2.57**	**$5.19**	**$8.38**	**$33.31**
Simultaneous Total		**$0.31**	**$2.73**	**$5.95**	**$11.06**	**$37.90**

Table 6. Employment Impacts of the Florida CAP

(thousands)

Scenario		2010	2015	2020	2025
	ESD 5	2.054	8.335	23.370	36.710
	ESD 6	0.000	0.000	-3.554	-7.130
	ESD 8	-0.681	-3.779	-7.616	-11.590
	ESD 9	0.000	1.129	2.980	3.569
	ESD 11	0.000	0.077	0.163	0.240
	ESD 12	0.158	3.023	6.097	8.666
	ESD 13a	0.000	2.554	6.722	10.920
	ESD 14	0.298	-0.202	-1.326	-0.301
Subtotal - ESD		1.829	11.137	26.836	41.084
	AFW 1	0.075	0.283	0.305	0.308
	AFW 2	6.760	18.300	29.450	40.000
	AFW 3	0.030	0.113	0.204	0.279
	AFW 4	0.000	2.957	9.600	20.470
	AFW 5	-0.023	0.034	0.090	0.142
	AFW 6	0.428	1.520	3.283	5.153
	AFW 7	0.000	17.290	15.460	7.447
	AFW 8	0.008	0.072	0.422	0.645
	AFW 9	0.273	1.996	4.079	6.440
Subtotal - AFW		7.551	42.566	62.893	80.883
	TLU 1	1.112	3.951	7.712	11.290
	TLU 2	0.000	0.126	0.265	0.370
	TLU 4	-0.140	-1.982	-3.981	-6.701
	TLU 8	0.985	0.509	0.945	2.283
Subtotal - TLU		1.958	2.604	4.941	7.242
Summation Total		**11.338**	**56.307**	**94.670**	**129.210**
Simultaneous Total		**11.380**	**57.720**	**100.400**	**148.300**

The NPV total GSP impact for the period 2008-25 is about $33.3 billion (constant 2000) dollars, with the impacts increasing steadily over the years to an annual high of $8.4 billion in 2025. In that year, the impacts represent an increase of 0.66% in GSP in the State.

Table 5 highlights several important points:

- The macroeconomic impacts of 15 of the 20 options are positive.

- Option ESD-5 (Renewable Portfolio Standard) yields the highest positive impacts to the economy—an NPV of $16.22 billion; option ESD-8 (Combined Heat and Power) results in the highest negative impacts to the economy—an NPV of -$4.21 billion.
- Mitigation options from the Energy Supply and Demand sector would yield the highest positive impacts to the economy, followed by the options from the Agriculture, Forestry, and Waste Management sector.

Most of the options 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 Florida, thus stimulating the economy. The cost-savings emanate both from direct reductions in lower fuel/electricity costs, by simply using existing resources more prudently, or through the payback on initial investment in greener technologies. Those options that result in negative macroeconomic impacts do so because, while they do reduce GHG's, 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.[5]

The employment impacts are summarized in Table 6 and are qualitatively similar to those in Table 5. In this case, 16 of 20 options yield positive employment impacts. By the year 2025, these new jobs accumulate to the level of about 129 thousand full-time equivalent jobs generated directly and indirectly in the Florida economy by the Climate Action Plan. This represents an increase over baseline projections of 0.99%. 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. 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.

In contrast to the impacts to GSP, the simulation results indicate that mitigation and sequestration options in the AFW sector would create more jobs than the mitigation options in the ESD sector. The reason is that the AFW options would affect sectors that are relatively more labor-intensive than the ESD options.

The CAP options have the ability to lower the Florida Price Index by 0.29% from baseline by the Year 2025. This price decrease, of course, has a positive stimulus on GSP and employment.

The last row of Table 5 and Table 6 present the simulation results of the GSP and employment impacts for the simultaneous run, in which we assume that all the policy options are implemented concurrently. When we implement the simultaneous run in the REMI model, we "shock" the model by including all the variable changes in the individual runs together.

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[5] The results for ESD-8 (cogeneration), for example, can be decomposed into negative and positive stimuli, with the net effects being negative. The negative economic stimuli of this option 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 Electrical Equipment & Appliance Manufacturing sectors; and increase in final demand in Forestry (biomass) and Oil & Gas Extraction (NG and oil) sectors due to the increased demand of fuels and feedstocks to supply the CHP facilities.

The simultaneous simulation indicates a GSP impact in NPV terms of $37.9 billion for the period 2008-2025, with the impacts increasing steadily over the years to an annual high of $11.06 billion in 2025. This increase represents 0.87% of GSP in the State in that year. The cumulative new job creation in 2025 is about 148 thousand full-time equivalent jobs, an increase of about 1.13% from the baseline level.

A comparison between the simultaneous simulation and the summation of simulations of individual options shows that the former yields higher positive impacts to the economy—the GSP NPV is 13.8% higher and the job increase in 2025 is 14.7% higher. 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 non-linear. The simulation results are magnitude-dependent and are not calculated through fixed multipliers. Therefore, when we model all the mitigation options together, the increased magnitude of the total stimulus to the economy causes wage, price, cost, and population adjustments to occur differently than if each option is run by itself.

Table C1 and Table C2 in Appendix C present the impacts on GSP and employment of each individual economic sector for the simultaneous simulation. The impacts of the various mitigation options vary significantly by sector of the Florida Economy. One would expect producers of wind and solar 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, Retail Trade, Professional and Technical Services, Wholesale Trade, and Agriculture. The first and last of this set expand primarily because of the TLU options.

One would expect Electric Utilities related to fossil fuels, including gas pipelines to witness a decline. In fact, the Utilities sector is expected to have the largest negative impact by far -- $9.84 billion. Other negatively affected sectors in descending order of impacts are Passenger Transit, Apparel Manufacturing, Petroleum Refining, and Leather Goods Manufacturing. However, none of these sectors is expected to have a decline of more than $1 billion. The Passenger Transit impact is surprising, but probably represents one of the limitations of the model in not being able to incorporate all of the technological changes associated with the policy options.

B. Sensitivity Tests

We performed sensitivity tests on two parameters of the analysis for some of the options. For example, for ESD-8 (cogeneration) these parameters are: fuel prices and costs. In the simulations we assumed:

1. The fuel prices 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 Oil/Gas Extraction sector and Forestry sector (in value terms).

2. The costs of the CHP systems are 50% lower or 50% higher than the levels used in the current analysis. The costs of the CHP systems include three parts: annualized capital costs, fuel costs, and O&M costs. The sensitivity of the fuel costs is analyzed in #1. In the REMI analysis, we assumed that the O&M costs on the new CHP systems would be equal to the O&M costs on the production of energy in the conventional ways. Thus, we confine the sensitivity analysis to the capital cost. This translates into the demand for production for the Construction, Electrical Equipment, and Appliance 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:

Upper-Bound case--the two variations that result in the highest estimate

Lower-Bound case--the two variations that result in the lowest estimate

The Upper-Bound case involves fuel costs that are 50% higher (thus yielding higher savings) plus CHP investment costs that are 50% lower. 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.

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 $37.90 billion to $55.51 billion. When a 7% discount rate is used, the base case estimate drops to an increase of $29.77 billion.

Finally, we note that our results are similar, though much more positive than those of other 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 Florida 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.

VI. CONCLUSION

This report summarizes the analysis of the impacts of the *Florida Energy and Climate Change Action Plan* on the State's economy. We used a state of the art macroeconometric model to perform this analysis, based on data supplied from six Florida Technical Work Groups who vetted them through an in-depth, consensus based technical assessment and stakeholder process. The results indicate that the majority of the greenhouse gas mitigation and sequestration options have positive impacts on the State's economy individually. On net, the combination of options has a Net Present Value of increasing Gross State Product by about $37.9 billion and increasing employment by 148 thousand full-time equivalent jobs by the Year 2025. The Florida Renewable Portfolio Standard contributes the highest GSP gains, or nearly 50% of the total. Afforestation and Restoration of Non-Forested Lands and the Renewable Portfolio Standard contribute the highest employment gains, which combined to account for nearly 60% of the total job creation.

The economic gains stem primarily from the ability of mitigation options to lower the cost of production. This stems primarily from their ability to improve energy efficiency and thus lower production costs and higher consumer purchasing power. The results also stem from the stimulus of increased investment in plant and equipment.

Note that the estimates of economic benefits to Florida 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.

Overall, the *Florida Energy and Climate Change Action Plan* is a win-win policy.

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APPENDIX A. DESCRIPTION OF THE REMI POLICY INSIGHT MODEL

REMI Policy Insight is a structural economic forecasting and policy analysis model. It integrates input-output, computable general equilibrium, econometric and economic geography methodologies. The model is dynamic, with forecasts and simulations generated on an annual basis and behavioral responses to wage, price, and other economic factors.

The REMI model consists of thousands of simultaneous equations with a structure that is relatively straightforward. The exact number of equations used varies depending on the extent of industry, demographic, demand, and other detail in the model. The overall structure of the model can be summarized in five major blocks: (1) Output and Demand, (2) Labor and Capital Demand, (3) Population and Labor Supply, (4) Wages, Prices and Costs, and (5) Market Shares. The blocks and their key interactions are shown in Figures A1 and A2.

The Output and Demand block includes output, demand, consumption, investment, government spending, import, product access, and export concepts. Output for each industry is determined by industry demand in a given region and its trade with the US market, and international imports and exports. For each industry, demand is determined by the amount of output, consumption, investment, and capital demand on that industry. Consumption depends on real disposable income per capita, relative prices, differential income elasticities and population. Input productivity depends on access to inputs because the larger the choice set of inputs, the more likely that the input with the specific characteristics required for the job will be formed. In the capital stock adjustment process, investment occurs to fill the difference between optimal and actual capital stock for residential, non-residential, and equipment investment. Government spending changes are determined by changes in the population.

The Labor and Capital Demand block includes the determination of labor productivity, labor intensity and the optimal capital stocks. Industry-specific labor productivity depends on the availability of workers with differentiated skills for the occupations used in each industry. The occupational labor supply and commuting costs determine firms' access to a specialized labor force.

Labor intensity is determined by the cost of labor relative to the other factor inputs, capital and fuel. Demand for capital is driven by the optimal capital stock equation for both non-residential capital and equipment. Optimal capital stock for each industry depends on the relative cost of labor and capital, and the employment weighted by capital use for each industry. Employment in private industries is determined by the value added and employment per unit of value added in each industry.

The Population and Labor Supply block includes detailed demographic information about the region. Population data is given for age and gender, with birth and survival rates for each group. The size and labor force participation rate of each group determines the labor supply. These participation rates respond to changes in employment relative to the potential labor force and to changes in the real after tax compensation rate. Migration includes retirement, military, international and economic migration. Economic migration is determined by the relative real after tax compensation rate, relative employment opportunity and consumer access to variety.

The Wages, Prices and Cost block includes delivered prices, production costs, equipment cost, the consumption deflator, consumer prices, the price of housing, and the wage equation. Economic geography concepts account for the productivity and price effects of access to specialized labor, goods and services.

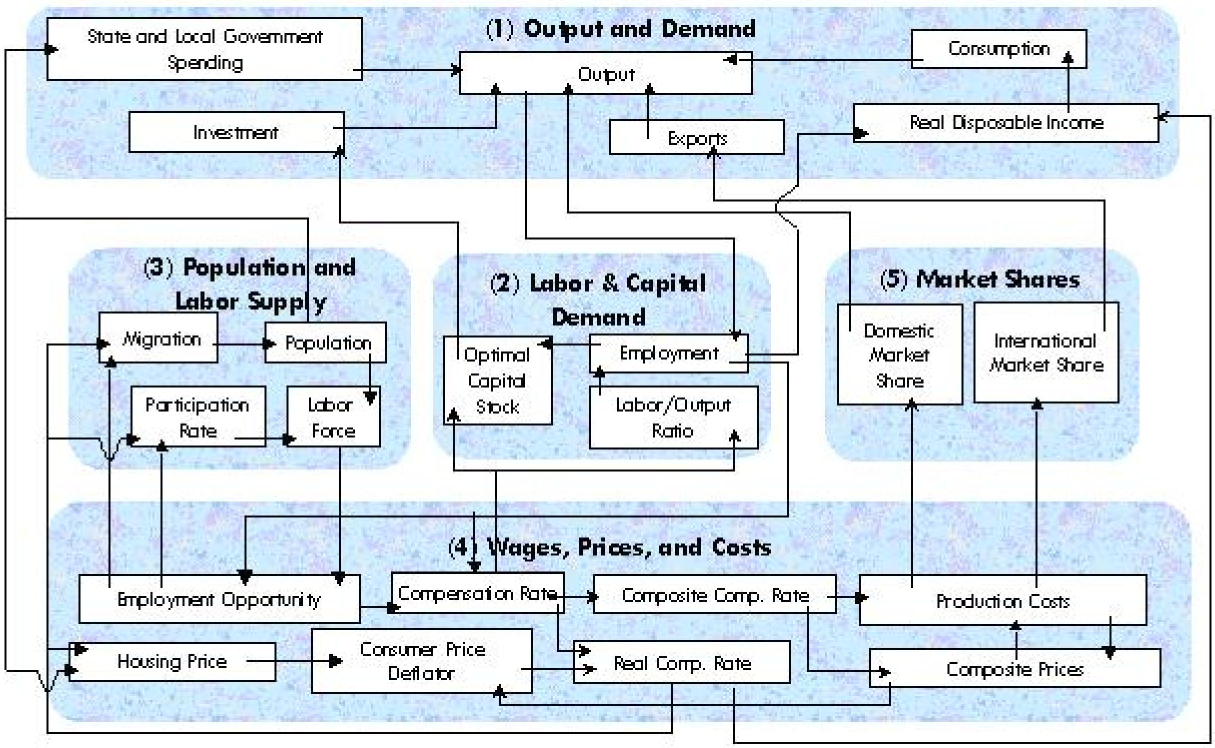

Figure A1. REMI Model Linkages (Excluding Economic Geography Linkages)

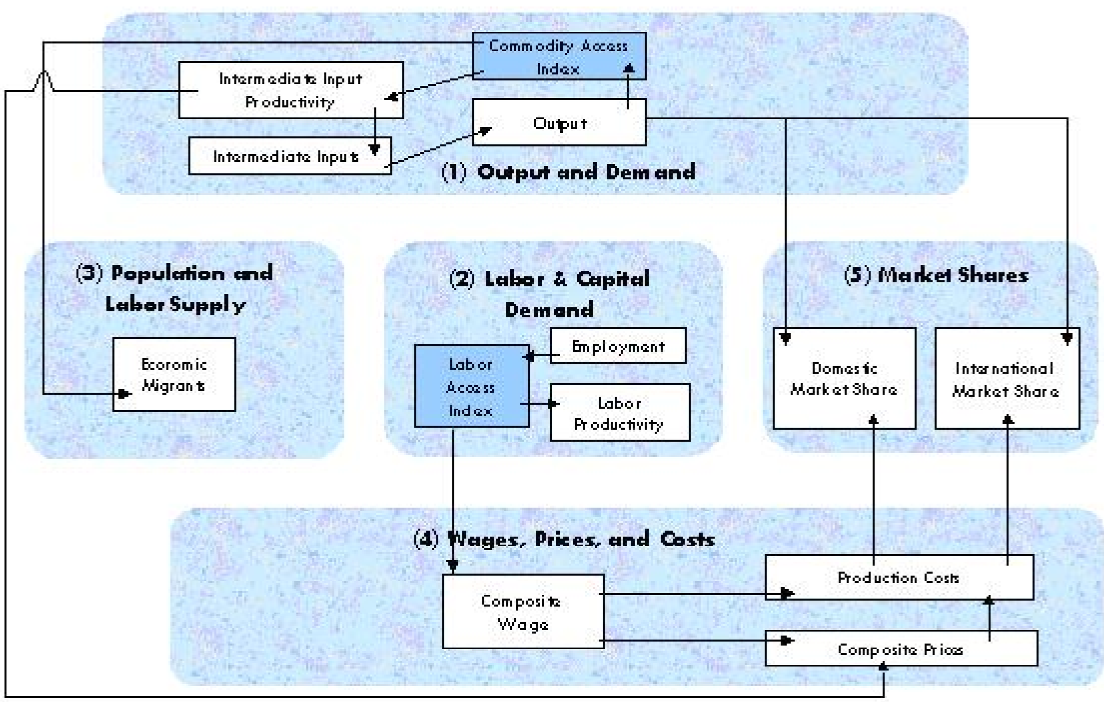

Figure A2. Economic Geography Linkages

These prices measure the value of the industry output, taking into account the access to production locations. This access is important due to the specialization of production that takes place within each industry, and because transportation and transaction costs associated with distance are significant. Composite prices for each industry are then calculated based on the production costs of supplying regions, the effective distance to these regions, and the index of access to the variety of output in the industry relative to the access by other uses of the product.

The cost of production for each industry is determined by cost of labor, capital, fuel and intermediate inputs. Labor costs reflect a productivity adjustment to account for access to specialized labor, as well as underlying compensation rates. Capital costs include costs of non-residential structures and equipment, while fuel costs incorporate electricity, natural gas and residual fuels.

The consumption deflator converts industry prices to prices for consumption commodities. For potential migrants, the consumer price is additionally calculated to include housing prices. Housing price changes from their initial level depend on changes in income and population density. Regional employee compensation changes are due to changes in labor demand and supply conditions, and changes in the national compensation rate. Changes in employment opportunities relative to the labor force and occupational demand change determine compensation rates by industry.

The Market Shares equations measure the proportion of local and export markets that are captured by each industry. These depend on relative production costs, the estimated price elasticity of demand, and effective distance between the home region and each of the other regions. The change in share of a specific area in any region depends on changes in its delivered price and the quantity it produces compared with the same factors for competitors in that market. The share of local and external markets then drives the exports from and imports to the home economy.

As shown in Figure A2, the Labor and Capital Demand block includes labor intensity and productivity, as well as demand for labor and capital. Labor force participation rate and migration equations are in the Population and Labor Supply block. The Wages, Prices, and Costs block includes composite prices, determinants of production costs, the consumption price deflator, housing prices, and the wage equations. The proportion of local, interregional and international markets captured by each region is included in the Market Shares block.

APPENDIX B.

Table B1. Detailed Simulation Results of Policy Option ESD-5 Renewable Portfolio Standard

Differences from the BAU Levels									
Variable	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Total Emp (Thous)	1.0	2.1	3.2	4.3	5.6	6.9	8.3	10.1	12.2
Total GRP (Bil Fixed 2000$)	0.1	0.2	0.3	0.4	0.5	0.6	0.8	1.0	1.2
Output (Bil Fixed 2000$)	0.1	0.3	0.5	0.7	0.9	1.1	1.3	1.7	2.1
Population (Thous)	0.2	0.5	1.1	1.7	2.5	3.5	4.6	5.9	7.4
Real Disp Pers Inc (Bil Fixed 2000$)	0.0	0.1	0.1	0.1	0.2	0.2	0.3	0.4	0.5
PCE-Price Index (Fixed 2000$)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Levels									
Variable	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Total Emp (Thous)	11,013.3	11,186.5	11,374.9	11,535.0	11,700.7	11,886.7	12,040.0	12,190.7	12,325.8
Total GRP (Bil Fixed 2000$)	756.6	787.4	820.2	852.5	886.2	922.7	954.8	987.5	1,020.4
Output (Bil Fixed 2000$)	1,097.8	1,144.2	1,193.5	1,242.1	1,292.7	1,347.7	1,396.8	1,446.6	1,497.0
Population (Thous)	19,210.5	19,569.8	19,928.5	20,290.0	20,651.5	21,009.4	21,356.5	21,694.9	22,018.8
Real Disp Pers Inc (Bil Fixed 2000$)	579.4	595.5	613.2	629.0	645.6	663.7	680.3	697.2	713.8
PCE-Price Index (Fixed 2000$)	122.5	125.9	129.1	132.3	135.4	138.3	141.3	144.3	147.4

Percent Change from the BAU Levels									
Variable	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Total Emp (Thous)	0.01%	0.02%	0.03%	0.04%	0.05%	0.06%	0.07%	0.08%	0.10%
Total GRP (Bil Fixed 2000$)	0.01%	0.02%	0.03%	0.05%	0.06%	0.07%	0.08%	0.10%	0.12%
Output (Bil Fixed 2000$)	0.01%	0.03%	0.04%	0.05%	0.07%	0.08%	0.10%	0.12%	0.14%
Population (Thous)	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.02%	0.03%	0.03%
Real Disp Pers Inc (Bil Fixed 2000$)	0.01%	0.01%	0.02%	0.02%	0.03%	0.04%	0.04%	0.05%	0.07%
PCE-Price Index (Fixed 2000$)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%

Differences from the BAU Levels									**NPV**
Variable	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2009-2025**
Total Emp (Thous)	14.9	18.4	23.4	26.6	29.4	32.0	34.4	36.7	N/A
Total GRP (Bil Fixed 2000$)	1.6	2.0	2.6	3.0	3.4	3.8	4.1	4.5	16.2
Output (Bil Fixed 2000$)	2.6	3.4	4.4	5.0	5.7	6.3	6.9	7.5	27.2
Population (Thous)	9.2	11.5	14.3	17.4	20.6	23.9	27.1	30.4	N/A
Real Disp Pers Inc (Bil Fixed 2000$)	0.6	0.7	1.0	1.1	1.3	1.4	1.5	1.7	6.1
PCE-Price Index (Fixed 2000$)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A

Levels								
Variable	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Total Emp (Thous)	12,445.6	12,563.6	12,668.2	12,768.4	12,865.8	12,960.6	13,052.3	13,138.7
Total GRP (Bil Fixed 2000$)	1,051.9	1,083.8	1,115.2	1,146.7	1,178.5	1,210.6	1,242.9	1,275.2
Output (Bil Fixed 2000$)	1,545.2	1,594.3	1,642.7	1,691.1	1,740.1	1,789.5	1,839.3	1,889.0
Population (Thous)	22,327.1	22,621.0	22,902.8	23,175.1	23,442.1	23,701.8	23,955.7	24,205.6
Real Disp Pers Inc (Bil Fixed 2000$)	730.5	747.5	764.6	781.9	799.7	817.8	836.3	855.1
PCE-Price Index (Fixed 2000$)	150.5	153.7	156.9	160.2	163.6	167.0	170.4	174.0

Percent Change from the BAU Levels								
Variable	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Total Emp (Thous)	0.12%	0.15%	0.19%	0.21%	0.23%	0.25%	0.26%	0.28%
Total GRP (Bil Fixed 2000$)	0.15%	0.18%	0.24%	0.26%	0.29%	0.31%	0.33%	0.35%
Output (Bil Fixed 2000$)	0.17%	0.21%	0.27%	0.30%	0.33%	0.35%	0.38%	0.40%
Population (Thous)	0.04%	0.05%	0.06%	0.08%	0.09%	0.10%	0.11%	0.13%
Real Disp Pers Inc (Bil Fixed 2000$)	0.08%	0.10%	0.13%	0.14%	0.16%	0.17%	0.19%	0.20%
PCE-Price Index (Fixed 2000$)	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%

Table B2. Detailed Simulation Results of Policy Option AFW-2
Afforestation and Restoration of Non-Forested Lands

Differences from the BAU Levels

Variable	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total Emp (Thous)	4.6	6.8	9.0	11.3	13.7	16.0	18.3	20.6	22.8
Total GRP (Bil Fixed 2000$)	0.0	0.1	0.1	0.2	0.3	0.4	0.6	0.7	0.8
Output (Bil Fixed 2000$)	0.2	0.3	0.4	0.6	0.8	1.0	1.3	1.5	1.8
Population (Thous)	1.1	2.5	4.4	6.6	9.2	11.9	15.0	18.1	21.5
Real Disp Pers Inc (Bil Fixed 2000$)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
PCE-Price Index (Fixed 2000$)	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1

Levels

Variable	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total Emp (Thous)	11,016.9	11,191.3	11,380.7	11,541.9	11,708.8	11,895.8	12,050.0	12,201.2	12,336.4
Total GRP (Bil Fixed 2000$)	756.5	787.3	820.1	852.4	886.0	922.5	954.6	987.2	1,020.0
Output (Bil Fixed 2000$)	1,097.8	1,144.1	1,193.5	1,242.0	1,292.7	1,347.7	1,396.7	1,446.5	1,496.7
Population (Thous)	19,211.4	19,571.8	19,931.9	20,294.9	20,658.1	21,017.9	21,366.9	21,707.2	22,032.9
Real Disp Pers Inc (Bil Fixed 2000$)	579.5	595.6	613.3	629.3	645.9	664.0	680.7	697.6	714.3
PCE-Price Index (Fixed 2000$)	122.5	125.8	129.1	132.3	135.3	138.2	141.2	144.2	147.3

Percent Change from the BAU Levels

Variable	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total Emp (Thous)	0.04%	0.06%	0.08%	0.10%	0.12%	0.14%	0.15%	0.17%	0.19%
Total GRP (Bil Fixed 2000$)	0.00%	0.01%	0.02%	0.03%	0.04%	0.05%	0.06%	0.07%	0.08%
Output (Bil Fixed 2000$)	0.01%	0.03%	0.04%	0.05%	0.06%	0.08%	0.09%	0.11%	0.12%
Population (Thous)	0.01%	0.01%	0.02%	0.03%	0.04%	0.06%	0.07%	0.08%	0.10%
Real Disp Pers Inc (Bil Fixed 2000$)	0.02%	0.03%	0.05%	0.06%	0.08%	0.09%	0.10%	0.12%	0.13%
PCE-Price Index (Fixed 2000$)	-0.01%	-0.01%	-0.02%	-0.03%	-0.03%	-0.04%	-0.04%	-0.05%	-0.05%

Differences from the BAU Levels

Variable	2018	2019	2020	2021	2022	2023	2024	2025	NPV 2009-2025
Total Emp (Thous)	25.1	27.3	29.5	31.6	33.8	35.9	38.0	40.0	N/A
Total GRP (Bil Fixed 2000$)	1.0	1.1	1.2	1.4	1.6	1.7	1.9	2.0	8.0
Output (Bil Fixed 2000$)	2.0	2.3	2.6	2.8	3.1	3.4	3.7	4.0	17.1
Population (Thous)	24.9	28.4	32.0	35.7	39.4	43.1	46.9	50.7	N/A
Real Disp Pers Inc (Bil Fixed 2000$)	1.0	1.2	1.3	1.4	1.5	1.6	1.8	1.9	8.8
PCE-Price Index (Fixed 2000$)	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	N/A

Levels

Variable	2018	2019	2020	2021	2022	2023	2024	2025
Total Emp (Thous)	12,455.8	12,572.5	12,674.3	12,773.4	12,870.2	12,964.5	13,055.8	13,142.0
Total GRP (Bil Fixed 2000$)	1,051.3	1,082.9	1,113.9	1,145.1	1,176.7	1,208.5	1,240.6	1,272.7
Output (Bil Fixed 2000$)	1,544.6	1,593.2	1,640.8	1,688.9	1,737.5	1,786.6	1,836.1	1,885.5
Population (Thous)	22,342.7	22,637.9	22,920.5	23,193.4	23,460.9	23,721.1	23,975.5	24,225.9
Real Disp Pers Inc (Bil Fixed 2000$)	730.9	747.9	764.9	782.2	799.9	818.0	836.5	855.3
PCE-Price Index (Fixed 2000$)	150.5	153.6	156.8	160.1	163.4	166.8	170.3	173.8

Percent Change from the BAU Levels

Variable	2018	2019	2020	2021	2022	2023	2024	2025
Total Emp (Thous)	0.20%	0.22%	0.23%	0.25%	0.26%	0.28%	0.29%	0.31%
Total GRP (Bil Fixed 2000$)	0.09%	0.10%	0.11%	0.12%	0.13%	0.14%	0.15%	0.16%
Output (Bil Fixed 2000$)	0.13%	0.14%	0.16%	0.17%	0.18%	0.19%	0.20%	0.21%
Population (Thous)	0.11%	0.13%	0.14%	0.15%	0.17%	0.18%	0.20%	0.21%
Real Disp Pers Inc (Bil Fixed 2000$)	0.14%	0.15%	0.17%	0.18%	0.19%	0.20%	0.21%	0.22%
PCE-Price Index (Fixed 2000$)	-0.06%	-0.06%	-0.06%	-0.07%	-0.07%	-0.07%	-0.08%	-0.08%

APPENDIX C.

Table C1. Sectoral GSP Impacts of the Florida CAP—Simultaneous Simulation (in 2000 fixed billion $)

Sector	2010	2015	2020	2025	NPV
Forestry et al.	$0.023	$0.108	$0.181	$0.243	$1.19
Agriculture	$0.057	$0.234	$0.416	$0.615	$2.84
Oil, gas extraction	$0.000	-$0.001	-$0.004	-$0.007	-$0.02
Mining (except oil, gas)	$0.000	-$0.004	-$0.009	-$0.018	-$0.06
Support activities for mining	$0.000	$0.000	$0.000	-$0.001	$0.00
Utilities	-$0.099	-$0.672	-$1.481	-$2.550	-$9.84
Construction	$0.064	$0.149	$0.290	$0.421	$1.96
Wood product mfg	$0.000	$0.003	$0.007	$0.013	$0.05
Nonmetallic mineral prod mfg	$0.001	$0.006	$0.013	$0.024	$0.09
Primary metal mfg	$0.000	-$0.004	-$0.013	-$0.027	-$0.09
Fabricated metal prod mfg	$0.002	$0.007	$0.018	$0.035	$0.12
Machinery mfg	$0.001	$0.008	$0.020	$0.046	$0.14
Computer, electronic prod mfg	$0.028	$0.111	$0.272	$0.563	$1.93
Electrical equip, appliance mfg	$0.007	$0.035	$0.123	$0.195	$0.70
Motor vehicle mfg	$0.000	-$0.001	-$0.002	-$0.003	-$0.01
Transp equip mfg. exc. motor veh	$0.000	$0.001	$0.004	$0.009	$0.02
Furniture, related prod mfg	$0.001	$0.005	$0.013	$0.030	$0.09
Miscellaneous mfg	$0.001	$0.010	$0.024	$0.048	$0.16
Food mfg	$0.001	$0.009	$0.015	$0.024	$0.11
Beverage, tobacco prod mfg	$0.002	$0.009	$0.016	$0.024	$0.11
Textile mills	-$0.001	-$0.006	-$0.018	-$0.037	-$0.12
Textile prod mills	$0.000	$0.000	-$0.002	-$0.005	-$0.01
Apparel mfg	$0.000	-$0.007	-$0.026	-$0.065	-$0.17
Leather, allied prod mfg	$0.000	-$0.006	-$0.019	-$0.047	-$0.13
Paper mfg	$0.000	$0.000	-$0.001	-$0.002	-$0.01
Printing, rel supp act	$0.000	$0.004	$0.009	$0.017	$0.06
Petroleum, coal prod mfg	-$0.003	-$0.010	-$0.019	-$0.027	-$0.14
Chemical mfg	$0.004	$0.025	$0.081	$0.141	$0.47
Plastics, rubber prod mfg	$0.001	$0.006	$0.014	$0.028	$0.09
Wholesale trade	$0.004	$0.178	$0.457	$0.950	$2.96
Retail trade	-$0.033	$0.233	$0.781	$1.887	$4.96
Air transportation	$0.002	$0.010	$0.022	$0.038	$0.15
Rail transportation	-$0.013	-$0.005	-$0.011	$0.005	-$0.08
Water transportation	$0.000	$0.000	$0.000	$0.000	$0.00
Truck transp; Couriers, msngrs	-$0.005	$0.015	$0.041	$0.078	$0.23
Transit, ground pass transp	-$0.002	-$0.033	-$0.073	-$0.109	-$0.47
Pipeline transportation	$0.000	-$0.001	-$0.003	-$0.005	-$0.02
Scenic, sightseeing transp; supp	-$0.001	-$0.005	-$0.011	-$0.016	-$0.07

Sector	2010	2015	2020	2025	NPV
Warehousing, storage	$0.000	$0.002	$0.006	$0.011	$0.04
Publishing, exc Internet	$0.003	$0.034	$0.082	$0.158	$0.55
Motion picture, sound rec	$0.000	$0.001	$0.008	$0.028	$0.06
Internet serv, data proc, other	$0.002	$0.024	$0.053	$0.098	$0.35
Broadcasting, exc Int; Telecomm	$0.010	$0.097	$0.211	$0.359	$1.40
Monetary authorities, et al.	$0.027	$0.157	$0.327	$0.578	$2.26
Sec, comm contracts, inv	$0.006	$0.041	$0.088	$0.163	$0.61
Ins carriers, rel act	$0.010	$0.058	$0.134	$0.259	$0.93
Real estate	$0.137	$0.885	$1.922	$3.517	$13.30
Rental, leasing services	$0.004	$0.036	$0.084	$0.163	$0.57
Prof, tech services	$0.028	$0.224	$0.479	$0.811	$3.18
Mgmnt of companies, enterprises	$0.004	$0.043	$0.114	$0.236	$0.75
Administrative, support services	$0.012	$0.103	$0.236	$0.452	$1.60
Waste mgmnt, remed services	$0.030	$0.309	$0.342	$0.347	$2.32
Educational services	$0.004	$0.016	$0.030	$0.050	$0.21
Ambulatory health care services	$0.020	$0.121	$0.271	$0.485	$1.85
Hospitals	$0.008	$0.046	$0.105	$0.189	$0.72
Nursing, residential care facilities	$0.004	$0.020	$0.042	$0.071	$0.29
Social assistance	$0.005	$0.022	$0.044	$0.071	$0.31
Performing arts, spectator sports	$0.002	$0.014	$0.028	$0.048	$0.19
Museums et al.	$0.000	-$0.001	-$0.004	-$0.008	-$0.03
Amusement, gambling, recreation	$0.008	$0.044	$0.090	$0.153	$0.62
Accommodation	$0.004	$0.021	$0.041	$0.075	$0.29
Food services, drinking places	$0.019	$0.092	$0.172	$0.267	$1.21
Repair, maintenance	$0.004	$0.040	$0.068	$0.105	$0.46
Personal, laundry services	$0.006	$0.031	$0.061	$0.100	$0.42
Membership assoc, organ	$0.007	$0.032	$0.063	$0.103	$0.44
Private households	$0.001	$0.008	$0.018	$0.029	$0.12
Total*	**$0.405**	**$2.934**	**$6.236**	**$11.428**	**$42.19**

* The total represents the sum of all the sectoral effects. The totals shown in this table differ from the simultaneous solutions shown in the last row of Table 5. The gap between the two is farm value added and government compensation, as well as rounding error.

Table C2. Sectoral Employment Impacts of the Florida CAP—Simultaneous Simulation (in thousands)

Sector	2010	2015	2020	2025
Forestry et al.	0.355	1.432	2.102	2.470
Agriculture	8.550	33.000	56.800	81.560
Oil, gas extraction	-0.006	-0.051	-0.123	-0.223
Mining (except oil, gas)	-0.010	-0.088	-0.236	-0.462
Support activities for mining	-0.001	-0.009	-0.029	-0.061
Utilities	-0.324	-2.009	-4.095	-6.511
Construction	1.312	1.381	0.800	-1.991
Wood product mfg	0.003	0.028	0.042	0.059
Nonmetallic mineral prod mfg	0.011	0.040	0.059	0.068
Primary metal mfg	-0.005	-0.046	-0.125	-0.244
Fabricated metal prod mfg	0.018	0.062	0.118	0.196
Machinery mfg	0.013	0.066	0.139	0.289
Computer, electronic prod mfg	0.068	0.167	0.294	0.475
Electrical equip, appliance mfg	0.066	0.251	0.743	0.992
Motor vehicle mfg	-0.003	-0.009	-0.023	-0.041
Transp equip mfg. exc. motor veh	-0.002	-0.003	-0.009	-0.011
Furniture, related prod mfg	0.010	0.063	0.155	0.307
Miscellaneous mfg	0.008	0.054	0.101	0.168
Food mfg	0.017	0.081	0.113	0.143
Beverage, tobacco prod mfg	0.009	0.036	0.056	0.071
Textile mills	-0.008	-0.071	-0.174	-0.300
Textile prod mills	0.001	-0.003	-0.016	-0.035
Apparel mfg	-0.001	-0.056	-0.174	-0.365
Leather, allied prod mfg	-0.006	-0.063	-0.189	-0.412
Paper mfg	-0.001	-0.010	-0.044	-0.094
Printing, rel supp act	0.005	0.049	0.085	0.137
Petroleum, coal prod mfg	-0.022	-0.062	-0.103	-0.130
Chemical mfg	0.017	0.091	0.271	0.380
Plastics, rubber prod mfg	0.005	0.026	0.047	0.071
Wholesale trade	0.017	0.798	1.634	2.834
Retail trade	-0.638	2.751	7.860	16.310
Air transportation	0.007	0.032	0.051	0.075
Rail transportation	-0.083	-0.029	-0.052	0.013
Water transportation	-0.001	-0.003	-0.007	-0.009
Truck transp; Couriers, msngrs	-0.107	0.225	0.545	0.912
Transit, ground pass transp	-0.094	-1.202	-2.575	-3.691
Pipeline transportation	-0.001	-0.009	-0.022	-0.043
Scenic, sightseeing transp; supp	-0.027	-0.103	-0.200	-0.264
Warehousing, storage	-0.001	0.011	0.008	-0.004
Publishing, exc Internet	0.023	0.177	0.344	0.556

Sector	2010	2015	2020	2025
Motion picture, sound rec	-0.002	0.007	0.092	0.329
Internet serv, data proc, other	0.014	0.106	0.180	0.275
Broadcasting, exc Int; Telecomm	0.041	0.299	0.520	0.721
Monetary authorities, et al.	0.181	0.853	1.442	2.122
Sec, comm contracts, inv	0.089	0.433	0.750	1.146
Ins carriers, rel act	0.110	0.585	1.233	2.219
Real estate	0.575	3.233	6.268	10.510
Rental, leasing services	0.012	0.080	0.155	0.267
Prof, tech services	0.366	2.570	4.818	7.247
Mgmnt of companies, enterprises	0.019	0.169	0.354	0.613
Administrative, support services	0.283	2.162	4.309	7.419
Waste mgmnt, remed services	0.422	4.295	4.474	4.211
Educational services	0.153	0.604	1.077	1.720
Ambulatory health care services	0.287	1.563	3.242	5.395
Hospitals	0.152	0.747	1.465	2.335
Nursing, residential care facilities	0.143	0.685	1.355	2.201
Social assistance	0.241	1.028	1.884	2.868
Performing arts, spectator sports	0.075	0.368	0.654	0.996
Museums et al.	-0.004	-0.052	-0.134	-0.243
Amusement, gambling, recreation	0.120	0.551	0.917	1.311
Accommodation	0.069	0.267	0.391	0.618
Food services, drinking places	0.774	3.388	5.664	8.046
Repair, maintenance	0.094	0.778	1.130	1.527
Personal, laundry services	0.158	0.623	0.980	1.294
Membership assoc, organ	0.254	1.057	1.854	2.721
Private households	0.113	1.011	2.098	3.187
Total*	**13.910**	**64.409**	**111.343**	**164.254**

* The total represents the sum of all the sectoral effects. The totals shown in this table differ from the simultaneous solutions shown in the last row of Table 6. The gap between the two is public employment, as well as rounding error.