Costs to the State of Connecticut of Proposed Legislation to Limit Greenhouse Gas Emissions

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Key Findings

The State of Connecticut is considering legislation that would lead to progressive reductions in the state's greenhouse gas emissions. Section 3 of SB.595 establishes Connecticut's GHG emissions goals:

- 1990 levels by 2010;
- 10% below 1990 levels by 2020; and
- 75% to 85% below 2001 levels by 2050 (unless another year is set).

A conservative estimate is that costs per Connecticut household of meeting these caps would be between $700 and $1300 per year over the next three decades, accompanied by the loss of about 20,000 jobs. Connecticut's state product would be reduced by about 1.3% from baseline levels by 2020, and these losses would either remain stable or grow, depending on whether costs of sequestration level decline or remain constant. The state's budget problems would be worsened, with lower wages and incomes leading to a loss in tax collections of about $250 million per year by 2010. Moreover, the bill would directly impose costs on the state to set up the trading system, and would raise energy costs for state and local governments.

Approach

Using Charles River Associates' general equilibrium model of the US economy (MRN), we modeled the low end of the range of long term emission caps (assuming a target 75% below 2001 levels by 2050) with two different assumptions about the cost of developing carbon sequestration technology. We divided the US into two regions: Connecticut and the other US states. In the Flat300 scenario, we assume that the cost of carbon sequestration technology (backstop technology) remains constant at $300/tonne of carbon. In the Decline scenario, we assume that carbon sequestration technology could sequester carbon at $300/tonne of carbon in 2010, and this cost would decline to about $100/tonne of carbon by 2050.[1] In both scenarios, we allow banking of permits. These assumptions of limits on the cost of reducing carbon emissions could be based on other long-term future technologies utilizing carbon-free sources of energy, but in light of current assessments carbon sequestration seems the most likely possibility.

These may be optimistic assumptions, given the current unproven status of sequestration technology and lack of agreement on how carbon dioxide can be stored safely and

[1] In the MRN model, the existence of a backstop technology is reflected as an exogenously specified price per ton (denoted in $/ton of carbon) at which CO_2 can be sequestered. This technology can be deployed in any sector that emits carbon dioxide, and for simplicity, we assume a uniform price across all sectors. Realistically, it will be much less costly to develop technology to sequester CO_2 emissions from large point sources and therefore, the cost is likely to vary greatly across sectors. To be conservative, we derive our cost estimates from estimates of carbon capture technologies combined with integrated gasification combined cycle power generation.

permanently. Therefore, costs could exceed those estimated in this study, especially in later years with particularly severe caps.

Reductions in Carbon Emissions

The policies in SB.595 would cause very substantial reductions in carbon emissions from the growing levels of emissions expected under current policies. Figure 1a shows the percentage reduction in emissions predicted to occur as a result of compliance with the provisions of SB.595, and the amount of carbon sequestered under the assumed backstop carbon sequestration technology. Figure 1b shows the total carbon emissions for the baseline and the two scenarios. Emissions increases after 2020 are offset by increased carbon sequestration, so that net emissions meet the goals mandated under SB.595.

Figure 1a: Predicted reductions in emissions from baseline levels under SB.595.

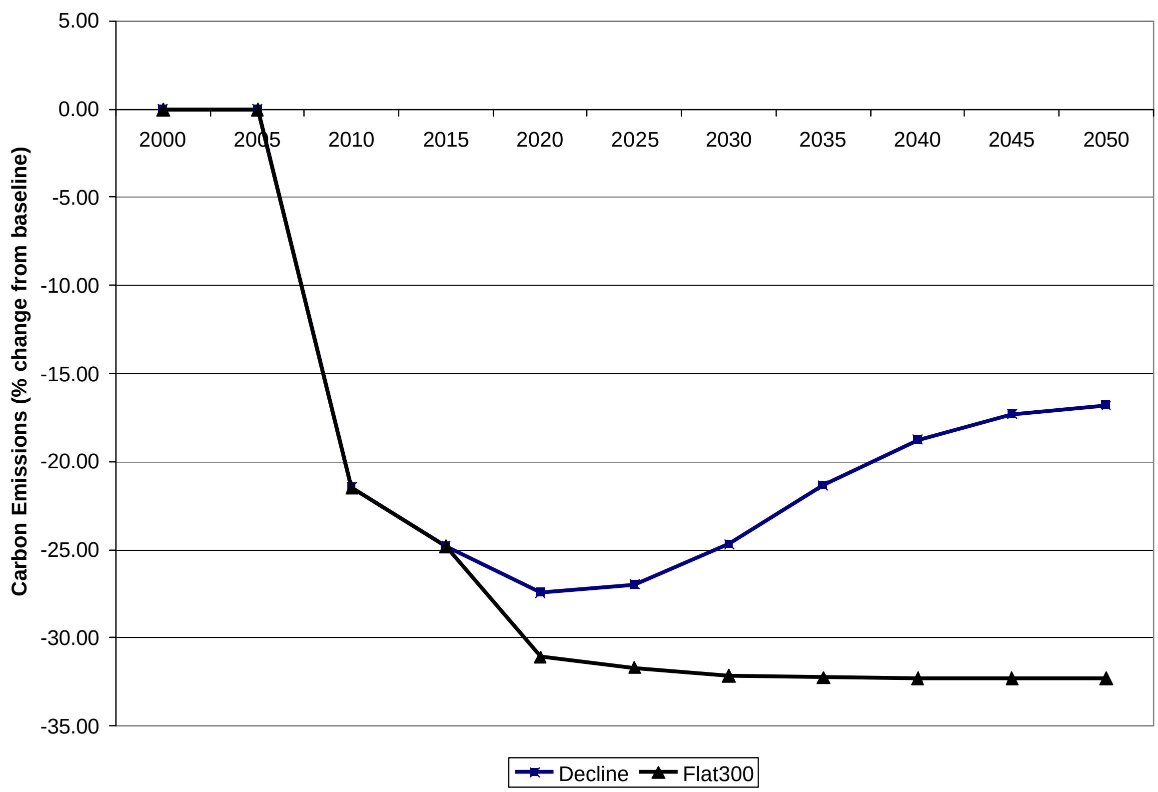
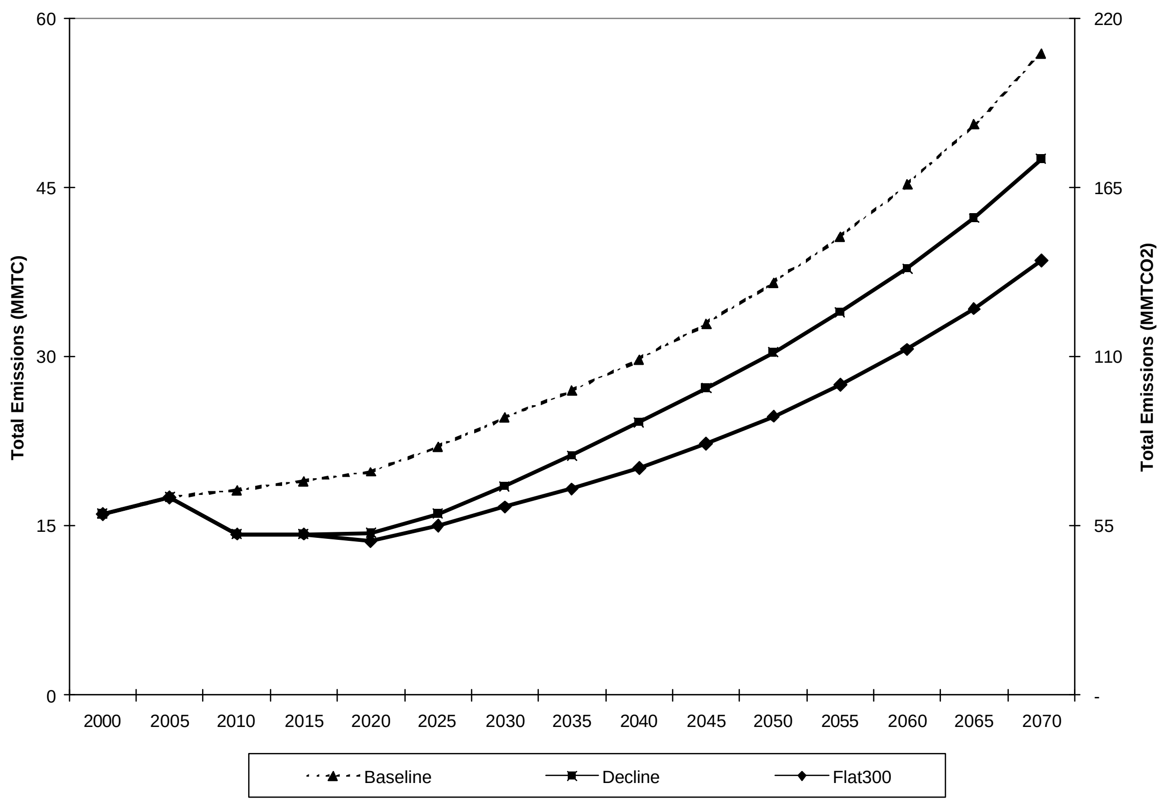


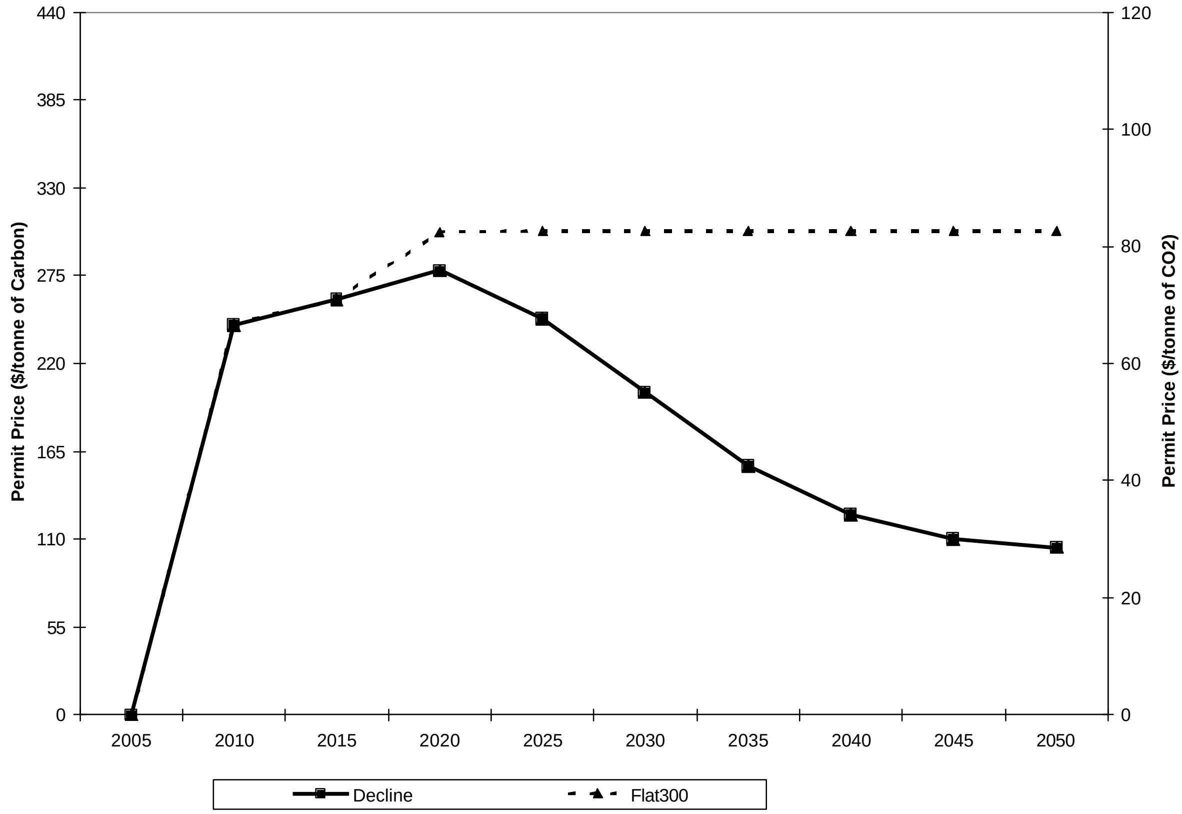
Figure 1b: Total carbon emissions (in MMTC and MMTCO2)



Price of Carbon Permits

To enforce these reductions, we assume that there is a statewide permit trading program. All sources of emissions from burning fossil fuels would require these permits, which permits are traded freely across sectors of Connecticut's economy until the marginal cost of abatement is equalized throughout the state. That is, permit trading will occur so that the cost to reduce one more ton of emissions from the transportation sector would be the same as the cost to reduce one more ton of emissions from the electricity sector. Figure 2 displays this uniform carbon permit price under the two scenarios. Even the high end of the range of carbon permit prices is less than the marginal cost of targeted reductions estimated in the Connecticut Climate Change Stakeholder Dialogue (CCCSD) stakeholder report, and the CCCSD targeted reductions would achieve only about half the mandated reductions in 2010 and 2020. Thus even if the CRA baseline for Connecticut emissions is higher than the CCCSD baseline, our estimated control costs for fully achieving the emission caps are lower than costs of partial control estimated by CCCSD.

Figure 2: Marginal cost of abatement through 2050.



Cost per Household

These permit prices are indicators of the cost of meeting carbon emission limits. Meeting those limits will impose substantial economic costs on Connecticut. Table 1 reports the average cost per household over time. The per household costs rise over time as the emission limits become more binding.

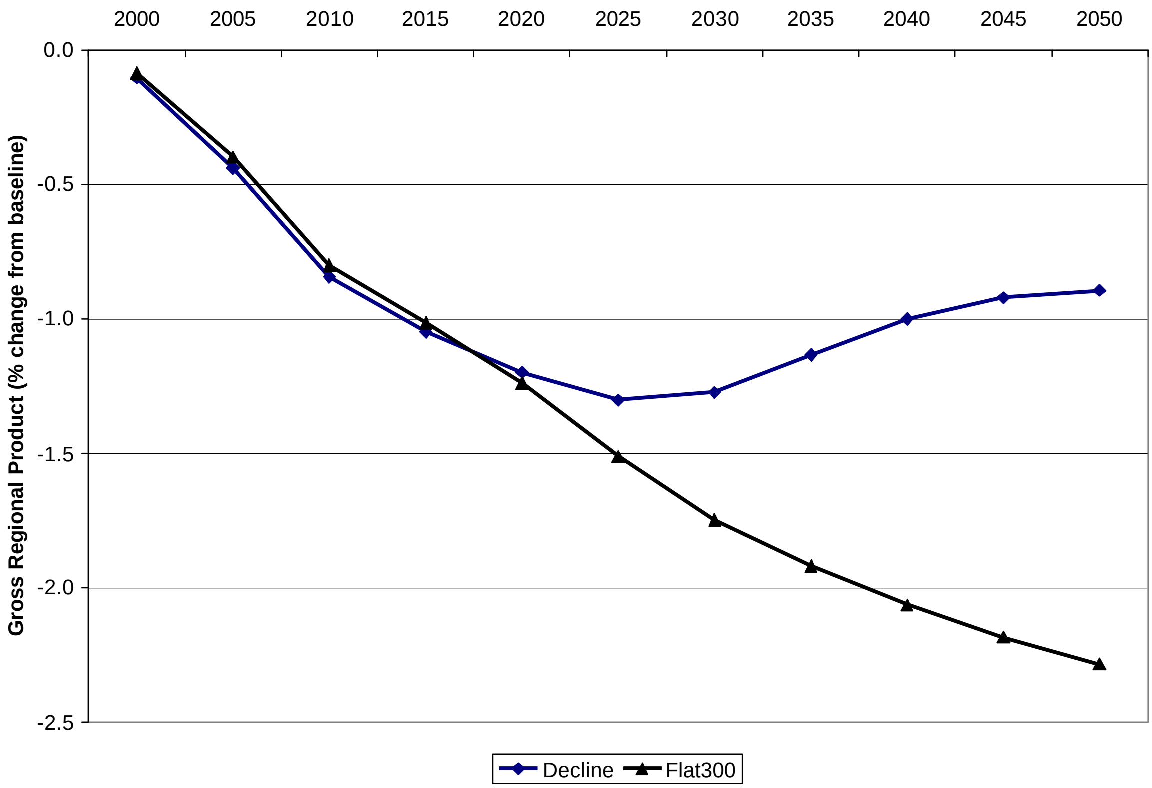
Table 1. Per household loss under SB.595 ($/HH)

	2010	2020	2030
Decline	$708	$692	$664
Flat300	$1,039	$1,166	$1,361

Reductions in Economic Activity

Figure 3 reports the loss in gross regional product for Connecticut. Impacts would grow over time, reaching 1% of state product by 2010. After 2020, impacts depend on whether some long term substitute for fossil fuels or carbon sequestration becomes available at a high or a moderate cost. Losses would continue to grow unless new technologies with falling cost become available over time.

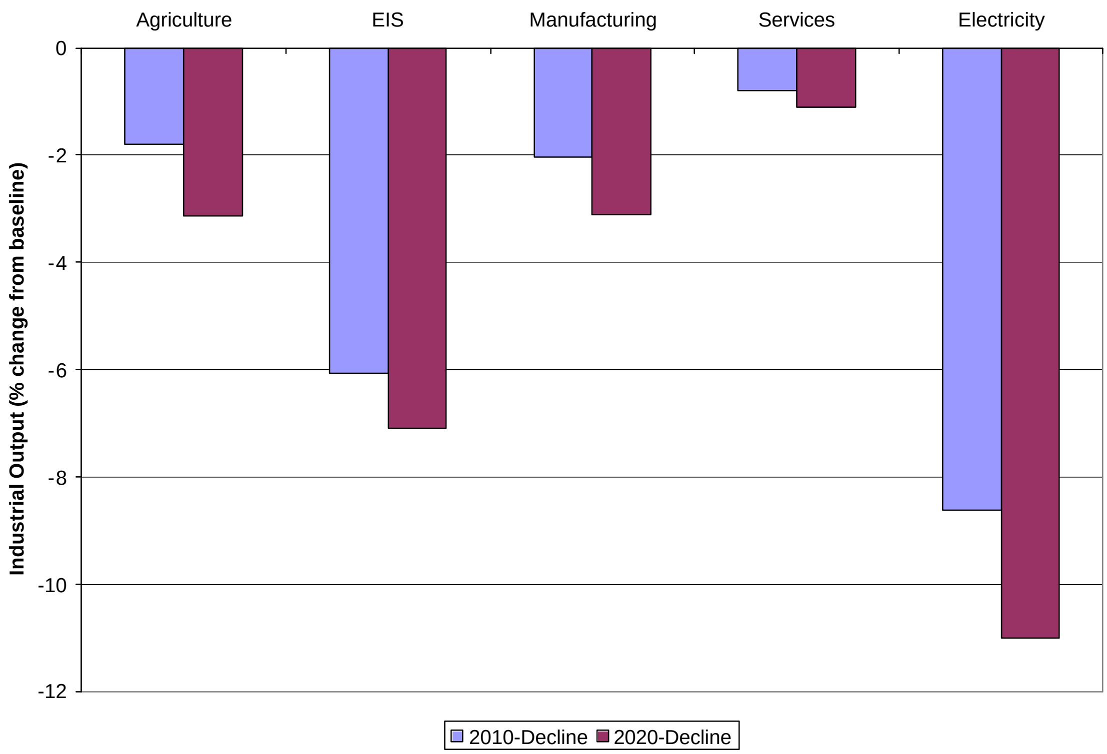
Figure 3: Impact on Connecticut



Impacts on Industrial Output

Looking more in depth at the underlying factors that comprise the loss in GRP, we see that industrial output is down in all sectors throughout Connecticut (see Figure 4). In particular, manufacturing and energy-intensive sectors fall by 2 to 6% in 2010 and 3% to 7% in 2020 due to the carbon dioxide regulation. Reduced activity in these sectors will cause a loss in jobs in these and related industries. Impacts in both scenarios are about the same through 2020, so that Figure 4 displays results only for the more optimistic CT-Decline scenario in which costs of sequestration are assumed to fall.

Figure 4: Change in industrial output for Connecticut



Impacts on Employment

Higher costs and reductions in output of Connecticut industries ultimately feed back to individuals in the form of lower wages and fewer jobs. Because of lower wages, labor supply is reduced, further trimming incomes and reducing the productive potential of the economy. Figures 5 and 6 show, respectively, the impacts on wages and employment in Connecticut.

In both scenarios for future costs of sequestration, Connecticut would lose about 17,000 jobs in 2010 and over 20,000 jobs in 2020 as a result of the pending legislation.

Figure 5: Reduction in Wages

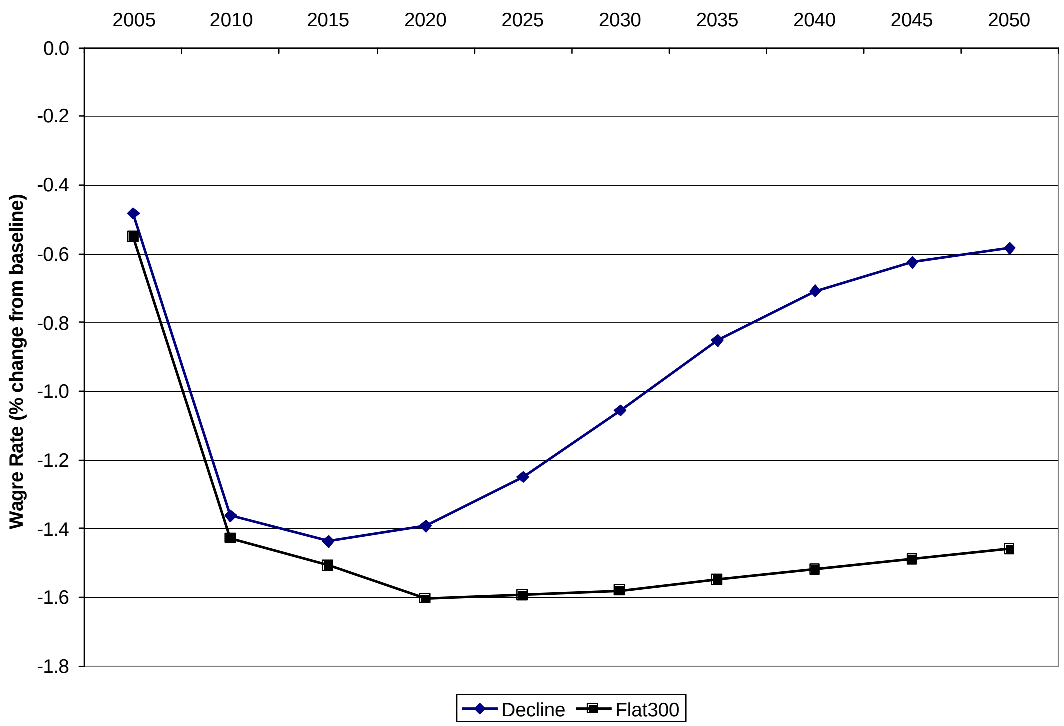
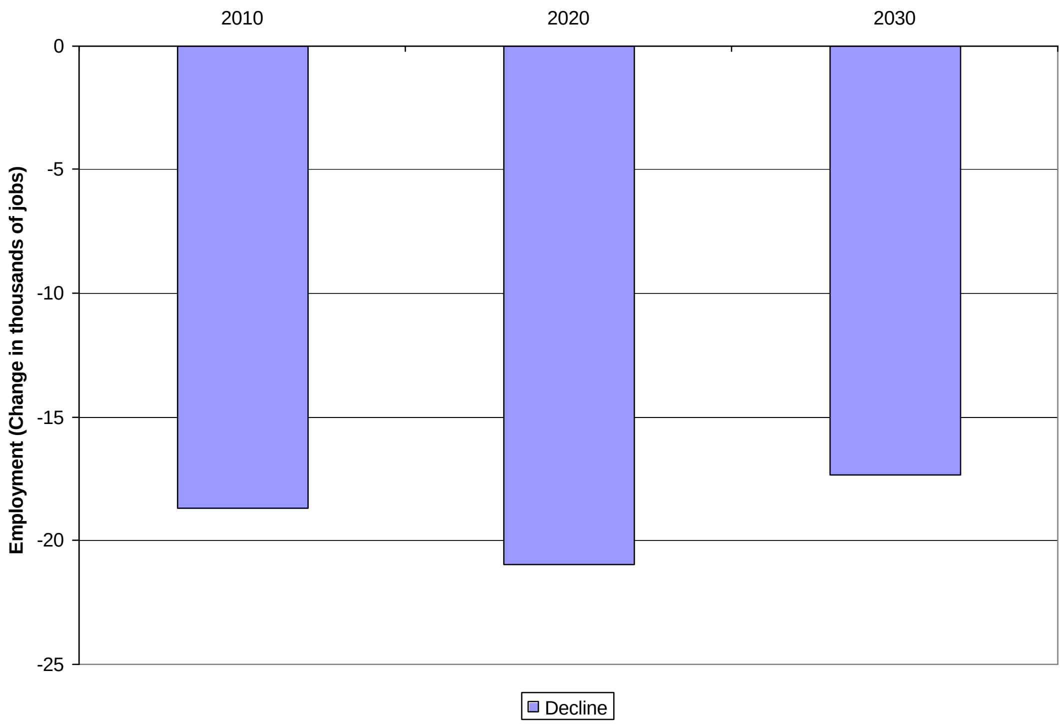


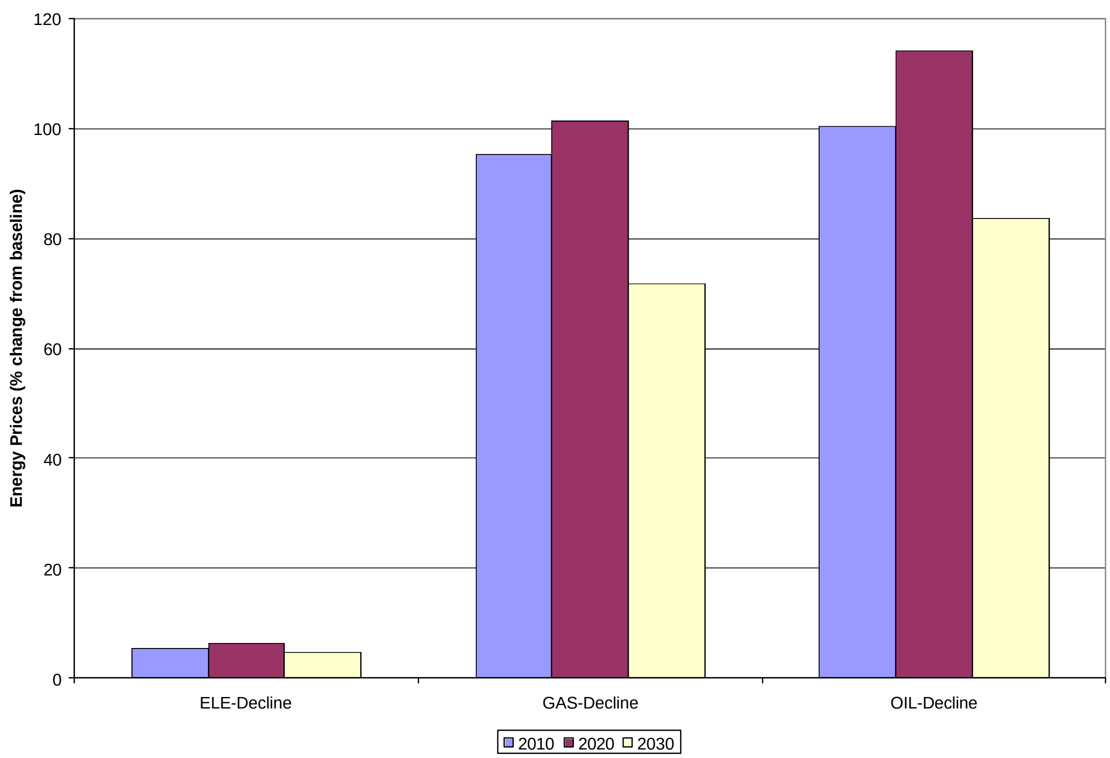
Figure 6: Reduction in Employment



Energy Prices

Prices of refined petroleum products (gasoline and heating oil) and natural gas would increase by about 100% over the period 2010 to 2030 under either scenario. Since Connecticut has little coal-fired generation and almost 50% of its generation is from nuclear power, delivered electricity prices would increase by a relatively lesser amount (about 5% from the baseline).

Figure 7: Change in Energy Prices (% change from baseline)



State Budget Impacts

Lower wages and lower employment lead to a double hit on overall labor earnings. This combined with the drop in industrial output and utility sales reduces the level of state tax collections. The lower level of worker income and state output will reduce state sales and income tax revenues. The impacts of carbon dioxide regulations on wages and employment will also affect the State's expenditures, increasing unemployment benefits and other transfer payments to affected workers. In addition, the bill will impose direct costs on the state for setting up the emission trading system and will increase energy costs for state and local governments, particularly those related to fuel for public transportation, state vehicle fleets, and school buses, and heating and cooling public buildings, schools and hospitals.

In analyzing impacts on the state economy, our analysis estimated the percent change in sales of electricity, natural gas and motor fuels, and also the change in labor earnings in 2010. We used 2002 data on state tax collections to estimate revenue loss, and increased these by 30% to account for likely revenue growth between 2002 and 2010. Based on these calculations, the State of Connecticut could expect to see a loss in revenue of almost $250 million dollars in 2010 due to the provisions of SB.525. Any increases in state outlays for energy related costs would increase these impacts.

Table 2: Revenue Impacts in 2010

	2002 Revenues	% Change in Sales	Loss from 2002 Revenues	Revenue Loss in 2010
Electric and Power Companies	$30,882,437	-16.618	($5,132,197)	($6,671,856)
Gas Companies	$31,181,829	-9.401	($2,931,262)	($3,810,640)
Gas and electric Companies	$74,762,744		($9,726,275)	($12,644,157)
Motor Vehicle Fuels Tax	$421,805,196	-18.377	($77,515,513)	($100,770,167)
		% Change in Labor Earnings		
Income Tax Revenue	$4,266,291,049	-2.149	($91,664,855)	($119,164,311)
Total			($186,970,102)	($243,061,132)

Appendix Description of MRN model

For the analysis in this paper, we use our Multi-Region National model.[2] We have employed it in numerous studies to measure the economic costs of the climate change policies. MRN is a computable general equilibrium (CGE) model of region-specific impacts and regional interaction in the U.S. economy. The model solves for income, production levels, relative prices, trade, and consumption by accounting for behavioral as well as technological responses to changes in policy. The equilibrium is fully dynamic, meaning that investment decisions determine the future capital stock, which in turn determines future income and consumption. Furthermore, decisions to consume or invest are taken with correct expectations about future policy and opportunities. Investment today requires foregoing consumption of current output (current GDP). Consumer decisions maximize utility, which implies that an optimal trade-off is made between consumption today and consumption in the future.

Data that characterize the interrelationships of commodities within the economy are of primary importance in quantifying the impacts from alternative carbon abatement implementation. Many of the impacts of reducing carbon emissions indirectly increase the cost of production and consumption. For example, a regulation on the quantity of allowable emissions from electric utilities will result in higher electricity prices. Furthermore, higher electricity prices will raise production costs, especially in sectors that use electricity-intensive processes. As a starting point for characterizing the inputs and outputs in the economy we utilize a Social Accounting Matrix (SAM) developed for each state by the Minnesota IMPLAN Group, Inc. (MIG). The IMPLAN database represents the activities in 530 sectors for all 50 states and the District. Adjustments to the original data were necessary to bring them in line with the EIA's state level energy data, which are more accurate than the corresponding IMPLAN data. The SAM that results from the combination of IMPLAN and EIA data fully tracks the intensities of commodity use for the modeled production and consumption sectors for any regional aggregation of states. In addition, the SAM completes the circular flow with an account of factor incomes, household savings, trade, and institutional transfers.

Conceptually, the SAM is taken to represent a snapshot of the economy along a dynamic growth path. Calibration of the dynamic equilibrium is completed by incorporating growth forecasts for industries, population, and carbon emissions. Currently, the forecasts used in MRN are those made in the Energy Information Administration's 2001 Annual Energy Outlook. For calibration, projections of energy use in industry and transportation are used as constraints on the multi-sector growth model to reveal the factor productivity shifts necessary to meet the projected equilibrium. This new equilibrium, with these productivity shifts, is used as the baseline for policy analysis.

MRN can be adapted to examine the details of policy impacts on a number of different sectors of the economy. Aggregation of regions and sectors is completely flexible. Since SB.595 only restricts Connecticut's emissions, we aggregate all the other states into one region and run our model with two regions - Connecticut and the rest of the U.S.

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[2] We use our international CGE model (Multi-Sector Multi-Region Trade model) to provide international prices to MRN, but all reported economic impacts come from MRN.

All the important energy sectors in contained in the detailed SAM are represented in MRN since carbon emissions are highly correlated with energy use. We then aggregate the remaining non-energy sectors into five categories to capture the diversity in energy intensity across sectors. We break out motor vehicles separately so that we can correctly account for individuals' responses to higher fuel costs caused by carbon abatement policies. Therefore, the model is run with the following ten sectors:

Table 3.1 MRN model's sectors for analyzing SB.595

Energy Sectors	Non-Energy Sectors
Coal extraction	Agriculture
Gas distribution	Energy intensive sectors
Oil and gas extraction	Manufacturing
Oil refining/distribution	Services
Electricity generation	

MRN explicitly models just the U.S.; therefore, it needs a source for international prices that must be consistent with the chosen MRN scenario. To incorporate external market impacts, we have built a hierarchical structure of models in which relevant international information is passed down from a more complete geographic model to MRN, which is the more detailed regional model. Therefore we decompose the problem into separate models that are consistently linked such that external impacts are incorporated into MRN. This approach avoids the complexity added by modeling the rest of the world.

Our international trade model, Multi-Sector Multi-Region Trade (MS-MRT) model, examines the impacts of international carbon emissions agreements under alternative international abatement policies on world regions and industries. For this analysis, we used a version of MS-MRT that incorporates nine regional trade blocks and the nine commodities in MRN model.[3] MS-MRT fully tracks the physical flows of energy and their embodied carbon. Because the United States is one of the trade blocks, MS-MRT predicts changes in the prices of U.S. imports and exports.

In other words, MRN produces results for the U.S. regions modeled; but because we incorporate the terms of trade impacts from MS-MRT for the same policy, these results are consistent with the international trade implications of international commitments to reduce emissions. MRN takes all international prices for goods and services as exogenous. Utilizing MS-MRT insures that the domestic responses simulated within MRN are consistent with a broader global economic equilibrium.

To correctly account for long-term impacts of GHG abatement policies, specifically on saving and investment decisions, we extend MRN's model horizon out to 2070 in 5-year time steps.

[3] For a full description of MS-MRT, see P.M. Bernstein, W.D. Montgomery, T.F. Rutherford (1999) "Effects of Restrictions on International Permit Trading: The MS-MRT Model," *The Energy Journal*, Kyoto Special Issue, pp. 221-256.

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IMPROVE government efficiency through privatization, competition and other market-based initiatives.

LIGHTEN the burdens of taxation, government spending and regulation to enhance the economy and improve our quality of life.

ENCOURAGE freedom of choice and competition in education to improve academic excellence and give parents more control over how their children are educated.

PROTECT property rights by ensuring that government regulation is fair, impartial and respectful of individual sovereignty and free choice.

PROVIDE market-based opportunities for the advancement of all citizens that reflect a commitment to personal liberty, strong families, hard work, and sound moral values

Danger to Freedom

Unfortunately, Connecticut citizens are increasingly prevented from enjoying and exercising the personal liberty that is our birthright. Ever expanding federal and state taxes, burdensome regulations, and unconstitutional laws restrict the voluntary choices of private individuals and businesses, robbing us of opportunities to pursue happiness and create prosperity for ourselves, our families, and our neighbors.

To make matters worse, demagogic politicians try to divide the cities from the suburbs, the affluent from the poor, and ethnic minorities from the broader population with ideologies that contradict America's time tested principles of self-reliance, personal responsibility, and individual choice.

The Solution

But there is a solution. And the Yankee Institute for Public Policy is leading the way.

Ever since 1987 the Yankee Institute has been on the front lines, helping Connecticut citizens -- and our elected officials -- better understand the Constitutional and free market principles that maximize freedom and well-being for peoples of all economic and social backgrounds. Our public policy initiatives bolster a market economy, encourage limited government, promote respect for private property, and preserve our Constitutional rights.

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