BHI Policy Study

The Economic Analysis of the Western Climate Initiative's Regional Cap-and-Trade Program

David G. Tuerck, PhD

Michael Head, MSEP

Paul Bachman, MSIE

Alfonso Sanchez-Penalver, MSF

THE BEACON HILL INSTITUTE AT SUFFOLK UNIVERSITY
8 Ashburton Place
Boston, MA 02108
Tel: 617-573-8750, Fax: 617-994-4279
Email bhi@beaconhill.org, Web www.beaconhill.org

MARCH 2009

Table of Contents

Table of Tables

Executive Summary

In 2007, the governors of Arizona, California, Montana, New Mexico, Oregon, Utah and Washington, along with the premiers of British Columbia, Manitoba, Ontario and Quebec, signed the Western Regional Climate Action Initiative Agreement. In doing so, they agreed to "collaborate in identifying, evaluating and implementing ways to reduce greenhouse gas (GHG) emissions."[1] To advance the goal of reducing GHG emissions, they established the Western Climate Initiative (WCI). Placing a cap-and-trade program at the center of their effort, they aim to improve "overall environmental health and economic vitality."[2]

On September 23, 2008, the WCI commissioned a report entitled, *Design Recommendations for the WCI Regional Cap-and-Trade Program*. The report recommends a broad-based cap-and-trade system to achieve the WCI regional goal of reducing GHG emissions by 15% below 2005 levels by 2020. The system would cover emissions of carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride. Industries that are covered include the electric utilities, industrial and commercial facilities, industrial processing (including oil and gas), residential, commercial and fuel combustion facilities, and transportation fuel combustion.[3]

The report considers three scenarios for implementing the cap-and-trade system. The first is a "Narrow Case" which considers only stationary sources of GHG and the electricity sector, while the second and third cases use a "Broad" definition which includes the narrow sources in addition to transportation, and residential and commercial fuels. The two "Broad Cases" are distinguished by whether or not they allow offsetting forms of GHG reduction, such as planting trees or paying to preserve rainforests.

The report also recommends implementing three "complementary" policies. These policies include California Clean Car Standards; energy efficiency policies to reduce total demand growth

[1] Western Climate Initiative, *Design recommendations for the WCI Regional Cap-And-Trade Program,* http://www.westernclimateinitiative.org/WCI_Documents.cfm (accessed January 21, 2009).
[2] Ibid.
[3] Ibid.

of electricity and natural gas by 1%; and policies to reduce growth of vehicle miles traveled (VMT) by 2%. The report estimates that the combination of the cap-and-trade system and complementary policies will produce net cost saving of $11.4 to $23.5 billion dollars annually for the member state economies. The report also predicts that price changes for the covered fuels (electricity, natural gas, fuel oil, gasoline and diesel) would range from a decrease of 2.4% to an increase of 182.4%.

A Cost Benefit Analysis (CBA) is typically used to evaluate the desirability of a given intervention. The costs and benefits of the impacts of an intervention are evaluated in terms of the public's willingness to pay for them (benefits) or willingness to pay to avoid them (costs). Inputs are typically measured in terms of opportunity costs — the value of the best alternative use. The guiding principle is to list all of the parties affected by an intervention and place a monetary value of the effect it has on their welfare as it would be valued by them. On this basis, a study should be able to conclude whether a given policy change is expected to provide benefits in excess of its costs. Thus, a CBA is essential before a new policy intervention is adopted.

In this report, the Beacon Hill Institute at Suffolk University (BHI) analyzes the WCI projections of cost savings and provides independent estimates of the economic impact of the proposed cap-and-trade scenarios coupled with the complementary policies. BHI uses its STAMP® (State Tax Analysis Modeling Program) to estimate the economic effects of the WCI recommendations.[4]

Upon reviewing the WCI report, we find that:

1. The report explains only the California Clean Car Standards in detail and fails to provide any details for the initiatives to reduce the electricity and natural gas demand growth and Vehicle Miles Traveled (VMT) — rendering any attempt at an accurate CBA impossible. We are left to conclude these polices are, at best, goals or government mandates.

2. The report fails to assign any benefits to the lost VMT or consumption of electricity and natural gas, account for the opportunity costs of allocating resources toward the programs or account for the program costs of implementing these yet unspecified policies.

[4] Detailed information about the STAMP® model can be found at www.beaconhill.org.

3. The report fails to answer a key question: If the purported gains in energy efficiency and in reductions to VMT produced tens of billions of dollars in savings annually, why wouldn't economic agents capture these gains without the necessity of a government policy?
4. The cap-and-trade program would increase input costs for producers located within the WCI states, placing them at a competitive disadvantage to those outside the area. The pressure would be especially acute for producers that utilize large amounts of energy in the production process, such as manufacturers.

BHI utilized the WCI's own projections of fuel price increases that would result from implementing the cap-and-trade and complementary policies to measure the effects on the economies of the seven U.S. member states for the three recommended cases. We assume that state governments would auction off permits to emit greenhouse gases under the cap-and-trade programs and thus generate revenue. Table ES1 summarizes our findings.

Table ES1 : Summary of BHI Estimates for 2020

Policy	*Employment*		*Gross Private Investment*	*Personal Income*	*Disposable Income*	*Disposable Income*
	Private	*Public*	*($ million)*	*($ millions)*	*($ millions)*	*($ per Capita)*
Auction 100% of GHG Emission Permits						
Broad with no offsets	-251,674	142,241	-1,448.41	-18,308.56	-17,420.86	-172.60
Broad with offsets	-113,558	57,269	-712.57	-10,451.68	-7,838.56	-78.35
Narrow with offsets	-103,931	83,519	-547.75	-6,344.97	-5,138.98	-59.23
Auction 25% of GHG Emission Permits						
Broad with no offsets	-165,397	19,710	-4,539.55	-47,706.88	-30,316.49	-272.34
Broad with offsets	-59,240	6,920	-989.22	-13,094.59	-6,302.83	-62.65
Narrow with offsets	-35,177	-354	-1,620.21	-10,195.15	-6,341.78	-63.47

We find that the cap-and-trade policy recommendations would have substantial negative effects. Under the scenarios that 100% of the permits would be auctioned to emitters, the seven states combined would lose 103,931 to 251,674 private sector jobs, while the permit revenue would allow the states to hire 57,269 to 142,241 state employees. Firms would also slow investment in the region by $548 to $1,448 million. Total personal income would fall by $6.35 to $18.31 billion per year, and disposable income per capita by $59 to $173.

Under the scenario that member states auction the minimum of 25% of the permits issued, the member economies would suffer greater losses in investment and income. Fewer private jobs would be destroyed as real wages would decrease relative to the price increases making labor more attractive relative to capital. The states would have far less revenue available to hire public employees and thus public sector employment would increase slightly or fall as the price increases crowd out the states' ability to hire. Private sector employment would fall by 35,177 and 165,397 jobs while the states would either shed 354 employees or hire 19,710. Firms would also slow investment in the region by $1,620 to $4.54 billion. Total personal income would fall by $10,195 to $47,71 billion per year, and disposable income per capita by $63 to $272.

Table ES2: Estimates for Individual WCI States, 2020

	Net Employment jobs	*Personal Income $ million*	*Per Capita Disposable Income $*
Arizona	-4,801to -20,496	-722.27 to -5,397.10	-47.60 to -224.98
California	-7,886 to -78,694	-4,038.18 to -30,398.72	-62.72 to -287.63
Montana	-548 to -2,869	-91.77 to -689.21	-54.77 to -250.79
New Mexico	-8 to -4,689	-165.16 to -1,242.23	-47.84 to -219.41
Oregon	-1,823 to -10,748	-320.60 to -2,419.17	-46.42 to -213.65
Utah	-2,546 to -9,899	-246.34 to -1,846.52	-40.38 to -185.83
Washington	-2,800 to -18,292	-760.64 to -5,713.92	-66.02 to -302.54

Table ES2 displays a range of individual results for each of the seven WCI member states using the least damaging scenario (100% Auction, "narrow with offsets") and the most damaging (25% Auction, "broad with no offsets"). California would bear the bulk of the economic losses, since it has the largest economy of the member states. California stands to lose between 7,886 and 78,694 jobs, $4.0 and $30.4 billion in personal income; which translates into between $62.72 and $287.63 in disposable income for every resident. Arizona and Washington would suffer the next highest job and income loses, followed by Oregon and Utah. New Mexico and Montana, with their smaller economies would endure relatively fewer job loses and erosion of income. None of the seven WCI member state would escape the economic damage wrought by the proposed WCI cap-and-trade systems.

The proposals' negative economic effects stem from the price and tax increases they would impose on the energy and transportation sectors. Our results contrast with the positive results

produced by the WCI report, which suffers from the previously-described deficiencies. Policymakers in the states need to be careful of the economic consequences of implementing a regional cap-and-trade system.

Introduction

The Western Climate Initiative (WCI) began in February 2007 as a collaboration of the governors from Arizona, California, New Mexico, Oregon and Washington. Soon after the formation of the WCI, the governors of Montana and Utah, as well as the Premiers of British Columbia, Manitoba, Ontario and Quebec joined. The WCI's mission is to identify, evaluate and implement collective and cooperative ways to reduce GHG emissions in the region, focusing on a market-based cap-and-trade system.

On September 23, 2008, the WCI released a report titled, "Design Recommendations for the WCI Regional Cap-and-Trade Program."[5] The report recommends a broad-based cap-and-trade system to achieve the WCI regional goal of reducing GHG emissions by 15% below 2005 levels by 2020. The system would cover emissions of carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride. Industries that would be covered include the electric utilities, industrial and commercial facilities, industrial processing (including oil and gas) facilities, residential, commercial and fuel combustion facilities, and transportation fuel combustion.

According to the report, the WCI system is intended to mitigate economic impacts, specifically on consumers, income and employment. The WCI reports that its cap-and-trade system combined with complementary policies, such as energy efficiency and reductions to vehicle miles traveled, can meet their emission goals and produce a small net savings to the economy. The savings derive exclusively from the complementary policies, which would be funded through the auctioning of emissions allowances.[6]

Several studies have found that cap-and-trade systems would suppress economic activity.[7] Moreover, studies that purport to calculate the cost-benefits of programs identical to the

---

[5] Western Climate Initiative; *Design recommendations for the WCI Regional Cap-And-Trade Program.*
[6] Ibid., 13, Sec. 8.2.
[7] For more information see David G. Tuerck, Paul Bachman, Alfonso Sanchez-Penalver and Michael Head, *The Economic Effects of Climate Change Legislation in North Carolina* (The Beacon Hill Institute: April 2008);
American Council for Capital Formation and the National Association of Manufacturers, *Analysis of*

complementary policies listed above suffer shortcomings in their methodology.[8] This report reviews the WCI's finding that substantial savings can be sustained to the benefit of the economy. Finally, BHI utilizes the WCI's projections of fossil fuel-price changes to determine the effect of the policy on economic indicators, including employment, investment and incomes.

The Lieberman-Warner Climate Security Act (S. 2191) Using The National Energy Modeling System (NEMS/ACCF/NAM); William W. Beach, David Kreutzer, Ph.D., Ben Lieberman and Nicolas Loris; *The Economic Costs of the Lieberman-Warner Climate Change Legislation, The Heritage Foundation,* May 12, 2008, *http://www.heritage.org/Research/EnergyandEnvironment/cda08-02.cfm, (accessed January 31, 2009)*

[8] See also North Carolina Climate Action Plan Advisory Group, Rocky Mountain Climate Organization, Minnesota Climate Change Advisory Group, Montana Climate Change Advisory Group and 16 other states that partnered with the Center for Climate Strategies.

The WCI Cap-and-Trade & Complementary Programs

The WCI employs four implementation tools to achieve the goal of reducing emissions to 15% below 2005 levels, each affecting economic decisions and economic activity in the participating states and provinces. The first tool is capping carbon emissions, then auctioning or allocating permits to firms allowing the right to emit a ton of carbon dioxide equivalent. The WCI also calls for the implementation of three "complementary" tools used to help achieve the goal; including the implementation of California Clean Car Standards, energy efficiency programs aimed at reducing energy demand growth by 1%, and programs designed to reduce vehicle miles traveled growth by 2%.

The WCI report also analyzed three different cap-and-trade cases. A "Narrow Case" which caps only stationary sources of GHG emissions within the electricity sector, and two "Broad Cases" that include all the "Narrow case" emission sources, plus transportation fuels (gasoline and diesel) and electricity and heating fuels used by residential and commercial buildings. The two "Broad Cases" are distinguished by whether or not they allow offsetting forms of GHG reduction, although the report states "the WCI Partner jurisdiction will include a rigorous offset system."[9]

A cap-and-trade program contains two major parts. The first part is the "cap" which sets the maximum quantity of GHG emissions. In 2012, the first year that the cap-and-trade policy would take effect, the WCI cap would be set at the best estimate of expected emissions. The cap would then decrease annually until 2020, when the cap would be equal to 15% below 2005 emissions. The program would also require all emitters to report their GHG emission levels, and possess an offsetting permit allowing for the emissions.

The second part is the "trade" or trading of permits. Typically a cap-and-trade program will involve some form of an auction or other method to distribute permits to emitters. The WCI mandates that the participating states auction a minimum of 10% of the permits in 2012, increasing to 25% by 2020; individual states are free to auction or distribute the remaining

[9] Western Climate Initiative; *Design Recommendations for the WCI Regional Cap-And-Trade Program*, 16.

permits. Thus the government artificially creates a shortage of permits to emit greenhouse gases and a market to trade the now valuable permits.

At the end of each three-year compliance period, each emitting firm would either find itself in the unlikely situation of having a perfect match between its actual and permitted level of emissions or, more likely, a mismatch between actual and permitted emissions in the form of a shortage or surplus of permits. At this point, the firm can trade for the difference with other companies. This quasi-market based system allows firms with relatively lower costs to reduce emissions to "sell" permits to companies that have a relatively higher reduction costs.

The WCI also outlines three complementary policy initiatives that would complement the cap-and-trade program to help reduce emissions. The policies focus on the industries most affected by the cape and trade system.

Transportation

Two of the three complementary policies focus on the transportation sector. The first would implement the so called California Clean Car Standards (CCCS) which requires all new, light duty vehicles sold to produce 30% less emissions, phased in over 7 years. The WCI estimates that the CCCS policy would reduce emissions by 30.1 million tons and lead to a total savings of $1.618 billion in 2020 alone.[10]

The second complementary policy is the implementation of programs to reduce the total amount of Vehicle Miles Traveled (VMT) by 2% below the reference case by 2020. The WCI estimates that VMT reduction policies would provide cost savings of $17.48 billion in 2020.

Thus the WCI estimates that the complementary policies for the transportation sectors would save the citizens living in the WCI geographical area $19.098 billion in 2020. However, the WCI fails to identify the specific policies or strategies that would reduce the VMT by 2%. Thus the VMT reduction is, in fact, not a policy at all, but rather a mandate or goal.[11]

---

[10] Ibid., 90.

[11] When the authors contacted WCI to obtain the details of the complementary polices, they were told that the WCI was not that far along in the process.

Energy

The third complementary policy is a mere suggestion to implement "aggressive energy efficiency programs that achieve a one percent reduction in the annual rate of electricity and natural gas demand growth."[12] The WCI again fails to identify the specific programs needed to achieve a 1% reduction in demand, let alone provide an estimate of their costs and benefits. As with the two transportation programs, the WCI's modeling concludes that the aggressive energy efficiency programs would result in net savings to the WCI economies. The WCI's 1% reduction in electricity and natural gas demand is simply a mandate; it is not a set of polices or strategies to complement the cap-and-trade program.

[12] Western Climate Initiative, *Design Recommendations,* 89.

The Beacon Hill Institute Analysis

A cap-and-trade system aims to artificially drive up the price of carbon intensive production relative to other goods in the market, and thus alter the market in favor of goods that can be produced with lower emissions. This higher price is intended to reduce consumption of these products — fossil fuels used in the utility and transportation sectors — resulting in lower GHG emissions. Since the emissions are capped, the trading of emissions allows a government-created market to determine what higher price of fuel would be needed to reduce emissions. The WCI predicts that fuel price changes that will range from a decrease of 2.4% to an increase of 182.4% , with only four of their 45 simulations resulting in lower prices.[13]

In fact, a cap-and-trade system poses serious economic problems, especially when implemented on a regional basis. In an economy closed to trade, the cap-and-trade system raises the production costs of all goods and services that require energy, heat or fuel ─ in effect all goods and services. This increase in the price of a resource in production causes a decrease in the supply of goods and services using the resource. To cover the increase in cost by raising prices, producers are forced to raise prices. Moreover, the marginal or high cost producers will be forced out business because they are no longer cost-competitive. As a result, equilibrium price increases and the quantity of goods and services supplied decreases.

However, the WCI area is, in fact, open to a vigorous trade with other U.S. states and Canadian provinces. The volume and importance of such trade places an additional burden on the producers within the regional cap-and-trade system. They are subject to inequitable competition from outside producers who are not affected by the price increases. As a result, industries that require a higher relative energy content in their production process, such as manufacturing, would relocate to regions outside the WCI area, reducing local production even further. The WCI commissioned report is consistent with the basic economics of a cap-and-trade system, insofar that it acknowledges price increases for the different types of fossil fuels. Basic economic

[13] Western Climate Initiative; *Design Recommendations,* "Table B-16: Cap-and-Trade Case Fuel Price Results: Eight WCI Partners," 95.

analysis shows the WCI cap-and-trade system will reduce economic activity within the affected geographical area.

Although the WCI report finds that fuel prices would increase under the cap-and-trade system, it also manages to find significant overall cost savings under the three cap-and-trade cases. According to the report, participating states and provinces could, by 2020, see a negative cost, or net annual savings of $23.525 billion for the "Broad with no offsets" case; $22.080 billion under "Broad with offsets" case and $11.422 billion under the "Narrow with offsets" case. The report derived the net savings figures exclusively from the three proposed complementary policies: Implementing CCCS, reducing vehicle miles traveled by 2%, and reducing the growth in energy consumption through energy efficiencies policies by 1%.

Since these complementary policies produce net cost savings when implemented in conjunction with the cap-and-trade, they must, in fact, produce even larger net costs savings than reported, if they were implemented in the absence of the cap-and-trade policies. If we are to believe the report's analysis, increasing the cost of fossil fuels, the main sources of energy for all economic agents within the affected region, will generate large net gains resulting from the effects of the complementary polices.

BHI reviewed the analysis of the WCI's combination of cap-and-trade and complementary policies to determine whether this is a classic case of "having one's cake and eating it too." Since economic agents are not making these choices today, we must assume that these policies will induce agents to make these changes under the proposed system. Therefore we should measure the proposals for complementary policies against the baseline of no change.

CCCS requires that new light-duty vehicles produce 30% fewer emissions than under the baseline of no change. When measuring the costs and benefits of implementing the program, one needs to compare the higher costs associated with producing the more fuel-efficient vehicles against the benefits of the fuels saved from operating the vehicles. Variables, such as fuel prices and manufacturing costs affect the outcome of the calculation, and changing the assumptions about the future cost of each will affect the outcome of the analysis. For example, gasoline prices in July of 2007 averaged over $4 per gallon in the United States, but plunged 50% to below $2 per gallon by January 2009. The payback, in terms of fuel saved, for more fuel efficient vehicle is much more apparent at $4 per gallon than at $2 per gallon.

A realistic cost-benefit analysis will also consider the dynamic effects exerted on consumers. For example, the CCCS only applies to the sale of new cars. If fuel prices remain low, then consumers can simply forgo purchasing new cars and opt instead to purchase used vehicles with desired features such as larger size with more leg room and more powerful engines but with less fuel efficiency.

There are other considerations that the WCI ignores. While agents can derive savings by reducing their future energy costs through the purchase of energy efficient products today, these future savings must be discounted to their present value in today's dollars. Also, by diverting resources to energy efficiency programs today, agents forego making other valuable use of these resources, such as investing in healthcare and wellness programs, thus incurring an opportunity cost.

The WCI analysis considers only a narrow definition of costs in its calculations. For VMT policy and the CCCS, the WCI only includes changes in fuel and capital costs in order to derive its net costs, leading to incorrect conclusions.[14] For each mile reduced, less fuel will be used. Thus, capital costs, due to lower maintenance and replacement costs, will decrease. The policy is a clear-cut winner when fuel costs and capital costs are the only considerations of costs and benefits. However, the WCI fails to consider the benefit consumers derive from driving to Yosemite National Park for a vacation or visiting a patient in a hospital. Taken to its natural conclusion, a policy banning all transportation would yield enormous savings with a 100% reduction of both fuel and capital costs. A complete consideration of all costs and benefits is needed before pronouncing that a policy supplies net savings.

If indeed there were large net savings to be realized from these policies, the question arises: Why is a policy needed? Consumers would take advantage of the cost savings on their own. If more efficient vehicles were indeed a free lunch, supplying more then $1 billion dollars of benefits per year, customers would choose to purchase these vehicles without a mandate. The WCI complementary policies do not measure benefits that lead people to purchase their current cars. Desirable characteristics such as electronics, leg and head room in addition to shape and size all

[14] Email from Karl Hausker, Ph.D. Vice President ICF International replying to questions directed to Patrick Cummins, Project Manager of the WCI, December 10, 2008.

contribute to a heavier weight, resulting in reduced fuel efficiency. Yet, they remain desirable features. Moreover, the WCI admits that their calculations do not account for "the cost of VMT Reductions programs," rendering the policy recommendation useless.[15] Why would the WCI exclude the cost of the VMT reduction programs in their analysis? Because, there are no VMT reduction programs put forth on which to base these costs.

The WCI fails to identify or define the specific policies or strategies that will be implemented to achieve the 1% reduction in the growth of energy consumption or 2% reduction in VMT. The WCI also report makes no attempt to identify any specific means to reduce the growth of energy consumption or possible effects these policies would have. The policies are not, in fact, policies but rather goals or mandates, which introduce additional problems to the analysis.

If the policies are only goals, then the WCI should conduct sensitivity analysis to determine the net costs under alternate scenarios in which the goals were missed or exceeded. For example, what are the net costs under a VMT policy that achieves a 1% or a 3% reduction in VMT? What if the energy efficiency programs achieve no reduction in the growth of fossil fuel demand? The absence of any sensitivity analysis leads one reasonably to conclude that these policies are not goals but rather mandates that are achieved only through the implementation of the cap-and-trade system. As such, these mandates would only incur billions of dollars in costs instead of billions in benefits.

If all costs and benefits are considered, it is hard to believe that $17.480 billion in annual savings resulting from driving less or billions of dollars in benefits from consuming less heat is being left on the table by consumers. People make a rational decision to drive their car because they derive benefits from the trip. A patient derives benefits when her doctor uses energy to power an MRI machine while a couple enjoys the electricity used to project a movie onto a screen in a theatre. However, the WCI seems to completely ignore these benefits. Policies that brought electricity usage and care travel to zero would clearly not make people better off.

[15] Western Climate Initiative, *Design Recommendations*, 90.

BHI Estimates and Results

BHI has created a number of Computable General Equilibrium (CGE) models that are useful in estimating the economic effects of the WCI cap-and-trade program. The purpose of the BHI model, called STAMP (State Tax Analysis Modeling Program), is to identify the economic effects of a variety of state policy changes.[16]

STAMP is a five-year dynamic CGE model that has been programmed to simulate changes in taxes, costs (general and sector specific) and other economic inputs. As such, it provides a mathematical description of the economic relationships among producers, households, governments and the rest of the world. It is general in the sense that it takes all the important markets, such as the capital and labor markets, and flows into account. It is an equilibrium model because it assumes that demand equals supply in every market (goods and services, labor and capital). This equilibrium is achieved by allowing prices to adjust within the model. It is computable because it can be used to generate numeric solutions to concrete policy and tax changes.[17]

To reduce GHG emissions, the WCI cap-and-trade system seeks to change the behavior of economic agents, such as producers, consumers and governments. They do so by changing the incentives, both negative and positive, faced by all three when consuming energy whose production generates GHGs.

BHI examined the cap-and-trade proposals, inclusive of the complementary polices, and estimated their effect on the economy of the seven WCI states. The WCI report mandates that member states auction at least 25% of the GHG permits by 2020, with a goal of auctioning 100% of permits. To be consistent, we estimate the STAMP models under both the 25% and 100%

[16] For more information about STAMP see www.beaconhill.org.
[17] For a clear introduction to CGE tax models, see John B. Shoven and John Whalley, "Applied General-Equilibrium Models of Taxation and International Trade: An Introduction and Survey," *Journal of Economic Literature* 22 (September, 1984): 1008. Shoven and Whalley have also written a useful book on the practice of CGE modeling entitled *Applying General Equilibrium* (Cambridge: Cambridge University Press, 1992).

permit auction scenarios. We also assume that the auctioning of permits creates a revenue stream for the state governments. In order to generate the revenue, we treat each proposal as a change in state tax policy within our models. We treat the percentage of permits that are not subject to auction as a price increase.

Once we quantified the tax and price changes, we simulated their effects on the state economy using STAMP models. The model provides estimates of the proposals' impact on employment, wages and income in the affected states. Each estimate represents the change that would take place in the indicated variable against a "baseline" assumption about the value that variable would take in the indicated year.

BHI utilized the estimates of price increases for energy and transportation fuels under their three cap-and-trade cases from the WCI report. We then determined a weighted change of fuel costs due to the three different polices in the Residential, Commercial and Industrial, and Transportation sectors and modeled the changes in STAMP as a state tax or price increase on fuel to measure the dynamic effects on the state economies.[18] Table 1 shows our results for the WCI region.

The "Broad Case" without offsets is by far the most intrusive, since it would require firms to reduce emission without the ability to offset emissions. The states would lose 251,674 and 165,397 jobs in the private sector while they created 142,241 and 19,710 jobs in the public sector, due to the increased government revenue. The public sector creates fewer jobs under the auctioning of 25% of permits because (1) state governments have less permit revenue to hire workers, and (2) the public sector faces the same energy and transportation prices increases as the private sector, which, in turn, increases costs and reduces production for a given $1 of revenue.

[18] BHI has not built a model of Canadian provinces and thus we do not model the effects on the Canadian member provinces that may incur as a result of the WCI's recommended policy.

Table 1: BHI Estimates of Economic Variables for the WCI Cases, 2020

Policy	*Employment*		*Gross Private Investment*	*Personal Income*	*Disposable Income*	*Disposable Income*
	Private	*Public*	*($ million)*	*($ millions)*	*($ millions)*	*($ per Capita)*
Auction 100% of GHG Emission Permits						
Broad with no offsets	-251,674	142,241	-1,448.41	-18,308.56	-17,420.86	-172.60
Broad with offsets	-113,558	57,269	-712.57	-10,451.68	-7,838.56	-78.35
Narrow with offsets	-103,931	83,519	-547.75	-6,344.97	-5,138.98	-59.23
Auction 25% of GHG Emission Permits						
Broad with no offsets	-165,397	19,710	-4,539.55	-47,706.88	-30,316.49	-272.34
Broad with offsets	-59,240	6,920	-989.22	-13,094.59	-6,302.83	-62.65
Narrow with offsets	-35,177	-354	-1,620.21	-10,195.15	-6,341.78	-63.47

The higher cost of energy would hurt profit margins, causing firms to reduce investment in the member states. We estimate that investment would drop by $1.448 billion to $4.540 billion. Total personal income would fall by $18.309 billion and $47.707 billion, total disposable income would fall by $17.421 billion and $30.316 billion. Disposable income would fall by $172.60 per capita and to $272.34 per capita.

The "Broad case" policy with offsets has smaller effects than the "Broad case with no offsets", because some of the emission reductions can derive from offset projects located outside of the WCI member states. These external offsets are less expensive to implement (or they would not be undertaken) than the most expensive forms of emissions reduction in the seven states, leading to lower fuel price increases. The member states would see private employment decrease by 59,240 to 113,558 with public employment increasing by 6,920 and 57,269. Additionally, personal income would fall by between $10.452 billion and $13.095 billion disposable income per capita would decrease by from $62.65 to $78.35 annually.

The final policy, a narrow consideration of emission with offsets, would be the least obtrusive, since fewer emission sources would be affected. Employment would fall by between 35,177 and 103,931 in the private sector and experience either a drop of 354 public sector jobs for the auctioning of 25% of permits and an increase of 83,519 public sector jobs for the auctioning of 100% of the permits. The price effect outweighs the revenue increase from the 25% of permits, forcing the public sector to cut jobs under this scenario. Personal income would fall by $6.345

billion and $10.195 billion, and per capita disposable income would fall by between $59.23 and $63.47 below the baseline.

Table 2: BHI Estimates for the Individual WCI States, 2020

	Net Employment jobs	*Personal Income $ million*	*Per Capital Disposable Income$*
Arizona	-4,801to -20,496	-722.27 to -5,397.10	-47.60 to -224.98
California	-7,886 to -78,694	-4,038.18 to -30,398.72	-62.72 to -287.63
Montana	-548 to -2,869	-91.77 to -689.21	-54.77 to -250.79
New Mexico	-8 to -4,689	-165.16 to -1,242.23	-47.84 to -219.41
Oregon	-1,823 to -10,748	-320.60 to -2,419.17	-46.42 to -213.65
Utah	-2,546 to -9,899	-246.34 to -1,846.52	-40.38 to -185.83
Washington	-2,800 to -18,292	-760.64 to -5,713.92	-66.02 to -302.54

Table 2 displays a range of individual results for each of the seven WCI member states using the least damaging scenario (100% Auction, "Narrow with offsets") and the most damaging (25% Auction, "Broad with no offsets"). California would bear the bulk of the economic losses, since it has the largest economy of the member states. New Mexico and Montana, with their smaller economies, would endure relatively fewer job loses and erosion of income. None of the seven WCI member states would escape the economic damage wrought by the proposed WCI cap-and-trade systems.

Conclusion

In its September 2008 report, the WCI released its research on a cap-and-trade policy intended to reduce the amount of greenhouse gas emission to 15% below 2005 emission levels by 2020. Additionally, it introduced three complementary policies to aid in this reduction. Due to an inadequate, if not omission, of a cost and benefit review, the WCI's results show tens of billions of dollars of savings annually. However, the WCI findings are incomplete.

Using the WCI's own projections of increases in fuel costs, BHI finds that the policies will decrease employment, investment, personal income and disposable income. While the WCI claims the "design is also intended to mitigate economic impacts, including impacts on consumers, income, and employment," they fail to quantify the impacts.[19]

If state governors and provincial premiers seek to truly meet the goals underscored in the WCI proposals, they should require a complete and thorough cost benefit analysis. This consortium of state and provincial governments should understand that, whatever the benefits of the proposals, they will place the state and regional economies at a competitive disadvantage to other regions through higher prices for energy and transportation, and exert measurable, negative effects on their economies.

[19] Ibid., 7.

Appendix A: Methodology

The Beacon Hill Institute (BHI) used the Western Climate Initiative's (WCI) own price projections to determine the amount of government intervention that would be seen in the cap-and-trade policy. Using "Tables B-9: Reference Case Fuel Price" and "B-16: Cap-and-Trade Case Fuel Price Results" from the WCI report, BHI modeled the dynamic effects of the policy using existing STAMP models for states with similar economic structures.[20]

BHI estimated the impact of the WCI cap-and-trade system using two assumptions from the WCI report. First, the WCI report calls for a minimum of 25% of the emissions permits to be auctioned off by 2020. The WCI report also sets a goal for the auctioning of 100% of the permits at some point in the future.

For the 100% permit auction assumption, we modeled the price increases as an increase to the state fuel tax, in the case of households and the transportation sector, or a state fee, in the cases of the commercial and industrial sectors. We chose state fees and taxes because they best mirror how the cap-and-trade system that would (1) drive up electricity and fuel prices and (2) provide a stream of revenue to the participating states. For the 25% permit auction assumption we modeled the 25% of the price increase as a tax and 75% of the increase as an increase in the price index for the applicable sector.

We assume that the cap-and-trade system is fully implemented and the corresponding price increases are fully realized in 2020 and report the results for this year. The WCI provides fuel price changes that are divided into two general categories: source and sectors. The sources include electricity, natural gas, oil, liquid propane, coal, gasoline and diesel, while the sectors are residential, commercial, industrial or transportation. The WCI data is replicated in Table 3.[21]

[20] Western Climate Initiative, *Design Recommendations.*
[21] Ibid., 95, Table B-16.

Table 3: The WCI Projections for Fuel Price Changes, 2020

		Base Case	*Broad w/ No offsets*	*Broad w/ offsets*	*Narrow w/ offsets*
		($, per mmBtu*)*	*(% increase)*	*(% increase)*	*(% increase)*
Residential					
	Electricity	30.10	-0.3	1.0	12.7
	Natural Gas	14.50	31.4	12.2	1.0
	Oil	25.50	20.4	7.7	-0.1
	Liquid Propane Gas	21.60	14.6	5.6	0.0
Commercial					
	Electricity	27.30	-2.4	-0.2	14.3
	Natural Gas	10.10	23.7	7.9	-1.0
	Oil	24.60	4.9	2.1	0.4
	Liquid Propane Gas	21.40	9.2	4.4	1.3
Industrial					
	Electricity	15.40	4.7	6.6	35.6
	Natural Gas	6.30	19.2	7.1	20.2
	Coal	2.10	167.4	64.3	182.4
	Oil	20.70	17.2	6.5	19.4
	Liquid Propane Gas	23.10	6.2	2.9	7.0
Transportation					
	Gasoline	28.00	17.4	6.6	0.0
	Diesel	27.70	16.8	6.4	0.0

The data provided in Table 3 needed further adjusting before it could be entered it into the STAMP models. We calculated a weighted average price change for each sector using the U.S. Energy Information Agency data of energy consumption by fuels source and sector.[22] Within each sector the price change for each fuel source was weighted by their portion of total fuel consumption for each sector.

For example, in the "Broad with no offsets" policy the WCI projects, gasoline used in the transportation sector is expected to increase in price by 17.4% above the baseline in 2020, while diesel used in the transportation sector will increase by 16.8% above the baseline cost. These prices were combined using a weighted average of energy consumption by the transportation sector.[23]

[22] U.S. Department of Energy, Energy Information Administration, Table A2. Energy Consumption by Sector and Source, http://www.eia.doe.gov/oiaf/aeo/pdf/appa.pdf (accessed January 29, 2009).
[23] (.7274) 28.17 + (.2726) 27.83. Calculation based on U.S. Department of Energy, Energy Information Administration. "Annual Energy Outlook 2009," Table 2, Energy Consumption by Sector and Source. http://www.eia.doe.gov/oiaf/aeo/aeoref_tab.html

For the auction portion of the price increase, we applied the expected fuel price increases for the residential sector in the STAMP model as a fuel tax increase, distributed evenly across all income groups. We modeled the fuel price increases for the transportation sector as an increase in the existing fuel taxes paid by the transportation sector. Finally, we combined the commercial and residential price increases, using each industry's proportion of the total fuel consumption from the Energy Information Administration as a weight, and applied the increase to all sectors in the model. This fee was applied to each sector using, as a weight, the amount each sector spends in the UTILITY sector. For the other portion of the price increase, not attributed to the auctioning of the permits, we increased the price index for the applicable sector in the model, such as UTILTY, and solved the model, comparing the results against the baseline of no change.

Currently Washington is the only the WCI state for which BHI has an existing STAMP model. However, BHI has recently built STAMP models for a number of states outside the WCI areas: Washington, South Carolina, New York, Indiana and Pennsylvania. We were able to utilize these models to simulate the WCI price increases and derive the percentage changes in the economic variables of interest, such as employment and investment. (The variation in percentage changes from model to model in our simulations is modest, which is reassuring for our purposes here.) We then calculated an average of the percentage changes in the economic variables that we applied to variables for the WCI member state.

For example for the "Broad with no offsets" case, the average fall in private employment of 0.90% for the fuel price increase, which varied from a low of a 0.63% decrease to a high of a 1.21% decrease. This percentage decrease was then applied to data from the Bureau of Labor Statistics (BLS) or the Bureau of Economic Analysis (BEA) data, grown to 2020 using the growth rate through the last business cycle (2003-2008) for each state in the WCI area. The growth rate was adjusted for inflation using the growth in the Consumer Price Index for the Western region reported by BLS.[24] The total loss of employment for all seven WCI states, using this methodology is 251,674 or the expected decrease in private employment for this case.

[24] U.S. Department of Labor, Bureau of Labor Statistics; "The Consumer Price Indexes," http://data.bls.gov/PDQ/servlet/SurveyOutputServlet (accessed January 2009).

These steps were repeated for numerous economic indicators, such as public and private employment, wages, investment, personal income and real disposable income, enabling inferences to be drawn about the effects of the different cap-and-trade policy cases.

Appendix B: BHI State Estimates

Table 4 displays the detailed results by state for all the scenarios and cases considered by BHI.

Table 4: Detailed State Results, 2020

	Narrow with offsets			**Broad with offsets**			**Broad with no offsets**		
	Net Employment jobs	*Personal Income $ million*	*Per Capita Disposable Income $*	*Net Employment jobs*	*Personal Income $ million*	*Per Capita Disposable Income $*	*Net Employment jobs*	*Personal Income $ million*	*Per Capita Disposable Income $*
Auction 100% of GHG Emission Permits									
Arizona	-4,801	-722.27	-47.60	-9,105	-1,189.76	-62.96	-18,440	-2,084.14	-138.71
California	-7,886	-4,038.18	-62.72	-28,474	-6,651.85	-82.97	-54,156	-11,652.26	-182.78
Montana	-548	-91.77	-54.77	-1,198	-151.17	-72.45	-2,385	-264.81	-159.61
New Mexico	-8	-165.16	-47.84	-1,413	-272.06	-63.28	-2,498	-476.58	-139.40
Oregon	-1,823	-320.60	-46.42	-4,348	-528.11	-61.40	-8,574	-925.10	-135.26
Utah	-2,546	-246.34	-40.38	-4,538	-405.78	-53.41	-9,265	-710.83	-117.68
Washington	-2,800	-760.64	-66.02	-7,213	-1,252.96	-87.33	-14,114	-2,194.84	-192.38
Auction 25% of GHG Emission Permits									
Arizona	-4,876	-876.52	-51.01	-7,352	-1,490.61	-50.35	-20,496	-5,397.10	-224.98
California	-19,395	-5,768.88	-67.21	-28,245	-8,333.90	-66.34	-78,694	-30,398.72	-287.63
Montana	-690	-124.48	-58.69	-1,029	-189.40	-57.93	-2,869	-689.21	-250.79
New Mexico	-1,185	-231.54	-51.26	-1,684	-340.86	-50.60	-4,689	-1,242.23	-219.41
Oregon	-2,601	-482.35	-49.74	-3,857	-661.65	-49.10	-10,748	-2,419.17	-213.65
Utah	-2,340	-320.38	-43.27	-3,551	-508.40	-42.71	-9,899	-1,846.52	-185.83
Washington	-4,444	-1,037.64	-70.75	-6,602	-1,569.79	-69.83	-18,292	-5,713.92	-302.54

Bibliography

American Council for an Energy Efficient America. "Technical Options for Improving the Fuel Economy of U.S. Cars and Light Trucks by 2010-2015." (June 2001) http://www.aceee.org/pubs/t012.htm.

Armington, Paul. "A Theory of Demand for Products Distinguished by Place of Production." *International Monetary Fund Staff Papers* 16 (1969): 159-78.

Bartik, Timothy. "Who Benefits from State and Local Economic Development Policies?" (Kalamazoo, MI: W.E. Upjohn Institute, 1991)

Berck, Peter, Elise Golan, and B. Smith, with John Barnhart, and Andrew Dabalen. "Dynamic Revenue Analysis for California." University of California at Berkeley and California Department of Finance (1996): 117. http://www.dof.ca.gov. (accessed April 17, 2008).

Baumert, Kevin A, Tim Herzog and Jonathan Pershing; "Navigating the Numbers: Greenhouse Gas Data and International Climate Policy" The World Resources Institute. (December, 2005); http://www.wri.org/publication/navigating-the-numbers. (accessed August 8, 2008).

Harris, John R. and Michael P. Todaro. "Migration, Unemployment and Development: A Two Sector Analysis." *American Economic Review* 40 (1970): 126-42.

Liss, William E., Michele M. Dybel, Randal. West and Larry Adams. "Development of Innovative Distributed Power Interconnection and Control Systems: Annual Report-December 2000-December 2001." (November 2002): NREL/SR-560-32864. http://www.nrel.gov/docs/fy03osti/32864.pdf. (accessed August 25, 2008).

Reinert, Kenneth A. and David W. Roland-Holst. "Armington Elasticities for United States Manufacturing Sectors." *Journal of Policy Modeling* 14, no.5 (1992): 631-639.

Robins, Phillip K. "A Comparison of the Labor Supply Findings from the Four Negative Income Tax Experiments." *Journal of Human Resources* 20 (1985): 567-82.

Roland-Holst, David W., Kenneth A. Reinert, and Clinton.R. Shiells. "A General Equilibrium Analysis of North American Economic Integration." *Modeling Trade Policy: Applied General Equilibrium Assessments of North American Free Trade* ed. Clinton R. Shiells and Joseph F. Francois. (New York*:* Cambridge Univ. Press, 1994): 47-82.

Shoven, John B. and John Whalley. "Applied General-Equilibrium Models of Taxation and International Trade: An Introduction and Survey." *Journal of Economic Literature* 22 (September, 1984): 1008.

_____. *Applying General Equilibrium*. (Cambridge: Cambridge University Press, 1992).

Tuerck, David G., Jonathan Haughton, In-Mee Baek, James Connolly, and Scott Fontaine. *The Texas State Tax Analysis Modeling Program: Methodology and Applications. The Beacon Hill Institute at Suffolk University*. (February 1999).

U. S. Congress. *America's Climate Security Act of 2007*, S 2191, 110th Cong. 1st session, GovTrack.us. http://www.govtrack.us/congress/bill.xpd?bill=s110-2191. (accessed April 17, 2008).

U.S. Department of Commerce, Bureau of Economic Analysis. "Underlying Detail for the National Income and Product Account Tables." http://www.bea.doc.gov/, table 7.2.5S. (accessed April 17, 2008).

U.S. Department of Energy, Energy Information Administration. *Annual Energy Outlook: 2008 (Early Release)*. "Table 3. Energy Prices by Sector and Source." http://www.eia.doe.gov/oiaf/aeo/excel/aeotab_3.xls (accessed April 17, 2008).

_____. Energy Information Administration. "Forecasts and Analysis, Alternative Fuels: Ethanol." http://www.eia.doe.gov/oiaf/ethanol3.html. (accessed April 17, 2008).

U.S. Department of Transportation. Bureau of Transportation Statistics. "State Transportation Statistics 2006 in "Table 7-4: Motor Fuel Use: 2005." http://www.bts.gov/publications/state_transportation_statistics/state_transportation_statistics_2006/html/table_07_04.html. (accessed April 17, 2008).

_____. Bureau of Transportation Statistics. "State Transportation Statistics 2005," in "Table 5-1: Motor-Vehicle Registrations." http://www.bts.gov/publications/state_transportation_statistics/state_transportation_statistics_2005/index.html. (accessed April 17, 2008).

U.S. President. Fact Sheet. "The Energy Independence and Security Act of 2007," http://www.whitehouse.gov/news/releases/2007/12/20071219-1.html (accessed April 17, 2008)

The Beacon Hill Institute Modeling Team

David G. Tuerck is Executive Director of the Beacon Hill Institute for Public Policy Research at Suffolk University where he also serves as Chairman and Professor of Economics. He holds a PhD in economics from the University of Virginia and has written extensively on issues of taxation and public economics.

Alfonso Sanchez-Penalver is an Economist at the Beacon Hill Institute. He holds a Master of Science degree in Finance from Boston College and a BSBA in Finance from Suffolk University. He is currently enrolled in the PhD program in Economics at Suffolk University. He has an extensive career in web programming and project management, as well as in accounting and financial analysis.

Paul Bachman is Director of Research at BHI. He manages the institute's research projects, including the STAMP model and conducts research on other projects at the BHI. Mr. Bachman has authored research papers on state and national tax policy and on state labor policy and produces the institute's state revenue forecasts for the Massachusetts legislature. He holds a Master of Science in International Economics from Suffolk University.

Michael Head is a Research Economist at BHI. He holds a Master of Science in Economic Policy from Suffolk University.

The authors would like to thank Frank Conte, BHI Director of Communications, for editorial assistance.

The Beacon Hill Institute at Suffolk University in Boston focuses on federal, state and local economic policies as they affect citizens and businesses. The institute conducts research and educational programs to provide timely, concise and readable analyses that help voters, policymakers and opinion leaders understand today's leading public policy issues.

©March 2009 by the Beacon Hill Institute at Suffolk University

THE BEACON HILL INSTITUTE
FOR PUBLIC POLICY RESEARCH
Suffolk University
8 Ashburton Place
Boston, MA 02108
Phone: 617-573-8750 Fax: 617-994-4279
bhi@beaconhill.org
http://www.beaconhill.org