Oregon Cap-and-Trade Economic Impact Analysis

Draft Report

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ECONorthwest

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1. INTRODUCTION

Governor Ted Kulongoski has announced that one of his priorities for the 2009 legislative session is to pass climate legislation, specifically a cap-and-trade program. At the Governor's behest, Oregon is collaborating in the Western Climate Initiative (WCI) to develop regional strategies to reduce greenhouse gas emissions.[1] In September 2008, WCI released a report that provided design recommendations for a market-based cap-and-trade system to help achieve the greenhouse gas reduction goal.[2]

A coalition of organizations (the Business Committee) was formed for the purposes of analyzing the potential economic impacts to Oregon of the proposed WCI cap-and-trade system as described in the September 2008 report. Members of the Business Committee funded the Oregon Cap-and-Trade Economic Impact study and include the following companies and organizations:

- The Global Warming Commission
- Oregon Economic and Community Development Department (OECDD)
- Oregon Business Council
- Portland Business Alliance
- Oregon Business Association
- Associated Oregon Industries
- Portland General Electric
- PacifiCorp
- Northwest Natural Gas
- Western States Petroleum Association
- Oregon Trucking Association
- Lemelson Foundation

The Business Committee contracted with ECONorthwest to estimate the potential economic impacts to Oregon of the proposed WCI cap-and-trade system. This work was begun in 2008 and builds on the WCI modeling conducted by ICF International (ICF) using the ENERGY 2020. As part of the process or developing the WCI design recommendations, ICF used the ENERGY 2020 model to forecast changes in energy prices and energy demand that would result from the cap-and-trade and complementary policies.

There were two overarching tasks for the Oregon Cap-and-Trade Economic Impact study:

1. **Estimate the potential economic impacts specific to Oregon of the proposed WCI cap-and-trade policy as currently modeled for the region by the WCI.** A priority for this study was to provide Oregon with the information needed to evaluate the WCI cap-

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[1] The Western Climate Initiative is a partnership of seven Western states and four Canadian provinces with numerous other US states, Canadian provinces and Mexican states participating as observers. Additional information on the WCI is available on the website www.westernclimateinitiative.org.

[2] Design Recommendations for the WCI Regional Cap-and-Trade Program (September 23, 2008), which is available on the WCI website www.westernclimateinitiative.org.

and-trade design as recommended in WCI's September 2008 report. Consequently, the cap-and-trade policy features used for the Oregon analysis were taken directly from WCI. This also allowed us to take the regional ENERGY 2020 modeling results produced by ICF and use them in an Oregon-specific economic model. Alternative policy designs other than those currently being discussed by WCI members are outside the scope of this study.

2. **Develop scenarios around the WCI policy option that would capture plausible best-case and worst-case scenarios.** Additional scenarios were run for Oregon to test the sensitivity of the economic impact estimates to some of the underlying assumptions used by ICF in the ENERGY 2020 model.

The analysis methods and results for the Oregon economic impact analysis are discussed below.

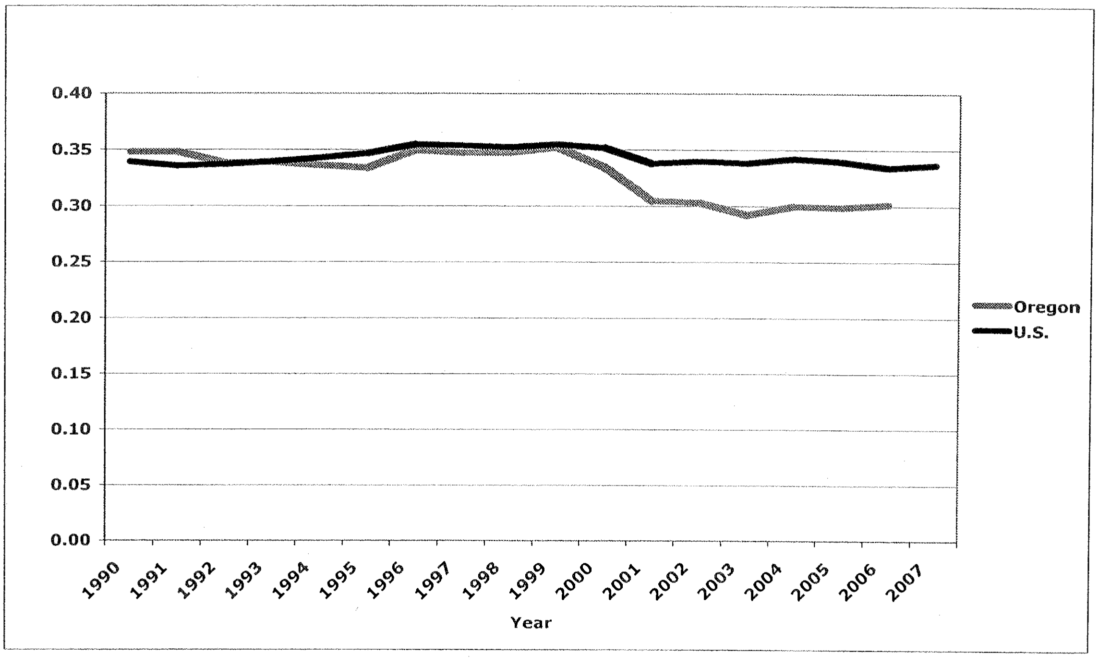
2. Oregon Economic Analysis Framework

2.1 Current Oregon Trends in Carbon and Energy Intensity

The goal of the cap-and-trade and other carbon reduction policies is to reduce carbon emissions at the lowest cost to the economy. Any reduction in carbon emissions will be closely related to trends in energy use and the role that energy plays in Oregon's economy. The following charts show the recent trends in important statistics relating carbon use, energy consumption, and economic output.

Figure 1 shows per capita energy consumption (all sectors) for both Oregon and the US. Oregon has a slightly lower per capita energy use relative to the rest of the country, and while the US has remained relatively constant during this period, per capita energy consumption in Oregon has fallen by 13 percent from 1990 to 2006. During this same period, Oregon's population grew 32 percent, from 2.8 million to 3.7 million.

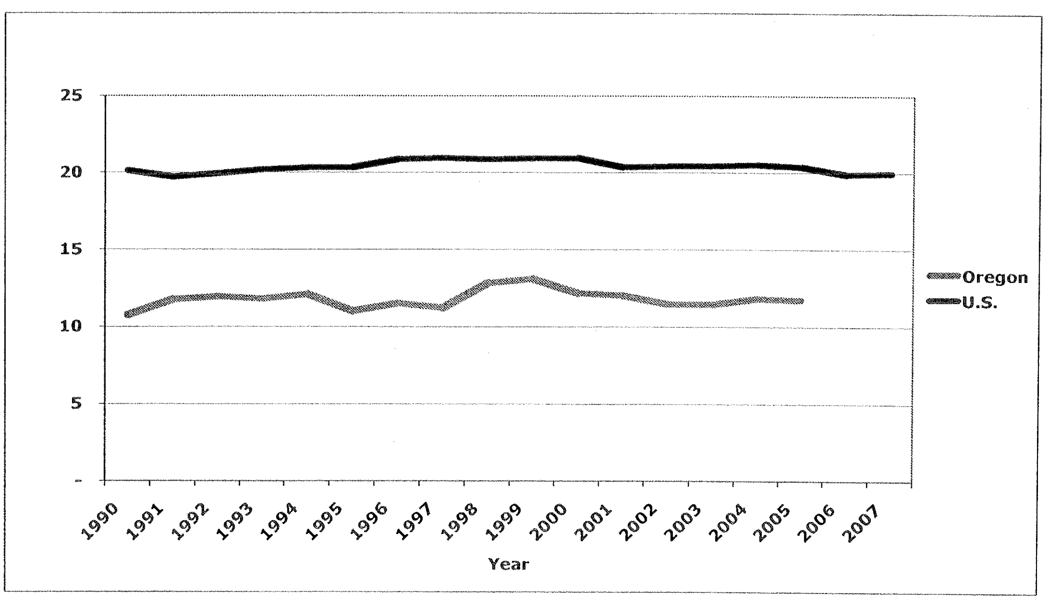
Figure 1: Energy Consumption Per Capita (1990-2007)



Source: US DOE Energy Information Administration (EIA), US Census

Figure 2 shows emissions per capita for both Oregon and the US over the same period. As with energy use, Oregon per capita emissions levels have remained relatively stable since 1990 with an increase of 9 percent over that period. Oregon's level of per capita emissions are almost half the levels observed for the rest of the country, in part due to the large hydropower resources enjoyed in this region.

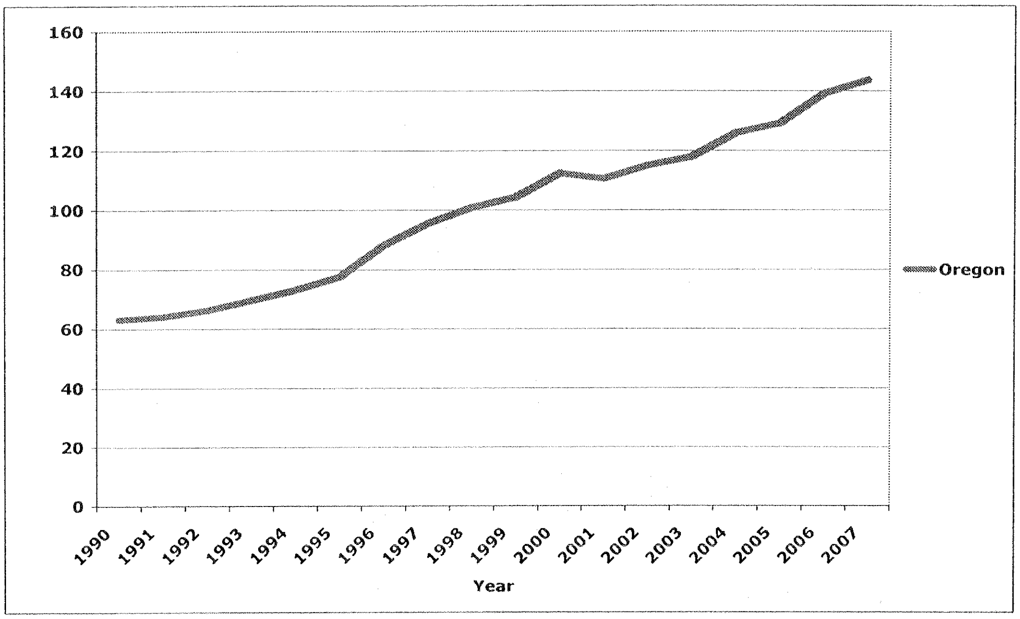
Figure 2: Carbon Emissions Per Capita 1990-2007



Source: EIA, US Census

During the same period, both the Oregon and US economies enjoyed substantial growth, as shown in Figure 3. From 1990 to 2007, Oregon's economy more than doubled with an increase of 127 percent. During this same period, the US economy as a whole increased by 62 percent.

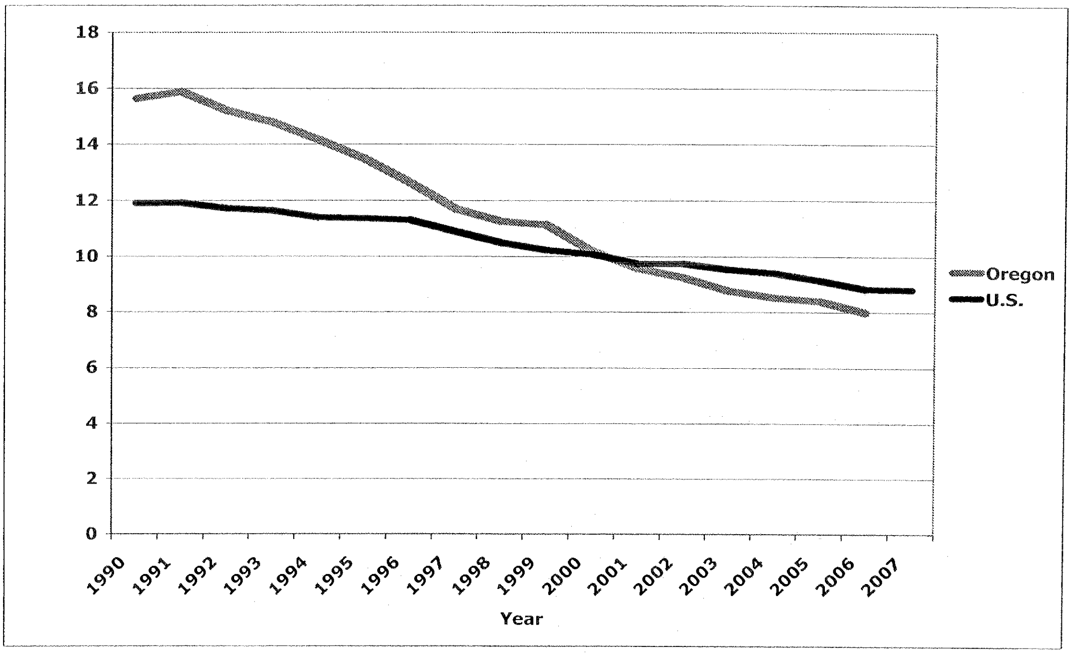
Figure 3: Oregon Economic Growth (1990-2007)



Source: US Bureau of Economic Analysis (BEA)

Although the Oregon and US economies have been growing rapidly over the last 20 years, at the same time the economy has become less reliant on energy as a factor of production. The metric that helps demonstrate this is energy intensity as measured by energy consumption per dollar of economic output (GDP). Figure 4 shows this trend for Oregon and the US and in both cases there has been a sharp decrease in energy intensity over time. Since 1990, energy required for each dollar of GDP produced in Oregon has decreased by 49 percent.

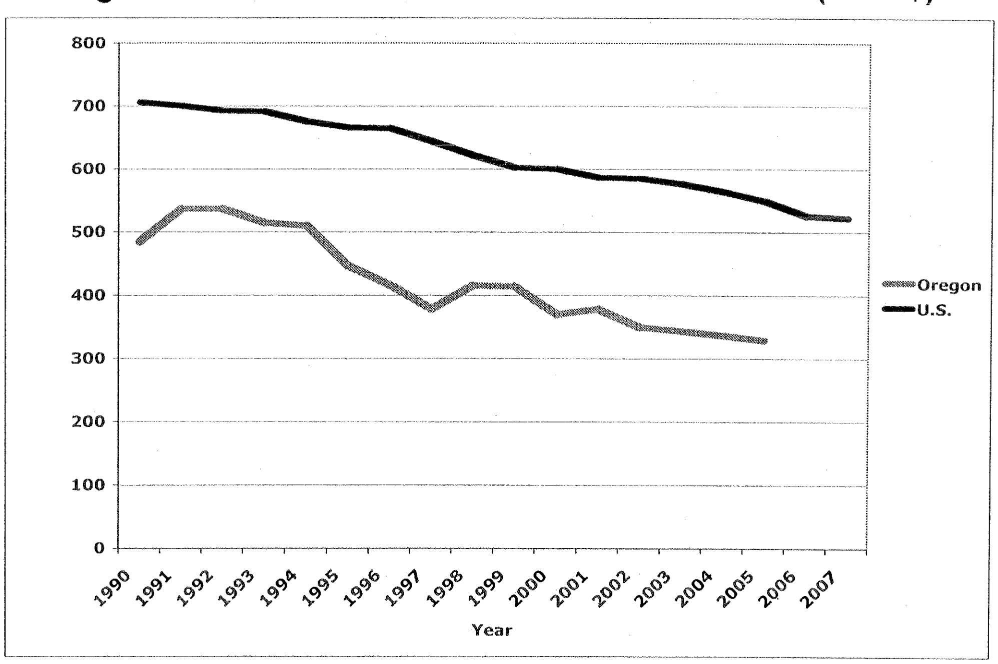
Figure 4: Energy Consumption Per Dollar GDP (2000 $)



Source: EIA, BEA

A similar trend for carbon intensity and economic output has also been observed over this period, as shown in Figure 5. A decrease has been observed for the US as a whole, but Oregon uses substantially less carbon in its economy (40 percent less than the US average in 2006).

Figure 5: Carbon Emissions Per Dollar Real GDP (2000 $)



Source: EIA, BEA

As the preceding trends indicate, Oregon has already been moving toward a less energy intensive and less carbon intensive economy. The cap-and-trade policy is designed to accelerate this trend by creating an even steeper decrease in energy (and consequently carbon) intensity. A greater reduction over the existing trend is needed to reach the WCI emission reduction goals while taking into account the expected load growth in Oregon by 2020.

2.2 ECONOMIC COSTS OF DOING NOTHING

For this study, it is taken as given that 1) global warming is occurring, 2) global warming is caused by human activities, and 3) Oregon has an obligation to do its part in adopting policies that will reduce emissions and mitigate the global warming problem. Other issues such as whether global warming is naturally occurring, the accuracy of climate forecasting models, and evaluating the efficacy of alternative carbon abatement policies (such as a carbon tax) are outside the scope of the current project, although undeniably important issues for research.

Given this context, this analysis is focusing on a very narrow area of potential costs and benefits: the potential impact on Oregon's economy of a cap-and-trade system (with complementary carbon reduction policies) as currently designed and recommended by the WCI and characterized in its September 2008 report. With this narrow scope, it is important to remember the broader context for adopting a carbon reduction policy, which is to reduce global warming and prevent catastrophic impacts on the environment that in turn will result in much greater impacts on the economy than those discussed in this report.

These broader impacts are sometimes referred to as "the costs of doing nothing" to prevent global warming. Some examples from the literature that are most specific to Oregon come from the 2005 report The Economic Impacts of Climate Change in Oregon, produced by the Resource Innovations Institute for a Sustainable Environment at the University of Oregon. The types economic costs identified in that report include the following:

- **Drinking Water.** Water supplies will be most affected where reserves are dependent on snowpack. A decrease in snowpack means a reduction in summer stream flow and a potential for reduced water quality, due to the same number of pollutants having to be diluted by a smaller volume of water. Many areas in Oregon will have to devote additional resources to find a solution to the anticipated reduction in fresh drinking water. Resource Innovations Institute states in their report that, "Warming of this magnitude is expected to accelerate the reduction of the Cascades snowpack – one projection indicates a reduction of more than half by 2040. One consequence will be very large reductions in summer stream flows – and intensification of summer drought – especially on the east side of the Cascades."[3]

- **Agriculture.** This sector of the Oregon economy is inherently sensitive to changes in climate, and changes to water supply may further exacerbate climate change impacts. While Oregon farmers are accustomed to a certain amount of drought, an increasing

[3] Page 3, The Economic Impacts of Climate Change in Oregon, Resource Innovations Institute, October 2005.

shortage of water may put some farms out of business. The moderate temperature increases expected could help farmers initially by lengthening growing seasons and increasing output. However, at a certain threshold, rising temperatures will damage crops and reduce quality and yields. For example, the wine industry in the Willamette Valley would likely suffer or even fail as the temperature increases to a point where wine grapes can no longer grow in this climate zone.

- **Forestry.** Rising temperatures due to climate change increase the risk of forest fires, especially east of the Cascades, which would increase the costs of wildfire control. Currently, the state spends an average of $9.5 million per year in suppressing fires. In a severe wildfire year (such as 2002), Oregon can spend as much as $50 million.[4] Increasing temperatures could make this level of expenditure more commonplace as the risk of fires becomes greater.

- **Snow-based recreation.** Snow sports resorts bring in tourists from around the state and country and accounts for more than 10,000 full and part-time jobs in Oregon.[5] The 2005 ski season was shortened due to lack of snowfall and many resorts shut down during the typical peak of the season. With unabated climate change, shortages in snowfall may become more frequent causing winter resort revenues and the associated tourism to decline.

- **Coastal Tourism, Recreation, and Infrastructure.** As global air and water temperatures rise, glaciers and polar ice caps are expected to melt, resulting in a rise in sea levels rise around the world. Along the Oregon coast this would increase beach erosion and changes to the landscape, thereby bringing down property values and attractiveness to tourists.

- **Power Generation.** The Columbia River hydro system will likely be impacted by climate change in two ways: the services it supplies and the demand for those services. The anticipated increase in winter stream flows and decrease in summer stream flows means a drop in potential power generation and could mean a loss of $230 million to the local economy by 2020.[6] Summer electricity demands could also increase, due to air conditioning and irrigation pumping needs.

- **Salmon Recovery.** Salmon will suffer from increased water temperatures, reduced summer stream flows, altered timing of run-off, and changes in ocean circulation patterns. In addition, ocean acidification, as a result of rising carbon dioxide levels, has the potential to affect fish stocks in the Pacific and the associated fishing industry. Increased acidity will affect the ability of ocean life to form shells and skeletons from calcium carbonate. This will affect mollusks and some types of plankton, which are

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[4] Source: http://governor.oregon.gov/Gov/fd/ffaq.shtml.

[5] Page 11, Resource Innovations Institute.

[6] Ibid.

essential in sustaining salmon species in the Pacific Northwest.[7] As a result of these impacts the salmon recovery effort will become even more difficult and costly than it is today.

The remainder of this report should be reviewed within this broader context of potential costs, as the potential economic costs to Oregon from not adopting an emissions reduction policy extend far beyond the narrow range of economic impacts discussed below.

3. WCI Analysis Background

The WCI scenario modeling was conducted by ICF International in 2008 using the ENERGY 2020 model. Details on the ENERGY 2020 model have been documented by ICF in two separate volumes that present the initial modeling assumptions and modeling results for the recommended policy design.[8] Given the large number of assumptions and the existing documentation, the details of the ENERGY 2020 model will not be replicated here accept for a few key assumptions.

The WCI modeling included several different scenarios involving various combinations of complementary policies, offsets, and other design considerations. For the Oregon economic impact analysis, we took the Oregon-specific results from one of the final WCI policy options for use in the IMPLAN model discussed below. This scenario will be referred to as the WCI Policy scenario throughout this report.[9]

The WCI analysis includes several characteristics that are referred to as the "Broad Scope" for the Energy 2020 modeling. Under the Broad Scope, the following areas are assumed covered under cap-and-trade[10]:

- Electricity generation, including emissions from electricity imported into WCI jurisdictions from non-WCI jurisdictions.
- Combustion at industrial and commercial facilities.
- Industrial process emission sources, including oil and gas process emissions.
- Residential, commercial, and industrial fuel combustion at facilities with emissions below the WCI thresholds.
- Transportation fuel combustion from gasoline and diesel.

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[7] Page 72, Stern Review on the Economics of Climate Change.

[8] The two documents are Economic Analysis and Modeling Support to eh Western Climate Initiative ENERGY 2020 Model Inputs and Assumptions (July 15, 2008) and Design Recommendations for the WCI Regional Cap-and-Trade Program (September 23, 2008). Both of these documents are available on the WCI website www.westernclimateinitiative.org.

[9] This corresponds to the scenario described as "Broad Scope, with complementary policies and with offsets" on page 17 of the report Design Recommendations for the WCI Regional Cap-and-Trade Program Appendix B: Economic Modeling Results. It is also referred to as "Case G" in the detailed data spreadsheets provided by ICF for this analysis.

[10] Page 17, Design Recommendations for the WCI Regional Cap-and-Trade Programs.

Additional assumptions for the WCI scenario examined for Oregon include the following:

- Banking of allowances for use in future years is allowed.

- Offsets are allowed up to 5 percent of the annual compliance obligation, valued at $20/ton.

- The WCI ENERGY 2020 modeling assumes that the transportation sector is included beginning in 2012, even though the recommended WCI policy does not include transportation until 2015.

- All of the allowances are assumed to be auctioned, as opposed to having some or all of the allowances are allocated at no cost.

The recommended WCI design assumes that Oregon enacts complementary policies in addition to the cap-and-trade framework. These complementary policies include[11]:

- Energy efficiency programs that are able to reduce the annual rate of energy consumption growth by 1 percent are included in the WCI scenario. These programs are expected to reduce carbon emission by about 74 million metric tons in 2020 relative to the WCI Reference case.

- Clean Car Standards (equivalent to California's Pavley I and Pavley II polices) are assumed in the WCI scenario. These standards reduce emissions by about 30 million metric tons in 2020 relative to the Reference case.

- Programs that reduce vehicle miles traveled (VMT) by 2 percent in 2020 relative to the WCI Reference case. These programs are expected to reduce carbon emissions by 4 million metric tons in 2020 (in addition to the Clean Car Standards reductions).

All of the modeling completed by ICF was evaluated relative to a WCI Reference case, which estimates market conditions in absence of any type of new carbon reduction policy such as cap-and-trade.[12] This will be referred as the Reference case throughout the remainder of this report.[13]

The WCI Policy scenario is modeled for Oregon using the characteristics described above. The ENERGY 2020 outputs are included in the WCI Design Recommendations report and include the following:

- Changes in spending on energy efficient equipment

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[11] Complementary policies and associated emissions reductions are taken from page 17 of Design Recommendations for the WCI Regional Cap-and-Trade Program Appendix B: Economic Modeling Results.

[12] Existing policies such as Oregon's Renewable Energy Standard are included in the WCI Reference Case.

[13] Additional detail on the assumptions included with the WCI Reference Case are included in the document Economic Analysis and Modeling Support to the Western Climate Initiative ENERGY 2020 Model Inputs and Assumptions available on the WCI website www.westernclimateinitiative.org.

- Changes in fuel prices
- Changes in spending on fuel
- Carbon allowance prices
- Changes in carbon emissions

A subset of the ENERGY 2020 model outputs specific to Oregon were provided to ECONorthwest by ICF for use in this analysis, as described below.

4. Economic Impact Analysis Methods and Results

4.1 ENERGY 2020 Model Results Used in the Oregon Economic Impact Analysis

Two data elements were taken from the WCI ENERGY 2020 modeling results and used for the Oregon economic impact analysis:

1. **Spending on energy efficient equipment**. The WCI modeling provided estimates of how much Oregonians would need to spend on new, more energy efficient equipment in order to achieve the reductions in energy consumption needed to meet the emissions goals by 2020. This was provided by sector, with additional sub-sectors broken out for energy intensive industries.[14]
2. **Reductions in fuel spending.** The WCI modeling also provided estimates of reductions in fuel spending for each year that are needed to reach the emissions goals by 2020. These estimates are also done by sector and take into account changes in fuel prices (electricity, natural gas, transportation, and all other fuels) and additional costs of emissions allowances.

The tables below show the values for these inputs for selected years.

Table 1 shows the expected change in energy efficiency equipment spending by market sector for selected years, relative to the Reference case. For energy intensive industries, for example, equipment spending is estimated to increase by $146.8 million relative to the Reference case where there is no cap-and-trade policy. In 2015, equipment spending in the energy intensive industries increases to $202.5 relative to the Reference case. In 2020, expected equipment spending for this sector is $325 million relative to the Reference case.

For the Residential sector and the Commercial sector in later years, spending on energy equipment spending is estimated by WCI to *decrease* relative to the Reference case. Equipment

[14] The WCI reports separate this spending into two categories: "Device" and "Process" spending and report each category separately. Since the economic impacts of these types of spending are likely to be similar and closely related, we have combined them into one category for the Oregon analysis labeled "Energy Efficiency Equipment Spending".

spending on in the passenger transportation is also estimated to decrease under the WCI cap-and-trade scenario. The results are counterintuitive given that we would expect equipment spending to increase when fuel costs increase as a result of the policy.

It is not clear from the ENERGY 2020 model documentation why energy efficiency equipment spending is predicted to decrease (rather than increase) in the WCI Policy scenario. Based on information provided by ICF during various WCI meetings, it appears that this may be a result of the assumptions used in the ENERGY 2020 model that have efficiency increasing by 1 percent annually and VMT decreasing by 2 percent in 2020 relative to the Reference case. As discussed below, this results in some counterintuitive results, as some sectors are predicted to spend less on energy efficient equipment (relative to the Reference case) while at the same time becoming more energy efficient and reducing their energy consumption.[15]

For this analysis, we have used the ENERGY 2020 model results as provided by ICF to run a WCI Policy scenario without any adjustments to the data (except as described below). This was done to produce Oregon-specific economic impact results that are as consistent as possible with the cap-and-trade and complementary policies currently being discussed by the WCI partners. In a separate, "High Cost" scenario we have adjusted some of the ENERGY 2020 in an attempt to correct for the counterintuitive ENERGY 2020 results that have negative energy efficient equipment spending for several sectors.

Table 1: WCI Model Results – Change in Equipment Spending Relative to Reference Case for Selected Years (2010, 2015, 2020)

WCI Sector	2010 Equip Spending (Million $)	% Change from Ref Case	2015 Equip Spending (Million $)	% Change from Ref Case	2020 Equip Spending (Million $)	% Change from Ref Case
Residential	-40.9	-0.1%	-454.2	-1.0%	-690.8	-1.3%
Commercial	10.5	0.1%	-60.0	-0.4%	-71.5	-0.4%
Energy Intensive Industry	146.8	19.2%	202.5	22.1%	325.0	25.0%
Paper	108.6	30.7%	147.2	35.0%	238.8	41.6%
Chemicals	36.5	25.7%	59.1	30.7%	94.6	37.8%
Petroleum	1.7	6.3%	2.4	6.7%	3.8	8.0%
Nonmetallic Minerals	0.0	-0.1%	0.0	0.1%	0.3	0.4%
Primary Metals	0.0	0.0%	-6.3	-3.7%	-12.5	-4.4%
Mining Except Oil and Gas	0.0	0.0%	0.0	0.0%	0.0	0.0%
Oil and Gas Extraction	0.0	0.0%	0.0	0.0%	0.0	0.0%
Other Industry	152.2	2.0%	206.6	1.6%	302.2	2.4%
Passenger Transportation	-201.6	-1.0%	-263.4	-1.1%	-394.4	-1.3%
Freight Transportation	0.0	0.0%	-2.3	-0.3%	-9.4	-1.2%
Agriculture	0.0	0.0%	0.0	0.0%	0.0	0.0%
Power Sector	0.0	0.0%	0.0	0.0%	0.0	0.0%
Waste & Wastewater	0.0	0.0%	0.0	0.0%	0.0	0.0%

Table 2 shows the change in annual fuel spending (electricity, natural gas, transportation, and all other fuel sources) for the WCI Policy case relative to the Reference case. As expected, given the

[15] It is our understanding that these assumptions will likely be revisited by WCI and ICF in the next phase of ENERGY 2020 modeling.

reduced energy consumption and investments in more energy efficient equipment, annual fuel costs decrease relative to the Reference case. By 2020, fuel cost savings in the residential sector are expected to be 133.3 million annually while in the commercial sector spending on energy will experience $121.8 million in savings annually. Similarly, for energy intensive industries annual spending on fuel is expected to be $83.8 million lower compared to the Reference case.

The largest annual decrease in fuel spending, relative to the Reference case, is for passenger transportation, where by 2020 annual expenditures are estimated by WCI to be $716.1 million lower relative to the Reference case. As with the other sectors, the passenger transportation reductions are the result of reduced demand (fewer VMT) and investments in more fuel efficient vehicles. In the ENERGY 2020 model, these reductions are due both the cap-and-trade system in combination with the Clean Car Standards.

Table 2: WCI Modeling Results – Change in Fuel Spending Relative to Reference Case for Selected Years (2010, 2015, 2020)

WCI Sector	2010 Fuel Spending (Million $)	% Change from Ref Case	2015 Fuel Spending (Million $)	% Change from Ref Case	2020 Fuel Spending (Million $)	% Change from Ref Case
Residential	-1.8	-0.1%	-103.3	-4.6%	-133.3	-5.7%
Commercial	-2.6	-0.2%	-98.3	-7.4%	-121.8	-9.2%
Energy Intensive Industry	-2.2	-0.2%	-57.5	-5.0%	-83.8	-6.6%
Paper	-0.9	-0.2%	-20.4	-5.9%	-31.7	-8.8%
Chemicals	-0.6	-0.3%	-11.8	-5.2%	-20.3	-8.3%
Petroleum	0.0	0.0%	-0.5	-1.1%	-0.8	-1.5%
Nonmetallic Minerals	-0.2	-0.2%	-4.9	-4.4%	-7.7	-6.3%
Primary Metals	-0.5	-0.1%	-20.0	-4.7%	-23.3	-4.7%
Mining Except Oil and Gas	0.0	0.0%	0.0	0.0%	0.0	0.0%
Oil and Gas Extraction	0.0	0.0%	0.0	0.0%	0.0	0.0%
Other Industry	-1.0	-0.1%	-43.9	-3.6%	-54.4	-4.0%
Passenger Transportation	-135.3	-2.7%	-520.6	-9.8%	-716.1	-13.0%
Freight Transportation	0.0	0.0%	-8.1	-0.4%	-34.2	-1.3%
Agriculture	0.0	0.0%	0.0	0.0%	0.0	0.0%
Power Sector	0.0	0.0%	0.0	0.0%	0.0	0.0%
Waste & Wastewater	0.0	0.0%	0.0	0.0%	0.0	0.0%

4.2 Oregon Economic Impact Modeling Framework

The changes in fuel costs and energy efficient equipment spending predicted by ENERGY 2020 will affect Oregon's economy through several different channels. Spending in these areas impact the economy *directly*, through the purchases of goods and services locally, and *indirectly*, as those purchases, in turn, generate purchases of intermediate goods and services from other, related sectors of the economy. In addition, the direct and indirect increases in employment and income enhance overall economy purchasing power, thereby *inducing* further spending on goods and services. This cycle continues until the spending eventually leaks out of the local economy as a result of taxes, savings, or purchases of non-locally produced goods and services.

The economic modeling framework that best captures these direct, indirect, and induced effects is called input-output modeling. Input-output models provide an empirical representation of the economy and its inter-sectoral relationships, enabling the user to trace out the effects (economic impacts) of a change in the demand for commodities (goods and services).

ECONorthwest utilized a specific input-output model called IMPLAN (for IMpact Analysis for PLANning) to develop the economic impact estimates presented in this report.[16] The IMPLAN model uses multiplier factors based on historical spending patterns within Oregon to develop the state-level impacts. In addition to estimating impacts on households, IMPLAN contains information on 506 different industry sectors within Oregon and provides very detailed information on the distribution of spending impacts across various industries.

The IMPLAN model reports the following economic impacts:

- *Total Industrial Output (Output)* is the value of production by industries for a specified period of time. Output can be also thought of as the value of sales including reductions or increases in business inventories.

- *Employee compensation (Wages)* includes workers' wages and salaries, as well as other benefits such as health and life insurance, and retirement payments.

- *Proprietary income (Business Income)* represents the payments received by small business owners or self-employed workers. Business income would include, for example, income received by private business owners, accountants, lawyers, etc.

- *Employment (Jobs)* impacts include both full-time and part-time employment.

- *Indirect business taxes* are taxes paid by businesses to local, state, and federal taxing jurisdiction. In Oregon, indirect business taxes consist primarily of property taxes. Further, in Oregon, approximately 85 percent of the indirect business taxes paid accrue to state and local taxing jurisdictions; the remainder goes to the federal government.

ECONorthwest took the spending data from ENERGY 2020 specific to Oregon (as shown in Table 1 and Table 2) for each year from 2008 through 2020 and ran the IMPLAN model separately for each year. The effects of energy savings impacts from prior years are carried over for the commercial and industrial sectors, as the increased efficiency of production due to the energy efficiency investments will have a sustained positive impact on the economy over time.

The IMPLAN model is a static model that provides a snapshot of Oregon's economy in a particular point in time. While we have made some adjustments to make the model more dynamic (such as the use of the elasticity factors discussed below), more complex market relationships (such as the entry of new businesses and exit of existing businesses) are not

[16] IMPLAN was developed by the Forest Service of the US Department of Agriculture in cooperation with the Federal Emergency Management Agency and the Bureau of Land Management of the US Department of the Interior to assist federal agencies in their land and resource management planning. Applications of IMPLAN by the US Government, public agencies and private firms span a wide range of projects, from broad, resource management strategies to individual projects, such as proposals for developing ski areas, coal mines, and transportation facilities, and harvesting timber or other resources.

accounted for in this analysis. As a consequence, the makeup of Oregon's economy in 2020 is assumed to be the same as 2008 in terms of the types and sizes of industries operating within the state. Despite its static nature, running the IMPLAN model annually does provide useful information on the general trends that are likely to occur if the WCI policy were enacted.

Additional information was provided by WCI on the types of equipment spending that was expected to occur based on the ENERGY 2020 results. Upon reviewing the WCI estimates, however, we determined that there was better information available from other sources regarding the market areas with the most likely potential for energy efficiency.[17] For the Oregon economic impact analysis, we used information from Energy Trust of Oregon and the Northwest Power and Conservation Council on energy efficiency potential in the region to allocate the energy efficiency equipment spending.[18]

The energy efficiency potential distributions are shown in Table 3. The energy efficiency spending amounts from ENERGY 2020 (shown in Table 1) were distributed across these categories and then input into the IMPLAN model as an increase in spending (benefit) for the various sectors that are likely to provide these types of equipment (e.g., contractors, retail sales, construction sectors). The costs of these investments were also subtracted from the money available for household spending on other goods and services. For the commercial and industrial sectors, spending on new equipment is added to the overall costs of production.

Table 3: Energy Efficiency Equipment Spending Categories by Market Sector

End Use	Residential Sector Potential	Commercial Sector Potential	Industrial Sector Potential
Lighting	55%	48%	14%
Appliances	12%	20%	--
Other equipment	4%	9%	--
Water heating	6%	12%	--
Shell	16%	3%	--
HVAC	7%	2%	6%
Controls, O&M	--	6%	--
Hydraulics	--	--	<1%
Wastewater	--	--	13%
Fresh water	--	--	4%
Refrigeration	--	--	5%
Motors	--	--	2%
Compressed Air	--	--	19%
Process pumping	--	--	14%
Process modification	--	--	16%
Process fans	--	--	<1%
Pneumatic Conveyance	--	--	7%
Total	100%	100%	100%

Source: Energy Trust of Oregon, Northwest Power and Conservation Council

[17] The WCI results, for example, had approximately zero percent of the equipment spending going to lighting, while Energy Trust of Oregon estimates that 55 percent of the efficiency potential in the residential sector and 48 percent of the efficiency potential in the commercial sector comes from lighting.

[18] Energy potential numbers for the residential and commercial sectors are from Energy Trust of Oregon's Energy Efficiency and Measure Resource Assessment, May 2006, available at http://www.energytrust.org/library/reports/db/report_list.php. Efficiency potential numbers for the industrial sector are from Northwest Power and Conservation Council's The Fifth Northwest Electric Power and Conservation Plan, May 2005, available at http://www.nwcouncil.org/energy/powerplan/5/Default.htm.

An important parameter in the Oregon economic modeling was determining an appropriate elasticity factor relating the costs of energy and device spending to economic productivity. As costs for energy and equipment increase, production will decrease (all other factors held constant). The sensitivity of this relationship is referred to in economics as an elasticity. In the short term, the sensitivity is likely to be relatively low as there are limited options other than to simply reduce energy consumption.

In the longer term, once firms and households have time to react to the change in costs, then the sensitivity will be greater as firms adapt to the higher prices with more substantial changes in behavior and possibly by purchasing new energy efficient equipment.[19] Over time, these changes may result in an *increase* in economic productivity associated with that particular input. For example, nationally, real energy prices for industrial use increased by 6.3 percent annually between 1998 and 2006. Over this same period, real economic output grew by 1.5 percent annually, while energy consumption actually declined by 1.0 percent annually. In Oregon, the average annual changes were even greater. The real value of industrial output grew 9.1 percent per year while industrial energy consumption actually decreased by 2.6 percent annually. Some of the changes nationally and for Oregon are explained by changes in the mix of industrial output, as the US economy continually adjusts to new national and global changes in demand and economic opportunities.

Another important benefit of investments in energy efficient equipment is that energy cost savings will occur annually throughout the expected life of the new equipment. For example, if in the industrial sector an investment is made that will decrease energy costs by 10 percent, then with the elasticity factor of -0.95 the economic productivity will increase by 9.5 percent (10 percent x 0.95). If the equipment installed is expected to last 15 years, then the 9.5 percent increase in productivity will continue each year for 15 years, assuming no other changes to the system.[20] This has a cumulative effect over time, as each year has a new round of investments in energy efficient equipment.

The elasticity values used in this analysis are shown in Table 4. Note that elasticity values are likely to vary within and across industry sectors based on a wide range of factors including (but not limited to) capital intensity, availability of lower cost capital and labor substitutes, competition from other firms, and access to capital. We have used a single elasticity factor for the industrial sector for this analysis as developing industry-specific elasticity values is beyond the scope of this project. The overall sensitivity of the economic impact estimates to the elasticity assumptions is tested in the High Cost and Low Cost scenarios discussed later in this report.

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[19] A recent example with high gasoline prices helps illustrate this point. When gas was over $4 a gallon, consumers cut back on driving by carpooling, taking public transit, eliminating trips, etc. As the high gas prices persisted, consumers were more likely to invest in newer, more fuel efficient cars.

[20] If at the end of 15 years the old equipment is replaced again with new energy efficient equipment, then the productivity gains will continue over the expected life of the new equipment.

Table 4: Elasticity Factors Used in Oregon Economic Impact Scenarios[21]

WCI Sector	WCI Policy Scenario	Low Cost Scenario	High Cost Scenario
Commercial	-1.04	-0.52	-1.56
Energy Intensive Industry	-0.81	-0.41	-1.22
Paper	-0.81	-0.41	-1.22
Chemicals	-0.81	-0.41	-1.22
Petroleum	-0.81	-0.41	-1.22
Nonmetallic Minerals	-0.81	-0.41	-1.22
Primary Metals	-0.81	-0.41	-1.22
Mining Except Oil and Gas	-0.81	-0.41	-1.22
Oil and Gas Extraction	-0.81	-0.41	-1.22
Other Industry	-0.81	-0.41	-1.22
Passenger Transportation	0.00	0.00	0.00
Freight Transportation	-1.04	-0.52	-1.56
Agriculture	-0.81	-0.41	-1.22
Power Sector	-0.81	-0.41	-1.22
Waste & Wastewater	-0.81	-0.41	-1.22

An additional adjustment was made to help correct for the negative spending results produced by the ENERGY 2020 model. For passenger transportation, we have assigned an elasticity value of zero for the fuel cost savings. This has the effect of removing from the impact estimates all spending benefits that occur from fuel savings and device costs for the passenger transportation sector. This was done for several reasons. First, this adjustment helps correct for the effect of the negative equipment cost estimates from the ENERGY 2020 model for multiple sectors. Secondly, this adjustment also helps provide a more conservative estimate of the portion of transportation benefits that can be attributable to the cap-and-trade mechanism rather than the complementary Clean Car Standards that are also assumed in the ENERGY 2020 model. This adjustment results in a substantially more conservative estimate of economic benefits to Oregon overall. Note that this adjustment is only made to the passenger transportation sector. Freight and shipping costs in the commercial and industrial sectors are not adjusted.

5. Oregon Economic Impact Estimation Results

5.1 WCI Policy Scenario Results

The following tables show the economic impact estimates to Oregon for the WCI Policy scenario for selected years based on the Oregon IMPLAN model results.

[21] The average commercial sector elasticity was derived by ECONorthwest based on elasticity estimates from Bernstein and Griffin (2005), Dahl (1993), and Jorgensen (2000). The industrial elasticity values were estimated by ECONorthwest based on a simple regression analysis of economic productivity ($ output / energy consumption) and energy prices. This model was estimated using natural logs of both variables, with state-level industrial sector data on energy prices, energy consumption, and gross state product from 1998 to 2006. (Appendix showing model results will be added to final report).

Table 5 shows the economic impacts estimated for 2010. Column 2 shows the impacts associated with spending on energy efficient equipment while column 3 shows the effects of energy cost savings that result from reducing energy use. For 2010, spending on energy efficiency equipment is expected to reduce economic output by $410 million and decrease employment by 1,742 jobs. At the same time, the benefit of lower energy cost is expected to increase economic output by $137 million and add 1,034 jobs to the economy. The net result of these two impacts is shown in column 4, with a net loss of $273 million in economic output and a loss of 708 jobs in the very early years of the policy.

Columns 5 of Table 5 shows the benefits of energy cost savings from spending on energy efficiency equipment in prior years. Given that the policies are just beginning in 2010, there are no cumulative effects carried over from previous years.

Table 5: 2010 Oregon Economic Impact Estimates

Type of Impact (1)	Energy Efficiency Equipment Spending Impacts (2)	Energy Cost Savings Impacts (3)	Total Impacts 2010 (4)	Cumulative Impacts From Prior Years (5)
Output (Million $)	-410	137	-273	0
Total Value Added (Million $)	-151	78	-73	0
Wages	-88	43	-45	0
Business Income	-11	10	-1	0
Other Income	-44	21	-23	0
Indirect Business Taxes	-9	4	-4	0
Jobs	-1,742	1,034	-708	0

Table 6 shows the economic impacts for investments made in 2015, as well as showing the cumulative impacts from prior years. The combined effect of equipment spending and energy cost savings in 2015 alone will increase economic output by $422 million and increase employment by 7,063 jobs relative to the Reference case.

As shown in columns 5 and 6, the cumulative impacts from prior years begin to add substantially to the overall economic impacts.[22] As shown in column 5, the benefits from energy savings from prior years is adding $1.2 billion of output to Oregon's economy in 2015 relative to the Reference case. These earlier investments are also sustaining 10,109 additional jobs in 2015.

[22] Note that the cumulative impacts from prior years are limited only to those resulting from energy cost savings, which are sustained over the life of the new equipment. In contrast, impacts related to spending on energy efficient equipment (rather than energy cost or bill savings) last only for the year in which the spending occurs and are not carried over into subsequent years. For those years where equipment spending impacts are negative, the negative impacts are counted against the positive economic impacts of energy cost savings. In this case, only the energy cost savings over and above any losses from equipment spending are carried forward into future years. This is done to provide a more conservative estimate of the magnitude of impacts that can be sustained over time.

This represents an increase in employment of approximately 2 percent of total Oregon employment in 2007.[23] Again, these increases are all relative to the WCI Reference Case.

Table 6: 2015 Oregon Economic Impact Estimates – WCI Policy Scenario

Type of Impact (1)	Energy Efficiency Equipment Spending Impacts (2)	Energy Cost Savings Impacts (3)	Total Impacts 2015 (4)	Cumulative Energy Cost Savings Impacts From Prior Years (5)
Output (Million $)	2	420	422	1,206
Total Value Added (Million $)	113	250	363	731
☐ Wages	72	134	206	388
☐ Business Income	10	22	32	70
☐ Other Income	15	74	89	218
☐ Indirect Business Taxes	16	20	36	55
Jobs	3,486	3,577	7,063	10,109

Table 7 shows the results for 2020, the last year covered in the ENERGY 2020 model. For energy efficiency equipment spending (column 2), the WCI policy is estimated to reduce economic output by $28 million while at the same time increase employment by 5,033 jobs relative to the Reference case. This last result should give pause to both economists and non-economists, as it is very rare for an economic impact analysis to predict an increase in jobs along with a decrease in economic output. In fact, this result is an artifact of the scenario analysis conducted by ICF with the ENERGY 2020 model, where both equipment spending and energy consumption is estimated to decrease for several sectors of the economy in 2020.[24]

As shown in column 4, the combined effect of the energy efficient equipment and energy cost savings is an increase to Oregon's economy of $566 million in output and increase wage income for Oregon workers of $511 million. An additional 10,034 jobs will also be added due to spending in 2020.

From the ongoing energy cost savings from previous years (column 5), Oregon's economy will add $3.9 billion in new economic output and an additional 33,135 jobs as a result of investments needed to meet the WCI emission reduction goals. Combined with the impacts from 2020, Oregon employment is expected to increase by 43,169 and economic output is expected to increase by $4.4 billion relative to the Reference case. This represents an increase of 2.5 percent in Oregon employment over 2007 levels.

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[23] Based on total non-farm employment for Oregon of 1,731,600 in 2007. Source: Oregon OLMIS, http://www.qualityinfo.org/olmisj/CES?areacode=01000000&action=summary&submit=Continue

[24] As discussed previously, the elimination of the passenger transportation benefits from the WCI Policy scenario is designed to help counteract this issue.

Table 7: 2020 Oregon Economic Impact Estimates – WCI Policy Scenario

Type of Impact (1)	Energy Efficiency Equipment Spending Impacts (2)	Energy Cost Savings Impacts (3)	Total Impacts 2020 (4)	Cumulative Energy Cost Savings Impacts From Prior Years (5)
Output (Million $)	-28	594	566	3,908
Total Value Added (Million $)	154	357	511	2,331
□ Wages	100	192	292	1,254
□ Business Income	13	32	45	210
□ Other Income	17	106	123	686
□ Indirect Business Taxes	23	27	51	181
Jobs	5,033	5,001	10,034	33,135

Figure 6 and Figure 7 show the same trends graphically using the combined effects of energy savings and device cost spending in each year, plus the cumulative effects from energy savings from investments made in previous years. Figure 6 shows the annual and cumulative effects for jobs while Figure 7 shows the trend for economic output for the WCI Policy scenario.

Figure 6: WCI Policy Scenario Annual and Cumulative Job Impacts

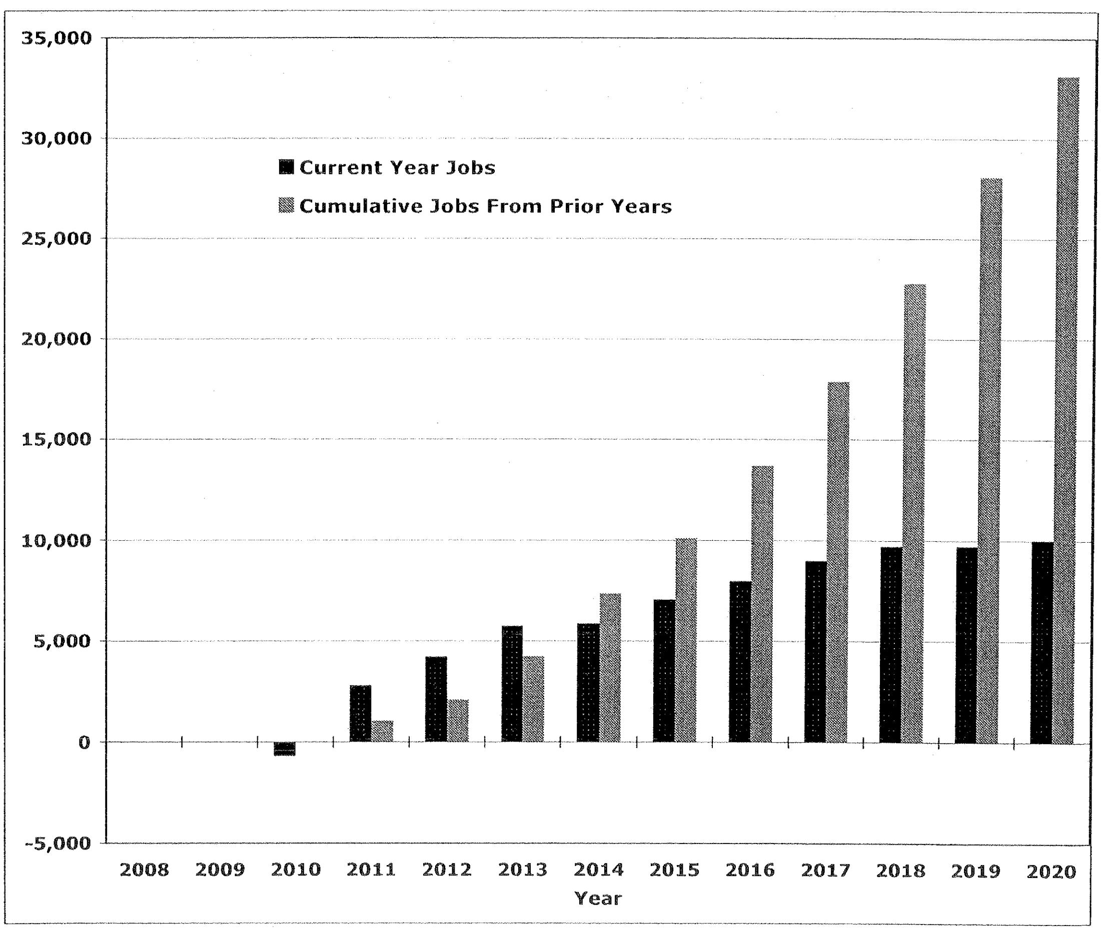
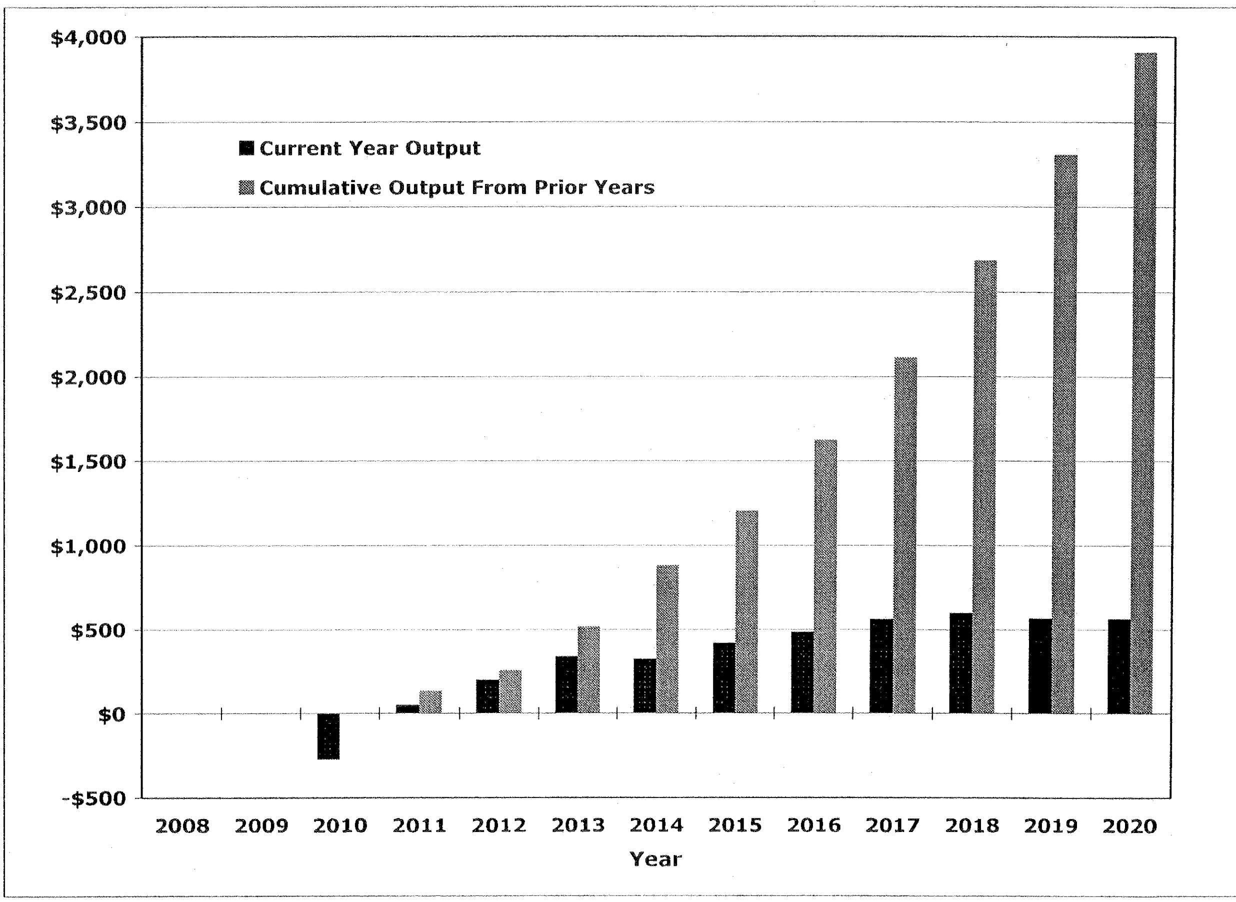


Figure 7: WCI Policy Scenario Annual and Cumulative Output Impacts



5.2 HIGH COST SCENARIO RESULTS

In addition to the WCI Policy scenario, a separate High Cost scenario was also developed based on the IMPLAN model results for Oregon. The High Cost scenario uses more conservative assumptions for model input parameters. Specific changes made for the High Cost scenario include:[25]

- A 50 percent decrease in the elasticity values assigned to commercial and industrial sectors;
- Reductions in energy efficiency equipment spending relative to the Reference case are set to zero.

[25] We had originally planned to include energy price increases as part of the High Cost scenario. However, the ENERGY 2020 output data do not include sufficient detail on energy prices by fuel type and energy consumption by fuel type and market sector to allow for price changes to be incorporated into the Oregon scenario analysis.

The 50 percent reduction in elasticity assumptions (shown in Table 4) has the effect of reducing the overall sensitivity of economic productivity to energy and equipment costs. As a consequence, this change in elasticity limits the impact on production in the commercial and industrial sectors from energy cost savings accruing over time.

Finally, in the High Cost scenario, all equipment spending amounts that are estimated in ENERGY 2020 to be *lower* in the WCI Policy case relative to the Reference case are set to zero. For example, the negative spending amounts shown in Table 1 for the residential, commercial, and transportation sectors are set to zero in the High Cost scenario. This change is made to address the counterintuitive ENERGY 2020 modeling result of achieving both reductions in equipment spending and energy consumption estimated for the WCI Policy scenario.

The results of the High Cost scenario for 2020 are shown in Table 8. The impacts related to equipment spending are negative in this year, due to the fact that all of the new equipment spending is restricted to the industrial sector in this scenario. The benefits from energy cost savings are enough to erase the job losses and most of the decrease in economic output relative to the Reference case, as shown in columns 3 and 4.

The issue of having a negative estimate of economic output along with a positive estimate of job impacts remains in the High Cost scenario for both the 2020 estimate and the cumulative results. Again, this is an artifact from the ENERGY 2020 model results used for the Oregon analysis, where some sectors have a decrease in energy efficient equipment spending relative to the Reference case. Even though the High Cost scenario is designed to mitigate this issue to some degree by setting negative changes in equipment spending to zero, the result is that the vast majority of the investments made for energy efficiency equipment come from the industrial sector, specifically the more energy-intensive sectors such as manufacturing. Because these sectors are more capital intensive, increases in production costs will have a correspondingly greater impact on economic output relative to employment.

Table 8: High Cost Oregon Economic Impact Scenario (2020 Only)

Type of Impact (1)	Energy Efficiency Equipment Spending Impacts (2)	Energy Cost Savings Impacts (3)	Total Impacts 2020 (4)	Cumulative Impacts From Prior Years (5)
Output (Million $)	-923	820	-103	-807
Total Value Added (Million $)	-350	443	93	539
□ Wages	-203	254	51	288
□ Business Income	-26	47	21	131
□ Other Income	-100	113	13	69
□ Indirect Business Taxes	-22	30	8	51
Jobs	-4,239	6,591	2,352	14,377

5.3 Low Cost Scenario Results

A separate Low Cost scenario was run that simulates conditions where the emissions reductions are achieved at a lower cost than that predicted in the ENERGY 2020 results. Since the WCI Policy scenario already results in a net positive impact on the economy, the Low Cost scenario was used to test the assumptions made regarding elasticities. The only change made in the Low Cost scenario is that the elasticity assumptions are increased by 50 percent (shown in Table 4) relative to the WCI Policy scenario. The other parameters for energy costs and spending on energy efficient equipment remain the same as the WCI Policy and are taken directly from the ENERGY 2020 model results. Note that the previous caveats regarding the ENERGY 2020 results and the estimates of negative equipment spending still apply.

The results of the Low Cost scenario are shown in Table 9 for 2020. Note that the energy equipment spending impacts (column 2) are unchanged from the WCI Policy case shown in Table 7. The energy cost impacts (column 3) have increased relative to the WCI Policy scenario as businesses are assumed to receive a greater benefit to their production capabilities due to the investments made in energy efficiency. The 50 percent increase in the elasticity factor resulted in approximately a 35 percent increase in cumulative job and output impacts from the WCI Policy scenario results shown in Table 7.

Table 9: Low Cost Oregon Economic Impact Scenario (2020 Only)

Type of Impact (1)	Energy Efficiency Equipment Spending Impacts (2)	Energy Cost Savings Impacts (3)	Total Impacts 2020 (4)	Cumulative Energy Cost Savings Impacts From Prior Years (5)
Output (Million $)	-28	837	809	5,407
Total Value Added (Million $)	154	476	630	3,068
Wages	100	262	363	1,688
Business Income	13	41	55	269
Other Income	17	137	154	875
Indirect Business Taxes	23	36	59	237
Jobs	5,033	6,836	11,869	44,571

6. Distributional Effects

An important component of this analysis is to examine how the potential economic benefits and costs are distributed across Oregon industries. To explore this issue, it is useful to reiterate where the major sources of spending are occurring:

- All commercial and industrial customers will have an increase in economic output over time if they have made investments in energy efficient equipment. Lower energy costs will also increase household spending.

- Suppliers of energy efficient equipment (contractors, construction, retail trade sectors) will benefit from increased spending on energy efficient equipment.

- Industrial customers will have an increase in costs due to greater investments in energy efficiency equipment. These higher costs are mitigated to some degree by energy cost savings for these same customers in future years after the initial investment is made.

- Residential customers, commercial customers, and passenger transportation spending are all estimated to *decrease* relative to the Reference case based on the ENERGY 2020 model results. This has the benefit of lower costs to these sectors, but also reduces the benefit to suppliers of energy efficient equipment, as less is spent in these industries.

The net effect of all these factors is shown by industry sector for the WCI Policy case in Table 10, with sectors expected to have significant economic costs shaded in red and sectors with significant economic gains shaded in green.[26] As shown by the red areas, the manufacturing sectors in Oregon are predicted to see the largest costs resulting from the cap-and-trade policy. This is likely inflated to some degree by the ENERGY 2020 modeling results that predict negative spending on energy efficiency equipment in the commercial, residential, and passenger transportation sectors. In all likelihood, these other sectors would need to have positive efficiency investments in order to meet the emission reduction goals. This would have the effect of shifting some of the costs of the policy from manufacturing to these other sectors.

The green shaded areas reflect those sectors that are likely to see some economic benefit from the WCI policy. These benefits are the combination of increased investment in energy efficient equipment plus greater economic productivity in all sectors due to the installation of the more energy efficient equipment. Since all sectors are estimated to have reductions in energy costs, the benefits are more widely distributed across industry sectors. Additionally, energy cost savings in the residential sector is assumed to follow historical spending patterns, which results in increases in economic benefits for such sectors as Health Care and Accommodation and Food Service.

In terms of new job creation, most of the jobs that might result from the WCI policy will occur in established industries. Much of the jobs that can be expected would come from contractors supplying and installing energy efficient equipment such as windows, insulation, commercial lighting, air conditioners, and heat pumps. While installation contractors are not traditionally considered as 'green jobs', they will likely see substantial increases in economic benefits as spending on these types of measures increase in response to the cap-and-trade policy. Additional jobs will also be created with other contractors, designers, builders, and engineers that specialize in assisting customers plan, evaluate, and install more energy efficient equipment.

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[26] Table 10 shows all impact gains and losses that occur from 2008 through 2020 regardless of impact duration. In previous tables, only energy savings impacts over and above any losses due to equipment cost spending are carried over from year to year. Consequently, the total impacts are not equal across tables.

Table 10: 2020 Cumulative Economic Impacts by Industrial Sector (WCI Policy Scenario)

WCI Sector	Jobs	Output (Millions of $)	Wages (Millions of $)	Business Income (Millions of $)	Other Income (Millions of $)	Indirect Business Taxes (Millions of $)	Total Value Added (Millions of $)
1. Agriculture, forestry, fishing and hunting	-39	-109	-11	-14	-13	-1	-40
2. Mining	-28	-9	0	-1	-1	0	-2
3. Utilities	4,377	784	232	102	265	31	629
4. Construction	-1,635	-399	-64	-18	21	0	-61
5. Food manufacturing	-30	-26	0	0	-1	0	-1
6. Beverage and tobacco manufacturing	-52	-23	-2	0	-1	-2	-5
7. Textile mills and product manufacturing	-2	0	0	0	0	0	0
8. Apparel and leather manufacturing	98	11	2	0	1	0	3
9. Wood product manufacturing	-1,668	-366	-77	-6	-55	-2	-140
10. Paper manufacturing	-2,321	-1,239	-213	-23	-168	-12	-416
11. Printing	-84	-8	-4	0	-1	0	-6
12. Petroleum and coal product manufacturing	-29	-22	-2	-3	-1	0	-6
13. Chemical manufacturing	-601	-439	-40	-13	-44	-2	-99
14. Plastics and rubber products manufacturing	-1,009	-276	-48	-2	-40	-2	-93
15. Nonmetallic mineral product manufacturing	138	36	7	1	6	0	14
16. Primary metal manufacturing	566	216	47	2	19	2	71
17. Fabricated metal manufacturing	-461	-92	-23	-1	-12	-1	-36
18. Machinery manufacturing	659	172	39	0	14	1	55
19. Computer and electronic product manufacturing	-976	-643	-105	0	-7	-3	-115
20. Electrical equipment, appliance and component manufacturing	-81	-27	-4	0	-2	0	-6
21. Transporation equipment manufacturing	-363	-185	-22	-1	-4	-1	-28
22. Furniture and related product manufacturing	-513	-67	-23	0	-9	0	-33
23. Miscellaneous manufacturing	-58	-13	-3	-1	0	0	-4
24. Wholesale trade	1,934	360	128	8	53	53	243
25. Transportation and warehousing	2,288	258	99	10	24	5	139
26. Retail trade	14,942	1,022	379	35	120	141	674
27. Information	1,295	327	68	3	55	11	138
28. Finance and insurance	3,795	696	196	16	142	17	371
29. Real estate and rental and leasing	4,038	587	49	50	229	67	395
30. Professional and technical services	3,581	375	121	46	22	4	193
31. Management of companies and enterprises	332	65	29	0	8	1	37
32. Administrative and waste services	4,326	222	100	12	20	3	135
33. Educational services	2,812	126	56	4	4	1	65
34. Health care and social assistance	15,273	1,308	601	90	97	10	797
35. Arts, entertainment, and recreation	2,558	103	33	6	10	6	55
36. Accommodation and food services	8,418	460	149	7	49	26	231
37. Other services, except public administration	5,942	328	109	17	34	11	172
38. Government	3,984	344	246	0	36	0	282
Total	71,404	3,859	2,048	325	871	363	3,607

7. CONCLUSIONS AND POLICY CONSIDERATIONS

7.1 SUMMARY OF FINDINGS

The results of Oregon economic impact analysis of the WCI recommended cap-and-trade policies include the following:

- For the WCI Policy scenario, the cap-and-trade combined with the complementary policies is expected to add 10,034 jobs to Oregon's economy in 2020 relative to the Reference Case. The cumulative benefit from energy cost savings from years prior to 2020 will result in an additional 33,135 jobs in Oregon. The combined increase of 43,169 jobs by 2020 represents a 2.5 percent increase in Oregon employment from 2007 levels. These jobs will be sustained beyond 2020 as energy cost savings are expected to last throughout the expected life of the energy efficiency equipment.

- In a more conservative scenario (High Cost scenario), there is still a net gain in employment of 2,352 jobs in 2020 relative to the Reference case, and net job gains from prior years total 14,377. The overall effect on economic output is negative, with a decrease of $103 million in economic output estimated for 2020 relative to the Reference case and a cumulative negative impact on economic output of $807 million. As discussed previously, the conflicting results of positive employment impacts and negative output impacts results from the negative equipment spending estimates obtained from the ENERGY 2020 model.

- Costs are being borne by the manufacturing sectors and other energy intensive sectors, due to the higher amount of equipment spending projected in these areas by the ENERGY 2020 model. This is due in part to the assumptions made in the ENERGY 2020 model that result in negative spending on efficiency equipment in the residential, commercial, and passenger transportation sectors. Increased costs for equipment in these other sectors (the likely outcome of the WCI policy) will help reduce the burden shown here for the industrial sector.

In general and despite the caveats relating to the counterintuitive inputs from the ENERGY 2020 model, the Oregon economic impact analysis shows a consistent trend in the type and magnitude of job impacts that result from the WCI policy. Investments made in energy efficient equipment result in positive impacts for Oregon employment, and the cumulative effect of these benefits increases over time. By 2020, the combined effect of energy efficiency investments from prior years result in an overall increase in employment for Oregon's economy relative to the Reference case and is consistent in all three scenarios examined in this study.

7.2 Design and Policy Considerations

From the analysis results presented here has several implications for the design and timing of the cap-and-trade policy:

- Auctioning permits and having the entire cost passed on to the consumers (as is assumed in all three scenarios evaluated in this report) does not result in an overall negative economic impact to Oregon's economy. However, the relative benefits of auctioning permits compared to allocating for free some or all of the allowances was not addressed in this analysis.

- A longer time horizon for implementing the cap-and-trade policy will likely increase the economic benefits of the policy. Having additional time allows firms and households to be more flexible and ultimately reduce the costs of complying with the cap-and-trade policy. Allowing for more investment in efficiency in earlier years will reduce upward pressure on both electricity prices and carbon allowances. Furthermore, efficiency investments made earlier will provide more energy cost savings over time as these benefits have a longer period over which to accumulate.

- Any estimates of economic impacts must look at both costs due to equipment spending in combination with the long-term, positive impacts relating to energy cost savings. Although these results are presented and discussed separately in this report, this is done only to show how the overall economic impact results are derived from the individual modeling components. From a policy perspective, the impacts from equipment spending and energy cost savings need to be considered together.

Considering only one effect while ignoring the other will result in an extremely distorted image of the potential economic impacts and should therefore be avoided.

Additional policy considerations should include increasing financial assistance to those sectors that are expected to bear most of the equipment costs, particularly in the industrial sector. Increasing funding to existing programs such as Oregon's Business Energy Tax Credit, Residential Energy Tax Credit, and the programs offered by Energy Trust of Oregon are possible ways to help reduce the equipment investment costs borne by these customers.

The analysis shows generally an initial negative impact due to the spending on energy efficient equipment and then a positive impact growing over time from the cumulative effect of energy cost savings. One policy that can take advantage of the timing of these costs and savings is a financing option that allows customers to borrow money to finance the new equipment purchases. This would allow the equipment costs to be paid back over time, with loan payment amounts calculated to approximately coincide with the amount of the expected energy cost savings. This could mitigate or even eliminate any cash flow issues of having customers pay a large upfront cost to retrofit their facilities.

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