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EXECUTIVE SUMMARY

This policy brief focuses on the potential impact of climate change policies like cap-and-trade programs on carbon-intensive manufacturing in Oregon. Although Oregon is well-positioned to thrive in a clean energy economy, some of Oregon's industries may be at risk as the clean energy transition occurs. These industries use large amounts of energy and emit large quantities of greenhouse gases, and will therefore face higher costs from the implementation of a cap-and-trade policy or other regulations that require firms to pay for the cost of emissions. It is important for policy makers to understand how climate change policies could impact these industries so they can design them in such a way as to minimize negative impacts on the state's economy and safeguard the environmental integrity of the climate policies.

Specifically, this policy brief addresses the risk of "leakage" in Oregon's carbon-intensive manufacturing industries due to proposed climate policies. Leakage refers to the movement of production (and greenhouse gas emissions and jobs) from a region with stringent emissions standards to one with lower standards. This issue is of particular concern to labor unions and other worker advocates in Oregon because the state's manufacturing industry, whose average pay is higher than other industries, has already been losing jobs in recent decades as production shifts to other parts of the world—a trend that has been seen throughout the United States.

A variety of national studies have assessed which industries are potentially vulnerable to leakage. The industries that most analyses conclude will be vulnerable to leakage are contained in the broad categories of primary metals, non-metallic mineral products (including cement), chemicals, pulp and paper, and petroleum refining. National studies' estimates of business cost increases in these sectors range widely, with many researchers estimating only 1 or 2 percent increases, and others estimating up to about 11 percent increases for the most affected industries such as steel. However, CO_2

emissions in manufacturing industries in the Pacific Northwest are considerably lower than the U.S. average in general because of the greater use of hydro-electric power, thus the cost increases for Oregon's carbon-intensive industries prove to be lower as well.

Findings

This policy brief presents research on the increase in business costs that would occur if Oregon companies were required to pay for their carbon emissions, using a set of scenarios with carbon prices ranging from $10 to $50 per ton. Our approach assesses, using the most detailed industry breakdown data available, the industries that will face significantly higher production costs once they must purchase carbon allowances under a cap-and-trade program. We also assess how many jobs are in these industries.

The appropriate threshold on business cost increases for determining industries that are vulnerable to leakage is an open question, and in practice is determined politically. Many industries easily absorb or pass on small increases in costs as a percentage of their shipment value over a ten-year period. To make sure that we include all industries that will have a reasonable claim for special assistance in climate policy, we use a very generous threshold of a 2 percent or greater increase in business costs at a $15 per ton carbon price.

We find that most Oregon industries will experience cost increases that are quite low—less than 1 percent—at a $15 dollar per ton carbon price. The industries that will experience a cost increase of more than 2 percent are cements (4.2 percent cost increase), lime (7.5 percent), pulp mills (3.4 percent), paperboard mills (2.8 percent), alkalis and chlorine (2 percent), carbon black (3.4 percent), other basic organic chemicals (2.6 percent), and nitrogenous fertilizers (3.1 percent).

We calculate a total of 12,745 jobs are in industries that may be vulnerable to job loss. This is about 0.2 percent of Oregon employment. Though few, these jobs are generally good jobs, with average wages ranging from $44,000 to $66,000 annually. Since these are manufacturing jobs, they also help support other jobs in Oregon economy.

All the Oregon carbon-intensive industries that we have categorized as vulnerable to leakage will be eligible for allowances under the American Clean Energy and Security Act (ACES) passed by the U.S. House of Representatives in June 2009. Under the ACES Act, eligible firms would be provided allowances based on their actual production levels and the average emissions for their industries. As of this writing, similar language is being proposed in the Senate climate policy introduced in September 2009. Since Oregon's industries are less carbon-intensive than the national average for these industries, they may actually receive more allowances than they will need and be able to sell their surplus on the carbon market.

Recommendations

⌘ Maximize Quality Green Job Creation Opportunities

Oregon's leadership in reducing GHG emissions offers an opportunity for the state to develop new green jobs in areas like renewable energy, energy efficiency, and public transit. The state should exploit the potential for the creation of clean energy manufacturing jobs by helping manufacturers access clean energy markets and adopt innovative, energy-efficient manufacturing technologies. To ensure that the new clean energy jobs are high-quality jobs, the state should attach job and training quality standards to public investments through such policies as prevailing wages, state-approved apprenticeship job training standards, project labor agreements, and best value contracting. The state should also make sure that Oregon has a trained workforce prepared for new clean energy jobs.

⌘ Minimize Job Loss in Carbon-Intensive Industries

The small number of jobs found to be at risk from climate change policies in Oregon does not mean that the state should ignore the issue of job loss and leakage and the potential negative impact of climate change policies on these industries. Rather, because the problem is small, it can be addressed through targeted assistance to specific carbon intensive industries, their workers, and the communities where they are located. A variety of policies are available for addressing leakage, including free allowances, output-based rebates, border adjustments, and international sectoral agreements (all of which are discussed at length in this report). Oregon should implement one or more of these policies to minimize leakage. It should also use part of its carbon allowance revenues and other funding sources to encourage investment in lowering the carbon emissions of these basic manufacturing industries.

⌘ Implement Transition Programs for Workers and Communities

A climate adjustment assistance program should be established to support and provide retraining for workers who are displaced because of climate mitigation policies. The AFL-CIO developed strong worker protection language that was included in the American Clean Energy and Security Act. The bill provides workers who lose their jobs because of climate change policies an adjustment allowance representing a 70 percent wage replacement and 80 percent health benefit replacement for up to three years. It also includes bridges to retirement for workers near retirement. A similar policy should be adopted by Oregon if it decides to participate in a cap-and-trade program.

⌘ Conduct Further Studies

Oregon should conduct its own study of the particular position and prospects of its carbon-intensive industries. This is necessary to pinpoint which particular companies will be vulnerable to closure, to assess the costs of lowering their carbon content, to assess the options and transition needs of their workforce, and to carry out the community economic development planning necessary to implement solutions.

The Impact of Climate Change Policies on Carbon-Intensive Manufacturing Industries in Oregon

INTRODUCTION

This policy brief focuses on the potential impact of climate change mitigation policies on carbon-intensive manufacturing in Oregon. Oregon is among many states, cities, and countries that are implementing policies to slow down climate change and prevent its most harmful effects. In Oregon, those effects include an increase in severe storm events and flooding; human health impacts like declining air quality and changing disease patterns; shrinking average snow packs, affecting water supplies and causing drought; catastrophic wildfires; and threats to West Coast fish populations, among others.[1] A recent study estimates that if nothing is done to address climate change in Oregon, its negative impacts could cost the state an estimated $3.3 billion per year by 2020,[2] about 2 percent of Oregon's 2008 GSP.[3]

In order to address climate change's threat to the state—and the planet—Oregon has set goals for reducing the state's greenhouse gas (GHG) emissions and has adopted a variety of climate change mitigation measures, including a renewable energy portfolio standard and a low-emission vehicles program. Oregon is also considering participating in a regional cap-and-trade program called the Western Climate Initiative (WCI). And if national climate legislation passes, Oregon will be covered under the national cap on carbon emissions.

Clearly, climate change policies will create many jobs in a variety of industries as investments in energy efficiency, renewable energy, and alternative transportation reshape the Oregon economy. Many studies of the impact of climate change policies show net job gain—greater job gain than job loss overall.[4] Oregon's historic investment in hydro-electric power, environmental protection, and energy efficiency gives the state a competitive advantage because some of the costs of lowering emissions have already been absorbed.

However, some of Oregon's industries may be at risk as the transition to a clean energy economy occurs. Industries that currently use large amounts of energy and emit large quantities of carbon dioxide and other GHGs will face higher costs from the implementation of a carbon price due to a cap and trade policy. Businesses facing these higher costs respond in a variety of ways. They may be able to pass on these costs to consumers or adopt energy-saving practices. However, one possible response is to cut back production and jobs. It is important to assess the risk of cutbacks, quantify the number of jobs at risk, and examine options to avoid job loss.

This policy brief also addresses the risk of job loss and of "leakage" in Oregon manufacturing industries due to proposed climate policies. Leakage is a term used to describe the shift of production from a region with stringent emissions standards to one with lower standards. Leakage not only results in business and job loss, but also undermines the goals of climate policy by moving, rather than lowering, global emissions.

We present research on the increase in business costs that would occur if companies are required to pay for their carbon emissions using a set of scenarios with a carbon price ranging from $10 to $50 per ton. We calculate the cost of purchasing allowances in each industry and calculate how much firms would have to raise prices to offset the cost increase. We use this estimation to assess which industries and how many jobs might be at risk. We then present alternative policies to 1) avoid leakage, 2) support businesses to lower their emissions and energy use, and 3) support workers and communities that may face job loss.

Carbon-intensive manufacturing is a vital part of Oregon's economy and labor movement, providing high-quality union jobs with above-average wages and benefits and providing the economic engine for many other jobs and entire communities. Oregon policy makers must understand how climate change policies could impact manufacturing in the state so that they can design policies that prevent or minimize the leakage of jobs and carbon emissions. Such leakage would hurt the state's economy, undermine the environmental goals of the climate change measures, and place most of the costs of the transition to a clean energy economy on a small number of workers and communities.

BACKGROUND ON CLIMATE CHANGE POLICIES AND JOBS

Oregon Climate Change Policies

In order to address the threat of climate change, Oregon passed a bill in 2007 that set goals for reducing GHG emissions in the state. House Bill 3543 states that Oregon will begin to reduce GHG emissions by 2010, then reduce emissions to 10 percent below 1990 levels by 2020, and to 75 percent below 1990 levels by 2050. Oregon's GHG emissions are generated primarily by the electricity generation and transportation sectors of the economy.[5]

To meet these goals, Oregon has adopted a variety of climate change mitigation measures. For example, the state has a renewable energy portfolio standard (RPS), requiring the largest utilities in Oregon to provide 25 percent of their retail sales of electricity from renewable energy sources like wind, solar, and biomass by 2025. Oregon has also established a Low Emission Vehicles program, which will require reductions in GHG emissions from automobiles. In 2009, the Oregon legislature passed several climate and clean energy measures, including an emissions performance standard requiring new power generation sources to have emissions equal to or better than the most modern natural gas plant, a greenhouse gas emissions reporting program to track GHG emissions from out-of-state sources, and a new financing mechanism to encourage residences and businesses to improve their energy efficiency, among others.

Western Climate Initiative Cap-and-Trade Program

Oregon is also considering participating in a regional climate change mitigation program called the Western Climate Initiative (WCI). The WCI is an effort by eleven states and provinces in the U.S. and Canada to reduce their GHG emissions through a cap-and-trade program, which is a market mechanism being used to reduce GHG emissions throughout the world. Under cap and trade, the government places a "cap," or limit, on emissions from carbon-intensive industries in a specific region and requires firms to obtain permits, often called allowances, to emit. Depending on the specific policy design, the government may provide firms with free permits or may require firms to purchase them. Since these permits can be bought and sold, this will effectively put a price on carbon, which will then encourage companies, individuals, and government entities to reduce their carbon emissions so as to avoid paying an additional cost for carbon allowances. Companies will either upgrade their facilities to make them more energy efficient or they will have to buy carbon allowances that permit them to continue emitting. To the degree that companies pass these costs on to business and household consumers, these consumers will then change their behavior in response to the price signal and will reduce the quantity of carbon-intensive products they consume and energy they use.[6] This may in turn create business opportunities in green products and therefore more green jobs.

For the private sector, cap and trade is often a more palatable GHG emissions reduction approach than direct regulation because it allows companies the flexibility to find the least costly way to reduce emissions. If cap and trade works well, its flexible approach can lower the overall costs to society created by climate mitigation policies. A cap-and-trade program can also be a source of revenues if the government auctions emissions allowances rather than giving them to emitting businesses at no cost. These revenues can help consumers adjust to higher energy costs, help businesses lower emissions, and help develop a clean energy economy.

On the other hand, cap-and-trade programs are controversial for many stakeholders. The reasons include doubts that a market free of fraud, speculation, and windfall profits for companies can be created; concerns that a cap-and-trade program will allow businesses to buy carbon permits instead of reduce their GHG emissions, particularly in low-income neighborhoods with high levels of co-pollutants; and general distrust of market solutions. In Oregon, opponents of cap and trade and the Western Climate Initiative have asserted that the WCI will eliminate jobs while supporters of the program have said that it will create green jobs in areas like energy efficiency and renewable energy.

The WCI proposes the implementation of a regional cap-and-trade program in Arizona, British Columbia, California, Manitoba, Montana, New Mexico, Ontario, Oregon, Quebec, Utah, and Washington. Its goal is to reduce regional GHG emissions 15 percent below 2005 levels by 2020. The program would go into effect on January 1, 2012, and its cap on emissions would decline over time, reducing GHG emissions in order to reach the program's target.

During the first three years, the WCI cap will cover GHG emissions produced by electricity generation; combustion at industrial and commercial facilities; and industrial process emission sources, including oil and gas process emissions. Beginning in 2015, GHG emissions from gasoline and diesel fuel combustion and some additional residential, commercial, and industrial fuel combustion facilities will also be covered. Only facilities that emit 25,000 metric tons or more of carbon dioxide equivalents (CO2e) annually will be required to participate in the cap-and-trade program.

Federal Climate Change Policy

In addition to regional efforts such as the WCI, federal climate change policies are moving forward. On June 26, 2009, the U.S. House of Representatives passed HR 2454, the American Clean Energy and Security (ACES) Act (also known as the Waxman-Markey bill). The ACES Act sets a national target to reduce aggregate GHG emissions for all covered entities to 3 percent below their 2005 levels in 2012, 17 percent below 2005 levels in 2020, 42 percent below 2005 levels in 2030, and 83 percent below 2005 levels in 2050.[7] It would create a national cap-and-trade system as well as a federal combined renewable energy and energy efficiency standard, among many other measures to reduce GHGs. The Act would put all state and regional cap-and-trade programs, including the WCI, on hold from 2012 to 2017.

The U.S. Senate introduced a similar climate change bill in September 2009, S. 1733, the Clean Energy Jobs and Power Act (also known as the Kerry-Boxer bill). Meanwhile, the Obama administration is moving forward with other climate change measures, such as the clean car standards it announced in May 2009. Similar to Oregon's Low Emissions Vehicle program, the new national standard will cut global warming pollution from passenger vehicles 30 percent by 2016.

Federal policy, if passed, may pre-empt the WCI, though some proposals allow state and regional cap and trade programs to co-exist with federal programs. However, if federal policy does not pass, there will be new impetus to go forward with the WCI.

In conclusion, climate policies at the state, regional, and federal levels are moving forward, though their fate is still uncertain. These policies include both regulatory standards such as vehicle emissions standards, renewable portfolio standards and others, and market mechanisms such as cap and trade. The ultimate mix of policies and the amount of emissions reductions they will mandate is still undetermined, but all will result in economic incentives or mandates to lower emissions.

Job Impacts—Opportunities and Threats

Climate change measures offer tremendous economic opportunities Oregon. With their successful implementation, Oregon can become a center of green innovation and an export powerhouse for new technologies, products, and services. State, regional, and federal climate measures will induce billions of dollars in private and public investment in such areas as energy efficiency retrofits, new construction, and renewable energy generation, presenting growth opportunities in traditional economic sectors and in new markets yet to be developed. Policymakers, in partnership with organized labor, business, and community stakeholders, can use the economic changes brought about by climate change measures to develop a new array of well-paying jobs with good benefits.

Oregon is well-positioned to thrive in a clean energy economy. A recent study by the Pew Charitable Trusts estimates that in 2007, Oregon had 1,613 clean businesses, 19,340 clean jobs, and that clean job growth from 1998-2007 was 51 percent, outperforming overall state job growth, which was only 7.5 percent. Moreover, a full 1 percent of Oregon's jobs were clean energy jobs, the highest percentage of any state in the nation.[8] Another recent study by the Oregon Employment Department, using a broader definition of green jobs, finds that in 2008 Oregon had 51,402 green jobs spread across 5,025 employers. According to this study, green jobs accounted for three percent of Oregon's private, state government, and local government employment in 2008.[9] Finally, another recent study shows that the clean energy investments that will flow into Oregon from the American Recovery and Reinvestment Act and the ACES Act could lead to the creation of nearly 21,000 jobs in the state as Oregon shifts from a fossil fuel to a clean energy economy.[10]

However, the implementation of climate change policies also presents daunting challenges. Green technologies will not flourish without a well-trained technical and blue-collar labor force. In the absence of careful and farsighted implementation, climate measures could potentially cause serious detrimental effects: the trade-off of well-paying jobs for new jobs of lesser quality, the departure of businesses from the state for "less green pastures," a greater concentration of environmental damage in low-income communities, and higher energy costs that disproportionately affect low-income people.

One of the specific challenges of climate change policies is the possible detrimental impact on carbon-intensive manufacturing. This issue is of particular concern to labor unions and other worker advocates in Oregon because the manufacturing industry in Oregon, whose average pay is higher than other industries, has been losing jobs in recent decades due to shifts in production to other parts of the world—a trend that has affected the United States as a whole. In 2007, manufacturing jobs accounted for nine percent of Oregon's non-farm employment. But these manufacturing industries have been hit hard by the current economic crisis, and the total number of manufacturing jobs in June 2009 was 167,400, a drop of 28,700 jobs in one year.

Climate change measures will not impact all manufacturing industries in Oregon—they will only impact the manufacturing industries that emit the most greenhouse gases. These industries include primary metals (iron, steel, and aluminum), pulp and paper, chemicals, and nonmetallic mineral products (cement and glass). Serious concerns have been expressed that these industries will decrease production in Oregon when they are subject to a cap-and-trade program—eliminating jobs and shifting GHG emissions to other states or countries with less stringent GHG regulations, perhaps resulting in higher, rather than lower, global emissions. Such an outcome would not only undermine the environmental goals of the WCI but would also negatively impact jobs in Oregon.

If Oregon policymakers want to preserve Oregon's manufacturing base and the solid, middle-class jobs it provides—and even expand it with the growth of clean energy components and systems—measures must be taken to address the myriad of factors that are leading manufacturers to close shop in Oregon and re-open in places with lower labor and environmental standards.

The long-term decline in manufacturing is largely due to market-driven globalization and there has been little action or inclination by the federal government to stop it. In contrast, the role of government in helping U.S. businesses, workers, and communities adjust to an emissions cap is accepted and prominent. This is a unique opportunity for affected stakeholders to receive support for the transition.

JOB LOSS AND LEAKAGE

Climate change policies like cap and trade will only have an impact on production levels if businesses' costs rise significantly. For example, producers of high-value equipment like computers, even if faced with much higher energy costs, will not lose sales because energy costs are a minuscule part of their total production costs. However, the impact of a carbon pricing policy on carbon-intensive industries is significant because the purchase of electricity, fuel, and fossil-fuel-based feedstock is a large share of their total costs of production. When a price is placed on carbon, their energy costs will rise, either indirectly through the purchase of electricity generated by fossil fuels, or directly through the combustion of fuel and fossil-fuel-based feedstock, and through industrial process emissions.

The impact of climate policies on carbon-intensive industries is also dependent on the degree to which businesses can pass on the cost increases to customers without losing sales. This in turn depends on whether or not customers can use less of the particular product—i.e., use less electricity by insulating homes or buying energy-efficient appliances—or buy the same product at a lower price from competitors who don't face the same cost increases. This distinction is important for climate policy because declines in the consumption of carbon-intensive products are the goal of climate policy. However, the purchase of the same product from competitors who do not face cost increases from climate policy simply shifts the geographic location of emissions and in some cases increases overall emissions.

Only businesses that meet both of the following criteria will be vulnerable to leakage:

- The increased business costs due to the carbon pricing policy are significant enough to impact firm production and location decisions, and
- The increased business costs cannot be passed on to consumers because consumers can purchase imported products from regions that do not face these costs.

For example, under the Western Climate Initiative (WCI), a cement plant serving Eastern Oregon might decide to move its production out of Oregon, which is part of the WCI, to Idaho, which is not part of the WCI. Another possibility is that the facility might simply decrease production or shut down, and an Idaho cement plant might sell to Oregon consumers. Similarly, competitors to Oregon's pulp and paper industry, such as China or Indonesia, might also gain a competitive advantage if they are not covered by the same emissions regulations as Oregon. This could result in an overall increase in global emissions from pulp and paper since environmental standards are generally stronger in Oregon than in these nations.

What Do National Studies Say about Job Loss and Leakage?

A variety of national studies have attempted to analyze carbon-intensive industries in more depth to assess which subsectors are more susceptible to leakage and why. Other studies have taken the further step of forecasting how much production will be lost (and how many corresponding jobs will be lost) at different projected carbon prices. These studies use a number of different economic modeling methodologies and produce a wide variety of results.

For this report, the authors reviewed four studies that represent the most recent major studies in this area: Fisher and Fox's "Comparing Policies to Combat Emissions Leakage,"[11] Ho, Morgenstern, and Shih's "Impact of Carbon Price Policies on U.S. Industry,"[12] Aldy and Pizer's "The Competitiveness Impacts of Climate Change Mitigation Policies,"[13] and Yudken and Bassi's "Climate Policy and Energy-Intensive Manufacturing."[14]

⌘ Industries Subject to Leakage

National studies are in agreement that the following broad industries meet the criteria of carbon-intensive manufacturing industries that are also subject to some degree of global competition:

Primary metals (iron, steel, and aluminum), pulp and paper, and chemicals and nonmetallic mineral products (cement and glass). These industries emit large amounts of GHGs per unit of good produced (that is, they are carbon intensive). Energy costs are a large portion of their total costs, and they are also subject to substantial global competition.

⌘ National Production and Employment Declines

Though these studies agree on the broad categories of leakage-prone industries, they vary greatly in their estimates of the degree to which cap-and-trade policies will result in actual production declines. This variation depends not only on methodological differences, but also on differing assumptions about the particular climate policies, the resulting price of carbon, and the design options that can address the leakage issue. Macro-economic models used by Fisher and Fox and Ho, Morgenstern, and Shih find very little impact on business costs and production declines of 1.5 percent or less per industry, as shown in Table 1. Using statistical techniques, Aldy and Pizer also predict very small production and employment declines, with paper and pulp experiencing the largest decline of 2.1 percent for a $15 per ton carbon allowance price.

Table 1

Estimations of Production Loss from Macroeconomic Models by Broad Industry

Percentage change in production	Ho, Morgenstern & Shih, 2007 $10 per ton carbon price	Fisher & Fox, 2009 $50 per ton carbon price	Aldy & Pizer, 2008 $15 per ton carbon price
Paper, Pulp, Printing	–0.5	–0.3	–2.1
Primary Metals	–1.5	–0.6	–1.6
Chemicals and Plastics	–1.0	–1.1	–1.5
Non-metallic Minerals (including cement)	–0.6	–0.9	–0.4

In contrast, the system dynamics modeling approach taken by Yudken and Bassi, which is based on a wider variety of detailed industry and historical data, including not only production and energy costs data but also market trends, shows much greater vulnerability to leakage. For example, they estimate that production costs will increase as much as 11 percent for iron and steel. Yudken and Bassi do not forecast production declines.

⌘ Technological Solutions to Lowering the Carbon Content in Leakage-Prone Industries

A critical issue in addressing the impact of climate policy on carbon-intensive industries is the cost of reducing the carbon content of these industries. The Yudken and Bassi study is important because it assesses the near, medium, and long-term technology options for each sector by estimating the level of energy efficiency gains that need to be met to offset the costs of a carbon fee under the 2007 Lieberman-Warner Climate Security Act. This analysis can be used by policy makers, economic development planners, unions, and other community organizations to assess the options for particular firms in their regions and the extent to which they are using best practice technology. For example, the results of their study suggest that for the iron and steel industry, fuel efficiency would have to improve by 34 percent, electricity efficiency by 7 percent, and feedstock by 42 percent to offset the cost of purchasing carbon allowances under the Lieberman-Warner proposal. As of this writing, Yudken and Bassi are conducting a similar impact analysis for the current federal climate change bills.

⌘ Climate Policy and Eligibility Thresholds for Leakage-Prone Industries

Climate policy requires a practical approach for determining which industries are vulnerable to leakage and should thus be eligible for leakage policy remedies. Such a practical approach requires using detailed industry breakdowns that drill deeper than the broad carbon intensive industry categories discussed above, because within these categories there is much variation in both carbon content and trade exposure. In addition, a practical approach requires picking thresholds to determine which industries may be vulnerable to leakage and subject to special treatment in the policy. The relevant thresholds are measures of the following:

- *Cost increase:* a specific level of business cost increase associated with the climate policy in specific industries, and

- *Pass-through capacity:* a specific measure of the degree to which businesses can pass on higher costs to consumers in specific industries.

By definition, picking the thresholds is somewhat arbitrary because it is difficult to assess the threshold at which business decision-makers decide to decrease production or move it to regions with less stringent standards. Is it when they experience a one percent or five percent increase in costs? This depends as well on how much they can pass costs on to consumers and how consumers respond to higher prices.

The ACES Act passed in June 2009 by the House of Representatives uses the methodology suggested by the Energy Intensive Manufacturing Industry Working Group.[15] The Working Group's eligibility threshold for cost increases is any industry that has greater than 4.5 percent energy intensity and for price pass-through capacity is any industry with greater than 15 percent trade intensity.[16] The

Working Group defines *energy intensity* as energy costs as a percentage of shipment value, and *trade intensity* as imports as a percentage of domestic production plus imports. Using this criteria, the Energy Intensive Manufacturing Working Group's study concludes that a very broad range of industries would be vulnerable to leakage and thus worthy of government assistance or exemption from the policy. Their list includes not only the industries recognized by other researchers as vulnerable to leakage, but a set of other industries such as beet sugar and porcelain electric supplies that are beyond those pinpointed by other researchers.

The ACES Act sets aside a pool of allowances for these eligible industries through an allowance rebate based on their levels of production and industry-wide average levels of emissions. Firms emitting less than the industry average will benefit by receiving more allowances than they need to cover current emissions, which can then be sold in the carbon market.

THE IMPACT ON OREGON

Our study assesses, at the most detailed industry breakdown possible, which industries in Oregon will face significantly higher production costs once they must purchase carbon allowances under a cap-and-trade program.

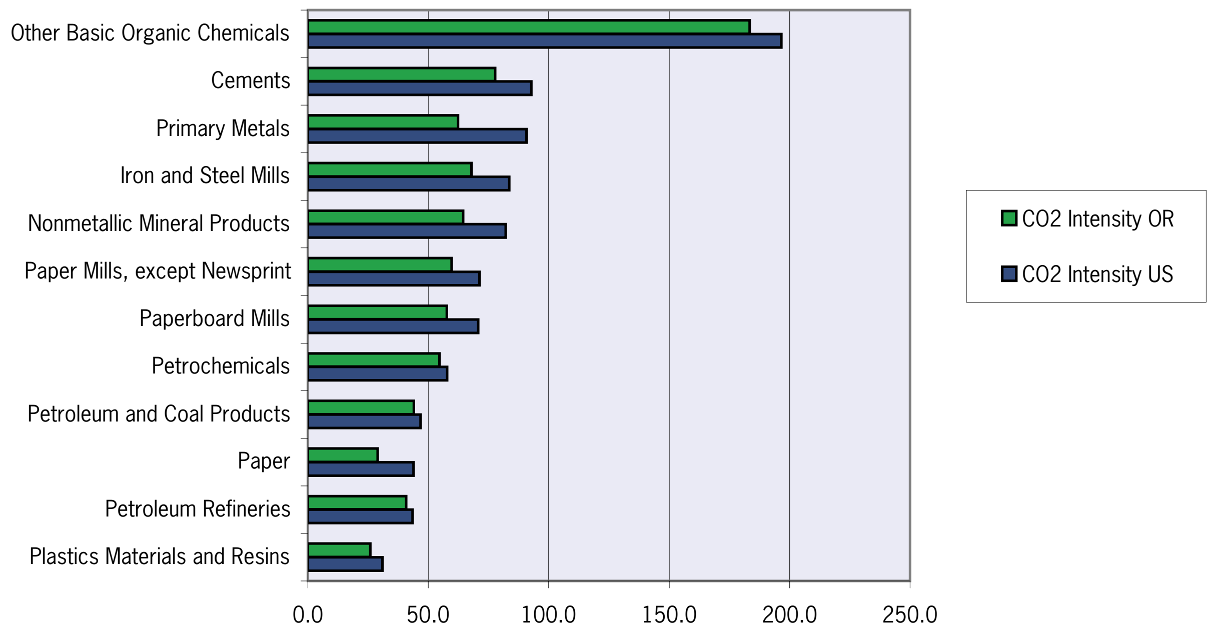
In order to assess the impact of a cap-and-trade system on firms' costs, we first calculate the CO2 content of all the fuels used for energy and feedstocks in each industry, using the U.S. Energy Information Agency's manufacturing energy consumption (MECS) data.[17] We do this by calculating how much energy is used to produce each product and what mix of sources is used to produce that energy. Since CO2 content varies by source, an energy-intensive product that uses mostly hydro-electric power will generate a low level of CO2 emissions whereas a product that uses much less energy but derives that energy from coal may generate a higher level of CO2 emissions. The MECS data also allows us to compare Oregon's energy sources with the nation as a whole. We are not able to calculate process emissions due to data limitations. Process emissions account for a substantial amount of emissions in iron and steel, cement, lime, and nitrogenous fertilizer, thus we will under-estimate the CO2 content for these industries. In addition, we only measure carbon dioxide emissions, not all greenhouse gas emissions, due to data limitations.

Chart 1 (page 19) compares the CO2 content of the energy used by Oregon's manufacturing industries with U.S. manufacturing industries as a whole. Oregon's manufacturing industries consistently produce less CO2 emissions per unit of energy used than the average for the U.S., due both to the prevalence of hydro-electric power in Oregon and the state's history of strong environmental regulation.

This is important because Oregon clearly will be less affected than many other states in the nation by the introduction of a carbon price. *In fact, if federal legislation passes with the language in the current bills, Oregon's industries will receive more free allowances than are needed to cover current emissions, resulting in a windfall for these industries.*

Chart 1

CO2 Intensity in Manufacturing: Emissions per Unit Energy from Fuels and Feedstocks



Sources: This study, using data from EIA Manufacturing Energy Consumption Survey (MECS) 2006 (Energy and Fuel Use) and EIA Carbon Emissions Factors (U.S. Energy Information Agency (EIA), "Energy-Related Carbon Dioxide Emissions in U.S. Manufacturing," memo by Mark Schipper, 2006).

Our calculation of CO2 content in each industry is then used to directly estimate the additional costs that these firms would face if they were required to purchase carbon allowances equal to their carbon content. We calculate both their direct carbon emissions and the carbon embedded in the electricity they use. Since this cost would vary depending on the actual price per ton of carbon, we perform these calculations using scenarios with a range of carbon prices. In order to compare across industries, we express the cost increase as a percentage of the industry's total value of shipments, or TVS. (TVS = price X output).

We start with an examination of average cost increases within broad industry sectors. Table 2 (page 20) shows the increase in business costs for these broad sectors if businesses were required to purchase carbon allowances at prices of $10, $15, $25, and $50 per ton of carbon. The $10-$50 price range was chosen to cover a broad range of predictions of the carbon allowance prices for various policy proposals and to allow comparisons with previous studies. The EPA estimates of carbon prices resulting from the ACES Act range from $17 to $33 in 2020, when the first GHG emissions reduction targets will be reached. The estimated California carbon price, due to AB 32, the California Global Warming Solutions Act, is $11 per ton in 2020. After 2020, the price under both the national and California policy is expected to rise as the carbon cap is reduced; however, there are no price projections for future years.

Table 2

CO2 Allowance Cost as Percent of Manufacturing Industries' Total Value of Shipments 2006: The United States and Oregon Compared

Broad Industry Groups		United States				Oregon				
NAICS	Sectors & Sub-sectors	% CO2 Intensity $10/ton	% CO2 Intensity $15/ton	% CO2 Intensity $25/ton	% CO2 Intensity $50/ton	% CO2 Intensity $10/ton	% CO2 Intensity $15/ton	% CO2 Intensity $25/ton	% CO2 Intensity $50/ton	% Energy Cost Intensity
331	Primary Metals	0.87	1.30	2.16	4.33	0.67	1.01	1.69	3.37	5.12
327	Nonmetallic Mineral Products	0.75	1.13	1.88	3.77	0.64	0.96	1.60	3.20	5.81
324	Petroleum and Coal Products	0.60	0.90	1.50	3.00	0.58	0.86	1.44	2.88	2.24
322	Paper	0.61	0.92	1.53	3.06	0.47	0.70	1.16	2.33	5.37
325	Chemicals	0.42	0.63	1.04	2.09	0.34	0.51	0.85	1.70	3.34
313	Textile Mills	0.49	0.74	1.23	2.46	0.33	0.49	0.82	1.63	3.97
321	Wood Products	0.31	0.47	0.79	1.57	0.24	0.35	0.59	1.18	2.13
311	Food	0.19	0.29	0.48	0.96	0.15	0.22	0.36	0.73	1.85
326	Plastics and Rubber Products	0.19	0.29	0.48	0.96	0.11	0.16	0.27	0.54	2.35
332	Fabricated Metal Products	0.12	0.18	0.31	0.61	0.08	0.12	0.20	0.39	1.64
312	Beverage and Tobacco Products	0.09	0.13	0.21	0.43	0.06	0.09	0.15	0.31	0.92
323	Printing and Related Support	0.10	0.15	0.26	0.51	0.06	0.09	0.15	0.29	1.55
335	Elec. Equip., Appliances, & Components	0.09	0.14	0.24	0.47	0.06	0.09	0.15	0.29	1.10
337	Furniture and Related Products	0.09	0.13	0.21	0.43	0.05	0.07	0.12	0.25	0.97
336	Transportation Equipment	0.07	0.11	0.18	0.36	0.05	0.07	0.11	0.23	0.69
333	Machinery	0.08	0.11	0.19	0.38	0.04	0.06	0.11	0.21	0.81
315	Apparel	0.05	0.08	0.13	0.27	0.03	0.05	0.08	0.16	1.01
334	Computer and Electronic Products	0.05	0.07	0.12	0.25	0.03	0.04	0.07	0.13	0.72

Sources: This study, using data from EIA Manufacturing Energy Consumption Survey (MECS) 2006 (Energy and Fuel Use), EIA Carbon Emissions Factors, Economic Census 2006 (Total Value of Shipments), & Annual Survey of Manufacturings, 2006 (Energy Costs). CO2 Intensity = (Total CO2 Emissions X CO2 Price)/Total Value of Shipments; Energy Cost Intensity = (Fuel & Electricity Expenditures)/Total Value of Shipments.

The increase in business costs due to a carbon price is very low for most of these broad industries, even if carbon prices rise to $50 per ton. The industries that would experience the highest cost increases are primary metals and nonmetallic mineral products.[18]

Table 2 also shows that CO2 emissions in manufacturing industries in the Pacific Northwest are considerably lower than the U.S. average in general because of the greater use of hydro-electric power. The first four columns of Table 3 (page 21) use data on CO2 content for all of the U.S.; the second four columns use data for CO2 content for Oregon. The Oregon emissions figures are consistently lower than for the nation as a whole.

Table 3 drills down to a more detailed breakdown of industries. It shows that within each broad industry sector there is substantial variation in the degree to which specific industries will be affected by the requirement to purchase carbon allowances. Most industries will experience quite

Table 3

CO2 Allowance Cost as a Percent of Total Value of Shipments: Detailed Industries in the United States and Oregon

Broad Industry Groups		United States				Oregon			
		% Cost Increase for a CO2 Charge				% Cost Increase for a CO2 Charge			
Industry and Subsectors	NAICS	$10/ton	$15/ton	$25/ton	$50/ton	$10/ton	$15/ton	$25/ton	$50/ton
Primary Metals (331)									
Iron and Steel Mills	331111	1.27	1.91	3.18	6.37	1.03	1.55	2.59	5.17
Electrometallurgical Ferroalloy Products	331112	2.06	3.08	5.14	10.28	0.90	1.34	2.24	4.48
Secondary Smelting and Alloying of Aluminum	331314	0.15	0.23	0.38	0.77	0.12	0.18	0.30	0.61
Aluminum Sheet, Plate and Foils	331315	0.24	0.36	0.60	1.19	0.14	0.21	0.35	0.71
Aluminum Extruded Products	331316	0.30	0.44	0.74	1.48	0.17	0.25	0.42	0.83
Iron Foundries	331511	0.74	1.10	1.84	3.68	0.39	0.59	0.98	1.96
Aluminum Die-Casting Foundries	331521	0.33	0.50	0.83	1.66	0.18	0.26	0.44	0.88
Aluminum Foundries, except Die-Casting	331524	0.37	0.55	0.92	1.83	0.22	0.33	0.56	1.12
Nonmetallic Mineral Products (327)									
Flat Glass	327211	1.31	1.97	3.28	6.56	1.07	1.60	2.67	5.33
Glass Containers	327213	1.03	1.55	2.58	5.16	0.66	0.99	1.65	3.31
Glass Products from Purchased Glass	327215	0.69	1.03	1.72	3.43	0.52	0.78	1.30	2.59
Cements	327310	3.34	5.00	8.34	16.68	2.80	4.20	6.99	13.99
Lime	327410	5.40	8.10	13.51	27.01	5.03	7.55	12.58	25.15
Gypsum	327420	0.94	1.42	2.36	4.72	0.80	1.20	2.00	3.99
Mineral Wool	327993	0.75	1.13	1.89	3.77	0.44	0.66	1.09	2.18
Petroleum and Coal Products (324)									
Petroleum Refineries	324110	0.51	0.76	1.27	2.54	0.48	0.72	1.19	2.39
Paper (322)									
Pulp Mills	322110	2.44	3.66	6.09	12.19	2.27	3.41	5.68	11.36
Paper Mills, except Newsprint	322121	1.45	2.17	3.62	7.23	1.21	1.82	3.03	6.06
Newsprint Mills	322122	2.45	3.68	6.13	12.25	1.16	1.73	2.89	5.78
Paperboard Mills	322130	2.31	3.47	5.78	11.57	1.88	2.83	4.71	9.42
Chemicals									
Petrochemicals	325110	0.53	0.79	1.32	2.64	0.50	0.75	1.25	2.49
Industrial Gases	325120	1.58	2.37	3.94	7.88	0.53	0.79	1.31	2.63
Alkalis and Chlorine	325181	1.81	2.72	4.53	9.05	1.35	2.03	3.38	6.76
Carbon Black	325182	2.42	3.63	6.06	12.12	2.24	3.35	5.59	11.18
Other Basic Inorganic Chemicals	325188	0.98	1.48	2.46	4.92	0.48	0.73	1.21	2.42
Cyclic Crudes and Intermediates	325192	0.54	0.81	1.35	2.70	0.33	0.49	0.82	1.65
Ethyl Alcohol	325193	0.57	0.85	1.41	2.83	0.48	0.71	1.19	2.38
Other Basic Organic Chemicals	325199	1.85	2.77	4.62	9.23	1.72	2.58	4.31	8.61
Plastics Materials and Resins	325211	0.64	0.96	1.60	3.20	0.53	0.80	1.33	2.66
Synthetic Rubber	325212	0.41	0.61	1.02	2.05	0.31	0.46	0.77	1.54
Noncellulosic Organic Fibers	325222	1.10	1.64	2.74	5.48	0.76	1.13	1.89	3.78
Nitrogenous Fertilizers	325311	2.28	3.42	5.71	11.42	2.08	3.12	5.20	10.41
Phosphatic Fertilizers	325312	0.30	0.45	0.76	1.52	0.20	0.29	0.49	0.98
Pharmaceutical Preparation	325412	0.05	0.07	0.11	0.23	0.02	0.04	0.06	0.12
Photographic Film, Paper, Plate, and C	325992	0.21	0.31	0.52	1.05	0.16	0.25	0.41	0.82
Wood Products (321)									
Sawmills	321113	0.48	0.71	1.19	2.38	0.33	0.50	0.83	1.65
Veneer, Plywood, and Engineered Woods	3212	0.53	0.79	1.32	2.63	0.34	0.51	0.86	1.71
Food									
Wet Corn Milling	311221	1.35	2.02	3.37	6.75	1.08	1.63	2.71	5.42
Transportation Equipment (336)									
Automobiles	336111	0.04	0.06	0.11	0.21	0.02	0.03	0.05	0.11
Light Trucks and Utility Vehicles	336112	0.03	0.04	0.07	0.14	0.01	0.02	0.03	0.07
Aircraft	336411	0.03	0.05	0.08	0.15	0.01	0.02	0.03	0.05
Computer and Electronic Products (334)									
Semiconductors and Related Devices	334413	0.12	0.18	0.30	0.61	0.04	0.06	0.10	0.19

Sources: This study, using data from EIA Manufacturing Energy Consumption Survey (MECS) 2006 (Energy and Fuel Use), EIA Carbon Emissions Factors, Economic Census 2006 (Total Value of Shipments), & Annual Survey of Manufacturings, 2006 (Energy Costs).

low cost increases, less than 1 percent, at a $15 dollar per ton carbon price. The exceptions are cements, lime, pulp mills, paperboard mills, alkalis and chlorine, carbon black, other basic organic chemicals, and nitrogenous fertilizers, each of which will experience a cost increase of more than 2 percent at a $15 per ton carbon price. The cost increases vary from 7.55 percent for lime to 2.03 percent for alkalis and chlorine.

Table 4 (page 23) includes the total employment and average wages in these disaggregated carbon-intensive industries in 2007, the last year the data is available at this detailed industry breakdown. Unfortunately, at the most detailed industry breakdown, in order to protect confidentiality the government represses information when there are a very small number of firms that could be individually identified. When that is the case, information on wages and employment are not available (N/A). For the chart, we take the lowest level of disaggregation available.

The appropriate cost threshold used to determine which industries are vulnerable to leakage is an open question, and in practice is determined politically. Many industries easily absorb or pass on small increases in costs. If costs increase by a few percent of firms' total value of shipments in Oregon due to a carbon price, but not in other parts of the country, is this a significant problem for Oregon industry? To put the cost increases in Tables 2, 3, and 4 into perspective, we can consider past changes in relative prices between Oregon and other states. For example, in the mid-late 1970s, industrial electricity prices in Oregon were considerably lower than in the United States as a whole. By the mid-1980s, however, the Oregon price had risen significantly relative to the U.S. price, and remained that way throughout the 1990s. Data show that the resulting cost advantage lost by Oregon's most carbon-intensive industries (primary metals, nonmetallic mineral products, paper, and chemicals) was about 2 percent of their total shipment value.[19] Thus, the cost increases faced by the hardest-hit Oregon industrial sectors as a result of a $15 per ton carbon charge will be approximately as great as the cost increases they faced from changes in relative electricity prices in the late 1970s and early 1980s.

If we think about comparable cost changes for Oregon industries relative to its competitors from other nations, we might also consider exchange rates. Movement in exchange rates can raise or lower costs to U.S. businesses relative to their international competitors. Given our focus on Oregon industry, it makes sense to consider the exchange rate with the Canadian dollar, as Canada and Oregon are both major producers of wood and paper products. In the last 40 years this exchange rate has fluctuated dramatically. In 1976, the U.S. and Canadian dollars were equal in value. From there the U.S. dollar slowly gained on the Canadian dollar, and was worth 1.6 Canadian dollars by 2002. However, the U.S. dollar then fell rapidly against the Canadian dollar, and the two were again equal in value in 2008. As such, the "cost increase" Oregon businesses faced as a result of the worsening exchange rate in the 2000s was much larger than the cost increases a $15 per ton carbon charge would imply.

For this analysis, we chose to categorize industries as vulnerable to leakage if their business costs would increase by 2 percent or greater at $15 per ton carbon price. A 2 percent increase due to a

Table 4

Oregon Industries: Employment, Wages, and CO2 Cost Increases for a $15 Carbon Price

Industry and Subsectors	NAICS	CO2 Charge as % of Total Value of Shipments ($15/ton CO2)	Oregon Employment 2007	Oregon Average Annual Wages 2007 ($)	Oregon as % of U.S. Employment 2007
Primary Metals	331	0.9	9,165	66,056	2.0
Iron and Steel Mills	331111	1.6	1,304	89,229	1.4
Electrometallurgical Ferroalloy Products	331112	1.3	–	0	0.0
Iron Foundries	331511	0.6	n/a	n/a	n/a
Alumina and Aluminum	3313	0.5	724	46,558	1.0
Foundries	3315	0.4	5,478	60,346	3.4
Aluminum Foundries, except Die-Casting	331524	0.3	186	115,567	0.8
Aluminum Die-Casting Foundries	331521	0.3	185	49,647	0.8
Aluminum Extruded Products	331316	0.3	n/a	n/a	n/a
Steel Products from Purchased Steel	3312	0.2	n/a	n/a	n/a
Aluminum Sheet, Plate and Foils	331315	0.2	n/a	n/a	n/a
Nonferrous Metals, except Aluminum	3314	0.2	1,460	75,330	2.1
Secondary Smelting and Alloying of Aluminum	331314	0.2	n/a	n/a	n/a
Nonmettalic Mineral Products	327	0.9	5,482	44,014	1.1
Lime	327410	7.5	n/a	n/a	n/a
Cements	327310	4.2	n/a	n/a	n/a
Flat Glass	327211	1.6	n/a	n/a	n/a
Gypsum	327420	1.2	n/a	n/a	n/a
Glass Containers	327213	1.0	n/a	n/a	n/a
Glass Products from Purchased Glass	327215	0.8	n/a	n/a	n/a
Mineral Wool	327993	0.7	n/a	n/a	n/a
Petroleum and Coal Products	324	0.8	430	56,091	0.4
Petroleum Refineries	324110	0.7	–	0	–
Paper	322	0.6	6,174	66,633	1.3
Pulp Mills	322110	3.4	n/a	n/a	n/a
Paperboard Mills	322130	2.8	1,147	81,033	3.1
Paper Mills, except Newsprint	322121	1.8	1,769	70,984	2.1
Newsprint Mills	322122	1.7	n/a	n/a	n/a
Chemicals	325	0.5	3,789	49,146	0.4
Carbon Black	325182	3.4	–	0	–
Nitrogenous Fertilizers	325311	3.1	n/a	n/a	n/a
Other Basic Organic Chemicals	325199	2.6	130	67,428	0.4
Alkalis and Chlorine	325181	2.0	–	0	0.0
Noncellulosic Organic Fibers	325222	1.1	–	0	0.0
Plastics Materials and Resins	325211	0.8	186	63,761	0.3
Industrial Gases	325120	0.8	96	62,395	0.5
Petrochemicals	325110	0.7	–	0	0.0
Other Basic Inorganic Chemicals	325188	0.7	185	54,149	0.6
Ethyl Alcohol	325193	0.7	n/a	n/a	n/a
Cyclic Crudes and Intermediates	325192	0.5	–	0	–
Synthetic Rubber	325212	0.5	n/a	n/a	n/a
Phosphatic Fertilizers	325312	0.3	–	0	–
Photographic Film, Paper, Plate, & Chemicals	325992	0.2	464	48,522	1.6
Textile Mills	313	0.4	105	27,497	0.1
Wood Products	321	0.3	29,713	39,212	5.5
Veneer, Plywood, and Engineered Woods	3212	0.5	9,745	40,447	8.3
Sawmills	321113	0.5	7,653	45,658	7.3
Food	311	0.2	22,865	32,228	1.6
Wet Corn Milling	311221	1.6	n/a	n/a	n/a
Fruit & Vegetable Preserving & Specialty Food	3114	0.2	n/a	n/a	n/a

Sources: This study, using data from EIA Manufacturing Energy Consumption Survey (MECS) 2006 (Energy and Fuel Use), EIA Carbon Emissions Factors, Economic Census 2006 (Total Value of Shipments), & Annual Survey of Manufacturings, 2006 (Energy Costs).

carbon charge of $15 per ton translates into about a 6.5 percent increase at a $50 carbon price, as illustrated in Table 4. We believe 2 percent is a reasonable threshold below which businesses are unlikely to make decisions to cut or shift some or all of their production. It is a lower threshold than the 5 percent cost increase proposed by some European analysts, including Clo,[20] and thus results in the inclusion of a greater number of industries in the category of "vulnerable to leakage."

Table 4 provides the information necessary to estimate the number of jobs in industries that meet or exceed the 2 percent threshold at a $15 per ton carbon charge. Because Oregon suppresses so much information about employment at the detailed industry breakdown, we assume that all jobs in the broad industry categories in Table 4 meet the criteria unless the data is available to show that the jobs do not meet the criteria.[21] We calculate that a total of 12,745 jobs are in industries that may be vulnerable to job loss. This is about 0.2 percent of Oregon employment. Though few, these jobs are generally good jobs, with average wages ranging from $44,000 to $66,000 annually. Moreover, manufacturing jobs support a variety of jobs in other parts of the Oregon economy.

It should be noted that states in the WCI will collect CO2 emissions data from individual manufacturing businesses in the future. When this data is available, we will have much more detailed and accurate information about factory-level emissions, which will increase the accuracy of our assessment of the impact of carbon prices on business costs and competitiveness.

Competitiveness and Import Intensity

There remains the question of how much, if at all, production will fall in response to the cost increases associated with a carbon charge. Businesses' decisions about whether or how much to cut production depends on how much sales will go down if they pass on cost increases to consumers. This pass-through capacity depends on customers' ability to reduce their consumption of the particular product as well as their ability to purchase the product from businesses that do not face policy-induced cost increases.

A commonly used proxy metric for the ability of businesses to pass along costs is import intensity, which measures the share of domestic consumption that comes from imports. For our purposes, this metric is problematic for two reasons. First, it only measures foreign imports and does not take into consideration competition from states that have not implemented a carbon pricing policy, so it is less relevant to an analysis of policy affecting an individual state or a sub-national region. Second, it only captures the cost sensitivity due to imports, not due to a reduction in consumption of the product overall. Since the goal of climate change policy is to reduce emissions, the reduction in consumption is a positive outcome and is the ultimate purpose of the policy. However, we are also interested in the overall loss of production and employment in each state, regardless of whether it is due to an increase in imports or a decrease in consumption.

Job loss for either reason needs to be addressed with adequate transition assistance. If coal production declines due to climate policy and workers are laid off, addressing their need for transition is important even though imports of coal will not increase.

Thus we base our criteria for determining vulnerability to job loss solely on the basis of the business cost increase, and make the generous assumption that no industry can pass on these costs to consumers without facing sales losses. In Oregon, it is clear that almost all the industries that would face significantly higher business costs if carbon pricing policies were instituted are clearly also vulnerable to global competition.[22]

Companies Vulnerable to Leakage

Appendix B (page 37) lists the companies that have production facilities in Oregon that meet the criteria of carbon-intensity—all businesses that are in the industries that have a greater than 2 percent increase in costs as a percentage of total value of shipments. Although the list contains 73 businesses in many different industries, about one half of the businesses are in the paper and pulp industries and include large multi-national companies like Boise Cascade, L.L.C.; Georgia Pacific; International Paper Company; and Weyerhauser.

Technological Options for Greening Vulnerable Industries

The other key ingredient of firms' responses to a carbon price is the cost of reducing the carbon content of the product. Our study was unable to analyze technological options for greening the specific industries found to be vulnerable to leakage in Oregon. National studies have shown that there are opportunities for improvements in energy efficiency and reductions in emissions in the main carbon-intensive industries. Further research is needed at the state level to understand how close to best practices Oregon industries are, and what incentives and public investments are needed to encourage adoption of the best technologies.

In sum, the results from our analysis show that Oregon's businesses are in a strong position to address the cost increases associated with a policy like cap and trade. Carbon-intensive industries account for a small number of jobs in Oregon, and these industries produce lower emissions than similar industries in the country as a whole. Using calculations of the additional costs of buying allowances at $10, $15, $25, or $50 per metric ton of carbon as a percentage of the total value of shipments, we find that most manufacturing industries would experience very small cost increases. The most vulnerable industries in Oregon are the iron and steel mills and paper and pulp industries, which together have over seven thousand workers and will experience cost increases ranging from 1.6 percent to 3.4 percent at a $15 per ton carbon price. Although climate change policy that does not protect leakage-prone industries might not affect production decisions by itself, given the other pressures and options that these manufacturers face the lack of protective policy could tip the balance in favor of plant contraction or closure. Our study cannot evaluate the specific fate of Oregon's most carbon-intensive industries, but it does provide a guide for state and local economic development planners as to which industries should be carefully assessed.

POLICY OPTIONS FOR PREVENTING LEAKAGE

The ACES Act that was passed by the U.S. House of Representatives in June included free allowances for all industries in which energy costs are at least 5 percent of total shipment value. According to our analysis, if ACES becomes law with this language intact, all of Oregon's carbon-intensive industries will receive free allowances. In addition, since businesses will receive free allowances based on their actual output and the national industry average emissions rate, Oregon's businesses are likely to receive more free allowances than they will need to purchase. While this would eliminate one pressure that could cause leakage, there are other policies that Oregon might consider to mitigate its threat.

Within the WCI, one of the WCI committees, the Cap Setting and Allowance Distribution Committee, is planning to carry out an analysis of leakage during the first quarter of 2010 and recommend options for addressing leakage in the second quarter of 2010.

Several options to address leakage have been proposed at the state, regional, national, and international levels. Following, we discuss the primary options: Sectoral agreements, free allowances, output-based rebates, border adjustments, and incentives for energy-efficient investments.

Sectoral Agreements

A sectoral agreement is an international agreement that would reduce industrial emissions from a key sector. The agreement could require global industry-wide product standards, emissions targets, or a direct carbon tax.

Most experts agree that sectoral agreements would be the ideal policies to address leakage because they would level the playing field within an industry across the globe. The ACES Act includes a statement of policy that the United States will work proactively to establish binding sectoral agreements, "committing all major greenhouse gas-emitting nations to contribute equitably to the reduction of global greenhouse gas emissions."

The downside of sectoral agreements is that they are out of the control of the U.S. and Canadian policy makers who will be making policy design decisions on the WCI. These agreements will have to be negotiated internationally, and it could take a long time to conclude such agreements.

Free Allowances

Under this policy option, companies in industries susceptible to leakage would be given carbon allowances for free instead of having to buy allowances. The cap-and-trade programs in the European Union and in Australian plan to use free allowances to protect vulnerable industries.

Giving leakage-susceptible industries free allowances has the benefit of reducing the short-term economic impact for affected firms. It will give these firms more time to prepare themselves for a future carbon price, during which they may choose to implement energy efficiency technologies that will help them reduce their GHG emissions.

On the other hand, critics argue that free allowances will result in windfall profits for polluting companies because the companies will be able to sell for a profit the allowances they were given for free. There is nothing to stop this money from going directly into the pockets of shareholders. Additionally, if companies choose to continue business-as-usual operations during the time period when they are receiving free allowances, they may not end up improving the energy efficiency of their operations and could find themselves even further behind their international competitors that are already working to reduce their GHG emissions. A good example of this phenomenon would be the U.S. auto industry, which fought higher fuel economy standards and restrictions on GHG emissions and was eventually unable to compete with international companies that had already started mass producing fuel-efficient, low-GHG-emitting cars.

A final criticism of free allowances is that the more free allowances that are distributed under a cap-and-trade program, the less revenue there will be from the auction of allowances that could be used for various programs that will smooth the transition to a green economy. Such programs might include investments in clean energy technology research and development, support for green jobs training programs, transition programs for workers in carbon-intensive industries whose jobs might be eliminated in the green transition, and assistance for low-income consumers who will face higher energy costs at home and at the pump when a price is placed on carbon emissions.

Output-Based Rebates

Output-based rebates are a type of free allowance that provides incentives for firms to maintain their levels of production within a state or country that has placed a price on carbon. The free allowances in the ACES Act are in fact output-based rebates, because the number of allowances that eligible industries will receive will be based on their actual output and the industry-wide average emissions rate.

As is the case with all free allowances, output-based rebates reduce the short-term economic impact for affected firms and give these firms more time to prepare themselves for a future carbon price. Unlike other free allowances, a company would not be rewarded with allowances if it reduces production within a region that has a cap-and-trade program, because the amount of its rebate would depend on its maintaining its level of production. This would eliminate the problem of windfall profits for high GHG-emitting companies.

Additionally, if the number of allotted allowances were based on the industry's best practice for energy efficiency, this policy could maintain an incentive for leakage-vulnerable companies to reduce their GHG emissions. Companies that reduce their emissions would need to buy fewer carbon permits but will still get the same amount of allowances they received when their emissions were higher, as long as output remains stable.

The ACES Act would provide full output-based rebates for all the industries that this study has determined are carbon-intensive, as these industries meet the national criteria of greater than 5 percent energy cost intensity and greater than 15 percent trade intensity. The rebates last until 2036, as they are meant to support these businesses as they adjust to the new regulatory environment. In addition, there are a wide variety of incentives, loan guarantees, and direct investment programs that can be tapped by Oregon manufacturing industries that invest in energy efficiency and/or produce clean energy components and final products.

Border Adjustments/Consumption-Based Accounting

Under this policy, the carbon emissions associated with products *consumed* within the cap-and-trade program area would be treated similarly to those products *produced* within the area. This is how the WCI currently addresses concerns about electricity being imported into the WCI geographic region from states that are not part of the WCI and do not have comparable GHG emissions limits.

Under this policy, for example, a chemical company located in Nevada (which is not part of the WCI) whose products are being imported into Oregon would have to buy carbon allowances, as do firms whose production resides within Oregon, a WCI participant. Alternatively, the Nevada firm could pay a carbon fee at the Oregon border.

The benefits of a border adjustment policy (also called consumption-based accounting, because it addresses the GHG emissions of products consumed in a state, not just products produced in a state) are that it levels the playing field between firms operating within the WCI and firms operating in states or countries without comparable GHG emissions limits. In terms of federal climate change policy, border adjustments could level the playing field between the United States (if it implements a cap-and-trade program) and nations without comparable climate change policies. In the ACES Act, border adjustments are a fall-back option if an international climate change agreement has not been reached by 2018.

A key question that is beyond the scope of this policy brief is whether border adjustments would trigger legal challenges, either because they conflict with inter-state commerce laws or international trade agreements. There are arguments on both sides, and it would be wise for Oregon to seek advice on the legal questions surrounding this policy option. In fact, such legal opinions may already exist, as similar legal arguments would be expected to apply to the first jurisdictional deliverer policy that the WCI has decided to implement for the electricity sector.

Additionally, there are a number of technical challenges with measuring the carbon content of imports. Within a covered region such as the WCI, states can mandate reporting of carbon emissions at the level of individual companies, and have begun to do so through carbon registries. It is not possible to do so for imports without the cooperation of the state or country from which the imports originate. Because of this inability to measure carbon content of imports at the firm level, the measurement and corresponding fee or quantity of allowances to be purchased would have to be determined at the industry level, thus eliminating any incentive for a firm that exports carbon-intensive products to the WCI to improve its energy efficiency. It could also end up penalizing firms with very low emissions.

Another concern with border adjustment policies is that they could end up increasing costs for manufacturers of final products, and thus leak jobs and emissions in final goods production. For example, if U.S. automakers are importing steel from China, and a border adjustment is applied to steel imports, this will make manufacturing cars in the U.S. more expensive and could reduce the competitiveness of U.S. auto manufacturers.

Finally, there is the possibility that manufacturers could game the system if a border adjustments policy were put into place for products coming from countries without comparable GHG emissions restrictions. Manufacturers in such countries—like India—could re-route their trade through a country—like Japan—that does have comparable restrictions, thereby avoiding having to pay an adjustment at the U.S. or WCI border.

Incentives for Energy Efficiency Investments

Studies that have looked at what technologies exist or could be developed to help leakage-susceptible industries become more energy efficient have concluded that substantial investments may be required by firms if they want to avoid significant production cost increases when a carbon price goes into effect.[23]

In addition to the policy options presented above, the WCI should consider providing assistance to help these industries become more energy efficient. That assistance could come in the form of financial support for research and development programs, commercialization efforts, and demonstration programs. It could also come in the form of investment incentives such as tax breaks for companies that invest in energy efficiency upgrades.

The technologies that are available and the costs to implement them vary widely by industry and will not be discussed in detail in this paper. However, an incentive program for energy efficiency investments would need to be tailored to each industry, depending on whether its primary challenges are that the technology is not yet available or that the technology is available but is prohibitively expensive.

CONCLUSION AND RECOMMENDATIONS

The specter of droughts and flooding, future water shortages, catastrophic wildfires and other threats to the state have led to a consensus in Oregon that the cost of unchecked climate change is much greater than the cost of reducing greenhouse gas emissions. The state's various climate change policy measures—from its renewable energy portfolio standard to its participation in the Western Climate Initiative's cap-and-trade program—will reshape not only the energy industry, but the whole economy. As this green economic transition moves forward, Oregon policy makers must ensure that the state maximizes the economic opportunities associated with its climate change policies and minimizes the risks.

Maximize Quality Green Job Creation Opportunities

Oregon's leadership in reducing GHG emissions offers an opportunity for the state to develop new green jobs in areas like renewable energy, energy efficiency, and public transit. A recent study of the clean energy investments that will flow into Oregon from the American Recovery and Reinvestment Act and the ACES Act if it becomes law could lead to the creation of nearly 21,000 jobs in Oregon as the state shifts from a fossil fuel to a clean energy economy.[24] There are numerous policies the state could implement both to increase the number of green jobs created in the state and ensure that green jobs are also good jobs that pay family-supporting wages and offer benefits and career advancement opportunities.

In terms of green job creation, the state should exploit the potential for the development of clean energy manufacturing jobs by helping manufacturers access clean energy markets and adopt innovative, energy-efficient manufacturing technologies, as well as by helping manufacturers obtain loans, grants, and other financing to re-tool, expand, or establish clean manufacturing operations in Oregon.

Oregon should also make sure that the state has a trained workforce prepared for new clean energy jobs. Toward that end, the state should build upon the existing workforce development infrastructure in Oregon—rather than creating an entirely new infrastructure—to make sure that green jobs skills are incorporated into the range of workforce and education programs. (See "Worker Re-Training, page 33, for specifics.)

In terms of job quality, the state could attach job and training quality standards to public investments through such policies as prevailing wages, state-approved apprenticeship job training standards, project labor agreements, and best-value contracting. The state could also include criteria for structuring public investment to prioritize industry projects that include labor-management partnerships, as was part of the national Green Jobs Act of 2009 language.

Minimize Job Loss in Carbon-Intensive Industries

This policy brief focuses on the risks associated with climate change policies for a small number of jobs in carbon-intensive manufacturing industries. Many of these industries have already declined and face ongoing pressures due to global competition. They have also been negatively impacted by the recent economic downturn.

The industries that are of concern are those that will face significant cost increases due to a carbon pricing policy or other regulations and standards. If they are not able to pass on these costs to customers without losing sales, they may decide to decrease production in Oregon when climate change policies like the Western Climate Initiative go into effect.

Our research shows that there are very few jobs in those Oregon industries that will see significant business cost increases at realistic carbon prices. Iron and steel mills are the only industry with more than 1,000 employees that would see their production costs increase by more than 2 percent under the carbon price expected under the Western Climate Initiative. If we include industries with more than 1,000 workers that would experience a production cost increase of more than 1 percent, paperboard mills and paper mills would also be included.

The small number of jobs involved does not mean that Oregon should ignore the issue of job loss and leakage and the potential negative impact of climate change policies on these industries. Rather, the concentration of costs in a few key sectors justifies an approach that spreads these costs more fairly across the whole state. And because the problem is small, it can be addressed through targeted assistance to specific carbon intensive industries, their workers, and the communities where they are located.

⌘ Implement Policies to Minimize Leakage

Several policies for addressing leakage have been described above. They include free allowances, output-based rebates, border adjustments, and international sectoral agreements. Output-based rebates are the policy option that was included in the national climate change bill, the ACES Act. Providing output-based rebates to firms that are susceptible to leakage could reduce the short-term economic impact on these firms. The policy is similar to free allowances, but also provides for incentives for firms to maintain their levels of production within WCI jurisdictions. The ACES Act policy could be improved if the rebates were also designed to encourage firms to improve their energy efficiency.

Border adjustments could also be effective in addressing leakage. However, they may trigger legal questions regarding interstate commerce and international trade. Those legal questions are beyond the scope of this policy brief, but it would be worthwhile for Oregon to look into them to see if border adjustments would be feasible. In the ACES Act, border adjustments are a fall-back option if an international climate change agreement has not been reached by 2018.

An important consideration in designing a policy to address leakage is that it should seek to minimize carbon and job leakage while at the same time minimizing the number of free allowances that are distributed to companies. If undeserving industries are included among those that receive assistance, then less allowance revenue will be available to the state for such purposes as clean technology investments, worker training and transition assistance, and assistance to low-income consumers who may face higher energy costs under climate change policies.

⌘ Invest in Energy Efficiency Upgrades for Industry

In addition to addressing leakage through output-based rebates or border adjustments, Oregon should consider using part of its allowance revenues to help carbon-intensive industries become more energy efficient. That assistance could come in the form of financial support for research and development programs, commercialization efforts, and demonstration programs. It could also come in the form of investment incentives such as tax breaks for companies that invest in energy efficiency upgrades. Such support could encourage these industries to stay in Oregon, where they could continue providing high-quality jobs to Oregon residents.

Implement Transition Programs for Workers and Communities

⌘ Worker Transition Assistance

Job loss resulting from leakage is likely to be quite small in Oregon. Thus any job loss that cannot be prevented by the policies described above can be addressed by generous transition programs that will be affordable because of their small scale. Just as the Trade Adjustment Assistance Program was set up to help workers whose jobs were eliminated by increased imports after trade agreements like NAFTA went into effect, so there should be a climate adjustment assistance program to support and provide retraining for displaced workers.

The AFL-CIO developed strong worker protection language that was included in the ACES Act. The bill provides workers who lose their jobs because of climate change policies an adjustment allowance representing a 70 percent wage replacement and 80 percent health benefit replacement for up to three years. It also includes bridges to retirement for workers near retirement. A similar policy should be adopted as part of the WCI.

⌘ Worker Re-Training

Workers who have lost their jobs or are threatened with losing their jobs due to leakage should also receive support to be re-trained for new jobs in the growing clean energy economy. To ensure that workers are trained in the skills needed for new green occupations the state should evaluate its current workforce training and education infrastructure and make sure that new green skills are incorporated into the range of existing vocational, community college, union apprenticeship, and other training programs.

⌘ Community Transition Assistance

Since many of the carbon-intensive industries are key economic engines in their communities and regions, the state should invest in community economic development that can help diversify local economies and redeploy the skills of its workforce. The state should help businesses, labor, community stakeholders, and local government to assess the many opportunities to manufacture components for the clean energy economy. The state should help localities tap into the many new funding and support programs that the Obama administration has launched. After years of market-only policy direction, the renewed commitment to industrial planning creates real opportunities to leverage climate change policy for building partnerships to upgrade and or redeploy manufacturing plants in Oregon.

⌘ Further Study is Needed

The WCI is planning an analysis of leakage and will recommend options for addressing the problem by mid-2010. However, Oregon should conduct its own study of the particular position and prospects of its carbon-intensive industries. This is necessary to pinpoint which particular companies will be vulnerable to closure, to assess the costs of lowering their carbon content, to assess the options and transition needs of their workforce, and to carry out the community economic development planning necessary to implement solutions. Such research is critical if Oregon is to support the narrow subset of industries that actually needs assistance and to avoid broad subsidies and waivers for unaffected industries, which would deprive Oregon of allowance revenues that could be used for the green transition.

In conclusion, climate policy holds risks for Oregon's carbon-intensive manufacturing industries but there are policy remedies for those industries that may be vulnerable to leakage. Oregon's industries have lower carbon content than the same industries in other parts of the country. National climate policy as embodied in the House ACES bill would benefit Oregon, because the allocation of carbon allowances would be more than sufficient to cover current emissions. If national policy fails or changes dramatically, this may not be the case.

APPENDIX A
Methodology

This section describes the methodologies used to estimate the direct cost increases in Oregon's manufacturing sectors at the most disaggregated level of information available (six-digit NAICs codes) under a proposed cap-and-trade system.

We first estimated annual CO2 emissions from manufacturing sectors in the United States, adjusting for lower average emissions rates at the state level. For energy consumption from feedstocks, sequestration rates were used to account for the amount of carbon sequestered in the end product.[25] (Feedstocks are defined as any energy used in manufacturing that is not burned for heat, power, or electricity generation.[26])

To find out how much firms would have to pay if they were required to purchase carbon allowances, we multiplied the estimated annual tons of CO2 emissions by hypothetical carbon prices of $15, $25, and $50 per ton of CO2. Finally, we divided this result by each industry's annual total value of shipments to arrive at an estimated percentage change in cost for a given CO2 price. This data was combined with employment data at the U.S. and state levels in order to examine employment levels and wages for at-risk industries. To summarize, we carried out the following calculations:

1. Calculated total CO2 emissions by industry
2. Multiplied total CO2 emissions by industry by hypothetical CO2 prices to find total CO2 charges
3. Divided total CO2 charge by annual total value of shipments to find percent cost increase

DATA SOURCES

⌘ Energy Data

We used data on energy consumption for fuel and feedstock from the Energy Information Agency (EIA) 2006 Manufacturing Energy Consumption Survey[27] combined with EIA reports on carbon factors and emissions rates from electricity.[28]

Some energy figures in the MECS data were withheld to protect confidentially, so we were not able to calculate energy consumption for all sectors. In sectors where data accounting for more than 10 percent of energy consumption was missing, we did not calculate CO2 emissions. On average, only three percent of energy data was withheld within sectors and only five of the industries had above 10 percent missing fuel data. Only one sector included in our calculations, photographic film, paper, and plate and chemical manufacturing, had above 5 percent missing fuel data (6.8 percent) and this sector was not a large emitter relative to others.

⌘ Carbon Content

CO2 factors by fuel type (CO2/energy unit consumed) came from the EIA.[29] CO2 for each industry was calculated using a bottom-up approach, using data on energy consumption for each fuel type and its carbon factor, so that total CO2 equals energy by fuel times CO2 factor.

Next, we added up the CO2 content of each of the fuels used by industry. For feedstocks, we used the same method as above but subtracted emissions that were sequestered in the end product. For example, if the amount of CO2 emitted from using coal as material in producing a widget equals 100 tons but 30 percent of that CO2 stays in the widget then the feedstock CO2=100 X (1-.3).

We were not able to calculate process emissions, which are significant for the cement, lime, iron, steel, and nitrogenous fertilizer industries but small for other industries.

We used fuel composition for the nation by each industry, with a state-level adjustment for CO2 emissions from electricity for Oregon.

⌘ Economic Data

Data on value of shipments is from the 2006 Economic Census.[30] Employment figures were obtained from the Oregon Workforce Employment Department.[31] Where employment or wage data for 2007 were withheld or unavailable, annual averages from the most recent three years were used (e.g. 2005-07 annual average).

APPENDIX B
List of Leakage-Vulnerable Oregon Businesses

Industry	NAICS	Business Name	Carbon allowance cost increase for $15 carbon fee
Pulp Mills, Mechanical And Recycling Processing	322110	Alley Cat Recycling	3.4
Alkalies And Chlorine, Nec	325181	Arkema Inc	2.0
Cement, Hydraulic	327310	Ash Grove Cement Company	4.2
Cement, Hydraulic, Nec	327310	Ash Grove Cement Company	4.2
Lime	327410	Ash Grove Cement Company	7.5
Nitrogenous Fertilizers, Nec	325311	Atlantis International Trading LLC	3.1
Pulp Mills	322121	Boise Cascade, L.L.C.	3.4
Container, Packaging, And Boxboard	322130	Bordeleau Packaging Services LLC	2.8
Pulp Mills, Mechanical And Recycling Processing	322110	C2f, Inc.	3.4
Pulp Mills	322110	Cascade Pacific Pulp, LLC	3.4
Pulp Mills	322110	Cascades Tissue Group-Oregon Inc.	3.4
Lime	327410	Cathie Lime LP	7.5
Lime, Nec	327410	Chemlime NJ Inc	7.5
Container, Packaging, And Boxboard	322130	Chesapeake Corporation	2.8
Alkalis And Chlorine, Nec	325181	Clorox Products Manufacturing Company	2.0
Coated And Treated Board	322130	Early Ford V8 Club of America	2.8
Coated And Treated Board	322130	Evanite Fiber Corporation	2.8
Pulp Mills	322110	Georgia-Pacific LLC	3.4
Paperboard Mills	322130	Graphic Packaging International, Inc.	2.8
Chemical Preparations, Nec	325199	Hercules Incorporated	2.6
Pulp Mills, Mechanical And Recycling Processing	322130	Heron Blue Paper Company	3.4
Aldehydes And Ketones	325199	Hexion Specialty Chemicals, Inc	2.6
Nitrogenous Fertilizers, Nec	325311	Hyponex Corporation	3.1
Linerboard	322130	International Paper Company	2.8
Paperboard Mills	322130	International Paper Company	2.8
Nitrogenous Fertilizers	325311	J R Simplot Company	3.1
Fuel Briquettes And Waxes	324199	Kingsford Products Company, The Inc	8.3
Lime	327410	Lemon-Lime Creative Marketing	7.5
Lime	327410	Lime Lite Productions	7.5
Pulp Mills	322110	M S T Corporation	3.4
Lime	327410	Macauley Industrial Services	7.5
Paperboard Mills	322130	Mill Technical Services LLC	2.8
Fuel Briquettes And Waxes	324199	Oak Royal Enterprises Inc	8.3
Coated And Treated Board	322130	Pacific Quest Corp	2.8
Nitrogenous Fertilizers, Nec	325311	Robert F Bernard	3.1
Paperboard Mills	322130	Smurfit-Stone Container Corporation	2.8
Paperboard Mills	322130	Smurfit-Stone Container Enterprises, Inc.	2.8
Pulp Mills, Dissolving Pulp Processing	322110	Sofco	3.4
Paperboard Mills	322130	Sonoco Products Company	2.8
Cardboard, Tagboard, And Strawboard	322130	Spacekraft	2.8
Nitrogenous Fertilizers, Nec	325311	The Scotts Company LLC	3.1
Blast Furnaces And Steel Mills	324199	Western Smelting & Metals Inc	8.3
Cardboard, Tagboard, And Strawboard	322130	Weyerhaeuser Company	2.8
Paperboard Mills	322130	Weyerhaeuser Company	2.8

Source: Dun and Bradstreet business data, 2008.

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[6] For a more detailed explanation of how a cap-and-trade program works see http://www.epa.gov/captrade/captrade-101.html

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[17] United States Energy Information Agency. *Energy consumption and expenditures* (data file). Retrieved from http://www.eia.doe.gov/emeu/mecs/contents.html

[18] Petroleum products are the third most carbon-intensive industry, but petroleum refining—its major subsector—will not be subject to leakage because refineries are not able to relocate away from existing transmission delivery infrastructure and will be able to pass on costs to consumers.

[19] Historic electricity prices in each state are from the U.S. Department of Energy at http://www.eia.doe.gov/emeu/states/_seds.html. At the national level, electricity purchase costs by sector and TVS by three-digit NAICS code are from the U.S. Census Bureau at http://factfinder.census.gov/servlet/IBQTable?_bm=y&-ds_name=AM0631GS101. These data are from 2006; we assume that the relationship of electricity purchases to TVS in past years is the same. We divide the U.S. industrial electricity price by the Oregon industrial electricity price in each year. We then multiply this ratio by electricity purchases over TVS to convert it to a percentage of TVS. Higher electricity prices in the U.S. were responsible for about 4 percent of the TVS in extra costs in the late 1970s, and about 2 percent of the TVS in extra costs in the mid-1980s, the difference between which is 2 percent.

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[21] To make this calculation of the number of jobs in industries vulnerable to job loss, we start with the total number of jobs in the broad industries (NAICS three-digit level) and subtract only the

industries where data is available and where business costs increase less than our 2 percent threshold. For example, for primary metals, we start with 9,165 jobs, and subtract the number of jobs in NAICS codes 3313, 3315, and 3314 because these detailed industries fall below the threshold. The total is then 9,165 minus 724 minus 5,478 minus 1,460, resulting in 1,503 jobs in primary metals that may be vulnerable to dislocation.

[22] The exception is cement, which faces little global competition because of its weight-to-value ratio but which may face production declines from high carbon prices due to competition from other states or declines in domestic consumption. However, these pressures may be offset by increasing demand for cement due to new construction in alternative transportation and renewables.

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