



Business-Smart Strategies for Decarbonizing Oregon's Economy

March 2017

PREFACE

In January 2016, we convened the Oregon Business Leaders' Greenhouse Gas Emissions Reduction Task Force to design a five-year strategy for significantly reducing greenhouse gas emissions while maintaining the viability and competitive health of Oregon businesses. The task force came together with the recognition that (1) climate change presents a significant threat to our livelihoods and well-being; (2) accelerating actions to reduce emissions today is critical; (3) decoupling our economy from carbon will make us more competitive in the future; and (4) the Oregon business community can and should play an important role in determining how to best transition to a lower-carbon economy. The longer we delay, the more climate change adaptation and mitigation will cost. Taking the wrong actions today could also increase costs; increasing energy prices would hurt the pocketbooks of Oregonians and reduce the competitiveness of Oregon businesses in the global marketplace.

As members of the business community, representing a wide range of industries from manufacturing to farming and forestry, our goal was to identify practical solutions that reduce greenhouse gas emissions and contribute to a prosperous future. The task force met from January through December 2016. We were assisted by an expert technical team that provided a series of briefing papers to give task force members a foundation of common understanding regarding Oregon's greenhouse gas emissions profile, policies, programs and possibilities. We covered a range of topics including residential, commercial and industrial energy use; transportation; and forestry and agriculture; as well as multisector strategies such as carbon pricing, incentive programs and administrative measures.

The following report identifies a set of strategies and measures the task force members think show promise for reducing greenhouse gas emissions while creating jobs, growing the economy and positioning the State to provide leadership and model positive change. Oregon acting alone, no matter how well intentioned, will not have a significant national or global impact on greenhouse gas emissions reduction. But our actions can demonstrate leadership and provide meaningful options for the larger economy.

By recommending these strategies and measures, we hope to put Oregon in a position to help advance viable energy alternatives and benefit from what is likely to be a more than $1 trillion market to decarbonize the global economy.

We acknowledge that the sum of the strategies presented here will not fully realize the State's greenhouse gas reduction goals, but we do believe they are part of a significant next step in Oregon's history—one we have been honored to participate in.

Sincerely,

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The Nature Conservancy

Merritt Paulson,
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The Nature Conservancy
Oregon

The Nature Conservancy's mission is to conserve the lands and waters on which all life depends by advancing solutions that help nature and people thrive together. The Conservancy provided technical support to the Oregon Business Leaders' Greenhouse Gas Emissions Reduction Task Force to provide a forum for business leaders to identify smart strategies for reducing greenhouse gas emissions and inform our work in Oregon. The Nature Conservancy's Oregon Board of Trustees endorses the task force's work and extends its thanks to task force members for their time and dedication to this important issue.

[1] The recommendations in this Strategic Plan represent the personal views of the task force members and don't necessarily represent the views of the companies they are associated with.

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

GREENHOUSE GAS EMISSIONS AND CLIMATE CHANGE

Global greenhouse gas[2] (GHG) emissions, as measured in carbon dioxide equivalents or CO_2e, are increasing and, in turn, exponentially increasing atmospheric CO_2e concentrations. Increased GHG concentrations are already resulting in significant climate change impacts.

To avoid the irreversible consequences of climate change, consensus in the scientific community predicts that we need to keep global warming to less than 2° C, and preferably, less than 1.5° C. For this to happen, atmospheric concentrations of CO_2e need to stay below 450 parts per million (ppm) (Intergovernmental Panel on Climate Change [IPCC] 2014). In March 2016, CO_2e concentrations surpassed 400 ppm. Stabilizing concentrations at 450 ppm requires that we significantly reduce emissions as soon as possible while also investing in ecosystem approaches to mitigating GHG emissions.

How quickly we act to reduce and offset GHG emissions will have profound effects on the health and prosperity of businesses and communities in Oregon and around the world. Failing to act now will result in drastically higher climate change adaptation and mitigation costs later.

THE BUSINESS CASE FOR TAKING ACTION NOW

In 2014, the Risky Business Project, co-chaired by Henry Paulson, Michael R. Bloomberg and Tom Steyer, issued a report, *The Economic Risks of Climate Change in the United States* (Risky Business Project 2014). The report highlights the substantial and diverse risks facing the United States economy and assets due to rising sea levels, increased damage from storm surges, more frequent extreme heat events, and other side effects of climate change. The report urges business leaders to "act aggressively to both adapt to the changing climate and mitigate future impacts by reducing carbon emissions."

In addition to avoiding business costs that would result from increased climate change impacts, early investments in climate change mitigation and adaptation have the potential to significantly benefit Oregon's economy in the immediate future. As carbon becomes more constrained and expensive around the world, businesses that pursue innovations to reduce their footprint and produce products that help others reduce their GHG emissions will have a significant market advantage. Similarly, jurisdictions that have a low-carbon, low-cost energy supply and supportive policies for reducing GHG emissions will be well positioned to attract new businesses and to incite business expansion in their communities.

OREGON'S GHG PROFILE

Oregon has made significant headway in decoupling our GDP and GHG emissions. Oregon companies have taken significant actions to redesign their products and production processes to reduce their carbon footprint. Public investments and policies have also played an important role in supporting business efforts to reduce GHG emissions and innovate. The carbon intensity of Oregon's economy is already one of the lowest in the country. However, the Oregon Global Warming Commission (OGWC) (2017) projects that the State will not meet its 2020 or 2050 legislatively adopted GHG goals without further economy-wide actions to reduce emissions.

STRATEGIES AND MEASURES

The task force heard from experts and discussed a wide range of strategies to reduce GHG emissions in various sectors including residential, commercial and industrial energy use; transportation; and forestry and agriculture; as well as multi-sector strategies such as carbon pricing, incentive programs and administrative measures. We looked for GHG emissions reduction strategies with the potential to create jobs, grow the economy, and position the State to serve as a role model of responsible economic and environmental stewardship.

[2] Greenhouse gases are atmospheric gases that contribute to the greenhouse effect by absorbing infrared radiation produced by solar warming of the Earth's surface. They include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (NO_2), and fluorinated gases, including hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride.

With these goals in mind, the task force recommends the following set of strategies and measures for reducing GHG emissions in Oregon.

Strategy 1: Address congestion in the Portland metropolitan area to get freight and people moving.

- Direct and fund the Oregon Department of Transportation to work with the City of Portland, TriMet and Metro to design and implement congestion pricing and a complementary transit improvement program for the Portland metropolitan area.
- Strategically invest funds generated as part of the 2017 transportation package in order to:
  - Accelerate the adoption of "intelligent transportation systems" to improve the flow of traffic, reduce delays, and provide travelers with information that improves driving habits and choices.
  - Address key bottlenecks in the Portland metropolitan area, specifically the Abernathy Bridge on I-205, Highway 217 between Denny Road and I-5, and I-5 around the Rose Quarter.

Strategy 2: Accelerate conversion to alternative-fuel vehicles.

- Design alternative-fuel vehicle incentives to achieve maximum GHG benefits, including the electrification of buses and the use of compressed natural gas/renewable natural gas in refuse collection and other medium- and heavy-duty truck fleets.
- Support development and implementation of utility plans and the regulatory treatment of utility costs to stimulate greater investment in alternative-vehicle infrastructure.
- Develop a blueprint for the deployment of renewable natural gas as an important low-carbon resource, especially valuable for the heavy-duty vehicle sector.

Strategy 3: Regain Oregon's leadership in energy efficiency.

- Adopt progressive building codes and design Oregon's energy efficiency incentive programs to buy down the incremental cost of meeting the new codes.
- Develop a new state tax incentive program for building owners who provide energy efficiency retrofits for their renters.

Strategy 4: Invest in the development of a thorough analysis and modeling effort to inform development of any carbon pricing program.

The task force had a robust discussion of carbon pricing. While the task force was open to the possible development of a carbon pricing program designed to be neutral to positive for Oregon's economy and business sectors, task force members had differing views on how to best frame a strategy recommendation. There was strong support for actively endorsing and developing such a program as the best way to make a major impact on carbon emissions. There was equally strong support for the importance of further examination before endorsing a carbon pricing program. All task force members agreed that an effective carbon pricing program would need to be informed by a thorough analysis of the potential impacts to the economy, including impacts to the competitiveness of Oregon business sectors, energy prices and interactions with the existing regulatory framework (e.g. the Renewable Portfolio Standard and Oregon Clean Electricity and Coal Transition Plan). The program must also include effective mitigation measures to protect low-income Oregonians. The task force recommends that the business community participate constructively in any legislative effort to develop a carbon pricing program.

Strategy 5: Maximize Oregon's potential to benefit from agriculture, forestry and ecosystem-based climate mitigation solutions.

- Develop comprehensive land-based carbon accounting for Oregon and policies to expand economically sound use of ecosystem-based carbon mitigation.
- Invest in life cycle assessments and forest carbon analysis to document the carbon implications of woody biomass utilization.
- Extend the Biomass Producer or Collector Tax Credit for a wide range of biomass types, including incentives for woody biomass, municipal food waste and food processing residues to produce biomethane or renewable energy.
- Invest in modernizing irrigation systems where it will reduce energy consumption, increase water conservation, create opportunities for hydropower generation and produce additional environmental benefits.

Strategy 6: Modernize how Oregon invests in GHG emissions.

- Reauthorize the Energy Incentive Program with modifications to maximize private-sector investment. Specific improvements should:
  - Increase incentive levels and provide incentives for a broader array of energy efficiency projects.
  - Allow for funds to be disbursed on a rolling basis until the tax credit allocation is met in its entirety for the biennium.
  - Allow for incentives to be paid out based on performance instead of on an individual measure basis.
  - Allow for incentives to be provided for deep retrofit improvements that currently are required in the energy codes.
  - Better align the conservation incentive program with climate goals (i.e., tie an incentive to meeting an energy efficiency target baseline reduction, rather than to utility avoided cost rates).
- Authorize Oregon's Small-Scale Energy Loan Program to use credit enhancements and other beneficial financial tools to better leverage private sector investment, transforming the program into a fully functioning Green Bank.

Strategy 7: Require the State to develop an effective climate change mitigation and adaptation plan, and adequately fund an implementation strategy to ensure that we meet our GHG emissions reduction goals.

Strategy 8: Advocate for increased federal investments in research and development and continued investment in Oregon Built Environment and Sustainable Technologies to maintain Oregon's leadership in low-carbon technologies.

DESIGNING EFFECTIVE POLICIES

Decarbonizing Oregon's economy and adapting to the unavoidable impacts of climate change will require a strong economy that can support significant public and private investments. Just as climate change is predicted to have detrimental impacts on people and nature, measures to reduce GHG emissions, if not well designed, can also have significant negative impacts on people and nature.

Our approach to climate change adaptation and mitigation matters. Maintaining affordable energy will be critical, not only to protect rate payers—particularly low-income Oregonians—but also to maintain one of Oregon's best economic development tools. The strategies and measures listed above will need analysis and careful design to keep the economy vibrant while we reduce GHG emissions.

This report describes why it is imperative that we act now. It provides an overview of important basic facts about Oregon's economy and GHG emissions. It gives examples of how effectively designed policies can reduce our GHG footprint while strengthening our state's economy. Finally, it presents background and justification for the recommendations described above.

All too often we are faced with the false dichotomy of either protecting our environment or enhancing our economy. It is our hope that the actions described in this report will provide a roadmap for how the business and environmental communities can work together to make significant headway in reducing GHG emissions while strengthening the overall economy.

THE IMPACTS OF CLIMATE CHANGE

Climate change is ranked as the number one threat to both people and nature (Figure 1). The clearest and most economically significant climate change risks include damage to coastal property and infrastructure from rising sea levels and increased storm surges, climate-driven changes in agricultural production and energy demand, and the impact of higher temperatures on labor productivity and public health (Risky Business Project 2014).

Small changes in global temperature result in significant increases in the frequency of extreme weather events (Intergovernmental Panel on Climate Change [IPCC] 2007). Extreme weather events associated with climate change—already detrimentally affecting our transportation, drinking water, wastewater and energy systems—increase maintenance costs, interrupt business activity and put people's safety at risk. From 1995 to 2015, weather-related disasters affected an estimated 4.1 billion people and resulted in $1.891 trillion in financial losses (U.N. Office for Disaster Risk Reduction and Centre for Research on the Epidemiology of Disasters 2015).

The frequency and size of uncharacteristically severe fires, a different kind of extreme event, are also increasing. Climate change's side effects—increased annual average temperatures, decreased summer precipitation, decreased snowpack and earlier snowmelt—all contribute to longer fire seasons (Westerling et al. 2006; Littell et al. 2009; Vose, Peterson and Patel-Weynand 2012; Klos, Link and Abatzoglou 2014). The global mean fire-weather season expanded by more than 18 percent from 1979 to 2013, and the area affected by long fire-weather seasons doubled (Jolly et al. 2016). Uncharacteristically severe wildfires impact ecosystems, increase air pollution, interrupt business activity and put communities in harm's way. They have also had increasing impacts on the federal budget. In 2015, firefighting cost tax payers more than $2 billion, up from $240 million in 1985, consuming more than 50 percent of the Forest Service's budget (National Interagency Fire Center 2016).

Increasing temperatures and drought are impacting crop production in some regions. Studies predict a 12 percent decline in corn yields by 2035 (Hawkins et al. 2012) and a 30 percent decline in wheat and soybean harvests by 2050 (Challinor et al. 2014) as the world warms. In 2012, the hottest year on record, the United States had the worst corn yields in 20 years (Carrington 2013).

In the ocean, increasing temperatures and acidification are resulting in more dead zones and harmful algal blooms impacting fisheries. Climate-driven warming reduces vertical mixing of ocean water that brings nutrients up and delivers oxygen to down to deeper waters. Ocean acidification increases the energetic cost of calcification, impacting coral reefs and oyster beds, and reduces some marine organisms' ability to absorb oxygen (Fabry et al. 2008). Ocean acidification, along with the reduction of nutrients at the surface and oxygen at depth, hinders ocean productivity and the economic benefits it provides (Behrenfeld et al. 2006).

Climate change is already responsible for several known species extinctions (Urban 2015). Staudinger et al. (2012) reported these conclusions:

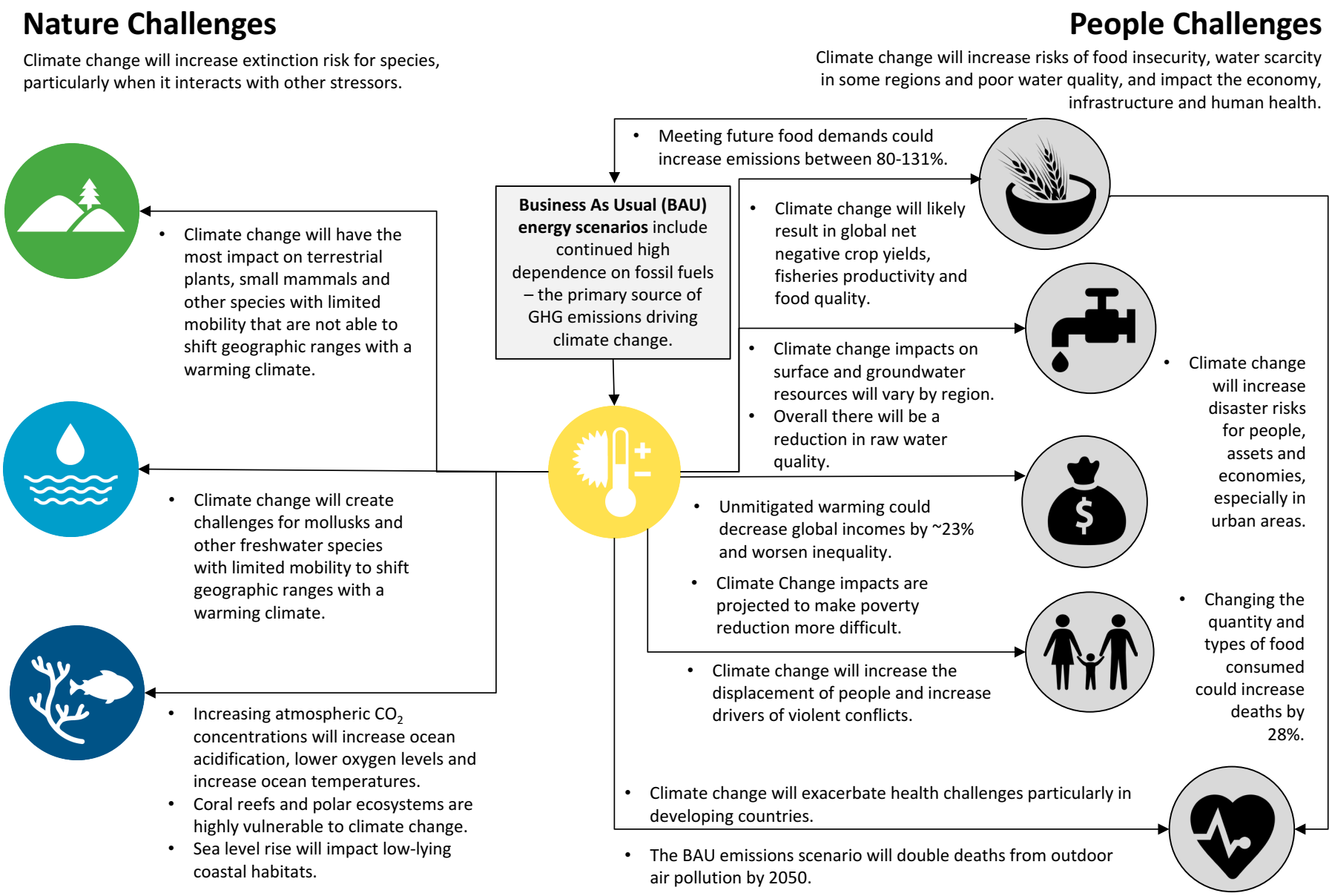
- Evidence that climate change is having impacts on biodiversity is "unequivocal" and expected to increase.
- Terrestrial species are moving upward in elevation at rates two to three times faster than earlier estimates; marine species' ranges are shifting at rates that exceed those reported for terrestrial species.
- Scientists have documented population declines that can be directly attributed to climate change.
- Species at the greatest risk of extinction are those that are ecological specialists and those that live at high altitudes and latitudes.

If the earth warms by 2°C, more than five percent of global species are predicted to become extinct. On the current emissions trajectory, the risk increases substantially with the predicted extinction of one in six species (Urban 2015).

Dalton et al. (2017) provide the following overview of expected climate changes in Oregon if we stay on our current GHG emissions trajectory:

- Oregon's climate is expected to warm on average 3 to 7°F by the 2050s and 5 to 11°F by the 2080s.

Figure 1: Overview of Climate Change Impacts on Nature and People



Sources: IPCC 2014; Burke, Hsiang, and Miguel 2015; Searchinger et al. 2013; Springmann et al. 2016; Tilman and Clark 2014

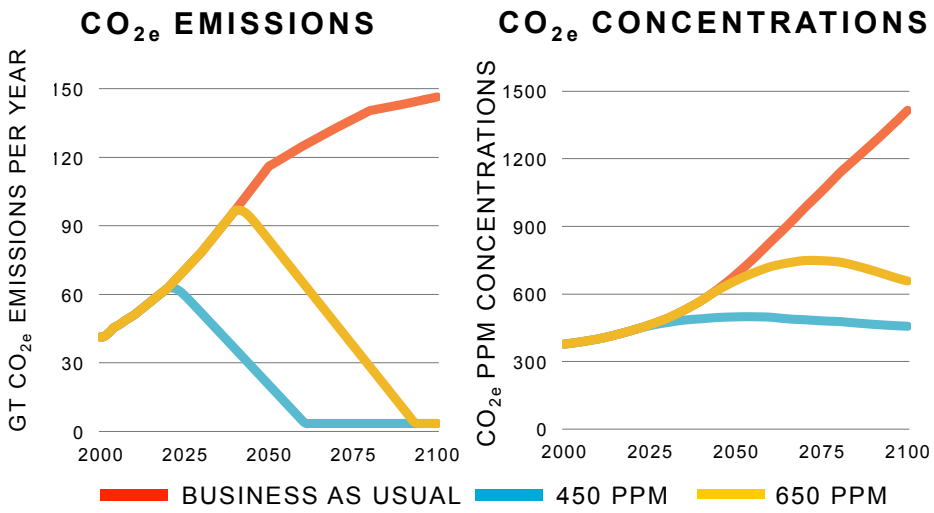
- Extreme heat events are expected to increase in frequency, duration and intensity due to warming temperatures.
- Oregon's already dry summers are projected to become drier while winter, spring and fall are projected to become wetter.
- The median summer drought extent is projected to triple during the 21st century.
- By 2050, the snowpack will be reduced by more than 50 percent from what it was in the last century.
- At Newport, Oregon, for example, sea level is projected to rise between 12 to 47 inches by the end of the 21st century.
- Impacts from greater ocean acidity, less dissolved oxygen and warmer ocean temperatures are already occurring, including impacts to oyster hatchery operations.
- Wildfire frequency and scale in all forest types will increase.

While these changes are sobering, predictions are that the Pacific Northwest will be less impacted by climate change than other parts of the country and the world. More significant climate change impacts elsewhere are predicted to increase migration to the Pacific Northwest, putting increased demands on our land and water resources and infrastructure, and compounding the impacts of climate change.

To avoid the irreversible consequences of climate change, consensus in the scientific community is that we need to keep global warming to less than 2° C, and preferably less than 1.5° C. For this to happen, atmospheric concentrations of CO_2e need to stay below 450 parts per million (ppm) (IPCC 2014). Stabilizing concentrations at 450 ppm requires that we significantly reduce emissions as soon as possible (Figure 2). In March 2016, CO_2e concentrations surpassed 400 ppm.

Decarbonizing our economy alone will not be enough to stabilize the climate. Investments in ecosystem approaches to reducing and mitigating GHG emissions will also be critical. How quickly we act to reduce and offset GHG emissions will have profound effects on the health and prosperity of businesses and communities in Oregon and around the world.

Figure 2: Change in CO_2e Concentrations Resulting from Three Different CO_2e Emissions Scenarios



Source: Energy Innovation; graph data come from Climate Interactives C-Roads Model

OREGON'S GREENHOUSE GAS EMISSIONS AND THE ECONOMY

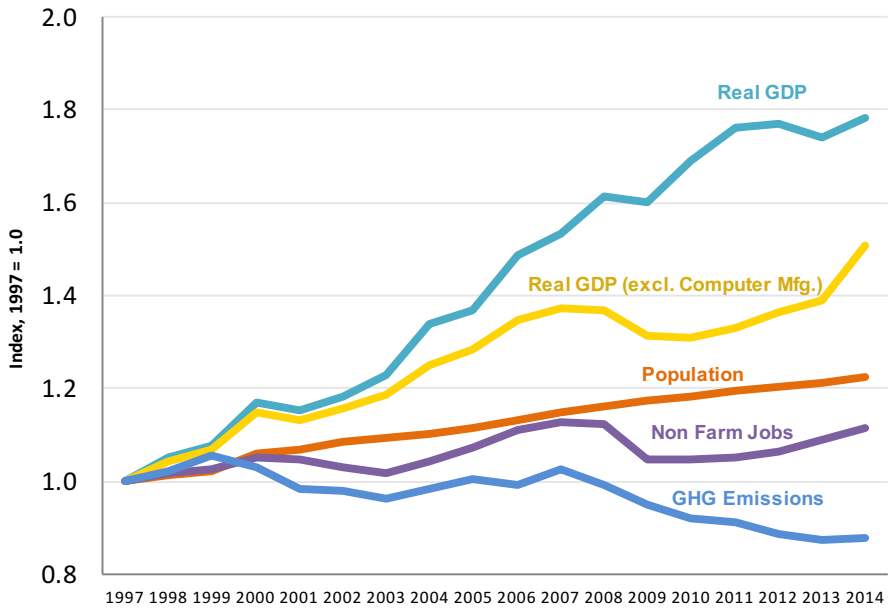
Greenhouse gas emissions vary considerably across states—whether measured on an absolute or on a per capita basis (U.S. Energy Information Administration 2015). Oregon currently ranks 38th in the nation in both total energy consumption per capita and total carbon dioxide emissions. A number of factors affect a state's GHG intensity, including the available fuel mix used to generate electricity, population density and climate, as well as state policies and investments. In terms of these factors, Oregon is generally advantaged. The state is situated in a relatively temperate corner of the continent, has access to hydroelectric power, and has long promoted policies to curb urban expansion and encourage public transportation.

The make-up of the economy also affects a state's GHG intensity. States with higher shares of manufacturing often have higher energy use and higher GHG emissions. Manufacturing represents nearly 30 percent of Oregon's GDP, second only to Indiana (Scott 2015). Manufacturing is critically important to many urban and rural communities in Oregon, with jobs that pay 30 percent more relative to the average worker's wage (Oregon Office of Economic Analysis 2015).

Historically, GHG emissions in Oregon were strongly influenced by economic conditions. The stronger our economy, the more GHG emissions we produced. However, since 1999, GDP and GHG emissions have been largely "decoupled." From 1997 to 2014, Oregon's real GDP increased by almost 80 percent while total GHG emissions declined by approximately 12 percent (Figure 3).

Taken together, at any one point in time, fuel mix and a temperate climate make Oregon a relatively low-emissions state. Over time, innovation and improved energy efficiency are reshaping the relationship between the value of goods and services that Oregonians produce and the resulting level of GHG emissions.

Figure 3: Indexed Measures of Economic Activity and GHG Emissions, 1997-2014



Sources: Oregon GDP data: U.S. Bureau of Economic Analysis, 2016; Oregon Nonfarm Jobs and Population: Federal Reserve Bank of St. Louis, Federal Reserve Economic Data (FRED), 2016; Oregon Greenhouse Gas Emissions, 1990-2014, Oregon Department of Environmental Quality, accessed October 2016

> Oregon's GDP and GHG emissions have been largely "decoupled."

CONTRIBUTIONS FROM OREGON BUSINESSES

Businesses in Oregon have taken a leadership role in helping to achieve this decoupling. Oregon semiconductor manufacturers are a good example of business achievements through innovation. They have exponentially increased the power and economic value of semiconductor chips while reducing energy inputs. Intel, for example, has reduced their global GHG emissions by nearly 60 percent since 2000. They purchased approximately 18.9 billion kilowatt hours (kWh) of green power globally from 2008 through

Advantages of Energy Efficiency

Improvements in energy efficiency allow businesses to produce goods and services at a lower cost, and allow households to save on their energy bills. The funds no longer spent on energy can be reinvested in other goods and services.

The American Council for an Energy-Efficient Economy (2015) estimated that a $15 million investment in energy efficiency creates 66 net jobs—45 in year one to implement the efficiency measures and another 21 per year (for 20 years) from energy savings redirected to other uses.

Over time, the reduced costs of energy production and the increased economic output resulting from efficiency measures can raise the overall productivity of the economy and result in higher incomes, more jobs, and a better quality of life (Whelan, Krebs, and Morgan 2014).

2015, which has had a GHG emissions impact equivalent to taking 2.7 million cars off the road for one year. Through collaboration with their logistics suppliers, they have reduced their transportation-related GHG emissions 32 percent since 2011. Intel is committed to further reducing direct GHG emissions globally by 10 percent on a per unit basis by 2020 (from 2010 levels).

Many other businesses have also stepped up in significant ways to reduce GHG emissions. Since 2002, Oregon's energy efficiency programs in investor-owned utilities have generated $3.9 billion in economic activity, including $1.2 billion in wages and $223 million in small-business income, and created 3,200 full-time jobs. They have saved ratepayers $1.9 billion on their utility bills and reduced carbon dioxide emissions by 14.6 million tons, the equivalent of removing more than 2.5 million cars from the roads in a single year (Energy Trust of Oregon 2014). Similarly, the Bonneville Power Administration and Oregon's public utilities have made significant investments in promoting energy efficiency.

The Port of Portland joined a coalition of aviation leaders, including Boeing, Alaska Airlines, and their sister Ports in Seattle and Spokane, to pursue a shared vision to increase the use of fuels produced from biomass. They have addressed the first challenge: proving that jet fuel developed from biomass can be used interchangeably with conventional fuel with no impact on performance. The next challenge is to develop regional feedstocks for biofuels (including oilseeds, forest residue, solid waste and algae) at the necessary scale for aviation fuel. According to the Port, one step in accomplishing this goal is to develop price signals, through policies such as the Clean Fuel Standard, to bolster development of biofuels.

The Oregon trucking industry has made significant strides in improving fuel economy and continues to seek innovative ways to increase vehicle efficiency. Many Oregon businesses have converted, or have started to convert, their fleets to alternative-fuel vehicles. In addition, many businesses have installed workplace charging stations for their employees, creating a rippling GHG reduction effect. Employees are six times more likely to own an electric vehicle if their workplace provides charging stations (Drive Oregon 2015).

According to The Energy Trust of Oregon (2015), "Oregon's dairies, wastewater treatment plants, municipal solid waste collectors and food processors collectively produce enough organic material to generate about 100 megawatts (MW) of biogas capacity annually—enough electricity to power all the homes in the City of Salem for a year." As of 2014, these entities had invested in the infrastructure needed to generate 20 MW of renewable energy.

Many of these innovations produce multiple benefits for Oregonians. Investments in biodigesters, for example, reduce greenhouse gas emissions; reduce food and other organic wastes that would otherwise end up in landfills; improve local air and water quality; recover nutrients; produce a local source of fertilizer for farms; and create jobs—all while generating new revenue streams and cost savings for our farmers, small businesses and water treatment facilities.

While most, if not all, businesses continue to invest in reducing their energy consumption and GHG emissions, it is important to remember that some goods and services are energy intensive by nature. For these businesses, especially those that are highly traded, changes in state policies can have a major impact on their global competitiveness. Many energy-intensive, highly traded businesses—specifically, Intel, Precision Castparts, Greenbrier, Vigor Industrial and Daimler Trucks—are in Oregon's computer,

electronics, metals and transportation manufacturing sectors. The long-term stability and viability of our manufacturing sector is an important economic consideration for Oregon.

In addition, when thinking about GHG emissions and our economy, it is important to remember that Oregon is big and geographically diverse. Long distances separate individuals in rural Oregon from necessary goods and services, and even longer distances separate rural towns and urban centers. Thus, measures to reduce GHG emissions need to recognize and avoid disproportionate impacts on rural economies.

CONTRIBUTIONS FROM LOCAL, STATE AND FEDERAL POLICIES AND PROGRAMS

Local, state and federal policies and programs have played an important role in supporting business efforts to decarbonize the economy.

In 2007, in Oregon Revised Statute 468A.205, the Oregon State Legislature codified the following non-binding GHG emissions goals:

- Begin to reduce greenhouse gas emissions by 2010.
- Reduce greenhouse gas levels to 10 percent below 1990 levels by 2020.
- Reduce greenhouse gas levels to 75 percent below 1990 levels by 2050.

Additionally, the Legislature directed the Oregon Department of Environmental Quality (ODEQ) to begin tracking emissions from transportation, energy generation, residential use, waste processing and disposal, and agricultural and industrial operations. And in 2015, Governor Brown signed the *Subnational Global Climate Leadership Memorandum of Understanding* (better known as the "Under 2 MOU").

The OGWC reports to the Legislature each biennium on the state's progress in reducing GHG emissions and works to analyze options for further reductions. For these purposes, the State tracks both in-boundary emissions and consumption-based emissions (OGWC 2015).

Along with setting emissions reduction goals, Oregon has already enacted a wide range of policies to help reduce greenhouse gas emissions. Here are some examples.

Energy Efficiency

Sector-specific incentive and rebate programs have helped to maximize energy efficiency and conservation. Oregon has adopted on-bill financing for energy efficiency, passed energy efficiency codes and standards for appliances and buildings, required low-income weatherization programs, and enabled energy savings performance contracting.

Energy Generation

In 2007, the State Legislature passed a bipartisan bill to authorize the state's Renewable Portfolio Standard (RPS). The RPS requires all electric utilities in Oregon to invest in a percentage of renewable resources but leaves each utility to decide how, when and where to invest. In 2016, with the passage of Senate Bill 1547, the Oregon Clean Electricity and Coal Transition Plan, the Legislature increased the RPS for Portland General Electric and PacifiCorp, the two largest investor-owned utilities in Oregon. The legislation requires these utilities to generate 50 percent of their total energy resource mix from renewable energy sources by 2040. In addition, the bill requires electric investor-owned utilities to completely divest from coal generation. In combination with Oregon's large supply of hydroelectric power, this bill should result in at least 80 percent of Oregonians' power being generated by renewable resources after 2040.

Under 2 MOU

The Under 2 MOU links Oregon to 135 other jurisdications, representing 32 countries and six continents. Together, they represent more than 783 million people and $21 trillion in GDP, equivalent to more than a quarter of the global economy. By signing the MOU, jurisdictions are pledging to reduce their GHG emissions by 80-95 percent, or limit emissions to below two metric tons CO_2 equivalents ($MTCO_2e$) per capita by 2050. In 2015, Oregon's per capita metric GHG emissions were approximately 15.8 $MTCO_2e$. For Oregon, achieving the Under 2 MOU goal would require an 87 percent reduction in per capita GHG emissions.

In addition to the RPS, the State has a number of complementary policies and programs to increase investments in clean energy generation, including distributed generation, net metering and tax incentives.

Transportation

Oregon has dramatically increased efficiencies in transportation and reduced fuel consumption and emissions over the last four decades. Investments in transit and bike infrastructure over the past 20 years in Portland have resulted in significantly fewer average annual driving miles per person. The Continuous Lower Energy, Emissions and Noise (CLEEN) program, within the Federal Aviation Administration's NextGen program, is improving the efficiency of commercial and freight aircraft and reducing travel delays.

Other state policies and programs that have reduced Oregon's transportation GHG footprint include:

- Investments in compact, multimodal and mixed-use communities.
- Accelerated fleet transition to alternative-fuel vehicles.
- Implementation of intelligent transportation systems.
- Incentives for alternative-fuel vehicles and lower-carbon fuels.
- Innovative financing programs.

Research and Development

Research and development serves the vital function of ensuring that progress in clean energy technologies is ongoing and that we have ever greater opportunities to reduce GHG emissions. Strong research and development also can serve as an important economic development tool. Most clean technology research and development is conducted through the U.S. Department of Energy's national laboratories.

The Oregon Innovation Council created the Built Environment and Sustainable Technologies (BEST) program to help transfer technologies from Oregon University System schools to businesses, and to provide mentorship programs and lab space to people working on developing clean energy technologies. In their first six years, they helped over 220 faculty members leverage more than 10 dollars of revenue for every state dollar invested in clean technology research or startups and helped dozens of companies develop, test and deploy new products. BEST has invested in a number of projects that will contribute to GHG emission reductions.

Finally, Oregon has been working for a number of years to closely align its emissions reduction policies with those of other West Coast jurisdictions, including British Columbia, Washington State and California. Working from a memorandum of understanding signed by the jurisdictions' leaders in 2013 and updated in 2016, the states and province are able to leverage each other's programs to lower the cost of reducing greenhouse gas emissions through economies of scale.

As a result, based on the in-boundary analysis Oregon's total GHG emissions declined by approximately 10 percent, or 7.3 MMT CO_2e, between 2000 and 2015. As part of that reduction, statewide per capita GHG emissions have dropped by 24 percent (ODEQ 2016).

Oregon BEST Success Stories

Indow Windows was a fledgling startup in 2010 with a prototype of a new thermal insert that creates the equivalent of a double-pane window without the cost of window replacement. With connections and funding from Oregon BEST, Indow Windows was able to document energy savings from their window inserts. Today, Indow Windows has 30 employees at its Portland headquarters and more than 100 dealers across the United States, Canada, and the Bahamas.

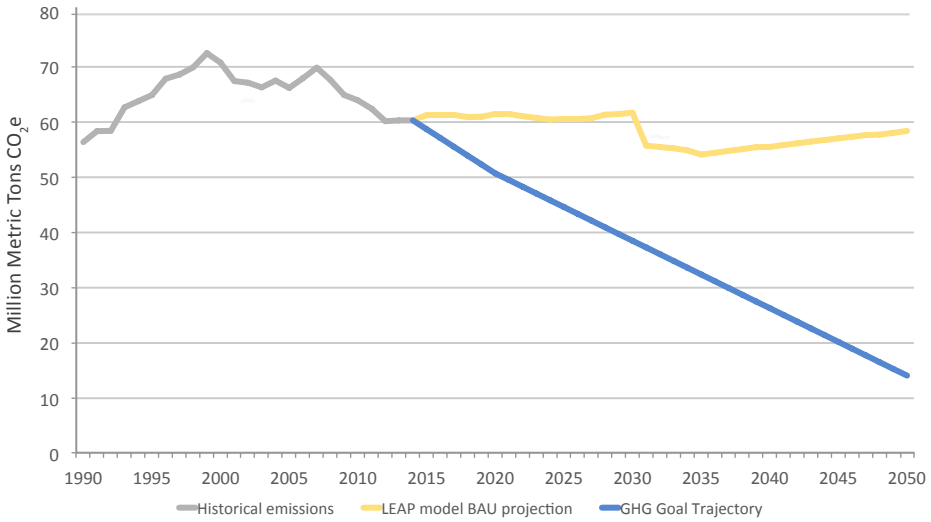
Other examples of Oregon BEST investments that will reduce GHG emissions and help grow new businesses include sensors to help better manage fertilizer applications; a high-tech tool that dramatically cuts the time needed to test solar cells for defects; and energy-saving, healthier portable classrooms that consume about half the energy of a standard portable classroom.

WHERE DO WE GO FROM HERE? STRATEGIES FOR SUCCESS

While Oregon has made important gains in reducing our GHG emissions, more can, and must, be done to continue decarbonizing our economy. On our current path, the state's forecast indicates that we will exceed Oregon's 2020 GHG emissions reduction goal by 22 percent, just under 11 $MMTCO_2e$, and far exceed the 2050 goal (Figure 4).

Developing effective measures for reducing GHG emissions requires an understanding of complex interacting factors, including the changing composition of Oregon's economy, ongoing innovations in energy use, Oregon's existing regulatory framework and emissions reduction policies in neighboring jurisdictions. The task force reviewed Oregon's greenhouse gas emissions profile and evaluated policies and programs that could be adopted to further reduce our GHG emissions. The topics we covered included residential, commercial and industrial energy use; transportation; forestry and agriculture; as well as multisector strategies such as carbon pricing, financing mechanisms and administrative measures.

Figure 4: Oregon's Historical Greenhouse Gas Emissions, and the Current "Business as Usual" Forecast Compared to the 2020/2050 Goal Trajectory



Source: OGWC 2017

Our goal as business leaders is to promote practical solutions that reduce greenhouse gas emissions while creating a prosperous clean energy future. We looked for strategies and measures that would support the following objectives:

- Make a meaningful difference in Oregon's GHG footprint.
- Have potential for creating jobs and providing benefits to Oregon businesses.
- Avoid or mitigate disproportionate impacts to low-income Oregonians and to rural economies.
- Build on Oregon's strengths.
- Meet multiple state goals.

We believe that the following eight broad strategies and associated measures outlined below are critical elements of a blueprint for a lower-carbon economy. These strategies and measures will help protect us from future risks and competitively position the State to provide technological solutions, not just in Oregon but as Oregon, to help advance the larger solution.

Strategy 1: Address congestion in the Portland metropolitan area to get freight and people moving.

Strategy 2: Accelerate conversion to alternative-fuel vehicles.

Strategy 3: Regain Oregon's leadership in energy efficiency.

Strategy 4: Invest in the development of a thorough analysis and modeling effort to inform development of any carbon pricing program.

Strategy 5: Maximize Oregon's potential to benefit from agriculture, forestry and ecosystem-based climate mitigation solutions.

Strategy 6: Modernize how Oregon invests in GHG emissions.

Strategy 7: Require the State to develop an effective climate change mitigation and adaptation plan and adequately fund an implementation strategy to ensure that we meet our GHG emissions reduction goals.

Strategy 8: Advocate for increased federal investments in research and development and continued investment in Oregon Built Environment and Sustainable Technologies (BEST) to maintain Oregon's leadership in low-carbon technologies.

The suggested strategies fall into seven categories:

- Transportation
- Energy efficiency
- Carbon pricing
- Agriculture, forestry and ecosystems
- Public investment programs
- Agency structure and authorities
- Research and development

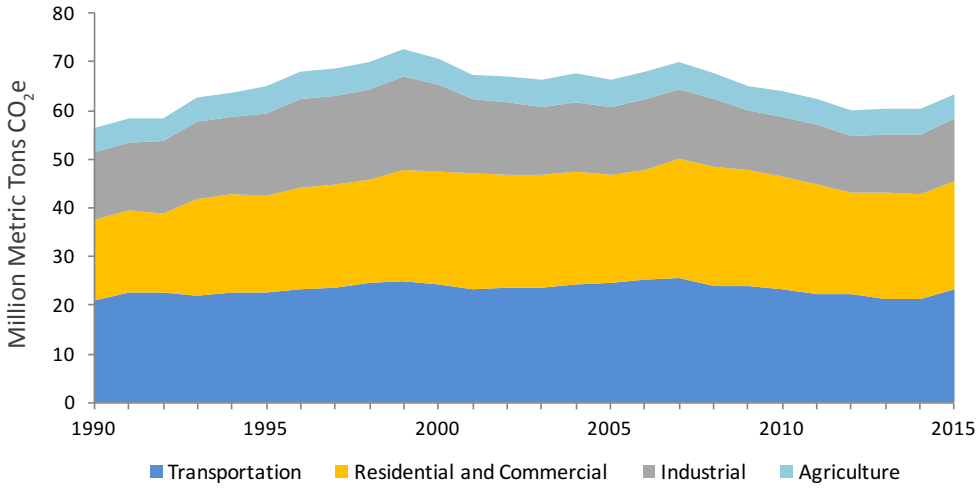
Additional information on why each of these strategies and their associated measures are being recommended is described below.

TRANSPORTATION

Sound transportation policy and investments are essential for meeting Oregon's GHG emissions reduction goals and critical to Oregon's economic future. At 23.2 million metric tons of carbon dioxide equivalents ($MMTCO_2e$), the transportation sector makes up 37 percent of Oregon's GHG emissions (ODEQ 2016) (Figure 5).

Businesses move products to market, employees travel to and from work, and customers use roadways to buy goods and services. In 2012, more than $300 billion in goods moved on all of Oregon's modes of transportation (Economic Development Research Group 2014). In that same year, there were more than 193,000 transportation-related jobs in Oregon and another 153,300 transportation-dependent jobs—nearly 20 percent of all jobs in Oregon. Oregon's traded-sector industries (computer equipment, electronics, wood products, agriculture, food/beverage manufacturing and metal manufacturing) are especially reliant on efficiency across all modes of transportation in the West Coast network.

Figure 5: Oregon's Greenhouse Gas Emissions (in $MMTCO_2e$) by Sector



Source: ODEQ 2016

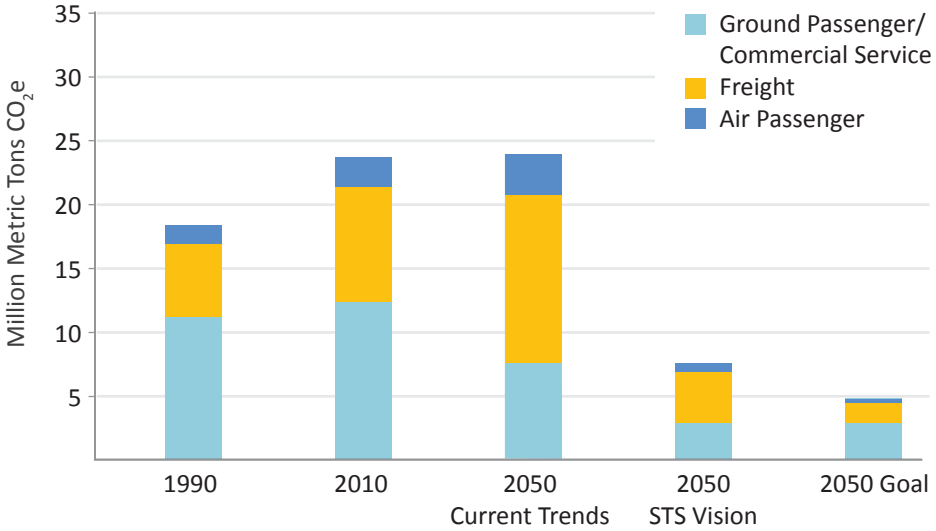
Governor Brown and the Legislature have both prioritized passing a transportation package in 2017, creating an important opportunity to advance transportation measures for reducing GHG emissions. The task force identified two key strategies in this sector.

Strategy 1: Address congestion in the Portland metropolitan area to get freight and people moving.

Freight vehicle miles traveled and the associated GHG emissions have been growing faster than any other transportation segment and are projected to increase under business as usual projections to 2050. (Figure 6.) Much of the increase in freight emissions is due to the growing congestion in Portland, an issue of statewide concern to Oregon business leaders (Transportation Vision Panel 2016). In 2014 alone, Portland area drivers consumed 39 million excess gallons of fuel as a result of congestion (Schrank, 2015). The total cost of congestion in 2014, which included wasted time and fuel, was $1.8 billion. As a result, the task force recommends that the Legislature:

Direct and fund the Oregon Department of Transportation to work with the City of Portland, TriMet and Metro to design and implement congestion pricing and a complementary transit improvement program for the Portland metropolitan area. (Measure 1.1)

Figure 6: Past and Projected Statewide Transportation Sector GHG Emissions



Adapted from the Oregon Department of Transportation's 2013 Statewide Transportation Strategy (STS)

Given the growing scope of the congestion problem and its impacts on businesses across the state, we believe it is critical for businesses to show strong support for accelerated action to implement a congestion pricing program. Reducing congestion in the Portland metropolitan area would reduce costs to businesses and speed delivery of goods to market, while improving air quality and reducing air quality related health costs. At least 14 states, including California, Florida and Texas have implemented forms of congestion pricing.

Three types of congestion pricing should be considered:

- Dynamic highway tolling (charging higher tolls to travel on highways during high-use times and lower or zero tolls during off-peak hours).
- Cordon pricing (implementing a congestion charge for entering the downtown "cordon").
- Peak-hour parking fees (placing a surcharge on entering/exiting parking garages at peak hours).

The latter two approaches would be effective tools for reducing congestion in the downtown area. However, they would be ineffective at changing incentives for drivers who do not originate or terminate a trip in downtown Portland. Drivers on Hwy 217 and I-205, and those on I-5 who bypass the city center, would be unaffected by these policies. All three types of congestion pricing may be beneficial as part of a comprehensive program for the Portland metropolitan area. Dynamic highway tolling would do the most for freight movement.

Dynamically priced highways have several benefits. First, they incentivize drivers with less need to travel at peak times to alter their time, route or mode of travel. Less congestion means less wasted time for drivers, less fuel consumption and greenhouse gas emissions, and easier mobility for freight traffic. Second, collection of tolls provides revenues for highway improvements that can address pinch points and further ease congestion. Third, the tolls can be mapped to tell transportation officials the location of high-demand facilities. As a member of the federal Value Pricing Pilot Program, Oregon is eligible to implement tolling on existing interstate highways if the tolling scheme is done to manage congestion.

Two primary issues need to be addressed to implement a fair and effective congestion pricing program. First, congestion pricing has disproportionate impacts on low-income motorists who often have less flexibility about when they work and where they live. Any congestion pricing program needs to address this concern. The Oregon Department of Transportation should work with stakeholders—particularly those representing low-income Oregonians—to fully understand the costs, benefits and community-wide implications of congestion pricing in order to design a fair and equitable program. Second, for congestion pricing to work, complementary improvements must be made in public transit to provide alternative options for drivers. For example, when London introduced their congestion pricing scheme, they deployed an extra 300 buses with new and expanded routes. They documented a 14 percent increase in bus ridership as a result of the congestion pricing scheme.

Moving people by train, bus or trolley, to and from their homes and where they work or shop, significantly reduces congestion and GHG emissions. The Transportation Vision Panel's (2016) report to Governor Brown recommends making public transit options easier to use in order to increase ridership. Specifically, they recommend reducing gaps in transit

service, maximizing transit funds (particularly the potential for leveraging federal matching funds) and increasing the flexibility of K-12 student transportation services.

Finally, while transportation experts warn that it is impossible to build your way out of congestion problems, the task force also recommends strategically investing funds generated as part of the 2017 transportation package in order to:

Address key bottlenecks in the Portland metropolitan area: the Abernathy Bridge on I-205, Highway 217 between Denny Road and I-5, and I-5 around the Rose Quarter. (Measure 1.2)

Accelerate adoption of "intelligent transportation systems" to improve the flow of traffic, reduce delays, and provide travelers with information that improves driving habits and choices. (Measure 1.3)

Strategy 2: Accelerate conversion to alternative-fuel vehicles.

Today, there are an estimated 10,000 electric and 80,000 hybrid vehicles in Oregon. The OGWC *Roadmap to 2020* (OGWC 2010) projects that the state would need to convert 10 percent of the fleet to electric by 2020 to meet the state's goals (about 300,000 cars). Oregon and California have regulations requiring automakers to increase electric vehicle car sales to 15 percent by 2025 (about 130,000 cars). The Oregon Sustainable Transportation Strategy (ODOT 2013) estimates that 53 percent of vehicles in Oregon, or about 90 percent of all new vehicles sold, will need to be electric or hybrid-electric vehicles by 2050 to reach the state's GHG emissions reduction goals.

Converting personal, public and commercial vehicles from gasoline and diesel to alternative fuels (including natural gas, renewable natural gas or biomethane, electricity, hydrogen fuel cells and biofuels) would not only significantly and immediately reduce GHG emissions, it would save consumers and businesses money. The task force recommends that the Legislature advance the following measure:

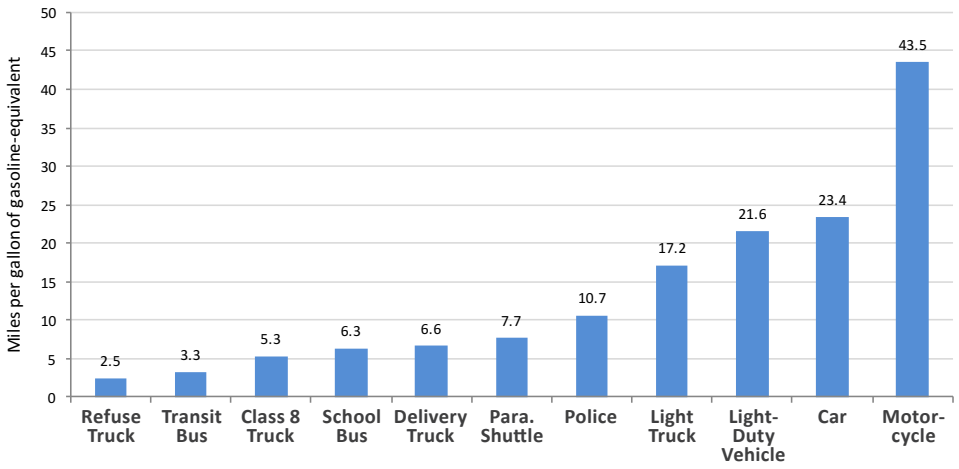
Design alternative-fuel vehicle incentives to achieve maximum GHG benefits, including electrification of buses and the use of compressed natural gas/RNG in refuse and other medium- and heavy-duty truck fleets. (Measure 2.1)

Conventional transit buses and refuse trucks have the lowest average fuel economy and higher operations and maintenance costs as compared to those fueled by electricity (Figure 7). In addition, the 2012 *Federal Transportation Act,* MAP-21, includes incentives for the acquisition of alternative-fuel buses. Both TriMet and the Lane Transit Districts received grants to purchase electric buses and are in the process of doing so.

Making alternative-fuel vehicles more practical to own and operate requires investment in residential, workplace and public charging stations (to ensure that users can fuel up when and where they need to) and public investments and incentives to accelerate the adoption of alternative-fuel vehicles.

Oregon currently ranks ninth in public and private alternative-fuel fueling stations—23 biodiesel (B20 and above), 15 compressed natural gas, 10 E85-ethanol flex fuel, 529/1,217 electric-electric vehicle stations and outlets, zero hydrogen, two liquefied natural gas, and 58 liquefied petroleum gas—with a total of 1,325 stations (U.S. Department of Energy 2016). California ranks first with 13,655 stations. Expanding natural gas fueling infrastructure is especially important to provide an alternative fuel for long-haul trucks.

Figure 7: Average Fuel Economy of Major Vehicle Categories



Source: U.S. Department of Energy: Alternative Fuels Data Center 2015

It will be difficult to establish the necessary public charging and refueling infrastructure without the engagement of Oregon's utilities. As a result, the task force recommends the Legislature and/or the Public Utility Commission advance the following two measures to expand refueling infrastructure:

Approve the development and implementation of utility plans and the regulatory treatment of utility costs as a way to accelerate investment in alternative-fuel infrastructure. (Measure 2.2)

Develop and approve a blueprint for the deployment of renewable natural gas (RNG) as an important low-carbon resource, especially valuable for the heavy-duty vehicle sector. (Measure 2.3)

The recent Oregon Clean Electricity and Coal Transition Plan enables Portland General Electric and PacifiCorp to plan for expanding the adoption of electric vehicles. These plans might include such options as a quick-charge network, a time-of-use pilot, dealer/customer education and a low-income pilot. We also support passage of legislation to enable natural gas utilities to develop similar plans for expanding the adoption of natural gas vehicles. The Oregon Department of Transportation has designated key alternative-vehicle corridors and has nominated these for future development. State policies and utility plans should be proposed that are consistent with and supportive of this coordinated corridor development.

Unlike the plans for renewable electricity, the policy and regulatory framework for integrating renewable natural gas into our transportation systems, homes and businesses has not been fully developed. A roadmap is needed to guide the policy, incentives and regulatory structures required to make these opportunities commercially viable. Legislation would be needed to implement certain portions of the roadmap and establish capital investment incentives—either on capital investment such as tax credits or through production incentives like the Renewable Fuel Standard—to help build the asset base needed for RNG to support GHG reduction goals. As an example, California's renewable fuel policies have resulted in half of all natural gas vehicles operating on RNG rather than on conventional natural gas.

In addition, Oregon currently has a great opportunity to target the $68 million Volkswagen settlement to reduce diesel emissions.

ENERGY EFFICIENCY

Strategy 3: Regain Oregon's leadership in energy efficiency.

The task force recommends that the State focus on the built environment, which is Oregon's second largest contributor to GHG emissions.

Energy efficiency, conservation and demand management are universally recognized as the most cost-effective ways to meet increasing energy needs and reduce GHG emissions. In addition, energy efficiency investments make a positive contribution to a region's economic growth potential (Whelan, Krebs, and Morgan 2014). As described earlier, improvements in energy efficiency allow businesses to produce goods and services at a lower cost, and allow households to save on their energy bills. The funds no longer spent on energy can be reinvested in other goods and services. Over time, the reduced costs of energy production and the increased economic output from efficiency measures can raise the overall productivity of the economy resulting in higher incomes, more jobs and a better quality of life.

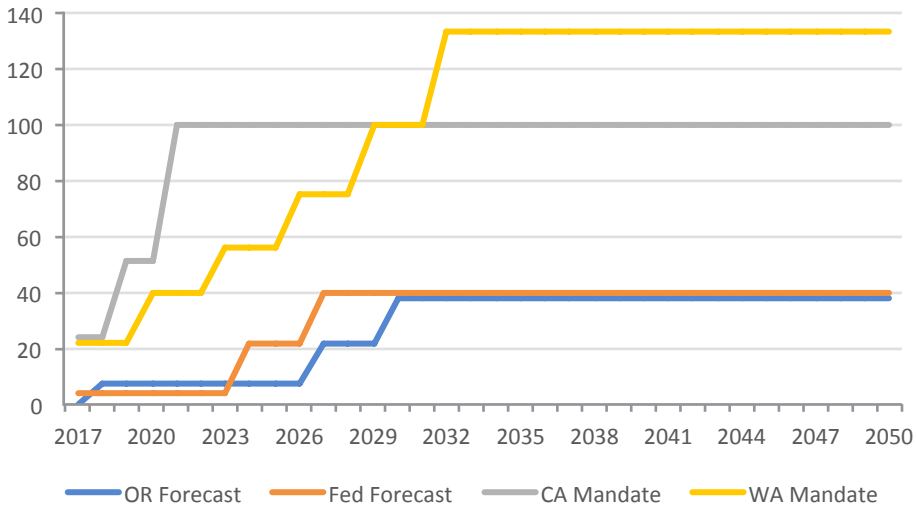
Despite the success of Oregon's existing energy efficiency programs, there is still significant work to be done to reduce emissions in this sector. The OGWC (2015) projected that investments in energy efficiency and conservation measures could result in a reduction of 6.6 MMT of carbon dioxide equivalent, or 30 percent of the total reduction from all sectors (not including a carbon tax).

The Northwest Power and Conservation Council's *Seventh Power Plan* (2016) projects that 100 percent of the region's predicted 36 percent increase in energy demand can be met through energy efficiency and conservation. The council's modeling found that energy efficiency consistently proved to be the least expensive and economically risky means of meeting future demand growth. They recommend aggressive action for the next six years to achieve this energy efficiency goal.

While Oregon has been a national leader in deploying energy efficiency, our residential and commercial energy codes have fallen behind those of other states (Figure 8). Therefore, the task force recommends two important measures to regain Oregon's leadership in energy efficiency:

Adopt progressive building codes and design Oregon's energy efficiency incentive programs to buy down the incremental cost of meeting the new codes. (Measure 3.1)

Figure 8. Forecasted Oregon and Federal Residential Energy Codes Relative to Oregon's 2014 Energy Code and Compared to Washington (Legislative) and California (Administrative) Mandates*



Source: Earth Advantage 2017

* The area under each mandate or projection represents the relative energy savings from different residential energy codes.

The task force considered two options: U.S. Department of Energy's 2015 Model Code or the Architecture 2030 Code. Both options have been adopted by other jurisdictions and provide implementation case studies.

In 2015, the U.S. Department of Energy developed a new model code for residential and commercial buildings. That code has been adopted by Idaho, Montana, Alabama and Utah to name a few.

Other jurisdictions are working to adopt the Architecture 2030 code, a code ensuring that all new buildings, developments and major renovations will be carbon neutral by 2030. Steps toward adopting the 2030 goal have been taken in a number of states. For example, Minnesota, Illinois and Ohio have laws that require buildings receiving state funding to meet the goal. New Mexico has an executive order requiring the same for state-funded buildings. Massachusetts has a grant program to help building owners achieve the goal. States have been creative in developing implementation strategies that work well for their own jurisdictions and economies. The 2030 codes have been endorsed by the National Governors Association, the United States Conference of Mayors and the National Association of Counties. Oregon's voluntary Reach Code is modeled on the Architecture 2030 Code. Building code updates can be implemented through a regulatory process administered by the Building Codes Division of Oregon's Department of Consumer and Business Services or by legislative action or executive order.

The Pacific Northwest National Laboratory (2014) conducted an analysis of nationwide adoption of the 2015 Model Code. Their analysis, looking at a period from 2013 to 2040, predicts that the cumulative energy cost savings of adopting the new code would equal approximately $330 billion (in 2012 dollars). Annual CO_2 savings potential would reach 461 MMT at the end of 2040; the cumulative potential carbon savings by 2040 are estimated at more than 6.2 billion metric tons of CO_2. The laboratory (2013) also conducted a study of the cost effectiveness of implementing the model code. That study found all of the model code measures to be cost effective.

According to the U.S. Department of Energy's calculations, the economic impact of adopting the model code for commercial buildings in Oregon would save commercial building owners $0.097/square foot annually, save $0.253/square foot in construction costs and save $1.5/square foot over the life cycle of the asset.

California recently adopted ambitious performance-based building codes. The state set an aspirational goal that all new residential buildings need to be zero net energy by 2020, and all commercial buildings must follow suit by 2030. The code also applies to retrofit projects that pass certain thresholds. The California Energy Commission (CEC) anticipates that their recently adopted residential energy code will cut energy use in homes by 28 percent and save consumers $31 a month. In addition, CEC found that the standard will cut energy use by about 281 gigawatt hours of electricity and 16 million therms of natural gas per year, reducing carbon dioxide emissions by about 160,000 metric tons per year. The 30-year cumulative savings add up to the equivalent energy use of 12 large power plants.

In the finance section below, we propose that the Oregon Legislature reauthorize the Energy Incentive Program and modify the program to maximize private-sector investment to help drive down emissions in the built environment.

Finally, there is no population in greater need of the benefits of energy efficiency than low-income Oregonians. While there are programs to help prevent their utilities from being shut off, there are insufficient resources to ensure energy efficiency retrofits for renters. In addition, building occupants are often served by separate meters and therefore pay their own utility bills. Incentives may be provided to building owners to retrofit their buildings but, since they are not paying the utility bills, there is no economic incentive for them to retrofit. Renters are left having to pay for the utilities but with no way to reduce their bills. Therefore, the task force also recommends that the State:

Develop a new tax incentive program to encourage building owners to provide energy efficiency retrofits for their renters. (Measure 3.2)

The program should provide a meaningful financial incentive, such as a property tax abatement, for landlords serving a low-income population to conduct energy efficiency retrofits. It could be administered by Oregon Housing and Community Services or another relevant agency, with technical energy oversight, measurement, and verification provided by Oregon Department of Energy. The energy savings would benefit low-income tenants.

CARBON PRICING

Strategy 4: Invest in the development of a thorough analysis and modeling effort to inform development of any carbon pricing program.

Economists overwhelmingly consider putting a price on carbon a less costly approach to reducing GHG emissions than regulatory measures (University of Chicago Booth School of Business 2011). There are two overarching economic arguments for pricing carbon. One, it corrects an underlying market failure by including the external costs of GHG emissions and their contribution to climate change. And two, it reduces GHG emissions at a lower cost than source- and sector-based mandates for technologies or processes (CCES 2013).

There are two major mechanisms for pricing carbon, carbon taxing and emissions trading. The latter is often referred to as a "cap-and-trade" or "cap-and-invest" program. Both options lead to lower emissions without dictating exactly where and how the reductions occur. Likewise, both also generate revenues. Individual pricing programs vary in how those revenues are distributed or invested. A carbon tax is effective in providing certainty on the price of carbon, while a cap-and-trade system is better at providing certainty on carbon reductions. To achieve needed emission reductions, a carbon tax needs to be high enough to substantially change behaviors that result in higher GHG emissions. Over time, the tax rate can be adjusted to achieve the emissions levels desired.

A cap-and-trade program involves setting a cap on the amount of carbon dioxide emissions that can be produced in a given jurisdiction over a given compliance period. Cap-and-trade programs provide emitters with

Emission Trading Programs

Regional Greenhouse Gas Initiative: In the eastern U.S. the Regional Greenhouse Gas Initiative (RGGI) placed a cap on carbon emissions from the power generation sector across Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. The cap has been in effect since 2009, and the emission allowances are auctioned quarterly. The auction revenues are reinvested in a variety of emission reduction programs, including energy efficiency. Market participants are allowed to offset a portion of their emissions through projects that reduce carbon emissions or sequester carbon in other sectors. In 2016 the cap is set at 86 million U.S. tons and will decline each year by 2.5 percent until 2020. The auctions have raised over $2 billion, and emissions from power plants in the region have declined 40 percent since 2005.

California and Quebec Cap and Trade Programs: California and Quebec started economy-wide emission trading programs in 2013 that placed carbon emissions caps on a range of entities, including power generators, industrial facilities, and fuel distributors. In California the program began by giving away most allowances to emitters, and it will incorporate more allowance auctions over time. Emitters have the opportunity to trade permits, which allows the market to determine where, in the economy, the emissions reductions occur. In 2014, Quebec and California combined their carbon markets, so that participants could trade permits with parties in either location. Ontario joined the California and Quebec carbon market starting January 1, 2017.

flexibility in how they comply. Permits (or "allowances") to emit carbon up to that overall cap are distributed (sold, auctioned or given away for free) to emitters. Entities that emit over their allowance are required to either reduce their emissions or purchase credits to come into compliance with their allowance through a carbon marketplace. Entities that emit less than their allowance can sell a portion of their allowance or "credits." Cap-and-trade programs identify an array of other activities that can be used to "generate credits," such as forestry and agricultural measures that capture and store carbon. As more credits flood the market, the value decreases, lowering the cost of compliance. Cap-and-trade programs include provisions for adjusting the cap downward over time, which leads to the creation of a stable and predictable long-term market. A cap-and-trade program would address one of the key challenges we currently face in meeting Oregon's GHG emission goals by turning Oregon's non-binding goals into mandatory goals.

Ideally, a global or national pricing system would be adopted to level the playing field for businesses in different jurisdictions. However, implementation of global or national system seems unlikely in the near term. Just as there are potential impacts from adopting a carbon pricing program, there are risks to waiting. In addition to avoided business costs from increased climate impacts, over the long term, early investments in climate change mitigation and adaptation has the potential to significantly benefit our economy. As carbon around the world becomes more constrained and expensive, jurisdictions that have a full suite of supportive policies for reducing GHG emissions will be well-positioned to attract new businesses and incite business expansion in their communities.

The state commissioned a marginal abatement cost curve study to evaluate the cost effectiveness of measures that could be taken in various sectors: transportation; energy generation; residential, commercial and industrial energy efficiency; agriculture and materials; and waste (Oregon Department of Energy 2012). The OGWC used the cost curve study to evaluate whether implementing a combination of cost-effective sector-focused measures would meet the state's 2035 GHG target. In their analysis, using sector measures alone, the state's GHG emissions would exceed the 2035 goal by 30 percent—when factoring in carbon pricing in addition to sector measures, the state's GHG emissions would meet the 2035 goal.

The task force had a robust discussion of carbon pricing. While the task force was open to the possible development of a carbon pricing program designed to be neutral to positive for Oregon's economy and business sectors, task force members had differing views on how to best frame a strategy recommendation. There was strong support for actively endorsing and developing such a program as the best way to make a major impact on carbon emissions. There was equally strong support for the importance of further examination before endorsing a carbon pricing program. All task force members agreed that an effective carbon pricing program would need to be informed by a thorough analysis of the potential impacts to the economy, including impacts to the competitiveness of Oregon businesses, energy prices and interactions with the existing regulatory framework (e.g. the Renewable Portfolio Standard and Oregon Clean Electricity and Coal Transition Plan). It would also need to include effective mitigation measures to protect low-income Oregonians.

In March 2016, the Legislature requested that the ODEQ conduct a study (completed in February 2017) on how a market-based approach to reducing greenhouse gas emissions could work in Oregon, specifically a cap-and-trade program. Their results indicate that a cap-and-trade program can produce emission reductions at a lower cost and can more effectively mitigation impacts to businesses than a carbon tax.

A number of critical questions must be addressed as Oregon considers next steps in developing a carbon pricing program. One of the most important questions to answer is, "How can we design a program that does not result in Oregon businesses shifting production or relocating to states or countries with a lower price on carbon?" This is referred to as "leakage." The potential for leakage can be especially significant for emissions-intensive and trade-exposed business sectors. Oregon will need to identify and evaluate the risks of leakage to different business sectors and identify the policies that would work best to avoid leakage.

A variety of policies could be considered for mitigating potential impacts to Oregon businesses:

- Proceeds from a carbon pricing program could be used to help companies reduce their emissions.
- A portion of allowances can be distributed free of charge to emissions-intensive, trade-exposed sectors.

- Market design features can be included to provide compliance flexibility.
- The use of offset credits can be allowed as a compliance instrument.
- Border carbon adjustments could be used to level the playing field for traded goods (e.g., electricity imports) and reduce leakage.

In addition, the State will need to address additional design considerations that could have positive and negative impacts on Oregon business sectors:

- Would carbon pricing be introduced as a revenue generating or revenue neutral program?
  - If revenue generation is a goal, what would the revenue fund and how would that spending affect environmental outcomes?
  - If revenue neutrality is a goal, which existing taxes and fees would be reduced and what would be the economic effects of the resulting package? And, as carbon reduction goals are met, how would the tax system be adjusted to remain neutral instead of reducing overall revenues for public services?
- How should the implementation of carbon pricing affect the levels of other existing energy taxes?
- How should the State mitigate impacts to low-income households that spend a disproportionate share of their incomes on energy?
- How should the State address disproportionate regional impacts—especially on rural populations?
- How should a local pricing system address non-CO_2 agriculture and forest-related emissions?
- If a price on carbon is introduced, should the State adjust other regulations (e.g. Renewable Portfolio Standard and Oregon Clean Electricity and Coal Transition Plan) designed to reduce GHG emissions or tailor the pricing mechanism to recognize the GHG emission reductions achieved by the existing regulations?
- How should the State administer a tradable-permits market and/or monitor emissions?

The task force recommends that business leaders invest in the development of additional economic modeling to test the assumptions and conclusions in ODEQ's report and constructively engage and inform any legislative efforts to develop a carbon pricing program for Oregon.

AGRICULTURE, FORESTRY, AND ECOSYSTEMS

Strategy 5: Maximize Oregon's potential to benefit from agriculture, forestry and ecosystem-based climate mitigation solutions.

Agriculture and forestry are an important part of Oregon's heritage. They provide products and raw materials for our manufacturing sector and are a large contributor to our rural economies. These sectors are unique in that they both produce GHG emissions but also can provide GHG emissions mitigation through actions that increase sequestration. The potential to reduce GHG emissions from these sectors appears to be much smaller than from the energy generation, energy efficiency and transportation sectors. However, due to their importance in Oregon, the task force believes it is important to advance measures to reduce GHG emissions that would benefit these sectors. The right investments in the way we manage our farm and forest lands would not only help to continue the positive economic benefits these land uses provide, but also set the stage for continued innovation that would provide GHG benefits and help achieve other state goals, such as increased efficiency in water use and reduction of wildfire risk.

The 2015 Paris Climate Agreement encourages the use of land- or ecosystem-based measures to reduce emissions and sequester carbon. A recent global analysis estimates that these natural pathways involving conservation, restoration and changes in land management could provide up to 37 percent of the global GHG emissions reduction needed by 2030 (Griscom et al. *in review*).

Calculating greenhouse gas emissions related to agriculture, forestry and ecosystem is complex. Scientists disagree on how to best calculate the carbon emissions implications associated with land management actions and the use of biomass as a substitute for other fuels. The State's current GHG emissions tracking protocols don't fully account for emissions or for the sequestration potential in Oregon's farms, forests and ecosystem-based carbon pools. Without a more comprehensive assessment, it is hard to create an ecosystem market that maximizes contributions from these sectors. The task force recommends advancing four measures to reduce emissions and increase opportunities for sequestration in this sector:

Develop comprehensive land-based carbon accounting for Oregon and policies to expand economically sound use of ecosystem-based carbon mitigation. (Measure 5.1)

Improved land-based carbon accounting would offer new opportunities for landowners to finance sustainable land management activities and help to mitigate climate change. The OGWC is currently collaborating with Oregon's Departments of Forestry, Energy and Environmental Quality to discuss issues related to the natural carbon flux associated with different forest types and different management scenarios. We recommend that these discussions be expanded and that the State develop a comprehensive carbon accounting methodology for all lands.

Invest in life cycle assessments and forest carbon analysis to document the carbon implications of woody biomass utilization. (Measure 5.2)

If sourced appropriately, woody and agricultural biomass can be a lower-carbon source for energy production than traditional baseload fossil fuels. In order to realize these benefits, policy development and planning and implementation of biomass projects need to be fully informed by science.

Oregon is in a strong position to add expertise in forest carbon accounting to these debates. In addition, Oregon has active programs to accelerate forest restoration and state policies that promote the use of sustainable biomass for energy production. Once the State has addressed the outstanding questions about the role biomass can play in meeting Oregon's GHG targets and federal compliance requirements, additional policies could be implemented to support scientifically sound use of woody biomass to replace fossil fuels.

Extend the Biomass Producer or Collector Tax Credit for a wide range of biomass types, including incentives for woody biomass, municipal food waste and food processing residues to produce biomethane or renewable energy. (Measure 5.3)

As described earlier, anaerobic digesters allow for the production of biomethane that can produce renewable electricity or gas that can be conditioned into pipeline-quality renewable natural gas to be used to fuel vehicles or to serve natural gas customers. Anaerobic digesters may be located at waste water treatment plants, farms, food processing facilities, and food waste handling facilities. Food waste has been recognized as a significant contributor to methane emissions, and the ODEQ has reported that only two percent of food waste is currently recovered. There is significant room to improve the management of these organic waste streams to provide beneficial and GHG-reducing uses.

Oregon currently provides an incentive for anaerobic digesters through the Biomass Producer or Collector Tax Credit. Under this program, biomass that is delivered to an anaerobic digester facility and used to produce energy is eligible for a volumetric incentive, depending on the type of biomass that is used. The current program provides an incentive for animal manure, agricultural biomass, used oil, and woody biomass. In 2015, the Oregon Legislature extended the tax credit for animal manure through 2021 at a reduced rate. Incentives for the other forms of biomass will end in 2017, when the broader program is set to expire.

Invest in modernizing irrigation systems where it will reduce energy consumption, increase water conservation, create opportunities for hydropower generation and produce additional environmental benefits. (Measure 5.4)

Oregon State University reports that the agricultural industry in Oregon accounts for more than $49 billion, or 15 percent, of the state's economic activity (Oregon Business Plan 2016). Associated jobs number more than 260,742 or 12 percent of the state's employment. Irrigation systems in Oregon move 85 percent of the state's water; many irrigation systems were built decades ago without the benefit of modern technology. Modernizing irrigation systems can provide multiple agricultural and environmental benefits. Where modernization can reduce waste, such water can be put back into streams to benefit fish and wildlife and/or be made available to more junior water users. Where new systems decrease the amount of energy needed to pump water and provide an opportunity for in-conduit hydropower installations, this can also reduce GHG emissions.

Oregon currently has utility-funded agricultural energy efficiency programs, such as those administered by the Bonneville Power Administration and the Energy Trust of Oregon, as well as policies and programs that encourage the installation of hydropower generation facilities. Business leaders should support a continuation of these incentive programs.

PUBLIC INVESTMENT PROGRAMS

Strategy 6: Modernize how Oregon invests in GHG emissions.

Transitioning to a low-carbon economy will require "unprecedented amounts of dependable, accessible, and fully-scaled capital-financing … with varying risk tolerances" (Berlin et al. 2012). While regulations provide a pathway to reducing GHGs in Oregon's economy, public

investment programs can help to reduce the cost of compliance, scale new technologies, accelerate market transformation, and spur private sector innovation and investment.

Federal investments in clean energy projects through direct lending, tax expenditures and loan guarantees have declined significantly since 2009 (Jenkins et al. 2012). Oregon's primary clean technology investment programs—*the Energy Incentive Program, the Renewable Energy Development Grant Program, and the Transportation Tax Credit Program*—are scheduled to expire at the end of 2018. The Legislature would need to reauthorize them in the 2017 session. This would provide an opportunity to make changes to the energy conservation incentive program. Also, these programs could be better designed to maximize private sector innovation and investment, leveraging the state's dollars to achieve a greater level of total investment and GHG reduction. To work best, state investments and incentive programs should be assessed and updated as new technologies are developed and market conditions change. In addition, they should be designed to leverage federal, rate-payer or private funding programs, and to maximize the total investment. Well-designed public financing programs can create jobs, increase state revenue and leverage private sector investment that otherwise would not happen. The task force recommends two measures for modernizing Oregon's investments in GHG reduction:

Reauthorize the Energy Incentive Program (EIP), with modifications, to maximize private sector investment. (Measure 6.1)

Specific improvements should include the following objectives:

- Increase incentive levels and provide incentives for a broader array of energy efficiency projects.
- Allow for funds to be disbursed on a rolling basis until the tax credit allocation is met in its entirety for the biennium.
- Allow for incentives to be paid out based on performance instead of on an individual measure basis.
- Allow for incentives to be provided for deep retrofit improvements that currently are required in the energy codes.
- Better align the conservation incentive program with climate goals (i.e., tie incentives to meeting targeted energy efficiency baseline reduction, rather than to utility avoided-cost rates).

Authorize Oregon's Small-Scale Energy Loan Program to use credit enhancements and other beneficial financial tools to better leverage private sector investment, transforming it into a fully functioning Green Bank. (Measure 6.2)

"Green Banks" bridge existing gaps between borrowers who wish to install smaller renewable energy and energy efficiency projects and existing sources of private capital. The differentiating principle of a Green Bank is that it can leverage public funds by deploying them to facilitate private financing, rather than directly granting or gifting funds. Green Banks are designed to be self-sustaining; public funds are recovered and reused. Green Banks help leverage an initial seed investment from the state. Connecticut's and New York's Green Banks have successfully done so through offering credit enhancement to the private sector.

Green Banks can help with market transformation. By intervening in the market and facilitating the private financing of renewable energy projects, Green Banks can lower overall costs by growing the market for renewable energy and efficiency projects, and achieving economies of scale in installation and manufacturing. A Green Bank would accomplish this goal by acting as a direct lender to small renewable energy and energy efficiency projects, and by providing credit enhancements to private lenders.

Oregon's Small-Scale Energy Loan Program (SELP) has the same overarching goal as other Green Banks in that it is used to fund clean technology. However, the SELP is currently only able to do direct lending; it does not have the authority to use all of the financial instruments available to more sophisticated Green Banks. The Legislature would need to authorize the use of credit enhancements for the agency administering the program. In addition, the task force supports Governor Brown's recommendations to move financial oversight of SELP to Business Oregon; to create a way for Oregon Department of Energy to provide technical oversight, measurement, and verification for renewable energy and energy efficiency grants, loans and loan guarantees; and to fully recapitalize the program.

AGENCY STRUCTURE AND AUTHORITIES

Strategy 7: Require the State to develop an effective climate change mitigation and adaptation plan and adequately fund an implementation strategy to ensure that we meet our GHG emissions reduction goals.

Agency structure, authorities, and funding also limit Oregon's ability to meet our GHG emissions reduction goals. The programs for reducing GHG emissions in Oregon are spread across numerous state agencies. Currently, the OGWC, staffed by personnel (less than one full-time equivalent) housed in the Oregon Department of Energy, is responsible for reporting the State's progress toward climate goals and developing policy recommendations. The commission receives little to no state financial support. The Oregon Legislature's Joint Interim Committee on Department of Energy Oversight (2016) identified climate policy as needing more attention and better coordination at the state level. Without an effectively resourced and functioning focal point for climate policy, it will be extremely difficult, if not unlikely, for Oregon to meet our GHG emissions reduction goals. The task force supports action to develop an effective climate change mitigation and adaptation plan and adequately fund an implementation strategy.

With the proper staffing and funding, the OGWC could leverage its existing expertise to help the State make faster progress in reducing GHG emissions. Increasing OGWC's staff and analytic capacity would create an entity that can comprehensively address long-term and incremental planning for meeting the state's GHG reduction goals. Moreover, these changes will help ensure the State places meeting its GHG reduction goals alongside other priorities.

Increasing staff and analytic capacity for the OGWC would provide the State and stakeholders with better data regarding potential pathways to meeting GHG reduction goals and their economic impacts. Over time, the state would benefit from more strategic oversight, planning, and implementation of policies and programs. This new capacity and function for OGWC would also increase transparency and improve input into policy proposals.

While it is not appropriate for OGWC to have regulatory oversight over the broad array of state agencies that need to engage in GHG emissions reduction, the OGWC does need to be able to access existing data from these agencies to inform policy development moving forward. The Joint Interim Committee on Department of Energy Oversight (2016) recommended that each agency with a role in reducing GHG emissions be given statutory direction on their roles and expected contributions to meeting the state's climate goals.

RESEARCH AND DEVELOPMENT

Strategy 8: Advocate for increased federal investments in research and development and continued state investment in Oregon BEST to maintain Oregon's leadership in low-carbon technologies.

Last, as described earlier, research can play a critical role in accelerating new technologies and building Oregon businesses. As noted above, most clean technology research and development is conducted through the U.S. Department of Energy's national laboratories. However, the Oregon BEST program has helped to build Oregon businesses by transferring technologies from Oregon University System schools, and providing mentorship programs and lab space to people working on clean energy technologies. The task force recommends that business leaders support continued investments in Oregon BEST.

DESIGNING EFFECTIVE POLICIES

We are confident that the strategies and measures identified above are important for further reducing GHG emissions in Oregon. However, it also matters how these measures are ultimately designed. Just as climate change is predicted to impact people and nature, measures to reduce GHG emissions can also impact people and nature if they are not designed well. We will not succeed in meeting our climate mitigation and adaptation goals if measures to reduce our GHG footprint drive businesses out of Oregon.

Energy Innovation (2015) cautions that there are many more examples of ineffective GHG emissions reduction policies than there are of good ones. For example, aggressive policy mandates with no consumer protection mechanisms can spike the cost of energy, whether electricity or transportation fuels. Today, Oregon ranks 43rd in the nation in total energy expenditures per capita. We have some of the most competitive energy prices in the country (U.S. Energy Information Administration 2015). Maintaining affordable energy is not only important to protecting rate payers, particularly low-income individuals; as described earlier affordable energy is an economic development tool the State can use to recruit large industrial and manufacturing facilities and other businesses to Oregon.

In addition to reducing greenhouse gas emissions, Energy Innovation suggests that the best policies should save money, boost the economy, and preserve the environment. They identify a number of design principles that are important to achieving all of these desired outcomes.

Performance Standards

- Design standards to provide businesses with long-term certainty and a fair planning horizon.
- Build in continuous improvement.
- Set the desired outcomes and allow businesses to find the best way to achieve them.

Economic Signals

- Create a long-term goal and provide business certainty.
- When the cost of negative externalities for a technology is known, set taxes or subsidies at that price and let the market achieve the outcome.
- When the desired performance outcome is known, use price-finding mechanisms to achieve the outcome.
- Streamline processes to accelerate adoption of clean energy technologies.
- Reward production, not investment, for clean energy technologies.
- Capture 100 percent of the market and go upstream when possible.
- Ensure that economic incentives are liquid and minimize unnecessary transaction costs.

Support for Research and Development

- Create long-term commitments to research.
- Use peer review to help set research priorities.
- Set milestones to identify underperforming projects early and redirect funding.
- Concentrate research and development by type or subject to build critical mass, reduce coordination challenges, facilitate knowledge sharing, and avoid duplication of work.
- Make high-quality public sector facilities and expertise available to private firms.
- Protect intellectual property without stymying innovation.
- Ensure that companies have access to high-level science, technology, engineering, and math talent.

These principles—along with the importance of the manufacturing sector in Oregon's economy, the disproportionate impact GHG emissions reduction measures can have on low-income Oregonians, and the added burden remote, rural communities face due to longer travel distances—should all be taken into account in deciding how the strategies and measures we recommend are designed and implemented.

CONCLUSIONS

The Risky Business Project (2014) identified the substantial and diverse economic risks climate change poses to businesses and communities. Our task force took these risks seriously.

As we reflect on our task force discussions, three key take-aways stand out:

- It is possible to grow the value of the goods and services we produce while reducing GHG emissions. Oregon's GDP and GHG emissions have been largely "decoupled." Over the past two decades, Oregon businesses have proven this by growing the value of the goods and services they produce by almost 80 percent while helping to reduce total GHG emissions by approximately 12 percent.
- Well-designed public policies and investments have an important role to play in supporting business efforts to reduce GHG emissions and innovate; they can also provide economic benefits. We learned of many examples of the positive effects GHG emissions reduction measures can have on the economy.
- Oregon needs to strengthen its approach to addressing emissions and climate adaptation. Oregon will not meet our GHG emissions reduction goals without additional sector-specific and economy-wide actions. On our current path, the state's forecast indicates that we will exceed Oregon's 2020 GHG emissions reduction goal by nearly 11 $MMTCO_2e$ or 22 percent, and far exceed the state's 2050 goal. Climate policy needs more attention and better coordination at the state level. All relevant agencies need statutory direction on their roles and expected contributions to meeting the state's climate goals.

The strategies and measures we selected will significantly reduce GHG emissions in Oregon. If done well, they will also improve the resilience of our economy, create jobs, and protect and enhance our natural environment. The business community can, and should, play a vital role in the design and implementation of the strategies and measures we identified to ensure that we achieve all of these goals critical to Oregon's future.

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