OREGON:

Changing Climate, Economic Impacts, & Policies for Our Future

Environmental Entrepreneurs

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Author and Contributors

This report was authored and designed by Rebecca Deehr for E2. Mary Solecki and Jeff Benzak of E2 provided editorial support.

Acknowledgements

Thank you to the authors and publishers of key reports that contributed to this document: the Institute for a Sustainable Environment at the University of Oregon and ECONorthwest, for their 2009 publication, "An Overview of Potential Economic Costs to Oregon of a Business-As-Usual Approach to Climate Change"; the 2013 publication, "Climate Change in the Northwest", by editors Meghan M. Dalton, Philip W. Mote, and Amy K. Snover, as well as the Northwest section of the 2014 National Climate Assessment (with convening lead authors Mote and Snover); Bloomberg New Energy Finance's publication, "2016 Sustainable Energy in America Factbook", produced for the Business Council for Sustainable Energy; and the Risky Business Project's 2014 publication, "Risky Business: the Economic Risks of Climate Change in the United States" which provided the initial inspiration for this document. To these authors, entities, and publishers, and to the many others referenced in this document: thank you for your work and for your contributions to climate change research and knowledge.

Additional thanks to the following people for their review and feedback on this document: E2 Oregon Chapter Directors Chris Dennett, Alex Wall, and Erik Wohlgemuth, Kathie Dello of the Oregon Climate Change Research Institute, Jana Gastellum and Angela Crowley-Koch with Oregon Environmental Council, Mike Mercer with E2, Brad Reed and Thomas Wheatley of Renew Oregon, Sarah Severn with Sarah Severn Consulting, and Kristen Sheeran with Climate Solutions. Report contents are the view of E2 and the author. Bob Keefe of E2 made funding for this report possible, with generous support from E2 members and Energy Foundation.

About E2

Environmental Entrepreneurs (E2) is a national, nonpartisan group of business leaders, investors, and professionals from every sector of the economy who advocate for smart policies that are good for the economy and good for the environment. Our members have founded or funded more than 2,500 companies, created more than 600,000 jobs, and manage more than $100 billion in venture and private equity capital. For more information, see www.e2.org or follow us on Twitter at @e2org.

June 2016

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INTRODUCTION

Climate change costs us millions of dollars each year, dragging down the economy and directly impacting business and industry.

Warmer temperatures, drought, and severe weather wreak havoc on farmers and ranchers. Vanishing snowpack and dwindling streamflow impact the outdoor recreation industry as well as agriculture, fisheries, and our public utilities. Ocean acidification causes steep losses for the shellfish industry. Ever-increasing wildfires impact the timber industry and many other sectors. And the list goes on.

Taking action now to address climate change will help alleviate these existing economic burdens, and will also lessen the even more severe economic impacts we know will arrive in the coming decades.

The same policies that can be enacted to address climate change can benefit the economy directly, today. Putting in place measures like clean fuel standards, renewable portfolio standards, and pricing for pollution boosts the economy. These policies can create more local, high-paying jobs, bring significant economic gain, reduce consumer spending, and bring an impressive return on investment.

It would seem that *not* taking action on climate change is the riskiest economic move to make.

Some states and countries have recognized this, and put in place policies that mitigate climate change and grow the economy at the same time. Oregon, with its clean fuel standard, standards for renewable energy creation,

its support for energy efficiency, and more, has taken impressive steps.

But more needs to be done. In order to stay on this path, where a clean economy is a powerful and effective solution to climate change ills, as well as a major contributor to the economy as a whole, continued action is necessary.

With continued action, we will begin to see a path forward that is far less damaging and costly, where the growth of a successful clean economy helps us battle the central economic and environmental challenge of our generation – climate change.

What's in this Report?

This document includes three parts. "Part I: The Economic Impacts of Climate Change in Oregon" reviews the documented changes that are most notable or severe and the associated economic impacts. "Part II: The Clean Economy" discusses the state of the clean economy in the U.S. and Oregon. "Part III: Model Policies and their Economic Impact" lays out policies that can address climate change and also provide economic benefit.

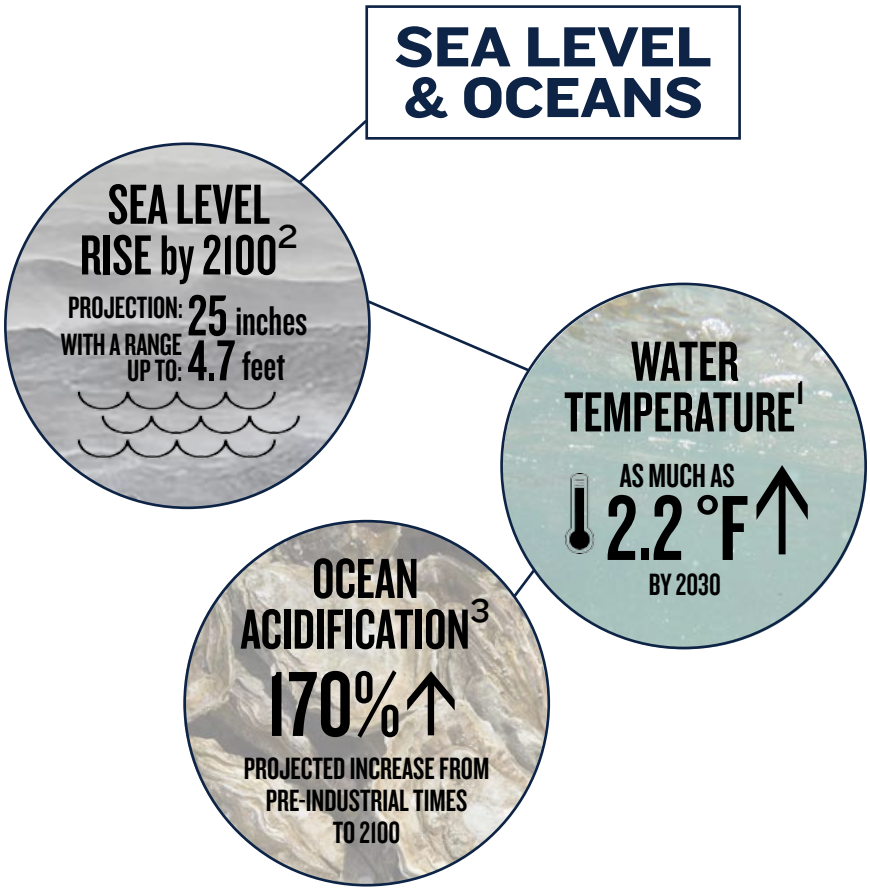
This report is meant to serve as a resource for businesses, entrepreneurs, and policymakers who wish to know more about the economic aspects of climate change in Oregon. Though Oregon is the focus, regional, national, and international information is used for context when appropriate and when state-level information is unavailable.

Future Environmental Changes: What to Expect

Environmental changes are the driver for the economic impacts discussed in Part I and are included here to give context.

There are notable and in some cases drastic changes for Oregon in store, even with a small average temperature change. In the Pacific Northwest, we can expect an increase in annual temperature of 3.3 °F to 9.7 °F for 2070-2099 (compared to 1970-1999), with the low end possible only with significant emissions reductions.[1]

These projections are based on the best available science and are all specific to Oregon. Some of these projections reflect a "business as usual" emissions scenario, where our current emissions levels are modeled and are therefore more severe than a future with reduced emissions.



WATER & SNOW

EXTREME HEAT by 2100[4]

MORE EXTREME HEAT DAYS THAN TEXAS IN 2015

SUMMER PRECIPITATION[1]

AS MUCH AS ↓30%

SNOWMELT, 2050[1]

3-4 WEEKS EARLIER

IRRIGATION WATER SHORTAGE[1]

77% CHANCE EACH YEAR, BY THE 2080s

"EXTREME" PRECIPITATION[1]

AS MUCH AS 20%↑

BY THE 2040s

FORESTS

WILDFIRE # of ACRES BURNED[1]

X4

(2080s)

EASTERN OREGON[1]

UP TO 600%↑

ACRES BURNED

(2080s)

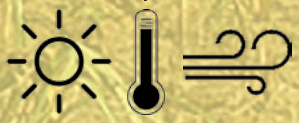
OREGON'S AGRICULTURE:
Oregon's agriculture sector contributes $5.4 billion in commodities to the economy.

Hay (alfalfa and other) and wheat top the list of crops at 1,030,000 acres and 818,000 acres, respectively.

The top ten commodities are 1. Cattle & calves, 2. Greenhouse & nursery, 3. Hay, 4. Milk, 5. Grass seed, 6. Wheat, 7. Potatoes, 8. Hazelnuts, 9. Pears, and 10. Grapes for wine.

2014 rankings and information.[5]

U.S. EXTREME WEATHER COSTS
$9 BILLION
EACH YEAR, 1980-2011



5 °F INCREASE=
$5 BILLION
EACH YEAR IN U.S. DRYLAND FARMING LOSSES

PART I:
ECONOMIC IMPACTS OF CLIMATE CHANGE IN OREGON AND BEYOND

WATER & SNOW

As the annual temperature increases, businesses and communities will experience many changes. Lack of snow, earlier spring snowmelt, and reduced summer rainfall will impact industries dependent on both snow and summer streamflows, such as skiing and outdoor recreation industries, fisheries, the power sector, agriculture, and more. In turn, higher food production costs will increase the cost of food.

At the same time, there will be a higher likelihood of seasonal flooding and landslides on our urban roads, rural highways, and other infrastructure, placing a greater burden on public and private infrastructure and investments.

I. AGRICULTURE

EXTREME WEATHER: The cumulative effects of extreme events (e.g. flooding, heat, drought) cost the agriculture sector over $275 billion between 1980 and 2011 across the U.S. – or nearly $9 billion a year.[6]

CROP PRODUCTIVITY LOSSES: In the U.S., after temperature increases, crop yields begin to decline. One study found that a 5 °F increase resulted in annual losses of $5 to $5.3 billion for dryland farming. Other studies note crop yields have already begun to decline, globally.[7]

FOOD PRICES: Food price increases have already occurred; the price of commodities such as cereals, grain, and rice more than tripled between 2005 and 2008. There

were multiple factors leading to this increase, but droughts in numerous countries were a main source of this change.[8]

In the U.S., food price increases of 20% on average are expected by 2050. This comes along with a 17% reduction in productivity.[9]

DROUGHT COSTS: Droughts covering multiple states can be very costly; the 2012 U.S. drought came with an estimated price tag of $31.2 billion and was the most severe drought since the 1930s.[10] By 2080 the risk of a water-short year may increase from 14% to 77% in Oregon.[11] 2015 started out with record-low snowpack, saw two-thirds of counties declare drought by July, and ended up being the warmest year on record. Not as severe as 2015, the 2001-2002 drought was still damaging, with 200,000 irrigated acres of farmland impacted.[12]

COST OF EXTREME HEAT: Record temperatures in 2011 caused heat-related losses that exceeded $1 billion nationally.[13] In Oregon, where cattle and calves were the number one commodity in terms of dollar value (in 2014), this may become a greater concern. ECONorthwest's 2009 publication on climate change economic impacts in Oregon estimated losses due to reduced beef production of $7 million and $11 million in 2020 and 2040, respectively, based on 2007 production and value.[14]

2. OUTDOOR RECREATION

CAMPING/HIKING LOSSES: The national-level loss estimate for forest-based recreation like camping and hiking (with a doubling of CO_2, a 4.5 °F temperature increase, and a 7% precipitation increase) is approximately $1.2 billion by 2060, converting 1990 dollars to 2016 dollars.[15]

SKI INDUSTRY LOSSES: One study (Loomis) estimated that downhill and cross-country skiing visitor days

OREGON'S OUTDOOR RECREATION INDUSTRY:

- $12.8 billion in consumer spending
- 141,000 direct jobs
- $955 million in local and state tax revenue
- $4 billion in wages and salaries
- 68% of Oregon residents participate in outdoor recreation of some kind each year[18]
- 1.9 million visits for skiing[19]

OREGON SNOW-BASED RECREATION LOSSES

$124 MILLION

each year by 2040

COLD-WATER FISHING

$266 MILLION

LOSS EACH YEAR IN OREGON BY 2040

ROAD CLOSURE

$7.5 MILLION/DAY

ON I-5 NEAR PORTLAND

would be cut in half or more by 2060.[16] Mid-elevation ski resorts are especially prone to more rain and less snow, later opening dates and earlier last days, and increased costs to patrons.[17] The Loomis study estimate for impact to snow-based recreational industries across the U.S. by 2060 is $4.2 billion in 1990 dollars – or, nearly $8 billion in 2016 dollars. ECONorthwest's 2009 estimate for Oregon snow-based recreation losses amounted to $124 million in 2040.

SPORT FISHING LOSSES: Fish and wildlife-based recreation in Oregon is estimated to be valued at $2.5 billion annually.[20] With suitable habitat for native fish species including trout and salmon declining by 47% on average (compared to 1978-1997), the sport fishing industry will also be affected.[21] ECONorthwest also estimated losses for cold-water angling at $266 million in 2040, if values decline proportionally to the decline in habitat.[22]

3. INFRASTRUCTURE

STORM DAMAGES: Weather and climate disasters in 2012 (excluding drought) cost the U.S. economy more than $89 billion. Excluding major events (Hurricane Isaac and Superstorm Sandy), $18.6 billion was incurred by a host of other smaller events. West Coast flooding events in 1996 and 1997 (including Oregon) cost nearly $6 billion.[23]

LANDSLIDE/FLOODING COSTS: With a 20% increase in extreme precipitation and a 13% increase in days with over one inch of precipitation, flooding and landslides will occur more frequently and incur greater costs.[24] Closing I-5 for 24 hours costs an estimated $7.5 million, if a busy (i.e., 15,000 average daily truck traffic) part of Interstate 5 were to close, and using a $500/24 hour estimate for one truck.[25]

Landslide repair is another notable cost. Repairing all of the landslide sites on the State of Oregon's existing "high

priority" and "immediate need" lists have a price tag of over $780 million, and this does not include funds spent statewide on emergency repair, which is sometimes as much as $100 million a year.[26]

INSURANCE LOSSES: Global economic losses covered by insurance (not including health costs) rose from $5 billion in 1970 to $27 billion in 2010, and an average annual loss of $33 billion each year is projected by 2030.[27]

4. POWER

COOLING AND HEATING COSTS: A national study of the future changes of "cooling degree days" and "heating degree days" likened a future Portland, Oregon, to today's Sacramento, California.[28] Sacramento's warm summer months average in the low 90's, and the cold winter months average in the mid-50's during the day.[29]

One estimate for increased air conditioning in Oregon amounted to $16 million out of consumers' pockets in 2020 and $37 million in 2040, using the assumption that historical electricity prices remain similar and stable.[30]

POWER GENERATION: Oregon's power is comprised of nearly 45% hydroelectricity.[31] While some winter increases in hydropower production will occur due to earlier snowmelt, there will be more extreme decreases in summer months, at the same time that increased production for cooling is needed. There is a region-wide seasonal hydropower reduction of 18-21% projected by the 2080s.[32]

5. PUBLIC HEALTH COSTS

MAJOR DISASTER COSTS: Impacts from wildfire, the aftermath of flooding events, extreme heat, and other weather events can be costly. Major climate events added $14.1 billion (2008 U.S. dollars) to U.S. healthcare costs between 2002-2009 for major events that will predictably be increased by climate change.[33]

LANDSLIDE REPAIRS
$780 MILLION
CURRENT BACKLOG IN OREGON

AIR CONDITIONING COSTS
$37 MILLION
TO OREGON CONSUMERS IN 2040

PUBLIC HEALTH COSTS
$14.1 BILLION

2002-2009 in the U.S.; includes the following:

SMOG - $6.5 billion

HEAT WAVES - $5.3 billion

HURRICANES - $1.4 billion

WILDFIRE - $578 million

MOSQUITO-BORNE DISEASES - $207 million

RIVER FLOODING - $20 million

OZONE POLLUTION HEALTH COSTS
$1.1 BILLION
EACH YEAR IN OREGON BY 2040

PROPERTY LOSS
$238-$507 BILLION
IN THE U.S. BY 2100

AIR POLLUTION COSTS: The effects of ozone air pollution, when exceeding national standards, were found to result in health costs of $6.5 billion in 2008 U.S. dollars.[34] An Oregon-specific study of health costs due to ozone pollution based on morbidity, premature mortality, and lost worker productivity estimated that there would be costs of $688 million a year in 2020 and $1.1 billion in 2040.[35]

EXTREME HEAT COSTS: Extreme heat events will increase, with one study projecting 51 extreme heat events and thirteen deaths for Portland, Oregon at the end of the century.[36] ECONorthwest, using these numbers to project the health-related costs for heat events, estimated $171 million each year by 2040.[37]

SEA LEVEL & OCEANS

By 2100, the acidity of the ocean may climb to 170% what it was in pre-industrial times,[38] and ocean acidification has already deeply affected Oregon's shellfish industry. Sea level rise as much as 56.1" (4.7 feet) by 2100 will also alter the 363 miles of coastline through the coming decades.[39] With reduced and altered habitat for economically-important species, the fisheries industry is likely to see substantial losses. Shoreline properties and beaches will be damaged by rising seas and erosion. These factors, together with an increase in extreme weather, will lead to destructive and costly events occurring more frequently.

1. PROPERTIES & INFRASTRUCTURE

U.S. COASTAL IMPACTS: For the U.S., coastal impacts are considered the most expensive consequences of climate change due to the triple threat of sea level rise, ocean acidification, and extreme weather – as well as higher population centers located by water. By 2100, between $238 billion to $507 billion worth of property could be below sea level.[40]

COASTLINE DAMAGES: Almost 19% of the housing units in Oregon state are located in its coastline counties – nearly a fifth of all housing in the state, in places like Astoria, Coos Bay, Florence, Lincoln City, Seaside, Tillamook, etc.[41] Estimates using population, median home value, and miles of coastline predict damages of $16 million a year by 2020 and $33 million by 2040.[42] While this figure doesn't take into account the full picture of sea level, increase in storms and high water events, and Oregon's particular erosion issues, this is still a helpful estimate.

FISHERIES: Erosion, impacts to coastal marshes and riparian areas, rising water temperatures, and ocean acidification will all contribute to degraded habitat and reduced numbers of fish. Salmon that rely on both ocean and river habitats will be at risk, with particular species (juvenile chum and Chinook salmon) potentially seeing more damage. Another estimate specific to economic damages in Oregon projects that in 2040, $1.04 billion could be lost due to declining salmon habitat.[43]

BEACHES AND TOURISM: Oregon's beach-related economic activity is estimated to exceed $5 billion. Though there is no estimate to the impacts to beach tourism, with beach erosion and potential property risk from storms and sea level rise, it is likely that this sector will be affected.

2. SHELLFISH & FISHERIES

OCEAN ACIDIFICATION LOSSES: The Pacific Northwest has served as a bellwether for ocean acidification in the U.S., with Oregon's Netarts Bay receiving attention due to the effect on the local economy. In the mid-2000s, two Pacific oyster hatcheries began experiencing severe mortality (around 80%) of oyster seed, signaling the beginning of production failures – and resulting in a 22% production decline, a 13% decline in gross sales, and a $73 million product loss in 2009. A 2014 survey of the shellfish industry found that half of respondents had been

OREGON'S CHANGING COAST:
In Washington and Oregon, more than 140,000 acres of coastal lands lie within 3.3 feet in elevation of high tide.[44]

Projections for sea level rise at Newport, Oregon:
- 2030 - up to 8.9"
- 2050 - up to 18.9"
- 2100 - up to 56.1" (4.7 ft)[45]

Additionally, local beach erosion rates as high as 14.4 feet a year have been seen over the 1967 to 2002 time period.[46]

COASTLINE DAMAGES
$33 MILLION
EACH YEAR IN OREGON BY 2040

FISHERIES LOSSES
$1.04 BILLION
EACH YEAR IN OREGON BY 2040

PACIFIC NORTHWEST FISHERIES:

- Regionally, the seafood industry generated an estimated $8.4 billion in sales and $2 billion in income
- In Oregon, economic contributions of commercial fishing and seafood processing are estimated to amount to $518 million in personal income in Oregon, or the equivalent of 16,000 jobs
- Shellfish landings represent about half of the total value of all landings in Oregon[49]

NW SHELLFISH LOSSES
$73 MILLION
DUE TO OYSTER MORTALITY IN 2009

negatively affected by ocean acidification, with 97% of those respondents reporting financial impacts.[47]

Nationwide, ocean acidification could cause losses of $400 million each year by 2100.[48]

FORESTS

Roughly half of Oregon is covered in forest, and there is significant change coming in the decades ahead to these forests and the industries that rely on them. Lack of precipitation, insect infestations caused by temperature shift, long-term changes in habitability for certain species, and a stark increase in wildfire will cause widespread damage and irreversible changes throughout the state. The costs of fighting fire and the many other costs resulting from wildfire will continue to rise as well.

1. FIGHTING FIRE, WILDFIRE COSTS

FIRE SUPPRESSION COSTS: Oregon has been experiencing larger and more severe fires in recent decades, and this trend will continue, with a forecast for a quadrupling of median acres burned each year by the 2080s – for a 50% chance each year that as many as 2.2 million acres would burn, in comparison a 5% chance now.[50] Using these numbers, we can estimate that fire suppression costs could reach over $700 million each year by the 2080s.[51]

ADDITIONAL FIRE COSTS: Timber loss, a reduction in outdoor recreation, environmental costs, property destruction, and public health costs are also incurred from wildfires. Studies of individual fires have analyzed some of these costs and found that the cost of wildfire is four to five times greater than the costs of fire suppression alone.[52] Keeping this in mind, total wildfire costs could be closer to $2.8 billion to $3.5 billion per year in Oregon (four to five times the suppression estimate). Additionally,

costs to the State of Oregon and private timberland owners to purchase fire insurance have been on the rise.[53]

TIMBER LOSSES: The 2013 fire season in Oregon, with over 350,000 acres burned, resulted in a timber loss of $370 million.[54] If a similar percentage of private timber lands (versus all forestland) burned during a year with 2.2 million acres – the average for 2080 – then this would translate to $2.3 billion (in 2013 dollars).

FIRE SUPPRESSION IN OREGON

$700 MILLION

PER YEAR

BY THE 2080s

TOTAL FIRE COSTS IN OREGON

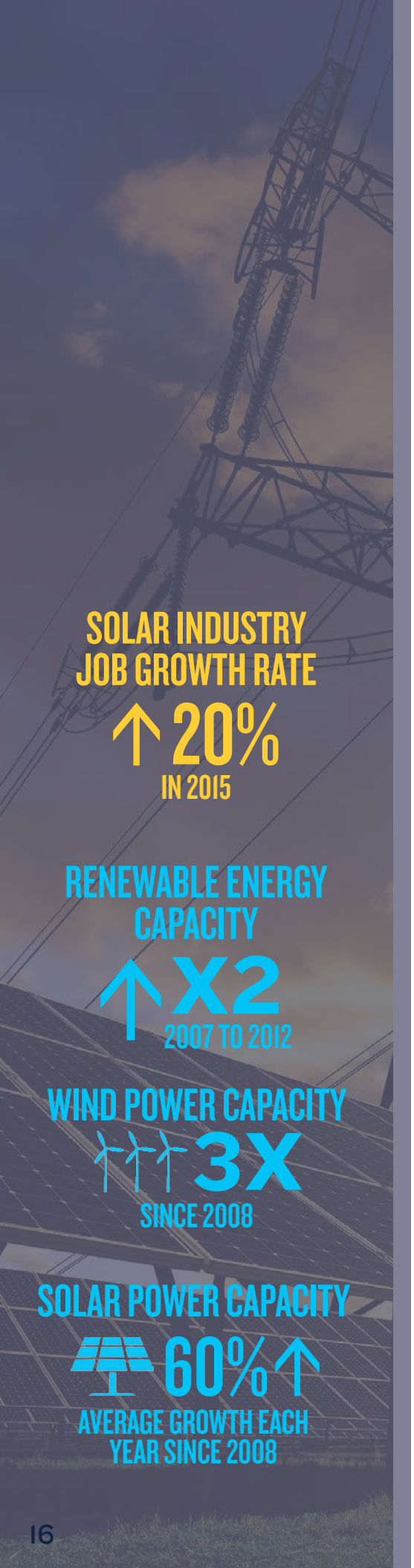
$3 BILLION

PER YEAR

BY THE 2080s

OREGON'S FORESTRY SECTOR:

- The forestry industry contributes $12.7 billion each year in Oregon[55]
- In 2013, forestry jobs numbered 58,814[56]
- Oregon is number one in the U.S. for softwood lumber production and plywood production[57]



PART II:

THE CLEAN ECONOMY

THE STATE OF THE CLEAN ECONOMY IN THE U.S.

CLEAN JOBS

There are now 2.5 million jobs in clean energy nationwide, with 1,880,148 of those jobs in energy efficiency and 413,924 jobs in renewable energy. Clean fuels, clean energy distribution, and advanced vehicles make up the remainder.[58]

Job growth is a hallmark of the clean energy sector. A 2012 study projected that 2020 clean economy jobs for Oregon, Washington, California, and British Columbia would grow from 508,000 jobs in 2010 to more than 1.5 million jobs by 2020.[59]

Nationally, today's solar industry employs 300,000 people,[60] and in 2015 solar job growth was over 20%.[61]

ENERGY CAPACITY

In 2015, renewables (with hydropower) reached 20% of electricity generation, at 221 GW of capacity. This increase was made possible through a doubling of non-hydropower renewable sources in recent years.[62]

Wind power produced 75 GW in 2015 - three times the amount that existed at the end of 2008, while the growth each year in capacity for solar power averaged 60%. Other renewables (geothermal, biomass, biogas, waste-to-energy) have grown more slowly but have still added 15% capacity since then.[63]

INVESTMENT

Since 2007, investments in clean energy and related technology have totaled $445 billion ($56 billion in 2015 alone) with over half invested in solar and 21% invested in wind.[64]

LOWER PRICES

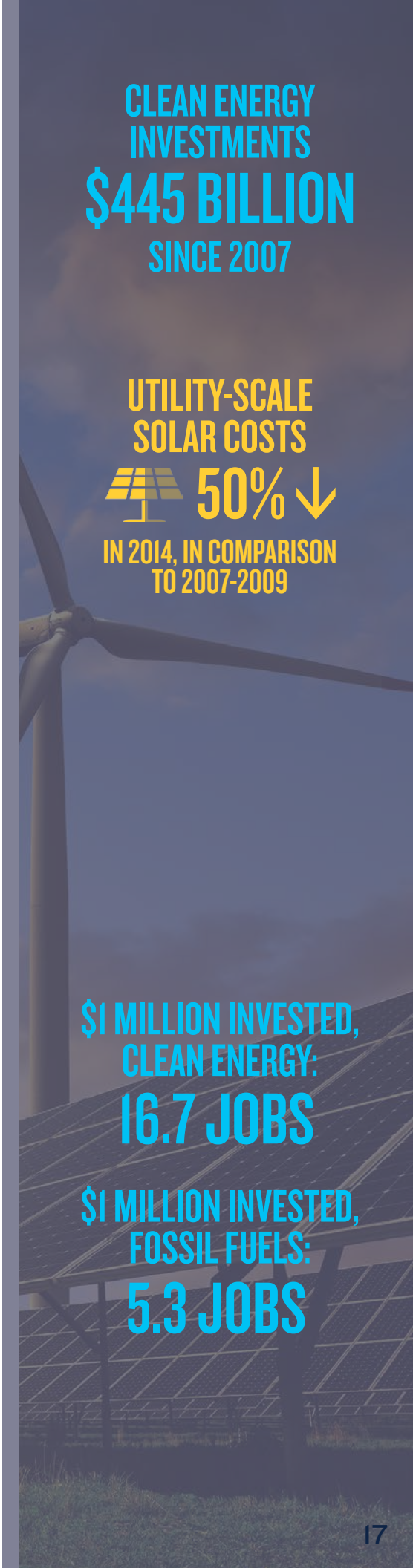
In 2014 the median cost of installed utility-scale solar projects fell by more than 50% compared to 2007-2009. The cost to generate power has also gone down, with Power Purchase Agreements (PPAs) for wind as low as $19 per MWh, and solar rate PPAs around $50 per MWh.[65]

Vehicle and fuel efficiency help drive down costs of transportation; in 2013, Americans used four million fewer gallons of fuel than in 2005.[66] The addition of new transportation fuels, like electricity, natural gas, and biofuels, drives a market for fuels to compete on cost.

TRANSITION TO A CLEAN ECONOMY

Retirement of coal-fired power plants is happening across the country, with 40 GW less from coal-fired plants since 2005 and more planned to be shut down. In 2015, coal provided just 34% of electricity in the U.S., in comparison to 50% in 2005.[67]

For every million invested in clean energy, 16.7 jobs are created. Spending that same million on fossil fuels only generates 5.3 jobs.[68] And, the solar industry is growing nearly 11 times faster than mining, quarrying, and oil and gas extraction.[69]



OREGON'S CLEAN ECONOMY

CLEAN JOBS

Oregon's $7 billion clean energy GDP is pulling its weight; the job growth rate for clean economy jobs is more than twice that of other job sectors.[70]

INVESTMENT

$9.3 billion was invested in renewable energy in Oregon from 1998 to 2014.[71]

PROGRAMS & SAVINGS

Oregon's incentive and encouragement programs for renewable energy and energy efficiency have helped spur this investment. As a result of programs with tax credits, loans, and other incentives, Oregon has saved over 46 million BTUs and nearly $2 billion dollars.[72] Businesses that applied for tax credits for renewable energy projects have made an estimated $774 million in capital investment (through 2011) in return for $215.6 million in credits.[73] The same credit program leveraged nearly $6 billion in energy investments and helped to create 1,840 direct manufacturing jobs and almost 7,000 indirect and induced jobs.[74]

OREGON RANKINGS

Oregon has maintained top-five rankings for per-capita green jobs for years.[75] Oregon is ranked 13th (in 2013) in lowest total energy consumed per capita, and ranks 14th in low greenhouse gas emissions.[76] One ranking system, the "U.S. Clean Energy Leadership Index" takes into account incentives, clean energy technology, and more. Oregon ranked fourth in the country in 2016 (down from number two in 2012).[77]

RECENT LEGISLATION

The transition to a clean economy can be strongly evidenced in Oregon itself, with the "Clean Electricity and Coal Transition Plan" passed by the legislature in March of 2016, calling for 50% renewable energy for the state's two biggest power providers by 2040, and phasing out coal power completely by 2030.

Oregon is also one of two states in the country with clean fuel standards that decrease the carbon intensity of fuels over time, joining California in 2015. Requiring lower carbon emissions from fuel producers sends a market signal to industry participants, encouraging investment in biofuels, biodiesel, and clean electricity while spurring increased production.

RENEWABLE ENERGY GENERATION

Oregon is number three in the U.S. for net generation of renewable electricity (including hydropower), and number six for dollar value per unit of energy expended.[78]

CHALLENGES

Despite impressive growth, there are barriers affecting our transition to a clean economy. In the U.S., gasoline prices have fallen by more than 40%, and is a factor in a less robust market for efficient vehicles in 2015. Also in 2015, there was a slight uptick in the emissions per unit of energy consumed nationwide, despite a years-long downtrend.[79] By continuing policy adoption at a local level that spurs investment dollars in clean energy and fuels, we can help ensure that Oregon remains competitive.

PART III:
MODEL POLICIES AND THEIR ECONOMIC IMPACT

Putting the right policies in place is critical if we are to transition to a clean economy. While there are a host of policies for all levels of government, we will focus on three major policies with known outcomes that benefit the economy and are effective at reducing greenhouse gas emissions: putting a price on carbon, clean fuel standards, and renewable portfolio standards. We also highlight the importance of energy efficiency, vehicle electrification, and transportation choices.

CARBON POLLUTION PRICING

Countries have been putting a price on carbon emissions since 1990, and today more than 22% of emissions from more than 60 jurisdictions are covered worldwide. This number will increase significantly once China, which has already instituted pilot programs in several provinces, implements a national program (expected in 2016).[80] For many countries, states, and provinces, putting a carbon pricing policy in place has helped achieve many goals: lowering emissions, encouraging investment, encouraging technology innovation, creating jobs, and making a decisive shift to a cleaner economy.

Successful and well-designed programs are marked by positive economic gain – even when only considering direct benefits such as increased investment dollars, net job creation, and return on investment of proceeds (if applicable). This does not take into account indirect benefits such as the avoided future costs of climate change impacts, which are substantial.

North America now has five carbon pricing programs in place, with others being planned. Three are featured here.

1. REGIONAL GREENHOUSE GAS INITIATIVE

The Regional Greenhouse Gas Initiative (RGGI) program covers 22% of emissions (all from the electricity sector) in the Northeast U.S. and is a partnership between 10 different states. Since 2009, there have been more than 30,000 job-years (with a "job-year" being equal to one job for one year) created due to the program. RGGI is estimated to have generated $2.9 billion in economic gain for the region. Between 2012 and 2014, RGGI also helped keep money inside the region and in the states by reducing purchases of outside fossil fuels by over $1.27 billion. Reduced consumer spending on electricity also amounted to $1.1 billion.[81]

In addition to being successful financially, greenhouse gas emission reductions were 45% below the cap as of 2012. The cap was reworked to be approximately equal with the emissions levels at the time, 91 MMT of CO_2.[82]

2. CALIFORNIA CAP-AND-TRADE

California's cap-and-trade program covers 85% of emissions, and includes reinvestment of proceeds.

So far, $1.7 billion of these proceeds have been allocated to projects and programs. These funds have leveraged over $5.7 billion in additional investments.[83] Having cap-and-trade in place also serves as a market signal. Along with reinvestment dollars acting as a multiplier for jobs and economic gain, it is clear that it is contributing to positive trends: clean economy jobs in California are growing at a rate of 23.9%, about eight times faster than jobs overall – adding 71,000 jobs from 2010 to 2014.[84]

In terms of emissions, reporting from 2014 has 2013 emissions reduced by 3.8%, or about 5.53 MMT of CO_2 equivalent, which was 11% below the cap.[85]

3. BRITISH COLUMBIA'S CARBON TAX

British Columbia's carbon tax, being revenue neutral, has a different investment scheme for tax monies. Proceeds from the tax, which covers 70% of emissions, are used primarily for reducing corporate income tax and personal income tax for those in lower tax brackets. Between 2008 and 2015, $6.1 billion in proceeds were used to lower taxes.[86] Greenhouse gas emission reductions of 17.4% show that

the tax was successful in its primary goal. At the same time, GDP was slightly higher than the rest of Canada. B.C. now has the lowest personal income tax rate in the country, and corporate tax rates are among the lowest in North America.[87] In one study referencing several studies of economic effect, it is determined that the tax has had negligible effect on economic performance as a whole, either positive or negative.[88] Unfortunately, emissions rose in 2012 and 2013,[89] pointing to the need for adjustments.

CLEAN FUEL STANDARDS

Clean fuel standards help the economy in several ways: they typically bring investment dollars to the state as clean fuel producers bring refineries, feedstock production, other infrastructure, and technology investment; they encourage local money to stay local, using homegrown fuel; and they create high-paying local jobs.

In 2015, Oregon took another major step in transforming its fuel sector to result in fewer emissions and more in-state dollars, as the reauthorization of Oregon's Clean Fuels Program (CFP) was signed into law and final implementation measures were put in place.

Nationally, nearly $4 billion in private investment has been made into advanced biofuel producers and companies since 2007, the year the Low Carbon Fuel Standard (LCFS) was instituted in California.[90] Little of this was directly invested in Oregon, but there are a host of benefits that may come to the state through the clean fuel standard as it is implemented. An economic impact analysis completed in 2011 estimated that Oregon could see an increase of up to $2.1 billion in Gross State Product. An estimated $2.6 billion (over ten years) could also be added to personal income in the state through the nearly 30,000 jobs that could be created.[91]

In addition to an increase in state dollars, personal income, and jobs, residents of Oregon will benefit in other ways. One place is at the pump: Oregonians spent $5.1 billion dollars in 2014 on transportation fuel.[92] A preliminary estimate for consumer savings at the pump (due to reduced sales) is $1.6 billion in fuel purchases.[93]

The estimated future benefit to public health – and reduced public health costs – is tremendous. While an estimate for Oregon doesn't exist, a dollar estimate for California's LCFS does, taking into account savings from fewer asthma, cardiovascular, and respiratory ailments. A 2014 report found that public health cost savings due to the LCFS would be $8.3 billion by 2025.[94]

The cost at the pump for California, while controversial during policy creation, has been shown to be negligible in implementation; the cost for compliance for the first years of the program was less than a third of a penny, according to a University of California-Davis study.[95] This is much less than the historical price fluctuation of $.75 for gas and $.63 for diesel.[96]

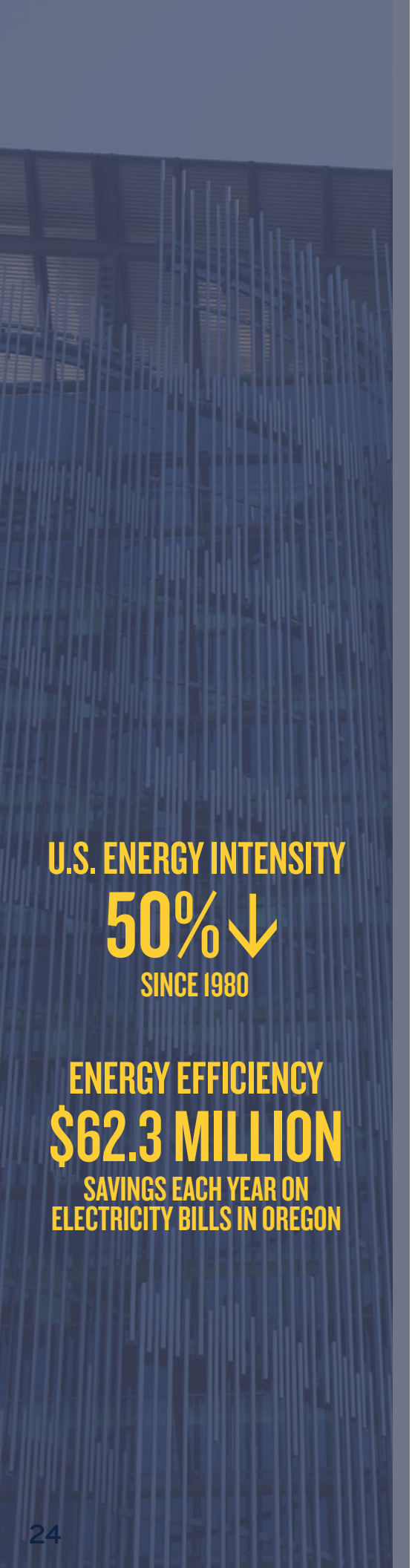
Continued coordination between Pacific Coast states that are implementing clean fuel standards will result in the greatest economic gains, and send a clear market signal to investors.

RENEWABLE PORTFOLIO STANDARDS

In a 2016 report from the National Renewable Energy Laboratory (NREL) and Lawrence Berkeley National Laboratory (Berkeley Lab), the economic benefits of Renewable Portfolio Standards (RPS) from 29 states and Washington, D.C. were calculated for 2013 alone at $2.2 billion from greenhouse gas emissions reductions (using the U.S. government's Social Cost of Carbon), and $5.6 billion, from the reduction of other air pollution, namely SO_2, NO_x, and particulate matter.[97]

The creation of renewable energy involved the creation of nearly 200,000 jobs, and spurred over $20 billion in GDP. It also put up to $1.2 billion back in the pockets of electricity consumers, from reduced electricity costs.[98]

Oregon's RPS, initially implemented in 2007, requires 25% of electricity sales from large utilities to come from renewable sources by 2025. Another NREL/Berkeley Lab report looking at Oregon's compliance found that it was cheaper to create renewable energy than non-renewable energy, resulting in a negative compliance cost.[99]



A 2011 assessment by the Oregon Department of Energy reported an in-flux of wind farms in Oregon since the RPS was implemented, with 11 new farms built from 2007 to 2011, six farms expanding, and 19 facilities in the development or planning phase. Of those 19 facilities, records indicate a potential increase in permanent positions of between 182 and 221 workers, with 2,600 construction positions.[100]

In March of 2016 the Oregon legislature passed legislation that requires a higher percentage of renewables for large utilities: 50% by 2040 (in addition to existing hydropower), helping spur more investment and jobs.

One 2015 study analyzing future renewable use estimated that Oregon has the potential to deploy as much as 98% of its electric power from renewables by 2030 (including hydropower). If that were to occur, it is estimated that nearly 140,000 jobs would be created, with over $8 billion in wages and benefits during construction of facilities. After construction, this would amount to nearly 2,500 additional jobs and $150 million in wages.[101]

ENERGY EFFICIENCY

The U.S. has decreased its energy intensity per dollar by about 50% from 1980 to 2014 in part as a result of energy efficiency. In 2014, efficiency savings (in comparison to 1980) amounted to $800 billion, or $2,500 per capita.[102]

For Oregon, the average yearly spending total on energy efficiency from 2008-2012 was $272.3 million. This represents 4,931 jobs, $257.1 million in gross labor income, and $342.2 million in gross regional product, along with a $62.3 million reduction in electricity bills.[103]

In the Northwest as a whole, investments in efficiency by utilities over 12 years ($2.4 billion, from 1990 to 2002) is recovered in energy savings in just 18 months.[104]

VEHICLE ELECTRIFICATION

Expansion of electric vehicle charging networks, incentives in transportation infrastructure for drivers of electric vehicles (such as HOV lane or parking), tax credits or

rebates for purchasing vehicles, and technology research and development have had the most impact in encouraging cleaner and efficient cars and fleets.

A stronger and more prolific electric vehicle market will also result in more jobs, to add to the 170,000 current jobs in advanced vehicles nationwide.[105] One forecast for the future projects that by 2030 there will be a market share of 64% for electric vehicle sales for personal use, which would create a baseline of 129,185 additional jobs. With vehicle purchase subsidies, 351,861 jobs could be created.[106]

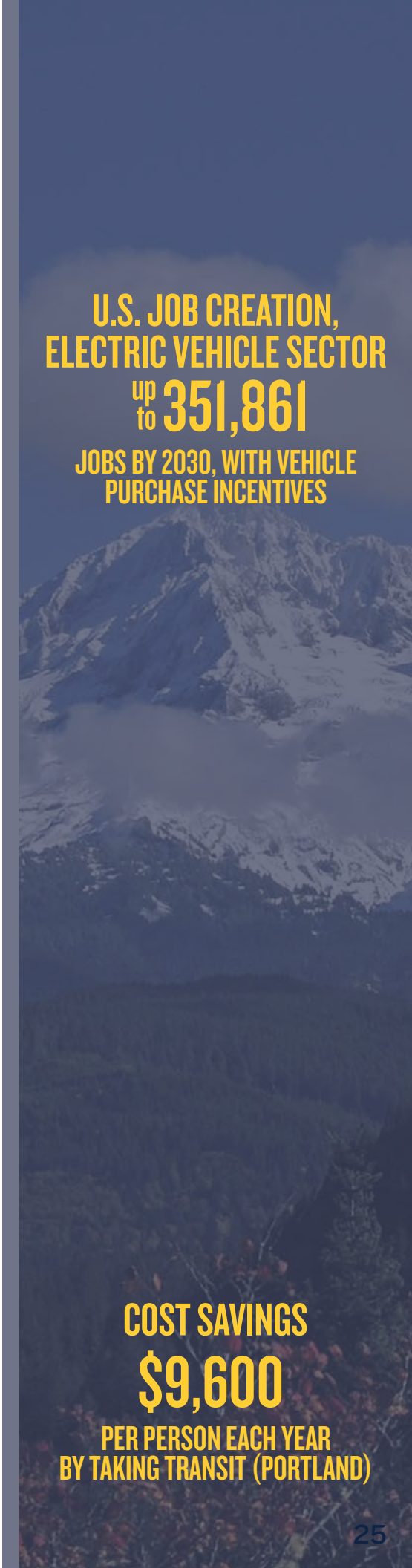
An Oregon-specific estimate for an electric vehicle adoption rate of 45% by 2030 included estimates for economic activity, jobs, wages, and taxes. Economic gain would range from $26.8 million to $43.4 million, with $15 million in wages from new jobs. In 2015, the electric vehicle industry already represents about 1,500 jobs and $266 million in economic activity.[107]

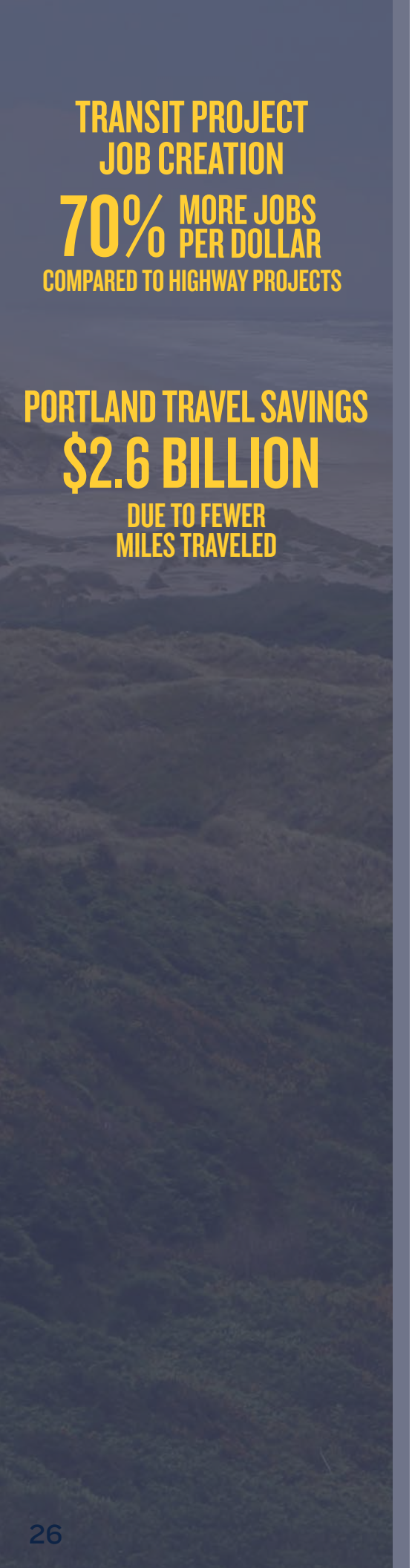
Provision of charging infrastructure is also a factor in ease of use for some electric vehicles. It is also a point of uncertainty. Increase in public charging stations only grew 10% from 2014 to 2015.[108] However, the same legislation from March 2016 that set a time line for coal-free electricity and an increase in renewable power also included utility investment in charging stations.

TRANSPORTATION CHOICES

Available transportation choices and transportation infrastructure are decisive factors in determining how people choose to travel – and how much pollution is emitted in the process. Cities or towns without easy access to transit and a lack of friendly biking and walking infrastructure will continue to see a car-dominated and emissions-heavy transportation sector.

Cities with transportation choices cost people less. The American Automobile Association (AAA) estimates that a large sedan costs more than $10,000 a year to own and operate in 2015,[109] and taking transit, if available, saves an average of over $9,000 a year nationally and over $9,600 in Portland.[110]





Building public transit infrastructure creates more jobs than highways – 70% more jobs, in fact, and about 30% more jobs than new roads or bridges. Even repair and maintenance of existing roads yields 16% more jobs than new roads or bridges.[111] A similar study on biking and walking projects found that approximately 40% to 50% more jobs were created on these projects, in comparison to highway projects.[112]

Portlanders also save time and money because of availability of transportation choices; with 2.9 billion fewer miles traveled and 100 million fewer hours in comparison to the median U.S. city, $2.6 billion a year is saved.[113] In particular, Portland is looked to as a model for bicycle infrastructure across the country, with the highest percentage of any large city in the U.S. biking to work (6.1% of people) in 2012. A network of streetcars throughout the downtown and surrounding neighborhoods contribute to around 12% of people taking transit to work.[114]

Even though the Portland area contains many examples of best transportation practices, the transportation sector for the whole of Oregon still contributes 39% of its emissions. There are policy and funding decisions that could contribute to lower emissions for this sector. Increasing funding at the state level for multimodal transportation (transit, biking, and walking) will help increase use of these low-impact and affordable travel choices. Oregon is 20th in the nation for state transit spending per capita, for example, spending only $8.38 per person. In comparison, transit-rich states at the top of the list, like Massachusetts, spend more than $187 per person.[115]

While land use, housing, and transportation decisions in smaller towns can still have an impact, rural Oregon will continue to rely heavily on automobiles. One can see the importance of focusing emission reductions across many sectors and geographies: in electricity, industry, the fuel sector, electrification, energy efficiency, and in city and town infrastructure.

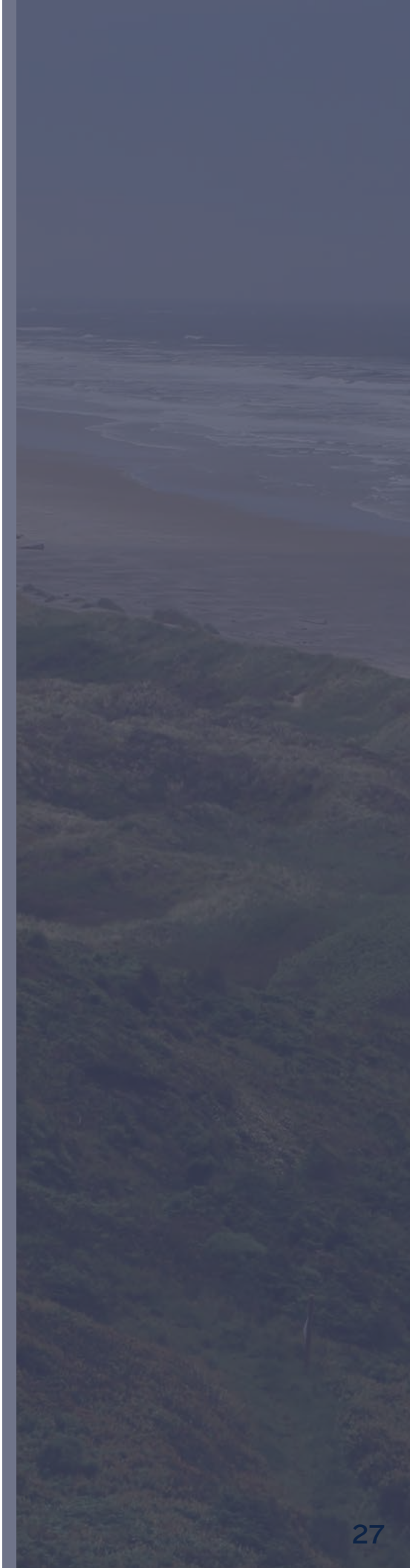
CONCLUSION

Oregon has implemented forward-thinking policies in recent years that will expand the use of renewable energy, make clean and homegrown fuels more widely available, increase the energy efficiency of the places we live and work, and make it easier to get around in low-impact ways.

If we want to work our way toward clean energy and economic success and away from severe economic impacts, the work must continue.

Our decision-makers must continue to fully implement smart policies, like Oregon's clean fuel standard, its renewable energy standards, energy efficiency measures, and more. Implementation of additional policies (such as putting a price on carbon pollution) must also occur.

Continued action will ensure that Oregon's economy – and its future – are on a prosperous, secure path.



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