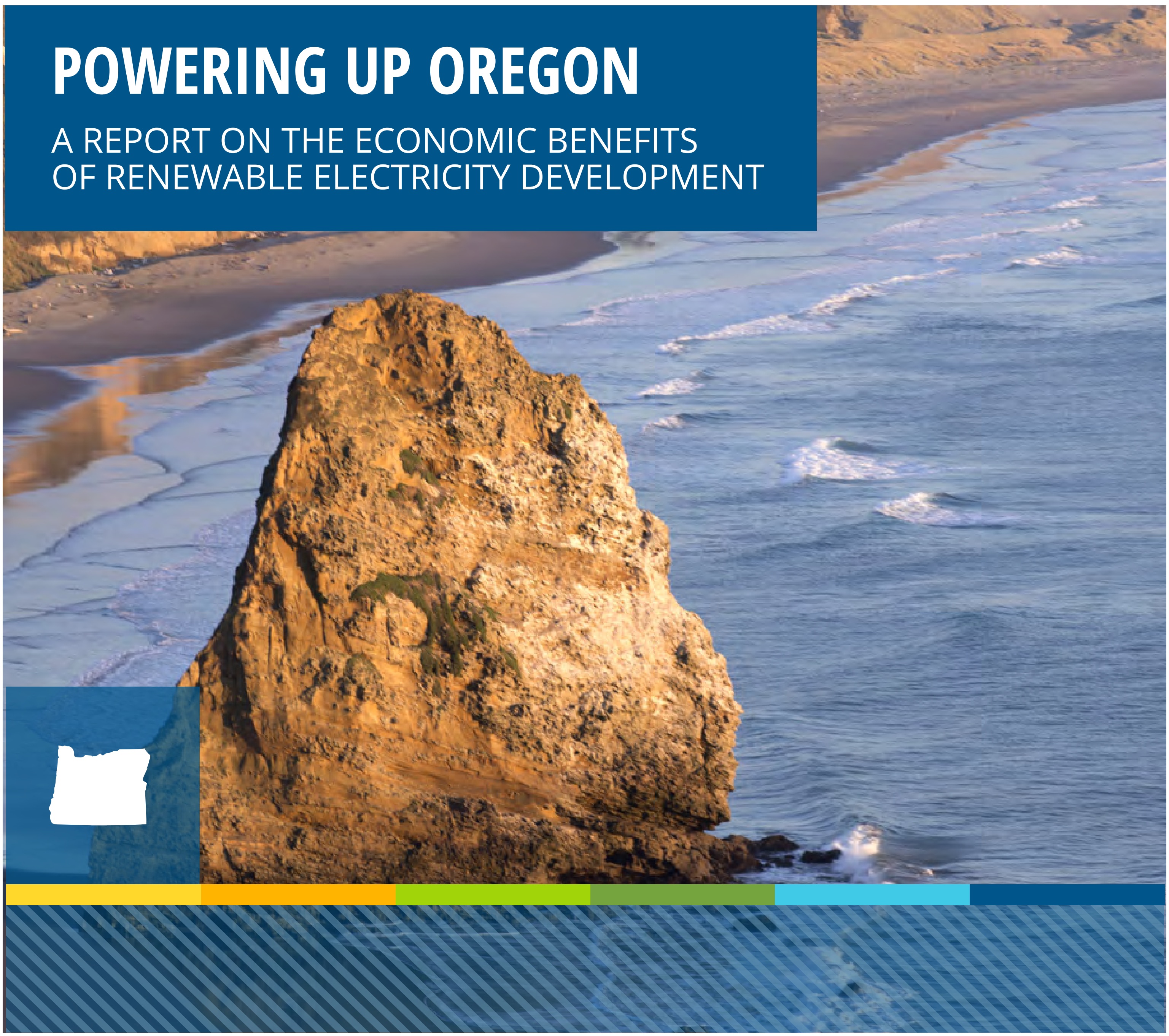
POWERING UP OREGON

A REPORT ON THE ECONOMIC BENEFITS OF RENEWABLE ELECTRICITY DEVELOPMENT

A Renewable America



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PUBLISHED IN COLLABORATION WITH THE OREGON INSTITUTE OF TECHNOLOGY

Oregon TECH

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EXECUTIVE SUMMARY

Economic growth, energy independence, and new job creation are just a few of the many reasons that a significant majority of Americans consistently support developing renewable electricity.[1] Technological innovations continue to lower costs, and in recent years, several of the renewable electricity sectors have experienced significant growth, attracting billions in new private investment.

Solar, wind, hydropower, biomass, geothermal and waste-to-energy already provide more than 13 percent of U.S. electricity, and renewables are capturing an increasing share of the power grid every year.[2] In 2013, the major renewable electricity technologies provided well over 527 million megawatt hours of electricity to the utility grid – enough to supply the equivalent of over 43 million average American homes.[3] The renewable electricity industries also represent an important source of American jobs, directly employing over half a million people.

This report examines the current and potential economic benefits from developing renewable electricity in Oregon. The Beaver State's existing deployment of renewable energy is already delivering significant economic benefits, as $9.3 billion has already been invested to bring new renewable energy projects online through 2014.[4]

The state also has considerable untapped renewable electricity potential, and this analysis finds that developing these resources can deliver significant economic gains.

Renewable electricity is **driving economic growth** and creating jobs in communities across Oregon. The state is already home to more than an estimated 68,700 jobs in renewable power industries, energy efficiency and other conservation services.[5]

Renewable electricity offers an **affordable source of power**, as the cost of renewable electricity has declined dramatically in recent years. Renewable power purchase agreements are typically long-term, fixed cost agreements, helping protect ratepayers from price spikes associated with other energy sources. Wind power costs have fallen over 50 percent in the last five years.[6] Solar installation costs have fallen nearly 40 percent since 2010.[7]

A **reliable source of power**, renewable electricity can displace the most expensive, least efficient power sources on the utility grid.

While there are many examples of successful Oregon renewable electricity projects, this report features four case studies that are representative of the current and future potential for the state's renewable power industries. Utility-scale projects including Biomass One, the Marion County waste-to-energy facility, and the Klondike Wind farm in Sherman County, as well as projects by large institutions, including Oregon Institute of Technology, are featured in greater detail below. The case studies demonstrate that renewable energy is delivering low cost, reliable electricity, and creating jobs, while also saving businesses and other institutions money.

This report also builds on a scenario from the U.S. Department of Energy's (DOE) 2012 *Renewable Electricity Futures* study, which demonstrates that the U.S. is able to reliably and affordably meet 80 percent of its electricity use by 2050.

In a **"High Renewables" scenario**, Oregon has the potential to deploy as much as 7,864 megawatts (MW) of additional installed renewable electricity capacity by 2030 (enough to supply over 98 percent of overall state electricity use). Our report finds that this deployment would:

- Create almost 140,000 additional local jobs and over $8 billion more in wages and benefits during construction.
- After construction and during its operation, this new renewable energy would create nearly 2,500 additional annual jobs and nearly $150 million in annual wages and benefits.

Even in a **"Low Renewables" scenario**, characterized by low growth in electricity demand and 'Business-As-Usual' with no new policies, about 2,967 MW of additional renewable electricity capacity would be added by 2030. These additions would be driven by Oregon's Renewable Portfolio Standard (RPS) and the increasing competitiveness of renewable energy technologies. Our report finds that this deployment would:

- Create over 60,000 additional local jobs and $3.6 billion more in wages and benefits during construction.
- After construction and during operation, these new renewable electricity facilities would create more than 1,150 annual jobs and nearly $70 million in annual wages and benefits.

Finally, in June 2014, the U.S. Environmental Protection Agency (EPA) proposed a rule, known as the Clean Power Plan, to reduce carbon dioxide emissions from existing power plants. The rule aims to cut national emissions 30 percent from 2005 emissions by 2030, with an interim target of 25 percent on average between 2020 and 2029.[8] In developing emission reduction targets for each state, EPA assumed a certain level of renewable energy development, energy efficiency improvement, and increased natural gas use in each state.

EPA's proposed rule calls for Oregon to reduce carbon dioxide emissions by 48 percent by 2030.[9] Based on our "High Renewables" case, Oregon could produce four times as much renewable energy as projected by EPA.[10] Even in the "Low Renewables" case, Oregon would exceed the EPA assumption of renewable energy development thanks largely to the Oregon RPS. As demonstrated in greater detail below, these results imply that Oregon should be able to easily meet or exceed its emission reduction target.

OREGON RENEWABLE ENERGY SUCCESS STORIES

Oregon is home to hundreds of companies that either produce renewable electricity or supply the components to build and maintain new projects. These companies employ thousands of workers and contribute billions to the state's economy.

Oregon's existing deployment of renewable energy is already delivering significant economic benefits, as $9.3 billion has already been invested to bring new renewable energy projects online through 2014.[11]

This section features an overview of current renewable electricity generation in Oregon and includes four examples that illustrate the benefits of renewable power development. Utility-scale projects including Biomass One, the Marion County waste-to-energy facility, and the Klondike Wind farm in Sherman County, as well as projects by large institutions, including Oregon Institute of Technology, a public university of more than 4,300 students, are featured in greater detail below.

Nearly 75 percent of Oregon's electricity generation currently comes from renewable sources:[12]

- 3,153 MW of Wind Power
- 79 MW of Solar Power
- 33.3 MW of Geothermal
- 8,425 MW of Hydropower
- 402.6 MW of Biomass Power
- 13.1 MW of Waste-to-Energy

DRIVING ECONOMIC GROWTH

Renewable electricity is helping to fuel Oregon's economy.

- The state is home to more than an estimated 68,700 jobs in renewable power industries, energy efficiency and other conservation services.[13]
- There are more than 130 in-state wind and solar companies and suppliers – varying from manufacturing and operations to construction and other support sectors.[14]
- The Oregon biomass industry creates local, rural employment – an estimated 6 jobs for each MW of power produced.[15]

AFFORDABLE SOURCE OF POWER

The cost of renewable electricity has declined dramatically in recent years. Renewable power purchase agreements are typically long-term, fixed cost agreements, helping to protect ratepayers from price spikes associated with other energy sources. In many cases, renewable electricity is now cost competitive with traditional electricity sources. For example:

- Wind power, biomass, and some forms of utility-scale solar power are all cost-competitive with natural gas, according to a recent report from the Oregon Public Utility Commission.[16]
- Wind power costs have fallen over 50 percent in the last five years.[17]
- Solar installation costs have fallen nearly 40 percent since 2010.[18]

RELIABLE SOURCE OF POWER

Renewable electricity can displace the most expensive, least efficient power sources on the utility grid.

- Every year in Oregon, hydropower generates enough reliable electricity to power over 3.3 million households.[19]

KLONDIKE WIND FARM HELPS REVIVE RURAL COMMUNITY

"Iberdrola Renewables doesn't just invest financially in a community, we like to get buy-in from all the community members, from landowners, farmers, and ranchers, to the state and local representatives and businesses. We create hundreds of short-term jobs during the construction phase of our wind projects and more than 40 full-time positions after the projects are completed."

PAUL COPLEMAN
COMMUNICATIONS MANAGER, IBERDROLA RENEWABLES

EXECUTIVE SUMMARY:

Sherman County has attracted an estimated $1 billion in investment, tax revenue and job creation as a result of wind farm development across this rural community. The 400 megawatt (MW) Klondike Wind farm generates enough electricity to power 115,000 homes. Total cumulative land lease payments to farmers and landowners for these projects are expected to total $3.9 million in 2015 alone. Since 2001, the Klondike Wind Farm has created hundreds of construction jobs and over 40 permanent positions. The property taxes generated by the Klondike Wind farm have increased the Sherman County general fund by an estimated 30 percent.

BACKGROUND AND CONTEXT

The Klondike Wind project represents four distinct wind farms developed between 2001 and 2008. Spread across thousands of acres, this project was designed and developed by Iberdrola Renewables, the second largest wind energy developer in the United States. At a total of 400 MW, the power is sold to several utilities and customers through long-term power purchase agreements and is transmitted through the Bonneville Power Administration's upgraded 230 kilovolt transmission line.

Historically, Sherman County, with less than 2,000 residents, has relied on ranching and agriculture. In recent decades the region has suffered from declining revenue and a shrinking population. The Klondike Wind farm represents an investment of nearly $1 billion into the local and regional economy, creating 42 long-term jobs, hundreds of short-term construction jobs, an estimated $5.3 million in tax revenue in 2014, and an estimated $3.9 million in direct land-lease payments for 2015.

NEW INVESTMENT AND JOB CREATION

Sherman County has attracted nearly $1 billion in investment, tax revenue and job creation as a result of wind farm development across the community. The Klondike Wind Farm created 42 long-term jobs and hundreds of short-term construction jobs.

ADDED TAX REVENUE AND PAYMENTS FOR FARMERS AND LANDOWNERS

Sherman County has received more than $5.3 million in property taxes through 2014, and landlease payments to farmers and landowners are expected to total $3.9 million in 2015 alone.

The Klondike Wind farm generates enough electricity to power 115,000 homes in Sherman County. Photo courtesy of Iberdrola Renewables

MAKING THE INVESTMENT

Utilizing General Electric, Siemens, Mitsubishi and Suzlon wind technology, the Klondike Wind project consists of a total of 271 turbines. Farmers and ranchers receive thousands of dollars per year, per turbine. The footprint of each turbine is less than 0.25 acres, allowing farmers and ranchers to continue using nearly all of their available acreage. In 2015, farm owners and ranchers expect to receive $3.9 million in total lease payments. This project, and the added revenue from it, has allowed many families to remain on their farms and has helped to revive much of Sherman County. The Klondike Wind farm increased the Sherman County general fund by an estimated 30 percent and constituted more than $5.3 million in property taxes through 2014.[20]

GEOTHERMAL AND SOLAR ENERGY POWER OREGON TECH

> "Renewable energy is a fast growing industry, especially in Oregon, where public and private programs and incentives fuel rapid growth. Combining Oregon Tech's nationally ranked academic programs – it had the first bachelor's degree program in Renewable Energy Engineering in the country – our establishment of the Oregon Renewable Energy Center, and the development of renewable energy projects by its faculty and students, Oregon Tech is recognized as a leader in renewable energy education and practice."
>
> ***CHARLIE JONES***
> *DEAN, COLLEGE OF ENGINEERING, TECHNOLOGY AND MANAGEMENT, OREGON INSTITUTE OF TECHNOLOGY*

EXECUTIVE SUMMARY:

About six years ago Oregon Institute of Technology (Oregon Tech) had a vision that is close to becoming a reality: supply all of the Klamath Falls campus electricity needs through a combination of geothermal and solar energy. In 2014, the university began producing approximately 2 megawatts (MW) of electrical power from its two geothermal power plants, and an additional 2 MW from a 9 acre solar array on a hillside above the campus. A separate geothermal heating system, in place since the mid-1960s, meets 100% of campus heat needs, replacing the equivalent of about $1 million a year in natural gas costs. By creatively combining its solar and geothermal resources, Oregon Tech is the first university in the U.S. to develop the systems to meet all of its energy needs from this combination of renewable electricity and heating sources.

BACKGROUND AND CONTEXT

Oregon Tech's Klamath Falls campus, on the eastern slope of the Cascade Mountains in southern Oregon, is in an optimal spot to lead in renewable energy usage. Klamath Falls boasts nearly 300 days of sunshine a year, and the Klamath Basin sits atop a geothermal reservoir. Oregon Tech has heated all of its buildings with geothermal water since the current campus location was constructed in 1964. The campus has grown to nearly one million square feet over the last 50 years and is still completely heated with geothermal water. In 2010, Oregon Tech installed a 280 kilowatt geothermal electrical power plant, and then in 2014, partnering with Johnson Controls, Inc. who designed and constructed the turbine and generator, added a custom-built 1.75 MW geothermal electrical power plant. Oregon Tech also partnered with SolarCity on the development of a 2 MW solar array on 9 acres of its Klamath Falls campus, which came online in the spring of 2014. Oregon Tech is leading in the higher education sector by becoming the first U.S. university to develop the systems necessary to meet all campus energy needs with renewable electricity from geothermal and solar sources. These projects also serve as an onsite lab for the campus' Oregon Renewable Energy Center and Geo Heat Center.

MAKING THE INVESTMENT

Oregon Tech's location in Klamath County provides some of the best geothermal resources in the country. Capitalizing on this reliable and affordable resource, geothermal power heats all campus buildings and water, and is even used to melt snow and ice from sidewalks, stairs, and handicap ramps, replacing the equivalent of about $1 million a year in natural gas costs. The university also recently signed a 20-year power purchase agreement with SolarCity to purchase 2 MW of solar at a fixed-rate, ensuring long-term price stability. Excess kilowatt hours of additional generated power will eventually be donated to Pacific Power's low-income subsidy program, making Oregon Tech one of the largest non-utility net metering contributors in the state. All of these projects were financed through grants provided by the Energy Trust of Oregon, U.S. Department of Energy, Oregon DOE, and Pacific Power's Blue Sky Renewable Energy Program.

RESULTS

In 2005, Oregon Tech furthered its commitment to sustainable power by introducing the first Bachelor of Science in Renewable Energy Systems in North America (now known as Renewable Energy Engineering). In 2010 Oregon Tech enhanced its renewable energy engineering curriculum by establishing a Master of Science in Renewable Energy Engineering degree. The school is also the home to the Oregon Renewable Energy Center (OREC) and the Geo-Heat Center (GHC). OREC conducts applied research, provides education and technical assistance, and works with industry and electric utilities across the state to encourage renewable energy development. The GHC is a national center for technical assistance for developers and operators of geothermal direct-use, small scale power generation and geothermal heat pump projects.

TECHNOLOGY SPOTLIGHT: GEOTHERMAL POWER IN OREGON

Oregon has many unique geological features that make geothermal power feasible. The city of Klamath Falls, where Oregon Tech is located, is able to heat homes, schools, hospitals and public buildings in the downtown and industrial core areas with geothermal resources. This clean, affordable, and reliable resource is attracting businesses to Klamath Falls such as Klamath Basin Brewing Co. and IFA Nurseries Inc., where they can take advantage of low heating costs as compared to natural gas.[21]

RENEWABLE INVESTMENTS DRIVING COST-SAVINGS

Oregon Tech replaces the equivalent of $1 million a year in heating and electricity costs from its on-campus geothermal and solar facilities.

RENEWABLES PROVIDING RELIABLE POWER

The campus is the first U.S. university to meet all of its energy needs with renewable electricity.

Oregon Tech's 2 MW solar array and 1.75 MW geothermal plant in Klamath County, Oregon. Photo Courtesy of Oregon Tech

BIOMASS ONE BRINGS JOBS AND POWER TO JACKSON COUNTY

"Biomass One provides 30 MW of power in southern Oregon – 24/7, every day of the year – where there are few other base-load generating plants. Our facility will continue to produce power and jobs for decades to come."

GREG BLAIR
MANAGING GENERAL PARTNER, BIOMASS ONE

EXECUTIVE SUMMARY:

Biomass One is a 30-megawatt (MW) waste-wood biomass facility that is able to produce enough electricity to power 28,000 homes across southern Oregon. The facility supports 54 direct on-site employees and sustains an estimated 100 indirect jobs in wood waste gathering and other forest management related positions. The Biomass One project also provides a crucial economic outlet for otherwise unmarketable waste wood products.

BACKGROUND AND CONTEXT

Biomass One began operations in 1985 and currently generates 30 MW of electricity, which is sold to Pacific Power through a long-term fixed rate power purchase agreement. All electricity produced is distributed to customers in the Rogue Valley.

The project has also provided a local opportunity to reduce landfill disposal of clean woody biomass material and sustain the local timber economy. Biomass One has an on-site woodyard that accepts clean woody biomass from the public, including tree and shrub trimmings and clean construction and demolition materials. The company also delivers and retrieves bins for clean waste wood from various local manufacturers, contractors, and landowners.

Biomass capabilities are regionally and geographically specific, but when scaled appropriately are able to service many different needs in a regional economy. The Biomass One facility consumes an estimated 370,000 tons of clean woody biomass annually. The woody biomass is acquired from multiple sources, including wood grinding operations, local primary and secondary wood products manufacturing, and recovery from county landfills in southern Oregon and northern California.

Biomass One is engineered with state-of-the-art emissions control and monitoring equipment to significantly reduce particulate emissions from the combustion of wood waste. The facility reduces particulate matter by 99.2 percent and emits one particulate for every 500 particulates that would be emitted from open burning of wood waste. In addition, emissions are monitored and furnace operations controlled to maximize combustion efficiency and thereby minimize creation of source pollutants.

JOB CREATION

The Biomass One facility supports 54 skilled on-site jobs, and an estimated 100 indirect jobs in the community.

COST SAVINGS

Dozens of institutions across the state have switched to biomass heating systems, saving $7 million since 2007.

Biomass One turns 355,000 tons of wood waste into 30 MW of electricity. Photo courtesy of Biomass One

MAKING THE INVESTMENT

The plant supports 54 skilled, direct on-site jobs ranging from electrician to instrumentation technician to environmental engineers. In addition, the facility also supports an estimated 100 indirect jobs such as wood gathering, waste wood harvesting, and trucking in and around the rural community. With a high reliability factor, Biomass One is able to operate 24 hours a day, 7 days a week, providing 30 MW of reliable electricity to more than 28,000 homes in southern Oregon.

In support of the local logging and timber industry, Biomass One sources clean woody biomass material from over 40 suppliers. Loggers and forest landowners are able to earn extra income by harvesting the residual material resulting from timber harvest or forest improvement projects. Biomass One is crucial resource for this rural community.

TECHNOLOGY SPOTLIGHT: BIOMASS IN OREGON

The Oregon biomass industry creates local, rural employment – an estimated six jobs for each MW of power produced. Dozens of institutions across Oregon, ranging from hospitals to high schools, have collectively saved more than $7 million since 2007 by switching over to biomass fueled heating systems.[22]

MARION COUNTY TRANSFORMS WASTE INTO ENERGY

"Here at the Covanta Marion County waste-to-energy facility, we see resource recovery as doing a number of things simultaneously that benefit the county. First, waste-to-energy allowed us to avoid the costly prospect of constructing, operating and maintaining another landfill. Second, the facility has allowed the county to take in up to 90 percent of the revenue that we get from selling the power to PGE which is then used by the county to fund various waste reduction programs. Third, the facility has brought many well-paying, full time positions to the area. And finally, waste-to-energy has proven that it is better for the environment than landfilling as it reduces greenhouse gases and provides renewable power."

JEFF BICKFORD
ENVIRONMENTAL SERVICES DIVISION MANAGER, MARION COUNTY DEPARTMENT OF PUBLIC WORKS

EXECUTIVE SUMMARY:

Operational for almost 30 years, the Marion County waste-to-energy facility has reduced landfill disposal by 90 percent and generates 13.1 megawatts (MW) of electricity that is sold to Portland General Electric. Total direct revenues for this facility are estimated at more than $18 million a year, with total indirect and induced revenues estimated at almost $14 million a year. With over 40 full-time employees, the Marion County waste-to-energy plant has had a substantial and positive impact on this small, rural town.

BACKGROUND AND CONTEXT

The Marion County waste-to-energy facility began commercial operation in March of 1987, servicing the solid waste management needs of the 300,000 residents of Marion County. It is privately owned and operated by Covanta Marion Inc. At the time when the project was being considered, residents voted in a local referendum to construct the waste-to-energy facility over a plan to ship local waste to another county's landfill to generate reliable, affordable, and clean energy. The plant processes 550 tons-per-day of municipal solid waste. Marion County has one of the highest rates of recycling in the state. In fact, Marion County has been so successful in their waste reduction efforts that they are able to accept waste from neighboring counties, adding further to the county's revenue stream. At just 15 acres, the Marion County waste-to-energy facility is much smaller than a typical landfill, does not produce odors or release methane, and allows the county to collect renewable energy credits.

The facility was the first mass-burn resource recovery facility in the United States to use dry flue gas scrubbers and fabric filter baghouses to control acid gases and particulates. Waste-to-energy is classified by the U.S. EPA as a net greenhouse gas reducer over a traditional landfill, as waste-to-energy facilities do not generate methane.[23] The waste-to-energy facility has reduced trucking loads and encouraged recycling among the county's residents.

MAKING THE INVESTMENT

Waste-to-energy facilities require substantial upfront capital investments. It is estimated that each new facility generates approximately $1 billion in total direct and indirect spending with an estimated 700 to a 1,000 construction jobs created over the average two and a half year construction time span.[24] The Marion County project was financed through municipal bonds which were paid back through revenue generated from the sale of the 13.1 MW of electricity from the facility to Portland General Electric. Total direct revenues for this facility are estimated at more $18 million a year with total indirect and induced revenues estimated at almost $14 million a year. The facility supports over 40 full-time employees and has created 73 indirect and induced jobs.[25]

Plant managers and operators must ensure a steady and consistent supply of municipal solid waste in order to maintain a reliable and consistent power supply. The Marion County facility has been able to maintain a 95 percent reliability rate and over 90 percent generation capacity. Since opening the Covanta facility almost 30 years ago, Marion County has seen its recycling rates double to 54.5 percent of total waste generated, the second highest rate in Oregon. Much of the revenue generated by the facility is used to enhance county-wide waste reduction efforts and invest in newer and upgraded equipment to make the facility cleaner and more efficient. In addition, the county benefits from tipping fees that it is able to charge other counties for bringing their waste to the facility.

TECHNOLOGY SPOTLIGHT: WASTE TO ENERGY IN THE U.S.

Nationwide, the waste-to-energy sector employs approximately 5,400 Americans with direct labor earnings estimated at $459 million in wages, salaries, and benefits. Waste-to-energy generated approximately 14.5 million megawatt hours of electricity in 2012, enough to power 1.3 million average U.S. homes.[26]

LOCAL REVENUE

Total direct revenues for the Marion County facility are estimated at more than $18 million a year, with total indirect and induced revenues estimated at almost $14 million a year.

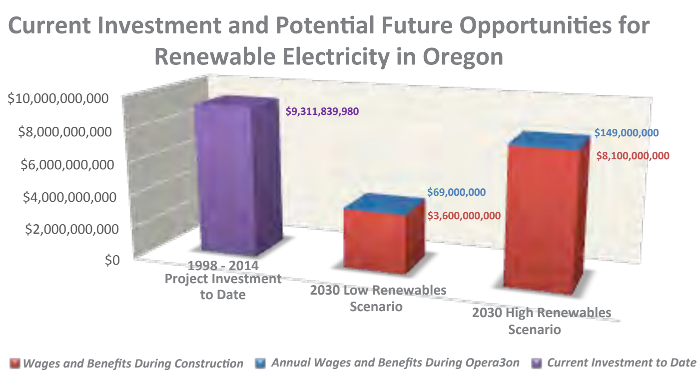
JOB CREATION

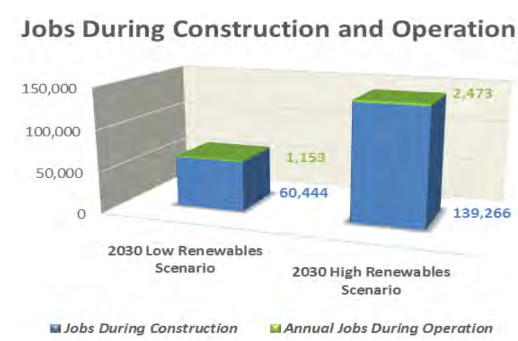
The facility supports 113 direct, indirect and induced jobs.

The Marion County WTE facility has provided reliable power since 1987. Photo courtesy of Marion County

OREGON'S RENEWABLE FUTURE

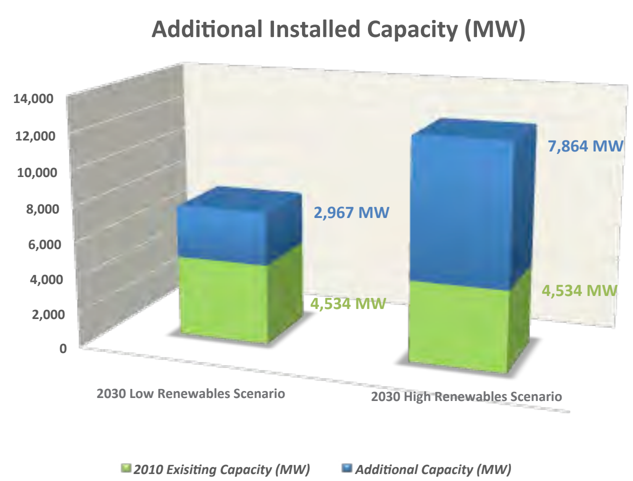
Our key findings are listed in the summary table below (see Methodology section for data sources and methods used).

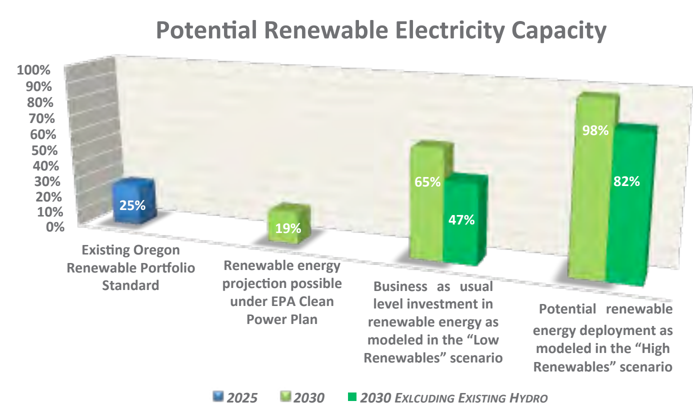




In a "High Renewables" scenario, Oregon has the potential to attract over $8 billion more in wages and benefits during construction.

In a "High Renewables" scenario, Oregon has the potential to create almost 140,000 additional local jobs during construction and nearly 2,500 additional annual jobs committed to operations and maintenance.





In a "High Renewables" scenario, Oregon has the potential to supply over 98 percent of overall state electricity use from renewable energy.

In our "High Renewables" case, renewable energy development (excluding existing hydroelectric power) would produce four times as much renewable energy as EPA projected.

OREGON'S RENEWABLE ELECTRICITY DEVELOPMENT POTENTIAL FAR EXCEEDS THE PROPOSED CLEAN POWER PLAN

The EPA Clean Power Plan calls for Oregon to reduce carbon dioxide emissions by 48 percent by 2030.[27] EPA based Oregon's target on cuts through the following measures:

- A 2.2 percent reduction through increased efficiency of coal plants
- A 19 percent reduction through increased use of low-emitting natural gas combined cycle plants where excess capacity is available
- A 15.8 percent reduction through the use of more zero-emitting power sources such as renewable energy and nuclear power, and
- An 11.2 percent reduction through energy efficiency improvements to reduce electricity demand.[28]

Oregon has a great deal of flexibility in developing its compliance plan, and may choose these or other carbon reduction strategies. A state could select a different balance among the approaches than EPA used to set the proposed emission reduction target.

Analysis from the Union of Concerned Scientists (UCS) demonstrates that even under a conservative growth scenario, states can achieve twice the renewable energy proposed by the EPA. According to UCS analysis, the Clean Power Plan does not sufficiently consider existing renewable energy deployment rates or the falling costs of renewable energy.[29]

Another recent analysis based on modeling by ICF International, a business management consulting firm, concludes that the EPA utilized outdated renewable energy cost considerations, including "levelized costs for both wind and solar energy that are 46 percent above current average costs".[30] The recent price drops in renewable energy will likely make the proposed rule less expensive to meet, and provide even greater opportunity for renewable energy development.

Our analysis shows that Oregon could meet the entire EPA emissions reduction target through the increased use of renewable energy.

Indeed, Oregon also has the potential for significant renewable electricity development far beyond what is likely under the proposed standards. Developing those resources would attract substantial investment to the state and create thousands of new jobs.

Renewable energy projection possible under EPA Clean Power Plan[31]	**19% by 2030**
Existing Oregon Renewable Portfolio Standard*	**25% by 2025**
Business-as-usual level investment in renewable energy (excluding existing hydroelectric power) as modeled in the "Low Renewables" scenario	**47% by 2030**
Business-as-usual level investment in renewable energy as modeled in the "Low Renewables" scenario	**65% by 2030**
Potential renewable energy deployment (excluding existing hydroelectric power) as modeled in the "High Renewables" scenario	**82% by 2030**
Potential renewable energy deployment as modeled in the "High Renewables" scenario	**98% by 2030**

In the proposed Clean Power Plan, the EPA proposed a 2030 target emissions rate for each state. This target is based on EPA estimates of how each state could leverage a mix of measures, including adding new renewable electricity generation. States are not required to achieve EPA's renewable projections in order to comply with the proposed Clean Power Plan, or they may exceed them if cost-effective for the state. For Oregon, EPA projects 19 percent renewable energy generation under the proposed rule by 2030.

Oregon already meets the EPA proposed target and is on track to significantly exceed it before 2030, due to a robust state Renewable Portfolio Standard of 25 percent by 2025.

The "High Renewables" scenario modeled here and in the NREL *Renewable Electricity Futures* study would exceed the EPA proposed target four-times over.[32]

** Oregon's Renewable Portfolio Standard does not include hydroelectric power, while the "Low Renewables" and "High Renewables" scenarios both include hydroelectric power.*

RESEARCH METHODOLOGY

PURPOSE OF STUDY

David Gardiner and Associates (DGA) conducted this study for the Wind Energy Foundation and the A Renewable America campaign to assess the overall opportunity for renewable energy-based economic development in Oregon.

METHODOLOGY

DGA modeled the economic effects of a renewable electricity future in 2030 for Oregon based on two trajectories from the 2012 National Renewable Energy Laboratory (NREL) Renewable Electricity Futures (REF) study, the most comprehensive analysis of high-penetration renewable electricity in the United States to date.[33] That study involved a collaboration of more than 100 experts from 35 institutions representing national energy labs, academia, utilities, grid operators, industry, financial institutions, environmental groups and renewable energy businesses. It found that the United States could reliably meet at least 80 percent of its electricity needs from renewable energy resources by 2050, at a cost comparable with other scenarios for reducing harmful carbon dioxide (CO_2) and other power plant pollutants.

DGA features a "Low Renewables" and a "High Renewables" scenario based on updated 2014 results of the NREL Regional Energy Deployment System (ReEDS) model, completed by authors of the original REF study.[34]

- The "Low Renewables" scenario in this study is based on the "Low Demand Baseline" in the REF study. It assumes that electricity demand grows very slowly, and that no new renewable energy policies are enacted. Existing federal policies are assumed to expire as scheduled.
- The "High Renewables" scenario in this study is based on the REF "Core 80% RE scenario '80% RE-ITI'". It assumes that policies are enacted to achieve 49 percent of total contiguous U.S. electricity generation from renewable sources in 2030 and 80 percent in 2050, without specifying which of many policies could enable achieving that goal. It also assumes low electricity demand growth, and only incremental technology improvement (ITI) that reflects partial achievement of the future technical advancements that may be possible for each technology.

DGA did not utilize the scenario from REF that assumed a higher rate of "Evolutionary Technology Improvement", or scenarios that assumed "No Technology Improvement" or that assumed various potential constraints on renewable energy development, such as inadequate available renewable resources, inadequate transmission, or inadequate flexibility technologies, such as energy storage, needed to balance electricity demand with supply.[35] DGA also did not utilize REF scenarios with high energy demand, which would have produced higher levels of renewable energy development.

ReEDS calculates the mix of renewable energy and other technologies in each state that could meet the national renewable energy goals at the lowest total system cost.

DGA then calculated the economic development impacts of the five major renewable electricity technologies (biomass, geothermal, hydroelectric power, solar, and wind) using the NREL Jobs and Economic Development Impact (JEDI) model, with its generic default cost assumptions. JEDI was initially designed to estimate economic impacts of renewable energy to state economies, and later refined to focus on specific renewable energy projects. It includes both direct employment in the projects and their supply chains, and indirect and induced employment including wages and benefits spent in the state or local region.

The JEDI model is not a macroeconomic model, and does not calculate any offsetting reduction in employment in other parts of the economy, such as extracting fossil fuels. Many previous studies have found, however, that renewable energy technologies yield more employment per dollar or per megawatt than fossil fuel technologies, and thus lead to net increases in employment.[36]

DGA has also not calculated the economic benefits of other investments needed to enable the "High Renewables" scenario, such as upgrades to transmission and distribution systems, or the development of energy storage or other flexibility resources. ReEDS calculates that the "High Renewables" scenario would also be accompanied by 2,165 MW of electricity storage technologies by 2030.

While distributed generation solar photovoltaics are exogenous to the ReEDS model, which focuses primarily on utility-scale solar opportunities, the REF study utilized a separate model to represent rooftop solar PV deployment.

The REF study and JEDI model do not include specific estimates for waste-to-energy technology. We include an estimate of the technical potential for waste-to-energy expansion in the key findings section of the report, based on a recent study from Columbia University.[37] The growth assumptions for waste-to-energy in this report are based on the percent of municipal solid waste (MSW) used at waste-to-energy facilities in Europe (which process 25 percent of MSW using waste-to-energy facilities, as opposed to 7.6 percent in the United States). Unlike the ReEDS modeling for other technologies, that estimate is not based on any assessment of the economic competitiveness of waste-to-energy relative to other electricity generation technologies. Other studies, such as the U.S. Energy Information Administration Annual Energy Outlook, have found that significant expansion of waste to energy is unlikely under business-as-usual or with modest renewable energy or greenhouse gas reduction policies. Expanded use of waste-to-energy is possible under policies favorable to that technology, however.

APPENDIX

Total Renewable Electricity (Biomass, Geothermal, Hydroelectric, Solar, and Wind)	2030 High Renewables Scenario	2030 Low Renewables Scenario
Additional Installed Capacity	7,864 MW	2,967 MW
Local Jobs During Construction	139,266	60,444
Wages and Benefits During Construction	$8.1 billion	$3.6 billion
Annual Jobs During Operation	2,473	1,153
Annual Wages and Benefits During Operation	$149 million	$69 million
Wind (2,077 MW in 2010)	2030 High Renewables Scenario	2030 Low Renewables Scenario
Additional Installed Capacity	4,037 MW	1,049 MW
Local Jobs During Construction	15,558	4,044
Wages and Benefits During Construction	$869 million	$226 million
Annual Jobs During Operation	534	139
Annual Wages and Benefits During Operation	$29 million	$7.8 million
Hydroelectric Power (2,209 MW in 2010)	2030 High Renewables Scenario	2030 Low Renewables Scenario
Additional Installed Capacity	3,227 MW	1,853 MW
Local Jobs During Construction	96,847	55,611
Wages and Benefits During Construction	$5.9 billion	$3.4 billion
Annual Jobs During Operation	1,655	950
Annual Wages and Benefits During Operation	$99 million	$57 million
Solar (19.3 MW in 2010)	2030 High Renewables Scenario	2030 Low Renewables Scenario
Additional Installed Capacity	423 MW	N/A*
Local Jobs During Construction	25,300	N/A*
Wages and Benefits During Construction	$1.2 billion	N/A*
Annual Jobs During Operation	187	N/A*
Annual Wages and Benefits During Operation	$11 million	N/A*
Geothermal (0 MW in 2010)	2030 High Renewables Scenario	2030 Low Renewables Scenario
Additional Installed Capacity	155 MW	31 MW
Local Jobs During Construction	1,506	323
Wages and Benefits During Construction	$64 million	$14 million
Annual Jobs During Operation	63	26
Annual Wages and Benefits During Operation	$7 million	$3 million
Biomass (230 MW in 2010)	2030 High Renewables Scenario	2030 Low Renewables Scenario
Additional Installed Capacity	22.4 MW	22.4 MW
Local Jobs During Construction	52	52
Wages and Benefits During Construction	$4.1 million	$4.1 million
Annual Jobs During Operation	35	35
Annual Wages and Benefits During Operation	$1.6 million	$1.6 million

*** NREL assumed no growth for distributed generation solar PV in the Low Renewables scenario.**

Separately, this report also reviewed the technical potential for waste-to-energy in Oregon.

Waste-to-Energy (13 MW in 2014)	2030 Additional Capacity Potential
	68 MW

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Page 1: Sunset at Klondike Wind Farm. Photo courtesy: Will De Freitas on Flickr.
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ABOUT THE ORGANIZATIONS

A RENEWABLE AMERICA

A project of the Wind Energy Foundation, a 501c3 nonprofit organization, *A Renewable America* provides education about the many benefits of American-made renewable electricity. A Renewable America raises public awareness of how each of the six major U.S. renewable electric technologies – biomass, geothermal, hydro, solar, waste-to-energy, and wind power – are already providing a substantial amount of clean, affordable, and reliable electricity.
For more information, visit www.arenewableamerica.org.

OREGON INSTITUTE OF TECHNOLOGY

The Oregon Institute of Technology (Oregon Tech) offers one of the top engineering programs in the country, and introduced the first Bachelor of Science and later the first Master's Degree in renewable energy systems, now called Renewable Energy Engineering. With its Klamath Falls campus sitting atop geothermal springs, Oregon Tech began using geothermal energy to heat campus buildings in 1964. Fifty years later, the campus has now installed two geothermal power plants that, together with a 9-acre solar array, make the university the first in North America to generate all of its electricity onsite through these two clean, renewable sources.
For more information, visit www.oit.edu.

WIND ENERGY FOUNDATION

The Wind Energy Foundation is a 501c3 nonprofit organization dedicated to raising public awareness of wind as a clean, domestic energy source through communication, research, and education. The Foundation is also committed to supporting ongoing research that furthers the continued growth of wind energy.
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For more information, visit www.dgardiner.com.

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