WINDS OF CHANGE

The economic impact of Colorado's wind industry — and how to keep it growing

E2
ENVIRONMENTAL ENTREPRENEURS®




Photos courtesy of NREL

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ABOUT E2

E2 is a national, nonpartisan group of business leaders, investors and others who promote smart environmental policies that drive economic growth. E2 members, active in nearly every state in the country, have built or financed more than 1,700 companies that have created more than 570,000 jobs, and manage more than $100 billion in venture and private equity capital. Our Rocky Mountains Chapter was founded in 2007 and has grown to more than 75 members. E2 is an affiliate of the Natural Resources Defense Council. Learn more at **www.e2.org or follow us on Twitter at @e2org.**

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INTRODUCTION

Photo courtesy of NREL

Few states have benefited more from the wind industry than Colorado.

Thanks to smart policy decisions, beginning with passage of the first voter-approved state renewable portfolio standard in 2004, as well as abundant natural resources and skilled workers, Colorado has transformed itself into a leader for wind and other renewable energy sources. Colorado is now the top state for wind manufacturing jobs and ranks third for wind jobs overall.[1]

But Colorado today is at a crossroads. In order to adequately support what has become a major sector of the state's economy, and remain a national front-runner in clean, renewable energy, Colorado's leaders need to take action with policy opportunities that are good for its economy and good for its environment.

Two such opportunities are now on Colorado's doorstep.

First is the federal Clean Power Plan, which as proposed would cut carbon emissions from dirty power plants in Colorado by 35 percent in part by increasing clean renewable energy and energy efficiency. A strong state CPP implementation plan that focuses on renewable energy and energy efficiency promises to speed up growth in the wind industry and other clean energy businesses.

Second is planning for the future of the state's Renewable Portfolio Standard (RPS). The current standard, which has driven growth for the past decade, will be met by 2020. To prevent industry slow-down, new policy direction is needed to expand the state's renewable energy portfolio. The CPP presents an opportunity to develop new, strong standards to continue to help the renewable industry grow beyond 2020.

What's at stake in Colorado is huge.

The wind industry already is producing enough energy to power nearly 700,000 Colorado homes. It has the potential to power the state 24 times over.[2]

It also is creating jobs and driving economic growth all across the state. As this report shows, the wind industry in Colorado:[3]

- Has created between 6,000 and 7,000 jobs total as of 2014
- Employs nearly 10 percent of the nation's wind industry workforce
- Operates 22 manufacturing plants
- Operates 29 wind farms
- Has invested more than $4.8 billion in the state's economy
- Generates $7.8 million in annual lease payments to ranchers, farmers and other landowners
- Has saved Colorado more than $20 million in fuel costs

Photo courtesy of NREL

According to Environmental Entrepreneurs' (E2's) quarterly clean energy job announcement reports, more than 2,500 permanent and temporary wind jobs have been announced in the state since September 2011 alone. For example, a single company, Vestas Wind Systems, now employs more than 1,000 workers at its Pueblo tower manufacturing facility, and hundreds more who are producing turbine blades in Brighton and Windsor, and assembling nacelles — the electrical "guts" of the turbines — in another facility in Brighton.

Vestas' decision to site such large manufacturing centers in the state has spurred the growth of smaller manufacturing companies that supply the larger facilities. One example is PMC Technology, which opened a facility in Golden in 2009 to manufacture hydraulic components, which they sell to Vestas.[4]

Vestas isn't the only company attracted to Colorado because of the state's leadership in renewable energy policies. Wind, solar and battery developer RES Americas announced in 2008 it was moving its headquarters from Austin, Texas, to Broomfield, bringing with it nearly 100 jobs with an average salary of $110,000. RES Americas said it was Colorado's "immense leadership" in developing renewable energy resources that helped prompt the headquarters move.

Taking advantage of Colorado's strong wind energy resources, wind farms up and down the state supply nearly 14 percent of the state's electricity.[5] NextEra Energy owns approximately half of Colorado's wind capacity and the state's largest utility Xcel Energy, along with cooperative utilities Platte River and Tri-State Generation and Transmission Association, buy most of the state's wind power on its customers' behalf.

The wind industry is bolstered by — and is bolstering — Colorado's research and development and education sectors as well.

For example: At Aurora-based Ecotech Institute, the nation's leading college devoted to preparing students for careers in sustainable energy, workers learn the basics of operating and maintaining wind farms.

At the National Renewable Energy Laboratory (NREL) in Golden, the premier institution studying wind energy production, more than 100 of the lab's 1,700 scientists and engineers develop more efficient wind turbine technologies.[6]

Beyond these areas, employment impacts of the wind industry extend far into Colorado's economy. To complete a typical 250 MW wind project — Colorado has seven wind farms that are nearly this size — 1,100 workers are needed in fields ranging from engineering and land surveying and construction to manufacturing of components such as blades and ball bearings.[7]

Colorado companies are essential to completing large-scale projects like these.[8] To continue to grow the state's wind economy and the jobs and benefits that come with it, smart policies such as the Clean Power Plan and the RPS are critical.

CASE STUDY —
VESTAS BRINGING BIG MANUFACTURING BOOST TO COLORADO

In 2008, major Danish wind turbine manufacturing company Vestas set up shop in Colorado, investing $700 million in wind turbine manufacturing facilities in the state. Vestas currently employs nearly 3,000 workers in Colorado who are manufacturing blades, towers, and nacelles and providing support to the company.

Vestas built its first facility in Windsor in 2008, and hired 400 workers to manufacture blades. As blade demand increased to 1,800 per year, the company hired 250 more workers. In 2010, Vestas developed new projects in Brighton where it developed a nacelle assembly plant and an additional blade plant, collectively creating 1350 jobs.[9]

In 2013, Vestas completed a new facility in Pueblo that can produce up to 1,300 wind turbine towers a year. The plant employs a substantial number of welders, needed to build the stem of the turbine. Vestas sited the plant based on the area's existing manufacturing workforce, access to transportation hubs, state and local incentives, and a streamlined permitting process. Vestas also installed a turbine on site to partially power the plant.

Vestas continued to bolster its production in 2014, and announced the addition of 1,500 workers in Colorado throughout the year.[10, 11]

"Vestas' significant investment in facilities and employees within Colorado over the last 4–6 years has spurred growth within the stateside supply chain and within Colorado," said Craig Walker of Denver-based Walker Component Group. Walker started his electronic component distribution company in the 1970s, and branched into the wind industry in one of his manufacturing facilities several years ago.

Walker Component Group employs nearly 50 workers in its wind energy manufacturing facility that produces cable and electronic assemblies supplying Vestas. Soon, Walker plans to hire 18 more employees to meet increasing demand. "We are revising our demand forecast upwards weekly."

To meet its workforce needs, Vestas is working with community colleges to help prospective and current employees develop the skills necessary to work in the wind energy industry. The company partnered with Aims Community College for continuing education programs that keep its employees up to date on the latest wind technologies, and supports additional training programs.[12, 13]

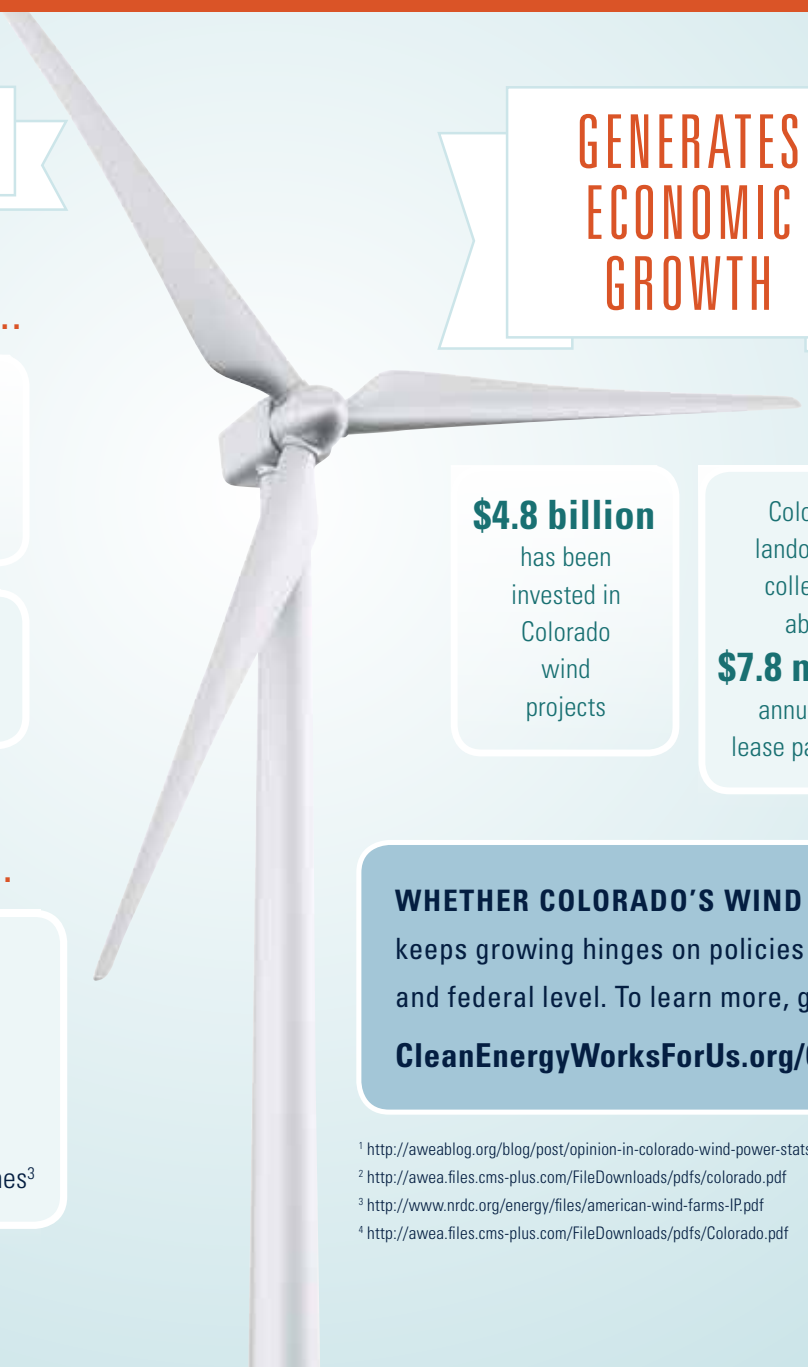
WINDS OF CHANGE

HOW DOES THE WIND INDUSTRY IMPACT COLORADO'S ECONOMY?

Colorado generates enough wind energy to power nearly 700,000 homes.

In fact, Colorado has enough wind potential to power the state 24 times over.[1]

BUT WIND ENERGY DOES MORE THAN GENERATE ELECTRICITY. IT ALSO...



GENERATES JOBS

6,000–7,000
WIND ENERGY JOBS...

22 wind industry manufacturing plants

29 operating wind farms

and many other companies up and down the extensive supply chain[2]

TO COMPLETE A TYPICAL 250 MW WIND FARM...

1,100 workers
are needed to do things like:

- survey and engineer sites
- manufacture components ranging from blades to ball bearings
- pour concrete pads and erect turbines[3]

GENERATES ECONOMIC GROWTH

$4.8 billion has been invested in Colorado wind projects

Colorado landowners collecting about **$7.8 million** annually in lease payments[4]

WHETHER COLORADO'S WIND INDUSTRY keeps growing hinges on policies at the state and federal level. To learn more, go to **CleanEnergyWorksForUs.org/Colorado**

[1] http://aweablog.org/blog/post/opinion-in-colorado-wind-power-stats-will-blow-you-away and EIA
[2] http://awea.files.cms-plus.com/FileDownloads/pdfs/colorado.pdf
[3] http://www.nrdc.org/energy/files/american-wind-farms-IP.pdf
[4] http://awea.files.cms-plus.com/FileDownloads/pdfs/Colorado.pdf

COLORADO'S STRONG POLICIES SPUR GROWTH

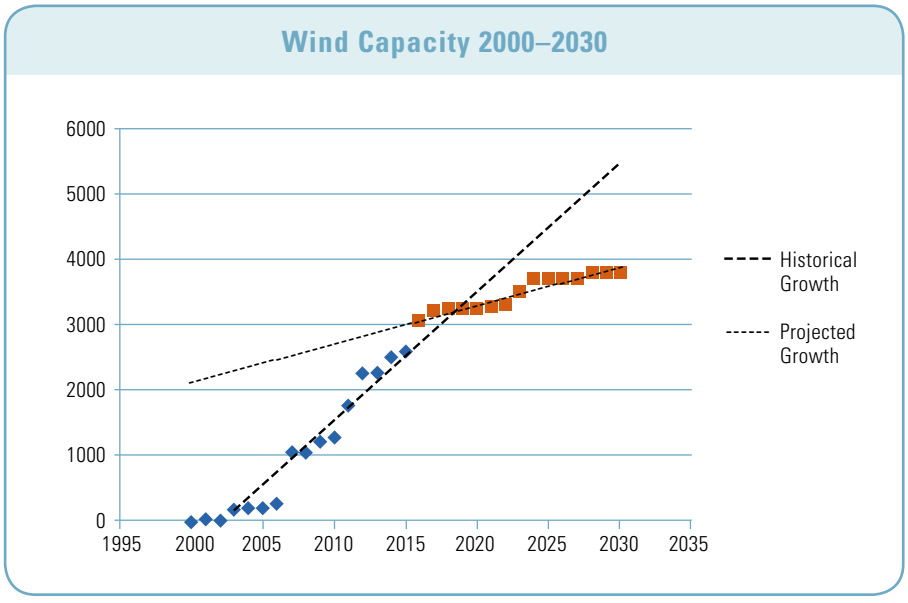
Recognizing the economic potential in harnessing its abundant wind resources, Colorado has crafted policies designed to attract to the state more private-sector manufacturers, suppliers, and developers active in the wind industry.

The 1–2 punch of the federal Production Tax Credit (PTC) plus the state's renewable portfolio standard, or RPS, has been key to scaling up the industry and lowering costs 50 percent in the last five years. But the PTC has now expired, again, and Congress has yet to consider legislation that would extend that program.

At the same time, Colorado's RPS will be met by 2020, and the state's electricity suppliers expect wind growth to slow to a trickle in the following years as a result. The question looms: will Colorado continue to encourage clean energy in the years ahead through a revised RPS and other job-creating policies such as the federal Clean Power Plan?

The effectiveness of smart clean energy policies is clear. Colorado's renewables targets are the second-highest in the country. The 6,000-plus wind jobs that have been created and the $4 billion-plus in wind energy investments in the state are proof.

The requirements of the federal Clean Power Plan, which are expected to be released in summer 2015, can easily be met by extending



As illustrated above, the rate of wind growth is expected to slow significantly post-2020.[14]

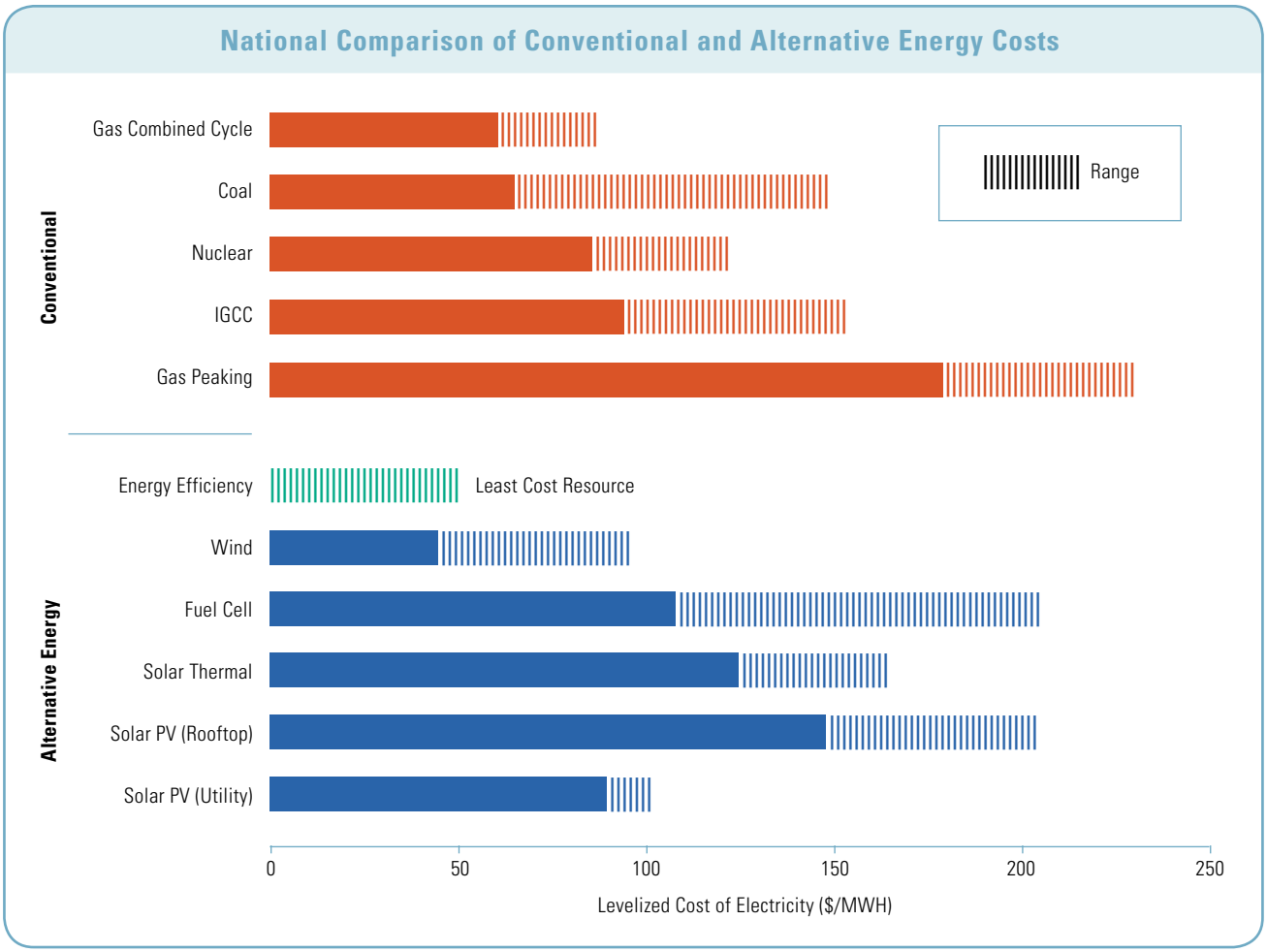
Photo courtesy of NREL

Colorado's success in clean energy — and can create thousands more jobs along the way.

Meanwhile, the industry created by these policies has brought electricity prices down for Coloradans. Thanks to wind cost declines, the state's biggest utility, Xcel Energy, recently got permission to buy even more wind power because it is cheaper than natural gas.[15] Wind is expected to save Colorado $231 million over 20 years, and has already saved the state more than $20 million in fuel costs.[16] Wind Power is making the grid more resilient and reliable

Expanding the state's availability of clean, renewable energy is not expected to damage grid reliability or increase integration costs.[17]

Grid operators like PJM and MISO have been managing electricity variability since the build-out of our power system more than a century ago. Our huge, interconnected grid means that declines in power output in one region can be



Wind energy is increasingly cost-competitive with natural gas. Nationally (which this chart represents) and in Colorado, where Xcel will soon operate 2,600 MW of the renewable resource, wind is cheaper than existing natural gas. *Source: Lazard.*

balanced by increases in another region. While fossil and nuclear power sources can have large, abrupt, and unpredictable output changes, wind and solar power fluctuations tend to be gradual and predictable.[18]

By using better weather forecasting and improving renewable energy power output, Xcel Energy improved its wind forecasting by 37 percent between 2009 and 2013. This saved its customers $37.5 million.[19]

Much of the savings comes from needing fewer reserves. Grid operators run back-up power plants that can be switched on when there's an outage. Conventional power plants require more fast-acting backup than renewables due to the potential for sudden, drastic outage. These fast-acting reserves are more expensive than slow-acting reserves, which are the type primarily needed to balance wind power's more gradual output fluctuations.[20]

On Texas and the Midwest's grids, which each carry more than 10,000 MW of wind power — some of the highest numbers in the country — grid operators have found that only a small increase in fast-spinning reserves are needed to accommodate wind's variability. The rest can be met with slow reserves. In Colorado and Wyoming, this can translate to $1.1 million in savings by increasing renewables penetration from 25% to 35%, according to NREL analysis.[21]

Thanks to management, planning, and improving grid technologies, Colorado can cut pollution, increase energy efficiency, and add renewable energy capacity while maintaining a strong and reliable electric grid.

IMPACT OF THE PRODUCTION TAX CREDIT ON THE WIND ENERGY INDUSTRY

Colorado's state policies have significantly bolstered its wind industry, but the federal Production Tax Credit (PTC) plays an outsize role in the industry's recent growth. A 2.2 cent per kWh tax credit, the PTC drives investment in wind, and has been critical in driving 30% annual energy capacity additions, dropping prices by 43% over the past four years, and supporting 80,000 jobs across the country.[22]

In recent years, Congress has let the PTC expire several times, creating market uncertainty which has slowed growth and caused planning challenges. PTC uncertainty has also led the industry to shed a considerable number of jobs; in 2012, Vestas which has multiple facilities in Northern Colorado, laid off approximately 500 employees in the state due to the credit's expiration. Colorado's clean energy economy could hugely benefit from a long-term, stable tax policy.

COLORADO'S RPS KEY DRIVER OF RENEWABLES GROWTH

Moving forward with strong Clean Power Plan implementation and other clean energy measures builds upon the state's history of leveraging energy efficiency and renewable energy to become more energy independent.

In 2004, Colorado became the first state to enact an RPS by voter approval. The RPS requires utilities to source 30 percent of their retail electricity sales from renewables by 2020, helping usher in the installation of more than 1,500 wind turbines and helping put nearly 2,600 MW of Made-in-Colorado electric generation capacity on line.[23]

When the RPS was passed, 0.6% of Colorado's power came from renewable energy. Today, renewables supply 15% of Colorado's electricity, most of which comes from wind.[24]

Utilities are meeting the standard at little to no cost, in many cases even exceeding the renewables targets — thanks to the cost-effectiveness of wind and solar resources.[25] As 2020 approaches, will Colorado continue to lead the nation in renewable energy?

Photo courtesy of NREL

RURAL COMMUNITIES BENEFIT FROM WIND

In 2007, Colorado authorized property owners to collect taxes or credits from renewable energy systems installed on their own property.[26]

For Colorado's agricultural communities, these lease payments have been especially beneficial. For each wind turbine installed on private land, landowners like farmers and ranchers can over 20 years receive up to $120,000 in lease payments.

More than 80 percent of Colorado wind is located in the rural counties of Logan, Prowers, Weld, and Lincoln. In these counties, wind farms have boosted property tax collection by millions of dollars annually, which provides school districts in the area with higher budgets to do things like hire more teachers and purchase more books.[27]

Farming and ranching families also benefit from smaller-scale projects, said Ramah, Colorado, rancher Christian Hertneky. "Historically, small windmills harnessed wind to pump water or provide electricity to rural homes. Today, technological innovation and efficiencies in wind generation bring incredible opportunities for farmers, ranchers and our rural communities."

Colorado's cooperative utilities are helping lead wind development in rural parts of the state. The Tri-State Generation and Transmission Association and San Isabel Electric Association were both recognized as WINDExchange Wind Cooperatives of the Year by the Energy Department and National Rural Electric Cooperative Association (NRECA) in February 2015.[28]

CASE STUDY — ECOTECH INSTITUTE


Photo courtesy of Ecotech

Founded in 2010, Ecotech Institute, based in Aurora, is the nation's leading college dedicated to training students for careers in clean energy.

Ecotech offers academic programs in subjects like wind energy technology, solar energy technology, and power utility technology.

The school attracts students ranging from recent high school graduates to military veterans to mid-career workers looking for a transition. Many students enter Ecotech with no prior knowledge or experience in manufacturing or engineering, and some lack the skills needed to earn salaries beyond minimum wage.

"For students looking to build a career, this is where they choose to do it," said wind energy instructor Walter Christmas.

In the two-year wind energy technology program, for example, students learn the mechanical, electrical, and safety skills needed to service complicated turbines that harness wind energy 100 meters off of the ground.

Nearly 200 students graduate from Ecotech each year. Wind program graduates enter the industry earning a base salary of $18 to 22 dollars per hour, with opportunities to accumulate more income through travel.

On-site training provided by companies is a critical last step to technicians operating independently, but many Echotech grads enter the clean energy workforce a step ahead of their competition.

"Ecotech graduates have an excellent foundation of skills to build on," said Michael Rucker, head of Boulder-based wind operations company Harvest Energy Services, which employs several Ecotech alumni.

Chris Oberle, a career development specialist at Ecotech, said students focused on wind energy often have jobs lined up before they graduate. They find work at major wind industry players like NextEra, Vestas, DeWind, and General Electric.

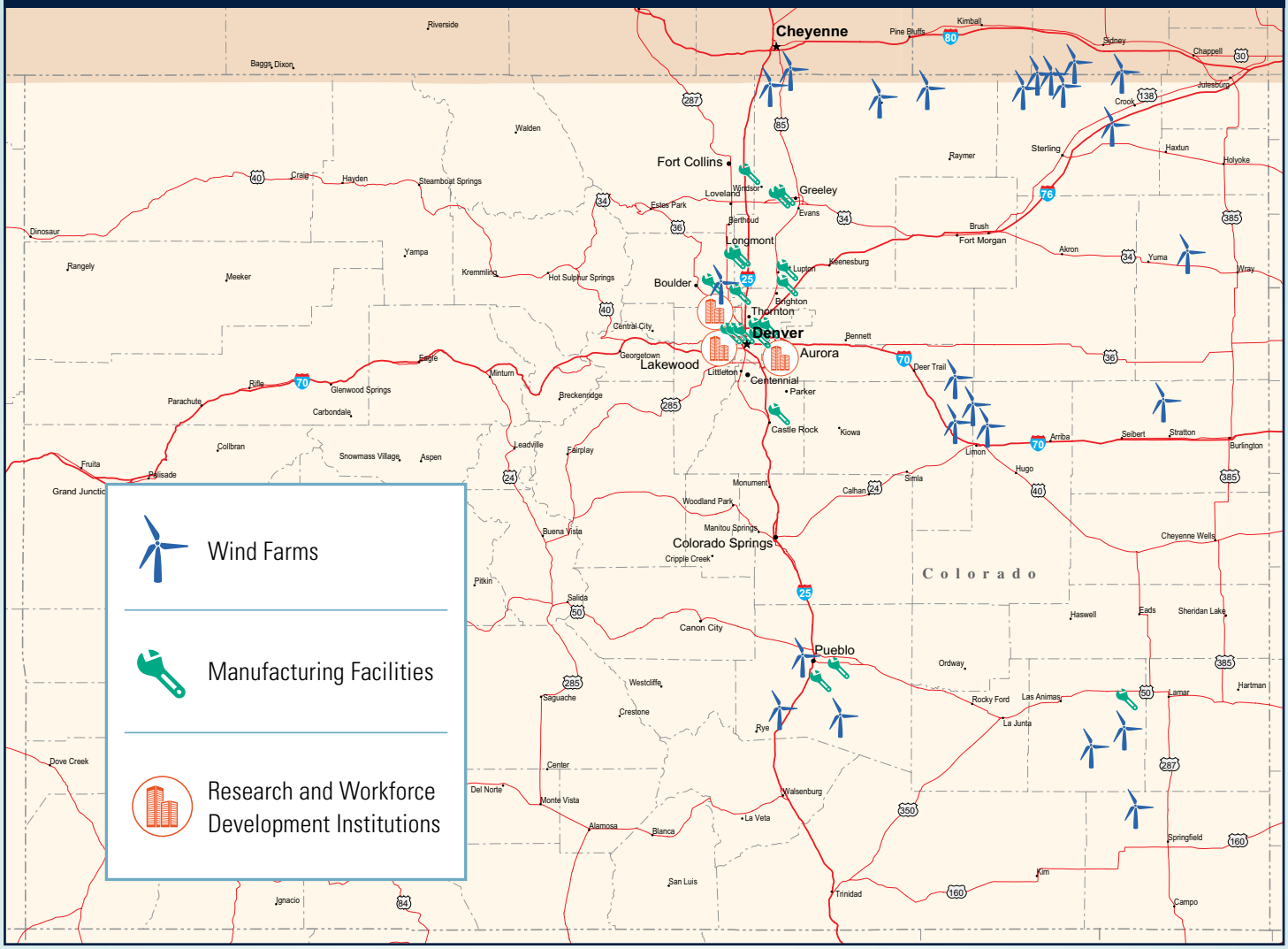
NextEra, which owns four wind farms in Colorado, including its Limon project with nearly 400 turbines, is the biggest employer of Ecotech wind grads. It employs 21 grads.

Ecotech has become fundamental to the growth of Colorado's wind industry, which has expanded thanks to smart policies at the state level.

"The future is bright," Oberle said. "We have to continue the transition from non-renewables to renewables."

COLORADO'S WIND INDUSTRY

Farms, Factories and Future Innovation



WIND FARMS

Limon I Wind Farm
Limon II Wind Farm
Limon III Wind Farm
Cedar Point Wind Farm
Kit Carson Windpower Project
Lamar Wind (Baca County)
Twin Buttes
Colorado Green
Busch Ranch Wind
Huerfano River Wind Project
Vestas Towers America
Wray School District
Colorado Highlands Wind Project
Spring Canyon III Energy Center
Northern Colorado Wind (NCW)
Spring Canyon I Energy Center
Spring Canyon II Energy Center
Peetz Table Wind Energy Center
Logan Wind Energy Center (Peetz Table II)
Ridge Crest Wind Partners (Peetz Table)
Cedar Creek Wind II
Cedar Creek Wind Project
Ponnequin Phases II and III
Ponnequin Phase I
NREL Superior

MANUFACTURING FACILITIES

Aldridge Electric
Aluwind Inc
AnemErgonics
Bach Composite Industry
Creative Foam Corporation
DeTect, Inc
Dragon Wind
Hexcel Corporation
Lockheed Martin Coherent Technologies
O'Neal Steel
O'Neal Steel
PMC Technology
Primus Windpower
SGB USA
Siemens Energy Inc
Vestas Blades America, Inc.
Vestas Nacelles
Vestas
Vestas
Walker Component Group

RESEARCH AND WORKFORCE DEVELOPMENT INSTITUTIONS

National Renewable Energy Laboratory
Ecotech Institute
National Wind Technology Center (NWTC)

RESEARCH, DEVELOPMENT AND WORKFORCE TRAINING

Colorado is home to Department of Energy-funded NREL and its National Wind Technology Center (NWTC), the premier wind research center in the United States. Scientists and engineers there, working closely with industry partners, advance wind technology to improve performance and reliability while lowering costs.[29]

Photo courtesy of NREL

"We also benefit from the local economic and academic climate which brings a steady flow of industry and research talent into the area for partnership and collaboration opportunities," said David Glickson, spokesperson for NREL.

NREL, working with the Electrical Power Research Institute (EPRI) also recently launched an incubator network to help entrepreneurs commercialize the technologies developed at the lab.[30] An NREL-developed software program that models wind power output on wind farms based on geography and air flow is already being used by wind developers figuring out how to site turbines to harness the most wind energy possible.

The Center for Research and Education in Wind (CREW) is a job-training collaboration between the University of Colorado in Boulder, The Colorado School of Mines in Golden, and Colorado State University in Fort Collins. The Renewable and Sustainable Energy Institute at the University of Colorado in Boulder offers education in renewable energy, including wind.

The institutions combine resources and work closely with industry to drive economic benefits for the wind energy sector.[31] A public-private partnership, Colorado matches industry funding. The loop is complete when industry members hire graduate and post-graduate students for research at these research centers.[32]

There are also opportunities for students at community colleges to learn skills to succeed in the wind industry. Arapahoe Community College, Red Rocks, and Colorado Mountain College are some of the schools offering programs.

CASE STUDY —
XCEL ENERGY A MAJOR DRIVER OF GROWTH

Xcel Energy was the first energy service provider to build a utility-scale wind energy project in Colorado when it developed the Ponnequin Wind Farm in the northern part of the state. With one-third of the turbines manufactured by Vestas, the project showcases the state's wind supply chain at work.

Between 1998 and 2012, Xcel Energy played a role in the development of over a dozen wind farms in Colorado, adding about 2,000 megawatts in capacity. In 2014, the company signed an agreement to purchase power from a 200 MW wind farm in Limon.[33]

Thanks to technological advances and taller wind turbines that have improved performance,[34, 35] Xcel Energy recently proposed, and received approval from the Colorado Public Utility Commission, to buy more wind than required by the state's RPS because it was cheaper than existing gas.[36]

In May 2013, the utility recorded an hour when 60% of Xcel Energy's Colorado system electricity came from wind — a national record.[37, 38] Overall, Xcel has sold more than 2 billion kWh of wind energy in Colorado.[39]

CONCLUSION

Wind is powering Colorado's economy. All up and down the supply chain, wind companies in Colorado are taking advantage of the state's supportive policies and strong resources to manufacture wind turbines, construct wind farms, and operate and maintain the power plants.

For its wind energy sector to remain competitive with other state-based wind energy economies, Colorado must continue to lead on clean energy policies. The renewable energy standard has been a huge success, but Colorado's growing renewable energy sector will need new policy momentum for the years after 2020. Colorado has the opportunity to grow its wind sector even more with strong renewables and efficiency policies to support state implementation of the federal Clean Power Plan.

Colorado's leaders should seize these smart policy opportunities — and reap the benefits of new jobs, investment, and a strengthened economy that come with them.

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