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U.S. WIND ENERGY SEES CONTINUED GROWTH IN 2Q

AWEA chief re-states need for PTC renewal for industry stability

With 1,661 MW of newly installed wind turbines coming online during the second quarter of 2015 and more than 13,600 MW under construction, American wind power continues to increase its contribution to the U.S. electric power grid. The approval in May of Florida's first purchase of wind energy, from a wind project in Oklahoma, added to the growing trend of Southeastern states purchasing wind power, as did the recent announcement of the first utility-scale wind farm to be built in North Carolina.

Building on that momentum, Congress also took a step in the right direction on July 21 when the U.S. Senate Finance Committee voted 23-3 to extend the primary federal tax incentives for growing renewable energy as part of a larger tax policy extension bill.

"With a near-record amount of wind capacity under construction, this looks to be a strong year for American wind power," said Tom Kiernan, CEO of the American Wind Energy Association. "However, to create longer term stability for the industry the full Senate and the House of Representatives must move quickly to extend the PTC and ITC. Hence the overwhelming bipartisan vote by the Senate Finance Committee ... to extend the PTC and ITC is good news for the 73,000 Americans employed by the wind power industry."

The federal renewable energy Production Tax Credit (PTC), which has the option to be taken as an Investment Tax Credit (ITC) instead, is the primary federal tax incentive for wind energy. This incentive has helped drive more than \$100 billion in private investment in the U.S. since 2008, and has been instrumental in allowing the industry to lower costs by more than 50 percent in the last five years.

AWEA's Second Quarter 2015 Market Report released July 22 shows 1,994 MW were installed during the first half of 2015. While that figure more than doubles installations during the same time period last year, it is still well below the pace set in 2012, when the U.S. industry installed more than 2,900 MW in the first half of the year and eventually provided 42 percent of all new U.S. electric generating capacity at year's end.

Looking forward, more than 100 wind projects are

under construction in 24 states, representing more than 13,600 MW of total wind capacity and over \$20 billion worth of private investment. The majority of new wind construction activity is in Texas, with Oklahoma, Kansas, Iowa, and North Dakota also benefiting from large amounts of new investment.

"This was the strongest second quarter ever for wind and we continue to see robust activity in the industry. However, uncertainty around federal tax policy clouds the outlook for new growth and could result in the industry being forced off another cliff," said Hannah Hunt, Research Analyst for AWEA.

There are now 67,870 MW of installed wind capacity in the U.S. and over 49,000 wind turbines online. Texas continues to lead the nation with over 15,000 MW of installed wind capacity, and California now has over 6,000 MW of installed capacity.

NEW TRENDS AS INDUSTRY GROWS

The Florida-based utility Gulf Power and the Arkansas Electric Cooperative Corp. signed power purchase agreements (PPA) for 180 MW and 108 MW of wind in the second quarter, respectively, building on the trend of Southeastern utilities choosing to purchase wind energy.

These announcements are paired with recent news in July that construction will begin on the first commercial-scale wind farm in North Carolina. At 208 MW, the announced project will be far larger than any other in the Southeast, and the first utility-scale project in the region since 2004. Once online, it will bring the total number of states with utility-scale wind projects to 40. Technological advances, primarily the use of taller wind turbine towers and longer blades to reach higher quality wind resources, are opening up all regions of the country to wind project development. The Southeast has long been a center of wind industry manufacturing, and these recent developments bring even more benefits to the region.

In total, utilities signed over 800 MW of new PPAs for wind power in the second quarter of 2015, building on the roughly 12,000 MW of power purchase agreements signed since the beginning of 2013.

Successful U.S. companies and other non-traditional purchasers are also increasingly turning to

wind energy as a source of clean, stably-priced energy. Amazon Web Services (AWS) will purchase the output of the recently-announced North Carolina wind project. In announcing the agreement, Jerry Hunter, vice president of infrastructure at Amazon, stated that the company encourages policymakers to “extend the tax incentives” for renewable energy projects:

“This agreement, and those previously in place, puts AWS on track to surpass our goal of 40 percent renewable energy globally by the end of 2016. We’re far from being done. We’ll continue pursuing projects that deliver clean energy to the various energy grids that serve AWS data centers, we’ll continue working with our power providers to increase their renewable energy quotient, and we’ll continue to strongly encourage our partners in government to extend the tax incentives that make it more viable for renewable projects to get off the ground.”

The second quarter also saw the commissioning of two utility-scale wind projects with corporate purchaser investment. Both a 98 MW wind farm in Illinois owned by IKEA and a 211 MW Texas wind farm invested in by Mars, Inc. are now online

and will be providing low-cost wind power to satisfy the companies’ high energy demands.

Facebook also made news in the second quarter when it announced its new data center in Texas would purchase the output of a 200 MW wind plant. Tom Furlong, vice president of infrastructure for Facebook had the following comments on the announcement:

“[The data center] will be powered by 100% renewable energy, thanks to the 200 MW of new wind energy we helped bring to the Texas grid as part of this deal. Thanks to our continued focus on efficiency and our investments in renewables in recent years, the carbon impact of one person’s use of Facebook for an entire year is the same as the carbon impact of a medium latte.”

Hewlett Packard also announced this week that it plans to power its Texas data centers with wind power, signing a 112 MW PPA for the energy output from a planned wind farm in the state.

These companies and traditional utilities have explained that they are attracted by wind energy’s unique lack of fuel cost, which builds a more balanced energy portfolio that protects against increases in the price of other fuels. ✎

— Source: AWEA

GROWN-UP WIND INDUSTRY PRESSES ITS CASE AHEAD OF COP21

Cost reduction and innovation among EWEA 2015 discussion topics

As the world’s attention turns towards the landmark COP21 climate negotiations in Paris later this year, the wind industry is in a confident mood; global wind power installations are growing at the fastest pace ever.

A fundamental shift is underway as maturing technology and falling costs are ensuring that wind energy is becoming increasingly competitive with fossil fuels around the world and in many cases, the more economical option for investors.

As a result, wind energy is now the power source of choice for a diverse and growing set of blue-chip companies, ranging from tech giants such as Google and Apple, to automotive heavyweights including General Motors and Renault Nissan.

When Google announced as early as 2007 that the company was going carbon neutral, it included “invest in and use renewable energy sources” as one of its three basic strategies for cutting emissions. Since investing in its first wind farm in 2010, the company has built up a portfolio of three power purchase agreements (PPA) in Europe and nine in total across the world.

Some corporations, notably IKEA and LEGO, have directly invested in offsite wind farm ownership. LEGO has a commitment to source 100 percent renewable energy by 2020 and recently set an intermediate milestone goal of becoming carbon positive in 2016.

Cost reductions, power purchase agreements, corporate transitions and innovative technologies are just a few of the signs that wind energy has staked its claim as a dominant force in the global energy race.

These are all key issues that EWEA will look at when the association goes to Paris in November for its 2015 annual event.

EWEA will present an international platform for the wind energy industry in Paris to showcase and demonstrate the sector’s latest products and services. The event features a broad conference program, unrivaled networking opportunities and an extensive exhibition.

Malgosia Bartosik, acting CEO of EWEA, said:



“Scaling up wind power is crucial to combating climate change. In 2015 the EWEA Annual Event will take place in Paris two weeks before world leaders meet to discuss climate negotiations at the UN Summit in the French Capital. Where better to show the strength of the wind industry!”

Numerous developments of significance in the European market are converging to make this year’s EWEA Annual Event the place to be for new business: European utilities are making a strategic shift towards renewables, the offshore market is booming with 26.4 GW of consented offshore projects in the pipeline, and the focus on efficiency and innovation is translating into new business opportunities for U.S. wind technology and maintenance companies.

On a global level, wind energy is seeing a surge in large markets outside of Europe. In 2014, wind energy was the largest power source in

the US and Brazil, while China has ramped up its production steadily, accounting for over more than 40 percent of global installations last year.

GWEC reports that installed global wind power capacity had grown to 370 GW at the end of 2014, with annual installations exceeding 50 GW for the first time. This means that wind power capacity will soon overtake the world’s nuclear fleet.

The best wind projects around the world — for example in the Texas panhandle in the U.S. — are already consistently delivering electricity for \$0.05 per kWh without outside financial support. This means onshore wind is easily within the same cost range, and often even lower, as that of fossil fuel generated electricity. When externalities such as the cost of air quality and climate change are factored in, wind in Europe is cheaper than gas, nuclear or coal generation.

Onshore wind is firmly established as one of the lowest-cost sources of electricity available. The global average levelized cost of energy [LCOE] has fallen by around 10 percent since 2010, while turbine prices have fallen by around 30 percent since 2009, with prices in China — the world’s biggest wind power market — having fallen by as much as 35 percent.

The wind sector will continue delivering for corporations, governments and citizens who want affordable, carbon-free and secure electricity supplies. Support from policymakers and large commercial end-users have increased growth opportunities but this also entails important responsibilities for the wind sector to help deliver renewable capacity and lead the way in tackling climate change.

For more information visit www.ewe.org/annual2015. ♪

— Source: EWEA

CANWEA ANNOUNCES PROGRAM SESSION TOPICS FOR 2015 EVENT

Canadian wind industry's annual event to be held October 5-7 in Toronto

The Canadian Wind Energy Association (CanWEA) and Hannover Fairs (Canada), Inc. recently announce the 31st CanWEA Annual Conference and Exhibition 2015 program session themes. Every year, CanWEA's conference sessions focus on a wide range of topics of interest for wind energy professionals from around the world. The 31st CanWEA Annual Conference and Exhibition will be held at the Metro Toronto Convention Center in Toronto, Canada from October 5-7.

The event will host approximately 1,500 delegates and more than 150 exhibitors from more than 13 countries. Additionally, event attendees will see the latest wind energy solutions from the world's leading equipment and solutions providers, such as EDF EN Canada, Enbridge Inc., ENERCON, GDF SUEZ Canada Inc., GE Power & Water, Siemens, Vestas and more.

"Canadian wind energy enjoyed record breaking years in 2013 and 2014, and we are on track to maintain this momentum in 2015 and 2016," said Robert Hornung, CanWEA president. "With more than 10 GW of installed wind

energy capacity, enough to power 3 million average Canadian homes, Canada is one of the world's top wind energy producers. Visitors to our 31st CanWEA Annual Conference and Exhibition will come together to share insights, to find new business contacts and to discuss key wind energy issues facing Canada and its provinces going forward."

CONFERENCE SESSION HIGHLIGHTS

The conference will include multiple educational sessions and a variety of notable speakers. Keynote speakers such as Ontario Energy Minister, the Hon. Bob Chiarelli, and Ontario Minister of the Environment and Climate Change, the Hon. Glen Murray, have been invited to speak.

This year's program will address a variety of wind energy challenges and offer solutions, such as:

• *Realizing Wind Energy's Potential in Ontario – Today's Successes and Tomorrow's Opportunities*

Speakers will showcase the economic benefits of wind energy for communities across Ontario. Several leading wind energy companies will preview case studies of wind

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WoWE 2014 Rudd Mayer Fellows

(L-R): Michelle Montague (WoWE Board);
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Kaitlyn Bunker, Melissa Showers, Huiyi Zhang,
Kristen Graf (WoWE Staff)



Spring 2014 WoWE Board Meeting

(Back Row L-R): Trudy Forsyth, Karen Conover,
Jan Blomstrann, Michelle Montague, Jennifer Martin,
and Julia Dalger (Front Row L-R): Kristen Graf,
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energy's positive impact on their regions from creating new jobs to creating new sources of income. During this session, CanWEA also will release the results of a new study on the economic benefits of wind energy in Ontario, highlighting the success the wind sector has enjoyed in Ontario to date. A panel discussion will wrap up this opening session with a provocative discussion among experts from the electricity and environmental sectors who will share insights and perspectives on increasing the role that wind energy plays in the province.

- ***The Status of Wind Energy in Canada's Major Markets***

CanWEA's regional directors will provide an update on markets in British Columbia, Alberta, Saskatchewan, Ontario and Quebec. During this session, attendees will gain wind energy updates specific to their region.

- ***Operations and Maintenance — An Asset Managers Perspective***

Canada's growing wind fleet means more attention is being paid to issues related to the operation and maintenance of wind farms. During the session, asset managers will speak about their challenges and how to overcome them.

- ***Cost of Wind — The Lowest Cost Power Around... But for How Long?***

Via an interactive panel format, this session will feature four presentations that explore four key factors that will determine wind's current and future cost and competitiveness relative to other sources of generation, including pure energy cost, technology evolution, value to the grid and financing. The session will explore how all four factors are set to affect the cost competitiveness of wind.

- ***Renewable Energy's Role in Combating Climate Change in Canada***

The session will start with internationally focused keynote presentations about the role Canada should play during the Paris climate change talks. The session will then cover Ontario's next steps in regards to climate change and the role renewables, such as wind energy, will play in decarbonizing Canada's energy supply.

CANWEA AWARDS BANQUET

The annual CanWEA Awards Banquet recognizes individuals and groups who have contributed significantly to the advancement of wind energy in Canada.

The annual banquet recognizes and awards Individual and Group Leadership.

CanWEA also presents the Matt Holder Community Connection Award for responsible and sustainable development within a community; the Friend of Wind Award for outstanding community level contributions by individuals or groups not employed by the wind energy industry; the R.J. Templin Award to an individual or organization that has undertaken scientific, technical, engineering or policy research and development work that has significantly advanced the wind energy industry in Canada and the Wind Energy Project Award to a CanWEA Member for a Canadian wind energy project that has demonstrated an exceptional commitment to responsible and sustainable development in all phases of the project.

During the 2015 event, Women in Renewable Energy (WiRE) will also present the Wind Power Woman of Distinction Award.

INNOVATION ZONE — NEW FORMAT

The annual Innovation Zone at CanWEA provides a showcase for cutting edge technologies in partnership with the research community and industry leaders. This year's Innovation Zone is divided into four strategic areas: Research & Science, Electric Vehicles, Innovative Technologies (featuring battery storage, smart grid technology, cold weather climate solutions, hybrid systems & remote applications) and the Learning Center for exhibitor presentations.

"Wind energy is an exciting industry in Canada and the world over," said Larry Turner, CEO of Hannover Fairs (Canada), the subsidiary of trade event organizer Deutsche Messe and CanWEA exhibition partner. "Continued and growing support for CanWEA's annual event comes from leaders in the global wind energy community."

For more information about CanWEA 2015, visit the conference web site at <http://windenergyevent.ca/>. ✎

SENATE COMMITTEE MOVES TO EXTEND PTC AND ITC

Finance Committee's 23-3 vote signifies bipartisan support of tax incentives

The American wind energy industry in July praised members of the U.S. Senate Finance Committee for voting overwhelmingly to extend over 50 tax policies through 2016, including the renewable energy Production Tax Credit (PTC) and Investment Tax Credit (ITC) that incentivize the building of more U.S. wind farms.

The committee on a final vote of 23-3 reported out a "tax extenders" bill preserving language that allows wind farms to qualify so long as they start construction while the tax credits are in place.

Those credits expired at the start of this year, again throwing the future of American wind energy into doubt once projects currently under construction are completed.

"This is a big step in the right direction," said Tom Kiernan, CEO of the American Wind Energy Association (AWEA). The federal PTC and ITC are predominant drivers of new wind farm development, and have helped lower the cost of American wind power by more than half over the last five years, while making the U.S. number one in the world in wind energy production.

During the hearing, Senate Finance Committee Chairman Orrin Hatch (R-UT) regularly acknowledged the strong sense of bipartisan support for renewing the tax extenders package. Sens. Pat Toomey (R-PA), Dan Coats (R-IN), and Rob Portman (R-OH) withdrew amendments opposing the PTC, while Sen. Michael Bennett (D-CO) made the senators aware of the tremendous amounts of economic benefits and jobs wind power has created in Colorado.

In 2013, after the renewable energy tax credits were allowed to expire even briefly, installations of new wind farms fell 92 percent, causing a loss of 30,000 jobs across the industry that year. After Congress renewed the

PTC, the U.S. wind energy industry added 23,000 jobs the following year, bringing the total to 73,000 at the end of 2014.

Wind energy brings taxes and other revenues to rural communities, benefiting county and local services, schools, and health care and public safety facilities. With over 98 percent of all wind farms on private land, wind energy projects already deliver an additional \$195 million a year in lease payments to landowners.

Earlier in the week, Sen. Chuck Grassley (R-IA) penned an op-ed renewing his call for Congress to extend the tax credits, saying they "bring certainty to investment that helps boost development, sustainability and expansion of homegrown renewable energy," and that "the facts show that bringing stability and certainty

to clean energy policy is good for the economy and the environment. Championing renewable energy that's engineered by human ingenuity and produced by human hands builds upon America's centuries-long promise of prosperity."

Today, more than 70 percent of congressional districts contain operating wind turbines, wind-related factories, or both, according to industry data.

In June this year, proposed legislation threatened to eliminate the PTC. That led to 85 companies sending a letter to Congress to protest the bill saying if passed, the bill would "take away an effective, business tax incentive that creates jobs, drives rural economic development and reduces energy costs for Americans across the country."

— Source: AWEA

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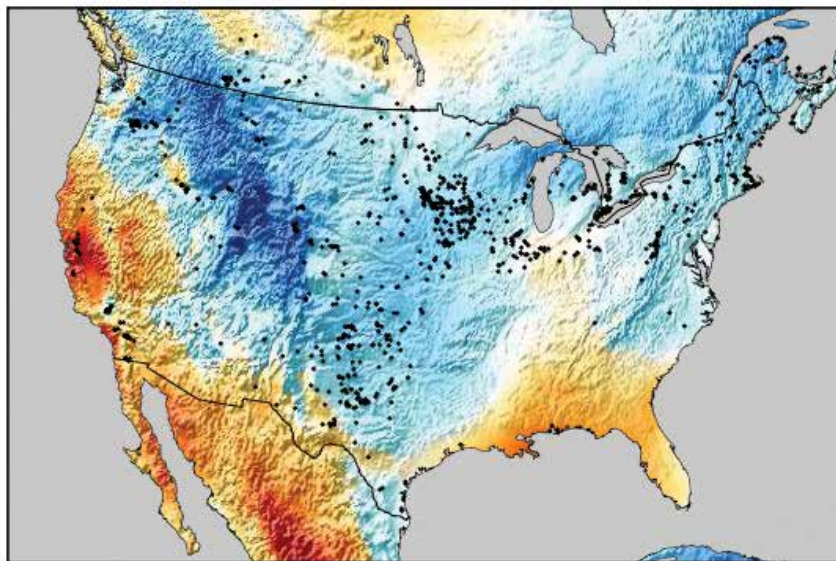
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VAISALA PREDICTS LOW U.S. WIND PRODUCTION IN Q4

Enduring El Niño causing lower than average wind speeds in many regions

VAISALA

U.S. Wind Performance Forecast Q4 2015



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Departure from normal
Below Neutral Above

After the record low wind anomalies that challenged many project operators in the United States in the beginning of the year, wind energy performance is expected to remain below normal in most regions into the final quarter of 2015. This is due to a persistent El Niño that is forecast to remain in effect throughout the end of the year.

The prediction was released today by Vaisala, a global leader in environmental and industrial measurement, based on its analysis of historic and forecast deviations from average wind conditions across North America.

The wind forecast anticipates that power producers in the Northeast, Northwest, and much of the U.S. wind belt will see below average wind

speeds in Q4 2015. While the El Niño pattern largely has a negative impact, particularly along the Rocky Mountains, it will have a positive impact in some areas with significant wind generation.

The Southwest, Southeast, Indiana, and southern Texas are all expected to see above normal wind speeds. California is an especially bright spot with a high likelihood of elevated wind speeds, which should signal a return to smooth profitability for investors following the lows of the last six months.

Vaisala has been following the evolution of North American wind anomalies in particular detail since the release of its Q1 study revealing 40-year record low wind speeds. The

low wind event caused significant reductions in generation for utilities and project owners, a number of whom reported expected shortfalls in quarterly and annual wind production.

In the first quarter of the year, wind production in southern California fell to just 64% of 2014 levels, recovering somewhat in the second quarter to 80% of 2014 levels. Texas wind production was 93% of 2014 levels over the first half of the year. However, it is important to bear in mind that year-over-year nameplate wind capacity increased in Texas by 10%, meaning actual production was much lower in 2015 than in 2014 given the number of plants in operation.

Since the end of Q1, wind speeds west of the Rocky Mountains have

remained lower than average, though to a much lesser extreme, while an area from Texas northward to the Hudson Bay saw wind speeds 10-20% above normal in May. In June, widespread low wind speeds returned with most areas west of the Mississippi River seeing below normal conditions. Rocky Mountain states and central and northern California were especially hard hit with wind speeds roughly 20% below normal.

Large-scale anomalies such as this can lead to cash flow fluctuations that threaten profitability and the perception of wind energy as a low-risk investment proposition. For capital providers seeking stable returns through YieldCo structures in the U.S. market, this Q1 and Q2 underperformance serves as a strong reminder to better diversify portfolios by geography and technology to account for the underlying variability of the climate.

As wind power operations continue to expand across North America, placing recent performance in a long-term context and monitoring production against resource availability will become increasingly critical to portfolio profitability and investor reporting.

“For managing portfolio risk, it is imperative to have a detailed understanding of how over or underperformance at each of your project sites fits within the historical record,” said Dr. Jim McCaa, Manager of Advanced Applications at Vaisala. “As acquisition and merger activity increases, the industry also needs to start thinking strategically about the variability of the assets they are looking to buy and how they fit within the existing portfolio.”

As mentioned above, Vaisala’s forecast is based on the wide agreement of the atmospheric research community and all the major global weather models that the current El Niño climate signal will continue through the end of the year. The forecast was created using an ensemble approach blending mesoscale model predictions with three of the leading reanalysis datasets, each representing 35 years of climate data.

For further information, please download Vaisala’s 2015 U.S. Wind Performance Maps, which include the Q4 forecast as well as details on wind conditions experienced from January through June across the country.

Vaisala is an expert in wind measurement, project assessment, and energy forecasting. For more information on the range of services offered by Vaisala to the renewable energy sector, please visit www.vaisala.com/energy. ↴

HP TO POWER TEXAS DATA CENTERS WITH WIND

Tech giant signs 12-year, 112-MW PPA with SunEdison

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Those credits expired at the start of this year, again throwing the future of American wind energy into doubt once projects currently under construction are completed.

“This is a big step in the right direction,” said Tom Kiernan, CEO of the American Wind Energy Association (AWEA). “We applaud the committee’s vote because it recognizes that the vast majority of American voters support these policies and want them continued. We urge the full Senate and the House of Representatives to follow the Senate Finance Committee’s bipartisan lead,

and quickly pass this tax extenders package, which will continue to grow American jobs and heavy manufacturing, and support rural economic growth.”

The federal PTC and ITC are predominant drivers of new wind farm development, and have helped lower the cost of American wind power by more than half over the last five years, while making the U.S. number one in the world in wind energy production.

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Earlier in the week, Sen. Chuck Grassley (R-IA) penned an op-ed renewing his call for Congress to extend the tax credits, saying they “bring certainty to investment that helps boost development, sustainability and expansion of homegrown renewable energy,” and that “the facts show that bringing stability and certainty to clean energy policy is good for the economy and the environment. Championing renewable energy that’s engineered by human ingenuity and produced by human hands builds upon America’s centuries-long promise of prosperity.”

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— Source: HP

AMAZON WEB SERVICES TO BUILD 208-MW PROJECT IN SOUTHEAST

North Carolina’s first utility-scale wind farm will power cloud data centers

Amazon Web Services, Inc. (AWS), an Amazon.com company, recently announced that it has contracted with Iberdrola Renewables, LLC to construct and operate a 208-MW wind farm in Perquimans and Pasquotank counties, North Carolina, called the Amazon Wind Farm US East. This new wind farm is expected to start generating approximately 670,000 MWh of wind energy annually starting December 2016 — or enough to power more than 61,000 U.S. homes in a year. When completed, it will be the first utility-scale wind farm in the state of North Carolina, with the energy generated delivered into the electrical grid that supplies both current and future AWS Cloud data centers.

In November 2014, AWS shared its long-term commitment to achieve 100 percent renewable energy usage for the global AWS infrastructure footprint. In April 2015, AWS announced that approximately 25 percent of the power consumed by its global infrastructure was from renewable energy sources with a goal of increasing that percentage to at least 40 percent by the end of 2016. As part of its renewable energy push, AWS is continuously working on ways to increase the energy efficiency of its facilities and equipment. Additionally, the company continues to launch projects that increase the availability of renewable energy resources on the electrical grids that supply power to current and future AWS Cloud data centers in Virginia and Ohio.

Together with Amazon Wind Farm US East announced today, Amazon’s renewable projects will be responsible for delivering more than 1.3 million MWh of additional renewable energy into electric grids across the central and eastern U.S., or roughly the equivalent amount of energy required to power 122,000 U.S. homes.

“This agreement, and those previously in place, puts AWS on track to surpass our goal of 40 percent renewable energy globally by the end of 2016,” said Jerry Hunter, Vice President of Infrastructure at Amazon Web Services. “We’re far from being done. We’ll continue pursuing projects that deliver clean energy to the various energy grids that serve AWS data centers, we’ll continue working with our power providers to increase their renewable energy quotient, and we’ll continue to strongly encourage our partners in government to extend the tax incentives that make it more viable for renewable projects to get off the ground.”

“As a leading Internet platform and cloud services provider, Amazon continues to invest in renewable energy by supporting this wind farm in our great state,” said North Carolina Governor Pat McCrory. “This kind of collaboration between Amazon and Iberdrola Renewables promotes North Carolina’s continued economic growth and highlights the importance of supporting the ongoing expansion of the technology sector in our state.”

— Source: Amazon Web Services

UK TO REMAIN TOP OFFSHORE WIND POWER MARKET BY 2025

Offshore capacity to exceed 23 GW, according to GlobalData



The UK will remain the leading offshore wind power market globally by 2025, with its installed capacity increasing from 4.5 GW in 2014 to 23.2 GW by the end of the forecast period, representing an impressive Compound Annual Growth Rate (CAGR) of 30.5 percent, according to research and consulting firm GlobalData.

The company's latest report states that the UK accounted for a significant 51.3 percent share of global offshore capacity in 2014. Denmark and Germany followed, with respective shares of 14.5 percent and 11.9 percent.

According to Harshavardhan Reddy Nagatham, GlobalData's Analyst covering Power, the UK and Denmark's shares are expected to decrease to 30.6 percent and 4.4 percent, respectively, by the end of 2025, mainly due to other countries, such as the U.S. and China, increasing their market presence over the forecast period. Germany's share will grow to 16.1 percent by the end of 2025.

The UK's installed offshore wind power capacity increased from 0.4 GW in 2007 to 4.5 GW in 2014, at a CAGR of 22.3 percent, driven primarily by strong policy support and aggressive targets.

While these factors are currently driving the market, there is more uncertainty following the UK environment minister's calls for a reduction in offshore wind sector costs. However, industry leaders have urged the minister

to provide more clarity on long-term offshore wind power support to improve project investment.

"The UK government is aiming to achieve 18 GW of offshore wind capacity installations by 2020, based on the roadmap laid out by the Department of Energy & Climate Change (DECC)," Nagatham said. "To incentivize project development, it is looking to reduce the generation cost by 30 percent to £100 (approximately \$152) per megawatt hour.

"Despite the higher costs of offshore wind compared to onshore, the government continues to support the former with contracts for difference, with the aim of achieving lower generation costs in the long term and the 18 GW installation target."

The analyst concludes that the UK possesses the largest offshore wind resources in Europe, with the North and Irish Seas providing high-potential areas for offshore wind farm developers.

Siemens remained the UK's leading offshore wind market player in 2014, boasting a 76.2 percent share of the country's cumulative capacity. Vestas was a distant second, with 19.9 percent, followed by Senvion and Samsung with 3.8 percent and 0.2 percent, respectively.

— Source: GlobalData

WIND ENERGY: A LONG-TERM PASSION

NREL's 91-year-old senior engineer still actively involved following an established career in wind research

By Ernie Tucker



Three afternoons a week, 91-year-old Palmer Carlin comes into the Energy Department's National Wind Technology Center (NWTC) at the National Renewable Energy Laboratory (NREL), and begins having fun. That's where the senior engineer fields questions from the public, often from would-be inventors convinced they have the next big renewable energy breakthrough.

"Across the U.S., there are inventors, students, small businesses, and entrepreneurs with wind-related questions who continuously shower emails and voicemails on all of us here at the wind site," said Carlin, a dapper man with a sweep of silver hair at his jacket collar.

Carlin said he imagines that the typical inventor's scenario begins when a retired machinist goes out to a garage workshop at the suggestion of an exasperated spouse. "Then the guy invents some sort of wind machine and calls me up," he said with a laugh.

He recalled being contacted by a person who was convinced he had a major discovery. After discussing the details of the invention with the modern-day Da Vinci, Carlin paused, and then asked the man if the invention really ran on wind energy. No, the man said. Palmer realized the concept was a perpetual-motion machine. "I said, 'Well, I only talk about things that need wind.'"

This is something he has been doing since the early

1990s, and these exchanges work well for him, as he catalogues each call and files the record. "Having made some technical contributions at the NWTC in the past, I am pleased that a niche has developed for me in which my task is responding to these inquiries that my fellow workers forward to me," he said.

Now, the recent release of the Energy Department's Wind Vision Report has added an important tool in his arsenal. "This will become an excellent information source for me as well as my callers," he said.

EARLIER TIMES AND EARLIER TRIES

The Energy Department report is a far cry from the early days of modern wind energy research, when things were, well, up in the air. Carlin built an early prototype turbine while at the University of Colorado (CU) Boulder as an electrical engineering professor — a gizmo that had magnets around the outside. "It never worked very well," Carlin said simply. Despite his own visions, he never dreamed he would see the giant megawatt-scale turbines towering 90 meters or more — or the widespread acceptance that is chronicled in the Wind Vision Report.

Back in the fall of 1977, he began a three-semester leave from his professorship to help in the creation of what was the Wind Energy Test Site in the buffer zone adjacent



to the Rocky Flats Atomic Energy Installation. He remembers that a couple of trailers were the only things on the site, and he would travel with other early pioneers to work with developers of small 10- and 20-kilowatt machines. But Carlin was not merely an observer.

Eventually, the lure of NREL (then known as the Solar Energy Research Institute, or SERI) proved too strong, and he retired from CU and joined SERI in 1986. As the organization pushed for wind's future, Carlin's role was perhaps a bit more complex than he lets on. Colleagues heap praise on him. "We worked together in the 1970s to set up the small wind systems research efforts here at what was then the Rocky Flats Small Wind Systems Test Center," NREL Research Fellow Bob Thresher said.

Thresher also noted that Carlin consulted with the staff on electrical systems analysis. "He authored some of the seminal analysis papers on variable speed technology and collaborated with many small wind companies of that era on the development of variable speed electrical topologies."

DIFFERENT TIMES ON CAMPUS

Times were different when Carlin was younger, and the nation was in the middle of World War II. After growing up in the 1920s on a prairie farm in Wiley, Colorado, where he tinkered with spare engine parts, he

arrived on the CU Boulder campus in 1942 as part of the second class ever of CU's Naval Reserve Officer Training Corps. The group often started the day performing "calijumpic" exercises at dawn before getting cleaned up and dressed in uniform for class. Gas and food were rationed; travel was a luxury because nobody had a car. Carlin's student days weren't focused on wind research, though he was interested in electrical engineering — but it was the overall campus experience that had the most impact.

"It was educational for me, meeting new people from all over," he said. After all, his high school graduation class had only 19 members, including several who were later killed in service. When he graduated with his electrical engineering degree in 1945, the war was ending — but he still had about 18 months of service. He was selected to go to the Navy Yards in New York City. "There I was at Times Square — I'd come from a small town to New York, by way of Boulder."


Eventually, Carlin returned to CU to pursue a master's degree and Ph.D. — but he was fueled by a new interest in physics. He began teaching physics to undergrads. "The atom bomb had happened, so all at once, it was interesting to go into particle physics," he said. And as he pursued his doctoral degree in 1955, he was involved in several of the major historic scientific events of the day.

One was a form of research that required wire. Lots and lots of wire. Carlin was part of a project to monitor seismic activity, which involved setting up three monitors in Boulder, two miles apart, unspooling wire along fence lines and even to a barn. The goal was to detect motion from distant earthquakes or atomic tests. The project successfully noted at least one such U.S. test. Another time, on the evening of October 4, 1957, he heard that the Russians had launched a satellite, so he and his colleagues hurriedly went to test a long-range radar system they were studying. "Sputnik happened to be going over, and we could basically look out into space, and the radar could see it," he said—and noted it was one of the very first sightings that happened "just by accident."

Not everything happened by accident, of course. Carlin's work with the NREL low-speed, direct-coupled wind turbine resulted in several reports and papers, including "Some Analysis of Energy Production from the NWTC Variable Speed Test Bed," which was awarded Best Conference Paper at the 1997 American Society of Mechanical Engineers Wind Energy Symposium.

Through the years, wind energy has also remained a passion. "It's supposed to be the 'in' thing, and it's fun in itself," he said. When asked how long he'll keep coming to work from his Boulder home, Carlin paused, and then said: "I'm having too good a time out here. I'm very pleased I worked at NREL. Everyone here is working because they are doing something they are proud of."

"Whenever I hear people talking about global warming, I feel proud. We're trying to keep the planet's temperature down. Wind is one way to do that," he said.

Learn more about wind research at the National Wind Technology Center (NWTC) by visiting www.nrel.gov/nwtc. 

— Source: *National Renewable Energy Laboratory*