Using More Of The Grid We’ve Got

Technology advances – and a few policy tweaks – can increase wind delivery over existing transmission lines.

Spotlight: Canada
How one agency is advancing wind energy north of the border.
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Spotlight: South Dakota
At long last, the state may finally achieve its wind potential.
page 18
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Despite its importance to wind energy, transmission remains the most under-reported aspect in the renewables segment. And I’m not sure why. Granted, transmission is not a subject that can be easily broached. As soon as the conversation turns to such lofty debates as cost allocation and permitting across state lines, something seems to happen to right-thinking individuals. And don’t even get me started about pancaked transmission rates and the lack of transparent regional spot markets in nearly one-third of the country.

The fact is that there are fewer transmission plans in the works now than a decade ago, when the U.S. wind industry was able to get transmission lines built in Texas, the Northern Plains and the central U.S. Meanwhile, installed wind capacity has not subsided. Do the math. Increased wind and no new transmission means increased instances of congestion and curtailment.

Fortunately, there are workable solutions, some of which involve existing infrastructure and technology. In this month’s cover story, wind industry veteran Rob Gramlich details how the U.S. wind industry can wring out more interconnection using the wires that already exist through the increased use of dynamic line ratings and advanced power flow control. He ought to know after having served in the government, organizations and private industry. For example, Gramlich developed initiatives on renewable energy integration, market design and transmission policy. Most notably, he led the wind industry negotiations on the Federal Energy Regulatory Commission’s (FERC) Orders No. 890, which lessened imbalance charges and created conditional firm transmission service, and No. 661, which established standardized wind interconnection requirements.

Speaking of FERC, Gramlich notes how the federal agency could begin to work to alleviate the constraints, beginning with the recent appointment of four new FERC commissioners. With a few alterations and tweaks to existing policy, Gramlich says the agency can begin to work through transmission’s deep-seated issues. On the flip side, the new commissioners to think outside the box isn’t exactly in the FERC job description. Just the same, Gramlich is confident new leadership often brings a fresh perspective to the proceedings and can often overcome the inertia and blind allegiance to the agency’s past. Let’s hope so. Otherwise, it only serves as more evidence to my opening point: When talking about transmission issues, few, if any, are straightforward.
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DOE Updates The State Of U.S. Wind Energy

According to the U.S. Department of Energy’s (DOE) annual wind market reports, the U.S. added more than 8.2 GW of wind capacity last year, representing 27% of all energy capacity additions in 2016. The DOE says its three new market reports – covering land-based utility-scale, offshore and distributed wind – demonstrate continued growth in wind power nationwide.

The reports were prepared by the DOE’s Lawrence Berkeley National Laboratory, whose contributions were funded by the DOE’s Office of Energy Efficiency and Renewable Energy.

According to the DOE, recent and projected near-term growth is supported by the industry’s primary federal incentive, the production tax credit (PTC), as well as myriad state-level policies. Wind additions have also been driven by improvements in the cost and performance of wind power technologies, yielding low power sale prices for utility, corporate and other purchasers. At the same time, the prospects for growth beyond the current PTC cycle remain uncertain, given declining federal tax support, expectations for low natural gas prices and modest electricity demand growth, the agency points out.

Utility-scale onshore wind

According to the report, utility-scale wind installations stand at more than 82 GW, enough to meet about 6.2% of U.S. end use electricity demand in an average year.

In total, 40 states and Puerto Rico operated utility-scale wind projects in 2016. Texas led the nation in capacity, with over 20 GW of wind installed. Notably, utility-scale wind came online in North Carolina in early 2017.

The report also finds that wind energy continues to be sold at attractive prices through power purchase agreements – making wind cost-competitive with traditional power sources such as natural gas in many parts of the U.S., especially when wind is sold at a fixed price over 20 years.

In the past year, Iowa and South Dakota produced more than 30% of their electricity from wind, and 12 other states exceeded 10% (Kansas, Oklahoma, North Dakota, Minnesota, Colorado, Vermont, Idaho, Maine, Texas, Oregon, New Mexico and Nebraska).

The Berkeley Lab notes that wind energy pricing for land-based utility-scale projects remains attractive to utility and commercial purchasers.

Offshore wind

In December, Deepwater Wind completed the commissioning of the Block Island Wind Farm, marking a milestone as the first commercial offshore wind project in the U.S.

According to the report, the U.S. offshore wind project development pipeline includes over 20 projects totaling 24,135 MW of potential installed capacity. Most of the near-term activity is concentrated in the Atlantic off the Northeast coast, but projects have also been proposed in the Southeast Atlantic, the Pacific, the Gulf of Mexico and the Great Lakes.

Of the U.S. projects in deeper waters – where traditional, bottom-mounted technologies are not feasible – proposed floating offshore wind projects now total 1,993 MW of announced capacity, the report says.

Notably, the DOE adds, news of the declining costs for offshore wind projects in Europe have spurred confidence in the domestic U.S. offshore wind market over the past year. Several states, including Massachusetts, New York and Maryland, have
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enacted new policy or bolstered their existing policy to support the development of over 4 GW of offshore wind.

Distributed wind

Compared with traditional, centralized power plants, which send power over transmission lines to distant end users, distributed wind energy installations supply power directly to homes, farms, businesses and communities. In total, U.S. wind turbines in distributed applications reached a cumulative installed capacity of 992 MW through 2016.

This capacity comes from roughly 77,000 turbines installed across all 50 states, the District of Columbia, Guam, Puerto Rico and the U.S. Virgin Islands.

Turbines used in these applications can range from a few hundred watts to several megawatts; this helps power remote, off-grid homes and farms, as well as local schools and manufacturing facilities, the report explains.

Furthermore, U.S. manufacturers continued to dominate domestic sales of small wind turbines (up through 100 kW), and half of U.S. small wind turbine manufacturers also exported their products to other countries.

Between 2014 and 2016, U.S.-based small wind turbine manufacturers accounted for more than $240 million in small wind turbine export sales, the report adds.

Other findings

According to the Berkeley Lab, the report also finds that bigger turbines are enhancing wind project performance: The average generating capacity of newly installed wind turbines in the U.S. in 2016 was 2.15 MW – up 11% from the average over the previous five years.

In addition, the average rotor diameter in 2016 was 108 meters, representing a 13% increase over the previous five-year average, while the average hub height in 2016 was 83 meters, which was up 1% over the previous five-year average.

Moreover, turbines originally designed for lower wind speeds are now regularly deployed in higher wind speed sites, boosting project performance, the Berkeley Lab says. Increased rotor diameters, in particular, have begun to dramatically increase wind project capacity factors. For example, the average 2016 capacity factor among projects built in 2014 and 2015 was 42.6% compared with an average of 32.1% among projects built from 2004 to 2011 and 25.4% among projects built from 1998 to 2001.

Further, low wind turbine pricing continues to push down installed project costs. Wind turbine equipment prices have fallen from their highs in 2008 to $800-$1,100/kW, and these declines are pushing down project-level costs, according to the report. The average installed cost of wind projects in 2016 was $1,590/kW, down $780/kW from the peak in 2009 and 2010.

The report also finds that manufacturing supply chains continued to adjust to swings in domestic demand for wind equipment in 2016. Wind sector employment reached a new high of more than 101,000 full-time workers at the end of 2016, and the profitability of turbine suppliers has generally rebounded over the last four years. For wind projects recently installed in the U.S., domestically manufactured content is the highest for nacelle assembly (>90%), towers (65%-80%), and blades and hubs (50%-70%). However, it is much lower (<20%) for most components internal to the turbine, the report says.

Although there have been a number of manufacturing plant closures over the last decade, each of the three major turbine manufacturers serving the U.S. market (GE, Vestas and Siemens) has one or more domestic manufacturing facilities in operation, according to the report.

“The wind industry continues to install significant amounts of new capacity and supplied about six percent of total U.S. electricity in 2016,” states Daniel Simmons, acting assistant secretary for energy efficiency and renewable energy. “As our reports explain, a combination of federal subsidies, state mandates and technological advancements continue to help drive new wind capacity additions.”

Ryan Wiser, senior scientist at the Berkeley Lab, adds, “Wind energy prices – particularly in the central United States and supported by federal tax incentives – are at all-time lows, with utilities and corporate buyers selecting wind as the low-cost option.”

“The Department of Energy’s research shows that wind power is a bright spot on the American energy landscape,” says Tom Kiernan, CEO of the American Wind Energy Association.

“U.S. wind projects are already among the most productive in the world, and this new data proves we have even greater potential to deliver affordable, reliable and clean electricity to the American people.”

Developer Makes Inroads Outside Of Texas

Tri Global Energy (TGE) is developing a whole lot of wind in Texas. In fact, citing the American Wind Energy Association’s recently released U.S. Wind Industry Second Quarter 2017 Market Report, TGE says its wind farms represent more than half of all facilities under development in the state.

The company says Texas, which “easily leads all other states” in under-construction wind farms, is currently working on almost 5.34 GW of wind power.

However, in early August, the Dallas-based company announced its expansion into new territory: Nebraska. Moreover, the newly planned project will represent TGE’s first wind project developed outside of the Lone Star State.

The Sugar Loaf Wind Energy Project is a 100 MW facility whose development will begin sometime this year, TGE estimates. With Sugar Loaf, the company, which was founded in 2009, is growing its wind portfolio to more than 2.9 GW.

“We are proud to add our Nebraska project as we continue to help meet the growing energy needs of Americans with wind energy,” says John Billingsley, chairman and CEO of TGE, in a press release.

When asked why Nebraska was selected for its latest wind venture, TGE told North American Windpower in a statement that it has “received interest from communities across the U.S.”
We empower trust by providing sound technical advice for renewable energy projects as they evolve from concept to durable operating assets. True to our roots, we remain keenly responsive to the needs of our clients, helping them build projects that reduce humanity’s global carbon footprint and generate healthy financial returns.

Acquired by UL, AWS Truepower is now part of an even more extensive portfolio of renewable energy services.
and that Sugar Loaf “represents an opportunity to work cooperatively with the community and local partners.”

“The community and partners share TGE’s core values and desire for economic development in rural communities,” the company explains.

As for any future plans to keep on expanding to other states, TGE “intends to stay true to its Texas roots.” Still, the company says, “We’ll look to replicate our success in other regions of the country.”

**ALLELTE Refurbishes Turbines For Safe Harbor**

Duluth, Minn.-based ALLETE Clean Energy, a wholly owned subsidiary of ALLETE Inc., has announced a strategic initiative to refurbish 385 turbines at three wind farms in Minnesota and Iowa.

The project includes replacing select blades, gearboxes and generators on turbines at the Lake Benton wind site in Lincoln County, Minn., and the Storm Lake I and II wind sites in Buena Vista and Cherokee counties, Iowa.

According to ALLETE, the initiative will improve turbine performance and reliability, generate federal production tax credits (PTCs) at each site, and support the renewal of power sale agreements at the Storm Lake sites.

“As a central part of ALLETE Clean Energy’s multifaceted growth strategy, this $80 million reinvestment will contribute to future earnings growth,” states Allan S. Rudeck Jr., president of ALLETE Clean Energy. “Revenue from our existing wind sites such as Lake Benton and Storm Lake is the foundation for ALLETE Clean Energy’s momentum and growth. Neighboring communities also benefit by keeping these older sites viable and valuable, which maintains jobs and landowner lease payments.”

The refurbishment will be staged from 2017 through 2020 to minimize turbine downtime and maximize safe energy production at each site, the company notes. In total, the sites produce approximately 700,000 MWh of energy per year and represent about 50% of ALLETE Clean Energy’s current electricity sales.

In addition to the turbine refurbishments, the project includes installing new communications infrastructure at the sites to better integrate them into ALLETE Clean Energy’s corporate operations structure. This includes new fiber optic connections, servers, and data acquisition and management systems.

Energy from the Lake Benton site is fully contracted through 2028, and approximately 8 MW of Storm Lake I production is contracted through 2032. ALLETE Clean Energy is working to re-contract the balance of the Storm Lake I and II power sale agreements, which expire in 2019.

The turbine refurbishment project follows the company’s December $100 million investment in wind turbine components that meet the standards for the PTC’s “safe harbor”

**NYSERDA Wraps Up Initial Offshore Wildlife Surveys**

As part of the state’s initiative to pursue responsible offshore wind development, the New York State Energy Research and Development Authority (NYSERDA) has completed its first year of aerial wildlife data collection over an offshore wind area.

Over three years, NYSERDA is acquiring regional-scale baseline information on seasonal wildlife distribution, abundance and movement over a 16,000-square-mile area. The potential effects of individual offshore wind projects, as well as any possible cumulative effects of multiple projects, will be better understood with this data, says NYSERDA. The authority and other state agencies are in the middle of developing the New York Offshore Wind Master Plan, due by the end of the year.

“This survey underscores the importance of our commitment to the preservation of the wildlife in our coastal areas and our commitment to environmental stewardship as we develop offshore wind,” comments Alicia Barton, president and CEO of NYSERDA. “The state is undertaking a series of studies to ensure that offshore wind is a win for New York’s environment from both a carbon-reduction standpoint and a resource-preservation standpoint.”

With each pixel corresponding to 1.5 centimeters on the ocean surface, the gathered images provide details to allow taxonomists to identify the species for an extremely high percentage of the birds and marine animals, according to NYSERDA. Bird species identified include shearwaters, double-crested cormorant, petrels, gulls and terns. Remarkable as these images are, however, it is important to note that the vast majority of the images (more than 90%) show no birds or marine animals at or near the water surface, the authority points out.

As the survey progresses, distribution of organisms will be evaluated for patterns to aid in identifying areas of lower biological activity where offshore wind development may be feasible.

NYSERDA has developed a website that allows the public to see some of the different animals that have been recorded. The aerial surveys are being conducted in coordination with other research, including visual surveys from the New York State Department of Environmental Conservation and federal entities.

NYSERDA’s study is being carried out by Normandeau Associates Inc. and APEM Ltd. It is one of more than 20 studies NYSERDA is undertaking to provide current information about potential environmental and social sensitivities, economic and practical considerations, and regulatory requirements associated with offshore wind energy development. These studies cover topics such as fish and fisheries, marine wildlife, sediments, port infrastructure, and permitting.

APEM has begun surveying for the project using a newly developed camera system, Shearwater III, which was developed to push image resolutions to as low as a 0.5-centimeter resolution. APEM carries out the surveys, and the images are then analyzed by experts at Normandeau and APEM to identify birds and other marine species.
provision. The investment in safe harbor turbines allows ALLETE Clean Energy to pursue a three-pronged PTC strategy before the 2020 federal PTC phaseout. The strategy includes building and operating new wind farms based on long-term power purchase agreements, building wind farms for other companies for a development fee, and refurbishing its existing wind farms while extending power sale agreements.

Al Hodnik, president and CEO of ALLETE, says, “Maintaining and enhancing the Lake Benton and Storm Lake sites, along with extending power sales agreements, provide a cost-effective platform for the strategy that is already bearing fruit as the safe harbor turbines connect ALLETE Clean Energy with new industry partners nationwide.”

ALLETE Clean Energy was established in 2011 to acquire or develop capital projects to create energy solutions by way of wind, solar, biomass, hydro, natural gas, shale resources, clean coal technology and other emerging innovations.

**LEEDCo Advances Offshore Demo Project**

Representing a major step forward for the proposed offshore demonstration project, the Ohio Power Siting Board (OPSB) has found that Icebreaker Windpower Inc.’s application for a permit to construct North America’s first freshwater offshore wind project is now in compliance and is ready to be processed. According to Icebreaker Wind, the OPSB will issue a public notice, and review of the application will continue. The six-turbine, 20.7 MW demonstration project is proposed eight to 10 miles off the shore of Cleveland. Icebreaker says the project would create nearly 500 jobs and provide power for approximately 7,000 homes.

Icebreaker says OPSB’s completeness determination followed the developer’s submission of two memoranda of understanding with the Ohio Department of Natural Resources regarding monitoring protocols to determine any project impacts on fisheries, aquatic resources, and birds and bats.

“The OPSB’s determination that our application is now complete is a major step forward in the state permitting process,” states Dr. Lorry Wagner, president of project developer Lake Erie Energy Development Corp. (LEEDCo). “We are confident that our application demonstrates conclusively that our offshore wind demonstration project will not only have minimal adverse impact on fish and wildlife, but will also create jobs, boost the local and regional economy, and provide a local source of clean energy.”

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Northern Power Rolls Out Energy Storage Suite

Northern Power Systems Corp., a Vermont-based provider of distributed energy power systems, is now offering a suite of megawatt-scale energy storage solutions that incorporate various battery types and capabilities, depending on the application and end user need.

The company has already begun integrating batteries from three suppliers: UniEnergy Technologies is a vanadium-redox flow battery supplier. Flow batteries are known for their long duration and maintenance-free operating life. They are designed for shifting energy demand or storing and delivering renewable energy. Eos Energy Storage offers a zinc hybrid cathode battery that is particularly well suited to daily solar PV energy time shifting. Samsung SDI manufactures and supplies high-performance lithium-ion batteries for a variety of applications and charge-discharge requirements.

Northern Power’s energy storage systems incorporate batteries from these suppliers, along with the company’s FlexPhase power conversion platform, controls, battery management hardware and ancillary systems.

The company is currently working on multiple projects using the different battery technologies: These include a 1 MW/4 MWh system in Washington state with flow batteries from UniEnergy Technologies and a 1 MW/4 MWh system using Eos batteries, being installed at an existing location with more than 5 MW of wind and solar capacity in Brazil.

“For over 40 years, our company has supplied wind power, microgrid and power-conversion systems across all seven continents,” states Ciel Caldwell, Northern Power’s president and chief operating officer. “With our deep know-how and proven expertise in the energy industry, storage systems are a natural complement to our turnkey solution offerings.”

AWEA Unveils Interactive Map Tool

Using a new map tool released by the American Wind Energy Association (AWEA), anyone can now easily view the location of every utility-scale wind project and wind-related manufacturing facility in the U.S.

With the very first American Wind Week in full swing, AWEA says it released the map to help people visualize the growth of America’s largest source of renewable energy capacity.

“Wind power has become a vital part of the U.S. economy, drawing billions of dollars in capital investment to rural communities each year and supporting over 100,000 U.S. jobs across all 50 states,” says John Hensley, deputy director of industry data and analysis for AWEA. “I’m pleased this new map tool helps Americans visualize how world-class U.S. wind resources are being put to work in all parts of the country.”

A time-lapse feature built into the map shows the progress of wind power development across the country. Starting from 1981 in the passes of California, where the first modern wind energy projects were completed, users can see the story of American wind power unfold across heartland states such as Texas, Iowa, Oklahoma and Kansas and eventually to the first U.S. offshore wind project completed off Rhode Island last year.

The map also features markers for the more than 500 wind-related manufacturing facilities in the U.S. today. These factories support 25,000 U.S. manufacturing jobs across 41 states, notes AWEA.

The association says its new map uses only a small percentage of the full wind project and manufacturing data available to AWEA members through Market Database Pro, a comprehensive, interactive database of all online, under-construction and advanced-development wind projects, as well as all active wind-related manufacturing facilities.

For more information, check out AWEA’s website at awea.org.

New Grout Technology Suited For Offshore Wind

Tracerco, part of London-based Johnson Matthey PLC, has launched a new product that the company says enables offshore operators in the oil and gas and offshore wind markets to ensure the quality and strength of grout during installation.

According to Tracerco, the technology is able to provide quick and accurate grout density profiling. Real-time monitoring enables the measurement of grout density to be taken as it is pumped into the pile annuli; this allows offshore operators to determine that the density of the grout is as specified in the design – in turn, ensuring a secure foundation.
“Tracerco’s unique grout monitoring system ensures that accurate grout data profiles can be quickly obtained,” states Kim Thye Lee, strategic support manager. “Highly reliable density measurements remove the need to over-pump the grout volume, saving on raw material costs and reducing the time taken during cleanup. This, combined with live data recording and robust analysis, ensures that grout pumping can be optimized with a full traceable record of activity.”

The system can be interfaced with any type of remotely operated vehicle and can also be deployed using a diver.

Sentient Science Grabs Millions In Funding

Buffalo, N.Y.-based Sentient Science has announced that Toronto-based growth equity firm Georgian Partners will fund $22.5 million in a Series B, growth-stage investment in the company, which currently monitors and provides life-extension actions for 20,000 wind turbines across 200 projects globally, as well as simulates 440,000 bearings and 100,000 gears within its DigitalClone Live software.

According to Sentient Science, the capital funds will be used to provide new technical, software and software capabilities within DigitalClone Live, which is now expanding to operators and suppliers in aerospace and rail.

Hiring plans include an additional 70 employees, including a chief financial officer, vice president of software, software developers, and sales and marketing staff, in the offices located in the U.S., Europe and China.

“We incentivize our employees with pre-IPO stock options, so we’re very strategic in who we bring in as partners. We’re very excited and proud to be working with Georgian Partners, who is another important partner on our journey to IPO,” comments Ward Thomas, CEO and president of Sentient Science.

“Ward and his impressive team at Sentient Science have a unique technology and business model that lowers the cost of energy through supply-and-demand integration,” says Simon Chong, managing partner at Georgian Partners. “Their DigitalClone Live software fits perfectly with our thesis area for artificial intelligence, and we look forward to working with Sentient to expand technical capabilities and added value within the core applications.”

This is Sentient Science’s third round of funding since its inception in 2001. Previously, the U.S. federal government awarded more than $30 million in Small Business Innovative Research grants for the development of science-based software.

3M Partnership Features Use Of Drones

In an effort to reduce wind turbine downtime that can affect annual energy production, 3M recently announced an agreement with Camp Six Labs – a provider of drone-based infrastructure maintenance – to apply 3M products to wind turbine blades by using soon-to-be-developed Camp Six robotic applicators.

Camp Six will use small industrial robots mounted on drones to conduct routine wind turbine maintenance. During maintenance or upgrade work, the federally certified pilots will secure a safe flight perimeter and position the blades. After the unmanned aircraft are flown into position, the specialized robots will conduct repairs and improvements with 3M products – e.g., 3M Wind Protection Tapes, fillers, adhesives and coatings.

“3M’s wide range of technologies and products offer improved performance and protection against weathering and harsh environments and are used to build and maintain wind turbines around the world,” says Santhosh Chandrabalan, global business manager for 3M Electrical Markets. “Drone application technology offers an exciting and innovative way to provide O&M services for wind turbines.”

According to the companies, the new offering will also reduce potential workplace risk to technicians.

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How One Agency Is Advancing

Through research and technology, Natural Resources Canada’s CanmetENERGY gives wind north of the border a fighting chance.

By Tom Levy

Natural Resources Canada’s CanmetENERGY Ottawa (CEO) has a simple goal: to lead the development of energy science and technology solutions for the environmental and economic benefit of Canadians.

CanmetENERGY, a research and technology organization in the field of clean energy, operates a network of research laboratories throughout Canada. Active areas of research include transportation, clean fossil fuels, buildings and communities, bioenergy, oil sands, industrial processes, and renewable sources of power, including wind energy. The CEO lab coordinates national research efforts in the field of wind energy.

CEO is actively involved in a number of areas of research and development concerning wind energy, which are broadly categorized into three main areas: grid integration, cold climate operations, and remote/off-grid communities and industrial operations.

Grid integration

Grid integration encompasses a number of ongoing and potentially future activities. CEO staff are directly engaged in a technical support role with the North American Renewable Integration Study (NARIS) and the Regional Electricity Cooperation and Strategic Infrastructure (RECSI) initiative.

NARIS. Spurred through previous work undertaken by the National Renewable Energy Laboratory, such as the Eastern Renewable Grid Integration study and the Interconnection Seams study, as well as the Canadian Wind Energy Association’s Pan-Canadian Wind Integration study, this latest body of work involves collaboration with utilities across Canada, the U.S. and Mexico to model the North American power system.
Canadian Wind Energy

under various future scenarios, consisting of multiple renewable technologies. Noted as the largest renewable energy integration study to be undertaken to date, NARIS will study the power system through a series of models, including production cost-modeling at five-minute intervals using PLEXOS, an energy model and simulation software. The scenarios to be modeled – based on various capacity expansion models for several future years (e.g., 2025, 2030 and 2050) – will account for current commitments and goals among all three countries. Capacity expansion will also include a number of optimization runs and will consider generation technologies on both the distribution and transmission network. Sensitivities will account for variables such as gas prices, transmission build-out and hydro dispatch, among others. Results from NARIS will be available in 2019 and 2020.

RECSI. The goal of RECSI is to assess a variety of projects (relative to a base case) in order to rank and prioritize provincial-led initiatives that will lead to the greatest reduction in greenhouse-gas emissions, by cost, in different regions across Canada. As announced in the 2016 federal budget, projects will be evaluated against a base case that will include projects or initiatives that are already planned, such as new transmission (e.g., Maritime Link) or changes to generation (coal retirement in Alberta). Projects to be assessed will include a wide range of potential initiatives, including significant new transmission opportunities, electrification of liquefied natural gas, new embedded storage projects, new large hydro projects, a mixture of regionally focused non-hydro renewable projects, or a combination of the above.

Two key regions are participating – the western region, consisting of British Columbia, Alberta, Saskatchewan and Manitoba, and the Atlantic region, consisting of Newfoundland and Labrador, Prince Edward Island, Nova Scotia, and New Brunswick. Representatives from provincial governments, utilities and system operators are participating in working groups led by the Renewable Energy and Electricity Division of NRCan and supported by CEO staff. Results from both the western and the Atlantic region studies will be available at the end of 2017.

Advanced wind plant forecasting. CEO has contracted with the University of New Brunswick, which, in collaboration...
with the Wind Energy Institute of Canada (WEI-Can) and the TechnoCentre éolien (TCE), is working directly with utilities in the establishment of new approaches to forecasting techniques that meet the emerging needs concerning wind plant forecasting. These include improved short-term forecasts, the development of a ramping forecast product and an ice production loss forecast. The various forecasting tools are being developed and tested using the Environment Canada weather forecasting modeling software. At the completion of this research, a methodology will be published that will be available to the public.

Wind plant data research. Although Canada has a significant amount of utility-scale wind energy in all 10 provinces and two of the three territories, there is a lack of timely and accurate wind plant data. Through the Canadian Wind Energy Association, CEO has teamed up with the wind industry and WEICan to organize the collection, aggregation and analysis of representative Canadian wind fleet data. Of primary interest is data related to energy production and wind turbine availability. This ongoing, multiyear effort will serve to provide reliable wind plant operational data for the benefit of owners and the public alike.

Wind plant frequency regulation. The ability of a wind plant to follow an automatic generator control (AGC) signal set point was tested by WEICan under a contract with CEO. This research demonstrated the capability of their wind plant to follow a utility-supplied, four-second AGC signal. A performance evaluation demonstrated that the wind plant was able to achieve a higher performance score than gas, coal or hydro generators in the same balancing authority. CEO is planning future research involving several utilities, wind plant owners, wind plant OEMs and WEICan to demonstrate frequency regulation capabilities and potentially other essential reliability services, such as inertia and governor response during frequency disturbance events.

Cold climate operations
The Canadian wind fleet operates in harsh and cold environments, and as such, wind plant owners face unique challenges in this regard. In response to this, CEO has been studying the effects of cold climate on wind plant operations, as well as researching tools that can be used to forecast and mitigate icing effects on wind plants.

Assessment of cold climate on wind plant performance. CEO completed a study of 23 wind farms across eight Canadian provinces with the objective of quantifying the degree to which cold climate operation affects wind energy production in Canada. Over the six-year study period from May 2010 to April 2016, the average loss factor for the summer period (May to October) was estimated to be 4.2% compared with 8.1% for the winter period (November to April), resulting in an average cold climate loss factor of 3.9%. For individual wind farms, the 2010-2016
average cold climate loss factor ranged from -6% (higher losses in summer than winter) to 16%. Cold climate losses were estimated to total 959 GWh across the country each year (based on the 2016 installed capacity), representing lost revenue of approximately $113 million annually. The granularity of the monthly production data prevented identifying losses related to non-meteorological sources such as maintenance, outages or curtailment. Further research will help to accurately classify and quantify losses directly attributable to winter weather conditions.

**Development and validation of an ice prediction model for Canadian wind farms.** CEO contracted with TCE to develop and validate the GEM-LAM-Jones-Makkonen (GLJM) model for forecasting meteorological icing. This model is the result of pairing the GEM-LAM weather forecasting model, developed by Environment Canada, with those designed by Jones and Makkonen to predict icing accretion. The objective of the validation was to assess the capacity of the GLJM model to predict icing episodes at wind farms and the associated production losses. Meteorological data, coupled with in situ observations and the Weather Research & Forecasting (WRF) ice prediction model, formed the basis of comparison for this study. Meteorological data collected in the winters of 2013-2014 and 2014-2015 was used to identify and characterize icing events in order to evaluate the production losses sustained by the wind turbines included in the study. The events were modeled with GLJM, and the production losses associated with the icing predictions were calculated.

Although the GLJM model has been developed in the context of this project, its performance was similar to that of the WRF model. Consequently, TCE recommended that the model be further tested and refined in order to improve its use within an operational context (see Advanced Wind Plant Forecasting above).

**Remote/off-grid communities**

Researchers in CEO’s wind group and other researchers within the broader CanmetENERGY family are providing ongoing technical support to federal departments engaged in reducing the reliance on diesel fuels in northern and remote energy systems. These efforts will move toward the implementation of renewable energy solutions (including wind-diesel-storage hybrid generating systems) in remote and off-grid communities. Recent projects have demonstrated that wind-diesel systems at the Ramea Island community, located off the coast of Newfoundland and Labrador; the Diavik diamond mine in Northwest Territories; and the Raglan mine in Northern Quebec can reliably and economically reduce diesel fuel usage for electricity generation. The CEO wind group will continue to support wind-diesel-storage opportunities as they arise over the next several years and will be developing additional in-house tools to support various efforts in these areas.

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Boasting some of the strongest wind resources in the country (fourth, according to the National Renewable Energy Laboratory) and the wide open spaces that developers relish, it’s no surprise that South Dakota is in the midst of a wind boom.

Last year, the state generated more than 30% of its electricity from wind power, the second highest in the country. But with the construction of the CapX2020 transmission portfolio, which will provide access to new markets, and some recent improvements to the state’s tax climate, South Dakota is a state ripe for significant new wind development opportunities.

Indeed, there is a major build-out of wind being planned in the Mount Rushmore State. Even though South Dakota gets nearly a third of its electricity from wind power, with just 977 MW installed, the state lags well behind neighboring states such as North Dakota, Minnesota and Iowa in installed capacity.

But that may soon change, however. According to the American Wind Energy Association’s Second Quarter Market Report, South Dakota currently has 90 MW under construction and an additional 600 MW in advanced development.

And wind companies are interested in doing much more business in the state. South Dakota spans two different regional transmission organizations, the Midcontinent Independent System Operator and the Southwest Power Pool, and planners for those two entities are currently studying thousands of megawatts of new utility-scale wind energy projects for potential development. The development of these projects will bring...
significant economic development to the state, adding to the $2.1 billion in capital investment the state has already received.

As utilities in the Midwest seek to add additional clean energy resources on their system, particularly as the federal production tax credit winds down, South Dakota is one of the states poised to take advantage of this new market demand. South Dakota already receives millions in local tax revenue from existing wind development, and the farmers and ranchers who lease their land to wind projects are benefiting from significant lease payments that provide a drought-resistant source of income. South Dakota companies, such as Marmen Energy in Brandon, which manufactures wind towers, or MFG Wind in Aberdeen, which manufactures and services wind turbine components, are directly benefiting from the development of wind energy in South Dakota.

But the real opportunity lies on the horizon in South Dakota. Several large wind projects have recently been announced in the state, including the 600 MW Crowed Ridge project. This wind farm is part of Xcel Energy’s plans to add over 1.5 GW of low-cost wind energy to its system over the next several years. Not only will this project – and others like it – provide cost-effective electricity for residents of South Dakota and beyond, but these projects will also drive billions of dollars of private investment in the state, providing millions in new tax revenue to communities and landowners, as well as creating hundreds of new jobs.

This level of development is not without challenges, however. Several anti-wind organizations have formed in South Dakota in recent years, each one with a seemingly increasing level of sophistication. In a state where wind energy facilities are permitted at the local county level, these groups have targeted several counties and pushed for restrictive setbacks. Although these organizations say they support renewable energy, they argue that burdensome setbacks are needed to protect property values, the public health and the viewshed of rural residents. And, in Lincoln County, in the southeast corner of the state, they recently succeeded in enacting and upholding a half-mile setback, effectively banning future wind development in the county.

And while these challenges are not unique to South Dakota, the number of megawatts on the line and the fact the state spent nearly a decade working to address transmission constraints and fixing an uncompetitive tax climate to get to this point makes this a fascinating state to monitor. Several other counties in the state are actively weighing modifications to their zoning ordinances in response to proposed wind farm development. In many cases, the justification for these changes is based on misinformation and anxiety stemming from the activism of these dedicated anti-wind organizations. At least two South Dakota newspapers recently editorialized that county officials are wise to promote more restrictive setbacks, basing their opinions on outdated or ill-informed information.

Over the years, numerous political voices – from governors to the Congressional delegation to state lawmakers – have led the charge in building out the infrastructure in South Dakota that is needed to accommodate the anticipated growth in wind power. Sen. John Thune, R-S.D., may have said it best when he spoke at the September 2015 groundbreaking ceremony of the Big Stone South – Brookings 345 kV transmission line, part of the CapX2020 portfolio, when he likened the importance of the project for local wind development to the railroad tracks and trains that are needed to move corn out of the state. Republican governor Dennis Daugaard has made clear his position on this industry, saying in June 2016, “I will continue to promote the expansion of renewable energy, including South Dakota’s excellent wind resource, within our state, given its many economic and environmental advantages.” Now that key projects like Big Stone South – Brookings are nearing final completion, it is crucial that these political leaders continue their advocacy and remain engaged to see these wind projects cross the finish line, the culmination of their years of hard work in supporting South Dakota’s energy economy.

The ability of each individual wind company to overcome the opposition of a vocal minority will determine the future of wind energy in South Dakota. Companies must continue to educate the public about the benefits that this investment will provide – while also working hard to address legitimate issues when they arise. Finding local community leaders who understand these benefits, leveraging the existing fact-based literature that counteracts the opposition’s talking points, and developing strong relationships with decision-makers and the community at large will all be critical to building the support needed to move forward with a wind project.

It’s not enough, however, to find and deploy wind supporters only when trouble arises. Developers would be wise to proactively recruit, engage and cultivate their supporters long after the first battle is fought. Continuing to keep in touch through open houses, newsletters, social media and other means will prove very helpful when the tables turn again and there is a need for those supporters to show up at the Capitol or local hearings and talk about the benefits the project has provided.

If companies are successful in building this level of support, it will mean substantial new economic opportunities for people across the state of South Dakota, and it could propel the state into the leadership circle with neighboring states in the nation’s wind belt. 

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Using More Of The Grid We’ve Got

There are significant technological and economic opportunities to increase delivery of wind energy over existing transmission lines.

By Rob Gramlich

My daughter’s WAZE GPS app sends her a different route to work every day. Back in the old days (2015), she would have had to sit in more traffic because she would have no idea where the congestion was or any ability to avoid it. Congestion on the transmission grid is both annoying and extremely costly for wind project owners. It is increasingly causing low locational energy prices and even physical curtailment. The wind industry can and should build more roads and more transmission lines in certain cases. The industry can also get more out of the grid with technologies that are now readily available.

Dynamic line ratings and power flow control are two examples that can help alleviate congestion and deliver more wind over existing lines. The wind industry and utility sector have succeeded before in improving use of the existing grid. The development of regional transmission organizations (RTOs) and independent system operators (ISOs) was, in part, an effort to allow the free physical flow of electrons in a region, unconstrained by scheduling and reservation restrictions. In the Federal Energy Regulatory Commission’s (FERC) transmission tariff reform effort that led to Order No. 890 10 years ago, the commission agreed with the wind industry and created Conditional Firm Transmission Service to allow use of the physical capacity that demonstrably existed but was not being sold by transmission operators (TOs). When the industry works with transmission owners, RTOs and FERC, a case for increased efficiency while protecting reliability, improvements can be made.

Dynamic line ratings (DLR) is one transmission utilization technology that can improve the economics of wind energy. There is an unexploited opportunity based on the fact that transmission lines can deliver more energy when they are...
cooled by wind. The same wind that generates wind energy cools lines and allows them to deliver more energy without harm to the lines or reliability. The transmission owner can change its line ratings from static to dynamic, adjusting each line’s capacity over time based on monitoring of actual conditions to allow increased flow when the capacity exists. A U.S. Department of Energy (DOE) study tested DLR on the Oncor and New York Power Authority (NYPA) systems and found as follows:

- An increase in wind speed of 3 ft/s at a 90° angle to the line revealed a 44% increase in capacity;
- NYPA believes wind farm curtailment could be mitigated using dynamic ratings;
- Oncor observed real-time capacities that, on average, were between 30% and 70% greater than static ratings and between 6% and 14% greater than ambient-adjusted ratings; and
- NYPA observed even greater increased real-time capacity of between 30% and 44% above the static rating.

DLR is not a new concept, and the wind industry has been advocating it for well over a decade. What is new is the maturity and commercialization of the technology to monitor lines and integrate line monitoring information with ambient conditions to be able to predict flow capacity. System operators have also significantly improved their grid operations techniques, and at least one (PJM) now has security-constrained economic dispatch software that can accept dynamic ratings.

Another promising transmission utilization technology is advanced power flow control. This technology "pushes" and "pulls" power flow to move flow from constrained or congested lines to underutilized parallel lines. According to the DOE’s ARPA-E program, which supported the technology’s development, power flow control could increase grid utilization by 30% and result in cost-savings of 50% compared with other solutions. Any reduction in physical congestion would improve the locational prices received by wind generators and potentially reduce physical curtailments.

Better yet, when these two technologies are paired together, they create compounding benefits to grid efficiency, with the DLR system acting as the intelligent alerting system revealing the additional capacity and the power flow control devices directing the electrons based upon this information.

So how will these technologies be deployed? If they are so great, why aren’t TOs using them? Those are fair questions. They also sound like the classic joke about the economist who says the $20 bill on the street cannot possibly exist because someone would have already picked it up.

But here’s why the bills are lying all over the street: Transmission is a monopoly, so only one entity operates the lines, and revenues are currently regulated without any connection to how much energy is delivered. It is as if only one person is allowed to walk down the street and pick up the bills, but that person isn’t allowed to keep them.

The regulations causing perverse incentives are the responsibility of FERC. In much of the country with RTOs or ISOs, transmission owners are regulated using cost-of-service regulation such that they are compensated for their “revenue requirement,” which is a function of an allowed return on equity (ROE) and their invested capital, or rate base. The RTO or ISO collects access charges from load-serving entities and other
transmission customers on behalf of TOs and distributes them out to participating TOs in their region. It is now standard practice to allow “formula rates” such that any under- or over-collection is trued up in subsequent years, making it nearly automatic for TOs to recover their revenue requirement.

Nothing in the above regulatory regime is connected to how much service is provided, how much power is delivered or any other metric of performance. TOs could deliver twice as much power but would get nothing for it. The actual facilities for power flow control or DLR could easily be incorporated into transmission rate base, but that is not enough; the tiny fraction of total rate base invested in the equipment makes the whole system more efficient, and those savings need to be leveraged to give appropriate incentive to employ them.

If we want TOs to deliver more power, we need to give them a reason. It is not their fault they are following the incentives that have been established for them. If we help them change the incentives, they might keep a portion of the economic savings created.

FERC can change the incentive structure. FERC has full jurisdiction over the rates, terms and conditions of service for these TOs. FERC uses performance-based rates in its regulation of oil pipelines so it can be done within its authority. In its regulation of gas pipelines and transmission service outside of RTOs/ISOs, revenues are a function of the volume of service (such as dollars per mmbtu or dollars per megawatt-hour), so there is some incentive to increase delivery. It needs to find that rates are just, reasonable and not unduly discriminatory or preferential. If the efficiency savings are as much as studies indicate, there will be plenty of savings to share between transmission customers and TO shareholders while providing more service to wind generators and others.

FERC’s authority to provide incentives was significantly strengthened and clarified by the Energy Policy Act of 2005: “The Commission shall establish, by rule, incentive-based (including performance-based) rate treatments for the transmission of electric energy … reducing the cost of delivered power by reducing transmission congestion … The rule shall … encourage deployment of transmission technologies and other measures to increase the capacity and efficiency of existing transmission facilities and improve the operation of the facilities.”

Some willingness to innovate in regulatory policy will be needed by the new commissioners. FERC is an extremely precedent-driven organization. In the same way that people do not get fired for doing things the same way as before, FERC orders do not tend to get overturned by courts if they are following precedent. Innovation is not exactly FERC’s forte.

The EPAct provision above was implemented but failed to result in any change in the incentives for grid utilization. The main focus of FERC’s implementation in Order 679 was on grid expansion, not grid utilization. And the effort devolved
into a mere determination of ROE adders, and opponents of higher ROEs succeeded in getting FERC to limit ROE incentives, so the structure is pretty much back to where it started before the EPAct.

The wind industry has an opportunity for regulatory innovation as four new FERC commissioners take their seats on the commission. First, the commission could allow a performance metric of congestion as an adder/subtractor above or below standard rates. The incentive could be ex ante, based on expected congestion and modeled congestion reductions, or ex post, based on actual congestion relative to expected levels. It need not be a whole new regime that tosses out formula rates, which are firmly entrenched at this point. The great regulatory economist Alfred Kahn was fond of saying “all regulation is incentive regulation.” It would be a great start for FERC to recognize the incentive properties inherent in the current structure and open a process to consider modifications without necessarily taking on all the baggage from earlier “incentive ratemaking” attempts.

Another opportunity is the commission could require or encourage advanced technologies in transmission planning. Each region is required to have a transmission planning process. Those requirements are being reviewed in a process begun last year to review Order 1000. When Order 1000 was introduced in 2009 and when earlier planning requirements were installed in Order 2000 in 1999, these technologies were not ready for wide deployment. Order 1000 provided for “non-wires alternatives,” but these alternatives were described as demand response, storage and energy efficiency, not grid utilization technologies. If grid utilization isn’t “transmission” or a “non-wires alternative,” then the commission could require consideration of a third category called grid utilization improvements.

Finally, these technologies could be options in the interconnection process. A coalition of DLR providers submitted comments to FERC in the interconnection proposed rule proceeding requesting DLR as an option if transmission capacity were limited.

There are significant technological and economic opportunities to increase delivery of wind energy over existing lines ready to be deployed just when we need it.

To move these solutions forward, the wind industry will need to identify congested transmission systems that limit wind production and find TOs willing to try new technologies. Also, the wind industry needs to continue developing a tariff change to file with FERC that allows TOs to profit from the efficiency gains. These steps can all be made to avoid congestion and improve project economics soon before the problem worsens. 

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As the wind industry continues to develop into a key provider of electricity around the world, operators and manufacturers are demanding more from their machines. This continual evolution of wind has led to larger turbines and larger wind farms. As output increases, so do the acting forces and importance lubricants play in the reliability of these powerful machines. Lubricants ensure the efficient operation of these facilities and are an integral part of the system. As a result, lubricants must be accounted for in the design and maintenance in this demanding field.

Wind turbines have a unique list of requirements from lubricants. The main task of the lubricant is to ensure reliable operation of the machine elements. The lubricant should also meet demands for service life, load carrying capacity and thermal resistance over an extended period of time. Meeting these demands with taller and bigger turbines produces an increasingly challenging environment. Important lubrication points in wind turbines include the main gear drive, yaw system gear, main and generator bearing, pitch adjustment unit, and nacelle slewing ring.

Among other things, lubricants offer high thermal resistance, resistance to oxidation, and high wear protection for bearings and gears.

By Jestin Hulegaard
Changes to the design of wind turbines create additional demands on lubricants that are used in the wind power industry. As interest in the industry grows, engineers work to improve the efficiency and the output of wind turbines. Gearbox designs contain more equipment designed to produce more work, and more work leads to the generation of more heat in the gearbox. As a result, lubricants must function at higher operating loads while helping to reduce temperatures in the gearbox.

Mineral oils cannot meet these demands, and operators of wind power plants have turned to synthetic oils to satisfy these demands (improved thermal resistance, better viscosity characteristics, product longevity and longer machine component life). Different base oils (polyalphaolein, polyglycol or rapidly biodegradable ester) are used to formulate these gear oils. Today, however, many basic synthetic oils cannot meet the new requirements created by changes in the industry. As a result, operators are turning with increasing frequency to new, higher-performance synthetic oils.

The lubricant industry is responding with specialty products that meet and even exceed the standards set before them. These new lubricants offer high thermal resistance, resistance to oxidation, a more consistent viscosity at rising or falling temperatures, lower friction coefficients, high wear protection for bearings and gears, good load-carrying capacity in bearings and gears, and low residue formation. They also offer extended service intervals, resulting in more economical operations. Developing these lubricants requires knowledge of additives – their chemistry, which additives to use, what combinations to use them in – and of base oils. The purer the molecular structure of the base oil, the better the lubricant.

Wind lubricants are designed for very specific applications, such as a generator bearing in the gearbox. Photos courtesy of Kluber Lubrication

Lubricants help reduce temperatures in the gearbox. Photos courtesy of Kluber Lubrication

New tests and standards
Like the traditional synthetic oils that preceded them, new, high-performance synthetic oils are subject to the tests of original equipment manufacturers (OEMs) and must meet a number of universal standards. For example, industrial gear oils are classified in accordance with Deutsches Institute for Normung (DIN) 51 517. Part 3 of this standard defines the requirements for gear oils that are exposed to high loads. In addition to the usual tests on viscosity, pour point, foaming characteristics, and steel and copper corrosion, the scuffing load characteristics of the oils are determined in the Gear Research Center (FZG) scuffing load test. DIN 51 517, Part 3, stipulates a scuffing load stage greater than 12 for gear oils.

Because gear oils should also be suitable for lubricating the rolling bearings in the gearbox, the standard DIN 51 517, Part 3, also contains the FE 8 rolling bearing test rig developed by the rolling bearing manufacturer FAG. The FAG FE 8 test rig can be used to assess the anti-wear properties of an oil and its effect on the rolling bearing service life. In this test, the wear of the rolling elements should not exceed 30 mg.

The assessment of gear oil performance for wind turbines also includes tests that measure scuffing load resistance and micro-pitting resistance. A test developed by FZG measures anti-wear properties of the lubricant at low gear speeds as the planetary gear stage is run at the lowest speed. In this test, better-performing lubricants fall within the low-wear category.

Gear efficiency is determined to a large extent by the friction characteristics of the lubricating oil. The friction coefficients of different base oils can be seen in the result of the FZG test rig. Today’s gear oils can reduce temperatures by as much as 68°F (20°C) and power losses by as much as 18% when compared to standard gear oils. Cutting power loss leads to more power being delivered to the rotor, as well as increased profits simply by increased performance of the lubricant.

As the industry continues to develop by finding more efficiencies, lubricants are also contributing to cost-savings through better power transfer and component reliability. As a result, the value placed upon high-performance lubricants continues to increase. What was once a commodity selected on the basis of price is now considered by many as a machine element, carefully specified in much the same way gears and other components are specified.

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CANADA’S STRONG, STABLE AND SUPPORTIVE WIND ENERGY MARKET OFFERS EXCITING NEW OPPORTUNITIES

Canada is home to the eighth largest wind generating fleet in the world and is led by a supportive government that is dedicated to addressing climate change.

CANADA IS A GLOBAL LEADER
Wind energy has been the largest source of new electricity generation in Canada for the past decade and Canada now has close to 12,000 MW of installed wind energy capacity.

90% CARBON FREE BY 2030
The Federal Government is aiming for 90% of Canada’s electricity to be carbon free by 2030.

7,000 MW NEW WIND ENERGY
Existing provincial energy strategies are targeting the installation of as much as 7,000 MW of new wind energy capacity by 2030 with procurement for 600 MW already underway. Additional energy strategy/policy announcements are expected this year.

$450 MILLION O&M BY 2020
Wind farm operations and maintenance market revenue opportunity is estimated to be $450 million by 2020.

JOIN US at the Canadian Wind Energy Association’s (CanWEA) Annual Conference and Exhibition to exhibit your products and services and learn more about our wind energy market.
windenergyevent.ca/whycanada
A new study on the economic effects of existing climate and clean energy policies in California’s Inland Empire estimates a net benefit of $9.1 billion in direct economic activity and 41,000 net direct jobs from 2010 to 2016.

When accounting for the spillover effects of these benefits, the net value jumps to $14.2 billion in economic activity and over 73,000 jobs over the same seven-year period, according to the study, “The Net Economic Impacts of California’s Major Climate Programs in the Inland Empire,” released by nonprofit group Next 10, which commissioned researchers from UC Berkeley’s Center for Labor Research and Education and the Center for Law, Energy and the Environment to prepare the report.

The study focuses specifically on San Bernardino and Riverside counties, which both face unique economic and air-quality challenges. The report analyzes not only the benefits of California’s climate and clean energy policies, but also compliance expenditures, investment expenses and other costs.

“The Inland Empire is extremely important to the economy of California and is uniquely at risk to environmental and economic challenges,” says F. Noel Perry, founder of Next 10. “This report indicates that overall, policies including cap and trade and the renewable portfolio standard, as well as energy efficiency and distributed solar programs, are contributing jobs and economic benefits.”

According to Next 10, smog in San Bernardino and Riverside counties is consistently among the worst in the state, and, as a result, more residents are diagnosed with pollution-related health conditions. Residents’ per capita income is approximately $23,000, compared with the state average of $30,000, placing the region among the lowest-earning metro areas in the state. Furthermore, 17.5% of the residents of Riverside and San Bernardino counties are living below the poverty line, compared with 14.7% of all Californians, the study says.

Researchers looked at four key California climate and clean energy policies, including cap and trade, renewable portfolio standards (RPS), distributed solar policies, and energy-efficiency programs, to determine whether they are helping or hurting the Inland Empire’s economy.

“The Inland Empire has benefited overall – no question. But as happens with any economic transition, the move toward a low-carbon economy creates challenges for certain industries while boosting others,” notes Betony Jones, the report’s lead author and the associate director of the Green Economy Program at the Center for Labor Research and Education.

The report finds that the construction industry benefited most from these policies: It found an increase of over $9.6 billion in business investment and 36,000 jobs from 2010 to 2016, mostly from the development of wind and solar projects. Firms involved in the operation of new wind and solar power plants increased revenue by $1.8 billion and created over 900 ongoing maintenance jobs, the report says. In addition, local retailers, wholesalers and real estate establishments saw revenues and job counts rise.

According to the study, those facing challenges included...
companies involved in fossil fuel power generation; the authors modeled a negative impact of $1.7 billion in sales and over 1,100 jobs in the Inland Empire from 2010 to 2016. The model shows that businesses involved in extracting oil and gas lost almost $15 million in sales and over 40 jobs, the report notes.

"Employment and sales trends highlight the need for robust transition programs that can help workers and communities affected by the decline of greenhouse gas-emitting industries build good futures in the emerging clean energy economy," says Ethan Elkind, a report contributor from the Center for Law, Energy and the Environment. "That's one of the recommendations we make in the report."

**RPS**

The researchers found that the proliferation of renewable energy plants was responsible for over 90% of the direct benefit of California's climate and clean energy policies in the Inland Empire. As of October 2016, San Bernardino and Riverside counties were home to more than 17% of the state's renewable generation capacity, according to the California Energy Commission. The region totals 3,721 MW of renewable capacity – enough to power 2.6 million homes – with projects representing another 2,162 MW already permitted and awaiting construction, according to the report.

"Constructing new renewable power plants created the largest number of jobs, generating 29,000 high-skilled, high-quality direct jobs over the seven-year period," Jones says. "When you incorporate ongoing jobs in operations and maintenance, as well as spillover effects to the economy that boost other areas of employment, a total of over 60,000 jobs were created, even after accounting for job losses in the natural gas industry. In total, the net impact in the region from the renewables portfolio standard exceeded $12.4 billion and helped boost the Inland Empire's competitive advantage in the renewables sector."

**Cap and trade**

After accounting for compliance costs and investment of cap-and-trade revenue that leaks out for vehicle purchases, researchers found cap and trade had a net positive economic impact of $25.7 million in San Bernardino and Riverside counties from the first four years of program implementation (2013-2016). That includes $900,000 in tax revenue and net economy-wide employment growth of 154 jobs. When funds that have been appropriated but have not yet been spent are included, projected net economic benefits reach nearly $123 million, with 945 jobs created and $5.5 million in tax revenue, the report finds.

"The legislature’s recent decision to advance cap and trade through 2030 creates a level of certainty going forward, and our research indicates that’s good for the Inland Empire’s economy," Elkind explains. "We recommend disbursing auction proceeds in a timely manner and ensuring the Inland Empire receives a fair share of the money, given the region's needs. It’s also worth considering dividends to consumers to account for the region’s higher-than-average transportation fuel and electricity use."

**Distributed solar and energy efficiency**

The researchers also looked at the costs and benefits of the California Solar Initiative, solar investment tax credit and investor-owned utility energy-efficiency programs. These programs provided about $1.1 billion in subsidies in distributed solar and $612 million in investments in energy efficiency in the Inland Empire between 2010 and 2016.

While researchers calculated benefits for these two programs separately, the costs to ratepayers must be considered as a whole, they say. When costs to ratepayers are weighed against the job and economic benefits of distributed solar and energy-efficiency programs, the net impact resulted in the creation of more than 12,000 jobs and $1.68 billion across the economy.

While the state subsidies for distributed solar have been fully implemented, sharply reduced costs, the federal tax credit and net metering continue to drive solar investment, the study points out. Researchers found that the Inland Empire has enormous potential for continued investment and improvements in energy efficiency, however; it is one of the hottest regions in the state, and energy use is above the state average.

"With such a great need for cooling and relatively higher energy demand, the Inland Empire is a prime candidate for expanded efficiency investment. Our report recommends expanding energy-efficiency incentives and expenditures to improve the building and housing stock while reducing energy costs and creating jobs and economic activity," Jones adds.

**Policy recommendations**

Given the economic benefits of California’s climate and clean energy policies in the Inland Empire, the researchers offered recommendations for maintaining and improving results going forward:

- Developing a comprehensive transportation program, equal to California’s renewable energy programs, to maximize benefits and minimize harm for local industry and residents. The importance of warehousing and logistics and the distances traveled by residents each day to and from work makes transportation the greatest unknown of California’s climate program.
- Disbursing auction proceeds in a timely and predictable manner and ensuring that the Inland Empire receives an appropriate level of statewide spending based on its economic and environmental needs.
- Developing robust transition programs for workers and communities affected by the decline of the Inland Empire's greenhouse gas-emitting industries, including re-training and job placement programs, bridges to retirement, and regional economic development initiatives.
- "Other states and nations look to California for leadership on climate and clean energy, both to learn from our experience and to craft their own policies," Perry concludes. “We hope this
report gives policymakers and stakeholders the concrete data they need to weigh policy options and invest in the best choices to minimize costs for the most vulnerable – in the Inland Empire and beyond.”

Fifty Entities Urge N.C.’s Cooper To Take Offshore Action

On Aug. 9, 50 elected officials, small businesses, community groups and environmental organizations sent a letter to Gov. Roy Cooper, D-N.C., to urge him to embrace offshore wind as a key part of North Carolina’s energy plan.

According to signee Environment North Carolina, the letter comes in the wake of the recent passage of H.B.589, which included an amendment to set an 18-month moratorium on onshore wind power developments. After signing the bill into law, Cooper issued Executive Order 11, which expressed support for wind power. Though the order was a promising statement about the future of offshore wind, says Environment North Carolina, the letter signees are urging him to go further by backing it up with tangible investments and a specific target for wind energy production.

“With strong energy demand, good wind resources, port access, excellent academic institutions and maritime know-how, the Tar Heel State can usher in a new era of economic development,” says Simon Mahan of the Southern Wind Energy Association.

Another City Takes 100% Renewables Pledge

Nevada City, Calif., has joined the growing list of U.S. cities that are officially committed to transition to 100% clean, renewable energy.

Surrounded by city council members, key members of the community and partners, Nevada City Mayor Duane Strawser announced the city’s near-unanimous vote to ensure that the city’s electricity will come entirely from renewable sources by 2030 and that all energy sources would be renewable by 2050.

According to the Sierra Club, Nevada City is now the 41st city in the U.S. to establish a 100% renewable energy goal, which also comes on the heels of similar pledges from other mountain communities, including South Lake Tahoe, Calif., and Park City, Utah.

“Nevada City’s commitment for 100 percent renewable energy is driven by our community,” said Strawser. “The passion for the natural environment and our responsibility to take care of it is part of the fabric of what makes Nevada City a very special place to live. I challenge other communities across the nation to join us in this goal.”

The Sierra Club says Nevada City’s resolution is grounded in a burning reality as the growing impacts of climate change threaten the mountain community. Fourteen of the 15 hottest years on record globally have occurred since the beginning of this century, and 2017 is predicted to be the second warmest on record.

“If this summer is any indicator of what climate change can mean for the future of our community, it is time to do all we can to avoid its impacts,” said Don Rivenes with the Nevada County Climate Change Coalition. “Over the last three years and particularly the last few months, we have seen citizens from across our community come together to tackle climate change by helping our city officials take bold action. We’re thrilled to see Nevada City commit to 100 percent renewable energy today.”

Nevada City has an existing Energy Action Plan (EAP) with a goal of a 28% reduction in electricity use by 2020. The resolution will lead the way toward updating the EAP to transition to 100% renewable energy by 2050.

“The Sierra Nevada Alliance [SNA] is proud to work with cities like Nevada City,” said Jenny Hatch, SNA’s executive director. “Nevada City recognizes the many impacts on the local economy and environment that climate change will bring. At Sierra Nevada Alliance, we bring together the passion to fight climate change with the passion to protect our mountain communities to make an unstoppable force for change. That’s why it is no surprise that mountain cities are leading the way on renewable electricity.”

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Patent Wars Flare Again: GE Tags Vestas For ZVRT In U.S.

On Aug. 1, GE filed a complaint, 2:17-CV-5653, in the U.S. District Court in the Central District of California alleging that Vestas is infringing a patent on zero-voltage ride through (ZVRT). GE contends that the Vestas V90-3.0, V100-2.0, V112-3.0 and V117-3.3 wind turbines comprise technology that utilizes a converter control system capable of riding through a grid voltage drop down to “approximately zero volts.”

Interestingly, this is the same patent that was used by GE in a previous patent litigation against Mitsubishi Heavy Industries. During the course of those patent litigation trials, the patent went through a “re-examination” process at the U.S. Patent & Trademark Office to determine whether it was a valid patent. While the GE patent seems to have been battered a bit through that re-examination process, it has survived mostly intact and is considered valid.

In this new complaint, GE lists the San Gorgonio Wind Farm, Brookfield Wind Farm, Alta II-IX Wind Farms and Solano III Wind Farm, which comprise Vestas turbine units, as potentially infringing the ZVRT patent. GE also cites other U.S. project sites where the same turbine models have been installed in California, Texas, Oklahoma, New Mexico, Maine, New Hampshire, Vermont and Kansas.

Pending litigation against Vestas in the other states referenced is unknown at this time. However, for the project sites identified in California, GE is within its rights to request an injunction on the ongoing operation of those projects in order for the potentially infringing technology in the converter control system to be removed or otherwise altered. This type of injunction creates a significant financial risk that goes well beyond the commercial damages of the patent litigation, considering the injunction could further expose liquidated damages for lost production.

Vestas may be listed as the only defendant in the court trial, but typically in such matters, it is not alone. Project developers and asset owners share in the risk due to the terms typically used in turbine supply agreements throughout the industry by multiple OEMs. Surprisingly, most OEMs do not fully indemnify developers and asset owners from patent infringement liability.

As we saw in the U.K. recently when Enercon sued Siemens for patent infringement on wind turbine controls, project developers and even engineering, procurement and construction contractors may have some responsibility and liability for patent infringement. The Enercon litigation against Siemens had threatened over $5 billion worth of projects in the U.K. offshore sector. Even though the lawsuit was ultimately decided in favor of Siemens, it highlights the shared risks noted previously, considering both DONG and A2SEA were named as co-defendants in the litigation trial.

Though Siemens was likely contractually obligated to defend DONG and A2SEA in the trial, there was a chance that Enercon could have been successful with an injunction that may have delayed the start of project construction on both Westermost Rough and Gunfleet Sands. Equally, London Array could have faced a shutdown order until the potentially infringing technology was removed from the turbine control systems.

But how does a matter like this end up in court? Why aren’t the similarities between products and competitor patents uncovered during the product design/development process, when it is easier and less costly to change the design? Why aren’t intellectual property risks identified and mitigated during the project finance due diligence or type certification process? Why do the insurance underwriters continue to ignore $2.3 billion in total patent infringement liabilities in the wind sector?

Sadly, this matter was probably avoidable, as is the case so many times in patent infringements. Intellectual property (IP) risk is not considered a “real” risk by most companies unless litigation happens. But you don’t have to see the inside of a courtroom to suffer commercial harm.

In the complaint filed in the California court, GE cites a number of documents that make reference to the Vestas product specifications for the V90, V100, V112 and V117. Such documentation pops up quite frequently online when project developers are obligated to reference such documents for siting committees and the like. Although many documents comprising technical specifications and other proprietary information are redacted when shared in the public domain, not all of them are.

But the key isn’t to simply avoid being caught.

So how do we keep OEMs and others out of court? An independent IP due diligence, similar to getting a type certification, is the simple answer. Proactive companies that have already undertaken this have saved a collective $293 million in royalties they would have otherwise paid to companies like GE. They avoided the cost by identifying where the potential land mines were and navigating a path around them during product design.

Presently, independent IP infringement risk certification is not mandated in the wind industry (or virtually any other industry in which project finance is utilized). Most turbine OEMs provide their own internal data and validation to turbine purchasers and project financiers – but only if asked and typically only in matters related to publicly acknowledged patent infringement litigation in which a competitor is known to be in active litigation (such as this new matter between GE and Vestas).

But in-house validation from the OEM is, indeed, not an independent assessment. What most turbine OEMs do not realize, or else they have not publicized, is that they are all infringing on one another to a certain degree. The only reason more litigation has not sprung up is due to the recognition of the mutual costs of pursuing patent infringement litigation against one another and the inevitable counter-suits each would face.

No one should ever want to see the inside of a courtroom for an IP litigation, but the time to understand the risk profile is not right before you have one foot past that threshold.

– Philip Totaro

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Mortenson Gets The Nod For MidAmerica’s Beaver Creek

Mortenson Construction has been selected to build the 170 MW Beaver Creek wind farm in Iowa for MidAmerican Energy Co.

The project represents Mortenson’s 13th wind farm for the utility. Beaver Creek, being constructed across Greene and Boone counties near the town of Grand Junction, will have 85 V110 turbines from Vestas. The turbines are expected to be in service in December.

The Beaver Creek wind farm is part of MidAmerican Energy’s Wind XI expansion, which is adding 2 GW of wind generation capacity in Iowa. The Beaver Creek wind farm is also expected to create 150 temporary construction jobs, Mortenson says.

Mortenson, which says it has built 55% of all the wind power in Iowa, will now be a part of the largest economic development investment in the state’s history, the company notes.

“We are pleased to be part of Iowa’s leadership in wind energy. It was in Iowa where we entered the wind energy market in 1995 by erecting our first turbine near Adair,” says Tim Maag, vice president and general manager of Mortenson’s wind energy group.

Acciona Building 424 MW Mexico Wind Project

Acciona has been commissioned by Mexican energy company Zuma Energia to build a 424 MW wind farm in Reynosa, located in the state of Tamaulipas in northeastern Mexico.

According to Acciona, the project, worth approximately $600 million, is part of the capacity awarded in Mexico’s second long-term electricity auction, held by the government’s Secretariat of Energy and National Energy Control Centre this month. In the auction, Zuma Energia was awarded a total of 725 MW of renewable energy capacity, 424 MW of which will be covered with the Reynosa wind farm.

Acciona will build the foundations for 123 wind generators, each with a capacity of 3.45 MW to 3.6 MW, on 120-meter towers, as well as roads and accesses. It will also install the medium-voltage (34.5 kV) network for the entire wind farm, the 400 kV high-voltage network with three substations (two step-up transformers and one for interconnection), and 40 kilometers of double-circuit lines.

“This is a major achievement for Zuma: In just three years, it has established a pipeline of 800 MW, secured funding for its largest project and positioned itself as the leading Mexican company in the country’s renewable energy industry,” says Adrián Katzew, CEO of Zuma Energia. “This is also solid evidence of the transformation of Mexico’s energy industry, where renewable energy is growing in importance in both economic and environmental terms.”
Goldwind Americas Signs Distributed Wind Order

Goldwind Americas, a wholly owned subsidiary of Xinjiang Goldwind Science & Technology Co. Ltd. (Goldwind), has signed agreements to supply Findlay, Ohio-based One Energy Enterprises LLC with 60 MW of wind turbines.

The turbines will be supplied for various distributed generation wind projects as part of One Energy’s Wind for Industry model. The company says its Wind for Industry model is designed to reduce an industrial facility’s electrical consumption from the grid, as well as provide manufacturers with 20 years of electricity-rate certainty, by installing one or more utility-scale wind turbines and interconnecting them on the facility’s side of its utility meter.

As part of the framework agreement, a firm order of 20 GW 87/1500 turbines is scheduled for immediate delivery. The financing for One Energy’s projects is being provided by Prudential Capital Group as part of a combined senior and subordinated debt facility. The first four turbines will supply wind to Whirlpool Corp. facilities in Marion and Ottawa, Ohio.

One Energy plans to start stocking turbines at its yard in the U.S. in order to shorten the project delivery time for Wind for Industry projects. This turbine agreement was designed to create a framework in which One Energy can work toward delivering wind projects in 90 days.

“We are delighted to be working with One Energy and Prudential Capital in directly powering industrial facilities for some of the largest companies in the United States,” says David Halligan, CEO of Goldwind Americas.

Alliant Seeking Approval For 500 MW Expansion

Alliant Energy’s Iowa utility subsidiary is seeking approval from the Iowa Utilities Board to add up to 500 MW of wind energy in Iowa.

The company received approval in 2016 for a similar expansion. The combined projects would represent a $1.8 billion investment and add up to 1 GW of new wind generation in Iowa – enough to power up to 430,000 Iowa homes a year.

“The customers and communities we serve will benefit from this cost-effective clean energy,” states Doug Kopp, president of Alliant Energy’s Iowa energy company. “Our wind projects will help keep energy costs stable over the long term for customers.”

“Iowa has seen tremendous benefits from the expansion of the wind energy industry in our state,” says Bill Northey, Iowa’s secretary of agriculture. “We appreciate Alliant Energy continuing to invest in wind and other renewable energy sources to power our state.”

The company expects the board to make its decision in early 2018.

Vestas Selected For Cactus Flats

Vestas has received a firm and unconditional order from Southern Power, a subsidiary of Southern Co., for the Cactus Flats wind farm in Texas.

The 148 MW order comprises supply and commissioning of 43 V126-3.45 MW turbines and a 20-year service contract designed to maximize uptime and energy production. Delivery and commissioning are planned for 2017 and 2018, respectively.

“We are pleased to be part of Southern Power’s growing wind portfolio,” says Chris Brown, president of Vestas’ sales and service division in the U.S. and Canada. “This order further expands our 4 MW footprint in North America, reaffirming both the versatility and proven ability of our platforms to deliver low-cost, reliable wind energy.”

The Cactus Flats project was recently sold to Southern Power from Renewable Energy Systems.

Austin Utility Signs PPA With Avangrid

Avangrid Renewables, the U.S. subsidiary of Iberdrola, has signed a long-term wind power purchase agreement (PPA) with Texas utility Austin Energy.

A Texas wind farm to be built between 2018 and 2019 will generate clean energy for the city of Austin over the next 15 years.

Iberdrola, which will own and operate the wind project, says Austin is the 14th most populated U.S. city. Austin Energy,
serving more than 448,000 customer accounts and more than 1 million residents in Greater Austin, was named one of the American Wind Energy Association’s top utility wind energy providers of 2015.

The location of the wind farm, which will have a 200 MW capacity and require an investment of nearly $300 million, will be chosen over the next few weeks, says Iberdrola.

Siemens Gamesa Notches Mexican Wind Deal

Siemens Gamesa has inked a Mexican wind turbine order totaling 76 MW from independent developer Fuerza y Energía Limpia de Tizimin.

Over the course of this year, the firm will be installing 36 G114-2.1 MW turbines at the Tizimin wind farm, being developed in the state of Yucatán. Commissioning is scheduled for 2018.

The agreement also encompasses the operations and maintenance of the turbines for five years. The deal represents the first between the two companies in Mexico; they’ve already fulfilled a 100 MW order in Uruguay.

Siemens Gamesa will use a new technique for the foundations, namely braces (a concrete base akin to a plinth). The solution, deployable when a wind farm meets certain conditions, increases the turbines’ output by increasing the height of the hub by up to five meters. This, in turn, brings down the facility’s overall cost of energy and delivers design flexibility in terms of tailoring the blueprints for the terrain, the company says.

Vestas Announces Texas Wind Order With Alterra

Vestas has received an order from Flat Top Wind I LLC, an indirect subsidiary of Alterra Power Corp., for the 200 MW Flat Top wind project in central Texas.

The order, the company’s first with Vestas in the U.S., includes supply and commissioning of the turbines, as well as a 10-year Active Output Management 5000 service agreement, a full-scope service package designed to maximize uptime and energy production.

Delivery of the 100 V110-2.0 MW turbines is expected to begin in the fourth quarter of this year, and commissioning is planned for the first quarter of 2018. Turbine components will be manufactured at Vestas’ Colorado factories.

“With Flat Top Wind I LLC’s order and the transaction above, we are honored to partner with Alterra Power Corp. on our inaugural U.S. project together,” states Chris Brown, president of Vestas’ sales and service division in the U.S. and Canada. “Over the course of its lifetime, a single turbine creates 30 jobs, and with the Flat Top project, we will once more demonstrate the economic benefits that wind energy delivers to both the local and state communities.”

Alterra announced that it had completed financing and partnerships for the Flat Top project.

Quanta Services Inks Largest-Ever Contract

Houston-based Quanta Services Inc. has been selected by American Electric Power (AEP) to provide engineering, procurement and construction (EPC) solutions for the Wind Catcher Generation Tie Line, which will be part of Invenergy’s planned 2 GW Wind Catcher wind farm in the Oklahoma Panhandle.

The anticipated contract value for the project makes it the largest in Quanta’s history, the company says. The Wind Catcher Tie Line consists of approximately 350 miles of a single-circuit, 765 kV power line located between Guymon and Tulsa, Okla., and two new substations.

Quanta, providing turnkey EPC services for the entire project, estimates that up to 1,000 people could be working on the project in Oklahoma, supported by technical and engineering operations in Texas. Once completed, the Wind Catcher Tie Line would deliver energy from the Wind Catcher wind farm in western Oklahoma to customers in Arkansas, Louisiana, Oklahoma and Texas.

“We are pleased to provide an innovative solution to a long-standing customer and partner,” says Duke Austin, Quanta’s president and CEO.

Quanta expects construction to begin in late 2018 and to be completed in late 2020. The project is subject to AEP’s obtaining state and federal regulatory approvals.
Columbus, Ind.-based Cummins Inc., a provider of diesel and natural gas engines and related technologies, has entered into a virtual power purchase agreement (PPA) with EDP Renewables North America to expand a wind farm in northern Indiana. The agreement is another step for Cummins as it works to reduce greenhouse-gas (GHG) emissions.

The expansion will add 75 MW – enough to power approximately 20,000 average Indiana homes – to the existing 600 MW capacity at the Meadow Lake Wind Farm. When fully operational, the wind farm expansion will generate renewable electricity equivalent to the amount Cummins uses at its Indiana facilities, the company says. The PPA provides a hedge against rising energy prices, and the company will receive renewable energy certificates to ensure GHG reductions.

Cummins, a Fortune 500 company, says it has been actively pursuing energy efficiency and GHG reduction in its facilities since 2006, when it set its first GHG-reduction goal. The company also has a total of 11 solar arrays, including projects in Jamestown, N.Y., and Beijing, China.

“With all of our environmental sustainability goals, we want to maximize our impact,” says Mark Dhennin, director of energy and environment at Cummins. “Though it’s impractical to transfer the power directly to our facilities, it was very important to us to choose a project that added real renewable energy capacity in the marketplace while providing tangible environmental and community benefits. Our analysis showed that supporting wind power through a [virtual] PPA was the most cost-effective way to achieve the greatest greenhouse-gas reduction in Indiana.”

Pattern Energy Acquires Majority Of Meikle Wind

Pattern Energy Group Inc. has completed the acquisition of a 51% interest in the 179 MW Meikle Wind facility from Pattern Energy Group LP (Pattern Development 1.0) for $68 million, which represents a 10x multiple of the five-year average cash available for distribution. The Public Sector Pension Investment Board (PSP Investments) acquired the remaining 49%.

Located in the Peace River Regional District of British Columbia, the Meikle Wind facility consists of 61 GE wind turbines, including 35 3.2 MW turbines and 26 2.75 MW turbines.

“Completing the acquisition of Meikle Wind adds British Columbia’s largest wind power facility to our portfolio and is one of the first initiatives in our new strategic relationship with PSP Investments,” says Mike Garland, CEO of Pattern Energy.

The purchase price of the Meikle Wind acquisition, funded from available cash, draws under the company’s revolving credit facility.

Meikle Wind commenced commercial operations in the first quarter of this year. It operates under a 25-year power purchase agreement with BC Hydro.
2017 SUMMER & FALL EVENTS

WIND RESOURCE & PROJECT ENERGY ASSESSMENT CONFERENCE
September 27 - 29 | Snowbird, Utah, USA

OFFSHORE WINDPOWER CONFERENCE & EXHIBITION
October 24 - 25 | New York, New York, USA

WIND ENERGY FINANCE & INVESTMENT CONFERENCE
October 25 - 26 | New York, New York, USA

WIND ENERGY FALL SYMPOSIUM CONFERENCE
November 7 - 9 | Albuquerque, New Mexico, USA

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