

BONUS SECTION

MARKET OUTLOOK

THE FUTURE OF WIND

Giving Wind Direction

WIND SYSTEMS

THE WIND REVOLUTION

IN FOCUS

Lubrication & Filtration ▣ Turbine Foundations

A FOUNDATION OF BEST PRACTICES

PROFILE

American Chemical Technologies

AUGUST 2018

windssystemsmag.com



info@torkworx.com

888.502.WORX

torkworx.com

ONSITE BOLTING SERVICES DONE RIGHT.
CALL US TO ACCELERATE THE BIG 6...
unless you're into wasting money.



WIND ENERGY SOLUTIONS

- ACCELERATED TORQUE AND TENSION SERVICES
- TURNKEY BOLTING SERVICES
- COMPLETE OEM TORQUE AND TENSION SYSTEMS
- BOLTING CONSULTATION SERVICES
- ISO 17025 ACCREDITED CALIBRATION SERVICES
- REPAIR SERVICES FOR MOST TOOL MODELS
- ERAD DIGITAL TORQUE CONTROL SYSTEMS
- ELECTRIC GEAR TURNING SYSTEMS
- WTG SPECIFIC BOLT TENSIONING SYSTEMS
- HYDRAULIC WRENCH SYSTEMS
- WTG SPECIFIC SELF LOAD INDICATING FASTENERS

extreme bolt working solutions

sales
rental
service
consulting
engineering



FROM PROTECTING YOUR ASSETS TO POWERING OUR CITIES

TOGETHER IT'S POSSIBLE

Innovative lubrication that enhances performance.

Wind turbines are a vital part of the electricity network, the world's largest and most complex machine. Often operating in extreme environments, the effective lubrication of gearboxes and bearings are vital for wind turbines to deliver optimum performance. As well as offering a range of lubricants and greases, our experts are ready to share the knowledge and practices that will help ensure maximum performance, no matter what the conditions. To find out how we can help you power tomorrow, go to shell.us/power

SHELL LUBRICANTS
TOGETHER ANYTHING IS POSSIBLE



CONTENTS

MARKET OUTLOOK

THE FUTURE OF WIND

12

THE WIND REVOLUTION

Forecasts show American wind power is on track to supply 10 percent of the country's electricity by 2020.

ALSO

East Coast offshore wind forecast. **16**

Balancing advancements and risks. **20**

State spotlight on Wyoming. **24**

IN FOCUS

A FOUNDATION OF BEST PRACTICES

*Understanding what to look for today can save millions tomorrow when it comes to inspections and maintenance of turbine foundations. **28***

SIGNIFICANT ENERGY BENEFITS

*Sine pumps optimize high viscosity resin delivery for Enercon, one of the world's largest wind turbine manufacturers. **32***

PROFILE

American Chemical Technologies has offered its polyalkylene glycol-based lubricants to a variety of industries, and now the company is showing how it can help turbine gearboxes. **34**



CONVERSATION

Uptake's managing director of global energy solutions Sonny Garg talks about how sharing data is crucial to performance. **38**

THIS IS DARYL WILSON, CEO OF HYDROGENICS. AND HE'D LIKE TO INTRODUCE YOU TO OUR ADVANCED HYDROGEN TECHNOLOGY MANUFACTURING FACILITY.



Today Daryl is feeling inspired. After all, he's leading a shift to a cleaner, global energy future through hydrogen technology. With growing production facilities in Canada, the U.S., Belgium and Germany, we're designing and engineering innovative solutions for hydrogen generation, power storage and transportation. OEMs, cities, and other partners are looking to Hydrogenics for carbon-free solutions that

reliably and safely transform how we consume energy. While our leadership comes from our technology, our success is the result of one essential ingredient – the human one. Our experts, our engineers, our researchers and our day-to-day people are focused on advancing hydrogen technology for a better, earth-friendly energy source. Learn how the human factor is changing the world at [Hydrogenics.com](https://www.hydrogenics.com)

HYDROGENICS

The **human** factor. The most advanced part of our technology.

▸ THE FUTURE OF WIND



DIRECTION

8

U.S. wind repowering returns stand up against wholesale prices, for now ▸ Be Power and ABB team up for power generation project



CROSSWINDS

52

CUTTING PRODUCTION TIME

Sandia National Laboratories recently led an effort to use 3D printing to slash more than a year from turbine blade R&D time.

TAILWINDS

THE BUSINESS OF WIND



▸ MAINTENANCE

Seacat sends ships to Beatrice Wind Farm **45**

▸ CONSTRUCTION

Siemens Gamesa to install two large onshore projects in South Africa **40**



▸ MANUFACTURING

Siemens Gamesa secures Brazil's largest-ever contract **50**

▸ INNOVATION

Suction bucket concept gets test installation **43**

WINNING THE BATTLE AGAINST BEARING WEAR

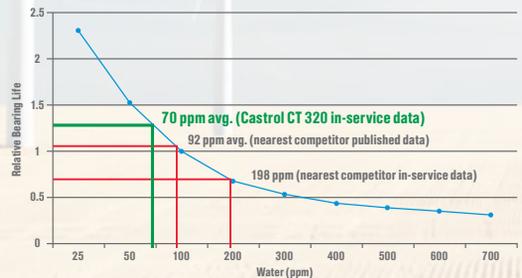
Bearing failures are the most important issue in wind turbine gearbox maintenance, accounting for 70% of gearbox failures*. Castrol® Optigear® Synthetic CT 320 retains half the water PPM on average than our nearest competitor using similar types of chemistry**. By choosing Castrol Optigear you can increase your bearing life by 50% and win the bearing life battle.

If you want to get the lowest water content in the field opt for Castrol Optigear Synthetic CT 320.

For more information go to
castrol.com/windenergy
or call 1-877-461-1600

WATER vs. BEARING LIFE

(R.E. Cantley Formula, Timken Corp: Circa 1977)



*WEU Operations and Maintenance Report 2016.
**Based on sample data available to Castrol.

IT'S MORE THAN JUST OIL. IT'S LIQUID ENGINEERING.®

 **OPTIGEAR**®

FROM THE EDITOR

Enjoy our new and improved Wind Systems

While pulling your new issue of *Wind Systems* from your mailbox or mail pile, you may have noticed something different.

For the past few months, we have been hard at work redesigning the magazine in order to better present to you the fascinating information the industry has to offer.

We've given *Wind Systems* a fresh, updated look specifically designed to make it easier to find the wind energy news you've grown accustomed to reading every month. The features are packaged with a bolder, more energetic approach, pulling you in with breathtaking photographs of wind farms from around the world, while keeping you reading with educational and informative articles from the best and brightest in the wind industry.

We've kept the Direction section as its own entity, because it helps look at the future of wind, while our other departments you've come to know — Construction, Innovation, Maintenance, and Manufacturing — have been packaged into a quick and easy-to-read format we've dubbed "Tailwinds."

In addition to our InFocus section, which this month highlights Lubrication & Filtration and Turbine Foundations, this issue also includes a bonus section: our annual Market Outlook.

In this special section, experts from AWEA, Business Network for Offshore Wind, and S&P Global Ratings share their extensive knowledge on the state of wind in the U.S. — both on and offshore — as well as the future of the industry on a global scale.

Market Outlook also spotlights the state of Wyoming, where one of the largest wind farms in the world is set to deliver more than 3,000 MW of power when it goes live in the next few years. Wyoming has had a few starts and stops in its wind production in the past, but several projects are set to make Wyoming a major contender in the renewables arena.

In addition to our redesigned magazine, we are also busy putting finishing touches on a new *Wind Systems* website that will bring you digital books, the latest industry news, our 10-year archives, and much more in a dynamic, easy-to-navigate format. We've been working on it for months, and I'm excited to bring it to you in the coming weeks.

There's definitely a change in the wind, and I'm eager to share it all with you. As we continue to roll out these changes, please let me know what you think of them. I always want to hear from our readers and make sure we are serving you to the best of our abilities.

So, enjoy our new and improved *Wind Systems*, and, as always, thanks for reading!



Kenneth Carter, editor

Wind Systems magazine
editor@windssystemsmag.com
(800) 366-2185, ext. 204



Giving Wind Direction
WIND
SYSTEMS

David C. Cooper
Publisher

Chad Morrison
Associate Publisher

EDITORIAL

Kenneth Carter
Editor

Jennifer Jacobson
Associate Editor

SALES

David Gomez
Regional Sales Manager

Tom McNulty
Regional Sales Manager

CIRCULATION

Teresa Cooper
Manager

Cole Morrison
Assistant

Jamie Willett
Assistant

DESIGN

Rick Frennea
Creative Director

Michele Hall
Graphic Designer

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information storage-and-retrieval system without permission in writing from the publisher. The views expressed by those not on the staff of *Wind Systems* magazine, or who are not specifically employed by Media Solutions, Inc., are purely their own. All "News" material has either been submitted by the subject company or pulled directly from their corporate web site, which is assumed to be cleared for release. Comments and submissions are welcome, and can be submitted to editor@windssystemsmag.com.



Published by Media Solutions, Inc.
P.O. Box 1987 • Pelham, AL 35124
(800) 366-2185 • (205) 380-1580 fax
info@msimktg.com

David C. Cooper
President

Chad Morrison
Vice President

Teresa Cooper
Operations Director



How much does it cost to bail out uneconomic power plants?

From AWEA

As the administration continues developing plans to prop up aging, uneconomic coal and nuclear plants, many have wondered what the price tag for consumers would look like. A recent new report from the Brattle Group gives a glimpse of what a two-year down payment for bailing out these plants could cost: between \$9.7 and \$35 billion a year.

Here's a rundown of what cost figures could look like:

➤ **\$16.7 billion per year**, or roughly \$34 billion for two years as proposed, if every coal and nuclear plant in the country were given a uniform (\$ per unit of capacity) support at the level of the average financial shortfall experienced by such plants.

➤ **\$9.7 billion to \$17.2 billion annually**, or roughly \$20 billion to \$34 billion over two years, if only those plants now facing shortfalls were given payments sufficient to cover their operating losses.

➤ **\$20 billion to \$35 billion annually**, or \$40 billion to \$70 billion total, if power plant owners were also granted a return on their invested capital in addition to payments for operating shortfalls.



The American Wind Energy Association (AWEA) is the premier national trade association that represents the interests of America's wind energy industry. For more information, go to www.awea.org



- Grout Sleeves are More Effective in Protecting Bolts from Grout
- Saves Labor – Enhances Safety – No More Cutting Foam
- Displace Almost No Grout, Resulting in a Considerably Stronger Foundation



800.359.0372
JWBRUCE@NTCWIND.COM
NTCWIND.COM

Call to inquire about our special limited time pricing!

WHEN THE WIND DOESN'T BLOW IN YOUR FAVOR
WINDBLADE REPAIR TRAINING
Classes fill up fast - ENROLL TODAY!

ABARIS TRAINING

+1.775.827.6568 • www.abaris.com
 Leading the World in Advanced Composite Training Since 1983!

U.S. wind repowering returns stand up against wholesale prices, for now

U.S. production tax credits (PTCs) have accelerated wind repowering activity as operators look to use technology advancements to optimize aging fleets. Falling costs and growing wholesale market exposure have pressured margins for suppliers and operators.

Most recently, PacifiCorp ordered 260 MW of turbines from Vestas to repower the Marengo 1 & 2 wind farms in Washington. The Marengo wind farms were built in 2007 and 2008, and the turbines will be upgraded from 1.8 MW models to more advanced 2.0 MW units from the second quarter of 2019, Vestas said June 29.

Repowering allows operators to install larger, more efficient turbines and introduce operations and maintenance (O&M) improvements.

Operators may choose to perform a “full repowering” of major wind farm infrastructure or a “partial repowering” where typically the existing tower and foundations are kept in place.

About 2.1 GW of U.S. online wind capacity were repowered in 2017 and more than 15 GW of capacity is “ripe” for repowering in 2018, ICF consultancy said in a report published in May. Repowering could add 300 MW of additional U.S. wind capacity in 2017-2022, according to Bloomberg New Energy Finance (BNEF).

Projects installed between 2003 and 2010, underperforming plants and those with high maintenance costs are likely candidates for partial repowering, ICF said. Similarly, turbines from suppliers no longer in business can be swapped out under a repowering program.

Extended in 2016, the PTC support program provides 10 years of tax credits at \$23/MWh for greenfield and repowering projects started in 2016. The



Repowering offers output gains and operational efficiencies but tax credit is falling 20% per year. (Courtesy: ZU_09)

PTC drops by 20 percent for projects started in 2017 and is scaled down by 20 percent annually with zero support from 2020. This means projects started in 2018 can capture \$13.8/MWh of credits.

Partial repowering projects in 2018 can earn an Internal Rate of Return (IRR) after tax of 11 percent, according

to ICF. This is based on a captured energy price of \$24/MWh (flat) and capital expenditure of \$950/kW.

Even with the reduced PTC level this year, “repowering can make economic sense,” ICF said. But ICF warned falling margins demand more careful scrutiny of energy output gains, capital costs and O&M efficiency.

“It may make better financial sense this year than it will next year or the year after,” said Chris Mertes, ICF’s Wind Practice Lead and co-author of the report.

REPOWERING STRATEGIES

ICF’s indicative IRR calculation is based on an increased net capacity factor and a 10-year extension of asset life.

Energy production gains are clearly a crucial driver of repowering economics. According to the consultancy, a 1 percent increase in capacity factor can increase IRR by 0.8 percent.

To qualify for the PTC, the value of the repowering project must be at least 80 percent of total plant value.

Partial repowering work can differ between projects, but longer blades are typically fitted, and it often involves the replacement of the entire rotor and the refurbishment of other parts of the wind turbine, such as the nacelle or hub, said Eric Soderlund, senior manager and structural engineer at Sargent & Lundy.

Some partial repowerings have focused primarily on generator replacement, Soderlund said.

“This is done to increase the wind turbine capacity ... PTCs are received so long as the 80/20 rule is met,” he said.

In a recent report covering 23 U.S. repowering projects, partial repowering projects retained — at the very least — the existing wind turbine foundations, turbine towers and electrical balance of plant (BOP). Some of the projects reused yaw systems, nacelles, and generators, while replacing hubs, main shafts, main bearings, and gearboxes.

MARKET RISK

The contracting of wind-energy supplies is evolving as costs fall and subsidies are removed. While some projects will benefit from long-term PPA contracts, many will be exposed to wholesale market prices that have been flattened by the U.S. shale gas boom.

The economics of repowering can be “feasible” if captured wholesale prices are in the mid-\$20’s/MWh range, ICF said in its report.

A 1 percent change in wholesale prices can affect IRR by about 0.4 percent, based on the above project assumptions, it said.

Repowering projects have the advantage of actual historical site performance and market data, the ICF consultants noted.

OPERATIONS AND MAINTENANCE

Repowering decisions must also factor in O&M costs over the lifetime of the project.

Aging turbines incur higher O&M costs, and the average turbine age in North America will rise from 5.5 years in 2015 to 11 years by 2025, IHS Markit said in a recent report.

U.S. O&M costs are forecast to rise from \$45,000-\$50,000/MW per year for turbines aged between five and 10 years, to about \$50,000-\$60,000/MW per year for turbines aged between 10 and 15 years, IHS Markit said.

According to ICF, O&M contracts for new projects currently range between \$15,000 and \$25,000 per MW per year.

“The O&M cost delta is a significant driver in the economics of a repower project: A \$5/kW-yr difference in our base case makes for a difference in IRR of 1.4 percent,” the ICF consultants said.

Market competition also has spurred a widening choice of repowering “add-ons” that can further reduce costs over the lifetime of the asset.

Original equipment manufacturers (OEMs) are now offering repowering packages that include upgrades to main equipment as well as O&M, grid, and forecasting solutions.

In one example, GE supplied the turbines for Leeward’s Sweetwater 1 & 2 repowering project along with O&M services and tax equity financing through the GE Energy Financial Services arm.

“Repowering is so much more than simply providing new wind-turbine equipment,” Anne McEntee, GE Renewable Energy vice president and Services CEO, said in 2017. “We’re bringing the entirety of GE to the table for our customers, providing options for servic-

ing, grid solutions, forecasting, and tailored financing solutions.”

MORE INFO newenergyupdate.com

Be Power and ABB team up for power generation project



Paolo Martini, managing director of Be Power. (Courtesy: Building Energy)

Be Power and ABB will cooperate in the Dispatching Service Market (MSD). Be Power is the Digital Green Utility of the Building Energy Group with a business model based on the synergies between the markets of energy and mobility. This model aims at integrating the opportunities arising from the opening of the MSD to widespread facilities of power generation (demand/response) with a proprietary infrastructure of charging stations and e-vehicle fleets. The partnership with ABB — a technological leading player in the industrial automation and power grids as well as in the electrification products, robotics, and motion control solutions — will allow Be Power to join the Terna pilot project that has opened the participation to the MSD also to the distributed gener-

ation, including the generating units powered by renewable sources and storage systems.

By setting up the pilot project (AEEG SI Resolution 300/2017), the national grid operator intends to optimize the provision of dispatching resources encouraging a wider participation in this market as already happens in some European countries. Hence, consumption and production units of any size and technology – including non-significant generating plants with capacity lower than 10 MVA – can offer dispatching services through an “aggregator” by establishing production, consumption, and mixed units (UVAP, UVAC and UVAM).

Be Power will enter the Market for Dispatching Services as “aggregator” through its subsidiary 4energia, the energy trader specialized in purchase of electricity from independent producers managing more than 700

MW of the total capacity in the last years, while ABB will provide services of advanced analysis, aggregation, and data management through its advanced services, ABB Ability™ Collaborative Operations. ABB will be responsible for creating, qualifying, and managing the Aggregated Virtual Units (UVA) assigned to the MSD for production and/or consumption with the relevant measurement devices in each plant (UPMx) and the installation of a central unit (UVAx) to gather the data toward the Terna grid. All the data will be processed by the ABB Ability™ Collaborative Operations Center in Genoa.

“We are proud to take part in the pilot project of Terna entering the Market for Dispatching Services together with ABB, a company specialized in the development of this technology,” said Paolo Martini, managing director of Be Power. “Thanks to this partnership as ‘Aggregator,’

we will benefit from the consolidated experience in trading of our subsidiary 4energia to offer the energy producers and consumers an additional value through the optimization of their assets. The companies that will join our grid will be able to obtain additional margins by entering more profitable markets.”

“This pilot project fully understands the essence of the ABB Ability Collaborative Operations, a true evolution in the data analysis and aggregation, said Danilo Moresco, head of the Power Generation & Water Unit in Southern Europe. “This new approach is able to gather in a unique circular flow the plant data as well as both the Be Power and the ABB control centers in an ongoing exchange of accurate and timely pieces of information to optimize the performance of the monitored assets.”

MORE INFO www.buildingenergy.it



GRIPTIGHT

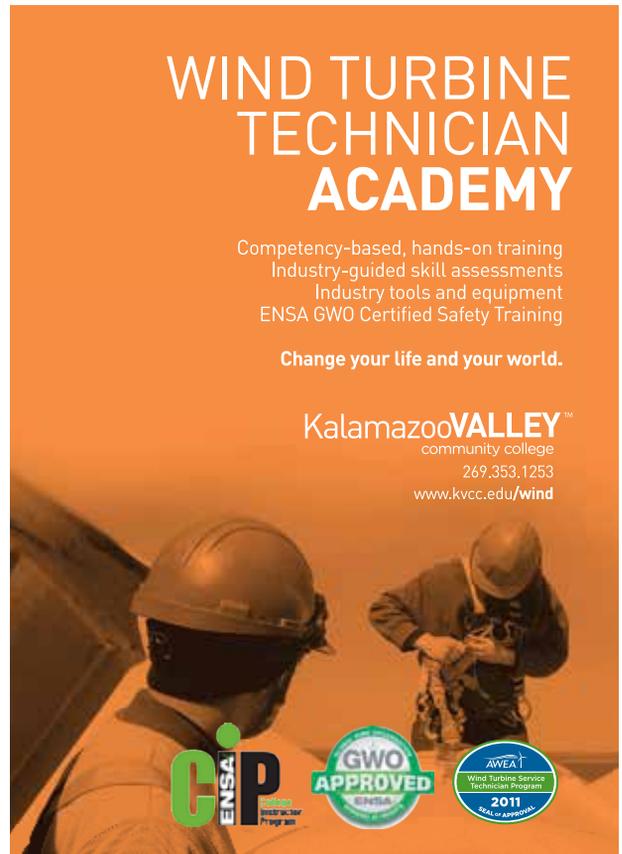
Griptight Anchor Bolt Covers are
Patented & Guranteed

Ask about our new customer special

- * U.S. Patent #8,002,508
- * Over Ten Years of Proven Protection
- * Made from High Quality Polypropylene
- * UV Package Included
- * Three Sizes Available
- * Fits Most Anchor Bolts
- * Easy to Install
- * Removable and Reusable

WINDsecure INC.

248-563-6234
www.windsecure.com



**WIND TURBINE
TECHNICIAN
ACADEMY**

Competency-based, hands-on training
Industry-guided skill assessments
Industry tools and equipment
ENSA GWO Certified Safety Training

Change your life and your world.

KalamazooVALLEY™
community college
269.353.1253
www.kvcc.edu/wind

ENSA **GIP** **GWO APPROVED** **AWEA**
2011 Seal of Approval

canwea



ANNUAL CONFERENCE
AND EXHIBITION

CALGARY, ALBERTA

OCTOBER 23–25, 2018

BMO CENTRE



windenergyevent.ca

MODERN. COST-COMPETITIVE. CLEAN.

Organized by



canwea
CANADIAN WIND
ENERGY ASSOCIATION | ASSOCIATION CANADIENNE
DE L'ÉNERGIE ÉOLIENNE



Deutsche Messe



MARKET OUTLOOK

THE FUTURE OF WIND

THE WIND REVOLUTION

Forty-one states now have utility-scale wind projects, and by the end of the year, the U.S. had enough installed wind capacity to power the equivalent of 27 million American homes. (Courtesy: AWEA)



Forecasts and trends show American wind power is on track to supply 10 percent of the country's electricity by 2020.

By JOHN HENSLEY

It turns out that tapping into a free and abundant natural resource that exists everywhere is among the cleanest and most efficient ways of producing electricity. Investments and innovations over the past decade have brought wind's costs down to their lowest levels ever — 66 percent cheaper than in 2009 — making wind power a mainstream source of reliable, affordable energy.

Over the past five years, the United States has more than tripled its wind-generating capacity, with wind representing 25 percent of new power generating capacity that came online. Wind also surpassed conventional hydropower as the largest renewable energy source by capacity.

Recent market trends show this impressive growth should continue in the years ahead, as wind has become the cheapest source of new electricity in many parts of the country.

Continued technological and manufacturing improvements also allow new turbines to reach stronger, steadier winds, meaning more electricity can be generated at a lower cost. As we continue adding new chapters to this American success story, let's take stock of the state of U.S. wind power.

ALL IN FOR WIND

Utilities and Fortune 500 companies continue to show a strong appetite for wind. Their demand has helped grow the number of new wind projects under construction or in advanced development 40 percent since this time last year.

In 2017, the industry added 7,017 MW of new capacity across 24 states, enough to power millions of homes. Forty-one states now have utility-scale wind projects, and by the end of the year, the U.S. had enough installed wind capacity to power the equivalent of 27 million American homes.

Overall, wind now supplies more than 6.3 percent of America's electricity. However, figures are even more impressive at the state level. Iowa, Kansas, South Dakota, and Oklahoma now all generate at least 30 percent of their electricity using wind. In total, 14 states generate at least 10 percent of their electricity with wind.

Though Texas remains the country's largest wind producer, New Mexico has made headlines by tapping into its large and abundant wind resources. In 2017, it had the highest rate of new wind-power growth in the country, putting the Land of Enchantment on pace to join the ranks of other wind powerhouses.

"I'm proud that New Mexico's wind power capacity grew at a faster rate than any other state and generated an unprecedented level of private sector investment and job growth," said U.S. Senator Martin Heinrich. "As consumers and major companies demand cheaper and cleaner power sources, our state stands to benefit and become an even bigger leader in this booming energy sector — especially in rural communities."

In many states like New Mexico, wind offers new job opportunities and much-needed tax revenue that helps revitalize rural communities. It has not only allowed communities to profit from the passing breeze but has also done so in a manner that leaves 98 percent of the land undisturbed, so that it can remain useful for farming, ranching, or natural-habitat preservation.

Because of the success at the Block Island Wind Farm, America's first offshore project, states are looking to tap into vast wind resources off the coast.

Fortune 500 companies have also recognized the benefits of wind power. Many of them have committed to procuring wind energy for their energy-intensive manufacturing and data center operations. To guarantee a reliable and price-stable supply of renewable energy, many companies have entered into power purchasing agreements (PPAs). PPAs allow companies to contract with a wind-energy provider to buy electricity over a specified period of time at a fixed rate.

In fact, corporate buyers account for 94 percent of total non-utility wind deals. In 2017, companies contracted for more than 2,000 MW of wind energy. This helps them plan for the long term while also reaching internal sustainability goals.

"Helping to grow the renewable energy market is not only good for the environment, it is a strategic business move as we strive for long-term sustainability," said Anheuser-Busch CEO Joao Castro Neves.

Already in 2018, companies such as Nike, T-Mobile, Facebook, and Bloomberg have entered into new agreements to buy wind power. The complete list includes first-time wind

buyers such as Adobe Systems, AT&T, Brown Forman, Kohler, and Nestlé. Every month, the list of companies that have committed to buying wind gets longer.

"As one of the world's largest companies, we know how we source our energy is important," said Scott Mair, president of AT&T Operations. "Many companies are focused on their own carbon footprint, but we believe our industry can do more. We've been working for a long time to ensure our wind projects deliver for both our business and the environment."

Corporate procurement and PPAs will continue to play an important role in wind's growth in the coming years.

2018 has seen a healthy start, with non-utilities accounting for nearly a third of PPAs. During the first quarter of this year, project developers have signed more than 3,560 MW of PPAs. That makes Q1 the strongest quarter for PPA growth since AWEA began tracking it.

THE PROMISE OF OFFSHORE

While land-based wind continues to expand, the U.S. is also on the cusp of developing more offshore capacity. The development of offshore wind in the coming years represents billions of dollars of investment and thousands of new manufacturing and shipping jobs. Offshore wind farms offer the promise of efficiently providing electricity to major population centers along the coast, allowing us to tap into a new ocean energy resource. Offshore wind is a proven technology that holds enormous potential for the United States.

"The European offshore wind market is 27 years old," said Roy Francis, vice president of Business Development for Gulf Island Fabrication, a Texas-based offshore energy construction firm. "We are taking the best from the mature European industry and pairing it with American know-how."

Because of the success at the Block Island Wind Farm, America's first offshore project, states are looking to tap into vast wind resources off the coast. By the end of 2017, there were already 17 offshore wind projects in various stages of development, spanning 11 states off the East, West, and Great Lakes coasts. These new offshore projects represent more than 11,600 MW of wind-power development.

Many states are looking to offshore wind to secure affordable energy, achieve renewable goals, and reduce carbon pollution. For example, Massachusetts utilities intend to procure 1,600 MW of offshore wind by 2027. New Jersey has also launched massive plans to develop more than 3,500 MW of offshore wind by 2030.

Other projects also are coming along. In 2017, Maryland's Public Service Commission awarded Offshore Renewable Energy Credits (ORECs) to U.S. Wind and Deepwater Wind, which together will produce more than 368 MW.

New York also has announced ambitious plans to develop up to 2.4 GW of offshore wind over the next decade to help meet its goal of 50 percent renewable energy by 2030. The state released its Offshore Master Plan in January, which identifies areas for wind development and potential pathways to procurement. New York also intends to hold two requests for proposals (RFPs) over the next two years to launch



Corporate buyers account for 94 percent of total non-utility wind deals. (Courtesy: AWEA)

development. On top of that, New York will invest \$15 million in education programs to train workers for offshore wind jobs and developing its port infrastructure.

Offshore is a new frontier for the American wind industry, and it promises to support thousands of new manufacturing and shipping jobs across the country. This is only the beginning of the country's ability to tap into the strong and steady winds off our coasts.

A CONFIDENT INDUSTRY WORKS FOR AMERICA

As interest from utilities and companies steadily increases and technological advances continue to drive down costs, American wind power will keep growing. And that means more benefits for local communities in farming and factory towns that need new opportunities.

American wind power invested \$14 billion in new wind projects last year, and farmers and ranchers hosting turbines on their property received \$267 million in lease payments in 2017 alone. Added wind revenue for local budgets also lessens the tax burden on many host communities, helping them pay for school improvements, road repairs, and law enforcement.

Every community has a story. For example, Nolan County, Texas, about 190 miles west of Fort Worth, has increased its taxable value five-fold since wind arrived.

"In pre-wind, our county taxable value was \$500 million," said Ken Becker, executive director of the Sweetwater Economic Development Corp. "In 2008, it was \$2.8 billion."

For some landowners, this translates to nearly \$1,000 per month for a single turbine on their property. For the town of Sweetwater—population 10,000—wind means stable job prospects for 18 percent of residents.

The reality of new career opportunities has not been limited to Sweetwater. These benefits are being felt across the United States. Today, more than 105,000 Americans across all 50 states work in wind, and as wind continues to expand, this number will only increase. Already, wind technician is the country's second fastest-growing job according to the U.S. Bureau of Labor Statistics.

The U.S. wind industry has made massive strides over the previous decade. Forecasts and trends show American wind power is on track to supply 10 percent of the country's electricity by 2020. As a mainstream source of clean, affordable energy for the United States, wind continues to work for America. ✨

ABOUT THE AUTHOR

John Hensley is the senior director for Research & Analytics at the American Wind Energy Association.

A photograph of an offshore wind farm under construction at sunset. The sky is a mix of orange, yellow, and blue. In the foreground, the dark blue sea has small waves. In the middle ground, a large steel structure for a wind turbine is being assembled. To the right, a construction vessel with a crane is positioned near the structure. The overall scene is industrial and serene.

EAST COAST OFFSHORE WIND OUTLOOK



When it comes to the offshore wind industry, progress is being made with a regional approach.

By LIZ BURDOCK

There is no question that 2018 is emerging as a watershed year for the offshore wind energy industry in the U.S., with several large wind farms having their site plans approved and states increasing their commitments and goals for offshore wind energy.

In the midst of this energy and excitement, we need to keep in mind that regional cooperation between developers, suppliers, and between the states is going to be critical to building a healthy and sustainable industry supported by a viable supply chain.

We use the term “co-opetition” to describe the combination of competition and collaboration, and apply it to remind the industry that no single state is going to own the entire supply chain. The U.S. offshore wind energy pie is big, and there is enough for every state so they don’t need to fight but work together on complex issues such as commercial fishing, navigation, environmental impacts, and supply chain development on a regional basis.

To those waiting for this technology to come online and start replacing fossil fuel power plants, a year or two or even five years may seem like a long time to wait, but timing projects so we have a “good pipeline” — a steady, consistent stream of projects throughout the 2020s — is important, so construction projects don’t stack up on each other and we don’t have huge, expensive pieces of customized offshore wind equipment and highly skilled labor forces standing idle one year and strained to the breaking point the next.

FEDERAL ROLE

The Trump Administration is streamlining permitting, accelerating design, and reviewing a recommendation for a future offshore wind leasing program that could cover 20 GW of capacity, or 2 GW per year over a decade. All of these factors present a strong business case for offshore wind investment in the United States.

The two main federal agencies overseeing the offshore wind process, the Department of Interior’s Bureau of Ocean Energy Management (BOEM) and the Department of Energy (DOE), support the industry with auctions of offshore wind-energy areas, research, environmental and engineering review, industry guidelines, and outreach such as regional task force meetings and presentations at industry events.

BOEM has stated offshore wind fits the administration’s “All of the Above” approach to energy development and is working to streamline the offshore approval process, while DOE just issued an \$18.5 million grant for offshore wind research and development, administered by NYSERDA (see New York below).

BOEM also recommends a regional approach. “The offshore wind industry is experiencing exciting momentum as a result of growing industry-wide confidence in the U.S offshore wind market, thanks to decreasing global costs, stronger state policy commitments, and this Administration’s commitment to American energy,” said BOEM’s Jim Bennett, Chief of the Office of Renewable Energy Programs. “However, experience has shown that it will take a concerted effort by the Federal and State governments to propel this industry forward. States and regions often find themselves with shared economic interest. To realize the full potential of offshore wind, we need to take a regional look at how the offshore wind industry is going to come together.”

Here is where we see the northeastern and mid-Atlantic coastal states going in the next six months or so:

MASSACHUSETTS

Perhaps the most dynamic of the East Coast states, Massachusetts has aggressively moved into a leadership position in offshore wind, highlighted by its announcement that Vineyard Wind had been selected out of three bidders for the state’s first, 800 MW solicitation in May. Vineyard Wind is a joint venture of Avangrid Renewables and Copenhagen Infrastructure Partners.

The Power Purchase Agreement (PPA) for Vineyard Wind’s 800 MW project was scheduled to be submitted to the Massachusetts Department of Public Utilities for approval July 31, 2018. Vineyard Wind has continued to advance the planning of its project and should be soon selecting some of its tier 1 contractors — including turbine manufacturers, foundation suppliers, and installation contractors. It hopes to start construction next year and begin delivering clean energy by 2021.

BOEM is scheduled to auction the two remaining offshore wind energy lease areas in the Massachusetts Wind Energy Area (MAWEA) by the end of the year, which provides the possibility of having additional offshore wind developers competing for the next Massachusetts

Offshore Wind Solicitation next year.

To coordinate with the commercial fishing industry, the state is working with the Massachusetts Fisheries Working Group, Rhode Island Fisheries Advisory Board, BOEM, National Marine Fisheries Service, and others to establish the Southern New England Fisheries Science Panel to track interactions between fisheries and offshore wind structures. They also are working with the Massachusetts Clean Energy Center to create a state-wide workforce training program.

In June, the state Senate passed a law to raise its Renewable Portfolio Standard (RPS) to 100 percent by 2047. The state also has supported investing millions to redevelop and modernize dock space in the old whaling and fishing village of New Bedford for offshore wind.

RHODE ISLAND

On the same day that Massachusetts announced the selection of Vineyard Wind, Rhode Island awarded Revolution Wind — a wind farm led by Deepwater Wind — its solicitation of 400 MW. Jeff Grybowski, CEO for Deepwater Wind, called the joint announcements “the first really large-scale procurement ever for offshore wind in the United States.” Deepwater Wind also developed the nearby Block Island 30-MW wind farm.

Revolution Wind hopes to start local construction of the project by 2020, with 50 turbines operating by 2023.

CONNECTICUT

Deepwater Wind scored again on June 13, when it won a competitive bid to supply Connecticut with 200 MW of wind power. The state’s Department of Energy and Environmental Protection (DEEP) noted the project is expected to create about 1,400 direct, indirect, and induced jobs. Deepwater Wind has committed to invest \$15 million in the New London State Pier.

Deepwater Wind will now work on negotiating 20-year contracts with electric utilities Eversource and United Illuminating, which will then be reviewed by the state’s Public Utilities Regulatory Authority (PURA) for final approval.

NEW YORK

Another regional powerhouse, New York is moving quickly to stake out its offshore wind territory and compete with Massachusetts to the north and New Jersey to the south. Gov. Andrew Cuomo kicked off the year with a call for a solicitation for a total of 800 MW of offshore wind in 2018 and 2019, part of his goal to generate 2,400 MW of offshore wind by 2030.

Equinor, formerly known as Statoil, leased 80,000 acres for \$42 million at auction just south of New York City and Long Island in December 2016. Now the New York State En-

ergy Research and Development Authority (NYSERDA) has requested and BOEM has agreed to a call for four new wind energy areas (WEAs) in the New York Bight between New Jersey and Long Island. BOEM has held several meetings on the proposal and set a July 30 deadline for comments from the public. BOEM hopes to hold auctions for the New York Bight properties in late 2019.

On June 15, NYSERDA was awarded an \$18.5 million grant from the U.S. Department of Energy to lead the National Offshore Wind Research and Development Consortium. The agency already has begun bringing together the offshore wind industry, utilities, research laboratories, and other states (New Jersey has signed on). This national and independent consortium will help reduce industry barriers; advance technologies and methods to reduce siting and installation costs; address operations challenges; and foster job growth throughout the supply chain.



Sunset at Block Island wind farm. (Courtesy: Dan Clark)

On July 12, Cuomo announced NYSERDA will procure approximately 800 MW of offshore wind through a solicitation issued in the fourth quarter of 2018, in consultation and coordination with the New York Power Authority and the Long Island Power Authority. Awards are expected to be announced in the second quarter of 2019. If needed, a second solicitation will be issued in 2019.

NEW JERSEY

Despite being a little late to the party, New Jersey inaugurated a new governor in January whose administration is strongly committed to offshore wind. On May 23, Gov. Phil Murphy signed the Clean Energy Bill, which increased the state’s RPS to 50 percent by 2030, with an objective of 3,500 MW of offshore wind power built in.

Also on May 23, Murphy signed Executive Order No. 28, requiring state agencies to update the Energy Master Plan (EMP) that prepares a strategy for achieving 100 percent clean energy by January 1, 2050. The new EMP is scheduled to be finalized and published by June 1, 2019.

The state has three active projects, led by the small (24

MW) Fishermen's Energy wind farm located about three miles off Atlantic City. Fishermen's Energy, now owned by EDF RE, was scheduled to file a new application with the NJ Board of Public Utilities (BPU) by the end of July, and the BPU will have 90 days to review their proposal. If approved, Fishermen's could have its four 6-MW turbines producing electricity by 2020.

The Danish developer Ørsted has the Ocean Wind project under way 10 miles off Atlantic City, which will provide electricity to 500,000 homes when fully built. Ocean Wind had its Site Assessment Plan (SAP) approved May 17, the same day it opened a new office in Atlantic City. Just to the north, U.S. Wind has a second major wind development planned for 183,353 acres.

New Jersey BPU is also working on its Offshore Wind Renewable Energy Credits (OREC) funding mechanism, a solicitation for 1,100 MW of offshore wind, and an Offshore Wind Strategic Plan, all due by the end of this year.

MARYLAND

The first state to pass legislation that uses ORECs as the funding mechanism for offshore wind, Maryland has one active offshore wind project: U.S. Wind near Ocean City.

On March 22, BOEM approved the SAP for the U.S. Wind project. The SAP approval allows for the installation of a meteorological tower; a seabed-mounted acoustic Doppler current profiler (ADCP) sensor; and a conductivity, temperature, and depth (CTD) sensor, so U.S. Wind can conduct the testing required for the next critical step, the Construction and Operations Plan (COP).

VIRGINIA

Another state that is catching up on offshore wind, Virginia doesn't have a formal RPS, but its Grid Transformation and Security Act of 2018 declares that 5,000 MW of renewable energy are in the "public interest," including a carve out for 12 MW of offshore wind.

Dominion Energy Virginia (a utility) is partnering with Ørsted to build the Coastal Virginia Offshore Wind project 27 miles off Virginia Beach. This 12-MW demonstration project of two 6-MW turbines could be installed by 2020 and is directly adjacent to an 112,800-acre site leased by Dominion.

Once the Virginia State Corporation Commission (SCC) approves Dominion's funding request for 12MW of offshore wind to be paid by the ratepayers — approval is expected this year — then construction may start. The state would then need to increase its offshore wind carve out beyond 12 MW to use the much larger commercial lease area held by Dominion.

To accelerate the state's offshore wind development, the Virginia Department of Mines, Minerals, and Energy (DMME)



Department of Interior Secretary Ryan Zinke speaking at the International Offshore Wind Partnering Forum in April. (Courtesy: Business Network for Offshore Wind)

posted a Request for Proposals May 22 from qualified contractors to "develop a plan to position Virginia as the East Coast offshore wind supply chain and service industry location of choice."

MAINE

A large northeastern state with 378 land-based wind turbines and good offshore wind potential, Maine is being held up because its governor opposes wind energy and claims that it would be too expensive for ratepayers (much like New Jersey's former governor). In January, Gov. Paul LePage imposed a moratorium on new wind-energy projects until a new Maine Wind Energy Advisory Commission reports on wind

power's economic impacts. The commission also could affect the experimental Maine Aqua Ventus floating wind farm, which is being developed by the University of Maine.

The governor leaves office in January, and offshore developers and investors are waiting to see who wins the election in November before making their next moves.

NORTH CAROLINA

Like Maine, North Carolina has a long coastline and tremendous wind resources off its shores but is being held up by state politics. The state has three WEAs: Kitty Hawk (122,000 acres), Wilmington West (52,000), and Wilmington East (134,000), but similar to Maine, it is facing resistance, in this case from the state Senate.

In a report released March 28, offshore wind advocates demonstrated the steady winds blowing off the North Carolina coast could provide 4.7 times the state's electricity usage each year. Avangrid Renewables, which won the offshore wind lease for the Kitty Hawk parcel in 2017, stated in March that plans for a massive wind farm off the North Carolina coast are "moving faster than I think anybody anticipated," according to CEO Laura Beane.

However, the company still faces some challenges, including the lack of infrastructure in that area, the relatively low cost of competing energy sources, and political obstacles.

Overall, it's clear the U.S. East Coast as a region is moving forward and seizing the opportunities provided by the offshore wind-energy marketplace.

As the projects move toward completion, supply chains develop, and scale drives costs down, it will be essential for developers and state governments to team with the federal agencies and work together to avoid missing out on this chance to make the most of the global clean energy revolution.

ABOUT THE AUTHOR

Liz Burdock is the executive director for Business Network for Offshore Wind.

BALANCING ADVANCEMENTS AND RISK

The Global Wind Energy Council (GWEC) predicts that worldwide wind-energy capacity will reach 817 GW by 2021. (Courtesy: Global Wind Energy Council)



While there are still a number of risks for project owners to consider, what's clear is that renewables projects are seemingly trending toward more advanced technologies at lower costs.

By JESSICA WILLIAMS

Greater decarbonization efforts are driving the continued advancement of clean power. As a result, cost-competitive renewable technologies — such as solar and wind — are increasingly being incorporated into the global electricity grid. By 2040, the share of all renewables in total power generation is expected to reach 40 percent — by which time the International Energy Agency (IEA) estimates that global photovoltaic (PV) solar energy will become the largest source of low-carbon capacity [1].

Meanwhile, the Global Wind Energy Council (GWEC) predicts that worldwide wind-energy capacity will reach 817 GW by 2021, as wind power continues to make its mark on the market — second only to hydropower in terms of capacity in 2017.

However, as the renewables surge continues, there are changing technological, regulatory, and political landscapes to consider. On the one hand, assets are becoming increasingly viable — and by exploiting technological advancements, renewable power can provide solutions to regions suffering from less predictable supply and demand trends (often in remote geographical locations). On the other hand, the rate of industry development is still bound by restrictive policies, technology risk, and unpredictable weather conditions. If wind and solar projects are to further leverage the vast potential of renewable energy sources around the world, the risks should be understood and appropriately mitigated.

ADVANCEMENTS TAKE HOLD

As wind and solar power become increasingly viable, S&P Global Ratings is observing a burgeoning pipeline of projects that are addressing local electricity challenges. Take the U.K. market, for example, where costs for offshore wind projects have fallen by a little under a third in just five years. In

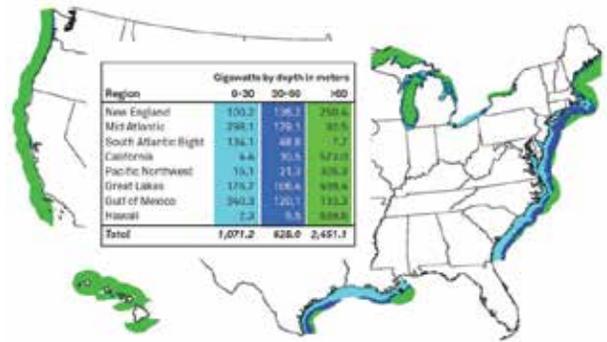
turn, we are increasingly seeing wind projects employing enhanced turbine and submarine cable technology – the Western Link initiative, for example, is a 1 billion pound bi-directional cable project that will transfer 900 MW of onshore and offshore-generated electricity from Scotland to England and Wales.

Similar projects are coming to fruition elsewhere. For instance, in the U.S., Cross Sound Cable is an under-sea transmission line moving excess clean electricity from renewable-rich New England to Long Island, New York, which has historically faced both gas and electric transmission constraints. The project can transmit 330 MW of hydrologic and wind power, and it will deliver carbon savings equivalent to approximately 600 MW of wind capacity. What’s more, the cable is bi-directional, allowing electricity to flow in either direction according to the grid’s demand needs. The U.S. also has considerable offshore wind power potential that is yet to be explored – a 2012 study by the U.S. government-owned National Renewable Energy Laboratory (NREL) estimates potential offshore capacity at 4,200 GW. Wind speeds off the Atlantic coast and in the Gulf of Mexico are generally lower than wind speeds off the Pacific Coast and Hawaii, but the Atlantic has shallower waters that are more economically attractive due to the likely lower costs of installing turbines (see Chart 1).

There have been significant technological advancements for wind turbines, too – most notably in Europe. For example, one trend is the production of larger and more efficient rotors – and wind-turbine generators (WTGs) established on better foundations. And because offshore wind projects typically spend the largest proportion of capital and operational expenses on WTGs, rotor sizes will likely continue to increase as operators pursue economies of scale – thereby reducing their costs per MW produced and optimizing their yields and efficiency ratios. And as the costs continue to fall, the number of wind projects will continue to increase.

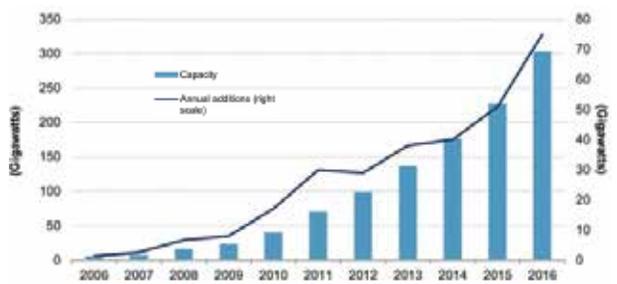
Advancements to PV technology also have resulted in solar power becoming more viable – with solar additions to the grid increasing at pace every year (see Chart 2). In Asia Pacific, for example, the Asian Renewable Energy Hub project will harness Western Australia’s wind and solar resources and export the electricity generated to Indonesia. In addition to the 2,400 MW of electricity produced by PV solar panels, more than a thousand 300-meter-high onshore wind turbines will also generate electricity to power 7 million homes – enough renewable energy to offset almost 1 billion metric tons of CO₂ during the project’s lifespan.

Elsewhere, U.S.-based Hannon Armstrong Sustainable Infrastructure Capital, Inc. last year issued \$163 million of sustainable yield bonds to refinance its land leases, which support a portfolio of 57 utility-scale solar electricity generation projects, with a total generating capacity of approximately 1,200 MW; 73 percent of that is in California, adding to the state’s rapidly growing solar power capacity—in 2010, California laid claim to just 7 MW of capacity; today it boasts 8,618 MW [2].



Source: National Renewable Energy Laboratory

Chart 1: Potential wind capacity by weather depth.



Source: Renewables 2017 Global Status Report.

Copyright © 2016 by Standard & Poor’s Financial Services LLC. All rights reserved.

Chart 2: Solar photovoltaic global capacity and annual additions, 2006-2016.

MITIGATING RISKS

Yet, with technological developments materializing at pace, there are myriad risks to address – not least possible environmental ramifications during the assembly and implementation phases. These can include considerations during the construction phase (including technology and counter-party risks) or during the operation phase (such as resource, regulatory, and market risks). Importantly, as technologies continue to advance, we can expect their associated risks to evolve, too.

Notably, wind-farm projects face significant construction risks. For example, the U.K.-based Greater Gabbard wind farm, a 504 MW-capacity project constructed by Shanghai Zhenhua Heavy Industries Ltd., was subject to cost and schedule overruns after cracks in the monopiles were discovered. However, we believe that as the industry matures, construction risk is being better understood – and with understanding comes the improved ability to mitigate. There are also operational considerations, namely resource risk. For example, project owners must consider whether the project has the necessary wind resources to meet performance requirements. The development of more sophisticated undersea cables also means that projects are moving farther from shore – which, in turn, may also bring heightened risks (particularly in the form of harsher weather conditions and deeper sea levels).



There have been significant technological advancements for wind turbines. (Courtesy: Global Wind Energy Council)

These complexities can become accentuated when the technologies installed are different to those proposed during the bidding phase. Notably, we are observing that some Germany-based utilities are factoring in immediate technological advancements as part of their assumed costs for offshore wind projects to be built in the next decade. Limiting the environmental impacts during construction has also become progressively more significant for market participants: The TenneT project, for instance, requires all contractor ships to certify they do not discharge waste into the North Sea while installing undersea cables.

Similarly, solar power generators can come up against construction risk, market risk, and the risk of inconsistent energy generation because of a lack of sunshine. However, new technologies could help to mitigate this risk, with battery storage technology expected to be the next major disruption to the American grid. As the U.S. heightens its reliance on solar energy — often through state-based Renewable Portfolio Standards (RPS), such as in California — its intermittent nature could see grid stability become a risk. That is, unless large-scale batteries can come online to secure power consistency.

So, while there are still a number of risks for project owners to consider, what's clear is that renewables projects are seemingly trending toward more advanced technologies at lower costs — and deeper market penetration globally. As both wind and solar advance, one can expect the technological risks, in some scenarios, to become increasingly complex — a factor that project owners must be prepared to balance. That said, the industry is not deterred. Renewable projects (and market opportunities) continue to be launched — benefiting from the promise of abounding renewable energy potential around the world. ✨

REFERENCES

- [1] www.iea.org/publications/renewables2017/
- [2] www.energy.ca.gov/renewables/tracking_progress/documents/installed_capacity.pdf

ABOUT THE AUTHOR

Jessica Williams is an analyst with S&P Global Ratings' Sustainable Finance team.



A wind project in Carbon County, Wyoming, under construction. (Courtesy: CCWYED)

STATE SPOTLIGHT ▸ WYOMING

HARNESSING WIND'S POTENTIAL

Wind power is on the verge of turning Wyoming into a major player in the field of renewable energy.

By KENNETH CARTER ▸ Wind Systems editor

Wyoming has some of the best wind in the country, but the Cowboy State's contribution to renewable energy has been sporadic at best, ranking it 16th in the nation of wind energy production, according to a recent study by the University of Wyoming.

That study's ranking translates to roughly less than 1,500 MW of wind energy currently produced in the state.

All that could change when several planned large-scale wind-energy projects go online within the next two to eight years. Those projects would total 7,500 MW of new capacity. That could bring Wyoming up to the No. 2 spot in wind production based on current capacity levels, according to Wyoming officials.

CHOCKECHERRY AND SIERRA MADRE

One in particular, the Chokecherry and Sierra Madre Wind Energy Project will be a 1,000-turbine wind farm south of Rawlins in Carbon County. With approximately 3,000 MW of capacity, it is expected to be one of the largest wind-energy projects in the world.

"Construction for the project started in September 2016 (permitting began in 2007-2008)," said Kara Choquette,

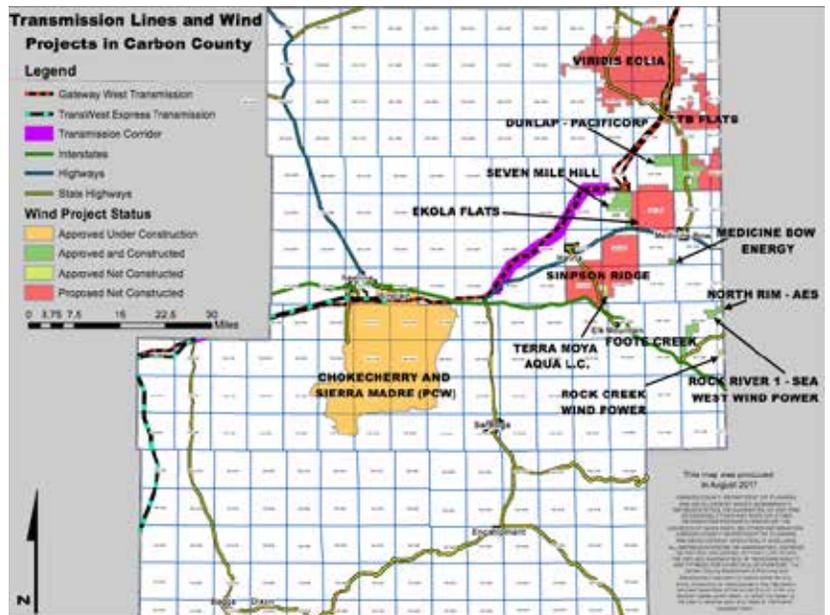


A wind farm between Hanna and Medicine Bow, Wyoming. (Courtesy: CCWYED)

director of communications with the Power Company of Wyoming. “We anticipate Phase One to be complete in 2021 with the first 500 turbines. Phase Two with up to 500 turbines should be complete by 2023.”

Some of the challenges that have faced wind energy in Wyoming include the state’s small market for power, according to Cindy Wallace, executive director of Carbon County Economic Development Corporation.

“Wyoming is farther from the largest markets on the western grid than other western states,” she said. “Our transmission capacity that went out of state was limited, so that’s the reason why some of our wind growth quit because of the lack of transmission lines to deliver power out.”



LAND RED TAPE

Another unique scenario for Wyoming is dealing with the land itself.

“Some people don’t understand that in some states you can just go to farmland and ask the farmer, ‘Can I lease your land?’” Wallace said. “In Wyoming, not quite half of our land is federal. So there’s quite a bit of land, in other words, where every other section is all federal land.”

Permits are required by the Bureau of Land Management and the Federal Government, which adds quite a bit of time and effort to do these projects, according to Wallace.

“That’s part of the reason that the Power Company in Wyoming’s Chokecherry and Sierra Madre has taken so long, because they have had to go through all the permitting and necessary requirements required by the BLM and the Federal Government,” she said.

The Chokecherry and Sierra Madre Wind Farm is being built on land owned by the Overland Trail Cattle Company. The ranch spreads out over 320,000 acres, but the massive

wind project will only cover 5/10ths of a percent of the ranch, or 2,000 acres, according to Wallace.

“So, they’ll still be able to continue their cattle ranching and operations on there,” she said.

WIND VS. COAL

Another challenge springs from the fact that, for decades, Wyoming has been synonymous with coal and fossil fuel production, but officials say they believe there is room for all forms of energy production, old and new.

“There’s always the belief that, if renewable wind energy is succeeding, then that means that other traditional energy sectors are going to be facing a harder future,” said Nathan Wendt, vice president of initiatives with the Jackson Hole Center for Global Affairs. “We don’t believe that’s true. We believe that it can be an all-of-the-above pathway for the state to take. Because Wyoming is an energy-producing state, a lot of people make their livelihood by producing

energy. Sometimes there's a perception that if wind is succeeding, then that means that traditional fossil fuel sources of energy are failing. We think that's a false choice, and that this is an additional opportunity that will be useful to the state and be helpful in driving economic diversification."

Part of that breaking with tradition is evident in the logo designed for Rawlins' 150th anniversary, according to Choquette.

A locomotive from the Union Pacific Railroad illustrating the past shares the picture with a quintet of wind turbines, signifying Rawlins' future. It also shows how Wyoming is set to embrace renewable energy on a scale larger than it ever has before.

TRANSMISSION LINES

But before the turbines for the big projects can start going up, first transmission lines and actual roads need to be constructed, Wallace said.

For the Chokecherry and Sierra Madre project, that includes the TransWest Express, a DC transmission line more than 650 miles long that will deliver power to the Southwest. Other wind projects also are developing transmission networks to accommodate the expected power generation, including Rocky Mountain Power's Gateway West Transmission line project.

Thousands of miles of roads are under construction now using gravel from a nearby quarry, according to Wallace. But once construction begins, it will be the beginning of a job boom thanks to the project.

"At the peak of construction, which would be the months of April through October, there will be 975 construction workers," she said.

Once completed, the Chokecherry and Sierra Madre project would create 116 permanent, high-paying jobs, according to Wallace. The transmission line projects would bring even more jobs, and that doesn't include ancillary jobs that will be created by these massive wind projects.

"There's a lot of promise in those projects, and they will generate a lot of jobs and generate a lot of tax revenue," Wendt said. "And also, we believe that it would really open up some of these additional opportunities like attracting wind manufacturers to the state and tapping into the corporate demand for renewable energy. That's really where we see the future and the vision that we're working to promote."

CREATING JOBS

That job potential is already showing up years before Wyoming's massive wind projects go online. The Wyoming Wind Coalition, which is a part of the Jackson Hole Center of Global Affairs, recently worked with Goldwind Americas to roll out free training to anyone who wanted to become a wind technician, a position that is one of the fastest growing occupations in the U.S., according to Wendt.

"I think there's definitely interest in the job potential that wind can bring to the state and the extent that the wind industry can contribute to that," he said.



The logo designed for Rawlins 150th anniversary indicates how Wyoming is set to embrace wind energy. (Courtesy: Carbon County Visitors Council)

Operations and maintenance of the wind farms during their 20-year lifespan has the potential to create \$3.6 billion in new economic activity, according to the university study, which also estimates another \$2.6 billion would be created by direct plant expenditures and yet another \$1 billion in additional indirect and induced economic activity.

In addition to the Chokecherry and Sierra Madre project, several other projects — both large and small — are scheduled to be built within the next two years, according to Wallace.

Four projects from Rocky Mountain Power are expected to generate more than 1,300 MW of power, and the Ekola Flats Wind Energy project plans another 250 MW with up to 100 turbines. The TB Flats Wind Energy Project is another wind farm in the works that will deliver up to 500 MW of energy.

And making it off the drawing board is a project from Viridis Eolia that would see a nine-phase 1,870 MW facility built in Shirley Basin.

"When you combine all these projects, we're going to be generating a lot of energy out here," Wallace said.

These projects have put pressure on state legislators to find new sources of revenue to replace lost energy revenue from oil, natural gas, and coal, which account for up to 80 percent of the state's operating budget needs, according to the university study. As of now, how to take advantage of potential revenue without have a negative effect on planned and potential wind projects is still being debated, the study said.

Wyoming is set to be a major player in the wind industry over the next decade with billions in new revenue and thousands of work hours at play. It's just a matter of time.

"The real story in Wyoming is what could be," Wendt said. "Because there are huge wind projects that are planned, that if they came online, would catapult Wyoming into being the top wind producer in the nation." ✎

IN FOCUS

LUBRICATION & FILTRATION ► TURBINE FOUNDATIONS

A FOUNDATION OF BEST PRACTICES

Typical spread footing prior
to pouring concrete pedestal.
(Courtesy: Wind Secure Inc.)



Understanding what to look for today can save millions tomorrow when it comes to inspections and maintenance of turbine foundations.

By JESSE TARR

As our fleet of wind turbines continue to age, understanding the structural integrity of its foundations becomes increasingly important. With millions of fatigue cycles annually, the punishment foundations must withstand is immense. When constructed properly and maintained within engineering specifications, the foundations are up to the task. However, when subjected to neglect, the minor deficiencies will almost certainly compound, exposing significant economic liabilities and perhaps safety concerns for those working above.

In order to better care for a foundation, it's important to better understand them. First off, foundations are not a dead, static mass. They're precisely engineered structures designed to properly dissipate the tremendous forces coming from above. The anchor bolts, grout, concrete, and reinforcing steel have very relevant jobs to this happening properly. Though several different designs exist, the majority of U.S. wind turbines are built on "spread" footings. Differing designs rely on certain components more than others, but the general principle stays the same: to keep your turbines anchored to the earth.

FOUNDATION COMPONENTS

Anchor Bolts: The anchor bolts are generally held in tension, which is effectively pulling the turbine to the foundations. As an example: A turbine has 160 anchor bolts times 100,000 pounds of specified post tension each equals 16 million pounds of collective "pull." The design engineer, based on complex calculations, determined this turbine needs 16 million pounds pulling it down to the foundation.

Grout: The grout is the buffer of the 16 million pounds of pull (plus weight of turbine) between the base flange and the pedestal concrete. The grout is the first line of defense from the forces above. It evenly distributes the loads from above to the foundation concrete.

Concrete: The concrete is the ballast or weight keeping the turbine from overturning. Simply put, it's a giant weight.

Reinforcing Steel: This keeps the concrete as one cohesive mass and distributes the loads evenly. It is important to know that in the past 15 years, design standards have changed (twice), increasing the amount of reinforcing steel within the foundations.



A grout failure requiring repair. (Courtesy: Wind Secure Inc.)

INSPECTION AND MAINTENANCE PROCEDURES

To mitigate the potential for major foundation problems, a foundation maintenance and inspection procedure should be implemented: AWEA's Operations and Maintenance Best Practices has detailed procedural recommendations. A proper foundation inspection and maintenance program doesn't need to be overbearing, cumbersome, or expensive. The best programs are based on common sense, with an escalation of service, based upon preliminary findings. Foundations require much less maintenance than the rest of the structure but should be systematically inspected and tested for abnormalities. For starters, it's extremely important to know if the anchor bolts are holding their specified tension.

There are many reasons why an anchor bolt could be holding improper tension:

- Design data.
- Construction techniques.
- Material/construction deficiencies.
- Concrete shrinkage.
- Anchor bolt relaxation.
- Seating losses.
- Corrosion.
- Turbine abnormalities.
- Incorrect equipment.
- Improper calibration.
- Neglect.
- Weather/seismic events.



Corrosion of the anchoring hardware can lead to significant and unexpected costs to fix and jeopardize the integrity of the foundation. (Courtesy: Wind Secure Inc.)

Besides ensuring proper anchor bolt tension, each foundation should be visually inspected yearly for the first several years after construction. A visual inspection could simply be documenting hardware condition (corrosion?), concrete cracking or spalling, interior water, and any other abnormalities. Whatever conditions are discovered during the first inspection, they need to be recorded as the benchmark, with future inspections referencing the known problems. Remember the fatigue cycles? If your foundations are not in proper shape, you will be point-loading the grout, concrete, and steel near the failing areas, greatly jeopardizing the total number of fatigue cycles your foundation can withstand. Not all foundations are perfect, and some small failures may be inevitable, but the larger more expensive issues can often be greatly reduced, if not prevented entirely.

SUBTERRANEAN INSPECTIONS

If significant cracking is visible at ground level, re-powering is being considered, or your foundations were designed before 2007, inspecting the interface between the pedestal and spread footing can save a catastrophic event. Exposing and inspecting the critical interface between the pedestal and spread footing during operating conditions is becoming common practice when one or more of these conditions exist. If the pedestal is found to be moving independently of the spread footing, you have a big problem that needs to be fixed before a catastrophe ensues.

CORROSION CAUSE AND EFFECT

Hardware corrosion is often an indicator to the health of the foundation. If the hardware is excessively corroded, there is a higher likelihood of larger foundation concerns. Ultimately, there are two problems that corrosion will lead to: The first is the degradation of hardware (particularly washer and lower nut), resulting in post tension loss in the anchor bolts. Fractions of millimeters of lost washer/nut thickness will directly result in tension losses to the anchor bolt.

The other major issue stemming from corrosion is improperly functioning hardware. In many cases this problem continues to elude operators who don't know what to look for. We've come across stuck nuts in every state we've worked, in every type of atmospheric environment. Stuck hardware can generally be overcome, but it takes the conscious wherewithal to identify and then rectify the problem. You need to use the right equipment to properly identify stuck hardware. If the tensioning system doesn't allow for full visibility of the anchoring nut during tensioning, how do you know what you're doing? Secondly, you need enough torque in the tooling to free corroded hardware. Anything less than a large wrench often won't work. It's important not to assume hardware that looks visually OK is functioning properly. Frequently, an uncovered anchor bolt may look fine but is severely stuck. Unless a high quality never-seize was applied under the nut during construction, the hardware is more than likely stuck. Proper testing will identify such issues. Corrosion is one of the largest threats to a founda-



Properly greased anchor bolts ensure all exposed surfaces are adequately coated, with extra attention given to the washers and nuts where the hardware is most susceptible to corrosion. (Courtesy: Wind Secure Inc.)

tion's long-term structural longevity. It is a compounding issue that can lead to significant problems with the rest of the structure over time.

CONCLUSION

A foundation will tell you how it's doing. It's your job to pay attention. A simple maintenance plan with periodic tension testing and annual visual inspections will go a long way in preserving a foundation's integrity. If small problems are found, fix them before they become large problems. It seems common sense, yet as our industry ages, it's increasingly clear that every component can be replaced except the foundation. With extended lifespans and re-powering now commonplace, it is valuable to know your foundations can handle the job long into the future. ↵

ABOUT THE AUTHOR

Jesse Tarr is founder and president of Wind Secure Inc. and Corrosion Control Solutions Inc. Based in Lake Orion, Michigan, Tarr's companies have provided products and services to the wind sector since 2007. For more information, go to www.windsecure.com or contact Tarr at jesse@windsecure.com or (248) 563-6234.

SIGNIFICANT ENERGY BENEFITS

One of the world's largest wind turbine manufacturers, Enercon, is using MasoSine SP5 sinusoidal pumps from Watson-Marlow Fluid Technology Group to optimize the delivery of protective impregnating resin at its Magdeburg production facility in Germany. (Courtesy: Watson-Marlow Fluid Technology Group)

Sine pumps optimize high viscosity resin delivery for Enercon, one of the world's largest wind turbine manufacturers.

By RUSSELL MERRITT

One of the world's largest wind turbine manufacturers, Enercon, is using MasoSine SPS sinusoidal pumps from Watson-Marlow Fluid Technology Group to optimize the delivery of protective impregnating resin at its Magdeburg production facility in Germany.

These robust and efficient positive displacement pumps were selected for their powerful suction capability.

RING GENERATORS

Among the core wind-turbine components produced at Magdeburg is the ring generator, which is exposed to particularly high stresses during operation.

"In the interests of long service life, resin impregnation is an important process stage," said Manfred Müller, the plant's technical operations manager.

By performing impregnation, several objectives are achieved: Firstly, the windings of the generator are protected against humidity, dirt, and chemically aggressive substances. Secondly, a potentially disturbing hum from the wind turbine is prevented and any resulting heat can be better directed to the environment.

At Magdeburg, two MasoSine SPS 400 sine pumps were deployed. Each of the pumps delivers approximately 40,000 l/h of (15,000 mPas) impregnating resin at a pumping pressure of about 4 bar (58 psi), to coat the copper windings of the ring generator.

INNOVATIVE DESIGN

MasoSine sine pumps are particularly suitable for use with high-viscosity fluids as the rotation of the sinusoidal rotors creates four equal circumferential chambers into which the impregnating resin is delivered. Sealing from the pressure side to the suction side is ensured by means of a gate on the rotor, which diverts the pumped material by 90 degrees in the direction of rotation, or to the outlet. Since the chambers are moved as a whole and the volume during the process does not change, MasoSine sine pumps process even viscous and highly viscous media with ease.

Another benefit of the MasoSine pumps at Enercon is their high suction capability. The impregnating resin is first pumped from a reservoir through a pre-filter before it is directed to the dipping tank. However, this task proves no problem for the SPS sine pumps, which, with a vacuum of up to 0.85 bar (12 psi), have the necessary suction capacity.

Since the formation of small lumps in the resin can never be ruled out (despite using a pre-filter), the pumps also must be capable of transferring larger particles without sustaining damage.

"For the SPS 400 pumps, lumps of resin up to the size of a

grape are absolutely no problem," Müller said.

CONTINUOUS COOLING PREVENTS GELLING

Despite the attributes of MasoSine SPS technology, the impregnating resin used at Enercon has proven to be an extremely problematic fluid to pump.

"Without a cooling system, the resin naturally begins to gel quickly, which, particularly with high rotational pump speeds, can lead to clogging, especially of the shaft seal," Müller said. "As a result, the service life of the seal – and consequently the whole pump assembly – can decrease significantly."

Thanks to intensive cooperation between Enercon's Magdeburg plant and MasoSine, these initial difficulties were quickly resolved, and both pumps were retrofitted with a continuous cooling system that delivers coolant from heat exchangers through the pump housing and front cover.

Without a cooling system, the resin naturally begins to gel quickly, which, particularly with high rotational pump speeds, can lead to clogging.

The cooling system ensures a certain temperature is maintained on the mechanical seal, and gelling of the resin as well as clogging of the seal is thus reliably and permanently prevented.

ENERGY EFFICIENT PUMP PRINCIPLE

Sine pumps also offer significant energy benefits, especially in applications with high-viscosity fluids. In contrast with other operating principles, the rotor of the sine pump does not cut through the product to be delivered, meaning that, even with high-viscosity media, there are only minimal frictional losses. Nor does the torque need to be appreciably increased, so there is practically no rise in energy consumption even with higher viscosity fluids.

Depending on the medium and the application, sine pumps consume up to 50 percent less energy than comparable displacement pumps.

Watson-Marlow Fluid Technology Group (WMFTG) is a world leader in niche peristaltic and sinusoidal pumps and associated fluid path technologies. It is founded on nearly 60 years of supplying engineering and process expertise, with more than 1 million pumps installed worldwide.

MORE INFO www.wmftg.com

ABOUT THE AUTHOR

Russell Merritt is the marketing manager for Watson-Marlow North America. Contact him at russell.merritt@wmftg.com.

PROFILE

AMERICAN CHEMICAL TECHNOLOGIES, INC.

MAKING A BETTER LUBRICANT

**AMERICAN CHEMICAL
TECHNOLOGIES, INC.**

FOUNDED
1977

HEADQUARTERS
Fowlerville, Michigan

WEBSITE
www.americanchemtech.com

ACT Product Manager Steve Kovanda says he expects ACT to continue to impress the wind industry with its PAG lubricant. (Courtesy: Shutterstock)

American Chemical Technologies has offered its polyalkylene glycol-based lubricants to a variety of industries, and now the company is showing how it can help turbine gearboxes.

By KENNETH CARTER ▸ Wind Systems editor

For more than four decades, American Chemical Technologies has supplied lubricants to a variety of industries. But over the last several years, the company has been making inroads in getting its special lubricants into wind turbines.

ACT is offering a lubricant unlike what has been traditionally used in turbines.

“Since the beginning of the wind industry, there have been issues with the lubricants,” said Steve Kovanda, product manager for ACT. “They have been — over 99 percent of the time — PAO-based fluids (PolyAlphaOlefin).”

ACT, however, offers polyalkylene glycol-based lubricants (PAGs), which have proven to have much longer life for machines in other industries, such as combustion and steam turbines, according to Kovanda.

“There’s only so much you can do to change a PAO,” he said. “You have your set spectrum of additives. They’re all using similar base stocks, so, at the end of the day, you can keep beating your head against the wall trying new PAOs, or you could go a different route and think, ‘these PAGs have worked fantastically in gas turbines, mobile equipment, air compressors, and other industrial gearboxes, so instead of trying another new PAO product, why not go for a different base stock and see how it works.’ That was the real driver for it. Because, at the end of day, a PAO is never going to be a fill-for-life fluid in a wind turbine, but PAGs have that capability.”

GETTING INTO WIND

ACT got that chance when an engineer with a leading energy company in Oklahoma decided to use a variant of ACT’s turbine fluid in its wind turbines.

“They ended up converting 63 units to our EcoGear 270 XP,” Kovanda said.

But he expressed how important it was to get a foothold in the wind industry with ACT’s PAG lubricant.

“The fact that we are uptower in 63 units in Oklahoma is a very big deal in itself,” Kovanda said. “Getting uptower is no easy feat at all. Turbines are expensive. To get up into 63 of those, you’re talking about people who are really putting their trust in you. I’ve been making a lot of progress with

a lot of different corporations, looking to get some trials done, hopefully before the end of this year or early 2019. We’re also doing some work with NREL and Argonne National Laboratory. We are gathering data, which obviously takes time, but is necessary for us to gain a foothold in the industry.”

The big benefits of EcoGear and PAGs in general are that they are hydrolytically stable, and that they have excellent wear characteristics, according to Kovanda.

PAOs VS. PAGs

“Everything in the industry right now on these PAO fluids is that you want to keep it at 100 ppm of water or less,” he

said. “With a PAG, you can handle 16,000 ppm of water without having any issues. That’s because that water in the fluid is not free water. PAGs have oxygen in the backbone of the molecule, and that acts as a bonding site for each of the water molecules. They can’t group together and form droplets. Once they form droplets, that’s where you have your rusting issues, increases in acid, foaming problems, etc. So, right off the bat, we totally crushed that in terms of eliminating that issue.”

Keeping moisture out of gearboxes is a constant challenge, so

much so that some companies invest in dryers, according to Kovanda.

“They’re constantly blowing dry air across the top of the gearboxes in hopes of keeping the water out,” he said. “You don’t want that humidity in there. They are effective, but it’s just another piece of equipment you have to pay for. It’s another expense, and it’s another potential maintenance item. I’m sure those things will have their own issues as well.”

With PAGs, that extra expense is unnecessary, according to Kovanda. And chemically, PAGs don’t create sludge or varnish.

“It’s not as big of an issue in wind as in combustion turbines, for example, but I still have talked with engineers and site managers who have absolutely had issues where their gearboxes are just coated with varnish,” he said. “Another big benefit is that PAGs have a lower coefficient of friction and a higher load carrying capacity. Overall, they are just better lubricants. They can carry a higher load, and there



Typical varnish seen when running a PAO lubricant. (Courtesy: American Chemical Technologies)



Varnish-free reservoir. (Courtesy: American Chemical Technologies)

is less friction created when the lubricant is used, meaning you will see a reduction in wear.”

OFFSHORE POSSIBILITIES

The ability to work when excess moisture is present is certainly an advantage that could lead to PAGs being used in the offshore wind market, according to Kovanda.

“Because the U.S. is far behind in offshore, we haven’t made much progress in offshore,” he said. “That is what my next goal is: to figure out who’s who in the offshore applications.”

Kovanda admits that PAGs can sometimes be a hard sell when PAOs are often the norm, but he said that’s just part of ACT’s overall philosophy.

“We’re always trying to think outside the box,” he said. “We’ve always taken the hard road. We are a formulator/blender. We can choose any base stock we want to make our own products. We could have easily formulated a PAO gear oil, gone to the industry, and just tried to push that. The end users – the OEMs – they’re all familiar with PAOs and would have been much more receptive to PAOs. But we know that PAGs bring you an entire other group of benefits. They can do so much more for these customers. So, we’d rather go with that uphill battle and truly try to help these industries out.”

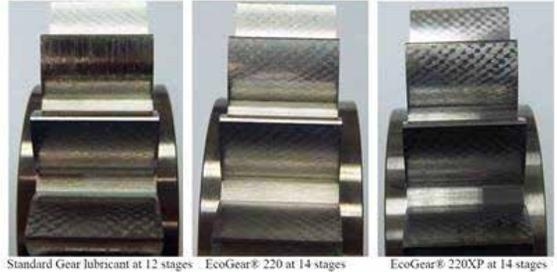
ACT’s success with gas turbines is what has helped with the company’s expansion into the wind industry.

“We have now been in two GE 7FA units at two different power plants for over 10 years now,” Kovanda said. “And the units have been varnish free, trip free, for those 10 years. That is a very big deal. Before we got into the gas turbine industry, we were seeing that plants were getting anywhere from four to seven years of life before the units would be varnishing, tripping, and they would be losing out on hun-

	TinKan OK load ASTM D-289	4-ball EP Weld Load ASTM D-278	4-ball EP Load Wear Index ASTM D-2783	FZG Total wear (14 stages) DIN ISO 14635-1
EcoGear® XP series	100 lbs	315 kg	82.88	3 mg
0 series	90 lbs	315 kg	6666	16 mg
9XP series	60 lbs	200 kg	61.49	

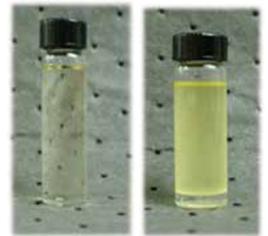
FZG-test A/8,3/90 DIN ISO 14635-1 EcoGear® 220

v = 8.3 m/s N₁ = 2170 U/min Temperature = 90 °C
Stages = 14+ T₁₇ = 714.2 Nm



Excellent wear characteristics for EcoGear XP. (Courtesy: American Chemical Technologies)

dreds of thousands of dollars because of these trips. For us to then come in and take that from four to seven years, now we are at 10 years, and the fluid is projected to run for another 25 years. With the life of a gas turbine being roughly 30 years, we should be a fill for life fluid in gas turbines.”



Hydrolytic stability shown: On the left is a PAG with 20,000 ppm water added, and it remains crystal clear. On the right is a PAO product. (Courtesy: American Chemical Technologies)

GAINING A Foothold

Kovanda said he expects ACT to continue to impress the wind industry with its PAG lubricant.

“I definitely see us having a foothold in that market,” he said.

Eventually, ACT will have enough data from product tests to prove to other OEMs that its PAG lubricant is the better choice for longer gearbox life.

“Instead of going for trials, we’ll definitely have all the data that people want to see so they will be comfortable,” Kovanda said. “We’ll be converting full wind farms for certain users.”

Part of Kovanda’s mission with the wind industry is to convince OEMs of the benefits of his PAG lubricant, knowing full well that OEMs are a slow-moving group that will have to be convinced of the lubricant’s attributes, but he said he’s up for the task.

“Is it awful at times taking the hard road and going against everyone? Yes,” he said. “But do I also know that the products that we sell will outperform our competitors? Absolutely.”

YOUR SOURCE FOR WIND ENERGY NEWS

For 10 years, Wind Systems magazine has been a leading authority on the wind-energy industry and its place in the world as a stable and sustainable source of renewable, clean energy.

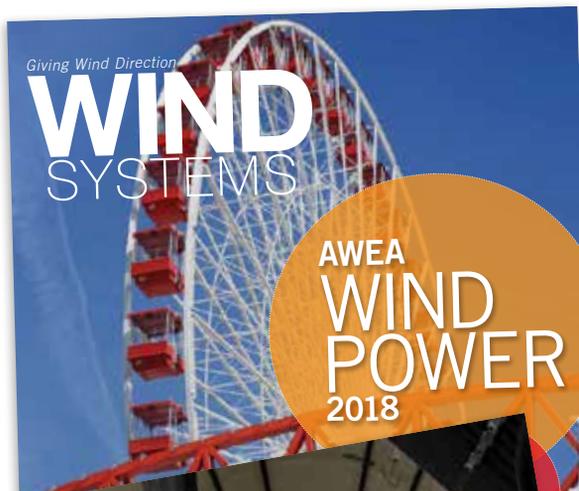
Each issue, Wind Systems offers the wind industry workforce timely, valuable information from key segment players in order to increase its readers' knowledge of the wind industry's positive future.

Best of all, it's free to you. All you need to do is subscribe.

JOIN THE *WIND SYSTEMS*
COMMUNITY
FOR ONLY
\$350
PER YEAR



On windsystemsmag.com, we have paired our vast archives with the latest web technologies to develop the most efficient, streamlined, user-friendly web experience in the wind-energy industry.



SUBSCRIBE FOR FREE
www.windsystemsmag.com

Giving Wind Direction
WIND
SYSTEMS



Sonny Garg

Managing Director, Global Energy Solutions ▸ Uptake

‘A lot of this is about sharing information in a way that everyone knows what’s going on’

▸ When equipped with better data and insights, what can wind companies accomplish? Is there an urgency to get more out of their data?

Yes. There is an urgency for this reason: What we’re seeing is power prices continuing to go down. As power prices go down, you have to be better at your operations. You’ve got to do two things: You’ve got to make sure you’re producing as much power as you can and get it into the market and get paid, and you’ve got to reduce your costs. Data can help you with both of those significantly. They go together if you do them intelligently.

[As a power producer], the first thing you need to do is be available. With insight and data, you can begin to not only detect anomalous behavior, but you can move faster and take action to fix it. You’re trying to be much more predictive. You’re not only trying to detect failures, but predict them so you don’t have the downtime. And if you know what’s going to happen and you can predict that, you can integrate that into your work plan and your parts ordering and fix it at the right time and at the lowest cost. If it breaks, then you’re scrambling and reacting to a problem that will cost you even more money.

The second reason why data is important is even when you are performing at the level you should be, there’s a maximum amount of megawatt-hours that you’re supposed to be producing when you’re operating. The question is: Are you actually producing those number of megawatts? It’s the equivalent, basically, of your car is running, but your fuel efficiency stinks. We want to give you the insights to tell you you’re available, but you’re not actually performing at the level you should be; you’re not actually getting the fuel efficiency. So, here’s why you’re not, and here’s what you should do about it so you can get more out of that asset.

▸ Working with MidAmerican Energy and other wind operators, what are some things you’ve learned that surprised you?

One thing we learned across multiple customers that was pretty shocking is that little things can result in big things. Typically, with a gearbox fix or a blade failure, you expect

to find value there. But, what surprised us was the returns we saw by tracking the health of smaller parts, such as an anemometer, for example. That’s a \$5,000 part. Another example was a site where a turbine was broken. It was underperforming by 12 percent, and it was costing them \$20,000 a year — that’s just for one turbine. So that one turbine needed a \$5,000 part. And if you multiply that by 100 turbines on a site, you get real money.

The other thing we’re seeing is there’s a bunch of stuff that’s really hard. Solving some of these problems that we’re trying to optimize on-site really takes some serious processing, data science, and ingenuity. Take wake management. When you’re on-site, there’s a wake effect on that site, which affects the performance of the turbine. We’re starting to figure out how we actually model that so you can actually understand what that wake effect is and how to optimize the turbine. And right now, it’s something that people haven’t done. If you’re an individual company trying to solve this problem by yourself, it’s going to be really hard.

▸ Uptake works across several industrial sectors, such as rail and transportation. You recently announced a partnership with the U.S. Army to support their Bradley vehicles. What can the wind industry learn from these sectors’ adoption of AI and data analytics?

Stepping back, all industrial sectors can first learn from how the consumer and retail sectors used data and data science. Take Uber. That’s a \$60 billion digital company, and they don’t own any assets. There’s a broader message here regarding the digital transformation of industries: It starts with looking for ways to use your existing data to optimize your assets.

There are lots of lessons to be learned from other industries on how they use data to improve their asset performance. At Uptake, we built a platform within data science with a machine-learning engine that are industry agnostic. Many of these problems are similar across industries. We have a failure prediction engine; we have an anomaly detection engine. We can tune those to each asset type.

The way digital typically works is you bring it in and you

optimize your current business model and make it better, which is what we're doing through the Uptake platform right now. But typically, digital also changes the way a business model works. And what industries can learn from each other is: What happens when you start getting really good at data science and predictive failures, and what does that mean about your industry?

An example is the Rolls Royce engine. They sell those on sort of a power-by-hour basis. They're not even selling you the asset itself. The reason they do that is they have so much confidence to predict and monitor the health of that asset. And that's where one industry can look at another's history and say, you're going to end up there. You may not be there today, but you're probably going to end up there, which changes every way of how you're going to sell your product.

► **What different value does predictive maintenance provide to different team members at a wind company — from a technician to a site manager to a CEO?**

In most sites and most farms in most places, there isn't a single version of the truth. With the Uptake software, you are getting a single version of truth across all the major stakeholders. Here's why that matters: As an executive, I can use the software and see what's going on with my turbines. I know what's down. I know why it's down. I know how much money I'm losing because it's down.

And that ties into what the engineer is seeing, who's actually monitoring the performance of the turbine. They're actually creating cases around what problems they should go fix based upon what they're seeing in the data based upon the insights that we're giving them.

That also ties into the site supervisor who is looking at, from an availability perspective, what work do I need to prioritize, what work do I need to put into the order system to get it done at the right time, so I don't have any downtime. And that feeds to the technician supervisor who's on the ground doing the plan of day, so they can see that and say, "OK, this is the plan of day and the priority of what I need to go fix today."

That gets to the technician, who gets that work order, and they know what to go do. Once they do the job, they report it back through the same system, and if I'm the executive, then I know that job is done.

A lot of this is about sharing information in a way that everyone knows what's going on, and there's a single version of the truth. It's about everyone agreeing with the priority of the work, when it needs to be done, and how it needs to be done. And a lot of it is about how do I do that work in a way that is predictive, so I'm not reactive, and I'm actually getting ahead of it, so I don't have downtime, and I can also align my cost structure in a way that I'm getting the lowest unit cost possible.

► **How can wind developers get the insights down to the technician in a way that they can easily act on?**

There are one or two ways that we do it. If you already have



An Uptake employee climbs a wind turbine. (Courtesy: Uptake)

some kind of work management system, then we generate the insight through an Application Programming Interface (API). You want to be able to deliver those insights into your existing work management system. The main thing is you want that insight to be on the radar of the site supervisor and the technician supervisor who are prioritizing the work. Once they have that, then they can easily send a technician who's already going to the site. The other option is: We have a front-end application that can be deployed on a mobile device that makes it easy for someone to prioritize the work and pick it up on their mobile, iPad, iPhone, or whatever device it is. And it can get integrated into their plan for the day.

► **Uptake released a report earlier this year showing if the U.S. eliminated downtime in its wind fleet, it could add 12 terawatt hours of energy (enough to power all the homes in Chicago for a year). How realistic is that and what would it take to get there?**

To get there, it's going to take a willingness for companies to embrace data-driven insights. And there's a network effect in that — the more people who use it, the smarter the algorithms become and the better we will become at it. The reason we put out that report is to show the opportunity. Having grown up at Exelon, knowing that their nuclear plants operated at 48 percent capacity, and by really focusing on it, they got it up to 93 percent, and now that's pretty standard across the industry. So, our belief is it's infinitely doable if we focus on it in the same way we focused on nuclear. And if we share insights, I think we can get there faster.

MORE INFO www.uptake.com



Siemens Gamesa will supply two wind farms with a combined capacity of 250 MW. (Courtesy: Siemens Gamesa)

► CONSTRUCTION

Siemens Gamesa to install two projects in South Africa

Siemens Gamesa Renewable Energy will supply two wind farms in South Africa, including 109 units of onshore wind turbines. The SWT-2.3-108 turbine will each feature a rated capacity of 2.3 MW and a 108 meters diameter rotor.

While the 140-MW Kangnas wind farm project is near Springbok in the Northern Cape, another 110 MW Perdekraal East wind farm is situated 80 kilometers northeast of Ceres in the Western Cape. A 10-year full-service agreement will secure the perfor-

mance of the wind farms, which will together supply enough clean electricity for approximately 214,000 South African homes.

A consortium led by Mainstream Renewable Power was awarded the contracts for the wind farms by the Department of Energy in South Africa as part of the Renewable Energy Independent Power Producers Procurement Program (REIPPPP). While Siemens Gamesa will start the supply of the wind turbines in early 2019, the wind farm's completion is planned for 2020.

"This is the next big milestone for Siemens Gamesa in South Africa and with adding these two wind farms, Siemens Gamesa will have installed more than 850 MW of wind capacity in the country," said Janek Winand, managing director of Siemens Gamesa South Africa. "We are proud to offer

services with a localized team based in Johannesburg with long-lasting experience and determined to generate value for South Africa by creating jobs, supporting local manufacturing, and driving development projects within local communities."

Present in South Africa since 2014, the accumulated base installed by Siemens Gamesa accounts today for 324 MW of rated capacity, and two wind projects totaling 280 MW under construction.

Owner of the wind farms is the Mainstream Renewable Power consortium. Mainstream is an independent global developer of renewable energy based in Dublin, Ireland, with offices in seven countries with one of their largest in Cape Town, South Africa. Siemens Gamesa has already delivered several projects to Mainstream in the

past with a total of 498 MW. The first 138 MW were supplied for the Jeffreys Bay wind farm in 2014, another 80 MW for Noupoort wind farm in 2016, and in 2017 a total of 280 MW were commissioned for Loeriesfontein and Khobab wind farms counting 140 MW each. Siemens Gamesa secured full service agreements of 10 years for Nouport, Khobab, and Loriesfontein and five years for Jeffreys Bay.

“We are very proud to have won further projects, part of the ambitious renewable energy program of South Africa in line with the national commitment to transition to a low carbon economy,” said Enrique Pedrosa, CEO Onshore for South Europe and Africa at Siemens Gamesa Renewable Energy. “We are strongly committed to continuously support the country on its path to provide more and more Africans with clean energy and will do everything to contribute to its so-

cio-economic and environmentally sustainable growth.”

MORE INFO

www.siemensgamesa.com

▮ **CONSTRUCTION**

Siemens Gamesa to supply 92 of its newest turbine models

Siemens Gamesa, Spain's leading wind turbine OEM, continues to fortify its strong position in the market with new orders for the supply of 289 MW to five different customers: Viesgo, Grupo Jorge, Comunidad General de Riegos del Alto Aragón, and two important energy companies. All of these projects fall under the scope of the renewable capacity allocated in recent auctions.

In all, the company will install 92 turbines at 10 wind farms being developed in Guadalajara, Lugo, Malaga, Zaragoza, Huesca, La Coruña, and Cadiz. Delivery of the new turbines will begin in October, depending on each project. The company will also operate and maintain all of these new facilities.

Most of the turbines correspond to two of Siemens Gamesa's most cutting-edge and sought-after models: the SG 3.4-132 (58 units) and the SG 2.6-114 (28 units). The six remaining turbines will be the SG 2.1-114.

More specifically, the company will supply Grupo Jorge with 23 of its SG 3.4-132 turbines (82 MW) for the Coscojar II and El Aguila II wind farms in the Zaragoza towns of Pedrola and Plasencia de Jalón, which it will service for 10 years.

Elsewhere, it will provide Viesgo with seven of its SG 3.4-132 turbines

AcraDyne
A Division of AIMCO

ACRADYNE DELIVERS High Tech for High Torque

Critical bolting demands tools that deliver high torque with superior performance. Coupled with AcraDyne's Controller, the HT Series tools combine these features in an electric, high-torque bolting system that beats the competition in accuracy, speed, and safety.

- Built-in transducer at the square drive, for optimal monitoring and control
- One of the most accurate high-torque tools in the world today
- 250 Nm-12,000 Nm — in Pistol, Angle, and Inline models
- One of the world's ONLY traceable systems at the square drive
- Accurate and Traceable Data
- Designed and MADE IN THE USA

AIMCO
www.AIMCO-GLOBAL.com
FOR MORE INFORMATION CALL
1-800-852-1368



Siemens Gamesa will install 92 turbines at 10 wind farms. (Courtesy: Siemens Gamesa)

(24 MW) for the El Marquesado wind farm in Puerto Real (Cadiz), a facility it will operate and maintain for 15 years.

Under the terms of the agreement with the Comunidad General de Riegos del Alto Aragón, a public irrigation scheme, Siemens Gamesa will build the El Balsón wind farm under an EPC arrangement, fitting it with nine SG 3.4-132 turbines for total capacity of 31 MW. This wind farm is being developed in Gurrea de Gállego (Huesca).

In addition, it will supply 25 turbines (19 SG 3.4-132 turbines and six SG 2.1-114 turbines) to an energy company for three wind farms in Lugo, Malaga, and Guadalajara, with aggregate capacity of 79 MW. Lastly, it will install another 28 of its SG 2.6-114 turbines for another energy company at three wind farms, two of which are in La Coruña.

These new agreements are incremental to the Spanish order intake of 352 MW announced by the company in recent months.

MORE INFO

www.siemensgamesa.com

CONSTRUCTION

Ørsted orders 165 turbines for Hornsea Two wind power plant

With the official signing of the wind-turbine order with Siemens Gamesa, the developer and operator Ørsted has now kicked off the largest offshore wind project to date. Once commissioned in early 2022, Hornsea Two will provide clean energy for approximately 1.3 million British households. The installation of the 165 large direct drive wind turbines at the project site 89 kilometers off the British east coast is expected to start in 2021.

The record-breaking project with a combined rating of 1,386 MW is not only the largest wind project in Siemens Gamesa's history but also the largest single order in the history of offshore wind energy. So far, this leading position has been defended by

Hornsea One with a capacity of 1,218 MW and which similarly was developed by Ørsted and is currently under construction.

“Ørsted is one of Siemens Gamesa's key partners to transform offshore wind from wind farm level to a clean energy source in real power plant scale,” said Andreas Nauen, Offshore CEO at SGRE. “We are proud and pleased to meet this challenge within the framework of a strong and long-term collaboration with an experienced player like Ørsted.”

“We are delighted to continue our partnership with Siemens Gamesa,” said Duncan Clark, Ørsted's program director for Hornsea Projects One and Two. “We've worked with them on many other U.K. projects, including Race Bank, ... and was the first project to use blades manufactured at the facility in Hull.”

The nacelles for Hornsea Two will be produced at SGRE's factory in Cuxhaven, Germany, while the majority of the blades will be made at the factory in Hull, U.K., where the

pre-assembly work will also be carried out. Towers are expected to be partly sourced from U.K. suppliers. A single 8-MW turbine is capable of generating enough electricity for more than 8,000 average European households. Originally planned for up to 300 turbines, Hornsea Two has been adapted to the progress of the significantly more powerful hardware. With only 165 units at the same total output, the project benefits from significantly improved economic efficiency and simultaneously reduced LCoE.

The new SG 8.0-167 DD is equipped with a rotor 167 meters in diameter. The blades, 81.5 meters long, deliver an 18 percent wider swept area and 20 percent more annual output than its predecessor, the SWT-7.0-154. It features the technology proven in the direct drive platform combined with a larger-scale rotor in order to offer customers higher returns while min-

imizing the associated costs and risks.
MORE INFO
www.siemensgamesa.com

► CONSTRUCTION

Lagerwey builds first 100% public wind farm in the Netherlands

Lagerwey has been contracted to build a new wind farm for De Windcentrale, which will be the first 100 percent public-owned wind farm in the Netherlands. The wind farm consists of three L82-2.3MW wind turbines that will generate wind energy for about 8,000 households. The wind turbines will be in the municipality of Staphorst, between Nieuwleusen and Rouveen. Lagerwey will start constructing the foundations at the end of September 2018.

The wind farm will be exclusively owned by the Dutch public once it is completed in May 2019. The windmill will be virtually divided into thousands of pieces, each of which will represent 500 kW/h. People who live in close proximity to the farm can acquire a piece of the windmill at a discounted price, which means they will gain the most benefits. De Windcentrale has already used this formula to great success with existing wind turbines. But this is the first time they are personally overseeing the construction of a whole wind farm.

“We are proud that a Dutch turbine manufacturer has been selected for this local project,” said Daniël Dubbelhuis, sales manager at Lagerwey. “The construction of this 100-percent cooperative wind farm is part of the Lagerwey Lokaal initiative, which aims at maximizing public participation in wind energy, thereby considering local surroundings while also improving employment opportunities in the Netherlands.”

MORE INFO www.lagerwey.com

► INNOVATION

Suction bucket concept gets test installation

Universal Foundation continues its partnership with Siemens Gamesa to showcase suction bucket technology with focus on industrializing suction bucket technology. The overall target is to decrease the cost of foundation construction and installation by 40 percent to support continued decreases in the Levelized Cost of Energy.

A consortium including Siemens Gamesa, Universal Foundation, Aalborg University, Fred. Olsen Windcarrier, and Offshoreenergy.dk has been awarded 3.8 million euros by the Energy Technology Development and Demonstration Programme (EUDP) via the Danish Ministry of Energy, Utilities and Climate. The partnership seeks to demonstrate how an industrialized suction bucket concept can slash the installation costs of offshore wind



The nacelles for Hornsea Two will be produced at SGRE's factory in Cuxhaven, Germany, while the majority of the blades will be made at the factory in Hull, U.K. (Courtesy: Siemens Gamesa)

foundations. The specific purpose of this Part 2 project is to complete an offshore trial installation campaign using the new suction bucket concept prototype.

The partnership builds on an ongoing project (Part 1) under which a next generation suction bucket concept has been designed and an 8x8 meter prototype has been fabricated. During Part 2, the prototype will be used for the offshore trial installation campaign. The new concept merges the noise-free installation advantages of suction buckets with industrialized fabrication methods using coil steel (instead of classical plate steel). The fabrication method was originally developed between Siemens Gamesa and the Danish steel specialist Ib Andresen Industries for application in onshore towers.



The new concept merges the noise-free installation advantages of suction buckets with industrialized fabrication methods using coil steel (instead of classical plate steel). (Courtesy: Universal Foundation)

“By applying this innovative fabrication method to suction bucket technology in offshore wind, the steel plate thickness can be reduced to below 20 millimeters, compared to today’s typical thickness of 30 to 40 millimeters for this type of foundation,” said Finn Daugaard Madsen, project manager with SiemensGamesa. “This means use of lower costs steel with higher supply availability. The assembly process is much more suitable for high volume manufacturing, and hence supply bottlenecks can be eliminated and costs reduced. A key element is to

ensure the structural integrity of the foundation both during installation and operation. During Part 2 of the project, we are excited to prove the installation integrity of the system.”

“The project is interesting in many ways,” said Søren Andreas Nielsen, head of R&D, Universal Foundation. “We all share the view that suction technology provides some obvious installation advantages, both in terms of environmental impact and costs. Cost of fabrication and supply security continue as one of the challenges to overcome for suction buckets. The competitive environment of offshore wind drives us to think innovation, and this project enables us to cut the total system cost by 40 percent.”

The aim is to mature the industrialized suction bucket concept toward full commercial scale.

MORE INFO

www.universal-foundation.com

► INNOVATION

Vestas and Maersk Supply Service partner to lower energy costs

Vestas and Maersk Supply Service have entered into an innovation partnership to jointly develop solutions and next-generation technology for the sustainable energy industry. The partnership aims to address the industry’s future challenges within installation and logistics to decrease the cost of energy.

Driven by consumer demand for sustainable energy and continuous reduction in levelized cost of energy, global wind energy production is set to double by 2027. One of the industry’s main challenges to continue this trajectory is to lower the cost of transporting and installing wind turbines as they increase in size and will be installed in remote locations.

Combining Vestas’ insight into sustainable energy with Maersk Supply Service’s marine and logistics experience, the companies will collabo-

rate on solving challenges within the industry related to logistics, installation, and service. Despite different backgrounds, Vestas and Maersk Supply Service have overlapping long-term goals — Vestas’ ambition is to be the global leader in sustainable energy solutions and Maersk Supply Service’s vision is to actively take part in solving the energy challenges of tomorrow.

As the partnership’s first step toward addressing these goals, the two companies are developing a crane solution for both onshore and offshore wind turbines that could significantly bring down the cost of installation. The installation concept, called Vertical Installer, involves a crane that will enable the use of lower cost assets in the logistics value chain. The project is being developed in cooperation with MHI Vestas Offshore Wind, and has received \$7.4 million in funding for the next three years from the Energy Technology Development and Demonstration Programme (EUDP) via the Danish Ministry of Energy, Utilities, and Climate.

“The partnership with Maersk Supply Service will significantly improve and expand Vestas’ existing market-leading capabilities for advanced installation and logistics solutions,” said Bo Svoldgaard, senior vice president for Innovation & Concepts at Vestas. “We have a strong strategic fit, and the new Vertical Installer crane underlines how the partnership will support our goal to improve our efficiency in an area that will grow in importance as turbine components get bigger and infrastructure become more complex.”

“This is an exciting step for Maersk Supply Service and a great example of how our marine knowledge and versatile fleet can be leveraged in new industries,” said Steen S. Karstensen, CEO of Maersk Supply Service. “Our partnership with Vestas and the development of Vertical Installer demonstrates that we are taking action to overcome industry challenges and ensure that the energy needs of the next generation are met.”

“The Vertical Installer crane is the latest example of innovation that will

continue to drive offshore wind forward,” said Flemming Ougaard, chief operations officer at MHI Vestas Offshore Wind. “The concept will allow for improved logistics and more efficient installation — critical areas for our customers’ business case. We are proud to participate with Vestas and Maersk Supply Service in bringing this concept to life.”

Maersk Supply Service initiated and continues to drive the Vertical Installer project with the aim of finding a more efficient method to install offshore wind turbines using its current fleet. Vestas and MHI Vestas Offshore Wind are providing the industry insight necessary to ensure the new solution is tailored to industry needs and developed with the most up-to-date knowledge of challenges, logistics, operator requirements, and potential design modifications for future wind turbine models. They are also providing access to test facilities both

off- and onshore, which will reduce project risks and the time required before the solution is available in the market.

MORE INFO:
www.maersksupplyservice.com

► **MAINTENANCE**

Seacat sends ships to Beatrice Wind Farm

Class-leading offshore energy support vessel (OESV) operator, Seacat Services, has secured a further charter agreement at Beatrice Offshore Wind Farm (Beatrice).

This latest two-year contract will see Seacat Mischief and her sister vessel, Seacat Magic, provide logistical support to manufacturer and service provider Siemens Gamesa Renewable Energy (Siemens Gamesa) throughout the operations and maintenance (O&M) phases.



Seacat Mischief and her sister vessel, Seacat Magic, provide logistical support to manufacturer and service provider Siemens Gamesa Renewable Energy (Siemens Gamesa) throughout the operations and maintenance (O&M) phases. (Seacat Services)

The pair of 23-meter jet propulsion catamarans will be based out of Wick Harbour in Scotland, with Seacat Mischief arriving on site in mid-August, and Seacat Magic in April 2019. They will become the third and fourth Seacat Services vessels to work at Beatrice, joining Seacat Resolute, which has just commenced a separate nine-month construction charter for Siemens

PROTECT YOUR INVESTMENT





PADDING/SHADING EQUIPMENT AVAILABLE FOR SALE, RENT OR LEASING.



WRS
WORLDWIDE RENTAL SERVICES



WORLDWIDE MACHINERY
SUPPLYING DIVISION

AUTHORIZED DEALERS OF





☎ 1.888.997.3687 ✉ RENTALS@WRSRENTS.COM 🌐 WRSRENTS.COM 🐦 @WRSRENTS

Stahlwille Tools is the ONLY tool company with dimensionally accurate hand tools!



TORQUE WRENCHES

- ⊕ Super accurate scale designed for industrial applications
- ⊕ Can be used as a breaker bar with no damage
- ⊕ Designed to ISO 12 month calibration cycle
- ⊕ Does not need to be "zero'd" after use
- ⊕ Interchangeable insert heads



MOBILE TORQUE TESTERS

STAHLWILLE TOOLS NA, SARASOTA FL, 800-695-2714
WWW.STAHLWILLETOOLS.COM

Dealer Inquiries Invited



Professional Tools made in Germany
 800-695-2714



Chevron Marine Lubricants' Taro® range of cylinder lubricants provide solutions for a range of engines, fuel types, and operating requirements. (Courtesy: Chevron Marine Lubricants)

Gamesa, and Seacat Intrepid, which remains on charter for project developer Beatrice Offshore Wind Limited (BOWL).

With a milestone development such as Beatrice — Scotland's first major offshore wind farm — there is an opportunity to set a benchmark when it comes to bringing new generation capacity online efficiently. In particular, flexible and versatile vessel support is required to overcome the technical and logistical challenges of the time-sensitive commissioning and early operational phases, ensuring that a wind farm gets up and running on budget and on schedule, and then performs effectively over the long term.

This charter not only extends Seacat Services' presence at Beatrice; it also extends the vessel operator's relationship with the Siemens Gamesa service team, following a two-year deal signed last year to support O&M activity at the 336-MW Galloper Wind Farm. Seacat Services' crews and shore-based team are therefore familiar, both with the demands of the project site and the technical and logistical requirements of supporting Siemens Gamesa throughout initial operations.

"When it comes to the make-up of an

offshore wind project team, consistency and familiarity is a real advantage," said Ian Baylis, managing director, Seacat Services. "It ensures that lessons learned are transferred effectively and, in turn, that efficiency continues to improve from site to site and project to project. As we continue to work at Beatrice, we're looking forward to building on our existing relationships with Siemens Gamesa, BOWL and the wider team based out of Wick."

"Having worked with Seacat Services in the past, we're aware of the critical role versatile and reliable OESV support plays for a project like Beatrice as it enters long-term operations," said Craig Morton, chartering manager at Siemens Gamesa Renewable Energy. "For us, it is essential that our technicians get around the site, safely, quickly, and in the best possible condition to carry out the work that ultimately keeps the turbines performing at their full potential."

Seacat Mischief and Seacat Magic are two of the most capable OESVs serving the U.K. and European offshore wind markets. They have recently returned from Ørsted's Race Bank project, where, together with Seacat Courageous and Seacat Volun-

teer, they safely completed more than 27,000 crew and equipment transfers, covering a total distance exceeding two trips around the globe.

MORE INFO

www.seacatservices.co.uk

MAINTENANCE

Chevron Lubricants receives NOLs from MAN Energy Solutions

Following successful field testing, Chevron Marine Lubricants has been issued with two NOLs (No Objection Letters) from equipment manufacturer MAN Energy Solutions, for the use of three of its Taro® cylinder oils with their cylinder oil mixing system, ACOM.

"Receiving the NOLs from Man Energy Solutions demonstrates the impressive performance of our products in the field," said Ian Thurloway, Chevron Marine Lubricants Brand & Marketing Manager. "The Taro range of cylinder lubricants provides solutions for the varied range of engines, different fuels, and the increasingly complex operating requirements that

we are faced with. It also highlights our continued strong working relationship with this leading OEM.”

Both sets of field tests were carried out on a 6S90ME-C8 MAN B&W two-stroke engine using MAN’s Automated Cylinder Oil Mixing (ACOM) system.

The first NOL demonstrates the high performance of Taro Special HT Ultra, a 140BN product that has achieved impressive results helping combat cold corrosion in slow speed vessels burning high sulphur fuel and which Chevron Marine Lubricants was first to market with in 2017, blended with Taro Special HT LF, a 25BN lubricant ideal for low sulphur, distillate and alternative fuel types.

The second NOL allows for blending Taro Special HT 100 (100 BN) and Taro Special HT LF. These successful tests prove that the Taro range of cylinder lubricants can provide maximum flexibility for operators, as well as reliable service for vessels.

Chevron Marine Lubricants, a leading provider of marine products and services, continues to provide reliability and innovation for its customers, being among the first to market with both a 100 BN and 140BN cylinder lubricant, providing a range of cylinder oils suitable for the majority of two-stroke vessels and engine types, compatible with a wide sulphur range of fuels and most alternative bunker fuels.

MORE INFO

chevronmarineproducts.com

MAINTENANCE

ANSI approves Dropped Object Prevention standard

ANSI, the American National Standards Institute, recently approved

the publication of a new standard addressing the need for dropped object prevention and tool tethering. It was approved July 2 and formally known as ANSI/ISEA 121-2018, American National Standard for Dropped Object Prevention Solutions.

This standard addresses the real need for reducing workplace accidents, injuries and deaths due to falling objects.

Dropped or falling objects from height present a significant safety hazard in many industries around the world today and the numbers are staggering. According to the Bureau of Labor Statistics, more than 52,000 “struck by falling object” OSHA recordable incidents occur every year in the U.S. alone. In 2015, the BLS reports 247 fatalities from being struck by a falling object, accounting for 5 percent of all workplace fatalities.

Most contractors rely on catching the falling object (netting, toe boards,



Bolt Tensioning & Torque tools
for wind turbines

Featured product
Micro-MAX Pumps



Electric with Remote
Series-70



Battery version
Series-72

www.ITH.com | (815) 363-4900
ITH is the worldwide leading system supplier in Bolting Technology




etc.) or erect temporary structures to shield people on the ground in the event of the inevitable drop. While this does help reduce the number of actual injuries caused by falling objects, it doesn't address the real root cause, and so the risk of injury or worse is always present. The only way to reduce the chance of injury or harm to zero percent is to prevent the uncontrolled fall in the first place.

Objects dropped from height strike the ground with incredible force. Take a simple tape measure weighing in at just 0.5 pounds. If it was dropped from a height of 10 feet, someone wearing PPE struck by it below will most likely only suffer a slight injury treatable with just first aid. Drop that same tape measure off the 17th floor of a building, and it will carry enough energy to defeat any PPE and even cause a fatality. A 2-pound wrench can be deadly from the fourth floor, and a standard power tool such as a drill can be serious from lower still.

The new standard is ground breaking, requiring dropped object prevention solutions to undergo dynamic drop testing to be considered fit for use.

When the ISEA 121 committee on Dropped Object Prevention (DOP) began working on the new standard, they made a keystone decision to require dynamic drop testing to prove all DOP solutions instead of the traditional static testing. But why is this important? How does this make us safer, and what is dynamic drop testing anyway?

Up until then, Dropped Object Prevention companies have tested their products the same way rock climbing companies test their rope and carabiners. They used a math equation and a static tensile test. To follow this method, you take the mass you're going to drop, use physics to determine the velocity it will be traveling at the full extension of the tether (aka lanyard) and, from that, determine the impact force that object will have when it is suddenly stopped by either the tether or the ground (hopefully the ground and not a person below). This force

is many magnitudes higher than just the simple mass of whatever was dropped. A 10-pound weight dropped 120 inches has an impact force of 460 pounds. To test the DOP device, a lab attaches it on a static (not moving) tensile testing rig and pulls or stretches it from both sides. The lab increases the force on the device until it breaks. If it breaks with a force higher than the minimum impact force, then it passes and is deemed safe for use. If it breaks at a force lower than the impact force, it's back to the drawing board or to a lower weight rating.

There is one problem with static testing. Static testing is an excellent way to determine how much force a safety device can withstand before it breaks (called load capacity) when it is

manufacturer wants to discover on the jobsite where lives are at stake.

With a dynamic drop test, an object of known weight is dropped multiple times. If the device prevents a drop, it passes. If it breaks and the object drops, it fails. The device is still subjected to the same impact force as it would be in a static test, but with the added challenge of proving the total solution can withstand the stress and strain of swings, bounces, and recoils real devices are subject to everyday. When (not if) things don't perfectly align during the test, the device must still fight off gravity and prevent a drop, and that is something you just can't simulate with a static test.

MORE INFO

www.dropsafetyequipment.com



RotaGel Cutting Lube is an environmentally safe lubricant because its core ingredients are based off of a food grade lubricant. (Courtesy: Hougen)

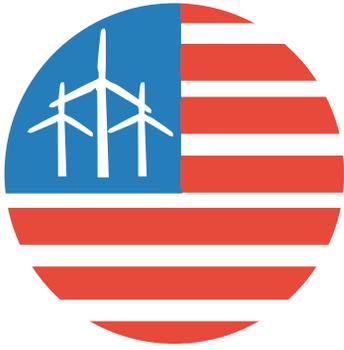
pulled straight down and everything is perfectly aligned. However, in real life, dropped objects rarely fall straight down. They tend to swing, ricochet off structures and scaffolding, bounce and recoil in unpredictable ways.

A device may pass a static test with flying colors, but when put into a real-life situation, when the straps or cable, d-rings, carabiners, and other part are stressed and strained in ways that are not perfectly aligned by gravity, motion, and dynamic force it may still fail and break and that's bad for anyone standing underneath. This is something no contractor, worker, or

MAINTENANCE

New environmentally safe RotaGel cutting lube increases tool life

Hougen Manufacturing, Inc., (Swartz Creek, MI) the leading manufacturer of magnetic drills and annular cutters announces their new RotaGel™ Cutting Lube. In most metalworking applications, nothing is more important than proper tool lubrication. RotaGel Cutting Lube is an industrial lubricant that provides superior



AMERICAN WIND WEEK

AUGUST 5 - 11, 2018

What is AMERICAN WIND WEEK?

American Wind Week is a celebration of how wind works for our country. Elected officials and wind supporters will join together at in-person events and online to show their support for the industry.

Learn more about how you can get involved at
www.americanwindweek.org

Contact windweek@awea.org for more information.



protection to the cutting tool even in hard, high-torque machining applications.

RotaGel Cutting Lube is an environmentally safe lubricant because its core ingredients are based off of a food-grade lubricant. It is non-toxic and biodegradable.

With the consistency of a creamy gel, RotaGel has properties that help it adhere to the tool and reduce friction throughout the cut. Because it is formulated with a Hougén blue color, it allows the operator to consistently gauge where the lubricant is applied and visually assures thorough coverage. Designed for use on all metals including carbon steel, stainless steel, inconel, hastalloy, titanium, aluminum, and other alloys and exotics, RotaGel is a versatile cutting lubricant that provides maximum lubrication and increased tool life with many different applications and tools. Examples of applications include: annular cutters, taps, drills, saws, reamers, endmills, general lubrication, and more. Not only does RotaGel provide lubrication to cutting tools, it also improves hole and surface finishes.

MORE INFO www.hougen.com

► MANUFACTURING

Siemens Gamesa secures Brazil's largest-ever contract

Siemens Gamesa has reinforced its position in Brazil having signed its largest contract in this market. The company will supply a total of 471 MW to Neoenergia, Iberdrola's Brazilian subsidiary.

The agreement encompasses the commissioning of 136 of the company's SG 3.4-132 turbines at the Santa Luzia complex, which comprises 15 wind farm developments, in the state of Paraíba, in north-eastern Brazil.

The SG 3.4-132 is one of the company's newest and most efficient turbines; its blades stretch 65 meters long. Lastly, this contract will



Siemens Gamesa will supply a total of 471 MW of turbines to Neoenergia, Iberdrola's Brazilian subsidiary. (Courtesy: Siemens Gamesa)

also help foster the local manufacturing base as the turbines will be made at Siemens Gamesa's factory in Camaçari.

"We are very proud that Iberdrola has selected us for such an important endeavor," said José Antonio Miranda, CEO of Siemens Gamesa in the Americas. "It constitutes a milestone in the history of the Brazilian wind sector as it is one of the largest turbines contract ever placed in this market."

MORE INFO

www.siemensgamesa.com

► MANUFACTURING

Ingeteam to deploy new wind standard

Ingeteam, an independent global supplier of electrical conversion and turbine control equipment, recently announced it just completed the training program designed to deploy the new APQP4Wind quality processes standards across the industry.

Ingeteam, as an excellence-driven converter manufacturer, voluntarily sought compliance with the demanding requirements and welcomes the quality standardization for the wind sector.

APQP4Wind is a new wind-industry standard designed to enable wind energy OEMs and component manufacturers to strengthen their cooperation with regards to quality

assurance processes.

It is also instrumental in establishing the common mindset and terminology needed in the industry to work collaboratively on these issues. For Ingeteam, fulfilling the requirements of APQP4Wind implies that the standards will be fully complied with throughout the designing and manufacturing processes, so they are well aligned with their partners' processes.

"Innovation is no longer just about technology. It is also about continuously finding new, more effective processes to deliver higher quality and increased customer satisfaction," said Ana Goyen, director of Ingeteam Wind Energy. "It is no accident that Ingeteam adopted APQP4Wind without actually being required to do so. Our company culture is innovative by design, which is why we have always been able to anticipate our customers' needs. It underpins our continued effort to stay ahead of the competition, striving to meet our clients' most stringent requirements."

The APQP4Wind project was initiated in 2016 by the Danish Wind Industry Association (DWIA) after the trade body recognized the importance of establishing quality processes standards for the wind industry. DWIA enlisted the support of key OEMs such as Vestas and Siemens Gamesa (formerly Siemens Wind Power) to contribute to the development of these new quality standards. ↘

MORE INFO www.ingeteam.com

BPA Worldwide.

Because auditing transparency and audience insights are more critical than ever.



BPA-AUDITED BUSINESS PUBLICATIONS PROVIDE MEDIA BUYERS WITH FULL CIRCULATION DISCLOSURE, IN-DEPTH DATA, AND ASSURANCE.

Circulation disclosure and audience insights have never been more vital in the media buying process. That's why the publication that you are reading is among the more than 2,000 B-to-B titles audited by BPA Worldwide. For more than 70 years, BPA Worldwide has been trusted by media buyers and media owners for auditing objectivity, rigor, reliability and timeliness. BPA Worldwide audits provide buyers and sellers with the in-depth information that they need to do business efficiently in today's complex, rapidly changing media environment. For more information, call 203.447.2800 or visit bpaww.com. BPA Worldwide. [Leading the World in Media Auditing](#)



CROSSWINDS

CUTTING PRODUCTION TIME

The Scaled Wind Farm Technology facility in Lubbock, Texas, where finished blades are sent for testing. (Courtesy: Sandia National Laboratories)

Sandia National Laboratories recently led an effort to use 3D printing to slash more than a year from turbine blade R&D time.

By KENNETH CARTER ▸ Wind Systems editor

An important process to get newly designed wind turbines up and spinning rests in the design phase. Blade development can be a slow, arduous process lasting many months, but Sandia National Laboratories recently led an effort to cut more than year off that crucial R&D time by using 3D printing.

“This project showed that 3D printing has a really viable use in making tooling for complex shapes that may be time-consuming and difficult to make in other ways,” said Josh Paquette, mechanical engineer at Sandia National Laboratories.

This was a partnership between Sandia National Laboratories, Oak Ridge National Laboratory, TPI Composites, as well as the National Renewable Energy Laboratory where some structural testing of the first prototype was done. And then at a higher level, the project was a partnership between two offices of the U.S. Department of Energy — the Wind Power Technology Office and the Advanced Manufacturing Office.

PROVING THE TECH

The Sandia project was originally developed to scale down a large wind-turbine rotor to a smaller size in order to prove out new technology as well as validate computer models, according to Paquette. As part of that project, Sandia was designing a new rotor that would go on the test machine.

“We had the opportunity to work with Oak Ridge National Laboratory and TPI Composites to manufacture the molds for the blade in a different way using 3D printing,” he said. “And so, typically, we would have the mold made by the manufacturer, and that would involve making a plug or a geometric representation of the blade. And for that positive mold, we would make a negative mold which then the blade could be produced out of. This is a time-consuming process, and often a lot of labor is involved in doing that. What 3D printing does is allow you to skip the first step and go directly to making the negative mold by using a 3D printer that you can feed in the exact geometry from your CAD file.”

The geometry for the blades was sent to Oak Ridge where it was modified for use in its 3D printer. That printer uses a combination of ABS plastic and chopped carbon fiber, according to Paquette.

“It’s actually pellets of this material that get put into an extruder, and the extruder heats up the pellets, and then it smashes them down where they need to be,” he said. “It goes around with a print head until it builds up this part.”

TRIAL-AND-ERROR WORK

This was the first time anything like this had been attempted, according to Paquette, so a lot of trial-and-error work was



A group of researchers gather around a completed, 3D-printed blade mold. (Courtesy: Oak Ridge National Laboratory)



Sandia National Laboratories created the first 3D-printed turbine blade. ((Courtesy: Sandia National Laboratories)

done before the 3D molding process was perfected.

“Once the final design for how you make the mold was completed, the process to make the pieces was a matter of a few weeks,” he said.

Ordinarily, designing and building the mold alone can take about 16 months. The 3D-printing method is estimated to take three, according to Paquette.

At the time of the project, the blade molds were printed on one of the biggest printers in the world, but now there are larger printers available.

“Even with our small blades, the mold had to be printed in six sections for each surface of the blade for two different surfaces,” Paquette said. “And then those pieces were overlaid with some additional composite material to form an impermeable mold surface. There was subsequently a small amount of machining done to that surface to bring it into the exact tolerances that we needed for the final shape. Once those pieces were completed, they were sent to TPI Composites, who had manufactured a steel frame for the pieces to sit on, and our blades were produced from those molds.”

REDUCING PRODUCTION TIME

The main takeaway from the project is, with the use of 3D printing, the time it takes to go from design to testing is dramatically reduced.

“To make a prototype wind-turbine blade, there’s time

There have been numerous innovations in blades in the past decade. New air foils have been proposed, new material choices, blade couplings that will allow blades to automatically adapt and shed loads after a gust hits the blade, reducing fatigue on the machine. 3D printing can help expedite those innovations. ▽

spent obviously in the design process but then also the manufacturing of the mold and the building and testing of the prototype; that can take two years or more for the entire process,” Paquette said. “We were looking for different ways that we could shrink different parts of that process in order to speed new technology to market.”

The shortened time element is certainly the main advantage to the 3D-printing process, but it also will allow designers to push their design ideas, since it will take less

ARE YOU MAXIMIZING YOUR EXPOSURE?

JOIN THE *WIND SYSTEMS*
COMMUNITY
FOR ONLY
\$350
PER YEAR



Connect your company to the wind-energy industry with a storefront in the Wind Systems Community. Storefronts paint a portrait of your company with a 500-word description and include your logo, website link, phone number, email addresses, and videos. Your social media pages such as Twitter and Facebook are integrated with live updates, which may also be re-posted through our social media feeds.

With a community storefront, your company also receives a premium listing in the annual Buyer's Guide published each November. Premium listings feature graphic treatments to draw more attention to your company.

For information on how you can participate in the windsystemsmag.com community storefront, contact dave@windsystemsmag.com.

Dave Gomez – national sales manager
800.366.2185 x 207

Giving Wind Direction
WIND
SYSTEMS

AD INDEX

Abaris Training Resources.....	7
AIMCO.....	41
American Chemical Technologies.....	60
AWEA (American Wind Energy Assn).....	49
BPA Worldwide.....	51
Castrol Industries.....	5
Hannover Fair USA.....	11
Hydrogenics.....	3
ITH Engineering.....	47
Kalamazoo Valley Community College.....	10
NTC Wind Energy.....	7
Ozzie's Pipeline Padder.....	55
Shell Oil Company.....	1
Snap-On Tools.....	59
Stahlwille Tools NA.....	45
TORKWORX LP.....	2
Wanhe Filtration, Inc.....	55
Wind Secure Inc.....	10
Wind Systems.....	37,53,56
Worldwide Machinery Pipeline Division.....	45

EXTEND YOUR COMPANY'S REACH

Present your company's message to the wind-energy industry in print and online through Wind Systems magazine. For 10 years, Wind Systems has served as a leading authority on the wind-energy industry. We offer a variety of media to connect you with potential customers. For details, contact:

David Gomez, Regional Sales Manager

✉ dave@windssystemsmag.com
☎ 800-366-2185 ext. 207



OZZIE'S PIPELINE PADDER

1.800.758.6634
sales@ozzies.com
www.ozzies.com



Replace Expensive Select Fill

Benefits of Mini-Padder:

- Reuse Native Soil For Backfill
- Reduce Cable Damage From Hard Materials
- Facilitate Even Heat Dispersal Through Better Soil Compaction



WIND FARMS



**EFFICIENT,
ECONOMICAL,
RELIABLE**



**▶ 1300R Oil
Filter Element**

**WH1300 R010
BN4HC-V-B4-KE50***

Beta rating:
β1000 @ 12.13µm(b)/10.89µm(c)

Dirt holding capacity: 242.72g

***R005" with 5µm media also available*

taylor@whfilter.com | 248-997-0233

time to prove their theories.

“When you know that it’s going to take a long time to go from a blade design to final product, you may not want to take as many chances on those because you might not be able to go back and make a lot of changes to the final design,” he said. “If we can speed up the time that it takes to test those out, presumably the designers might be more willing to try some other things.”

There have been numerous innovations in blades in the past decade, according to Paquette. New air foils have been proposed, new material choices, blade couplings that will allow blades to automatically adapt and shed loads after a gust hits the blade, reducing fatigue on the machine. 3D printing can help expedite those innovations.

“Blade designers can have the opportunity to be less conservative in their design choices and try out more new ways to design blades,” he said.

BIGGER BLADES POSSIBLE

And now that the technology has been shown to work, it can be used on even bigger blade designs, according to Paquette.

“There’s no inherent limitations to scaling this up to larger sizes of blades,” he said. “Larger printers than the one that we used are commercially available and are capable of doing this. This is not something that’s required to be limited to a specialized lab facility.”

Paquette said his team is looking at using 3D printing to create other parts other than blade molds.

“Going forward, 3D printing and additive manufacturing will have applications in a variety of different areas within wind turbines and wind-turbine blades specifically,” he said. “We plan to do more work to see if more parts of the blade can actually be directly printed or manufactured through some of these processes. Maybe not the entire blade itself, but in the near-term, part of the blade.”

“The logistics of transporting very large blades is something that’s being studied currently by the Department of

LARGE BLADE LOGISTICS

Energy,” he said. “Among the options being looked at are on-site or closer-to-site manufacturing by different transportation methods and possibly segmenting the blades into pieces and doing some final assembly on site.”

Paquette said he thinks 3D printing has a promising role not just in tooling for wind blades, but tooling for a variety of other industries that use complex shapes and large sizes. And thanks to the research from Sandia, that information is available for any company to take advantage of.

“We publicly disclosed as much as possible from the project so other people can take it and run with it,” he said. ↴



Sandia National Laboratories created the first 3D printed turbine blade. (Courtesy: Oak Ridge National Laboratory.)

ENGINEERED DROP PREVENTION SOLUTIONS



Since inventing the socket and driver back in 1920, Snap-on has been driven by innovation. This GE 1.5 Hub Hatch Tool is an engineered solution that replaces the homemade version in many technician bags. It includes a floating, certified attachment point, ensuring functionality and drop prevention.

GE Hub Hatch Tool



Stainless Steel Safety Coil is designed to slide freely along the handle, so you can hold the wrench where you need to.

CUSTOM DESIGNED AND TESTED DROP PREVENTION TOOLKITS WITH INVENTORY MANAGEMENT SYSTEMS ARE ORDERED AS A SINGLE LINE ITEM.



Contact Power Generation Manager John Tremblay
413-519-3380 or john.r.tremblay@snapon.com

www.snapon.com/industrial

Snap-on
INDUSTRIAL



Contemporary Lubricants for Machine Reliability

EcoGear 270XP

Eliminate oil
change headaches.

THE LIFETIME FILL

- ◆ Reduction in wear on critical equipment
- ◆ Higher load carrying capacity
- ◆ Non-sludge or varnish forming
- ◆ Hydrolytic stability forgives water ingress

Polyalkalene Glycol based synthetic lubricants by American Chemical Technologies protect your turbines and stay within spec while extending oil changes to 20 years.

American Chemical Technologies, Inc.

800-938-0101 • www.americanchemtech.com