inFOCUS

More Wind, More Jobs

The wind industry heads for new heights — and it will need a strong workforce to keep it soaring.

By Kenneth Carter
Managing Editor | Wind Systems

The Department of Energy recently announced there are now more than 100,000 jobs in the wind industry.

That's the good news.

The better news is that job-growth trend should continue as wind energy becomes an even bigger part of the power-generation picture.

"Right now, it's as strong as it's ever been," said Suzanne Tegen, wind and waterpower deployment manager for the National Renewable Energy Laboratory (NREL). "The fastest growing job in the United States right now is the wind-power technician."

But Tegen, whose work focuses on jobs, workforce, and economic analysis for distributed wind, utility-scale wind, hydropower, and other renewables, added that 25 to 30 percent of the wind workforce is in supply chain and manufacturing, and that also is showing an increase.

"That's an area that's growing, and those jobs are well-paying jobs both in cities and rural America," Tegen said.

With most wind farms being installed in rural America, they can be a boon for farmers, ranchers, and others who lease their land for wind turbines.

"They're receiving land-owner payments from developers and the local entities there," Tegen said. "So the states and counties are receiving property taxes, which really benefit their schools and their roads and their local police and fire departments."

STAYING STRONG

Wind and solar power — along with natural gas — have been at the top of energy growth in the U.S., and Tegen said NREL has been using different modeling techniques that show wind and solar are expected to stay strong.

"There have been a lot of scenarios that have come out of the Department of Energy where we have worked with industry to see what's possible in the coming years," Tegen said. "The Department of Energy's wind-vision report shows that we could have 20 percent of the country's electricity coming from wind by 2030, and 35 percent coming from wind by 2050. And if you look at wind growth today, we are actually exceeding the growth paths in those scenarios."

And that growth is going to need workers that run a gamut of vocations.

SKILLS ASSESSMENT REPORT

In 2012, NREL did a skills assessment report for the wind industry, and Tegen said she is working on another one this year.

More than 350 employees from the wind industry were asked what kind of candidates they were looking for and if those candidates needed to have wind-specific education.

What NREL found was the industry needed engineers, according to Tegen. A function of those engineers is resource assessment.

"We need engineers who can look at the wind resource itself and look at the site," she said. "Before the wind goes in, you have to take measurements for a year to two years and make sure you have a good, steady wind in that area. That's wind-resource assessment or wind-resource characterization. So we need the people who can do that."

The wind-turbine technician is one of the fastest growing jobs in the U.S. (Courtesy: NREL/DOE)

RANGE OF WORKERS

Workers also are needed in the manufacturing and supply chain. And researchers and scientists are necessary as well, according to Tegen.

"You have to do environmental surveys before you put in a wind farm," she said.

In addition to the assessments and surveys, different types of scientists are needed to look at cultural resources. A lot of effort goes into community acceptance.

Regulatory workers come in on the governmental side. These workers look at policies and issue permits in local, state, and federal areas, and these are people who need

ALSO IN THIS SECTION

With most wind farms being installed in rural America, they can be a boon for farmers, ranchers, and others who lease their land for wind turbines. (Courtesy: NREL/DOE)

to be informed about wind, according to Tegen. Along with regulatory workers, utility planners need to understand wind and how it can be integrated into a system.

"There are five states now that have more than 20 percent of electricity generated from wind energy," Tegen said. "Ten years ago, we never would have guessed that. We would have thought that would have taken a lot of storage, which it doesn't. We need electricity planners and utility employees who understand that."

GROWING DIVERSITY

In addition to getting more workers into wind, part of the challenge is also making that workforce more diverse, although Tegen said that diversity is increasing.

During the 2012 workforce interviews, NREL found the workforce was about 20-21 percent women. The recent DOE survey showed that number had risen to 30 percent, although Tegen said the DOE might have looked at a different population than the one interviewed by NREL five years ago.

But when compared to the engineering programs across the country, which are typically about 17 percent women, 30 percent is promising, but Tegen said more can be done.

"We're not trying to reflect current population," she said. "We need to be more proactive about this. And so we're looking at about 30 percent of the wind workforce. And a lot of those people are regulatory workers or attorneys and paralegals or administrative people. Not a lot of wind technicians are women. That's a very, very small percentage."

As far as other diversity, the DOE survey found about 25 percent were racial and ethnic minorities, according to Tegen. A lot of those jobs are in the trades and in the manufacturing and supply chain.

"We also looked at veterans, and that was about 10 percent," she said. "And there are some proactive programs there to employ veterans

With modern technology, hub heights will be 140 meters and higher. (Courtesy: NREL/DOE)

out of service because they have very similar skills to what wind technicians would need."

LOOKING AT EUROPE

Europe's wind workforce paints a different picture than the one in the U.S. Granted, Europe has been in the wind business a lot longer than the U.S., but an advantage it has is with its European Wind Energy Association and its focus on education.

"They make sure students have hands-on experience as well as academic experience, so you can actually get a master's in wind energy and a Ph.D. in wind energy in Europe," Tegen said. "Whereas here (in the U.S.) you go into a different discipline and then you maybe do your senior capstone project in wind energy or you do a week in one of your classes in renewable energy education."

That's one of the areas in the U.S. that needs to change, because companies that focus in wind want that wind knowledge right out of the gate, according to Tegen.

"They are hoping that those people do have hands-on experience as well as academic experience with renewable energy, and wind power is always a plus," she said.

TRAINING CHALLENGE

The dilemma is that there aren't a lot of training programs in the U.S. where engineers can get wind-energy education, according to Tegen.

There are some schools — James Madison University, UMass Amherst, Texas Tech — that do have programs like that," she said. "In most of the typical engineering schools, you'll have the engineers go into infrastructure, defense, or look at some of the more traditional energy sources. But the interest is growing, and we will see more renewable-energy programs for engineers."

One caveat learned by NREL is students in college or graduate school may not see wind power as a career option.

"Maybe they haven't heard of it, or maybe they don't see it as a viable option, but there are well-paying jobs out there in wind energy," Tegen said. "We need to do a better job in letting these students know that it's a good career option where you can actually go out and make real money and have a job that makes a

One of the advantages of wind for the American worker is that a lot of wind-turbine equipment comes from the U.S. (Courtesy: NREL/DOE)

difference in the world."

And that word needs to get out sooner rather than later, because wind is making strides in areas of the U.S. that, only a few short years ago, seemed untouchable.

SOUTHEAST U.S. WIND

"I just saw approval for the first wind farm in Virginia," Tegen said. "And so we're getting all the states onboard."

It used to be, for the Southeast, the thought was that the wind wasn't strong enough to support wind power. But that was when wind-turbine hub heights maxed out at 80 to 100 meters. With modern technology, hub heights will be 140 meters and higher. Those taller hub heights will have a positive impact on the wind potential in the Southeast.

"Certainly there's wind-power manufacturing in the Southeast right now, but we also think that as we have more tall wind installed — so taller towers — we're going to see more wind installations in the Southeast," Tegen said.

OFFSHORE POTENTIAL

And with the first offshore wind farm in operation off the coast of Rhode Island, the offshore wind industry is becoming another area that could take off.

"There could be a booming offshore wind workforce here," Tegen said.

Port jobs and O&M jobs already exist at Block Island Wind Farm in Rhode Island, and Tegen said that, for the first few projects, some workers and equipment will be coming from overseas because offshore wind is still new to the U.S.

"Some equipment will be from overseas because we haven't done this before, but certainly as we build these projects, you'll see more of a workforce develop around the ports," she said. "Besides the construction, manufacturing, and logistics, there will be long-term jobs in the maintenance of the wind farms."

It will be an exciting learning

curve for America's wind industry, according to Tegen.

"The turbines that are offshore are a lot bigger," she said. "And we don't have experience yet with the turbine maintenance except with the Block Island project. It'll be a great learning experience and a great opportunity for the United States workforce to be on the offshore side."

And Tegen said for the West Coast, offshore wind will likely offer new and different challenges compared to the burgeoning East Coast wind industry.

"On the West Coast, we're going to have to have floating offshore wind because the water is too deep right off the coast," she said. "So we will probably have offshore wind farther off the coast, and that's just a whole other learning opportunity for the port workers as well as the maintenance workers."

Port jobs will become more viable because of the very nature of the massive parts.

"One of the things for offshore wind is that the blades and the towers are so large — they're so much bigger than the land-based ones — that they need to be manufactured, so they can be shipped right to the offshore wind farms," Tegen said. "They can't go on highways. They're too big. So there will be more local jobs for Americans who live near the coast."

MADE IN THE USA

One of the advantages of wind for the American worker is that a lot of wind-turbine equipment comes from the U.S., according to Tegen.

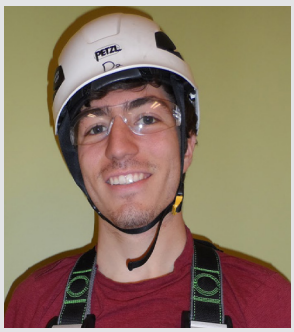
"And that's true of wind and not necessarily true of other energy resources," she said. "Most of the wind-turbine equipment comes from America. It's made in America already."

Part of what's helped push the wind industry is the Production Tax Credit renewed last year by former President Barack Obama. But the PTC ends in 2020, so with that gone, it's up to businesses and state governments to continue pushing for the clean energy that wind can supply, as well as the jobs the industry can create.

"I think the leadership from clean energy is coming from the states," Tegen said. "We do see states that are developing or have renewable portfolio standards — or that don't — that are looking to add wind energy because it's one of the best economic options. States are encouraging clean energy, and some states are putting together a set-aside for offshore wind. They're going to be pushing the envelope on creating these jobs, and these are brand-new jobs for American workers."

PERSPECTIVE

A Post-Millennial's View: Deciding to Study Wind



Jack Wolfe
Wind-Energy Technology Student
Ecotech Institute

While watching YouTube recently, an ad popped up at the bottom of the video. My immediate reaction was to hit the "X" and get back to Julian Edelman's ridiculous Super Bowl catch.

But I didn't. The ad that caught my eye was about the school I go to: Ecotech Institute — "Enroll today for a better tomorrow." The double meaning behind the slogan was even more apparent to me now. I am pursuing a degree from Ecotech Institute because I was looking for a school that would lead me to a career in wind energy.

I wanted to work with renewable energy. I wanted to contribute to a world that didn't run itself dry.

Becoming a wind tech would teach me about how the wind and wind turbines work while getting a paycheck I could count on. Since I was 22 at the time, I knew no one in the industry, and being a wind tech would put me in contact with knowledgeable people.

I am only a few terms in at Ecotech Institute, and I actually have been to NextEra Energy's massive 600 MW wind farm in Limon and the National Renewable Energy Lab, and I have met great people in the wind industry such as Auston Van Slyke and Walter Christmas.

It was an invaluable experience to see the Limon wind farm and talk to Nick Rohr, Jared Smith, and the guys operating the power plant, and to hear they had gotten there through schools like Redstone's wind program (now closed) and Ecotech Institute.

Every generation faces a drastically different career landscape than their parents faced. According to Forbes (2015), the generation after millennials makes up 25 percent of the U.S. population, larger than the baby boomers or millennials. My own journey through education and career training reflects much of the unexpected challenges facing my generation, often unoriginally referred to as "post-millennials" or "Generation Z." We are the newest generation to enter the workforce, and we will have a major impact on all industries, including wind energy.

After high school, I went to Indiana University of Pennsylvania. During my third year, I was delighted when the school started a sustainability minor.

I thought all the classes would include hands-on learning, and it would apply to the campus around us. However, the professors imagined it as a sustainability-minded deviation from their specialties. All I saw was talking and reading with no action.

I signed up for the minor, but I didn't take it. I didn't even finish that year of school. I needed to find something that was going to sustain me. I took a year off. Meanwhile I researched the state of the world, jobs, and renewable energy.

It was hard to ignore the projection the Bureau of Labor and Statistics had for wind-turbine technicians: fastest growing job in America. Here was a job where I could actually do something to help our planet breathe easier. I also knew I would be able to get a job after my studies. I have friends who graduated with teaching degrees and struggled to get hired. It wasn't that they slacked off or were bad students; there just weren't any jobs.

But if I became a wind tech, I knew a job would be waiting for me.

Strong majorities of Generation Z see improving the Earth as a priority, and they confidently see renewable energy as a step toward a healthier planet and an improved lifestyle.

I graduate at the end of the year, and the other half of Ecotech Institute's "enroll today for a better tomorrow" has become even clearer to me. It's not just a better tomorrow for me and the environment, it's a better tomorrow for the wind industry, too.

Jack Wolfe is a full-time wind-energy technology student at Ecotech Institute in Aurora, Colorado, where he is the founder and president of Ski+Snowboard Club. He looks forward to a potential future as a wind-turbine commissioner and learning more about project development. He graduates in December.

Condensing the Curriculum

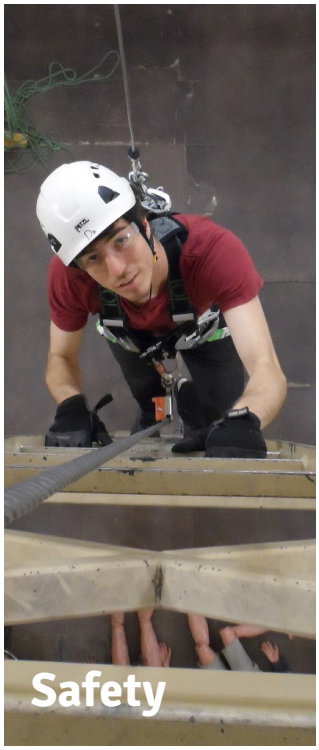
Courtesy: AWEA

Top five topics wind schools should be teaching future wind-turbine technicians.

By Walter Christmas

Today's wind-energy technology students want to compress their education into a year or less so they can enter the industry workforce right away. Similarly, industry employers can't wait two years or longer for technicians to gain the skills and knowledge needed to be highly capable and trainable wind-turbine technicians. They need good technicians now. This pressure from both sides is pushing wind-energy training programs to consider becoming leaner with their curriculum.

The challenge that may soon affect wind-energy training teams involves which courses and topics to keep and which ones to drop in a shortened program. To help with this hypothetical question, a panel of wind educators and hiring managers were asked, "What are the most essential topics (skills and knowledge) that must be taught in the technical colleges that cannot be learned as effectively in the field?"



Jack Wolfe practices climb safety skills. (Courtesy: Ecotech)

Walter Christmas demonstrates a rigging exercise. (Courtesy: Ecotech)

A.J. Thornburg works on a programmable logic controller. (Courtesy: Ecotech)

1 It probably comes as no surprise that "safety" should always be the single most important topic to be taught, and mastered, by students.

A classroom/lab-based course in basic industrial safety (OSHA-10 Hour or, better yet, OSHA-30 Hour) should precede all other courses for the immediate and future well-being of students. Specific topics mentioned include: CPR/First Aid, NFPA 70E arc flash, confined space, rotating equipment, work-at-height/climbing/tower-rescue, pinch points, and, of course, lock-out/tag-out.

2 Given that the workplace is close to 300 feet above the ground, having some classroom experience in securing a load to be lifted or lowered is essential.

Since there is some basic physics knowledge required to rig a load safely, learning about sling loads (the tension on the slings caused by the way we use them), is not something a newly hired technician should be learning while they are hoisting a heavy piece of equipment to the nacelle.

This skillset should be solid before they even touch the controls of a hoist or crane in the field.

> "A course in basic industrial safety should precede all other courses."

3 Any technician can change filters and take oil samples every six months. The real challenge that separates essential technicians from everyone else is their ability to troubleshoot down turbines to get them up and running again.

A solid understanding of the function of programmable logic controllers (PLCs), the program logic that runs them, the network hardware that makes them useful, and the circuits that keep them powered and functioning are essential to high-level troubleshooting.

If students are introduced to troubleshooting best practices in their schooling, they can make their entry-level time in the turbines more fruitful. This future-troubleshooter perspective helps them see the whole turbine as a single system rather than an assembly of separate systems.

It helps them create the habit of questioning why the turbine was designed as it was. This inquisitive attitude is a great motivator for a technician to seek increasingly higher-level training opportunities that benefit the company as much as the technician.

Understanding the PLCs, the neural network of the turbine, is the key to this process.

David Ramirez hydraulically torques a bolt. (Courtesy: Ecotech)

David Ramirez uses a power utilities high-voltage trainer. (Courtesy: Ecotech)

4 Torqueing and tensioning bolts may be the single most underestimated science in wind-energy technology. The old joke is that technicians should use the famous European standard for this by making the bolt "gutentight." All joking aside, good bolting practices involve habits that result in good accuracy, precision, and consistency in final bolt tension.

There is a tremendous amount of potential for error in bolting that all stems from a technician's lack of understanding of the physics involved. Here is one example: A bolt is considered to be under the desired amount of tension when it is turned and tightened to the point that the friction between nut and bolt threads matches the torque force of the tool.

If the instructions call for a dry torque, any oil or grease on the threads can cause an over-torqued and over-tensioned bolt that is prone to yield or failure of the bolt. Bolts are commonly shipped with a protective film of oil. Failure to thoroughly clean this oil can cause this dangerous situation.

Deeper understanding of metallurgy helps a technician comprehend why a grade-8 bolt cannot be substituted for a grade-5 one. It helps a technician understand why one washer of a different alloy than the rest is corroding, and the previously torqued bolt now has mismatched torque marks. This is due to a dissimilar-metals reaction.

Metallurgy also helps a technician to understand why a spring-loaded torque wrench needs to be set back to its lowest torque setting before being put away at the end of a torqueing session.

5 Mechanical and hydraulic principles seem to be fairly easy for students to grasp without extensive time spent in a classroom. Electrical principles, on the other hand, require a structured curriculum to master.

Alternating current and direct current circuits both exist in a wind turbine, and their voltages can range from a few volts to several hundred or even several thousand volts. Troubleshooting and repairing these circuits is not always as simple as opening the electrical junction box with the scorch marks and smoke damage.

The ability to trace a multi-page electrical schematic and to understand its function is critical to troubleshooting as well as staying safe in a 300-foot-high power plant.

The basic tool of electrical work is the digital multimeter. Wind-school graduates should be comfortable using this tool before entering the field. A basic understanding of power factor (reactive, apparent, and true power) is helpful as well; however, it is not covered in the curriculum of many wind schools. Only the best schools teach students how a frequency convertor functions, but this knowledge is critical for an ambitious career-climbing wind-turbine technician.

> The challenge that may soon affect wind-energy training teams involves which courses and topics to keep ... in a shortened program.

SKILLS THAT DIDN'T MAKE THE CUT

There are dozens of other skills and topics that likely will be covered briefly in short programs created by wind-technician programs. These skills and topics will no longer be given their own courses and units or assigned textbook chapters. However, instructors with field experience are aware of what students need to know before their first job. Instructors also know which skills and knowledge can be gained on-the-job or in the process of classroom activities not focused directly on those skills.

Turning a wrench, for example, may not be a valuable way to spend class time unless it is done as part of a full disassembly and reassembly of a component such as a pitch drive. Hydraulic systems seem to be easy for technicians to understand without the benefit of PowerPoints and lectures. By stripping down, inspecting, and rebuilding a pitch ram and directional control valve, students will experience an integration of learning even if these things are not part of formal lectures and textbook chapters anymore.

Basic computer skills, while essential for the job, really should be up-to-speed before students attend school. Students will be using MS Windows and MS Office applications while in school regardless of whether they are listed as learning objectives.

Options for students to attend more advanced courses following completion of a shortened program may become common at technical schools. Many operations and maintenance providers require technicians to complete continuing education units (CEUs) that offer additional ways technical schools can continue to meet the needs of the wind-energy industry while still speeding up the rate that graduates become available to fill field positions.

CONCLUSION

Ask 10 wind-energy instructors what five topics they would list and you might get as many different answers. Certainly, however, you will see quite a bit of overlap between the lists.

When this question was posted to wind-turbine technicians working in the field, the results were interesting. Many of the results had nothing to do with technical knowledge or skills. Specifically, the turbine technicians were asked to comment on the "most important skills or knowledge that you wish technicians had before getting hired to work uptower." (Technicians are typically not permitted to speak publically due to company policy, so their names have been withheld.)

Here are some of the results:

- "Listening, communication, and patience."
- "How to send up a heavy load properly!"
- "A teamwork mindset, no one is finished up tower unless the team is finished up tower."
- "Common sense."
- "Basic physical fitness."
- "How to put your phone away and pay attention to what is happening in front of you, and anticipate what will happen next."

Clearly, it seems the technicians are more focused on finding coworkers who are trainable, reliable, and team-oriented. These attributes are likely to be the most difficult for a school to address, but they are not impossible.

As courses focused on soft skills get squeezed out, perhaps this will increase pressure for the schools to recruit students with previous professional experience such as veterans and workers being laid off from other sectors of our energy industries.

Another solution is to include soft skills training by integrating it with the technical skills via team-oriented exercises.

One way or another, wind-energy technology schools must continue to meet, and hopefully exceed, the needs of America's fast growing wind-energy industry.

Walter Christmas is an instructor of Wind Energy Technology at Colorado's Ecotech Institute, the first and only accredited college in the U.S. solely focused on renewable energy and sustainability. He specializes in mechanical repair of generators, tower climbing, and rescue-at-height safety training, and using technology in the classroom. He has a technical diploma from Northwest Renewable Energy Institute, a Bachelor's of Arts in Environmental Studies from the University of California Santa Cruz, and a Master's of Education from Concordia University of Portland, Oregon.