

The background of the entire page is a dark blue gradient. Overlaid on this are several wind turbines rendered in a wireframe style, composed of glowing blue lines and dots. The turbines are positioned at various angles, creating a sense of depth and movement. The main title 'CREATING SOFTWARE-DEFINED ENERGY SYSTEMS' is centered over the middle of the image in large, white, sans-serif capital letters. At the top left, there are two dark blue horizontal bars. The top bar contains the word 'CROSSWINDS' in white, sans-serif capital letters. The bottom bar contains the phrase 'THE FUTURE OF WIND' in white, sans-serif capital letters. In the bottom right corner, there is a small white rectangular box containing a paragraph of text in a small, black, sans-serif font.

CROSSWINDS

THE FUTURE OF WIND

CREATING SOFTWARE- DEFINED ENERGY SYSTEMS

Through the Linux Foundation and LF Energy, projects that depend on the Linux kernel can be developed and nurtured to grow, which would be advantageous to the wind-energy industry. (Courtesy: Shutterstock)

Developing an open source strategy for grid transformation could be an essential step in mitigating how the U.S. creates and distributes power from wind and other renewables.

By KENNETH CARTER ▀ Wind Systems editor

With the Biden administration's ambitious plans to ramp up offshore wind production, along with a multi-trillion-dollar plan to boost the country's infrastructure, it becomes all the more important that essential software and computing power are accessible to help aid in the creation of new methods to build, maintain, and operate this massive undertaking.

To that end, the people behind LF Energy and The Linux Foundation are hard at work to ensure the Linux kernel is protected and available to all.

Just what is the Linux kernel? LF Energy's Shuli Goodman explains.

"The Linux kernel is probably one of the world's most amazing collaborative efforts," she said. "And it is, in essence, the operating system of the planet. The Linux kernel was a hack by Linus Torvalds. He was a student in Helsinki. He was unable to afford either a Microsoft server or a Sun workstation, so he hacked the solution on commodity hardware. And that project has been built and built and built — so much so that IBM gave up its own operating system."

To put it in even more perspective of the importance of the Linux kernel, Goodman said that, although Microsoft may have a Windows operating system, all of its business — particularly with regards to the cloud — is on Linux.

"It represents really the foundations of our digital world and what has happened in open source," she said. "And open source really could be defined as a permissive intellectual property license that allows for collaborative investment."

NEUTRAL GOVERNANCE

At the Linux Foundation, which was founded to protect the intellectual property of the Linux kernel, they believe that, in addition to permissive IP licenses such as Apache 2.0 or an MIT, neutral governance is also a must, according to Goodman. And through the Linux Foundation and LF Energy, projects that depend on the Linux kernel can be developed and nurtured to grow.

"Anyone can contribute to a project; you do not need to be a company, you do not need to have a special membership; it is what we refer to as a duocracy," she said. "There are probably 25 (million) or 30 million open source projects on GitHub. We are 425 projects, so these are the projects that basically run the planet and that allow industry to transform. It's kind of like putting in a superhighway and plumbing and then all of a sudden commerce can begin to move. We're the plumbing and the superhighway."

This type of arrangement could be crucial to renewable energy projects, particularly wind, according to Goodman.

"In order for renewable energy to scale and stay connected or integrated into a power-system network, a power-sys-

tem utility or a system operator has to be able to afford that renewable energy and continue to maintain balance in the grid," she said. "The grid that we have now was designed to utilize inertia to balance the grid, so that's the supply and demand. And because it's unidirectional — or has been until very recently — it has required a monopoly entity at the center in order to be able to ensure generation, transmission, and distribution for delivery into the home, so you automatically can switch a light, and it comes on. And most of us have never thought for a moment: How did that happen? It's very magical."

MOVING TO A DISTRIBUTED MODEL

With the use of open source software, the ability to move from a centralized model to a distributed model moves closer to reality, according to Goodman.

"You're essentially creating a web not all that dissimilar to the internet, and so we're moving in to a distributed model that requires distributed computing, and it requires a new way of doing things," she said.

Economically speaking, this type of model is ideal for wind energy, according to Goodman.

"If I were the wind industry, I would be absolutely looking at how I actually ensure that the people who buy my electrons have the capacity to actually afford as many as I can offer," she said. "And I think a big bottleneck for wind is that you have operators who actually don't know what to do with the wind, and so on any given day, you'll have a lot of electrons that get lost and aren't being utilized."

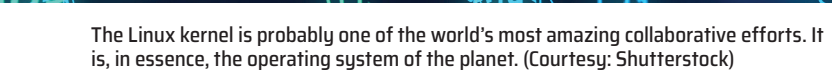
Some of the claims of things that will need to happen in order to fully realize the potential of wind are things such as load shifting — being able to move loads around, according to Goodman, and it's necessary to deal with those moving parts at a rapid pace in order to implement price-based grid coordination.

"What that will enable is the wind operator to deliver as quickly as possible their perishable commodity — that electron — to a consumer who wants to buy that electron," she said.

LIMITATIONS OF PROPRIETARY SOFTWARE

And these new market structures of managing supply and demand will be quite complex, according to Goodman, and proprietary software will not be able to keep up with the influx of projects that will be needed to accomplish a wide range of goals.

"It's in much the same way the internet never would exist if we continued to operate with proprietary software," she said. "So, changes in an industry require modifications of the lower levels of the stack. If I were a wind operator, I'd be stomping my feet and periodically cursing that the people I



want to sell my stuff to can't buy it because they don't know how to use it and they don't have systems that are enabled to use it, nor do commercial and industrial customers, for instance, have the capacity to be able to shift and shape load and demand."

“The wind industry is not going to be able to do that alone; they have to do it together with the operator and with the commercial interests so they can build that supply and demand and load shifting and load shaping, and that’s the reason why wind should be very interested and paying attention to the Linux Foundation and LF Energy,” she said.

LF Energy is there to provide the neutral governance as well as the legal framework for collective collaborative investment, according to Goodman.

COORDINATION AMONG INDUSTRIES

“The energy transition is not just going to be utilities; we have to coordinate with 5G, and that means telcos,” she said. “The new infra-

Some of those actors Goodman is referring to might include blockchain or, surprisingly, automotive.

"I just got off a call where we were really talking about the future of automotive, which of course is going to be of great interest to the wind companies, because they are basically going to be generating the electrons that are going to charge your car," she said. "Well, guess what? That is a really complex thing to make happen if you've got a bunch of wind

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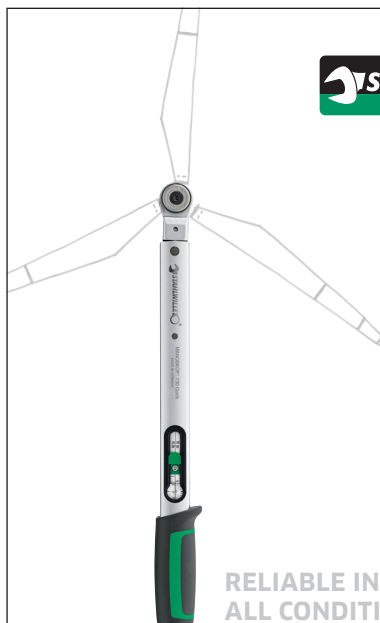
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The wind industry will need to look for new and innovative ways to ensure that the people who buy power have the capacity to actually afford as much as is offered. (Courtesy: Shutterstock)

farms. It requires a high degree of sensitive stakeholder engagement that is able to enable new paradigms to emerge.”

FEDERAL HELP

With the Biden administration pushing progressive goals on renewables and infrastructure, Goodman expects federal help to be a plus, but Goodman’s mission will still be a challenging one.

“I’m in conversations with a lot of people in the administration to try and create the infrastructure that will allow this to emerge, and it’s not a straight shot, even with a new administration,” she said. “I think that the bill that passed has a lot of influence in terms of the new kinds of infrastructures that we’re creating. But it’s critical. It’s essential. I think that there’s a real commitment, but that also does not mean that it’s a done deal. We have to create the future together, and so that’s what the Linux Foundation does best.”

INTERNATIONAL PARTICIPATION

Part of Goodman’s and the Linux Foundation’s mission involves global cooperation, which Goodman said is a priority of LF Energy.

“I’m working very hard,” she said. “I have a group right now that I’m running with Canada, the European Commission, and the Department of Energy, and the thing we’re looking at is electric mobility. The degree of cooperation that we can achieve in order to scale this would be extremely important. How will this happen?

Some of it will be back channel; some of it will be direct, and mine is more of a back channel, but I think that we are very much a global community, and I can say without any doubt, Europe is way ahead of us, and we have neglected our investments for a long time, and the consequences for things like what happened in Texas, where they basically chose profit over actually maintaining and managing infrastructure.”

Debilitating challenges to the system are going to continue to repeat, according to Goodman, and it’s frustrating to see that the rest of the developed industrial modern world doesn’t have the problems the U.S. tends to have.

“Our problems are directly because we have starved our infrastructure in order to provide outsized profits to a few individuals, and it’s a recipe for what happened in Texas, and there are some that suggest that the loss in Texas was approximately a half a billion dollars an hour,” she said. “If we have more of these things, we are going to cripple our economy. And we will have more, because I live in California where we had our own version of it.”

GETTING THE U.S. ON BOARD

Goodman stressed that her team at LF Energy has a lot of work to do to create such a massive shift to how power structures are maintained in the U.S., but around the world, many countries have become extremely receptive to the concept.

“In Europe, it is accepted; in Asia, it is accepted,” she said. “We just signed with Blockchain and Sony, so we are building our membership pool. But the United States doesn’t quite get it yet; the executives don’t quite get it that part of what the Linux Foundation does is transform markets, and that can’t happen alone. It has to happen with 5G. It has to happen with Edge. It has to happen with automotive. It has to happen with blockchain. It has to happen with supply chain security. It has to happen with cloud. All of these things require a really high degree of cooperation.”

And for a naturally progressive industry like wind energy, the Linux Foundation’s expertise and experience make it an ideal entity to push its efficiency and success, according to Goodman.

“I see wind as a really big winner,” she said. “To the degree to which you have a product that you can’t get to market, I believe LF Energy is actually your vehicle to enable that market. I want to help you get to market.”