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Greener **DELIVERIES**

Transportation and logistics company FedEx recently broadened its involvement with renewable energy, with two rooftop solar projects in Connecticut, its first projects in the state, working with solar power developer, Verogy.

By Diane
Mettler



It can seem like everywhere you look these days, you see a solar rooftop solar facility being installed. There's good reason. It's estimated that there is 160+ gigawatts of solar rooftop capacity in the U.S.—enough to power 12 million homes. That's only a fraction of the potential, with only an estimated 3.5 percent of commercial buildings in the U.S. taking advantage of rooftop solar facilities.

Verogy, a Connecticut-based company, is tapping into this capacity. Two of its most recent installations went up on the roofs of FedEx buildings in Stratford (866 kW) and Middletown (2,075 kW), Connecticut. They are FedEx's first solar projects in the state and are designed to reduce the facilities' carbon footprint while providing reliable clean, zero-emission energy.

The company has been involved in solar projects elsewhere. In 2022, FedEx installed what was then one of the nation's capital's largest solar arrays on the roof of its Express Eckington Place facility. The 915 kW array in Washington, DC was created in collaboration with Sol Systems and provides power to the community and electricity credits to a local charitable organization. FedEx, which is a global logistics company, also has a number of other solar projects on facilities in the U.S., and overseas.

With the Connecticut projects, the FedEx rooftops were ideal for solar installations in that they were large and are not shaded. In addition, the large parking lots provided ample space for staging during construction. The projects took two to three years from development to completion. The process, says Jenna Behan, Verogy's Head of Marketing and Public Relations, included everything from permitting to how to stage the equipment to completion.

"There is often a lot of coordination with local officials," she said. "But since both these buildings were privately owned and they had large parking areas for staging building materials, it was a fairly smooth process."

Preparing for projects is a crucial piece of an installation. "Preparation was typical in terms of understanding existing property operations so that project mobilization can occur with low impact," says Verogy Project Manager Luke Galvin, of the FedEx projects. "There was a lot of communication, on-site visits, identifying ground space needs and receiving a clear understanding of regular operations and how the solar build activity nestled into daily operations."

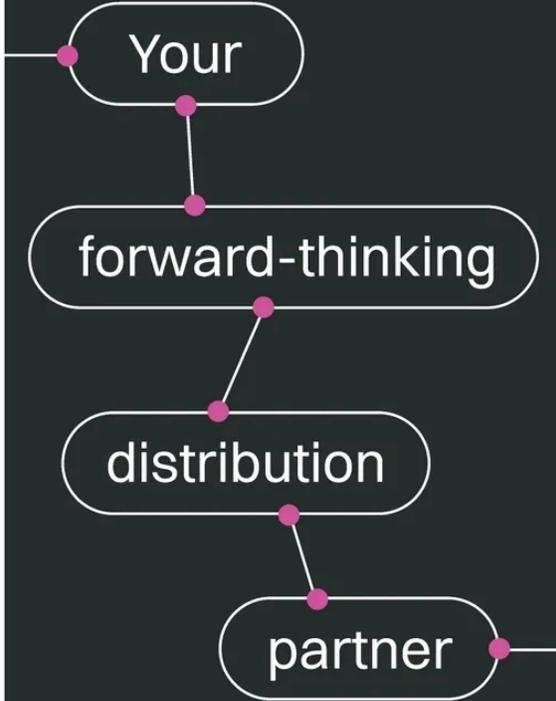
Galvin breaks the basic preparation into two pieces. First was the rooftop prep, which included walking, identifying the proposed solar area, and checking everything before installation and setting a target date.

The next step was to plan and coordinate the staging areas with the properties ahead of time, ensuring they wouldn't affect daily operations or transportation. Once the planning was complete, construction began. Galvin says there are two general activities that happen simultaneously—electrical and racking.

The racking for Stratford was done one section at a time. "Once the racking is laid out, then any necessary mechanical attachments were set and installed, then modules and string wire and wire management were completed. This project included 1,590 Phono Mono 545-watt modules and 11 Chint Power Systems inverters."

For Middletown, Galvin says racking installation was executed with additional crews working from opposite ends of the building, section by section.

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There were fifteen individual sections only connected by the wiring. And a heavier busway system was also installed for wire management. Once the racking was laid out, any necessary mechanical attachments were set and installed.

This rooftop included 3,800 Photo Mono 545-watt modules and 25 Chint Power Systems inverters.

Behan says the Photo Mono modules are fairly standard for their projects. "We like to use them. They're a Tier One piece of equipment, so they're the highest quality."

Verogy also used two different

Construction of the Connecticut solar projects went very smoothly, says Verogy. If there was a challenge, it was to get the planning and execution in place to have the least operational impact. But through the regular and consistent communications of Verogy with the FedEx team, the builds at each location were executed with minimal impact and maximum transparency.

racking systems. For the Stratford project they chose PanelClaw RF 10 and for the Middletown project used the Ironridge XR100 and S5! Clamps

"The only coordination with the municipality was for inspections," says Galvin. "The build team coordinated intermittent building and electrical visits throughout so the inspectors can mark and be knowledgeable on the process—installations meeting code requirements etc. It was critical that our communication with the municipality fos-

ters an engaged and cooperative relationship."

The project went very smoothly. If there was a challenge, it was to get the planning and execution in place to have the least operational impact. "Through the regular and consistent communications with the FedEx team, the builds at each location were executed with minimal impact and maximum transparency," says Galvin.

Both Behan and Galvin agree that the most important factor to a successful rooftop install is the team. The coordination between the suppliers and contractor with the building owner and/or occupant is critical says Galvin.

"You need seamless collaboration between all parties to coordinate that—deliveries, having the lifts there, getting everything up on the roof and then getting energized," says Behan.

Galvin adds, "When we work together efficiently with suppliers, projects are completed on time, within budget, and with optimal energy performance, maximizing long-term benefits for the property owner."

To complete this project in a timely manner meant clear communication between Verogy's on-site Construction Site Supervisors, (Tyler Goodall for Stratford and Mike Reola for Middletown). The two men set and led daily communications and coordination with the FedEx operations personnel.

"The importance of the site supervisors' efforts working with the building and our on-site build teams is what sets the expectations, and creates the cadence at which the build execution proceeds," says Galvin.

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"They really were the key to the success of each build."

Due to tremendous teamwork, Verogy finished the solar facility with no negative impacts to FedEx operations.

FedEx and Verogy chose to use a Power Purchase Agreement. Verogy will maintain ownership and FedEx will purchase the power at a discounted fixed rate. Behan says that FedEx will probably, however, use all the energy produced.

There were also state-level incentives with the FedEx project. "It's the

With the Connecticut projects, the FedEx rooftops were ideal for solar installations in that they were large and are not shaded. In addition, large parking lots provided ample space for staging during construction.

ZREC program and the LREC program—the Zero Emission Renewable Energy Credit (ZREC) and Low Emission Renewable Energy Credit (LREC) programs," says Behan. "They are Connecticut programs administered by the utilities. They have now been phased out by the NRES program—the Non-Residential Renewable Energy Solutions (NRES) Program.

"We like the new program," adds Behan. "It has front of the meter and behind the meter options, which is

great. We've had some pretty good success in the NRES program. We're actually coming to the end of that now. I think we're in the fourth year out of six, so we're coming to the end of it and I'm not sure what's on the horizon, so we'll see what the state has in store next."

Verogy, because it owns the install, will be handling the maintenance. Behan says that some people get worried about snow, but it's not a huge issue. "It just slides off."

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The panels that were chosen, she says, are durable and meant to be out there in the elements.

Verogy and FedEx are looking at the possibility of more projects outside the Connecticut area. Verogy is active in 21 states and these two installations are just the first two to be completed for FedEx, says Behan. "Many more, hopefully, to come down the pipe."

To handle these and many other projects, Verogy has been growing substantially over the last seven years. The company was founded in 2017 by six individuals and is currently 48 employees strong. Behan says Verogy is excited about the future. It is focusing on developing, constructing, and owning commercial, industrial, and small utility-scale projects. To date, they have already developed, financed, and constructed hundreds of solar projects across the U.S. And some of the more unique projects they are currently working on are solar facilities on capped landfills.

"We really pride ourselves on one point of contact and seeing a project all the way through from that initial stage to final completion," says Behan. "That would be one tier that we pride ourselves on and then the other would be just following through on expectations."

There are situations in the solar power industry of companies making an offer, making a proposal and then not being able to do it, she added. "They fluff the numbers too much and are not able to follow through and actually build the project. So, we really pride ourselves on our approach—maybe we don't win every single project if their numbers are accurate, but we want to be able to build every project that we win."

These two FedEx rooftops have been a win for both Verogy and FedEx, which has a goal to be carbon neutral by 2040. Combined, the two solar rooftops are expected to generate over 3,468,700 kilowatt-hours (kWh) of energy annually, which is enough to power 321 homes for a year. And the clean energy generated will offset approximately 2,423 metric tons of carbon dioxide annually, equivalent to the emissions produced by an average passenger vehicle driven nearly 6.2 million miles a year.

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Taking the plunge with **FLOATING SOLAR POWER**

The state of Ohio is taking the plunge with floating solar power projects, with one project completed, and another—the state's largest, at 2 MW—on the way.

By Tony
Kryzanowski

The business case for offsetting power costs for a variety of commercial and institutional consumers by including a renewable component like solar power continues to be strong—and companies are being very innovative in where these solar farms are being located if two new floating solar projects on water reservoirs in Ohio are any indication.

In business since 2015, Florida-based D3Energy has recently completed Ohio's first floating solar power installation and are embarking upon building the state's largest floating solar project for the City of Lima.

Ohio-based energy efficiency consultant MSI Utilities was instrumental in bringing together D3Energy with central Ohio water provider, Del-Co Water, in the first instance and the City of Lima with the second project.

Ray Eversole, Strategic Management Consultant with MSI Utilities, says that he has at least 10 more solar proj-

ects in Ohio at various stages of advancement on the books. Both he and D3Energy Managing Director, Stetson Tchividjian, remarked that they became aware that both Del-Co Water and the City of Lima were already interested in delving into solar power to offset their energy costs even before the successful business cases were put before them, which included their eligibility for various federal incentives and tax credits.

In both instances, because of the challenge of minimizing the footprint of a solar farm in areas where ground space is at a premium, the issues were where to site the solar farms and leveraging government incentives. Using the ample space on the surface of municipal water treatment facilities proved ideal.

The design of the Del-Co Water solar farm went even further in maximizing available above-ground space by installing solar panels on a nearby rooftop and carport as



Located in Delaware County, Ohio, the 1.5 megawatt Del-Co water solar project's floating array takes up about three acres of the raw water treatment plant's surface.

part of the overall installation.

"Del-Co had resigned themselves that they weren't going to be able to do anything large scale when it came to renewable energy on their system," says Tchividjian. "When MSI Utilities and D3Energy approached them about this concept of doing something on the water, they really fell in love with it because it was the perfect answer—and solution—for them."

He adds that floating solar arrays are proven as a viable endeavor and D3Energy has over a decade of experience working exclusively in this space, having built the most floating solar projects in the U.S. of various sizes and in a variety of climates.

Located in Delaware County, Ohio, the 1.5 megawatt (MW) Del-Co Water behind-the-meter project will offset about 50 percent of the utilities' energy costs to operate the facility. The floating array takes up about 3 acres of the raw water treatment plant's surface.

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"The interesting thing is that because we have so much more of a compact footprint than a ground system, had they looked to do this system on the ground, they would have needed closer to eight acres of land," says Tchividjian. "So in theory, by building on the water, they have conserved eight acres of valuable real estate there in Ohio."

Construction of the Del-Co Wa-

ter array began in early-2023 and it came online in the middle of 2024 after overcoming some delays with the local utility to gain approval to operate. Dealing with a floating solar array was a new experience for them so it took a bit longer. Construction was actually completed in late-2023. It consists of 2,921 bifacial solar panels supplied by Talesun Solar Technologies. The inverters were provided by

Appalachian Renewable Power was the local sub-contractor who installed the Del-Co water array for D3Energy. Energy management consultants MSI Utilities, which helps its commercial and institutional clients manage their energy consumption to reduce operational and utility costs, played a pivotal role in helping to advance both the Ohio floating solar projects.

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Chint Power Systems.

Appalachian Renewable Power (ARP), working in both Ohio and West Virginia, was the local sub-contractor who installed the Del-Co Water array for D3Energy.

The installation is owned by Gardner Capital which has negotiated a long-term power purchase agreement (PPA) with Del-Co Water. D3Energy helped to facilitate this arrangement and have worked with Gardner Capital many times in the past. D3Energy will continue to operate the system.

According to Eversole, in addition to playing a pivotal role in helping to advance both the Del-Co Water and City of Lima projects, MSI Utilities has been on the forefront of energy management consulting for over three decades by helping its commercial and institutional clients manage their energy consumption to reduce operational and utility costs. Over that time, brokering the inclusion of renewables to offset conventional power consumption has become a growing part of their services.

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What's notable with the Ohio floating solar arrays is that all the wiring is protected and above ground with only the solar panels situated on Ciel & Terre's floating pontoons. All of the inverters, switchgear and transformers are located on land beside the array. Both of the Ohio projects were welcomed by regulators and the public because they are producing renewable energy and not consuming any land for their development, which can be a common concern for solar developments.

<p>CARPORT 880 kW</p>	<p>SOLAR MOUNTS LLC</p>	<p>CARPORT 1.03 MW</p>
<p>GROUND MOUNT 3.3 MW</p>	<p>DESIGN MANUFACTURING INSTALLATION COMMERCIAL & UTILITY-SCALE SOLAR RACKING MADE SIMPLE</p>	<p>WALKWAY 186.84 kW</p>
<p>CARPORT 624.96 kW</p>	<p>RE+ TEXAS</p> <p>BOOTH #414</p>	<p>GROUND MOUNT 1.8 MW</p>
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Another valuable service they provide is helping clients become aware of available grants to help offset the cost of these installations, such as arranging power purchase agreements (PPAs), helping them to partake in grants available through the federal Inflation Reduction Act (IRA) and State incentives, and taking advantage of the Investment Tax Credit (ITC), while also helping them through the application process.

"We work with developers like D3Energy as well as more than 50 commodity suppliers who produce and supply energy in all deregulated markets across the U.S.," he says. "Not only do we assist in lowering the client's carbon footprint, we also help clients manage and budget their entire energy expenditures."

They are currently consulting on two more floating solar projects on water reservoirs in Ohio.

The Del-Co Water site is still connected to the AEP power transmission system so that when solar power is not being generated at night, the facility reverts to power consumption from their conventional power provider. The transition, as needed throughout the day and night, takes place automatically, with solar power being drawn about 60 percent of the time.

"Floating solar enabled us to move forward with a substantial solar installation without encumbering any of our valuable ground which may be needed for future expansion," says Glenn Marzluff, CEO of Del-Co Water. "We were also pleased with the possibility of reduced growth of algae related to sunlight reduction." The shade provided by the floating solar array also reduces water evaporation.

Tchividjian says that the utility is already considering expansion of the floating array to not only offset their entire power needs, but to also become a net producer of power to the utility grid in a community solar-type endeavor, given the success of this project.

The recently-approved City of Lima 2 MW project, also being constructed by D3Energy, will float on four acres of the Twin Lakes Reservoir, next to the City's water treatment plant. Power generated from this floating array is expected to take a significant bite out of the \$200,000 annual cost the City says it takes to operate the treatment plant. It will consist of about 3,700 solar panels.

They add that building the project will cost \$5.3 million, and will be significantly subsidized by a \$2.4 million grant from the federal Department of Energy and \$889,000 in tax credits from the federal Inflation Reduction Act, reducing the total cost to the City to only \$2 million. Like the Del-Co Water project, saving valuable ground space was an issue.

D3Energy says that it will look to implement a similar team to the successful Del-Co Water project for the City of Lima array. Details will be available when final engineering has been completed.

One of the obvious questions about building a solar array on water are the nuances that exist, since water is a good conductor of electricity. Tchividjian says that Ciel & Terre's Hydrelia floating system, which is a purpose-built system intended for floating solar arrays, is being used in both these installations and D3Energy are a distributor of the system in the U.S., having worked with them for the past decade.

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Ciel & Terre describes floating solar as the third pillar of solar installations, the other two being ground-mount and rooftop systems.

The company has supplied 325 of its floating solar systems worldwide and introduced the first patented and industrialized solution to the world in 2010. It is called the Hydrelío Classic system. Recently, the company announced its new Hydrelío aiR Optim system which is an upgrade of the Classic, resisting strong winds up to 130 miles/hr and UV stabilized for 30 years. It is also described as corrosion resistant and drinking water compatible.

What's notable with these floating solar arrays is that all the wiring is protected and above ground with

Ciel & Terre's Hydrelío floating system, a purpose-built system intended for floating solar arrays, is being used in both the Ohio installations. D3Energy is the distributor of the system in the U.S., having worked with them for the past decade.

only the solar panels situated on Ciel & Terre's floating pontoons. All of the inverters, switchgear and transformers are located on land beside the array.

"It's very similar to a ground-mount system, electrically-speaking," says Tchividjian. "Ten years ago, folks were giving us kind of crazy looks talking about putting solar panels on water. It's been fun to be at the forefront of this piece of the industry and really driving it forward. Now, we are seeing the fruit of that early labor really blossom because we have been able to become an industry leader in this niche part of the industry."

In terms of cost, he adds that it re-

ally depends on the project. Taking the Del-Co Water example, if they had to purchase or dedicate three acres of land near their site, then that system would have been considerably more expensive than building it on water. In terms of pure capital expense, he says a floating system is generally a little more expensive than a ground-mount system but cheaper than a rooftop system.

Both of these projects were welcomed by regulators and the public because they are producing renewable energy and not consuming any land for their development, which is a common concern for all solar developments. e

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Application Advantages and Technical Considerations of 690-800V AC Inverters

By Brian Nelson and Mark Sauls

The opportunity for community solar/distributed generation PV plants, typically at 5 MW and below, is growing. To take full advantage of this opportunity, the industry is in the midst of a technical transition to higher power densities in the solar collection system.

The solar power industry is constantly evolving, driven by the need for increased efficiency, reduced costs, and enhanced sustainability. One of the most impactful shifts in the industry is the move towards higher AC voltages, specifically 690-800V AC. This trend is particularly significant for community solar and distributed generation (DG) PV plants. By leveraging these higher voltages, developers can achieve reduced balance of system (BoS) costs, simplified plant architecture, and enhanced overall performance. This article explores why 690-800V AC is gaining traction in the U.S. and globally, and how it affects system design, equipment selection, and operational efficiency.

Historically, most AC collection equipment for solar PV plants has been rated at 600V AC. However, since 2018, string inverter manufacturers have started offering equipment with nominal output voltages ranging from 690-800V AC. This shift is largely driven by the need to maximize efficiency and minimize costs in increasingly competitive energy markets. Higher voltages allow for more efficient energy transmission, reducing resistive losses and increasing overall system performance.

Modern string inverters with 690-800V AC capability offer Multiple Maximum Power Point Tracking (MPPT), allowing for optimal energy harvest from each string of solar panels. This eliminates the need for a DC combiner box, simplifying the system architecture and reducing the number of components that can fail over time. In addition to simplifying the design, removing DC combiners reduces thermal losses and improves overall energy yield. Furthermore, by utilizing multiple MPPTs, the system can efficiently manage shading or mismatched modules, further enhancing performance. However, in some cases where a DC combiner box topology is advantageous (repower and virtual central requirements) there are now inverter offerings at 690-800V AC with single MPPT functionality.

Higher AC voltages allow for more efficient power distribution across the plant. By increasing the voltage, current is reduced for the same power output, leading to lower resistive losses and improved overall efficiency. This facilitates a simpler plant architecture by reducing the number of parallel circuits needed, leading to a more streamlined and cost-effective design. Additionally, higher voltages allow for longer cable runs without significant power losses, enabling more flexible plant layouts.

One of the most compelling reasons to move towards 690-800V AC is the significant reduction in BOS costs. Higher AC voltages allow for smaller conductor sizes, reduced conduit requirements, lower ampacity switchboards, and fewer connections. These cost savings are especially impactful in large-scale community solar

and DG projects, where extensive cabling and infrastructure are needed. By optimizing the system design with higher voltages, developers can achieve substantial cost reductions without compromising performance or safety.

The 690-800V AC systems enable higher power throughput, allowing for more efficient energy harvesting and distribution. This is particularly beneficial for maximizing the output of community solar installations, where space and infrastructure costs are critical considerations. Additionally, by reducing material usage and increasing system efficiency, 690-800V AC contributes to enhanced sustainability and a lower carbon footprint for solar energy projects. This supports global renewable energy goals by promoting efficient, scalable, and environmentally friendly solar power solutions.

Main breakers for 690-800V AC systems (now UL listed and readily available in the U.S.) must be designed with higher insulation distances, separations/phase barriers, and appropriate positioning of anchor plates. Separations and phase barriers are essential to prevent phase-to-phase faults and ensure safe operation. Insulating materials with high dielectric strength are necessary to withstand the increased electric field intensity associated with higher voltages.

Feeder breakers (also UL listed and available in the U.S.) play a critical role in protecting individual inverter circuits within the AC collection system. For 690-800V AC systems, considerations include insulation distance, separations/phase barriers, and reliable power connections. Increased insulation distances are required to prevent dielectric breakdown. Additionally, robust phase barriers and secure power connections are necessary to ensure safe and reliable operation under high voltage conditions.

In summary, the shift towards 690-800V AC in community solar and DG PV plants offers significant advantages, including reduced BoS costs, higher power output, and enhanced sustainability. However, it also introduces new challenges in system design, equipment selection, and safety compliance. Developers must carefully consider switchboard design, main and feeder breaker requirements, and compliance with UL and NEC standards to fully realize the benefits of 690-800V AC systems. By understanding the global trends driving this shift and making informed design decisions, solar developers and engineers can enhance the efficiency, reliability, and profitability of their solar PV plants.

As the industry continues to evolve, embracing higher voltage solutions will be essential for staying competitive and meeting the growing demand for renewable energy.

Brian Nelson is the Renewables Segment Leader at ABB (<https://electrification.us.abb.com/industries/renewable-energy>). Mark Sauls is Vice-President of Sales/Operations for EPEC Solutions (<https://epesolutionsinc.com/>).

Ask the Energy Experts

As part of the effort to support the industry in moving renewable energy forward, enerG is running a regular feature, Ask the Energy Experts, that poses a topical question involving renewable energy to industry representatives. Our question this issue is:

Q: What is the most surprising thing you've learned about renewable energy since you started in the business?

We thank our experts for participating!



**Brian Ghiglia, Vice-President Sales, REC Americas LLC
(www.recgroup.com):**

"The most surprising thing I've learned over 17 years in the industry is that most consumers continue to be under-informed about the value of renewable energy. In the residential segment, lack of consumer awareness translates into staggeringly high acquisition costs. In C&I, market penetration is stymied by an under-informed customer segment and compounded by a protracted sales process. The utility segment has distilled the value proposition most effectively, and yet there continues to be misinformation that deters ratepayers from clearly understanding that value. Demystifying solar remains a challenging problem across all segments. While solar power becoming mainstream may feel distant, I'm reminded every day of our industry's resilience, and the massive opportunity ahead."



**Noah Fulmer, Marketing Specialist, Solar Mounts LLC
(www.solarmounts.com):**

"When I entered the solar power industry, I was surprised to see the impact aesthetics can have on solar acceptance and adoption, especially in commercial and large-scale settings. It wasn't just about energy efficiency; the visual appeal of solar racking systems has proven to be a game changer. Low-profile solar structures blend seamlessly into architectural designs without disrupting the artistic appearance. Solutions like solar carports and walkway shading canopies have become increasingly popular and important features in parking lots and business spaces that are looking for clean power, overhead coverage, and visual appeal."



Dan Smith, Chief Technology Officer and Co-Founder, Affordable Wire Management (www.affordablewm.com):

"I've been surprised by the inconsistent enforcement of bonding and grounding standards in the utility-scale solar and storage industries. Safe bonding requirements outlined by UL2703, NEC Article 250, and IEEE comprehensively cover most metallic components within PV systems. However, plastic-coated metal cable hangers are 'exempt,' presenting long-term safety concerns. Plastic insulation isn't regulated for maintaining electrical integrity or rising, prolonged cable temperatures during a 40-year lifespan. In contrast, metallic hangers facilitate immediate dissipation of fault currents through a reliable grounding path, ensuring construction workers' and O&M teams' safety. Rigorous testing and compliance with established standards are critical. We must move beyond minimal compliance and raise the industry standard for cable management solutions to prioritize safety, reliability, and sustainable system performance."



**Chris Barrett, Senior Director of Systems Engineering, Yotta Energy
(www.yottaenergy.com):**

"I was (and continue to be) shocked to learn that many in the renewable energy industry don't grasp the difference between STC and PTC (NOCT) for solar modules. STC rates panels at peak power under ideal lab conditions, while PTC, using NOCT, reflects real-world performance by factoring in higher operating temperatures that reduce efficiency. This gap, e.g. a 300W STC module dropping to ~270W PTC, can skew system design and energy forecasts. It's surprising how this critical distinction, vital for accurate sizing and financial planning, remains misunderstood, potentially undermining the reliability of solar projects." **e**



Guest Column

The rapid expansion of data centers across the U.S. and the critical role of renewable energy in powering the grid

By Norm Russell, Chief Revenue Officer, American Wire Group

The demand for data centers across the U.S. is surging at an unprecedented rate, driven by advancements in Artificial Intelligence (AI), cloud computing, e-commerce, and the ever-growing need for digital storage. This demand has generated an unprecedented demand for power and connectivity, and raises critical concerns about energy consumption, sustainability, and how to meet these needs.

Renewable energy has emerged as the most cost-effective and environmentally responsible solution to meet the rapidly growing power supply demand.

Data Center Growth Trends

Data centers are proliferating in major metropolitan areas and rural regions alike. Key factors driving their growth include:

- Cloud Adoption: Increased reliance on cloud-based services.
- 5G Deployment: More connected devices demanding low latency.
- AI Workloads: Advanced computing needs requiring high energy.
- Remote Work: The shift to virtual collaboration increasing demand.

The rise of AI and machine learning has further intensified the need for high-performance computing, increasing energy consumption per facility. Recent projections indicate that the U.S. will need to build at least 1,000 additional large-scale data centers within the next decade to meet the increasing demand.

Virginia is the largest data center market in the world with over 500 data centers and is home to 35 percent of all known hyperscale data centers worldwide. Texas, Ohio, Arizona, and Georgia are emerging as major data center destinations due to their lower land costs, favorable tax incentives, and growing access to renewable energy sources. However, as new data centers come online, their electricity demand is placing unprecedented pressure on the nation's power grid.

Empowering the Digital Revolution

According to the Department of Energy (DOE), it's estimated that data centers in the U.S. currently account for 4 percent of the country's total electricity consumption. This number is expected to rise to between 6.7 percent and 12 percent by 2028.

Ensuring a stable and sustainable power supply for these centers is a top priority. Traditional fossil fuel-based energy sources, while historically reliable, are increasingly being replaced by renewable alternatives due to both cost and environmental concerns. Many states are implementing stricter carbon reduction goals, and major corporations—including data center operators—are committing to ambitious sustainability targets. As a result, renewable energy has become the preferred solution for powering these critical facilities.

Power Demand and Renewable Energy Integration

Wind and solar power have seen dramatic cost reductions over the past decade, making them more affordable than traditional fossil fuel power generation in many regions.

According to the DOE, the levelized cost of electricity (LCOE) for utility-scale wind and solar is now lower than that of coal and natural gas in many parts of the country.

Additionally, renewable energy projects benefit from long-term price stability. Unlike fossil fuels, which are subject to volatile market fluctuations, renewable energy sources provide a predictable and stable cost structure. This is particularly appealing for data center operators, who require reliable and cost-effective power to maintain operations.

Many of the nation's leading data center operators have already embraced renewable energy through direct power purchase agreements (PPA) with wind and solar farms. These agreements allow companies to secure long-term access to clean energy at fixed prices, reducing their exposure to energy market volatility, while also supporting sustainability goals.

Grid modernization efforts, including energy storage solutions and improved transmission infrastructure, will play a crucial role in ensuring a stable and resilient energy supply. Battery storage technologies are advancing rapidly, helping to mitigate the intermittency of renewables by storing excess power during peak generation periods and distributing it when demand is high.

Collaboration between data center operators, utilities, and policymakers will be key in facilitating this transition. Continued investment in renewable energy infrastructure, coupled with regulatory support for clean energy initiatives, will ensure that the digital economy can continue to grow sustainably.

The Role of Wire & Cable

Data centers rely on a diverse range of wires and cables to maintain uninterrupted operation. From fiber optic and data cables to low- and medium-voltage power cables, a robust infrastructure is essential for efficiency and scalability.

Wires and cables are critical to data center infrastructure, supporting both power transmission and data connectivity.

As renewable energy integration increases, durable, high-performance cables are vital to ensuring system reliability and operational efficiency.

Outlook

The rapid expansion of data centers across the U.S. underscores the urgent need for sustainable and reliable power solutions. As demand for digital services accelerates, integrating renewable energy into the power supply has become not just an option, but a necessity. The role of renewables and cable technologies will become even more intertwined. Innovations in wire and cable solutions, energy storage, and smart grids will play a crucial role in shaping the future of sustainable data centers.

American Wire Group (www.buyawg.com) specializes in wire, cable, hardware and equipment solutions for wind, solar, EV, battery storage, and other renewable energy sectors.

Generating wind-powered megawatts in **WINDY WYOMING**



The state of Wyoming, more known for its huge reserves of coal, is moving into renewable energy, the most recent example being Innergex's 330 MW Boswell Springs wind power project, the company's second largest wind farm in North America.

By Paul
MacDonald

When it comes to energy, the state of Wyoming is truly at the head of the pack.

For decades, Wyoming has been a leader in providing American utility companies with the coal that powers American power plants, and keeps the U.S. economy humming.

In recent years, though, Wyoming has been one of the leading states in developing renewable energy, as more wind and solar power has been produced in the Cowboy State. And longer term, the sparsely populated state—the entire state, at about 584,000 people, has fewer people than Louisville, Kentucky—could produce huge amounts of renewable power for other more popu-

lous states, such as California.

A recent renewable energy addition came last year, with Innergex's \$534 million, 330 MW Boswell Springs wind project. It is, in fact, the company's second largest wind farm in North America, just behind its 350 MW Foard City wind project in Texas. The company, which develops and builds renewable energy projects, currently has 90 facilities in operation, with 4,662 MW of installed capacity in the U.S., Canada, France and Chile.

The Boswell Springs project is located in Albany County, in the southeastern part of the state. The county borders on Colorado. The nearest town is Rock River, about 40 miles northwest of the city of Laramie.



The project site itself spans about 21,500 acres of private land which is largely undeveloped, and used for grazing cattle. The project, and its wind turbines, uses a small fraction of that land base, allowing the grazing to continue, virtually uninterrupted.

The almost 100 GE wind turbines on the project have power generation of 1,160 gigawatt-hours/year, enough to power 113,000 Wyoming households. The electricity being produced by the Boswell Springs wind project is being sold under a 30-year, 320 MW busbar Power Purchase Agreement with PacifiCorp, a Berkshire Hathaway subsidiary.

Julie Turgeon, Vice-President of Construction for Innergex, noted that the company had been working on the Boswell Springs wind project for several years. As with any major renewable energy company, she explained that Innergex has a number of projects in the pipeline at any point, and that projects move ahead as the company deals with any development matters, and lines up an off-taker, as it did with PacifiCorp.

Mortenson was the EPC on the Innergex Boswell Springs project. Its scope of work included access roads, foundations, underground collection, substation, and erection of the almost 100 turbines. The project involved building 12 miles of new road, and upgrading some 20 miles of existing road.

“From there, it depends a lot on the project how we approach it, choosing the type of wind turbines and securing equipment beforehand, or not—it’s site specific, and we have different strategies around different projects,” she explained.

Innergex’s renewable energy facilities are developed and operated with adherence to environmental guidance and regulations from agencies, development codes and best practices. On Boswell Springs, a series of studies and surveys on environmental resources was conducted over a number of years, including birds, plants, animals, cultural resources and socioeconomics to understand project constraints and setback to make informed decisions to minimize, mitigate or avoid environmental impacts.

While Boswell Springs represents

the company’s first project in Wyoming, Innergex has other renewable projects in the region. It has the Horseshoe Bend 9.5 MW run of river project and the 138 MW Mountain Air wind project in neighboring Idaho, to the west.

Turgeon explained that Wyoming, generally, has large private landholdings, so they only had to deal with one landowner for the Boswell Springs project. This compares with some other U.S. states where there can be more landowners to deal with because individual land ownership is in smaller acreages, and is agricultural land that is used to grow crops vs. the grazing land in Wyoming. There were several landowners they had to deal with in construction of the 34.5-mile transmission line.

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As with all the projects Innergex is involved with, the company works with landowners to keep them informed as projects are developed and built.

"It's really a partnership," Turgeon says. "We are going to be using their land and we want to make sure the project is implemented the way they want it—for example, if there are any areas they want to protect or areas where uses need to be accommodated.

"We have a continuous relationship with the landowners—when we are on site during construction, and after a project is built, they know exactly who is in charge of the project for Innergex."

They also work closely with local communities, such as Rock River or Medicine Bow. These towns of about 250 people each were closely consulted on what the project would involve, and a number of community meetings were held. This is especially important with smaller towns as a

project involves hundreds of huge trucks containing turbine equipment going through, or near, nearby towns.

Turgeon explained that being a good neighbor is a priority for Innergex. It has a long and successful track record of developing and operating high quality, environmentally responsible and socially acceptable renewable projects across the U.S.—and around the world. The company will be the long term operator of Boswell Springs.

When building projects, Innergex works to maximize local benefits, giving preference to hiring local people, consultants and contractors. Boswell Springs is expected to contribute \$79 million in property taxes, \$34 million in wind generation taxes and \$19 million in sales and use taxes over its 30-year lifespan.

Turgeon noted the area lends itself to wind power.

"It's pretty flat ranch land with quite a good constant wind, she said. "The wind resource is pretty stable because there are no obstacles,

no mountains and few trees."

Innergex arranged for the two main power transformers for the project, and dealt directly with GE for supplying the turbines. Mortenson was the EPC on the Boswell Springs project. Its scope of work included access roads, foundations, underground collection, substation, and erection of the almost 100 turbines. The project involved building 12 miles of new road, and upgrading some 20 miles of existing road.

Crane company Bigge's heavy-lift cranes were integral to turbine erection on the project. Its fleet, which includes eight cranes—four Crawler Cranes and four Rough Terrain Cranes—was on-site for five months. The Liebherr LR1800 cranes, equipped with a 325' main boom and 49' jib, are specifically designed to handle the demanding challenges of wind turbine construction. The turbines are aligned in north to south rows on the project site.

American Energy Inc. (AEI) built the 230 kV transmission line that connected with the PacifiCorp network.



Wyoming's geography of high altitude prairies with broad ridges makes the state an ideal site for the development of wind resources. Plans indicate that thousands of megawatts of wind power generation are coming to the Cowboy State's wind alleys.

such a large project, with two major contractors and, at peak, 300 construction workers on site.

"Our team's job is to ensure that all the pieces are aligned, and if there are changes, we communicate that. We meet on a daily basis, look at the work that is going on that day, and forecast what work is coming up. During construction, Innergex had a crew of four people who basically moved their lives to be nearby for the duration of the project."

Jason Sirois, who was the site engineer on site, is an example—he lives in the Canadian province of British Columbia, and moved to Wyoming for the project. Sirois has experience in building wind, solar and hydro projects.

"Our Innergex people bring outside the box expertise so when the teams are facing challenges or the contractors are facing challenges, we can bring a focus on completing the project, and deliver a reliable project that is going to be working for 35 years to the Innergex operating group," says Turgeon.

Innergex and its contractors brought plenty of skill and resourcefulness to building the project, with some unexpected high winds.

"Usually the summer is more of a quiet time in wind in this area, so

you can install the turbines then," explained Turgeon. "But we faced a lot of high winds in the spring and summer.

"But Innergex and its contractors and people brought ideas to deal with this, and we started to do erection work at night," she said. "That is where people bring cohesion and team spirit to a project, and figure out innovative ways to make sure we deliver the project on time."

When asked about the biggest challenges the project faced, Turgeon had a quick response: "Weather, weather, weather."

"With winter, you never know when it's going to start." When it was in full swing, they had upwards of seven feet of snow in some areas on the site, because of snow drifts. Roads can close in this area of Wyoming due to heavy snow, and at times they had to obtain special permits to continue to use some roads during construction.

"We had a small time window for the work and we had a buffer, but because of the high winds and the winter weather, that window got smaller," says Turgeon. But pulling together, they were able to complete the project before the window closed—and on time.

Having experienced people and contractors is a solid plus for any project, and often things go smoothly. But when a project runs into challenges that's when people rise to the occasion, and really put their talents to work.

The project's power connects into the PacifiCorp power grid at the PacifiCorp Freezeout substation in Carbon County, Wyoming, about 35 miles west of the wind project, via the Last Mile Transmission project.

Turgeon stressed that co-ordination and communication is key on

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While there will be changes to renewable energy-related legislation with the new Trump Administration, Innergex tapped into Inflation Reduction Act (IRA) funding, introduced by the Biden Administration, for Boswell Springs. The project is potentially eligible for up to 120 percent of Production Tax Credits (PTC), which includes a 10 percent Energy Community PTC Bonus and a 10 percent Domestic Content PTC Bonus. The project is eligible to benefit from the Energy Community Tax Credit PTC Bonus due to its location in an “energy community”, as defined in the Inflation Reduction Act. The eligibility for the 10 percent Domestic Content PTC Bonus is currently being evaluated, which should further enhance the profitability of the project.

There is more to come for Wyoming wind power, and there are still plenty of wind resources to tap into in the state. According to the National Renewable Energy Lab (NREL), southeast Wyoming has one of the densest concentrations of high

Crane company Bigge’s heavy lift cranes were integral to turbine erection on the Innergex Wyoming project. Its fleet, which includes eight cranes—four Crawler Cranes and four Rough Terrain Cranes—was on-site for five months. The Liebherr LR1800 cranes are specifically designed to handle the demanding challenges of wind turbine construction.

class wind energy potential in the country. NREL data shows that over 50 percent of the best quality (Class 6 and 7) wind capacity in the continental U.S. is located in Wyoming. This Class 6 and 7 wind resource has an energy potential of 235,000 GWh/yr.

Wyoming’s geography of high-altitude prairies with broad ridges makes the state an ideal site for the development of wind resources. Plans indicate that thousands of megawatts of generation are coming in the Cowboy State’s wind alleys of Albany, Carbon and Converse counties, for instance.

Construction work has already started on the 600-turbine, 3,000 MW Chokeycherry and Sierra Madre wind farm in Wyoming, with its \$5-billion price tag. It will become the largest wind project in the U.S. when it is completed. In the specific Chokeycherry and Sierra Madre proposed

project area, NREL data shows the wind power resource potential as “excellent,” “outstanding” and “superb.”

As for Innergex, the Boswell Springs wind project was officially commissioned in January 2025, and the company is working on developing renewable energy projects in other places. It recently completed a power storage project in Chile, and has announced wind power projects in the Canadian provinces of British Columbia and Quebec, the latter with Hydro-Québec and Indigenous Communities. Hydro-Québec is a major power exporter to the northeast U.S.

Innergex has other U.S. wind and solar projects in its project pipeline. It currently has renewable energy operations in six U. S. states including—now—Wyoming. e

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Clean Energy Industry



North American WIND

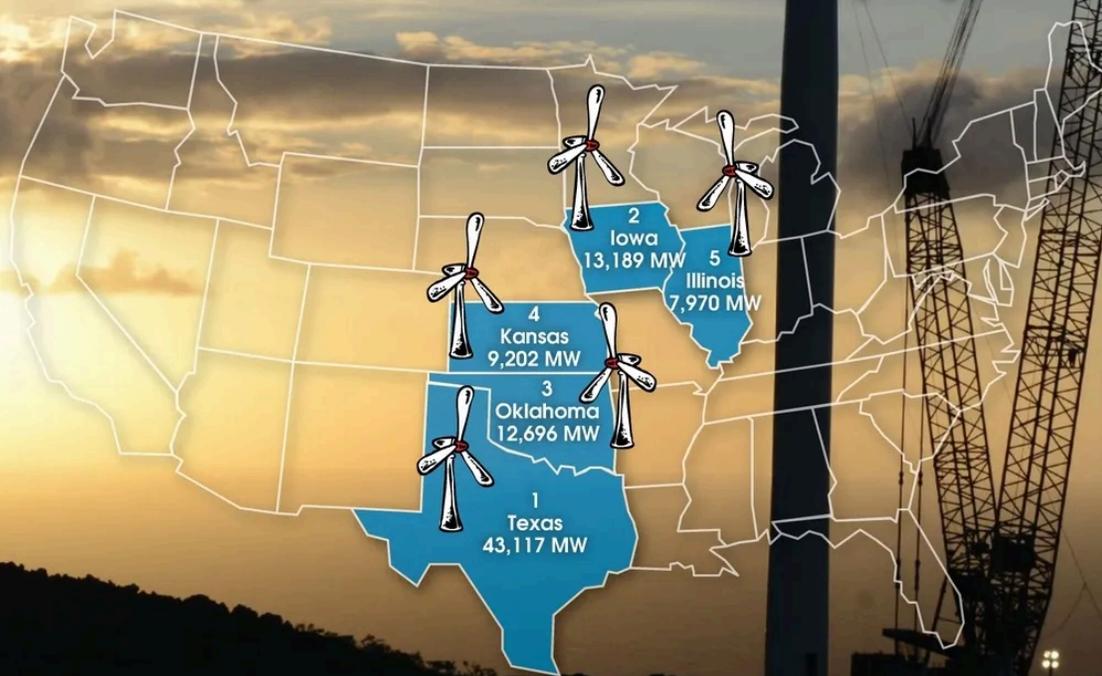
U.S. wind power generating capacity at the end of 2024—154,783 megawatts (MW)

Across 13 states, 25 land-based wind projects began operations in 2024. Ten states brought online more than 100 MW of capacity

Wind generating capacity installed in 2024: 4,058 MW

- ▶ Of the total of 4,058 MW of wind power added during 2024, 3,926 MW was land-based wind power, and 132 MW was offshore wind power.
- ▶ Land-based wind remains the most abundant U.S. clean power technology with 154,609 MW installed. Offshore wind power capacity is now 174 MW.
- ▶ The U.S. offshore wind industry reached a new deployment milestone in 2024, installing the country's largest project to date in March 2024. The 132 MW South Fork Wind project, off the coast of New York State, marks the first large-scale offshore wind project to begin commercial operations in the U.S.

The Top Five U.S. States in Wind Power Capacity



Top five operating U.S. wind farms

1. Western Spirit Wind, 1,056 MW, New Mexico
2. Great Prairie Wind (Firewheel Wind), 1,029 MW, Texas
3. Traverse Wind Energy Center, 996 MW, Oklahoma
4. Alta Wind Project, 946 MW, California
5. Los Vientos, 912 MW, Texas

All numbers are to the nearest MW. Sources: American Clean Power Association: www.cleanpower.org, the Canadian Energy Research Institute: www.ceri.ca

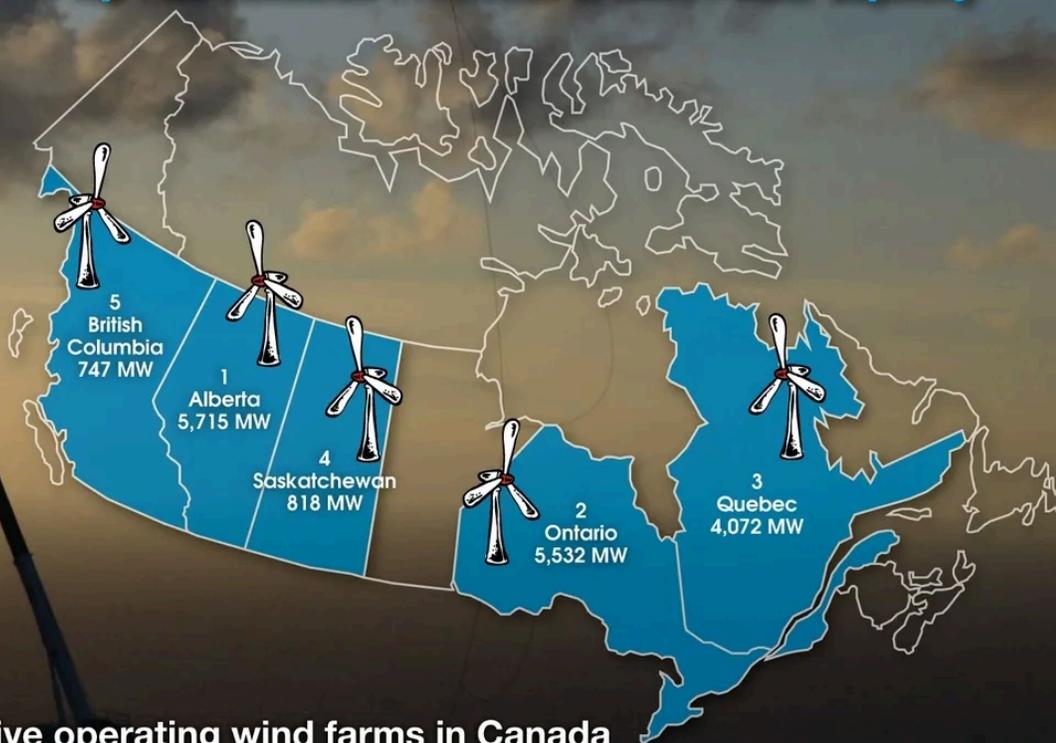
POWER *Fast Facts*

Canadian wind power operating capacity at the end of 2024—18,434 megawatts (MW)

Wind generating capacity installed in 2024: 1,448 MW

- ▶ With the start-up of the Buffalo Plains wind farm, the province of Alberta is now Canada's leader in wind power, with 5,715 MW of wind power capacity.
- ▶ Canada's wind power capacity has grown 35 percent in the past 5 years (2019-2024), and the country now has 341 wind energy projects.
- ▶ Canada's total wind, solar and storage installed capacity is now more than 24 GW, including over 18 GW of wind, more than 4 GW of utility-scale solar, 1+ GW on-site solar, and 330 MW energy storage.
- ▶ There was a major wind power announcement in late-2014. BC Hydro selected nine wind energy projects in a call for power in the province of British Columbia. These projects total 1,531 MW of capacity, enough to power 500,000 new homes. The development and construction of these new projects are expected to generate between \$5 billion and \$6 billion (Cdn.) in capital spending.

The Top Five Canadian Provinces in Wind Power Capacity



Top five operating wind farms in Canada

1. Buffalo Plains Wind Farm, 466 MW, Alberta
2. Henvey Inlet, 300 MW, Ontario
3. Blackspring Ridge Wind Project, 300 MW, Alberta
4. Sharp Hills Wind Farm, 297 MW, Alberta
5. South Kent Wind Farm, 270 MW, Ontario

end of December 2024.
Canadian Renewable Energy Association (CanREA) www.renewablesassociation.ca

SOLAR powering HEALTH CARE in Utah



Intermountain Health is celebrating a major advancement in its sustainability efforts with the opening of the 40 MW Castle Solar Farm in Utah, which will provide power for several Intermountain hospitals and clinics.

By Robin
Brunet

Hospitals are distinct among public facilities in that they require an unusual amount of reliable power, due to the large number of services and equipment that are operated around the clock and year-round.

So the recent opening of the Castle Solar Farm near the Emery County town of Huntington in Utah is a breakthrough not only for the high costs associated with hospital energy consumption, but on a broader basis, for the solar power industry.

The integration of solar power in healthcare facilities can provide many benefits. Solar power helps health facilities save money, which can be reinvested to support other priority health programs. Facilities can generate their electricity, significantly reducing energy costs and reliance on the grid. This cost-saving aspect is particularly crucial for healthcare institutions, which are among the largest consumers of energy and face substantial electricity expenses.

The 40-megawatt Castle Solar Farm, situated 140 miles

southeast of Salt Lake City, was contracted by Intermountain Health to produce enough electricity over the next 20 years to offset the total annual use of 17 Intermountain Health facilities, including 10 hospitals, resulting in a cost savings of over \$500,000 annually.

"This is one of the biggest sustainability investments we've ever made, and we will be seeing benefits for decades to come," said Eric Liston, Vice-President of Clinical Services for Intermountain Health—whose system includes 33 hospitals, approximately 400 clinics, a medical group, a health insurance company, and other health services.

"By making a cleaner environment in the communities that we serve, Intermountain is helping our patients live the healthiest lives possible," added Liston.

Utah's Enyo Energy, an independent wind, solar and storage company that specializes in developing utility-scale energy projects in the Intermountain West, originally developed Castle Solar. D.E. Shaw Renewable Investments (DESRI) acquired the project in 2020 and

The integration of solar power in healthcare facilities such as Utah's Intermountain Health can provide many benefits. Solar power helps health facilities save money, which can be reinvested to support other priority health programs. Facilities can generate their own electricity, significantly reducing energy costs and reliance on the grid.

the following year commenced construction of the farm on 450 acres of largely state trust lands.

NORD/LB, the National Bank of Canada, and City National Bank provided financing for the deal, while U.S. company SOLV Energy provided engineering, procurement and construction work at the project; DESRI will continue to provide operations and maintenance services in the future.

DESRI's guidance of the project is particularly apt. It is a leading developer, owner and operator of renewable energy projects in the U.S. and has a sizeable portfolio of solar projects currently in operation in Utah, one of the most recent being the 80 MW Elektron Solar facility in Tooele County. Castle Solar represents the

third solar project the company constructed in Emery County.

"Despite supply chain constraints in the past few years, we are glad to continue to deliver new projects for our partners," said Hy Martin, Chief Development Officer of DESRI, referring to PacifiCorp and the University of Utah, which in addition to Intermountain Health are recipients of Castle Solar's energy output (local utility Rocky Mountain Power, a subsidiary of PacifiCorp, is providing the transmission to the grid for the electricity generated at the solar plant).

The two DESRI-developed power purchase agreements with Rocky Mountain Power are key to the project's success. They were signed under the utility's Schedule 34 program, a system by which it can acquire power from a range of projects with a capacity of greater than 5 MW, to serve a number of customers. These customers can aggregate their electricity demand, to enable them to acquire power en masse from utility-scale renewables projects, and include Salt Lake City and Utah Valley University.

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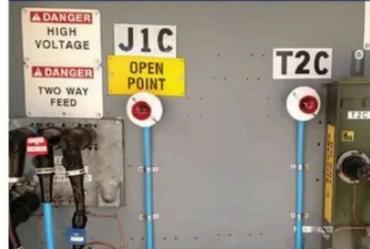
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While Castle Solar is a remarkable addition to Utah's solar landscape, the farm's development was aided greatly by the commitment of institutional and government bodies to making renewable energy a significant part of their operational portfolios.

Arguably, the University of Utah's participation in the project wouldn't have occurred had not the institution developed a thriving Sustainability & Energy group, which promotes maximum energy-efficiency at the university and reduces energy costs using utility procurement, incentives, and rebates. It also uses its role as a utility billing partner to identify other improvements in utility usage, such as electricity, natural gas, water, process water, and sewer.

The 40-megawatt Castle Solar Farm, situated 140 miles southeast of Salt Lake City, was contracted by Intermountain Health to produce enough electricity over the next 20 years to offset the total annual use of 17 Intermountain Health facilities, including 10 hospitals, resulting in a cost savings of over \$500,000 annually.

All of the group's efforts are geared towards making the university carbon neutral by 2040, and its early efforts in this regard are impressive: the university exceeded its goal of reducing energy by 20 percent by 2020 as part of the U.S. Department of Energy's "Better Buildings Challenge."

With regard to Castle Solar, Lissa Larson, Associate Director, University of Utah Sustainability & Energy, pointed out during a ribbon cutting ceremony that the project "will provide more than 20 percent of the university's purchased electricity," making "a measurable impact on the university's carbon footprint and stabilizing our operational costs."

She added that the solar farm, coupled with a geothermal energy contract signed in 2018, has resulted in the university's operations now deriving nearly 70 percent of its electricity from renewable sources.

At least some portion of the university's interest in Castle Solar pertained to economics. Thanks to the solar farm, the institution benefits from a fixed electricity rate for 25 years, providing predictable energy costs; and if the trend of rising electricity prices since 2010 continues, it is projected to save nearly \$40 million over the contract's duration without any increase in operational expenses.

Larson also pointed out to attendees that hundreds of jobs were created during Castle Solar's construction, and the project will generate substantial tax revenue for Emery County over its lifetime (the lease agreement will return some funds to Utah because the project was sited on state trust lands, which raise revenue to support public schools and institutions).

As for Castle Solar's other beneficiary and Utah's largest private employer, Intermountain Health views sustainable operations as an opportunity that coincides with its advocacy for healthy behaviors and business practices. Intermountain's main target is air pollution and has invested considerable resources to improve air quality, including a partnership in 2018 with Rocky Mountain Power and its Wattsmart Business Program to swap out all fluorescent lighting with LED lighting in all of its hospitals that year while making additional adjustments to reduce energy consumption.

From a national perspective, the Castle Solar project

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is presumably favoured by the U.S. Department of Energy (DOE), whose Office of Energy Efficiency and Renewable Energy states that, "Rapidly rising energy costs and tightening regulations on carbon emissions are making renewable energy increasingly compelling to hospitals."

The office goes on to point out that, "Renewables can reduce the impact of hospital operations on power plant emissions and thus have a positive effect on environmental health."

With regard to cost, it acknowledges that, "obtaining sufficient financing sometimes is the biggest roadblock to the use of renewable energy. When evaluating a project, hospitals should consider the merits of financing through direct ownership—in which there is an onsite, renewable energy asset—or third-party ownership—where there is a power-purchase agreement between the hospital and the owner of the renewable energy asset."

The DOE encourages health authorities responsible for the function of hospitals to consider several important market- and policy-related

factors in determining if renewables make sense for their facilities. These factors consist of:

- The availability of natural resources and the practicality of each type of renewable energy source vary widely by location.
- Capital costs, operating costs, scale of operation, and financing structure, all of which are critical to making a well-informed decision.
- Policies and incentives: government and utilities offer incentives that may strengthen the business case for renewable energy.

Also, the DOE notes that net metering laws encourage renewables by permitting a special metering/billing agreement between customers and utilities. Buildings' renewable energy-generating systems are connected to the power grid, and owners receive a credit for electricity generated in excess of their own needs and contributed to the grid.

Finally, Castle Solar contributes to Utah's growing strength in the renewables field. While the state is not a historic leader in America's solar space (coal remains the dominant resource used for electric generation in the

state), according to the Solar Energy Industries Association (SEIA), Utah had 2.7 GW of solar installed at the end of 2023, the 14th-most among the 50 states, up from 32nd earlier in the year.

The association expects Utah to add over 4 GW of new solar capacity over the next five years, the 13th-most in the U.S., with supportive legislation being a key driver of new installations.

Some other recent solar projects in Utah have been interesting, and added to those solar power generation numbers.

Mining giant Rio Tinto completed construction in 2024 on a new 5-megawatt solar power plant at its Kennecott copper operations in Utah. The 12,800 solar panel power plant will enable Kennecott to reduce its operational emissions by 3,000 tonnes of carbon dioxide equivalent per year.

The 30-acre solar array will serve as a pilot project with the goal of expanding Kennecott's solar energy supply in the future, says the company.

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Shifting to sustainable energy solutions is a priority for Kennecott, Rio stated. The mine closed its coal-fired power plant in 2019, moving to electricity paired with renewable energy certificates, which resulted in a 65 percent reduction in its carbon footprint and the elimination of over 1 million tonnes of carbon dioxide output per year.

"Rio Tinto Kennecott has a key role to play in supporting the energy transition," said Managing Director Nate Foster.

"We supply U.S. companies with

the copper and tellurium they need to produce solar panels, wind turbines, and conductors," Foster said. "We also continue to take steps to further decarbonize our business, from our battery electric vehicle trial to our renewable diesel trial and now to our own solar plant."

In northern Utah, the Steel Solar project in Plymouth, also a DESRI project, is now operational, and 250,000 solar panels are working to generate 80 megawatts. Named for its proximity to the Nucor Steel plant in Plymouth, Steel Solar covers 900 acres of former farm and rangeland.

The workers who built the project were supplied by SOLV Energy, a

San Diego-based company that has partnered with D.E. Shaw on dozens of other projects around the country. Less than 30 miles away from Steel Solar, another project of similar size and scope is now running. The Rocket Solar project, co-owned by D.E. Shaw and Enyo Energy, is another 80-megawatt producing solar farm that is selling the energy it produces to Rocky Mountain Power.

Located in Promontory, Rocket Solar is named for the Northrop Grumman facility nearby that develops rocket motors for the U.S. space program. e

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Do my solar power modules need to be cleaned?

By Jared T. Koch

The answer to the question above is yes, solar power modules do need to be cleaned. This is a critical aspect of maintenance that has only recently gained recognition in the solar industry.

Historically, many in the industry dismissed cleaning as an illegitimate need—but as the solar industry has evolved and our understanding of operations and maintenance (O&M) has deepened, the importance of regular cleaning has become increasingly clear.

However, there are still a lot of questions and misconceptions floating around today surrounding the frequency of cleaning, the purpose and importance of cleaning, what effect rain has on cleaning panels, and what types of soiling are harmful for panels.

Probably the most common question surrounding the cleaning of solar panels is, 'How often do they need to be cleaned?' There are several factors that all play a part in answering that question. In every case, these factors will include system size, geographic location, age of the system, and specific regional soiling challenges.

Using a Power Loss Study is one of the simplest, yet most precise ways to determine when cleaning is necessary. A system owner can conduct a Power Loss Study by simply cleaning a few modules and comparing the power output of the clean modules to the output of the same number of dirty modules. This quick and easy test will determine the power loss that is due to soiling. With this information, a conclusion can be drawn as to when the next cleaning is necessary.

One other simple test that can be done to check if a cleaning may be needed is to look back at the system's output over its lifespan. Output will vary from month to month, so system owners need to keep the bigger picture in mind when looking at efficiency decrease. If the efficiency of the system has dropped significantly, soiling is often to blame and it may be time for a cleaning.

A common misconception within the industry is that cleaning is merely for aesthetics—this is far from the truth. While a clean, shiny module certainly looks impressive, the benefits extend well beyond appearance. Clean modules operate at peak efficiency. Dirt traps heat, causing the module to operate at a warmer than desired temperature, which can significantly decrease the lifespan of the modules if not addressed. Specifically, bird droppings create dangerous hot spots that can lead to cell damage if left untreated. Moreover, clean modules expel snow much more effectively than their dirty counterparts. Perhaps most importantly, cleaning your modules can result in substantial increases in energy production, which results in larger financial paybacks.

Many ask about the extent of this improvement and, while there is variability, it is not uncommon to see boosts of between three percent to an outstanding 45 percent. Prioritizing the cleaning of your solar modules is not just beneficial—it's essential for optimal performance and longevity.

Many critics of solar cleaning claim that rain washes the modules, therefore cleaning is unnecessary. However, the rain is not enough; it will only rinse off a thin layer of dirt. To truly clean, you need some method of agitation. This can be provided by a professional solar washing company that uses proper methods for solar cleaning. These methods can include robotics or the use of manual brushing. In some extreme cases, specialized cleaners may even be required. For this reason, rain alone cannot clean the panels.

Soiling can look very different depending on where the system is located geographically. Pollen is a very sticky type of soiling that will cling to the module glass. Once a layer of pollen has adhered to the module, more dust will settle on the surface and attach to the pollen. Loose dirt is another common soiling factor. Dirt becomes an issue when it is made wet by dew, only to be baked on by the sun the following day. After many cycles of this, the layer of soiling will continue to grow, reducing efficiency and the lifespan of the module. Cleaning is and will always be needed in these scenarios.

When cleaning is needed, always contact a professional, experienced cleaner who will safely and efficiently clean the system. And remember, the cheapest price quoted is not always the best value.

In conclusion, cleaning is and will always be required at some time in a system's life. Have you done a power loss study to determine if your system is operating efficiently?

Jared T. Koch is the founder of JTK, LLC and JTK Solar Solutions (www.jtkllc.com and www.jtksolarsolutions.com). He has 10 years of solar washing experience with JTK, as well as five years of experience selling solar washing equipment. In 2015, Koch was a pioneer in addressing the soiling issue for underperforming solar arrays, using cleaning. He had the first company in North America with a robotic solution to clean modules safely and efficiently. Since then, Koch has served hundreds of clients across the U.S. He has also distributed many robotic cleaning solutions all over North America.



ON THE GRID

PROJECT: BOURBON MAKER CASTLE & KEY DISTILLERY, A LEADING PRODUCER OF KENTUCKY'S CRAFT SPIRITS, HAS COMPLETED PHASE 1 OF A MAJOR SOLAR ENERGY PROJECT.

SIZE: The first phase of the project covers 20,950 square feet and features 754 solar panels, generating 400 kW AC. When completed, the entire system will cover 63,350 square feet, generating 960 kW AC.

BACKGROUND: With this investment, the distillery says it is further solidifying its commitment to renewable energy, harnessing solar power across more than an acre of space, while continuing to produce high-quality spirits. The \$2 million project was supported by a Rural Energy for America Program (REAP) Grant, a federal initiative aimed at helping rural small businesses transition to renewable energy sources, reduce energy costs, and enhance American energy independence. Castle & Key's ground mount solar energy system is installed at the distillery's Versailles Warehouse in Woodford County, Kentucky, and is designed to provide a substantial portion of the distillery's energy needs. Phase 2 of the solar project is expected to begin this spring. With its stunning site dating back to 1887, the distillery is known both as the birthplace of bourbon hospitality and for the high-quality Kentucky spirits made there today.

BENEFITS: This solar energy initiative by Castle & Key reduces the distillery's carbon footprint, lowers energy costs, and reinforces the company's commitment to responsible innovation. The company is using 25 percent of the total solar production capacity. The remaining excess power is sold back to Kentucky Utilities as a green power source for the community to power homes, businesses and facilities. On average, this will equate to 270 to 350 homes in the community based on average power usage.

PROJECT: RIO TINTO'S DIAVIK DIAMOND MINE HAS COMPLETED INSTALLATION OF ITS SOLAR POWER PLANT IN CANADA'S NORTHWEST TERRITORIES. THE PROJECT REPRESENTS THE LARGEST OFF-GRID SOLAR POWER PLANT ACROSS CANADA'S TERRITORIES.

SIZE: The 3.5 MW, 6,620-panel facility is expected to generate 4.2 million kilowatt-hours of solar energy annually.

BACKGROUND: The solar project complements a wind power plant at Diavik, which has been operating since 2012 and is the largest wind power installation in Canada's North, having generated over 195 million kilowatt-hours of electricity since activation. Construction of the solar project began in February 2024, contracted to Whitehorse-based Solvest Inc. and the Indigenous-owned Tlicho Investment Corporation, with support from Diavik. Approximately 30 percent of the construction workforce came from the Tlicho Investment Corporation.

BENEFITS: The solar power plant will provide up to 25 percent of Diavik's electricity. The facility is equipped with bi-facial panels which not only generate energy from direct sunlight, but also from the light that reflects off the snow that covers Diavik for most of the year. It will reduce diesel consumption at Diavik by one million litres per year and cut greenhouse gas (GHG) emissions by 2,900 tonnes of CO2 equivalent. This is comparable to removing 630 cars from the road each year.

PROJECT: ATLANTA MOTORSPORTS PARK (AMP), A PREMIER MOTORSPORTS CLUB IN GEORGIA RENOWNED FOR ITS F1-STYLE ROAD COURSE AND THRILLING KARTING COURSE, HAS BUILT A LARGE SOLAR FARM AT ITS FACILITY.

SIZE: Located in Dawsonville, Georgia, the AMP campus is adding solar power through an array of 747 panels, generating 480 watts per panel, for a total of 358 kW. That's enough energy to power nearly 300 homes.

BACKGROUND: This investment follows AMP's work on sustainability with the recent addition of EV chargers: 10 Level 3 DC Superchargers, and 8 Level 2. Coupled with all-LED lighting, its solar powered CCTV/Signs, on site water/wastewater treatment, and efficient fixtures, all show AMP's commitment to making a positive environmental impact.

BENEFITS: The AMP solar installation powers about 60 percent of the campus's daily operational needs with renewable energy. It is connected to five buildings including the karting facilities and the park's newly constructed, member-exclusive Sky Deck. With the help of consultants at Hannah Solar, the project was able to recoup 50 percent of its total costs using a U.S. Department of Agriculture (USDA) Rural Energy for America Program Renewable Energy Systems, or REAP, Grant. The solar energy configuration was supplied by Hannah Solar, an Atlanta-based solar installation and maintenance firm. Hannah Solar acquired panels for AMP that were manufactured locally by Hanwha Q. Cells at their Dalton, Georgia fabrication plant. The array also makes use of SolarEdge inverters, in addition to racking hardware by Ironridge and Panelclaw.



Why solar power matters for my Virginia family farm

By Donna Miller

I own a farm in Augusta County, Virginia, that has been in my family for 75 years. We're proud of it and it's a legacy I'd like to pass down to my children, just like my father did for me.

But in today's economy, keeping the farm isn't easy. Costs keep rising, and each season brings a new set of challenges.

About four years ago, I entered into an option agreement with a solar energy developer. To my family, solar power represented a chance at stability and a new way to support the farm. It would allow us to preserve our land, create reliable income and keep our farm alive for the next generation.

The project would have provided 150 megawatts of clean energy to the community, while also generating \$3.25 million for Augusta County—funds that could go to schools, roads and emergency services. But the county commission chose to terminate the project.

When people think of solar projects, I understand that some might have concerns about using farmland. But here's the thing: Farmers take pride in caring for the land. Our approach to solar would have been no different. Unlike permanent real estate developments that require tearing up land or drastically changing its structure, solar offers a temporary use. Once the panels are gone, the land can return to agriculture. To us, this project wasn't about changing our farm but about helping it last for the next generation.

Solar also offered a financial safety net that could help us stay in farming even during hard times. It's not a replacement for farming—it's a way to support it. Instead of selling off pieces of the farm or struggling to make ends meet, we could rely on solar to keep our land intact and operational.

On a larger scale, Virginia's energy needs are only growing. Demand is expected to more than double in the next few decades. The Virginia Clean Economy Act calls for more renewable energy sources to meet that demand, but those sources need space. If we don't add solar, today's lowest cost form of energy, we'll end up relying on less sustainable options, which could impact our land, air, water and energy prices.

These secondary impacts of relying on less sustainable

energy ultimately make it harder, costlier and riskier for farmers to farm. Solar allows us to meet our state's energy goals while keeping our agricultural heritage alive.

There's also a significant economic impact for communities like ours. Augusta County could have used the \$3.25 million in tax revenue from our solar project to fund our schools, roads and emergency services.

Unlike other developments, solar doesn't require massive changes to infrastructure. It's a low-impact addition that could bring in much-needed funds for local programs. For us, solar wasn't just an economic decision for the farm but a way to support our community as well.

Virginia has always respected landowner rights, allowing people to choose how to manage their land in ways that work best for them. When the county blocked our project, it took that choice away from us. We weren't asking for special treatment; we just wanted to use our land in a way that made sense for our family, our farm's future, and our community. Solar is a choice that allows us to keep farming and keep contributing to the community.

Moving forward, I hope our state will find a more balanced approach to solar siting. There has to be a way to include local voices and address concerns without shutting down opportunities for local farmers. We need policies that allow farms like ours to survive in today's economy, even as we help meet Virginia's energy needs. We need support, not additional barriers.

For my family and for many others in Virginia, solar could be the key to keeping our farms alive. It's a chance to hold onto our land, preserve it and leave it better for the future. For Augusta County and for Virginia, I hope we can find a way to make solar a real option for farmers. It's a choice we should have the right to make.

Donna Miller is a multi-generational farmer based in Augusta County, Virginia, with over 75 years of family-operated experience. This column was originally published in the Virginia Mercury (www.virginiamercury.com).

The **CLEAN** Energy **REVOLUTION** Is **UNSTOPPABLE**

The Trump administration is determined to promote fossil fuels, but the economic and technological forces driving solar, wind and other sources are now too powerful to resist, say two renewable energy observers.

By Eric **Beinhocker** and J. Doyne **Farmer**

Since Donald Trump's election, clean energy stocks have plummeted, major banks have pulled out of a U.N.-sponsored "net zero" climate alliance, and major energy company BP has announced it is spinning off its offshore wind business to refocus on oil and gas. Markets and companies seem to be betting that Trump's promises to stop or reverse the clean energy transition and "drill, baby, drill" will be successful.

But this bet is wrong. The clean energy revolution is being driven by fundamental technological and economic forces that are too strong to stop. Trump's policies can marginally slow progress in the U.S. and harm the competitiveness of American companies, but they cannot halt the fundamental dynamics of technological change or save a fossil fuel industry that will inevitably shrink dramatically in the next two decades.

Our research shows that once new technologies become established, their patterns in terms of cost are surprisingly predictable. They generally follow one of three patterns.

The first is a pattern where costs are volatile over days, months and years but relatively flat over longer time frames. It applies to resources extracted from the earth, like minerals and fossil fuels. The price of oil, for instance, fluctuates in response to economic and political events such as recessions, OPEC actions or Russia's invasion of Ukraine. But coal, oil and natural gas cost roughly the same today as they did a century ago, adjusted for inflation. One reason is that even though the technology for extracting fossil fuels improves over time, the resources get harder and harder to extract as the quality of deposits declines.

There is a second group of technologies whose costs are also largely flat over time. For example, hydro power, whose technology can't be mass produced because each dam is different, now costs about the same as it did 50 years ago. Nuclear power costs have also been relatively flat globally since its first commercial use in 1956, although in the U.S. nuclear costs have increased by about a factor of three. The reasons for U.S. cost increases include a lack of standardized designs, growing construction costs, increased regulatory burdens, supply-chain constraints and worker shortages.

A third group of technologies experience predictable

long-term declines in cost and increases in performance. Computer processors are the classic example. In 1965, Gordon Moore, then the head of Intel, noticed that the density of electrical components in integrated circuits was growing at a rate of about 40 percent a year. He predicted this trend would continue, and Moore's Law has held true for 60 years, enabling companies and investors to accurately forecast the cost and speed of computers many decades ahead.

Clean energy technologies such as solar, wind and batteries all follow this pattern, but at different rates. Since 1990, the cost of wind power has dropped by about 4 percent a year, solar energy by 12 percent a year and lithium-ion batteries by about 12 percent a year. Like semiconductors, each of these technologies can be mass produced. They also benefit from advances and economies of scale in related sectors: solar photovoltaic systems from semiconductor manufacturing, wind from aerospace and batteries from consumer electronics.

Solar energy is 10,000 times cheaper today than when it was first used in the U.S.'s Vanguard satellite in 1958. Using a measure of cost that accounts for reliability and flexibility on the grid, the International Energy Agency (IEA) calculates that electricity from solar power with battery storage is less expensive today than electricity from new coal-fired plants in India and new gas-fired plants in the U.S. We project that by 2050 solar energy will cost a tenth of what it does today, making it far cheaper than any other source of energy.

At the same time, barriers to large-scale clean energy use keep tumbling, thanks to advances in energy storage and better grid and demand management. And innovations are enabling the electrification of industrial processes with enormous efficiency gains.

The falling price of clean energy has accelerated its adoption. The growth of new technologies, from railroads to mobile phones, follows what is called an S-curve. When a technology is new, it grows exponentially, but its share is tiny, so in absolute terms its growth looks almost flat. As exponential growth continues, however, its share suddenly becomes large, making its absolute growth large too, until the market eventually becomes saturated and growth starts to flatten. The result is an S-shaped adoption curve.



The energy provided by solar has been growing by about 30 percent a year for several decades. In theory, if this rate continues for just one more decade, solar power with battery storage could supply all the world's energy needs by about 2035. In reality, growth will probably slow down as the technology reaches the saturation phase in its S-curve. Still, based on historical growth and its likely S-curve pattern, we can predict that renewables, along with pre-existing hydro power and nuclear power, will largely displace fossil fuels by about 2050.

For decades, the IEA and others have consistently overestimated the future costs of renewable energy and underestimated future rates of deployment, often by orders of magnitude. The underlying problem is a lack of awareness that technological change is not linear but exponential: a new technology is small for a long time, and then it suddenly takes over. In 2000, about 95 percent of American households had a landline telephone. Few would have forecast that by 2023, 75 percent of U.S. adults would have no landline, only a mobile phone. In just two decades, a massive, century-old industry virtually disappeared.

If all of this is true, is there any need for government support for clean energy? Many believe that we should just let the free market alone sort out which energy sources are best. But that would be a mistake.

History shows that technology transitions often need a kick-start from government. This can take the form of support for basic and high-risk research, purchases that help new technologies reach scale, investment in infrastructure and policies that create stability for private capital. Such government actions have played a critical role in virtually every technological transition, from railroads to automobiles to the internet.

In 2021-22, Congress passed the bipartisan CHIPS Act and Infrastructure Act, plus the Biden administration's Inflation Reduction Act (IRA), all of which provided significant funding to accelerate the development of America's clean energy industry. Trump has pledged to end that support. The new administration has halted disbursements of \$50 billion in already approved clean energy loans and put \$280 billion in loan requests under review.

The legality of halting a congressionally mandated program will be challenged in court, but in any case, the IRA horse is well on its way out of the barn. About \$61 billion of direct IRA funding has already been spent. IRA tax

credits have already attracted \$215 billion in new clean energy investment and could be worth \$350 billion over the next three years.

Ending the tax credits would be politically difficult, since the top 10 states for clean energy jobs include Texas, Florida, Michigan, Ohio, North Carolina and Pennsylvania—all critical states for Republicans. Trump may find himself fighting Republican governors and members of Congress to make those cuts.

It is more likely that Trump and Congress will take actions that are politically easier, such as ending consumer subsidies for electric vehicles or refusing to issue permits for offshore wind projects. The impact of these policy changes would be mainly to harm U.S. competitiveness. By reducing support for private investment and public infrastructure, raising hurdles for permits and slapping on tariffs, the U.S. will simply drive clean-energy investment to competitors in Europe and China.

Meanwhile, Trump's promises of a fossil fuel renaissance ring hollow. U.S. oil and gas production is already at record levels, and with softening global prices, producers and investors are increasingly cautious about committing capital to expand U.S. production.

The energy transition is a one-way ticket. As the asset base shifts to clean energy technologies, large segments of fossil fuel demand will permanently disappear. Very few consumers who buy an electric vehicle will go back to fossil-fuel cars. Once utilities build cheap renewables and storage, they won't go back to expensive coal plants. If the S-curves of clean energy continue on their paths, the fossil fuel sector will likely shrink to a niche industry supplying petrochemicals for plastics by around 2050.

For U.S. policymakers, supporting clean energy isn't about climate change. It is about maintaining American economic leadership. The U.S. invented most clean-energy technologies and has world-beating capabilities in them. Thanks to smart policies and a risk-taking private sector, it has led every major technological transition of the 20th century. It should lead this one too.

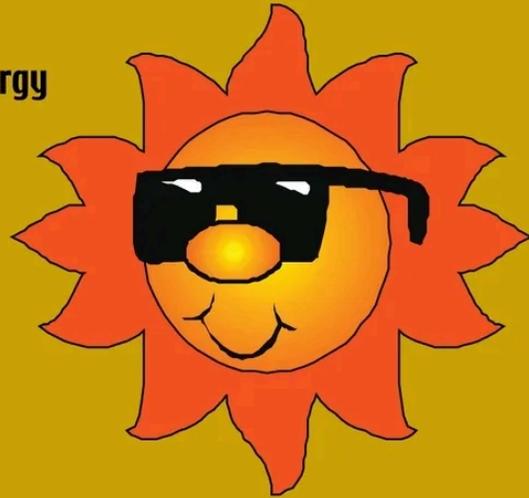
Eric Beinhocker is a professor of public policy practice at the Blavatnik School of Government at the University of Oxford. J. Doyne Farmer is the Baillie Gifford Professor of Complex Systems Science at the Smith School of Enterprise and Environment at the University of Oxford.

e

enerG Numbers

Interesting and sometimes amazing renewable energy information.

A 2.1 MW solar project recently completed in Albany County, NY, produces enough energy to charge **650,000 iPhone 13's** every day for a year or power **10 million hours** of video game playing.



Texas is by far the largest wind power producer in the U.S., and generated **115,000 gigawatt hours (GWh)** of wind-powered electricity from January to November of 2024.



The American Clean Power Association annual market report shows that the clean energy industry shattered records in 2024, deploying an unprecedented **49 GW of capacity—a remarkable 33 percent increase** over the previous record of 37 GW set in 2023.



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Yotta Energy introduces plug-and-play Yotta Block for commercial solar and storage

Yotta Energy, a leader in next-generation energy solutions for commercial buildings, has launched the Yotta Block—a strategic rebranding and next-generation evolution of its flagship SolarLEAF product.

Engineered to replace a standard ballast block, Yotta Block integrates directly behind photovoltaic (PV) modules, eliminating the need for dedicated battery storage space and streamlining design, permitting, and installation, says the company. Designed to make solar+storage more accessible and cost-effective, this innovative form factor simplifies deployment while reducing costs.

"Yotta Block is a game-changer for commercial solar storage," said Jordan Harris, CEO of Yotta Energy. "By designing a battery that replaces a standard ballast block, we've eliminated installation barriers and freed up valuable rooftop space—all without sacrificing power or intelligence. It's the perfect solution for businesses looking to cut energy costs and boost sustainability."

The commercial and industrial (C&I) sector accounts for 75 percent of U.S. electricity consumption and 35 percent of greenhouse gas emissions (NREL), yet only ~3 percent of commercial sites have solar PV—and even fewer have storage. Against this backdrop of evolving energy demands, a primary challenge the C&I market faces is space and installation complexity. Traditional battery storage requires additional infrastructure, electrical work, and engineering. Yotta Block changes this dynamic by making energy storage easier to permit, install, and scale, says the company.

"We continue to expand our service offerings and



project innovation solutions with the Yotta Energy family of products. Yotta's product reliability and service has proven successful in over 100 E2SOL commercial projects," said Anthony Baro, founder and managing principal at E2SOL.

Unlike traditional battery storage solutions, Yotta Block standardizes installation by integrating directly with rooftop solar panels. Yotta Block is designed for maximum flexibility, and its key advantages include:

Yotta Block is designed for maximum flexibility:

- Modular & Scalable – Expands in 1kWh increments to match evolving energy needs. [matches building needs to the specific 1kWh increment]

CAB Solar enhances cable management for agrivoltaics with 3D Locking Solution

CAB Solar, a leader in above-ground cable management, has released a Three-Dimensional Agrivoltaic Locking Solution that is compatible with all of their hanger variations for the solar industry.

This solution creates a dual-purpose environment where livestock can graze and control the grass while land owners reduce operational maintenance time and costs when managing sustainable solar projects. CAB Solar's team of engineers and project developers designed a 3D locking style that wraps around the messenger wire for increased cable security. This advance allows the system to withstand potential impacts ensuring cables remain in place during livestock grazing.

Any CAB Solar hanger variation can incorporate this 3D locking solution, allowing for unlimited customization.

"Providing customization to this level, such as this enhancement for agrivoltaics, is just one example how CAB Solar is here for their customers, big or small," says Kenyon Blough, Director of Solar Development.

As the demand for agrivoltaics solutions within the solar industry is growing, above-ground cable management continues to be the most cost-effective method. CAB Solar's above-ground cable management significantly reduces O&M costs and labor over the life of the project, says the company. This enhanced locking solution is currently available.

CAB Solar says their products are proudly sourced and manufactured in the U.S., and the company is a leader in above-ground cable management solutions specifically designed for the solar industry. www.cabsolar.com

RES and NREL collaborate on digital technology to drive wind turbine efficiency

RES, one of the largest independent renewables companies, and the U.S. Department of Energy's National Renewable Energy Laboratory (NREL), have partnered to license and deploy an innovative technology to optimize the performance of wind turbines.

The 'Dynamic Yaw' technology effectively innovates the yaw system of wind turbines—the component responsible for the orientation of a turbine toward the wind—to maximize the overall performance and efficiency of turbines in a wind farm.

While a single wind turbine is traditionally designed to work in isolation and self-orient in a manner that optimizes its own performance, the 'Dynamic Yaw' technology takes a systems approach to consider how each individual wind turbine on a wind farm can share data and work together as a team to increase the overall performance of the group of turbines. This systems approach has the effect of improving overall energy efficiency by adding the equivalent of one to three wind turbines to a 100 turbine-strong wind farm through enhanced management and controls.

"The renewables industry is on the cusp of widespread digitalization," said Alex Bamberger, Vice-President, Digital Solutions at RES. "The 'Dynamic Yaw' technology will help wind asset owners optimize the overall output of their assets through better utilization of their data, and subsequent autonomous action of the asset. By sharing farm wide data and transforming the yaw optimization strategy of a wind farm to maximize overall performance, the 'Dynamic Yaw' transforms a collection of individual turbines into a team."

Bamberger said that "licensing NREL's technology is a good example of the way RES is able to combine its deep renewables expertise and understanding of how assets work, with the technology of leading research institutions. Merging these two capabilities is enabling RES to use modern digital infrastructure to manage data and turn insight into action. This technology isn't a science project any more, it's real and able to help customers reach net zero much faster."

NREL Senior Engineer for Wind Energy Control Systems, Paul Fleming, sees that "this technology demonstrates the ability of coordinated wind farm control to deliver improved performance and energy yield."

Developed, installed and maintained by RES, and incorporating IP licensed from NREL, Dynamic Yaw has been trial tested by RES for over seven years across turbines at wind farms in the UK. The technology the NREL and RES collaboration unlocks will initially target customers in the Americas, but the technology can be installed anywhere in the world, bridging the gap between digital data and action on site.

As well as driving the energy efficiency of wind farms, the technology will improve supply chain efficiencies by enabling production of more renewable energy from the same investment. This will allow more efficient capital allocation, to extract all available renewable energy from existing assets.

www.res-group.com

- Easy Installation – 1-for-1 ballast block replacement, plug-play design, low-voltage DC architecture without additional skilled labor
- Universal Compatibility – Works with high-capacity PV modules and multiple racking systems.
- Advanced Thermal Regulation – Passive cooling technology maximizes battery life and safety while minimizing O&M costs
- Seamless Integration – Directly connects with Yotta's Dual Power Inverters (DPI) for 208V or 480V 3-phase output and Yotta's Energy Management Platform

With the launch of Yotta Block, Yotta Energy has enhanced its original SolarLEAF design to deliver:

- Broader compatibility with various racking systems
 - Faster installation through one-for-one replacement of ballast blocks
 - Fewer components through streamlined engineering reduces costs and improves efficiency
 - Remote monitoring with analytics, diagnostics, and performance reporting
- www.yottaenergy.com

Louth Callan Renewables begins construction on 28 MW solar project in Maine

Renewable energy construction company Louth Callan Renewables recently started construction on

the 28-megawatt (MW) Mousam Solar project in Sanford, Maine.

The Mousam Solar project, spanning approximately 110 acres, will generate enough clean energy to power thousands of homes and businesses in Maine upon completion. By leveraging solar technology, the project is expected to offset approximately thousands of metric tons of carbon dioxide emissions annually, contributing to state and national renewable energy targets.

"Breaking ground on the Mousam Solar project marks another milestone for Louth Callan Renewables as we expand our clean energy construction portfolio into utility scale solar projects," said Nicholas Sylvestre, Managing Member of Louth Callan Renewables.

"As we continue our successful transition into the construction of large scale solar projects, 30 MW and larger, we are proud to continue to deliver high-quality solar infrastructure projects that benefit both the environment, local communities and our IPP and utility partners."

The construction phase of the project will create 100 jobs at its peak, providing employment opportunities and economic benefits to the local workforce. Additionally, the project will contribute tax revenue and lease payments that support the local economy.

www.Louthcallanrenewables.com

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RoboForce debuts 'Robo-Labor', AI-enabled robotic workforce solution for the solar industry

RoboForce, an advanced "Robo-Labor" provider, debuted its AI Robot workforce solution publicly for the first time recently, at Intersolar 2025 in San Diego.

During Intersolar, attendees were able to see the latest generation of RoboForce's AI-enabled, all-terrain robot in the Startup Pavilion, and see the technology and mechanisms that enable Robo-Labor to build solar panels from ground to grid.

This is the first public unveiling of RoboForce's technology after the company announced \$10 million in early stage funding at the beginning of 2025.

The company said its robots are capable of 1 mm precision in fine motor movements and manipulations, in tandem with its internally designed and developed AI expert model, to install and secure solar modules for large-scale commercial and utility-scale projects. The robots can perform this installation labor at three times the efficiency and productivity rate of human labor and at a third of the average U.S. labor cost for the same work. With many solar projects of this scale being in harsh environments and remote, isolated locations, empowering the industry with Robo-Labor advances



Leeward Renewable Energy commences commercial operations of Morrow Lake Solar in Texas

Leeward Renewable Energy (LRE) has announced the completion and commercial operation of its 200-megawatt (MW) Morrow Lake Solar project, located in Frio County, Texas. The project will provide Microsoft Corp. with renewable energy under a previously announced long-term power purchase agreement.

Morrow Lake Solar is the first of two solar facilities developed under the agreement with Microsoft and is LRE's second project in Frio County, located across from its 200-MW Horizon Solar project. Morrow Lake Solar created over 300 jobs during peak construction, with 112 being local hires. The project utilizes First Solar ultra-low carbon, thin-film photovoltaic solar modules.

As part of LRE's continued commitment to land stewardship, it says Morrow Lake Solar utilized robust practices that promote soil health, preserve native plant species, and enhance biodiversity, including the introduction of sheep grazing for vegetation control. The project also has supported various community programs, including educational initiatives, and contributions to local events such as toy drives and holiday celebrations.

LRE acquired the Morrow Lake Solar Project in 2023 from Red River, a joint venture of SunChase and Eolian, which initiated the development of the Morrow Lake Solar Project in 2017. www.LREus.com

both decarbonization goals and increased energy demands at an accelerated rate, while filling the current labor storage and saving human labor from having to endure difficult working conditions, says the company.

With pilot projects commencing for early customers in early 2025 and commercial launch at the end of 2025, RoboForce is addressing the solar industry's ongoing labor shortages. The Solar Energy Industries Association (SEIA) recently reported that worker shortages and rising labor costs are flattening industry growth over the next five years, at a time when over 4,400 GW of solar power is projected to be built globally by 2030.

RoboForce and its Robo-Labor fleet can safely, efficiently work alongside humans where needed, while saving human laborers from repetitive and high force-demanding tasks. Ultimately, solar developers are enabled to meet demand without exceeding project costs or timelines.

"With over 100 years of combined team experience in the AI robotics field, RoboForce is prepared to help solar customers enable AI and automation needed to complete large- and utility-scale projects faster and cheaper," said Leo Ma, founder and CEO, RoboForce. "Those already employing our 'super worker' fleet will be able to overcome industry-wide challenges to bring us closer to the sustainably powered world we need."

As part of the progress towards commercialization this year, RoboForce has recently built an outdoor mini-farm solar testing site and is actively engaging with additional partners and customers. The company is also exploring real-world applications of general use Robo-Labor in additional sectors such as mining, nuclear power and space. www.roboforce.ai

Sol Systems builds solar project atop historic subsurface mine in Illinois

Sol Systems has announced the successful financial close and start of construction of a \$345 million, 182-megawatt (MW) solar project, which will produce enough clean energy to power approximately 33,800 Illinois homes annually.

Currently under construction on a 1,050-acre historic subsurface mine site, the project represents a powerful example of the energy transition in practice, transforming a carbon-intensive mining site in Randolph County, Illinois into a renewable energy asset generating community and ecosystem benefits for decades to come, says the company.

The Tilden project highlights Sol Systems' unique approach to clean energy development, going beyond the megawatt to deliver long-term community benefits, ecosystem protection, and economic opportunities, says the company. The successful financial close of the project was made possible through key collaborations with ING, Churchill Stateside Group, Qcells, Nextracker, and McCarthy Building Companies, demonstrating the value of bringing together financial expertise, domestic manufacturing, and innovative construction practices to achieve impact-driven clean energy solutions.

"This project represents what Sol Systems is all about—bringing renewable energy solutions to the most challenging and impactful sites," noted Yuri Horwitz, CEO, Sol Systems. "The Tilden project is a blueprint for how we believe clean energy development should be done."

An 840,000-acre swath of underground mines runs through Southern Illinois, challenging surface land development across the state. By utilizing this restricted land, Sol Systems pioneered a unique approach to renewable energy development. Historical mining operations helped advance economic development in the area for decades. When these mines closed in the 1990's, operations depleted the area of resources, no longer contributed to tax revenues, and in some instances prohibited infrastructure development on the surface, affecting the local community for generations.

Sol Systems collaborated with experts in mine engineering and reclamation to overcome challenges associated with the underground mining operation



and burdened surface rights. The team successfully collaborated with Nextracker on a safe and effective tracker and foundation design for the site, and secured 147 surface waivers from unique entities, demonstrating the project's complexity and Sol Systems' commitment to tireless problem-solving, the company says.

The financing for this project reflects a strong partnership with financial institutions that share Sol Systems' vision for impact-driven investment that supports local communities.

The Tilden project also underscores Sol Systems' commitment to domestic supply chains, with Qcells providing U.S.-manufactured solar modules and Nextracker supplying U.S.-manufactured racking systems. The project reflects Sol Systems' alignment with federal policy initiatives to promote domestic materials in renewable energy development.

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The Tilden project is a hallmark of Sol Systems' Infrastructure + Impact approach, which emphasizes delivering lasting community impact alongside clean energy deployment. On top of millions of dollars in estimated tax revenues, the project will deploy at least 20 years of ongoing investments in local workforce development, community partnerships, and environmental stewardship initiatives to ensure that the benefits of clean energy extend beyond the project itself. Additionally, the Tilden Solar project is creating approximately 300 construction jobs, with the majority being local hires in collaboration with area unions, including carpenters, operators, and electricians.

"Building this project on a subsurface mine requires innovation, precision, and a commitment to doing things safely," said Andy Poirot, Vice-President of the Tilden Solar project construction for McCarthy Building Companies, the project's engineering, procurement, and construction (EPC) contractor. "This is a prime example of how renewable energy projects can create new opportunities within our industry and for the communities where projects are being built, while preserving the environment for future generations."

Sol Systems is also working with conservation partners to implement ecosystem restoration initiatives, including efforts to promote and preserve native species and pollinator habitat on-site. www.solsystems.com

Vast federal lands in U.S. have potential for renewable energy—but only a small fraction is needed

Large expanses of land managed by the Bureau of Land Management in states like California, Nevada, Arizona, and New Mexico are suitable for utility solar photovoltaic energy.

Federal lands are used for many different purposes including recreation, conservation, livestock grazing, and energy development. Traditionally, energy development on these lands has focused on fossil production. About 12 percent of oil drilling in the contiguous U.S. is on federal lands, and the share of total natural gas production on federal lands is similar. In contrast, only four percent of operating utility-scale land-based renewable energy capacity—solar photovoltaic (PV), land-based wind, and geothermal—is currently located on federal lands.

But the National Renewable Energy Laboratory (NREL) is revising the potential for this development on federal lands.

In a new study, the NREL quantified how much solar PV, wind, and geothermal energy could be developed on federal lands in the contiguous U.S.—and found there is great potential for these technologies going forward, while still leaving substantial area for other uses.

"We learned that there is huge potential for renewable energy technologies on federal lands," said Trieu Mai, principal investigator and senior energy systems researcher at NREL. "The potential is far more than what will be needed to meet our future energy demands,



creating opportunities for development that have low conflict with other uses."

To understand future renewable energy deployment opportunities on federal lands, NREL created seven scenarios with a wide range of possibilities. All seven scenarios achieve 100 percent carbon-free electricity by 2035 and assume high electrification through 2050. NREL did this to understand the total maximum renewable energy development that could occur.

For each scenario, NREL used a power sector model to determine what energy technologies to build and where across the country to meet future energy demand. Those results were then downscaled to produce deployment estimates on federal lands.

In the central three scenarios, NREL estimates 51 to 84 gigawatts (GW) of solar PV, wind, and geothermal capacity are deployed by 2035 on federal lands. The total federal land area that is used for the three technologies ranges from 325,000 to 2 million acres. That is less than 0.5 percent of all federal land area, and a large fraction of the land could also have other uses. In the highest deployment scenario where siting on nonfederal is more constrained, renewable energy deployment on federal lands increases to 231 to 270 GW by 2035.

NREL modeled the technical potential on land administered by five agencies: the Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Department of Defense, and the U.S. Department of Energy. To ensure realistic siting in the model, NREL worked closely with these agencies throughout the study, including incorporating detailed geospatial data from BLM's Western Solar Plan.

"Each agency has its own mission priorities, which has implications for how its land is managed," said Anthony Lopez, a senior researcher at NREL. "We determined the technical potential by limiting renewable energy development based on other land uses, such as recreation, historic preservation, conservation, and critical habitat. Even when factoring in the other uses, we found a lot of remaining land area would be suitable for renewable energy development."

NREL estimates 5,750 GW of utility-scale PV could be

generated on 44 million acres of federal land across the U.S. Wind development has a potential capacity of 875 GW on 43 million acres. Hydrothermal systems could produce 130 GW on 12 million acres, and enhanced geothermal systems could produce 975 GW on 27 million acres. While these estimates represent the vast potential for renewable energy on federal lands, only a small percentage of the potential would be needed to meet future energy demands. www.nrel.gov

SolarPanelRecycling.com unveils first automated bifacial recycling line

SolarPanelRecycling.com (SPR) has announced the launch in North Carolina of the first dedicated bifacial solar panel recycling line in the U.S. that enables clean glass separation of bifacial modules at recovery rates of 99 percent or higher, achieving what the company says is unprecedented efficiency.

This advancement underscores SPR's ongoing commitment to achieving true recycling integrity, setting new industry standards in efficiency, recovery rates and eco-friendly processes for bifacial panel recycling, says SPR.

While the solar market was previously dominated by monofacial solar panels, the industry is quickly standardizing on bifacial modules, due to their higher efficiencies and energy yields, in the growing utility sector. With bifacial modules set to account for over 70 percent of the market by 2033 according to IEA-PVPS,

SPR's new automatic line ideally positions the company to meet the demand for bifacial recycling services. The company is already experiencing an uptick in bifacials hitting the recycling stream due to panels being damaged during transportation, installation or extreme weather.

"Our investment in a dedicated bifacial recycling line is a proactive step to ensure that our recycling services are scalable and that we can maximize recovery, minimize waste and support the sustainability goals of the industry," said Brett C. Henderson, CEO of SolarPanelRecycling.com.

"True solar recycling goes beyond shredding panels," added Henderson. "It requires cleanly separated commodities that can re-enter the supply chain, creating real value and minimizing environmental impact. This new technology marks a major milestone for SPR and for the solar industry as a whole."

The company says it has identified the inefficiencies that monofacial recycling lines presented for bifacial modules, particularly in glass recovery rates and manual labor. Recognizing this opportunity, SPR's engineers and R&D teams developed the new proprietary recycling line for bifacial modules that enables the recovery efficiency. Unlike partial recyclers who shred whole panels—commingling silicon, glass, metals and plastics into unusable waste—SPR's process ensures clean separation of all components. This approach epitomizes true recycling, as each material is returned to the manufacturing supply chain, significantly reducing waste and supporting a circular economy. www.SolarPanelRecycling.com

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Surfboards being made from decommissioned wind turbine blades

Renewable energy company ACCIONA has partnered with professional surfer Josh Kerr and his surfboard brand Draft Surf to create the world's first surfboards made from a retired wind turbine blade.

Crafted from a decommissioned blade from ACCIONA's Waubra wind farm in the state of Victoria in Australia, an initial range of ten prototype boards have been made as part of ACCIONA's Turbine Made initiative, which was recently launched as Australia's first initiative dedicated to exploring innovative ways to transform decommissioned wind turbine blades into new materials and products. It represents the next step in ACCIONA's efforts to advance a circular economy in the renewable energy sector in Australia.

The surfboards, hand crafted on the Gold Coast, feature repurposed turbine blade strips built into the deck for strength and flex control. The fins of the board, made from recycled fiberglass, provide stability, drive and speed and the outer shell

is further strengthened by incorporating recycled turbine blade particulate into the fiberglassing process.

"When ACCIONA approached us about being part of the solution and working together to create these surfboards, we jumped at the opportunity," said Josh Kerr, Australian professional surfer and founder of Draft Surf. "At its core, our brand is about enabling the best surfing experience with quality products, in a sustainable way—which aligns with ACCIONA's vision for Turbine Made".

ACCIONA Energia's Global Sustainability Director Mariola Domenech, said: "We know that in the next 10 to 15 years, countries like Australia will have a large volume of decommissioned wind turbine blades, so we're acting now to explore new ways to recycle and reuse the material they are built from."

"The creation of a surfboard prototype, developed locally, is an example of how we're reimagining the materials from decommissioned turbine blades and pushing the envelope of innovation when it comes to the circular economy," Domenech added.

More solar power for Wisconsin

Madison Gas and Electric (MGE) has announced the 250-megawatt (MW) Darien solar project in Rock and Walworth counties in Wisconsin is now operational, serving MGE electric customers with carbon-free energy.

MGE owns 25 MW of solar capacity from the Darien Solar Energy Center, and it will also own 7.5 MW of battery storage from the facility. Some 75 MW of battery storage is expected online in 2026.

"Carbon is our target, and the Darien Solar Energy Center is another important step as we continue our progress toward achieving our science-based carbon reduction goals," said Jeff Keebler, MGE Chairman, President and CEO. "MGE's investments to enable our continued transition toward deep decarbonization of our energy supply also serve to ensure that all our customers share in the economic and environmental benefits of our more sustainable energy future."

Located on about 2,000 acres in the town of Bradford in Rock County and the town of Darien in Walworth County, the Darien Solar Energy Center is expected to generate enough clean energy to power about 75,000 households each year. MGE's share of the output will power about 7,500 households annually.

We Energies and Wisconsin Public Service (WPS), subsidiaries of WEC Energy Group, own the remaining 225 MW of solar output and 67.5 MW of battery storage from the project. The facility was developed by U.S.-based Invenergy LLC.



The Turbine Made initiative builds on ACCIONA's previous work to repurpose decommissioned wind turbine blades, which has included a collaboration with European fashion brand El Ganso to create sneakers featuring recycled blade material in their soles, as well as the integration of recycled blade materials into the torsion beams of solar trackers at a solar plant in Extremadura, Spain. ACCIONA is also advancing in end-of-life turbine recycling through a blade recycling plant in Navarra, Spain, which is set to become operational in 2026, creating 100 jobs and a processing capacity of 6,000 tonnes of material per year.

OCI Energy and Arava Power announce joint venture for 260 MW Texas solar project

OCI Energy, based in San Antonio, Texas, and Arava Power, a pioneer in Israel's solar energy sector, have entered into their second agreement, forming a joint venture to develop Project SunRoper, a 260 MW solar farm in Wharton County, Texas.

Located approximately 60 miles southwest of Houston, the project will provide clean energy capacity to one of the highest electricity demands areas in Texas and the U.S., say the companies. Project SunRoper is slated to begin construction in 2025.

"The partnership between OCI Energy and Arava Power reflects our shared vision for advancing solar energy solutions and enhancing grid reliability in high-demand markets. Project SunRoper represents a significant step forward to drive economic growth and energy security across communities in Texas and beyond, advancing our mission to enable a sustainable, prosperous future," said Sabah Bayatli, President, OCI Energy.

This joint venture marks the continuation of a strong collaboration between OCI Energy and Arava Power, according to the companies. In 2021, Arava Power, acquired OCI Energy's Project SunRay, a 200 MW solar farm in Uvalde County, Texas which recently became operational in September 2024.

By leveraging their combined expertise, OCI Energy and Arava Power aim to synergistically provide reliable clean energy while strengthening Texas' overall domestic energy production.

Google and Apex collaborate on Virginia's first onshore wind farm

Apex Clean Energy and Google have announced a power purchase agreement for the full capacity of Rocky Forge Wind, Virginia's first onshore wind farm.

The 79.3 MW project represents a historic milestone, both for the Commonwealth and for Apex in its home

state, say the companies.

This partnership is the second between Apex and Google, following the agreement for Timbermill Wind in North Carolina. Rocky Forge will support Google's data centers in Virginia, advancing the company's 2030 goal to achieve net-zero emissions and 24/7 carbon-free energy, matching its electricity needs with clean energy every hour of every day.

"Rocky Forge represents a new chapter in Virginia's energy transition, delivering lasting economic and environmental benefits to Apex's home state while advancing Google's sustainability goals," said Eamon Perrel, Apex Executive Vice-President of Business Development. "Google—alongside many key stakeholders over the years—enabled this milestone, demonstrating the power of partnership in accelerating the shift to clean energy."

One of few wind farms in the PJM market, Rocky Forge presents a unique opportunity to support the decarbonization of expanding data center operations in the region. Given the nature of wind energy's generation, with strong production at night and during the winter months, wind is said to be particularly complementary to solar production.

"As we continue to progress towards our goal to operate every Google campus on clean electricity every hour of every day by 2030, we are always looking for opportunities to accelerate the delivery of

new clean power to the grid," said Amanda Peterson Corio, Google Head of Data Center Energy. "The Rocky Forge Wind project builds on our strong collaboration with Apex Clean Energy to both support decarbonizing our operations in Virginia and the broader PJM grid system."

Rocky Forge, located in Botetourt County, Virginia, will drive significant investment in southwest Virginia, generating up to 250 jobs during construction and approximately \$30 million in state and local tax revenue over the lifetime of the facility. The project will utilize GE wind turbines and is slated to begin commercial operations in 2026.

Nature Conservancy announces new solar projects on former Appalachian coal mines

The Nature Conservancy (TNC) and the Cumberland Forest Limited Partnership have announced new agreements with Sun Tribe Development and ENGIE to develop 14 solar energy and three battery storage projects on 360 acres of former coal mines in the Appalachians.

This is the second round of clean energy project announcements from TNC's Cumberland Forest Project in Virginia, Tennessee and Kentucky.



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The Cumberland Forest energy projects aim to demonstrate that developers can cost-effectively build clean and renewable energy on former mines while benefiting communities, say the organizations. They take an approach to renewable energy development that seeks to create benefits to climate, conservation and communities—what TNC refers to as the “3Cs.”

TNC solicited competitive project proposals using LevelTen Energy, ensuring that the selected projects would meet 3C criteria. As the projects are designed and built in the coming years, they are expected to provide increased local tax revenue, short-term construction job opportunities and a dedicated fund to finance additional community benefits.

“When selecting which companies to work with, we sought those who were willing to push the boundaries of clean energy development with us,” says Brad Kreps, TNC Clinch Valley director. “Developing projects on former coal mines—and in a way that engages with people in the local area so that communities can benefit—takes ingenuity, skill and determination. Ultimately, we



selected Sun Tribe and ENGIE, two experienced developers that have a great interest in bringing this vision to life.”

The new projects are expected to generate approximately 49 megawatts (MW) of solar energy and 320 MW of battery storage, the equivalent of powering 6,638 Appalachian homes annually.

The new projects will be developed on former coal mines, such as the surface coal mine in Campbell County, Tennessee.

The Cumberland Forest Project

protects 253,000 acres of Appalachian forest in Tennessee, Kentucky and Virginia and is one of TNC's largest-ever conservation efforts in the eastern United States.

“Locating solar and battery storage on former mine lands makes perfect sense to us,” said Danny Van Clief, CEO of Sun Tribe Development. “These sites and the communities they rest within have powered our country for more than a century—all we have to do is reimagine them for today's energy technology.”

Solar, battery storage expected to lead new U.S. generating capacity additions in 2025

The U.S. Energy Information Administration said it expects 63 gigawatts (GW) of new utility-scale electric-generating capacity to be added to the U.S. power grid in 2025, in its latest Preliminary Monthly Electric Generator Inventory report.

This amount represents an almost 30 percent increase from 2024 when 48.6 GW of capacity was installed, the largest capacity installation in a single year since 2002. Together, solar and battery storage account for 81 percent of the expected total capacity additions, with solar making up over 50 percent of the increase.

In 2024, generators added a record 30 GW of utility-scale solar to the U.S. grid, accounting for 61 percent of capacity additions last year. The EIA expects this trend will continue in 2025, with 32.5 GW of new utility-scale solar capacity to be added. Texas (11.6 GW) and California (2.9 GW) will account for almost half of the new utility-scale solar capacity addition in 2025. The EIA expects five other states (Indiana, Arizona, Michigan, Florida, and New York) each to account for more than 1 GW of added solar capacity in 2025 and collectively account for 7.8 GW of planned solar capacity additions.

In 2025, capacity growth from battery storage could set a record—it's expected 18.2 GW of utility-scale battery storage to be added to the grid. U.S. battery storage already achieved record growth in 2024 when power providers added 10.3 GW of new battery storage capacity. This growth highlights the importance of battery storage when used with renewable energy, helping to balance supply and demand and improve grid stability. Energy storage systems are not primary electricity sources, meaning the technology does not create electricity from a fuel or natural resource. Instead, they store electricity that has already been created from an electricity generator or the electric power grid, which makes energy storage systems secondary sources of electricity.

In 2025, the EIA expects 7.7 GW of wind capacity to be added to the U.S. grid. Last year, only 5.1 GW was added, the smallest wind capacity addition since 2014. Texas, Wyoming, and Massachusetts will account for almost half of 2025 wind capacity additions. Two large offshore wind plants are expected to come online this year: the 800-megawatt (MW) Vineyard Wind 1 in Massachusetts and the 715-MW Revolution Wind in Rhode Island.

Wind turbine components market to grow by \$47.7 billion from 2025 to 2029, says report

The global wind turbine components market size is estimated to grow by \$47.7 billion from 2025-2029, according to market research firm, Technavio.

The market is estimated to grow at a CAGR of 7.2 percent during the forecast period. Rapid growth of the global wind power market is driving market growth, with a trend towards consistently declining cost of wind power. However, complications associated with materials, control, and storage poses a challenge.

The wind turbine components market has seen significant growth due to technological advancements leading to more efficient and cost-effective wind turbines. With economies of scale making wind energy the least expensive source of power in several regions, the focus is on next-generation wind power plants using the System Management of Atmospheric Resource through Technology (SMART) strategy. This strategy includes high-fidelity physics modeling, real-time wind flow monitoring, innovative rotor and drivetrain technology, and large blades and tall towers, says Technavio.

Government support, such as the U.S. federal wind Production Tax Credit (PTC) and Business Energy Investment Tax Credit (ITC), also plays a crucial role in the market's growth. Competitive bidding for wind power has resulted in lower tariffs, potentially impacting vendor profit margins.

The wind turbine components market is witnessing significant growth due to the increasing demand for renewable power and sustainable energy sources. Key components include rotor blades, towers, generators, nacelles, gear-boxes, and control systems.

Crude oil and natural gas prices are driving the shift towards renewable resources. Industry sectors like construction and green buildings are integrating wind turbines to meet their electricity requirements, according to Technavio. Environmental organizations support this



trend as wind energy produces fewer greenhouse gas emissions compared to traditional power sources. Advancements in technology include 3D printed components, which reduce manufacturing costs and improve efficiency. Wind turbine components are essential for the sustainable economy, reducing

reliance on non-renewable resources. Wind speed, electrical conduits, base, power source, and gear box are other crucial components. The industry is expected to continue growing, offering numerous opportunities for businesses, says the company.

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Enel grazes Texas solar farms with largest U.S. solar grazing contract

Enel North America will deploy over 6,000 sheep to control vegetation at eight Texas solar plants through the largest announced solar grazing agreement executed in the U.S.

The company is partnering with Texas Solar Sheep Co., a family business that provides vegetation management at large solar plants, in a commitment to scale up sustainable practices in renewables.

Texas Solar Sheep will deploy over 6,000 sheep to graze on more than 10,100 acres of solar land, nearly 75 percent of the area of Manhattan, says the company. This is one of the most significant single contracts for dual-use solar, according to the American Solar Grazing Association, which estimates that 100,000 acres of solar sites are being grazed in the U.S. per a recent survey.

By embracing sheep grazing, Enel says it is reinforcing its commitment to "agrivoltaics," the practice of combining solar power generation with agricultural practices. This agreement also strengthens the company's presence in the Texas



market, where Enel is the leading operator of utility-scale battery storage.

"Enel's record-breaking collaboration with Texas Solar Sheep is an exciting step forward for sustainable dual-use solar practices," said Marcus Krembs, Head of External Relations and Sustainability at Enel North America. "By prioritizing sheep grazing for land management, we demonstrate how solar and agriculture can coexist while ensuring optimal performance of our solar facilities. Additionally, our sheep grazing commitment supports ecosystem

services and the local economy."

According to the National Renewable Energy Laboratory (NREL), the combined benefits preserving native habitats and grazing livestock at solar installations include improved soil health, enabling more efficient use of water, and reduced maintenance and operations costs.

By improving operational efficiencies and supporting sustainable practices, this approach augments the sustainable value of Enel's solar power production and fosters positive relationships with neighboring communities, says the company.

"We applaud Enel's commitment to dual land use solar facilities and look forward to expanding Texas agriculture along with solar energy production in the state," said JR Howard, owner at Texas Solar Sheep LLC.

Enel's existing solar grazing program has demonstrated substantial advancements in soil health, with some sites experiencing over a 200 percent improvement in organic matter. Sheep also promote pollinator-friendly habitats by allowing some native plants to mature and bloom, unlike traditional mowing methods. Furthermore, solar grazing benefits local economies by providing a new revenue stream for sheep herders.

"The American Solar Grazing Association is excited to see Enel carry the momentum forward on dual-use solar with their strong commitment to solar sheep grazing. Solar grazing is at the forefront of a booming agrivoltaics industry, and we are

NIPSCO completes third solar project in Indiana

Taking what it says is the next step forward in its electric generation transition to a more diverse, balanced and reliable portfolio, Northern Indiana Public Service Company LLC (NIPSCO) has announced the completion of another solar project in its electric generation fleet.

"The completion of Cavalry Solar, the third solar project in NIPSCO's generating mix, is a crucial step in advancing our energy generation transition plan to provide sustainable, cost-effective and reliable energy now and into the future," said Vince Parisi, NIPSCO President and Chief Operating Officer. "The inclusion of battery energy storage is an example of the advancing technology we're incorporating into our energy transition to best meet the needs of our customers."

Cavalry Energy Center, LLC, a subsidiary of NextEra Energy Resources, LLC, developed and constructed the 200-megawatt (MW) solar facility with an additional 45 MW of battery energy storage capability located in White County, Indiana.

The facility will produce enough energy to power approximately 60,000 homes, and it is expected to generate approximately \$25 million in additional tax revenue for White County over the life of the project.

Cavalry Solar joins two additional solar projects in NIPSCO's electric generating portfolio—Indiana Crossroads Solar also located in White County and Dunns Bridge I Solar located in Jasper County. Dunns Bridge II Solar, located in Jasper and Starke counties is under construction by another subsidiary of NextEra Energy Resources.

seeing more and more leaders in the solar industry investing in long-lasting partnerships with farmers and creating new opportunities for American agriculture," commented Kevin Richardson, Outreach Director at the American Solar Grazing Association.

With the U.S. solar industry expected to break construction records again this year, with 36.4 GW of utility-scale solar scheduled to be added to the grid by end of 2024 and Texas leading the nation in solar power operation, Enel anticipates this innovative collaboration will set a new standard for responsible land management and clean energy production within the solar industry.

Avantus and Toyota Tsusho start construction of Texas solar project

Avantus (formerly 8minute) and Toyota Tsusho America (TAI) have announced the beginning of construction of the 159 megawatt Norton Solar Project in Runnels County, Texas.

Issuance of a Notice to Proceed (NTP) follows Avantus' sale of the Norton project in November 2023 to TAI, a 100 percent subsidiary of Toyota Tsusho Corporation of Japan, one of the Toyota Group Companies. TAI has also closed on a construction and term financing agreement with global financial group Mitsubishi UFJ Financial Group.

The continued collaboration between Avantus and TAI underscores the value that Avantus and its portfolio can bring to leading, multinational companies looking to advance clean energy solutions and their sustainability goals, says Avantus. A long-term Power Purchase Agreement (PPA) has also been secured with a corporate customer for the project.

Avantus will oversee construction of Norton, which is expected to begin operations in late 2025. RES will provide the engineering, procurement and construction (EPC) services for the project.

"Texas is energy country, and that includes massive opportunities in solar. The Norton Solar Project represents the best of what we do at Avantus—develop high-quality clean energy projects that are



good for our customers, for the local economy, and for the planet," said Avantus Chief Financial Officer Patrick Goff. "This project was six years in the making, and I am proud of our team's persistence in getting Norton shovel-ready and for securing the project's successful sale to Toyota Tsusho America, Inc. to help meet their sustainability goals."

Norton is expected to create 250 jobs at peak construction and will provide direct economic benefits to Runnels County and the local community throughout its operating life.

Norton marks the seventh project Avantus has developed and sold in Texas, bringing the total amount of clean energy it has developed in the state to nearly 2 gigawatts (GW). With more than 80 projects currently in development, Avantus says it has one of the largest pipelines of solar and energy storage projects in the U.S., exceeding 46 GW of system capacity, including 30 GW of solar and 94 GW-hours (GWh) of energy storage—enough to provide power for more than 20 million people throughout the southwestern United States.

Rivian signs PPA deal for power from Champion Wind Farm in Texas

Electric vehicle manufacturer Rivian has signed a long-term power purchase agreement (PPA) with RWE for the electricity from an The PPA underlines RWE's ability to

support the demand for clean electricity from manufacturing, technology and other energy-intensive sectors, says the company.

Under the 15-year PPA, electricity from Champion Wind, a 127 megawatt (MW) wind farm in Nolan and Mitchell Counties, will help supply Rivian's fast-charging network, the Rivian Adventure Network, with 100 percent renewable energy.

The project contributes to Rivian's vision for a carbon-free future and commitment to enable 7 billion miles of renewable driving. The Champion Wind farm is currently undergoing upgrades to install new, state-of-the-art turbine nacelles and blades that will extend the lifetime of the facility. The repowering of Champion Wind will be completed in mid-2025.

Champion Wind was originally commissioned in 2008, and construction began in 2024 to repower the facility. RWE is partnering with the Mortenson Company to build the project. Siemens Gamesa is supplying 41 turbines with new nacelles and blades on existing towers. The nacelles and blades are being manufactured in the U.S.

In addition, as part of the repowering project, the wind farm will have six new Siemens Gamesa turbines rated at 3.1 MW. When Champion Wind resumes operations, it will generate enough electricity to power nearly 1 billion miles of renewable driving every year or the equivalent of 36,000 homes annually in Texas. e

MITIGATING PRICE VOLATILITY: HOW FLEXIBLE ASSETS CAN STRENGTHEN RENEWABLE PORTFOLIOS

As renewable energy's share in the U.S. grows, so does the challenge of managing the price volatility it brings for investors.

By Andrew Warrell, Spencer Holmes and Tyler Bowen

Renewable energy, which is set to grow from 25 percent to 45 percent of total generation by 2030, is transforming the U.S. power market. This rapid expansion, while crucial for a low-carbon future, brings new dynamics for investors to navigate—particularly around price volatility.

Solar and wind power, driven by variable weather patterns, can create differences between forecasted and actual output, leading to major price gaps in day-ahead vs. real-time markets. For renewable-heavy portfolios, managing this variability is key to ensure stable, resilient returns.

Additionally, demand mismatches exacerbate this volatility. Solar production peaks around midday, often when demand is low, and tapers off in the evening when demand rises. In states like California, where solar comprises a large share of power, this mismatch can lead to significant daily price swings. Adding to the challenge, many renewable assets are located far from demand centers, leading to locational price differences which can reduce profit margins.

Contrastingly, renewable generation can exceed demand at times of extreme wind or sunshine, leading to price drops that reduce revenues when output is at peak. For renewable-heavy portfolios, this "oversupply effect" underscores the need for stabilizing factors to secure a steady stream of revenue.

Flexible assets as a stabilizer

To counteract renewable energy source-driven volatility, flexible assets have become a remedy in managing supply-demand imbalances and stabilizing returns. Battery storage, gas generation and demand response are leading solutions, helping portfolios remain resilient in increasingly volatile markets.

Battery storage capacity in the U.S. is expected to increase from 13 GW today to 110 GW by 2030, marking an eightfold growth as investors respond to stronger demand for higher storage capabilities. Batteries allow excess energy to be stored when prices are low and released during peak demand—creating new revenue opportunities and reducing exposure in lower-price periods. With their ability to quickly respond to price fluctuations, batteries are becoming an essential asset for stabilizing returns.

Natural gas generation remains a reliable option for on-demand power supply. While gas comprises 43 percent of U.S. power generation, some investors weigh its carbon footprint against its role in stabilizing portfolios exposed to renewables. Gas plants can quickly adjust output, ensur-

ing reliable power when renewable generation falls short, offering a hedge against price instability.

Demand response programs have experienced rising participation, providing grid operators with the ability to incentivize consumers to lower usage during peak periods. Demand response now represents around 60 GW of capacity nationwide, helping to ease strain on the grid without requiring new infrastructure. For investors, it offers a flexible and sustainable way to balance renewables variability, enabling a dynamic approach to managing portfolio risk.

Together, battery storage, natural gas generation and demand response provide a crucial buffer against the risks associated with renewable energy, making portfolios more adaptable and financially resilient.

A strategic approach to building resilient portfolios

In addition to integrating flexible assets, a multi-pronged strategy is essential for long-term stability in renewable-heavy portfolios. Acquiring flexible capacity through M&A can add resilience to existing investments. By investing in established battery storage facilities or demand response assets, investors gain immediate capacity and increased control over risk, without the lengthy timelines typically needed for new energy infrastructure projects.

Integrated financial modeling allows investors to take a portfolio-wide view of potential risks and returns. By simulating how flexible assets and financial hedges perform under different market conditions, investors can optimize for risk-adjusted returns, structuring portfolios that strike a balance between risk appetite and stability.

Future-proofing for a renewable future

As renewable energy reshapes the power landscape, volatility will remain a defining characteristic of renewable-heavy portfolios. Investors can position themselves for success by integrating flexible assets and adopting a resilience-focused strategy that anticipates market swings.

With flexible assets and a proactive approach to risk management, investors can capture the promise of renewables while maintaining the stability needed for consistent returns. In this evolving energy landscape, such strategies are essential for securing long-term growth and safeguarding portfolio resilience.

Andrew Warrel is a partner, Spencer Holmes is an associate partner, and Tyler Bowen is an expert at consulting firm, McKinsey & Company (www.mckinsey.com). This column was originally published on the Utility Dive website (www.utilitydive.com).



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