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Job creation. Both on the campaign trail and ever since moving into the White House, Donald Trump has promised U.S. job creation. So then why is the president so fixated on reviving the coal industry while ignoring the vast economic benefits of renewable energy?

We all knew that Trump would roll back the Obama administration’s Clean Power Plan (CPP), a climate change initiative to regulate emissions from existing power plants. As of press time, the CPP hasn’t officially been dismantled, but Trump signed an executive order setting the process into motion in late March. During the ceremony, the president signed the order with a bunch of coal workers behind him - a photo op that again underscored the Trump team’s vow to “end the war on coal.”

Luckily, utilities and states across the country have taken the lead and reiterated their support for clean energy regardless of the CPP’s fate. For instance, Gov. Terry McAuliffe, D-Va., recently signed an order of his own directing an agency to establish new emissions regulations on Virginia power plants, meaning the rules would essentially serve as a state-level CPP.

“The threat of climate change is real, and we have a shared responsibility to confront it,” said McAuliffe. “Once approved, this regulation will reduce carbon-dioxide emissions from the commonwealth’s power plants and give rise to the next generation of energy jobs. As the federal government abdicates its role on this important issue, it is critical for states to fill the void.”

Nevertheless, the Trump administration’s affinity for coal is cause for concern. Before initiating the CPP rollback, for example, the president signed a separate executive order repealing what he deemed “another terrible job-killing rule” designed to prevent coal mining companies from dumping their waste into rivers and streams. Although the action will obviously perpetuate harm to the environment, the Trump administration again did it while citing the so-called “war on coal.”

I greatly respect and appreciate this country’s proud tradition of coal mining, and the coal industry has a long history of helping keep our lights on, but the time for a transition to cleaner energy - and, thus, cleaner air - is now. Furthermore, although modern environmental policies have put restraints on the coal sector, analysts say the industry’s decline and job losses are actually the result of market forces, namely the usage of less-expensive natural gas but also the rise of increasingly cheaper renewables.

Trump needs to finally realize that renewable energy poses the best opportunity for job creation. A widely shared New York Times article, titled “Today’s Energy Jobs Are in Solar, Not Coal,” recently cited U.S. Department of Energy (DOE) statistics showing that the solar industry, alone, provided more jobs than the coal industry in 2016. As previously reported, the Solar Foundation found that solar accounted for one out of every 50 new U.S. jobs last year, and the industry’s growth outpaced that of the overall U.S. economy by 17 times. Over 260,000 Americans spent all or at least half of their time in solar-related work last year, and the DOE stats say that total jumps to almost 374,000 Americans when including those who only spent “some portion of their time” on such work. The astounding figures dwarf those of the domestic coal industry, which employed approximately 160,000 workers in 2016. Of course, renewable energy employment isn’t exclusive to solar, either: The wind industry, for example, supported over 100,000 U.S. jobs last year.

Coal country, itself, is even embracing solar. In Kentucky, a coal mining company is planning to install a large solar project atop one of its old strip mines. The company says the project would repurpose the site, whose coal has already been fully extracted, in order to generate power and provide new jobs for out-of-work coal miners. Moreover, the Kentucky Coal Mining Museum also recently revealed it was going solar in order to save money on electricity.

Talk about symbolism! Coal is the past, and solar is the future.

Why is Trump working to resurrect the coal industry, pollute the environment and, as shown in his budget proposal, slash funding for clean energy programs? Despite what he says, the decline of coal isn’t a war - it’s a progression of science, of social responsibility. Importantly, it’s also about economics. As a proud businessman, the president should recognize that and start supporting renewables. There are thousand of jobs to create.
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Solar, Wind Provided Over Half Of New U.S. Capacity In Q1

Wind and solar power provided more than half of the new electrical generating capacity added to the U.S. grid during the first quarter of the year, says a new report from the SUN DAY Campaign, citing statistics from the Federal Energy Regulatory Commission (FERC).

According to the nonprofit’s analysis of FERC’s latest Energy Infrastructure Update, which offers data through March 31, wind and solar provided a total of 50.84% of the new electrical generating capacity during the quarter.

The organization says 13 units of wind, totaling 1,479 MW, combined with 62 units of solar, totaling 939 MW, exceeded the 2,235 MW provided by 21 units of natural gas and 102 MW provided by one unit of nuclear power. There was also 1 MW of capacity from other sources, such as fuel cells.

Notably, SUN DAY says that in the first three months of the year, no new generating capacity was provided by coal, oil, hydropower, biomass or geothermal.

Moreover, the pace of growth of new solar and wind capacity is accelerating, according to the report. For the first quarter of 2017, new capacity from those sources was 18.07% greater than that added during the same three-month period in 2016 (2,418 MW vs. 2048 MW).

Renewable sources (biomass, geothermal, hydropower, solar and wind) now account for almost one-fifth (19.51%) of the nation’s total available installed generating capacity: hydropower at 8.48%, wind at 7.12%, solar at 2.17%, biomass at 1.41% and geothermal at 0.33%, the report says.

By comparison, at the end of 2016, renewables provided 19.17% of the total generating capacity. If current growth rates continue, renewables should top 20% before the end of this year, according to SUN DAY.

Further, generating capacity by renewable sources is now more than double that of nuclear power (9.10%) and is rapidly approaching that of coal (24.25%), the analysis adds.

“The Trump administration’s efforts to reboot coal and expand oil drilling continue to be proven wrong-headed in light of the latest FERC data,” comments Ken Bossong, executive director of the SUN DAY Campaign. “Once more, renewables - led by wind and solar - have proven themselves to be the energy sources making America great again.”

In another recent report citing FERC data, the nonprofit said newly installed capacity from renewable sources totaled 61.5% of all new U.S. capacity added in 2016.

SUN DAY notes that generating capacity is not the same as actual generation: Electrical production per megawatt of available capacity (i.e., capacity factor) for renewables is often lower than that for fossil fuels and nuclear power. For instance, neither FERC nor the U.S. Energy Information Administration fully accounts for all electricity generated by smaller-scale, distributed renewable energy sources. FERC’s data, for example, is limited to plants with a nameplate capacity of 1 MW or greater and thereby fails to include distributed sources such as rooftop solar, the organization explains.

Community Solar Program Sells Out Within A Month

There’s no denying that community solar is quickly catching on as a viable alternative to rooftop solar all across the country. Underscoring that growing interest among consumers, utility El Paso Electric (EPE) has announced that subscriptions for its new community solar pilot program sold out fast - only a month after enrollment began.

“We’re very excited to see that our customers have really embraced community solar,” says Mary Kipp, the utility’s CEO. “The quick subscription time demonstrates our community’s interest in different options that provide more accessibility to solar power.”

The pilot program included the development of a 3 MW community solar project, located in El Paso, Texas. EPE, whose service territory includes parts of Texas and New Mexico, says the voluntary program is available to all of its Texas customers.
Minnesota Experiences ‘Dramatic’ Solar Growth

On a sunny Minnesota spring day, with solar panels in the background, Minnesota Commerce Commissioner Mike Rothman announced that the state is enjoying dramatic growth in solar power, adding nearly as much new solar capacity in just the first three months of 2017 as in all of 2016.

Rothman announced the latest solar statistics at the Schneiderman’s Furniture store in Plymouth, a Twin Cities suburb, in May. With support from state solar incentives, the family-owned furniture retailer has installed rooftop solar power systems at its Plymouth, Woodbury and Duluth stores in partnership with Minnesota-based commercial solar developer Ideal Energies.

“Solar is already a bright spot in Minnesota’s energy picture, and it’s getting even bigger and brighter,” said Rothman, whose agency includes the state energy office. “Minnesota is enjoying dramatic solar growth from residential, commercial, community solar and utility-scale projects. This solar growth is being driven by both innovative public policies and market forces, as solar becomes more and more cost competitive. What used to be called alternative energy isn’t alternative anymore. It’s mainstream.”

Rothman added, “Solar provides positive results for both our environment and our economy. Solar jobs in Minnesota increased 44 percent in 2016, with nearly 4,000 Minnesotans now employed in the industry. Solar presents our state with a tremendous opportunity for a clean, sustainable and job-creating energy future.”

According to data compiled by the Commerce Department, Minnesota added 203 MW of new solar electric capacity in the first quarter of 2017, compared to 207 MW during all of 2016. The state’s total solar capacity has grown from just 1 MW in 2009 to 447 MW as of March 31, with more than 800 MW projected by the end of the year.

Rothman said state and federal clean energy policies have helped spur Minnesota’s solar market growth by promoting technical advances, driving down costs, and increasing consumer and business demand. In 2013, Minnesota passed the Solar Energy Standard that requires investor-owned utilities to obtain 1.5% of their electric power from solar by the end of 2020, with a goal of 10% by 2030.

The bulk of new Minnesota solar in 2016 came from large utility-scale projects, including the 100 MW North Star solar project in Chisago County. According to utility filings, solar capacity in Minnesota is expected to increase by about 600 MW in 2017, with much of the new generation coming from many smaller (1 MW to 5 MW) community solar projects currently under construction. If projections are met, utility Xcel Energy will likely exceed the state’s 1.5% Solar Energy Standard by the end of 2017 - three years ahead of deadline.

Although solar currently provides less than 1% of the state’s total electricity, costs are dropping fast and the market is expanding rapidly, making it a growing contributor to Minnesota’s renewable energy portfolio.

“Solar power in Minnesota today is where wind power was 10 to 20 years ago,” said Rothman. “Wind now provides nearly 18 percent of Minnesota’s total electricity generation. Solar has the potential to grow even faster and larger in the years ahead. The classic Beatles/George Harrison song says it best: Here comes the sun.”

Under the terms of the transaction, Solar Spectrum has acquired Sungevity’s infrastructure, technology, installer network, supplier warranties and certain agreements. In an announcement, Solar Spectrum says it intends to hire the substantial majority of current Sungevity employees, and the company has also acquired Sungevity’s European businesses and will continue to operate them under their current branding.

Separately, Solar Spectrum says it intends to reach out to all current users of Sungevity solutions in the U.S. to offer an attractively priced warranty solution.

Solar Spectrum’s management team is led by CEO Patrick McGivern, former head of operations at Fitbit, and President and COO William Nettles, former general manager and head of acquisitions at VeriFone. McGivern states the transaction “marks a new beginning for this business.”

“I am proud to lead a new player in the residential solar market that has a healthy balance sheet and a competitive value proposition,” he says. “We thank our employees, customers and partners for their patience and for their continued support and commitment. Together, we will focus on building a sustainable and successful business at the forefront of solar as the industry continues to grow.”

Solar Spectrum Concludes Buyout Of Sungevity

Following approval from a bankruptcy court, California-based rooftop solar company Sungevity Inc. has sold substantially all of its assets to Solar Spectrum, a newly formed company backed by an investment group led by Minnesota-based private equity firm Northern Pacific Group.

After losing a deal to become a public company and raise much-needed capital, Sungevity filed for Chapter 11 bankruptcy in March, and according to reports, the court recently signed off on Sungevity’s $50 million sale to the Northern Pacific-led consortium. The investment group includes Hercules Capital and DGB Investments, a wholly owned investment vehicle of Douglas Bergeron, former VeriFone chairman and CEO.
Tesla Starts Taking Solar Roof Tile Orders

In May, Tesla officially started taking orders for its new Solar Roof tiles and finally released some details about the much-anticipated products.

The news came a bit later than originally planned, as Tesla CEO Elon Musk tweeted in March that the company would start taking orders in April. The billionaire entrepreneur first unveiled the Solar Roof building-integrated photovoltaic products last October and garnered a lot of media attention. However, details about the solar tiles, such as their price and potential delivery schedule, had been scarce - until now.

In typical fashion, Musk teased his latest announcement on Twitter at about 1 a.m. PT before Tesla unveiled more information “about 10 hours” later and released an official announcement on its website.

Key takeaways of the announcement include the following:

- The Solar Roof is expected to ultimately - i.e., after factoring in power savings - be less than what Consumer Reports estimated would be necessary to make it cost-competitive with a typical roof, with the solar solution costing the average homeowner about $21.85 per square foot;
- Only two of the four tile designs (smooth and textured) will be available this year, with the other two models (Tuscan and slate) available in early 2018;
- The tile will have a 30-year power warranty, while its tempered glass will have an “infinity” warranty; and
- Installations are expected to kick off in the U.S., starting in California, this summer and abroad next year.

Consumers and solar industry insiders, alike, have been impatiently waiting to learn more about Musk’s mysterious solar plans. Although Tesla still hasn’t explained all of the roll-out and technical information about the new tiles, some more details are available at tesla.com/solarroof.

LG Chem Brings Residential Batteries To North America

LG Chem Ltd., a provider of lithium-ion batteries for automotive, stationary and consumer applications, has formally launched its range of residential battery systems in the North American market.

The launch follows successful completion of UL certification and represents LG Chem’s initial foray into the North American residential market, though the company already provides residential systems throughout Europe and Asia.

LG Chem’s North American residential battery range offers AC- and DC-coupled solutions with capacities up to 9.8 kWh. Two voltage options are available, pre-matched with compatible inverters and suitable for both indoor and outdoor installation: low-voltage 48 V, with capacities of 3.3 kWh, 6.5 kWh and 9.8 kWh, and high-voltage 400 V, with capacities of 7 kWh and 9.8 kWh.

The company says the 400 V RESU10H (9.8 kWh) product is compatible with SolarEdge’s StorEdge, which is a DC-coupled storage solution based on a single inverter for both PV and storage. Additional inverter compatibility options will become available later this year to provide homeowners with a range of pre-tested solutions from the industry’s leading suppliers, according to LG Chem.

The company adds that its residential batteries will be available via a number of solar/storage providers in North America. For example, following last year’s announcement of a partnership with LG Chem, U.S.-based solar provider Sunrun will be supplying the residential battery systems and has already installed initial systems in both Hawaii and California. LG Chem says additional distribution channels are in advanced negotiations and will provide coverage to all U.S. states and Canadian provinces.

“LG Chem’s entry into the North American residential battery market is based on much planning, product development and system testing. We’re confident that our experience gained in Europe and Asia, coupled with strong inverter and distribution partners, will deliver exceptional performance and reliability for our residential customers in the U.S. and Canada,” says Peter Gibson, head of energy storage system sales for LG Chem in North America.

“Customers can now enhance the benefits of their residential solar systems by using our batteries to maximize consumption of solar energy and to use the batteries as a dependable source of energy during grid interruptions.”
DPW Solar Launches POWER DISK Mounting System

DPW Solar, a brand of Preformed Line Products, has announced its new POWER DISK rail-less rooftop solar mounting system.

According to the manufacturer, maneuvering mounting rails can be a demanding part of installing rooftop PV modules, but now installers can avoid that with the POWER DISK system. DPW Solar says the new roof attachment can go anywhere on residential rooftops and does not need to be secured to rafters.

“Layout takes a fraction of the time and requires fewer components and tools than traditional rail-less systems,” says John Markiewicz, general manager of DPW Solar. “The layout process is simple. You can place solar modules at precisely your preferred locations.”

The company says the pre-assembled solution allows workers to install solar modules in four steps: snap chalk lines, mount POWER DISK bases anywhere on the roof deck, set the modules in place, and spin the disks to vertically adjust the height to roof undulations. DPW Solar adds that POWER DISK fits most framed 60- and 72-cell modules and is UL 2703 code compliant and available in black.

Panasonic Offers 25-Year Warranty For HIT Module

Panasonic Eco Solutions North America has announced a new 25-year product workmanship warranty on its HIT photovoltaic module.

The company says this represents a big step forward in guaranteeing the long-term viability of its HIT product and is one of the longest such warranties for modules in the residential solar market.

Panasonic says that in addition to offering a guarantee that is more than twice as long as some panel manufacturers’ 10-year product warranties, the company also now guarantees 91% of rated power over the 25-year warranty. According to the company, the HIT panel also features a temperature coefficient of -0.258%/C, which reflects recent test results from a third-party safety organization.

“At Panasonic, we are proud to not only offer top-of-the-line residential solar panels that will provide huge savings for our customers, but to also stand behind those products and ensure their longevity,” says Dan Silver, president of Panasonic Eco Solutions North America. “This 25-year warranty and industry-leading temperature characteristics give our installers yet another asset when advocating for Panasonic HIT panels to customers.”

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Over the last decade, the costs of residential solar photovoltaic (PV) systems in the U.S. have steadily declined, and many stakeholders - including homeowners, utilities and regulators - are increasingly considering the value of energy storage tied to PV systems. How can distributed energy storage enhance grid operations? Is it cost-effective? How will costs evolve over time? Today, the answers to many of these questions largely depend on where the PV+storage system is installed. Locality-specific costs and processes like permitting, interconnection, net metering, and fire codes can vary widely across the U.S., affecting not only project costs, but also project timelines. Some of the biggest variables affecting the financial viability of grid-connected PV+storage projects are the local utility rates, incentives and how ancillary benefits of the systems are valued.

New research from the U.S. Department of Energy’s (DOE) National Renewable Energy Laboratory (NREL) and the DOE’s SunShot Initiative is shedding light on some of the barriers preventing widespread deployment of PV+storage systems. Summarized in a new report, “Installed Cost Benchmarks and Deployment Barriers for Residential Solar Photovoltaics with Energy Storage: Q1 2016,” the research offers insights that could help lower those barriers.

Broadly speaking, our report focuses on two main types of barriers to residential energy storage deployment: cost barriers and value barriers.

With respect to cost, although storage technology costs continue to decline, today’s installed system prices - which include non-hardware costs, such as customer acquisition, permitting, overhead and interconnection - remain relatively high for a typical homeowner. Previously, few studies have offered detailed, installed system price breakdowns for distributed storage. This lack of publicly available information limits our understanding of the main cost drivers and cost-reduction opportunities. Our report fills this gap in the research literature by providing granular installed system price breakdowns that include previously unknown non-hardware costs, such as those associated with the regulatory approval process.

With respect to value, the absence of actual markets in most parts of the U.S. for distributed energy storage services prevents utilities and storage owners from realizing the full value of energy storage and undermines the overall economics. While our report focuses on offering an extensive analysis of the system and component cost barriers, it also offers insights into the value barriers facing PV+storage.

Regular benchmarking and tracking of system prices and component costs can help provide insight into underlying cost drivers. Since 2009, analysts at NREL have annually benchmarked installed PV system prices for the residential, commercial and utility-scale sectors. NREL’s methodology includes bottom-up accounting for all component and project-development costs incurred when installing PV systems, excluding the investment tax credit (ITC). As the prices of these systems have fallen, NREL’s benchmarking analysis has shown the importance of reducing non-hardware costs to achieving the DOE SunShot Initiative’s cost and deployment targets by 2020 - and has revealed new opportunities to reduce costs even further.

Now, for the first time, NREL and SunShot have established granular system price benchmarks for residential PV+storage systems installed in the first quarter of 2016 (Q1’16). One aim of the report was to help technology manufacturers, installers, and other stakeholders identify cost-reduction opportunities and inform decision-makers about regulatory, policy, and market characteristics that impede PV+storage deployment.

For our PV+storage benchmarking, we adapted NREL’s proven approach for residential, stand-alone PV systems and model the cash purchase price, excluding the federal ITC. In general, we attempt to model typical installation techniques and business operations with an approach that enables benchmarking of costs independent from price, which is critical in understanding industry progress in reducing costs over time.
Our methodology provides a granular accounting for all direct and indirect costs and captures variation driven by multiple factors. For example, we capture cost variation driven by different system designs, product specifications, and the intended end use of installed storage capacity. The results of this original analysis and modeling were compared to a review of the published literature and validated through interviews with more than 22 industry and subject matter experts.

All of our hardware benchmarks represent the price at which components are purchased by the installer and represent the product offerings most commonly available today on a national average basis. Future work will expand the benchmarking analysis to account for geographic variability and regional trends, which will be especially important as new, lower-cost technologies become more widely available in specific markets.

We applied a 17% fixed margin to represent the net profit of the installer. Our analysis did not include any additional price gross-up or adders, which are common in the marketplace today. We used this approach because of the wide variation in installer profits in the residential sector, where end-user pricing is highly dependent on the region, local retail electricity rates, local rebates and incentives, competitive environment, and overall project or deal structures.

Analyzing storage system pricing and component costs presents the additional challenge of choosing an appropriate metric to use in adapting NREL’s stand-alone PV cost-modeling approach. Stand-alone PV has several standard metrics, such as dollars per watt ($/W) of installed capacity or levelized cost of energy (LCOE); however, energy storage lacks a similar, widely accepted metric.

Storage systems are designed for a variety of different customer needs that drive whether the cost per unit of power (dollars per kilowatt, $/kW) or cost per unit of energy (dollars per kilowatt-hour, $/kWh) storage capacity is more relevant for a given customer. In general, customers who have loads with high peaks of short duration may desire a high-power (kW) battery capable of meeting the high peak. Customers who have flatter loads with lower peaks of longer duration may prefer a high-energy (kWh) battery capable of longer-duration energy discharge. We decided to use total installed price of a typical PV+storage system as our primary metric, and we compared that metric across several different system configurations.

We considered four major characteristics when evaluating PV+storage systems:

- PV system capacity (in kW);
- Battery energy capacity (in kWh);
- Battery power capacity (in kW); and
- Whether the battery is direct-current (DC) or alternating-current (AC) coupled.
AC-coupled systems are generally more efficient in applications where PV energy is mostly consumed at the time of generation. DC-coupled systems are more efficient in applications where PV energy is mostly stored for use at a later time. However, future technological improvements that eliminate the need for the charge controller or increase the efficiency of battery-based inverters could reduce the efficiency gap between DC- and AC-coupled systems.

We also considered two different battery sizes: a “small-battery case” and a “large-battery case.” The small-battery case - which uses a 5.6 kW PV array and a 3 kW/6 kWh lithium-battery system - is designed to enable a typical customer to optimize self-consumption of PV electricity, including peak-demand shaving and time-of-use shifting, and to provide backup power for a limited number of critical loads in the event of a grid outage. The large-battery case - which uses a 5.6 kW PV array and a 5 kW/20 kWh lithium-ion battery system - is designed to optimize self-consumption of PV electricity and to meet greater backup power (kW) and energy (kWh) requirements in the event of a grid outage.

In total, we selected and analyzed the costs of five PV+storage systems. Their benchmarked costs for Q1’16 were the following:

- “Small-battery case,” DC coupled - $27,703;
- “Small-battery case,” AC coupled - $29,568;
- “Small-battery case,” AC coupled, battery retrofitted to system - $32,786;
- “Large-battery case,” DC coupled - $45,237; and
- “Large-battery case,” AC coupled - $47,171.

For comparison, the benchmarked cost for Q1’16 of a stand-alone 5.6 kW PV system was $15,581. Some interesting observations have emerged. For example, our work shows that the benchmarked price of a typical residential PV+storage system is about twice as high as the price of a similar stand-alone PV system due, in part, to the higher non-hardware costs of storage. Specifically, we found that hardware costs constitute about half the total price of a small-battery system and about 60% of a large-battery system, while the remaining costs comprise non-hardware items (such as net profit, sales and marketing, interconnection, or installation labor).

As noted earlier, energy storage deployment has been impeded by both cost and value barriers.

In our interviews with 22 representatives from 18 leading organizations closely involved with PV+storage research, product development and installation, we found that permitting and interconnection ranked among the most significant of the non-hardware cost barriers to PV+storage deployment. Obtaining permission to install and operate a residential energy storage device can be a complicated, expensive and uncertain process, with many jurisdictions and utilities requiring more documentation and inspections than typically required for stand-alone PV systems. Our benchmarking results suggest that permitting, inspection and interconnection (PII) costs add between $700 and $1,200 to the installed price of a stand-alone PV system, depending on the configuration. However, modeled PII costs, based on installed systems, do not sufficiently capture the costs of regulatory delay or inconsistent permitting and interconnection requirements.

Permitting and interconnection timelines and costs also reflect a lack of local familiarity with storage systems. Several industry stakeholders reported the need to work very closely with permitting officials and utilities throughout each step of the approval process to ensure that they addressed all concerns and questions raised. The unfamiliarity with storage and lack of standardized permitting and interconnection processes introduce additional regulatory uncertainty and can slow PV+storage growth.

In general, many of the benefits offered by PV+storage systems, especially those offered to the grid, are often under-valued. Distributed energy storage could be used to provide a number of grid-level benefits, such as voltage and frequency regulation, deferred infrastructure investment, and resource adequacy. New business models that aggregate and coordinate a fleet of networked residential PV+storage assets could provide these grid-level benefits. However, current market and regulatory constraints make it difficult to realize these value streams.

To the extent that these additional value streams could improve the economics of residential-scale PV+storage, the undervaluation of energy storage at the grid level poses a barrier to PV+storage deployment.

In U.S. deregulated electricity markets, generation, capacity and ancillary services are bought and sold on wholesale markets, whereas transmission and distribution services are generally rate-based. Energy storage can technically provide several of these services, but current regulatory structures typically require prospective storage aggregators and/or utilities to
make a mutually exclusive choice between selling into wholesale markets or rate-basing energy storage investments to provide transmission services. This structure prevents prospective aggregators from realizing the full potential value of aggregated energy storage devices - and passing this value onto residential customers.

Several recent Federal Energy Regulatory Commission (FERC) orders have begun to lay a framework for improved storage valuation by allowing non-generation resources to provide ancillary services and increasing payments to fast-responding resources - including batteries - that bid into frequency-regulation markets. In November 2016, FERC proposed an additional rule that would require regional transmission organizations and independent system operators to create regulations that accommodate the “physical and operational characteristics” of energy storage devices. These developments could ultimately allow residential customers to realize additional value streams from their PV+storage systems. This would improve the overall economics for individual systems, spurring further deployment.

Finally, flat electricity rates prevent PV+storage systems from providing value through load shifting because there is no incentive to shift excess PV generation from one time of day to another. This loss of value is most notable when net metering is available. Many of those interviewed for the report believe that properly designed, mandatory residential time-of-use rates could improve the load-shifting value proposition for PV+storage systems.

Taken together, these factors have resulted in significant regulatory uncertainty - frequently cited among the primary barriers to increasing deployment - higher soft costs, and unrealized or under-realized value for PV+storage.

Low-cost, customer-side energy storage products have the potential to optimize the value of rooftop PV while increasing the flexibility of electricity consumers and enhancing grid operations. Yet today, deployment of storage systems in the U.S. residential sector is lagging behind deployment in the commercial, industrial and utility-scale sectors. Of the total 226 MW of energy storage deployed in 2015, less than 35 MW was behind the meter, and only about 4 MW was residential.

However, analysts believe this ratio will change, estimating that 49% of total annual storage installations by 2021 will be behind the meter, including 463 MW in the residential sector. Further, the percentage of residential PV systems coupled with storage is projected to grow from 0.11% in 2014 to 3% in 2018.

Our report is the first in a planned series of studies to benchmark the evolving costs of residential PV+storage, and moving forward, we will further refine our cost model and include an even more comprehensive approach. Our long-term objective is to understand how distributed energy storage innovations - both in electrical battery storage and other forms - can interact with and enhance PV value.

Kristen Ardani is senior solar technology markets and policy analyst at the National Renewable Energy Laboratory. This article is adapted from a new NREL report co-authored by Ardani.
Examining three operational variables can provide insight into the impacts of solar in major U.S. electricity markets.

by Chris Vlahoplus, Paul Quinlan & Chris Becker

The question, then, is how can such a small set of resources have such a large operational impact? Answering this question requires a clear understanding of the dynamic relationships between three operating variables in an electric system: annual minimum midday load, peak solar production, and baseload or must-run generation. When taken together, these variables can be used to characterize a stress-case operating scenario and assess the oversupply risks an electric system faces when solar net load (i.e., system load minus solar generation) drops below must-run baseload generation.

This article builds from these dynamic relationships to derive new metrics that estimate the impacts and risks of solar in major U.S. electricity markets as of the end of 2015, the most recent year of data available. More specifically, the analysis examines select North American Electric Reliability Corp. (NERC) regions, as well as regional transmission operators (RTOs) and independent system operators (ISOs). The findings reveal the potential for the electric system to accommo-
date additional solar, though it is important to note that all results are contingent upon simplifying assumptions made involving an electric system’s operating variables. Changing these assumptions, leveraging advanced capabilities of utility-scale solar, or integrating storage with solar could yield different results.

Overall, the new metrics are valuable because they account for baseload generation considerations while signaling how close a region may be to experiencing oversupply risks from solar generation. Further, the new metrics provide solar stakeholders with a simple heuristic to assess oversupply risks across multiple markets.

Operational impact of solar
Assessing the operational impact of solar requires acknowledging that its effect on an electric system is not well described by simple measures of solar as a percentage of annual generation or total capacity. An increase in total generation capacity will not mitigate the impact of solar on baseload generation needed to meet load. In fact, what matters when discussing variable resources is not what capacity is available, but when that capacity is generating electricity in relation to the load at that time.

Consequently, any operational analysis of solar penetration should consider its effect specifically during midday hours (i.e., 8 a.m. to 8 p.m.). In particular, such an analysis should consider the annual minimum midday system load to assess the maximum operational impact of solar production.

An electric system’s baseload or must-run capacity can then be considered to determine whether such a stress-case operating scenario actually poses oversupply risks.

Thus, with just three core variables, we can begin making sense of solar’s operational impact:

A. Minimum Midday Load: The lowest daytime load during a given year. The minimum midday load will often occur on a weekend during a shoulder season (i.e., spring or fall), when heating and cooling demands are lower.

B. Solar Generation: Maximum potential production from existing solar capacity. To ensure a stress-case operating scenario, existing solar capacity should be assumed to be operating at full production.

C. Baseload Generation at Minimum Run: Baseload generation capacity is the thermal capacity expected to run for the majority of the year in a given electric system. The figure can be adjusted by minimum run estimates specific to each thermal resource. Minimum run capacity reflects the ability of a generation resource to ramp down output during low load periods.

Figure 1 on page 18 shows each of these variables in an illustrative minimum midday load scenario. In addition, the figure highlights two derivative calculations: an electric system’s oversupply cushion and its solar headroom. The oversupply cushion is an estimate of non-baseload generation that can operate during the minimum midday load. This load is typically served by imports or other generation assets, such as renewables or peaking units. The solar headroom calculation represents the
amount of new solar capacity that can be added to the electric system before grid operators must contend with oversupply risks.

Such oversupply risks arise when solar generation pushes net load (i.e., the green line) below baseload generation at minimum run (i.e., the orange line). In these instances, the combination of generation from solar and baseload assets exceeds the electric system’s total demand. Consequently, grid operators must pursue mitigation strategies such as curtailment, storage or export.

In light of these observations, two new metrics can be derived, which better account for the operational impact of solar during a stress-case scenario:

**Solar Capacity as a Percentage of Minimum Midday Load:** This metric reflects the relationship between peak solar production and annual minimum midday load. Using the labels in Figure 1, the metric is calculated in the following manner: Solar Capacity as a Percentage of Minimum Midday Load = B / A

**Solar Protection Factor (SPF):** This metric signals how close an electric system may be to experiencing oversupply risks from solar generation. A value greater than one provides directional evidence of oversupply risks during the minimum midday load. The metric does not speak to operational impacts associated with ramping. Using the labels in Figure 1, the metric is calculated in the following manner: SPF = B / (A - C)

Compared to traditional solar penetration metrics, these alternatives result in much higher penetration levels of solar across all major electricity markets in the U.S., thus helping to explain the impacts of solar we are witnessing today (see Figure 2). This trend is most evident in CAISO, where 9% of net generation translated into 40% of its minimum midday load and 55% of the ISO’s oversupply cushion (i.e., SPF), thus demonstrating the leverage effect. Also noteworthy is SERC Reliability Corp., whose SPF was more than 23 times greater than its traditional penetration metrics due to the NERC region’s comparatively small oversupply cushion resulting from its unique baseload composition.

It is important to note that this analysis focuses on the worst days of the year, from an operations perspective, to illustrate the point that solar generation’s impact is felt at specific times while not being an issue in annual averages. What’s more, this analysis combines control areas within a given NERC region or RTO/ISO, thus tempering the more dramatic impacts from solar in smaller balancing authorities. A more granular analysis would highlight these impacts and help to explain recent baseload retirements, such as the announced closing of the Diablo Canyon nuclear power plant in CAISO.

**Solar oversupply risks**

Building from these observations and metrics, we assessed the oversupply risks from solar in multiple electricity markets across the U.S. The analysis is indicative, not definitive. To perform it, we identified annual minimum midday load, installed solar capacity, and baseload generation as of the end of 2015 for select NERC regions and RTO/ISOs. Baseload generation was assumed to be thermal assets with a three-year average capacity factor greater than or equal to 65%. However, we did not consider coal units in SERC estimates to reflect assumptions in stakeholder comments filed in the Federal Energy Regulatory Commission’s recent technical conference on the Public Utility Regulatory Policies Act of 1978. Minimum run was assumed to be 100% for nuclear resources, 80% for coal resources and 60% for combined-cycle natural gas resources.
The results show the CAISO market with the greatest solar penetration during minimum midday load (see Figure 3). Further, the analysis shows CAISO having additional solar headroom (i.e., ability to accommodate additional solar generation) due to the relatively small amount of base load generation at minimum run. By comparison, the ability to accommodate solar is limited in other electricity markets due to the high percentages of base load capacity at minimum run. This situation is most pronounced in SERC, where a large reserve capacity and more than 25 GW of nuclear capacity exist. A similar dynamic, proportionally high base load generation, also appears in the PJM Interconnection.

It should be emphasized that the aforementioned results represent estimates based on simplified assumptions. For example, they do not account for the operational impacts of other variable generation such as wind or factors such as inter-regional trading. It is also worth noting that changes to an electric system’s base load composition or annual minimum midday load could significantly alter outcomes. For example, if base load generation capacity increases, solar headroom would shrink regardless of new solar additions. Conversely, if base load generation capacity decreases due to retirements, then solar headroom could grow. In addition, the analysis does not consider advanced power controls or the integration of energy storage, both of which could allow utility-scale solar to support electric system stability and reliability.

Despite these limitations, the value of this framework and the new metrics, such as the SPF, resides in their ability to quickly approximate oversupply risks using stress-case operating scenarios while accounting for base load generation. Further, the tools provide grid operators and solar stakeholders with the ability to assess oversupply risks across multiple electricity markets. The new penetration metrics are similar to hosting capacity assessments conducted at the distribution/circuit level and can be used as a milestone signaling the need for focused studies involving more detailed analysis.

In summary, our results suggest there remains room to accommodate solar growth, though electric systems with limited solar headroom or especially large base load generation capacity (e.g., those with significant nuclear assets) are likely to experience solar oversupply risks well before their peers. A separate analysis would be required to address ramping issues associated with the duck curve’s neck.

All three authors work at energy consulting firm Scott-Madden Inc., where Chris Vlahoplus is a partner and cleantech and sustainability practice leader, Paul Quinlan is cleantech manager, and Chris Becker is a research analyst.

Our analysis further indicates that in 2015, the Midcontinent Independent System Operator (MISO) could have potentially accommodated more than 20 GW of solar capacity before needing to address oversupply risks from solar generation (see Figure 4). This is reflective of the ISO’s small existing solar capacity at the time as compared to the minimum midday load of more than 58 GW. Finally, it is noteworthy that CAISO’s solar headroom was smaller than all markets except ISO New England (ISO-NE) in 2015. With this insight, it should not be a surprise that CAISO has since begun to increase renewable curtailments in 2017, following the installation of additional solar capacity and a marked increase in hydropower production following drought-busting rainfall.
Developing a utility-scale solar project requires a large upfront investment, which makes accurately predicting how much power it will produce a critical component of the process. The financial risks of both over- or underperforming expectations are substantial. Underperform and you risk defaulting on your loan. Overperform and you may discover you have overbuilt your plant, investing significantly more money (on equipment, maintenance and other ongoing project costs) than was actually required to meet the obligations of your power purchase agreement.

Weather, as the fuel of a project, is the greatest source of performance variability. Although it is impossible to predict with 100% accuracy what weather will be like at a site throughout a project’s entire lifetime, there’s a great deal solar developers can do in the pre-construction phase to reduce project uncertainty as much as possible. Solar resource and other weather components, such as precipitation, wind speed and temperature, directly impact power generation, and finding reliable weather information is essential for estimating system production and profits.

Several best practices can help developers reduce uncertainty in pre-construction solar resource assessments.

by Gwendalyn Bender & Francesca Davidson

Developers benefit from reducing energy estimate uncertainty because investors reward projects with low uncertainty with much more favorable financing terms. Although each project is impacted differently by uncertainty, research from pyranometer manufacturer Kipp & Zonen has determined that during project financing, for every 1% in resource uncertainty reduction, developers save $20,000 on average through improved financial terms.

Unfortunately, it is not uncommon to see errors in solar resource estimates equating to 2% to 5% reductions in energy produced. All of these percentages may seem small, but the associated financial losses add up in the long term. Consider a 10 MW PV project. If you underperform by 5%, in essence, you paid for a 10 MW plant but, in reality, ended up with a 9.5 MW plant. This would result in millions in lost revenue over the asset lifetime.

As solar capacity grows, more and more operational projects are coming online and performing outside the range of initial expectations. In response, the industry is beginning to wake up to the issue of resource assessment and call into question how initial solar energy estimates are calculated.

**Best practices for solar assessment**

Adopting a standard development and solar resource assessment process helps conserve time and money at each project phase and ultimately reduces the project’s overall level of uncertainty. To appropriately balance resource risk while controlling costs, solar developers need to ensure that they are using the most reliable weather data warranted by the size of the installation and its project phase.

During the initial prospecting stage, a developer will typically search for potential sites by conducting GIS analysis, comparing data layers from various paid and public sources, such as information on transmission, energy pricing, solar irradiance, temperature and wind speed. At this early phase, evaluating sites based on annual or monthly average weather
information is a reasonable starting point. One source is the Global Atlas for Renewable Energy hosted by the International Renewable Energy Agency, which includes free global resource and weather information.

Once a specific site has been selected, it is important to find a more accurate, long-term record of solar resource data with information at hourly intervals. This is partly due to the high uncertainty of publicly available sources. Developers also need long-term information because it best indicates how a project will perform over its lifetime. Data at an hourly timestep is required for most industry-specific software programs used to model utility-scale energy output and calculate the one-year P90 values needed for financing. A one-year P90 value indicates the production value the annual energy output will exceed 90% of the time.

Some developers will source monthly average resource data for this purpose and use the data directly in energy modeling software, allowing the software program to interpolate the hourly information. Recently, we at Vaisala conducted a study across several projects to see how this monthly methodology varied from using long-term, hourly average data.

When modeling a fixed-tilt PV system at locations with very stable climates, we found that the differences in energy calculations between using monthly average versus hourly average data could be as low as 0.5% to 1.5%. However, locations with higher resource variability, and particularly when modeling tracking systems, the energy calculation differences could be 2% to 5% between using monthly versus hourly resource data sources. Based on this experience, a good rule of thumb for utility-scale plants is to obtain long-term, hourly data from a high-quality source for any project where you would use a utility-scale solar software program to model energy production (typically 1 MW or larger).

In the not-so-distant past, the industry's only source for hourly data was typical meteorological year, or TMY. These datasets provide a one-year, hourly record of “typical” solar irradiance and meteorological values at a specific location in a simple file format. TMY datasets are freely available from the U.S. National Renewable Energy Laboratory (NREL) and commonly used at this early phase in the resource assessment process.

However, these datasets are not designed to show extremes, and NREL explicitly warns against using them to predict weather or energy production. Because low solar resource periods are actually screened out of TMY files, using these datasets can put your project at risk of loan default because it may not produce enough energy during these periods to make debt payments. For this reason, a TMY dataset alone is not appropriate for energy estimation at large-scale projects.

Due to the scarcity of direct observation networks and the short-term nature of their records, satellite processing methodologies, which generate long-term, hourly datasets of surface irradiance at a project location, have become the standard in pre-construction energy assessment practices for utility-scale development.

Evaluating long-term satellite data sources

Today, satellite-derived datasets are available from a number of providers, all of which use the same foundational satellite information but vary in their inputs and methods of calculating surface irradiance. For this reason, error and uncertainty can vary significantly between different sources.

Public information typically has high uncertainty. For example, NASA's global dataset has a 20% uncertainty and NREL's North American datasets have 5% to 12% uncertainty, depending on the version. Other free datasets that are available in various software packages can have 10% to 12% uncertainty, but high-quality data from a paid provider usually cuts resource uncertainty in half. For example, most proprietary solar datasets offer 5% or less uncertainty across the globe.

Another factor to consider when selecting a weather data source is how current it is. Has the dataset been kept up to date, or does it only offer values through 2010? This is
important because aerosols in the atmosphere, such as pollution, influence power performance substantially and have increased dramatically in many parts of the world, such as China and India, over the past 10 years. This has been discussed in a few different reports and is illustrated in the graph below, which shows how the doubling of aerosols in the atmosphere since 2006 at this location near Hyderabad, India, has created a downward trend for irradiance.

![Chart showing irradiance levels at a location near Hyderabad, India, demonstrating a downward trend since 2006 due to a doubling of aerosols in the atmosphere.](chart-courtesy-of-Vaisala)

Finally, a developer must evaluate how the dataset was validated and how accurate it is in the area where the project is located. To demonstrate accuracy, most data providers have compared their datasets against direct observations from publicly available ground stations. Additionally, in some cases, data providers have also used these ground stations to calibrate or enhance the accuracy of their solar resource information. A fair and unbiased verification study should reserve at least a subset of ground station data exclusively for validation purposes to provide its users with an accurate estimate of how the data will perform at their project locations. As a user of the data, it should be clear to you which validation points are independent and which are not.

With solar development expanding worldwide, the availability of accurate and consistent data across the globe is becoming increasingly important. When selecting a data source, be sure to check that it has been validated against ground stations in your project’s region. All solar analysts can agree that local conditions, such as pollution, dust or seasonal variation, have a great influence over solar resources - and, thus, your project’s future power generation.

These regional differences are often better captured in satellite data using a different aerosol or turbidity input or by employing a different irradiance model. For this reason, we actively maintain and update five different versions of our global dataset to give developers and financiers greater confidence and a more thorough understanding of local resource variability across the globe. However, today there are many available solar resource datasets that project developers can compare to select the one that works best for their project area.

Ideally, at this initial evaluation phase, utility-scale developers will collect long-term, hourly time series of weather data from the same provider they intend to use at the financing phase. This helps avoid the unpleasant surprise further down the development road map of changing your resource data source only to get a dramatically different number when estimating energy estimates.

Further reducing resource uncertainty

Beyond collecting high-quality satellite data to account for solar resource variability, seeking further uncertainty reduction can be critical in a number of circumstances. For example, in situations when a comparison of multiple solar resource data sources shows a wide spread between the answers, additional action to reduce project uncertainty may be required.

Most so-called “mega” solar projects (20 MW or larger) aim to achieve energy uncertainty levels between 6% and 9% because, as stated previously, a few percentage points can have a large effect on financing terms. For example, if a 20 MW project has a P90 of 40.9 GWh/year at 6% uncertainty, the P90 is 37.8 GWh/year at 7.5% uncertainty, and at 9% uncertainty, it drops to 36.2 GWh/year. This means a 3% decrease in uncertainty is an almost 10% increase in the P90 energy estimate, which is typically the value used for financing in order to ensure debt repayment.

Cases where a direct improvement in uncertainty can be tied to better project financial terms - for example, debt-financed projects - are good candidates for installing a privately-owned ground station at the site. Although these measurements generally provide a record of conditions only over a short period of time (six months to two years), ground observations capture micro-scale features affecting power performance that satellite-derived datasets frequently miss.

Direct measurements can also be combined with long-term satellite data using a technique called model output statistics, which produces a corrected record of solar resource. This methodology is the gold standard in solar resource assessment and has proven to reduce resource uncertainty, one of the largest factors in energy uncertainty, by 50%.

Keep in mind, however, that the success of this approach depends on the design and reliability of the ground station equipment. Ideally, your system should measure the parameters of irradiance, temperature, wind and precipitation. Irradiance and temperature data helps you correct long-term correction information from satellite-derived sources, which ultimately increases the accuracy of your energy estimates. On-site wind data is helpful for gust studies to determine the engineering specifications for racking, particularly if the project uses a tracking system to maximize energy. Precipitation data is useful for soiling and maintenance planning. Direct soiling information can be a nice addition, especially in dusty locations, but station maintenance and data management are even more important.

Poor maintenance can quickly turn first-class equipment into second-class equipment due to subpar readings. Additionally, a poorly maintained, low-quality system may cause more trouble than it is worth and result in added time and cost associated with quality controlling the observations and screening out erroneous readings.
Developers that are planning to own and operate the facility also gain substantial ongoing benefits from ground stations. For example, historical information, such as precipitation, can be used to budget maintenance costs. The station also provides real-time condition monitoring, which supports accurate energy forecasting, proactive performance reconciliation, and informed decisions about operations and maintenance activities.

Factoring in the probability of extreme weather is another aspect developers may need to consider. For example, when evaluating insurance options, it is important to analyze the likelihood of equipment damage in areas prone to lightning, high wind gusts or hailstorms. Heavy snowfall and haze from volcanic eruptions or wildfires can also impair energy production and may need to be accounted for in energy estimates during the resource assessment process.

Building trust in solar through performance

With solar power growing rapidly worldwide, it is imperative for solar projects to perform as close to expectation as possible, not only to build trust within the financial community, but also to enhance the reputation of the sector with the general public. As we have seen all too often in the early days of utility-scale renewable energy, underperforming projects often attract negative media attention, making banks reluctant to support future solar facilities or causing them to take a more conservative stance, penalizing future projects with a high cost of capital.

On-site observations from ground stations can help further reduce project uncertainty. Photo courtesy of Vaisala

As demonstrated here, the resource assessment process involves a number of key considerations, and its accuracy depends on the quality of the solar resource and weather data selected. To preserve the solar industry’s positive reputation, both developers and financiers must demand that solar resource assessments be executed with the care, precision and responsibility that the job requires. Otherwise, we may pay for the low-cost solutions and cut corners of today with the negative headlines and high investment costs of tomorrow.

Gwendalyn Bender is head of solar services at Vaisala, an environmental and industrial measurement company, and Francesca Davidson is the company’s energy communications expert.

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Contact Rob Simonelli at (562) 431-1630 or rob@solarindustrymag.com.
Developing Projects

Colleges and universities have a growing appetite for on-campus solar projects, which require some unique development considerations.

by Audrey Copeland

As a project developer at Borrego Solar, I’ve had the opportunity to work on several projects at colleges and universities, as well as learn from my colleagues who have also developed such projects. Through the nearly 40 MW we have installed in the education space, we’ve come to know the opportunities and challenges intimately. Here, I’ve boiled down the most important elements of developing a solar PV system at higher education institutions in the U.S., with a slight focus on the California market.

Why higher education?

Before jumping into the development details, it is important to discuss why the higher education segment offers a unique solar opportunity. There are three factors that come together: large amounts of on-site energy usage, sustainability objectives and the importance of reducing operational expenses.

As commercial solar developers well know, project economics break down at smaller system sizes. Higher education facilities typically have enough on-site load and space to support a sufficiently large system. In addition, most colleges and universities have a set of sustainability goals. For example, they might be signatories of the American College and University Presidents Climate Commitment or have other state-mandated carbon offset goals. In most cases, such goals cannot be reached without on-site renewable generation. The last point about reducing operational costs seems obvious, but it has a special meaning in the higher education world. Every penny spent on operational costs is a
Identifying the ideal location

The location of the solar project on campus is an important consideration. Although it is possible to put solar in many spots, there is a select group of scenarios that make the most sense.

In our experience, solar carports or ground mounts are the most advantageous and cost-effective for on-campus projects. That is because campuses tend to have large parking lots and, in some cases, vast open land (rural settings). We can achieve a large system size in one concentrated location.

Facility rooftops are also possible sites, but that depends on the state of the rooftops and whether there is enough open space. In my experience, it can be more challenging to identify a rooftop that is large enough and/or able to support the weight of a system. Of course, each campus setting is unique and ultimately must be evaluated with all of these factors in mind.

ADA considerations

The American Disabilities Act (ADA) is a non-trivial consideration for on-campus solar carport systems. Often, the ADA spots are located right up against the building and can’t be covered due to building setback issues and/or shading. This will necessitate adding ADA spots under the new shaded areas created by the solar project. This can trigger access pathway issues and overall ADA compliance issues with regard to the size of the spots and the orientation of the striping, even outside of the solar array. The cost of such upgrades can be significant. It is important for a developer to keep this in mind and look for opportunities to avoid ADA upgrades.

Interconnecting the system

Most colleges and universities operate on a 4.16 kV loop system or some other internal electrical infrastructure. What this means is that the meter may be located at one end of campus and would not be an ideal location for a direct interconnection due to the distance from the system. Instead, we look for opportunities to tie into one of the sub-meters throughout campus.

This piece can be challenging...
to figure out during the development stage. Ideally, the institution has up-to-date single-lines and a solid knowledge of the electrical infrastructure. We recommend asking for this information early on in the development process. It is also a good idea to request a site walk with the campus electrical engineer. Usually, there is someone at the site who is knowledgeable about the on-campus electrical infrastructure.

Scheduling

A majority of college and university projects are solar carport builds. During the development phase, this means crafting a schedule that minimizes disruptions while getting the project to the finish line as quickly as possible. We often build such systems during the summer months or employ a phased approach, during which we block out one section of parking at a time and roll throughout the parking lot.

In addition to phasing, it is important to coordinate regarding class schedules. We recommend educating the client on the parts of the work that are the most noisy and disruptive and then confirming the hours of work and how best to minimize the impact on the campus. The schedule can be a surprisingly continuous subject if all stakeholders haven’t been consulted.

Engaging stakeholders

An often overlooked but key ingredient for success is the degree to which the various stakeholders support the project. Universities and colleges have numerous departments, a board of directors, students and other key actors. Each of the relevant stakeholders should be on board with the project and understand the timeline, financial impact and benefits.

We have seen scenarios in which not all of the stakeholders were aware or supportive of the proposed project, which can lead to delays. Ideally, all parties will have a voice throughout the development phase. For example, on a recent community college project, we observed the best scenario when the school board, staff and administration all worked together to produce the request for proposals (RFP). This ensured the project moved forward smoothly. Each party understood its role and had approved the project previously.

Conversely, we worked on another project where the board wasn’t consulted for approval until the end of the RFP process. In this case, the board decided to pass on the project. We recommend asking questions early on about which stakeholders have been involved. If the board has never even heard about the project and the school is issuing an RFP, then that could pose challenges later on.

Environmental compliance

Environmental compliance is an important factor in California, where we’ve developed a number of higher education solar projects. The California Environmental Quality Act (CEQA) applies to all public-sector projects in the state (and private-sector projects with conditional approvals/permitting). This act requires that developers take steps to mitigate environmental impacts, especially as they pertain to endangered species. Solar carport and rooftop systems at existing sites are exempt from CEQA review. Ground mounts, on the other hand, typically do trigger CEQA review. This can add a few months or even potentially years to the project timeline. We recommend assessing CEQA impacts during the project development phase to see what might come up and if there is anything that can be done with the design to avoid these impacts. For example, if a part of the site has oak trees, we may want to avoid that area to minimize

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This 1.1 MW solar carport project was built at San Diego Miramar College. Photo courtesy of Borrego Solar
the CEQA impact. All campuses must comply with CEQA requirements, so it is really about understanding which projects trigger CEQA and what might be required per the authority having jurisdiction and project site. When in doubt, engage a CEQA consultant that can advise regarding the potential requirements.

Division of the State Architect (DSA)
Public-sector college and university projects in California must comply with DSA review and processes. The DSA has some nuances that can have significant schedule impacts. For example, if you work with a provider that has a DSA-pre-approved design, this is then eligible for an over-the-counter design review. This will save several months in the project schedule. For ground mounts, there is a special classification for “behind the fence” projects. These projects must comply with DSA guidelines but do not have to be submitted to the DSA for review. The college or university, in these instances, is effectively self-permitting. This will also cut several months out of the project timeline.

More information is better
During the development phase, the more information the university or college can provide, the better. This includes details on existing utility lines, easements, geotechnical information, and anything else related to the project site. Although this information is often obtained during the design phase, these details up front can mitigate the amount of rework and ensure the project doesn’t hit a critical flaw.

Design-bid-build vs. design-build
The vast majority of on-site solar projects are constructed via a design-build approach. It is important to educate your college or university client on this subject prior to an RFP solicitation. A design-build approach is advantageous for a university or college, as this will lead to a lower cost per watt and the institution will get the value adds that come with a turnkey project - e.g., production guarantee and warranties. In general, it is challenging for a solar provider to use a pre-existing design and produce a competitive and compelling project. The client will be disappointed when going down this route, even if that is the way the institution approached most other construction projects on campus. For all parties, some education at the beginning of the development process can save time later on.

As you can see, there are a number of development considerations to take into account for on-site college and university solar projects. From scheduling to engaging stakeholders, several factors make higher education projects unique. The key to success is understanding those unique hurdles and taking steps to mitigate these challenges early on.

Audrey Copeland is a California-based project developer at Borrego Solar.

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Arizona Utility Names Solar Farm In Memory Of Employee

Arizona-based utility UniSource Energy Services (UES) has dedicated a new 5 MW solar array in memory of an employee who helped to keep the lights on for more than 30 years in Mohave County. UES says the Steven H. Jacobson Solar Facility, located north of Kingman, will produce enough power to meet the annual electric needs of more than 900 homes.

“The Steven H. Jacobson Solar Facility adds to UES’ growing renewable energy portfolio. We’re honored to name this new clean energy resource after someone who worked for so long and so hard to provide service to our customers,” says Carmine Tilghman, senior director of energy supply and renewable energy at UES.

Jacobson, a California native, moved to Kingman in 1984 and worked as a lineman and construction supervisor for UES in Mohave County. He died in March 2015 after a two-year battle with amyotrophic lateral sclerosis, commonly known as Lou Gehrig’s disease. Jacobson’s family members joined coworkers to dedicate the facility.

“The idea of naming the facility after Steve was the result of his dedication to the company and the community,” says Bill DeJulio, senior director of UES subsidiary UNS Electric. “Whenever we had emergencies or storms, Steve was always there to help, whether he was a lineman or a foreman or a supervisor. He was always ready to contribute.”

Jacobson lent assistance to other utilities in times of need, traveling as far as Vermont and Hawaii to help local crews restore service after significant storms. He was dedicated to his family and coworkers, volunteered for several local non-profit organizations and served on Kingman’s Clean City Commission.

The Jacobson Solar Facility includes more than 15,000 photovoltaic modules covering 32 acres. Engineering and construction team members included Sverdrup Engineering Services, Bowman Consulting, Premier Builders Group and Sletten Construction. UES owns and will manage the facility, and the utility notes it is working to deliver 20% of its power from renewable resources by 2020, surpassing the requirements that must be achieved by 2025 under Arizona’s renewable portfolio standard.

City Of Houston Buys Solar From 50 MW Project

The City of Houston and French energy company ENGIE have announced completion of the 50 MW SolaireHolman solar project, which will provide up to 10.5% of the city’s electricity needs under a 20-year power purchase agreement (PPA).

Located in Alpine, Texas, SolaireHolman was jointly developed and implemented by ENGIE subsidiaries Solairedirect North America and ENGIE North America. The project includes 203,840 solar panels on 360 acres and will provide electricity for Houston locations as diverse as the Hermann Park Zoo, the Bob Lanier Public Works Building, wastewater treatment plants, and several Bush Intercontinental Airport terminals.

In February, Houston Mayor Sylvester Turner and the city council expanded the solar PPA from 30 MW to 50 MW, reaffirming the city’s commitment to renewable energy, reducing emissions and saving taxpayer money. “As the energy capital of the world, it is important that Houston lead by example and show that investing in solar and renewable energy is a critical
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tool cities must use to prepare for the future,” says Turner. “We’re very proud to serve the city of Houston, a national innovator and substantial customer by any measure,” comments Marc-Alain Behar, managing director for Solairedirect North America. The SolaireHolman plant helps solidify Houston’s national leadership in renewable energy and growing use of solar energy. For the past two years, Houston has ranked No. 1 in the U.S. Environmental Protection Agency’s Top 30 Local Government list of the largest green power users from the Green Power Partnership. The city uses nearly 1 billion kWh of green power annually, which represents more than 89% of its total energy needs.

**Furman University Completes $1.7M Solar Farm**

After nearly eight months of preparation and the installation of 2,994 solar panels, Furman University’s new $1.7 million solar facility has gone online and is supplying power to the Greenville, S.C., campus. The university first announced its plans to construct the project, located on six acres of land near the main campus entrance on Poinsett Highway, in August 2016.

Jeff Redderson, Furman’s associate vice president for facility and campus services, says, “The additional solar power will reduce our campus-wide electricity expenditures by up to five percent annually and reduce our greenhouse-gas emissions by three percent.”

The university notes that the 743 kW solar PV array is also set up for net metering, which means any excess power it generates can be sold back to utility Duke Energy. Redderson estimates the reduced energy costs will bring a return on Furman’s investment in eight years.

“Furman takes its environmental responsibilities seriously, and we’re proud to be a leader in our sustainability programs and renewable energy systems,” says Furman President Elizabeth Davis. “In addition to increasing the university’s solar power production and reducing our energy costs, the new solar facility will serve as a laboratory for Furman students pursuing careers in sustainability. We are constantly working to become a more sustainable campus, and this project is another example of our commitment to that goal.”

Davis says the new solar installation will also help Furman reach its goal of becoming carbon neutral by 2026, the year of the university’s bicentennial. Duke Energy contributed to the project by providing Furman with a $997,000 solar rebate, one of the company’s largest to date. Furman contracted with Power Secure Solar, a North Carolina-based company with a local office in Greenville, to oversee the solar installation.

**Lockheed Martin Adds Another Massive Solar Carport**

Advanced Green Technologies (AGT), a Florida-based solar contractor and sister company to Advanced Roofing Inc., has announced completion of Lockheed Martin’s new 145,379-square-foot solar carport in east Orlando, Fla.

AGT says the 2 MW solar carport, located at the global security and aerospace company’s Rotary and Mission Systems facility parking lot, is expected to produce 3.41 million kWh of electricity per year and save approximately $370,000 in energy costs annually. Providing shelter for 592 cars, the solar carport’s four superstructures include 6,688 Hanwha SolarOne S-series solar modules and inverters by SunGrow.

AGT had previously partnered with Lockheed Martin to design and build a 2.25 MW solar carport near Clearwater, Fla. Completed in 2015, that initial solar carport has consistently achieved its energy production goals, according to Clint Sockman, vice president of Advanced Roofing and AGT.

**Invenergy Tees Up Project At Former Golf Course**

Chicago-based clean energy company Invenergy LLC has broken ground on its Shoreham Solar Commons facility, a 24.9 MW solar project located in the town of Brookhaven in Long Island, N.Y.

Invenergy is building the project at the former Tallgrass Golf Course. The company notes the redevelopment won’t require any clearing of trees; in fact, it plans to plant an additional 2,000+ trees on the project’s site. Unlike the former golf course, the solar array will not require the application of pesticides, herbicides and fertilizers, which will directly benefit Long Island’s freshwater aquifer, according to Invenergy.

During peak construction, Shoreham Solar Commons will employ 175 workers and tradesmen. Over the life of the facility, the project is expected to provide $15 million in additional tax revenue, which is 10 times what the former golf course generated.

Invenergy says it currently has more than 220 MW of operating wind projects in New York, with another 1,165 MW of wind and solar projects in development across the state, including Shoreham.
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» 24 hours of dedicated networking opportunities.
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Florida Lawmakers Green-Light Pro-Solar Amendment 4

The Florida state legislature has officially approved a bill to implement the pro-solar Amendment 4, which voters overwhelmingly passed with 73% of the vote on the August 2016 primary ballot. The bill, S.B.90, is slated to reduce tax barriers for Floridians who want to go solar while also ensuring proper consumer protections are in place. The legislation passed both chambers of the legislature unanimously, and as of press time, Gov. Rick Scott, R-Fla., is expected to sign it into law.

The victory again highlights the power of grassroots campaigns. Thanks to the leadership of state Sen. Jeff Brandes and Rep. Ray Rodrigues, as well as the support of hundreds of businesses, solar advocates and thousands of volunteers, Floridians will likely enjoy lower energy costs after burdensome taxes on solar energy systems are reduced beginning Jan. 1, 2018, according to the Southern Alliance for Clean Energy (SACE).

Specifically, the group explains, the bill exempts 80% of the value of a solar installation from the tangible personal property (TPP) tax for both residential and commercial properties. SACE says the TPP tax, which covers everything other than real estate that is used in a business or rental property, has been identified as a major roadblock to more solar development. Examples of TPP include computers, furniture, tools, office equipment, leasehold improvements and supplies, and solar energy equipment also falls within the definition. Furthermore, SACE says S.B.90 exempts 80% of the value of a solar installation from the assessment of real property taxes for commercial properties; a 100% exemption already exists for residential properties.

“We applaud Florida lawmakers for implementing this important constitutional amendment in the closing days of the legislative session,” says Dr. Stephen A. Smith, executive director of Floridians for Solar Choice. “The importance of moving this forward cannot be overstated: With lower taxes for homeowners and businesses, solar energy development will increase, allowing Floridians to lock in energy savings, create jobs, spur economic development and bring much-needed diversity to the state’s energy mix.”

In addition to local advocacy groups, national organizations Solar Energy Industries Association (SEIA) and Vote Solar have been supportive throughout the process.

“The Florida legislature took a historic step forward today to expand solar across the state while recognizing Floridians’ desire for more choice over their energy options. And, importantly, the bill includes strong protections and increased transparency for consumers, helping ensure they fully understand solar transactions,” says Tom Kimbis, executive vice president of SEIA. “Consumer protection is both the right thing to do and critical to the success of the industry, and we congratulate the Florida legislature for advancing these protections without creating burdensome red tape for small businesses.”

Amendment 4 wasn’t the only major solar victory achieved through grassroots efforts in Florida last year. After passing that ballot initiative last August, voters also rejected Amendment 1, a utility-backed proposal, in November. Although Florida’s fledgling distributed solar market has been slow to take off, a number of major solar installers, including SolarCity and Vivint Solar, entered the Sunshine State not long after the votes.

A National First: Maryland Creates Storage Tax Credits

“Maryland is charging ahead!” proclaims the Energy Storage Alliance (ESA). In an announcement, the ESA says lawmakers recently passed a bill making Maryland the first state in the country to establish a dedicated tax credit for the installation of energy storage systems.

The bill, S.B.758, overwhelmingly passed the House of Delegates in a 101-11 vote and passed unanimously in the Senate before Gov. Larry Hogan signed it into law. The legislation will allow residents and businesses to receive state income tax credits that cover up to 30% of the total installed cost of an energy storage system. According to the bill text, the incentives will be capped at $5,000 for residential systems and $75,000 for commercial ones, and the credits will be available for systems installed from 2018 through the end of 2022. Overall, the incentive program will have a funding cap of $750,000 each year.

“Over the next five years, Maryland will play a significant role in the advancement of the energy storage industry,” says the ESA in its announcement, adding that the new law is “expected to directly spur more than 10,000 kilowatt-hours of customer-sited energy storage systems and will be paired with private-sector and homeowner investments.”

Furthermore, Maryland lawmakers also passed H.B.773, legislation to kick off a study of “regulatory reforms and market incentives that may be necessary or beneficial to increase the use of energy storage devices in the state” and make final recommendations to legislators before the end of 2018, according to the bill text.

“These two actions are a big win for Maryland’s advanced energy industry and open a path for the state to become a...
leader in the energy storage industry,” says the ESA in its announcement. “These efforts will not only support the deployment of hundreds of energy storage systems to help Maryland households and businesses lower their utility bills, but also will enable those buildings to relieve stress on the electric grid and be resilient to service disruptions.”

Although some other states - such as California and, more recently, Massachusetts - have turned to mandates in order to increase energy storage deployment, Maryland will now represent the first to offer a tax credit as an incentive to potential storage adopters. Solar and wind power tax credits have proven successful at both the state and federal levels, but efforts to pass a federal tax credit for energy storage have so far been unsuccessful. According to the ESA, Maryland has taken “a historic step.”

Senators Propose 100% Clean Energy By 2050

U.S. Sens. Jeff Merkley, D-Ore., and Bernie Sanders, I-Vt., along with U.S. Sens. Edward J. Markey, D-Mass., and Cory Booker, D-N.J., have proposed landmark climate change legislation that would transition the U.S. to 100% clean energy.

The “100 by ’50 Act” lays out a road map for a transition to 100% clean energy by no later than 2050. According to the lawmakers, it is the first bill introduced in Congress that would fully envision a transition off of fossil fuels in the U.S.

“America is home to innovative entrepreneurs and scientists who have tackled many challenges in our nation’s history - from harnessing electricity to putting a man on the moon to curing disease,” says Merkley. “The power to end the use of fossil fuels and completely transition to clean and renewable energy is within our hands, but just as with the moon landing, we need a road map, a goal and a passionate, shared national commitment to get us there. If an asteroid were hurtling its way through space toward our planet, we would do everything in our power to stop that asteroid. Our commitment to fighting climate change should be no less. Starting at a local, grassroots level and working toward the bold and comprehensive national vision laid out in this legislation, now is the time to commit to 100 percent by 2050.”

“The good news is that despite President Trump, we are winning this battle,” adds Sanders. “In Vermont and all over this country, we are seeing communities moving toward energy efficiency, and we are seeing the price of renewable energy plummet. Our job is to think big, not small. We can win the war against climate change. We can win the war in transforming our energy system and put millions of people to work doing that. We can create a planet that will be healthy and habitable for our children. There is no issue more important.”

The senators have included the following seven components in the bill:

1. Greening the Grid: Phase out fossil fuel electricity by 2050 and replace it with clean and renewable energy. This would be done through a mandatory fossil fuel phase-out and major investments in clean energy, storage and grid infrastructure.

2. Electrifying the Energy Economy: Electrify as many transportation and heating systems with power from the clean electrical grid through a national zero-emission vehicle standard; major investments in zero-emission vehicles and zero-emission heating systems; and carbon-taxing authority for commercial aviation, maritime and rail.

3. Clean and Renewable Energy for All: Ensure that low-income and disadvantaged communities share in the benefits of the transition through grants to make clean energy, energy efficiency and public transportation affordable and accessible and to provide job training in the clean energy sector.

4. Just Transition for Workers: Provide a just transition for those who work in fossil fuels, and make sure they get fair benefits between jobs or in retirement.

5. Ending New Fossil Fuel Investments: Stop approving major fossil fuel projects, such as the Keystone XL pipeline and Dakota Access Pipeline, and end fossil fuel subsidies.

6. Ensuring American Competitiveness: Make sure energy-intensive U.S. products maintain a level playing field with products imported from other countries by imposing a carbon tariff for imported carbon-intensive products.

7. Mobilizing American Resources: Create a major new source of funding to ensure a rapid and smooth transition to clean energy by auctioning climate bonds and investing the funds in the new programs created by the legislation. The climate bonds would ensure climate resiliency throughout existing infrastructure and communities and provide planning grants to organizations, communities, tribes and states to develop their own 100% clean energy plans and jump-start the transition.
Installers Must Adapt To Today’s Value-Conscious Shoppers

Across the U.S., the cost of solar energy systems continues to fall at an accelerating rate. Our latest data report saw prices drop by over 6% between the first and second half of 2016 - the greatest rate of decline since we started tracking prices in 2014.

Yet despite consumer-friendly prices, solar installers are still having a difficult time acquiring customers. Nearly 70% of the 360 respondents that completed our 2016 Installer Survey stated that customer acquisition either got harder or remained the same compared to the year prior. We expect this trend to continue in coming years as more solar installers enter the industry and successful installers expand their geographic footprint. Half of all solar installers surveyed said they directly compete with 20 or more competitors in their sales territories.

To compete in this changing market, solar installation professionals would benefit from better addressing two emerging trends among today’s solar shoppers - they’re shopping around more than ever, and they’re increasingly value-conscious.

Recently, SolarCity announced it would no longer sell solar door-to-door - a sales tactic that has fallen out of favor among consumers. Today’s modern consumers are much more sophisticated about how they want to shop for solar. They’re seeking an online-first experience that allows them to research solar equipment, prices, and companies from the peace and anonymity of their laptops. They’re comparison-shopping multiple offers before making a decision. Not surprisingly, only 2.7% of our shoppers indicate that they would prefer to speak with or invite an installer for a site visit before receiving quotes online.

The number of quotes consumers want when shopping for solar is going up, as well. According to the installers surveyed, the average number of quotes seen per customer increased from two to three, with many seeking five or more. What’s behind this shopping trend? As more solar companies enter the market, and as it becomes easier to find these companies online, solar shoppers are having an easier and faster time getting multiple quotes.

Customers don’t necessarily want the lowest price, but they do want peace of mind in knowing that they’re paying a fair price for the right quality product. Qualitative benefits such as an installer’s experience, aesthetically pleasing designs and responsive sales process may appeal to some. However, other savvy consumers will seek more measurable benefits, such as length of labor warranties, production guarantees and financing that maximizes savings. This is the type of information that today’s solar installers must focus on if they want to stand out. They’ll need to quantify their value proposition, especially if they’re hoping to charge a premium.

A recent report by the National Renewable Energy Laboratory (NREL) found that the country’s largest solar installers are charging, on average, 10% higher prices than smaller installers. NREL studied our solar quote data versus quotes received by the same consumer from large installers to study the effects of company size on solar pricing.

Value-conscious consumers see through this overpricing when they comparison-shop across multiple options. These shoppers are looking for the rationale behind why they’re getting charged 10% more, and the “bigger is better” answer isn’t as believable as it was before a wave of large solar installers exited the industry.

To grow business and close more sales, installers must present prospects with quantitative information to make calculated decisions based on the long-term return on investment. The installers that come to the table with tangible and measurable benefits, such as payback period and 30-year savings, will be much better positioned to win over today’s value-conscious solar shopper.

Vikram Aggarwal is the CEO and founder of EnergySage, an online comparison-shopping marketplace for rooftop solar, community solar and solar financing. For more on the reports mentioned in this op-ed, visit energysage.com/data and nrel.gov.
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