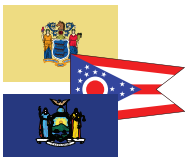
THE SOL SOURCE

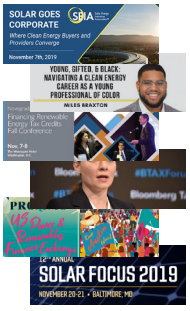
Solving price volatility in renewable energy wholesale markets See p6

SOLSYSTEMS

WELCOME

THE SOL SOURCE is a quarterly journal that our team distributes to our network of clients and solar stakeholders. Our newsletter contains energy statistics from current real-life renewables projects, trends, and observations gained through quarterly interviews with our team, and it incorporates news from a variety of industry resources.





STATE MARKETS

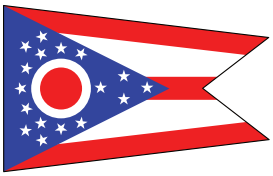
New Jersey

New Jersey continues to be a question mark for renewable energy developers. Once one of the strongest solar markets in the country, many are now uncertain as to what the state's solar future holds as stakeholders await a final program design for the transition program and for conversations to begin regarding the successor program's design.

Per the state's Clean Energy Act of 2018, the New Jersey Board of Public Utilities (BPU) is tasked with closing the existing SREC market once its 5.1% goal is achieved and developing a new solar incentive program. To date, the BPU has approved an initial draft proposal for how to calculate 5.1% attainment, thus marking the end of current status quo. This draft was met with mixed reviews from solar stakeholders, so it remains unclear what the final rule will look like, although not much is expected to change. Two potential options were put forward for the transition program, but initial drafts received pushback from solar participants, especially regarding low incentive levels set for residential systems. As a result, new incentive level options were released this month.

The dialogue will now begin again to establish the final transition order. Once that conversation is closed, the BPU will move toward the successor program discussion. With so many discussions up in the air, we've seen build slow in New Jersey as participants await certainty on the market's future.

Ohio



Ohio was certainly the biggest shake up in renewable portfolio standard (RPS) policy this year… and in recent history. In House Bill 6 (HB 6), the state legislature diverted money away from renewable and energy efficiency programs and toward nuclear plants. As a result, the state's 10-year-old RPS was cut from 12.5% to 8.5% and the solar carve out, which provided separate incentives to solar technologies, was eliminated beginning in 2020. This was a blow to Ohio's renewable market, and if the course is not corrected, Ohio risks thousands of renewables jobs being lost and falling behind its PJM peers that all seem to have ever increasing—not decreasing—renewables goals. At the end of September, the Public Utilities Commission of Ohio (PUCO) took the first steps toward implementing HB 6 by kicking off the processes for creating the mandated non-bypassable rate mechanism to provide cost recovery for legacy generation resources.

STATE MARKETS

New York

In June, we saw the New York legislature pass one of the most progressive renewable energy bills in the country. The bill increases the state's renewables goal from 50% to 70% by 2030 with a goal of 100% zero-carbon electricity by 2040. In addition to the renewables target, the bill goes further to curb carbon by setting a goal that New York will be totally carbon-neutral by 2050. These goals are certainly aggressive, and New York has its work cut out in reaching these deployment levels. According to the state Department of Environmental Conservation, 23% of New York's electricity currently comes from renewables, including hydro. This number will need to more than double over the next 10 years and installed solar capacity will need to more than triple to meet New York's distributed generation goals under the law. The implementation of this law will be critically important to seeing these ambitious goals successfully achieved. On the solar side, fixes may be needed to that state's Value of Distributed Energy Resources (VDER) tariff to further the industry's growth and make it possible to achieve those goals. Success will be a heavy lift, but New York will be an exciting market to watch over the next decade as implementation progresses.

All Solar on the Wasatch Front: Takeaways from Solar Power International Salt Lake

By Will Patterson

As solar continues its year-over-year growth, the massive Solar Power International conference (or North American Smart Energy Week, depending on who you ask) provides an annual opportunity for the industry to put on display its newest shiny objects. For solar veterans like Sol Systems VP of ~~Engineering~~ Everything Joe Song, it's easier to wade through the vast sea of hype and find the reality that sits in the midst. We asked him about his time at SPI 2019 in Salt Lake City.

❶ What main theme defined this year's conference for you?

JS: Busy. The industry is just busy, more focused on execution. Past years have been clouded with uncertainty or setbacks, namely Section 201 but also unknowns presented by Illinois, SMART, and other programs that were new and untested. This year, there is more certainty – we know ITC stepdown is ahead of us, the financial impacts of the module and steel tariffs, the outcomes of Illinois, SMART, and other efforts that were all unknowns last year. Hence, people are busy bringing projects to the finish line and safe harboring modules. EPCs, equipment manufacturers, and other pieces of the chain are busy as a result. A lot of business is happening right now. And that's great news for all of us.

❷ What was the biggest difference in this year's SPI from years past?

JS: On a technical front, a lot of what was at one time a "roadmap" or "to be available in 2019" has arrived on the scene. Module advancements such as PERC, Half-cell, bifacial, and Series 6 that were bright and shiny objects last year have now generally been accepted, adopted, and even accustomed to. String inverters are approaching the central inverter power class from 10 years ago or so; this is where inverter advancements are most pronounced.

❸ What interesting technology trends or innovations did you feel flew under the radar?

JS: Module integrated power electronics. Module manufacturers continue a trend in working with DC optimizers and producing integrated products. This is still cutting edge for now, but perhaps not a huge barrier for success. This is the right direction for this technology and where we might see meaningful impact at a system level in a few years once the technology is more established. It also happens to be the most elegant solution to comply with rapid shut-down requirements.

We are also seeing improvements in balance of systems (BOS) or soft costs efficiency. There continues to be a mindfulness and acknowledgement that BOS cost reductions are a mountain of opportunity. Shoals BLA product is a great example, as the benefits are numerous and there is a case that it reduces operating expenditures as well. Things like this just need field time to find maturity. Trackers that have integrated 2P technology, or simple pneumatics, are also potential solutions for labor reduction. High kW string inverters are another great example.

❹ What was the general feeling from the industry regarding its position leading into impending ITC stepdown?

JS: Prepared and ready to proceed forward under that plan.

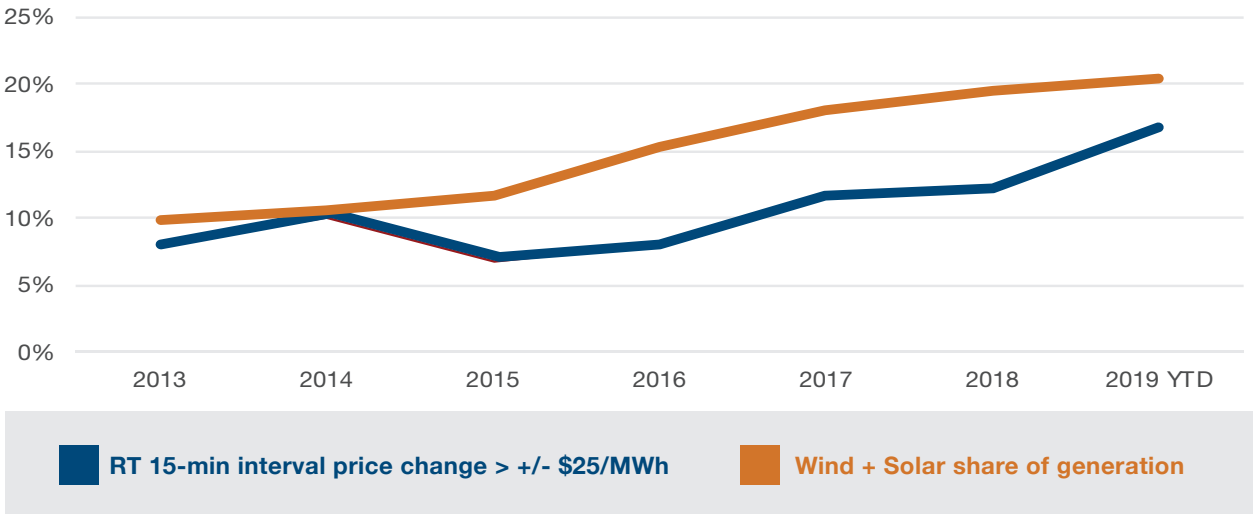
Solving price volatility in renewable energy wholesale markets

By Utsav Adhikari

Clean energy resources like solar and wind energy are fast becoming the cheapest sources of electricity generation in the United States. Since 2009, the levelized cost of electricity dropped by 69% for onshore wind power and by 88% for solar power. The numbers and trends are more or less accepted as fact—itself a triumph in these Orwellian times. The accompanying benefits speak for themselves and have won over many former skeptics. Solar and wind are thriving in states that lean conservative, including the next five biggest state markets after California for installed solar capacity and four of the top five for installed wind capacity. The clean energy transition is well underway, riding on the twin tailwinds of necessity and value.

In jurisdictions with competitive wholesale electricity markets, the growing penetration of renewables poses challenges, not only to grid operators but to all market participants. The variable levels of output of wind and solar resources increase price volatility in the energy markets. This has already become a reality in ERCOT and may soon be the case elsewhere too. Solar and wind projects are also increasingly exposed to this merchant power price volatility due to shortening PPA terms and offtake structures that put some price risk on the projects.

Large swings in energy prices in ERCOT have increased with wind+solar penetration



TRENDS & OBSERVATIONS

For someone unfamiliar with the mechanics of wholesale electricity markets, it may not be immediately apparent why adding greater volumes of cheaper resources, especially zero marginal cost resources like wind and solar, does not always depress power prices. The answer to the bi-directional volatility in prices lies in the operational attributes of other non-variable generators in the system.

A system with high renewables penetration is susceptible to fluctuating levels of output from wind and solar plants. Here, seasonal or day-to-day variability is perhaps less important than intra-day variability. If it is sunny and windy one day but cloudy and calm the next, it is still more predictable than a scenario where wind speeds suddenly drop off or cloud cover develops rapidly over some large solar plants. A week-long heat wave consistently pushed weekday peak prices above $1,000/MWh in ERCOT during the week of August 12, but prices truly spiked and reached the mythical $9,000/MWh cap when wind generation levels suddenly plummeted.

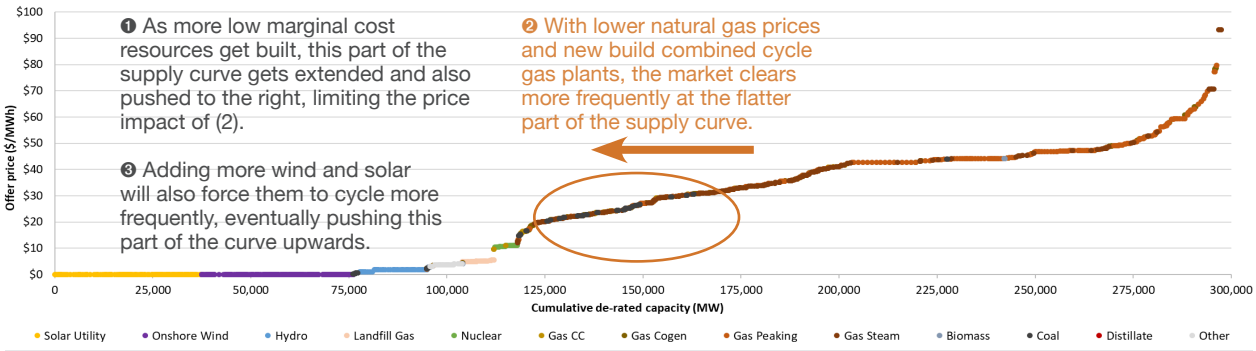
When faced with sudden shortfalls in generation, grid operators signal other non-variable resources to ramp up their production and make up for the lost generation from the renewable resources. Before the advent of solar and wind plants, supply-demand imbalances usually occurred when load increased or decreased rapidly. Generators that adjusted their production accordingly were called load-following generators, compared to baseload plants which churned out a steady amount of power regardless of the load profile.

However, ramping production up or down is not optimal for all conventional generators and adds more costs to their offers, thereby raising clearing prices. Furthermore, such generators face more wear and tear when they are forced to cycle more frequently than they were designed to, adding more maintenance costs over time. Further compounding this issue is that as more conventional generators retire, they are replaced by either variable renewable resources or combined cycle gas plants (which are not designed to ramp frequently), the very resources pushing them into retirement.

Owners/operators of coal plants and other older thermal generators complain about subsidized renewables driving their plants to retirement, but in truth the blame remains within the fossil fuel industry.

The efficiency of modern combined cycle gas plants, together with the shale revolution in the United States, which has drastically lowered natural gas prices, are primarily responsible for pushing market prices down and making coal, nuclear, and older thermal plants uneconomic. As those resources retire over time, and given the current trends of new generator build-out, combined cycle gas plants will form more and more of the supply curve. As the supply curve flattens as a consequence, the negative price impact from a rightward shift along the curve resulting from increased demand should get smaller. However, dynamic markets are also likely to see numerous other trends collide over the time horizon during which this effect plays out. Utilities exposed to price volatility may place greater emphasis on demand response and electrical vehicle charging programs. Generators are also continually adapting to market trends in their operations and asset management practices that help them capture incremental gains.

ERCOT 2018 supply stack by power plant type



Source: **Wood Mackenzie data**

Such market responses have the potential to mitigate volatility, but perhaps not to the extent that most market participants desire.

An obvious solution to managing the volatility caused by variable wind and solar is batteries. Indeed, large hydro plants have been tamping volatility for grid operators for some time, especially in the Pacific Northwest. These plants effectively simulate the functionality of batteries by adjusting their dams and the subsequent flow of water, which in turn generates electricity more responsively. Battery storage systems can rely on both charging and discharging modes to help ramp up or ramp down as long as there is sufficient storage capacity scattered strategically across the grid. As grid operators become more familiar and comfortable with the software controls, operational range, and capability of batteries, they can rely on batteries to smooth variable generation, regardless of whether or not they are co-located with the solar or wind project.

For flexible grid-scale storage to be operational reality, market prices must provide the incentives to invest in these resources. Although FERC's Order No. 841 addresses opportunities for storage resources to participate in wholesale markets, grid operators must also continue to reform how market pricing is determined. The value of the flexibility provided by batteries should be reflected in market prices to ensure that price signals incentivize investments in storage, whether as a standalone or a co-located resource. Again, FERC has recognized this and directed PJM and NYISO to revise their price formation procedures to accommodate fast-start resources. Continued evolution of these procedures as the penetration of renewables increases would accelerate the deployment of wind and solar deployment in the least disruptive manner possible.

SOLAR CHATTER

Ongoing siting and zoning issues in Maryland have led the state's Court of Appeals to give the Public Service Commission (PSC) final say in approving power plants, allowing them to override decisions handed down by local governments. Although opponents cite the protection of agricultural land as their main argument, new research by Scientific Reports found that if solar was put on just 1% of agricultural land, it could generate enough to power the world. Watch out, ethanol.

The Solar Energy Industries Association (SEIA) has officially launched its Defend the Solar ITC campaign, building support for the extension of solar's 30%federal Investment Tax Credit (ITC). The ITC has been the footnote on 52% average annual growth for the industry, helping create more than 200,000 jobs and bringing $140 billion in American investment. Join the fight!

Congratulations! Sol Systems customer Amazon reached its goal of hosting 50 solar energy systems by 2020 ahead of schedule. Sol Systems is proud to have worked with Amazon on some of company's largest rooftop projects, including a 7.5 MW project in Carteret, New Jersey, the largest rooftop project in the Garden State. Amazon has since announced plans to build another 45 MW project in Virginia.

A report published by the North Carolina Sustainable Energy Association shows just how massive the upside is for municipalities housing large solar projects. Data taken from 50 North Carolina counties showed a 2000% average increase in tax revenue after solar was brought to the area. Sol Customer Solutions, our joint venture with Capital Dynamics, works with municipalities across the country to bring energy savings and tax revenue to local governments through solar power projects.

Another Year, Another 200 Miles of Ragnar Relay

By Will Patterson

Last year, I wrote about my first time participating in the Sol Systems tradition of destroying our legs in the 12-person, 200-mile Ragnar relay. Twelve months rolled by and I found myself back in New Hampshire, waking up in a crammed van at five in the morning preparing to run six miles for the third time in 18 hours. Why? Because at Sol Systems, we know that to succeed in our goals, whether it's taking on a Ragnar or transforming our country's energy grid, we need to embrace the madness that comes with it.

For the unfamiliar, Ragnar relays are run by 12 brave individuals (or in some cases, six insane individuals) who each run anywhere from 12 to 26 miles over the course of three separate legs. Ragnars are run across the country, but for the past two years, our team has run Reach the Beach, which spans most of the length of New Hampshire, starting in Bretton Woods and ending at the Atlantic Ocean near Portsmouth, where our CEO and Ragnar teammate Yuri Horwitz was raised.

Running a Ragnar feels like a condensed version of working in the solar industry. Your body and mind need to be ready for the fight. When your legs are firing signals to your brain to stop, which my non-runner's body was doing a lot of, you need to push even harder. When a fossil-fuel-powered world is trying to stop the clean energy revolution, we need to work twice as hard to fight back. Change to the isn't created people who simply clock in and clock out every day, but by dedicated individuals hell-bent on bringing that change. In the same vein, Ragnar isn't run by folks who are set on walking.

However, I'd like to think that even in the solar industry, it's hard to find too many companies with 12 participants who are happily willing to spend 27 hours crammed in a van with 11 of their coworkers every year. I certainly never thought I'd be running the race, much less running it two years in a row. However, the feeling when you finish your last leg, and cheering on your teammates as they complete theirs, is well worth the struggle. Some of them will even tell you they had fun doing the running (I'm skeptical). In solar, the feeling of putting clean energy in the ground is well worth the scrapes you inevitably take along the way. Do you need to be able to run a Ragnar to be in the solar industry? Not at all. But solar professionals would have a better time relating to these runners than most. Perhaps the most relatable thing: at the end of each success, you deserve a cold beer.

Helios Completes First Solar Energy Asset Portfolio

Helios Infrastructure fund projects produce enough power for nearly 4,000 homes

On September 24, Sol Systems announced that Helios Infrastructure fund, its joint venture with Nationwide, completed the financing and construction of its first solar portfolio. The entire portfolio is now in service and includes eight projects in North Carolina totaling 48.4 MW, which is enough to power 3,890 homes per year.

These projects are part of a larger 135 MW acquisition announced last September that is currently under development. The acquisition itself is part of a broader set of portfolios the infrastructure fund plans to develop.

Launched in February 2018, Helios invests in utility-scale solar energy assets throughout the United States, combining tax-efficient sponsor capital, highly sophisticated financial structuring and environmental and electricity commodity expertise. Helios works closely with developers throughout the United States to co-develop, finance, and construct early-stage solar portfolios.

“This is a key first step in our efforts to develop a multi-state solar infrastructure portfolio,” said Jessie Robbins, Senior Director of Structured Finance at Sol Systems. “This portfolio was delivered on time and on budget, despite the inevitable challenges along the way. We greatly appreciate our finance and development partners, who worked collaboratively with us to navigate a complex portfolio in an ever-changing market.”

“Live Oak Bank is dedicated to lending to projects that bring jobs, economic benefits and low cost renewable energy generation to America’s rural communities,” said Jennifer Williams, SVP of Renewable Energy at the bank,

“and we are excited to be part of this innovative portfolio with Sol Systems, Nationwide, Seminole Financial Services, Cypress Creek Renewables, and U.S. Bank.”

Seminole Financial Services was the construction lender for the projects, U.S. Bank was the tax equity provider, and Live Oak Bank was the permanent lender for the portfolio. Cypress Creek developed and built the eight projects and will provide operations and maintenance support going forward.

“U.S. Bank has a long relationship with Sol Systems and we are excited to partner with Helios on this first portfolio,” said Jon Peeples, vice president with U.S. Bank and business development officer with the U.S. Bancorp Community Development Corp. “Environmental stewardship is important to us and these projects are a great addition to our growing solar portfolio around the United States.”

These solar developments represent a $74.1 million capital investment into rural North Carolina communities. Nearly 400 jobs were created throughout project construction, including 70 local jobs.

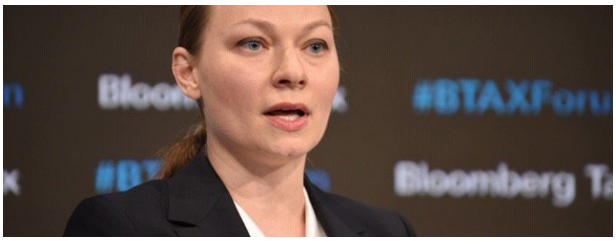
UPCOMING EVENTS

Solar Goes Corporate

November 7, 2019

The Eaton Hotel | Washington, D.C

Andrew Gilligan, Vice President of Sol Customer Solutions will speak on the panel, "Navigating Renewable Sourcing Options & Understanding Customer Needs" from 9:50 am – 10:35 am.



Bloomberg Tax Leadership Forum

November 19, 2019

Knight Conference Center at the Newseum Washington, D.C.

Olga Zelenova, Sol's Vice President of Finance, will speak on the panel, "Making the Most of Tax Incentives" at 10:35 am.

Miles Braxton - Young, Gifted, & Black - Navigating a Clean Energy Career as a Young Professional of Color

November 7, 2019

Burke Auditorium, Kroon Hall | Yale University

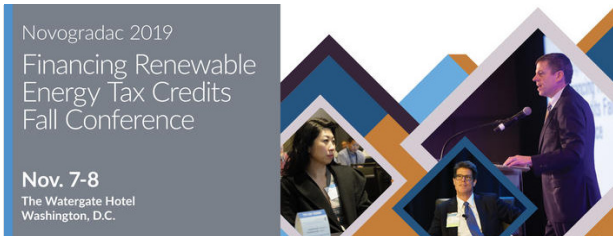
Miles Braxton, Business Development Analyst for Sol Customer Solutions, will share his professional journey to date and how he found his current area of expertise.

Proximo US Power & Renewables Finance Conference

November 19-20, 2019

Sheraton Austin Hotel at the Capitoll | Austin, Texas

Becca Glazer, Senior Director of Structured Finance, will speak on the panel, "Create to Mitigate: Have You Developed the Best Credit Enhancements?"



Novogradac 2019 Renewable Energy Tax Credits Conference

November 7-8, 2019

The Watergate Hotell | Washington, D.C.

Jessie Robbins, Senior Director of Structured Finance, will speak on the "Intermediaries" panel from 11:00 am – 11:50 am on Friday about what tax credit syndicators and other intermediaries look for in a transaction and how to maximize equity with their help.

Solar Focus 2019

November 20-21, 2019

Hilton Baltimore | Baltimore, Maryland

At MDV-SEIA's annual gathering for the Mid-Atlantic solar energy industry, Lauren Miller from Sol's Regulatory Affairs team will speak on the panel, "Maryland after the Clean Energy Jobs Act," from 11:30am – 12:30pm on Thursday.

NOW HIRING

Sol Systems is hiring for 13 roles across all teams in our offices in Washington, D.C. The company offers a full benefits package, a creative and fun work environment, and unparalleled opportunities for growth. Learn more about working at Sol Systems.

Corporate Accounting Controller

The Corporate Accounting Controller will oversee all accounting and tax functions and the preparation of financial reporting packages and tax filings for corporate and related entities. This person will report to the Vice President of Finance & Accounting and be part of the larger CFO team that supports Sol Systems' business units.

Senior Director of Regulatory Affairs, Energy Infrastructure & Markets

Sol Systems is seeking an experienced professional to represent the company as a diplomat to the industry and our stakeholders. This person will work directly with our project finance and trading teams and the CEO to help cultivate business development opportunities in key states and to defend business interests through policy advocacy and lobbying.

Vice President of Risk Management & Trading Operations

Sol is hiring a Vice President of Risk & Operations to join our team and help us grow and manage our Sol Trading risk and investment businesses. This position will be primarily focused on streamlining risk management functions to track, report and measure risk factors that impact the sustainable commodity trading desk portfolio and those risks that impact platform stability and success.

CONTACT US

If you have any questions about this information or wish to receive our quarterly newsletter via email, please contact our team. We would love to hear from you.

888.235.1538 or **SOURCE@solsystems.com**