PV and Storage, Fall 2022

By John Benson

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1. Introduction

I have tried to understand how many of the title projects are being developed over time, and probably have made some reasonable estimates of this via a database I created. The problem is, this is one strange market, with many different types of entities participating in it, a majority with different business methods. I will delve into this further in the "Projects" section below.

The last Post similar to this is described below with a link:

PV and Storage, Late Summer 2022: *I keep seeing that there are amazing renewable and storage technologies, and I REALLY believe that California can meet its climate change mitigation goals. I just hope the rest of the world can follow in our path.*

The most recent "PV and Storage" post was in early July, and this one is scheduled for late August.

As per my normal practice (usually) with these posts, Section 2 below is mainly on technical information about PV / Storage. Section 3 is about business developments for these renewables. Section 4 is about PV/Storage Projects. However, a bit of a different spin is that one of the projects uses a new scheme for a rather old storage technology, and it's really big. The fact that my last post had a similar project is nothing but good news for intermittent renewables like PV.

https://energycentral.com/c/cp/pv-and-storage-late-summer-2022

This post will cover various business issues, mainly for PV, some good news from the U.S. Energy Information Administration (EIA), some good news about my large project database, and some recent outputs from this database.

2. Business

2.1. Tesla's Expanding Solar Market

While Tesla's large-scale battery energy storage system (BESS) Products are doing very well in that market, since I don't cover the small-scale photovoltaic (PV) market I don't see much about their performance in that market.

Tesla's solar energy business cooled during the summer after posting its best quarter in more than four years during the spring.[1]

[1] David Robinson, The Buffalo News, N.Y. via Energy Central, "Tesla's solar energy business continues its rebound," Oct 20, 2022. https://energycentral.com/news/teslas-solar-energy-business-continues-its-rebound?utm_medium=eNL&utm_campaign=DAILY_NEWS&utm_content=416684&utm_source=2022_10_21

While Tesla deployed less solar generating capacity during the summer than it did during the spring, it still was the company's second-best quarter for solar energy deployments in five years.

The company said its residential solar business continued to grow during the third quarter, while its commercial solar installations, which can be more volatile, were down during the summer.

The results, released as Tesla reported slightly better-than-expected third-quarter earnings, indicate that the company's solar energy business has recovered from the supply chain issues that had disrupted installations during the winter.

Tesla, as has become typical in its quarterly reports, said nothing about production of its solar roof — the roofing product with solar cells built inside — that is supposed to be the signature item made at its South Buffalo factory, built with $950 million in taxpayer money.

Tesla's solar roof is complex, and that has slowed the development of the roofing system and its rollout. Tesla CEO Elon Musk admitted in the spring that the company made "significant mistakes" that underestimated how difficult the new roofing product would be to install on some roofs, especially those with odd dimensions and shapes.

Tesla, in its only comment related to the solar roof in its report to shareholders, said it has made progress making installations more efficient.

"Our solar installation team continues to improve installation efficiency, enabling higher volumes and stronger economics," the company said, repeating the identical comment it included in its second-quarter report…

2.2. FEMA Proposed Change to Renewables Risk Category

More than 315 clean energy companies in the US have called on the country's International Code Council (ICC) to reject a proposal from the Federal Emergency Management Agency (FEMA) that would see solar projects categorized as high risk structures.[2]

The proposed FEMA change to the 2024 International Building Code (S76-22) would require solar, storage and wind projects to meet Risk Category 4 requirements (which are the case for hospitals, fire and police stations), meaning solar plants would need to be built to withstand earthquakes, hurricanes and other natural disasters.

Instead, Solar Energy Industries Association (SEIA) has put forth a compromise proposal that includes an "important carve-out for solar projects" to be designated as Risk Category 2.

Improving grid resilience through strengthening project builds is the purpose of the proposed changes but SEIA said the proposals would actually reduce grid resilience as fewer projects would be built under the proposed framework given the higher construction costs.

[2] Sean Rai-Roche, PV Tech, "300+ US clean energy companies join SEIA's criticism of FEMA proposals," Oct 20, 2022, https://www.pv-tech.org/300-us-clean-energy-companies-join-seias-criticism-of-fema-proposals/

"The stated goal of FEMA's proposal is increased grid reliability, but when you needlessly make it harder to build resilient clean energy, the obvious effect is a reduction in reliability," said Abigail Ross Hopper, president and CEO of SEIA, which recently slammed the proposals as "a complete mess".

The latest development in the above FEMA Proposal: *In a release of preliminary results on the 2024 ICC Building Code online governmental vote, the International Code Council's (ICC) members have approved two compromise proposals from the Solar Energy Industries Association (SEIA) that designate solar and storage projects as Risk Category 2 infrastructure...*[3]

Following is a statement by SEIA president and CEO Abigail Ross Hopper:

"We are grateful to the ICC voters for recognizing how impractical it was to include solar and storage projects as Risk Category 4. This decision is undoubtedly a victory for clean energy deployment in the United States after more than 300 companies signed a letter urging approval of SEIA's compromise proposals.

"The extreme and overly burdensome code measures that would have been required under the FEMA proposal could have stifled clean energy growth without improving grid resilience. The resulting effect, whether intended or not, would have been a disastrous decrease in renewable energy projects while we aggressively strive to meet important climate goals.

"We can't stress enough how important it is for clean energy advocates to continue active participation in these codes and standards forums. The taxpayer-funded process managed by government agencies such as FEMA to develop building codes proposals should allow more collaboration, transparency and participation from stakeholders. In this case, it did not include input from the day-to-day experts on real world economic impacts, electricity grid reliability, sustainability and climate change.

"Together, we can better evolve solar and storage codes and standards and avoid any similar situations in the future."

Author's comment: See the recent post described and linked below on this subject.

Renewables and Natural Disasters: *For any electric generation source. It is reasonable to ask how resilient it will be in the face of expected natural disasters. The answers for these questions are complicated by the impact of these disasters becoming worse over time. Unfortunately, this has recently been the case due to climate change creating more, and much worse weather-related catastrophes.*

The most recent disasters worsened by climate change in the U.S. include wildfires (in the west), hurricanes (mainly on the Gulf and East Coasts) and non-coastal flooding (widespread).

This post will cover two subjects. The first and primary subject is hardening photovoltaic (PV) projects to withstand storms. The second subject is a case study for a small community's recovery efforts after extensive river flooding.

https://energycentral.com/c/cp/renewables-and-natural-disasters

[3] Solar Energy Industries Association (SEIA) Press Release, Nov 11, 2022, https://www.seia.org/news/compromise-code-proposal-prevails-victory-clean-energy

2.3. Reintroduced Production Tax Credit for Renewables

The revamped renewable tax credits under the Inflation Reduction Act (IRA) are expected to accelerate renewable generation, especially solar, over the next decade. However, certain provisions associated with these credits could increase development costs, according to Fitch Ratings. Solar represented approximately 2.5% of U.S. electricity generation in 2021. The IRA could increase solar capacity installation by 67% over ten years, according to Wood Mackenzie.[4]

The Production Tax Credit (PTC) is reinstated for solar projects under the IRA, a major boost for solar power producers. Solar projects can now choose between the PTC and the Investment Tax Credit (ITC) to maximize their economics, while large land-based wind projects (greater than 100 kW) are only eligible for the PTC. Companies like AES Corporation, NextEra Energy and Xcel Energy plan to increase solar development and are poised to benefit. The solar PTC was previously in effect from 1992 to 2005.

The PTC and ITC are extended for projects that begin construction before Jan. 1, 2025. After 2024, they become technology-neutral, emission-based and phase out starting 2032 or when U.S. electricity sector emissions are 75% below 2022 levels.

The long-life span of these credits mitigates uncertainties from political party changes and improves cash flow visibility. For solar projects, the extensions provide much-needed breathing room. According to the U.S. Energy Information Administration, in the first half of 2022, about 20% of the planned solar PV capacity deployment was delayed. Although supply chain constraints have caused delays globally, the Department of Commerce's (DOC) tariff-circumvention investigation for solar cells and modules has exacerbated the issue for the solar industry. Although the Biden administration invoked the Defense Production Act (DPA) in June 2022 and promised no new tariffs on solar power equipment for two years, Fitch believes it is unlikely to mitigate short- to medium-term project delays due to the advanced planning required for PV module production and shipment.

PTC and ITC now come with conditions that could increase development cost. To qualify for 2.6c/kWh PTC and 30% ITC, projects larger than 1MW must pay prevailing wages and meet union worker employment requirements. Failure to comply will reduce the PTC to 0.3c/kWh and the ITC to 6%. For projects that begin construction before 2023, at least 10% of construction labor-hours shall be performed by qualified union workers. The percentage goes up to 12.5% in 2023 and 15% thereafter. The provision will likely increase cost, especially for facilities that are located outside of California, as almost half of unionized workers in the renewable sector are in California.

The solar sector has enjoyed higher margins compared with other energy sectors, partially due to lower labor costs. According to the Bureau of Labor Statistics, the median annual wage for solar PV installers was $44,890, compared with a range of $70,310 and $81,460 for other energy sectors. Approximately 4% of solar of workers were unionized in 2019, compared with 10% to 12% in other energy sectors. Out of 61 utility-scale solar projects under construction in 2019, 40 are non-union.

[4] Fitch Ratings, Inc., "New Production Tax Credit Will Spur Solar Generation; Development Costs May Rise," Aug 30, 2022, https://www.fitchratings.com/research/corporate-finance/new-production-tax-credit-will-spur-solar-generation-development-costs-may-rise-30-08-2022

A 10% adder on PTC and ITC is eligible if a renewable power producer uses 100% U.S. steel and iron and if 40%-55% of the total costs of manufactured components are sourced in the U.S. U.S. domestic components are often much more expensive than imported parts. The potential cost escalation comes at a time when solar module costs went up by approximately 20% in 2021 due to price spike in raw materials, reversing the trend in the past decade. Full effects of the price hikes start to show in 2022 as existing inventory largely depleted in 2021.

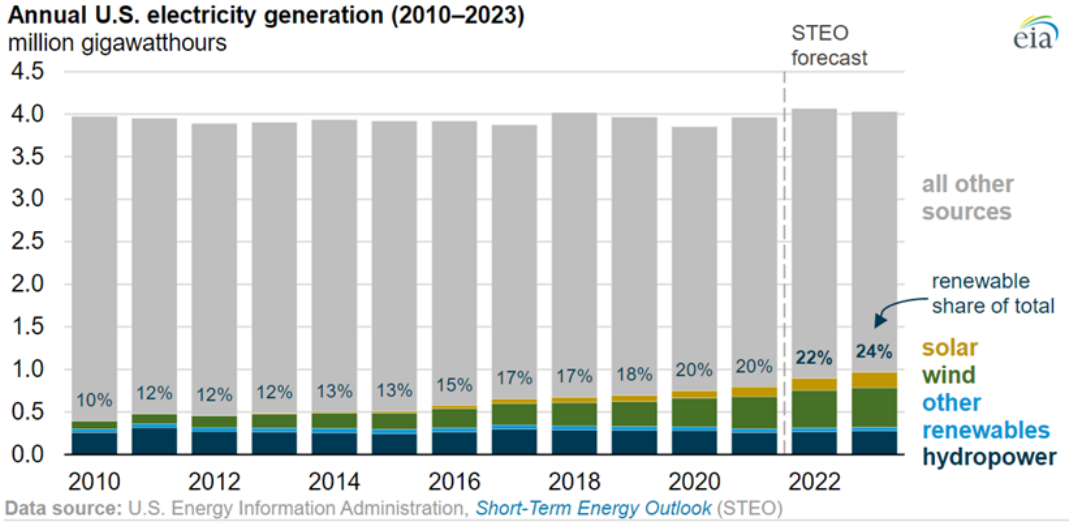
2.4. EIA: Renewables 22% of U.S. Electricity in 2022

U.S. electricity generation from renewable sources, such as hydropower, wind, and solar, accounted for 20% of electricity generation both in 2020 and in 2021. We expect that share to increase to 22% in 2022 and to 24% in 2023 as more generating capacity from wind and solar come online and other generation sources, such as coal and nuclear, are retired.[5] See two charts below.

We publish short-term forecasts for five renewable energy sources: conventional hydropower, wind, solar, biomass, and geothermal. We based our forecasts for 2022 annual values on our monthly historical survey data through May and forecasts for June through December.

Forecasts in our Short-Term Energy Outlook show how we expect 11 electricity markets in the United States will generate electricity. The two regions with the largest shares of renewable electricity generation during 2021 were the Northwest, where renewables accounted for half of the region's electricity generation, and California, where renewables accounted for 44% of regional electricity generation. Both of these regions' hydropower resources were constrained by droughts in 2021, but they still increased their renewable shares of electricity generation.

The Southwest Power Pool (SPP) region has had the most growth in the renewable share of electricity generation over the past decade, largely due to wind generation. In 2013, 13% of the region's electricity generation came from renewables. That share increased to 40% in 2021, and we expect it to rise to 44% in 2022.



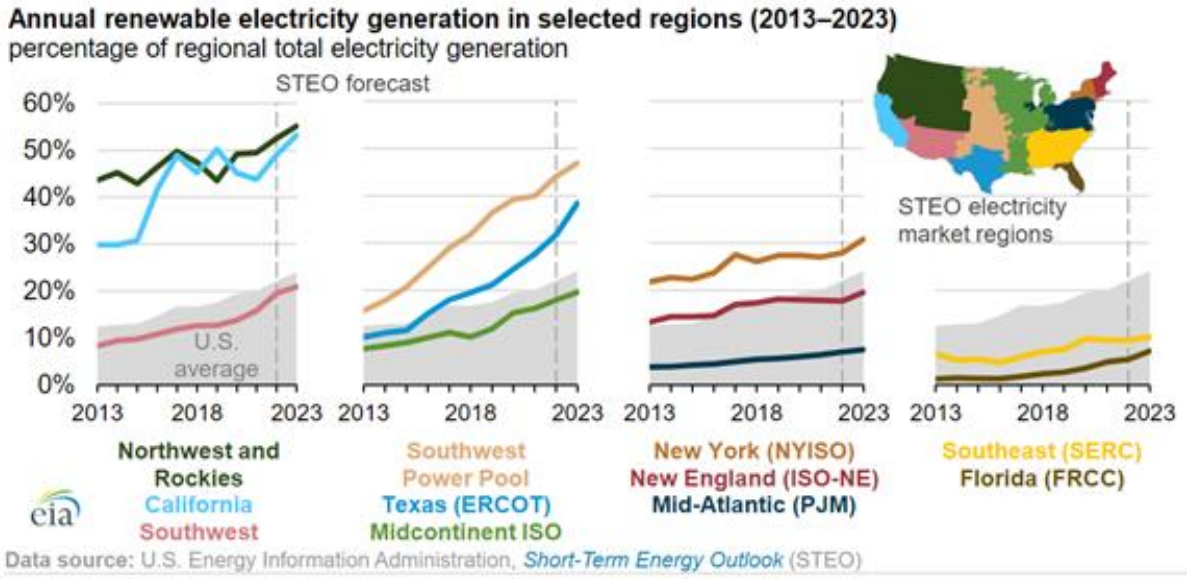
[5] Owen Comstock, EIA, "EIA expects renewables to account for 22% of U.S. electricity generation in 2022, Aug 16, 2022, https://www.eia.gov/todayinenergy/detail.php?id=53459#

Authors comment: It is reasonable that that above chart only estimates renewable power growth through 2023. The subjects of this paper (solar power and storage) will continue to grow more-or-less linearly throughout this period and beyond. However, offshore wind power will start a major ramp next year. The first significant east coast projects, (Vineyard Wind I and South Fork Wind) are scheduled to be commissioned next year, and that will open the floodgate for many other major projects). See the post linked below for more details.

https://energycentral.com/c/cp/offshore-wind-fall-2022

The Electric Reliability Council of Texas, or ERCOT, has also increased its renewable share, from 10% in 2013 to 32% in 2022. ERCOT is the only electricity market region where the renewable electricity share has transitioned from less than the U.S. average to more than the U.S. average from 2013 to present. Both SPP and ERCOT have added substantial generating capacity from wind turbines. Earlier this year, output from wind turbines in SPP and ERCOT contributed to wind becoming the second-highest source of electricity generation on a single day (March 29).

See the image below for other regions' renewable generation.



3. Projects

I commented on this in the Intro. The factors with future projects that make them difficult to forecast are:

- Frequent changes in developers
- Frequent project name changes
- Frequent schedule slippages
- High rate of projects that fail, particularly in the early stages

Since I've had a long career as an engineer, I have an intrinsic desire to get any information I author reasonably correct. Also the photovoltaic (PV) and battery energy

storage system (BESS) market is critically important to our industry. This is especially true as these technologies increase their percentage of overall generation capacity and displace older technologies that produce greenhouse gases (GHG).

I have recently found an important source of accurate information on new projects, the Preliminary Monthly Electric Generator Inventory from the U.S. Energy Information Administration. This is linked at the end of this paragraph. This is a huge database of all of the active generators (all technologies) in our country. This is compiled from all submitted EIA-860 forms.

https://www.eia.gov/electricity/data/eia860M/

The survey Form EIA-860 collects generator-level specific information about existing and planned generators and associated environmental equipment at electric power plants with 1 megawatt or greater of combined nameplate capacity.[6]

Note the "planned" in the above. Yes, this database has information on planned projects, but I have seen communications from the EIA in the past, that these regulators and the EIA-860 Forms have exactly the same problems with future projects that I do.

Thus, I will eventually evolve this paper and section to only look at commissioned projects. This will still define the yearly and geographic (by state) growth metrics.

Below I will list the first set of data for this: state total megawatts in major projects commissioned in 2021 (at least 100 MW for PV and/or BESS per project). This will be at the end of this section. Immediately below I will provide narratives for some of the major projects, but note that these will only be projects that have been commissioned or at least have a power purchase agreement (PPA) in place as of this writing (in early to mid-November, 2022).

In February to March 2022, I will reanalyze the big EIA database described and linked above, and publish the same metrics for major projects commissioned in 2022.

3.1. Selected Project Descriptions

3.1.1. Longroad Energy's Three Corners Solar project

Three Corners Solar is a utility-scale solar project located in Benton, Clinton, and Unity Township in Kennebec County, Maine, that has received full notice to proceed and began construction in November 2022. At 152MWdc and located in the heart of Central Maine Power's transmission system, the project will produce enough power for 30,000 Maine homes and will displace the dirtiest and most expensive generation. This $200 million investment offers economic, environmental, and community benefits.[7]

Project Summary:

- Five years in development, the project has received full notice to proceed, closed on financing and has begun construction.
- Largest solar project in Maine will generate approximately 200 gigawatt hours of electricity annually, enough to power ~30,000 homes (EIA calculator).

[6] U.S. Energy Information Administration, "Form EIA-860 detailed data with previous form data (EIA-860A/860B)," Sep 22, 2022, https://www.eia.gov/electricity/data/eia860/
[7] Longroad Energy Project Description, "Three Corners Solar project," https://www.longroadenergy.com/three-corners-solar-project/

- Footprint of ~690 acres under solar panels.
- Total project investment ~$200 million.
- A 5.2 mile generator lead line connects the project to Central Maine Power's (CMP's) Albion Road substation.
- Commercial operations expected by late 2023 or early 2024.

EDF Energy Services will purchase the total output of the project via a long-term PPA, using the renewable energy to supply its corporate customer load in New England. It is the largest corporate PPA in the New England power grid signed to date. Three Corners Solar will also contribute to the reliability of the Maine and the New England power grid by providing capacity to the ISO-NE system.

3.1.2. EDF Renewables - Palen Solar site

EDF Renewables' 620-MW California solar portfolio is completed. Palen Solar site is fully operational and delivering decarbonized energy to the grid. The site consists of four projects totaling 620 MWDC of solar and 200 MWh of energy storage.

The projects are located adjacent to each other on unincorporated land in Riverside County, California. The BLM designated this area as a Solar Energy Zone (SEZ) and Development Focus Area, land set aside for utility-scale renewable energy development.

The four projects composing Palen Solar are:

- Maverick 1: 173 MWDC (125 MW AC)
- Maverick 4: 137 MWDC (100 MW AC)
- Maverick 6: 131 MWDC (100 MW AC) + 200 MWh (50 MW) battery storage
- Maverick 7: 179 MWDC (132 MWAC)

Construction activity commenced in early 2020 with Maverick 1 and Maverick 4, followed by Maverick 6 and Maverick 7 in early 2021. The projects were completed in sequence starting in December 2020. At peak construction, the sites employed over 500 personnel, most of whom were local to Riverside County.

Note that Maverick 1 & 4 were covered in an earlier post "2021 Photovoltaic and BESS Projects."

Off-takers are:

- Maverick 1: Southern California Edison
- Maverick 4: Shell Energy
- Maverick 6: Clean Power San Francisco
- Maverick 7: Shell Energy

3.1.3. Lightsource BP - Happy Solar Park

The Conway Corp Board of Directors in Arkansas this week approved a 20-year purchase power agreement with Lightsource BP to be the offtaker for a 132-MWdc solar project in White County, Ark.

Lightsource BP will finance, build, own and operate the facility and will deliver the solar energy it generates to Conway Corp under the fixed-rate power purchase agreement. This project is expected to get commissioned in November 2022.

3.1.4. AES Corp. – Luna Battery Storage

Luna Battery Storage, a 100MW/400MWh battery energy storage system (BESS) project in California which was the subject of a “landmark” debt finance deal, is now online and serving community choice aggregator Clean Power Alliance (CPA).

CPA has contracted for 100MW of flexible energy storage capacity for a 15-year term with AES Corporation, which owns the project and developed it through subsidiary sPower – which was later merged into the parent company, becoming AES Clean Energy.

3.1.5. Ranger Power – Assembly II & III

D. E. Shaw Renewable Investments (DESRI) in partnership with Ranger Power have reached commercial operation of the Assembly II and Assembly III solar projects. Assembly Solar II is a 110 Mwac solar facility and Assembly Solar III is a 79 Mwac solar facility, both of which are located in Shiawassee County, Michigan. The Assembly II project reached commercial operation in December 2021, while the Assembly III project reached commercial operation in March 2022.

Assembly Solar II has two 25-year PPAs for a total of 110 Mwac with Michigan Public Power Agency (MPPA) and its largest member, Lansing Board of Water & Light (BWL). These PPAs are incremental to the two 25-year PPAs for 50 Mwac MPPA and BWL executed with Assembly Solar I, which reached commercial operation in 2020. Assembly Solar III has a 25-year PPA with DTE Energy.

3.1.6. National Grid Renewables – Noble Solar & Storage Project

The Noble Solar and Storage Project is a 275 megawatt (MW) solar and 125 megawatt (MW) energy storage project located in Denton County, Texas. The Home Depot and NRG have each executed individual 100 MW solar PPAs, and The Hershey Company has contracted for a 50 MW solar PPA with Noble. Nobel was commissioned in 2022.

3.1.7. Vistra – DeCordova Battery Energy Storage Facility

Vistra recently announced that its newest energy storage facility in DeCordova is now online, storing and releasing electricity to the ERCOT grid just in time for another hot Texas summer.

According to a Vistra news release, the 260-megawatt/260 megawatt-hour battery energy storage project is the largest of its kind in Texas.

Built on the site of a natural gas power plant operated by Vistra power generation subsidiary Luminant, the DeCordova Energy Storage Facility has the ability to instantly release energy to the power grid.

Plans to construct a new battery storage plant were first announced in September 2020. Construction began in June 2021, and the facility was completed in less than a year.

3.1.8. Copenhagen Infrastructure Partners – Fighting Jays Solar project

An affiliate of Copenhagen Infrastructure Partners P/S (CIP) has wrapped up the acquisition of the 350-MW Fighting Jays Solar project in Texas.

The parties closed it on July 22, 2020. A few weeks earlier, Shell Energy North America (US) LP signed a long-term hedge agreement under which it would buy physical power from the solar park.

A day after the project sale was finalized, Centerpoint Energy received the notice to proceed with the construction of a substation required to interconnect the facility into the ERCOT grid. This project was completed in the summer of 2022.

3.1.9. S&B USA – Brazoria West Solar Project

S&B USA has signed a definitive agreement to acquire 100% of Brazoria West Solar Project with 200 Mwac of planned solar energy capacity from Savion, part of Macquarie's Green Investment Group.

The project will supply power to the Houston area and has one commercial and industrial Power Purchase Agreement (PPA) in place and another PPA with an energy trading company. This project was completed in 2022.

3.1.10. Constellation – Skipjack Solar Center

The nation's first research university and a fount for early information on the spread of the coronavirus is also staking a claim as a leader in clean energy self-sufficiency.

The Johns Hopkins University in Baltimore has signed an agreement to purchase solar power from the100 MW Skipjack Solar Center in nearby Virginia. The solar farm site in Charles City County is about 175 miles from Baltimore.

The agreement will help the university achieve its goal to reduce GHG emissions by 51%, three years in advance. The purchase was made possible through a long-term agreement with carbon-free energy producer Constellation.

The Skipjack Solar Center was completed in 2022.

3.1.11. Dominion Energy – Fort Powhatan Solar

Fort Powhatan Solar PV Park is a 150 MW solar PV power project. It is in Virginia. The project was completed in 2022. The project was developed by SunEnergy1 and is currently owned by Dominion Energy.

3.2. 2021 New Large Projects Commissioned

The following table includes the number of large PV and BESS projects and the total MWac for each type. Large projects have at least 100 MWac of PV and/or BESS capacity that were commissioned in the states below. If a state is not in this table. There were no large PV or BESS Projects.

State	PV Projects	BESS Projects	PV MWac	BESS MWac
Alabama	1	0	227	0
Arizona	2*	1*	250	30
California	9*	8*	1,421	875
Colorado	1	0	300	0
Florida	0	1	0	409
Georgia	2	0	415	0
Iowa	1	0	128	9

State	PV Projects	BESS Projects	PV MWac	BESS MWac
Illinois	2	0	249	0
Nevada	8*	3*	1,581	100
New York	1	0	216	0
Ohio	1	0	265	0
Oregon	1	0	100	0
Texas	21*	6*	4,123	390
Utah	1	0	130	0
Virginia	2	0	325	0
Wisconsin	2	0	305	0
TOTAL US			10,035	1,813

*At least one integrated PV/BESS Project. In this case projects will be listed in both columns.

Final authors comment: One thing that seems to hold vs. my earlier attempts to analyze much more mixed data: the states that are early implementers of large PV projects (Nevada, and to a lesser extent Texas), frequently implement little or no BESS projects to offset the variability of PV. The states that have already implemented large amounts of large PV are also implementing large amounts of BESS (see California).