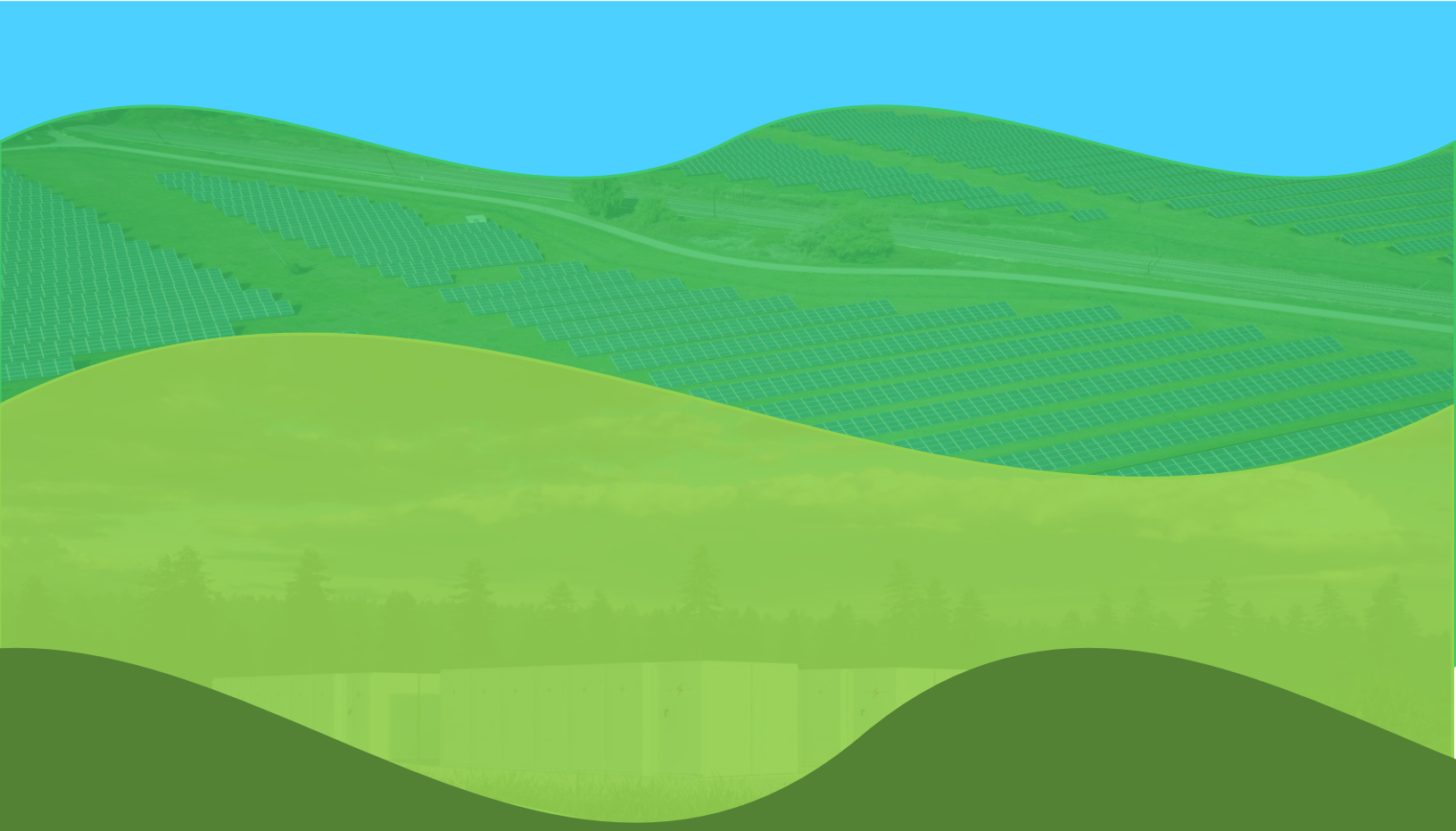

ENERGY STORAGE PROJECT RISK ALLOCATION VIA PROXY GENERATION PPAs

Cory Schaeffer, NexESS Analytics
Sean Halloran, NexESS Analytics

Energy Storage Project Risk Allocation via Proxy Generation PPA's

Executive Summary

The Power Purchase Agreement (PPA) as a contracting aid for bringing together corporate buyers and renewable energy generation has a history rooted in the energy crisis of the mid 1970s in the United States. Today the PPA is a standard financial tool used by renewable energy projects to align them with corporate targets on sustainable energy procurement. Over 40% of Fortune 500 companies now have initiatives related to clean energy to reduce their carbon footprint and to showcase leadership in climate change goals. The business case for corporate buyers, though, remains focused on energy procurement costs and associated risks. As the market for renewable energy has matured, more solutions have become available to help navigate the obstacles corporate buyers and project developers face when contracting for long term electricity cost affordability. The PPA has evolved to take advantage of these solutions and innovations and is now a standard consideration in both mature and emerging markets.

A recent development in PPAs is the Proxy Generation PPA (pgPPA), where the renewable energy project is paid for the generation it would have produced under a set of agreed upon conditions rather than the actual production. This type of proxy swap as a hedging solution has been used in financial transactions for power projects to assign risk where it is best managed, allocating fuel (weather) and shape risk to the buyer while the project retains operational and availability risk. The de-risking of corporate investment allows more corporate buyers to participate in the renewable energy markets at a time when demand for clean energy is growing and economically competitive projects are increasingly contracted with offtakers, with remaining higher-priced projects finding themselves in a seller's market. LevelTen Energy's 2020 pricing report shows an 11.5% increase in solar PPA prices while wind prices increased by 24.3%[1].

This paper will review the history of PPAs and the evolution of the creative applications of hedging like proxy generation in the context of how energy storage might add value to renewable energy contracts or even stand on its own with storage only swap contracts. Along with storage, we will examine how data plays a central role in the different parts of this process and what 3rd party calculation agents add to the contract settlement.

[1] "Renewable PPAs could see 'sellers market' in 2021 after years of price increases, LevelTen finds", Emma Penrod, Jan. 21, 2021, retrieved from https://utilitydive.com/news/renewable-ppa-prices-are-raising-for-the-first-time-creating-potential-sel

Risk Allocation, Renewable Energy and the PPA

The Power Purchase Agreement (PPA) came about as an alternative procurement method for emerging alternative energy generation in the 1970's. The 1976 oil embargo and the associated energy crisis that the USA faced led to the promotion of alternative energy development through the passage of the Public Utility Regulatory Policies Act of 1978 (PURPA). In doing so, PURPA established two classes of qualifying facilities, Cogenerators and Small Power Producers that would receive special rate and regulatory treatment[2]. PURPA PPAs were introduced as a way to encourage an end to promotional rate structures by managing the relationship between Independent Power Producers (IPP) and the utilities that controlled their electric grids through vertically integrated structures (essentially natural monopolies). This was one of the first laws that began the deregulation of energy companies and led to contentious debate on pricing/avoided cost, but eventually created enhanced system reliability, lower reserve margins and promoted distributed generation. More importantly, it established a risk management strategy for investment in alternative energy generation that requires competition in the utility industry and encourages renewables. The Union of Concerned Scientists claim that "PURPA has been the most effective single measure in promoting renewable energy."[3]

Virtual PPAs

By the 2010s, PPAs had demonstrated their utility in de-risking project financing for new renewable energy generating capacity, but were not as flexible as other financial instruments for varied use cases, such as direct contracting between renewable energy projects and corporate purchasers. The emergence of a Virtual PPA (vPPA) created a purely financial contract, allowing smaller buyers who might have less expertise in energy trading to participate in the corporate renewable energy market. It is also a better fit for highly distributed electricity loads or possibly loads in regulated markets and allows those companies to meet renewable energy goals and have rights or Renewable Energy Credits (REC) to renewable energy products sold or traded in various markets. The term 'virtual' is used to differentiate this type of PPA from a physical PPA, where the offtaker was typically contracting for large energy needs and the corporate buyer had sophisticated internal processes to manage this.

There is, however, still a holdover from the original PPA structure and that is how the contract allocates the risk. The corporate buyer is participating in most of the risk categories – fuel, operational and price – as if the project was a more traditional generation (i.e. thermal) project. Renewable energy projects have a different risk profile from fossil fuel projects and the acceptance of the vPPA has led to a

[2] Retrieved from "PURPA Qualifying Facilities: What is a Qualifying Facility?", www.ferc.gov/qf 1/13/21

[3] Retrieved from "Public Utility Regulatory Policy Act (PURPA)", www.ucsusa.org/resources/public-utility-regulatory-policy-act published 7/15/2015

reconsideration of how to allocate these risks. The owner/operator of the asset has an outsized influence on the operational risk of the project, with the buyer/offtaker often not able to deploy their toolsets to manage this risk. A re-allocation of this risk category back onto the project could correct this and further make available an expanding set of tools offered by insurance and commodity markets.

A recently introduced variant of the vPPA known as a Proxy Generation PPA (pgPPA) is an evolving tool that can correct the misallocation of risk while opening up opportunity for the corporate and industrial (C&I) buyer to better realize their goals of acquiring renewable energy. By sharing that risk which previously they might not have had the ability to manage, more projects are made available to help meet sustainability targets.

vPPA Basics

First, lets review an example of a vPPA as it could be executed in an unregulated market. Here we will use the ERCOT market for the project siting and New York as the corporate buyer's location (i.e. where the corporate buyer will pay its electricity bill). The buyer is engaging with the renewable energy project for associated RECs in exchange for a fixed price ($/MWh) paid for the electricity produced. The buyer is using the vPPA to take part in the production of clean energy even though the electricity produced is not directly supplying their facility in New York. As the ERCOT market is deregulated, the price at the node or hub (point of transaction) will vary over time, sometimes dramatically. The buyer is responsible for the 'market price' and a financial settlement occurs between the project owner and the buyer that makes up the difference between the variable market price and the vPPA contracted price. This is often referred to as a fixed-for-floating swap in a contract-for-differences structure and together with the RECs, this is referred to as the 'trade quantity'.

This example is based on the Rocky Mountain Institute's vPPA explanation and the figure below is from that document[4].

The phrase 'all electrons are fungible' is demonstrated in this explanation in that the project is supplying the ERCOT grid while the buyer is connected to NYISO.

This example also exposes in more detail some of the risks associated with a vPPA such as the variability of the market price, the contractual definition of where the

[4] Kansal, Rachit "Introduction to the Virtual Power Purchase Agreement", retrieved from www.rmi.org/insight/virtual-power-purchase-agreement/ 11/2018

vPPA is settled and the operation of the asset in its market (i.e. maintenance of the asset, ability to participate during advantaged conditions, etc.). It is the allocation of these and other risks between the project and the offtaker that offers an opportunity for the pgPPA to be deployed in these transactions.

Proxy Generation PPA

The unique element of the pgPPA is that it directly addresses and assigns the operational risk. The vPPA settles around a trade quantity that can be negatively affected by curtailment, bad maintenance practices or mismanaged timing for offline facility upgrades or repairs (i.e. scheduling maintenance during otherwise profitable periods). Availability guarantees can help protect the buyer from egregious cases of mismanagement, but the remainder of the operational risk is still present. Under a pgPPA, the trade quantity is settled on a calculation of what should have been produced by the asset as opposed to what was actually produced. This calculation is the proxy for real generation and shifts the operational risk from the buyer to the project. This should in turn motivate the seller to operate at maximum efficiency. Additionally, there are further fuel risk (weather) and price risk (market volatility) options available to the pgPPA because insurance companies can adequately calculate these risks when abstracted away from the operational risk and can therefore be made available to the project. These products are sometimes referred to as Volume Firming Agreements (VFA) and provide additional hedges for C&I buyers.

Typically, a third party 'calculation agent' is employed to measure generation data at an agreed temporal resolution (i.e. every fifteen minutes or every hour), then calculate the expected production under an accepted methodology to produce the proxy energy generation that feed into the trade quantity. Project specific RECs are still based on actual production and any variance from proxy generation is made up with supplemental (usually unbundled) RECs or contracted disbursement for under/over production.

Microsoft was an early adopter of the vPPA structure in its environmental sustainability policy, reducing the carbon footprint of their vast network of data centers. Their recognition of the operational risk involved in contracting for renewable energy and the inability to manage it led to the shift from traditional vPPAs to pgPPAs coupled with VFAs.

Early wind energy adoption of the pgPPA structure by Capital Power partnered with Allianz Risk Transfer in 2016[5] demonstrated predictable revenues. Microsoft was the buyer in that 10-year agreement. In 2018, Microsoft announced one of the first big pgPPAs paired with a VFA[6]. Since then,

[5] "Capital Power's Bloom Wind Project Receives Recognition as North American Wind Deal of the Year," Intrado/GlobeNewswire (March 16, 2017) https://globenewswire.com/news-release/2017/03/16/1187716/0/en/Capital-Power-s-Bloom-Wind-Project-Receives-Recognition-as-North-American-Wind-Deal-of-the-Year.html

[6] "Buying Renewable Energy Should be Easy – Here's One Way to Make it Less Complex," Microsoft Corporate Blogs (October 16, 2018)

multiple wind projects and recently a combined solar/storage project[7] have taken advantage of the pgPPA.

Storage and pgPPAs – Risk Allocation Based on Data

As the financial instruments are evolving to help C&I buyers reallocate risk, expand participation and hedge volatility in renewable energy projects, the role of energy storage in smoothing out the risk profile is evolving as well. With its ability to provide multiple services in both centralized and distributed generation, Battery Energy Storage Systems (BESS) projects are uniquely positioned to further enable participation of a diverse group of buyers in the renewable energy markets. A BESS could open up revenue opportunities and reduce the volume or shape risk by allowing a solar/storage project to 'shore-up' output profiles. This output flexibility increases consistency in the project deliverable. In addition, other ancillary services (i.e. frequency support, balancing) can provide further revenue generation for the seller, offsetting spread risk when reconciling settled pricing between proxy revenue and fixed payments between the project and the buyer.

In a possible two way settlement scenario, the hedge provider can reduce the risk for the corporate buyer by way of a derivative with the buyer, and may utilize further instruments to manage their volatility risk.

A hedge provider would then be a financial intermediary (often an insurer) taking on risk that is better managed by its portfolio approach where it can be distributed across multiple projects.

The storage component of the project can also improve the bankability of the project under the previous example, and potentially expand the pool of corporate buyers able to participate in the pgPPA structure. As the volume and shape risk are now able to be shifted from the buyer to the project, and lenders are typically conservative in their approach to aggregated risks, the application of a hedge or proxy swap like the pgPPA could locate the appropriate risks with those entities best equipped to manage them. Hedge providers who specialize in weather risk are now able to participate where they can focus their investments in deals where previously associated market risks would not have been attractive. Energy storage, by smoothing out volatility and extracting more value from the project, can make including weather risk in an integrated derivative contract more appealing. Although increased complexity and additional fees for implementing this type of structure can add to the project's cost, the repackaging of risk to allow a broader range of financial tools and the additional revenue possible can reduce economic uncertainty for renewable energy investors.

Storage has even seen some movement in the direction of a stand-alone storage swap.

https://blogs.microsoft.com/on-the-issue/2018/10/16/buying-renewable-energy-should-be-easy-heres-one-way-to-make-it-less-complex/

[7] "Innovative PPA debuts in US solar sector," PV Magazine (January 11, 2021) https://pv-magazine.com/2021/01/11/innovative-ppa-debuts-in-us-solar-sector/

It is reported that a "virtual storage" swap contract is being executed for the 2022 financial year between Hydro Tasmania and two large corporate buyers, Shell and Macquarie Group[8]. The structure of the contract allows selling the rights to storage discharging during higher priced periods while buying fixed energy volume at lower priced charging periods. Settlement by the hedge provider is then able to de-risk the sellers arbitrage revenue while encouraging investment from corporate buyers through increased liquidity provided by the swap.

The Role of Data

The success of the different types of standard financial tools in project financing like fixed volume price swaps or interest rate swaps are contingent on the data and models used to calculate the risk. The ability to produce a risk profile for proxy generation is also dependent on data and the calculation is the basis for a successful transaction. Proxy generation is typically calculated as the output generated by the project under certain conditions. For a solar/storage project, solar irradiance and operational efficiencies like availability, electrical losses, etc. would be factored into a model which would then take weather and market conditions as inputs to produce the settled generation. A third party is usually engaged as a trusted and independent source for this calculation, and their reporting services are part of the structure that enables the pgPPA to be used. Data and its origin, transformation and calculation are then the key components of the settlement. For example, the calibration of instruments used in the data acquisition chain are now part of a financial calculation and may be subject to contractual obligations on when and who would calibrate the instruments. Data transformation and possible error stack up along this route will also be scrutinized, and in some cases a full 'custody chain' employed to provide confidence in the data used in the settlement calculation (often referred to as shared ledger or blockchain). Data's central role in the contract is to provide a single source of truth for the calculation. The models used for developing the projected generation would also be verified for accuracy as small errors can have large impacts on production outputs.

The trusted 3rd party calculation agent can also provide ancillary and ongoing services that complement proxy settlement, such as operational insight into asset performance and coordination of data management for participating assets. Using machine learning with curated datasets, these services can be offered as custom models or SaaS products, delivering a report card on the asset relative to its architected output.

[8] "Game-Changing "Virtual Storage" Deal Struck Between Macquarie, Shell and Hydro Tas", Jan. 21, 2021, retrieved from https://globalenergyworld.com/news/sustainable-energy/2021/01/21/gamechanging-virtual-storage-deal-struck-between-macquarie-shell-hydro-tas