

Electricity Markets

Before we get into RECs, some background about the energy and specifically renewable energy, is needed. Electricity in the US operates very differently, depending on which state you are in. This can get quite complicated, and I won't pretend to understand all the intricacies because you really do need to be an expert to understand the granular nuances of electricity markets. Nevertheless, there are broadly speaking, two types of electricity markets (which are determined by state policy) in the US, regulated and deregulated electricity markets.

A regulated market is one in which the utility (or utilities) that operate in that state have a complete monopoly and are totally vertically integrated. In other words, the utility owns and operates the generation, transmission, distribution, and delivery of electricity; they own everything and get a guaranteed rate of return, which is determined by a state-wide public utility commission.

In a deregulated electricity market, things get more complicated. In a deregulated electricity market, utilities are referred to as the "poles and wires;" they handle transmission, distribution, and delivery of electricity from independent power producers (IPPs) to consumers and charge a price, which is regulated by state governments, to consumers for doing so. The power generation side of things is where the main difference between regulated and deregulated arise. Essentially in a deregulated electricity market, power generation is competitive and market-driven, which is to say power producers have to bid into a market to provide power for a certain time (usually down to a five-minute interval) on a certain day. From there, an independent systems operator assesses the bids and ensures reliability and the least-cost to consumers. The system operators are the ones that keep the lights on. Again, it is far more complicated than that, but that description will have to suffice.

In Illinois, we have a deregulated electricity market, and our systems operator is the Midcontinent Independent System Operator, referred to as MISO (I know what a creative name). Also, just to avoid any confusion and address common misconceptions, a deregulated electricity market does not mean that those electricity producers aren't subject to EPA regulation, for example, it has nothing to do with that type of regulation. In **MY PERSONAL OPINION**, deregulated electricity markets are the far better option and have been absolutely key in the rapid growth of renewable energy. I will note that that opinion is not very controversial, and most people in the renewable energy industry would agree with me on this. Also, it should be known that there are three grids in the US; the Eastern interconnect, Western interconnect, and the Texas Interconnect (yes, Texas has their own grid). Illinois is on the Eastern interconnect.

Here are three links to sources and further readings on some of the above topics that I suggest you look at or skim. Another piece of important information for understanding challenges with renewables is something referred to as the 'duck curve', and rather than me trying to explain it check out this [VOX article](#)/video, they do a solid job.

Here are some other resources:

<https://www.epa.gov/greenpower/us-electricity-grid-markets>
<https://www.electricchoice.com/map-deregulated-energy-markets/> (map of states with regulated/deregulated electricity and gas markets)
<https://www.arcadiapower.com/energy-101/energy-sources/a-guide-to-deregulated-energy-markets/>

Power Purchase Agreements

A power purchase agreement (PPA) is a legal agreement between an IPP and a consumer (referred to as an "off-taker") whereby the consumer commits to buying the electricity produced by that IPP for a specified amount of time at an agreed price that is, generally speaking, locked in for the duration of the contract, which is usually 10-25 years. Generally, there are two overarching forms of a PPA. There is a Physical PPA or a Financial PPA. For context, the UIUC sustainability community has adopted the term "Financial PPA" but it is also quite common in the industry for a Financial PPA to be called a "Virtual PPA."

This can get really confusing so bear with me. A PPA is just a contract between an IPP and an off-taker, it does not mean that the physical electrons from the power producer are actually going to the off-taker. This is not like putting solar on your roof, and using it all on-site. For both Physical and Virtual/Financial PPAs, the electrons are going into the grid and after that nobody knows exactly where they go.

Okay, now let's make the distinction between a Physical PPA and a Financial PPA, these terms are often thrown around, and many people think they understand the difference but actually, don't; it is very confusing.

A Financial PPA is where the IPP produces the electrons and sells that electricity on the open market. After a certain period (usually each month) the IPP and off-taker settle up based on their agreed-upon price. So basically, the IPP sells the electricity on the open market, and they get money for that sold electricity. If the IPP made more selling on the open market than that same amount of electricity would cost at the Financial PPA price, then the IPP writes a check to the off-taker with the extra money made. However, if the IPP made less money selling on the open market than that same amount of electricity sold at the Financial PPA price, then the off-taker has to send a check to the IPP for that difference. If that was confusing, try reading this [EPA informational article](#).

A Physical PPA is different in that the IPP builds the power generation project and sells that power into the grid. The off-taker pays the IPP directly for each unit of electricity that goes into the grid. Then the off-taker pulls an equal amount of power off the grid and uses it (the timing has to match up so that when the IPP puts power into the grid at the exact time the off-taker pulls electricity out of the grid at an equal amount). The off-taker in this scenario gets 'rights' to the electricity and has to pay the utility for the transmission and distribution (T&D) services the utility provided, i.e. the grid. But again, this doesn't actually mean the exact electrons coming

from the IPP are going to the off-taker, we just say that the off-taker has rights to that amount of electricity.

Check out this EPA informative article about [Physical PPAs](#). In Financial PPAs, the off-taker always gets the RECs, but in a Physical PPA, that doesn't always happen.

Here are two other sources to take a look at:

<https://3degreesinc.com/latest/faqs-ppa-vppa/>

<https://hub.resourceadvisor.com/renewable-energy/what-is-the-difference-between-direct-and-financial-ppas-for-corporate-buyers>

Renewable Energy Certificates

What is a REC, you might ask? A REC is a renewable energy certificate. When a solar or wind project produces 1 megawatt-hour of electricity that earns that project 1 REC, which encompasses the renewable aspects of the generated electricity. It is essentially an accounting tool to determine who is using renewable electricity and who is not because remember the grid is shared, so we don't know what is renewable and what is not; a renewably generated electron looks the same as a coal-generated electron. You cannot claim to produce renewable electricity without a REC. A quick input of **MY OPINION** is that a REC really should be called a renewable electricity certificate to avoid confusion but I don't make the rules; I digress.

RECs can be sold for money. You might ask, why would anyone go out of their way to pay for RECs? Two reasons: first, when you see states like California announce a renewable portfolio standard (RPS) where they say "by 2030 60% of California's electricity will be renewable" what that really means is that the utilities in their state have to own enough RECs to substantiate that 60% claim. That is called the compliance market because it is driven by state law. Second, is the voluntary market, whereby companies, universities, other organizations, or really anyone that wants (you and I) can go buy a REC and claim the use of that renewable electricity.

So when you see Apple or other companies say they are 100% renewable, to say that they need RECs to prove it (this is enforced by the Federal Trade Commission, see <https://www.ftc.gov/news-events/media-resources/truth-advertising/green-guides>). Here is a good [EPA article](#) on RECs. **MY PERSONAL OPINION**, on RECs, is that they are important for accounting purposes and generating market signals for renewables, but I cringe when companies and universities claim they are 100% renewable because they bought a bunch of RECs on the open market.

Here is why I cringe:

- 1) If the RECs are being purchased off the open market, then the purchase of RECs is not enabling a new additional renewable energy project to come online. In that way, the purchase of RECs hasn't substantially affected the number of renewable projects on the grid. I am more sympathetic if a company promises to buy RECs from an IPP before the project actually happens because then you can make the argument that the purchase of the RECs enabled a new project to be built.

2) From an engineering perspective, a lot of renewable projects in the US are located in a concentrated area, and the transmission lines can't handle the amount of power produced and so projects can't produce as much power (revenue) as they might have planned on . RECs cannot address that issue because power needs to be generated in order for RECs to be generated. This issue is referred to as 'merchant risk' and it is arguably the largest future challenge renewables face.

3) Building off point number 2, many staunch supporters of RECs would counter by correctly pointing out that markets account for the issue I raised in point number 2 because REC prices reflect the market/location they were generated in. For example, a REC from California or Texas is going to be super cheap because there is so many renewables there. Whereas a REC from Kentucky or Florida would be more expensive because there are not a lot of renewables in those states. However, if you think it through, there is no rule that says the University of Illinois (obviously located in Illinois) can't buy RECs out of state. In fact, it is quite common for organizations to buy RECs out of state. Taking that one step further the conclusion is quite clear; nobody is going to buy those more expensive RECs, which incentivize renewable energy projects in the states that need them and ultimately better for the energy transition. If you are Apple or the University of Illinois for that matter, and you need to buy a lot of RECs so you can tout your 100% renewable status, you want to do so at the lowest cost possible. Hence, you will buy RECs from Texas, which are dirt cheap. So back to the point I made in number 2, if everyone is going to buy cheap RECs then that does not help solve the problem at all. The locations with cheap RECs, generally speaking, have grids that are congested and can't handle more renewables and the value of the renewable projects in those locations are very low, hence the low-cost RECs. And this process incentivizes renewable energy projects in locations that can't handle anymore renewable energy projects. So unless there is a 'New Deal' scale build out of the grid, RECs are good for accounting but they certainly will not, in any meaningful way, further the energy transition.

It is for this reason that I strongly encourage the iCAP Working Group to avoid any proposal that relies on using RECs alone to meet our renewable electricity goals. So far, we have done a good job at avoiding that pitfall. However, there was a letter from a high ranking official in the University of Illinois System that made the rounds and suggested REC purchases as an alternative to an actual power purchase agreement procurement deal. Further, I am convinced that the only reason why the University of Illinois signed on to the 2050 carbon neutrality commitment was because the backup (and likely) plan is to buy a bunch of RECs and carbon offsets to meet the renewable energy and carbon neutrality goals, respectively. So I urge the working group members to be cautious and vigilant on this issue as I believe it would be a colossal failure and forfeit of leadership on the part of the University of Illinois if we go down the road of stand-alone RECs.

Thanks for reading, and hopefully, you found the above useful and informative.

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