





Voluntary Green Power Markets 101

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October 22, 2017

Renewable Energy Markets Conference, New York, NY

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

- What is the green power market?
- How do customers buy green power?
- What is the geography of green power?
- What are the major market trends?

Green power refers to the **voluntary** purchase of renewable electricity. Voluntary purchases are distinguished from wholesale procurement of renewable energy to comply with mandatory renewable energy targets imposed by law or regulation.

How Large is the Green Power Market?

In 2016, NREL estimates that about **6.3 million customers** procured about **95 million MWh** of renewable energy through green power markets. That is about 3% of annual U.S. retail electricity sales, and about 28% of U.S. non-hydro renewable energy generation.



Total renewable energy sales 2010-2016 (million MWh)

Renewable Energy Certificates

- RECs are the product of green power markets
- Customers can purchase renewable energy (embodied in RECs) through several market mechanisms:
 - Utility green pricing
 - Utility green partnerships
 - Unbundled RECs
 - Competitive suppliers
 - o CCAs
 - o PPAs
 - Community solar

Renewable energy sources generate two products: electricity and renewable energy certificates (RECs)

Compliance Purchase A regulated entity such as an electric utility buys RECs to comply with regulatory mandates for renewable energy purchasing. The electricity is generally delivered to the grid and may or may not be delivered to green power customers

Green Power Purchase End-use customers buy RECs to support renewable energy for voluntary purposes.



How Green Power Works

Green Power Market Mechanisms



Specific program structures vary



Specific program structures vary

In restructured electricity markets, customers may choose a competitive electricity supplier that offers a green power product. The competitive supplier provides the customer with power and RECs. The utility remains responsible for transmission and distribution. The competitive supplier may charge a premium for the green power product.

CUSTOMER

COMPETITIVE SUPPLIER

Basic competitive supplier sales structure Specific program structures vary

RE

GENERATOR

Unbundled RECs

Unbundled REC customers purchase RECs from renewable energy providers, typically through a third-party REC marketer. The unbundled REC customer does not receive power in the transaction.

CUSTOMER

Electricity is "unbundled" from the RECs and delivered to the grid, which need not be in the same service territory as the unbundled REC customer.

Basic unbundled RECs sales structure

Specific program structures vary

GENERATOR

Community Choice Aggregation

AGGREGATION

A CCA effectively "aggregates" the electricity demand of many customers (residential and non-residential) in order to procure electricity from an alternative supplier.

The CCA "switches" from an incumbent electricity supplier to an alternative supplier with a renewable energy product (though the switch may include a non-renewable product). The CCA purchases electricity and RECs from the alternative supplier, the utility remains responsible for transmission and distribution

GENERATOR

Basic CCA structure

Specific program structures vary

Power Purchase Agreements

PPAs are generally long-term contracts to purchase electricity between a non-residential customer and a renewable energy provider. The customer agrees to buy the electricity at a negotiated PPA rate throughout the contract term.



CUSTOMER

Although common, physical delivery of electricity is not a requirement in some PPAs. Financial PPAs use much of the same structure, including REC retention by the customer, without physical electricity delivery. The utility generally remains responsible for transmission and distribution. The customer pays the utility for transmission and distribution.

GENERATOR

Basic PPA structure

Specific program structures vary. See full report for a more complete description of the differences between physical and financial PPAs

Community Solar

A typical community solar program structure UTILITY The utility is generally responsible begins with a shared solar array generating and for crediting community solar feeding solar power into the grid. Most subscribers through bill credits that 0000 community solar arrays are owned by utilities or reflect their ownership stake in the third-party project developers. community solar array. **CUSTOMER** PROJECT

Community solar subscribers generally pay for their subscription through up-front purchases of capacity (kW) or output (kWh). In return, the subscribers receive bill credits and, in some cases, RECs. However subscribers do not commonly receive the RECs, in which case their subscription is not a green power purchase.

Basic community solar program structure

Specific program structures vary

The Geography of Green Power

The Geography of Green Power Mechanisms



Primary green power market mechanism by # of customers by state

Different products are available in different states, largely determined by whether the state has a restructured electricity market. Utility green pricing products are the primary mechanism in fully regulated markets, while CCAs and competitive suppliers provide green power in states with restructured electricity markets.

The Geography of Green Power Demand

Green Power Demand (x1000 Customers)



States with CCAs (CA,IL,MA,NY,OH) tend to have more green power customers than other states. Texas also has a large number of green power customers due to the competitive supplier market. OR leads the states in terms of utility green pricing program participation.

Source: O'Shaughnessy et al. (2017)

The Geography of Green Power Demand



Representative sample of green power customers by zip code Figure based on data provided by online energy services platform Arcadia Power

Green power demand is ubiquitous. Demand tends to be higher around large metropolitan areas, but green power demand extends to rural areas.

Source: O'Shaughnessy et al. (2017)

The Geography of Green Power Supply

Green Power State of Origin (million MWh)



Texas, California, and Illinois – three states with strong wind resources – account for more than one third of green power supply. Eighteen states generated more than 1 million MWh, and 42 states generated more than 100,000 MWh of green power in 2016.

Source: O'Shaughnessy et al. (2017)

20

15

10

Trends in Green Power Markets

Green Power Sales and Customers by Mechanism



Green power sales and customers by mechanism (2010-2016)

Source: O'Shaughnessy et al. (2017)

Major Trends



- NREL estimates that about 6.3 million customers procured about 95 million MWh of green power in 2016
- The voluntary green power market continues to grow, adding about 15 million MWh of sales and 2 million customers in 2016
- This continued growth is driven by increasing sales within existing green power mechanisms, but also the development of new products such as utility green partnerships, CCAs, and PPAs

See the full "Status and Trends in the Voluntary Green Power Market (2016 Data)" report at: <u>https://www.nrel.gov/docs/fy18osti/70174.pdf</u>.

Thank you!

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