

State of the Voluntary Green Power Market (2016 Data)

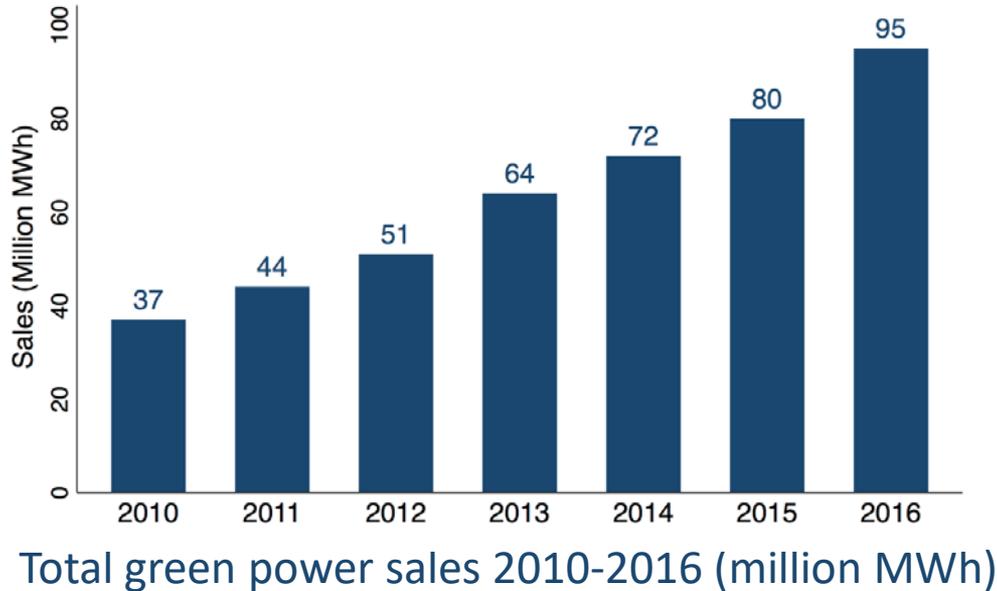
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Outline

- The big picture
- The markets
- Market trends
- The geography of green power

The Big Picture

In 2016, about **6.3 million customers** procured about **95 million MWh** of renewable energy through green power markets.



That represents about:

2.5%
of U.S. retail electricity sales

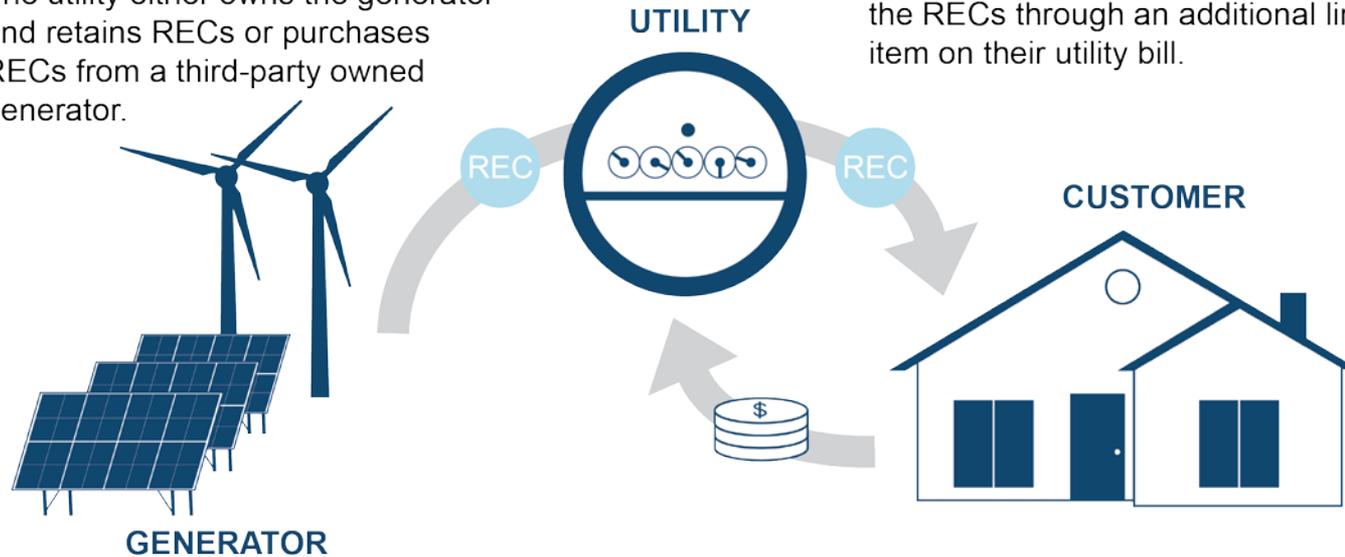
28%
of U.S. non-hydro renewable
energy generation

The Markets

Utility Green Pricing

Utility green pricing programs begin with a renewable energy generator. The utility either owns the generator and retains RECs or purchases RECs from a third-party owned generator.

The utility retires the RECs on behalf of green pricing customers, who pay for the RECs through an additional line item on their utility bill.

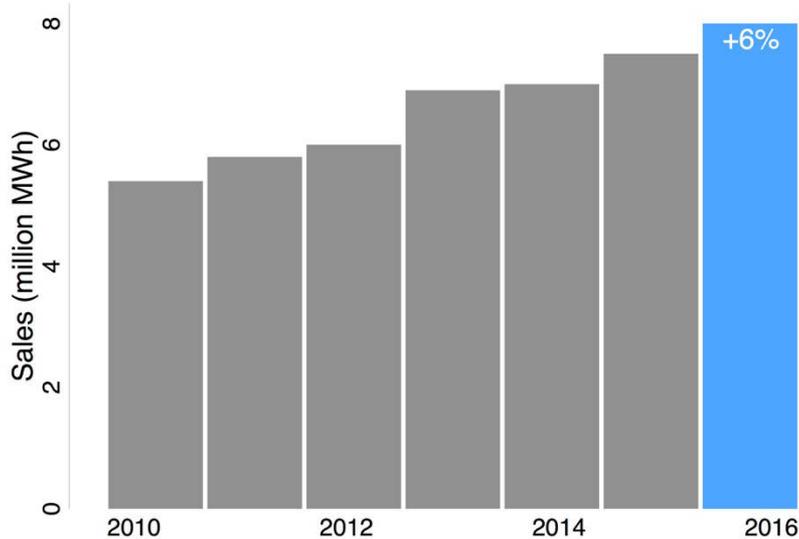


Basic utility green pricing program structure

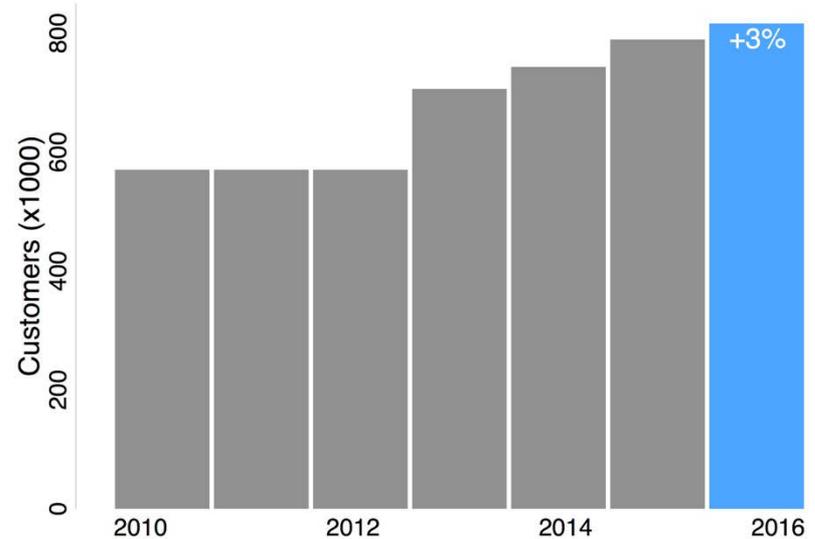
Specific program structures vary

Utility Green Pricing Trends

About **816,000 customers** procured about **8 million MWh** of renewable energy through utility green pricing programs in 2016. Utility green pricing sales grew by about 6% from 2015 to 2016.



Utility green pricing sales

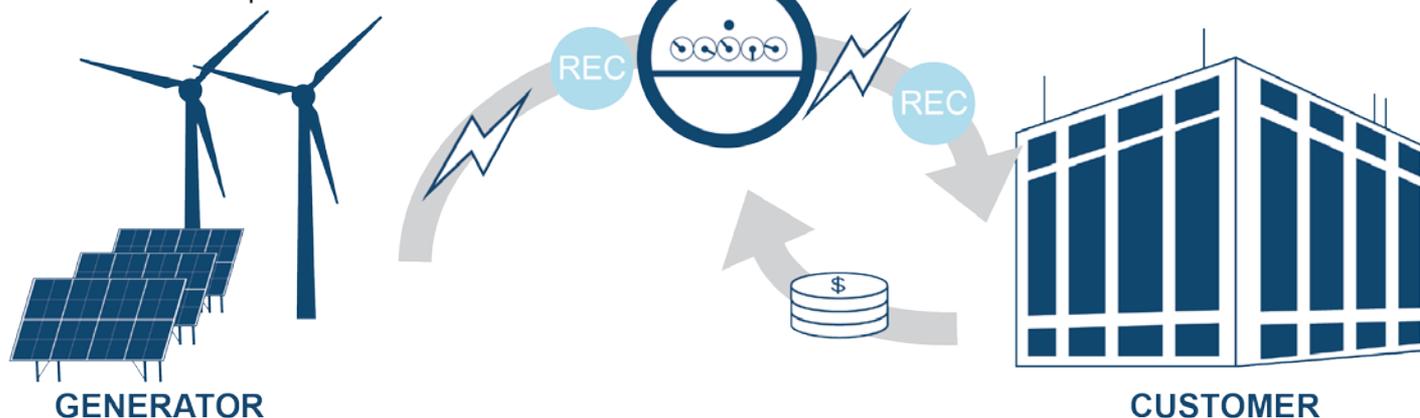


Utility green pricing participation

Utility Renewable Contracts

In a utility renewable contract, the customer enters into a contract with the utility to procure power and RECs from a renewable energy provider. Unlike green pricing programs, the customer may be able to specify the resource for the product.

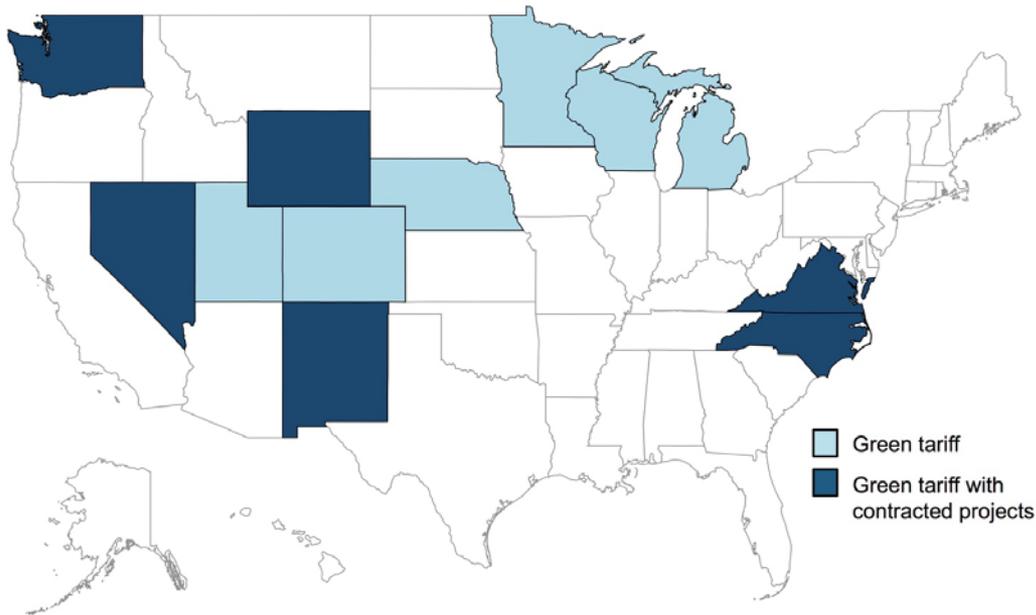
The utility provides the power and RECs to the customer. The customer continues to pay the utility with a modified green tariff or bilateral contract rate.



Basic utility renewable contract structure

Specific program structures vary

Green Tariff Programs



CO: Xcel Energy – Renewable*Connect

MI: Consumers Energy Company – Voluntary Large Customer Program

MN: Xcel Energy – Renewable*Connect

NC: Duke Energy – Green Source Rider

NE: Omaha Public Power District – Schedule No. 261

NM: Public Service Company of New Mexico – Green Energy Rider

NV: NV Energy – Green Energy Rider

UT: Rocky Mountain Power – Service from Renewable Energy Facilities

VA: Dominion Virginia Power – Renewable Energy Supply Service

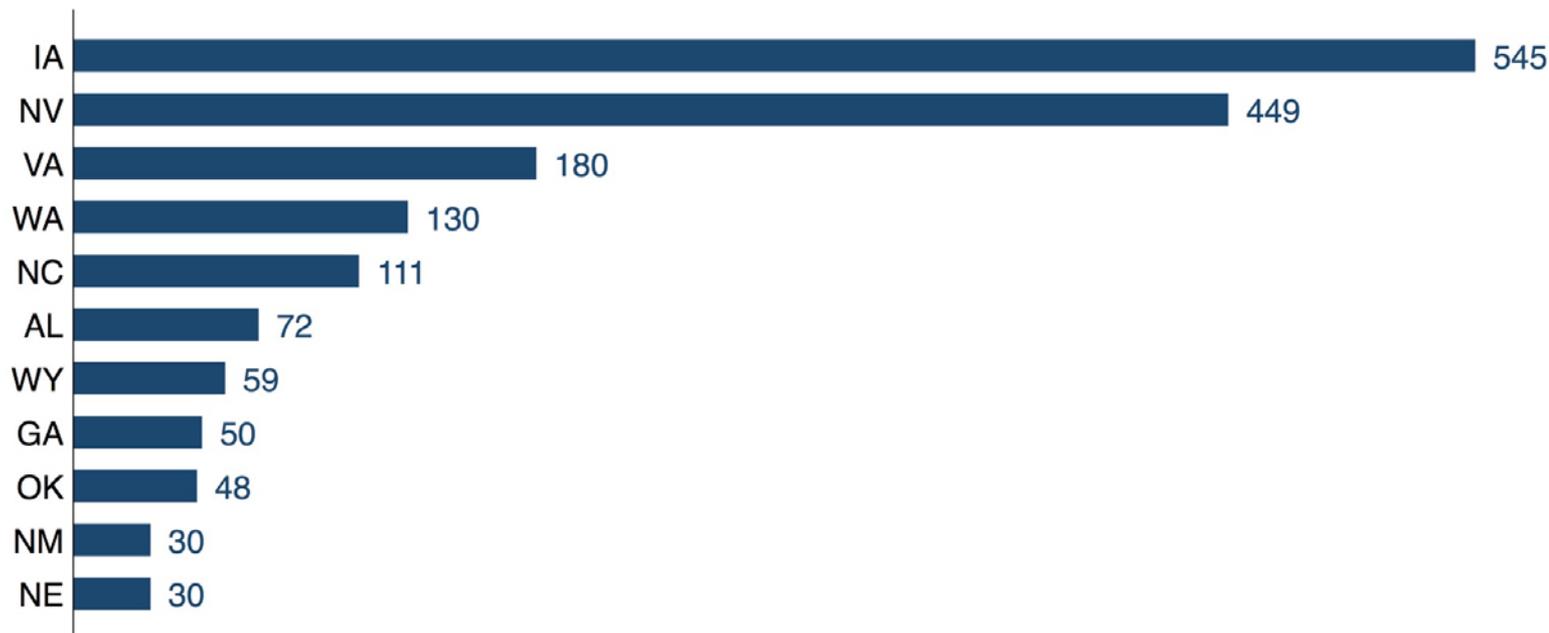
WA: Puget Sound Energy – Long Term Renewable Energy Purchase Rider

WI: Madison Gas & Electric – Renewable Energy Rider

WY: Black Hills Energy – Large Power Contract Service

Twelve utilities around the country offered utility green tariff programs by the end of 2017.

Utility Renewable Contract Capacity

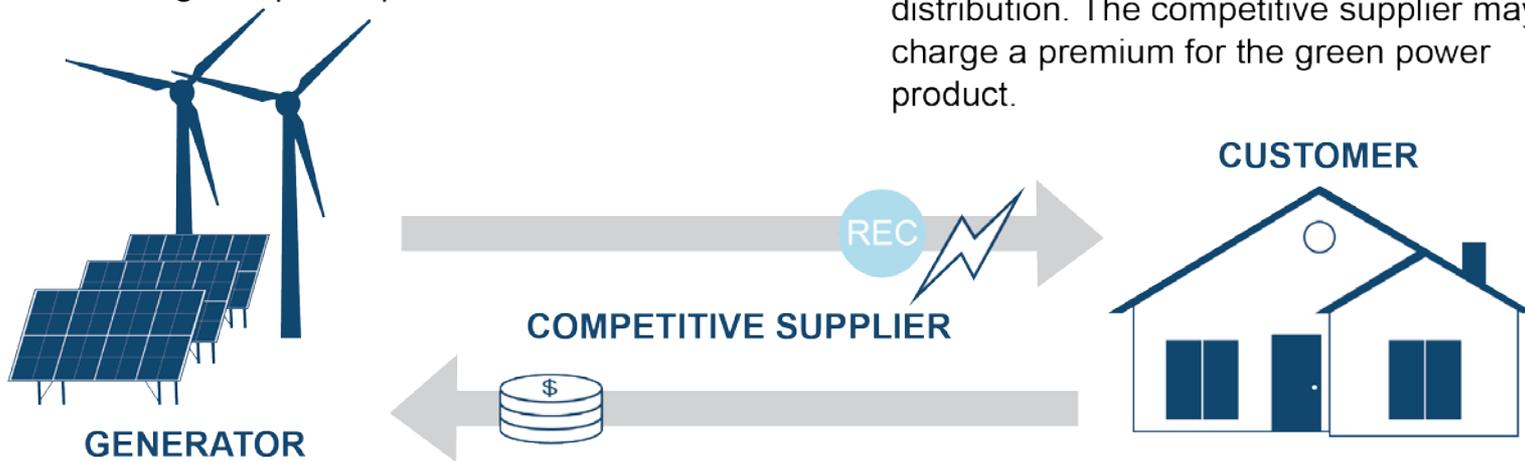


Cumulative utility renewable contract capacity by state (MW)

Competitive Suppliers

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.

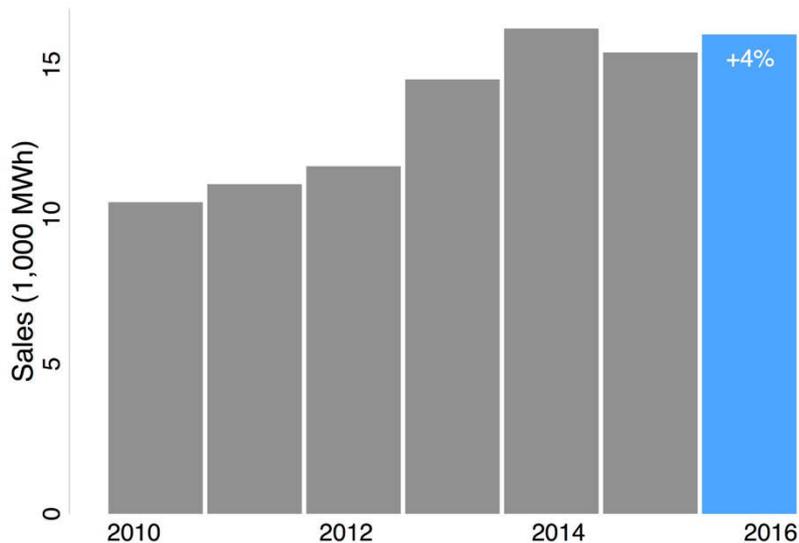


Basic competitive supplier sales structure

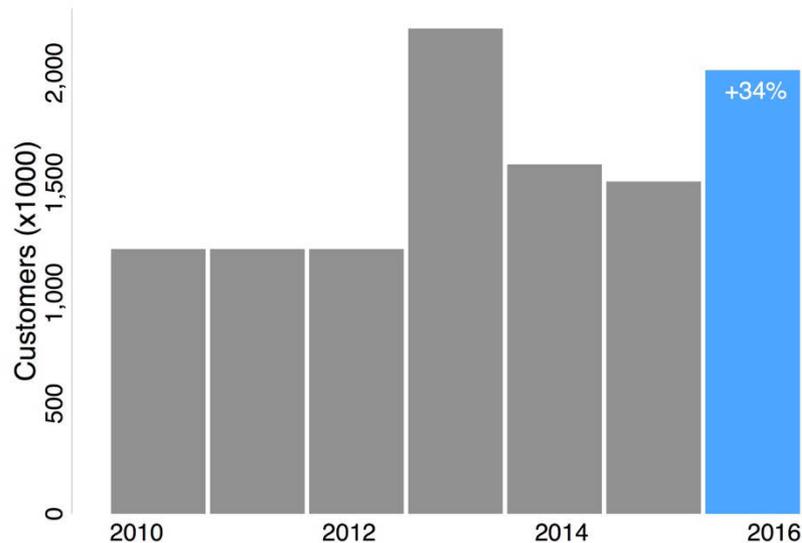
Specific program structures vary

Competitive Supplier Trends

In 2016, about **2 million customers** procured about **16 million MWh** of renewable energy through competitive suppliers.



Competitive supplier sales

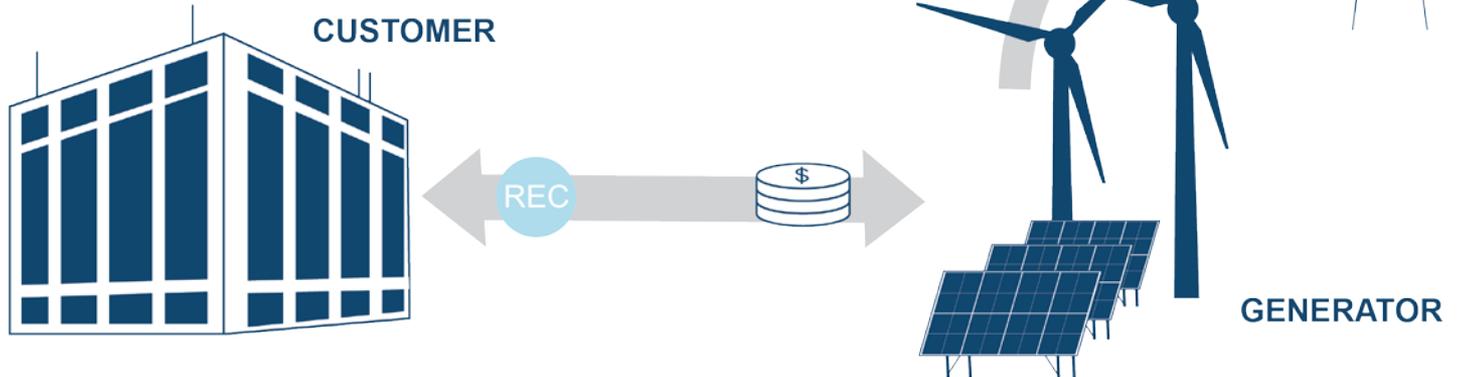


Competitive supplier participation

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.

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.

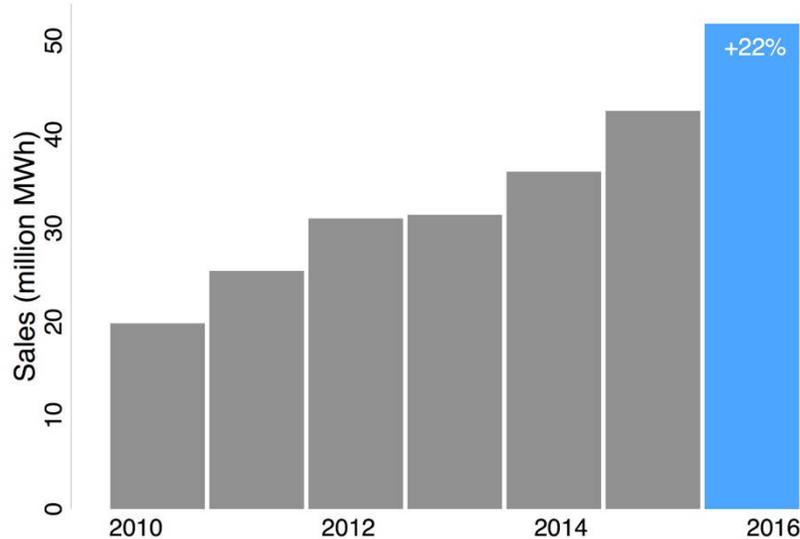


Basic unbundled RECs sales structure

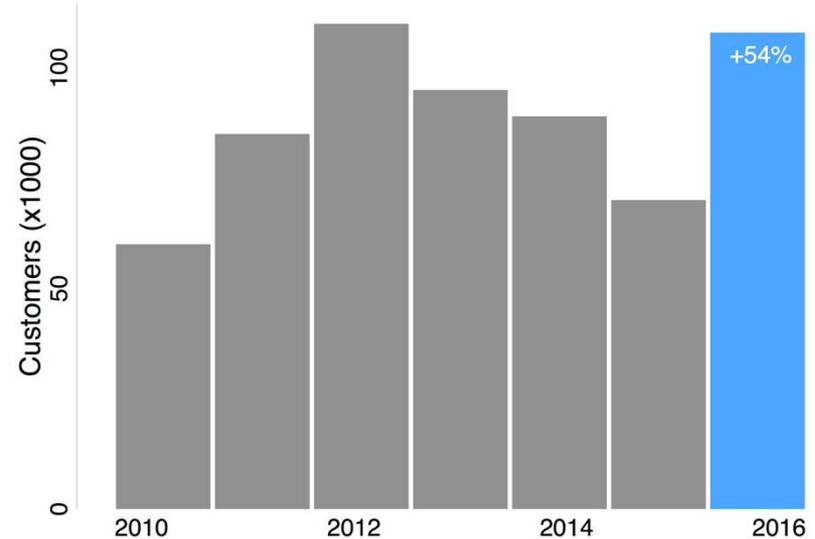
Specific program structures vary

Unbundled REC Trends

About **108,000 customers** procured about **52 million MWh** of renewable energy through unbundled RECs in 2016. Unbundled RECs sales comprise more than half of all green power sales.



Unbundled RECs sales

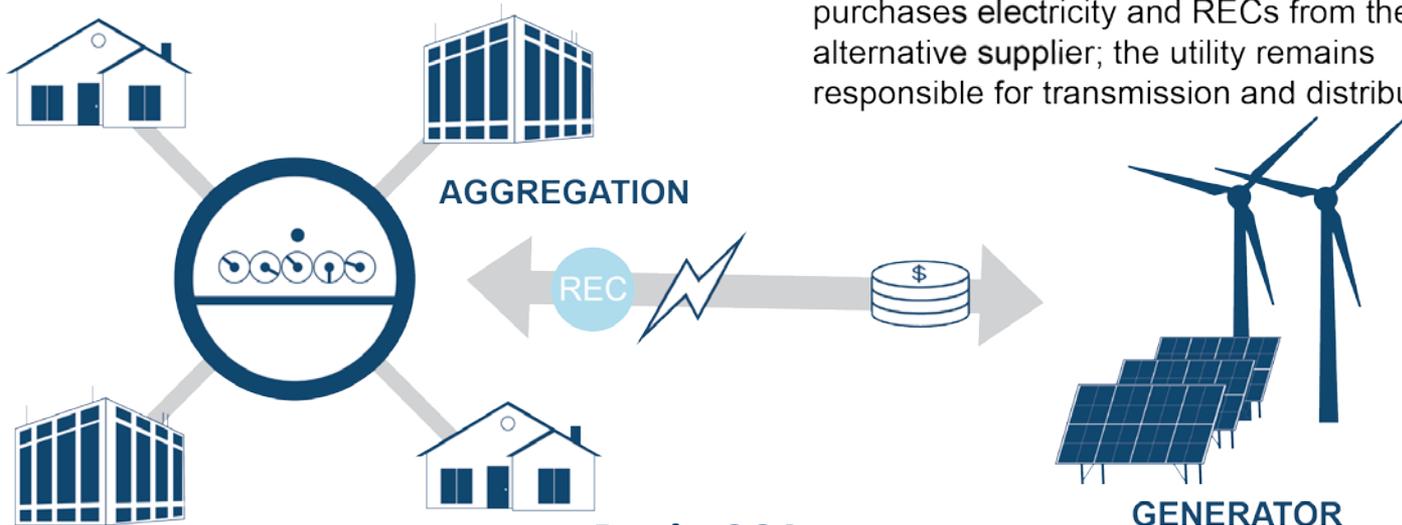


Unbundled RECs participation

Community Choice 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

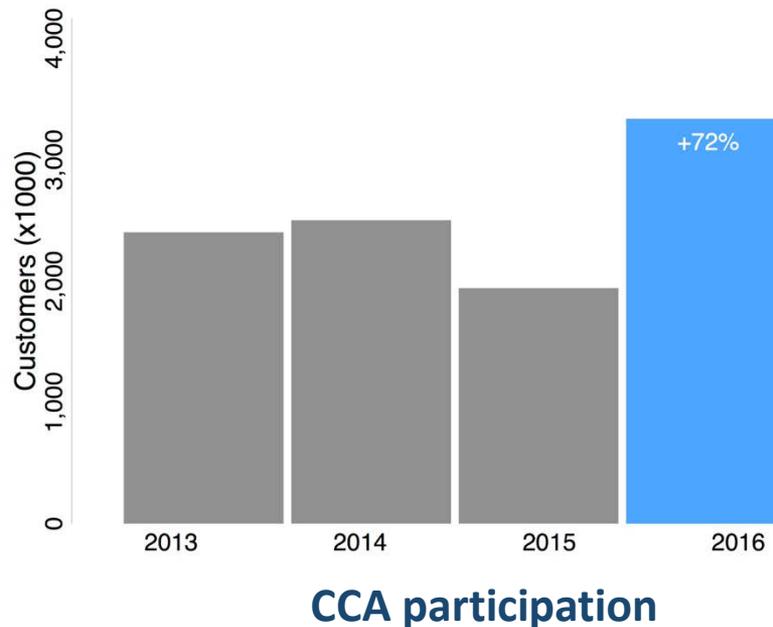
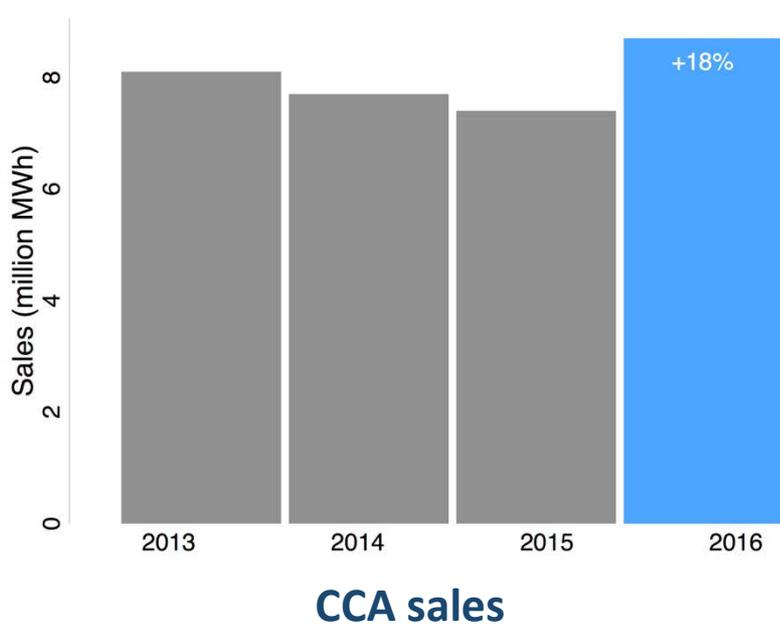


Basic CCA structure

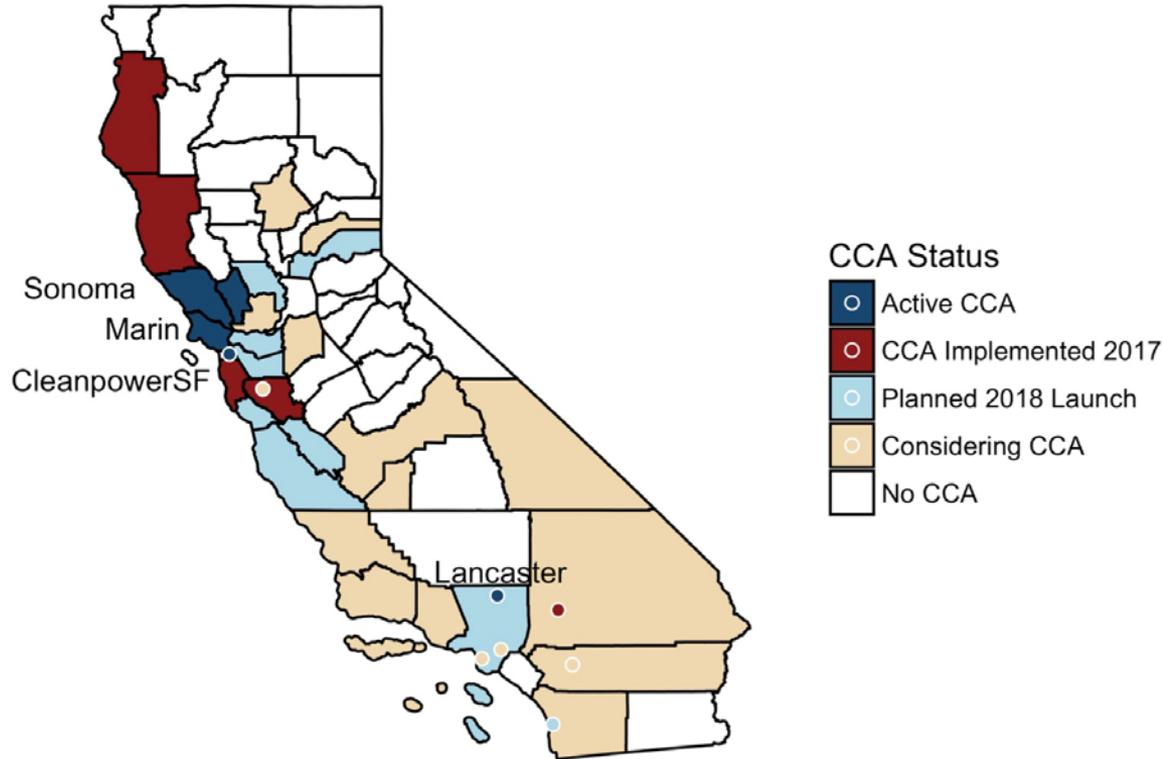
Specific program structures vary

CCA Trends

About **3.3 million customers** procured about **8.7 million MWh** of renewable energy through CCAs in 2016.



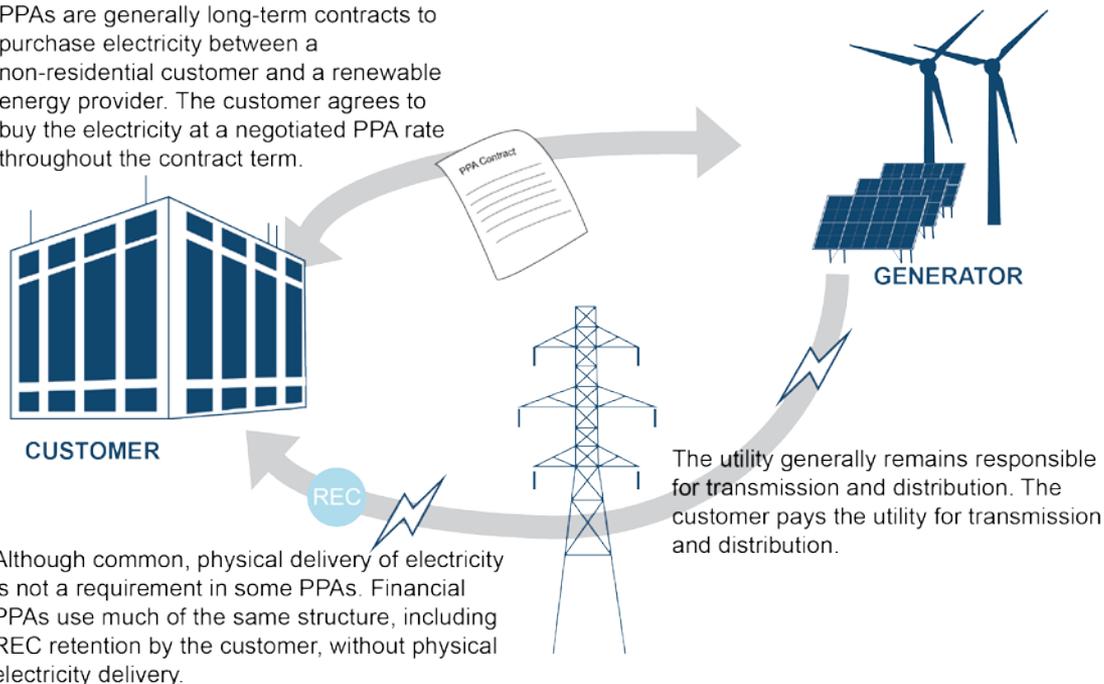
Expansion of CCAs in California



CCA continues to expand in California. As much as 85% of California's electric load could be served by CCAs, direct access, or customer-site generation by the mid 2020s

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.



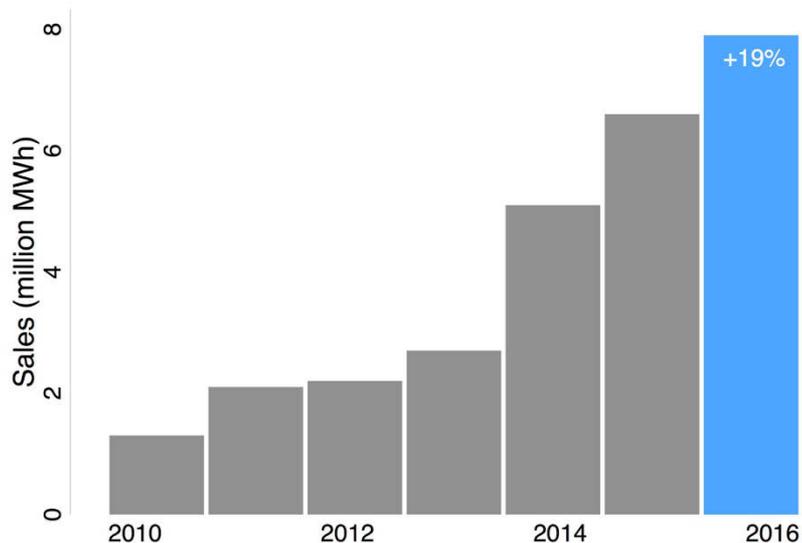
Although common, physical delivery of electricity is not a requirement in some PPAs. Financial PPAs use much of the same structure, including REC retention by the customer, without physical electricity delivery.

Basic PPA structure

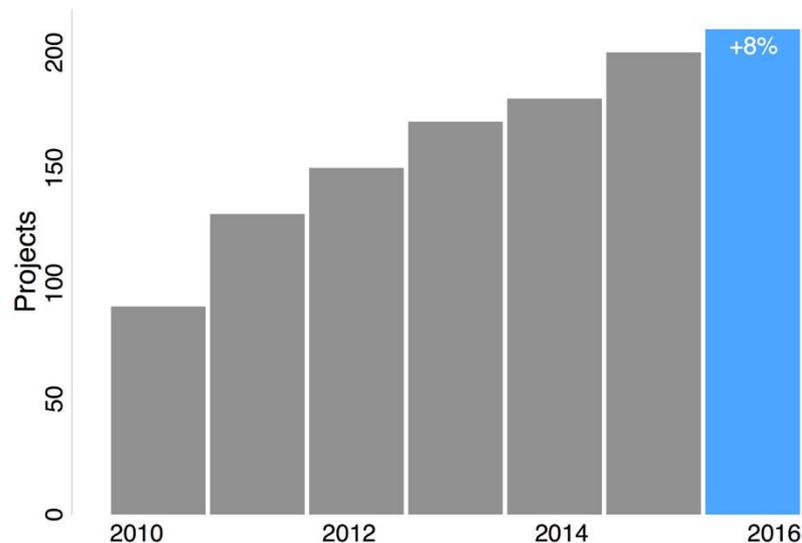
Specific program structures vary. See full report for a more complete description of the differences between physical and financial PPAs

PPA Trends

About **7.9 million MWh** of renewable energy were procured through **210 PPAs** in 2016.



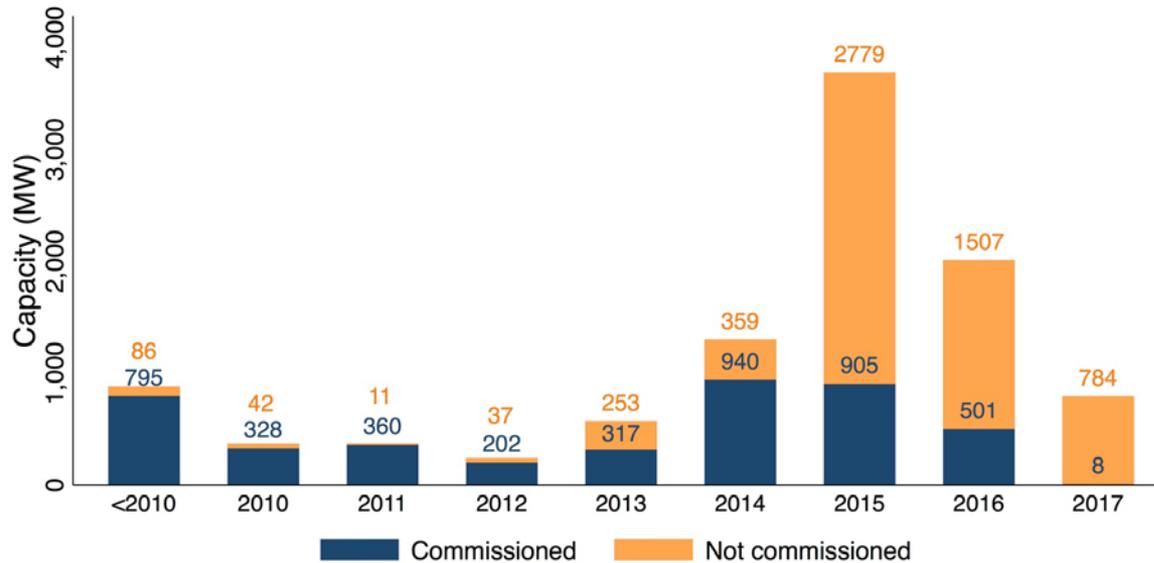
PPA sales



PPA participation

The PPA Project Pipeline

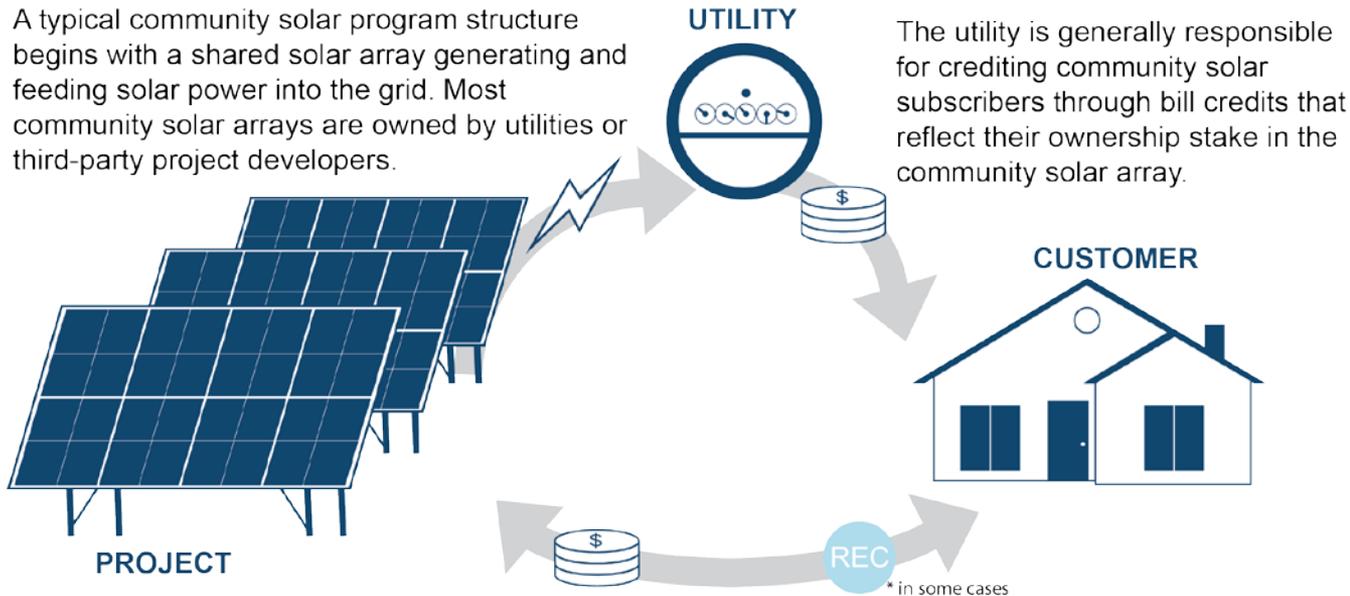
About 75% of signed projects have yet to be commissioned, representing a large project pipeline of green power coming online in coming years.



Signed Voluntary PPA Generation Capacity (MWh)

Community Solar

A typical community solar program structure begins with a shared solar array generating and feeding solar power into the grid. Most community solar arrays are owned by utilities or third-party project developers.



The utility is generally responsible for crediting community solar subscribers through bill credits that reflect their ownership stake in the community solar array.

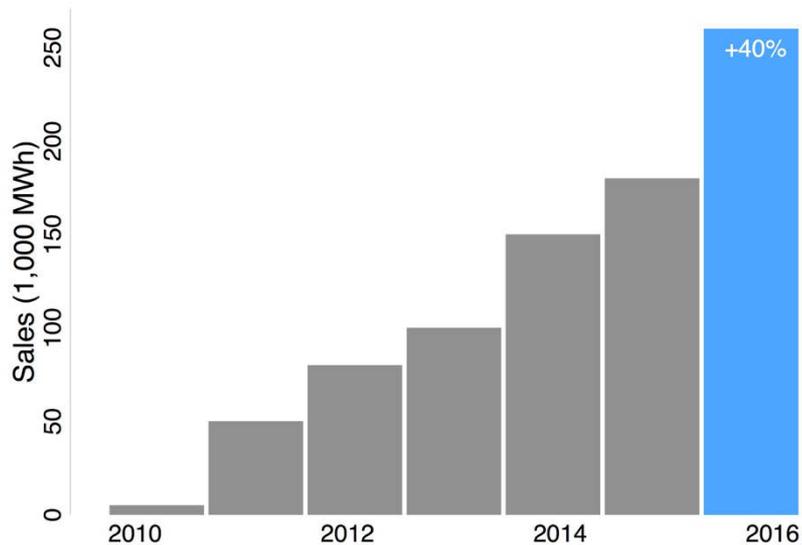
Community solar subscribers generally pay for their subscription through up-front purchases of capacity (kW) or output (kWh). In return, the subscribers receive bill credits and, in some cases, RECs. *However subscribers do not commonly receive the RECs, in which case their subscription is not a green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

Basic community solar program structure

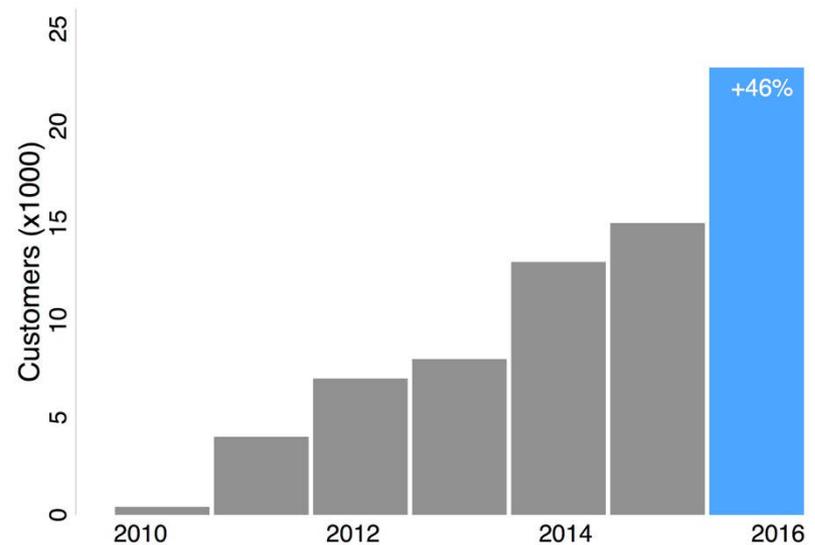
Specific program structures vary

Community Solar Trends

About **23,000 customers** subscribed to about **258,000 MWh** of community solar output in 2016. However it is unclear how many of these customers procured renewable energy (i.e., had RECs retired on their behalf)

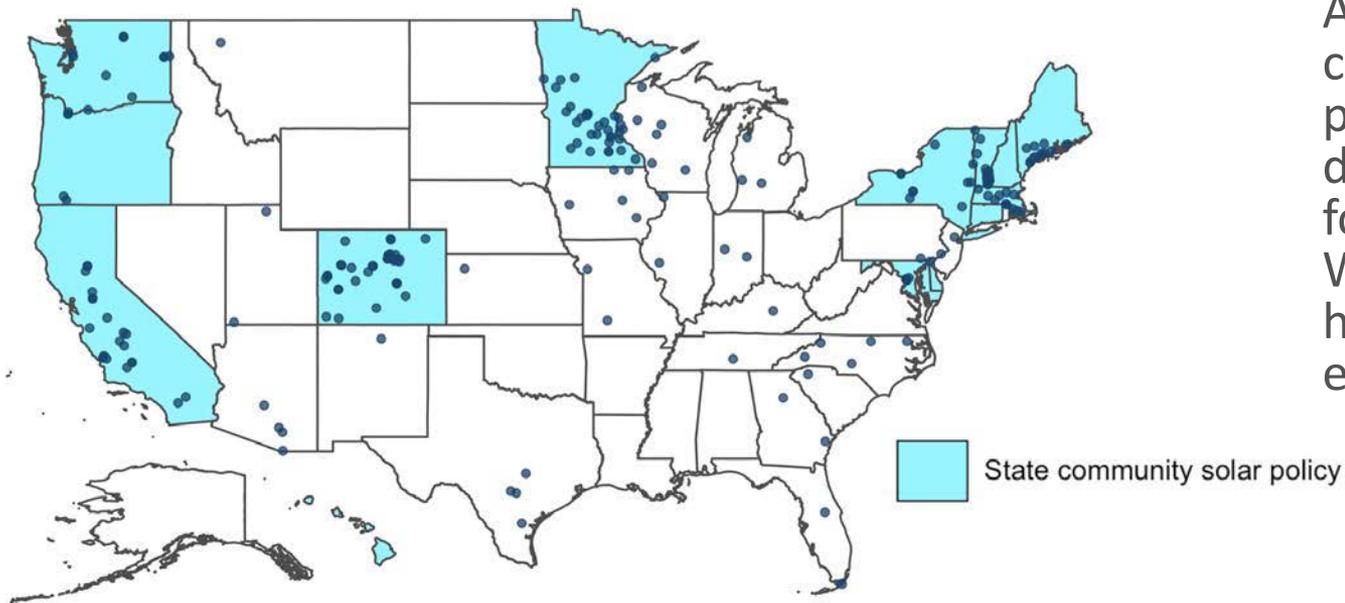


Community solar sales



Community solar participation

The Geography of Community Solar

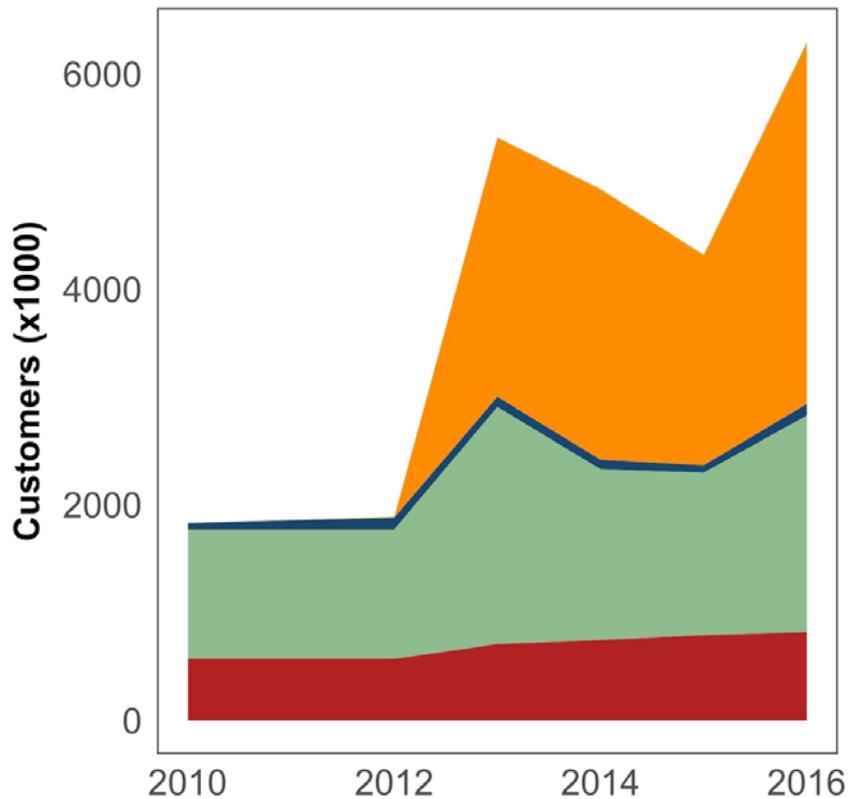
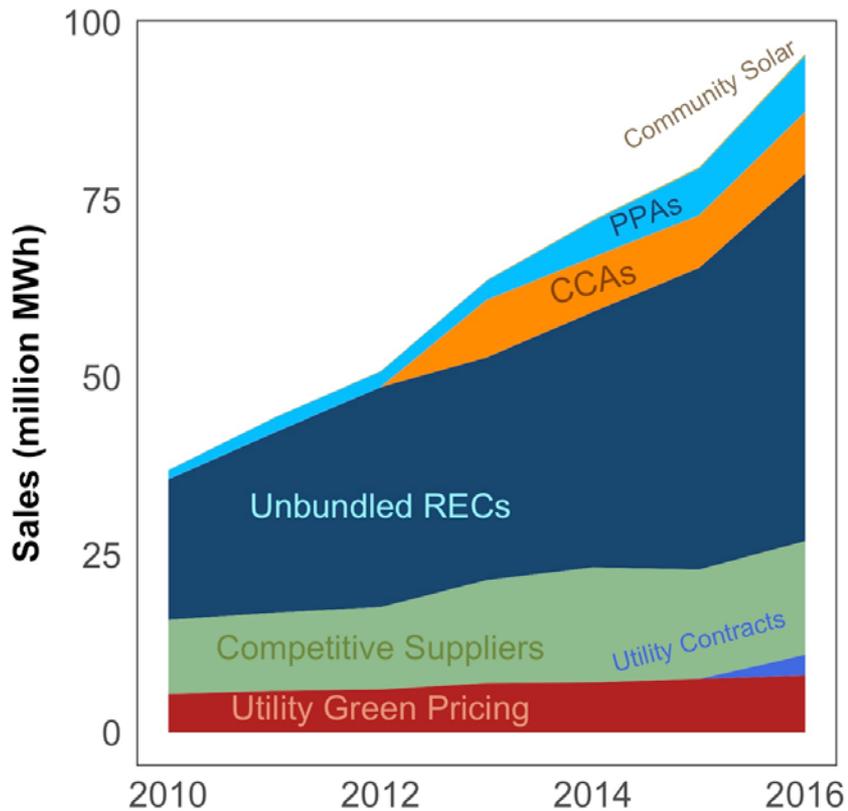


About 77% of community solar projects have been developed in the fourteen states and Washington, DC that have community solar-enabling legislation.

Community Solar Projects and State Policies

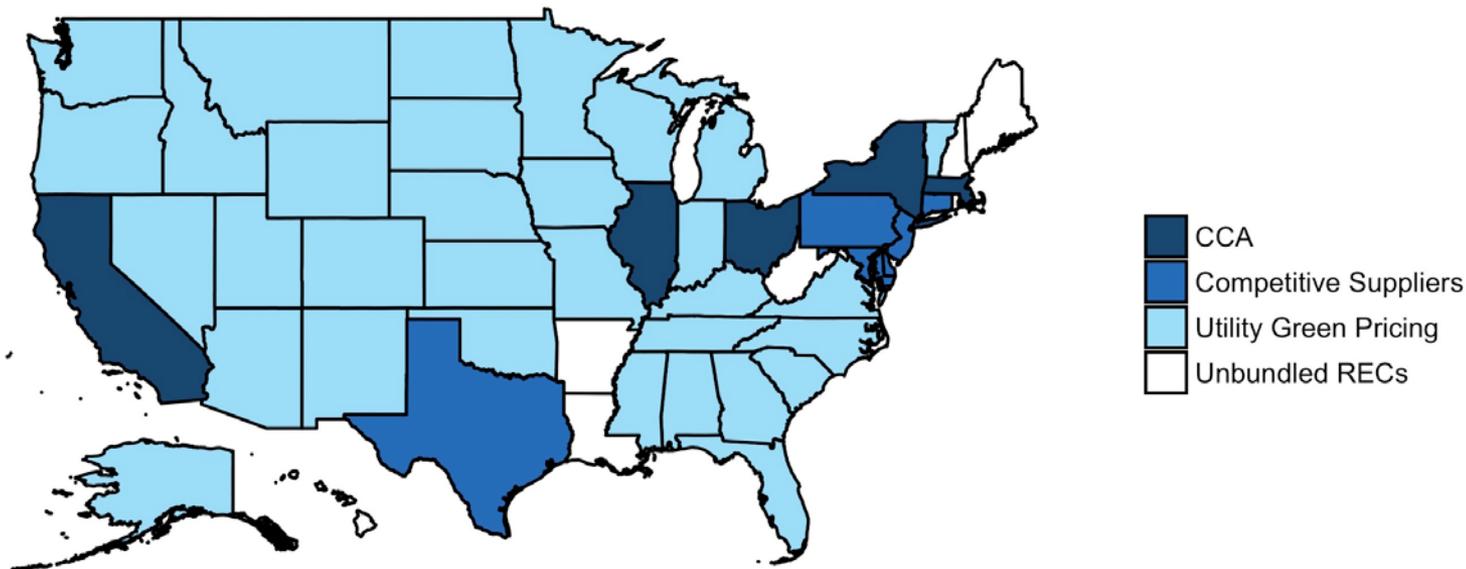
Market Trends

Green Power Sales and Customers by Mechanism



The Geography of Green Power

The Geography of Green Power Mechanisms

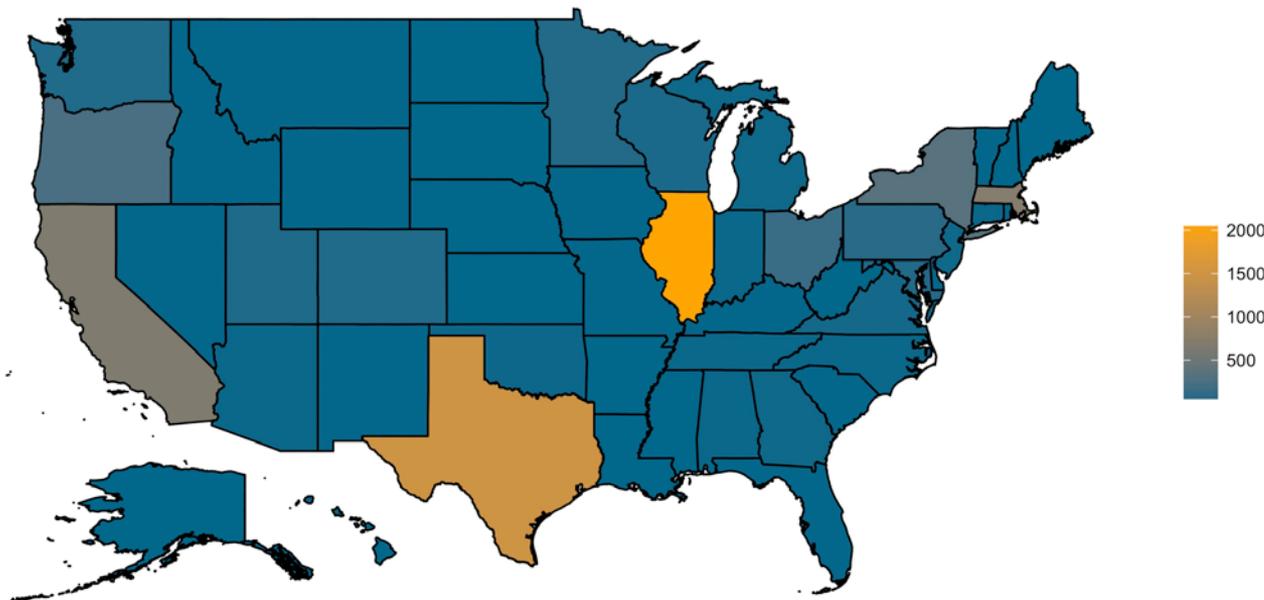


Primary green power market mechanism by # of customers by state

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

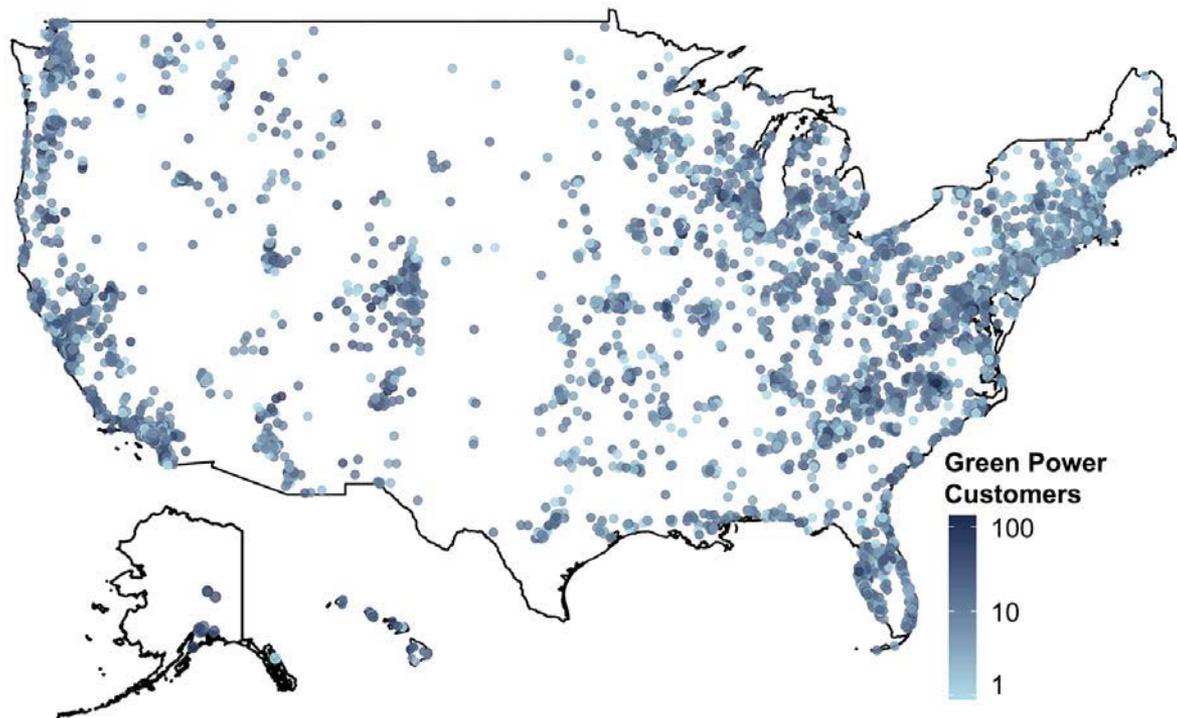
Green Power Demand (x1000 Customers)



Number of green power customers by state

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.

The Geography of Green Power Demand



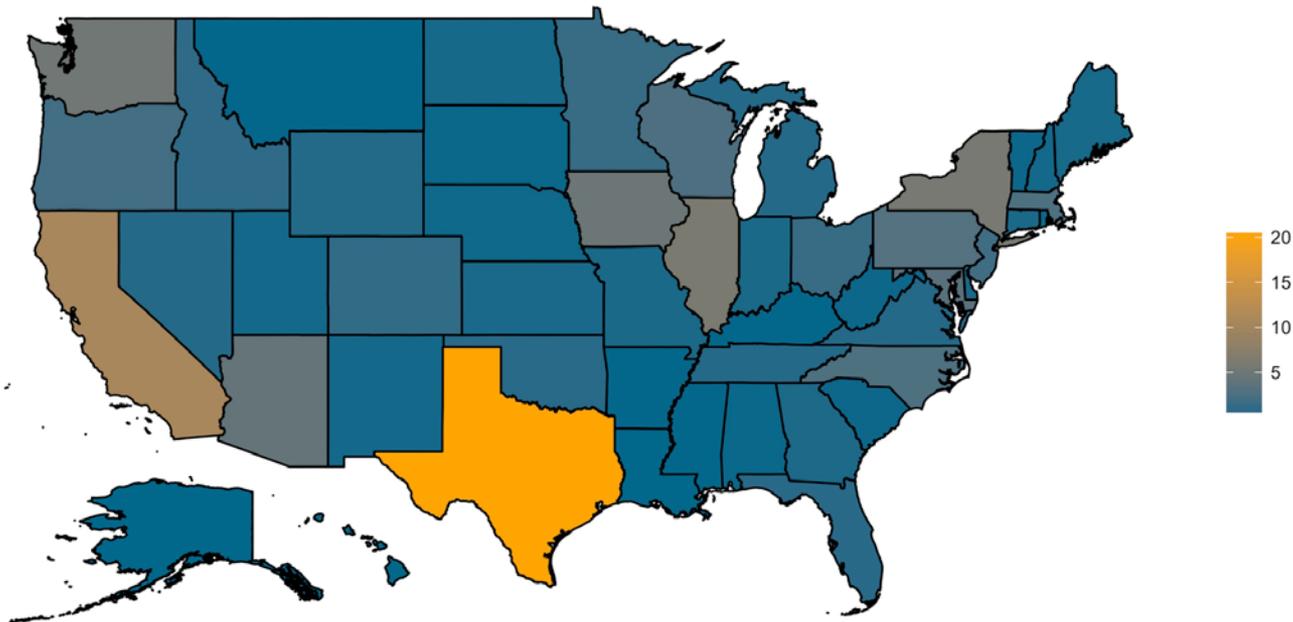
Green power demand is ubiquitous. Demand tends to be higher around large metropolitan areas, but green power demand extends to rural areas.

Representative sample of green power customers by zip code

Figure based on data provided by online energy services platform Arcadia Power

The Geography of Green Power Supply

Green Power State of Origin (million MWh)



Green power generation (million MWh) by state

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.

Reference

O'Shaughnessy, E., J. Heeter, J. Cook, and C. Volpi. 2017. *Status and Trends in the U.S. Voluntary Green Power Market (2016 Data)*. NREL/TP-6A20-70174.

Available at:

<https://www.nrel.gov/docs/fy18osti/70174.pdf>.

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