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NATIONAL RENEWABLE ENERGY LABORATORY





State of the Voluntary Green Power Market (2015 Data)

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January 25, 2017

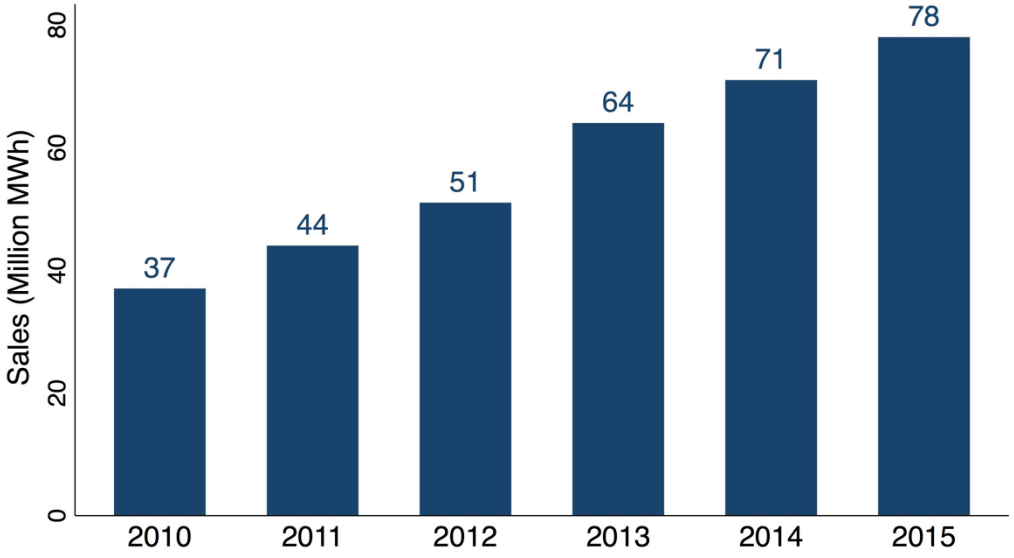
EPA State of the Market Webinar

Outline

- The big picture
- Utility programs
- Competitive suppliers
- Unbundled RECs
- Community choice aggregation
- Power purchase agreements
- Community solar

The Big Picture

In 2015, about **4.3 million customers** procured about **78 million MWh** of renewable energy through green power markets.



Total green power sales 2010-2015 (million MWh)

That represents about:

2%

of U.S. retail electricity sales

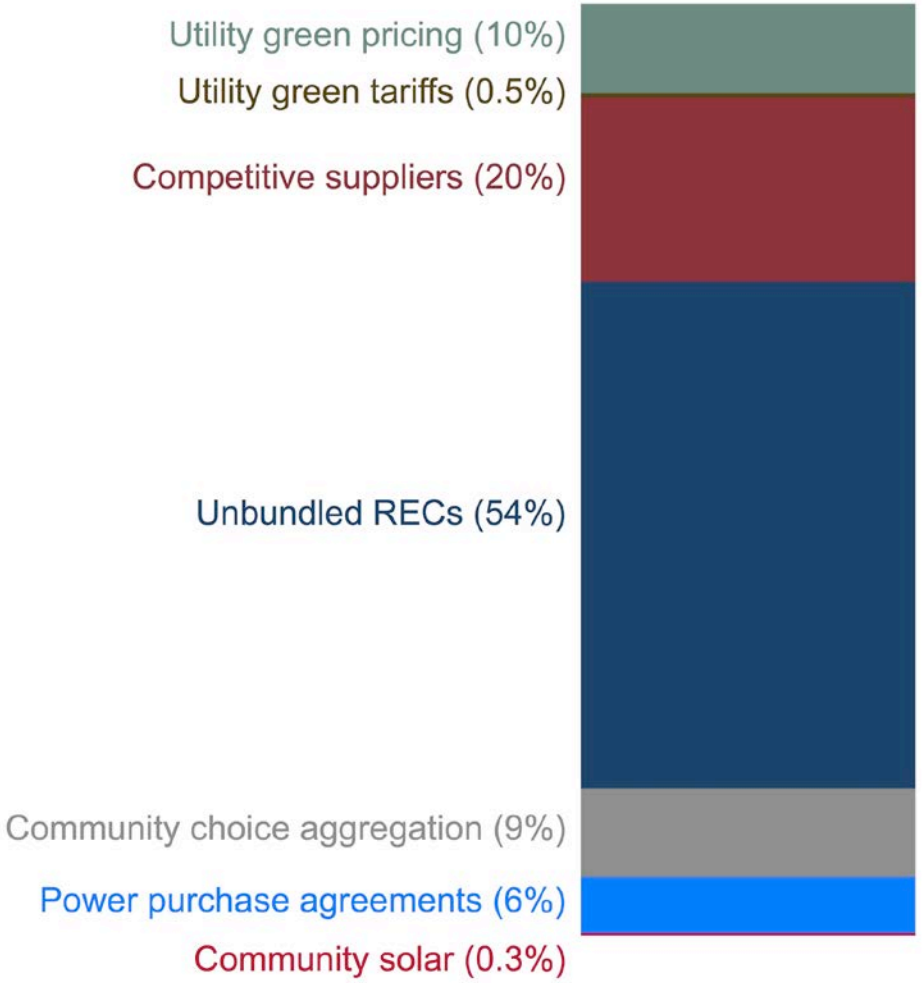
19%

of U.S. non-hydro renewable energy generation

Source: O'Shaughnessy, Liu, and Heeter (2016)

The Big Picture

- Unbundled RECs comprise about half of the market (in terms of sales)
- Utility green pricing and competitive supplier sales comprise about another third
- Voluntary PPAs and community solar remain relatively small, but are growing quickly



Share of Green Power Sales (MWh) by Green Power Option

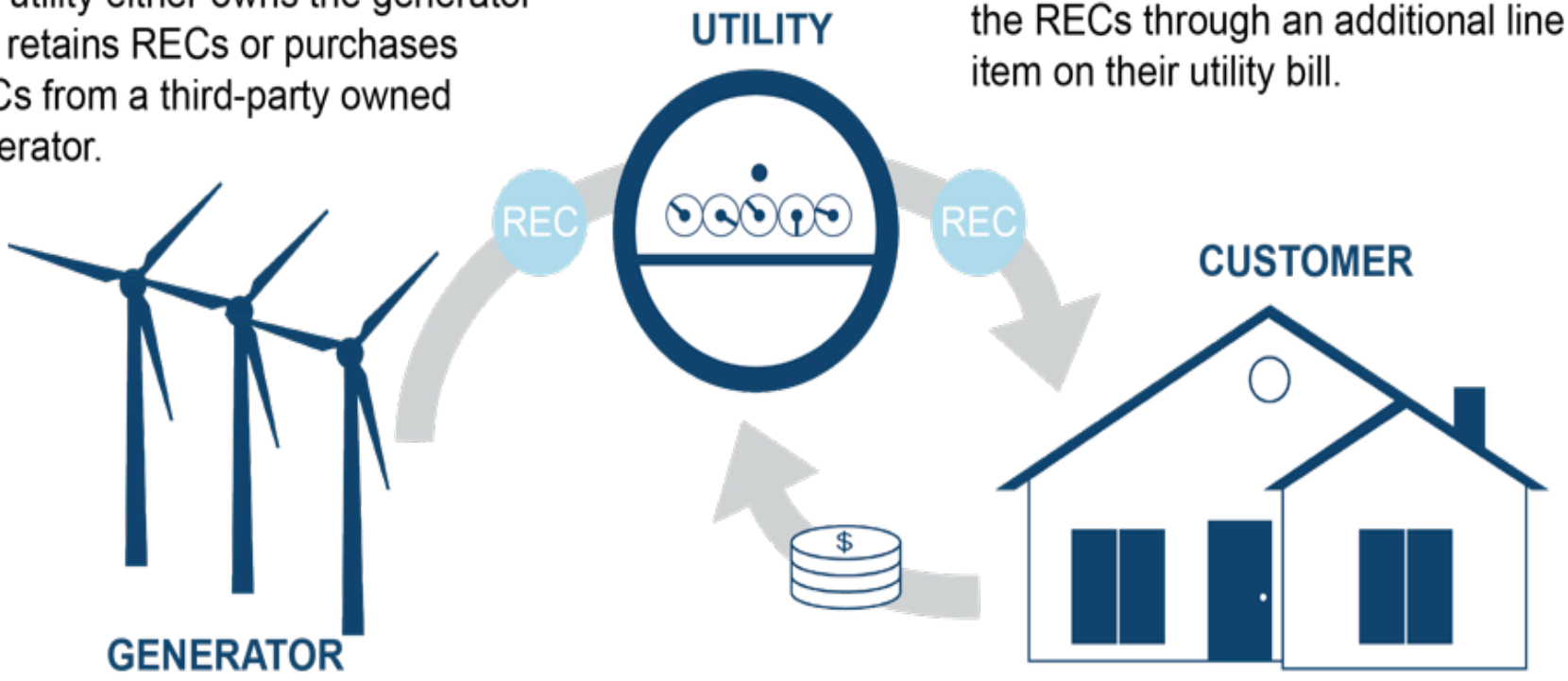
Source: O'Shaughnessy, Liu, and Heeter (2016)

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.

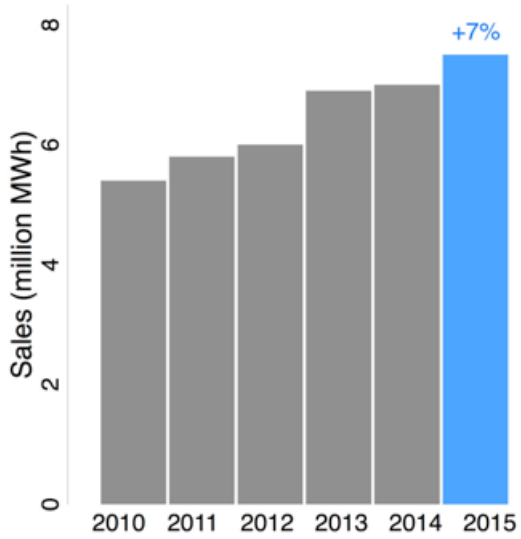


Basic utility green pricing program structure

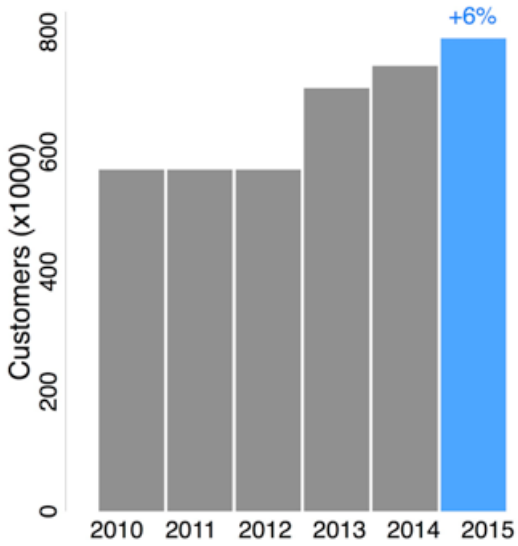
Specific program structures vary

Utility Green Pricing Trends

About **789,000 customers** procured about **7.5 million MWh** of renewable energy through utility green pricing programs in 2015. Utility green pricing sales grew by about 7% from 2014 to 2015.



Utility green pricing sales

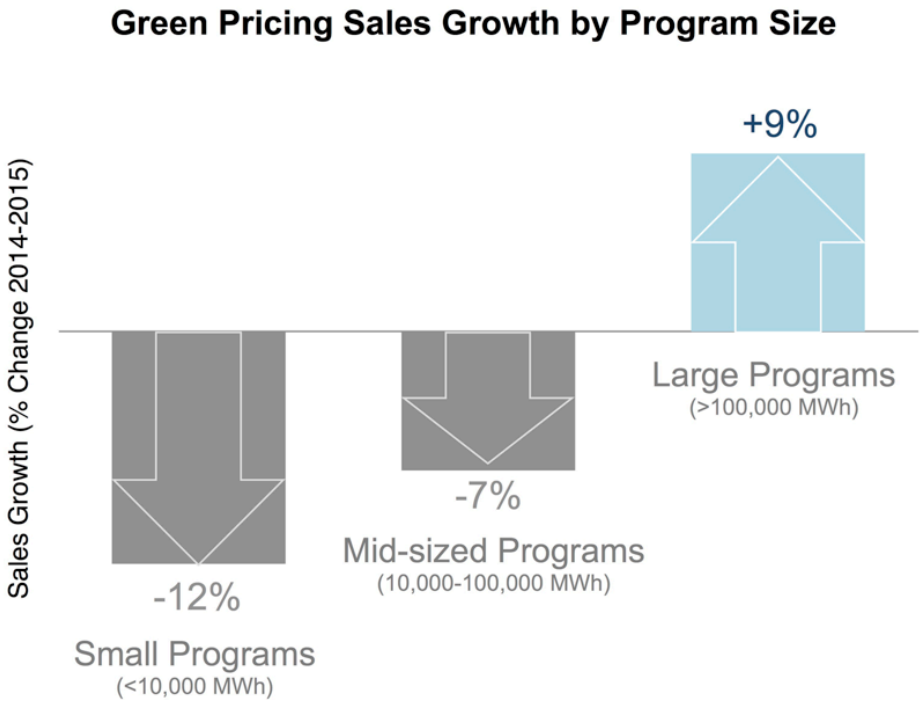


Utility green pricing participation

Source: O'Shaughnessy, Liu, and Heeter (2016)

Growth is Driven by Large Successful Programs

- The ten largest programs accounted for more than two-thirds of sales in 2015
- Large programs have shown strong growth, but sales declined for most programs in 2015



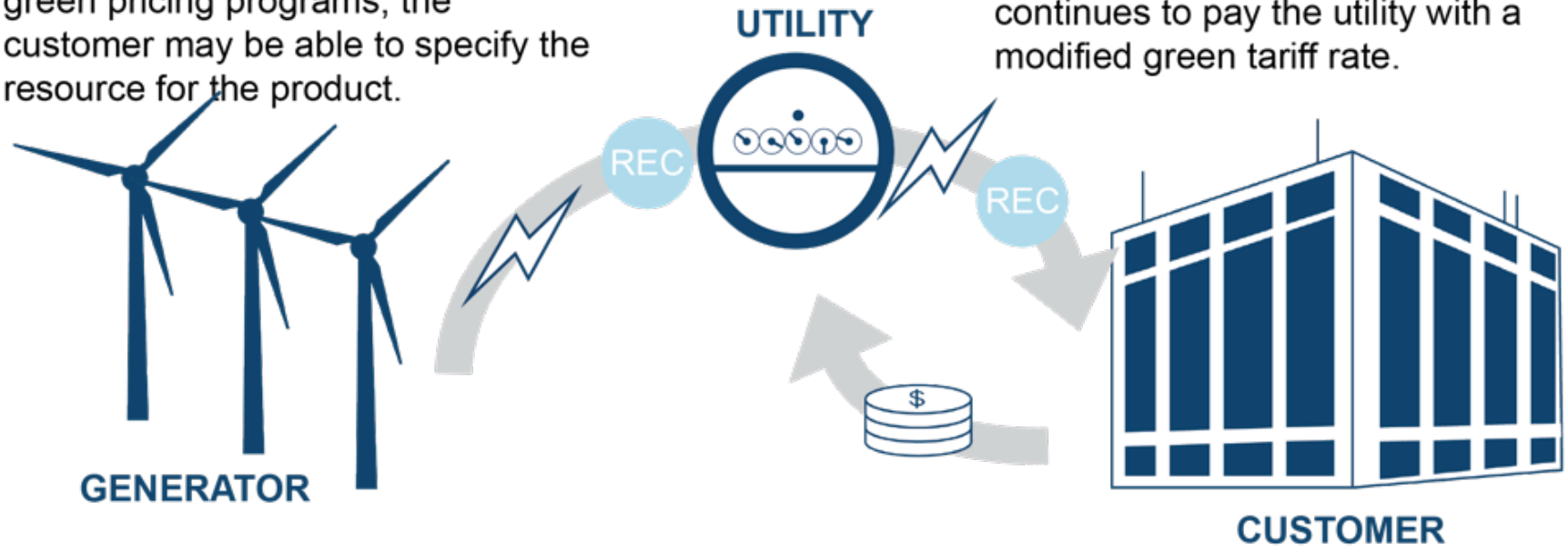
Green pricing sales trends by program size

Source: O'Shaughnessy, Liu, and Heeter (2016)

Utility Green Tariffs

In a utility green tariff program, the customer negotiates 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.

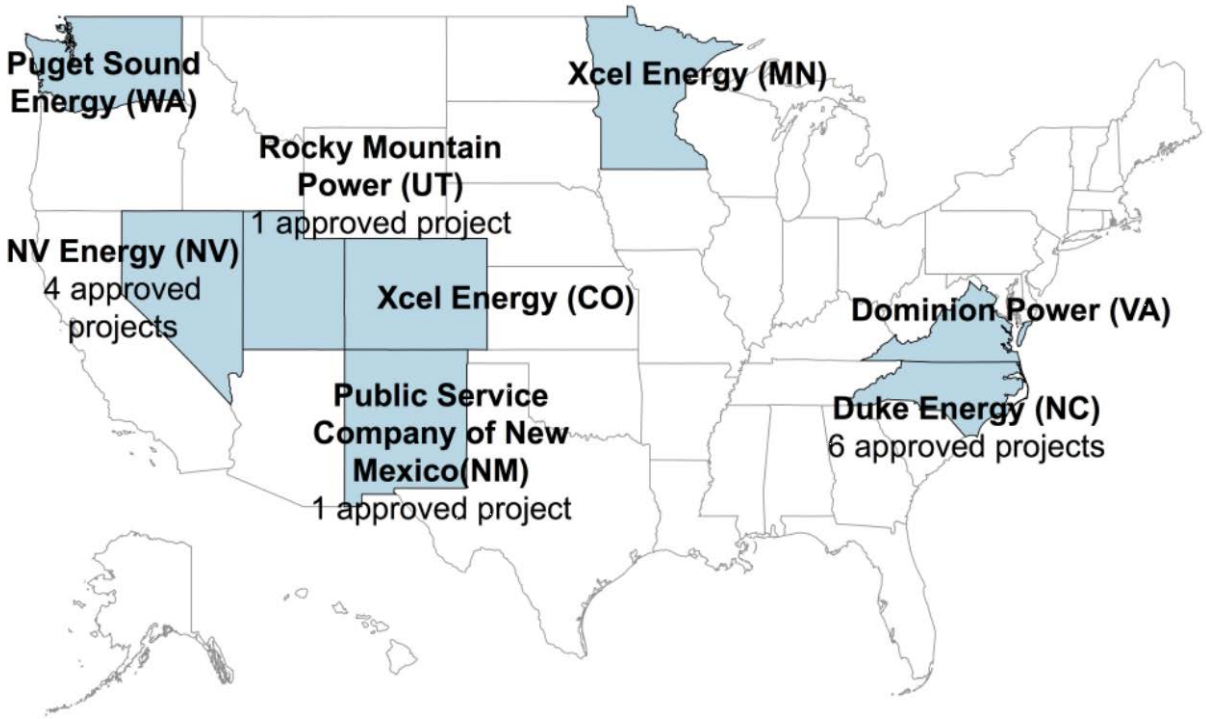
The utility provides the power and RECs to the customer. The customer continues to pay the utility with a modified green tariff rate.



Basic utility green tariff program structure

Specific program structures vary

Green Tariff Programs



Utility Green Tariff Programs

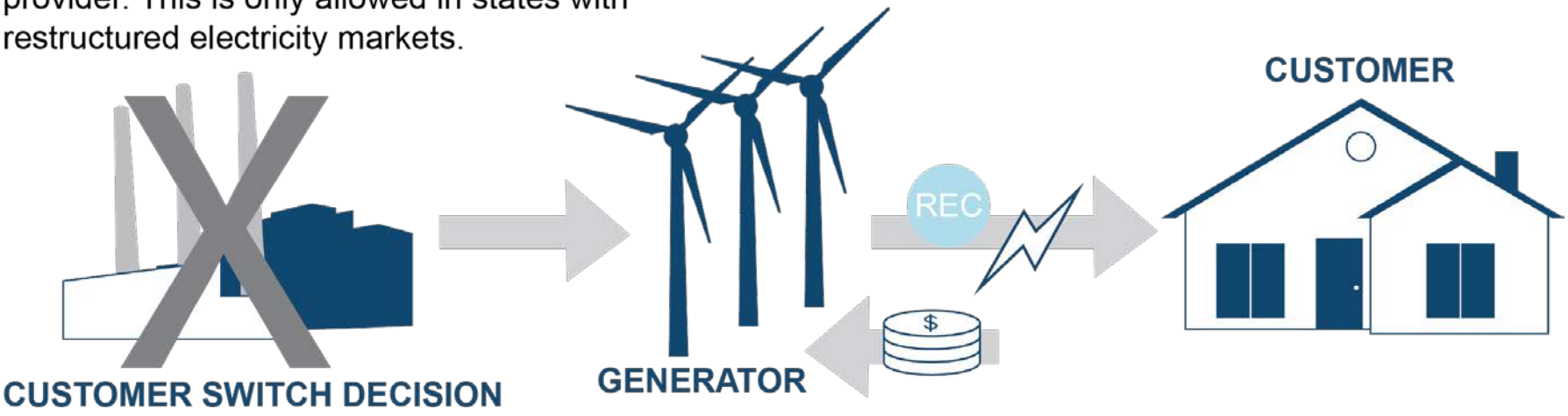
There are currently eight utility green tariff programs. Four programs have approved projects to date

Source: Tawney, L., J. Ryor, P. Barua, B. Baker. 2016. *Emerging Green Tariffs in U.S. Regulated Electricity Markets.* Washington, DC: World Resources Institute. Figure source: O'Shaughnessy, Liu, and Heeter (2016).

Competitive Suppliers

Competitive supplier green power begins with a customer decision to "switch" from their incumbent electricity supplier to an alternative retail electricity supplier that offers a renewable energy product. Customers may also choose to switch to green power products with their current provider. This is only allowed in states with restructured electricity markets.

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.

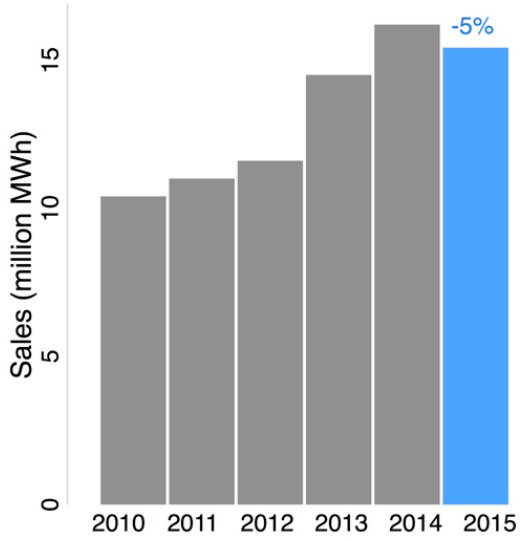


Basic competitive supplier sales structure

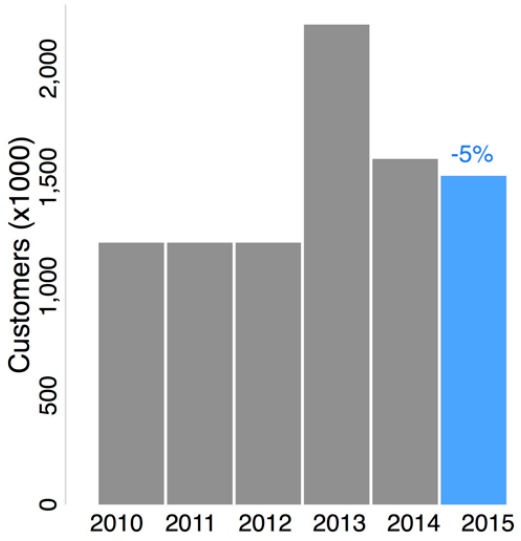
Specific program structures vary

Competitive Supplier Trends

In 2015, about **1.5 million customers** procured about **15 million MWh** of renewable energy through competitive suppliers. Stable sales in recent years may reflect stable U.S. retail electricity sales overall.



Competitive supplier sales



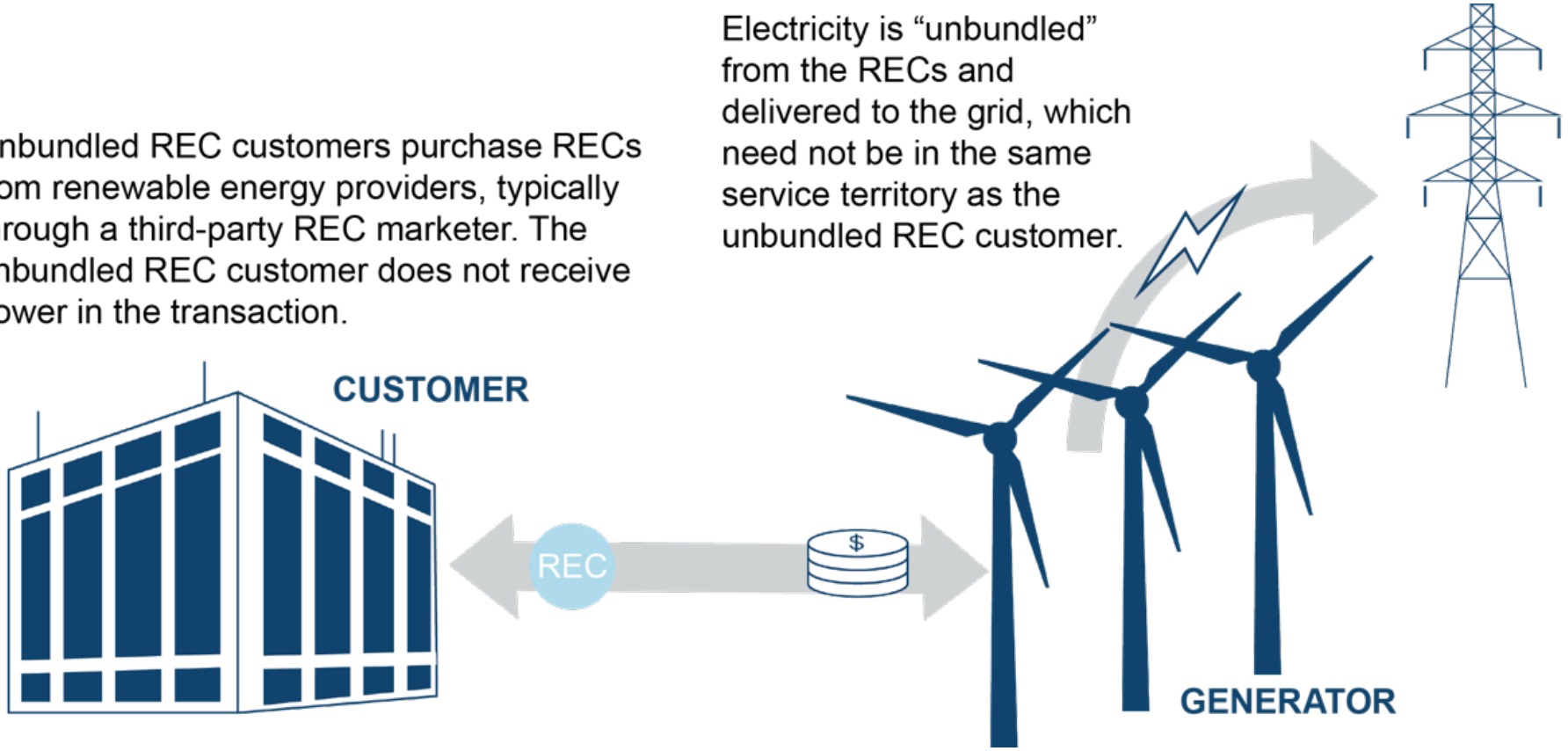
Competitive supplier participation

Source: O'Shaughnessy, Liu, and Heeter (2016)

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.

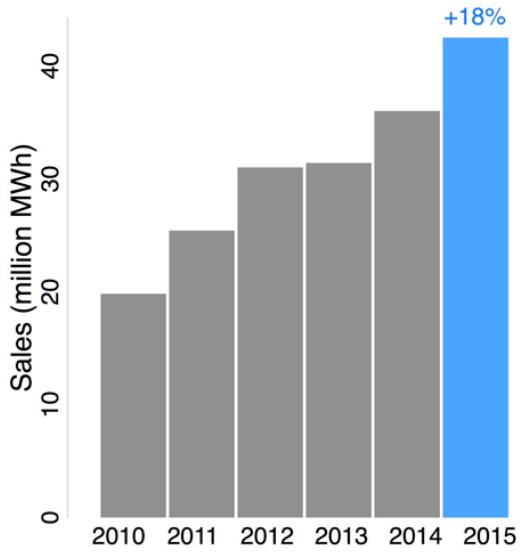


Basic unbundled RECs sales structure

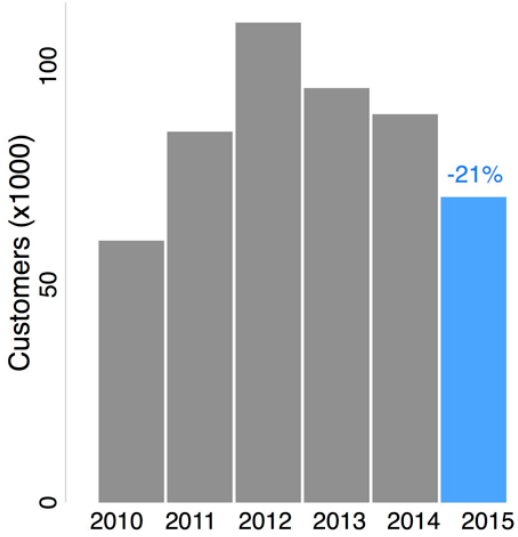
Specific program structures vary

Unbundled RECs Trends

About **70,000 customers** procured about **42 million MWh** of renewable energy through unbundled RECs in 2015. Unbundled RECs sales now comprise more than half of all green power sales.



Unbundled RECs sales

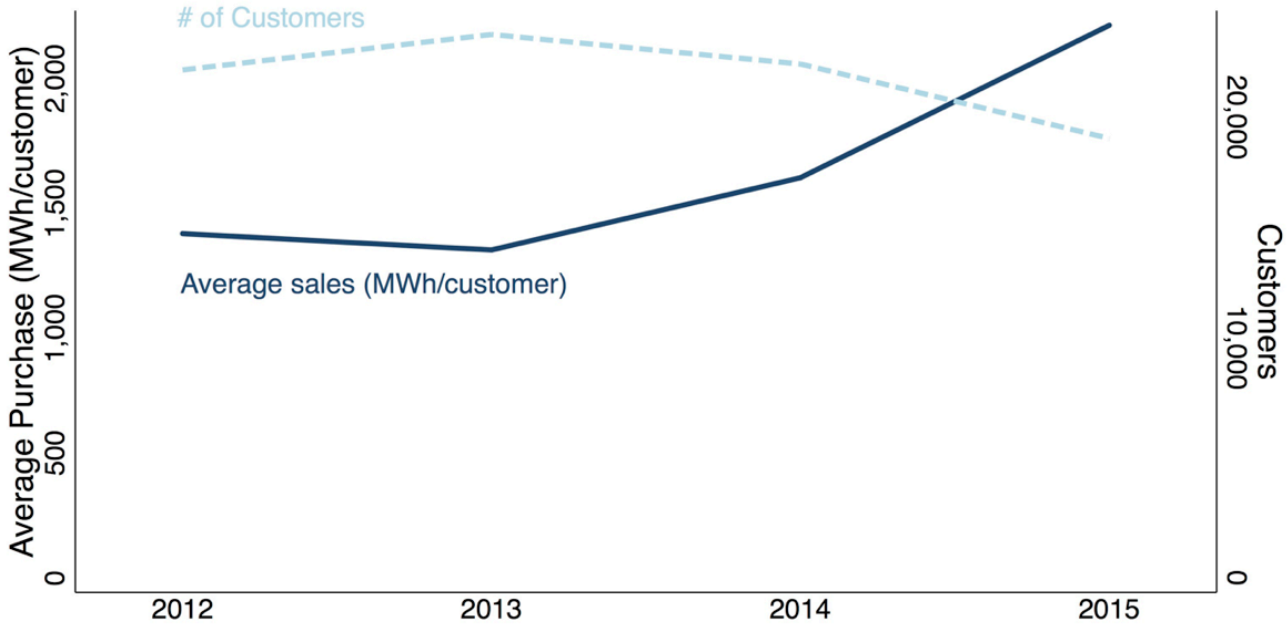


Unbundled RECs participation

Source: O'Shaughnessy, Liu, and Heeter (2016)

Customers are Making Larger Purchases

Growing unbundled RECs sales are attributable to large non-residential customers making larger purchases, even as the number of customers declines



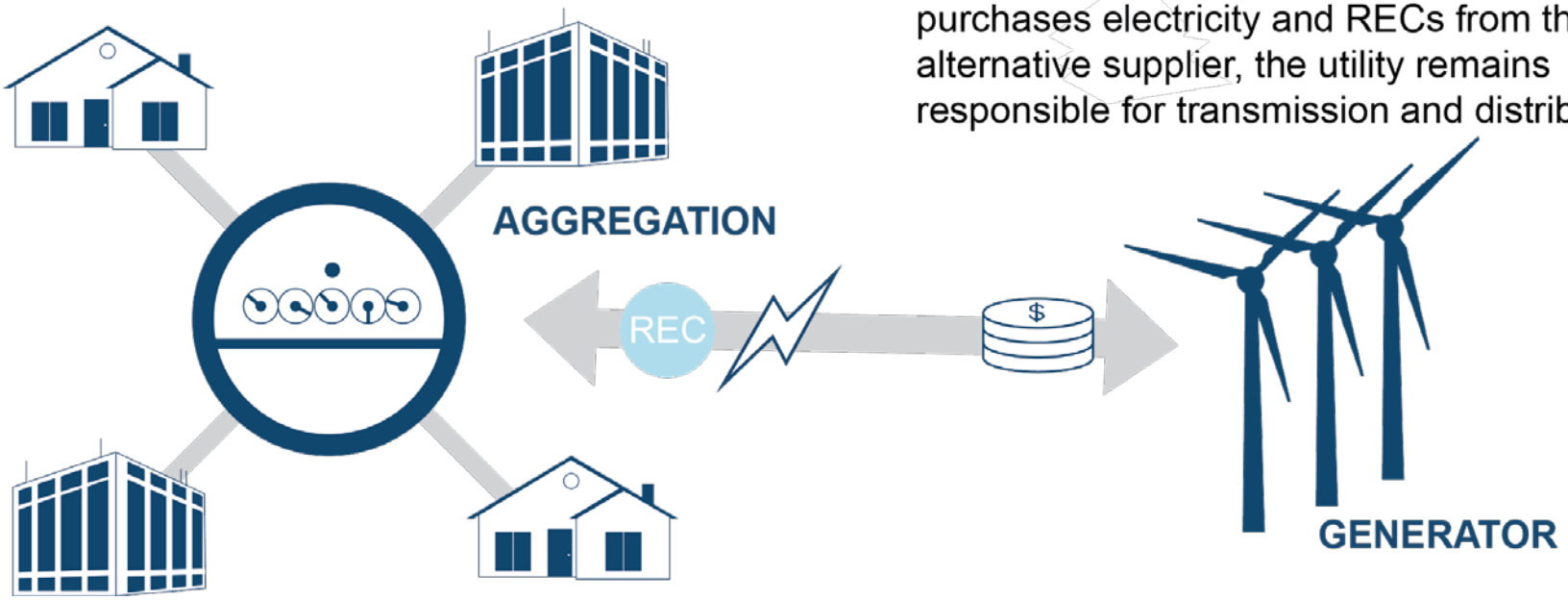
Unbundled RECs Non-Residential Participation and Average Sales 2012-2015

Source: O'Shaughnessy, Liu, and Heeter (2016)

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

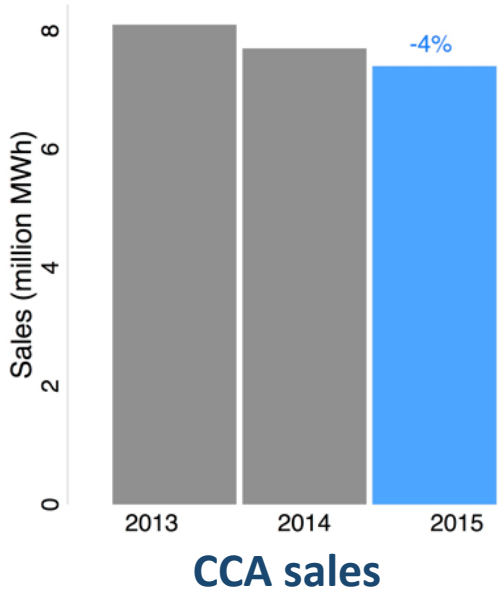


Basic CCA structure

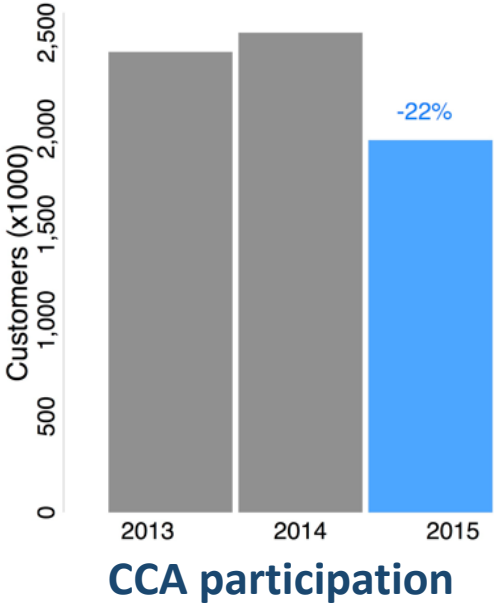
Specific program structures vary

CCA Trends

About **1.9 million customers** procured about **7.4 million MWh** of renewable energy through CCAs in 2015. Recent reductions in sales are due to dynamics in Illinois, currently the largest CCA market. But CCA sales are growing in California.



CCA sales

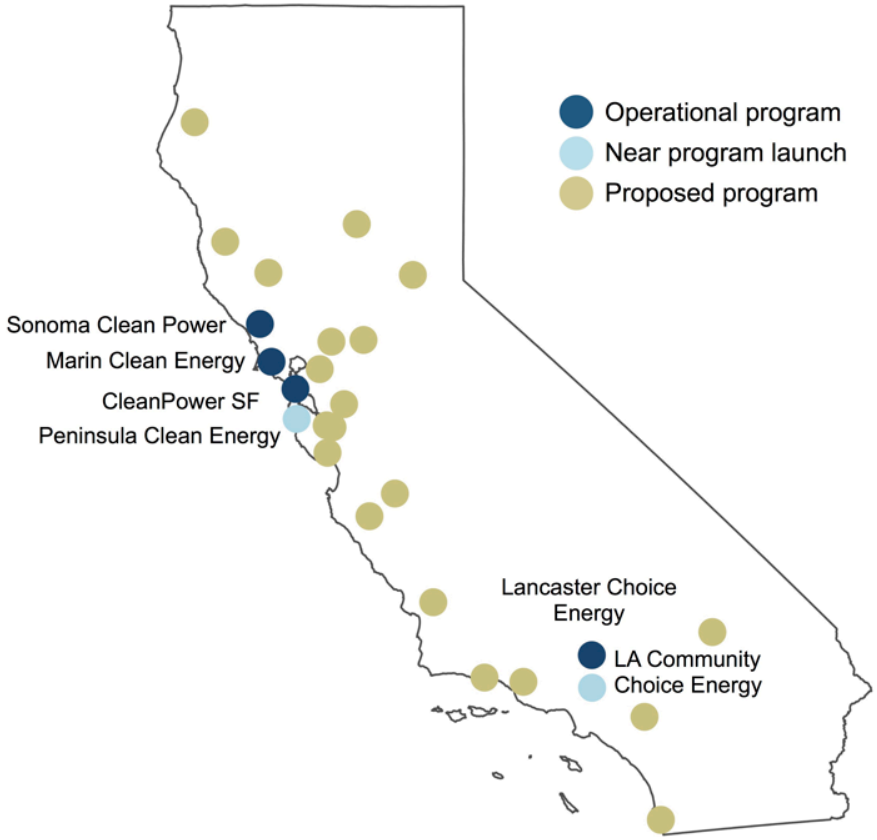


CCA participation

Source: O'Shaughnessy, Liu, and Heeter (2016)

Expansion of CCAs in California

- About 370,000 customers procured about 1.7 million MWh of renewable energy through 3 CCAs in California in 2015
- At least 20 other California jurisdictions have proposed CCAs

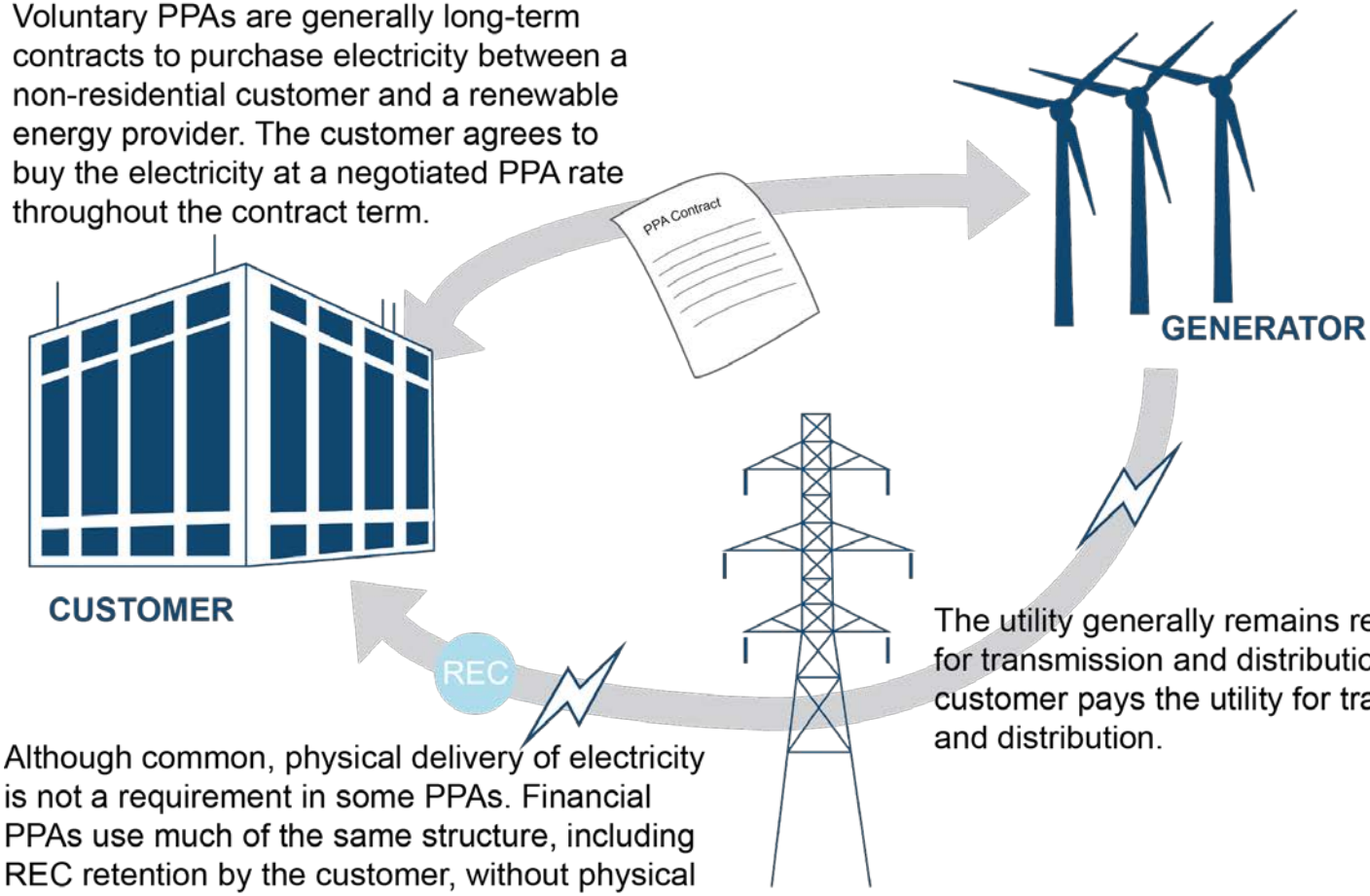


Active and Proposed CCAs in California

Source: O'Shaughnessy, Liu, and Heeter (2016)

Power Purchase Agreements

Voluntary 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.

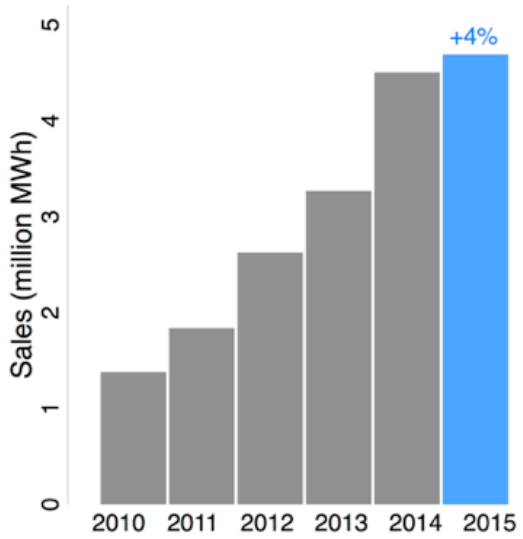


Basic PPA structure

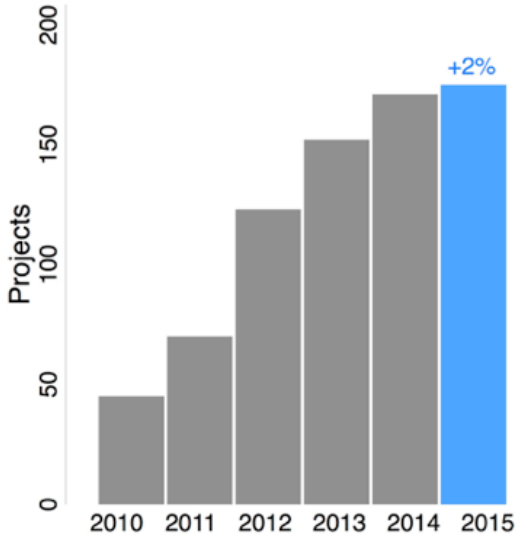
Specific program structures vary. See full report for a more complete description of the differences between physical and financial PPAs

PPA Trends

About **4.7 million MWh** of renewable energy were procured through **175 PPAs** in 2015. About 10 MWh of additional renewable energy generation is in the PPA project pipeline.



PPA sales

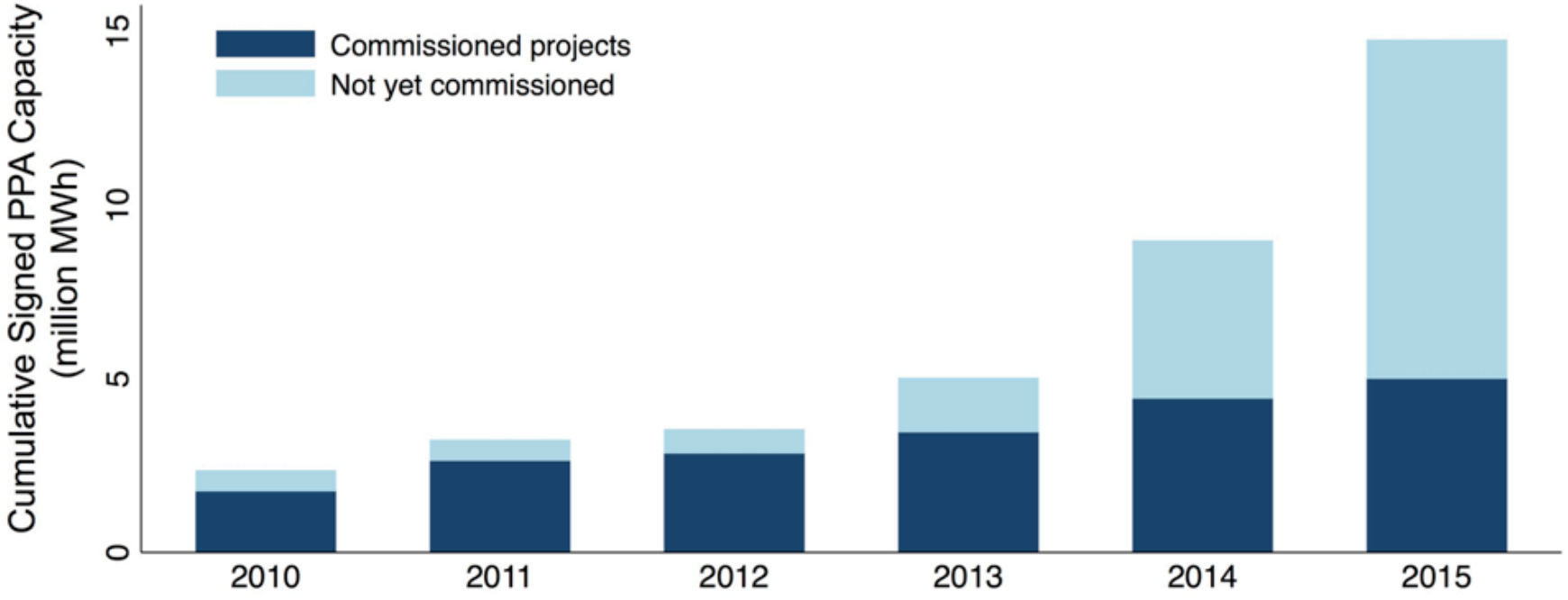


PPA participation

Source: O'Shaughnessy, Liu, and Heeter (2016)

The PPA Project Pipeline is Burgeoning

For PPAs signed as of the end of 2015, about 5 million MWh of annual generation capacity had actually been commissioned, an additional 10 million MWh was in the growing project pipeline.

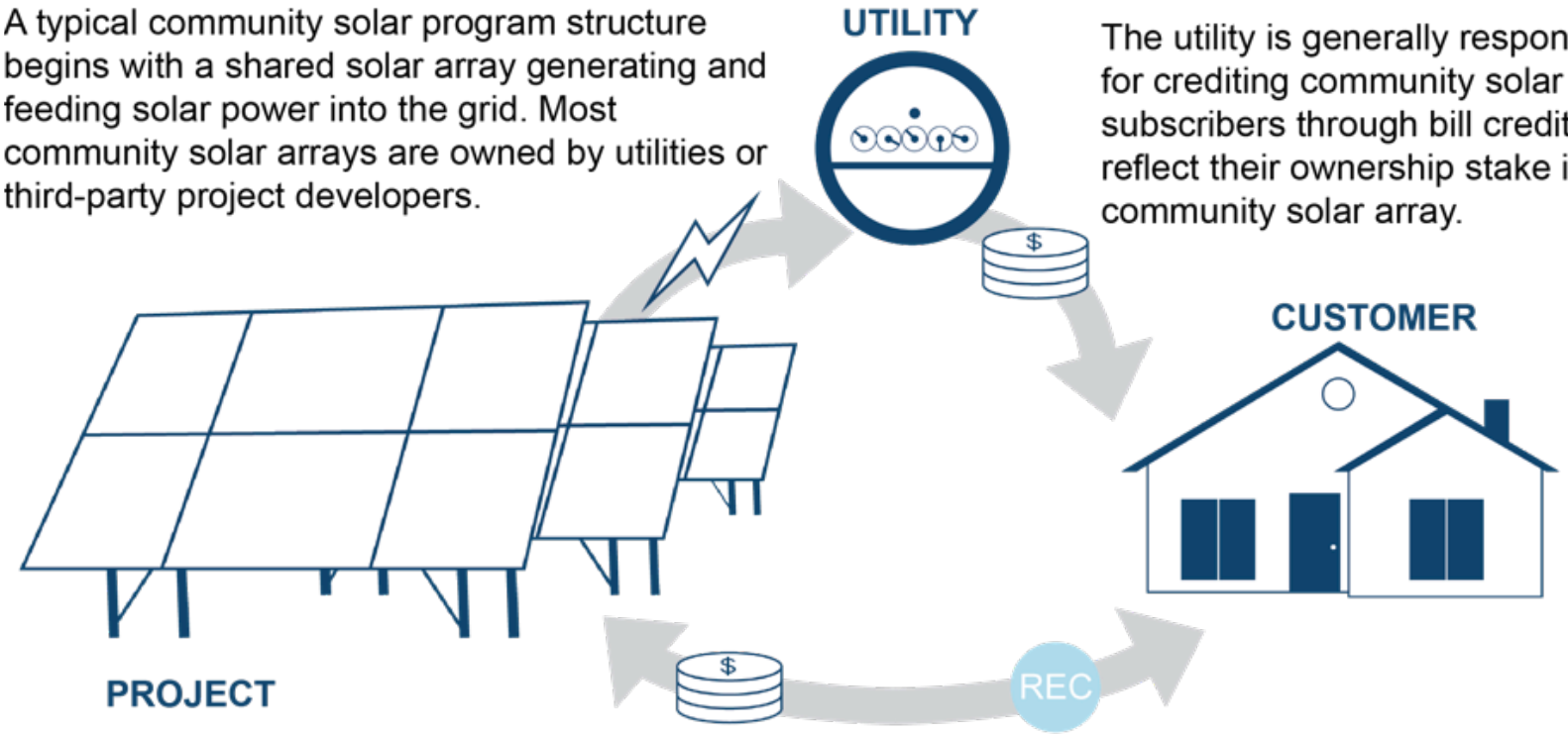


Signed Voluntary PPA Generation Capacity (MWh)

Source: O'Shaughnessy, Liu, and Heeter (2016)

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.

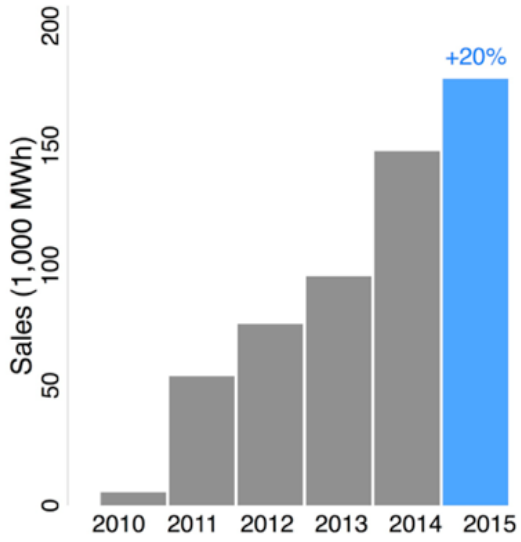
Community solar subscribers generally pay for their subscription through up-front purchases of capacity (kW) or output (kWh). In return, the subscribers receive bill credits and, in some cases, RECs. However subscribers do not commonly receive the RECs, in which case their subscription is not a green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

Basic community solar program structure

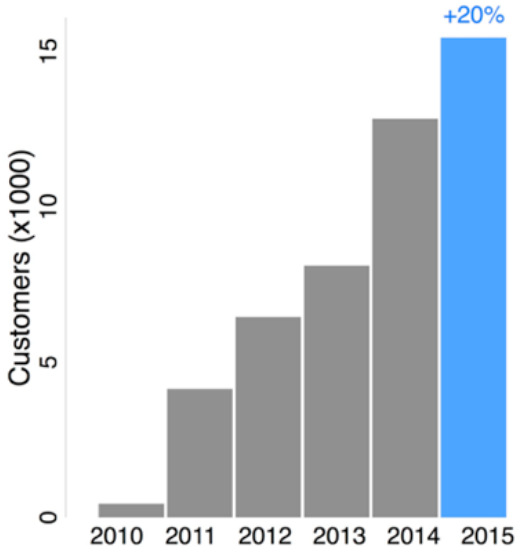
Specific program structures vary

Community Solar Trends

About **15,000 customers** subscribed to about **180,000 MWh** of community solar output in 2015. However it is unclear how many of these customers procured renewable energy (i.e., had RECs retired on their behalf)



Community solar sales

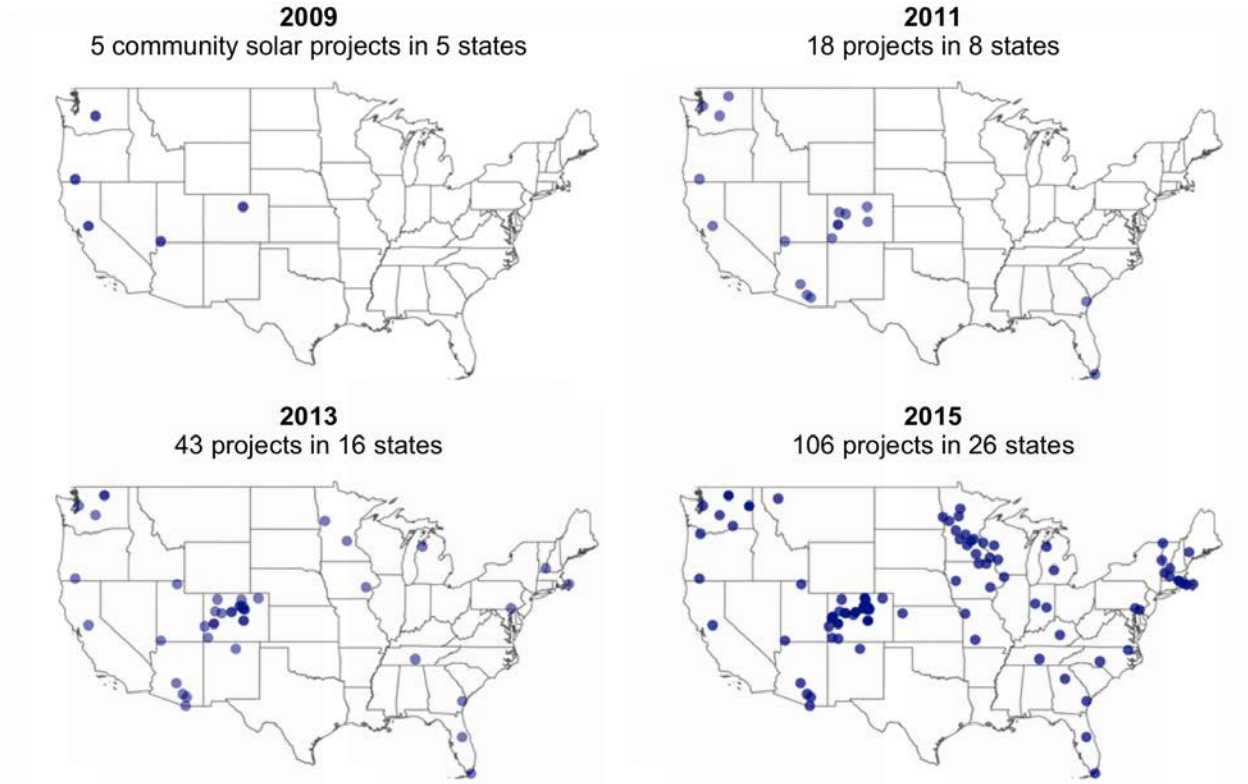


Community solar participation

Source: O'Shaughnessy, Liu, and Heeter (2016)

The Expansion of Community Solar

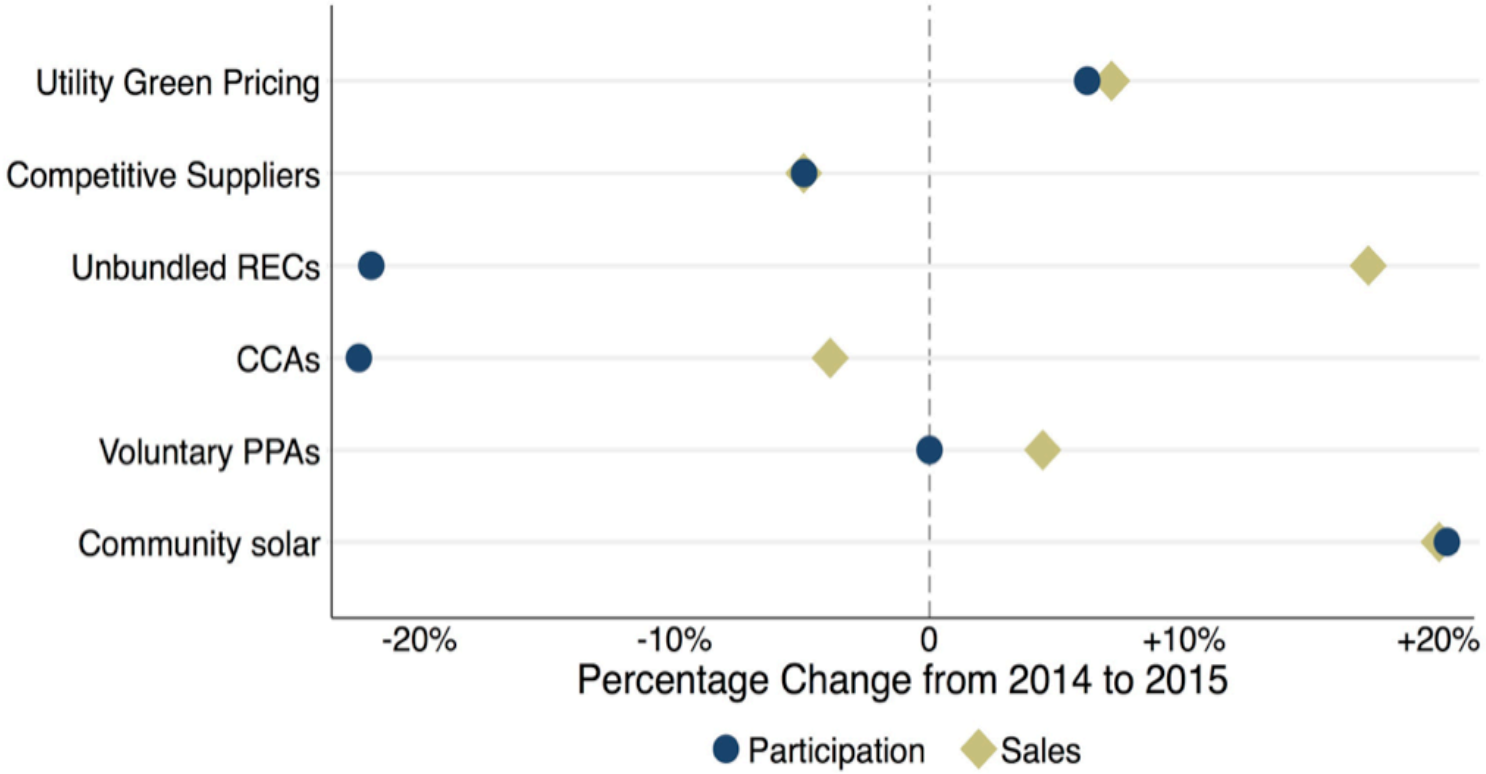
Community solar programs have expanded into more than half of U.S. states, though **most projects do not sell green power** (RECs are not retired on behalf of customers)



The Geographic Expansion of Community Solar Projects

Source: O'Shaughnessy, Liu, and Heeter (2016)

Looking Forward

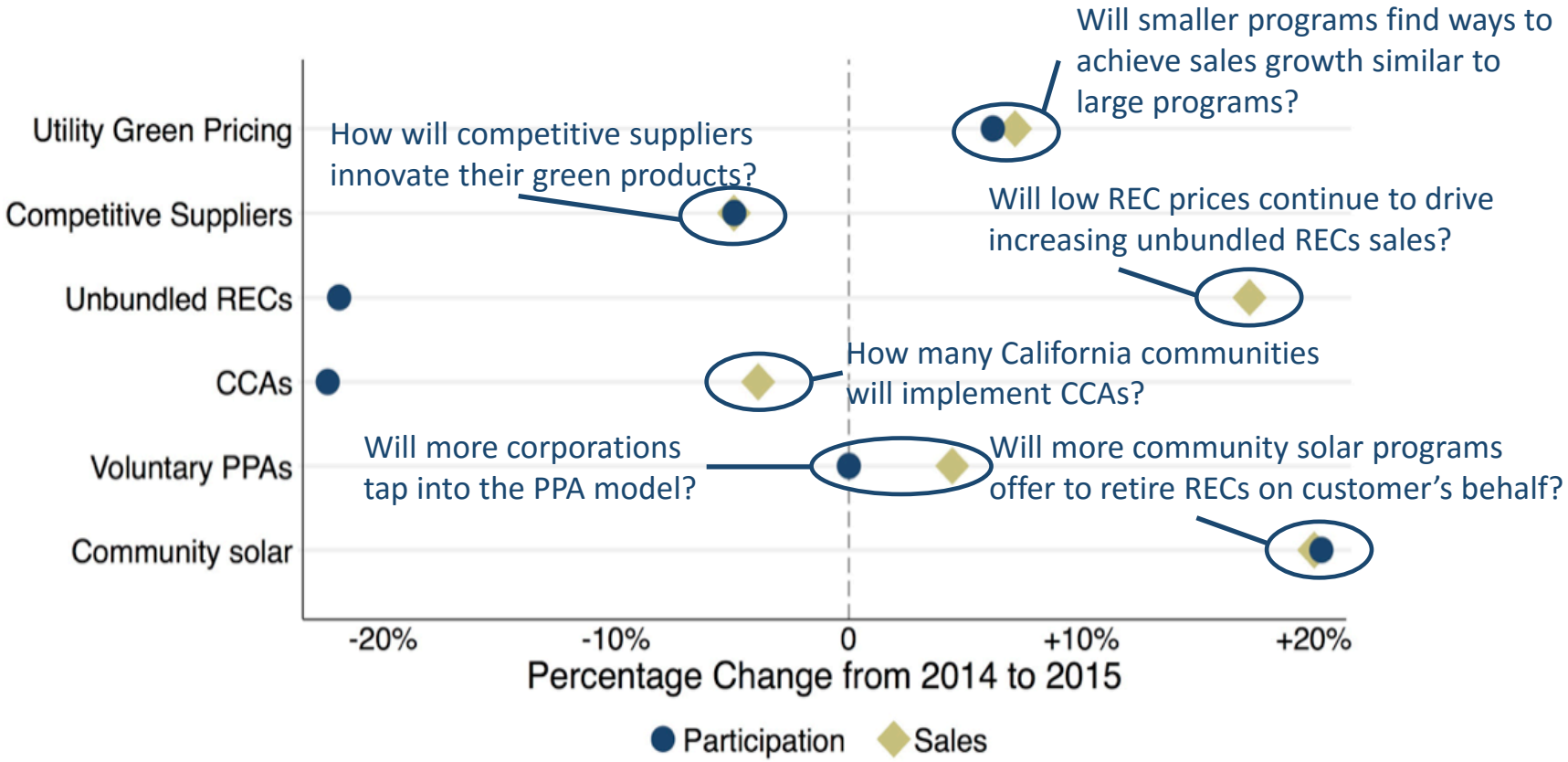


Percentage Change in Customer Participation and Sales from 2014 to 2015 by Green Power Market

Points to the left of the dashed line indicate reductions, points to the right indicate increases

Source: O'Shaughnessy, Liu, and Heeter (2016)

Looking Forward



Percentage Change in Customer Participation and Sales from 2014 to 2015 by Green Power Market

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Source: O'Shaughnessy, Liu, and Heeter (2016)

More information

- See the full “Status and Trends in the Voluntary Green Power Market” report at: http://www.nrel.gov/docs/fy17osti/67147.pdf

Thank you!

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