Status and Trends in the U.S. Voluntary Green Power Market (2015 Data)

Eric O'Shaughnessy, Chang Liu, and Jenny Heeter
National Renewable Energy Laboratory

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Technical Report
NREL/TP-6A20-67147
October 2016

Contract No. DE-AC36-08GO28308

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Prepared under Task No. SA15.0900

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List of Acronyms

CCA	community choice aggregation
CPUC	California Public Utilities Commission
EIA	Energy Information Administration
ERCOT	Electric Reliability Council of Texas
GSA	General Services Administration
GTSR	Green Tariff Shared Renewables Program
GWh	gigawatt-hour
ICT	information and communication technology
IOU	investor-owned utility
kW	kilowatt
kWh	kilowatt-hour
LACCE	Los Angeles Community Choice Energy
MW	megawatt
MWh	megawatt-hour
NREL	National Renewable Energy Laboratory
PCE	Peninsula Clean Energy
PGE	Portland General Electric
PG&E	Pacific Gas and Electric
PPA	power purchase agreement
PUC	Public Utilities Commission
REC	renewable energy certificate
RPS	renewable portfolio standard
SREC	solar renewable energy certificate

Executive Summary

The voluntary green power market refers to the sale and procurement of renewable energy for voluntary purposes by residential and commercial customers. The voluntary green power market, for the purposes of this report, encompasses seven green power procurement mechanisms: utility green pricing programs, utility green tariffs, voluntary unbundled renewable energy certificates (RECs), competitive supplier green power, community choice aggregations (CCAs), voluntary power purchase agreements (PPAs), and community solar.

The seven green power procurement mechanisms analyzed in this report showed various degrees of growth and stability from 2014 to 2015. Figure ES-1 illustrates percentage changes in green power participation and sales from 2014 to 2015. Points to the right of the dashed line at zero represent increases from 2014 to 2015. Utility green pricing sales grew by 7% in 2015, largely due to the expansion of a few large programs. The number of customers purchasing unbundled RECs fell by about 21%. However increasing average purchase sizes countered the drop in participation and sales of unbundled RECs (in MWh) increased by 18%. Voluntary PPA sales from operational projects grew by 4% in 2015. Contracted green power sales in the PPA project pipeline reached 10.2 million MWh with more than 5 million MWh added in 2015, equating to about 13% of total 2015 green power sales. Community solar continues to grow in terms of both sales and participation at above 10% per year, although the total market remains small.

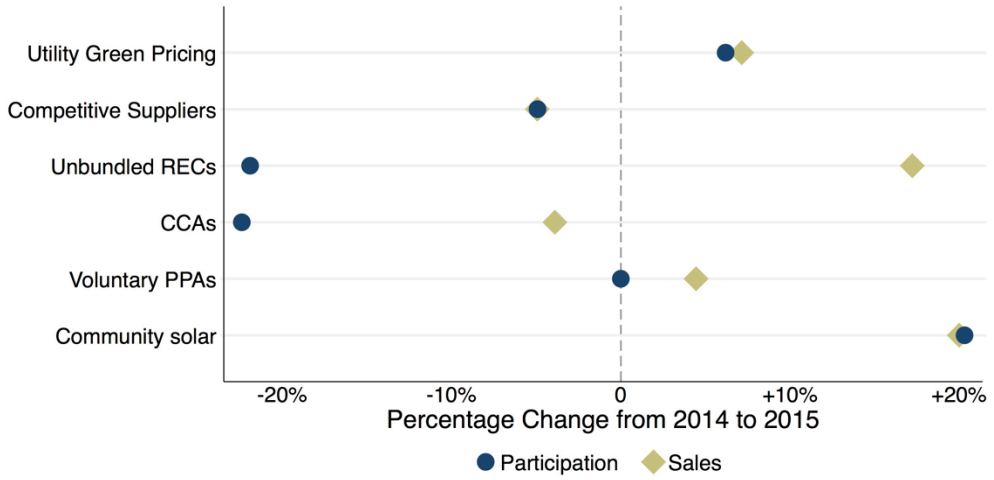

Figure ES-1. Percentage change in green power sales (MWh) and participation (number of customers) by green power mechanism from 2014 to 2015

Note: Utility green tariffs excluded. Utility green tariff programs are a recent phenomenon, with sales and participation only beginning in earnest in 2015.

Historically, the vast majority of green power transactions have been relatively small sales made to residential and small commercial customers. However, large customers have taken on an increasingly prominent role in the green power market in recent years. New green power mechanisms such as voluntary off-site PPAs and utility green tariffs allow large customers to enter into long-term contracts to procure renewable energy. Large customers have demonstrated increasing interest in using voluntary PPAs to achieve multiple corporate goals (e.g., price hedging, corporate sustainability). In response to demand by large customers for green power,

several utilities in regulated electricity markets have developed green tariffs that allow large customers to work with utilities for long-term green power contracts.

Three trends from 2015 and early 2016 suggest that the green power market is likely to continue to grow in the coming years. First, significant growth of the voluntary PPA project pipeline due to contracts signed by large corporate customers equates to built-in increases in future green power sales. Second, several large utilities are developing innovative green power mechanisms such as new utility green pricing, utility green tariff, and community solar products that could increase green power participation. Third, green power continues to expand geographically in terms of mechanisms available to customers in different regions and states. In 2016, California added two new CCAs and New York became the fifth state with a CCA offering a green power product; at least one community solar project is now operational in more than half of U.S. states; and utility green tariffs became available in two more states in 2016. These trends suggest potential for the continued growth of the green power market.

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1 Introduction

Green power refers to the voluntary purchase of renewable electricity. A voluntary purchase is any procurement undertaken by a retail consumer to achieve internal renewable energy or environmental goals. Voluntary purchases are distinguished from wholesale procurement of renewable energy for economic efficiency reasons or to comply with mandatory renewable energy targets imposed by law or regulation. Green power customers substantiate claims about their renewable electricity use by procuring renewable energy certificates (RECs) (Figure 1).[1] A REC represents the renewable energy attributes of one MWh of renewable electricity. A green power purchase may or may not also be bundled with a purchase of the underlying electricity.

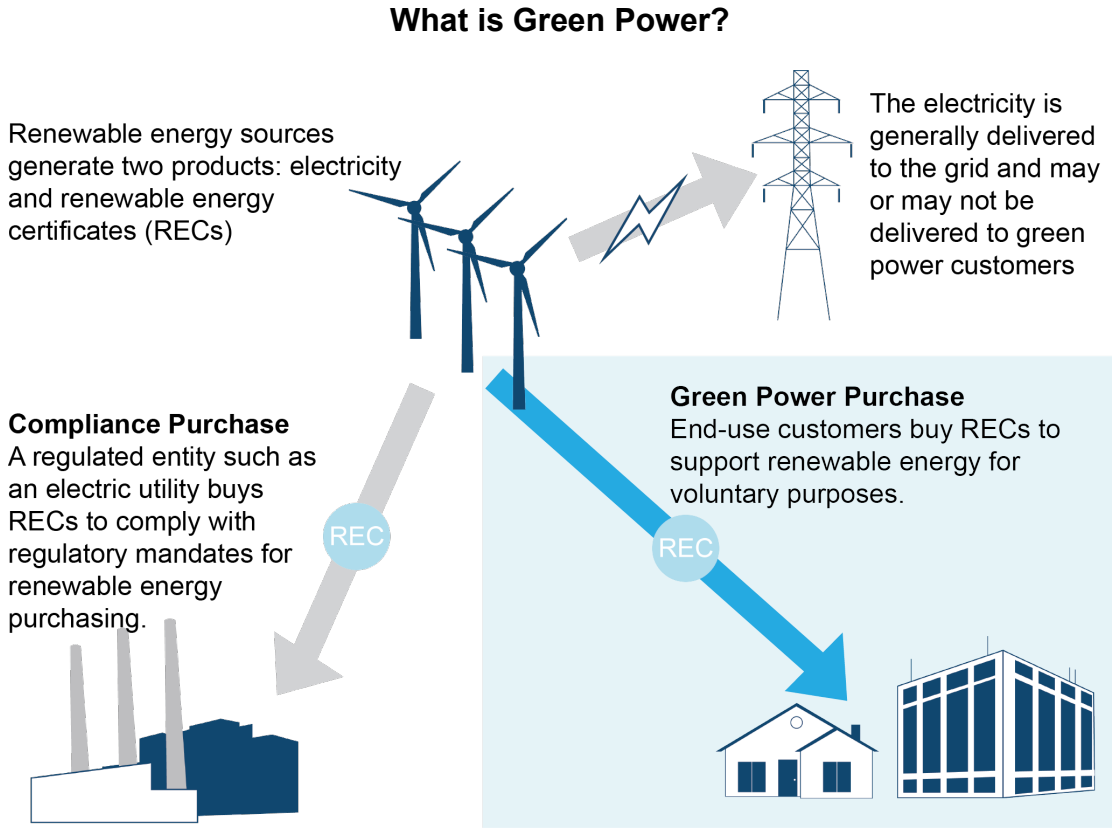

Figure 1. Schematic definition of green power

Green power customers have several options or "mechanisms" through which to buy green power. This report summarizes the status and trends of these green power mechanisms:

- **Utility green pricing (regulated utility markets):** Utility customers procure green power through an additional line item on their utility bill (Section 3).

[1] "The Federal Trade Commission's Green Guides provide a more formal definition for renewable energy claim substantiation through RECs: *"If a marketer generates renewable electricity but sells renewable energy certificates for all of that electricity, it would be deceptive for the marketer to represent, directly or by implication, that it uses renewable energy."* - FTC Green Guides §260.15

- **Utility green tariffs (regulated utility markets):** Large utility customers procure green power from their utility through a special tariff rate for energy from a specific renewable energy project (Section 4).
- **Competitive suppliers (competitive electricity markets):** Customers in competitive electricity markets may select an alternative retail electricity supplier that offers a green power product (Section 5).
- **Unbundled REC market (separate from electricity):** Customers buy RECs separated or "unbundled" from the underlying electricity (Section 6).
- **Community choice aggregation (CCA):** Communities aggregate their loads to collectively procure green power as a bulk purchaser through an alternative electricity supplier (Section 7). Not all CCAs offer green power; only those involving renewable energy are covered here.
- **Voluntary Power Purchase Agreements (PPAs):** Customers procure green power through a long-term contract with an off-site renewable energy provider (Section 8).
- **Community solar:** Customers buy a subscription in a shared solar array and accrue green power in proportion to their subscription (Section 9).

The data on voluntary market trends presented in this report build on data presented in *Status and Trends in the U.S. Voluntary Green Power Market (2014 Data)* (O'Shaughnessy et al. 2015). Green power market data are based on figures provided to the National Renewable Energy Laboratory (NREL) by utilities and independent renewable energy marketers and publicly available data.

Structure

Section 2 provides an overall summary of the status of the green power market with national totals of participants and sales (in MWh). Sections 3–9 summarize status and trends for each of the green power mechanisms. Section 10 analyzes the growing role of large non-residential customers in the green power markets. Section 11 provides conclusions.

2 Summary of Voluntary Green Power Participation and Sales

About 4.3 million U.S. electricity customers purchased about 77.9 million MWh of green power (sales) in 2015 (Table 1).

Table 1. Voluntary Green Power Participation and Sales in 2015

Green Power Option	Participants	Sales (MWh)
Utility green pricing	789,000	7,512,000
Utility green tariffs	<10	380,000
Competitive suppliers	1,506,000	15,419,000
Unbundled RECs	69,500	42,490,000
CCAs	1,940,000	7,420,000
Voluntary PPAs	175	4,690,000
Community solar	15,000	180,000
Total[2]	4,300,000	77,900,000

Figure 2 illustrates percentage changes in green power participation and sales from 2014 to 2015. Points to the right of the dashed line at zero represent increases from 2014 to 2015. Trends vary across the mechanisms: utility green pricing programs, unbundled RECs, voluntary PPAs, and community solar exhibited sales growth from 2014 to 2015, while competitive supplier and CCA green power sales showed some declines.

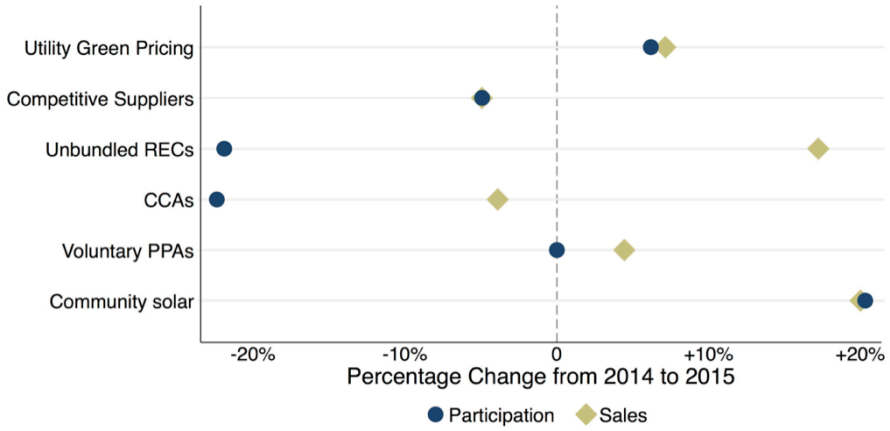

Figure 2. Percentage changes (2014–2015) in green power market participation and sales[3]

Table 2 and Figure 3 place 2015 estimates in an historical context based on previous estimates for green power participation and sales.

[2] Totals exclude community solar because many community solar customers do not retain the RECs associated with their purchase.

[3] Utility green tariffs excluded. Utility green tariff programs are a recent phenomenon, with sales and participation only beginning in earnest in 2015.

Table 2. Estimated Green Power Participation (×1,000 customers), 2010–2014

Green power option	2010	2011[a]	2012	2013	2014	2015
Utility green pricing	570	570	570	706	743	789
Utility green tariffs	-	-	-	-	-	0.001
Competitive suppliers	1,200	1,200	1,200	2,200	1,584	1,506
Unbundled RECs	60	85	110	95	89	70
CCAs	-	-	-	2,400	2,500	1,940
Voluntary PPAs[b]	0.05	0.07	0.1	0.2	0.2	0.2
Community solar[c]	0.4	4	7	8	13	15
Total[d]	**1,830**	**1,855**	**1,880**	**5,401**	**4,916**	**4,305**

[a] Utility green pricing and unbundled RECs data were not collected for 2011. Estimates for 2011 are based on the midpoint between 2010 and 2012.
[b] Results based on month and year in which the PPA was commissioned. Historic figures differ from previous reports due to improved methodology that restricts results to PPAs where the offtaker likely retains the RECs.
[c] Historic figures differ from previous reports due to new data made available from the Bright Arizona and Bright Tucson community solar programs in Arizona. (Tucson Electric Power 2016)
[d] Total does not include community solar (customers typically do not retain the RECs).

CCA participation declined significantly in 2015 due to trends in Illinois and Ohio (see Section 7). Despite declining participation in 2015, CCAs remain the largest source of green power customers. Hundreds of thousands of customers also procure green power through competitive suppliers and utility green pricing. In terms of customer participation, the remaining green power mechanisms are relatively small (Figure 3).

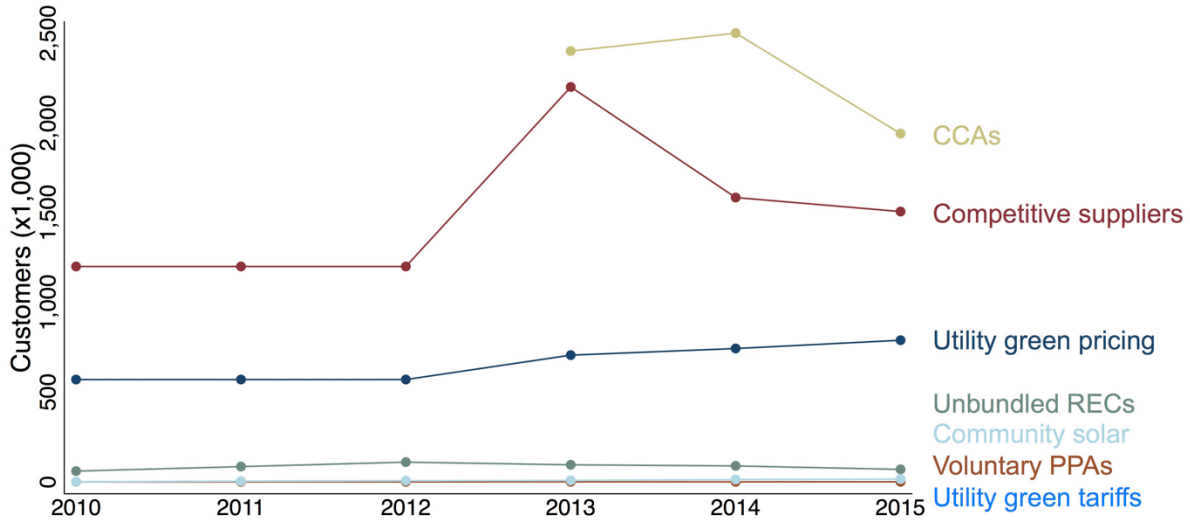

Figure 3. Green power customer participation (×1,000 customers) from 2010 to 2015

Table 3. Estimated Green Power Sales (millions of MWh), 2010–2014

Green power option	2010	2011[a]	2012	2013	2014	2015
Utility green pricing	5.4	5.8	6.0	6.9	7.0	7.5
Utility green tariffs	-	-	-	-	-	0.4
Competitive suppliers	10.4	11.0	11.6	14.5	16.2	15.4
Unbundled RECs	19.8	25.4	31.0	31.4	36.0	42.5
CCAs	-	-	-	8.1	7.7	7.4
Voluntary PPAs[b]	1.4	1.8	2.6	3.3	4.5	4.7[c]
Community solar[d]	0.005	0.05	0.08	0.10	0.15	0.18
Total[e]	**37**	**44**	**51**	**64**	**71**	**78**

[a] Utility green pricing and unbundled RECs data were not collected for 2011. Estimates for 2011 are based on the midpoint between 2010 and 2012.
[b] Results based on month and year in which the PPA was commissioned. Historic figures differ from previous reports due to improved methodology that restricts results to PPAs where the offtaker likely retains the RECs.
[c] Note: result represents projects commissioned in 2015. PPA capacity from signed contracts (not yet commissioned) was significantly higher in 2015. See Section 8.
[d] Historic figures differ from previous reports due to new data made available from the Bright Arizona and Bright Tucson community solar programs in Arizona. (Tucson Electric Power 2016)
[e] Total does not include community solar (customers typically do not retain the RECs).

Unbundled RECs remain the largest source of green power sales. Voluntary PPA green power sales are on a trajectory to surpass sales through utility green pricing programs and CCAs as soon as planned projects are completed (see Section 8). Community solar and utility green tariff green power sales remain small (Figure 4).

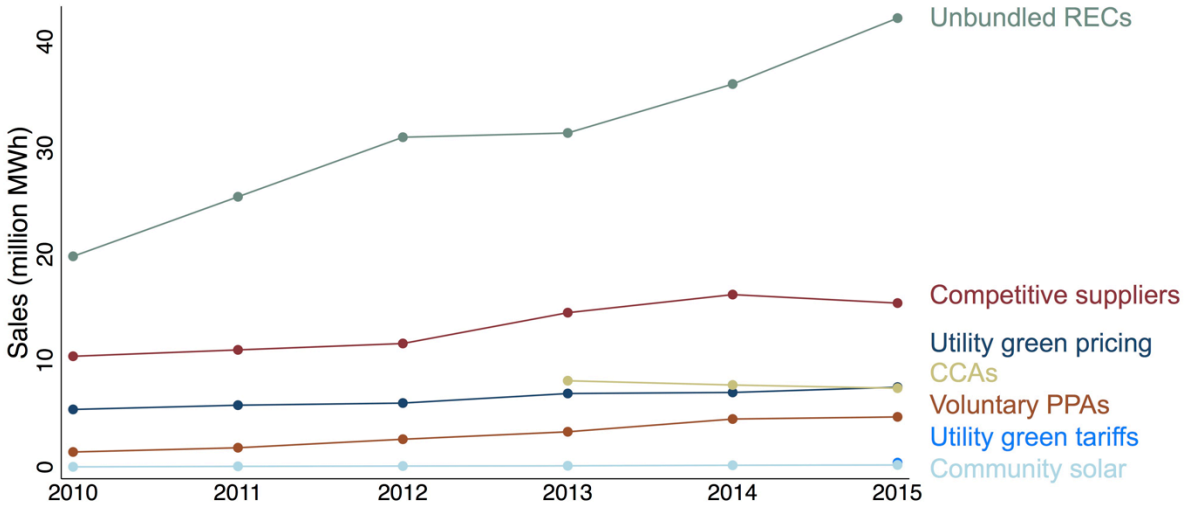

Figure 4. Green power sales (million MWh) from 2010 to 2015

3 Utility Green Pricing

Many utilities sell green power to residential and non-residential utility customers as part of their existing service through utility green pricing programs (see Figure 5). In a general green pricing program structure, the utility either generates or procures renewable energy (generally wind) and retires RECs on behalf of the customer in proportion to the quantity of green power purchased by the customer. Green pricing customers generally pay for the green power through an additional line item on their utility bill. Most utility green pricing premiums are in the range of 1¢–2¢/kWh.

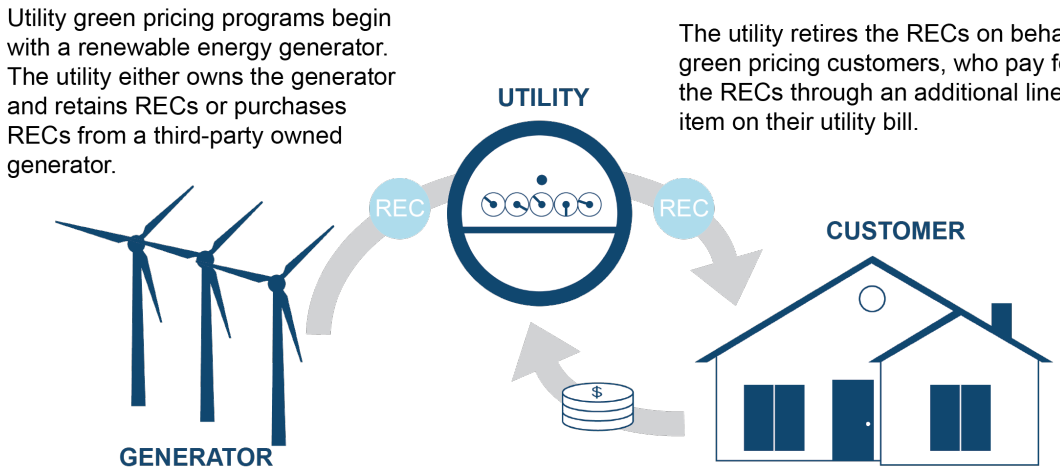

Figure 5. How utility green pricing programs work

Note: Figure provides a simplified schematic for visualization purposes. Specific program structures may vary.

3.1 Status of Utility Green Pricing Programs

In 2015, utility green pricing programs sold 7.5 million MWh of renewable energy to 789,000 customers (Figure 6). Utility green pricing programs continue to exhibit growth overall, increasing sales by 7% relative to 2014.

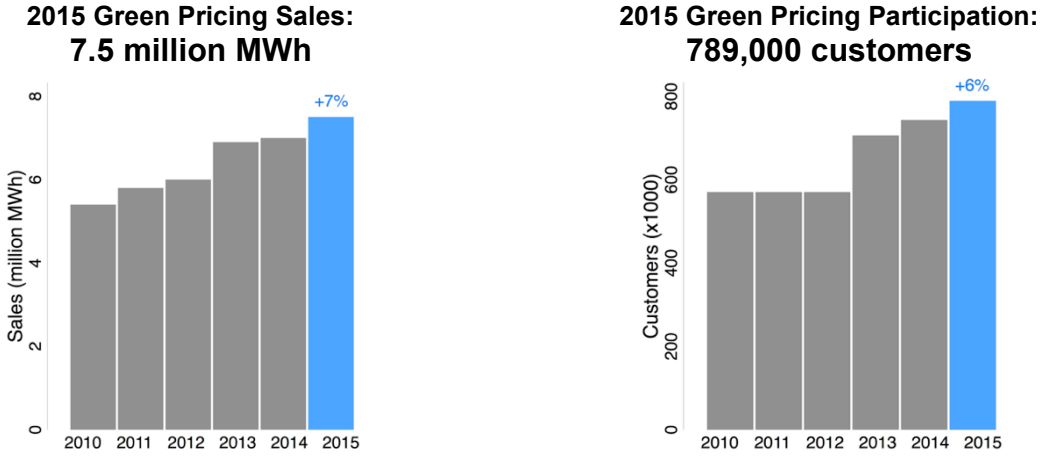

Figure 6. Utility green pricing program sales and participation in 2015

3.2 Trends in Utility Green Pricing Programs

We highlight four trends in utility green pricing programs in 2015: residential participation and nonresidential sales continue to grow; overall growth is driven by a few large and successful programs; wind remains the primary resource of utility green pricing programs; and utility green pricing programs are procuring more unbundled RECs.

Increasing residential participation and nonresidential sales drive growth

Residential customers greatly outnumber non-residential customers in utility green pricing programs; however, utility green pricing sales (by volume) are relatively even across the two sectors (Figure 7). Due to this dynamic, utility green pricing participation is more responsive to residential trends, whereas green pricing sales are relatively more responsive to trends in the non-residential sector. Residential customer participation in green pricing programs increased by about 45,000 customers from 2014 to 2015, or about a 6.3% increase, contributing to continued overall growth in green pricing customer participation. Green pricing sales to non-residential customers showed an impressive 7.6% increase from 2014 to 2015, contributing to an overall 6.7% increase in green pricing sales.

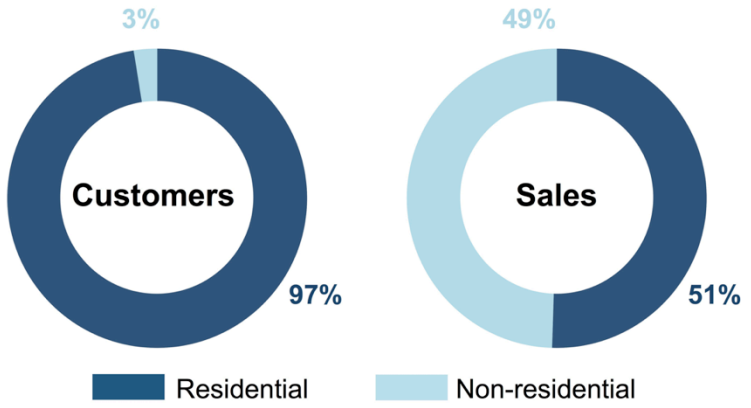

Figure 7. Residential/non-residential breakdown of green pricing customers and sales

Overall growth is driven by success in a few large programs

Despite continued growth in utility green pricing sales overall, the data suggest that utility green pricing sales are stable or even declining in most utility green pricing programs. This counterintuitive trend is due to slow growth in small and mid-sized programs that is offset by strong growth in large programs (Figure 8). The ten largest utility green pricing programs accounted for about 68% of all green pricing sales in 2015, meaning that the status of the market overall is driven strongly by trends in the largest utility green pricing programs. The success of large programs has several possible explanations, including unique and innovative program designs. Text Box 1 provides a case study of program innovations at Portland General Electric, one of the most rapidly growing utility green pricing programs.

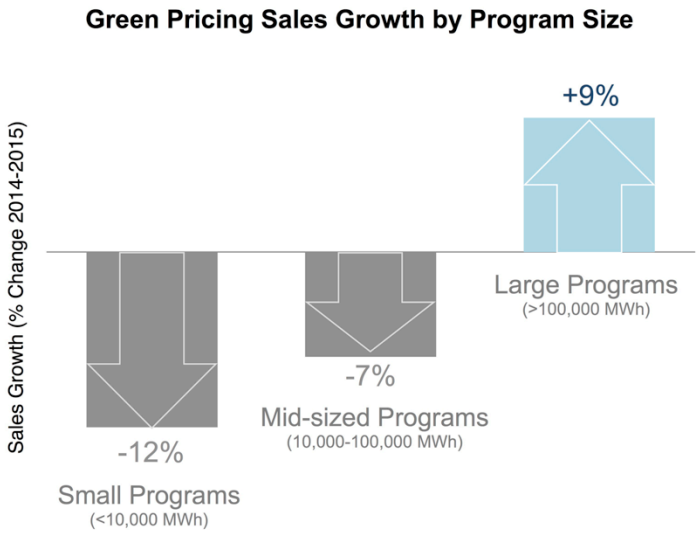

Figure 8. Green pricing sales trends (percentage change in program sales from 2014 to 2015) by program size[4]

Wind is the primary resource of utility green pricing programs

Wind remains the primary resource procured by green pricing programs (Figure 9). However solar power has increasingly gained shares of green pricing portfolios. Some programs, such as Portland General Electric's "Green Future Solar," offer utility customers the option to purchase RECs from local solar projects.

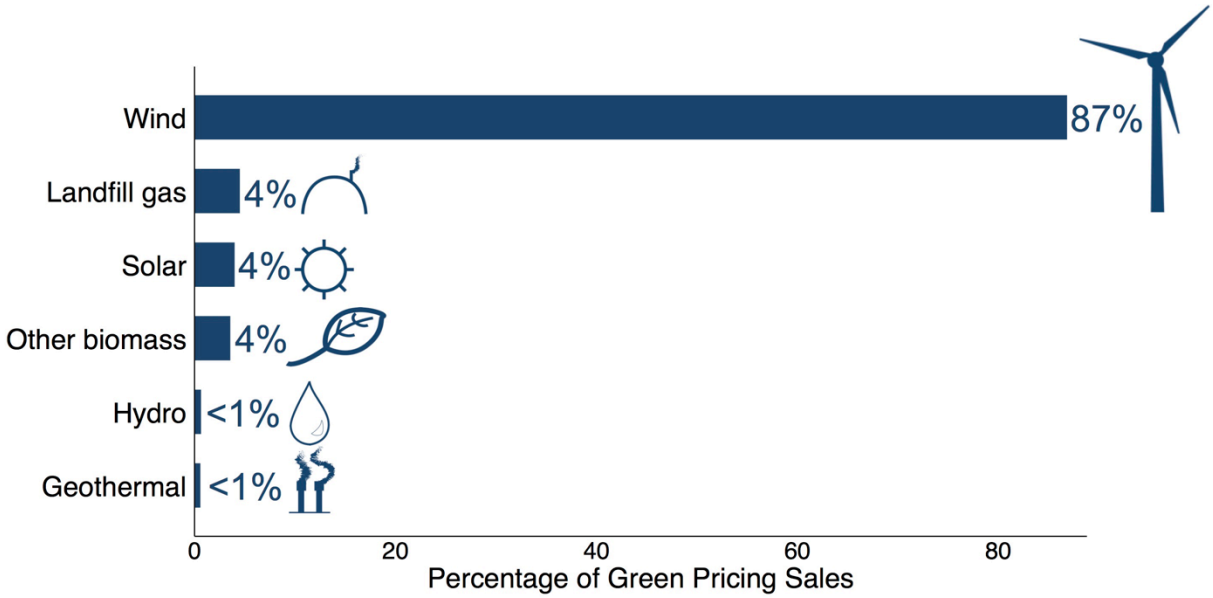

Figure 9. Renewable energy resources as percentage of all green pricing sales

[4] Two small programs with greater than 100% sales growth are excluded from the figure as outliers.

Text Box 1. Learning from a Leader: Case Study of the Portland General Electric Green Pricing Program

Portland General Electric (PGE), the Portland, Oregon-based utility, has consistently ranked as the largest green pricing program by both number of customers enrolled and volume of renewable power sold for the past several years. PGE's green pricing sales and participation increased by 13% and 10% annually from 2011–2015, respectively. PGE contributed to about one third of the green power sales growth in 2015. PGE currently offers three green pricing options: Green Source, Clean Wind, and Green Future Solar.

There are several key factors that contribute to PGE's successful green pricing program that may be replicated by other green pricing programs.

Outreach efforts: More than half of PGE's green pricing enrollments came from face-to-face (door-to-door, storefronts, and events) outreach in 2015. PGE reports that about 95% of customers engaged through door-to-door outreach remain in the program 6 months after enrolling—a higher retention rate than other outreach channels. According to PGE, face-to-face outreach is crucial to PGE's success because it provides the opportunity to immediately address customers' concerns, which include concerns over avian mortality rates, supply sources, and especially price. In fact, PGE reports that most utility customers over-estimate the price of green pricing programs, and that face-to-face interactions most effectively address these misunderstandings. High program participation rates illustrate the outreach's impact: about 16% of eligible PGE residential customers have enrolled in one of PGE's green pricing programs. For context, the second highest utility green pricing program participation rate in 2015 was about 12%, and most programs achieve a participation rate of less than 5%.

Customer engagement: PGE uses several strategies to retain existing customers. PGE provides welcome packets including window decals and Green-e content labels to new enrollees. PGE sends quarterly newsletters with program updates to all existing customers. Further, PGE offers its customers a free coupon book featuring deals at local businesses that are PGE green pricing customers. The coupon book acknowledges local businesses participating in the green pricing program. To cater to all customer preferences and reduce paper use, the coupon book and the newsletter are offered in both print and digital formats. At the end of each year, PGE sends customers CO_2 offset statements and thank you cards to acknowledge and offer appreciation for their accomplishments in choosing renewable energy.

Profit-neutral and locally sourced: Another reason for the success of the PGE program is the low cost to participants. In 2015, at $0.008/kWh, PGE's Green Source product was among the least expensive green pricing products in the United States. One reason for PGE's low price is that PGE operates its program profit-neutral. After RECs and all marketing efforts are paid for, any remaining revenue is put into a renewable development fund for the construction of local renewable energy projects. Additionally, PGE strives to source its REC supply as locally as possible. PGE customers have consistently demanded local renewable energy and expressed a willingness to pay a premium to support local projects, especially projects that support the local economy. PGE customers have expressed particular interest in local solar. PGE responded by launching the Green Future Solar program in Fall 2015, offering a green pricing product from a local solar project of 2.9 MW in Willamina, Oregon. The product quickly sold out, illustrating latent demand for local solar.

Source: Interview with Josh Halley (Portland General Electric) on 6/6/2016.

Utility green pricing programs increase procurement of unbundled RECs

Green pricing sales to the end-use customer are bundled by definition; however, programs may procure bundled or unbundled RECs at the wholesale level. The share of green pricing program sales derived from unbundled RECs increased from 42% in 2014 to 63% in 2015 (Table 4). Part of this shift may be economically motivated: unbundled RECs, especially from wind-heavy states, may be cheaper than RECs from utility-owned projects. However, part of this shift also reflects inconsistent categorization of REC procurement methods by utility green pricing programs. Some green pricing programs "purchase" the RECs from the parent utility and account

for these RECs as "unbundled" for budgeting and REC accounting purposes even though the utility also purchases the underlying electricity. Therefore, the distinction between unbundled and bundled RECs in utility green pricing programs may, in some cases, refer to how the RECs are delivered to end-use customers and in other cases how the RECs are treated within utilities. This ambiguity will be rectified in future iterations of NREL's annual utility green pricing program data collection effort.

Table 4. Contract Length by Type of Utility Green Power Procurement (MWh), 2015

Contract length	Unbundled RECs (%)	RECs bundled with electricity (%)	Projects owned by utility (%)	RECs produced by utility consumers (%)
≤1 year	23	0	0	0
2-5 years	74	10	73	52
6-10 years	3	54	24	21
≥11 years	0.1	37	3	27
Percent of total procurement	63	33	2	2

4 Utility Green Tariffs

In a utility green tariff, utilities contract for renewable energy on behalf of utility customers (see Figure 10). To date, only large non-residential customers have used utility green tariffs, and most programs are limited to large customers. Utility green tariffs are different from green pricing programs in three ways. First, the green tariff customer typically has the ability to specify the resource and project from which to procure renewable energy. Second, customers are typically receiving some form of price certainty, e.g., by not being required to pay fossil fuel charges. This second difference gives rise to the potential for future economic gains (relative to traditional utility rate) not possible through green pricing programs. Third, customers are typically committing to a utility green tariff for a longer period of time (2+ years), compared to green pricing programs, which allow customers to opt in and out on a monthly basis.

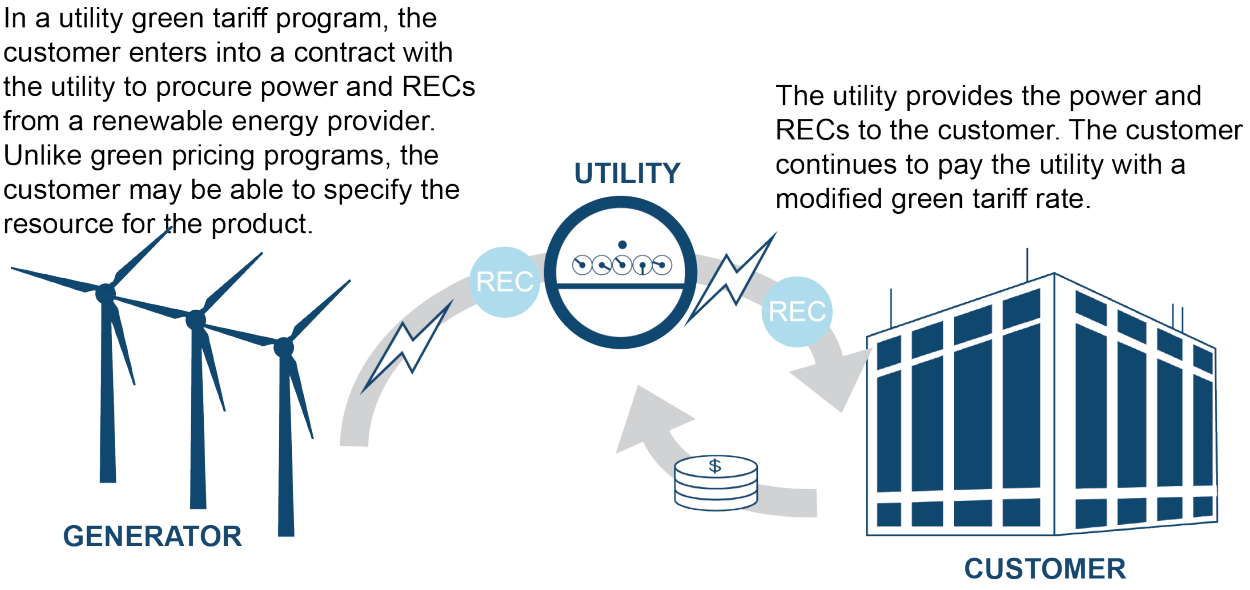

Figure 10. How utility green tariffs work

Note: Figure provides a simplified schematic for visualization purposes. Specific program structures may vary. Tariff structures may also vary within programs on a case-by-case basis.

4.1 Status of Utility Green Tariff Programs

This is the first year that utility green tariffs are included as a separate category in the annual Status and Trends report. By the end of 2015, about 350 MW of renewable energy had been procured through green tariffs (Barua 2016), with 250 MW signed for in Nevada (Tawney 2016). Assuming green tariffs resulted in green power production for part of 2015, we estimate that green tariffs resulted in about 380,000 MWh of green power sales in 2015.

Utility green tariffs are currently offered in eight utility service territories (Figure 11). The tariff programs are in various stages of implementation, and terms likewise vary (see Tawney et al. 2016 for a full overview). By September 2016, at least 12 renewable energy projects had been approved through utility green tariff programs (Tawney et al. 2016). The total capacity purchased through utility green tariffs to date is unknown because some projects are confidential;

however, by the end of 2015, at least 350 MW of renewable energy had been procured through green tariffs (Barua 2016).

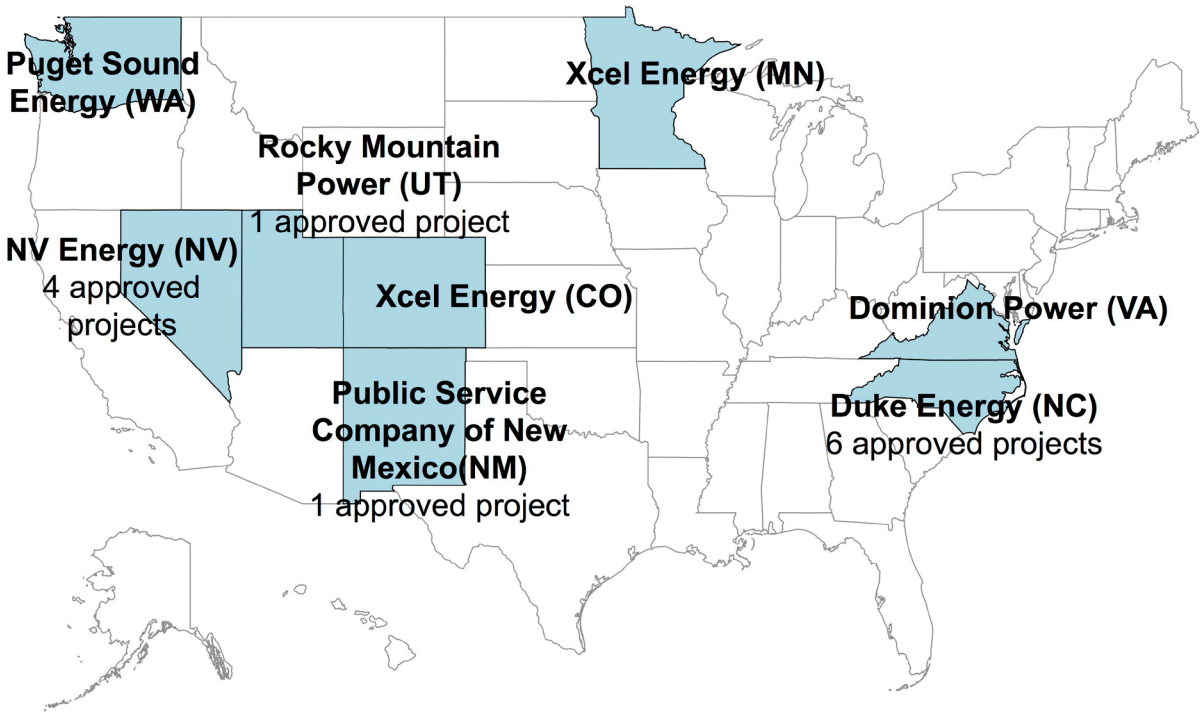

Figure 11. Utility green tariff programs

4.2 Benefits of Green Tariff Programs

Utility green tariff programs offer a potential "win-win" solution for utilities and large green power customers (Barua 2016; Tawney 2016). Large customers with operations in states with regulated electricity markets benefit from the opportunity to purchase bundled green power (electricity and RECs) locally. Further, in contrast to utility green pricing programs, which charge a premium for enrollment, utility green tariff programs may be designed such that customers earn long-term savings. Therefore, green tariff programs are a manifestation of large customer demand for both green power and the long-term fixed-price structures of renewable energy purchasing available in deregulated electricity markets (Tawney 2016). See Section 10 for further discussion of the influence of large customers on green power markets in general.

Utilities may also benefit from green tariff programs. First, green tariff programs allow utilities in regulated electricity markets to accommodate the green power and long-term fixed-price demands of large customers. In the absence of such a green power option, large customers may decide to not expand or invest further in service territories or attempt to leave the utility altogether, where state regulations allow (Barua 2016). For example, in 2014, the computing company Switch Energy filed with the Nevada public utility commission (PUC) to leave the utility NV Energy in order to pursue a renewable energy option. Following the Nevada PUC's rejection of Switch's request, Switch settled and remained with NV Energy as a customer under NV Energy's green tariff program (Rothberg 2016). Second, utilities benefit from the ability to enter into long-term contracts with large credit-worthy electricity customers. Such long-term contracts can improve long-term utility investment planning (Barua 2016).

5 Competitive Suppliers

In deregulated electricity markets, customers can switch their electricity service from the incumbent utility to a competitive supplier (see Figure 12). Some competitive suppliers offer green power options in which the competitive supplier procures renewable energy on behalf of the customer. Customers may pay a green power premium if green power is not included in the competitive supplier's default supply.

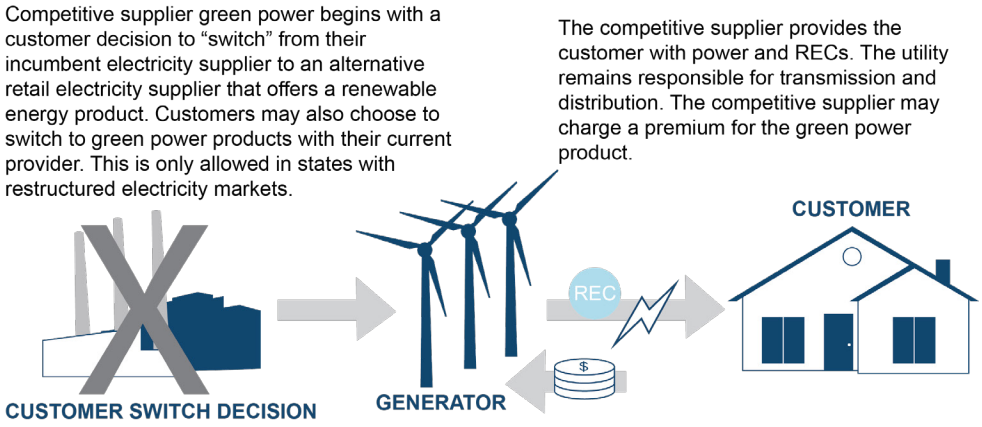

Figure 12. How competitive suppliers work

Note: Figure provides a simplified schematic for visualization purposes. Specific transactions may vary.

5.1 Status of Competitive Suppliers

In 2015, competitive suppliers sold about 15.4 million MWh of renewable energy to about 1.5 million customers (Figure 13).

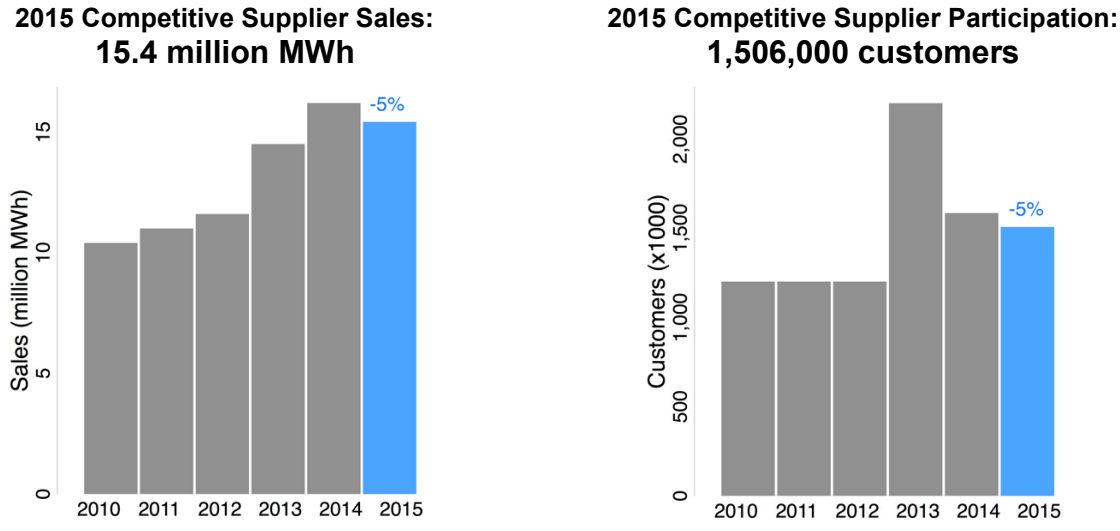

Figure 13. Competitive supplier sales and participation in 2015

5.2 Trends in Competitive Suppliers

We highlight two trends from competitive supplier green power sales: the relative stability of competitive supplier sales in 2015 may be due, in part, to stable overall retail electricity sales; and wind remains the primary resource of competitive suppliers.

Stable competitive supplier sales are consistent with overall U.S. retail electricity sales

We estimate that green power sales through competitive suppliers fell slightly in 2015, although some of this change may be attributable to lack of comprehensive data in previous years.[5] Methodological limitations notwithstanding, stable competitive green power sales are consistent with trends in sales of retail electricity in the United States overall. Retail electricity sales overall have been relatively stable for the past ten years and declined slightly from about 3,800 million MWh in 2014 to 3,700 million MWh 2015 (EIA 2016a). Stable retail electricity sales reflect increasing energy efficiency, modest economic growth, and the effect of increasing penetrations of distributed or "behind-the-meter" generation.

Competitive supplier green power is primarily wind-based

Competitive suppliers offer a broad range of green power products—from packages consisting of RECs sourced nationally from the least-cost renewable energy projects to local solar packages supporting local solar projects. Although the exact supply of renewables used for competitive supplier green power products is not available, data on registered generators in the Electric Reliability Council of Texas (ERCOT) are available. The ERCOT Renewable Energy Credit program,[6] which meets roughly half of the green power needs of the competitive supplier market, and wind is the primary resource in terms of number of projects (Figure 14). Given that wind projects tend to be larger in capacity than solar projects, this implies that wind is also the primary resource in terms of capacity.

[5] No comprehensive dataset exists on green power sales from competitive suppliers, and survey methods have not achieved high response rates. This year's estimate of competitive supplier sales relies on data on electricity sales from retail power marketers in an *early release* version of the 2015 EIA Form 861 (EIA 2016b). An estimate of green power sales was extrapolated from trends in renewable energy sales and historic trends in green power sales through competitive suppliers. Possible errors associated with the early release were minimized by comparing data for retail power marketers that had valid reports in both 2014 and 2015.

[6] Figures are reported by generators that provide power to both the voluntary and compliance markets.

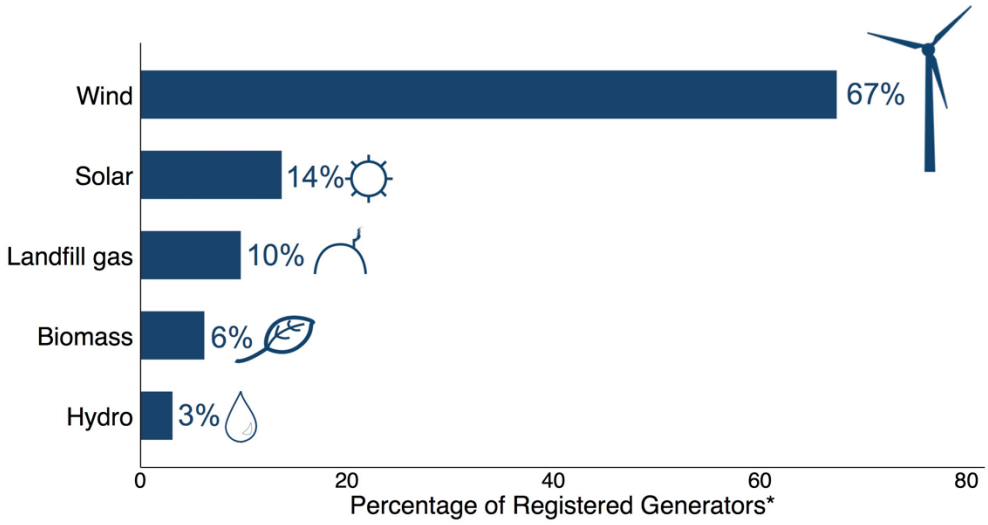

Figure 14. Renewable energy resources as percentage of registered generators in ERCOT REC program[7]

Note: Data from ERCOT (2016). ERCOT-registered generators meet roughly half of the demand for green power from competitive suppliers

[7] Project start date based on the program registration date of the parent company. In some cases, project start dates may not coincide perfectly with company registration, which could affect accuracy of the figure.

6 Voluntary Unbundled RECs

Some renewable energy generators sell electricity into local electricity markets without selling the associated RECs. RECs separated from the underlying electricity are known as unbundled RECs and may be sold into unbundled RECs markets (see Figure 15). Any electricity customer can buy unbundled RECs, typically through a third-party marketer. The voluntary unbundled RECs market is consistently the largest source of green power sales in the overall green power market.

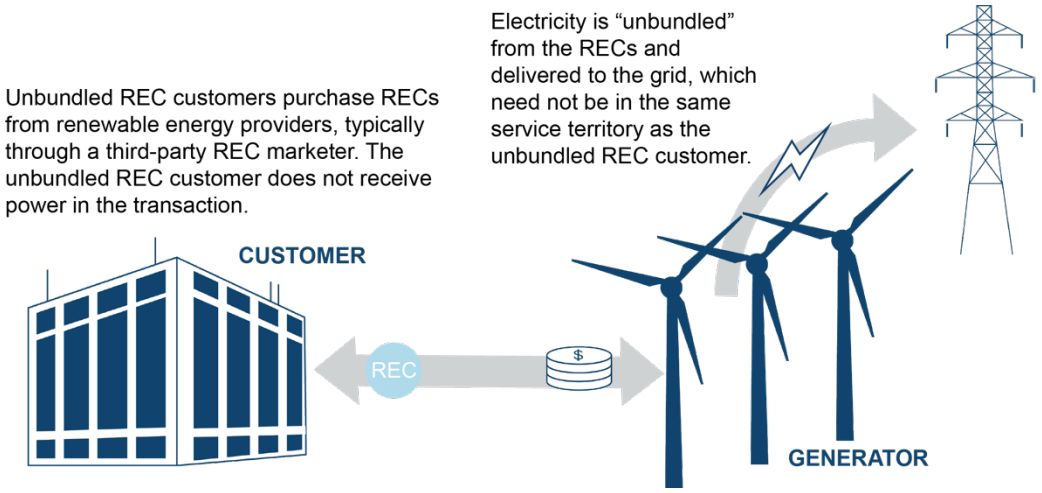

Figure 15. How voluntary unbundled RECs work

Note: Figure provides a simplified schematic for visualization purposes. Specific transactions may vary.

6.1 Status of Voluntary Unbundled RECs

We estimate that about 69,500 customers bought about 42.5 million MWh of green power through unbundled RECs in 2015 (Figure 16).

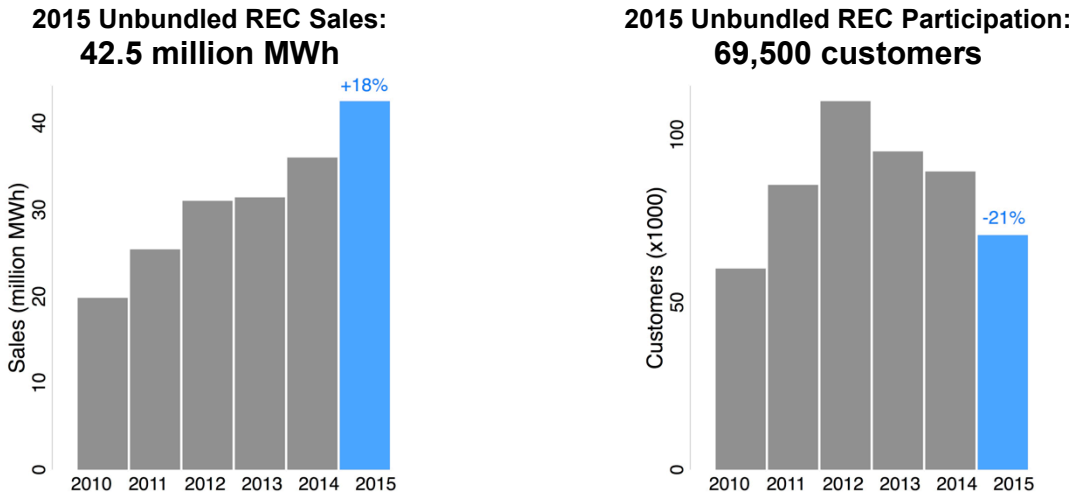

Figure 16. Unbundled REC sales and participation in 2015

6.2 Trends in Voluntary Unbundled RECs

We highlight three trends in unbundled REC markets: growing purchase sizes counter reductions in the number of customers; unbundled RECs derive primarily from the wind states in the central United States; and low REC prices may be driving increased REC sales.

Continued increase in non-residential sales per customer

From 2014 to 2015, we estimate that sales of unbundled RECs increased by 18% from 2014 to 2015, the largest year-over-year percentage change in unbundled RECs since 2012. At the same time, the number of customers buying unbundled RECs declined by an estimated 21%. This paradoxical result reflects a trend toward fewer customers making larger unbundled RECs purchases. More than 15,000 fewer residential customers and 3,000 fewer non-residential customers bought unbundled RECs in 2015 than in 2014. However, any reduction in sales associated with customer exit was overcome by growth in the average purchase size of non-residential customers. The average non-residential unbundled REC purchase increased from about 1,700 MWh per customer in 2014 to 2,200 MWh per customer in 2015 (Figure 17). Increasing non-residential unbundled RECs sales may be partially due to low voluntary REC prices (discussed below), as well as several other factors driving increasing green power sales to large customers (see Section 10).

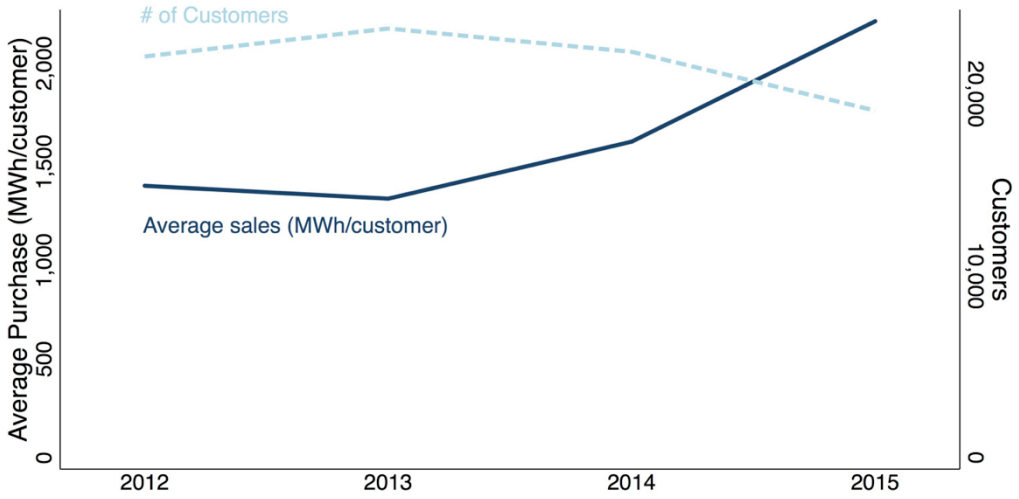

Figure 17. Number of non-residential unbundled RECs customers and average purchase size by non-residential customers from 2012 to 2015

Central wind states fuel unbundled RECs

Similar to utility green pricing programs and competitive suppliers, wind appears to remain the primary resource for unbundled RECs. More than half of unbundled RECs derive from wind-heavy Kansas, Oklahoma, and Texas (Figure 18).

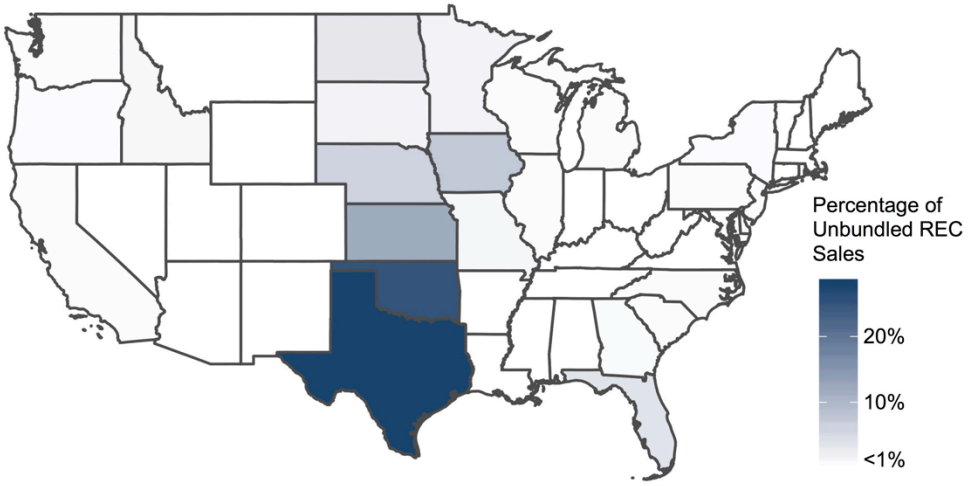

Figure 18. Source of unbundled RECs (% of total sales)

Data source: Leschke (2016)

REC pricing trends

Trends in unbundled REC markets may reflect trends in voluntary REC pricing. For context, we present data on both voluntary REC prices and compliance REC prices. Voluntary REC prices continued to remain historically low throughout 2015 (Figure 19). Voluntary REC prices fell from $1.13/MWh in January 2014 to $0.89/MWh in January 2015 and $0.34/MWh in January 2016 (Marex Spectron 2016). These historically low voluntary REC prices could explain some of the relatively large increase in sales of unbundled RECs from 2014 to 2015.

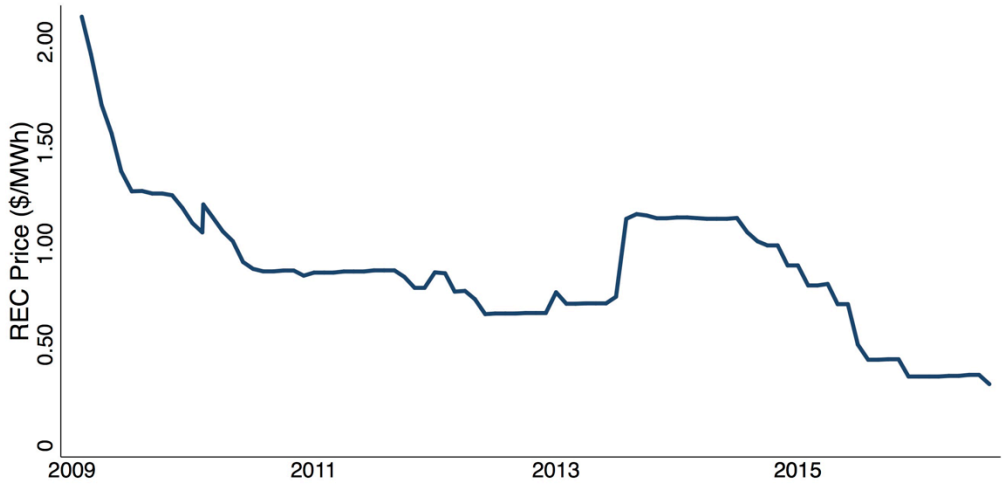

Figure 19. Voluntary national REC prices

Source: Marex Spectron (2016)

For further REC price comparisons, we present data for prices in compliance markets. Compliance REC prices also generally declined in 2015; however, the reduction occurred from

historically high levels (Figure 20). Compliance REC prices in most markets remain above 2011 price levels.

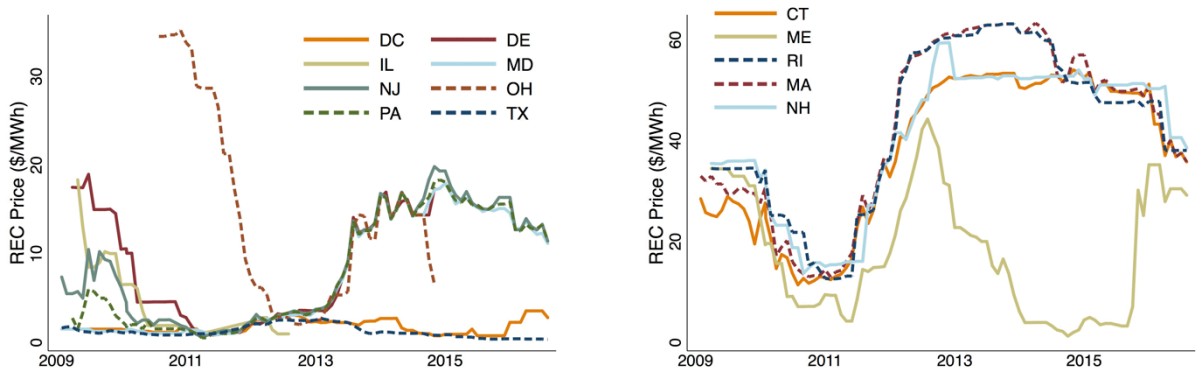

Figure 20. Compliance REC prices (excluding SRECs)[8]

Source: Marex Spectron (2016)

Some states have renewable portfolio standard (RPS) subprograms to support solar. Regulated entities use solar RECs (SRECs) to demonstrate compliance with solar-specific RPS requirements. SRECs are generally costlier than other compliance RECs due to the relatively high costs of solar compared to other renewable generation sources. SREC prices generally increased in 2015 (Figure 21).

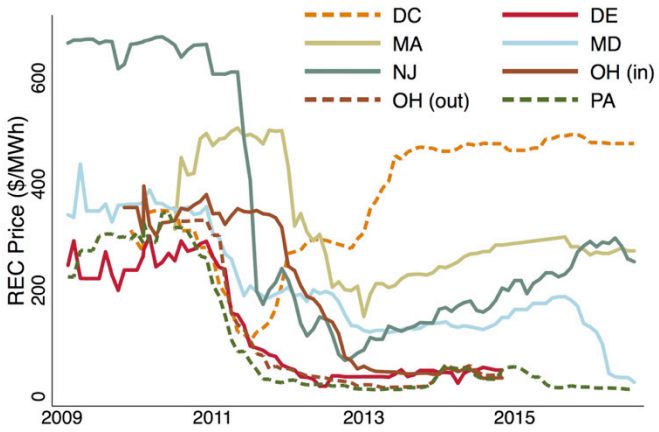

Figure 21. SREC pricing

Source: Marex Spectron (2016)

[8] The Ohio RPS program was frozen in 2015 and 2016.

7 Community Choice Aggregation

Seven states to date have passed legislation that allows certain jurisdictions to form community choice aggregations (CCA). A CCA aggregates electricity customers to procure electricity from an alternative electricity supplier (see Figure 22). In general, electricity customers are automatically enrolled into the electricity service selected by the CCA, and customers may opt out if they do not want to participate in the CCA. Several CCAs have procured green power products through alternative suppliers. CCAs may offer green power products either by default or as an optional premium package.

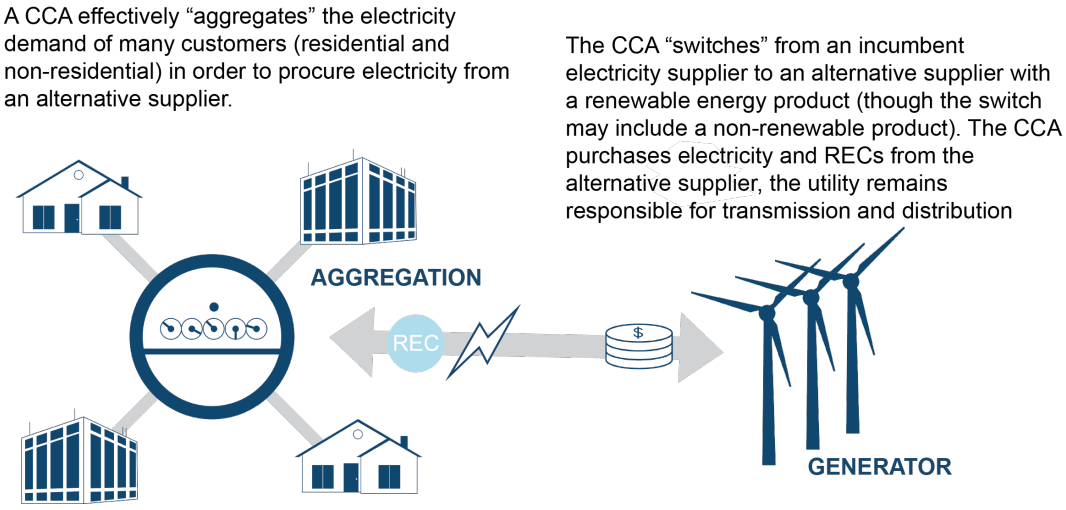

Figure 22. How community choice aggregation works

Note: Figure provides a simplified schematic for visualization purposes. Specific program structures may vary.

7.1 Status of CCAs

In 2015, community choice aggregations sold about 7.4 million MWh of renewable energy to about 1.9 million customers (Figure 23).

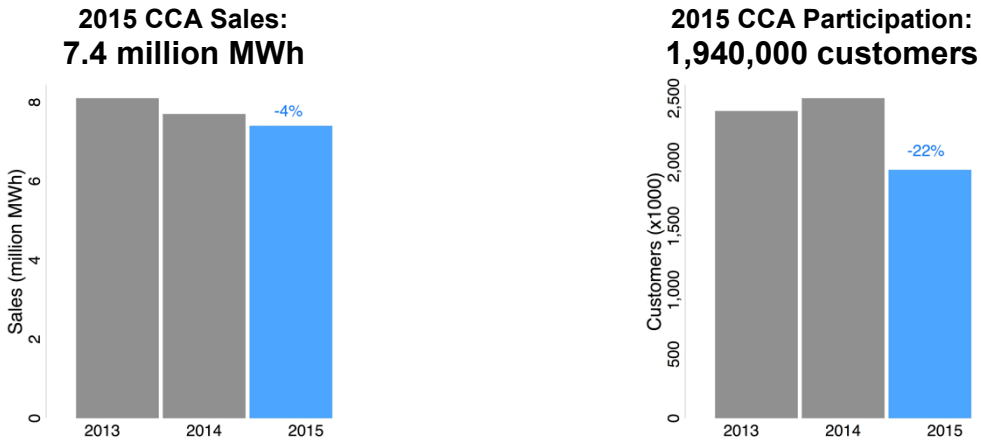

Figure 23. CCA sales and participation in 2015

7.2 Trends in CCAs

Green power sales and participation through CCAs fell from 2014 to 2015, despite program growth in California, due to falling numbers in Illinois and Ohio (Table 5). The addition of New York to the CCA green power program map could help CCA sales rebound in 2016. The experiences in each of these states is unique; therefore, we analyze trends in California, Illinois, New York, and Ohio separately.

Table 5. CCA Green Power Sales and Participation by State in 2015

State	Estimated green power sales (MWh) (%Δ from 2014)	Participants in CCAs with green power products (%Δ from 2014)	CCAs with green power products
Illinois[a]	4,920,000 (-5%)	1,450,000 (-31%)	54 programs
California[b]	1,650,000 (27%)	370,000 (29%)	Lancaster Choice Energy Marin Clean Energy Sonoma Clean Power
Ohio[b]	580,000 (-39%)	80,000 (-34%)	City of Cincinnati City of Cleveland
Massachusetts[a,b]	280,000 (0%)	32,000 (0%)	Cape Light Compact City of Lancaster City of Lowell

[a] Estimate extrapolated from publicly available reports of green power products in CCAs applied to historical data on electricity usage
[b] Based on NREL survey data

California

California's CCAs continued to grow in 2015. The Marin Clean Energy, Sonoma Clean Power, and Lancaster Choice Energy CCAs together sold about 1.65 million MWh of green power to more than 370,000 customers in 2015—about a 27% increase in green power sales from 2014. Marin Clean Energy continues to expand geographically; in addition to Marin County, the CCA now serves Napa County and six other cities. Marin Clean Energy grew its non-residential customer base by 48% in 2015, adding more than 7,000 non-residential customers and 120,000 MWh of non-residential sales. Sonoma Clean Power completed the full phase-in of customers in its first full year of operation in 2015. The CCA increased purchases of renewables to meet its growing load. As a result of these two factors, Sonoma Clean Power added 36,000 green power customers and increased green power sales by 26% in 2015. The City of Lancaster launched the Lancaster Choice Energy CCA in October 2015. Lancaster has contracted for 10 MW of local solar to offer customers 35% and 100% renewable energy products.

New CCAs are continuing to emerge in California. The CleanPowerSF CCA began serving the City of San Francisco in May 2016 after more than a decade of planning and delays. Customers in select parts of San Francisco are automatically enrolled in a standard "Green" offer delivering 35% renewable energy, mostly from local wind sources. The Green package is only a marginal green power offer over the incumbent utility's (Pacific Gas & Electric) 29.5% renewable energy supply. CleanPowerSF customers may opt into the "SuperGreen" offer for a premium of

$0.02/kWh over the standard Green package. Premiums from the SuperGreen package will be invested in local energy efficiency and renewable energy projects.

Two additional CCAs are slated to begin serving customers in 2016 and 2017. Peninsula Clean Energy (PCE) is due to begin serving customers in San Mateo County in October 2016.[9] PCE offers a 50% renewable energy product by default and an opt-in 100% renewable energy product. In July 2016, the County of Los Angeles conducted a feasibility study for a proposed Los Angeles Community Choice Energy (LACCE) CCA. The proposed plan would implement a CCA serving unincorporated areas of Los Angeles County in 2017, followed by the incorporation of additional cities that choose to join LACCE. The study assessed the feasibility of LACCE programs with 50% and 100% renewable energy products (EES Consulting 2016). At least 20 other California jurisdictions, including notably San Diego County, are exploring CCA implementation (Figure 24).

Figure 24. Operational and proposed CCAs in California

Data source: Lean Energy U.S. (2016)

A California Public Utilities Commission (CPUC) decision in late 2015 could derail the continued expansion of CCAs in California. The decision concerned a fee charged to CCA customers known as an "exit fee," designed to allow utilities to recoup sunk costs for power investments made on the behalf of customers that subsequently decide to join CCAs. CCAs compete by offering rates that are lower or competitive with utility rates after factoring in the exit fees. In December 2015, the CPUC decided to allow Pacific Gas & Electric (PG&E) to nearly double the exit fee charged to CCA customers. Under the decision, associated costs to residential customers would increase from about $6.70/month to $13/month (Johnson 2015). CCA advocates argue that the exit fees are exorbitant and undermine the viability of future CCAs (Miller 2015). The decision only applies to the PG&E service territory.

[9] As of September 2016, PCE was accepting enrollments with an expected launch in October 2016.

Illinois

Green power sales in Illinois CCAs have plateaued in recent years. We estimate that green power sales from Illinois CCAs fell from about 5.2 million MWh in 2014 to 4.9 million MWh in 2015. The number of customers participating in green power CCAs fell more significantly from about 2.1 million customers in 2014 to 1.5 million customers in 2015. The seeming disparity between the decline in sales and participation is attributable to the estimation approach. Several CCAs discontinued green power products in 2014. Customers from these CCAs were registered as green power customers in the 2014 participation totals, even though they only participated for part of the year.[10] The large 2015 reduction in green power participation reflects an adjustment for those customers that discontinued their green power product at some point in 2014.

We posit three possible explanations for the recent drop in Illinois green power sales. First, the market shares of the retail electric suppliers that supply energy to CCAs began to plateau in early 2013 (Figure 25). This trend illustrates a boom of retail electric supplier sales to small residential customers from 2011 to 2013 associated with highly competitive rates, followed by a period of stabilization as retail supplier rates became relatively less competitive. Second, many CCA programs that began with green power contracts have completed their contract cycle and have chosen not to renew the green power product. About half of CCAs up for contract renewal in 2014 chose to renew their green power product (O'Shaughnessy et al. 2015). Third, new CCA activity has slowed down in recent years. A total of 718 Illinois communities submitted a CCA referendum between 2012 and 2014, but only four communities have submitted a referendum from 2015 through mid-2016. Of these communities, only Stillman Valley offered an optional green power product.[11]

[10] In other words, customers that only participated for part of the year are not recorded as fractions of customers for estimation purposes. Therefore, a customer "leaving" in one year is reflected as a reduction in participation in the following year.

[11] Based on online product descriptions (Dynegy 2016).

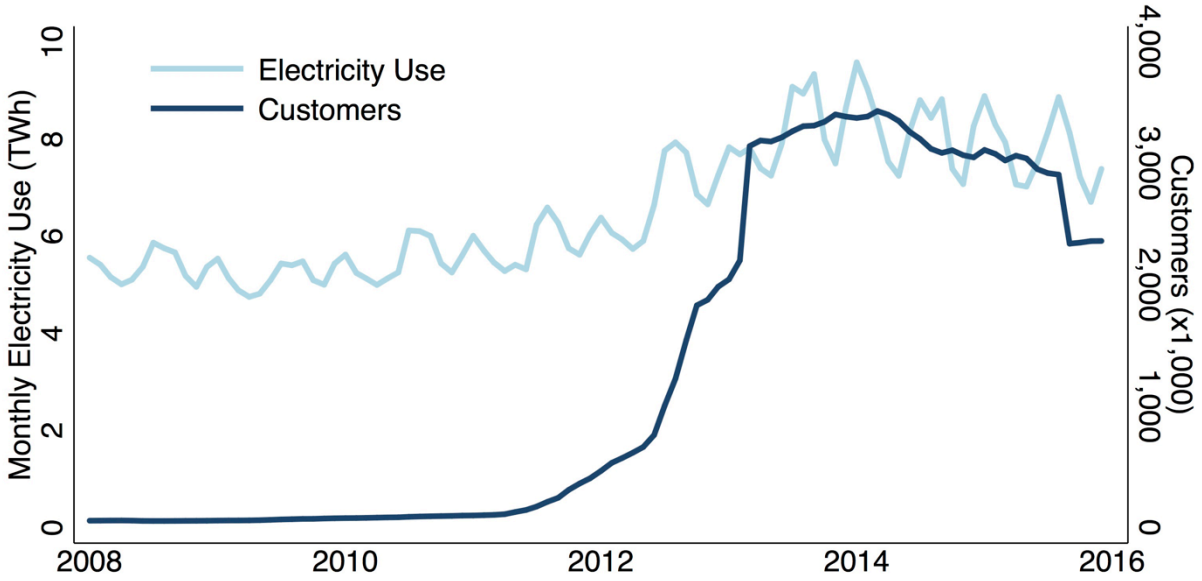

Figure 25. Retail electric supplier sales and customers in Illinois over time

Data source: ICC (2016)

New York

In 2016, New York's first pilot CCA began implementation of the "Westchester Smart Power" program. The aggregation "Sustainable Westchester" represents about 110,000 homes in 20 municipalities, making it one of the largest aggregations in the country. About two-thirds of the Sustainable Westchester communities opted for a 100% renewable product. Although the initial renewable energy product was unbundled RECs, Sustainable Westchester included provisions that would allow communities to displace unbundled REC products with local sources such as local PPAs and community solar as such resources become available (Tweed 2016).

Ohio

The cities of Cincinnati and Cleveland have administered two of the nation's largest green power CCAs since 2012 and 2013, respectively. However both CCAs showed reductions in green power participation and sales from 2014 to 2015. The combined number of customers in both programs fell from 121,406 in 2014 to 84,201 in 2015. The combined green power sales of both programs fell from 950,000 MWh in 2014 to 584,000 MWh in 2015. The reduction in CCA green power sales from 2014 to 2015 is in part due to program structures that result in cyclical variations in CCA participation. Under the terms of the City of Cincinnati's CCA contract, for example, customers that change electricity service upon moving are defaulted back to the incumbent utility. Such customers remain with the utility until the CCA refreshes accounts and customers are automatically opted back into the program. With a large renter population, the City of Cincinnati experiences gradual declines in CCA participation before each account adjustment. The reduction in CCA sales in Ohio may therefore represent the cyclical nature of CCA program participation rather than a longer-term trend of declining CCA green power sales.

8 Voluntary Renewable Energy Power Purchase Agreements

In a power purchase agreement (PPA), an electricity customer enters into a long-term contract with a generator to buy electricity. PPAs have been used, mostly by large non-residential customers to buy electricity from renewable energy projects located on the customers' premises (on-site projects) and remote from the customer (off-site). The analysis in this section is limited to off-site PPAs (see Figure 26).

PPAs have two primary forms. In a physical PPA, the customer enters into a contract to buy electricity at a negotiated PPA rate. The purchased electricity is credited toward the customer's electric demand such that, from a billing perspective, the customer uses the electricity (regardless of whether the electricity is physically delivered to the customer's site). Financial PPAs are typically structured as a contract for differences for electricity at a negotiated PPA rate. The generator sells electricity into the wholesale power market. The customer and generator are financially obligated to settle differences between the PPA rate and the wholesale rate: the customer pays the generator the difference when the wholesale rate is less than the PPA rate, and the generator pays the customer the difference when the wholesale rate is greater than the PPA rate. The customer continues to pay their same utility electricity bill; the financial PPA is not credited against it.

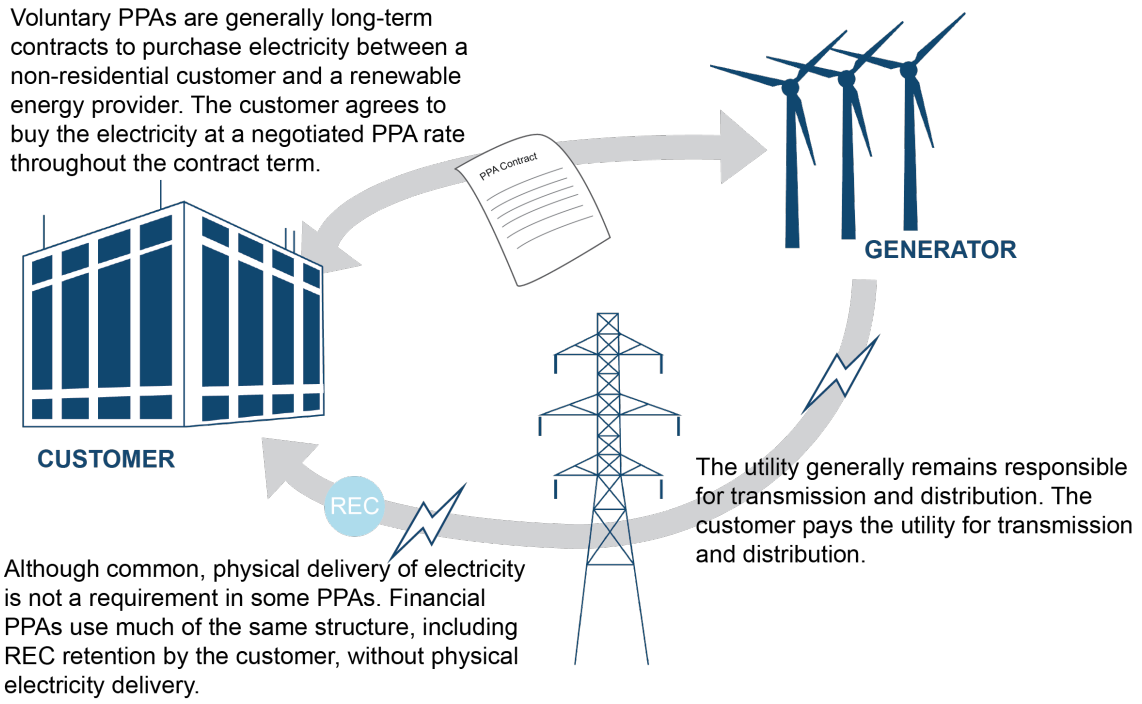

Figure 26. How voluntary power purchase agreements work

Note: Figure provides a simplified schematic for visualization purposes. Specific contract structures may vary.

8.1 Status of Voluntary PPAs

In 2015, about 4.7 million MWh of green power were consumed through 175 voluntary PPAs (Figure 27).[12] These results reflect projects commissioned by the end of 2015 where the customer purchases the RECs.[13] An additional 10.2 million MWh of voluntary PPAs have been contracted for but not yet commissioned.

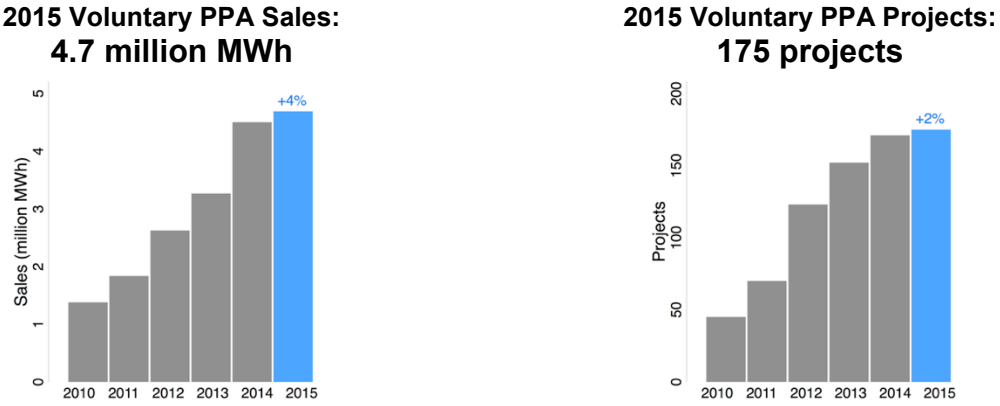

Figure 27. Voluntary PPA sales and participation from 2010 to 2015

8.2 Trends in Voluntary PPAs

The sales and participation results (based on commissioned projects) mask booming voluntary PPA sales in terms of signed contracts. At the end of 2015, about 14.9 million MWh had been signed for renewable energy (where RECs are retained), with 5.2 million MWh signed for in 2015 alone. We summarize four trends in voluntary PPAs: the voluntary PPA project pipeline continues to grow; PPAs are staying large; the tech and manufacturing sectors are leading sectors in voluntary PPAs; and PPAs are shifting toward wind.

PPA signatures are outpacing project commissioning

Only 4.7 million MWh of 14.9 million MWh of PPA contracts had actually been commissioned by the end of 2015. A substantial amount of additional generation has been contracted for but not yet commissioned – 10.2 million MWh. About 3 million MWh of signed contracts were added to the project pipeline in 2014, and an additional 5.2 million MWh of project pipeline was added in 2015. Because so many PPAs were signed in 2015 but not commissioned, MWh sales under commissioned projects will increase dramatically in the coming years as projects come online (Figure 28).

[12] Sales based on the estimated portion of all PPAs where customers retain the RECs. See Section 8.3 for a description of our methodology.
[13] All PPA data based on BNEF (2016).

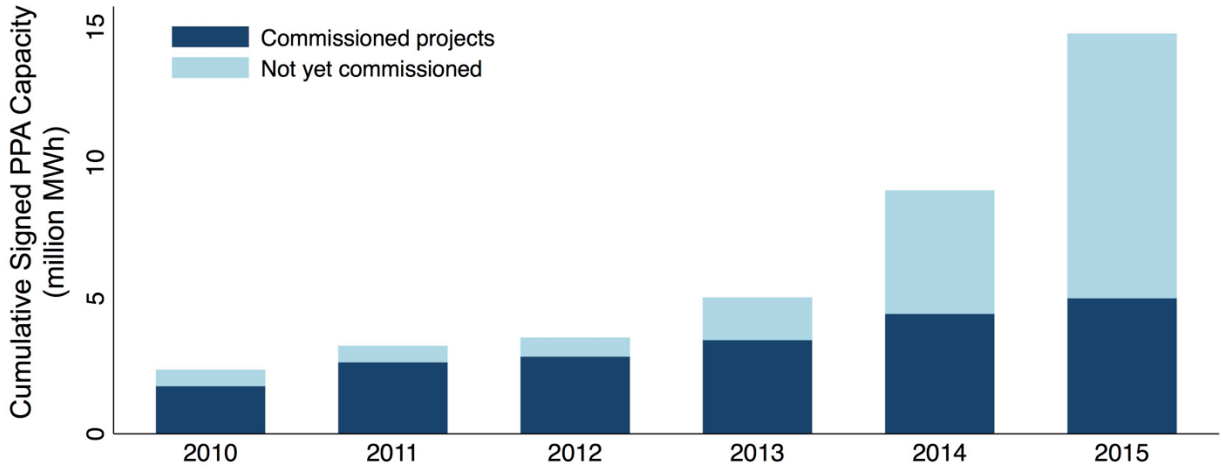

Figure 28. PPA generation capacity for commissioned and not yet commissioned projects, 2010–2015

PPAs remain large

The number of PPAs where we estimate RECs are retained have generally declined over time, with the exception of 2015. However, the average size of PPAs is increasing; thus, the annual MW signed has increased since 2012. Growing PPA sizes are further evident that PPA capacity growth (MW) is significantly outpacing growth in the number of projects (Figure 29). New signed capacity in 2015 was greater than signed capacity in 2014; however, this increase was due to more projects rather than larger project size. Average PPA size decreased slightly in 2015 (Figure 29), primarily because of a large 407 MW PPA signed by Google in 2014.

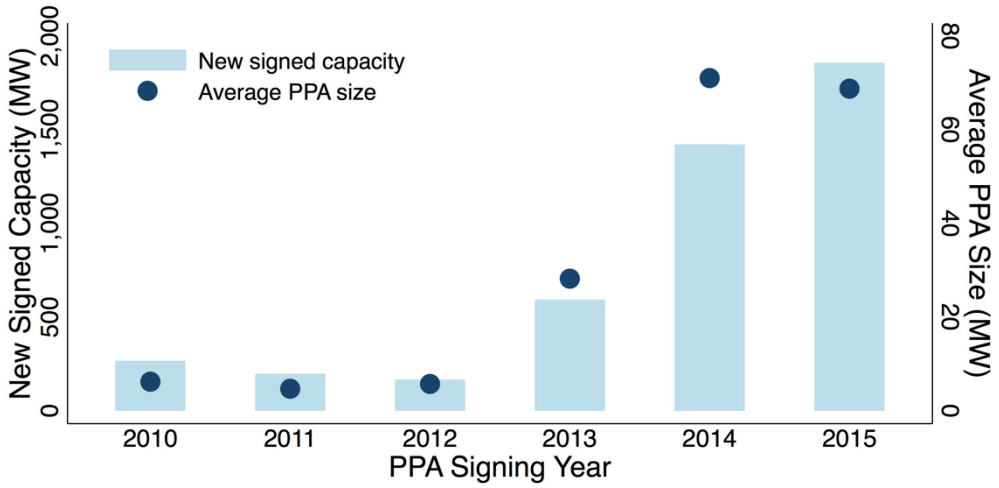

Figure 29. PPA new signed capacity and average project size from 2010 to 2015

Tech and manufacturing sectors lead the pack in PPAs

2015 PPA purchases were concentrated in the tech and manufacturing sectors (Figure 30), with the largest five purchasers being: Amazon Web Services (538 MW), Equinix (350 MW), Google

(316 MW), Facebook (202 MW), and Dow Chemical (200 MW).[14] While the tech sector has seen much publicity about their purchasing (Miller et al. 2014), Dow Chemical, Owens Corning, Proctor & Gamble, and General Motors together signed more than 600 MW in 2015. Government and university PPAs saw an increase in 2014 but subsequent decrease in 2015, mirroring 2010–2013 levels of procurement. The increase in 2014 was primarily due to a 110-MW wind PPA by the U.S. General Services Administration (GSA). Construction of that project has been delayed since a federal judge found that U.S. GSA's involvement in the project requires the agency to consider the environmental impact of the project (Law360 2015).

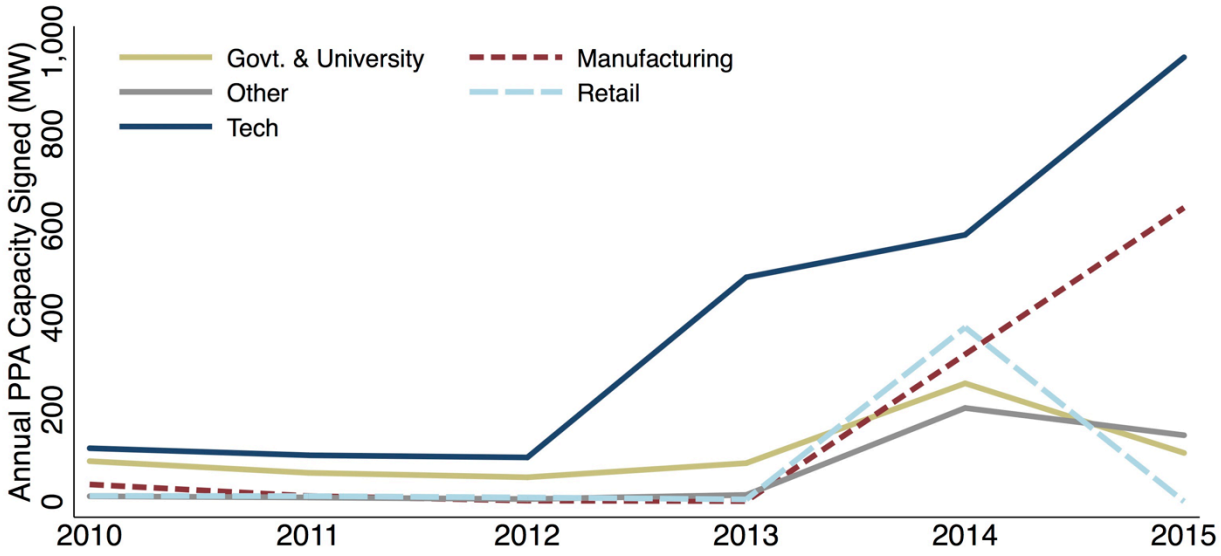

Figure 30. Annual PPA capacity signed (MW) by sector (2010–2015)

Offtakers are increasingly looking to wind

In 2010, offtakers signed 37 voluntary PPAs with solar providers for renewable energy, compared to just two PPAs with wind providers. By 2015, the balance of PPA resources had significantly shifted toward wind, with 15 solar PPAs and 11 wind PPAs (Figure 31). The shift toward wind PPAs partially reflects demand for big projects met by large wind farms and a shift toward financial PPAs.

[14] These totals include PPAs where the RECs may not have been retained by the purchaser.

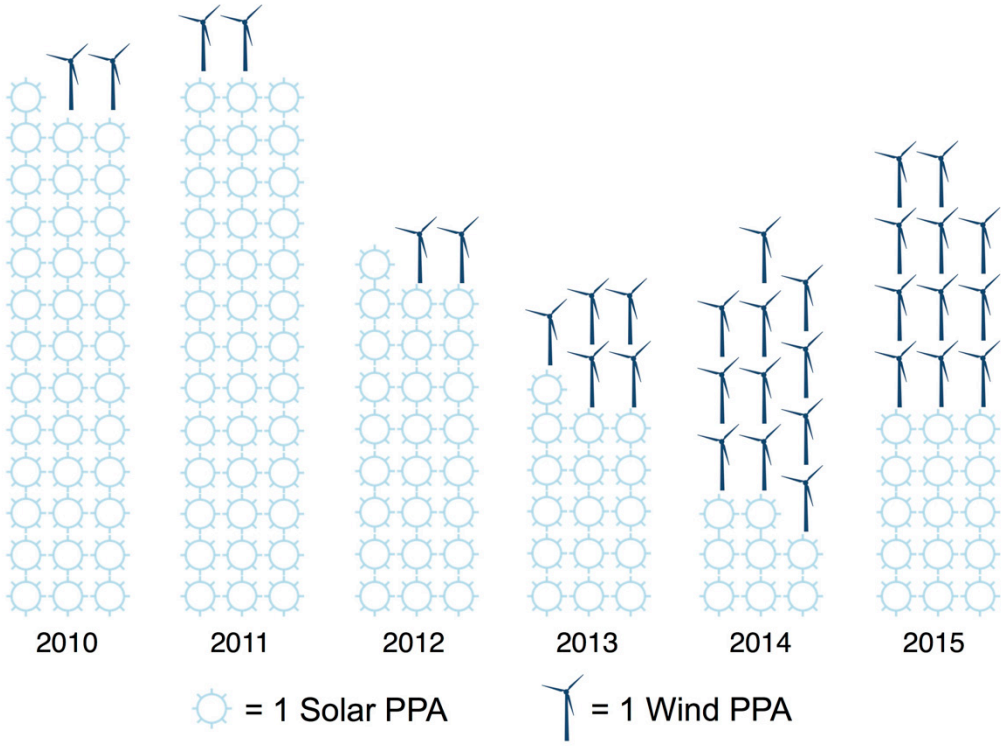

Figure 31. Number of voluntary solar and wind PPAs (2010–2015)

8.3 Estimating PPA Green Power Sales

PPAs do not always convey RECs to the offtaker. In this section, for the first time, we estimate the MWh of PPAs where the PPA offtaker is *likely* to have retained the RECs. We do not do this to say that there is no value to signing PPAs where the RECs are not retained by the purchaser. Rather, we do this to ensure that the PPAs we add to the voluntary market total are, in fact, additive. In some cases, purchasers may swap RECs from the PPA facility with unbundled RECs; when that is the case, those unbundled REC purchasers will be captured in our unbundled REC total, rather than in our PPA total.

To do this, we use data from Bloomberg New Energy Finance's U.S. Corporate PPA Project Database (BNEF 2016). To estimate the MWh of voluntary demand exclusively from PPAs, we take the signed MW from each PPA and apply a capacity factor to estimate MWh production. Estimated capacity factors were applied based on technology type and location of the generator.[15]

Estimating where offtakers retained the RECs was done based on a review of company claims in news releases, websites, and other project information. Where project data were not available, we assume no REC ownership by the PPA offtaker if the project was located in a state or utility service territory with an incentive program requiring REC exchange for a financial incentive. We err on the side of assuming that the RECs were not retained by the customer—so the estimates here present a lower bound for voluntary PPA green power sales. We estimate that offtakers are retaining the RECs for about 65% of PPA generation.

[15] Capacity factors from Lopez et al. (2012) and WindAction (2013)

9 Community Solar

In a community solar program, a utility or third-party project developer develops a solar project and sells the output to multiple subscribers (see Figure 32). Community solar subscribers generally pay for a subscribed amount of capacity ($/kW) or output ($/kWh) from the solar array. Community solar subscribers are generally compensated through utility bill credits proportional to the size of their subscription. Recent programs have deviated slightly from this format by allowing customers to subscribe to a community solar array through a utility bill premium similar to a green pricing program.

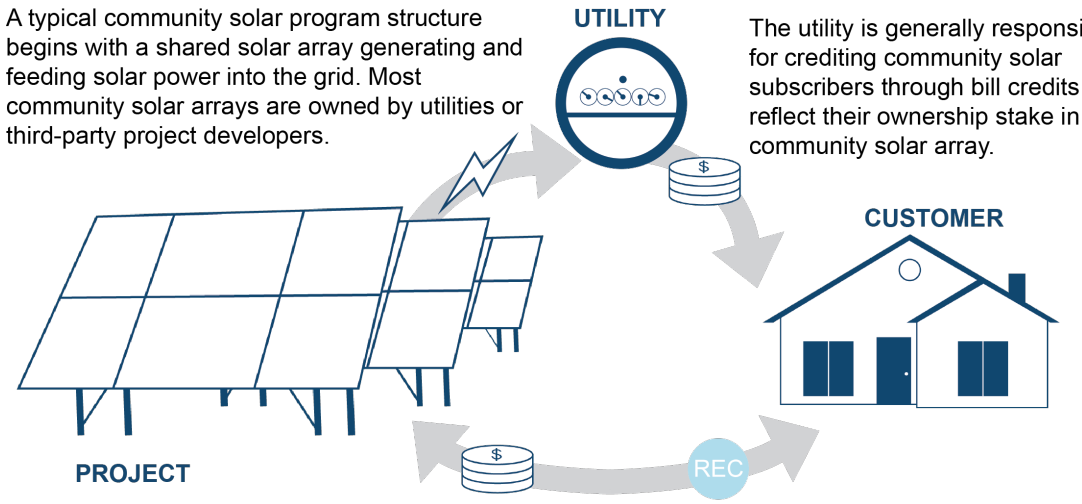

Figure 32. How community solar works

Note: Figure provides a simplified schematic for visualization purposes. Specific program structures may vary.

9.1 Status of Community Solar

In 2015, about 15,000 customers purchased 180,000 MWh of community solar output (Figure 33).[16]

[16] Data compiled from several sources including CEC 2016; IREC 2014; and CERT 2016. Due to data limitations, results include transactions where customer did not purchase RECs.

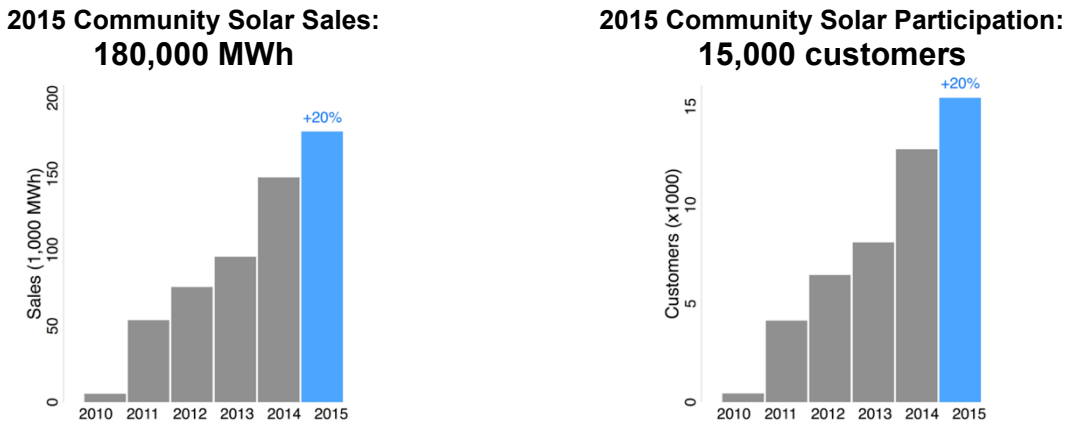

Figure 33. Community solar sales and participation from 2010 to 2015

9.2 Trends in Community Solar

As of September 2016, 112 community solar projects with a total of at least 119 MW of capacity were operational in the United States. Community solar continues to show growth, adding about 14 MW of capacity from 31 new projects in 2015 and an additional 14 MW of capacity to date from six new projects in 2016. Community solar has lagged behind early industry projections for far greater growth, largely due to regulatory uncertainty in Minnesota. We present three key trends from 2015: the geographic expansion of community solar continues; enabling legislation remains important to community solar growth; and the launch of California's community solar legislation means more customers have the opportunity to buy green power through community solar.

The geographic expansion of community solar continues

More than half of U.S. states now have a community solar project, with Montana and North Carolina becoming the 25th and 26th states to implement projects in 2015, and South Carolina and Texas becoming the 27th and 28th states to implement projects in 2016 (Figure 34). The geographic expansion of community solar is particularly notable because it has occurred in many areas not traditionally associated with strong solar markets. Hawaii and Maryland, both with proposed community solar pilot projects, are poised to become the 29th and 30th states to implement community solar projects.

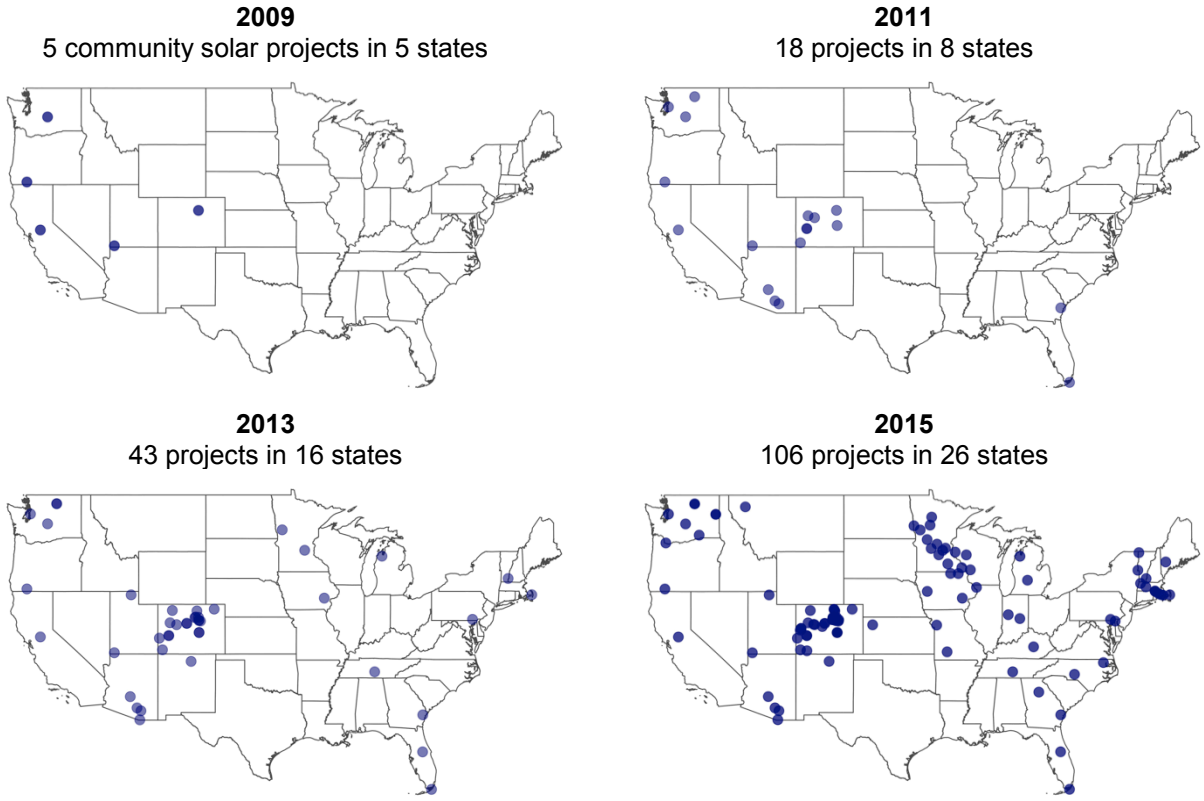

Figure 34. Community solar projects by year from 2009 to 2015

Community solar enabling legislation is important but not essential

Fourteen states and Washington, D.C., have some form of legislation enabling community solar deployment.[17] Enabling legislation can take many forms, including requirements for utilities to purchase community solar output (e.g., Colorado, Minnesota) and policies that explicitly allow virtual net metering (e.g., Massachusetts). About 66% of community solar projects have been developed in a state that had enabling legislation. However, the majority of states with community solar projects do not have legislation that explicitly enables community solar, and more than 60 MW of community solar have been deployed without the support of enabling legislation. Further, enabling legislation appears to have no effect on project size or whether the project has sold-out subscriptions.

Although it is clear that enabling legislation is not a prerequisite for the deployment of individual community solar projects, supportive policies may be foundational for large-scale community solar deployment. All four states (Colorado, Massachusetts, Minnesota, Washington) with more than five community solar projects have enabling legislation in place; however, in those states, some community solar projects have been developed without the use of enabling legislation. The role of enabling legislation is particularly salient in Minnesota. The launch of Xcel Energy's community solar program in 2014 attracted hundreds of applications in its first week and more than 1,500 applications by the end of the first year (Gleckner 2015). As of September 2016, at

[17] CA, CO, CT, DC, DE, HI, MA, MD, MN, ME, NH, NY, OR, VT, and WA.

least 12 projects were operational in Minnesota (0.8 MW), with an additional 39 projects under development (CERT 2016).

Community solar as green power emerges in California

Most community solar subscriptions do not qualify as green power purchases because most programs do not convey RECs to their subscribers (Shwastyk and Sterling 2015). Community solar RECs are generally monetized by project developers or retained by utilities for RPS compliance purposes. This REC treatment has contributed to community solar's rapid expansion by allowing project developers to offer competitive community solar rates (Shwastyk and Sterling 2015).

However, California's emerging community solar market provides a model for community solar as a green power product. In 2015, the CPUC, pursuant to California Senate Bill 43 (SB 43), established the Green Tariff Shared Renewables Program (GTSR) for California's three investor-owned utilities (IOUs). Following the rules of SB 43, the GTSR requires California's IOUs to offer 600 MW of community solar capacity to their customers that must be Green-e certified, meaning that customers must retain the RECs. The REC treatment requirement is a departure from community solar enabling legislation in other states (e.g., Colorado, Minnesota), and it creates the possibility of California's community solar market having a tangible impact on green power markets.

In February 2016, PG&E launched the Solar Choice program pursuant to the GTSR. By October 2016, the program had more than 10 MW of subscribed capacity (PG&E 2016a). The program's first round of solicitations aims to reach 50 MW of subscribed capacity. Under current terms, residential customers pay a premium of about 3.6¢/kWh to purchase the output equivalent of 50% or 100% of their home electricity use. Commercial subscription premiums range from 2.8¢/kWh to 4.9¢/kWh (PG&E 2016b).

10 Spotlight on Large Green Power Customers

The vast majority of green power participants are residential customers making relatively small purchases through green pricing programs, competitive suppliers, and CCAs. However, large non-residential customers have a disproportionate impact on green power sales by making large purchases. Further, several trends suggest that non-residential customers are taking on an increasingly prominent role in developing new green power products. This section describes the increasing share of non-residential green power sales in green power markets and posits several forces behind this large green power customer movement.

10.1 The Rise of Large Green Power Customers

Several green power market trends suggest that sales are increasing to large green power customers.

- A recent survey found that 72% of surveyed U.S. companies are actively pursuing renewables purchases (PWC 2016).
- Unbundled REC sales (primarily to non-residential customers) now comprise more than half of all green power sales, following an 18% increase from 2014 to 2015.
- U.S. corporations signed over 2.7 GW of PPAs for large-scale, off-site renewable energy in 2015, double the signed capacity in 2014, and more than triple the signed capacity in 2013 (BNEF 2016).[18] Including sales contracted for but not yet commissioned, voluntary PPAs would account for more than 15% of the green power market.
- As of August 1st, 2016, there are about 1,000 corporate partners voluntarily enrolled in the Environmental Protection Agency's Green Power Partnership program (a voluntary program in which partners commit to use green power)—collectively using over 30 million MWh of green power annually (EPA 2016).
- The emergence of utility green tariff programs in eight utility service territories offers an additional mechanism to meet large green power customer demand.

Recently, large non-residential customers are driving the creation of new green power products. The development of utility green tariffs was largely the result of large customers seeking to buy large quantities of green power in states that did not allow PPAs. Nevada has emerged as the epicenter of large customer pressure on the incumbent utility (NV Energy) to provide a green power option, illustrative of a larger green power customer movement. Several large customers (e.g., Apple, Switch) have reached resolutions with NV Energy by participating in the utility's Green Energy Rider,[19] whereas MGM Resorts is leaving NV Energy to pursue an alternative energy provider.

The recent surge in green power sales to non-residential customers has far outpaced overall growth in non-residential electricity consumption. The falling cost of renewables and low voluntary REC prices are critical factors explaining growing non-residential green power sales.

[18] U.S. corporations include all non-government entities in the BNEF US Corporate PPA Project Database (BNEF 2016).

[19] Switch's resolution is ongoing. In July 2016, Switch sued NV Energy and the Nevada PUC over its decision to reject Switch's request to leave NV Energy (Rothberg 2016).

Corporations are increasingly citing economic motives for buying renewable energy as falling costs make renewable energy more cost-competitive (PWC 2016). We discuss three additional explanations for the recent large customer green power movement: 1) corporate sustainability motives, 2) increased electricity consumption in the information and communication technology sector, and 3) advantages of procurement from large-scale renewable energy projects over on-site generation.

10.2 Green Power for Corporate Sustainability

Corporate sustainability has long been an important driver of renewable energy sales to non-residential customers (Wiser et al. 2001; Bird and Sumner 2011; Miller et al. 2014). Companies may be facing increasing pressure to find new ways to pursue sustainability. For example, to justify its decision to leave NV Energy to pursue renewable energy, MGM stated:

> "It is our objective to reduce MGM's environmental impact by decreasing the use of energy and aggressively pursuing renewable energy sources. Our imperative is heightened by increasing customer demand for environmentally sustainable destinations. Additionally, as a socially responsible company, our objective is to ensure that our decisions have a positive impact on our communities, and the people who live and work in them." (MGM 2016)

Sustainability has moved up the corporate agenda recently. A 2016 survey found that about 63% of corporations had become more inclined to purchase renewable energy in the past six months (PWC 2016). Companies are seeking to meet sustainability goals by increasing their green power use while receiving several co-benefits such as electricity price hedging, enhanced energy security, and improved corporate reputation.

In a 2016 survey, about 36% of surveyed companies had renewable energy goals (PWC 2016). Further, the survey found that 72% of the companies that are not actively pursuing renewables have greenhouse gas emission reduction goals, suggesting that more companies may pursue renewables in the future. Corporate sustainability goals were the primary driver for renewable procurement, although companies cited several other factors (Figure 35).

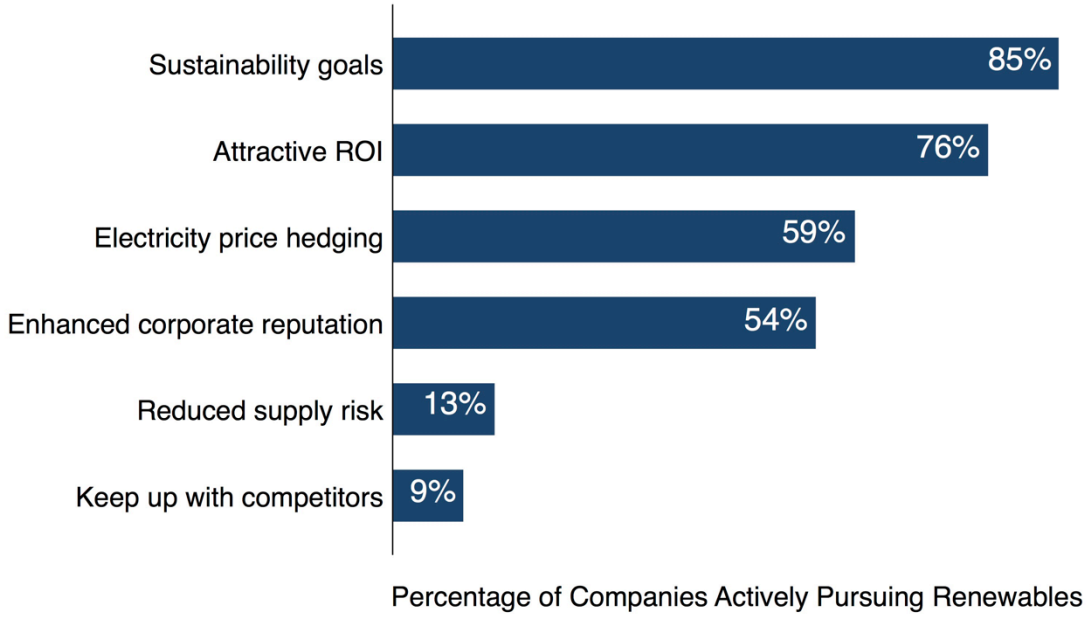

Figure 35. Corporate motives to pursue renewables

Data source: PWC (2016)

U.S. companies are also engaging with sustainability organizations to accelerate the transition to a low-carbon economy. RE100, a global collaborative initiative,[20] leads influential companies to work more proactively to address climate issues by becoming 100% powered by renewables. Among the RE100 companies, the retail sector alone used more than 10.8 million MWh of renewable electricity in 2014 (The Climate Group 2016). More than 50 companies from a variety of industries participate in the RE100 campaign, ranging from health care to manufacturing. Other organizations, such as the Rocky Mountain Institute's Business Center for Renewables, are also providing practical support for corporations to move forward with renewable energy.

10.3 Growing Renewable Electricity Demand by the ICT Sector

Despite energy efficiency improvements, the Information and Communication Technology (ICT) industry—including data centers, telecommunications, and end-user devices—still requires vast amounts of energy. U.S. data centers alone consumed about 70 million MWh of electricity in 2014 (about 1.8% of total U.S. electricity consumption) and are projected to consume nearly 200 million MWh by 2020 if energy efficiency remains at 2010 levels (Shehabi et al. 2016).

Driven by increasing energy costs and internal sustainability commitments, the large ICT companies have been important players in the large green power customer movement. ICT sector companies registered with RE100 have made more progress toward RE100 goals than any other sector—with an average of 64% renewable electricity as of 2014 (The Climate Group 2016). Between 2007 and 2014, ICT company participation in the EPA's Green Power Partnership

[20] RE100 is a collaborative, global initiative of influential businesses committed to 100% renewable electricity, working to significantly increase corporate demand and consumption of clean energy. It aims to accelerate the transformation of the global energy market and support the transition toward a low-carbon economy.

Program more than tripled, from 17 companies in 2007 to 61 companies in 2016. The 61 ICT partners in the EPA's Green Power Partnership have consumed nearly half as much green power as the other 1,338 partners combined as of August 2016 (Figure 36). In other words, ICT sector green power consumption accounts for about one third of all corporate green power purchases. Over the past decade, reported ICT sector green power use increased by more than 2,400%—from 429,073 MWh in 2006 to more than 10 million MWh in 2016 (EPA 2016).

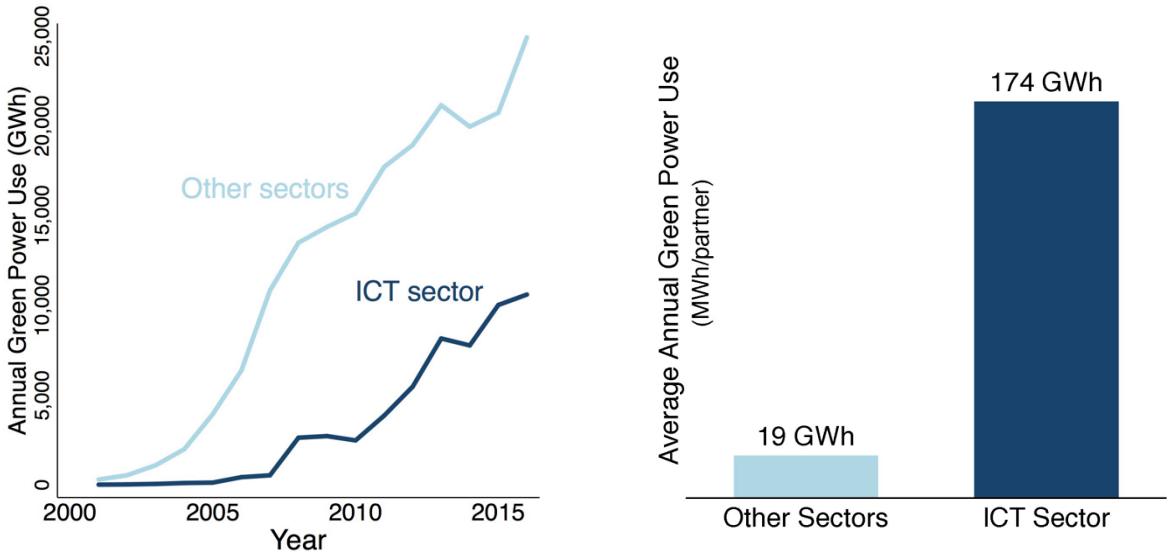

Figure 36. Green power consumption for ICT and other sector partners in the EPA Green Power Partnership

Data source: EPA (2016)

The ICT sector is projected to continue as a leader of the large green power customer movement. A previous NREL study found that 113 ICT companies sourced 14% of their electricity from renewable sources in 2014; however, the renewable share in the ICT sector could increase to 48% by 2020. With an estimated 4% annual growth in electricity demand, ICT companies could consume as much as 37 million MWh of renewable energy by 2020 (Miller et al. 2014), or about 47% of total green power sales in 2015. The ICT renewable energy expansion would be further facilitated by the increasing ease of purchasing renewable energy due to continued renewable cost declines and a growing variety of renewable procurement options including PPAs, on-site generation, utility green pricing, and utility green tariffs.

10.4 Advantages of Green Power Relative to On-Site Generation

Large customers with demand for renewable energy may be expanding from smaller on-site installations to larger off-site renewable energy products. On-site PPAs are the most popular corporate option for renewable energy procurement, although recent trends suggest a shift toward off-site PPAs (PWC 2016). There are several explanations for this shift.

First, off-site green power products, often large-scale wind farms, generally achieve lower costs through economies of scale than on-site products that typically consist of small-scale solar or small wind.

Second, the technical potential of on-site resources is more limited than the potential of off-site resources. Resource limitations such as roof size, structural obstructions (e.g., other buildings blocking sunlight), and available land space can result in on-site system capacity below what is required to meet the customer's load. Contractual restrictions, such as lease terms that do not allow on-site installations, can further limit the technical potential of on-site resources. Off-site green power options, which may be optimally sited according to the location of the renewable resource rather than the location of the customer's facilities, do not face similar technical potential constraints.

Third, off-site green power may be procured more flexibly. PWC (2016) posits that the current shift toward off-site PPAs may be driven by the growing popularity of financial PPAs. Financial PPAs can take a variety of forms, but fundamentally, they involve an agreement wherein the offtaker pays a fixed price for electricity that is not physically delivered to the offtaker. The PPA provider then sells the electricity onto the wholesale market on the offtaker's behalf. The financial PPA essentially acts as a price hedge: the offtaker earns on the PPA when the wholesale electricity rate is greater than the fixed price and loses when the rate is lower than the fixed price.

10.5 Summary

Large customers are increasingly using green power to meet a variety of corporate goals, including commitments to corporate sustainability and electricity price hedging. Recent survey results suggest that the large green power customer movement should continue for the foreseeable future as corporations show increasing interest in green power. The ICT sector has led the large green power customer movement, accounting for about a third of corporate green power purchases. Growing corporate interest in green power options may reflect some of the relative benefits of green power over on-site consumption, such as the higher technical potential of off-site resources and the contractual flexibility of green power options.

11 Conclusions and Observations

The U.S. voluntary green power market grew to 77.9 million MWh of green power sales sold to 4.3 million customers in 2015. Green power sales increased by about 9.9% from 2014 to 2015, a slightly lower growth rate than in previous years (10.9% from 2013 to 2014, and 25.5% from 2012 to 2013). The seven green power mechanisms summarized in this report showed various degrees of growth and stability in 2015.

- **Utility green pricing** sales grew about 7% to 7.5 million MWh in 2015. Increasing sales in a few large green pricing programs drives growth overall, despite falling sales in smaller programs.
- **Utility green tariffs** are a nascent green power mechanism, accounting for an estimated 380,000 MWh of sales in 2015. By September 2016, at least 13 projects had been approved under utility green tariffs (Tawney et al. 2016). Utility green tariffs may offer a win-win solution for large customers seeking green power options and utilities looking for ways to retain large customers.
- **Competitive suppliers** sold about 15.4 million MWh of green power to 1.5 million customers in 2015. The slight reduction in competitive supplier green power sales may reflect broader market trends, including falling retail electricity sales and the rise of behind-the-meter generation.
- **Unbundled RECs** sales increased by 18% from 2014 to 2015, due primarily to non-residential customers making larger purchases. With about 42.5 million MWh of green power sales, sales of unbundled RECs now comprise more than half of all green power sales.
- **Community choice aggregations** green power sales increased by 27% in California, but fell or remained steady in other states. Rising CCA sales in California are due to the continued geographic expansion of CCAs and the acquisition of more non-residential customers. Falling CCA sales in other states may be due to cyclical trends, including the responsiveness of CCA green power sales to changing economics in Illinois and cyclical program structures in Ohio.
- **Voluntary power purchase agreement** green power sales increased by 4% in 2015. At the same time, more than 5 million MWh of PPA green power sales are in the burgeoning PPA project pipeline. The full PPA project pipeline (more than 10 million MWh) equates to about 13% of total estimated 2015 green power sales.
- **Community solar** sales increased by 20% in 2015. At least one community solar project is now operational in 26 U.S. states. The launch of community solar programs under California's Green Tariff Shared Renewables program could provide a community solar model for green power where customers retain the RECs associated with their subscription.

Growth in green power sales are driven by increasing procurement by large customers. In 2015, more than 10 million MWh of green power sales entered the project pipeline in the form of signed voluntary PPA contracts. Adding this green power pipeline to total sales equates to about a 13% increase in green power sales. Further, the emergence of utility green tariff programs in

regulated states could further drive growth in large-customer green power sales. Growth in large-customer green power sales is driven by both environmental and economic motives including commitments to corporate sustainability and electricity price hedging. The ICT sector accounts for about one third of corporate green power purchasing (see Section 10).

On the other hand, in 2015, green power mechanisms designed primarily for smaller customers were relatively stable. Green power sales through utility green pricing programs, competitive suppliers, and CCAs collectively fell by about 2% from 2014 to 2015.

Looking forward, several recent trends from 2015 and early 2016 suggest that the green power market is likely to continue to experience growth in the coming years.

- Significant growth of the voluntary PPA project pipeline due to contracts signed by large corporate customers equates to built-in increases in future green power sales.
- Several large utilities are developing innovative green power mechanisms such as new utility green pricing, utility green tariff, and community solar products that could increase green power participation.
- Green power continues to expand geographically in terms of mechanisms available to customers in different regions and states. In 2016, California added two new CCAs and New York became the fifth state with a CCA offering a green power product; at least one community solar project is now operational in more than half of U.S. states; and utility green tariff programs expanded into two additional states in 2016.

These trends suggest potential for continued growth of the green power market.

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