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Status and Trends in the U.S. Voluntary Green Power Market (2013 Data)

Jenny Heeter
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With contributions from:

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Technical Report
NREL/TP-6A20-63052
November 2014

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Additional information on green power market trends and activities can be found on the Department of Energy's Green Power Network website at greenpower.energy.gov.

List of Acronyms

CCA	community choice aggregation
DG	distributed generation
EIA	Energy Information Administration
EPA	Environmental Protection Agency
ERCOT	Electric Reliability Council of Texas
GHG	greenhouse gas
ICT	information and communication technologies
IOU	investor-owned utility
kW	kilowatt
kWh	kilowatt-hour
M-RETS	Midwest Renewable Energy Tracking System
MW	megawatt
MWh	megawatt-hour
NC-RETS	North Carolina Renewable Energy Tracking System
NREL	National Renewable Energy Laboratory
PJM-GATS	PJM-Generation Attribute Tracking System
PPA	power purchase agreement
PV	photovoltaic
PUC	public utility commission
REC	renewable energy certificate
RPS	renewable portfolio standard
SREC	solar renewable energy certificate
TVA	Tennessee Valley Authority
WREGIS	Western Renewable Energy Generation Information System

Executive Summary

The "voluntary" or "green power" market is that in which consumers and institutions voluntarily purchase renewable energy to match all or part of their electricity needs. Voluntary action provides a revenue stream for renewable energy projects and raises consumer awareness of the benefits of renewable energy. There are numerous ways consumers and institutions can purchase renewable energy. Historically, the voluntary market has consisted of three market sectors: (1) utility green pricing programs (in states with regulated electricity markets), (2) competitive suppliers (in states with restructured electricity markets), and (3) unbundled renewable electricity certificate (REC) markets, where RECs are purchased by consumers separately from electricity ("unbundled"). This analysis, for the first year, also includes an assessment of an emerging sector, (4) community choice aggregation (CCA). CCAs allow communities to collectively choose the source of their electricity generation while maintaining transmission and distribution service from their existing provider. Many CCAs are sourcing significant amounts of renewable energy.

The voluntary market continued to exhibit growth and stimulate renewable energy development in 2013. Interest in products that have direct impact on renewable energy development is increasing. Utilities have begun offering programs for large industrial customers and are incorporating more local solar resources into their product mixes. CCAs are examining ways to buy local renewable resources. Large corporate purchasers in the internet and communications technology (ICT) sector are turning towards direct investment, long-term contracting, and other mechanisms to spur voluntary renewable energy development and/or realize financial gain. These customers are unique in that they have large, stable, long-term electricity load; they are purchasing in states with restructured electricity markets where there are opportunities for financial benefit. Based on our review of the voluntary market, we identified the following market trends:

- In 2013, voluntary retail sales of renewable energy totaled 62 million megawatt-hours (MWh) and represented approximately 1.7% of total U.S. electricity sales (Figure ES-1). From 2012 to 2013, total green power market sales increased 27%.[1]

[1] In this report, we gathered data and estimated the size of the CCA market for the first time. Because we include this market in the total sales figures for 2013 but not for 2012, some of sales growth from 2012 to 2013 is overestimated.

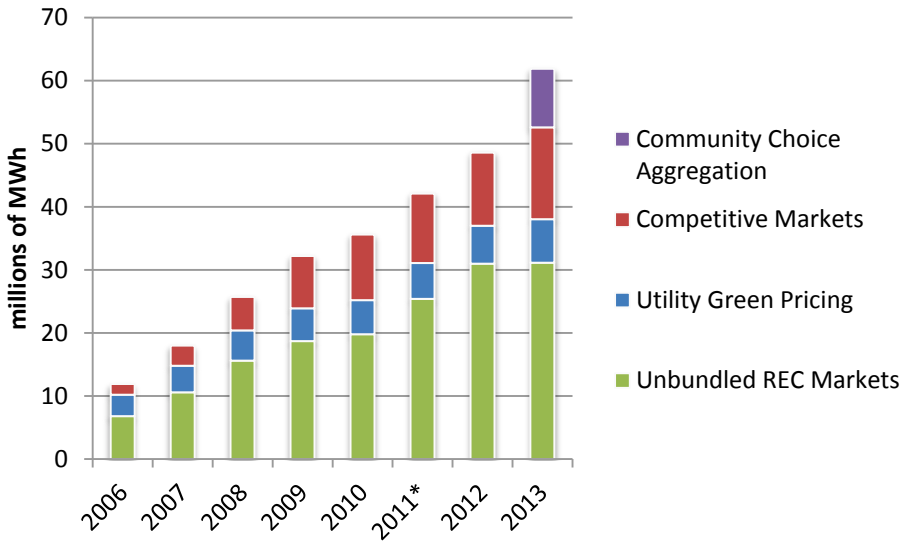

Figure ES-1. Estimated annual voluntary sales by market sector, 2006–2013

* Voluntary sales for 2011 are estimated as the mid-point of 2010 and 2012 sales.

- Approximately 5.4 million customers are purchasing green power. The number of customers in utility green pricing programs and the competitive market increased by 25% and 87%, respectively, while declining by 14% in the unbundled REC market. Residential REC market customers declined more than 20%, while nonresidential REC market customers increased by 4%.
- For 2013, we found approximately 2.4 million customers participating in CCAs that source renewable energy, totaling more than 9 million MWh of renewable energy.
- Utility green pricing sales exhibited strong growth of 15% in 2013, primarily due to sales increases in some of the largest programs.
- Competitive markets grew to 14.5 million MWh, a 25% increase from 2012, due in part to increased data availability. More competitive suppliers are reporting to Energy Information Association (EIA) through the Form 861.
- Unbundled REC markets saw little movement in 2013, increasing just 1%, to 31.4 million MWh. Increases in wholesale REC market prices and interest by large customers in procuring renewable energy in more direct ways may be causing the lack of aggressive growth seen in previous years.
- Wind energy continues to provide the most renewable energy to the voluntary market, at 75% of total green power sales, followed by landfill gas and biomass (7%), hydropower (4%), solar (1%), and geothermal (1%). The source for 12% of supply is unknown, though is likely mostly wind. Of the voluntary market sectors, green pricing programs are using the most solar; the percent solar used in green pricing programs increased from 2.0% in 2012 to 2.5% in 2013.

- The number of community solar programs is increasing. Community solar programs allow participants to purchase a portion of a larger solar array, and then receive the financial benefits of that investment, typically in the form of bill credits. In 2013, 15 new community solar projects were introduced, and as of September 2014, an additional 14 programs had begun. The capacity of existing community solar projects totals more than 40 MW, with an additional 17 MW of projects under development. The RECs from these projects are typically used to meet RPS compliance, and therefore, are not included in Figure ES-1.
- Wholesale RECs used in the voluntary market traded at around $1.20/MWh in 2013, up from less than $1.00 in previous years. Pricing is for nationally sourced projects; pricing differs by technology, region, and purchase size. The increased pricing may have contributed to the flat growth in the unbundled REC market in 2013.

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1 Introduction

"Voluntary" markets for renewable energy, or "green power" markets, are those in which consumers and institutions voluntarily purchase renewable energy to match their electricity needs. These purchases are in addition to renewable energy that is used to fulfill renewable portfolio standards (RPS). Traditionally, entities purchased renewable energy through utility green power programs, green power marketing activities in competitive electricity markets, or in unbundled REC markets. Emerging methods of voluntary procurement are providing customers with new ways to support renewable energy. In some cases, new models are providing a hedge against future electricity price increases or other benefits, but they do not provide the environmental benefit to the customer (i.e., the REC is transferred to another party). All of these approaches are covered in this report:

- **Utility green pricing (regulated utility markets).** Utility green pricing programs began in the early 1990s when a few utilities offered options to their customers. These programs continue to be offered by utilities in traditionally regulated electricity markets. In utility green pricing programs, RECs are obtained by the utility and offered to customers. Utilities differ in how they procure RECs for their green pricing programs but often enter into power purchase agreements for the energy and RECs. In other cases, they may procure unbundled RECs.
- **Competitive suppliers (competitive utility markets).** In states with competitive (or restructured) retail electricity markets, electricity customers can often buy electricity generated from renewable sources by switching to an alternative electricity supplier that offers green power. In some of these states, default utility electricity suppliers offer green power options to their customers in conjunction with competitive green power marketers so that switching is not required. More than a dozen states that have opened their markets to retail competition have experienced some green power marketing activity.[2]
- **Voluntary unbundled REC market (separate from electricity).** Whether or not customers have access to a green power product from their retail power provider, they can purchase green power through unbundled RECs. More than 60 companies offer unbundled RECs to retail customers via the Internet, and a number of other companies market RECs solely to commercial and wholesale customers.

[2] States with competitive offerings include Connecticut, Delaware, Illinois, Maine, Maryland, Massachusetts, Michigan, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, and Texas. Washington, D.C. also has green power marketing activity.

- **Community choice aggregation (CCA).** Authorized in six states, CCAs allow communities to determine their electricity generation sources by aggregating the community load and purchasing electricity from an alternate electricity supplier while still receiving transmission and distribution service from their existing provider. CCAs are sometimes described as a hybrid between services offered exclusively by investor-owned utilities (IOUs) and municipal utilities. CCAs are typically opt-out programs, meaning that customers must take action to opt-out, whereas green pricing programs are opt-in programs, requiring customers to take action to subscribe. This distinction leads to much higher enrollment rates for CCAs compared to green pricing programs.

  We tracked CCA renewable purchases for the first time in this report. We found that CCAs are purchasing more than 9 million MWh of renewable energy – making the sector larger than the utility green pricing sector. Although most of the supply for CCAs is coming from competitive suppliers, we separate the figures in this report to show the relative size of each.

- **Community solar.** Community solar programs allow utility customers to purchase a portion of a larger solar project. Customers then receive the benefits of the energy that is produced by their share. Structures differ, but a common model is for the RECs to be transferred to the utility to meet compliance with an RPS. As of September 2014, 64 community solar projects totaling more than 40 MW exist in the United States.

- **Large direct project investment and "crowdfunding."** Large organizations have made direct investments in renewable projects. For example, Google's investments have supported more than 2,500 MW of wind and solar in the United States. On a smaller scale, crowdfunding, which allows individuals to contribute to project financing, has supported solar development. For example, Mosaic, a crowdfunding platform for solar, has invested in more than 30 MW of solar. Project investments, whether large or small, typically do not convey the RECs to the investors. Investors also do not receive the power produced by the project.

- **Direct power purchase agreements and large commercial customer green power rates.** A number of corporations, universities, and others have negotiated power purchase agreements for renewable energy. Importantly, not all states allow for power purchase agreements. PPAs are more commonly allowed in states with restructured electricity markets. A few utilities now have new tariffs that allow large utility customers to purchase renewable energy from a specific facility in the utility service territory, instead of negotiating a power purchase agreement directly.

- **On-site solar/solar leasing.** On-site solar systems, which in some states are primarily owned by third parties, allow customers to provide a location for a solar system and potentially see savings on electricity expenditures. In most cases outside of California, the RECs from on-site solar systems are sold to a utility to use for RPS compliance, sometimes in exchange for an incentive.

Table 1 outlines these emerging models and highlights the relative market sizes compared to utility green power, competitive suppliers, and unbundled RECs. While the emerging methods have seen large growth in recent years, the capacity they support as of 2013 was much less than is supported by utility green pricing, competitive suppliers, and the unbundled REC market. In some cases, markets do overlap, making it difficult to compare true market sizes.

Table 1. Comparison of Voluntary Support Mechanisms

Support Mechanism	REC Ownership	Value Proposition	Market Size
Utility green power or competitive supplier	With customer	Match part or all of electricity use with renewables; corporate sustainability goals	8,700 MW
Unbundled RECs	With customer	Match part or all of electricity use with renewables; corporate sustainability goals	11,300 MW
On-site photovoltaics (PV)	Outside of California, typically sold to utility or exchanged for incentive payment	Support renewables development by providing a host site; potentially lower electricity bill through use of net metering	2,218 MW residential, 4,044 MW nonresidential[a]
CCA	Typically with consumer	Match part or all of electricity with renewables; meet municipal greenhouse gas (GHG) reduction or renewable energy targets	4,100 MW
Community solar	Varies, currently almost always sold to utility or exchanged for incentive payment	Support local solar development; potentially lower electricity bill	40 MW (September 2014)
Power purchase agreements/ large commercial customer green power rates	Varies	Corporate sustainability goals; support new renewables; potential price hedge	Unknown; 2.3 million MWh under long-term contract by EPA Green Power Partners as of January 2014
Direct project investment	Typically with project developer	Support new renewables; potential financial return	Aggregate unknown; 2,500 MW by Google[b]
Crowdfunding	Varies	Support new solar development; potential financial return	Aggregate unknown; 33 MW by Mosaic[c]

[a] SEIA and GTM (2014)
[b] As of May 2014 (Google 2014).
[c] As of May 2014 (Mosaic 2014).

The voluntary market continues to play a large role in the overall renewable energy market. Figure 1 estimates market sizes by showing the total non-hydropower renewable generation in the U.S. (EIA 2014), split into voluntary, compliance, and "other renewables"; "Other renewables" include renewable energy procured on a least-cost basis or by utilities that are not subject to an RPS and are not using the RECs to supply a voluntary program. This figure is only an estimate as some hydropower is used in compliance and voluntary markets. This figure will evolve over time; by 2015, compliance demand for new renewable energy due to existing state RPS policies is expected to be about 140 million MWh (Heeter 2013). [3]

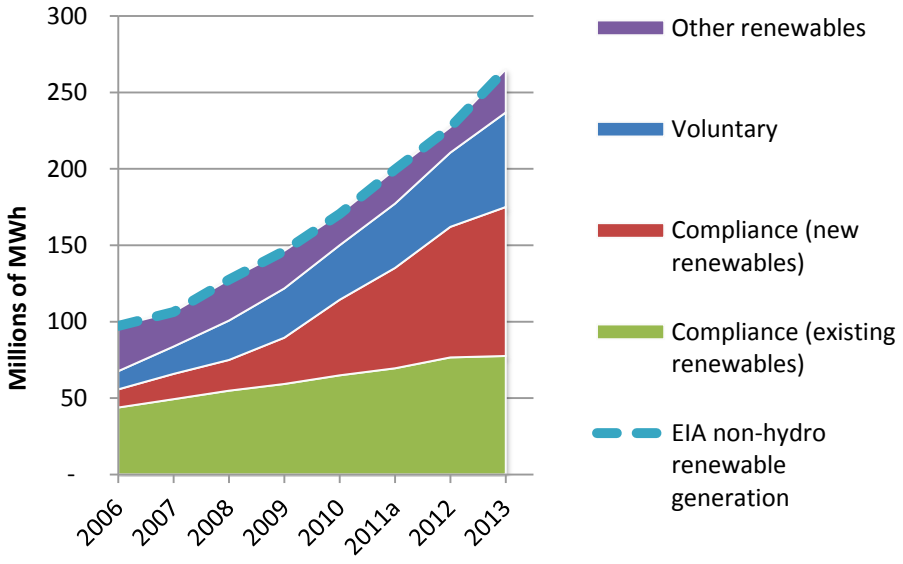

Figure 1. Comparison of renewable energy estimated market sizes, 2006–2013

Sources: Heeter (2013); EIA (2014a)

[a] Voluntary sales for 2011 are estimated as the mid-point of 2010 and 2012 sales.
Estimates of compliance market demand assume that RPS targets are fully met. Solar generation assumes a 25% capacity factor for CSP and an 18% capacity factor for PV.

The data on voluntary market trends presented in this report were formerly reported in *Status and Trends in U.S. Compliance and Voluntary Renewable Energy Certificate Markets (2012 Data)* (Heeter and Nicholas 2013), *Market Brief: Status of the Voluntary Renewable Energy Certificate Market (2011 Data)* (Heeter et al. 2012), and *Status and Trends in U.S. Compliance and Voluntary Renewable Energy Certificate Markets (2010 Data)* (Heeter and Bird 2011).[4]

[3] Although RPS policies generally allow pre-existing renewable energy generation sources (i.e., those installed *before* the adoption of the RPS) to meet their targets, the estimates presented here reflect only the amount of new renewable energy generation that these policies are expected to stimulate. These figures are compared to the voluntary market estimates because the voluntary market primarily supports generation from new renewable energy projects (i.e., those installed *after* voluntary green power markets were established). Estimates of compliance market demand assume that RPS targets are fully met.

[4] Voluntary market data from previous years are captured in earlier versions of this report, including Heeter et al. (2012), Heeter and Bird (2011), Bird and Sumner (2010), Bird et al. (2009), and Bird et al. (2008).

Voluntary market data are based on figures provided to the National Renewable Energy Laboratory (NREL) by utilities and independent renewable energy marketers. NREL also supplements this data with information from EIA, REC certifiers, REC tracking systems, and press releases describing large voluntary green power purchases. Because data cannot be obtained from all market participants, the estimates presented here likely underestimate the market size. Because obtaining data on competitive markets is particularly challenging due to market sensitivity and rapid changes in offerings, estimates of the competitive market are more uncertain.

This report presents data and analysis on voluntary market sales and customer participation, products and premiums, green pricing marketing, and administrative expenses. The report also details trends in REC tracking systems, REC pricing in voluntary and compliance markets, community and crowd-funded solar, and interest in renewable energy by the ICT sector.

2 Voluntary Green Power Market

Voluntary consumer purchases of renewable energy represent a market support mechanism for renewable energy development. In the early 1990s, a small number of U.S. utilities began offering "green power" options to their customers. Since then, these products have become more prevalent, offered by traditional utilities and renewable energy marketers operating in states that have introduced competition into their retail electricity markets or offering RECs online. Today, more than half of all U.S. electricity customers have an option to purchase some type of green power product directly from a retail electricity provider, while all consumers have the option to purchase RECs.

2.1 Voluntary Market Sales

Overall, retail sales of renewable energy in voluntary green power markets totaled nearly 62 million MWh and represented approximately 1.7% of total U.S. electricity sales in 2013.[5]

Green power sales (in megawatt-hours) increased by 27% between 2012 and 2013, or 8% when CCAs are not included (see Table 2 and Figure 2). Because we began estimating CCA sales in 2013, no prior market estimate is available. The unbundled REC market accounted for half of all green power sales, less than in previous years, and the competitive market sector is increasing its share. While we show the competitive market at 14.5 million MWh, much of the CCA supply (9.3 million MWh) also comes from competitive suppliers.[6]

Text Box 1 highlights purchasing by federal agencies, which has also increased in recent years, and will continue to increase through 2020.

[5] U.S. electricity sales totaled 3,692 million MWh in 2013 (EIA 2014b).

[6] The REC sales figures reflect sales to end-use customers separate from electricity. RECs bundled with electricity and sold to end-use customers through utility green pricing programs or in competitive electricity markets are counted in other categories.

Table 2. Estimated Annual Voluntary Sales (Millions of MWh) by Market Sector, 2006–2013[a]

Market Sector	2006	2007	2008	2009	2010	2012	2013
Utility Green Pricing	**3.4**	**4.2**	**4.8**	**5.2**	**5.4**	**6.0**	**6.9**
% Change from previous year	39%	23%	15%	7%	5%	5%[f]	15%
Competitive Markets	**1.7[b]**	**3.2**	**5.3[c]**	**8.3[c]**	**10.4**	**11.6**	**14.5**
% Change from previous year	-20%[d]	88%	64%[c]	56%[c]	25%	6%[f]	25%
CCA			**Not estimated**				**9.3**
Unbundled REC Markets[e]	**6.8**	**10.6**	**15.6**	**18.7**	**19.8**	**31.0**	**31.4**
% Change from previous year	75%	55%	49%	20%	6%	25%[f]	1%
Retail Total	**11.9**	**18.0**	**25.7[c]**	**32.2[c]**	**35.6**	**48.6**	**61.9**
% Change from previous year	40%	51%	43%[c]	25%[c]	11%	17%[f]	27%

[a] Includes sales of new and existing renewable energy; totals and growth rates may not compute due to rounding.

[b] Sales figures for 2006 may be underestimated because of data gaps.

[c] Competitive market sales for 2008 and 2009 were revised upward in this report to reflect data on green power markets in Texas published by the Texas public utility commission (PUC) in 2010 and 2011. For historical reports, see https://www.texasrenewables.com/reports.asp (Accessed October 14, 2013.)

[d] 2006 number is likely underestimated because of data gaps.

[e] Includes only RECs sold to end-use customers separate from electricity (unbundled).

[f] Compound annual growth rate for 2010–2012; changes from 2010 to 2012 were 11% for utility green pricing, 12% for competitive markets, 56% for unbundled REC markets, and 37% total.

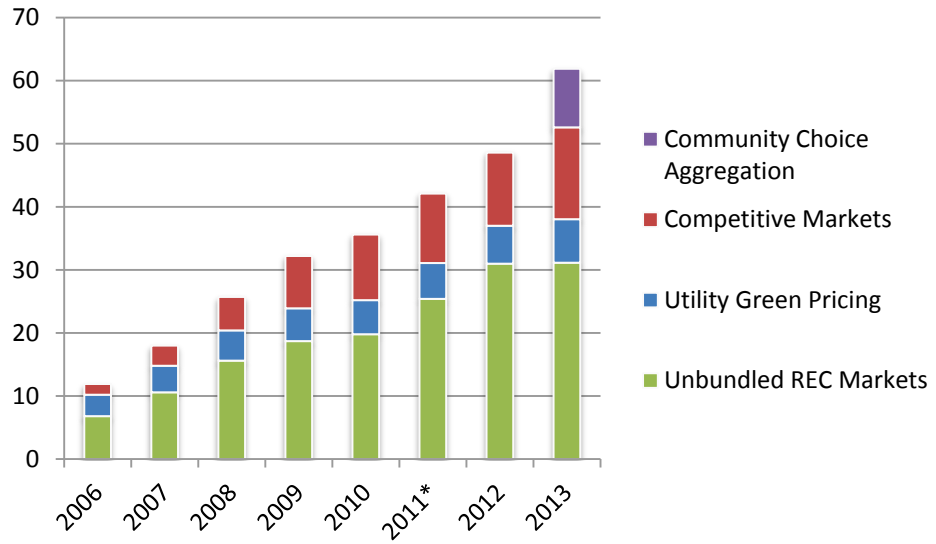

Figure 2. Estimated annual voluntary sales by market sector, 2006–2013

* Voluntary sales for 2011 are estimated as the mid-point of 2010 and 2012 sales.

Text Box 1. Federal sector renewable energy purchasing

The federal government is a large and growing purchaser of renewable energy. The Energy Policy Act of 2005 required that the federal agencies purchase 7.5% of their facility energy from renewable sources in 2013. By 2020, agencies are required – to the extent economically feasible and technical practicable – to use renewable energy equal to 20%, as directed by the December 5, 2013 Presidential Memorandum on Federal Leadership in Energy Management. The Department of Defense has a goal to develop 3 GW of renewable energy on Army, Navy, and Air Force installations by 2025.

In fiscal year 2013, agencies purchased 3.4 million MWh of "new" renewable energy, and 0.6 million MWh of "old" renewable energy, for total use of 4.1 million MWh, or 7.4% of facility energy use (DOE 2014). Federal policy allows for bonuses for renewable energy on federal or Indian land; when those bonuses are included, the percentage increases to 9.2%.

Of the renewable energy purchased by federal agencies (not including on-site generation), wood and wood residuals make up half, followed by wind (27%). Hydropower makes up 10% (conventional 7% and incremental 3%), followed by biogas (6%), municipal solid waste (3%), and solar PV (1%). Conventional hydropower is reported but does not count towards renewable requirements.

Federal government purchases (outside of on-site generation) are primarily through RECs (86%), though some renewable energy is being purchased through utility programs or other bundled contracts (14%).

In terms of resources used, wind energy represented 75% of 2013 total green power sales, followed by biomass energy sources, including landfill gas (7%), hydropower (primarily low impact or small hydropower, 4%), solar (1%), and geothermal (1%) (Figure 3). Of the voluntary market sectors, green pricing programs are using the most solar; the percent solar used in green pricing programs increased from 2.0% in 2012 to 2.5% in 2013.

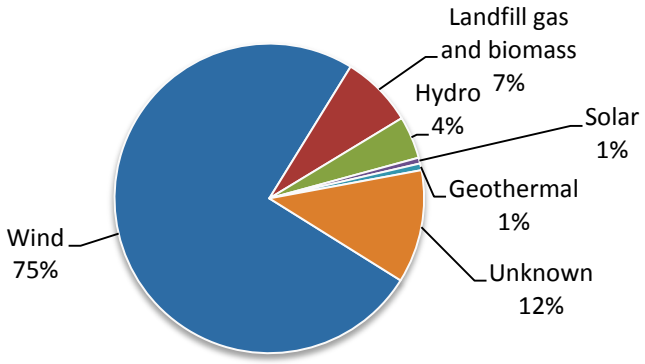

Figure 3. Estimated green power sales by renewable energy source, 2013

2.1.1 Utility Green Pricing Sales

Utility green pricing sales rebounded strongly in 2013, driven by large gains in some of the largest green pricing programs. Portland General Electric, Austin Energy, and CPS Energy increased green power sales by 18%, 16%, and 14%, respectively.

Collectively, utilities in regulated electricity markets sold about 6.9 million MWh of green power to customers in 2013 (Table 2). Green pricing program sales to all customer classes grew by a compound annual growth rate of 15% between 2012 and 2013, exhibiting growth similar to that in 2008 and prior years (Table 2). While some programs continue to grow robustly, growth in this sector is quite uneven, with some programs seeing large gains and others seeing declining sales.

In utility green pricing programs, the average residential purchase in 2013—approximately 5,400 kilowatt-hours per year (kWh/year)—was slightly lower than that in 2012 (5,800 kWh/year) but consistent with 2008 (approximately 5,500 kWh/year). The average nonresidential purchase increased about 9% in 2013, to about 248,000 kWh/year, after increasing nearly 60% between 2010 and 2012. Purchasing by the University of Tennessee, Knoxville in Tennessee Valley Authority's (TVA) green pricing program drove that utility's average nonresidential purchase rate up dramatically from the national average. The University of Tennessee, Knoxville is ranked 68th on the Environmental Protection Agency's (EPA) Green Power Partnership (GPP) top partner list, purchasing more than 80,000 MWh from TVA and through on-site generation.

In 2013, green pricing sales represented a small proportion of a utility company's overall energy sales. On average, renewable energy sold through green pricing programs in 2013 represented 1.3% of total utility electricity sales of the utilities offering green pricing programs (on a megawatt-hour basis). Top performing programs saw rates ranging from 3.3% to 23.8%. Due to

a large nonresidential purchase, one small utility reported that 23.8% of its total retail electricity sales were green power sales.

In 2013, utility green power supply typically came from within a utility's broader region (93%) (Table 3).[7] Nearly a quarter of utility green power supply came from within the utility's service territory.

When examining the type of procurement, unbundled RECs account for more than half (55%) of utility green pricing supply, followed by bundled RECs (36%). While unbundled RECs are typically procured through contracts of five years or less, the vast majority of bundled RECs (95%) are procured through contracts of 11+ years. Smaller portions of utility green power supply came from systems owned by the utility (7%) or was purchased from utility customers (e.g., from on-site solar systems) (2%). These trends are consistent with those reported for 2012.

Table 3. Location of Utility Green Power Supply, 2013

Within Service Territory	Within State	Within Region[7]
24%	61%	93%

Table 4. Contract Length by Type of Utility Green Power Procurement, 2013

Contract Length	Unbundled RECs	RECs Bundled with Electricity	Projects Owned by Utility	RECs Produced by Utility Consumers
≤1 year	46%	0%	0%	0%
2–5 years	52%	0%	0%	19%
6–10 years	2%	5%	0.02%	4%
≥11 years	0%	95%	99.98%	77%
Percent of total procurement	55%	36%	7%	2%

2.1.2 REC and Competitive Market Sales

In REC markets and competitive green power markets (i.e., in states with retail competition), an estimated 45.9 million MWh of renewable energy was sold to retail customers in 2013 (Table 2). Overall, 2013 saw large gains in competitive electricity markets but nearly flat growth in the unbundled REC market.

In competitive electricity markets, an estimated 14.5 million MWh were sold as a bundled green power product in competitive electricity markets—a 25% increase from 2012. The increase is likely in part due to increased data availability. Competitive suppliers increasingly reported to EIA in 2014. Overall though, due to the challenges of obtaining data from competitive marketers

[7] Utilities were asked to self-define region. Typically the region was considered to be the regional transmission organization or independent system operator boundary, or in the Western U.S., the Western Electricity Coordinating Council.

and the lack of current data on the Texas market, which has seen a dramatic increase in the number of companies offering renewable energy products in recent years, the sales figures for the competitive market are likely underestimated.

Retail REC sales (unbundled RECs) increased by 1% in 2013, to 31.4 million MWh. The declines are due to decreased purchasing by nonresidential customers. It is possible that the increase in REC pricing in 2013, from around $1.00/MWh to $1.20/MWh, impacted nonresidential sales of unbundled RECs. The lack of aggressive growth could also be due to some large purchasers switching from unbundled REC purchases to PPAs and on-site generation.

2.1.3 CCA Sales

For the first year, we estimate renewable energy sales by CCAs. The sector totaled 9.3 million MWh of renewable energy in 2013, dominated by sales in Illinois. Data come from competitive suppliers, communities themselves, news releases and other public information, as well as our own estimates. These trends are further discussed in Section 3.

2.1.4 Capacity Equivalent of Green Power Sales

At the end of 2013, megawatt-hour sales of voluntary renewable energy represented a generating capacity equivalent of approximately 24,000 MW (see Table 5).[8,9] The dramatic growth from 2012 to 2013 (39%) is due in part to the addition of CCAs to the 2013 survey. Not including CCAs, the voluntary market was 19,900 MW, a 16% increase from 2012.

Since 2007, when total renewable capacity supplying the green power market was 5,100 MW, the amount of renewable energy capacity serving green power markets has increased nearly five-fold.

[8] Capacity estimates are calculated based on reported green power kilowatt-hour sales, assuming capacity factors for each renewable resource type based on industry data and average capacity factors of operating plants. For wind, a capacity factor of 26% was assumed, 85% for landfill gas, 83% for biomass, 65% for geothermal, 42% for hydroelectric, and 14% for solar electric.

[9] "New" renewable energy capacity is defined here as capacity that was sourced from renewable energy systems that were built or repowered after January 1, 1997.

Table 5. Estimated Cumulative Renewable Energy Capacity (MW) Supplying Green Power Markets, 2008–2013

Market Segment	2009	2010	2012	2013
Utility Green Pricing	1,700	1,700	2,400	2,600
Competitive Markets and Unbundled RECs	7,700	9,400	14,900	17,400
CCA		Not estimated		4,100
Total	**9,400**	**11,200**	**17,300**	**24,000**

Note: Totals may not sum due to rounding.

2.2 Voluntary Market Customer Participation

In 2013, approximately 5.4 million electricity customers nationwide purchased green power products through regulated utility companies, from green power marketers in a competitive-market setting, from a CCA, or in the form of RECs (Table 6).[10] Participation in utility green pricing programs and competitive markets rebounded after an essentially flat year in 2012. REC market participation declined overall, due to declines in the number of residential customers. CCA participation totaled approximately 2.4 million, with 2.1 million of those customers coming from Illinois.

[10] It is important to note that there is greater uncertainty in our customer estimates for competitive and REC markets because of data limitations. For more detailed estimates by state for 2009 and 2010, see data from EIA 2011. Generally, our estimates are consistent with the EIA estimates when adjusted for customers in Ohio who participated in community aggregations in 2005 and earlier. We excluded these customers from our estimates because they purchase products with very low renewable energy content (1%–2%).

Table 6. Estimated Cumulative Green Power Customers by Market Segment, 2006–2013

	2006	2007	2008	2009	2010	2012	2013
Utility Green Pricing	**490,000**	**550,000**	**550,000**	**550,000**	**570,000**	**570,000**	**706,000**
Residential	470,800	526,700	519,700	526,300	544,700	549,600	683,600
Nonresidential	15,500	20,200	26,100	26,000	22,900	17,200	22,400
% Residential Growth	23%	12%	-1%	1%	4%	0.4%[a]	24%
% Nonresidential Growth	37%	30%	29%	-1%	-12%	-13%[a]	30%
Competitive Market	**~ 210,000**	**300,000**	**390,000**	**830,000**	**~ 1,200,000**	**~ 1,200,000**	**~2,200,000**
CCA				**Not estimated**			**~2,400,000**
Voluntary REC Market	**~ 10,000**	**> 10,000**	**30,000**	**< 20,000**	**> 60,000**	**~110,000**	**~95,000**
Retail Total	**~ 710,000**	**~ 860,000**	**~ 970,000**	**~ 1,400,000**	**~ 1,830,000**	**~1,870,000**	**~5,400,000**
% Change	~ 22%	~ 21%	~ 13%	~ 44%	~ 25%	~2%	~190%

In some cases, estimates have been revised from those reported in previous NREL reports as updated data have become available. Totals may not add due to rounding.

[a] Compound annual growth rate for 2010–2012.

2.2.1 Utility Green Pricing Participation

The number of green pricing customers rebounded in 2013 to more than 700,000 (Table 6). As in the past, a small number of green pricing programs account for the majority of customers, with just 10 utilities accounting for 68% of all participants.[11] Both residential and nonresidential customers increased in 2013; nonresidential customers increased to near-2010 levels, after declining in 2012.

At the end of 2013, the average participation rate in utility green pricing programs among eligible utility customers was 2.8% with a median of 1.1%. These industry-wide rates have shown little change in recent years. Participation rates in top-performing programs have remained relatively unchanged since 2007, thought they have improved compared to the ranges in early years: top-performing participation rates ranged from 6.5% to 18.2% in 2013, compared to a range of 3.9% to 11.1% in 2003.

Green pricing program drop-out rates are important for program managers to examine, as they may highlight issues with customer satisfaction. Customers may drop out of green pricing programs if they do not perceive real value in their participation, if there was a price increase, or for other reasons, sometimes not related to satisfaction. For example, some programs do not automatically transfer a customer's participation if they move within the utility service territory; it is up to the customer to re-enroll in the program. In 2013, utilities reported that an average of 8.7% and a median of 6.6% of customers dropped out of green pricing programs, consistent with 2012. These figures represent an increase from 2010 when utilities reported an average dropout rate of 7.0% and a median of 4.7%, but the figures are consistent with previous years. In 2012 the median dropout rate was 8.5% and the average was 7.2%; in 2009 utilities reported an average of 7.8% and a median of 6.3%.

2.2.2 Competitive Market Participation

The competitive market grew to 2.2 million customers in 2013, driven by increases in residential customers. Residential customers increased from 1.1 million in 2012 to 2.1 million in 2013. Nonresidential customers also increased from 75,000 to 120,000. Because obtaining data about the competitive market is particularly challenging, these figures likely underestimate the number of participants in competitive market programs. EIA has begun collecting more data from competitive suppliers through its Form 861.

EIA provides customer numbers for both utility green pricing and competitive suppliers, by state. Data for 2012 show that Texas remains the state with the most customers (1.2 million, including utility green pricing customers). Illinois saw a large increase in customers and sales between 2011 and 2012, due to competitive suppliers active in the CCA market, as will be discussed in

[11] NREL issues five different Top 10 lists based on total sales of renewable energy to program participants, total number of customer participants, customer participation rates, green power sales as a fraction of total utility sales, and the premium charged to support new renewable energy development. These lists can be found at http://apps3.eere.energy.gov/greenpower/markets/pricing.shtml?page=3.

Section 2.2.3. Maryland, New Jersey, and New York also had large increases in the number of customers.[12]

While the number of green power purchasers has expanded during the past few years in markets with retail competition, participation has been less consistent over time, as some markets have grown and then contracted. Between 2011 and 2012, participation increased in most states with competitive markets, with the exception of Delaware and Maine, which have relatively small numbers of customers to begin with (2,838 and 375, respectively).

Data from EIA also show that state participation rates vary greatly. More than 4% of electric customers in Texas were participating in either a green power or competitive market program, according to EIA data.[13] Several other competitive market states (Connecticut, New York, and Vermont) have seen participation greater than 1% in 2012 and 2011. Over time, participation has generally been more volatile in competitive markets than in traditionally regulated markets.

2.2.3 CCA Participation

Nationwide, approximately 2.4 million customers participate in CCAs purchasing renewables (Table 8). CCAs in Illinois include a total of approximately 2.1 million customer accounts, primarily on the residential side. We do not include Chicago's CCA in these totals because its supply only contains 5% renewable energy, but Chicago's CCA serves approximately 750,000 accounts. In 2015, California's Sonoma County is expected to have an additional 150,000 CCA subscribers. Sonoma County offers a 33% renewable product as its base product and a 100% renewable product for a premium. See Section 3 for more information about CCA participation.

2.2.4 Unbundled Voluntary REC Market Participation

The number of REC-only buyers declined to around 95,000 in 2013, after seeing large gains in 2012. The number of residential REC-only buyers declined from around 87,000 to 71,400. Nonresidential REC-only buyers increased slightly, from around 22,000 to 23,600.

While most REC buyers are residential customers, the majority of REC sales on a megawatt-hour basis are made to nonresidential customers, due to the much larger purchase sizes. As a result of large nonresidential REC purchases, REC sales represented about half of total green power megawatt-hour sales in 2013 (Table 2) and have grown dramatically in recent years.

2.3 Voluntary Market Products and Premiums

2.3.1 Utility Green Pricing Products and Premiums

Typically, green pricing programs are structured so that customers can either purchase green power for a certain percentage of their electricity use (often called "percent-of-use products") or in discrete amounts or blocks at a fixed price ("block products"), such as a 100-kWh block. Most utilities offer block products but may also allow customers to buy green power for their entire monthly electricity use. Utilities that offer percent-of-use products generally allow residential

[12] The EIA figures include customers in both utility green pricing programs and competitive market programs, but they do not include all competitive retailers; therefore, these estimates underestimate the total number of customers but serve to show at a minimum the level of growth in Texas.
[13] EIA data also include participants in utility green pricing programs.

customers to elect to purchase 25%, 50%, or 100% of their electricity use as renewable energy, while a few offer fractions as small as 10%. Under these types of programs, larger purchasers, such as businesses, can often purchase green power for some fraction of their electricity use as well.

More recently, the concept of community solar has emerged. In community solar programs, customers purchase a share of a community solar system. In return, they obtain a proportionate share of the system output, which is credited to them on their utility bills. These programs are offered by utilities or third parties operating in conjunction with utilities. Community solar programs differ in terms of the upfront cost and return payment received by participants. One program, the Holy Cross Energy solar project, sells upfront shares for $3.15 per watt (W) and credits participants at a rate of $0.11/kWh for producing their shares.[14] Community solar programs are addressed in depth in Section 4.

In 2013, the price of green power for residential customers in utility programs ranged from 1.04¢/kWh below standard electricity rates to 4.5¢/kWh above standard electricity rates, with an average premium of 1.77¢/kWh and a median premium of 1.50¢/kWh.[15] These premiums have been adjusted to account for any fuel-cost exemptions granted to green power program participants.[16] This is the first year that average and median premiums have increased. The increase was due to the additional data collection in 2013 from utilities with higher-priced programs. For programs that reported both 2012 and 2013 data, there was little change in average and median premiums; 20 programs had the same premium, 13 programs had decreased premiums, and 5 programs had increased premiums.

Despite the increase in average and median premiums in 2013, from 2002 to 2013, the average price premium dropped at a compound annual rate of 4% (see Figure 4). The general downward trend in price premiums can be attributed to lower market costs for renewable energy supplies or increased competitiveness with conventional generation sources. The competitiveness of wind and other renewables with conventional generation, as well as regional demand from state renewable energy standards, will affect premiums in coming years.

[14] For more information, see "Holy Cross Energy Launches 80 kW Community Solar Program" at http://apps3.eere.energy.gov/greenpower/news/news_template.shtml?id=1564 (accessed October 3, 2011).
[15] One program, TVA's Green Power Switch Pure Solar, is 16¢/kWh. We do not include it in the averages or medians because it is an outlier as a 100% solar product.
[16] For example, a small number of utilities exempt green pricing customers from monthly or periodic fuel charges imposed to pay higher-than-expected fossil fuel costs. For a detailed discussion of this topic, see Bird et al. (2008).

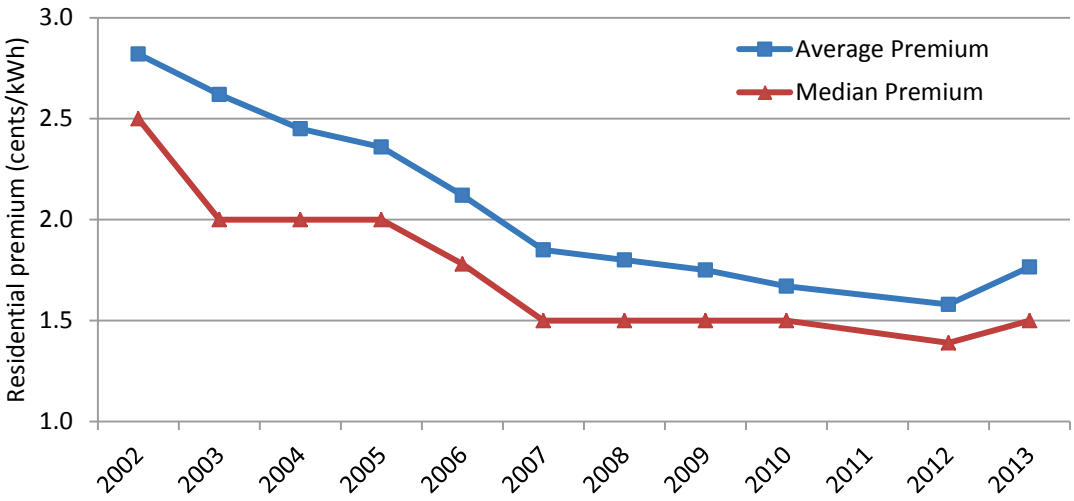

Figure 4. Trends in utility residential green pricing premiums, 2002–2013

Note: Average and median premiums for 2013 do not include TVA's Green Power Switch Pure Solar (16¢/kWh).

2.3.2 Unbundled REC and Competitive Market Products and Pricing

Green power products offered in electricity markets with retail competition tend to differ from those offered by utilities in regulated markets, as they are more likely to be sourced from RECs because suppliers may be less able to enter into long-term contracts with generators.

Green power marketers in competitive markets are often sourcing from new supply, a transition that has been encouraged by green power recognition and product certification programs. Both Green-e Energy[17] and the EPA Green Power Partnership[18] currently operate on a 15-year rolling window for defining a "new" facility, meaning that projects must have come online within 15 years prior to the sale of the green power in order to be classified as new. Under the Presidential Memo on Federal Leadership in Energy Management the Federal government will restrict REC purchases used to meet Federal goals to a 10-year rolling window.

The price premium charged for competitive-market products depends on several factors, including the price of default service and the cost of renewable energy generation available in the regional market. In recent years, some marketers (e.g., in Texas) have charged prices close to or even below the prevailing cost for system power; others have offered fixed-price products, providing customers with protection against increasing prices for a specified period of time—usually one year.

Competitively marketed green power products generally carry a price premium between 1¢/kWh and 2.5¢/kWh for residential and small commercial customers, although offerings have ranged from small discounts to a premium of about 10¢/kWh in recent years. For utility/marketer

[17] Administered by the Center for Resource Solutions, the Green-e Energy program certifies retail and wholesale green power products that meet its environmental standards, product content, and marketing standards. For details on the Green-e Energy National Standard, see the Green-e website at green-e.org.
[18] See the EPA's Green Power website at epa.gov/greenpower.

programs offered in states with retail competition, the average price premium for green power was about 2.1¢/kWh in 2013. In addition, price premiums can change frequently with changes in market conditions. Higher-priced products often contain a larger fraction of new renewable energy content or resources that are more desirable to consumers, such as new wind and solar.

Retail prices charged for REC products are not very transparent. In the past, REC marketers have posted pricing for specific REC product types on their websites, possibly for competitive reasons, but are increasingly now requesting that potential buyers call them for a quote. Wholesale REC prices in 2013 were around $1.20/MWh (see Section 7).

Because RECs are generally not subject to the same regulatory scrutiny as electricity and mandatory renewable requirements, REC buyers often seek certification due to concerns about double counting and to ensure a level of oversight and auditing. Buyers may also be interested in using the Green-e Energy label in communication materials. Nearly all REC products are sourced from "new" renewable energy generation projects as a result of product certification requirements.

Figure 5 shows Green-e Energy-certified retail transactions from 1998 to 2013. Green-e Energy certified 33.5 million MWh of retail transactions in 2013 (Heeter 2014a). This represents a decrease of 7%. Green-e Energy certified retail sales increased in the green pricing market but declined in the competitive electricity and unbundled REC markets.

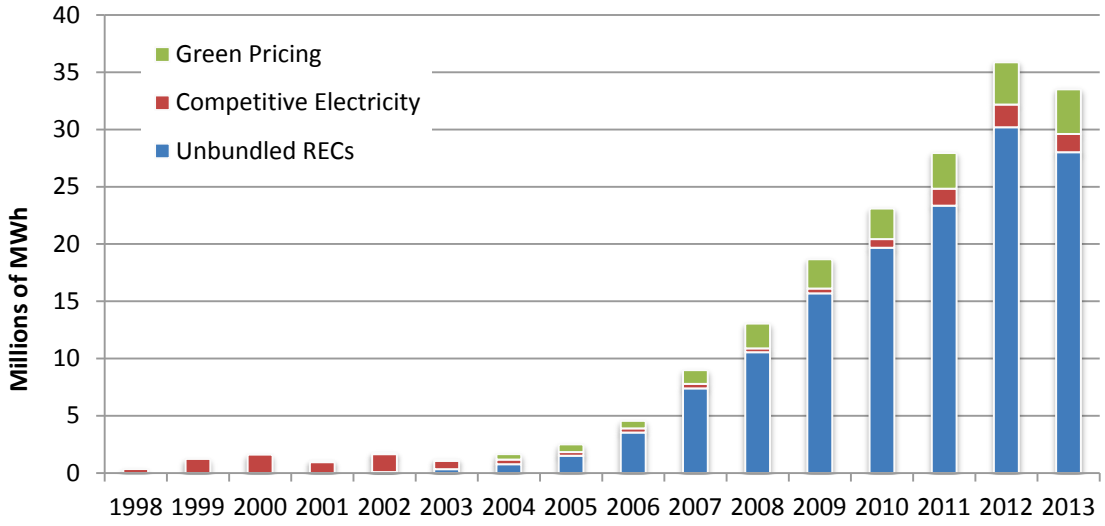

Figure 5. Total retail sales of Green-e Energy certified renewable energy, 1998–2013

Source: Heeter 2014a

The Green-e Energy program also certifies wholesale renewable energy transactions, which totaled 9.7 million MWh in 2013, down from 15.7 million MWh in 2012. It is important to note that 5.3 million MWh sold in certified wholesale transactions were resold in Green-e Energy certified retail transactions. The remaining 4.4 million MWh were sold in non-Green-e Energy certified transactions, most likely to utilities and electric service providers, power marketers, or retail customers. In total, Green-e Energy certified 38.8 million MWh of unique transactions in 2013.

2.3.3 CCA Pricing

CCAs around the country are procuring renewable energy at a savings compared to standard electricity rates. While rates vary, programs have seen savings of up to 21% (see Table 8 in Section 3 for more on CCAs). The level of savings depends on current electricity rates and the renewable energy content of the CCA procurement. In California, both Marin County and Sonoma County have developed base programs that contain 50% or 33% renewables, respectively, that come at comparable or a slight discount, as well as 100% renewable offers, which come at a premium. In Illinois, utilities had been locked in to high-priced contracts while market prices were declining; as a result, CCAs were able to secure supply at cost savings.

2.4 Green Pricing Marketing and Administrative Expenses

Retail product pricing typically reflects the costs involved in attracting and servicing retail customers to some degree, though data on marketing and administrative expenses are challenging to obtain. This section highlights marketing and administrative expenses for utility green pricing programs. While these data help illustrate trends in marketing and administrative expenses, each utility program will face unique circumstances when deciding how much to spend on marketing and administration. For a more detailed look at marketing and administrative expenses, see Friedman and Miller (2009).

Utilities in some cases are working with third parties to market their programs. In 2013, 39% of programs that reported to NREL indicated that they were working with a third party.

Marketing and administrative expenses increase with the size of the utility (measured as the number of eligible residential green power customers in their service territory) (Figure 6).

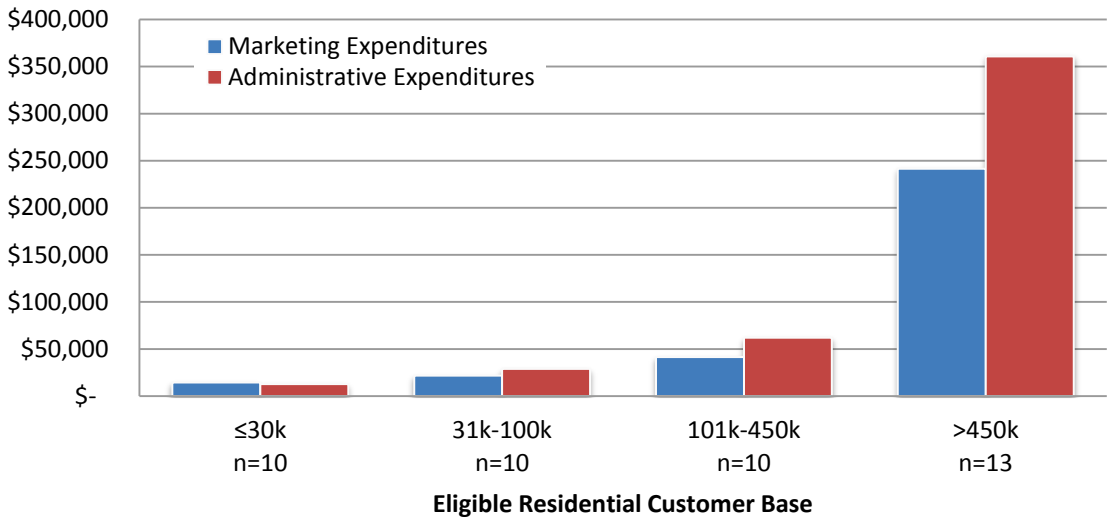

Figure 6. Estimated average marketing and administrative expenses, 2013

While Figure 6 shows that larger utilities spend more on marketing and administration, these increased expenses do not necessarily correlate to increased green power program participation. Large utilities may spend more on marketing in dollar terms because they have a larger territory

to cover. Also, in some cases, for example, a new program operating in a large service territory may spend heavily on marketing and administration and see large increases in customer participation, but may not see large increases in the participation rate for a number of years. Correlating marketing costs and participation rates is difficult because of the variation in the offers being marketed. For example, a marketing program for a product with a low premium or even savings and attractive renewable energy is likely to garner more participation per dollar than the same level of marketing for a more difficult product.

3 Community Choice Aggregation

Six states have enabled CCA, giving communities more market power and more control over electricity sourcing while still receiving transmission, distribution, and billing services from the local utility. In the past few years, CCAs have dramatically increased the number of households voluntarily buying renewables. As a result of this market growth, we estimate CCA market size for the first time in this series of annual reports on the voluntary market.

Among the 18 states and districts that have deregulated electricity generation, 6 states have passed further authorization to form entities that act on behalf of most of the customers in a community to bargain for choices in electricity supply that differ from what is available from the local utility (Table 7).[19]

Table 7. States with CCAs

State	Year CCA-enabling legislation passed
Massachusetts	1997 (HB 5117)
Ohio	1999 (SB 3)
Rhode Island	2002 (H 7786)
California	2002 (AB 117)
New Jersey	2003 (P.L. 2003, CH 24)
Illinois	2009 (HB 362)

Transmission, distribution, and billing services are still provided by the local utility, making CCAs a hybrid between traditional utility service and full municipalization of the electricity system. What gives these entities bargaining power is the fact that most CCAs are "opt-out" entities, meaning that the customer is by default part of the aggregation unless the customer opts out. This opt-out arrangement has given community aggregation entities much higher participation rates than utility green power programs. The lowest participation rate for opt-out programs that offer a renewable energy component is around 75%[20] compared to the highest participation rates in the low twenties for the most successful opt-in utility green power programs.

The laws that authorize the formation of CCAs typically require education and majority voter approval, especially if it is an "opt-out" program. The community must go through several steps,

[19] Other states have considered legislation authorizing CCAs. New York, Utah, and Minnesota have all seen bills introduced, but none has moved out of committee as of August 2014.

[20] According to its website, Marin Clean Energy has a participation rate of about 75%. According to news sources, the City of Chicago is serving about 700,000 out of 900,000 customers in its aggregation program, which gives a participation rate of about 78%. The opt-out programs in Massachusetts and Illinois enjoy high participation rates, averaging over 90%, according to spokespeople. The participation rates for the opt-out programs in Ohio were not available, but are expected to be high because of the savings over the traditional rate.

including submitting its plan to the appropriate state agency for approval, then obtaining and approving bids for electricity supply.

Communities may choose to form CCAs for a number of reasons, including lower cost, more cost stability, and local supply. One reason that many entities have been formed is to support renewable energy, which could have the benefits of reducing the community's carbon emissions and air pollutants and supporting local economic development. This section is focused on the CCAs that purchase renewable electricity in addition to any RPS requirement the state may have.

Most often, the mechanism for choosing renewable energy supply is through the selection of an alternative retail supplier that procures generation and RECs on behalf of the participating customers. Some CCAs have stipulated to the alternative retail supplier that they must purchase RECs from local renewable energy projects. Other CCAs work with affiliated agencies that have the legal authority to own generation assets.

CCAs may face conflicting goals; if purchasing renewable electricity is a top priority, the aggregation's offering may be more expensive than the offering from the local utility. One of the communities that pioneered community aggregation in Illinois – Oak Park – did not make renewable electricity part of its 2014 supply contract when its initial contract expired because it would have raised rates higher than the offering that was ultimately chosen.

3.1 CCA Market Overview

Illinois has seen the largest influx of CCA programs offering renewable energy (Table 8). In addition to activity in Illinois, CCAs in California, Ohio, and Massachusetts are purchasing renewable energy, often at a cost savings to customers. Programs that are 100% renewable sometimes come at a small premium. These details are discussed below in a state-by-state overview. Data on CCAs were obtained through direct survey, public information, and NREL estimates.

Table 8. Overview of CCA Programs Offering Renewable Energy

Location	Renewable Energy Content in Product	Type of Renewables	Start Date	Premium and/or Savings	Electricity Customer Accounts	Estimated Annual Sales of Renewable Energy (MWh)
Illinois communities (excluding Chicago)[a]	25%-100%	Varies	2010-2014	Varies	~2,100,000 (NREL estimate)	~7,800,000 (NREL estimate)
Marin County, CA	50% or 100%	Wind, Hydro, Biomass/landfill gas, Solar	2010	100% is $0.01/kWh extra	125,442	1,072,156
Cincinnati, OH	100%	Hydro, Wind, Solar	2012	7% savings	66,751	467,282
Cleveland, OH	100%	Wind, Hydro	2013	21% savings	63,254	253,766
Sonoma County, CA	33% (CleanStart) or 100% (EverGreen)	Geothermal, biomass and biogas, wind	2014	CleanStart 4-5% savings; EverGreen $0.035/kWh premium over CleanStart	154,000+ (2015)	1,750,000 (2015)
Cape Cod and Martha's Vineyard, MA	50% or 100%	Hydro, Solar, Wind	2002	$0.009/kWh to $0.016/kWh, depending on customer class and usage	~1,000	6,700
Lancaster, MA	Local PV incorporated into product mix	Solar	2013	~10% savings	~2,900	Not available
Lowell, MA	100%	Hydro, Solar, Wind	2014	8-10% savings	31,000	Not available
2013 totals					**>2,400,000**	**>9,500,000**

[a] Chicago's municipal aggregation has around 750,000 accounts, for an estimated 110,000 MWh of renewable energy sales. We do not include it in our summary table because the supply contains only 5% renewable energy.

Illinois

The latest state to pass legislation to authorize CCA formation is Illinois. When the electricity restructuring law was changed in 2009 to allow for the aggregation of electric load by municipalities and counties, interest in aggregation spread quickly across the state.

Through mid-2013, over 650 towns and cities in Illinois had formed CCAs, and of those, over 100 had made the choice for their supply to be at least partially from renewable sources through

RECs purchases. According to one count, these purchases represented 1.7 million people and increased demand for renewable energy sources by over 6 million MWh (Englum et al. 2014).

The rapid move to form CCAs was driven in part by market dynamics that allowed CCAs to save customers 25% to 30% of the generation cost, even while supplying customers with renewable energy. In the wake of lower demand caused by the 2008 economic downturn, market prices for generation were very competitive.

In 2012, Chicago became the largest city in the United States to form a CCA. Integrys Energy Services (an alternative retail energy supplier) won the contract with an offering that included no coal-fired generation. Most of the power comes from natural gas, but 5% is sourced from wind power.

However, the market dynamics that made a renewable option so attractive in the first years of the municipal aggregation law may be a double-edged sword. The cost savings enjoyed by the alternative retail suppliers evaporated by the summer of 2014 because contracts that ComEd and Ameren signed with generators when power prices were much higher expired and ComEd and Ameren are also able to obtain market rates.

As of August 2014, about 60 municipalities have allowed their CCA program to expire. A full list of municipal aggregations procuring 100% renewable energy in Illinois is available in Englum et al. (2014). In April 2014, CCA pioneer Oak Park chose to end its contract with Integrys in favor of Constellation Energy. The Constellation Energy product will offer customers an opt-in renewable choice (Fisher 2014). Cost was the main motivation behind the change (Fisher 2014). Because of recent rising electricity prices in the state, all new service contracts would have raised rates as compared to the original contract. The winning bid raised it the least, and the Village Board made the decision that low cost was its top priority. As price dynamics become more challenging for renewable energy options, other municipalities may follow suit.

California

Marin County was the first community in California to launch a CCA. Marin County CCA renewable energy requirements are met with a combination of RPS-eligible contracts and unbundled REC purchases. The default service in the CCA is the "Light Green" product, which is a guaranteed to have a minimum of 50% renewable energy content. Customers are also given an opt-in "Deep Green" choice for a premium of 1¢/kWh. According to the Marin Energy Authority Integrated Resource Plan, the proportion supplied by bundled renewable energy will increase during the planning period and displace purchases of unbundled RECs. The long-term goal is 100% renewable energy for all customers. This goal may be met by new renewable energy projects or unbundled RECs (Marin Energy Authority 2013).

Marin County is now in the process of evaluating new resource offerings for its 2014 Open Season process. The process yielded 32 offers with a variety of technologies including solar photovoltaic, wind, geothermal, and biomass/biogas (Marin Energy Authority 2014).

In the summer of 2014, CCAs fought off an attempt to reduce the market power of aggregators by requiring that programs be opt-in instead of opt-out. That requirement was dropped from

Assembly Bill 2145 during a meeting of the state Senate Energy, Utilities and Communications Committee.

Sonoma County began serving its first group of more than 20,000 customers in 2014. Constellation Energy will supply the majority of the CCA's power needs, including the default "CleanStart" program, which is made up of one-third renewable energy. A smaller contract with Houston-based Calpine Corp., the largest operator at The Geysers geothermal field in the Mayacamas Mountains, will provide a 100% renewable "EverGreen" program product offered as an option for customers at a 3.5¢/kWh premium.

Ohio

The 1999 electricity restructuring law in Ohio authorized the formation of CCAs. Because the motivation of most of the earlier CCA programs was to save money, they tended to be located in the north of the state where electricity rates were higher.

As of May 2014, nearly 200 communities (counties, cities, villages, and townships) in Ohio had community choice programs in place for electricity. A detailed map of the programs is published at the Ohio Public Utility Commission website at http://www.puco.ohio.gov/pucogis/agg/electric.cfm.

In recent years, renewable choice has become an important element of some programs. Cincinnati formed a CCA in 2011. First Energy Solutions won the first contract, which ran through May 2014. Due to market conditions, customers were able to gain large discounts on the generation portion of their bill. The first contract guaranteed customers a 23% discount from their "price to compare" from Duke Energy. Even with this discount, the product was 100% renewable energy. To promote locally sourced renewables, Cincinnati stipulated that the city would receive RECs from the University of Cincinnati's Central Utility Plant from coal mine methane gas and the solar canopy at the Cincinnati Zoo. The source of the rest of the RECs retired was to be at the supplier's discretion.

When Cincinnati's contract was due to be renegotiated in May 2014, the guaranteed savings had shrunk from 23% to 7% for the 100% green option. The Cincinnati City Manager originally decided to drop the green power option in return for another 1% of savings. However, the City Manager's decision was opposed by a majority of the City Council, and he ultimately changed his position (Kiefaber 2014).

Through its CCA, Cleveland is able to offer residents a 100% renewable program at over 20% off their utility's electric generation rate until July 2015. The source for the city's RECs is 30% Ohio wind, 20% out of state wind, and 50% hydropower (Chatterjee 2013).

Massachusetts

The electricity restructuring act passed in Massachusetts in 1997 authorized the creation of the Cape Light Compact, which was the first municipal aggregator in the country. The Compact serves all 21 towns on the Cape, Martha's Vineyard, and Barnstable and Dukes counties.

As of January 2014, the Compact was offering two opt-in products for customers that wanted to buy renewable energy: Green 50% and Green 100%. The Green 100% product consists of 75%

small hydro facilities, 16% from PV systems on rooftops across Cape Cod, and 9% land-based wind projects in Massachusetts. In addition to the 50% that is not from renewable sources, the Green 50% product is made up of 34.9% small hydro facilities, 7.5% wind, and 7.6% local PV systems (Cape Light Compact 2014).

The program advertises that 25% of the renewable energy sources in its green program were built after 1997, which is considered "new." In order to support new, local renewable projects, it has partnered with the Cape & Vineyard Electric Cooperative (CVEC), which was formed to coordinate and finance renewable energy projects on Cape Cod. The program does require its "Green" customers to pay a price premium over the standard offer rate, but strives to keep costs low with aggressive efficiency offerings. As of September 2014, Cape Light Compact's basic residential rate was 8.892¢/kWh. The 50% Green residential and commercial rates were 9.792¢/kWh and the 100% Green residential and non-residential rates were 10.492¢/kWh.

In addition to the Cape Light Compact, two other Massachusetts CCAs offer a renewable component to their electricity supply. The town of Lowell is offering a product that is 100% renewable through alternative supplier Dominion Retail (Colonial Power Group 2014). The town of Lancaster has required its supplier, Hampshire Energy, to purchase all the solar RECs from the PV panels installed on its municipal buildings to provide a funding stream for the PV systems (Belyeu 2014).

As of late August 2014, there were 19 approved CCAs in Massachusetts, which include 39 municipalities. In addition, 36 municipalities are currently seeking approval of their respective municipal aggregation plans (Massachusetts Department of Public Utilities 2014). It remains to be seen whether these communities will incorporate renewable energy into their supply.

Rhode Island

Municipal aggregation was authorized in the Rhode Island Utility Restructuring Act passed in 1996. In 1999, a consortium of 36 Rhode Island municipalities called the Rhode Island Energy Aggregation Program (REAP) was organized under the auspices of the League of Cities and Towns.

In January 2012, the League selected Direct Energy to be its supplier. The packages that Direct Energy offers are priced individually for each municipality based upon its load factors and interests. Each entity is allowed to contract for periods of one to four years. REAP states that this arrangement has won its members cost savings of 20% to 30% over the state's basic service rate.

As of 2012, eleven of the 36 REAP members had chosen renewable energy to be part of their supply contract. The contracts included 5% to 10% renewables. The resources supplying these contracts were northeastern hydropower, biomass, and landfill gas (LeanEnergyUS 2013).

New Jersey

CCA was authorized in New Jersey as early as 1999 in the Electric Discount and Energy Competition Act. However, the fact that the act included an initial rate reduction and a rate cap for standard rates dampened interest in CCAs. In addition, the 1999 act required the signature of each participant, greatly reducing a CCA's market power.

In 2003, the New Jersey Legislature passed the Government Energy Aggregation Act, which eliminated the opt-in provision for residential customers. The law still requires commercial and municipal accounts to opt in during a specified period. Now that the rate cap has expired, interest in community aggregation is growing. A contract may only be rewarded if the rate is lower than the default rate offered by the local utility, except in the cases in which the contract includes a higher percentage of renewable energy than is required by the state's aggressive renewable portfolio standard.

As of 2014, a small group of municipalities has formed aggregations and has selected its competitive suppliers. The motivation behind most of these efforts is lower cost and renewable energy supply is not a priority.

In late 2013, the municipalities of Lambertville and West Amwell announced that they had chosen First Energy Solutions as their generation supplier. First Energy Solutions offers an opt-in "100% green" contract for a rate premium of 1.5¢/kWh, for a total of 10.41¢/kWh.

3.2 CCA Market Implications

Although CCAs have quickly grown the market for voluntary unbundled RECs, some have raised questions about the extent to which this market demand has promoted the development of new renewable projects (Farrell 2014). From the experience of the small number of states that have experimented with CCA programs, there are a number of goals that may be driving CCA formation, and obtaining all the possible benefits of aggregation may not be possible at the same time. CCA contracts can be written in order to support new, local renewable energy project development, if that is of primary importance to the community. That goal may be at odds, however, with the goal of saving the largest amount of money. In California, the approach of buying unbundled RECs in the short term while building up local renewable project ownership gives communities a carbon benefit with greater price stability. The experience in Ohio and Illinois shows that purchase of unbundled RECs from non-local projects to reduce the carbon content of purchased electricity may be compatible with cost savings, but the costs are vulnerable to market swings.

4 Community and Crowdfunded Solar

Community solar programs provide solar access to electricity customers who cannot or choose not to install solar on their rooftop. Cases of unsuitability occur when electricity customers rent their residence, or reside in a home with suboptimal roof orientation for a solar installation or in a shaded area. Customers may also prefer to participate in a community solar program rather than install solar on-site because the transaction may be easier and may provide more financial benefits. Development of a community solar program allows electricity customers to purchase shares of a renewable system and derive environmental and economic benefits from its production.

For example, Soveren Solaris, a solar installation company in Vermont, plans to open at least four new community solar farms in the upcoming years. The company started construction of an initial 150 kilowatt solar farm in North Springfield in the spring of 2014. Under the community solar model, any Green Mountain Power (GMP) customer can purchase panels at a cost of $3.00/W in the solar array and the electricity the panels generate is credited towards the payment of electricity consumed at the customer's place of residence or business. Customers can use a 30% federal tax credit to aid in financing of their investment, in addition to Vermont's 7.2% investment tax credit (Weiss-Tisman 2014).

Community solar programs are underway in an increasing number of states (19 as of September 2014). As of September 2014, 64 community solar programs were operational around the country, totaling more than 40 MW of capacity (Figure 7). According to Campbell et al. (2014), the average community solar program has 213 participants and programs are around 70% subscribed.

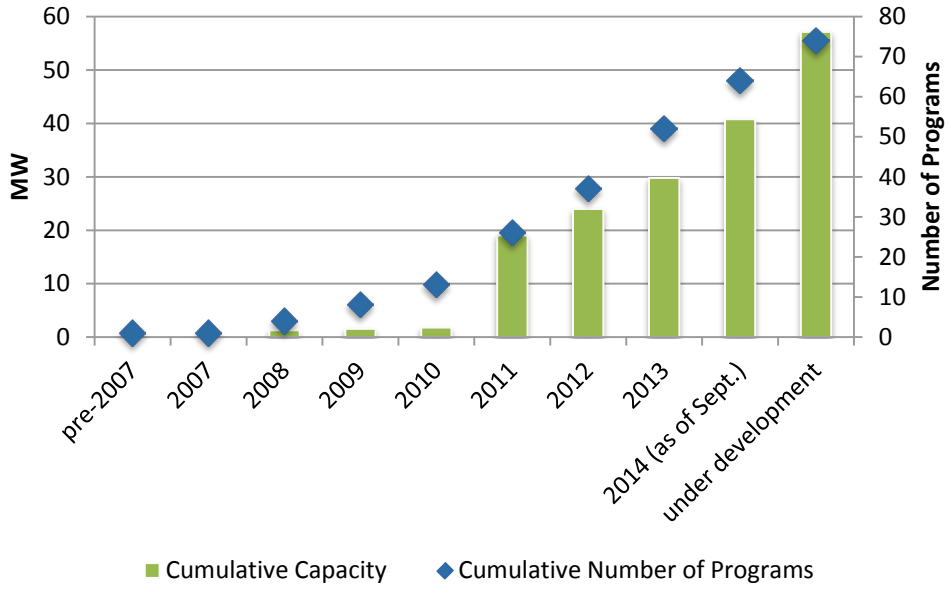

Figure 7. Number and capacity of community solar programs

California is poised to dramatically increase the amount of community solar available. IOUs in the state are planning to purchase up to 600 MW of new, renewable energy capacity from distributed generation projects that are under 20 MW in response to Senate Bill 43 (SB 43). SB

43 requires California's three largest investor owned utilities to develop two forms of clean energy options for their consumers. One of the green energy programs is a "Green Tariff", which will provide customers the option of paying a premium to purchase energy from a new, renewable resources portfolio located within their utility's territory. Similarly, the "Enhanced Community Renewables" program will provide the option of paying a premium to purchase energy from green resources, but the energy source could be located within 10 miles of the customer's place of residence or within the city or county of the customer (Frederick 2014). California's IOUs have proposed programs and are waiting for approval from the California Public Utilities Commission.

Legislative efforts in other states are also fostering increased community solar development. In 2013, Minnesota passed a law requiring Xcel Energy to set up and operate a community solar program. Xcel Energy is in the process of holding discussions with stakeholders on the community solar gardens program.

In Colorado, community solar projects are concentrated in Xcel Energy's service territory. Xcel Energy approved 12 community solar projects in 2013, ranging from 500 kW to 1500 kW, building upon the approval of 13 community solar projects in 2012, ranging from 108 kW to 1997 kW (Xcel Energy 2014).

In May 2009, Washington passed Senate Bill (SB) 6170, which allowed community solar projects to receive a production incentive, in addition to participating in net metering. For owners or participants of community solar projects of up to 75 kW in size, the base rate is 30¢/kWh. Each participant may obtain up to $5,000 per year in incentives. To qualify for these community solar incentives, projects must be located on local government property and require partnerships between governments, solar developers, and community members (DSIRE 2014).

In Washington, D.C., the Community Renewable Energy Act of 2013 (Bill No. 20-0057) was approved by the City Council in October 2013. The Act enables community solar and other aggregated net metering arrangements. Projects can be up to 3 MW in size and must have at least two subscribers. To date, no projects have been developed.

In Maine, there is no community solar requirement, but the state does have a pilot program to incentivize development of locally-owned renewable energy resources. In addition to virtual net metering, individual system-owners can qualify for incentives on up to 10 MW of generation. Participants can qualify for an incentive of 10¢/kWh generated under a long-term contract up to 20 years with their utility, or they can qualify for a renewable energy credit incentive worth 1.5 times the value of the electricity generated by the system. To be eligible for the program, the system must be grid-tied and at least 51% of the system must be owned locally (Clean Energy Authority 2014).

Crowdfunded and Related Programs

Crowdfunding is used to finance many types of projects, not just renewable energy. Kickstarter, for example, is a platform through which individuals can support a wide variety of crowdfunded projects. Crowdfunding renewable projects differs from community solar in that crowdfunding participants provide upfront capital to support the development of the project rather than purchase shares of the project. Crowdfunded programs allow anyone, regardless of utility

territory, to invest in the development of a renewable project. However, crowd-funders do not receive bill credits, RECs, or a price hedge against future electricity rate increases.

Mosaic, based in California, is a peer-to-peer lending platform[21] specifically for solar development. Mosaic's program provides lenders the opportunity to finance a solar facility, which is typically hosted by a nonprofit organization, though access may be restricted to certain states or accredited investors. To date, Mosaic has financed 29 solar facilities totaling more than 30 MW. The majority of projects (15) are located in California; other projects are located in Arizona, New Jersey, Florida, New Mexico, Connecticut, and Colorado. The first five projects were funded by more than 400 people for a total of more than $350,000 in zero-interest loans. Mosaic now offers projects with an annual return ranging from 4.4% to 7.0%.

VillagePower provides a platform that helps community organizations manage and finance solar energy projects by crowdfunding or aggregating investments from individuals within the local community and, when necessary, raising funds from investors interested in social responsibility. As of August 2014, VillagePower has 25 projects under development ranging in size from 22 kW to 40,000 kW; the vast majority of the projects will be located in California (VillagePower 2014).

RE-volv.org allows community members interested in supporting renewable energy to directly finance community solar projects. Through RE-volv's website, online tax-deductible donations are pooled and invested in solar energy on facilities that serve as community centers. RE-volv leases solar energy systems to the communities it serves for a period of 20 years. The lease payments are continually reinvested in additional community solar projects, thereby creating a revolving fund.

A new solar crowdfunding platform launched in April 2014 – CrowdSun.com. According to its website, the company has raised over $2 million across 11 campaigns as of October 2014. Accredited investors can buy CrowdSun Bonds, and then receive payments each month consisting of a return of principal plus interest. Funded projects include solar and geothermal for a school house in North Carolina and a 425-kW solar park for a major U.S. consumer products company in New Mexico.

[21] Mosaic's web site informs that the company's services are not representative of a crowdfunding program as referenced in Title III of the Jumpstart Our Business Startups Act (JOBS Act).

5 Sector Spotlight: Information and Communications Technology (ICT)

Consumers are increasingly accessing information online, through smart phones, social media, and online entertainment, including video streaming. As a result, energy usage in the ICT sector, particularly at data centers, has been growing rapidly. These customers are unique in that they have large, stable, long-term electricity load; they are purchasing in deregulated markets where there are opportunities for financial benefit. The ICT industry, including end-user devices, telecommunications networks, and data centers, accounted for 1.9% of global GHG emissions in 2011 and that number is expected to rise to 2.3% by 2020 (GeSI 2012).[22] When looking at electricity use by data centers in the U.S., Koomey (2011) found that U.S. data centers accounted for between 1.7% and 2.2% of U.S. electricity use in 2010.

Given the large and growing electricity footprint of ICT companies, many are engaging in a range of voluntary efforts to procure renewable energy. Some companies are procuring renewable energy as part of their plan to reduce GHG emissions. Hodum and Molitor (2013) found that 50% of Fortune 100 information technology companies have a GHG reduction target and 20% have both a GHG reduction target and an RE target; 33% of Fortune 100 telecommunications companies have a GHG target and 67% have both a GHG and RE target. At least six ICT companies have set goals to be 100% renewable: Apple, Facebook, Google, Rackspace, Box, and Salesforce.

Using data from EPA's GPP, the Carbon Disclosure Project, and company annual reports, we estimate the largest 70 ICT companies in 2013 used 23.4 million MWh of electricity, which is equivalent to 1% of industrial/commercial electricity use in 2013. Of the 23.4 million MWh, 36% (8.4 million MWh) was renewable energy. More than 80% of the sector's renewable energy purchasing comes from Intel, Microsoft, Google, Apple, Hewlett-Packard, and Cisco Systems, though many smaller ICT companies are purchasing green power equivalent to 100% or more of their electricity use.

A number of these ICT companies are seeking to create a more direct impact on renewable energy development by entering into long-term contracts for renewable generation or increasingly investing in on-site resources. Some companies have been making direct investments in renewable energy facilities, while others are working with utilities to purchase through new special tariffs. Although not the focus of this section, these companies are also innovating in efficiency – making data centers and end-user devices more efficient. This section highlights recent innovations and efforts in renewable energy procurement by Google, Microsoft, Apple, and Verizon.

Google

Google has a wide variety of involvement with renewable energy, including direct investments in renewable energy facilities and companies, and purchases of renewable generation through on-

[22] Although end-user devices accounted for nearly 60% of ICT emissions in 2011, data center emissions are expected to grow more rapidly (7.1% per year, compared to 4.6% per year for networks and 2.3% per year for end-user devices).

site generation, long term PPAs, and utility tariffs. Google uses 24% renewable energy and purchases carbon offsets for 65% of its electricity; the remaining 11% is renewable energy already on the grid. To date, Google has committed over $1.5 billion to renewable energy projects, satisfied through multiple types of contract structures and partnerships with a wide variety of green power providers. To supply its data centers, Google has signed PPAs with wind farms located on the same power grid as its data centers. Google buys bundled electricity and RECs directly and then sells the electricity back to the grid, keeping the RECs (Google 2013a). In order to buy and sell electricity, Google created a subsidiary, Google Energy, and received approval from the Federal Energy Regulatory Commission (FERC) to buy and sell wholesale electricity.

In addition to PPAs, Google is working with utility providers to develop renewable energy tariffs for large purchasers (See Text Box 2). Google notes that this type of tariff allows utilities to focus on their key capabilities and minimizes transaction costs (Google 2013b).

Companies are also supporting renewable energy in other ways. For example, Google makes direct financial investments in renewable facilities. It invested $100 million in a residential solar fund with SunPower Corporation in April 2014. Google has also made investments in large-scale solar and wind facilities. In September 2014, Google invested $145 million in an 82-MW solar facility in Kern County, California.

Microsoft

Microsoft is the second-largest purchaser on EPA's GPP Tech and Telecom list, after Intel, purchasing 1.3 million MWh of renewables, representing 50% of its total electricity use (EPA 2014). Microsoft assesses a fee on carbon emissions to its internal business groups. The carbon fee supports Microsoft's carbon reduction policy – to make its operations carbon neutral – and its investment strategy. Microsoft uses the fee to fund investments that help achieve its carbon reduction goal. For example, it has used funds to sign long-term power purchase agreements for wind energy (Microsoft 2014).

Microsoft has a 20-year PPA with RES Americas for the energy from the 110-MW Keechi Wind facility in Texas. Microsoft also signed a 20-year PPA with EDF Renewable Energy for the 175-MW Pilot Hill Wind Project in Illinois. Wind facilities are located on the same grids as Microsoft data centers. (Microsoft 2014)

Apple

Apple is purchasing more than 626,000 MWh of green power, the equivalent of 92% of its electricity use. Of that, 115,000 MWh are from on-site biogas for use in fuel cells and from solar projects, making it the second largest user of on-site green power in the EPA's GPP (EPA 2014). 100% of Apple's data centers are powered by renewable energy (Apple 2014).

Apple's policy for renewable energy procurement is to invest first in self-generated on-site projects, then to use local, grid-purchased renewables, and finally purchasing unbundled RECs only when it is not possible to develop on-site solutions due to local regulations.

In Nevada, Apple is working with NV Energy to participate in the utility's large customer renewable energy tariff. The tariff, called the GreenEnergy Rider, Option 2, allows large

customers to individually negotiate sourcing of renewable energy from projects in NV Energy's service territory, with no application fee or monthly administrative charge (NV Energy 2014). Contracts are approved on an individual basis by the Nevada Public Service Commission (NV Energy 2014). The tariff allows Apple to support an 18-MW to 20-MW solar facility near Fort Churchill, close to where its data center is located. See Text Box 2 for more information about renewable energy tariffs.

Verizon

Verizon has made part of its corporate mission to be the greenest wireless carrier in the country. In August 2014, Verizon announced plans to invest $40 million into 10.2 MW of solar power in five states across the country, on top of its existing 14.2 MW of on-site fuel cell and solar power (Verizon 2014). This initiative follows Verizon's announcement of a GHG emission intensity reduction goal of 50% by 2020. Similarly to Apple, Verizon views these investments as more than just an environmentally responsible action. Verizon invests in on-site renewable energy due to the reliability benefit it provides.

Text Box 2: Renewable Energy Tariffs for Large Utility Customers

The ICT sector has been pushing utility companies to offer green power programs tailored to large utility customers. Google published a white paper in 2013 advocating for utilities to develop a "renewable energy tariff" for large customers (Google 2013b). Three utilities currently offer renewable energy tariffs for large customers:

- Duke Energy Carolinas Green Source Rider: Customers pay the difference between the all-in cost of the renewable energy and RECs and the avoided cost of the renewable energy, in addition to a $2,000 application fee and monthly administrative charge of $500 + 0.02¢/kWh.
- Dominion Virginia Power Rider GH: Customers pay the difference between the all-in cost of the renewable energy and RECs and the customer's retail rate, in addition to a monthly administrative charge of $500 + 0.6¢/kWh-0.7¢/kWh.
- NV Energy GreenEnergy Rider, Option 2: Customers pay the cost of the renewable generation under a specialized contract to be approved by the Public Utilities Commission of Nevada. Customers pays the base electricity rate plus the incremental cost of the renewable resource, minus a renewable energy development surcharge.

For more information on large customer renewable energy tariffs, see Proudlove and Kennerly (2014).

6 REC Tracking Systems

States and others have created REC tracking systems to verify compliance with RPS targets. Tracking systems are also used for the voluntary market, though their use is not as predominant as in compliance markets. The Green-e Energy certification program, a leading certifier and auditor of RECs in the voluntary market, allows green power suppliers to use tracking systems to simplify some parts of the Green-e audit process. In 2013, 64% of Green-e Energy retail sales used a REC tracking system (Heeter 2014a).

These electronic tracking systems ensure that RECs are only "retired" (used to meet compliance or substantiate a voluntary claim) once by assigning a unique serial number to each megawatt-hour of renewable energy generation, which constitutes a REC.

Any generator that wants to be issued RECs in a tracking system must first register with the tracking system and provide information about the generator (e.g., type of renewable generation, project location). Tracking systems then issue RECs on a regular schedule based on the output of the generator. Output must satisfy the metering and verification requirements specified by the tracking system. RECs are issued to the generator's account, or to the account of an appointed representative. Market participants who have accounts with the tracking systems can transact the RECs; RECs can only reside in one account at a time.

In the United States, there are currently nine different tracking systems. REC tracking systems, in some cases, follow the same boundaries as local regional transmission organizations or independent system operators (Figure 8).

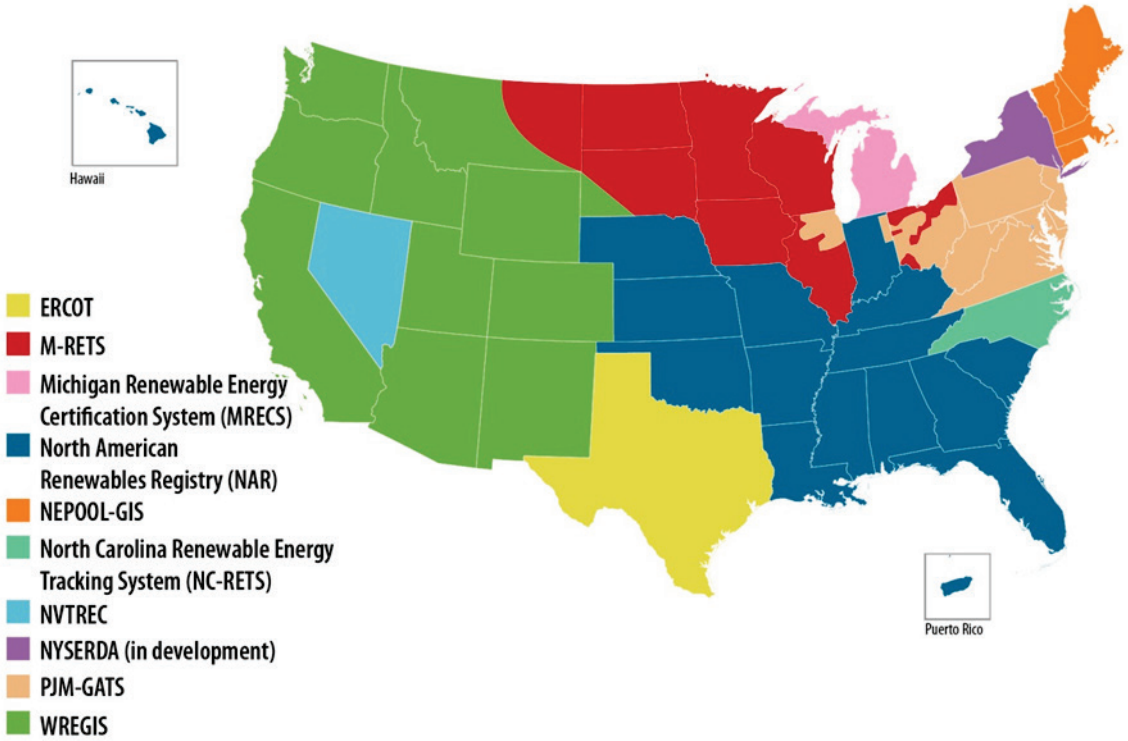

Figure 8. U.S. renewable energy tracking systems

The North American Renewables Registry (NAR)[23] covers states and provinces not covered by an APX, Inc. tracking system.
Source: Updated from ETNNA 2011

Tracking systems are evolving to incorporate additional functionalities. The ability of tracking systems to transfer RECs in and out of their system (exporting or importing of RECs) has increased over the past few years (see Table 9). In addition to the capabilities reported in Table 9, M-RETS has approved imports from NC-RETS, MIRECS, and NAR, though the import capability has not been developed yet. Import/export capability is important particularly in cases where RECs from beyond a state's region are eligible to meet RPS compliance. For example, in North Carolina, 25% of compliance can be met with out-of-state RECs (i.e., from anywhere in the United States). Delaware and New Jersey accept RECs that have been delivered into PJM along with the electricity.

[23] For more information, see the "Registries" Web page at http://narecs.com/resources/registries.htm (accessed September 18, 2013).

Table 9. Export/Import Capability of REC Tracking Systems

Exporting From	Exporting To
NAR	NC-RETS[a]
NC-RETS	NAR
NAR	MIRECS
MIRECS	NAR
M-RETS[b]	NAR
M-RETS	NC-RETS
M-RETS	MIRECS
PJM-GATS[c]	MIRECS
PJM-GATS	NC-RETS
WREGIS[d]	NAR
WREGIS	NC-RETS
ERCOT[e]	NC-RETS

Source: NAR 2014
[a] North Carolina Renewable Energy Tracking System
[b] Midwest Renewable Energy Tracking System
[c] PJM-Generation Attribute Tracking System
[d] Western Renewable Energy Generation Information System
[e] Electric Reliability Council of Texas

In addition to export/import capability, tracking systems are updating protocols for including small generators, such as rooftop solar. Tracking systems are, in some cases, accommodating aggregators, entities who enter registrations on behalf of a large number of distributed generation (DG) projects. One challenge for incorporating DG into tracking systems is that, compared to larger systems, it can be more difficult to validate data. Facilities, regardless of size, need a unique identifier. Larger systems typically have an EIA identification number and/or GPS coordinates that can serve as a unique identifier, but small systems will have to rely on a combination of the facility name, zip code, meter ID, or other identifying information. In February 2014, APX released its Distributed Generation Toolkit for REC Registries (APX 2014). The toolkit provides solutions for how tracking systems can incorporate DG.

Tracking systems can be important providers of public market information. They can provide information on the number of RECs retired in a given year. The Texas PUC has encouraged public access to REC market data by requiring ERCOT to report annually the aggregate quantity of RECs retired for voluntary and compliance purposes. In the current reporting year confidentiality is ensured to account holders that may be retiring compliance or voluntary RECs. After one year confidentiality expires and ERCOT publishes how many RECs were retired by each account holder.[24]

[24] ERCOT's Annual Report on the Texas Renewable Energy Credit Trading Program can be found at www.texasrenewables.com/reports.asp.

In ERCOT, voluntary retirements increased slightly in 2013, when retirements for previous years are included. In 2013, 7.4 million MWh were retired for compliance year 2013 and an additional 7.5 million MWh were retired for 2011 or 2012. A significant number of RECs are being retired in subsequent compliance years for the previous year; as of August 2014, an additional 9.9 million MWh were retired for compliance year 2013 (Heeter 2014b).

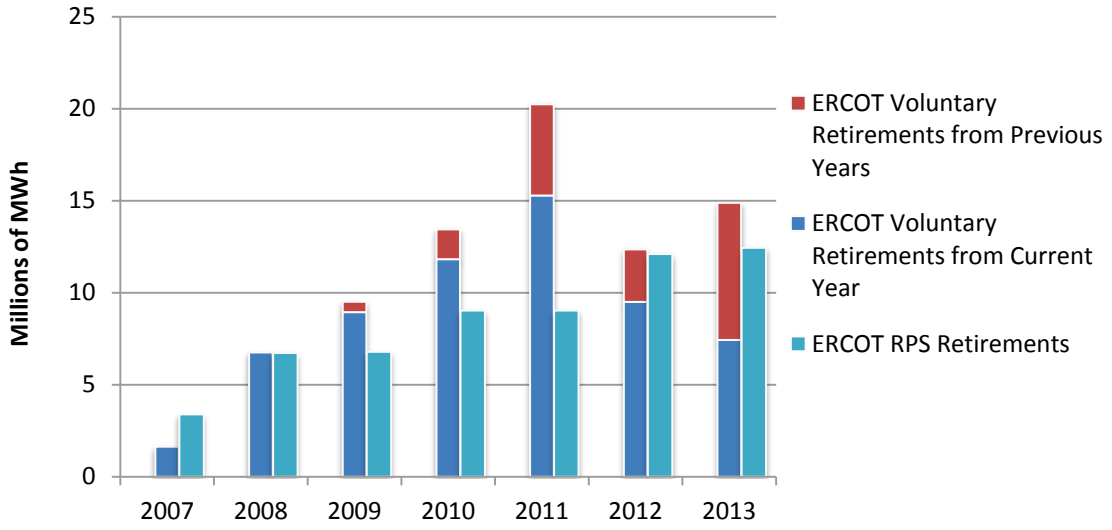

Figure 9. Compliance and voluntary retirements in ERCOT, 2007–2013

PJM-EIS has developed a public report on voluntary retirements, and other tracking systems are publishing the retirements of Green-e Energy eligible (not necessarily retired) RECs.[25]

[25] PJM-GATS public reports can be found at pjm-eis.com/reports-and-news/public-reports.aspx. In addition to voluntary retirements, PJM-EIS provides publicly available data on the RECs retired to meet RPS compliance in PJM states.

7 REC Pricing in Voluntary and Compliance Markets

Pricing for voluntary RECs differs from compliance REC pricing and from pricing offered by utility green pricing programs. Unlike compliance RECs, which typically must be sourced from within some geographic region to be eligible for RPS compliance, voluntary RECs can be sourced either regionally or nationally.

The overview of wholesale REC prices presented in this section is based on indicative data available from brokers and third-party data providers. With a few exceptions, there is little price transparency in REC markets. Most transactions are conducted as bilateral contracts between parties, and prices are not reported. In addition, prices can vary widely by region. Therefore, data presented here are only indicative and should be used with caution.

In general, REC values depend on several factors, including the technology, the vintage (year in which it was generated), the volume purchased, program eligibility (e.g., Green-e Energy), the region in which the generator is located, and the market supply/demand balance. Natural gas prices can also affect the cost competitiveness of renewable energy generation, which is reflected in REC prices.

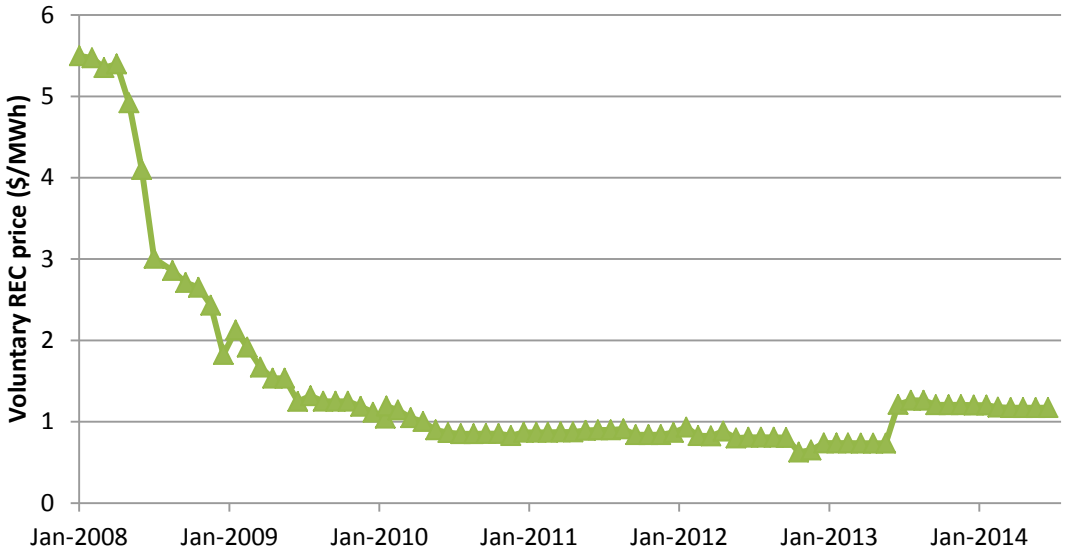

Figure 10. Voluntary national wind REC prices, January 2008–July 2014

Source: Marex Spectron 2014

As shown in Figure 10, wholesale RECs used in the voluntary market have traded at less than $2/MWh since 2009. As of July 2014, prices remained around $1.20/MWh, after dipping below $1/MWh for most of 2010 through mid-2013.

REC Pricing in Compliance Markets

Since the second half of 2011, REC prices in the Northeast, with the exception of Maine, have continued to remain in the $50/MWh to $65/MWh range. These prices are near alternative compliance payment (ACP) levels in Connecticut, Massachusetts, New Hampshire, and Rhode Island, while declining to around $5/MWh in Maine (Figure 11). Maine has seen an increase in

eligible generators, particularly biomass generators restricted from other state markets, causing REC prices to decline (Prince 2014). ACP levels in the region are generally between $55/MWh and $65/MWh, meaning that if REC prices were to increase above that level, compliance entities would likely pay the ACP instead of buying RECs.

In other regions, RECs traded at less than $5/MWh in 2013, though some markets began to increase in 2013 and continued to trade at more than $15/MWh in early 2014. REC trades in the mid-Atlantic were closing above $15/MWh in July 2014 in Delaware, Maryland, New Jersey, and Pennsylvania. In Texas, REC prices returned to 2011 levels of around $1/MWh, compared to highs in the mid-$2/MWh range in 2012.

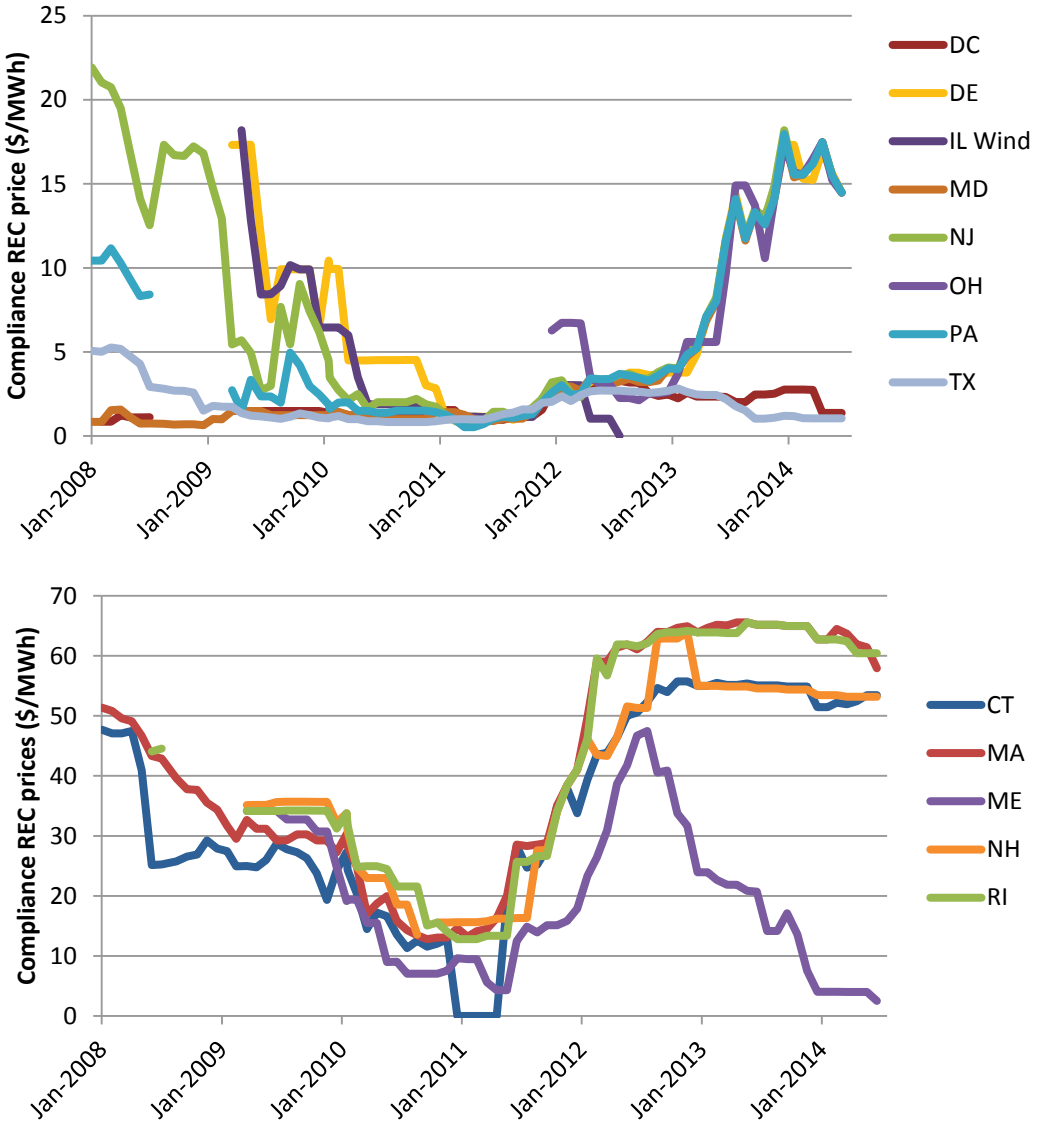

Figure 11. Compliance market (Tier 1) REC prices, January 2008–July 2014

Plotted values are the last trade (if available) or the mid-point of bid and offer prices for the current or nearest compliance year for various state compliance RECs.

Source: Marex Spectron 2014

Solar RECs have higher values than RECs from other resource types in compliance markets. This is true for several reasons. First, 17 states and Washington, D.C., have specific provisions to encourage solar or customer-sited generation (DSIRE 2014), which creates a different supply and demand dynamic than for REC markets in general. Second, the ACP level is often set higher for solar/distributed generation tiers than for standard RPS compliance because of the higher cost of solar relative to other renewables that may be used to meet the main RPS targets. For example, solar ACPs generally range from about $350/MWh to $650/MWh compared to about $55/MWh for the main RPS (Tier 1).

Spot pricing for solar renewable energy certificate (SRECs) is publicly available via platforms like SRECTrade and Flett Exchange.[26] SRECTrade hosts a monthly auction, while Flett Exchange is an online exchange. Both platforms cover markets in PJM states, Massachusetts, and Ohio, and similar price trends can be seen in reported data from both companies. Figure 12 shows SREC prices for the current or nearest compliance year.

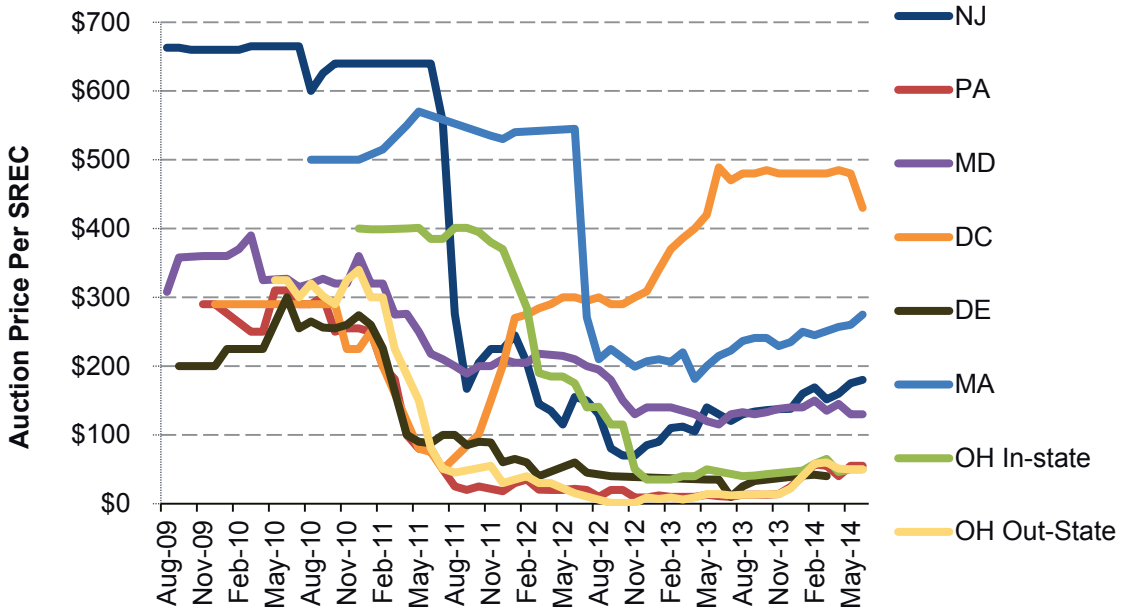

Figure 12. Compliance market SREC spot prices, August 2009–July 2014

Source: SRECTrade

In New Jersey, spot market prices for SRECs have been in the $50 to $150 range in recent years, after declining dramatically from highs of more than $600/MWh into mid-2011. In Pennsylvania, a similar, though not as dramatic, decline was seen in mid-2011. Spot prices for Pennsylvania SRECs dropped to less than $50/MWh in mid-2011, from around $300/MWh in mid-2010 (Figure 12), presumably due to oversupply in the market. By 2012, Pennsylvania SRECs were down to $50, and have declined to less than $15 in mid-2013.

[26] For more information, see www.srectrade.com and www.flettexchange.com.

In Washington, D.C., SREC spot prices have increased in recent years, due to policy modifications. In 2011, the Council of the District of Columbia closed the door to new out-of-district resources (out-of-district systems approved before January 31, 2011 were grandfathered in) and increased the ultimate solar requirement from 0.4% to 2.5% by 2023. In 2012, SREC prices ranged from $270 to $310, increasing to nearly $490 in 2013.

8 Conclusions and Observations

The voluntary green power market provides a way for individuals and institutions to support renewable energy. Historically, the voluntary market has included three market sectors: utility green pricing programs, competitive suppliers, and unbundled REC markets. Emerging methods for support include CCA, community solar programs, crowdsourced solar, and renewable energy tariffs for large customers.

Interest in products that provide a direct impact on renewable energy development is increasing. Utilities have begun offering programs for large industrial customers and are incorporating more local solar resources into their product mixes. CCAs are examining ways to buy local renewable resources. Large corporate purchasers in the ICT sector are turning towards direct investment, long-term contracting, and other mechanisms to spur voluntary renewable energy development and/or realize financial gain. Based on these emerging methods, as well as data from green power programs, competitive markets, and unbundled REC purchases, we have identified the following market trends:

- In 2013, voluntary retail sales of renewable energy totaled 62 million MWh and represented approximately 1.7% of total U.S. electricity sales. From 2012 to 2013, total green power market sales increased 27%.[27]
- Approximately 5.4 million customers are purchasing green power. The number of customers in utility green pricing programs and the competitive market increased by 25% and 87%, respectively, while declining by 14% in the unbundled REC market. Residential REC market customers declined more than 20%, while nonresidential REC market customers increased by 4%.
- For 2013, we found approximately 2.4 million customers participating in CCAs that source renewable energy, totaling more than 9 million MWh of renewable energy.
- Utility green pricing sales exhibited strong growth of 15% in 2013, primarily due to sales increases in some of the largest programs.
- Competitive markets grew to 14.5 million MWh, a 25% increase from 2012, due in part from increased data availability. More competitive suppliers are reporting to EIA through the Form 861.
- Unbundled REC markets saw little movement in 2013, increasing just 1%, to 31.4 million MWh. Increase in wholesale REC market prices and shifting customer demands may be causing the lack of aggressive growth seen in previous years.

[27] In this report, we gathered data and estimated the size of the CCA market for the first time. Because we include this market in the total sales figures for 2013 but not for 2012, some of sales growth from 2012 to 2013 is overestimated.

- Wind energy continues to provide the most renewable energy to the voluntary market, at 75% of total green power sales, followed by landfill gas and biomass (7%), hydropower (4%), solar (1%), and geothermal (1%). The source for 12% of supply is unknown, though is likely mostly wind. Of the voluntary market sectors, green pricing programs are using the most solar; the percent solar used in green pricing programs increased from 2.0% in 2012 to 2.5% in 2013.
- The number of community solar programs is increasing. In 2013, 15 new community solar projects were introduced, and as of September 2014, an additional 14 programs had begun. The capacity of existing community solar projects totals more than 40 MW, with an additional 17 MW of projects under development.
- Wholesale RECs used in the voluntary market traded at around $1.20/MWh in 2013; this increase from around $1.00/MWh in previous years may have contributed to the flat growth in the unbundled REC market in 2013.

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