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National Renewable Energy Laboratory
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Office of Energy Efficiency & Renewable Energy
Innovation for Our Energy Future

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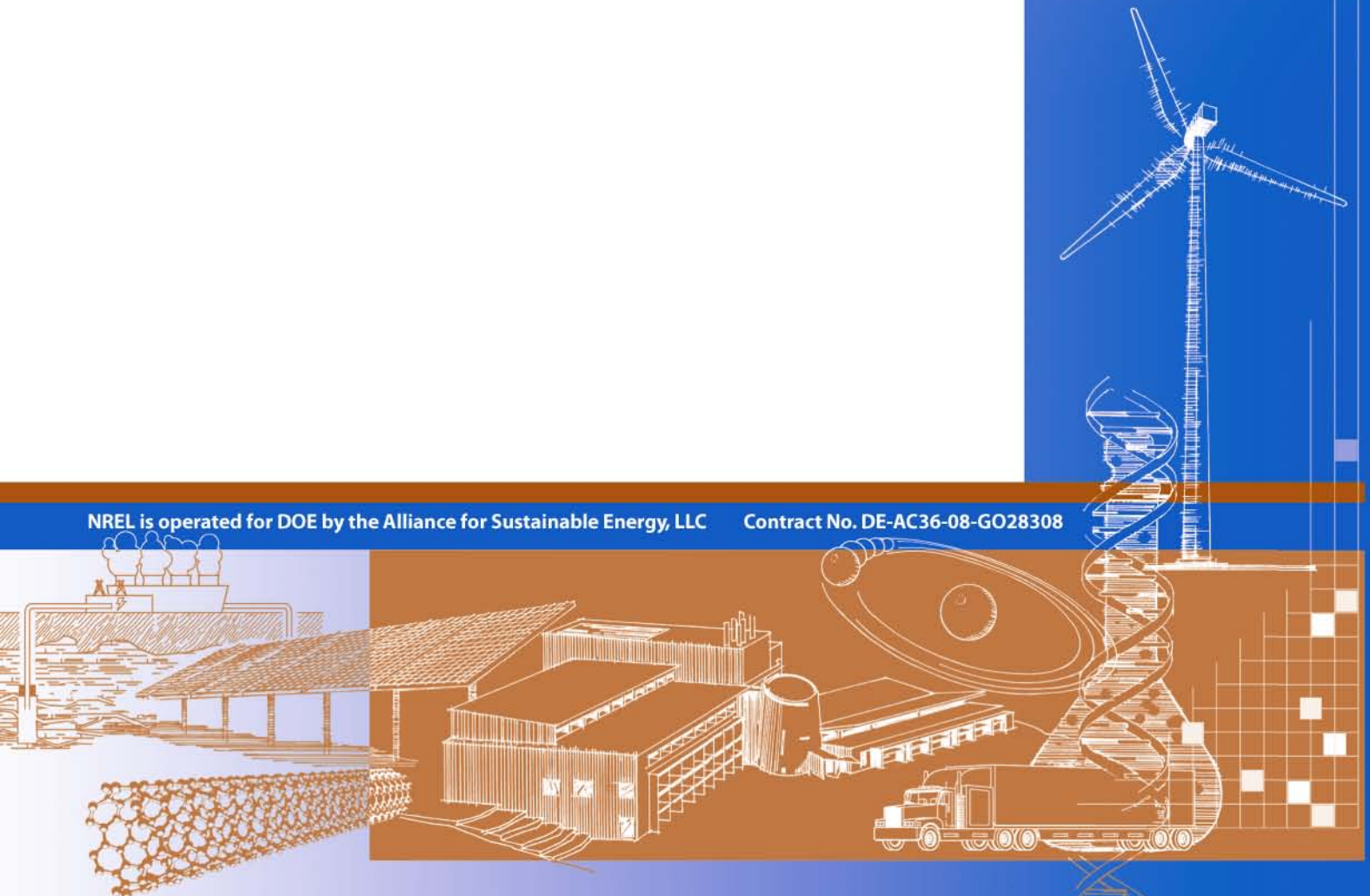

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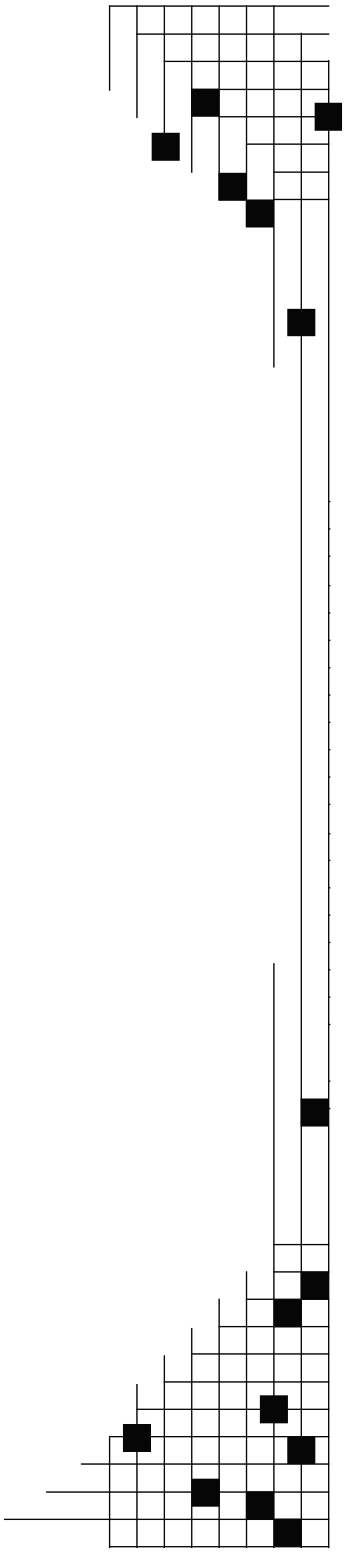

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Executive Summary

Voluntary markets for renewable energy in which consumers purchase renewable energy from their electricity providers or from renewable energy certificate (REC) marketers have existed for more than a decade. Going forward, various factors will influence the development of these markets, including potential climate policies, state and federal renewable portfolio standards (RPS), renewable energy prices, the level of consumer interest in purchasing green power, and the interest on the part of utilities in offering new green options and in continuing to promote existing programs.

This report presents estimates of voluntary market demand for renewable energy or green power through 2015. The forecast relies on historical data, including market sector sizes and growth rates, to inform our assumptions. Though we adjusted growth rates as discussed in the report, they remain the starting point for our analysis. Because of the different factors that affect utility programs, REC markets, and competitive electric markets, separate assumptions and methods are used to project demand for each submarket.

We developed a low-growth and a high-growth scenario for each market segment. The low-growth scenario reflects factors that may limit growth over time. The high-growth scenario represents optimistic growth assumptions. The difference between the scenarios reflects market and policy uncertainty and the difficulty predicting how consumers will react to factors affecting the voluntary market. The analysis includes a negative policy impacts scenario designed to reflect impacts on the market that might occur if future carbon policies significantly reduce the motivation for purchases. This scenario reflects the potential loss of a significant volume of existing purchasers.

Given the assumptions used in each market sector, our forecast projects the total voluntary demand for renewable energy in 2015 to range from 63 million MWh annually in the low-growth scenario to 157 million MWh annually in the high-growth scenario (Figure E-1). The range represents an approximately 2.5-fold difference. The negative policy impacts scenario reflects a market size of 24 million MWh. When extended through 2020, projections show 327 million MWh annually in the high-growth scenario and 94 million MWh annually in the low-growth scenario. This range is greater than the 2015 range, representing an approximately 3.5-fold difference. The negative policy impacts scenario projects 33 million MWh in 2020.

In both the high-growth and low-growth forecasts, REC markets continue to drive much of the growth, though the contribution of RECs is significantly less in the negative policy impacts scenario. On-site solar is projected to increase its share of the total voluntary market, while utility green power programs and competitive markets are projected to decline as a share of the total voluntary market.

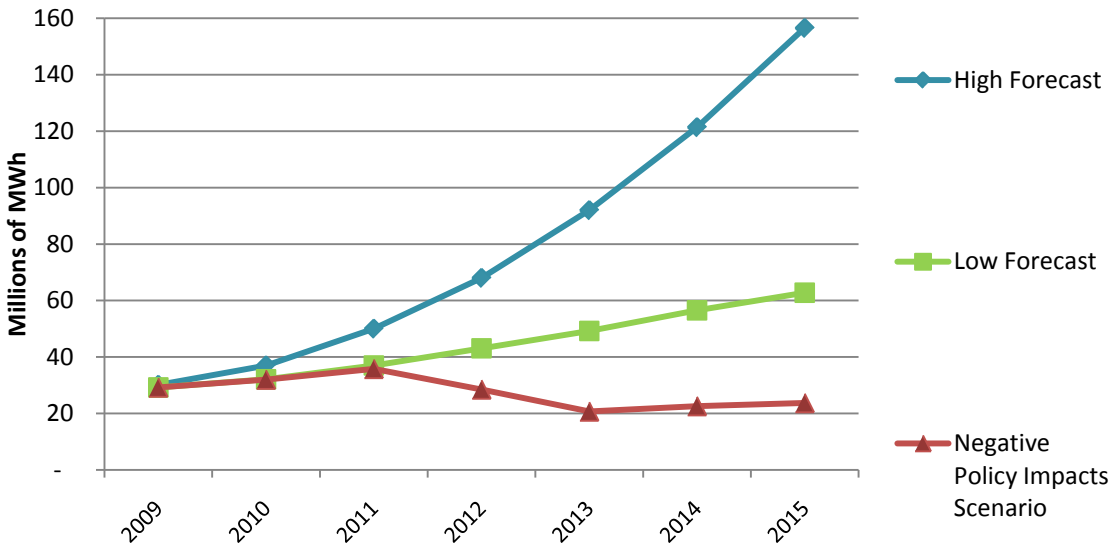

Figure E-1: Total voluntary demand for renewable energy (millions of MWh): High-growth, low-growth, and negative policy impacts scenario forecasts through 2015

Several key uncertainties affect the results of this forecast, including uncertainties related to growth assumptions, the potential impacts of policies on markets, the price and competitiveness of renewable generation, and the level of interest that utilities have in offering and promoting green power products.

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1 Introduction

Voluntary markets for renewable energy in which consumers purchase renewable energy for their electricity needs from their utilities or electricity providers have existed since the mid 1990's. Residential consumers participate in these markets and buy renewable energy for a variety of reasons: environmental concerns, including global climate change; energy security and independence; support for clean energy technologies; and conservation of resources for future generations. Businesses may have the same concerns as residential consumers but may also be motivated to differentiate their products, meet corporate environmental goals, or satisfy stakeholders.

Any consumer can purchase "green power"[1] through renewable energy certificates (RECs). RECs represent the "environmental attributes" of electricity generated from renewable energy-based projects. "Unbundled RECs" refer to RECs that are sold separately from electricity generation, thus allowing a consumer to support renewable energy without switching to an alternative electricity supplier. REC market sales reflect only those sales to end-use consumers that are separate from electricity.

The vast majority of RECs are sold to commercial and institutional customers, which have increasingly been driving the market. The Environmental Protection Agency's (EPA's) Green Power Partnership, a voluntary program that encourages organizations to purchase green power, has seen significant growth in recent years. The Partnership has grown from 104 partners in May 2003 to 1,203 partners in October 2009. Organizations report the quantity of RECs they purchase, which has increased from approximately 83,400 megawatt-hours (MWh) in May 2003 to approximately 13.3 million MWh in December 2009 (EPA 2010).

In addition to RECs, consumers and businesses in regulated utility markets may have the option to purchase some portion of their power supply as renewable energy. Regulated utility programs, or "green pricing programs" are offered by more than 850 utilities, or about 25% of utilities nationally. Finally, in competitive (or restructured) retail electricity markets, consumers may have the opportunity to purchase electricity generated from renewable sources by switching to an alternative electricity supplier that offers green power.

The total voluntary market for green power exceeded 24 million MWh in 2008. From 2007 to 2008, voluntary green power sales increased by 34% and annual growth rates have averaged 41% since 2004. From 2007 to 2008, REC markets grew by 47%, utility green pricing programs grew by 12%, and competitive markets grew by 22% (Bird et al. 2009a).

[1] "Green power is electricity generated from environmentally preferably renewable resources, such as solar, wind, geothermal, low-impact biomass and low-impact hydro resources" (EPA 2006).

A variety of factors will influence the development of these markets going forward, including potential climate policies, the development and implementation of state and federal renewable portfolio standards (RPS) and renewable energy price impacts, the level of consumer interest in purchasing green power, and interest on the part of utilities in offering new green options and in continuing to promote existing programs. A previous forecast of the voluntary market (Wiser et al. 2001) projected that green power demand in 2010 would range from 905 average megawatts (7.9 million MWh) in a low-growth scenario to a 6,971 average megawatts (61 million MWh) in a high-growth scenario. This analysis presents an updated forecast based on market experience from the last decade and addresses new market influences and trends.

This report presents estimates of voluntary market demand for renewable energy through 2015. Because of the different factors that affect utility programs, REC markets, and competitive electric markets, separate assumptions and methods are used to project demand for each submarket. A low-growth and a high-growth scenario were developed for each market segment, with the low case reflecting factors that may limit growth over time and the high-growth scenario representing optimistic growth assumptions. The analysis also includes a scenario in which future carbon policies have significant negative impacts on voluntary market demand.

2 Methodology

In forecasting demand for green power, we developed a spreadsheet model to estimate future market size based primarily on historical market trend data and factors that will influence uptake rates and offerings in the near term. This approach was used because of the availability of detailed historical market data on participation rates, purchase volumes, and product offerings, which provide a reasonable basis for forecasting trends over the near term, which is the focus of the study. It is not a mechanistic approach, however, in that we used judgment in adapting the historical data for our growth assumptions based on market maturity and potential policy impacts.

In the analysis, we treated each of the three market segments separately: unbundled RECs, regulated utility programs, and competitive electricity markets. Current market shares for each segment are shown in Figure 1. Sales from REC markets (15.6 million MWh) represented nearly two-thirds of voluntary demand in 2008. Utility green pricing programs and competitive markets represented 20% (4.8 million MWh) and 16% (3.9 million MWh) of the 2008 market, respectively (Bird et al. 2009a).

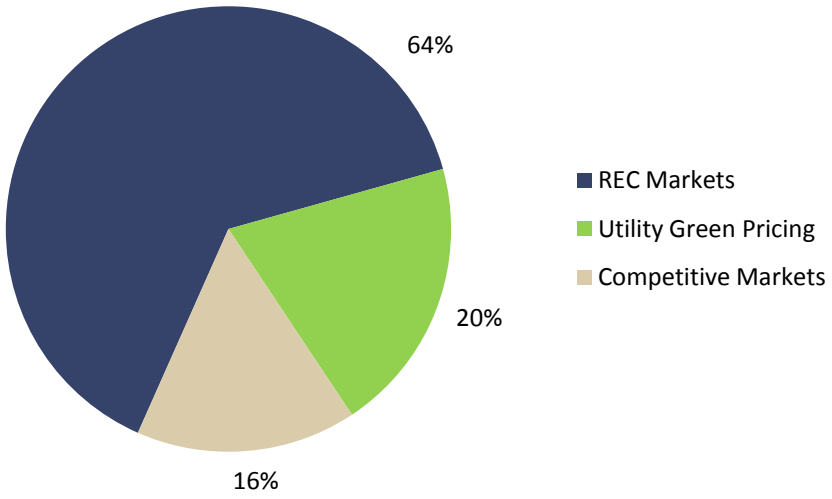

Figure 1. Share of 2008 green power sales by market segment

Source: Bird et al. (2009a)

For each of these submarkets, we used separate assumptions based on market differences and the historical data available for each, which are described in detail below. For each of these submarkets, we developed two scenarios: 1) a high-growth scenario with optimistic assumptions about offerings and participation levels, and 2) a low-growth scenario that assumed modest growth estimates to reflect potential policy impacts as well as more limited interest among utilities and retail suppliers in offering and promoting options and among consumers in purchasing green power. We also examined a negative policy-impacts scenario in which carbon policy design has significant negative impacts on the market.

The focus of this work is a projection of voluntary demand through 2015, though a projection was also made through 2020. While the 2020 results are presented in the summary (Section 8), there is greater uncertainty in these estimates, particularly because this forecast relies heavily on historical growth rates. There is also significant policy uncertainty over the timeframe that can impact market growth; therefore, we focus on the 2015 estimates.

3 Scenario Considerations and Assumptions

A number of external factors may affect growth in voluntary demand for renewable energy in the future, some by depressing demand in the low-growth scenario, and some by increasing demand in the high-growth scenario. The three market demand scenarios examined in this analysis are described below and summarized in Table 1.

3.1 High-Growth Scenario

The high-growth scenario (high case) reflects optimistic assumptions about growth in green power purchasing in coming years. It assumes that growth continues at fairly rapid rates comparable to those in recent years and that any potential federal or state policies will have no significant negative impacts on these markets. The high case assumes that there will be sufficient renewable energy supplies to meet demand and that any barriers to development are tractable so that voluntary market demand may be uninhibited.[2] Under this scenario, REC markets continue to grow strongly as prices remain relatively low and motivation for purchasing remains strong. This scenario also assumes utilities undertake renewed efforts to market green power and to offer new products to consumers, which could be spurred in part because utilities find that voluntary programs help them achieve portfolio diversity and reduce risks of future compliance through the purchase or ownership of renewables. Further, utilities may find that addressing both RPS and voluntary programs offers them a risk management strategy whereby they can acquire renewable resources in larger quantities, and in advance of compliance needs at lower cost. The high case also assumes optimistic growth in on-site renewable energy installations driven by aggressive cost reductions in solar photovoltaics. Finally, this case assumes that cap and trade legislation that supports the ability of renewable energy to reduce greenhouse gas (GHG) emissions is adopted, and this scenario specifically supports environmental claims by purchasers of renewable energy.[3] Because this would remove current uncertainty, it could lead to greater enthusiasm for purchasing renewable energy.

3.2 Low-Growth Scenario

The low-growth scenario (low case) reflects modest assumptions about growth in green power purchasing in coming years. It assumes that green power markets grow significantly more slowly than in the past because of reduced interest in purchasing and promoting products and because of potential price increases. It assumes that growing renewable energy mandates, at either the state or federal level, increase competition for

[2] This scenario assumes that consumers continue to purchase green power beyond that required by RPS targets (e.g., they may want to purchase renewable energy equivalent to 100% of their usage). An earlier NREL study found "no evidence to suggest that the adoption of RPS policies has adversely affected voluntary purchases of renewable energy to date" (Bird and Lokey 2007).

[3] This might be the case if a set-aside for voluntary renewable energy markets is adopted in future cap and trade programs, such as in the case of the Regional Greenhouse Gas Initiative (RGGI), the first operating cap and trade program in the United States, launched in 2009 by Northeast and Mid-Atlantic states. RGGI includes a voluntary renewable energy market set-aside that preserves the carbon benefits of voluntary green power purchases by retiring an equivalent number of carbon allowances. A similar provision has been included in the California preliminary draft cap and trade rules. Whether other emerging regional cap and trade programs or potential federal programs will include such provisions is unclear.

limited renewable resources, leading to higher REC prices, which slow demand growth. Demand may also slow if consumers feel that RPS or other renewable energy policies are adequately driving renewable energy generation. The low case also assumes that utilities are less inclined to offer and promote voluntary green power programs. This might occur if utilities struggle to meet RPS targets or if they do not see the need to promote the sale of renewable energy as a differentiated product and instead decide simply to include renewable energy acquisitions in rates for all customers. The low case assumes slower growth in on-site renewable energy installations, based on a scenario of more modest cost reductions in solar photovoltaics than in the high case. The low case assumes that even if carbon policy is adopted that purchasers are still able to use renewable energy purchases to address their electricity emissions in GHG inventory programs and to meet corporate environmental goals.

3.3 Negative Policy Impacts Scenario

The negative policy impacts scenario reflects a case in which future policies reduce motivation for purchasing green power and significantly reduce demand in coming years. In this scenario, the growth assumptions are generally the same as in the low case until policies are assumed to affect the market. This scenario reflects impacts on the market that could occur if cap and trade legislation is adopted that does not support the ability of renewable energy to reduce GHG emissions.

The negative policy impacts scenario assumes that future carbon policy design does not support environmental claims by purchasers of renewable energy, which significantly reduces motivation to purchase, even among existing purchasers. If renewable energy purchasers cannot account for the GHG benefits of renewable energy purchases in GHG inventories or cannot make carbon-neutral or emissions benefits claims, organizations motivated by an interest in the carbon benefits of renewable energy would likely lose motivation to purchase (see Bird et al. (2007) and Harmon and Hirschhorn (2006) for additional discussion of this issue).[4] This scenario assumes customers interested in the carbon benefits of green power cease purchasing or do not commit to purchases if green power can no longer be used as a carbon mitigation strategy. Also, marketers may cease to offer products without carbon benefits or may feel it is deceptive to offer products in which consumers may believe those benefits exist.

[4] There is significant uncertainty regarding this issue, as carbon policies are currently under development and may or may not be designed to preserve voluntary renewable energy purchasers' carbon claims. Because renewable energy sources create avoided emissions benefits by displacing fossil fuel generation, renewable energy generation may not be able to affect emissions levels once a carbon emissions cap is in place. Under some carbon policy designs, renewable energy sources would make it easier for emitters to achieve compliance with an emissions cap and would enable them to sell allowances to other emitters when renewable energy displaces fossil generation. Other policy designs are possible as well.

Table 1. Summary of Scenario Assumptions

High Case	Low Case	Negative Policy Impacts Case
Demand continues to grow rapidly and any price impacts from RPS are limited	RPS requirements are increased, creating competition for RECs and raising prices	RPS requirements are increased, creating competition for RECs
Potential carbon policies are designed to support emissions reductions claims by voluntary renewable energy purchasers (e.g., through allowance retirement)	GHG inventories allow green power purchases to count toward electricity emissions	Carbon policy is adopted that does not allow emission reduction claims and purchasers are not able to count green power purchases toward GHG emissions goals, causing many existing customers to cease purchasing.
Utilities actively promote programs	Utilities less inclined to promote programs	No new utility programs

Our forecast assumptions are influenced by these external factors but generally are not quantitatively tied to them. Further, our assumptions were influenced by an awareness of the typical life cycle of demand for new products. As voluntary markets mature, they can be expected to reflect the diffusion of innovation, or a standard "S" curve, starting slowly, and proceeding through rapid growth before tapering off (Holt and Wiser 1999). The challenge is that we do not know just where we are in this S curve, whether markets will experience considerably more growth in demand before growth flattens, or whether demand is nearing the top of the S curve and will soon turn flat. The high case would reflect a position in the steeper part of the curve, while the low case would reflect a point nearer the top.

4 Unbundled REC Markets

This section describes the methodology and assumptions used to estimate the size of REC markets in coming years. Subsequent sections of the report discuss the methods used to estimate utility programs, competitive markets, and demand for on-site systems.

Voluntary demand for RECs is driven primarily by corporations and large organizations, with residential REC purchases accounting for only about 1% of REC sales (Bird et al. 2009a). We assumed future growth in REC markets would continue to be dominated by nonresidential consumers because of the cost and challenges of explaining and marketing RECs to residential consumers, who unlike more-sophisticated nonresidential buyers are generally unfamiliar with the functioning of electricity markets. Because RECs are often sourced from a national market and because data on regional demand are limited, we did not attempt to differentiate REC market demand by region.

In our forecast, we rely on historical nonresidential demand data from the Green Power Partnership to determine historical growth rates. U.S. Environmental Protection Agency (EPA) data are divided by size of customer load into four categories. The largest customers, by size of load, account for 83% of Partnership REC demand in 2009, as shown in Table 2, and these shares have been consistent with no more than 1% variation since 2006.

Table 2. 2009 REC Sales to Green Power Partners, by Size of Customer

Total Load of Customer	Percent of RECs Purchased	RECs Purchased (MWh)
>100,000 MWh	83%	11,164,620
10,001-100,000 MWh	14%	1,843,608
1,001-10,000 MWh	3%	437,755
<1,000 MWh	<1%	50,823

Source: EPA (2009), as of October 15.

Table 3 shows growth rates for nonresidential customers in these load size categories and how they vary for different periods. Using rates prior to 2006 in the analysis would yield growth rates higher than are likely sustainable going forward. Some of the largest growth occurred in the early years of the Green Power Partnership program, and growth since then, though strong, has moderated somewhat. Table 3 shows somewhat slower growth from 2008 to 2009, presumably reflecting the economic recession.

Table 3. Average Annual Growth Rates for REC Sales

Customer Size (load)	2003*-2009	2006-2009	2007-2009	2008-2009
> 100,000 MWh	137%	53%	22%	9%
10,001 - 100,000 MWh	75%	51%	23%	3%
1,001 - 10,000 MWh	91%	65%	53%	35%
< 1,000 MWh	58%	36%	8%	6%
Total	114%	53%	23%	9%

Source: EPA (2010)
*Reflects year-end 2003 estimate based on May 2003 and July 2004 data.

Differences in the growth rates for the various customer size categories are generally not significant enough to affect overall growth rates substantially. This can be seen from the fact that the growth rates for the largest customer category are nearly the same as for the total customers in the Partnership. The growth rate for the smallest purchasers is considerably lower than for the other categories, but because they represent less than one percent of demand, using a different growth rate would have minimal effect on the outcome.

Because EPA's Green Power Partnership data offer greater detail, we analyzed them for trends. However, our forecast used National Renewable Energy Laboratory (NREL) data on REC markets reported in Bird et al. (2009a) to estimate the total market size in 2009, which serves as the basis of the forward projections.[5]

High Case

For our high-growth scenario (or high case), we assumed 25% growth in 2010, consistent with growth from 2007 to 2009, to reflect the likelihood that the economic downturn will continue to inhibit demand in the near term. Some companies have reduced the size of their purchases during this period and others may be waiting for a better economic climate to make substantial size purchases. However, we project that demand will increase in 2011 based on the expectation of an improved economy.

For the period 2011-2013, we assumed 40% growth per year, which is generally consistent with pre-recession growth rates, but somewhat below average growth from 2006 through 2009 (55%). Because of the difficulty in sustaining continually high and compounding growth rates year after year, and to account for other factors that may slow growth, we assumed growth rates of 30% in 2014-2015, 20% in 2016-2017, and 10% in 2018-2020. Such factors include the possible shift of some REC demand to on-site systems and the assumption that the innovators and early adopters of the classic market

[5] While NREL and EPA data tend to be fairly consistent, NREL REC sales numbers are generally 1-3 million kilowatt-hours (kWh) larger than the EPA data; this is because the EPA data capture only organizations that have joined its Partnership, whereas the NREL data may capture nonparticipants. For this reason, we added the incremental new 2009 REC purchases by organizations in the U.S. EPA Green Power Partnership to the 2008 NREL REC market estimate to determine total REC market demand in 2009, which is the basis for forward projections (see Table 4).

diffusion curve have already chosen to participate, making it more difficult to attract new purchasers over time. However, the high case reflected generally modest impacts because of these factors over the period, with the low case reflecting greater impacts.

Low Case

For our low case assumption, we assumed demand for RECs would grow at a rate of 10% in 2010 to account for the possibility of greater impacts of the economic downturn on demand than in the high case. For the period 2011-2013, we assumed 15% growth, which is consistent with the slow growth rate experienced in 2009 and substantially lower than the historical 55% growth rate for the 3-year period, which includes pre-recession growth. Consistent with declining growth in the high case, we assumed growth rates would be 10% in 2014-2017, and 5% in 2018-2020.

The lower growth assumptions reflect, in part, the possibility that REC prices will rise because of competition with the growing compliance markets, which could dampen demand in the voluntary REC market. Lower growth assumptions also reflect the possibility that the market is more mature and attracting new purchasers will become more difficult. These assumptions translate into slower growth but do not affect the level of current purchases.

Negative Policy Impacts Scenario

Because REC markets have been driven by a number of corporate or institutional purchasers that use RECs for carbon accounting purposes or for achieving carbon-neutrality goals, the negative policy impacts scenario examines a case in which carbon policy design significantly decreases REC purchaser motivation. If carbon policy and GHG accounting rules are designed so that renewable energy purchasers cannot account for the GHG benefits of renewables in GHG inventories or make carbon-neutral or emissions benefits claims, organizations motivated by an interest in the carbon benefits of renewables would likely lose motivation to purchase. This could lead to current purchasers, particularly many of the largest green power purchasers, moving away from green power purchases as a carbon mitigation strategy. Because large purchasers dominate the REC market segment, and because they are expected to be most affected by policy design considerations as they are most likely to be influenced by carbon accounting rules and to use public carbon emission inventories, REC markets could be substantially impacted.

To our knowledge, no comprehensive or statistically significant data are available to indicate the fraction of purchasers motivated primarily or exclusively for the carbon

benefits of renewable energy.[6] The data that are available, however, suggest that the ability to make carbon claims is a strong motivator for green power purchases by large organizations—those that are driving the growth in this market. The Center for Resource Solutions looked at the public claims made by the largest 15 corporate purchasers in the EPA's Green Power Partnership and found that two-thirds of them made statements relating to reducing their emissions or carbon footprint (Busch 2010). Still, some organizations have indicated that they are primarily interested in making claims about products made with renewable energy, and others have suggested that they are likely to move toward greater on-site renewables over time. Because of the variety of possible motivations and rationales for purchasing, [7] responses to future carbon policy changes may also be mixed. Therefore, it is difficult to determine how much of an impact this will have on participation.

In the negative policy impacts scenario, we assumed growth would be similar to that in the low case in 2010 and 2011, prior to the implementation of carbon policy, with purchases increasing by 10% in each year. We assumed that starting in 2012—when proposed carbon policies are slated to take effect—and over the two-year period through 2013, that two-thirds of REC purchasers will cease to purchase RECs if they can no longer be used for carbon-neutrality claims or to address emissions in GHG emission inventories. Thus, two-thirds of the volume of REC purchases is phased out evenly over the two-year period. We assumed that in 2014 and onward the market will continue to decline at a rate of -10% annually.

[6] Most RECs are purchased by non-residential consumers. A 2000 survey of 464 nonresidential customer purchasing green power found that their strongest motivation was fulfilling their organization's "strong and pervasive commitment to public health and the environment" (Holt et al. 2001). This research does not highlight global warming concerns but does indicate that the respondents were internally driven by their own environmental goals. Some surveys have found that residential purchasers are interested in renewable energy because of environmental benefits, but none has addressed carbon benefits specifically. In a 2009 survey, 46% of respondents indicated their top reason for supporting renewable energy was "protecting the environment" (NMI 2009). In a 2006 poll, 32% of respondents purchased or wanted to purchase renewable energy to improving the environment and 30% were concerned with leaving their children and grandchildren a cleaner environment (Opinion Research Corporation 2006). However, the nonresidential customers—not these residential customers—are primarily driving the demand for RECs.

[7] Federal agencies have purchased RECs as well as other forms of green power to fulfill federal requirements to purchase renewable energy. The Energy Policy Act of 2005, requires federal agencies to procure renewable energy for 7.5% of electricity usage by 2013 and thereafter. Total federal facility electricity usage in 2008 was approximately 56 million MWh.

Summary

Based on these assumptions, in 2015, the unbundled REC market is projected to be between 33.7 million MWh in the low case and 96.5 million MWh in the high case (Table 4). The 2015 high case projection is 2.9-fold higher than the projection in the low case and represents a 5.8-fold increase from the 2009 REC market. In 2015, the negative policy impacts scenario represents a 65% decrease from 2008, resulting in 5.4 million MWh.

Table 4: Historical and Projected Voluntary Demand for RECs (thousand MWh)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
High Case	6,800	10,600	15,600	16,700	20,800	29,100	40,800	57,100	74,300	96,500
Low Case	6,800	10,600	15,600	16,700	18,300	21,100	24,200	27,900	30,600	33,700
Negative-Policy Impacts Scenario	6,800	10,600	15,600	16,700	18,300	20,200	13,400	6,700	6,000	5,400

5 Regulated Utility Programs

To estimate growth in regulated utility green pricing programs, we relied on NREL data collected annually from utility green pricing programs. Data for a five-year period from 2004-2008 inclusive were used. The data were sorted by utility categories (investor-owned utilities (IOUs), public utilities (municipal utilities and public utility districts), and electric cooperatives), as well as by programs that worked with a marketing partner or not.

We differentiated our forecast assumptions for 1) existing utility programs and 2) new utility programs that may be added over the forecast period.

5.1 Existing Utility Programs

As shown in Table 5, the compound annual growth rates (CAGR) for the period 2004-2008 are not substantially different between IOUs and public utilities, although IOU programs grew at a slightly higher annual rate than public utility programs (29.2% vs. 24.5%). On average, cooperative programs did not grow during the period perhaps reflecting natural customer attrition and relatively lower levels of marketing once the programs are launched.[8]

Table 5. Green Power Sales Growth Rates for Existing Programs, by Type of Utility

Year	IOUs		Public Utilities		Cooperatives*	
	Sector GP Sales (MWh)	Growth from previous year	Sector GP Sales (MWh)	Growth from previous year	Sector GP Sales (MWh)	Growth from previous year
2008	2,779,830	9.6%	2,019,864	20.8%	56,656	-7.4%
2007	2,535,199	10.9%	1,672,101	15.9%	61,198	-3.2%
2006	1,851,335	66.3%	1,443,051	37.4%	63,210	-19.3%
2005	1,374,616	37.7%	1,050,140	24.9%	78,364	33.6%
2004	998,491	-	840,701	-	58,649	-
CAGR (2004-2008)		29.2%		24.5%		-0.9%
CAGR (2005-2008)		26.5%		24.4%		-10.2%

*Adjusted for outlier, see footnote 7.

[8] It should be noted that the cooperative green power sales data included one large generation and transmission cooperative that controls substantial renewable generation and consequently has sales to a number of large wholesale customers. Because this one program accounted for several times the sales of the remaining cooperatives and skewed the results for the category as a whole, we adjusted the cooperative data shown in Table 5 by removing this program. We have assumed this cooperative program would grow at a rate consistent with the public utility average growth rate.

Although not shown in the table, we also examined growth in programs that were supported by a third party marketer. An earlier study (Bird and Kaiser 2007) found that some programs (both IOU and public utilities) had larger customer participation if they worked with a marketing partner. However, as a group, growth in sales for utilities working with a marketer could not be differentiated from growth of those working without a marketer. For 2004-2008, utilities that partnered with marketers showed higher growth (29.4%) than those that did not work with marketers (26.3%), but for 2005-2008, the results are reversed (21.9% vs. 25.4%). As a result, we did not differentiate growth assumptions based on whether a marketing partnership is present.

High Case

For our high-case projection, we assumed IOUs would grow at an annual rate of 25% through 2014, with the exception of the 2009-2010 timeframe, where due to the downturn in the economy, we assumed growth of 10%. Although 25% growth is slightly less than the average actually experienced over a five-year period, we note that year-to-year growth from 2006-2007 and 2007-2008 was substantially lower than the earlier years, which may signal a slowing of growth not influenced by the later recession (although the 2007-2008 data may include some of the economic slowdown that began in 2008). To account for difficulties in attracting new customers over time and in sustaining high-growth rates over many years, we assumed growth slows to 20% in 2015-2017 and to 15% in 2018-2020.

For public utility programs, growth rates have been more consistent historically with no similar significant drop in growth in recent years. For this reason, we assumed a high-case growth of 25% through 2014 the same as for IOUs, even though the five-year average growth is slightly lower than that for IOU programs. We did not assume a slowdown in 2009-2010 because historical data do not show significant slowing from the economic downturn. Consistent with the IOU growth rates, we assumed growth slows to 20% in 2015-2017 and to 15% in 2018-2020 to account for difficulties in attracting new customers over time and in sustaining high-growth rates over many years.

Cooperative programs, based on our adjusted data, have seen slightly negative growth. Recent reductions in sales are within the bounds of typical program attrition as customers choose to leave the program or simply move away. For the 2009-2010 timeframe, we assumed growth would be consistent with 2008 observed trends, and in the high and low cases, we saw declines of 7%. For the high case, we assumed cooperative programs would grow by 10% per year from 2011 to 2014, and then decline to 5% annually from 2015 through 2020. Such growth is plausible if cooperative members show interest in green power and their management supports increased promotion and attention to the program. The reduction in 2015 is designed to account for the challenge in continuing to attract new customers as the market matures.

Low Case

The low case growth rate for existing IOU programs is assumed to be 10% annually from 2009 through 2014, based on the most recent two years of data, then declining to 5% growth annually in 2015 through 2020. In the IOU low case, we did not adjust growth for the economic recession because the growth rate used already mirrored the slow growth experienced in 2008.

For public utilities, we assumed growth rates were the same as for IOUs in the low case, with 10% annual growth from 2009 through 2014, falling to 5% annually in 2015 through 2020. Although we have no data to suggest this, the lower growth of IOUs might also apply to public utilities, especially as the programs get older and find it more difficult to acquire new customers.

For cooperatives, we assumed in the low case that growth in 2009 and 2010 would be consistent with 2008 observed trends, a decline of 7%. This is consistent with the assumption for cooperative programs in the high case. From 2011 through 2014, the low case assumed cooperatives would be satisfied with making the programs available to their customers and would not significantly promote them. Given this assumption of static programs and little marketing support, participation is projected to remain at 2010 levels (growth of 0%), and then decline by 5% annually from 2015 through 2020 as attrition erodes the participant base of programs.

Negative Policy Impacts Scenario

Under the negative impacts scenario, we assumed utility programs are impacted by carbon policy that eliminates green power as a carbon mitigation strategy but to a lesser extent than REC markets. Generally, utility programs are dominated by residential and small commercial customers that may not be interested in making carbon-neutral claims or participating in GHG emissions inventories, and therefore are less sensitive to the inability to do so. However, survey research suggests that some consumers are motivated to purchase green power for the environmental benefits, with one survey suggesting about 30% of consumers are concerned about long-term environmental benefits.[9] Therefore, some residential or small commercial purchasers may cease purchasing if carbon benefits are not conveyed to green power purchasers, and some marketers may cease to offer products if the environmental benefits are diminished or if the lack of carbon benefits may be considered deceptive to consumers who may think their purchases are reducing carbon emissions. In addition, a loss of a large fraction of commercial and institutional purchasers could have spillover effects on the rest of the market or result in a loss of some credibility. While significant uncertainty surrounds the actual impacts on this market segment and data with respect to the fraction of consumers motivated specifically by carbon mitigation benefits are lacking, we assumed initial

[9] Some surveys have found that residential purchasers are interested in renewable energy because of environmental benefits, but none has specifically addressed carbon benefits. In a 2009 survey, 46% of respondents indicated their top reason for supporting renewable energy was "protecting the environment" (NMI 2009). In a 2006 poll, 32% of respondents purchased or wanted to purchase renewable energy to improve today's environment, and 30% were concerned with leaving their children and grandchildren a cleaner environment (Opinion Research Corporation 2006).

growth consistent with that in the low case and a loss of one-third of existing purchases through utility programs in later years after carbon policy is adopted.

In the negative policy impacts scenario, consistent with the low case, the growth rate for existing IOU and public utility programs is assumed to be 10% annually in 2009 through 2011. For cooperatives, also consistent with the low case, we assumed a decline of 7% in 2009 and 2010. In 2011, we assumed cooperatives would see zero growth. For the 2012-2013 timeframe, we assumed all utilities would lose one-third of their 2011 demand, which is generally consistent with available survey data on customer motivations. For 2014-2020, we assumed annual decreases of 10% for all utilities.

Summary

For 2015, we forecast that existing regulated utility programs will range from 9.0 million MWh to 19.2 million MWh (Table 6). This growth represents between a 1.8- and a 3.9-fold increase from 2008 levels. The negative policy impacts scenario represents a 29% decrease from 2008, resulting in 3.5 million MWh in 2015.

Table 6: Historical and Projected Size of Existing Utility Green Power Programs (thousand MWh)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
High Case	3,400	4,300	4,900	5,600	6,600	8,200	10,200	12,800	16,000	19,200
Low Case	3,400	4,300	4,900	5,300	5,900	6,400	7,100	7,800	8,600	9,000
Negative Policy Impacts Case	3,400	4,300	4,900	5,300	5,900	6,400	5,400	4,300	3,900	3,500

5.2 New Utility Programs

Forecasting demand from new utility programs followed a slightly different approach. We determined the fraction of utility load that might offer a green power option over the forecast period, under both a high and a low case. First, we identified utilities with existing green pricing programs. These constitute nearly half of total U.S. utility retail electricity sales, as shown in Table 7.

Table 7. Percent of Utility Retail Sales with Green Power Option Currently Available

IOUs	Public Utilities	Cooperatives
47%	47%	45%

Next, we removed all of these roughly 850 utilities with green pricing programs currently in operation, which left us with a list of utilities not currently offering a green power program in states with traditional utility regulation. Then, we estimated the portion of this load that might conceivably have a green power program made available to it over the course of our forecasting horizon, with a modest assumption of new load in the low case and a more aggressive assumption in the high case. The determination of potential new

utility programs considered factors such as whether the utility has expressed interest in offering a program or is in a region where programs are already available. The new retail load to which a green option was made available was apportioned equally to each of the years of the forecast 2009-2020 in each scenario, so that some new load would be exposed to a new green power program startup in each year. Finally, we made assumptions about the percent of utility retail load served by green power in the launch year based on historical data for new programs. Subsequent year growth assumptions were informed by growth rates for existing utility programs.

High Case

In the high case, we assumed IOU load with a green power option available would increase by 25%, from 47% to 72% by 2020, while public utility and coop loads would increase by 15%, from 47% and 45% to 62% and 60%, respectively. The high case presents an optimistic view of utility interest in offering new green pricing programs. Utility interest might be increased if green pricing programs help manage regulatory risks or if utilities find the programs helpful in managing their renewable energy portfolios. The high case is also designed to reflect a higher level of utility program promotion and participating green power load, as consumer awareness of renewable energy options and interest in purchasing green power may continue to grow as it becomes more mainstream.

Low Case

In the low case, we assumed IOU load with a green power option available would increase by 10%, from 47% to 57% by 2020, while public utility and coop loads would increase by 5%, from 47% and 45% to 52% and 50%, respectively. The low case is designed to reflect modest utility interest in offering new voluntary programs in light of increasing mandates and competition for renewables to meet compliance obligations. Many utilities interested in offering green pricing programs may have already done so. Going forward, utilities may not want to offer voluntary programs that make compliance obligations more expensive and difficult to meet. Some utilities might shift to rate-basing renewables as renewable resources become more cost-competitive rather than offering green power as an optional product.

Furthermore, consumers might be less interested if the price of purchasing renewables through voluntary programs rises, or they might feel less need to support renewable energy if they believe that government is providing adequate support in the form of incentives or mandates. The low case is designed to reflect more modest participation as a because of these potential factors.

Negative Policy Impacts Scenario

Under the negative policy impacts scenario, we assumed there are no new utility programs offered. This might occur if the overall market loses credibility and if the environmental community does not support the development of new programs. .

The method for growing the new programs over time is the same in the low and high case. Utility green power programs see a substantial “bump” in sales in the first and second years of the program because programs are often heavily promoted when they are

initially launched and the early adopters enroll in the program. We assumed participation is 0.15% of the load newly exposed to a green power option in the first year based on historical green pricing program data from NREL (Table 8).[10]

Table 8: Average Green Power Load during First Year of Program

Program-Year Start	Average Percent of Green Power Load for Programs Starting in Year
2003	0.11%
2004	0.09%
2005	0.12%
2006	0.02%
2007	0.15%
2008	0.36%
Average	0.14%

In the second year, we assumed these new programs grow by 140%, again based on average data for growth of green pricing programs in their second year. Because of limited data on second year growth for programs that began in 2004 (3 observations), we used an average of programs that started in 2002 and 2003 (Table 9).

[10] NREL has data on the green power sales for at least 35 programs in the year of their launch.

Table 9: Utility Green Pricing Programs Second Year Growth

Program-Year Start	2nd Year Growth	3rd Year Growth	4th Year Growth	5th Year Growth
2002	129%	96%	36%	27%
2003	149%	11%	11%	10%
Average	139%	53%	23%	19%

For subsequent years, we used an average growth rate for existing utility programs, differentiated by utility type. We used the same rates for the high case, low case, and negative policy scenario. Specifically, we assumed IOU and public utility programs would grow at an average annual rate of 15%, and that cooperative programs would remain constant (0% growth) after the initial first and second years of growth. The growth rates used in the third and subsequent years are between the high- and low-growth rates used for forecasting the size of existing green pricing programs (see Section 5.1); the rates were selected to reflect new program growth without the bump in the first couple of years of the program.

Summary

New regulated utility programs are expected to reach between 620,000 MWh and 1.6 million MWh by 2015 (Table 10), under the low and high cases respectively. The negative policy impacts scenario results in no new utility programs.

Table 10: New Utility Programs (thousand MWh)

	2009	2010	2011	2012	2013	2014	2015
High Case	70	250	460	690	960	1,260	1,600
Low Case	30	100	180	270	370	480	620
Negative Policy Impacts Case	-	-	-	-	-	-	-

6 Restructured Markets

In states that have restructured electricity markets, green power options take a different form than those offered by traditionally regulated utilities. Therefore, we treated states with retail competition in the electric sector differently in this analysis. The voluntary demand for renewable energy in restructured markets is highly dependent on 1) changes in wholesale market prices, 2) requirements by states that standard-offer or default suppliers offer a green power option, and 3) the facilitation by states or utilities of green options available through customer electricity bills.

Fourteen states with restructured electricity markets allow retail customers to choose their electricity provider.[11] We do not anticipate any additional states will support customer choice at the retail level during the forecast horizon. In the 14 states with restructured markets, green power options have generally been presented to consumers either (1) as a bundled electricity product in which customers switch from standard offer providers to green power providers or (2) as an unbundled REC add-on to default electricity service, which we refer to here as "competitive programs." Offerings in the latter category are referred to as programs because they tend to be green power options sanctioned by state public utility commissions in conjunction with the provision of default supply.

Initially, competitive electricity providers offered a green power product bundled with electricity in many of these restructured electricity markets, but many of these bundled green power products were dropped because of difficulties competing in the market, and because in residential markets at least, customer switching to new providers was never very strong. Nevertheless, several of these competitive electricity providers continue to market green power products to retail customers. We treated them separately from "competitive programs" because of differences in their promotion, in their uptake rates, and in available historical participation data.

6.1 Competitive Marketers

In states such as Illinois, Maine, Maryland, New York, Pennsylvania, and Texas, green electricity products are marketed by electricity service providers. NREL has historical data from 2004 on competitive market sales that are based on information provided by marketers, but NREL does not have data for individual states. These markets have experienced overall growth over the past several years, but the growth has been mixed with declines as some marketers have exited markets (e.g., Connecticut, Ohio, and Pennsylvania) when market rules or conditions have made it too difficult to offer green products. Nevertheless, competitive market sales have experienced compound annual average growth rates of 4% for 2004-2008 and 13% for 2005-2008 (Table 11). These rates do not include growth in competitive programs, which are addressed in Section 6.2.

[11] According to the Energy Information Administration, the following states have restructured electricity markets: Connecticut, Delaware, Illinois, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, and Texas. Other states once supported retail choice but have since suspended that policy.

Table 11: Historical Growth in Competitive Marketers Sector

Year	Competitive Marketers (thousand MWh)	Change from Previous Year
2004	2,513	-
2005	1,861	-26%
2006	1,715	-8%
2007	2,532	48%
2008	2,996	18%
CAGR 2004-2008		4%
CAGR 2005-2008		13%

High Case and Low Case

For 2009-2010, we forecast that competitively marketed green power would grow by 5% per year in the high case and 0% in the low case due to the economic downturn. For 2011-2014, based on historical growth rates, we assumed demand for competitively marketed green power would continue to grow, in the high case by 15% per year, and in the low case by 5% per year. For 2015-2020, we assumed, as we have with the other market segments, that the market would mature and that attracting customers would be more difficult. Therefore, growth is estimated to slow in the high case to 10% annually and in the low case, 0%.

The high case reflects a more optimistic growth scenario, assuming that marketers can continue to gain traction and compete against wholesale prices in existing restructured markets. It also assumed relatively favorable market conditions and market rules persist. The low case assumed slower growth, reflecting more significant challenges to remaining competitive in these markets in the future.

Negative Policy Impacts Scenario

In the negative policy impacts scenario, we assumed declines similar to those of the REC market because this market segment is also dominated by generally large corporate or institutional purchasers and the same issues apply (see earlier discussion in Section 0). We assumed no growth in 2009 through 2011 and then a loss of two-thirds of 2011 demand by 2013. From 2014 onward, we assumed annual decreases of 10%.

Summary

Competitive marketers are expected to represent between 3.6 million MWh and 6.4 million MWh in 2015 (Table 12). This represents growth from 2008 of 1.2-fold in the low case to 2.1-fold in the high case. Compared to growth in other sectors, this growth is relatively modest. The negative policy impacts scenario represents a 73% decrease from 2008, resulting in 0.8 million MWh in 2015.

Table 12: Competitive Marketers (thousand MWh)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
High Case	2,500	1,900	1,700	2,500	3,000	3,100	3,300	3,800	4,400	5,000	5,800	6,400
Low Case	2,500	1,900	1,700	2,500	3,000	3,000	3,000	3,100	3,300	3,500	3,600	3,600
Negative Policy Impacts Case	2,500	1,900	1,700	2,500	3,000	3,000	3,000	3,000	2,000	1,000	900	800

6.2 Existing Competitive Programs

Competitive programs (also sometimes called "default supplier" or "check-off programs" for the ease in which customers can enroll) are currently available in several states, including Connecticut, Massachusetts, New York, New Jersey, and Rhode Island. These are programs in which REC marketers offer specific products that can be made available either centrally, such as through a state-sponsored Web site or through the Web site of a default service provider (i.e., usually through the distribution utility). We categorized these as competitive programs rather than as REC sales because the RECs are essentially bundled with the customer's electricity and the customer pays only one bill. It is up to individual marketers to promote their own products, but billing and collections are handled by the utility. Historically, competitive programs grew an average of 48% annually between 2005 and 2008, though the annual growth rate from 2007 to 2008 was only 25% (Table 13).

Table 13: Growth Rates for Existing Competitive Program Sector

Year	Competitive Markets (MWh)	Growth from previous year
2005	290,780	139%
2006	491,243	69%
2007	758,296	54%
2008	946,586	25%
CAGR 2005-2008		48%

High Case

To forecast continued demand for these programs, we assumed demand would grow in the high case by 25% from 2008-2009 and 2009-2010, and then 30% per year for 2011-2014 period. We assumed that this growth rate cannot be sustained through 2020, and therefore reduce growth rates to 25% in 2015 and 2016, 20% in 2017 and 2018, and 15% in 2019 and 2020.

The slower growth assumption for 2008-2010 is intended to reflect the effects of the economic downturn, although the impacts of the economy are assumed to be more modest in the high case than in the low case. The rate is based on the growth rate for existing programs of this type during 2008. The growth assumptions for the later years are more conservative than the historic rates, but are designed to reflect the challenges in

continuing to attract consumer segments after the most motivated customers are already enrolled. The high case generally reflects an optimistic scenario of growth for these programs going forward, assuming that they are actively promoted and that consumers are favorably disposed to participate. These programs have grown more rapidly than green pricing programs in regulated markets largely because these competitive providers do not make money unless they increase their sales.

Low Case

In the low case, we assumed sales grow at 10% during 2009 and 2010, because of the recession, and then grow at an annual rate of 15% for 2011-2014. Similar to the high case, we assumed growth rates will begin to decline in 2015. Growth rates were reduced to 10% in 2015 and 2016, 5% in 2017 and 2018, and 0% in 2019 and 2020.

The more modest growth rate reflects a scenario in which marketers do not place as much attention and resources in growing these programs as they have in the past. Also, it assumes that states do not continue to provide incentives or support for developing these markets, as has been the case in the past and has likely fueled some of the higher growth rates. The more modest growth also reflects decreased interest on the part of consumers in participating in these kinds of programs as a result of policy considerations noted earlier and perhaps higher renewable energy prices.

Negative Policy Impacts Scenario

In the negative policy impacts scenario, we assumed reductions in default supplier programs in competitive markets similar to those for regulated utility programs, because they are also dominated by residential and small commercial customers. Declines in these programs could occur if carbon policy is adopted that results in significant losses of large commercial and institutional REC purchasers, which result in spillover effects in other market segments and a potential loss of credibility in the market. Also, consumers interested in carbon benefits may cease purchasing as discussed earlier (see Section 0). We assumed growth in 2009 and 2010 is 10% annually, and growth in 2011 is 15%, consistent with the low case. In 2012-2013, one-third of 2011 demand is lost. From 2014-2020, 10% of demand is lost annually.

Summary

Existing competitive programs (default supplier programs) are forecasted to be between 2.2 million MWh in the low case and 5.3 million MWh in the high case (Table 14). This represents between a 2.3-fold and a 5.6-fold increase from 2008. The negative policy impacts scenario represents a 25% decrease from 2008, resulting in 0.7 million MWh in 2015.

Table 14: Projected Size of Existing Competitive Programs (thousand MWh)

	2008	2009	2010	2011	2012	2013	2014	2015
High Case	900	1,200	1,500	1,900	2,500	3,200	4,200	5,300
Low Case	900	1,000	1,100	1,300	1,500	1,700	2,000	2,200
Negative Policy Impacts Case	900	1,000	1,100	1,300	1,100	900	800	700

6.3 New Competitive Programs

Other states with restructured electricity markets could act over the next several years to encourage voluntary green power options. Most existing competitive programs emerged because of action by utility regulators or legislative action, and they were often driven by support from environmental and consumer protection organizations. For example, the Maine legislature passed an energy bill in 2009 that requires the Maine Public Utilities Commission to provide a green power option to all residential and small commercial electricity customers, in addition to the standard offer or default service. Maine's green power option or options will be selected through a competitive process and are expected to be available to consumers in 2011.

While we have not attempted to predict what form these program options may take, we made assumptions about the load that will be exposed to a green option and then forecast market size using a similar approach as was used for the new electric utility programs (see Section 5).

High Case

For the high case, we assumed six restructured states (New Hampshire, Pennsylvania, Maryland, Delaware, Ohio, and Illinois) that currently do not have a competitive program, in addition to Maine, would require that such a program be offered in the future. Given that Maine's offering is still being developed and that no other states have taken action to require a green power offering to date, we assumed no new offerings would come online in 2009 or 2010. Thus, we assumed, for the high case, that all IOU load in these seven states would be exposed to a green power option over the course of the forecast, 2011-2020.

We assumed these programs would experience an uptake of 0.15% of retail load, in the first year, similar that of new utility programs, and an increase of 150% in participation from year one to year two as the most strongly supportive customers sign up. Beyond the second year through 2015, we further refined the high case to assume that demand would grow at an annual rate of 50%, reflecting a scenario in which there is effective promotion by the providers and state support for customer awareness. From 2015 through 2020, we assumed growth of 20% annually, which reflects the challenges of attracting new customers as programs mature, and generally consistent with growth assumed for the existing competitive programs over that period.

Low Case

For the low case, we assumed Maine and two other states would require green options over the forecast period. Therefore, we assumed the IOU load in Maine and two-sixths of the IOU load in the other six states would be exposed to a green power option. This way we did not have to make any further assumptions about exactly which states would be most likely to create a new competitive program. As with the high case, we assumed no new programs would be added in 2009 or 2010. In the 2011-2020 timeframe, we assumed programs would experience an uptake of 0.15% of retail load, in the first year, similar that of new utility programs, and an increase of 150% in participation from year one to year two as the most strongly supportive customers sign up. From years three to 2015, we assumed annual growth would be 15% in the low case, based on a scenario of modest

promotion and little educational support due to a lack of funding. From 2015-2020, we assumed growth slows to 10% annually, generally consistent with growth assumed for the existing competitive programs over that period.

Negative Policy Impacts Scenario

In the negative policy impacts scenario, we assumed only Maine would require a green option over the forecast period, because legislation requiring it has already been adopted. Consistent with our assumptions about utility programs, we assumed no other new default supplier programs would be offered over the forecast period because of a potential loss of credibility and overall decline in the market. We assumed Maine's offering would begin in 2011. In the initial year of the program, we assumed only 0.10% of retail load would participate in the green power offering, and that there would be an increase of 100% in participation from year one to year two. From years three to 2015, we assumed more modest growth of 10% annually, and in 2015-2020, we assumed negative annual growth of 10%.

Summary

In restructured markets, new competitive programs are forecasted to represent 360,000 MWh in the low case and 1.35 million MWh in the high case (Table 15). The negative policy impacts scenario forecasts 10 thousand MWh in 2015.

Table 15: New Competitive Programs (thousand MWh)

	2009	2010	2011	2012	2013	2014	2015
High Case	0	0	80	280	570	920	1,350
Low Case	0	0	30	100	170	260	360
Negative Policy Impacts Case	0	0	1	3	6	8	10

7 On-site Renewable Energy

Demand for on-site renewable energy is expected to grow significantly over the next 5 to 10 years because of declining solar prices and state incentives. To forecast demand for on-site renewables, we developed separate projections for solar photovoltaics (PV) and other on-site resources. We relied on existing market projections available in the literature for the on-site solar PV forecast. The other on-site renewables were projected based on historical data from the EPA Green Power Partnership.[12]

For on-site renewable energy, we did not develop alternate assumptions for the negative policy impacts scenario because growth of on-site generation is not likely to be negatively impacted by future carbon policy, as it is driven primarily through reductions in cost as well as consumer interest in owning renewable generation. Organizations installing on-site systems would reduce their electricity purchases, and would likely be able to continue to reflect the purchased electricity emissions reductions in GHG accounting.[13] Also, carbon policy would likely help improve the cost-effectiveness of on-site systems. Therefore, the assumptions for on-site in this analysis are the same in the low case and the negative policy impacts scenario.

7.1 On-site Solar Projections

High and Low Case

For solar, we used projections that Navigant Consulting (Navigant) recently completed for NREL (Paidipati et al. 2008) to develop a low case and a high case. The Navigant study included four scenarios: worst case, base case, focused policies, and base case (Table 16).

We selected the focused policies case for both our low and high cases because it included an assumption that the federal tax credit would be fully extended through 2016 for both commercial and residential customers, and because it lifted the $2,000 cap on residential tax credit. Because this policy has already been enacted, the worst-case and base-case scenarios were not used in our analysis. The focused policies scenario also assumed that net metering is nationally available, that net metering caps are lifted (these improvements had a large impact, a 58% increase over the base case), and that price for carbon is $12.00 in 2012 and rises to $13.89 in 2015. The best-case scenario was not used because it was more aggressive than other forecasts that we examined and because of the potential challenges in achieving the assumptions. Table 16 compares the assumptions in each scenario.

[12] NREL estimates of the current green power market do not include on-site renewables; however, the U.S. EPA Green Power Partnership has data on nonresidential purchases of on-site renewables in recent years.
[13] On-site system owners could likely continue to report reductions in Scope 2 emissions (those associated with electricity purchases) in GHG inventories because they purchase less electricity. However, organizations that installed on-site systems would also not be able to make carbon emission reduction claims under some cap and trade program designs.

Table 16: PV Scenario Assumptions in Navigant Study

Scenario	Worst Case	Base Case	Focused Policies	Best Case
Interconnection Policy Scenario	current rules	current rules	current rules	improved
Net Metering Availability Scenario	current availability	current availability	nationwide availability	nationwide availability
Net Metering Cap Scenario	current caps	current caps	caps lifted	caps lifted
Cap and Trade Scenario	Low Carbon Economy Act of 2007	none	Low Carbon Economy Act of 2007	Low Carbon Economy Act of 2007
Electricity Price Escalation	Energy Information Administration (EIA) projections	accelerated	accelerated	accelerated
Federal Tax Credit	baseline	extended	fully extended	fully extended
Time-of-Use Rates	current availability	current availability	current availability	nationwide availability
RPS Solar Set-Aside Enforcement	no	yes	yes	yes

Source: Paidipati et al. (2008)

Navigant produced two forecasts of solar prices: a business as usual case (BAU) and a Solar America Initiative case, which assumed more aggressive cost reductions (Table 17). These cost reduction scenarios were used to create our low and high cases. We selected the focused policy scenario with aggressive price reductions (DOE Solar America Initiative pricing) for our high case and the focused policy scenario with business as usual price reductions for our low case.

Table 17: Navigant Study Price Reduction Assumptions

Price Projections		Retrofit Installed System Price ($2007)			New Construction Installed System Price ($2007)		
		2007	2010	2015	2007	2010	2015
Business as Usual	Residential	$7.40	$6.20	$4.80	$7.40	$5.90	$4.50
	Commercial	$6.41	$5.80	$4.50	$6.70	$5.50	$4.20
Solar America Initiative	Residential	$7.40	$5.11	$3.10	$7.10	$3.86	$2.44
	Commercial	$6.41	$3.75	$2.49	$6.23	$3.60	$2.32

Source: Paidipati et al. (2008)

Because the Navigant analysis projects solar generation for all purposes, we subtracted from these projections the amount of solar energy required by state solar carve-outs—as calculated by Lawrence Berkeley National Laboratory—so as not to double count generation for both the voluntary and the compliance markets. We did not account for any on-site systems in which RECs may be sold for RPS compliance other than through solar set-asides. We did not attempt to address this issue because of the difficulties in estimating the potential magnitude. However, it is only likely to occur in areas (such as California) in which PV is heavily subsidized—thus, making solar competitive with other types of renewable generation for RPS compliance—or if future cost reductions make it competitive.

The Navigant solar PV scenarios only project the growth of solar PV only to 2015. We extended the projections to 2020 by applying a growth rate calculated from two Solar Deployment System model scenarios (Denholm et al. 2009). We selected two model runs from the Denholm et al. (2009) study that used DOE Solar Energy Technology Program PV module cost projections and the market share estimates from the Navigant study (Paidipati et al. 2008). For our low case in the "out" years, we used a reference case with no price on carbon, and for our high case, we used an attractive case, assuming 1% annual electricity rate escalations and carbon prices between $20/ton and $30/ton through 2020. Solar electric demand for RPS compliance was subtracted from the two projections, and annual growth rates were calculated. The annual growth rates from the reference case were applied to the low-case projection and the annual growth rates from the attractive case were applied to the high-case projection.

Based on these assumptions, we projected voluntary market demand in 2015 for on-site solar would be 11.5 million MWh in the low case and 21.4 million MWh in the high case (Table 18). This growth represents a 4.7-fold increase in the low case and an 8.4-fold increase in the high case from 2009 levels.

Table 18: On-site Solar (thousand MWh)

	2009	2010	2011	2012	2013	2014	2015
High Case	2,600	3,400	5,000	7,200	9,700	15,400	21,400
Low Case	2,400	2,800	3,900	5,400	6,400	9,400	11,500

7.2 Other On-site Renewables

For non-solar on-site generation, we used data from the EPA's Green Power Partnership showing non-residential demand for on-site resources broken down by resource type. Most of this demand is being met by biogas, biomass, and to a lesser extent solar, wind and hydroelectric projects, as shown in Table 19.

Table 19: Generation by Resource (MWh), 2009

	Total Generation (MWh)	Resource Breakdown
Biogas	411,301	52.52%
Biomass	203,923	26.04%
Geothermal	0	0.00%
Hydroelectric	18,223	2.33%
Solar	95,470	12.19%
Unknown	0	0.00%
Wind	54,165	6.92%
Total	783,083	--

Source: EPA (2009)

High and Low Case

Using historical data from EPA for voluntary support for non-solar, on-site generation (shown in Table 19), we assumed 35% annual growth in the high case and 15% annual growth in the low case to reflect a more modest growth scenario through 2015. To account for potential limitations in availability of biomass available for on-site generation and to account for the fact that growth rates often moderate over time, we lowered the non-solar, on-site growth rates to 25% (high case) and 10% (low case) for 2016-2020.

In 2015, other on-site renewables are projected to be between 1.8 million MWh and 4.8 million MWh (Table 20). From 2009, this represents 2.3-fold growth in the low case and 6-fold growth in the high case.

Table 20: Other On-Site Renewables (thousand MWh)

	2009	2010	2011	2012	2013	2014	2015
High Case	800	1,100	1,400	1,900	2,600	3,500	4,800
Low Case	800	900	1,000	1,200	1,400	1,600	1,800

8 Summary of Results

Given the assumptions used in each market sector, our forecast projects the total voluntary demand for renewable energy in 2015 to range from 63 million MWh annually in the low-case scenario to 157 million MWh annually in the high-case scenario (Figure 2). The range represents an approximately 2.5-fold difference. The negative policy impacts scenario reflects a market size of 24 million MWh.

The forecast uses historical data, including market sector sizes and growth rates, to inform our assumptions. While growth rates have been adjusted as discussed in the previous sections, they remain the starting point for our analysis. The difference between the low and high cases reflects market and policy uncertainty and the difficulty predicting how consumers will react to various factors affecting the voluntary market. The negative policy impacts scenario is designed to reflect impacts on the market that might occur if future carbon policies significantly reduce the motivation among large purchasers in particular. This scenario reflects the potential loss of a significant volume of existing purchasers.

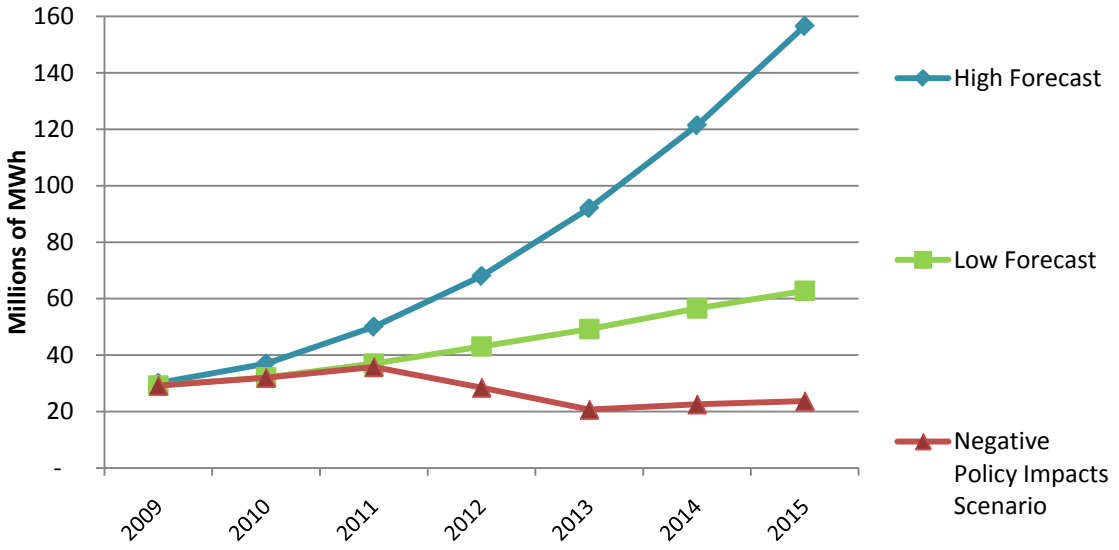

Figure 2: Total voluntary demand for renewable energy (millions of MWh): High, low, and negative policy impacts scenario forecasts through 2015

In 2008, total voluntary demand represented 0.65% of total retail electricity sales in the United States. To provide some perspective on future estimates, we compare them to total projected retail electricity sales in the United States. The high case represents 3.8% of total retail electricity sales projected by the DOE Energy Information Administration (EIA) in its Annual Energy Outlook 2009 (EIA 2009), while the low and negative-impacts cases represent 1.5% and 0.6% of total sales, respectively. In addition, a recent

analysis that estimated ranges of renewable energy supplies in 2015 (Bird et al. 2009b), shows that under a high supply scenario, these demand levels could be achieved.[14]

In both the high and low forecasts, REC markets continue to drive much of the growth. In 2008, REC markets represented nearly two-thirds of the total voluntary market. In 2015, REC markets are forecasted to represent between 54% and 62% of the total market. However, in the negative policy impacts scenario, the contribution of RECs in 2015 is significantly less, at 23% of the total market.

On-site solar is projected to increase its share of the total voluntary market. In 2009, on-site solar is estimated to represent 8-9% of the total voluntary market, whereas in 2015, on-site solar is forecasted to represent between 14% and 18% of the total market. In the negative policy impacts scenario, on-site solar represents 49% of the total market in 2015.

Utility green power programs are projected to decline as a share of the total voluntary market. In 2008, utility programs represented approximately 20% of the total voluntary market. By 2015, existing and new utility programs together are forecasted to represent between 13% and 15% of the total market. In the negative policy impacts scenario, existing and new utility programs represent 15% of the total market, although no new utility programs are forecasted.

The competitive market, while continuing to increase in size, represents less of the total voluntary market in 2015 than in 2008. In 2008, the competitive market represented 16% of the total voluntary market, but by 2015 it is forecasted to represent only between 8% and 10% of the total voluntary market. In the negative policy impacts scenario, the competitive market represents 6% of the total market in 2015.

[14] A recent analysis of potential renewable energy supplies (Bird et al. 2009b) found that in excess of 150 million MWh of renewable energy generation could be available in excess of what is needed to meet RPS requirements in 2015 under a high wind scenario, which would be adequate to meet the high case of voluntary renewable energy demand estimated in this analysis.

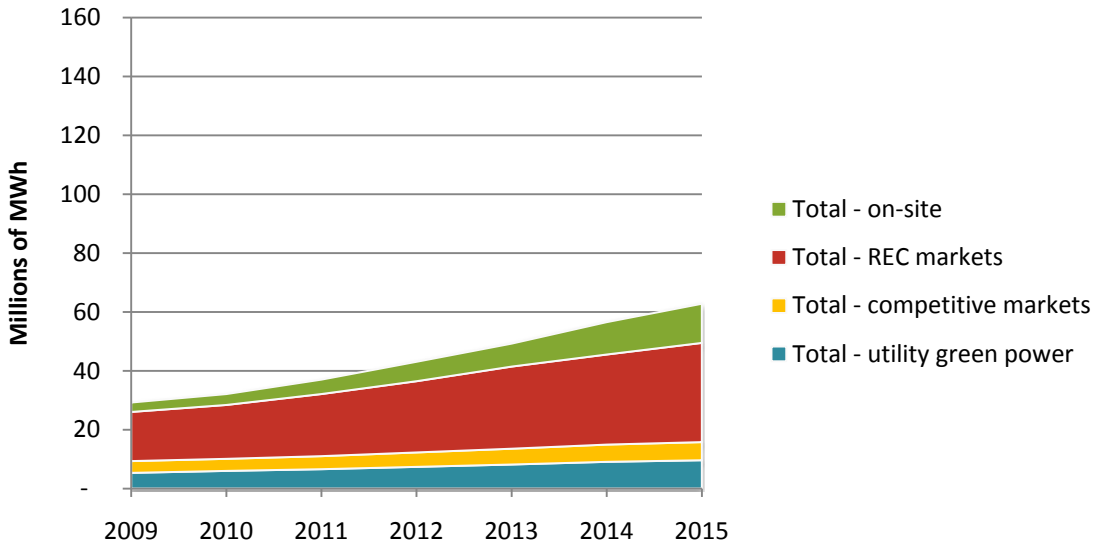

Figure 3: Low forecast of total voluntary demand for renewable energy (millions of MWh) by sector, through 2015

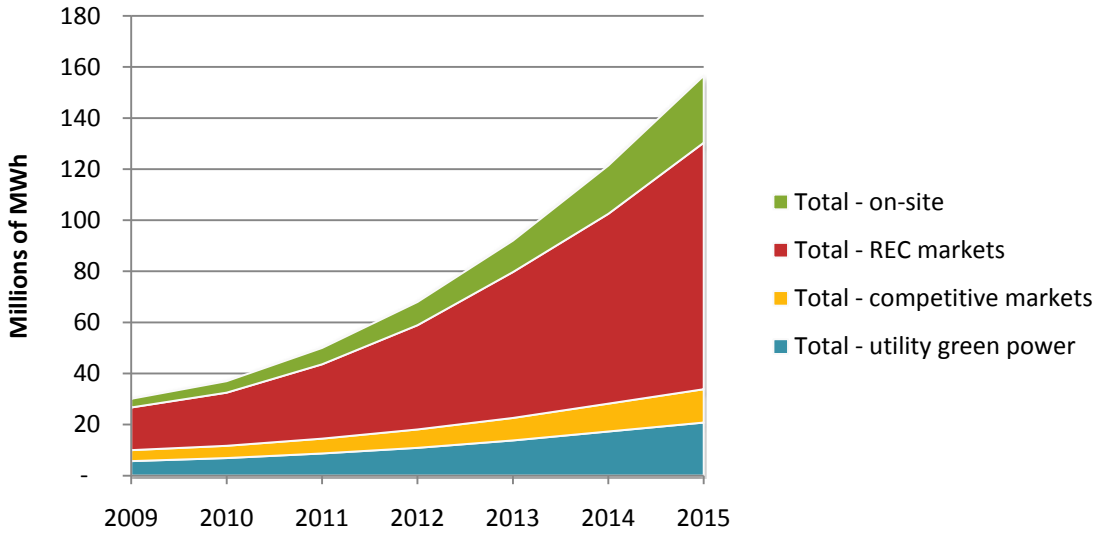

Figure 4: High forecast of total voluntary demand for renewable energy (millions of MWh) by sector, through 2015

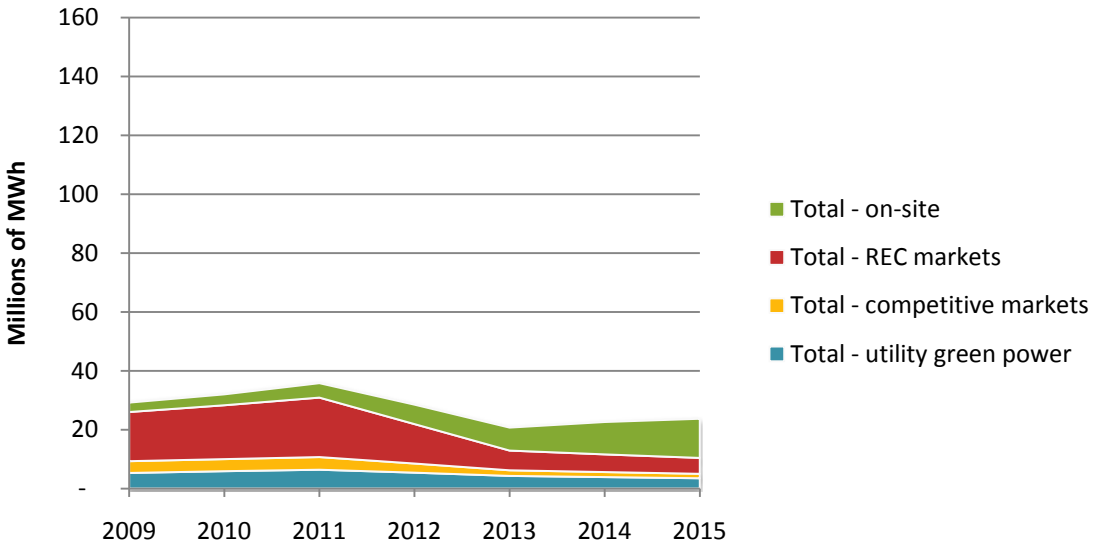

Figure 5: Negative policy impacts scenario forecast of total voluntary demand for renewable energy (millions of MWh) by sector, through 2015

Voluntary demand through 2015 was the focus of this forecast, but projections were extended through 2020. The 2020 projections show 327 million MWh annually in the high case and 94 million MWh annually in the low case. This range is greater than the 2015 range, representing an approximately 3.5-fold difference between high and low cases. The negative policy impacts scenario projects 33 million MWh in 2020.

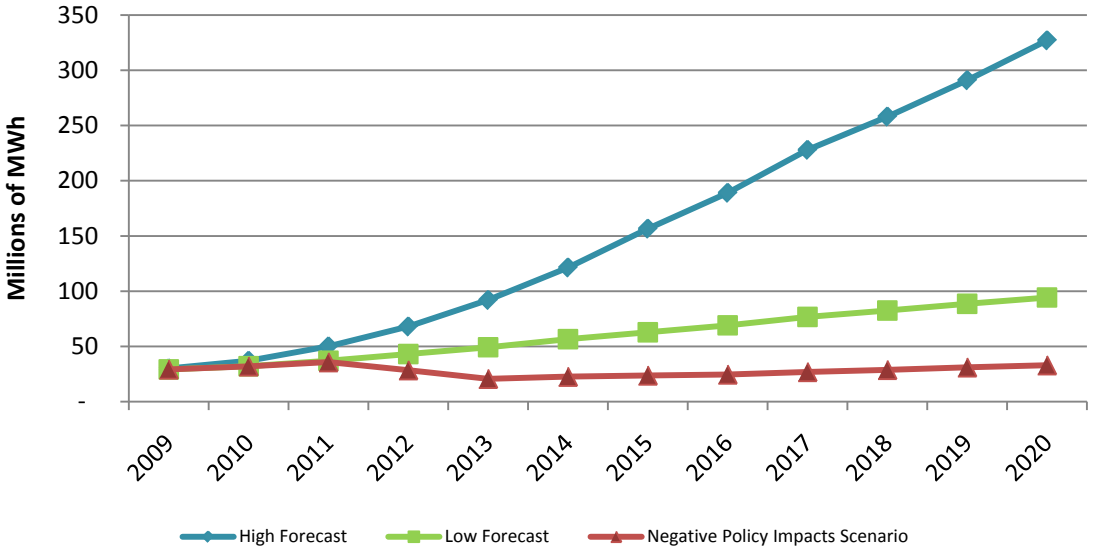

Figure 6: Total voluntary demand for renewable energy (millions of MWh): High, low, and negative policy impacts scenario forecasts through 2020

Uncertainties

A number of key uncertainties affect the results of this forecast.

- The growth assumptions are informed largely by historical growth rates in each submarket, but it is unclear where the market lies along the S-curve of market diffusion and how consumer interest will change.
- There is significant policy uncertainty over the time period analyzed. The design details and timing of any potential federal and state RPS policies as well as regional or federal cap and trade programs will have implications for the market that are difficult to predict without specific knowledge of the policies.
- Uncertainty surrounding the price of renewable generation over the period analyzed and its relative competitiveness with conventional generation has implications for consumer willingness to pay for renewables. Voluntary market demand can be price sensitive.
- There is significant uncertainty in the level of interest that utilities will show in offering and promoting green power products going forward. The level of promotion is an important factor in determining participation.

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Appendix. Summary Results

Table A-1. Projected Size of Voluntary Market, High Case (thousand MWh)

	2009	2010	2011	2012	2013	2014	2015
Existing utility programs	5,600	6,600	8,200	10,200	12,800	16,000	19,200
New utility programs	100	300	500	700	1,000	1,300	1,600
Existing competitive programs	1,200	1,500	1,900	2,500	3,200	4,200	5,300
New competitive programs	-	-	80	280	570	920	1,350
Competitive marketers	3,100	3,300	3,800	4,400	5,000	5,800	6,400
REC markets	16,700	20,800	29,100	40,800	57,100	74,300	96,500
On-site non-solar	800	1,100	1,400	1,900	2,600	3,500	4,800
On-site solar	2,600	3,400	5,000	7,200	9,700	15,400	21,400
TOTAL	**30,100**	**37,000**	**49,980**	**67,980**	**91,970**	**121,420**	**156,550**

Table A-2. Projected Size of Voluntary Market, Low Case (thousand MWh)

	2009	2010	2011	2012	2013	2014	2015
Existing utility programs	5,300	5,900	6,400	7,100	7,800	8,600	9,000
New utility programs	30	100	180	270	370	480	620
Existing competitive programs	1,000	1,100	1,300	1,500	1,700	2,000	2,200
New competitive programs	-	-	30	100	170	260	360
Competitive marketers	3,000	3,000	3,100	3,300	3,500	3,600	3,600
REC markets	16,700	18,300	21,100	24,200	27,900	30,600	33,700
On-site non-solar	800	900	1,000	1,200	1,400	1,600	1,800
On-site solar	2,400	2,800	3,900	5,400	6,400	9,400	11,500
TOTAL	**29,230**	**32,100**	**37,010**	**43,070**	**49,240**	**56,540**	**62,780**

Table A-3. Projected Size of Voluntary Market, Negative Policy Impacts Scenario (thousand MWh)

	2009	2010	2011	2012	2013	2014	2015
Existing utility programs	5,300	5,900	6,400	5,400	4,300	3,900	3,500
New utility programs	-	-	-	-	-	-	-
Existing competitive programs	1,000	1,100	1,300	1,100	900	800	700
New competitive programs	-	-	1	3	6	8	10
Competitive marketers	3,000	3,000	3,000	2,000	1,000	900	800
REC markets	16,700	18,300	20,200	13,400	6,700	6,000	5,400
On-site non-solar	800	900	1,000	1,200	1,400	1,600	1,800
On-site solar	2,400	2,800	3,900	5,400	6,400	9,400	11,500
TOTAL	**29,200**	**32,000**	**35,801**	**28,003**	**19,106**	**21,808**	**23,710**

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14. ABSTRACT *(Maximum 200 Words)*

Various factors influence the development of the voluntary 'green' power market--the market in which consumers purchase or produce power from non-polluting, renewable energy sources. These factors include climate policies, renewable portfolio standards (RPS), renewable energy prices, consumers' interest in purchasing green power, and utilities' interest in promoting existing programs and in offering new green options. This report presents estimates of voluntary market demand for green power through 2015 that were made using historical data and three scenarios: low-growth, high-growth, and negative-policy impacts. The resulting forecast projects the total voluntary demand for renewable energy in 2015 to range from 63 million MWh annually in the low case scenario to 157 million MWh annually in the high case scenario, representing an approximately 2.5-fold difference. The negative-policy impacts scenario reflects a market size of 24 million MWh. Several key uncertainties affect the results of this forecast, including uncertainties related to growth assumptions, the impacts that policy may have on the market, the price and competitiveness of renewable generation, and the level of interest that utilities have in offering and promoting green power products.

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voluntary green power markets; renewable energy markets; market demand; market forecast; on-site solar power

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