PSC REF#:207029

Public Service Commission of Wisconsin
RECEIVED: 06/26/14, 9:27:37 AM

Report on the Rate and Revenue Impacts of the Wisconsin Renewable Portfolio Standard

Docket 5-GF-245

Public Service Commission of Wisconsin

July 1, 2014

Docket 5-GF-245

Executive Summary

Electric providers have procured a significant amount of renewable resources, from 2006 through 2013, in order to meet their Renewable Portfolio Standard (RPS) requirements and achieve the RPS statewide goal of 10 percent of total electricity sales in Wisconsin from renewable resources by 2015. According to the Commission staff memorandum on 2013 RPS compliance,[1] this 10 percent goal was achieved two years ahead of schedule.

The previous report on RPS impacts, issued by the Commission in 2012, found an average 1.0 percent rate impact due to the RPS for the three year 2008 to 2010 period. The report also noted that approximately $1.7 billion in capital costs associated with electric provider owned renewable facilities were approved by the Commission at the time. Since then, the Rothschild Biomass Cogeneration Plant has come into service and has increased the total amount approved by the Commission to slightly below $2 billion.

This report contains an analysis to estimate the revenue requirement and rate impacts of the RPS for the years 2011 and 2012. Compared to wholesale electricity market prices, Commission staff estimates the net incremental costs of the RPS to be about $340 million for the two-year period. This represents about 2.5 percent of the total retail revenue collected by the state's electric providers for 2011 and 2012. With the early achievement of the RPS goal in 2013, Commission staff also provides an initial qualitative outlook for future rate impacts, surmising an increase in 2013 due to new renewable resources, and a flattening trend thereafter due to the RPS goal already being met.

[1] A copy of this memorandum is available on the Commission's Electronic Regulatory Filing (ERF) system which can be accessed at www.psc.wi.gov, in docket 5-GF-243 (PSC REF#: 206461).

RPS Efforts of Electric Providers through 2013

Since its enactment[2] in April 2006, electric providers have significantly increased their procurement of renewable resources in order to comply with the Wisconsin RPS. Renewable generation used to serve Wisconsin customers increased from about 2.6 million megawatt-hours (MWh) in 2006, to about 7 million MWh in 2013. In terms of annual statewide renewable energy percentages, these generation numbers represent 3.8 percent of the total retail sales from renewable resources achieved in 2006, and 10.2 percent in 2013.

Most of the renewable generation increase has come from wind resources, about 30 percent of which is located in Wisconsin. New biomass resources were added as well, predominantly located in-state. Solar photovoltaic facilities, interconnected at the distribution level, contributed a minimal amount to the RPS through 2013. No new hydroelectric resources have been added as of 2012.

Generation from all these renewable facilities has been tracked within the Midwest Renewable Energy Tracking System (M-RETS), in the form of Renewable Energy Certificates (REC). In addition, all electric providers report statistical and planning information to the Commission every year as part of their RPS requirements. Commission staff compile electric provider information in order to provide a statewide picture of RPS achievements, and establish annual statewide renewable energy percentages. This information proved useful in determining the quantity of renewable resources driven by the Wisconsin RPS.

[2] 2005 Wisconsin Act 141 was published on March 31, 2006, and went into effect the next day.

Methodology for RPS Impacts for the Years 2011 and 2012

Commission staff used a spreadsheet analysis approach, concentrating upon incremental energy procurement practices of electric providers, in order to estimate the incremental costs[3] and rate impacts of the RPS for the years 2011 and 2012. The quantity of renewable generation driven by the RPS over these two years was calculated using RPS compliance reports submitted by electric providers, verified by M-RETS generation data, and adjusted using supplemental electric provider information submitted via data request. Cost information was also obtained from electric providers in their responses to Commission staff data requests.

The counterfactual, what would have happened if the RPS were never enacted, was established by wholesale market energy prices in the form of average Day-Ahead Locational Marginal Prices (LMP) of Wisconsin load zones within the Midcontinent Independent System Operator, Inc. (MISO), energy market. This approach was taken given the guidance of Wis. Stat. § 196.378(4r) to compare the RPS cost impact with "the impact that would have occurred if renewable energy practices of electric providers were subject to market forces."

Annual renewable generation, and their associated costs, were spread across the hours of the year based on either their intermittent nature in the cases of wind and solar,[4] or consistent production output in the case of biomass resources.[5] These average hourly costs were then compared with fluctuating LMPs that are different each hour.[6] The primary assumption for the counterfactual scenario is that, in place of the net RPS renewable energy that was generated at

[3] "Incremental costs" refers to costs above and beyond the costs that would have occurred in a no-RPS scenario.
[4] See Appendix B.
[5] A brief M-RETS analysis confirmed the assumption that biomass resources produce consistent output throughout the year.
[6] See Appendix A.

varying times through the 2011 to 2012 period, electric providers would have had "market exposure" to LMPs in their respective load zones. Market exposure refers to a scenario in which electric providers would pay the cost of LMPs to cover their customers' load, without the mitigating effect created by generation, and associated costs and revenues, to serve that load.

In order to estimate the rate impact of the RPS, Commission staff used Energy Information Administration (EIA) revenue and retail sales data taken from Form 861. For both 2011 and 2012, the actual statewide average "all-in"[7] retail rate across all customer classes was calculated by simply dividing total revenues collected by total retail sales (load) of all Wisconsin electric customers. Holding retail sales constant, the counterfactual scenario reflected a drop in total revenues that would have been collected from Wisconsin electric providers, which is equivalent to the net incremental costs of the RPS. The percent change from the counterfactual to the actual scenario is the average retail rate impact.

This methodology is similar to the spreadsheet analysis approach taken by Commission staff for the previous RPS impact analysis for the 2008-to-2010 period.[8] The primary changes made were: (1) including all renewable resources used for purposes of the RPS, whereas wind was the primary resource examined in the previous analysis; and (2) plotting intermittent resource generation as they fluctuate, along with LMPs, across the hours and seasons of the year, whereas the previous analysis had a more simplified average on and off-peak LMP comparison dynamic. In short, additional renewable generation and LMP data replaced assumptions taken in the previous analysis.

---

[7] "All-in" refers to all fixed and variable costs and charges collected by electric providers from their retail customers.

[8] The prior report is available on the Commission's ERF system, docket 5-GF-220 (PSC REF#: 166782).

The results provide a statewide estimate for total revenue requirement and rate impacts of the RPS, but cannot be considered in and of itself as a benefit-cost analysis. A larger benefit-cost analysis would expand the scope to include several other variables. A list of additional benefits and costs *not captured by this analysis*, which could be covered by such a benefit-cost analysis, are included in Table 1:

Table 1: Benefits and Costs Not Covered by this Analysis

Additional Benefits	Additional Costs
Added value of transmission expansion caused by the Wisconsin RPS (i.e., reliability and market efficiency)	Transmission development costs limited to expansion caused by the Wisconsin RPS
Positive economic impacts of renewable resource development	Negative economic impacts caused by higher electric rates
LMP cost suppression caused by low renewable marginal cost offers supplanting higher cost unit offers in the marketplace	Additional congestion costs[9] associated with geographic and price differences between renewable facilities and the loads they serve
Peak capacity value of renewable facilities caused by the Wisconsin RPS	
Value of avoided emissions	

Additional details of Commission staff's generation and cost analyses are provided in the following sections that present the results, as well as in the accompanying appendices.

[9] LMPs contain a marginal congestion component, but this does not cover additional transmission service costs borne by electric providers to ensure generation facilities can serve their load. Many wind facilities are located at some distance from the loads they serve, and these congestion costs are not covered by this analysis.

Renewable Energy Generated for the Wisconsin RPS

Renewable energy quantity by resource type was taken from Commission staff memoranda for 2011 and 2012 RPS compliance.[10] The statistics within these memoranda aggregate the individual responses of electric providers, which reported annual renewable energy used to serve their Wisconsin retail customers. Electric providers also separate and report renewable energy that is generated for their voluntary green pricing programs (GPP), for which participating customers pay a premium for renewable energy that is beyond what is required by the RPS. All renewable energy intended for GPPs was removed in order to determine a "gross Wisconsin RPS energy" amount.

In order to determine a "net Wisconsin RPS energy" amount, baseline renewable energy was removed from the gross amount. This was accomplished using an M-RETS analysis of generator production, with supplemental information provided by electric providers. Renewable generators that are Wisconsin RPS-eligible, used by Wisconsin electric providers within M-RETS, and have an in-service date before the year 2007 were identified as "baseline facilities." Electric providers also provided individual lists of renewable facility "baseline exceptions" within their RPS portfolio. These are facilities that were in-service before 2007, but determined by electric providers to be primarily procured due to the current RPS. These exceptions were removed from the baseline facility list, and 2011 and 2012 baseline renewable generation totals were calculated. Table 2 and 3 present the gross, baseline, and net RPS energy amounts used for the impacts analysis.

[10] These memoranda are available on the Commission's ERF system: 2011 in docket 5-GF-214 (PSC REF#: 174240); and 2012 in docket 5-GF-230 (PSC REF#: 190801).

Table 2: 2011 Gross and Net RPS Energy by Resource Type (MWh)

Resource	Gross WI RPS Energy	Baseline Energy	Net WI RPS Energy
Wind	3,546,107	383,197	3,162,909
Biogas	67,889	2,453	65,436
Biomass	948,894	210,227	738,667
Solar	834	51	783
Hydro	1,530,430	1,530,430	-
Total	6,094,154	2,126,358	3,967,795

Table 3: 2012 Gross and Net RPS Energy by Resource Type (MWh)

Resource	Gross WI RPS Energy	Baseline Energy	Net WI RPS Energy
Wind	3,783,827	320,346	3,463,480
Biogas	121,130	1,965	119,165
Biomass	987,307	223,647	763,660
Solar	509	63	446
Hydro	1,156,654	1,156,654	-
Total	6,049,427	1,702,676	4,346,751

RPS Energy and Market Costs

Commission staff used electric provider cost information to determine average costs associated with RPS energy. In response to data requests, electric providers calculated their average costs per MWh for each renewable resource type. For facilities owned by electric

providers, Commission staff directed electric providers to estimate the levelized cost of energy (LCOE) for each facility. For facilities owned by other entities, Commission staff directed electric providers to calculate their net costs and purchased generation according to purchase power agreements (PPA) with independent power producers, and tariffs to purchase distributed generation from their retail customers. Electric providers then calculated an average cost per MWh per resource type, weighted by the production from each facility over the 2011 to 2012 period. Commission staff then created a statewide average for each resource weighted by the renewable generation amount of each reporting electric provider.

As a result of an RPS portfolio compromised of facilities owned by electric providers and independent entities, Commission staff call the statewide average RPS costs per MWh the "cost of procurement" because it reflects the costs to electric providers and their retail customers. To the extent a facility is owned by an electric provider, the facility's cost represents the cost to the generator. However, if a facility is not owned by an electric provider, the facility contract cost may not be the same as the cost to the generator. A PPA is negotiated, and subject to the supply and demand for bundled energy and RECs eligible for the Wisconsin RPS. Some electric providers noted an ability to procure short-term PPAs that were below the cost to the generator, however these costs were limited to the 2011 to 2012 period and are not applicable to future periods. Tariffs for distributed generation, particularly for solar used for purposes of the RPS, varied significantly by electric provider. It should also be noted that the majority[11] of distributed

[11] For the years 2011 and 2012, about 86 percent of distributed solar generation was designated for electric provider green pricing programs.

solar generation reported by electric providers in their RPS compliance reports is used for electric provider GPPs, and not included in this RPS impact analysis.

Table 4 presents statewide average procurement costs for renewable generation for purposes of the Wisconsin RPS. As described above, these costs per unit reflect the cost to electric providers and their retail customers. Since these statewide average costs *do not* entirely reflect the cost to the generator; they *should not* be considered the LCOE per resource type.

Table 4: Statewide Average Cost of Procurement for RPS Energy

Resource	$/MWh
Wind	$64.97
Biogas	$81.25
Biomass	$86.81
Solar	$150.06

In order to determine counterfactual market costs, Commission staff analyzed MISO Day-Ahead LMP data over the 2011 to 2012 time period. Limited to a representative sample of Wisconsin load zones, average LMPs were established for hours ending 1 through 24, on an average winter, spring, summer, and autumn day[12] for both 2011 and 2012. This approach enabled the creation of a counterfactual scenario: for each hour of the year, instead of renewable generator production and costs, electric providers would have had no owned or contracted

[12] See Appendix A for figures representing LMP seasonal and hourly fluctuation for 2011 and 2012.

generation to cover their customers' load, and would be exposed to market prices in the form of LMPs.

In 2011, the cost to generate nearly 4 million MWh of renewable energy distributed throughout the year was slightly more than $275 million, whereas the cost of LMPs for the same quantity was about $118.6 million. The difference of $156.4 million represents the net incremental costs of the RPS for 2011. In 2012, it cost about $301 million to generate 4.3 million MWh of renewable energy, whereas the cost for LMPs was $116.4 million; a difference of $184.6 million. Added together, the net incremental costs, or additional revenue requirement, of the RPS over the two-year period was slightly more than $341 million. A more detailed breakdown of costs can be found in Appendix C.

RPS Impacts to Retail Rates

The net incremental costs of the RPS described in the previous section were then used to estimate the average statewide rate impact of the RPS. Total revenues collected and total retail sales data, reported by Wisconsin electric providers for the years 2011 and 2012, were taken from Form 861 of EIA. The data were used for the actual scenario, with RPS costs already imbedded in total revenues collected. Over the two-year period, total revenues collected divided by total retail sales equaled an all-in electric retail rate of 10.25 cents per kilowatt-hour (kWh), which was the average statewide across all electric providers and all customer classes.

To calculate the counterfactual scenario, Commission staff simply held total retail sales constant while subtracting net incremental costs of the RPS from total revenues collected. This resulted in an average statewide retail rate of 10 cents per kWh, which is the estimate of what would have occurred if the RPS were never enacted. On average across the two-year period, the

actual retail rate was about 2.5 percent higher than the counterfactual with no RPS. Table 5 presents the estimated rate impact per year. These percentages represent total RPS cost impact to date. 2011 encapsulates all cumulative RPS costs that occurred in calendar year 2011. 2012 encapsulates all cumulative RPS costs that occurred in calendar year 2012. The 2011-2012 average is the weighted average impact over the two-year period. Additional tables with breakdown of total revenues collected and total retail sales for the actual and counterfactual scenarios are available in Appendix D.

Table 5: Average Retail Rate Impacts of the RPS

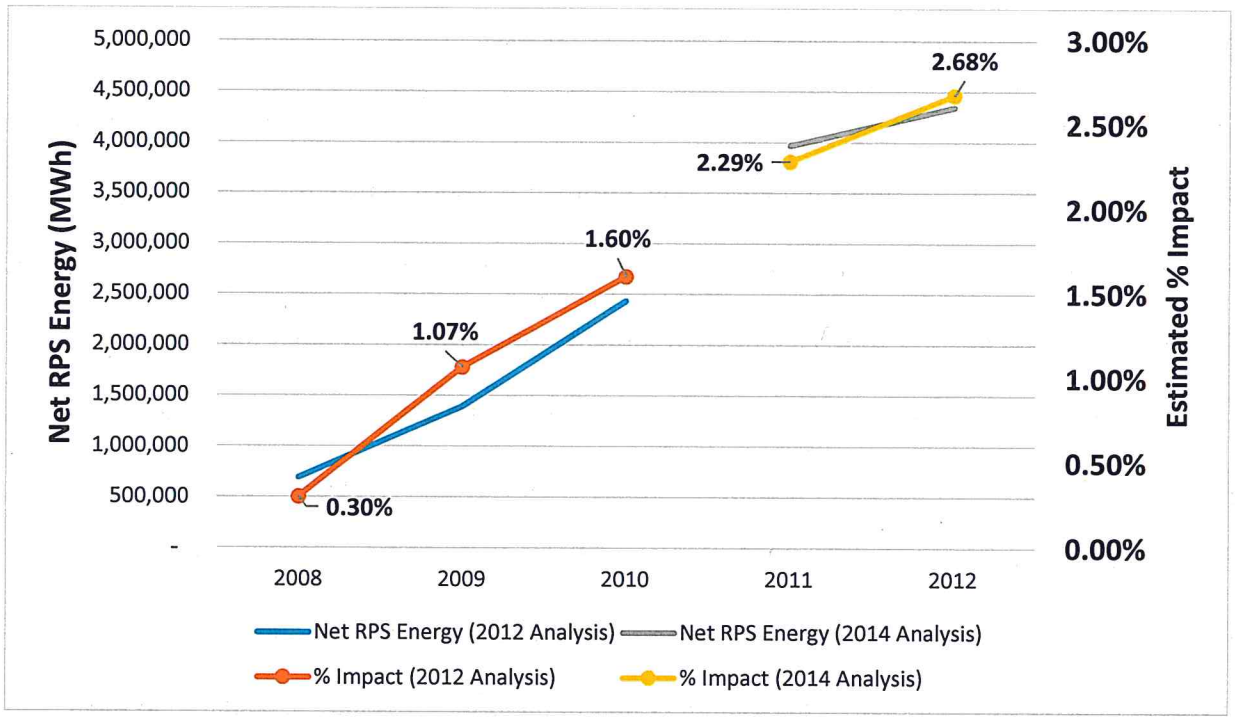
2011	2.29%
2012	2.68%
Two-Year Average	2.48%

Outlook for Future Impacts

To the extent renewable generation driven by the RPS increases, with all other variables held constant, one would expect an increase in estimated rate impacts. This analysis covered the 2011 to 2012 time period, when renewable energy for the RPS continued to increase from previous years. In the previous analysis, which covered years 2008, 2009, and 2010, the estimated rate impacts were 0.3, 1.1, and 1.6 percent for each respective year (a weighted average of 1.0 percent over the 3-year period). The increases to rate impacts are similar to net RPS energy increases over the years as determined by Commission staff in both the previous analysis (done in 2012), and the current analysis (done in 2014). This similarity is presented in

Figure 1, with Net RPS energy plotted against the left vertical axis, and estimated percent impacts plotted against the right vertical axis.

Figure 1: Net RPS Energy and % Impact (2008-2012)[13]



According to the Commission memorandum on 2013 RPS compliance (PSC REF#: 206461), total RPS renewable energy increased again, reaching 10.17 percent of statewide retail sales of electricity. Having achieved over 10 percent from renewable energy in 2013, and having accumulated a significant statewide bank[14] of RECs eligible for future RPS compliance, electric

[13] Results of the 2012 and 2014 analyses are purposefully split in this figure in order to reflect slight changes in methodology between the analyses, which are described in the methodology section above. Considering both analyses together, the weighted average over the 2008-2012 period is 1.62 percent.

[14] Commission staff estimated a bank of RECs among electric providers totaling between 10 and 15 million after 2013 compliance was completed.

providers have collectively met the statewide goal two years early and have positioned themselves to easily meet their individual requirements for the foreseeable future.

While there will likely be an increase in percent impact from 2012 to 2013 due to the early achievement of the statewide goal, a solid argument could be made that any additional renewable energy added to electric provider portfolios past 2013 will not be driven by the RPS. Any increases to renewable resource procurement beyond 2013 may be attributed to external drivers, such as electric utilities implementing a unified territory plan across states (some of which have a higher RPS than Wisconsin), adopting higher levels of renewable energy based on customer demand, and hedging against environmental regulations and other uncertainties. Additionally, RECs associated with surplus renewable energy generation could be sold and used for purposes other the Wisconsin RPS. Therefore, Commission staff believes that beyond the 2.68 percent impact estimated for 2012, there may be an increase in rate impacts in 2013, but thereafter the impact should level off, perhaps even decreasing at some point if MISO LMPs increase in price due to a recovering economy and tightening of resources available to meet demand.

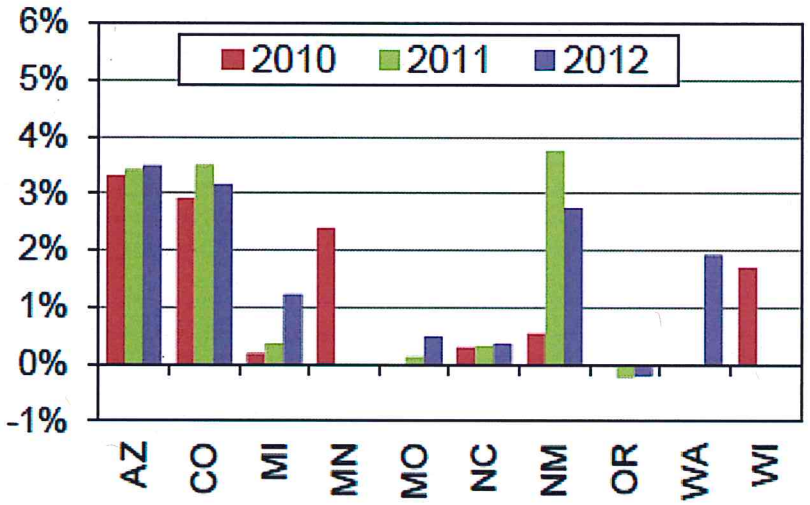
Other State RPS Impacts

For purposes of comparing state methodologies and estimates of RPS impacts, the National Renewable Energy Laboratory and the Lawrence Berkeley National Laboratory jointly issued a technical report[15] (NREL Report) with survey results of state RPS impacts. RPS results were based on reports issued by state agencies and utilities in each respective state. Figure 2

[15] The technical report, "A Survey of State-Level Cost and Benefit Estimates of Renewable Portfolio Standards," can be downloaded at: http://emp.lbl.gov/sites/all/files/lbnl-6589e.pdf.

includes available results from the NREL Report over the 2010 to 2012 period for regulated states with RPS programs. It should be noted that estimates vary due to methodology, enactment date of the state RPS, elevation of state RPS goals and requirements, progress towards goals, and resource availability and cost.

Figure 2: NREL Report of State RPS Impacts as Percent of Retail Rates[16]



Results from Wisconsin were taken from Commission staff's previous analysis, with an impact of 1.6 percent in 2010 as the most recent at the time of the NREL Report release. Compared with other state RPS impacts estimated for the year 2010, Wisconsin is in the middle between extremes (from slightly negative impact in Oregon to above 3 percent in Arizona). If Wisconsin's 2012 impact of 2.68 percent were added to this chart, it would also be in the middle of other state impacts where 2012 results were available at the time the NREL Report was released.

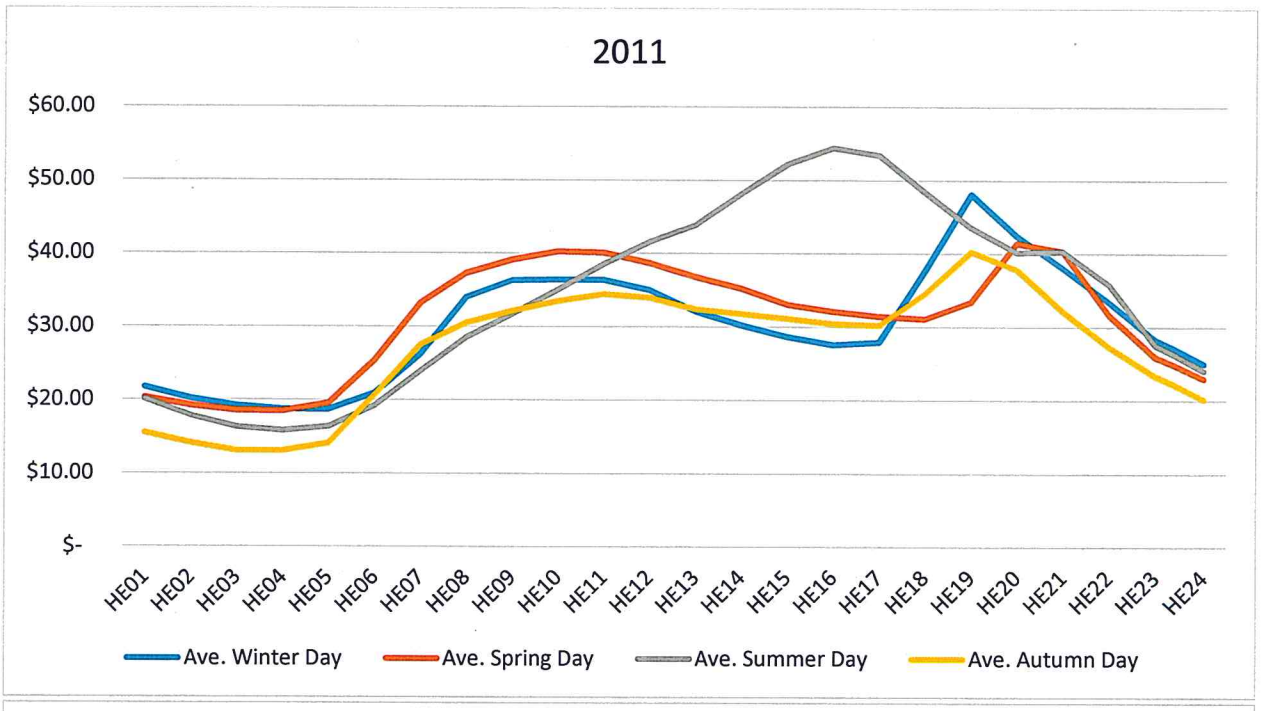
[16] Presented as Figure 8 on page 38 of the NREL Report.

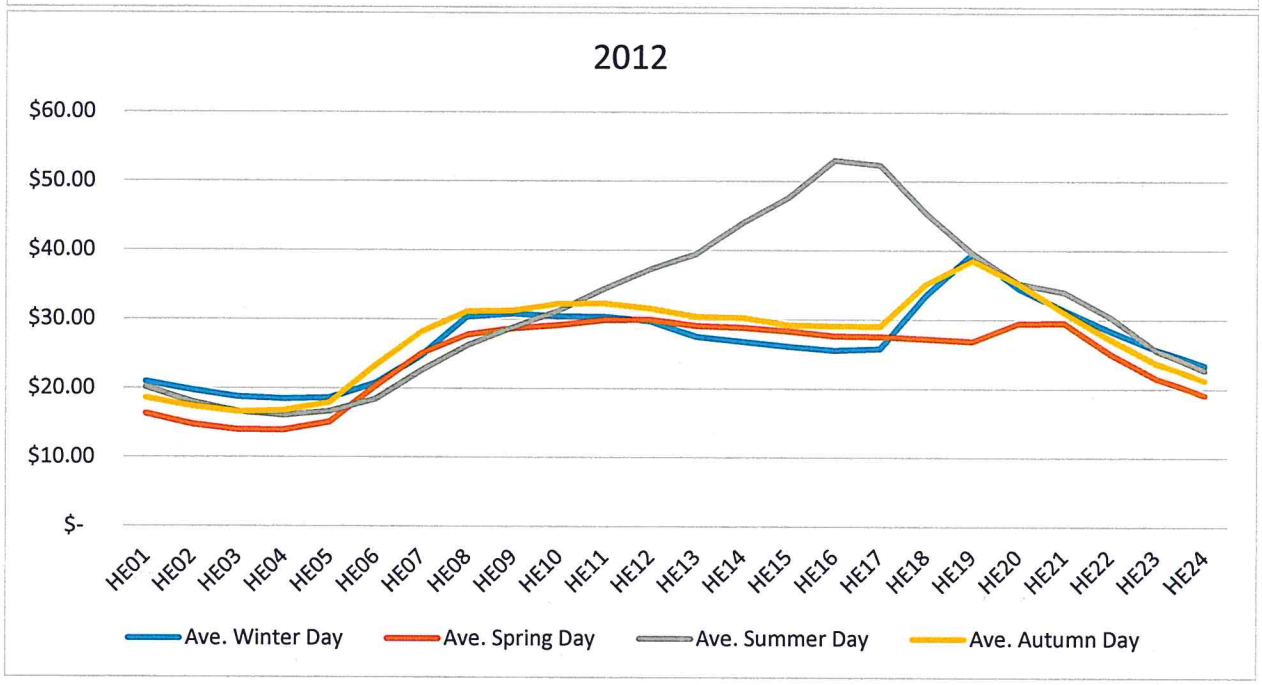
Docket 5-GF-245

DL: 00928962

Appendix A

Average Hourly Wisconsin Day-Ahead LMPs per Season (2011 and 2012)[17]

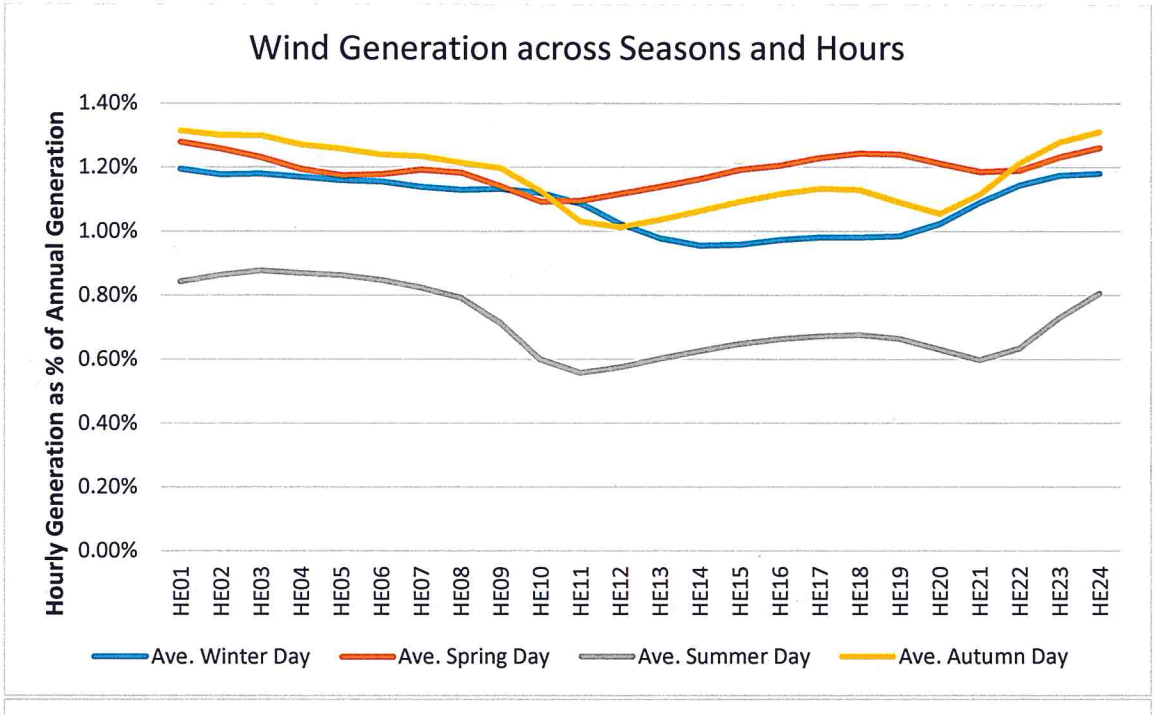


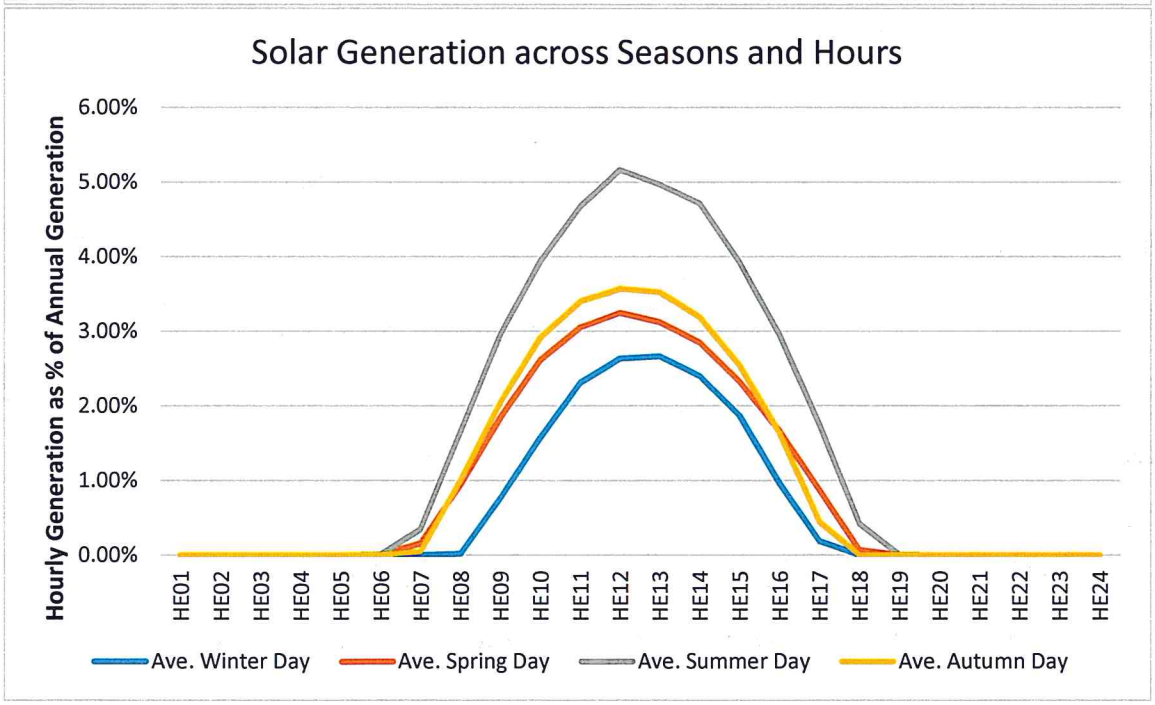


[17] LMP data downloaded from MISO's website (sample of Wisconsin load zones taken): https://www.misoenergy.org/Library/MarketReports/Pages/MarketReports.aspx.

Appendix B

Renewable Resource Generation Allocation per Average Hour across Seasons[18]





Appendix C

[18] Wind hourly and seasonal generation shapes were developed from MISO and M-RETS data. Solar hourly and seasonal generation shapers were developed from NREL's PV Watts Calculator and M-RETS data.

RPS Incremental Costs

2011 Statewide RPS Costs			
Resource	MWh	Average $/MWh	Costs to Procure Generation
Wind	3,162,909	$ 64.97	$ 205,508,240
Biogas	65,436	$ 81.25	$ 5,316,417
Biomass	738,667	$ 86.81	$ 64,123,906
Solar	783	$ 150.06	$ 117,500
Total	3,967,795	N/A	$ 275,066,063
Counterfactual	MWh	Average $/MWh	Costs to Procure Generation
LMP Purchases	3,967,795	Varies by Hour	$ 118,558,875
2011 Total RPS Incremental Costs			**$ 156,507,189**
2012 Statewide RPS Costs			
Resource	MWh	Average $/MWh	Costs to Procure Generation
Wind	3,463,480	$ 64.97	$ 225,037,693
Biogas	119,165	$ 81.25	$ 9,681,645
Biomass	763,660	$ 86.81	$ 66,293,553
Solar	446	$ 150.06	$ 66,919
Total	4,346,751	N/A	$ 301,079,811
Counterfactual	MWh	Average $/MWh	Costs to Procure Generation
LMP Purchases	4,346,751	Varies by Hour	$ 116,434,656
2012 Total RPS Incremental Costs			**$ 184,645,155**
2011-2012 Grand Total RPS Incremental Costs			**$ 341,152,344**

Appendix D

Rate Impact Information[19]

Actual Totals with RPS Costs Included			
Wisconsin Total	Revenues Collected	Retail Sales	Ave. Rate Across Classes
Year	$	kWh	$/kWh
2011	$7,002,534,500	68,611,622,000	$0.1021
2012	$7,077,825,000	68,820,090,000	$0.1028
2-Year Total	$14,080,359,500	137,431,712,000	$0.1025

Counterfactual Totals with Incremental RPS Costs Removed			
Wisconsin Total	Revenues Collected	Retail Sales	Ave. Rate Across Classes
Year	$	kWh	$/kWh
2011	$6,846,027,311	68,611,622,000	$0.0998
2012	$6,893,179,845	68,820,090,000	$0.1002
2-Year Total	$13,739,207,156	137,431,712,000	$0.1000

Rate Impact	
2011	2.29%
2012	2.68%
2-Year Average	2.48%

[19] Revenue and retail sales data were downloaded from EIA Form 861 data: http://www.eia.gov/electricity/data/eia861/. Counterfactual revenues have RPS incremental costs, from Appendix C, removed.