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October 31, 2013

—Via Electronic Filing—

Burl W. Haar
Executive Secretary
Minnesota Public Utilities Commission
121 7th Place East, Suite 350
St. Paul, MN 55101

RE: UPDATED SOLAR LOAD CARRYING CAPABILITY (ELCC) STUDY
DOCKET NO. E002/M-13-315

Dear Dr. Haar:

Northern States Power Company, doing business as Xcel Energy, submits the enclosed updated Effective Load Carrying Capability (ELCC) Study as discussed in our October 1, 2013 comments on the ELCC status in Docket No. E002/M-13-315.

The Company has modified the ELCC modeling assumptions based on input from interested parties. Specifically, parties requested that hourly solar and load patterns be based on actual annual data as to preserve the naturally occurring correlation between the two, that we test different panel orientations and that we use multiple years of data. The Company has not had an opportunity to receive feedback on the new results from parties, and therefore is not proposing to use these results to update the solar Standby Service Capacity credit at this time.

We have electronically filed this document with the Minnesota Public Utilities Commission, and copies have been served on the parties on the attached service list. Please contact amy.a.liberkowski@xcelenergy.com or (612) 330-6613 if you have any questions regarding this filing.

Sincerely,

/s/

AMY A. LIBERKOWSKI
MANAGER, REGULATORY ANALYSIS

Enclosures
c: Service List

I. Executive Summary

In this update to our original May 1, 2013 Solar ELCC study, we present the impacts of new hourly solar patterns and corresponding load shapes on the effective load carrying capability (ELCC) of solar PV resources. Our May 1 analysis used typical meteorological year (TMY) data to establish the contribution of solar resources to overall system reliability. Through our stakeholder outreach process it was recommended that hourly solar and load patterns should be based on actual annual data as to preserve the naturally occurring correlation between the two, and that we use multiple years of data. It was also recommended that we test different panel orientations.

The results of the updated analysis show a large range of ELCC values and illustrate how sensitive the analysis is to the underlying solar and load patterns used. Table 1 compares the results of the May 1 analysis and the results of our updated analysis. Table 1 illustrates the ELCC of solar was much lower in 2008 and 2009 than it was in 2010 or when the typical meteorological year data was used.

Table 1 – ELCC Summary

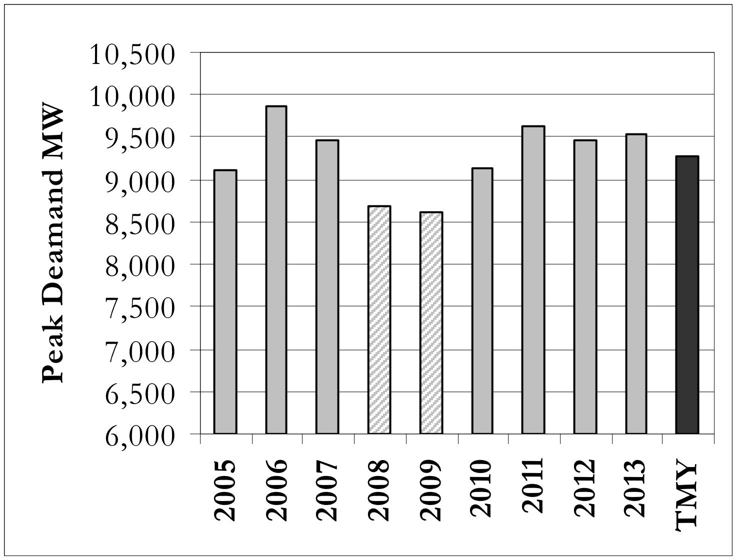
May 1st Results	TMY
Fixed Panel - 180deg Azimuth, 45deg Tilt	42.9%
1 Axis Tracking	48.1%

October Updated Results	2008	2009	2010	Average
Fixed Panel - 180deg Azimuth, 10deg Tilt	31.5%	27.9%	47.1%	35.5%
Fixed Panel - 180deg Azimuth, 30deg Tilt	31.2%	27.9%	43.2%	34.1%
Fixed Panel - 180deg Azimuth, 45deg Tilt	30.3%	26.7%	40.6%	32.5%
Fixed Panel - 200deg Azimuth, 30deg Tilt	31.8%	28.2%	47.6%	35.9%
1 Axis Tracking	38.6%	34.5%	57.5%	43.5%

Investigating the driving factors behind the ELCC results, we identified weak summer demand as the driving cause of the low ELCC values in 2008 and 2009. As a result of cooler than normal weather and the economic recession, customer demand was unusually low in the summer of 2008 and 2009. With weak summer demand the value of solar's contribution to reliability is diminished. Our perception is that these two years are not normal for the NSP system and that the TMY and 2010 results are more representative of the typical customer demand.

Figure 1 illustrates that peak demand in 2008 and 2009 was particularly low and also lower than the demand used in our May typical meteorological year analysis. The period of 2008-2010 was selected for this analysis as it was the most recent 3 years of solar radiation data available. The Company is continuing to evaluate other years to verify that the 2008 and 2009 are not typical for ELCC analysis.

Figure 1 – NSP Peak Customer Demand 2005-2013 & May 1 TMY Peak



II. Background

The Company completed a solar load profile study in response to the Settlement Agreement in the Company's 2011 Test Year electric rate case (Docket No. E002/GR-10-971). Specifically, the Settlement Agreement states:

> **F.2. Large Solar Facilities.** The Chamber proposed development of a new DG Solar rate that: a) would not have standby requirements; b) would not have demand charge penalties; and c) would reflect the Special MISO Mod E accrediting rating for solar installations. At this time, the Company lacks the information needed to determine the reasonableness of the Chamber's request. *The Company agrees to study the load profile of larger Solar facilities to determine the applicability of a solar facility's unique load characteristics to the standby and supplemental rate tariff and share those results with the Chamber by August 15, 2012.* (Italics added)

The Commission's May 14, 2012 FINDINGS OF FACT, CONCLUSIONS AND ORDER required the study results to be filed with the Commission and shared with the Department of Commerce. The Company complied with this requirement on August 15, 2012.

The Solar Load Profile Study provided an analysis of the production profiles of PV facilities greater than 60 kW_{AC} located at three customer sites using metering data.

The customer-based analysis was also applied to solar data sets based on a typical meteorological year[1] for locations at the Minneapolis-St. Paul International Airport (MSP) and the St. Cloud Regional Airport (StC). The results showed that the average solar generation during the summer peak demand hours of 1:00 p.m. to 7:00 p.m. ranged from 37 percent to 50 percent of maximum rated output. Table 2 provides the availability factor results from the Solar Load Profile Study.

Table 2: Solar Facility Availability Factor Summary

	1:00 p.m. – 7:00 p.m. On-Peak						
	Customer Sites			**Modeled Sites**			
Tracking:	Fixed	Fixed	1-Axis	Fixed	Fixed	1-Axis	1-Axis
Site	1	2	3	MSP	StC	MSP	StC
Summer	47%	43%	46%	37%	37%	50%	50%
Winter	25%	27%	24%	23%	23%	28%	29%
Annual	32%	33%	30%	25%	25%	33%	32%

The study concluded that solar contributes to meeting the Company's peak demand, but the contribution is highly variable by time of day, month, and customer load requirement. Due to the limited data available, the Company advised that further analysis would be needed to support decision-making.

In May 2013, the Company filed our original Solar ELCC analysis. This analysis built upon the Solar Load Profile study by utilizing hourly loss of load probability simulation from the ProSym model. This analysis used TMY data for both load and solar. However, the solar and load patterns did not perfectly correlate. The May 1 study also estimated what capacity accreditation solar might receive based on the methodology that MISO prescribes under its Resource Adequacy Business Practices Manual[2]. Table 3 summarizes the results of our May 1 study.

Table 3 – May 2013 Solar Study Results

	ELCC*	**MISO* Accreditation**
TMY – Fixed Panel	42.9%	45.4%
TMY – 1-Axis Tracking	48.1%	52.3%
Customer Site 1 – Fixed Panel	-NA-	60.7%
Customer Site 2 – Fixed Panel	-NA-	58.6%
Customer Site 3 – 1-Axis Tracking	-NA-	57.2%

*Percent of AC nameplate capacity

[2] https://www.midwestiso.org/Library/BusinessPracticesManuals/Pages/BusinessPracticesManuals.aspx

Through our collaborative stakeholder outreach process interested parties recommended that instead of TMY data, the study should be based on actual historic data to ensure the correlation between solar generation and total customer load is preserved. Also to ensure that any single year of data does not produce atypical results, parties requested multiple years of data to be evaluated. Finally, instead of a single fixed panel orientation, stakeholders felt multiple different orientations should be evaluated to investigate the impact on the ELCC results.

III. Effective Load Carrying Capability of Solar

A. Methodology

The calculation of ELCC incorporates the use of a measure of electric system reliability called loss of load expectation (LOLE). LOLE is calculated by summing the hourly loss of load probabilities (LOLP) over an entire year. LOLPs are in turn calculated using computer models to simulate a utility's hourly loads, generation capacity, forced outage rates, and maintenance rates. For this study, the Company set its reliability target as an LOLE of one day in 10 years (or 2.4 hours/year), which is an industry standard typically used when evaluating system reliability.

The ELCC attributed to solar generation can be calculated by analyzing two generation portfolios: one with incremental solar generation and another with an incremental, generic capacity resource such as a gas-fired combustion turbine. The total capacity of the incremental, generic capacity resource portfolio is adjusted until the sum of LOLPs is equal to the LOLE value achieved by the incremental solar generation portfolio. Then, the ELCC of the solar generation is obtained by dividing the incremental generic capacity resource MW_{AC} by the incremental solar MW_{AC}. For example, an ELCC measure of 45% indicates that 45 MW of combustion turbine capacity would supply the reduction in LOLE value as 100 MW of installed solar capacity. It can be considered the percent of a system's maximum AC output that solar contributes, on average, to meeting system peak demand.

The Company conducted this ELCC analysis utilizing ProSym[3]'s direct numerical convolution method that is part of the production cost simulation model. The specific procedure used in ProSym to calculate the ELCC of solar is as follows:

1) Set up ProSym model for reliability run analyses and convert all scheduled maintenance days to maintenance rates.

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[3] ProSym is a Ventyx product used in resource planning.

2) Adjust the firm generic resource capacity in ProSym until the system's LOLE is equal to 1 day in 10 years.
3) Add 100 MW_{AC} solar profile to the NSP system and run ProSym to record the resulting (lower) LOLE.
4) Remove the 100 MW_{AC} solar profile from ProSym and incrementally add firm generic resource capacity (natural gas combustion turbine) until the LOLE returns to the lower LOLE recorded in the step 3.
5) Calculate ELCC as Firm Resource Capacity MW_{AC}/100 MW_{AC} Solar

This analysis used 100 MW_{AC} solar increments because, after testing, it was determined that the actual 10 MW_{AC} level of solar on the NSP system was too small to result in reliable model results. Because the ELCC of solar is approximately 50% of maximum rating, the amount of firm capacity in the Prosym model using the actual 10 MW_{AC} on our system was only about 5 MW_{AC}. In the context of the 10,000 MW NSP system, such a small increment of firm capacity is "lost in the noise" of the rest of the model simulations. Testing with 100 MW provided much more stable results, allowing the ELCC values to be generalized to the smaller MW levels currently on the system.

B. Solar & Load Data

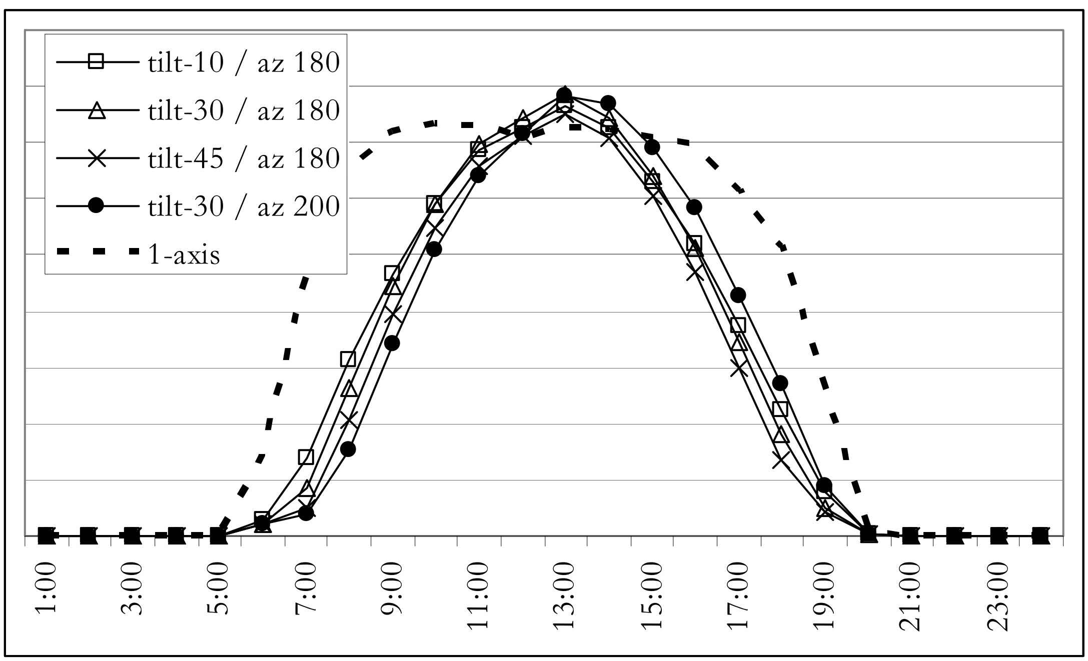
At the recommendation of interested parties this analysis utilizes actual data from 2008, 2009, and 2010. These were the most recent three years of data publicly available. Hourly solar generation patterns were developed using a two step process. First hourly solar radiation and other meteorological data were downloaded from the National Solar Radiation Database (NSRD)[4]. The NSRD includes the following data: global horizontal irradiance, direct normal irradiance, diffuse horizontal irradiance, temperature, dew-point, relative humidity, pressure, wind speed, and albedo. The second step of the process utilized the Solar Advisor Model (SAM)[5] to estimate hourly solar generation patterns, based on the NSRD radiation and weather data. With SAM the user can specify the type and orientation of PV panels as well as the type of inverter used. Based on the recommendation of stake holders we evaluated the following PV panel orientations:

[4] http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2010/targzs/targzs_by_state.html
[5] https://sam.nrel.gov/

	Panel Type	Azimuth Degrees from North	Direction	Tilt from Horizontal
1	Fixed	180	South	10
2	Fixed	180	South	30
3	Fixed	180	South	45
4	Fixed	200	South-Southwest	30
5	1-Axis	Tracking		Tracking

The impact of the different panel orientations is shown by comparing the hourly generation for a peak summer day. Figure 2 shows the different generation patterns for the five panel orientations evaluation for the date July 15th 2010. The figure shows that panels with a flatter, or more westerly orientation, have higher production in the afternoon hours. The figure also shows that a 1 Axis Tracking System significantly increases production in the morning and afternoon hours, although its peak generation at solar noon is lower than the fixed panel installations.

Figure 2 –PV Generation - July 15th 2010



The difference in annual solar patterns can be evaluated in several ways. First Figure 3 and Table 4 summarize the monthly capacity factors for a 45deg tilt 180deg azimuth installation for 2008, 2009, and 2010. The data shows that the 2010 data resulted in the highest overall solar generation, although the 2008 had the highest generation in July and August.

Figure 3 – Monthly Solar Generation 2008, 2009, 2010
45 Degree Tilt, 180 Degree Azimuth

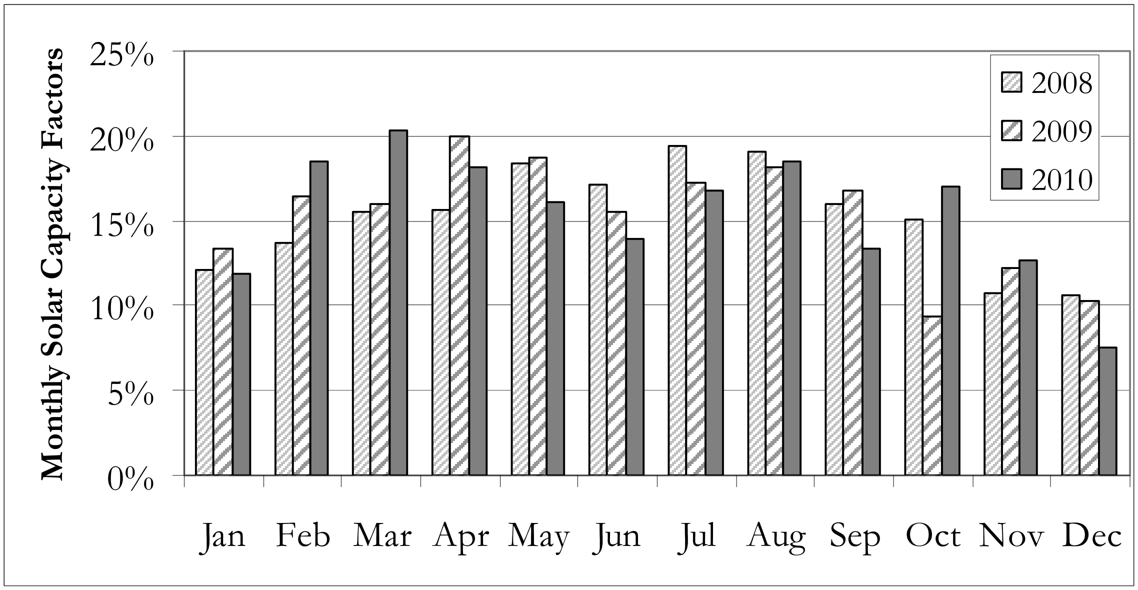


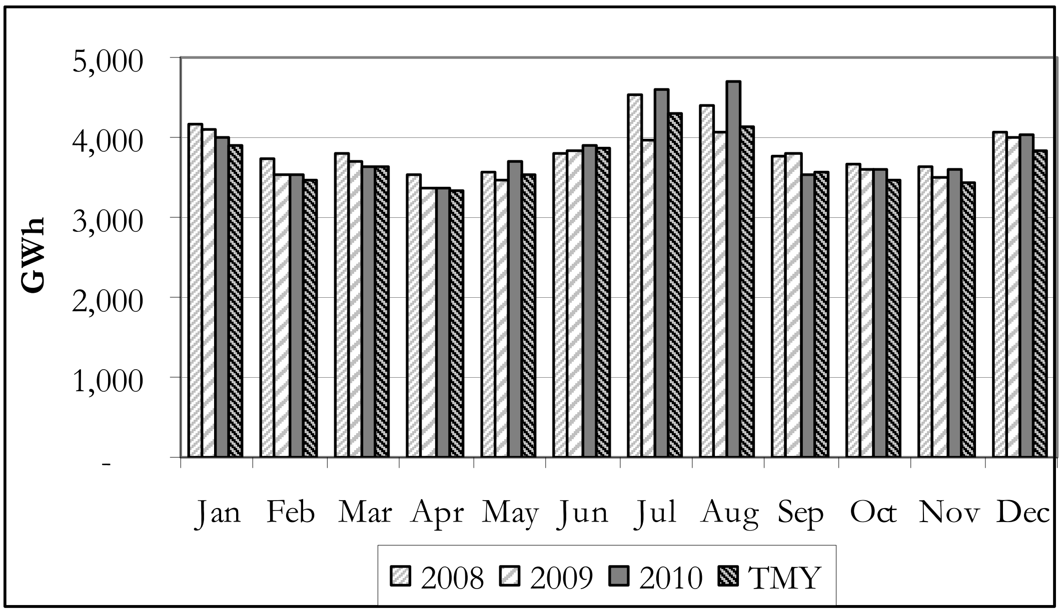
Table 4 – Monthly Solar Generation 2008, 2009, 2010
45 Degree Tilt, 180 Degree Azimuth
AC Generation Relative to Maximum AC Rating

	2008	2009	2010
Jan	12.1%	13.4%	11.9%
Feb	13.7%	16.4%	18.5%
Mar	15.6%	16.0%	20.3%
Apr	15.6%	20.0%	18.2%
May	18.4%	18.7%	16.1%
Jun	17.2%	15.6%	13.9%
Jul	19.4%	17.3%	16.8%
Aug	19.1%	18.1%	18.5%
Sep	16.0%	16.8%	13.3%
Oct	15.0%	9.4%	17.0%
Nov	10.7%	12.2%	12.7%
Dec	10.6%	10.3%	7.5%
Annual	**16.0%**	**15.9%**	**16.4%**

The load data used in this analysis is based on net measured customer demand in 2008, 2009, and 2010. The raw input data used for this analysis is provided in

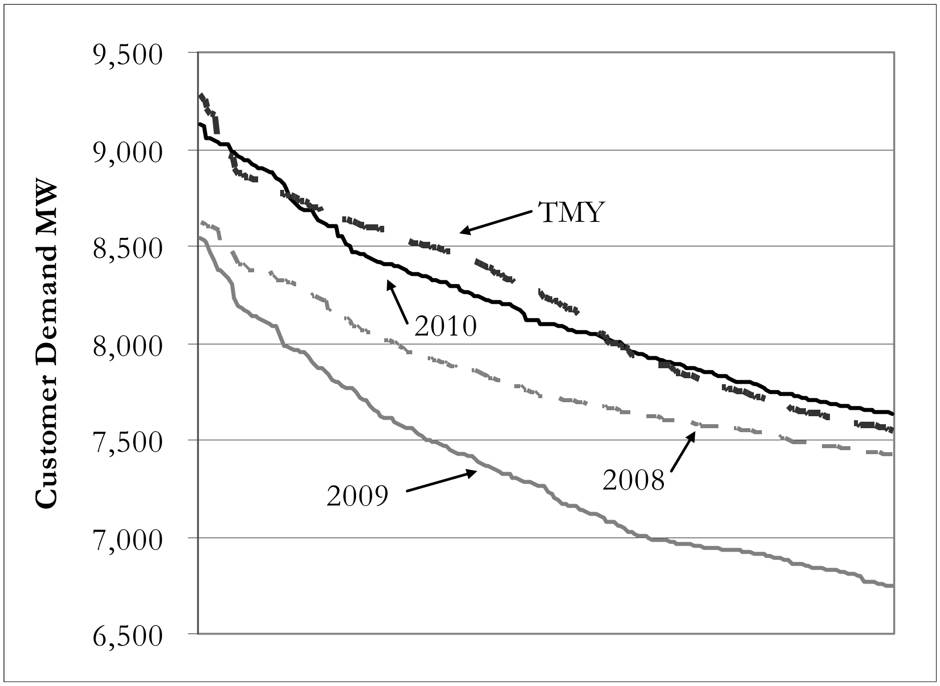
Appendix A. Inspection of monthly total energy does not indicate that 2008 and 2009 are particularly different from 2010 or the data used in the May 1st typical meteorological year analysis. Visual inspection of the monthly generation from each year and the TMY data does not indicate that 2008 or 2009 might be particularly problematic for ELCC analysis.

Figure 4 – Monthly Total Energy 2008-2010 & May 1st TMY



However, close inspection reveals that during the curtailment summer peak demand period, customer energy usage was particularly low in 2008 and 2009. Figure 5 illustrates hourly customer demand during the top 200 hours in June – July. The figure shows that during these critical hours, the demand in 2008 and 2009 was significantly lower. Our expectation is that this is the primary cause of lower ELCC values in 2008 and 2009.

Figure 5 – Top 200 Customer Demand Hours in June-August



The results of an ELCC analysis are primarily based on the correlation between PV generation and total customer demand. To illustrate the correlation between solar generation and load Figures 6, 7, and 8 plot the solar generation during the top 100 customer demand hours in each year.

Figure 6 – 2008 Solar & Load Correlation

Average PV Generation During Top 100 Hours = 39.3%

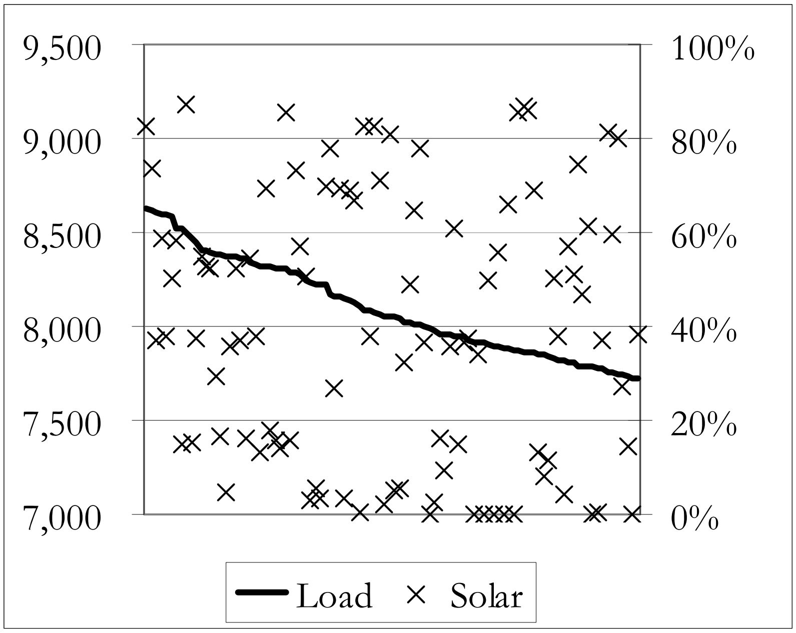


Figure 7 – 2009 Solar & Load Correlation

Average PV Generation During Top 100 Hours = 40.5%

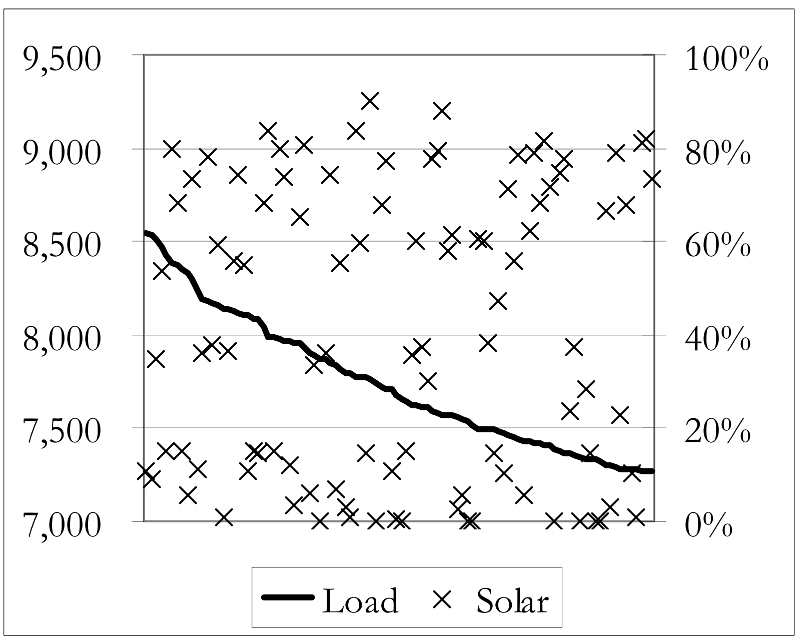
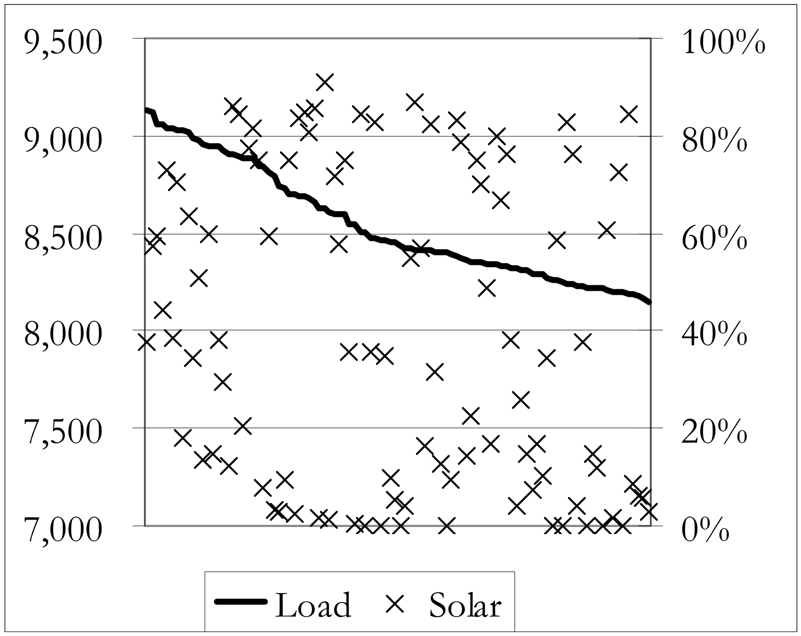


Figure 8 – 2010 Solar & Load Correlation

Average PV Generation During Top 100 Hours = 38.9%



C. Results

The results of the Prosym ELCC analysis showed considerable variation across years and panel orientations. The results for 2008 and 2009 are considerably lower than 2010 and lower than the results of our May typical meteorological year (TMY) analysis. Table 5 summarizes the ELCC results. The average ELCC is over 10 percentage points lower in 2008 and 2009 than in 2010 with a three year average of 34.5% for fixed panels and 43.5% for single axis tracking. The results for different panel orientations only result in a total ELCC variation of 3.4%, indicating that attempting to optimize panel position to maximize contribution to peak demand does not have significant value. Finally, consistent with our May 1st analysis, single axis tracking does increase contribution to meeting peak demand with ELCC values approximately 7% to 10% higher than fixed panel orientations.

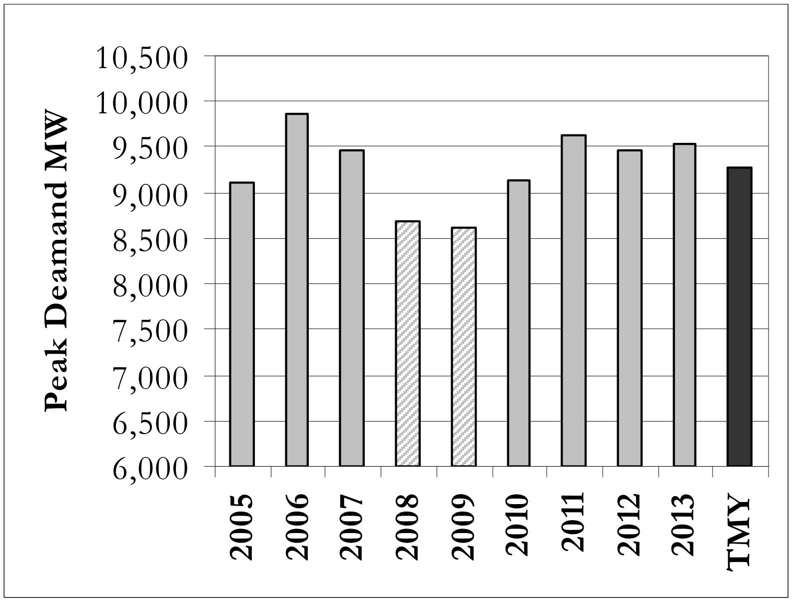
Table 5 – Updated ELCC Analysis*

	2008	**2009**	**2010**	**Average**
Fixed Panel - 180deg Azimuth, 10deg Tilt	31.5%	27.9%	47.1%	**35.5%**
Fixed Panel - 180deg Azimuth, 30deg Tilt	31.2%	27.9%	43.2%	**34.1%**
Fixed Panel - 180deg Azimuth, 45deg Tilt	30.3%	26.7%	40.6%	**32.5%**
Fixed Panel - 200deg Azimuth, 30deg Tilt	31.8%	28.2%	47.6%	**35.9%**
Fixed Panel Average	**31.2%**	**27.7%**	**44.6%**	**34.5%**
1 Axis Tracking	38.6%	34.5%	57.5%	**43.5%**

*AC accreditation as a percent of AC nameplate

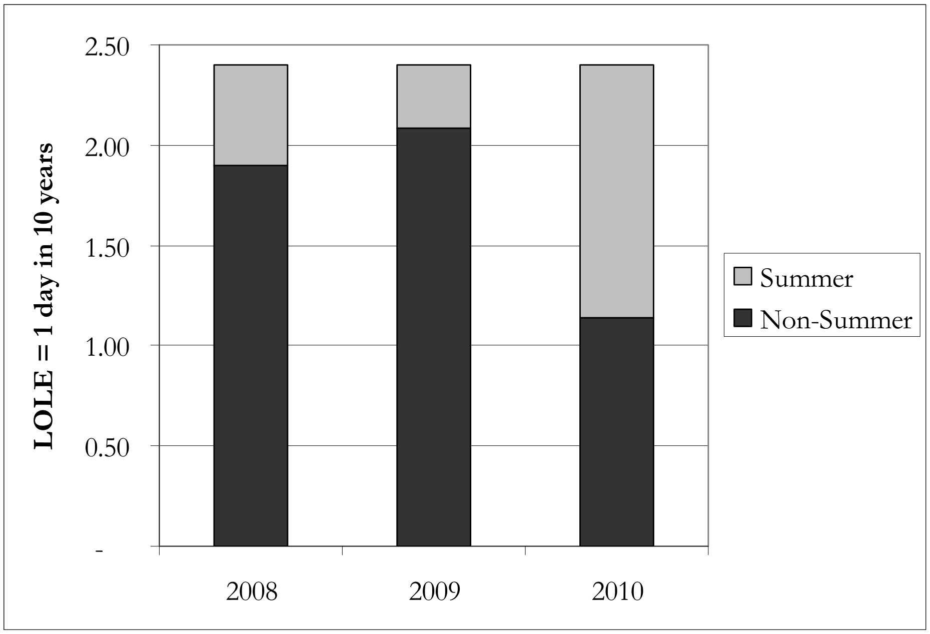
The lower results for 2008 and 2009 led the Company to research the details of the ELCC analysis in order to understand the driving factors behind the results. Our research identified weak customer demand as the primary cause for the low ELCC results. These two years stand out as having particularly low peak demands as a result of a weak economy and below normal summer temperatures. Figure 6 shows that 2008 and 2009 had the lowest peak over the past nine years and were lower than the peak used in the TMY analysis.

Figure 6 – Peak Customer Demand 2005-2013



The result of lower summer demand is that solar contributes less to system reliability in the months when its generation is at its highest. The diminished contribution to reliability during summer months can be seen by investigating monthly impact of solar on loss of load expectation (LOLE). As noted in the methodology section, for each year the Prosym model is adjusted to such that the LOLE equals one day in ten years, or 2.4 hours per year. Figure 7 shows that because customer demand was low in the summers of 2008 and 2009, when the model was adjusted to an LOLE of 2.4 hours per year only a small proportion of system reliability was placed in the summer months. The result for 2010 is more in line with expectation that about half of our system reliability risk occurs in the months June, July, and August.

Figure 7 – Loss of Load Expectation



Based on this analysis, the Company will continue to evaluate data from other years to verify the results for 2008 and 2009 are atypical and not representative of normal ELCC values. We look forward to stakeholder feedback.

Appendix A

Appendix A.xls – Solar Data for 2008, 2009, & 2010
Tab 1: Solar Load: Hourly & Monthly Summaries
Tab 2: Solar Generation: Monthly Capacity Factor Summaries & Hourly Data
Tab 3: Loss of Load Probability: Monthly Capacity Factor Summaries & Hourly Data

CERTIFICATE OF SERVICE

I, SaGonna Thompson, hereby certify that I have this day served copies of the foregoing document or a summary thereof on the attached lists of persons:

xx by depositing a true and correct copy or summary thereof, properly enveloped with postage paid, in the United States Mail at Minneapolis, Minnesota; or

xx via electronic filing

MPUC DOCKET NO. E002/M-13-315

Dated this 31st day of October 2013

/s/

____

SaGonna Thompson

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SaGonna	Thompson	Regulatory.Records@xcelenergy.com	Xcel Energy	414 Nicollet Mall FL 7 Minneapolis, MN 554011993	Electronic Service	No	SPL_SL_13-315_Interested Parties

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Kari L	Valley	kari.l.valley@xcelenergy.com	Xcel Energy Service Inc.	414 Nicollet Mall FL 5 Minneapolis, MN 55401	Electronic Service	No	SPL_SL_13-315_Interested Parties
Scott M.	Wilensky	scott.wilensky@xcelenergy.com	Xcel Energy	7th Floor 414 Nicollet Mall Minneapolis, MN 554011993	Electronic Service	No	SPL_SL_13-315_Interested Parties
Daniel	Williams	N/A	Powerfully Green	11451 Oregon Avenue N Champlin, MN 55316	Paper Service	No	SPL_SL_13-315_Interested Parties

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Ross	Abbey	abbey@fresh-energy.org	Fresh Energy	408 Saint Peter St Ste 220 St. Paul, MN 55102-1125	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Michael	Allen	michael.allen@allenergysolar.com	All Energy Solar	721 W 26th st Suite 211 Minneapolis, Minnesota 55405	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
John	Aune	johna@bluehorizonsolar.com	Blue Horizon Energy	7246 Washington Ave S Eden Prairie, MN 55344	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Sara	Bergan	sebergan@stoel.com	Stoel Rives LLP	33 South Sixth Street Suite 4200 Minneapolis, MN 55402	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Thor	Bjork	Thor.S.Bjork@xcelenergy.com	Xcel Energy	414 Nicollet Mall Minneapolis, MN 55401	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
William A.	Blazar	bblazar@mnchamber.com	Minnesota Chamber Of Commerce	Suite 1500 400 Robert Street North St. Paul, MN 55101	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Michael J.	Bull	N/A	Center for Energy and Environment	212 Third Avenue North, Suite 560 Minneapolis, MN 55401	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Jessica	Burdette	jessica.burdette@state.mn.us	Department of Commerce	85 7th Place East Suite 500 St. Paul, MN 55101	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Joel	Cannon	jcannon@tenksolar.com	Tenk Solar, Inc.	9549 Penn Avenue S Bloomington, MN 55431	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
John J.	Carroll	jcarroll@newportpartners.com	Newport Partners, LLC	9 Cushing, Suite 200 Irvine, California 92618	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Steve W.	Chriss	Stephen.chriss@wal-mart.com	Wal-Mart	2001 Southeast 10th St. Bentonville, AZ 72716-5530	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Steve	Coleman	scoleman@appliedenergyinnovations.org	Applied Energy Innovations	4000 Minnehaha Ave S Minneapolis, MN 55406	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Chris	Davis	christopher.davis@state.mn.us	Department of Commerce	Suite 500 85 Seventh Place East St. Paul, MN 551012198	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Dustin	Denison	dustin@appliedenergyinnovations.org	Applied Energy Innovations	4000 Minnehaha Ave S Minneapolis, MN 55406	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Dan	Donkers	N/A	Saint Paul - Ramsey County Public Health	Environmental Health Section 2785 White Bear Ave., Suite 350 Maplewood, MN 55109	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Bill	Droessler	N/A	Izaak Walton League of America-MWO	1619 Dayton Ave Ste 202 Saint Paul, MN 55104	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Rick	Evans	Rick.Evans@xcelenergy.com	Xcel Energy	404 Nicollet Mall Minneapolis, MN 55401	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Nathan	Franzen	nathan@geronimoenergy.com	Geronimo Energy	7650 Edinborough Way Suite 725 Edina, MN 55435	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Lee	Gabler	Lee.E.Gabler@xcelenergy.com	Xcel Energy	404 Nicollet Mall Minneapolis, MN 55401	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Benjamin	Gerber	bgerber@mnchamber.com	Minnesota Chamber of Commerce	400 Robert Street North Suite 1500 St. Paul, Minnesota 55101	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Elizabeth	Goodpaster	bgoodpaster@mncenter.org	MN Center for Environmental Advocacy	Suite 206 26 East Exchange Street St. Paul, MN 551011667	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Bill	Grant	Bill.Grant@state.mn.us	Minnesota Department of Commerce	85 7th Place East, Suite 500 St. Paul, MN 55101	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Lloyd	Grooms	lgrooms@winthrop.com	Winthrop and Weinstine	Suite 3500 225 South Sixth Street Minneapolis, MN 554024629	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Tony	Hainault	anthony.hainault@co.hennepin.mn.us	Hennepin County DES	701 Fourth Ave. S., Ste 700 Minneapolis, MN 55415-1842	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
J Drake	Hamilton	hamilton@fresh-energy.org	Fresh Energy	408 St Peter St Saint Paul, MN 55101	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Samuel	Hanson	N/A	Briggs And Morgan, P.A.	2200 IDS Center E 80 South Eighth Street Minneapolis, MN 55402	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Brandon	Heath	bheath@misoenergy.org	MISO Energy	1125 Energy Park Drive St. Paul, MN 55108-5001	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Lynn	Hinkle	lhinkle@mnseia.org	Minnesota Solar Energy Industries Association	2512 33rd Ave South #2 Minneapolis, MN 55406	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Holly	Hinman	holly.r.hinman@xcelenergy.com	Xcel Energy	414 Nicollet Mall, 6th Floor Minneapolis, MN 55401	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
David	Horneck	david.g.horneck@xcelenergy.com	Xcel Energy	1800 Larimer Street Denver, CO 80202	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Jan	Hubbard	Jan@AppliedEnergyInnovations.org	Applied Energy Innovations, LLC	4000 Minnehaha Avenue South Minneapolis, MN 55406	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Anne	Hunt	anne.hunt@ci.stpaul.mn.us	City of Saint Paul	390 City Hall 15 West Kellogg Boulevard Saint Paul, MN 55102	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Steve	Huso	steve.huso@xcelenergy.com	Xcel Energy	G.O. 7th Floor 414 Nicollet Mall Minneapolis, MN 554011993	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Ralph	Jacobson	N/A	Innovative Power Systems, Inc.	1413 Hunting Valley Rd Ste 1 Saint Paul, MN 55109-1555	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Dwight	Jelle	dkjelle@gmail.com	Best Power International, LLC	P.O. 5126 Hopkins, MN 55343	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Alan	Jenkins	aj@jenkinsatlaw.com	Jenkins at Law	2265 Roswell Road Suite 100 Marietta, GA 30062	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Linda	Jensen	linda.s.jensen@ag.state.mn.us	Office of the Attorney General-DOC	1800 BRM Tower 445 Minnesota Street St. Paul, MN 551012134	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Richard	Johnson	Rick.Johnson@lawmoss.com	Moss & Barnett	90 South 7th Street Suite #4800 Minneapolis, MN 554024129	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Kerry	Klemm	kerry.r.klemm@xcelenergy.com	Xcel Energy Services, Inc	414 Nicollet Mall Minneapolis, MN 55401	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List

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Mara	Koeller	mara.n.koeller@xcelenergy.com	Xcel Energy	414 Nicollet Mall 5th Floor Minneapolis, MN 55401	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Jon	Kramer	jk2surf@aol.com	Sundial Solar	4708 york ave. S Minneapolis, MN 55410	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Allen	Krug	allen.krug@xcelenergy.com	Xcel Energy	414 Nicollet Mall-7th fl Minneapolis, MN 55401	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Scott	Kurtz	Scott.J.Kurtz@xcelenergy.com	Xcel Energy	825 Rice Street St. Paul, MN 55117	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Amy	Liberkowski	amy.a.liberkowski@xcelenergy.com	Xcel Energy	414 Nicollet Mall 7th Floor Minneapolis, MN 554011993	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Bob	Long	rlong@larkinhoffman.com	Larkin Hoffman (Silicon Energy)	1500 Wells Fargo Plaza 7900 Xerxes Ave S Bloomington, MN 55431	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Rebecca	Lundberg	rebecca.lundberg@powerfullygreen.com	Powerfully Green	11451 Oregon Ave N Champlin, MN 55316	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Paula	Maccabee	Pmaccabee@justchangelaw.com	Just Change Law Offices	1961 Selby Avenue St. Paul, MN 55104	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Casey	Maccullum	casey@appliedenergyinnovations.org	Applied Energy Innovations	4000 Minnehaha Ave S Minneapolis, MN 55406	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Susan	Mackenzie	susan.mackenzie@state.mn.us	Public Utilities Commission	Suite 350121 7th Place East St. Paul, MN 551012147	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Kavita	Maini	kmaini@wi.rr.com	KM Energy Consulting LLC	961 N Lost Woods Rd Oconomowoc, WI 53066	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Pam	Marshall	pam@energycents.org	Energy CENTS Coalition	823 7th St E St. Paul, MN 55106	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Natalie	McIntire	natalie.mcintire@gmail.com	Wind on the Wires	570 Asbury St Ste 201 St. Paul, MN 55104-1850	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Brian	Millberg	Brian.Millberg@minneapolismn.gov	City of Minneapolis	350 South 5th St, #315 Minneapolis, MN 55415	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Stacy	Miller	stacy.miller@state.mn.us	Department of Commerce	State Energy Office 85 7th Place East, Suite 500 St. Paul, MN 55101	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Andrew	Moratzka	apmoratzka@stoel.com	Stoel Rives LLP	33 South Sixth Street Suite 4200 Minneapolis, MN 55402	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Martin	Morud	mmorud@trunorthsolar.com	Tru North Solar	5115 45th Ave S Minneapolis, MN 55417	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Michael	Noble		Fresh Energy	Hamm Bldg., Suite 220 408 St. Peter Street St. Paul, MN 55102	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Rolf	Nordstrom	rnordstrom@gpisd.net	Great Plains Institute	2801 21ST AVE S STE 220 Minneapolis, MN 55407-1229	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
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Nick	Paluck	nick.paluck@xcelenergy.com	Xcel Energy	7th Floor 414 Nicollet Mall Minneapolis, MN 554011993	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
James	Pearson	james.g.pearson@xcelenergy.com	Xcel Energy	414 Nicollet Mall Minneapolis, MN 55401	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Charlie	Pickard	cpickard@aladdinsolar.com	Aladdin Solar	1215 Lilac Lane Excelsior, MN 55331	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Donna	Pickard	dpickard@aladdinsolar.com	Aladdin Solar	1215 Lilac Lane Excelsior, MN 55331	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Gayle	Prest	gayle.prest@minneapolismn.gov	City of Mpls Sustainability	350 South 5th St, #315 Minneapolis, MN 55415	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Richard	Savelkoul	rsavelkoul@martinsquires.com	Martin & Squires, P.A.	332 Minnesota Street Ste W2750 St. Paul, MN 55101	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Larry L.	Schedin	Larry@LLSResources.com	LLS Resources, LLC	12 S 6th St Ste 1137 Minneapolis, MN 55402	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Matthew J.	Schuerger P.E.	mjsreg@earthlink.net	Energy Systems Consulting Services, LLC	PO Box 16129 St. Paul, MN 55116	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Kevin	Schwain	Kevin.D.Schwain@xcelenergy.com	Xcel Energy	404 Nicollet Mall Minneapolis, MN 55401	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Janet	Shaddix Elling	jshaddix@janetshaddix.com	Shaddix And Associates	Ste 122 9100 W Bloomington Frwy Bloomington, MN 55431	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Erin	Shea	eshea@silicon-energy.com	Silicon Energy	11168 Sumter Circle Bloomington, MN 55438	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Doug	Shoemaker	dougs@mnRenewables.org	MRES	2928 5th Avenue South Minneapolis, MN 55408	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Chanti	Sourignavong	chantipal.sourignavong@honeywell.com	Honeywell	1985 Douglas Drive North MN10-111A Golden Valley, MN 55422-3992	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Erin	Stojan Ruccolo	ruccolo@fresh-energy.org	Fresh Energy	408 Saint Peter St Ste 220 Saint Paul, MN 55102-1125	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
James M.	Strommen	jstrommen@kennedy-graven.com	Kennedy & Graven, Chartered	470 U.S. Bank Plaza 200 South Sixth Street Minneapolis, MN 55402	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Deb	Sundin	deb.sundin@xcelenergy.com	Xcel Energy	414 Nicollet Mall Minneapolis, MN 55401	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
SaGonna	Thompson	Regulatory.Records@xcelenergy.com	Xcel Energy	414 Nicollet Mall FL 7 Minneapolis, MN 554011993	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Lise	Trudeau	lise.trudeau@state.mn.us	Department of Commerce	85 7th Place East Suite 500 Saint Paul, MN 55101	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List
Jason	Willett	N/A	Metropolitan Council	390 Robert St N Saint Paul, MN 55101-1805	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Daniel	Williams	N/A	Powerfully Green	11451 Oregon Avenue N Champlin, MN 55316	Paper Service	No	SPL_SL_13-315_Solar Stakeholders List
Steven	Wishart	steven.w.wishart@xcelenergy.com	Xcel Energy	7th Floor 414 Nicollet Mall Minneapolis, MN 554011993	Electronic Service	No	SPL_SL_13-315_Solar Stakeholders List