

Renewable Development Fund Project EP3-12

Milestone 15 Final Report – 02/13/2011

Public



Solarflow Energy

an effortless shift to solar

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Project Title: A Solar Electric Solution for Residential Markets

Contract Number: EP3-12

Milestones: 15

Report Date: 02/13/2011

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Congressional District for Corporate office: 5.

Congressional Districts for Project locations: Across the Twin Cities - Districts 3, 4, and 5.

Executive Summary

The goal of this project, as stated in the proposal submitted on July 17, 2007, is “to demonstrate the commercial viability of providing solar-generated electricity to **homes and small businesses based on a leasing and service package**”. In addition, the "project will provide distributed residential solar energy through rooftop-mounted photovoltaic solar panels" and the importance of the project is to **overcome pricing and capitalization barriers in this market, which have been documented to be the biggest obstacles to solar expansion.**

The key objective of the project is to install 280 KW of solar capacity which ultimately became 25 sites distributed across the Twin Cities. The exact number of installation sites simply depended on the actual number of panels in each site. The list of actual installation addresses and sizes follows:

Solar leasing Pilot Project Installations		
Address:	Size kW:	
3xxx Evergreen Lane, Plymouth, MN 55441	7.200	Residential
5xxx Birchcrest Drive, Edina, MN 55436	5.625	Residential
1xxx Grantham Street, St. Paul, MN 55108	2.700	Residential
1xxx E 86th Street, Bloomington, MN 55425	2.700	Residential
3xxx E 25th Street, Minneapolis, MN 55405	4.625	Residential
3xxx Nicollet Avenue, Minneapolis, MN 55409	39.150	Commercial
1xxxx Jasper Lane, Eden Prairie, MN 55347	5.980	Residential
2xxx Blaisdell Avenue S, Minneapolis, MN 55404	5.980	Residential
2xxx E Franklin Avenue, Minneapolis, MN 55406	32.200	Commercial
3xxx 23rd Avenue S, Minneapolis, MN 55407	2.300	Residential

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1xxx Lincoln Avenue, St. Paul, MN 55105	4.140	Residential
1xxx 2nd Avenue N, Minneapolis, MN 55405	2.760	Residential
1xxxx 88th Place, Maple Grove, MN 55369	4.140	Residential
2xx Vincent Avenue N, Minneapolis, MN 55405	2.760	Residential
4xx Terrace Drive, Roseville, MN 55113	7.130	Residential
1xxx Thomas Avenue S, Minneapolis, MN 55405	2.070	Residential
1xxx W Hwy 36, Roseville, MN 55113	39.790	Commercial
6xxx 15th Street N, Oakdale, MN 55128	39.900	Commercial
1xxx B Washington Avenue S, Minneapolis, MN 55415	11.955	Commercial
1xxx S 2nd Street, Minneapolis, MN 55454	39.790	Commercial
8xxx Klein Drive, Waconia, MN 55387	4.600	Residential
6xxx W 23rd Street, St. Louis Park, MN 55426	4.140	Residential
1xxx Delano Way, Stillwater, MN 55082	4.140	Residential
2xxx 32 nd Avenue S, Minneapolis, MN 55406	3.450	Commercial
4xxx Washburn Avenue S, Minneapolis, MN 55410	0.920	Residential

280.145

The average residential install was 4.07 KW while commercial was 33.81 KW.

The delivery of 280 KW was grouped into 15 milestones, with the 15th and final milestone requiring the installation of 16.8KW. The last installation that completed the 280 KW is documented in the Interconnection Agreement included in Appendix A, this residence on 23rd Street, St Louis Park, MN 55426 – a 4.14 KW system. We enclose the picture capturing the installation of the very last panel in this project, which as the reader can see was very challenged by our snowy December.



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In order to visualize what a solar PV installation looks like, please follow the links below, which show time-lapsed videos summarizing the work in just a couple minutes:

- Residential – http://www.youtube.com/watch?v=viEpFOECW6E&feature=mfu_in_order&list=UL
- Commercial - http://www.youtube.com/watch?v=TzdZiWkXBo&feature=mfu_in_order&list=UL

Overall, **the project was successful in achieving its objectives to demonstrate the market viability and acceptance of solar leasing**: the enclosed Customer Survey in Appendix B shows the overwhelming acceptance of this service by the customers, as well as the areas where we can make improvements. Please see subsequent sections of this report for more details.

In addition, the **project came in within budget**, given that the contracted budget was \$2,460,429 and the actual total cost came in at \$2,266,092, which is equivalent to an **overall cost of \$8.09 per watt installed (no maintenance costs)**. This total cost includes, not just costs directly associated with the installation equipment, installation labor and installation permits, but also overhead of promoting and managing leases, doing solar assessments, project management and coordination. If we exclude overhead costs, and we consider only costs directly associated with the installation of solar, then **the average residential install cost was \$6.90 and the average commercial \$5.70**. Lastly, systems have not been in operation long enough yet to have gathered any meaningful maintenance cost data.

In terms of project schedule, there was a **significant delay to the start of the installation phase** (November 2009 instead of spring 2009, as planned), but once the installations started, they were **completed in less than the 14 months that were contractually allocated**. The initial **delay in the start of the installation phase was due to the difficulty in finding matching private funds to complement the RDF funding, as a result of the financial crisis of October 2008**. We did, however, ultimately obtain financing and executed on the installations.

One of the goals of the project was to facilitate and participate in development of best practices in the area of permitting and inspections. In this area, our findings were as follows: Solarflow experienced a wide range of requirements and associated costs for permitting. Systems with a similar size and scope varied from \$95 and 2 days time in a northern Twin Cities suburb to \$900, 3 weeks time and a complete structural and wind-load analysis in a southern Twin Cities suburb. The issue that changed from city to city and provided the greatest level of uncertainty was permit cost. In Minneapolis and St. Paul, the permits are based on labor costs alone- most other cities include material costs, which increases the permit fee by 10 times.

Solarflow permit requests included a full set of plan and elevation drawings- showing exact module location, distance from roof, height above existing ridge, set-back from ridge/eave/valley, and a detailed view of the rafters showing unsupported rafter length and

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proposed attachment method and location. After submitting these documents (in cities other than Minneapolis/St. Paul), Solarflow usually received a permit in 1-3 weeks with few issues.

In general, Solarflow found that an initiative to streamline and standardize permitting is very broad in scope and will take years. It is, however, ideally suited for an industry-wide forum, such as the Solar America Cities program. As a participant in this program, Solarflow has contributed to such initiatives and will continue to do so in the future. Given this, no particular milestone accomplishments can be reported regarding best practices for solar permitting.

Market receptivity and pricing for residential vs. commercial

The project intended to explore both the residential and the small business markets, consequently, we completed 18 residential installations and 7 commercial flat-roofs. Although both markets required that **both environmental and pricing goals be met**, it became clear that the **commercial market was more price sensitive**. In other words, if the leasing model did not show savings in relation to electricity costs, either from day one or during the term of the lease, then commercial customers were not inclined to choose solar leases. It also appeared that **the duration of the lease was a lesser concern for businesses, and we established 18 year leases for commercial, while residential leases were 15 years**.

For the **commercial market, we proposed two pricing models** – equally attractive from the standpoint of the choices made by our customers:

- Pricing Model A – Solar lease pricing matches electricity costs for the first five years, and subsequently the price is fixed for the remaining 13 years of the lease, presumably offering savings to the customers as conventional electricity rises with inflation.
- Pricing Model B – Solar leasing prices offered at 20% below electricity prices, but subject to upward revisions no greater than conventional electricity price increases, thus offering 20% savings at all times during the lease.

For the **residential market, there was a single pricing model that was successful: solar lease pricing had to be approximately equal to the current cost of electricity**, with no price increases, thus providing ever increasing savings over the 15 year lease as conventional electricity rises with inflation.

The above findings at the end of the project contrast with the results of our web-based pricing sensitivity survey conducted at the beginning of the project. The intent of the survey was to explore the viability of solar leasing and the pricing sensitivity ('willingness-to-pay') of the Twin Cities market. The results from 218 responses from February 2008 to June 2008 were:

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- The average electricity bill is \$80 a month
- 94% of respondents understand that conventional electricity has a negative environmental impact (thus an understanding of the benefits of solar electricity)
- 95% of respondents are interested in solar PV for their home
- Based on the benefits of a monthly lease program, the average respondent is willing to pay 1.49 times their current electric bill
- If a commitment to leasing solar *today* would result in a decreasing lease rate over five years, respondents would be willing to pay 1.65 times their current electric bill

Technical Progress

From a technical perspective, the installation was successful with no major issues. As stated in previous reports, the process began with equipment ordering and permit requests, engineering analysis (as needed). In particular, each installation requires an electrical permit (\$35-150), an Xcel Interconnection Agreement (\$250) and a building permit (\$225- 2,600). The building permit cost traditionally scales up and down with the total cost of the work being performed (materials and labor), however, Minneapolis and St. Paul only assess fees on the basis of labor, greatly reducing the cost to solar installers.

On installation day, the process entails racking and ballasting, installation of micro-inverters and panels, and lastly electrical conduits/ circuits to the home electrical service. The enclosed picture will help the reader visualize some of the listed components:



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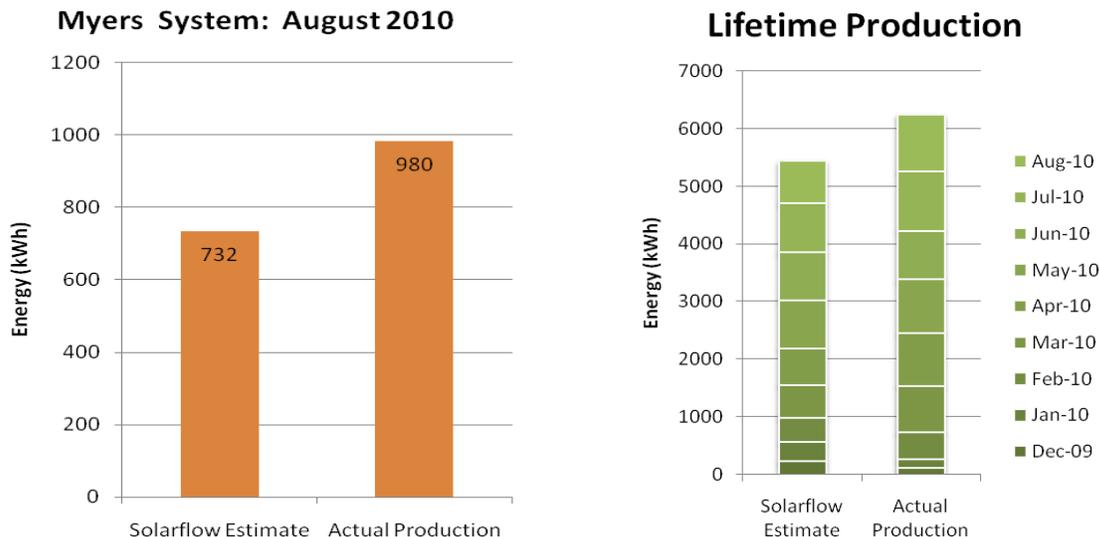
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Electrical inspections are generally conducted through the state by a licensed state electrical inspector. Building inspections are conducted through the city or county, depending on local jurisdiction. At the tail end of each project, there were generally 1-2 weeks between calling for an Xcel inspection and meeting the field tech on site. All inspections were conducted successfully and the resulting signed documents from Xcel are enclosed to this report in Appendix A (confidential information, given that it includes customer data).

In terms of **solar electricity production, it is difficult to draw any broad conclusions yet, since we do not have a full year's worth of data for all the systems installed.** However, the early installs have already been operating for a year, and the **data so far indicates that we are generating above the forecasted values.** As an example, we include a monthly report that we started sending to our customers on a regular basis to show their solar production:



The installations included a variety of roof pitches and configurations for residential, as well as a variety of array configurations and racking systems/tilts for commercial. We include below some photographs showing a sampling.

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Project Benefits

Project benefits are:

1. **Demonstration of the viability of 'solar-as-a-service'** – Viability was demonstrated in the successful completion of the project. In other words, the proposed scope of the project was to deliver 280 KW in 14 months of construction schedule, therefore the metrics are KWs and time. Both of these were met. In terms of the viability of solar leasing without the RDF grant, we submit that it can currently be extended on the basis of the available solar rebates and Investment Tax Credits. Such rebates and tax credits could take the place of the RDF grant and make solar leasing attractive to private capital and therefore expanded in the Xcel service territory.
2. **Delivery of 280KW of generating capacity**, which will count towards the Xcel Energy goal for Renewable Energy Standard (25% renewable energy by 2025) – **COMPLETED!**
3. **Green job generation** – Six full time positions have been created (Project Manager, Project Coordinator, Accounting, Information Technology, Sales and CEO), plus

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anywhere between two to six additional hourly positions for installations, which are scheduled on a per-installation basis.

4. **Generation of clean electricity** for a minimum of 15 years. During 2010, with the majority of the KW installed during the second half of the year, we generated over 91.1 MWh of solar electricity. On that basis, we believe we will achieve our forecasted annual production of 355 MWh/year starting in 2011 once we have all systems operational for a full year. In terms of environmental attributes, and based on electricity equivalencies drawn from the Xcel Energy 2009 Corporate Responsibility Report, we submit the following emissions avoided as a result of the solar leasing:

	<u>Emission</u>	<u>Lbs/year</u>
Year 2010 (partial)	CO2	109,866
Year 2010 (partial)	SO2	246
Year 2010 (partial)	NOx	173
Year 2010 (partial)	Hg	.00255
Year 2011 (forecast)	CO2	428,130
Year 2011 (forecast)	SO2	959
Year 2011 (forecast)	NOx	675
Year 2011 (forecast)	Hg	.01

Lessons Learned

- The leasing proposition is desirable to consumers and business owners, as expressed in the Customer Survey in that a lease eliminates the up-front capital expense of purchasing. The monthly price of the lease, however, needs to compete with electricity costs, as we described previously.
- Process controls for delivery and procurement are key to cost optimization and predictability – and they are not difficult to achieve, since the construction projects are small and low risk (the novelty in this case is that the equipment used is solar, hence the challenges around financing, permitting, etc.)
- Demand Charges (electricity bill charges based on power delivered as opposed to energy delivered) are a major disadvantage for solar small businesses – a 50% savings in electricity does not translate to 50% savings in the electric bill. **This we see as the biggest barrier to solar acceptance in the commercial market.**

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- Web-monitoring is key for solar visibility and acceptance. The link below lists all systems delivered and their real-time and historical performance:

http://enlighten.enphaseenergy.com/installer_systems/590/freEner-g

- Customers expressed during the Customer Survey that they had difficulty understanding their electrical bills after the solar installation, particularly in determining the savings that the solar system was providing. The lesson learned is that electrical bills need to improve in terms of readability to better communicate solar electric savings.
- Our customers experienced incorrect Xcel billing right after installations and corrections took several billing cycles to properly reflect the electric service provided. The lesson learned is that processes to transition the billing from before-solar to after-solar should be improved to avoid errors, customer confusion and subsequent corrections.
- From the standpoint of **financing the growth of solar leasing in Minnesota beyond this pilot project**, the prospects are excellent given current rebates and tax credits. However, rules for the current Solar Rewards program would have to be modified to support third-party ownership, which is necessary for solar leasing.

Project Findings – Customer Perspective

For this Final Report, we would like to provide the Customer’s perspective as to what went well and what to improve. As stated before, we conducted a Customer Survey, with 10 questions that a majority of the customers addressed during personal or phone interviews (at their preference). The majority of the questions were regarding the performance of Solarflow Energy as a solar leasing provider, which are enclosed in Appendix B as support documentation. In addition, one of the questions was directly related to the customer decision process to select solar leasing, which provides a relevant finding for this project. The question and the results are captured below:

What factor(s) (price, environmental concern, etc.) ultimately convinced you to sign with us?

- **79% of responses cited BOTH environmental AND pricing as the two basic parameters for their decision to do solar.**

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**Appendix A – Xcel Energy Signed Interconnection Agreement -
DELETED DUE TO CONFIDENTIAL INFORMATION**

Appendix B – Customer Survey responses

What factor(s) (price, environmental concern, etc.) ultimately convinced you to sign with us?

- Environmental concern first, but also the deposit got cheaper and helped. Also, the leasing was affordable.
- Environmental benefit, definitely lease price. Solarflow doing professional installation.
- Both environmental and pricing.
- Ease of installation, compared to doing self. Easy startup-financing/capital. Help other small businesses. In favor of solar.
- Price was a big benefit, since monthly spread of cost. In addition, interest in using sustainable energy sources.
- Price was part of it, but not the kicker. Environmental was a big part of decision
- Experienced solar in cottage previously. We are firm believers even it does not exactly cash flow, it is simply the right thing to do.
- Not having capital costs & that there is a future capture.
- Environmental factors mostly, future money at the end maybe...positive paying less than electricity.
- Environmental factors for kids but all the economics for the parents. \$\$ electricity bill plus the lease \$38 less than old electric bill. More aware of electricity today. Spoke hope cause always wanted solar, but could not afford the upfront cost. Save \$ so we can spend on other things. Also like to brag/show off. All buildings should have solar so that we have more money for the poor – also bicycles.
- Employee X - her willingness to discuss & answer and enthusiasm. Along w/ information & price reduction. Babysitting me, I'm pretty analytical and cautious. Long time interest in solar technology.
- Environmental and the leasing w/o the commitment to purchase was very attractive...can't remember how we first heard. It's consistent with how we live our lives.
- Environmental & price, both.
- Price was a big one. Concern originally that they saved money or at least break even. Also that it was renewable resource. Leasing agreement is attractive factor.
- Price was important – no capital was available. Obviously wanted to do for environmental also. Financial tipped it. On the other side, there is no financial benefit at the end, therefore the environmental tipped it.

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What was the most confusing or frustrating part of our process? In other words, what one thing could we do better?

- Billing from Xcel is confusing, and meshing of the production, data.
- Overall having multiple contact people, instead of one single project manager. Some communication problems prior to Employee X... process started early & took long.
- Top of the line, we were great. But help understand options: purchase vs. lease and also independent external references – rebates, etc.
- Installing the meters/inside-coordinating with Xcel. Making a timeline/impact assessment for customer: unpredictable risks/regulations/events: installation, inspections, metering billing.
- Handout or brochure that summarizes how energy is produced and delivered by solar to the house.
- Conveying the amount of power that the array would produce, particularly, with respect to panel capacity, and efficiency.
- EMU – aggravating, temperamental device for installation. Concept is wonderful, but frustrating – second unit. OK now.
- Lease negotiations: exit terms for purchase option. Installation good, timeline, communications...minimal disruption - friendly staff.
- Can't get snow off the portion of panels on the house side. A harness or/and anchor would be required/recommended. Home energy audit was frustration to set up, not the audit itself.
- Finish the trench, dad had to fill up, a lot of repeat visits, not understood when we were done, what are the steps. Had to send emails to inquire, instead of being told up front.
- Confusion of coordinating: electrician, Xcel personnel, completion of process.
- First I said not because of sun window, and then I said yes...It was hard coordinating when we were going to do the installation.
- Nothing comes to mind.
- Nothing – process was smooth. Other than delays due to manufacturer certification.
- Leasing figuring out why it made sense to Solarflow and just understanding it & explaining it to people. A better explanation.

How would you describe our level of service (sales, installation, etc.)?

- Sales: timing/lag in the sales process/customer did not push. Generally great.
- Overall good to very good.
- Good! Helped w/ roof claim... will it ultimately be resolved. Solar will have to be removed/reinstalled.
- Good
- Top notch
- Excellent
- Excellent
- Change primary contact to Employee Y, Employee Z only for contractual matters. Not clarity around billing...Xcel stumbled...not use to two meters.
- Excellent!
- Friendly... they like coffee... quick email responses... efficient. Friendly staff, answered the kids questions... paused to answer... not grumpy. Attentive. Nice people working. Trustworthy w/ young children.
- Installation went quickly. Overall very good.
- Very good
- 5 stars across the board – fabulous. Employee X is great.
- Excellent!
- Great... fabulous job.

Was our team accessible and responsive to all your questions and concerns?

- Yes. Even answered during the Olympics.
- Yes
- Yes
- Irritation around rock moving/noise that did not allow customer to work. Impact on customer – expectations. Billing was not started/applied properly at the beginning. Question around billing start date.
- Yes, probably to a fault. With passion behind explanations.
- Most definitely
- Yes
- Yes!
- Absolutely
- See above (Friendly...they like coffee...quick email responses...efficient. Friendly staff, answered the kids questions...paused to answer...not grumpy. Attentive. Nice people working. Trustworthy w/ young children)
- In the last month, sent email w/ questions, got a response generalizing & not responding to the questions, directly. Direct questions require clear direct answers.
- Yes
- Very
- Yes, definitely
- Yes

Was our explanation of solar technology and our leasing model clear and understandable?

- Yes
- Yes
- Don't know... did not explain well what panel options were available and how they compared.
- Yes... remind the customer the process.
- Yes, clearly
- Yes, even with the changes made along the way... for example, payment method.
- Yes
- At first not, during lease negotiations, ultimately worked thru. Xcel billing still unclear, requires more figure out.
- Yes, sure
- Had already researched solar... Yes, but don't understand solar, science difficult. Solar panels could be prettier, but not an eye-sore. Don't necessarily understand the inner workings. The math was hard to understand because it was so little money. Hard to do without the financial assistance. Still would have done lease for a higher number.
- Yes
- Yes
- Yes, with a modification for the lease contract.
- Yes
- Leasing model: see previous response. We were diligent in providing responses.

Did our staff exhibit professionalism at all stages of work? If not, in what area could we improve?

- Great. Even avoided tracking dirt.
- Mostly yes, a couple situations early on when Employee Z came out during winter & put ladder on roof & climbed on the roof – aggressive... not responsive to customer. Also gave me wrong information a couple times.
- Yes
- The manner in which roofing extra cost was handled professionally & communicated clearly.
- Everybody was professional & human at the same time.
- Great, really
- Yes
- Very much so! Wish all vendors would do the same. Provided reasonable recommendations when needed.
- Excellent, easy to deal with, & enthusiastic!!
- One situation: gave coffee & turned down cream until told to be more familiar & less professional. Initiated by family.
- Really good. One concern, since the start... cringing with all the traffic on the rear roof on asphalt. Is there a way to mitigate? Not sure what can be done. Impressed with knowledge.
- One panel wasn't turned on and it was replaced. And gave us credit – no complaints.
- Yes
- They did!
- Yes, you did

How would you describe our quality of work? In other words, are you fully satisfied with your solar installation?

- Yes
- Yes. Absolutely very satisfied. Installers had to make a small change in configuration, they asked for customer feedback & made adjustments. Employee Y was very good to conceal wiring.
- So far so good. Snow removal questions... how to share FAQ from different users in solar community.
- Yes... we can show people.
- Yes, for example, re-evaluating roof space for installation & taking my feedback.
- Yes, most definitely... the only point of concern is around walking on asphalt shingles on very hot days.
- Yes
- Yes...today installed – out of the way – no leaks. Not visible. LEED Gold
- Yes, absolutely
- Yes...panels straight, no damage to house. Trenched by Solarflow because it had to be done, but fill back up by owner. Majority by Solarflow cause of weather changing. Many return visits.
- Yes
- Yes
- Yes. The only thing is the membrane pressure, it's too thin. Put additional protective measures.
- Sure, roof has not caved in 😊 Satisfied... would like to see monitoring in action soon!
- From what I've seen of it, absolutely. Can't wait to see it perform after the snow.

What would you say to a third party who asked you about us?

- They have said lots! Megawheels?!? Like to tell that no batteries are needed.
- Recommend for purchase and/or lease...talked to father-in-law.
- Recommend, in fact she did.
- Recommend for ease...fantastic!
- You should contact immediately, knowledgeable & passionate.
- Couldn't recommend you highly enough.
- Already recommended to several people without hesitation.
- Install went well, contract reasonable, reconciliation will need to go smoothly. Recommended to two other parties. Would like to be able to talk about residential.
- Do it... brag about it... referred to Dave XXX... another lead: commercial owner
- Recommend, give contact info... definitely worth using-satisfying to get solar... joyful crew & process. Never said it was a boring day.
- Encourage them to look into it & he has... refer to website. Patrick XXX has had an assessment and have not heard back.
- I think it's a wonderful thing to do, it depends on their expectations. I have a sense that we are saving money, but since that was not the goal... I would recommend and have recommended. If Xcel would tell us how much we are saving, it would be very useful. We compare year to year & the bill is considerably lower.
- Do it! I have been telling everybody.
- Would recommend exploring the solution and good customer experience and flexibility.
- I have referred you...

Do you have any other thoughts or concerns?

- 15 year commitment seems long. Could be compensated with a replacement system. Roof is not lacking but it seems concerning. Noticed that the house stays cooler in the summer – shielding!
- The only other thing: would appreciate education/introduction on the solar technology and terminology... billing in kw or kwh? Surprised when met w/ Employee X to sign contract with bank account information and then payments are by check. Other comment: enphase website is appreciated but the subscription will run out after an initial period.
- No
- Don't like having to let Xcel meter reading personnel in the premises.
- No concerns... would be happy to put yard signs or roof placards... Solar home tour was great!
- Put on more systems.
- Not an issue caused by Solarflow necessarily, but truly have a leak on the roof. Probably won't know until spring if there is a connection.
- Providing an introduction/explanation of solar system & how it works – presentation. Appreciated that the user manual is custom & helpful. Schedule thru Employee Y after Holidays. For example, when email alerts arrive – what they mean. Time-lapse of enphase production. Link of Customer website...
Reconciliation needs to be done by mid-July
- Question: Son visiting from NZ, what happens if break-thru in technology?
- Be kind to poor people. Make solar be cheaper for all people. It is hard to make a difference environmentally if not rich or too poor.
- Enphase site shows temperature disparity. Snow removal suggestion for snow removal service. Having the panels anodized? Or dark colors or purchasing anodized frames. Billing is not clear, yet, the bill does not match the explanation sheet. Two bills plus a revision. Electrical load is down w/ some efficiency measures. Billing is still unsettled & we will continue to track.
- Really pleased that we have done this, not sure what diff it's making with the bill...lost grid electricity for 5 days but solar did not help...
- No
- No other concerns. Wireless in the building should be available in the spring. (March-April). Billing has not begun. Would like a visit to present the user manual. Protocol for access to roof: call M-F business hours & coordinate with Employee Y, the maintenance supervisor.
- Process went pretty well

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