

Review and Analysis of Renewable Energy Options for Minnesota Valley
Electric Cooperative (MVEC)

Capstone Paper

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Executive Summary

The University of Minnesota (UMN) project team reviewed and analyzed the current and proposed renewable energy programs and opportunities for Minnesota Valley Electric Cooperative (MVEC) and gathered survey data from MVEC member-owners to gain an awareness of interest and preferences toward renewable energy options. The team found that MVEC members possess a significant level of interest in new renewable energy opportunities and a willingness to pay for new options. The contract design for a 1 MW Community Solar array may have enough interest to fully support the project, but improvements to contract design may be possible to attract more subscribers and better meet member preferences. Our recommendations address this opportunity for MVEC.

Interest in the project originated from conversations between MVEC and faculty at the Humphrey School of Public Affairs at the University of Minnesota. MVEC expressed an interest in obtaining a better sense of member interest and preferences for renewable energy programs within the cooperative. This interest helped facilitate a capstone project for Science, Technology, and Environmental Policy graduate students at the Humphrey School of Public Affairs.

This report supplements the presentation made to the MVEC board on April 30, 2018.

Methodology

Project options were first evaluated by conducting research on the current landscape for renewable options in Minnesota and across the United States. Considerations for effective programs considered environmental benefits of additional generation, financial costs to both the utility and subscribers, and any residual community effects of local generation.

Once a background was established, the team built a survey for MVEC members to better understand member demand for renewable energy, including: motives, concerns and willingness to pay. A survey was then sent to all registered MVEC member email addresses, 22,054 in total. 1,399 unique member responses were received.

Analysis of the survey data, MVEC proposed renewable energy options and contract design, and comparisons among other cooperative utilities in Minnesota led to the formation of two recommendations from the UMN project team.

Overview of Findings

Survey data informed much of this report. After extensive analysis, a few key takeaways from MVEC members can be drawn:

- Additional demand for renewable energy options does exist. Of 1,399 survey respondents, 968 expressed interest in MVEC's proposed renewable energy credits (RECs) or community solar program. Over 93% of respondents were interested, to some degree, in participating in additional renewable energy options not currently offered by MVEC.
- A willingness to pay in addition to the regular retail rate exists for renewable energy options. Respondents do appear price sensitive, however. About 16% of respondents had a blind willingness to pay, whereas 59% of respondents were willing to pay, *but* the program would have to be right for them.
- Members hold valuation preferences for renewable energy which may dictate participation. These preferences include primarily 1) financial benefit, 2) environmental benefit and 3) local generation.

Recommendations

After review and analysis of program features, in addition to member survey responses, the University of Minnesota project team makes the following recommendations: MVEC should continue to pursue community solar to meet member demand for renewable energy options. In order to increase the number of subscribers, and meet more of the member interest, we recommend that MVEC considers:

1. Providing additional community solar contract options with a longer contract length and potentially lower kWh rates for subscribers of long-term contracts in either pay up front (PUF) and/or pay as you go (PAYG) contracts.
2. We recommend MVEC recognize there is an overlapping member demand for both renewable energy credits and community solar; member education may help potential subscribers find the option that works best for them. For this reason, and due to uncertain futures for renewable energy credits, we recommend MVEC continue to work to diversify its renewable energy portfolio to include community solar in addition to renewable energy credits.

Introduction

Minnesota Valley Electric Cooperative (MVEC) is an electric distribution cooperative in southern Minnesota. Recent innovations in renewable energy and customer support have led to a variety of renewable options commonly employed throughout the state. MVEC currently has a Renewable Energy Credit option for its members, but would be interested in furthering the choice portfolio with a community solar garden if there is sufficient demand to build the garden to at least 1 megawatt and incur little to no risk to the cooperative or its members.

The UMN project team met with MVEC staff on January 15, 2018 at MVEC's office in Jordan, MN to establish scope and intention of the project. To foster strong communication, the UMN project team and MVEC staff engaged in weekly phone calls throughout the duration of the project. The UMN project team attended the MVEC annual meeting on April 10th, 2018 in New Prague to gain additional face-to-face interaction with members in addition to a digital survey conducted March 17 - 31. The UMN project team completed the project with a presentation to the MVEC Board of Directors on April 30, 2018.

Proposed options by MVEC

MVEC has calculated pricing on three distinct renewable energy opportunities:

1) GreenSource Wind RECs

Options are 0.5 cent per kWh in 100 kWh commitments. Subscribers are not restricted to contracts, deadlines, or commitments.

2) GreenSource Solar RECs

Options are 1.25 cents per kWh in 100 kWh commitments. Subscribers are not restricted to contracts, deadlines, or commitments.

3) GreenSource Community Solar

Ten year contract in 100kWh blocks/month. 3.55 cent adder per kWh without Energy Wise; 1.86 cent adder per kWh with Energy Wise.

In order for the community solar option to be viable, MVEC suspects 130 residential members will be needed to fully subscribe their household electricity. If this threshold is met, MVEC would proceed to sign a power purchase agreement and develop the garden.

Basin Electric Power Cooperative (Basin Electric) is the major power supplier for MVEC. The community solar array must either be owned as a generation resource of Basin Electric at the purchase rate, or a permanent substituted fixed resource can be met with GRE. Another alternative would be to utilize the Public Utility Regulatory Policies Act, via an agreement with a MVEC member.

In order to provide security to itself and its members, MVEC would then undergo a secondary review of the proposal to finalize price measures and insure a final commitment by the interested members. Ideal site location would be a workable, non-commercial piece of land.



Figure 1: Proposed MVEC renewable energy options and associated costs.

Overview of Renewable Energy Options

Renewable Energy Credits (RECs)

Renewable energy credits (RECs) -- also referred to as Green Tags or Tradable Renewable Certificates -- are a tradable, non-tangible energy commodity representing 1 MWh of electrical generation from a renewable source. Thus, renewable energy producers are credited one REC for every 1 MWh connected to the grid. In this sense, a REC ensures this energy generation was dispersed through a shared grid system for consumption. RECs ensure a claim for purchased renewable energy sold separately from

the commodity electricity (US Department of Energy, 2010). RECs are limited to solar, wind, geothermal, low impact hydropower, biomass, hydrogen fuel cells, and in some cases combined heat and power systems. *RECs represent a way to ascribe ownership to the generation of renewable energy and the external environmental, economic, and social externalities that align with it.* If one does not own the REC, one cannot claim a facility/household is powered by renewable energy.

After a REC is connected to the electrical grid (as is mandated), it may be sold on the open market, accompanied by a unique identification number to prevent double counting. Once a REC is consumed, it is retired either 1) to comply with statutory or regulatory requirement for a consumer, utility, or generator; 2) by a public claim, by purchase from a end-use customer; or 3) for the sale of any component attributes for any purpose. Once a REC is retired, it must remain in the domain it is retired to.

Environmental Benefit

RECs incentivize carbon reduction through carbon-neutral generation by providing production subsidies to renewable electricity. All else held constant, purchasing of RECs furthers investment in renewable generation by increasing cash flow to investors in the renewables sector, furthering incentives. This may be a deciding factor for an investor in the build vs. not-build decision process. RECs show contributions and responsibility for companies, meet regulatory standards for renewable energy mandates, and incentivize further development of renewable energy generation (EPA, 2018). In order for RECs to be most effective for furthering production, they must be supported by 1) low electricity prices, 2) favorable cost-competitiveness of project development, and 3) aid from public policy (Holt, 2011).

RECs fall into two markets, 1) compliance markets and 2) voluntary markets. The Renewable Portfolio Standards of 29 states establish policy directives governing compliance markets. Minnesota's RPS was established in 2007 under §216B.1691. These policy directives require electric utilities to meet a minimum threshold of energy produced from renewable generation, which tends to increase over time. One way to meet these standards is to purchase RECs. Compliance demand is relatively certain and has grown from 30 million MWh in 2009 to over 100 million MWh in 2014 (Holt, 2011).

Voluntary markets are so named because they are fed by consumers willing to purchase RECs for the purpose of using renewable energy. Voluntary markets have no threshold or criteria to meet for any legal purposes. Transactions are completely voluntary, which makes them less certain. In spite of this, voluntary REC purchases grew 37% between 2005 and 2009 (Holt, 2011). RPS compliance markets often overlap with voluntary

markets -- a projected 95.7% of the time (Gillenwater, 2013). Brokers, asset managers, and marketers typically offer assistance in REC trades, but credits may be traded directly as well. Voluntary market RECs differ in price structure from compliance market RECs. Voluntary RECs typically range from \$1/MWh to \$10/MWh (Holt, 2011). Voluntary RECs can be influenced by compliance markets -- if pricing overlaps, they compete for the same RECs. Voluntary markets typically incur high transaction costs and creditworthiness.

REC price is dependent upon 1) year of generation 2) location of facility 3) supply and demand 4) the Renewable Portfolio Standard 5) and solar REC (SREC) markets vs. Wind REC markets (DSIRE, 2017). To combat high SREC pricing and favor a diversified RPS mix, some states have a mandated SREC percentage. SREC prices have declined in recent years, as the cost of solar has continued to fall. Rates for 2015-2017 RECs average from \$0.15 to \$0.045 per kWh produced. As prices drop, the incentive to add new renewables to the grid diminishes.

Implications

Green power programs across the country averaged around \$20/MWh from 2006-2015, down from about \$35/MWh in 2000 (EPA, 2018). Average residential premiums were around \$18/month (EPA, 2018). Falling prices of RECs over the years have led to questions over whether or not REC purchasing incentivizes further development of renewable generation (Holt, 2011).

There is serious concern over whether or not voluntary RECs lead to further renewable generation, and the scale at which they incentivize further renewable energy development. Voluntary REC purchases have been found to have very little *actual* impact on additional renewable energy generation, while “green power” marketers typically (implicitly) claim that their RECs create additional renewable energy (Gillenwater, 2017).

Reasons for this divide are purely economic. Developers must have financial viability to build a project. Returns come from sale of energy, RECs, and financial incentives (tax credits, grants, depreciation). Therefore, RECs are seen as part of the revenue stream driving decisions to add further generation. However, major investors (i.e. banks) will only base evaluation of investment on the contracts that are in place. Any risk-adverse lender will behave this way, “lenders and equity investors generally insist on long-term contracts for large projects (Holt, 2011). Further, *Long term contracts avoid risk, whereas short term magnify risk. Since investors are rarely able to receive contracts*

of greater than 3 years for voluntary RECs, voluntary contracts are typically discounted to \$0 by investors when considering future investments (Holt, 2011).

RECs are only effective at ramping renewable energy generation if they lead to additional investment in renewable generation (Gillenwater, 2013). While RECs may be discounted, their revenues are still accepted and accounted. So while financing additional projects with voluntary RECs may be difficult, its revenue stream is not forgotten by investors, even if it is not calculated. Further complicating the issue is an apparent oversupply of RECs on the market, high transaction fees, and packaging deals, which burden the amount of cash flow that makes it back to the renewable industry (Holt, 2011).

The National Renewable Energy Laboratory confirmed this supposition. Project developers seek to maximize profits, and will thus accept all forms of REC purchases, which is why voluntary markets are accessible and easy to buy into. However, investors and lenders seek to minimize capital risk and need certainty about revenues. They will not recognize REC revenue in their financial decisions unless a contract is in place with a creditworthy counterparty. This applies to both compliance and voluntary markets, however, long-term contracts are far easier to obtain in compliance markets than in voluntary markets. Long-term contracts are rarely signed in voluntary markets due to uncertain futures for wholesale and retail voluntary market participants (Holt, 2011).



Figure 2: Voluntary REC contract lengths (EPA, 2010)

Case Studies on REC Contract Structures

However rare in practice it may be, there are case examples of long-term voluntary contracts (National Renewable Energy Laboratory).

- In 2011, Google Energy signed a 20 year renewable energy PPA. “Instead of taking the risk of selling into the power market on a short-term basis, Google is

providing the seller with a guaranteed revenue stream for 20 years. This is something the developer can literally take to the bank.”

- The US State Department signed a 20 year agreement in 2011 to purchase renewables from Constellation energy. Energy totals are estimated at 120,000 MWh/year.
- In 2009, Maryland committed to a 20 year PPA of renewable energy from 4 project sites.
- In 2008, Steelcase agreed to purchase all of the RECs from Wege Wind Energy Farm for 5 years (35,000 MWh/year). This offer was unique in that Steelcase bought RECs from a specific provider, not just the market, and provided a long-term contract in the financing stage. Steelcase received sponsorship rights as a result, “Without a doubt, the sponsorship rights played a vital role in that project moving forward and being constructed.”
- In 2007 DTE Energy signed a 10 year agreement with Heritage Sustainable Energy to supply RECs for the voluntary green power program. This agreement allowed for the construction of Stoney Corners Wind Farm.

How can issues with REC uncertainty be addressed? (EPA, 2018)

- 1) Encourage long-term fixed price contracts: Helps developer secure financing; End user has stable electric contract
- 2) Host auctions for medium to long-term contracts for smaller projects
- 3) Implement a REC price floor
- 4) Contribute funds for project development instead of generated energy credits

In summary, renewable energy credits are limited by uncertain price futures, overproduction of credits, and concerns over the weight/meaning of credits as they lead to further generation. Education to interested subscribers, coupled with other renewable energy options may help to strengthen utility renewable energy portfolios and create a stronger grid.

Community Solar (CS)

Community solar is an emerging approach to deploying solar energy that promises to expand the market for solar by allowing a group of electricity customers without roof space or access to capital to own, finance, or lease a share of an offsite, centralized solar facility. Community solar programs are being developed across the country, and as of

February, 2018, Minnesota has the country’s largest set of programs, with well over 250 MW-AC installed (Chan et al., 2017). Cost and benefit transfer, alongside risk burden, is convoluted among contract stipulations, policy restrictions, and utility agency. In spite of this, cooperatives across Minnesota have built a variety of voluntary programs under a variety of different designs, parameters, and payback mechanisms.

Since municipal and cooperative utilities are not mandated by the state to create community solar programs, they are able to create creative programming models. Utilities in Minnesota have tied their solar subscription to a product to help reduce overall peak energy costs, changed contract time spans to suit their demographics, and allowed people who move to sell their panels back to the utility. Cooperative utilities have a strong network in the state of Minnesota and across the nation, supporting a system of cooperation among cooperatives. Community solar program managers all stated they have a strong network utility professionals that offer both support and advice. This support helps to limit barriers to program development (Chan et al., 2017). Community solar programs across Minnesota tend to vary according to the five properties listed in Table 1.

Accessibility	Are contracts flexible, (e.g. with variable lengths and accommodating exit provisions), and are multiple payment offerings available for the same CS project?
Affordability	What is the lifetime net present value per watt (NPV/watt) of the subscription? Do subscription options offer potential savings upfront or over the life of the contract? Does the program offer flexible payment options, such as loan/leases or pay-as-you-go subscriptions? Does the program offer half-panel subscriptions (if upfront payments)?
Subscriber Acquisition	What outreach and partnership strategies did the program pursue to acquire its subscribers? How fully subscribed is the program and what are the incentives/penalties for less-than-full subscription?
Utility and Developer Motivations	Does the utility identify social or ancillary services/benefits from the CS project that motivate the utility or developer? How is CS viewed as part of other utility and developer objectives (e.g. revenue erosion from DER adoption)?
Subscriber Agency	How engaged are utility customers or member-owners in CS program design? Do potential subscribers have the political, economic, or institutional capacity to drive CS development? Does the design of the CS program respond to customer demand? Are program design decisions democratic or focused around particular interests?

Table 1: Community solar project design properties (Chan et al., 2017).

Cooperative incentives for development typically arise from member interest and engagement and flexibility from being outside of state mandates (Chan et al., 2017). Appeasing customer demand and support is vital to cooperative success. Community solar allows for this demand to be met while allowing for utility control, opposed to distributed generation; flexibility in design means cooperatives are not bound to a Value of Solar requirement, unlike the Minnesotan IOU Xcel Energy. Barriers include restrictions on cross-subsidization, support failing to become subscriptions, and communication barriers.

Different approaches to CS program design are starting to reveal opportunities and barriers for success. Developers, subscribers, and utilities all have vested interest in the outcomes of program design. Policy guides the parameters of these features but also leaves a wide breadth for variance (Chan et al., 2017).

- 1) Contract structures vary between pay-up-front (PUF), pay-as-you-go (PAYG) and loan-lease (LL) options. This presents a range of cost between fully upfront high-capital investments and rate-structured billable payments;
- 2) Payback varies anywhere between immediate and never. Of contracts that do offer payback capital, PUF typically offers forecasted savings in the latter years of contracts, from either fixed rate agreements, rate credits, or both;
- 3) Subscriber acquisition and agency follow parallels across programs, and are led either by subscribers, nonprofit/for-profit intermediaries, or utilities;
- 4) Motivations for development range widely and are not mutually exclusive: appeasing solar mandate requirements, job creation and innovation, member demand concerns, low income accessibility to renewable energy, and mitigating the revenue-erosion or cost-shifting effects of net metered distributed generation.

MVEC Member Survey

In order to ascertain customer demand and interest in renewable options, we developed a digital survey for MVEC to distribute to membership. The survey link was emailed to all 23,357 members for whom MVEC had email addresses. From that initial number, 22,054 emails were successfully delivered, 6,927 were opened, and 1,399 unique responses were recorded over a two-week timeframe.

Analysis of survey methodology among other renewable energy preference data provided insight as an effort to minimize biases and optimize survey responses. Findings of best practice for survey construction are listed below in a series of four consolidated tools/strategies; takeaways strongly influenced questions used in the MVEC member survey.

Tool 1: Willingness-to-pay two-step format

- 1) Would you pay a medium (stated) increase?
- 2) Yes: would you pay a higher (stated) increase?
No: would you pay a lower (stated) increase?
- 3) What is the highest price you would pay?
- 4) What would you do if the price were too high?

This tool would allow for options to be considered in reference to MVEC's proposed rate versus the average rate for cooperative community solar contracts in Minnesota. It also levelizes response rates to "Yes" or "No" options and then allows for open-ended responses once a baseline has been established (Foreit, 2004).

Tool 2: Referendum format

- 1) Determine gradients of valuation preferences for respondents
- 2) Data exported into quantitative outputs and evaluated
- 3) Can be modified to fit into Tool 1
- 4) Payment for a new commodity may reduce the consumption of other goods

This tool would be a series of Yes/No responses, or gradient responses, such as: "Rate your preference 1-5, with 1 being the least favorable and 5 being the most favorable." This would allow respondents to have wide array of response opinion and queue optimal analysis of valuation (Gunatilake, 2007).

Tool 3: Open-ended response format

- 1) At what price would this product be so inexpensive that you would doubt its quality?
- 2) At what price would this product be so expensive that it would not be worth buying?
- 3) Include an additional stage to inform respondents of current alternative prices and then give them the opportunity to indicate any change in behaviour with this knowledge
- 4) Data exported into a frequency distribution chart

This tool would allow for MVEC customers to express their opinion in a qualitative manner and consider answers outside of the scope of design. It would also give information on respondent education and transparency within the renewable sector (Izaret, 2018).

Tool 4: Formatting willingness-to-pay questions

- 1) Would you be willing to pay \$x for the gain?
- 2) Would you be willing to accept \$x in compensation to forgo the gain?
- 3) Would you be willing to accept \$x in compensation to incur the loss?
- 4) Would you be willing to pay \$x to forego the reduction in a gain?

This tool teaches ways in which interpretation dictates response. It is important to realize the ways in which these seemingly identical questions lead respondents. Best practice will seek to minimize a biased response (Gunatilake, 2007).

General Practice

- 1) Ensure that questions are clear and as intended (i.e. with no ambiguity)
- 2) Adopt a simple experimental design when a number of alternatives are being considered
- 3) Introduce any choice valuation task by setting the context for the issue whilst reminding the respondents that this falls within their wider day-to-day considerations
- 4) Lean into the notion that community solar is more expensive than traditional energy, but clarify why the difference exists
- 5) Include diagnostic questions to assess the extent to which the respondents understood the task
- 6) It is important to express the importance of what you *should* pay and why

Assumptions

Outcomes can be interpreted differently by customers. For example, interest in renewable energy could stem from a multitude of reasons, including concerns about air pollution, climate change, a desire to divest from oil, coal, natural gas, financial benefits, grid transformations, etc. Phrasing is important to involve a wide spectrum of opinion.

Customers are willing to pay the price they are currently paying for their product or service. An individual's maximum price is the highest price she has explicitly agreed to. If a respondent answers no to \$4 and yes to \$2, the maximum price would be \$2. Willingness to pay is transitive downwards: clients who are willing to pay a given price for a product or service are also willing to pay any lower price for that product or service. Unwillingness to pay is transitive upwards: clients who are not willing to pay a given price for a product or service are also unwilling to pay any higher price.

Limitations

All research includes limitations. In this survey, we suspect that three primary sources of bias impacted our results. This section describes the categories of bias and the strategies used to minimize them.

1) Selection Bias - Respondents do not necessarily represent a random sample of the target market (all MVEC members), so conclusions are not necessarily generalizable across the cooperative.

We will mitigate this limitation by reporting results as aggregate numbers of respondents, or as percentages of respondents. Percentages of responses should never be interpreted as proportional to true percentages of MVEC members' opinions, unless outside evidence indicates that this is the case. Within this constraint, we can still assess the question of threshold interest in community solar.

2) Strategic Bias - Respondents may intentionally provide misleading answers.

To mitigate this limitation, we offered the same incentive to all members in the survey audience, independent of their choice of answer.

3) Hypothetical Bias - Respondent cannot accurately predict how they would behave in the situation described.

In open-ended willingness to pay responses, it is impossible to mitigate this source of bias. In general, survey respondents will overestimate their willingness to pay for a resource. To mitigate this limitation, we offered respondents concise, thorough descriptions of the programs under consideration, to ground their responses.

Explanation of Survey

The team worked with MVEC employees and University colleagues to develop a survey that would yield meaningful data about member preferences and demand for renewable

energy. This survey was designed specifically to improve MVEC's understanding of the preferences of its members.

The survey opened with an interest-gauging question to assess members' preferences for renewables without further input. For members uninterested in renewables, it offered a quick path to the end of the survey, in hopes of mitigating selection bias. The second through fourth sections were for members with at least some interest in renewable energy - they included questions about general preferences for renewable energy, as well as specific questions about the rates suggested by MVEC. Section five was only seen by members who expressed a lack of interest in renewable energy - it offered additional information about MVEC's proposed renewable options, opportunity for feedback, and a chance for members to complete sections two through four. All respondents completed section six, which asked for open-ended feedback, and recorded information from members interested in the bill credit drawing.

MVEC delivered an email with a link to the Google Forms survey to 22,054 member emails. A two-week response window was outlined with the opportunity to win one of five, \$50 bill credits as an incentive to take the survey. 1,399 unique responses were recorded, including over 1,100 in the first twenty-four hours the survey was available.

The following sections will present the survey questions, including justifications, and summary results from each survey question.

Summary of Survey Questions

MVEC Survey Discussion

This discussion outlines a renewable energy interest survey designed for MVEC members to gauge interest in proposed types of renewable energy options outlined by MVEC staff. Questions are given in bullet-point form.

Direction

Survey questions were categorized into five sections based on participant response. The survey sought to harness initial customer opinion and guide participants through a series of questions that increased understanding of proposed options, while allowing for open-ended feedback.

Section 1: Introduction

Section 1 served as an introduction and contained limited information intentionally. It captured the existing perceptions/feelings of members without bias of options, prices, or renewable availability. Furthermore, it attempted to mitigate selection bias by offering members with no interest in renewable options a quicker path to complete the survey.

- **If MVEC were to offer new renewable energy options, would you be interested in participating?**
 - No, I would not be interested (skip to Section 5)
 - I might be interested, but I need more information
 - I would be interested

- **What motivates your answer?**
 - Allowed open-ended reactions to the question. These answers have been analyzed and categorized for keywords like: cost, hassle, uncertainty, time, etc.

Section 2: Renewable Energy Preferences

This section identified MVEC member preferences when considering renewable energy options. Only respondents “interested” or who “might be interested” were presented with these questions.

- **Do you have a preference of how renewable energy is generated?**
 - The two options proposed by MVEC are listed (RECs and Community Solar), but additional options were open to be added by respondents.
 - Cost is added as an option as it is a primary factor in program participation.

Importance/Preference Questions

1-4 scale does not allow for a neutral opinion by design.

- **Is it important for renewable electricity to be produced locally?**
 - This is a significant driver for community solar participation.
- **Is it important for new electricity production to be free from carbon emissions?**
 - This is often a significant driver for renewable energy program participation. If pollution is not a paramount concern, financial benefits (next question) may be more important.
- **Would you participate in a renewable energy program that addresses the above concerns, but doesn't provide financial benefits to you?**
 - This gauges financial expectations in renewable programs for potential subscribers. This question may highlight the need to provide opportunities for members to obtain financial benefits to participate. (Comments surrounding cost on follow up questions can be analyzed in conjunction with this question.)
- **If MVEC built and managed a local solar array to produce electricity, would you have any interest in purchasing electricity from it?**
 - This yes/no question simply measures basic interest in participating in a Community Solar program.
 - If yes, willingness to pay in addition to current bill is asked in follow-up section.

Section 3: Willingness to Participate - Solar Array

- **What is the highest additional cost per month you would pay for 50% of your electricity to come from a solar array built and maintained on land by MVEC?**
 - Responses given in \$ amounts allow for a common baseline of responses.
 - The 50% benchmark was used to make it easy for all members. Explaining tiered, 100 kWh rates would have added too many variables.

Section 4: Potential GreenSource Energy Options

This section brings in options already considered and willing to be offered by MVEC. Graphics & charts take the place of additional text to facilitate an easier survey experience for respondents.

Frequently Asked Questions:

- **Would you subscribe to the Community Solar program option at the price listed above?**
 - Obtain interest given basic program features and cost.
- **Would you participate in Renewable Energy Credits at the prices listed above?**
 - Obtain interest given basic program features and cost.
- **What concerns do you have about the above options?**
 - Gathers qualitative information to inform the above question.
 - Critiques of the options may also be of value to identify which preferences are not being met.
 - Responses are used to inform opportunities for MVEC to improve contract design to better meet member interest and demand.

Section 5: Follow-Up Questions for Initially Uninterested Respondents

This section is Section 2 for respondents who answer “Not interested” in response to the first question in Section 1. Only this pool of respondents is directed to this section. If they become interested after this section, they can indicate so and will be directed to Section 2: Renewable Energy Preferences.

- **Potential Renewable Energy Options Chart**
 - Educational opportunity to address potential concerns that led to no interest
 - Education about program details often address misconceptions individuals hold about Renewable Energy Program design or costs
- **Do you have any questions regarding these options?**
 - Informs respondent that any additional questions can be asked later. This gives them time to think about it.
- **Do any of these options address potential concerns?**
 - Identifies impact and effectiveness of additional information to respondents.
- **After seeing these options are you interested in any of them?**
 - If response is yes, respondents were directed to the remainder of the survey.
 - If no, additional thoughts or questions were asked on final page.

Section 6: Additional Thoughts or Questions

Serves as conclusion and final thoughts section of the survey to capture items not addressed or particular items of concern for potential subscribers as well as barriers for non-subscribers.

- **Do you have any additional thoughts or questions for MVEC concerning renewable energy?**
 - Allows for additional qualitative analysis of respondents.
 - Opportunity for member feedback.

Survey Results

Section 1: General Interest

From the outset, the survey sought to gain an unbiased look at the general level of interest among MVEC's membership.

Out of 1,399 responses, 1,304 respondents (93.2%) indicated definite or potential interest in participating in a new renewable energy option from MVEC from the outset. An additional 9, who were initially uninterested, expressed interest after learning more about potential programs. This high rate of interest validates the need to explore opportunities to meet member interest and demand.

I might be interested, but need more information - 919 (65.7%)

I would be interested - 385 (27.5%)

No, I would not be interested - 95 (6.8%)

What motivates your answer?

This open-ended questions sought to get a glance at what members seek from their response in the first question. What is it that influenced the interest in new renewable energy options?

Economic Considerations - 524 respondents (37.5%) highlighted economic concerns (keywords: cost, price, economic, saving money). This was the greatest concern among respondents. These results suggest an economic benefit is important to members when deciding to participate in a renewable energy program.

Environmental Considerations - 264 respondents (18.9%) highlighted environmental concerns (keywords: environment, planet, climate) as reasons for determining interest in renewable energy programs.

Section 2: Preferences

This section was administered next for the 1,304 respondents who indicated current or potential interest in renewable energy programs as well as 9 respondents who were initially uninterested that became interested after learning more about renewable options (described in Section 5) to give a total sample of 1,313 respondents. The section sought to identify the extent to which members have a preference for certain attributes in renewable energy projects. These were identified from past research into renewable energy program interest and participation (SEPA and SunShot, 2016; SEPA and Solar Market Pathways, 2016).

Do you have a preference for how renewable energy is generated?

Whatever is Most

Affordable - 703 (53.5%) of respondents indicated the most affordable option is their primary preference. This is consistent with the economic considerations highlighted previously in section 2.

No Preference - 322 (24.5%)

Solar - 194 (14.8%)

Wind - 40 (3%)

Other Responses - 54 (4.1%)

Question Discussion

The lack of unanimity in any specific option and the majority concern for affordability suggests that the type of renewable energy source is not a primary consideration. Economic/affordability considerations remain the primary variable.

Is it important for renewable electricity to be produced locally?

This question weighted the value respondents put on locally-sourced renewable energy from 1 (low) to 4 (high).

1 (low) - 173

2 - 221

3 - 501

4 (high) - 418

Question Discussion

It seems locally-sourced renewable energy is a considerable preference.

919 of the 1,313 respondents (69%) asserted a moderate or high importance.

Is it important for new electricity production to be free from carbon emissions?

A common reason cited for renewable energy is often the comparatively lower carbon emissions. Respondents rated the importance from 1 (low) to 4 (high).

1 (low importance) - 89

2 - 156

3 - 394

4 (high importance) - 674

Question Discussion

1,068 respondents indicated moderate or high importance. Carbon emissions appear to be a significant consideration in renewable energy programs.

Would you participate in a renewable energy program that addresses the above concerns, but doesn't provide financial benefits to you?

In the proposed MVEC Community Solar pricing, there is no opportunity to recover costs or provide financial benefit to subscribers. This question highlights willingness to accept additional financial burden without the ability to recover participation costs.

Yes - 217

Maybe, but the program would have to be right - 827

No - 269

Question Discussion

It appears many respondents may consider participation without extensive or immediate financial benefits if it addresses concerns. The extent is difficult to extrapolate, though, until specific contract and pricing information is made available to respondents. This data is found, in part, in Section 4.

If MVEC built and managed a local solar array to produce electricity, would you have any interest in purchasing electricity from it?

Yes - 1,159 (88.3%)

No - 154 (11.7%)

Question Discussion

It appears there is significant interest in participating in a community solar type of solar project. This further validates findings in Section 1 highlighting considerable interest. Willingness to participate will be based on how well the potential subscriber preferences are met.

Section 3: Community Solar Program - Willingness to Pay

Respondents who indicated interest in purchasing electricity from a local solar array (1,159 respondents) were directed to this question. Willingness to pay data in this question will vary from actual willingness to pay because the respondents will envision a program that is ideal to them. This will likely differ from what a contract with limitations and restraints can offer potential subscribers. Educating members about specific programs will also influence support for renewable program participation.

What is the highest additional cost per month you would pay for 50% of your electricity to come from a solar array built and maintained on land by MVEC?

This question is used to determine a willingness to pay among potential subscribers - not considering any contractual circumstances or variables - for 50% of the member's electricity use per month.

Nothing (less than \$1) -

255

\$1 - \$4.99 - 38

\$5 - \$9.99 - 113

\$10 - \$19.99 - 325

\$20 - \$30 - 291

\$35 - \$45 - 16

\$50 - \$99.99 - 92

\$100 - \$200 - 29

Question Discussion

A wide array of willingness to pay above the retail rate exists among survey respondents.

Section 4: Potential GreenSource Energy Options

This section provides some basic education about Community Solar and Renewable Energy Certificates (RECs) and outlines rates that MVEC put forward. This is the first time survey respondents had been introduced to pricing data in the survey.

Would you subscribe to the Community Solar program option at the price listed above?

The pricing for Community Solar highlighted that participants could choose how much they would like to subscribe to. The cost would be roughly \$10/month for 50% of the typical MVEC residential member if participating in the EnergyWise program.

Yes - 847 (64.5%)

No - 466 (35.5%)

Question Discussion

This question further illustrates the interest for Community Solar participation. It is difficult, however, to determine the actual level of willingness to subscribe given the limited time and information dedicated to the respondents about the program.

In Section 3: Willingness to Pay, 54.4% (690 of the 1293) respondents were willing to pay \$10 or more for 50% of their power from community solar. One would assume the response on this question should have been the same or less than the results of Section 3. This, however, is not the case. Educating members about options actually increases the number of interested members. This is consistent with previous Community Solar outreach data in other utilities.

Would you participate in Renewable Energy Credits at the prices listed above?

Similar to Community Solar pricing, cost for 50% of the average MVEC residential member per month was used as the baseline price. Additional rates for the average household to get half their energy from RECs were \$2.75/month for wind and \$6.88/month for solar.

Yes - Wind or Solar RECs - 524

Yes - Wind RECs only - 222

Yes - Solar RECs only - 192

No - 375

Question Discussion

938 of the 1,313 responses (71.4%) indicated willingness to participate in RECs given the rates provided. The actual willingness to pay for RECs will vary due to a number of factors: (1) whether or not Community Solar becomes an option for MVEC members, (2) member education about the REC program, and (3) identifying members who already are subscribers to renewable energy programs. Because MVEC does not control the prices of RECs on the REC market, little analysis will be done on REC demand or willingness to pay.

Section 5: Follow-Up Questions for Initially Uninterested Members

Question 1 of the survey asked if survey respondents were interested in participating in a new renewable energy program if MVEC offered one. 95 respondents indicated no interest. Section 5 sought to gain more insight on these respondents and offered some information about potential renewable options.

Yes - 27

No - 68

Question Discussion

27 of the 95 respondents (28.4%) indicated that the programs outlined addressed potential concerns. This is consistent with the evidence that education about renewable energy programs often provides insight and addresses issues that uninterested parties misunderstand.

After seeing these options, would you be interested in any of them?

After becoming acquainted with the details of the proposed programs, 9 of the 95 initially uninterested respondents became interested.

Yes - 9

No - 86

Question Discussion

As with the previous question, some people become more favorable toward renewable energy options as they become more familiar and as they discover that they may address some of their concerns.

Only 86 survey respondents, out of the total 1,399 respondents, indicated that they have no interest in renewable energy programs.


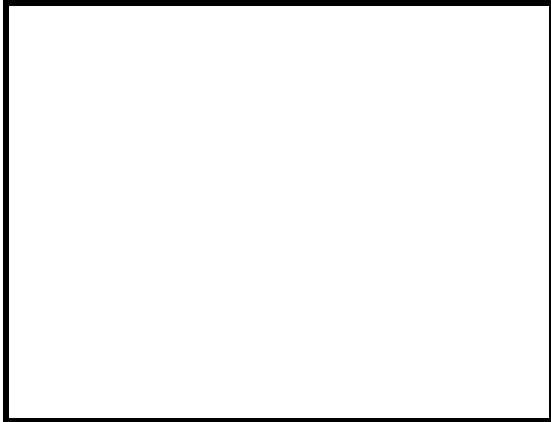
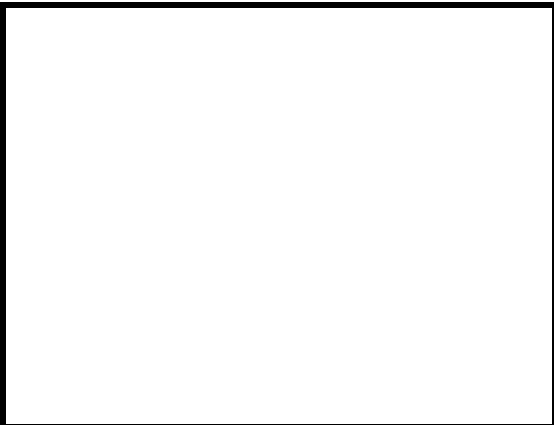



Member Analysis

The survey gauged members' interest in renewable options before providing them information about the specific options proposed by MVEC, to offer perspective for MVEC's marketing campaign. The data used for preliminary analysis are found in the graphs on the following page, which are copies of graphs from the section above.

Our first question (Figure 1) asked whether members would be interested in a new renewable energy program. Although 95 respondents expressed no interest, 385 said they were interested, and a further 919 said they might be interested if given further information. Members were invited to share the motivations for their answers to this section through a short-answer section, where 524 respondents (38%) indicated financial concerns as a key motivator, and 264 (19%) indicated environmental concerns.

In the next section, the 1,304 members who indicated interest in renewable energy were asked their preference for the source of their renewable energy. Figure 2 shows their preferences for carbon-free electricity production. Over 80% of these members indicated that the importance of carbon-free energy ranked in the upper half of their preferences, with a majority (52%) indicating the highest level of importance in their response. Figure 3 indicates the same respondents' preference for locally-produced renewable electricity. While only 69% of respondents indicated a preference level of 3 or 4, many respondents interested in renewable energy are also interested in local production. Figure 4 indicates that a slight majority (703 respondents) preferred the renewable option which was most affordable, with an additional 322 respondents having no preference among renewable options. For those interested in a particular renewable option, solar was the clear leader, with 194 respondents choosing it, as opposed to 40 with a preference for wind and 54 with another renewable-energy preference. In aggregate, these responses indicate respondents' interest in carbon-free energy production, local renewable energy production, and affordability.

The survey also gauged members' preferences for program design. Figure 5 shows respondents' interest in a renewable-energy program without financial benefits to them. More than half of respondents said they might participate given the right program, and an additional 217 said "Yes" to participating. Furthermore, Figure 6 indicates that 88% of respondents would be interested in purchasing energy from a local solar array managed by MVEC. These results indicate that respondents will look for a program design that fits their needs, but that a strong majority of respondents interested in renewables would consider purchasing renewable energy produced locally.

Member Interest Graphs	
	
Figure 1: Interest in Participating	Figure 2: Interest in Environment
	
Figure 3: Interest in Locality	Figure 4: Preference among Renewables
	
Figure 5: Interest in Financial Benefit	Figure 6: Interest in Local MVEC Solar

Member Demand for Renewables

The remainder of the survey investigated member demand for the specific renewable energy options proposed by MVEC.

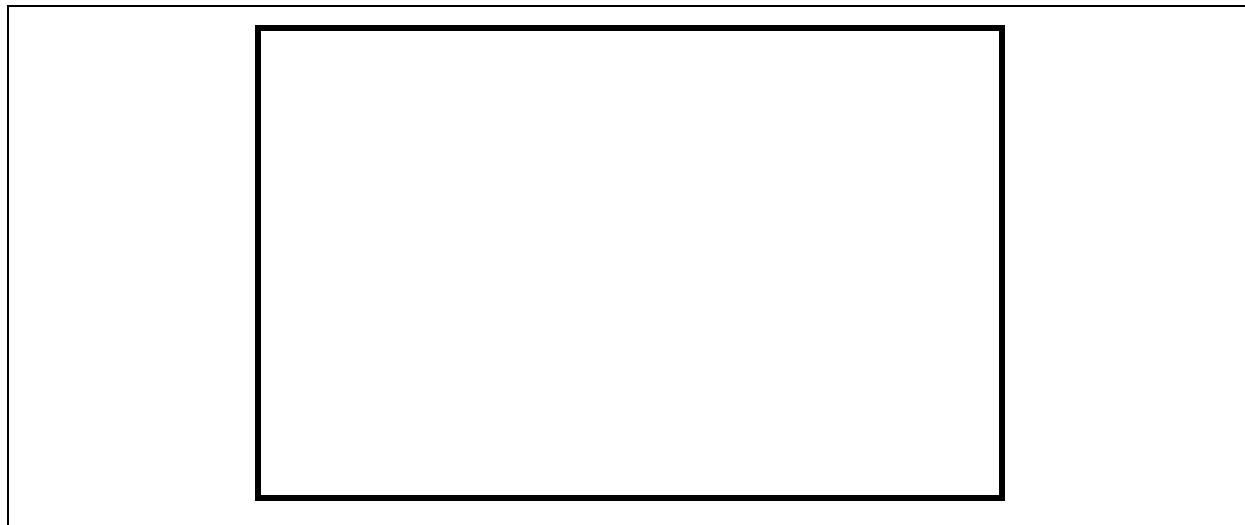


Figure 7: Displays the number of respondents interested in MVEC’s proposed REC and community solar options. The left two columns indicate respondents interested in community solar, the right two columns indicate those not interested in community solar. Colors designate a respondent’s interest in RECs.

We presented detailed information about each option, and asked members to indicate (1) whether they would pay MVEC rates for community solar, and (2) whether they would pay MVEC rates for RECs. Of respondents interested in renewable energy options, 96% were interested in both RECs and community solar (graph above, left-most column). The second-largest group (343) were interested in purchasing neither RECs nor community solar. Quantifying demand for RECs and community solar, and analyzing the details of respondent preferences for each option, will help to inform MVEC’s marketing strategy.

This section will first analyze members’ preferences for community solar, then provide analysis of members’ demand for RECs. This analysis will include combining data across multiple questions to display differences in respondents’ attitudes, and use respondents’ actual energy consumption statistics to generate a demand curve for community solar.

Community Solar Analysis

This section examines what motivated respondents’ interest in community solar. First, we generated a demand curve for community solar, to assess how expressed interest corresponds to the demand needed to justify the creation of a community solar array.

Next, we examine respondents' expressed willingness to pay for community solar, and how it corresponds to their expressed interest in MVEC's program. Finally, we explore the contrasts in preferences between respondents interested in community solar and those not interested in community solar.

The first priority in survey analysis was to determine whether the 1MW community solar array proposed by MVEC was realistic. Prior to the survey, MVEC had received some interest in renewable options from members, but was unsure whether that interest was enough to justify further research on a community solar program. According to conversations with MVEC, this array would generate about two million kWh of electricity per year, or 167,000 kWh per month. Our survey presented members with an overview of the proposed MVEC community solar plan, without pricing information, and asked them how much they would be willing to pay to participate in the program. By combining their answers with their actual energy consumption data, we generated a demand curve (Figure 8) which indicates how many kWh of energy would be purchased by survey respondents as a function of the price charged.

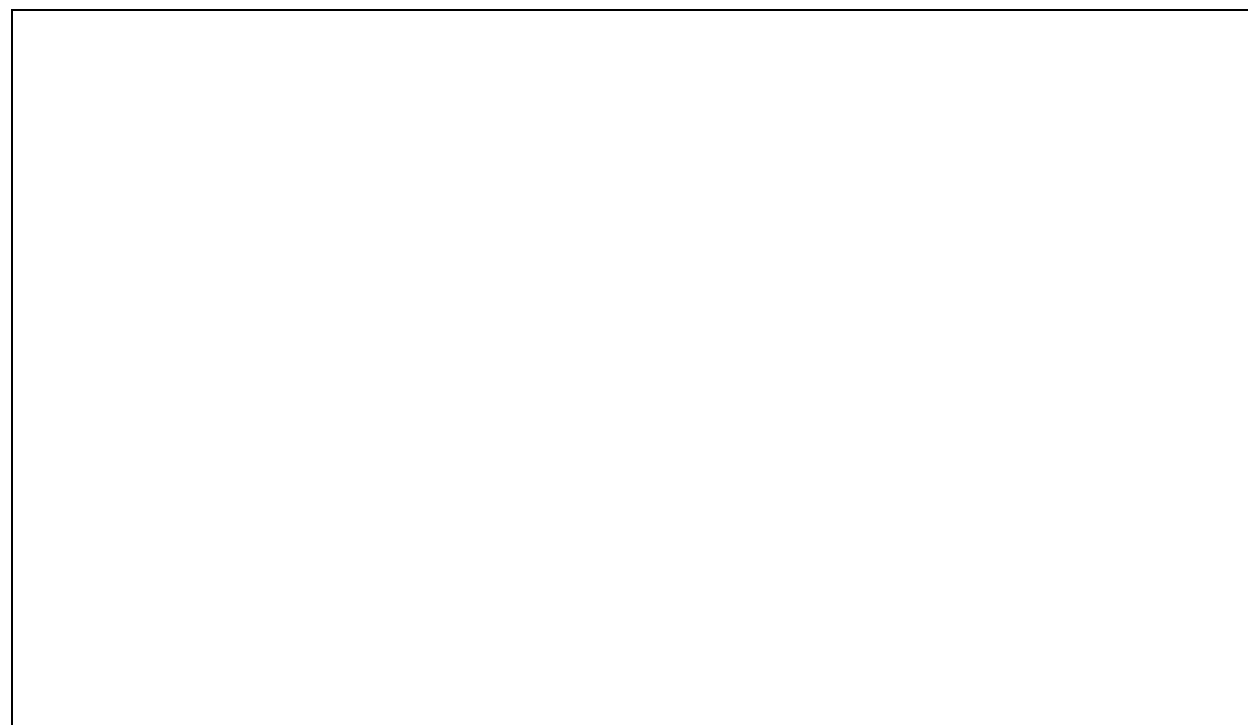


Figure 8: This graph uses respondents' actual electricity rates and energy consumption, and their expressed willingness to pay for community solar, to create a graph of their demand for renewable energy. Respondents who expressed a willingness to pay above \$0.1524/kWh consume a total of 140,000kWh/month on average, and respondents who expressed a willingness to pay above \$0.1355/kWh consume a total of 306,000kWh/month on average.

Results indicate that the 249 respondents willing to pay above the general- member rate consume 140,000 kWh in an average month, and that the additional 218 members who would pay above the EnergyWise rate consume an additional 166,000 kWh per month. The total average demand of all survey respondents willing to pay above the minimum price for community solar is 306,000 kWh per month, which is above the projected generation capacity of MVEC's proposed solar garden.

These results should not be treated as a guarantee that community solar is viable for MVEC. In general, survey respondents tend to exaggerate their willingness to pay on surveys, compared to what they actually pay when the option is presented. Furthermore, the significant overlap in member interest between RECs and community solar means that members willing to pay a high price for community solar may choose to subscribe to a cheaper REC option instead. MVEC should not use this report as justification to break ground on community solar without further de-risking.

Willingness to Pay for Community Solar	
<p>Figure 9: Responses to the question “What is the highest additional cost per month you would pay for 50% of your electricity to come from a solar array built and maintained on land by MVEC?” The <i>No Interest</i> column counts people who did not answer this question, but were otherwise interested in renewables. An additional cost of \$10/month would allow the average residential member to purchase 50% of their electricity as community solar.</p>	<p>Figure 10: The same data as Figure 9, with columns subdivided by responses to the question “Would you subscribe to the Community Solar program option at [an additional \$10/month for half your power]?” Green columns indicate respondents who answered yes, red columns indicate no.</p>

Additional evidence about the viability of community solar can be derived from respondents' expressed willingness to pay. Members who responded "Yes" when asked if they would have some interest in purchasing energy from a local solar array managed by MVEC (See Figure 6) were presented with information about the proposed community solar program, and asked what additional price they would pay to purchase 50% of their energy from the program. The results are reported in Figure 9. Of the 1,019 respondents who answered the question, 69% expressed a willingness to pay at least \$10/month.

After members indicated the price they would pay for solar, they were presented with the full details of MVEC's plan (See Section 4) and asked whether they would subscribe to the MVEC community solar plan. Two trends stand out in Figure 10, which breaks down the data in Figure 9 based on respondents' interest in MVEC's solar program. First, none of the 690 respondents who were willing to pay above \$0 for community solar declined MVEC's proposed community solar program. Furthermore, 23% of respondents who originally indicated they would pay \$0/month for community solar, and 13% of members previously uninterested in community solar indicated interest in MVEC's plan when additional details were presented to them. These trends indicate that additional education about the community solar program is unlikely to change the opinion of an individual interested in community solar, but may persuade a skeptic to consider subscribing.

Understanding members' motivations to subscribe to community solar will help MVEC determine how to proceed with its program. This section breaks down respondents' preferences for locality and renewable generation to determine whether meaningful differences exist between those interested in community solar and those uninterested.

Motivations for Community Solar	
<p>Figure 11: Responses to the question “Is it important for renewable electricity to be produced locally?” The left columns count respondents who expressed interest in the MVEC community solar program, and the right columns count those who with no interest in the MVEC community solar program.</p>	<p>Figure 12: Responses to the question “Do you have a preference for how renewable energy is generated?” (Figure 4). The left group of columns count respondents who expressed interest in the MVEC community solar program, and the right group of columns count those who with no interest in the MVEC community solar program.</p>

A preference for locally-produced power often translates into a greater likelihood of support for community solar relative to non-local RECs. Figure 11 breaks down survey responses to determine whether that trend holds for MVEC members. Over three-quarters (76%) of respondents interested in community solar expressed moderate or high interest (3 or 4) in locally-produced power, in contrast to 59% of uninterested respondents. Respondents with an interest in community solar are more likely to prefer locally-produced power than members who would not participate in community solar.

The variety of renewable options available from MVEC mean that understanding the preferences of members interested in community solar could help MVEC choose how to proceed with the program. Figure 12 displays the number of members with each preference for renewables, broken down by interest in community solar. Solar power is not the top preference for respondents in either category; instead, it takes third place to the most affordable option, with “no preference” in second for both groups. The

difference between the groups comes in the magnitude of responses. While 63% of respondents uninterested in community solar prefer the most affordable option, only 48% of those interested in community solar prefer the affordable option. This hints at lower importance of affordability of renewable options for members who would choose community solar, but also indicates that some members with interest in MVEC's community solar option might choose lower-cost REC options instead.

REC Analysis

Interest in RECs is divided among wind and solar RECs. This section examines respondents' interest in RECs and how their motivations correlate to their preference for renewables.

REC Interest Graphs	
<p>Figure 13: Displays responses to the question “Would you participate in Renewable Energy Credits at the prices listed above?” These prices were \$2.75/month extra to subscribe to wind RECs for an average household, and \$6.88/month to subscribe to solar RECs for an average household.</p>	<p>Figure 14: Displays the data from Figure 13 broken down by responses to the question “Do you have a preference for how renewable energy is generated?” (Figure 4). Columns are labeled with members' preferred REC program, and the height of the bars in each column designates the number of respondents who preferred the renewable with the corresponding color.</p>

Figure 13 reports the total number of respondents interested in each REC option. The highest number of respondents (524) were interested in both varieties of RECs, and the

second-highest number (375) were interested in none of the REC options, with approximately equal numbers interested in wind RECs (222) and solar RECs (190). Of note is the fact that more people chose both wind and solar RECs than either REC option independently. This overlap motivates us to consider the differing motivations between subscribers to each REC independently.

To understand members' motivations for RECs, we counted the number of respondents with each REC preference who indicated a preference for how renewable energy is produced. Figure 14 summarizes the results. In each REC category but solar, the highest percentage of respondents picked the most affordable renewable option; respondents interested only in solar RECs put solar power as their most preferred option. This may indicate that the benefits of solar power relative to other energy sources are meaningful to members. The emphasis on affordability among those interested in wind RECs, or both REC options, may suggest that more of the respondents interested in both options will choose wind RECs.

Additionally, the percentage of respondents who preferred affordable renewables is highest for respondents interested in wind RECs and those with no interest in RECs (63% for both), indicating that the two lowest-cost options were most often picked by people with a preference for affordability. Twenty percent of respondents who chose no RECs had a preference for wind, solar, or another renewable option, which indicates that even if a member is interested in renewables, they may not choose to subscribe to RECs.

MVEC Community Solar Contract Analysis

The initial contract design suggested by MVEC for Community Solar consists of three key elements:

Contract Length - MVEC has suggested a 10-year contract length.

Pricing - The pricing would be dependent on participation in the Energy Wise program and based on a rate adder model exclusively - a \$0.0186/kWh adder with Energy Wise or \$0.0355 adder without Energy Wise. A two percent escalator would be used for annual pricing increases.

Subscription Sizing - A minimum subscription size of 100 kWh/month scalable in 100kWh blocks and capped at a maximum of average electricity use (about 1,000kWh/month for average residential member).

In this model, subscribers would agree to a moderate-length contract, but would be able to choose the size of their subscription. This option facilitates flexibility in subscription size based on usage.

In terms of pricing, a rate adder is the only model proposed in this contract design. A two percent annual escalator would keep the additional rate higher than the retail rate for the near future. The adder would raise the retail rate of electricity from \$0.1169 to \$0.1355 (15.9% rate increase) if the member participates in Energy Wise and from \$0.1169 to \$0.1524 (23.3% rate increase) if the member does not participate in Energy Wise. This higher rate, locked in for a ten year contract with a two percent escalator, does not provide an opportunity for the subscriber to cost-recover any investment into the program.

This economic consideration weighs heavily on potential subscribers. Survey responses (e.g. Figures 4-6) indicate that financial benefit and affordability are key criteria in the decision-making of respondents.

Numerous contractual options exist for community solar programs and have been utilized by cooperative, municipal, and investor-owned utilities. Each program design yields different costs and benefits to the utility and to the subscriber. Program designs influence numerous perceived : (1) risk, (2) economic costs and benefits to subscribers and the utility, and (3) limitation of cross-subsidization among subscribers and non-subscribers.

Recommendations

After review and analysis of program features, in addition to member survey responses, the University of Minnesota project team makes the following recommendations:

MVEC should continue to pursue community solar to meet member demand for renewable energy options.

Recommendation 1

MVEC should consider offering additional Community Solar contract options to provide more choices to members while minimizing risk to MVEC.

Under the proposed community solar 10-year contract, little opportunity exists for subscribers to realize any financial benefits. The rate for electricity from the community solar subscription will remain higher than the retail rate for the foreseeable future. This is of concern as many of the survey respondents prioritized economic or financial benefit for interest when valuing renewable energy options.

Offering a longer length contract of about 20 years would reduce the risk and liability for MVEC. Currently, MVEC would need to address the future of the array after the initial 10 years of contracts as the costs for the array would not be fully recovered. MVEC could calculate what the value of this reduced risk is in a longer term contract and lower the kWh rate that could be offered. Members could subscribe to a longer contract at a lower kWh rate in exchange for the reduced risk to the utility.

This could be done in the existing pay-as-you-go contract (PAYG) or as part of an additional pay up front (PUF) contract option. PUF would allow MVEC to see more upfront capital, further reducing liability, and allow for interested subscribers to lock in rates, as opposed to PAYG. This would reduce subscriber uncertainty and address potential concerns.

By adding additional contract options, members would be able to choose what works best for them and would have agency to lock in or guarantee a rate into the future. Offering a variety of options can increase the number of subscribers and increase the likelihood of meeting the renewable preferences of the membership. It also increases the potential for the 1 MW threshold for the array to be met.

If additional contract options are added, all options should be offered to members simultaneously. As a standalone contract option, MVEC's proposed community solar contract best achieves subscriber value and reduced risk to the utility.

Recommendation 2

MVEC should acknowledge that members have interest in both community solar and renewable energy credits. While there is demand for a community solar program, there is also concurrent demand for renewable energy credits, which makes it difficult to predict which option members will choose. Transparency and education may help potential subscribers decide which option is best for them. Uncertain futures over REC impact, weight, and longevity are too fragile to rely on as MVEC's only option. Instead, MVEC should recognize the importance of a diversified portfolio of renewable options, including options such as community solar, to best meet customer demand.

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