CAMPUS PV DEVELOPMENT ROADMAP

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Acronyms

CERTS Clean Energy Resource Teams
CHP Combined Heat and Power
CSG Community Solar Garden
DOE U.S. Department of Energy
IOU Investor Owned Utility
ITC Investment Tax Credit
kW Kilowatt
MACRS Modified Accelerated Cost Recovery System
MREA Midwest Renewable Energy Association
MSA Minnesota Student Association
MW Megawatt
NREL National Renewable Energy Laboratory
PI Principal Investigator
PPA Power Purchase Agreement
PUC Public Utilities Commission
PV Photovoltaic
REC Renewable Energy Credit
RLF Revolving Loan Fund
SUN Solar University Network
UMD University of Minnesota, Duluth
UMF University of Minnesota Foundation
UMN University of Minnesota
Acknowledgements

The Solar Endowment Project is a collaboration of Midwestern Universities known as the Solar University Network (SUN) and the Midwest Renewable Energy Association (MREA) with support from the United States Department of Energy (DOE) under the SunShot Initiative. The University of Minnesota Campus PV Roadmap has been prepared by the Energy Transition Lab with guidance from the Institute on the Environment. Ellen Anderson, Executive Director of the University of Minnesota, the Energy Transition Lab led the Sun Delegation with the help of graduate student coordinators Laura Burrington and Megan Butler and ETL staff Erin Sikkink.

This Roadmap would not have been possible without the support of the SUN Delegation’s advisors including:

- Lewis Gilbert (PI), COO, Institute on the Environment
- Jerome Malmquist, Director of Energy Management, University of Minnesota, Twin Cities
- Shane Stennes, Director of Sustainability, Twin Cities Campus
- Mindy Granley, Office of Sustainability, Duluth Campus
- Beth Mercer-Taylor, Institute on the Environment
- Paul Imbertson, Professor at Department of Electrical and Computer Engineering
- Dan Svedarsky, Director of Sustainability, Crookston Campus
- Troy Goodnough, Sustainability Director, Morris Campus
- David Quinby, Attorney, Stoel Rives (energy finance)
- Sara Bergan, Attorney, Stoel Rives (renewable energy)
- Adam Schurle, Stoel Rives (tax)
- Brian Ross, Senior Program Director, Great Plains Institute
- Jared Schoch, Principal and Founder, Turning Point Energy

In addition, multiple partnerships across the University of Minnesota and outside of campus have been developed and fostered through the Solar Endowment Project. We would also like to thank the University of Minnesota Department of Geography, Department of Electrical and Computer Engineering, University of Minnesota Duluth (UMD) Engineering Department, the Geospatial Analysis Center, University of Minnesota Foundation (UMF), UMore Development, Ecolibrium3, Innovative Power Systems-Solar (IPS), Clean Energy Resource Teams (CERTS), Minnesota Solar Energy Industries Association (MnSEIA), National Renewable Energy Laboratory (NREL), Innovative Engineers, Eutectics LLC; and local Minnesota utilities including Xcel Energy and Minnesota Power.

Solar energy has the potential to provide a great number of benefits to educational institutions in the United States. Potential benefits include hands-on experiential learning and research opportunities, improved resiliency of campus infrastructure, diversification of university investments, opportunities to engage alumni and donors as well as attract new students and faculty, advancing university sustainability goals, and both energy and monetary savings. To facilitate the adoption of solar on University campuses in, the Midwest Renewable Energy Association (MREA) has collaborated with Midwest University partners including University of Minnesota, Purdue, and Illinois State University to form SUN Delegations.

The University of Minnesota SUN Delegation

The University of Minnesota, the largest research university in the U.S., consists of five campuses spanned across the state. Before 2016, the idea of solar power was relatively new to University of Minnesota. However, interest in solar has been increasing in both the administrative and academic areas.

In 2015, the University’s Energy Transition Lab created the SUN Delegation with guidance from MREA and the Institute on the Environment. Between 2015 and 2017 the Delegation focused its efforts on identifying pathways for the University to invest in at least one Megawatt (MW) of solar by installing solar photovoltaic (PV) panels on University property or subscribing to community solar gardens (CSGs). Because of these combined efforts, UMN leadership ultimately committed to investing in up to six MW of solar including both on-campus solar installations and subscriptions to CSGs. As there are no case studies in existence of other universities who have a CSG subscription of more than one MW, the University pioneered this approach. This campus roadmap describes the process that UMN students, faculty and staff undertook to investigate and ultimately invest in solar. The SUN Delegation compiled this roadmap recognizing that sharing the story about our process can help to guide other higher education institutions considering a path to solar.

1 A CSG is a centralized, shared solar project connected to the energy grid with multiple subscribers. Subscribers receive a credit on their electric bills based upon the production of the solar facility and their subscription share.
I. The SUN Delegation Team

Over the course of the project (2015-2017) the SUN Delegation consisted of nearly 100 Undergraduate, Masters and Doctoral students from diverse academic backgrounds as well as University of Minnesota faculty and staff. Each semester, SUN Delegation students broke into groups to work on specific tasks including Legal/Regulatory Analysis, Site Assessments; Historical Designation; LiDAR; Finance; Outreach; Community Solar; Solar Ready Campuses; and Solar Testbed.

Student engagement and retention strategy

While student turnover (due to graduation or scheduling conflicts) was an obstacle to continuity, the SUN Delegation consistently attracted new students with unique interests and backgrounds. More experienced students developed important leadership skills as they guided new Delegation members. To keep students engaged, the Delegation offered opportunities such as:

**SUN Delegation Group Formalization:** We officially made the SUN Delegation a student group, with officers and a monthly stipend to provide snacks for student meetings.

**Renewable Energy Pathways Course:** In 2016, the University Provost approved the new three-credit course as a Grand Challenge Curriculum interdisciplinary model, providing a credit opportunity for students. The course focuses on hands-on action projects such as the SUN Delegation.

**Credit Opportunities:** Several courses provided opportunities for students to receive credit for SUN Delegation participation. For example, engineering professors at UMD incorporated SUN Delegation work into their courses to help identify ideal locations for solar on the UMD campus.

**Online Courses:** MREA provided students with the opportunity to take the online PV Site Assessment course and become a certified solar site assessor.

**Off Campus Learning Opportunities:** SUN Delegation students attended several conferences including the 2015 Association for the Advancement of Sustainability in Higher Education conference (Minneapolis), the 2016 Smart and Sustainable Campuses Conference (Baltimore); and the 2015 and 2015 Minnesota Solar Energy Industries Association conferences (Minneapolis). In November 2015, students also

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2 [Click here to see the recruitment document and application](#)
visited the National Renewable Energy Laboratory (NREL) and received guidance from some of the lab’s top experts.

**Professional Development Opportunities:** In addition, students received opportunities to participate in internships through the SUN Delegation program.

These opportunities for experiential learning incentivized participation and consistently attracted new students to the Delegation. In addition, these opportunities were excellent growth and networking opportunities for students. Several students have secured solar industry jobs through connections they made by participating in the SUN Delegation.

**Campus Outreach**

The Delegation’s campus engagement activities focused on recruiting new SUN Delegation members and generating support for solar on campus. The group developed the outreach tools and materials discussed below.

**Minnesota Student Association Mission (MSA) Statement:** The Minnesota Student Association adopted a position statement calling for integration of renewable energy at the University. Twelve campus organizations, representing many students from different colleges and disciplines, supported the position statement. [Click here to see the Position Statement](#)

**Student Petition:** In collaboration with the MSA students created a petition to help to make a statement to campus decision makers about student interest in solar. The petition also gathered contact information from students eager to support solar initiatives on campus.

**Outreach Video:** The video advertises the SUN Delegation’s work and is an accessible way to elevate the conversation about solar power on campus. The video reviews the need for solar energy, the benefits of solar, and how to get involved with the Delegation. [Click here to watch the video](#)

**SUN Delegation Facebook Page:** The goal of the Facebook page is to gather like-minded people who support solar energy on campus. Students from outside the Delegation are enthusiastic about the topic and post content on their own. [Click here to visit the Facebook Page](#)

**UMD Solar Energy Summit:** On April 20, 2016, University of Minnesota Duluth hosted a Solar Summit. The Summit allowed UMD students, faculty, and staff working on solar to present their work and gain the community’s input on the future of solar at UMD.³

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II. Decision-Making Process and Key Stakeholders

Key Stakeholders

One of the first steps that SUN Delegation students took was to map out key stakeholders, categorizing them as gatekeepers, key decision makers, and catalysts.

Catalysts: Students. Engaging and capturing the enthusiasm of the student body was an instrumental strategy of the Solar Endowment process. During the project, students’ hard work and enthusiasm to validate preexisting University faculty/staff interest in solar served as a catalyst for the University to consider solar. The students’ well-organized campus engagement and research provided University decision-makers with the broadly based “buy in” to support solar investment.

“One of the greatest accomplishments the SUN Delegation has made over the past year is the momentum that students have created related to interest in solar on campus”

-Mindy Granley, UMD Sustainability Coordinator

Gatekeepers: Sustainability Coordinators. Shane Stennes, Director of Sustainability, advised students on budget and energy system constraints and facilitated communication among students, staff, and decision makers. Mr. Stennes was a champion for solar investment and he credits the SUN Delegation with raising visibility and providing the pivotal “push” to get solar on the University’s agenda.

Key Decision Makers: The Delegation identified the following key decision makers

- The Board of Regents: UMN delegates financial decisions that exceed certain dollar amount to higher administrative staff and the Board of Regents.
- Vice President (VP) of University Services: University Services oversees University physical infrastructure and operating systems decisions. The University Services VP had an important say in the system and the budget implications of solar infrastructure investments.
- Chief Financial Officer (CFO): Because the decision to invest in solar involved changes in the University budget, the CFO was a key advocate for the SUN Delegation.
- Director of Energy Management: He was one of the Delegation’s main advisors and had been previously involved in energy upgrades on campus.
- Facilities Management Associate VP: The facilities VP provided valuable perspective regarding facilities and energy management.
- University Finance and Controller: This office analyzes the potential impacts of any investments on debt service and debt capacity.
- Office of the General Counsel: This office provides legal services for the University.
- Transportation Services: On-campus projects sited on parking garages and other transportation infrastructure are under the jurisdiction of Transportation Services.
- Capital Planning: This office oversees the University’s capital and campus development plans.
Key Concerns of Priority Decision Makers

Energy Transition Lab Director Ellen Anderson met with University decision makers to tell them about the project and prepare them for upcoming proposals. These conversations helped inform the SUN Delegation strategy and the pre-briefings ensured that University leaders felt this was a cooperative effort. If they saw the project as adversarial, it could have undermined its progress. Internal University staff were critical partners and it was important to cooperate and listen to their concerns and advice throughout the process. Based upon multiple conversations, interviews, and presentations with priority decision makers, the SUN Delegation identified key concerns related to solar investment:

**Financial Exposure and Accounting Risk:** University decision makers wanted to ensure that any solar-related investment produced a positive return on investment (ROI) within a reasonable span of time.

**Renewable Energy Credits (RECs):** These tradable credits represent benefits associated with renewable energy. One REC equals one-megawatt hour (MWh) of solar energy. UMN can claim RECs from a CSG subscription or energy produced on campus and use them toward its sustainability goals.

**Grid Integration:** Interconnection fees vary between locations and utilities, posing a financial risk when considering a renewable energy project.

**Existing Energy Projects:** Facilities staff advised against solar on the campus’ East Bank because they wanted to understand energy production vs. demand for the new CHP plant before adding solar.

**Regulatory Risk:** The regulatory environment governing the solar industry is nuanced and relatively new. This environment is risky because of the potential for changes that could affect the University.

**Developer Risk:** The solar industry experiences significant turnover because it is still maturing and state/federal policy is unsettled. This adds unpredictability when signing contracts with developers.

**Reputation:** A successful project can demonstrate the University’s commitment to sustainability and boost its reputation. An unsuccessful project could negatively affect public perception. Also, if students support solar investment, ignoring popular opinion can damage the University’s reputation.

**Visible Leadership:** Some Regents have expressed enthusiasm for solar on campus as a visible symbol of future-facing sustainability leadership, which can appeal to students, alumni, and donors.

**Sustainability Commitments:** In 2008, the University signed the Climate Leadership Commitment, a formal recognition climate change, and committed to reduce emission levels through operational, societal, and educational changes. The goal is for the University to be carbon neutral by 2050.
III. Identifying Priority PV Development Sites

The following section describes the SUN Delegation’s investigation of on-campus solar for the Twin Cities campus.\(^4\) \(^5\) The Twin Cities campus has an incredible solar resource with opportunities for siting solar on brownfields, rooftops, and vacant spaces. The SUN Delegation narrowed down potential solar locations based upon factors described below:

Solar Insolation/LiDAR Site Assessment

The LiDAR team produced a map\(^6\) detailing rooftop solar potential for the Twin Cities Campus.

We generated an insolation model of the Twin Cities campus, which provided values for yearly total solar radiation. We worked with data from University Services to generate values for entire roof sections of the Twin Cities campus. This allowed us to calculate monthly totals, maximum daily values, and total generation potential based on assumptions about PV efficiency. The data also includes structural and surface information that was helpful for estimating whether a surface could support panels. Structurally, it is important to look at how a roof is designed as well as how much weight it can support to determine its solar suitability.

-LiDAR Assessment Team

In Duluth, the SUN Delegation worked with UMD’s Geospatial Analysis Center, local nonprofit Ecolibrium3, and the city of Duluth and Great Plans Institute to develop a web map of solar energy potential for the entire city of Duluth. Both students and Duluth residents can use this tool for local solar project planning.

\(^4\) Similar efforts were also conducted on the Duluth and Crookston campuses
\(^5\) The CSG subscription option is discussed in Section V.
\(^6\) Click here to View the Campus Map and Click here to view the LiDAR Team’s Full Report
Students also used the Solar Insolation Application developed by the Clean Energy Resource Teams (CERTS). This resource provides estimates of the solar resource that exists in different areas of Minnesota.

Future Building Plans

Historical Designation Issues: The Twin Cities campus was established in 1851 and some buildings in use today were built in 1886. These buildings often have special historical designations. The State Historic Preservation Office restricts modification of historically designated buildings which means that the University is not allowed to modify historically designated buildings with solar panels.

Campus Construction Plans: New construction/renovation projects provide special opportunities for solar. By scheduling solar projects with existing construction plans, it is possible to reduce costs by ensuring that the building structural/electrical infrastructure easily accommodates solar. In addition to trying to identify potential sites based on construction plans, Delegation students also produced a Solar Ready Building Guide. Large universities typically have new construction projects on a recurring basis. The guide encourages the University to consider the future solar applications of all new construction and ensure that new buildings on campus are designed to allow for the cost-effective addition of solar projects anytime in the buildings’ lifetime. Click Here to Read the University of Minnesota Solar Ready Guidelines.

Figure 5: Historic Designation on Twin Cities Campus. Source: University of Minnesota Master Plan, 2009.

We identified the historically designated buildings and buildings slated for construction in the upcoming years. Using this information, we created a hierarchy of buildings that list the structures that would be the most difficult to add solar equipment, as well as the structures that might be easier considering they will be under-construction or remodeled anyway.

-Site Assessment Team
Electrical Infrastructure and Electrical Rate Analysis

**Electrical Infrastructure:** Compatibility with existing electrical infrastructure is another factor that influences a site’s solar suitability. The University owns and operates its own distribution system with interconnection points with the local utility Xcel Energy. Xcel has a meter at each interconnection point and the University has its own meters for each building for internal use. On-site solar projects are “behind the meter” because the energy produced remains on the campus-owned distribution system to be used internally. This makes on-campus solar projects less complicated compared to projects with interconnection straight back to the utility.

**Electrical Rate Analysis:** The Twin Cities campus consumes over $50 million annually in purchased utilities (including electricity, gas, steam, and chilled water) with electricity and steam making up the majority of these costs. Energy consumption varies based upon the time of day and time of year.

**Site Assessments (2015)**

The site assessment team identified locations with the greatest solar potential by researching building historic designations, construction schedules, insolation data, and building structural and electrical infrastructure. The priority sites were identified using an elimination process facilitated by a decision matrix developed by students for all potential sites. The matrix enabled students to track the research conducted for each site and provided a reference for why certain sites were being considered over others. This allowed students to show University faculty and staff that they have done the proper background work.

**Twin Cities Potential Sites**

Figure 6: Potential Solar Sites on the University of Minnesota Twin Cities Campus

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7 All campuses experience different utility rates. Interconnection costs can also vary greatly depending upon the local substations. Based upon initial calculations, The Twin Cities has a higher payback than other campuses. Due to this, much focus is upon twin cities in this report.
The Delegation ultimately identified six potential sites on or near the Twin Cities campus. The list of sites consisted of four types of panel layouts: ground level, rooftop, parking lot canopy, and parking structure canopy. The team assumed that: the system would use of non-tracking solar panels, co-siting arrays would minimize cost, and MW per site would be limited by the electrical interconnection, building structural integrity (for rooftop solar), and maximum density of panels. For each of the six sites, the team: gathered information on the solar insolation, looked at the system size that the site could support, estimated the amount of energy the system could produce, estimated the cost of the system, identified potential non-financial benefits from the system, and consulted University staff on structural/electrical integration considerations and future use.

The Delegation initially used NREL’s PV Watts modeling software to develop a general estimate of the potential energy production and costs of different sized PV panels (5 kW, 750 kW and 1 MW) at specific locations on campus. This allowed the team to obtain a rough projection of potential revenue and identify the financial feasibility of a site. For more complex financial analysis, the team used the System Advisor Model (SAM) software also developed by NREL. SAM is a financial modeling tool for decision makers involved with renewable energy.

Students ranked the list of sites based on the highest estimated ROI. Then, students considered additional factors such as decision-maker support, future plans, and likelihood of project success. This was an important learning experience for students as they worked to consider technical, financial, political, and cultural aspects of each potential site. Eventually, they ranked the sites from highest potential (1) to lowest potential (6):

1. Gortner Ave Ramp: 1395 Gortner Ave, St. Paul MN
2. 21st Ave Ramp: 400 21st Ave S, Minneapolis, MN
3. UMORE Park: 170th St. E, Rosemount MN
4. Carlson School of Management: 321 19th Ave S, Minneapolis MN
5. TCF Bank Parking Lot: 420 SE 23rd Ave, Minneapolis MN
6. Athlete’s Village: 15th Ave SE, Minneapolis MN

After the initial assessments, The SUN Delegation performed a second round of site assessments, which included a more in-depth financial analysis and site assessments.
IV. Costs, Risks and Legal/Regulatory Considerations

Utility Interconnection Description

Utility interconnections must comply with utility and state guidelines in addition to Federal Energy Regulatory Commission requirements. Because the energy produced by on site solar panels will be used on the University-owned and managed distribution system, we do not anticipate any difficulties with interconnection.

Permitting and Inspection Description

When considering solar installation, it was important to complete the following three steps:

Step 1) Have Panels Approved by the University’s Planning Process: It was necessary to go through the University’s capital planning process. This also helped identify where the University could put the panels.

Step 2) Identify Potential Occupational Hazards: Check with the University’s Health and Safety-Occupational Health Department to ensure the health and safety of anybody that services the panels. For example, if a panel is on a roof it may be necessary to install guardrails or ensure that panels be set back from the edge of the roof by a certain distance.

Step 3) Installation and Permitting: The final step in this process is to investigate university, local, regional, state, and national codes pertaining to solar installations. All solar construction projects must comply with the current Minnesota State Building Code, which designates building weight requirements for accommodating snow loads. Other pertinent codes include the 2014 National Electrical Code and the 2012 International Building Code. All Minnesota solar suppliers must also show that they are registered with the Solar Rating and Certification Cooperation (SRCC) and obtain electrical and building permits.

Planning and Zoning Restrictions

The University of Minnesota’s zoning system is relatively unique and may be very different from other universities. Each campus has a master plan, which is effectively the zoning document and prescribes all future use of space on the campus. According to the Twin Cities Campus Master Plan, Solar is consistent with future-plans for use of space on campus.
State Policies and Incentives

Minnesota has several state policies that aid in renewable energy development:

**Minnesota State Renewable Energy Standard (RES):** The RES requires Xcel Energy to obtain at least 30% of its electricity from renewable sources by 2020. Other utilities must acquire at least 25% of their energy from renewables by 2025. In states that have passed a RES, suppliers must either produce the energy or purchase RECS to comply with the law and avoid penalty.

**Minnesota Solar Energy Standard:** While solar energy could count towards RES goals, Minnesota also has a solar standard to encourage development in the state’s solar sector. All investor owned utilities (IOUs) must obtain 1.5% of their energy from solar by 2020, with at least 10% of that amount coming from 20 kW or smaller installations. Municipal and cooperative energy providers are exempt from the solar standard. The University can also purchase or retain RECs.

**Community Solar Legislation:** Xcel Energy is required to develop a CSG program. CSGs allow individuals or organizations to subscribe to a large solar array and offset their electricity bill with renewable energy. CSGs in Minnesota have several legal stipulations: 1) At least five entities or individuals must subscribe to the project. 2) Subscribers must live within the utility’s service area, and within the county or a contiguous county of the project site. 3) One community solar subscriber may purchase, at maximum, 40% of the power produced. 4) Individual projects cannot exceed one MW.

**Made in Minnesota (MIM):** The MIM program is a rebate program for solar hardware manufactured in Minnesota. Enrollees receive a 40% rebate over a 10-year period for systems under 40 kW.

**Value of Solar:** A value of solar methodology can be used to establish a value of solar tariff (VOST). With a VOST, consumers pay their utility bill and receive credits for solar electricity production. A value of solar rate can be used to value solar projects on the electric grid and increase pricing transparency for CSGs. In 2016, the Minnesota Public Utilities Commission (PUC) adopted a value of solar rate for Xcel Energy’s CSG Program.

**Property Assessed Clean Energy (PACE):** Several cities and municipalities throughout Minnesota have PACE Programs that allow businesses to invest in energy efficiency/renewable energy at no upfront cost, and then repay the cost of the system on their property tax bill.

**Solar Easements Laws:** In Minnesota, once a solar installation exists, the owner has the rights to that sun window and others cannot build something that interferes with it. This ensures the future integrity of the solar insolation despite any construction plans for neighboring properties.
**Federal Business Energy Investment Tax Credit (ITC):** The ITC runs through 2019\(^8\) and reduces federal income taxes for tax-paying solar installation owners based on capital investments. The ITC is equal to 30% of expenditures with no maximum amount. The credit is realized in the year in which the PV project begins commercial operations, but vests linearly over a 5-year period (i.e., 20% of the 30% credit vests each year over a 5-year period). If the owner sells the project before the end of the fifth year since the start of operations, the unvested portion of the credit will be recaptured by the IRS.\(^9\)

**Modified Accelerated Capital-Recovery System (MACRS):** This system of rules and schedules for accelerated depreciation allows businesses to recover solar energy investments in certain property through depreciation deductions over five years. This reduces a project’s taxable income and improves its overall ROI. Like the ITC, MACRS requires the system to be owned by a tax-paying entity. Since the University has no tax burden, it cannot take direct advantage of MACRS or the ITC. To leverage these credits indirectly, the school would have to enter into a third-party ownership deal and purchase the solar power through a PPA.

**Net Metering:** With net metering renewable energy generators connect to the utility grid and surplus power is transferred onto the grid, allowing customers to offset the cost of power drawn from the utility. The net metering limit for IOUs is one MW in Minnesota. For systems outside of IOU areas that are 40 kW-1 MW, net excess generation is credited at the avoided cost rate, or customers may elect to be compensated in the form of a kWh credit. Excess credit is reimbursed at the end of the year.

**Tax Exemptions:** Solar equipment in Minnesota is 100% exempt from property and tax.

**Xcel Energy’s Renewable Connect Program:** This program allows customers to subscribe to receive up to 100% of their electricity from a blend of wind and solar resources. The Twin Cities campus could potentially subscribe to have up to 100% of the energy purchased from Xcel come from renewables.

**Utility Incentive Programs:** Xcel Energy offers an incentive program called Solar*Rewards for systems under 20 kW at $0.08 per kWh produced for 10 years. For the Duluth Campus, local utility Minnesota Power offers an incentive for solar PV up to 60% of installed costs, with a maximum of $20,000.

These state and regional policies reduce the cost of solar and incentivize local developers, financiers, and utilities to collaborate with the University to maximize its solar investment potential.\(^10\) The declining prices of solar panels combined with the increasingly favorable policy landscape incentivized the University to explore solar investments on and off campus.

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\(^8\) The Consolidated Appropriations Act extended the expiration date for PV and solar thermal technologies, and introduced a gradual step down in the credit value for these technologies. [DOE, 2016](https://energy.gov/)

\(^9\) The Energy Transition Lab recently published a study ([Minnesota Clean Energy: Economic Impacts and Policy Drivers](https://www.energy.gov/)) detailing the positive impact that the ITC and other federal policies have had in Minnesota.

\(^10\) For more information see the NREL White Paper: [Solar Power, Policy Overview and Good Practices](https://www.nrel.gov/).
Draft Policy Recommendations

Student Work

The SUN Delegation prepared two draft Requests for Proposals (RFP) for solar PV\textsuperscript{11} for sites with different characteristics:

- One rooftop (parking deck), suitable for 500 kW: Click here to read the full RFP
- One ground-mounted, suitable for two MW or more: Click here to read the full Request for Proposal and click here to review the proposal’s executive summary

Students prepared the RFPs based upon University decision makers’ concerns, old RFPs from other projects at the University and solar projects conducted by local municipalities. Much of the RFP’s content could easily be adapted for other locations. They include guidance for potential developers to propose one or a combination of three ownership models: Community Solar Garden, Power Purchase Agreement (PPA), or University-owned installation.

University Request for Proposals

Using the student work as a helpful foundation, the University underwent a continuous redrafting process and developed two separate solar RFPs. The first RFP for a two MW CSG subscription was released in March 2016. During fall, 2016 the University released a second RFP for four MW of on-site including projects on the Twin Cities, Duluth, Crookston, and Morris campuses. The idea behind packaging multiple solar projects across several campuses into a single RFP was to attract bigger developers and lower pricing per kWh. The University developed a completely new model for the on-site solar RFP, which incorporates general contracting and professional services.

Policy Recommendations

The Delegation has also identified several simple policy recommendations that, if implemented, would facilitate additional renewable energy investment and encourage university research, teaching, and outreach related to solar. These recommendations include:

- **Include solar installations on University printed materials**: The University has made great progress with solar energy investment. Ensure that the University is seen as a solar energy leader by making the solar installations highly visible. Highlight the installations on printed materials for prospective students, alumni and donors to show UMN’s sustainability commitment and attract students/donors.

- **Ensure that all new construction and renovations are solar-ready**: The University should consider the future solar applications of all new construction and ensure that new buildings on campus are designed to allow the cost-effective addition of solar projects anytime in the buildings’ lifetime.

\textsuperscript{11} To guide the development of RFPs, SUN Delegation students used the following resources: Steps to a Successful Request for Proposal, 2016, NREL’s Solar Requests for Proposals.
Adjust Funding Streams for Solar: We recommend that the University take the responsibility for installing on-site solar away from the University’s capital budget and fund solar installations from the electricity budget. This would allow the University to analyze solar investment opportunities compared to alternative energy opportunities more directly and solar installations would not go through the complex capital planning process designed for large-scale construction and retrofits.

Adjust UMN Investment Policies: The University should alter its investment policies so they reflect the University’s sustainability commitment. According to a MREA white paper, university endowments can directly support solar through either public or private market investments. Investigating means of incorporating more solar and renewable energy into the University’s endowment investment strategies can help align investment strategies with the University’s mission. The University’s investment policies currently do not allow the University to use endowment funds to finance projects such as solar panels. However, there are still opportunities to increase the endowment’s support of solar. For example, the University could adopt policies that encourage hiring fund managers that specialize in renewables. The University could also adopt policies that encourage fund managers to invest in a way that supports renewable energy.

Adopt Internal Carbon Prices: Incorporating a cost of carbon estimate into financial planning would help to ensure that the UMN is accurately considering the true costs and benefits of solar.

Figure 8 below describes the process by which the University adopts new policies.
V. Project Financial Goals and University Investment Opportunities

The SUN Delegation investigated a range of financing options. The groups’ assessment of each model with barriers, opportunities, and recommendations is listed in the section below.\(^{12}\)

Community Solar Options

A Community Solar Garden (CSG) is an arrangement where a developer owns a PV array and sells the electricity to subscribers. The land or building used for the array, often referred to as a host site, typically is leased by the developer for 25-30 years. The University could participate in CSGs in up to three ways:

1. Lease University property to a CSG developer
2. Develop their own CSG
3. Purchase power from a CSG on

Each different CSG Scenario would provide different benefits to the University. See Table 1 for details comparing options.

\(^{12}\) For examples of Universities that have used some of the following financing options please see the White Paper *Investing in Clean Energy: Campuses and Endowments*. 
<table>
<thead>
<tr>
<th>Option</th>
<th>Lease Property to CSG Developer(^\text{13})</th>
<th>Develop a UMN CSG</th>
<th>Subscribe to a CSG</th>
</tr>
</thead>
<tbody>
<tr>
<td>UMN Property</td>
<td>UMN property used for the CSG. The developer pays to use the space.</td>
<td>UMN property used for the CSG. University ownership means more project control.</td>
<td>CSG not be located on UMN property.</td>
</tr>
<tr>
<td>Electricity Output</td>
<td>UMN could subscribe to up to 40% of the project’s electricity output.</td>
<td>UMN could use 40% of the array. UMN could gain additional revenue from energy sales.</td>
<td>The UMN could subscribe to 40% of a project’s electricity output (400 kW).</td>
</tr>
<tr>
<td>Price Stability</td>
<td>The University could issue a RFP with rate stipulations to ensure price stability or term lengths for subscribers.</td>
<td>UMN would bear the risk of possible rate changes.</td>
<td>Price for subscriptions higher than if owning an array, but lower than electricity retail rate over time.</td>
</tr>
<tr>
<td>Debt Load</td>
<td>Hosting CSG does not impact UMN’s debt load.</td>
<td>UMN bears the risk of possible rate changes.</td>
<td>Minimal transaction costs once the subscription is arranged.</td>
</tr>
<tr>
<td>Transaction Costs</td>
<td>Requires legal contracts and coordination to allow site access.</td>
<td>UMN would be responsible for managing subscriptions.</td>
<td>It is very simple, just like paying a utility bill but buying solar electricity.</td>
</tr>
<tr>
<td>Maintenance</td>
<td>UMN not responsible for maintenance.</td>
<td>UMN has maintenance responsibilities.</td>
<td>UMN not responsible for maintenance.</td>
</tr>
<tr>
<td>Visibility</td>
<td>Could be used for tours, classes, and events.</td>
<td>Could be used for tours, classes, and events.</td>
<td>Off-campus translates to less visibility.</td>
</tr>
<tr>
<td>Pollinators</td>
<td>Land with solar panels on campus could also host pollinator friendly vegetation.</td>
<td>Land with solar panels on campus could also host pollinator friendly vegetation.</td>
<td>UMN has no control over vegetation around panels.</td>
</tr>
<tr>
<td>Low-Income Customers</td>
<td>UMN could allocate a certain percentage of subscriptions to low-income customers.</td>
<td>UMN could allocate a certain percentage of subscriptions to low-income customers.</td>
<td>UMN has no control over low-income subscriptions</td>
</tr>
<tr>
<td>Sustainability</td>
<td>The UMN would be supporting the CSG in Minnesota and contributing to campus sustainability commitments.</td>
<td>The UMN would be supporting the CSG in Minnesota and contributing to campus sustainability commitments.</td>
<td>The UMN would be supporting the CSG in Minnesota and contributing to campus sustainability commitments.</td>
</tr>
<tr>
<td>Economic Development</td>
<td>CSGs can benefit the local economy from the construction and operation of the facility.</td>
<td>CSGs can benefit the local economy from the construction and operation of the facility.</td>
<td>CSGs can benefit the local economy from the construction and operation of the facility.</td>
</tr>
</tbody>
</table>

\(^{13}\) Read the Guide to Sample Community Solar Garden Leases produced by Law Students Here
Ultimately, the University chose to pursue an off-campus CSG subscription. The University will receive a bill credit for each kWh produced, but does not have to install or maintain the solar array directly. There are two CSG subscription models:

- **Pay upfront**: One-time installment contract usually with a time parameter. Has the benefits of lower prices due to the time parameter of the model.

- **Pay-as-you-go**: Operates on a monthly payment schedule and does not have as much benefit in terms of pricing except for less costly subscription cancellation charges.

**Community Solar Garden Subscription Roadmap**: SUN Delegation students prepared a CSG Subscription Roadmap that explains the process the campus went through to obtain a CSG subscription. [Click Here to View the Full Community Solar Subscription Roadmap](#).

### On-site Solar Financing Options

The following section discusses the financing options available to Universities interested in installing solar panels on campus property.

**Third Party Finance/ Power Purchase Agreement (PPA)**

A PPA\(^{14,15}\) is an agreement to purchase power from a specific project for a set period at an agreed price. Under this financial model, a third party developer finances and owns the project and the University purchases the electricity from the project.\(^{16}\) One example of this type of third party financing in the Twin Cities is the [Green Line Solar Project](#).

The project developer is responsible for operating and maintaining the system throughout the entire PPA term. In most cases, the site host initially pays no more for PV power than it would otherwise pay the utility. The PPA rate typically escalates annually between 1% and 5%. PPA terms can range from 10 to 25 years, but most PPAs also include an “early buyout” option that allows the site host to purchase the system for fair market value. The site host does not automatically own the RECs associated with the system as RECs typically reside with the system owner. Most PPA providers give the site host the option to purchase some or all of the project’s RECs. A PPA incurs fewer transaction costs than issuing tax-advantaged debt or entering into a tax-exempt lease. Based upon the SUN Delegation’s financial analysis, aside from community solar a third-party finance model would have the best ROI with the 30% ITC and accelerated depreciation. A third-party finance option also has an

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\(^{14}\) A legal analysis was released by the [Environmental Law and Policy Center](#) in the hopes of making the path forward clearer for third party financing arrangements.

\(^{15}\) UMN Law Students produced [this report on third party PPAs for nonprofits and Universities](#).

\(^{16}\) [Investing in Clean Energy: Campuses and Endowments](#).
advantage over CSG because the solar would be installed on campus, making it more visible, tangible, and easier to organize around.

**Cash Purchase**

Under this model, the University directly purchases the solar panels. While this may be a viable option for a small solar system, it is unlikely the University would be willing to do this for a larger system with a larger upfront investment. One possibility is to create a donation recruitment, crowdsourcing effort to fund at least part of a project. However, there are specific regulations and approvals required by the University when considering donor solicitation.

**Donor Model**

This option is essentially a Public Private Project (PPP/P3), which is an agreement between private and public entities. P3s are relatively new in the United States but are quickly becoming widespread. This model encourages the use of a new technology, in this case solar power, by lowering the upfront installation costs through the involvement of a private party donor who utilizes available tax incentives (MARCS and ITC). The private party donor finances the solar installation, takes ownership of it and acts as a second utility by selling energy to the University through a PPA. We estimate that a private donor could provide solar energy to UMN at a minimum rate of $0.10/kWh rising by 2% annually. The donor would then depreciate the solar energy system asset and sell it to the University.

**Student Green Fees**

Student green fees can be mandatory or optional student fees for a specific purpose or part of routine budget cycle allocation. The University of Minnesota’s Crookston campus has a Green Fund and the Duluth Campus Student Services Fee approved a $100,000 Green Fund to install solar on UMD campus in 2016 as a result of SUN Delegation efforts.

**Revolving Loan Fund (RLF)**

A RLF provides capital for projects that create some level of return or cost savings that then are used to repay the fund until the full project cost has been paid off. The most common source of seed capital is administrative funds but student fees, student government funds, pre-existing efficiency savings, and donations have also been used to seed RLFs.

**Tax Exempt Lease Purchase Agreements**

Tax-exempt leases are structured so that the full cost of the project assets is amortized over the lease period. Contracts typically include a nominal purchase option (e.g. $1) which the lessee is expected to exercise at the end of the lease period. Tax-exempt leases are easy to enter and offer flexibility, making them useful for relatively small projects in the range of $1 to $5 million. However, this
financing arrangement is likely to be less economical than tax-advantaged debt or third-party ownership because it has a higher effective interest rate than municipal debt, yet cannot take advantage of tax benefits, and must assume operations and maintenance as well as performance risk.

Tax Advantaged Debt

Clean Renewable Energy Bonds (CREBs) may be used to finance renewable energy projects and are issued by electric cooperatives, government entities, and certain lenders. The bondholder receives federal tax credits in lieu of a portion of the traditional bond interest, resulting in a lower effective interest rate for the borrower. The issuer is responsible for repaying the principal on the bond. From the borrower’s perspective, CREBs are the equivalent of a zero-interest loan.

Pre-Paid PPA (Bond-PPA Hybrid)

A “prepaid” service contract capitalizes on both tax-exempt debt and tax benefits by having the tax-exempt site host issue tax-advantaged debt and use the proceeds to pre-pay a portion (e.g., 50%) of the power to be generated by the PV system over the contract term. The developer uses the prepayment to finance construction, but books the prepayment as income over time as it is earned when power is generated and delivered to the site host. Apart from the prepayment, the site host pays for any power generated above and beyond the pre-paid quantity during the contract term. Because the project benefits from both low-cost, tax-exempt debt financing and private sector tax benefits, the cost of power to the site host can be significantly lower than under other financing options. However, this model is only economical if legal and other transaction costs can be minimized.

Eutectics Financial Analysis

The University also hired local consulting firm Eutectics to analyze different financial models for investing in solar. In total Eutectics analyzed six different financial models for on-site solar: cash purchase, a traditional PPA, a PPA involving a donation, a Pre-Paid PPA, a tax-exempt lease purchase, and CREBS bonds. The financial analysis assumed a time frame of 25 years and a 3% discount rate. The model also assumed two MW of solar would be installed on campus, and valued the cost of avoided electricity at 9.2 cents per kWh. The analysis also operated under the following parameters:

- The option could not involve long-term debt on the part of the University.
- The University wants to be able to keep RECs or have an option to buy RECs.
- The University wants the investment to be cash positive.
VI. Recommendations and Conclusion

The UMN SUN Delegation worked with University Facilities, Energy, and Sustainability offices since Fall 2015 and has been an instrumental catalyst in the University’s decision to invest in solar. Since the SUN Delegation began in 2015, the University has taken the following steps to invest in solar:

**Community Solar Garden Subscriptions:** In March 2016, the University issued an RFP to purchase subscription services and ultimately selected a CSG being developed by Geronimo Energy, LLC. The purchase was presented to, and approved by, the Board of Regents Finance Committee in October 2016. The University subscribed to two MW of solar power for a 25-year commitment. Because of restrictions in Minnesota’s laws that restrict the size of community solar gardens as well as the percentage of a garden’s energy that an individual subscriber can purchase, the University actually subscribed to five separate one MW community solar gardens. Collectively the gardens are named the Equuleus Community Solar Garden. Over the life of the contract, the University is expected to realize a total savings of approximately $800,000. Based on current emissions rates, the project will offset ~55,300 metric tons of greenhouse gases over its lifetime. The University will pay the developer, Geronimo Energy, LLC, directly for the subscription. Charges will be based on actual production from the CSG and the University will not incur any upfront costs or have debt or capital invested in the garden. The cost of the subscription is expected to be less than the bill credit currently received from Xcel Energy.

What led the University to go through with solar this time, as opposed to the other times solar investment was considered?

"Economics have improved since the last renewable energy evaluation. The Community Solar Market has matured since initial launch - regulations are more certain and the marketplace of potential vendors is better established."

*Shane Stennes, Director of Sustainability*

As with any purchase, there is some inherent risk. Through the purchasing process the University has worked to manage that risk. Here are some examples of risk that were anticipated and addressed through the procurement process: If the garden does not get built or does not produce as much electricity as projected, the expected benefits described above are not realized or are diminished. The Minnesota CSG program was created through legislation and is regulated by the PUC. If the legislation or regulations change, the subscription may be impacted. However, these risks are seen as minimal and

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17 Geronimo Energy is a North American utility-scale wind and solar development company based in Minneapolis, Minnesota with over 1,500 megawatts of wind and solar projects throughout the United States.
18 For more information, see pg. 301-304 on this [facilities committee docket](link).
19 Actual emissions reductions will depend on the electricity the project is offsetting (i.e. how "green" is the grid at the time of generation).
in Spring 2017, the UMN released a second RFP looking for additional CSG subscriptions. While CSGs are continually being proposed, the UMN’s ability to subscribe to additional MW of solar from CSGs may be limited by availability, as there is also a great demand for CSG subscriptions. Minnesota Power has also approached the Duluth campus for a PPA to subscribe to 100 kW in a new CSG.

Was there a key voice or stakeholder that changed their stance and became pro-solar? What changed their mind?

“I am not sure anyone involved was anti-solar, but several people articulated legitimate concerns and questions throughout the process. Stakeholders and key decision makers endorsed the recommendation to proceed with Community Solar procurement as those concerns were satisfactorily addressed through information, data, etc.”

Shane Stennes, Director of Sustainability

On-Site Solar Installations: An RFP is currently in negotiation for up to four MW of on-site solar panels. Two MW will be located on the Twin Cities campus (West Bank and St. Paul) and the other two proposed MW will be located on the Morris, Crookston, and Duluth campuses.

University of Minnesota Solar Testbed: To enhance the research and education goals of the University, students also developed a small transportable educational and research array. As a land grant university, the University of Minnesota has a responsibility to share knowledge and innovations that serve the greater good in the state. The trailer will be located on campus and students will be able to use the array to charge electronics such as cell phones and laptops. While the testbed array would be hosted on campus as a living laboratory, there would also be potential to use it for educational activities off campus. Click Here to Read the Full Solar Testbed Proposal

Duluth Student Green Fee: UMD Duluth will be installing an additional 33 kW array, which will be purchased directly using funding from the $100,000 obtained from the Student Services Green Fee.

Solar Added to New Construction: In addition, the University’s new bell museum will have solar as an educational asset. The Bell museum will have a 29.43 kW roof array and the building’s level two patio deck will have a semi-transparent array that is 583 watts. The new Bell museum is located on the St. Paul campus and was constructed in 2016/2017.
**Xcel Energy Renewable Connect Program:** Xcel’ Energy’s Renewable Connect Pilot Program was recently approved by the PUC. The University submitted a letter of support to the PUC for Xcel Energy’s Renewable Connect pilot program. Through this program, the University will potentially be able to subscribe to have up to 100% of the energy purchased from Xcel come from renewable sources.

With the commitments, the University of Minnesota has taken a step forward in advancing its campuses’ sustainability and resiliency through the deliberate decision to invest in solar power as a source of energy. The University recognizes this not only as a step forward towards sustainability, but also as a wise financial investment.

**The Benefits of Solar Investment**

These investments are expected to have significant benefits over time:

**Cost Savings:** Financial viability was a major factor that stakeholders at the University considered when deciding whether to invest in solar. The University expects to enjoy a positive ROI on solar investments.

**Sustainability:** Encouraging solar on campus has provided valuable opportunities to improve the University of Minnesota’s leadership in sustainability. The University of Minnesota recognizes climate change as one of the grand challenges humanity will have to overcome in the 21st century and is dedicated to research and is “driven to discover” new knowledge and solutions for the world. Renewable energy technology, combined with energy reduction strategies, have a huge potential to mitigate climate change without sacrificing our quality of life.

**Educational Value:** Solar arrays will advance research and education at the University. Data produced from a solar array and weather stations will allow researchers to create and enhance photovoltaic system models. The solar arrays would also allow educational site visits for classes and student groups across the University. In addition, this work has helped to make University of Minnesota a pioneer in university solar investment. For example, there are no case studies in existence of other universities who have a CSG subscription of more than one MW. The University of Minnesota is a pioneer in this endeavor.

**Support for Research:** Participation in the Solar Endowment program provided additional resources and legitimacy to students and faculty interested in solar. For example, students encouraged the University to consider opportunities for solar projects aimed at generating low carbon energy while providing valuable pollinator habitat.¹
**Positive Public Image**: Solar investment will increase the visibility of the University’s position as a leading institution on clean energy and combating climate change. While efforts such as energy efficiency and the CHP project have also had a tremendous effect on the campus’ carbon emissions, the visibility of solar panels will help the University to demonstrate a public commitment to sustainability. This could potentially help the University recruit sustainability-minded students and donors.

These actions surpass the University of Minnesota’s original goal of investing one MW of solar, demonstrate the UMN’s commitment to sustainability, and establish the University as a national model for higher education institutions. This roadmap outlines the process that the University took to investigate and ultimately invest in solar, and demonstrates some of many ways that other Universities throughout the United States can make environmentally, socially, and economically wise solar investments.