

Solar Power: A High Winds and Patagonia Collaboration

I. Introduction

Environmental degradation and climate change have been approaching an extent that has and will continue to threaten earth's natural systems and all species' wellbeing. This environmental degradation has undoubtedly been caused by humans, according to the 2013 IPCC report¹. The American public has begun taking note of these consequences and are making efforts to live sustainably, which is defined as meeting the needs of the present generation without compromising the ability of future generations while maintaining a functioning global environment, promoting social justice, and a strong economy.

In the face of these global environmental problems, the Fall 2014 Sustainability and the Campus class aimed to provide sustainability assessments and recommendations to departments at Macalester College. Our team of three chose to focus on the High Winds Fund (HWF). The HWF is a nonprofit fund, founded in 1956 by a gift from Dewitt Wallace, connected to the college. The Fund's mission is to maintain and improve the beauty, serenity, and security of the surrounding Macalester College neighborhood. The HWF oversees and owns many properties in the neighborhood including houses, retail shops, and apartments (see appendix A), but decided to have our group focus on preparing for solar panels on the roof of Patagonia. Although this is an off campus project, Macalester College has also strived to reduce its environmental impact since the 1960s. In 2008, the Sustainability Office was founded to aid in promoting the college's environmental responsibility. In that sense, the college declared its Sustainability Plan in 2009 with ambitious goals to reach carbon neutrality by 2025 and zero waste by 2020. The success of this pilot project may provide an example and incentive for adding solar panels to campus buildings.

During the project, we aim to document previous sustainability initiatives accomplished by the High Winds Fund, provide a cost-benefit analysis of installing solar panel for

¹ http://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_SPM_FINAL.pdf

Patagonia, and actually help to install solar panels by continuing to work with HWF and the chosen vendor.

II. High Winds Fund Sustainability Initiatives

The HWF has initiated numerous sustainable projects that have impacted both Macalester College and the community. Primarily, the High Winds Funds tries to help newly-started sustainability projects in the Mac-Groveland area by providing them with one-time initial investments. We came to a conclusion that installing solar panels on one of the buildings would further promote their commitment to sustainability. The following are past HWF projects related to sustainability:

- Purchased first HourCar to make their parking lot across from Patagonia the 11th HourCar hub.
- Bought a Nice Ride hub, the first one in St. Paul, next to the same parking lot.
- Piloted a project to collect compost in 104 Mac-Groveland households. Compost was collected on bike by Eureka. As a result, compost can now be dropped off behind Patagonia for a \$40 annual subscription. Eureka has expanded its compost areas to other parts of the city as well.
- Piloted selling Go-To Cards at the Campus Center to promote the use of public transit by college students. This project also provided a sample for the research conducted by Metro Transit.
- Funded two nonprofits that focus on transportation: St. Paul Smart Trips and Transit for Livable Communities. Helped to push for initiatives for pedestrian safety, bus rapid transit (BRT), and bike infrastructure.
- Created the medians on Grand Avenue and on Snelling Ave to calm traffic and make the neighborhood more pedestrian-friendly

- In their Ashland Avenue apartment (of 14 units), an old steam boiler was replaced with a 95% efficient hot water system for \$65,000, and new storm windows were added for \$35,000. Also, a window restoration company added modern windows, smaller, more efficient refrigerators in 7 units, and older less energy-efficient light bulbs were replaced with less toxic, long-lasting LED lights.
- In their 1664 Grand apartments above French Meadows a similar efficient boiler was added with outdoor sensors, including extra insulation.
- Pushed for composting in the neighborhood even before Macalester did. Tenants in two apartments and three houses were educated and the Waste Management company started collecting compostables.

III. Solar Panel Research and Progress

Fossil fuels such as oil and gasoline are non-renewable energy sources and their usage is one of the primary sources of atmospheric carbon dioxide (a greenhouse gas) and a main driver in global climate change. Practically applicable sustainable energy sources include wind energy, hydropower, geothermal energy, bioenergy, ocean energy, and solar energy. Due to Macalester's (and Patagonia's) urban setting, there are several limitations to which renewable energy source would be most successful. Considering the abundant roof availability and steady sunlight exposure on and around the Macalester campus the most cost-effective, efficient, and practical renewable energy source would be photovoltaic array (PV), also known as solar panels.

What makes this alternative more attractive is that, other businesses and residential homes have already successfully installed and operated photovoltaic systems for several years in areas next to the Macalester campus. Installing, operating, and benefiting from a PV system turned out to be very easy and practical in this neighborhood and are currently being done by several people near the campus. Among the HWF properties, the most ideal site would be the roof of Patagonia at 1648 Grand Avenue, because Patagonia is already energy-efficient and has little energy demand, meaning the solar project could potentially meet a large portion of its energy needs (about 50%)².

² PowerfullyGreen19.8kWCommercial.pdf

This pilot project's success will show that the installation of solar arrays is possible on campus to aid in reaching carbon neutrality by 2025. Also, since the college itself has been trying to install solar panels, its success will create a bigger impact by showing the possibility. With the college leading the way, this and similar future projects will help advance the neighborhood's shift towards renewable energy sources, which is one of the HWF's foundational goals. In addition, Patagonia will be able to further promote their sustainable reputation in the neighborhood.

1. Introduction to PV Systems

PV systems convert sunlight directly to DC electricity. They work any time the sun is shining, but more electricity is produced when the sunlight is more intense and strikes the panels directly. The electrons freed by the interaction of sunlight with semiconducting materials in the PV cells create an electric current³. The basic building block of PV technology is the solar cell. Multiple PV cells are connected to form a PV module or a solar panel. Multiple PV modules connect to form an array. Modules range in power output from about 10 watts to 300 watts. A PV system connected to the utility grid has these components (see figure 1):

- One or more PV modules, which are connected to an inverter
- The inverter, which converts the system's direct-current (DC) electricity to alternating current (AC)

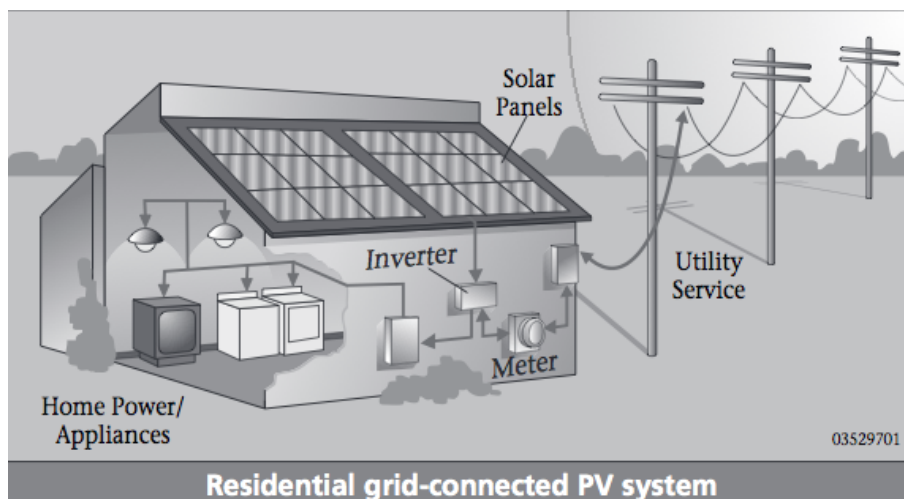


Figure 1. A diagram of a residential solar setup.

³ A Consumer's Guide: Getting your Power from the Sun. U.S. Department of Energy. <http://www.nrel.gov/docs/fy04osti/35297.pdf>

2. Finance

When installing a PV array, the most important criterion is whether the long-term financial benefits of the installation exceed the initial cost. Since a solar array is a consistent and reliable energy source, it is easy to predict payback periods, project how much energy will be produced annually in the future, and how much money can ultimately be saved from producing electricity instead of purchasing electricity from the grid. When making these calculations one must consider all of the available rebates that make installing an array more economically feasible. The following is the major rebates available for solar arrays installed in Minnesota:

- Federal Business Energy Investment Tax Credit (30% of initial cost after installation)⁴
- Xcel Energy Minnesota Solar Rewards program (\$.08 per kWh production, paid annually for 10 years)
- Made-In-Minnesota (\$.13 per kWh production)⁵

There are two important things to note regarding the incentives. First, due to Minnesota state regulations, any agency (including an individual, a business, or a nonprofit) planning to install solar arrays can only apply to **one of the two last incentives** (Xcel Solar Rewards Program and Made-In-Minnesota reward.) Second, nonprofits such as HWF **cannot** apply to Federal Business Tax Credit because they do not pay taxes. Thus, businesses planning to install solar panels can apply for Federal Tax Credit and one of the last two incentives. On the other hand, nonprofits cannot apply for Federal Tax Credit, so they can only apply for one of the last two.

Although it seems disadvantageous to nonprofits, a very easy option exists which solves our current problem of a nonprofit fund wanting to install a solar array without the ability to apply for federal tax incentives. Called a “swap” in the solar industry, a nonprofit can offer a suitable site for a solar array to a group of “commercial sponsors”. The commercial sponsors who own for-profit businesses pay for the installation of the PV array while receiving all tax benefits and rebates for 10 years, after which it no longer helps their business save money. Then, the commercial sponsor would sell the array back to the nonprofit for an extremely low price allowing it to own and benefit directly from the PV array for at least 15

⁴ http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US02F

⁵ <http://www.mn.gov/commerce/energy/topics/resources/energy-legislation-initiatives/made-in-minnesota/what-is-made-in-minnesota.jsp>

additional years until the warranty expires. Solar manufacturers provide a 25-year warranty (an industry standard) for their products including the solar panels and their parts. Usually, solar vendors already have a pool of commercial sponsors, and they coordinate the connections between nonprofits and business-owners.

3. Solar Vendors

While going through the process of selecting a vendor to install a solar array there were several traits/merits we investigated, such as:

- Company reliability
- Overall attitude towards renewable energies
- Previous projects in similar neighborhoods
- Knowledge of solar field and rebates available⁶

Similarly, solar vendors have specific details they look for at any site, which help them determine the feasibility and effectiveness of a proposed project. These details all eventually add up to a picture of how long the solar array will be exposed to daily sunlight, approximately how much energy the array will produce annually, and the total payback period. Some of these specifics are:

- Can the roof support the weight of array, including that of snow?
- Other local solar array's annual energy outputs
- Obstructions (trees, chimneys, other buildings, billboards)
- Angle, area, and type of roof

4. Solar Vendor Assessment

The following is a brief outline of solar vendors who work in the Twin Cities metro area, including their contact information.

Powerfully Green:

A small local company with several prior customer recommendations emphasizing their passion for renewable energies and sustainability in general. They have previous experience

⁶ <http://completesolar.com/10-things-to-consider;>
<http://www.americnpv.com/PDFs/AmSolar-10-Things-To-Consider-In-Your-Solar-Vendor.pdf>

with projects of this type in this neighborhood and have extensive knowledge and connections within and around the solar community. We have received a full quote from them.

Rebecca Lundberg - rebecca.lundberg@powerfullygreen.com - 763.438.1976

Green Circuit:

Another company with many engaged people who really want to install arrays and make a positive change in the world. Previous customer recommendations are positive, but most past works have been for larger arrays. We received several prior customer recommendations stressing their professionalism and reliability. We have received a full quote from them.

Zach Robinson - robinsonzacharyd@gmail.com - 651.206.7858

Dragonfly Solar:

A larger company with experience in investor-funded array installations. It installed currently largest array in Minnesota, and is extremely reliable and reputable around solar community. It would be a better contact for future larger installations such as solar arrays on the Macalester campus itself.

Steve Peters - s.peters@dragonflysolar.com - 612.246.3139

Cooperative Energy Futures: Timothy Den-Herder Thomas

<http://cooperativeenergyfutures.com/about/our-team/>

Northern Sun Power: Chris LaForge <https://www.midwestrenew.org/node/3057>

Sun Share: <http://mysunshare.com/>

5. Cost/Benefit Analysis

Here is a table derived from quotes submitted to us by Green Circuit and Powerfully Green highlighting financial costs associated with each array option after tax incentives and rebates. We received several options highlighting the financial difference between nonprofit and commercial ownership and the size of the solar array, ranging from 4.4 kW to 19.8 kW, solely dependent on the degree of tree trimming desired by the HWF on Macalester property. We suggest that a modest amount of tree trimming around the property be done, but not a

complete cutting down, which will result in a range of 10-15 kWh of power. The vendor would be able to determine the exact amount of trimming needed to achieve optimal energy production.

	Green Circuit		Powerfully Green			
Scenarios	10 KWh Non-Profit	10 KWh Commercial Sponsor	4.4 KWh Non-Profit	4.4 KWh Commercial Sponsor	19.8 KWh Non-Profit	19.8 KWh Commercial Sponsor
Cost	\$40,000 ⁷	\$12,000 ⁸	\$15,758 ⁹	\$10,804 ¹⁰	\$18,192 ¹¹	\$36,915 ¹²
Payback Period	9 years ¹³	6 years ¹⁴	18 years ¹⁵	7 years ¹⁶	9.7 years ¹⁷	4.4 years ¹⁸

Table 1. Cost-benefit analysis of solar vendors Green Circuit and Powerfully Green. (These figures are from proposals from each vendor.)

IV. Recommendations

After their visits to Patagonia’s roof, both Powerfully Green and Green Circuit sent us several proposals (attached) regarding payback periods and future costs depending on each scenario. However, all of their proposals suggested that allowing a commercial sponsor to buy and benefit from the PV array and then later sell back the array back after 10 years is the most financially beneficial choice for the HWF. Also, this choice will simplify the process for

⁷ GreenCircuit10kWNNonProfit.pdf

⁸ ibid

⁹ PowerfullyGreen4.4kWNNonProfit.pdf

¹⁰ PowerfullyGreen4.4kWCommercial.pdf

¹¹ PowerfullyGreen19.8kWNNonProfit.pdf

¹² PowerfullyGreen19.8kWCommercial.pdf

¹³ GreenCircuit10kWNNonProfit.pdf

¹⁴ Ibid

¹⁵ PowerfullyGreen4.4kWNNonProfit.pdf

¹⁶ PowerfullyGreen4.4kWCommercial (2).pdf

¹⁷ PowerfullyGreen19.8kWNNonProfit.pdf

¹⁸ PowerfullyGreen19.8kWCommercial.pdf

the HWF, all that is necessary is to compare the cost and fees for each solar vendor¹⁹, and determine which vendor to conduct the rest of the swap process with. Both solar vendors have pools of commercial sponsors that include different types of businesses that want to receive solar tax credits and rebates. Thus, without difficulties, the vendor would be able to find a commercial sponsor, pay for it, and then install the PV array on Patagonia. Since Patagonia is a tax paying business, we think it would be possible to ask Patagonia representatives if they would be interested in paying for the array by being the commercial sponsor. On the other hand, if Patagonia is not interested, either vendor could quickly find a commercial sponsor from the pool who would buy the array. After 10 years, tax incentives will expire and the commercial sponsor would sell the array back to the HWF for permanent ownership, with a continuing manufacturer's warranty of 15 years. If this option is pursued, the HWF will be able to arrange for a solar array to be installed on top of Patagonia immediately without much effort, promoting sustainability and showing Macalester and the surrounding community that renewable energy is possible and financially beneficial. After 10 years, the HWF will then buy back the array for a considerably cheaper price. This action would help propel Macalester and eventually the greater Metro area into a more sustainable future.

V. Conclusion

Solar power is a necessary step towards a sustainable future. It will allow individuals, organizations, and businesses to take advantage of pollution-free energy while reducing their dependence on the energy grid. The HWF, which has a history of funding sustainability initiatives in the Mac-Groveland area, is seeking to add solar panels to the roof of their business, Patagonia, on Grand Avenue. Taking our research in solar power, chosen qualifications, and financial incentive programs into account, we recommend that HWF hire one of two solar vendors and let a commercial sponsor (perhaps Patagonia) buy and benefit from the array. After 10 years, we recommend the HWF buy back the solar array for a reduced price. In the future, if this project is successful and profitable, it will show that it is natural for Macalester College to begin attempting to install their own solar panels to fulfill their goal of carbon neutrality by 2025. At the moment, the MacCares organization is already researching and vetting vendors to begin an analysis for buildings on campus. Markim Hall,

¹⁹ For the coordination fees, Powerfully Green charges the commercial sponsor an \$4,000 upfront fee, Green Circuit charges the commercial sponsor a fee of 50% of the installation cost.

the Leonard Center, Olin Rice, and Dupre Hall have been selected as buildings potentially able to produce solar power on a large scale. If a large scale PV array was to be undertaken by Macalester College, we would recommend that a commercial sponsor be found (by the chosen vendor) to pay for the huge initial cost, while the College can benefit from sustainable electricity. Eventually, Macalester could buy back the array for a fraction of a price which would launch the sustainability initiative towards success.

Appendix

A. The High Winds Fund Properties

1798 Ashland

1662-64-66 Grand Avenue

French Meadow & apartments

Houses

1657 Lincoln

1661 Lincoln

1665 Lincoln

1673 Princeton

Scotsdale (1573-79 Grand)

1579 Grand / Breadsmith

1577 Grand / Jamba Juice

1575 Grand / The Squire Barbershop

1573 Grand / Saint Paul Cheese Shop

Lampert Condo

38 South Snelling / Common Good Books

Grand Avenue

1648 Grand / Patagonia

1681 Grand / Pad Thai

1674 Grand Avenue (retail & apartments)