From Roofs to Rivers: Moving the Needle on Skidmore's Sustainability Goals

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Executive Summary

Increasing levels of greenhouse gases and pollutants in our atmosphere have led to individual, institutional, and governmental action, yet global temperatures continue to rise. Although it's clear fossil fuel consumption is directly linked to climate change, 83% of Skidmore's energy still comes from fossil fuels. Skidmore has committed itself to sustainability by setting goals in five areas: energy, food, lands and grounds, waste, and engagement. Our research focuses on addressing the energy and engagement goals. Our research has culminated in a feasibility study in which we identify renewable energy projects that will help Skidmore address its energy and engagement goals.

The first component of our findings portfolio is Solar on Campus. With this project, we propose that Skidmore harness the potential it has in all of its rooftops by installing solar panels on its main campus. We conducted a feasibility analysis to determine how this could be done, and in doing so we learned that Skidmore could either enter into a Power Purchase Agreement (PPA), or a lease agreement. In both cases, Skidmore would not own, operate, or maintain the panels, but rather would be a third party leasing its rooftop space to a solar provider, who would financially compensate Skidmore in return. We recommend Skidmore opt for the lease agreement, mainly because it would involve less uncertainty regarding Skidmore's compensation. With this option, Skidmore would be projected to net $49,488 in the first year and $1,264,160 over 20 years. We propose that Skidmore use this revenue to start a "Green REC Fund," which would be used to purchase RECs that would allow Skidmore to claim renewable energy use and GHG emissions reductions. With the first year revenue from the lease, Skidmore could purchase 2,206 RECs, which would give Skidmore a 9.2% increase in electricity from renewable sources, and a 5.2% reduction in GHG emissions.

The second component is a subscription to a utility-sponsored Community shared solar project. This project would involve no investment on behalf of Skidmore, is available for purchase immediately, and would lower the price we pay per kWh on Skidmore's auxiliary electricity meters by 10%. We determined that, if implemented, this would save Skidmore $9,350 annually. If these saving were reinvested into the purchasing of RECs, the amount of energy Skidmore receives from renewable sources would increase by 2%, and our overall GHG emissions would be lowered by 1%.

The third component is a proposed alternative student housing option in the form of tiny homes. As the average American house size continues to grow, so too does their environmental footprint and GHG emissions. Tiny homes, in part, are a response to over consumption and global climate change through sustainable living and practices. We propose that Skidmore College develop a course in which students learn how to design tiny homes in the first semester and build them in the second. Students could then use their knowledge to teach their peers and Saratoga community members about the benefits of sustainable living. We estimate that tiny homes could be built by students for roughly $30,000. If Skidmore charged the same price to live in tiny homes as a single occupancy residence hall, the tiny homes would have a payback period of just over three years. These tiny homes will primarily address the engagement component of

Skidmore's Campus Sustainability Plan by allowing students to live in direct contact with solar power.

For our final component, we recommend that Skidmore look to hydropower. We worked with New England Hydropower, a Massachusetts-based hydropower company that specializes in restoring old sites with Archimedes Screw technology, and identified a potential site situated on an old canal system in Upstate New York. The project, which is projected to have a 200 kW nameplate capacity, represents a profile of an existing site ready for development. We believe that this project, or one like it, would constitute a great addition to Skidmore's renewable energy portfolio.

Together, the Solar on Campus and Community Shared Solar projects would result in a 11.2% total increase in energy from renewable sources and a 5.2% reduction in greenhouse gas emissions if the revenue and savings were used to purchase RECs. With the additional power that could be generated from a future hydropower facility, Skidmore has the potential to achieve its energy goals.

Introduction

Humans have understood the concept of the greenhouse effect for at least a century, but it wasn't until 1990 that the Intergovernmental Panel on Climate Change's (IPCC) First Assessment Report affirmed that global warming is a serious threat (Chasek et. al, 2017). Since then, four additional reports have been published, with the most recent report concluding that "human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history." It also stated that anthropogenic greenhouse gas emissions are "extremely likely to have been the dominant cause of observed warming through the mid-20th century" (IPCC, 2014). These claims are evidenced by observed increases in temperature in the atmosphere and the oceans that correlate tightly with historical anthropogenic greenhouse gas (GHG) emissions. Currently, the concentration of CO_2 equivalent GHGs in the atmosphere is around 405 parts per million (ppm), and the IPCC contends that keeping this concentration at 450 ppm or lower by 2100 will "likely" maintain warming below 2°C over the 21st century relative to pre-

International Efforts

It is clear that the GHG emissions being released through our energy production and consumption are directly linked to climate change, yet internationally 83% of our energy still

renewable energy is proving able to meet demand for reliable, affordable, and environmentally sustainable energy. Having only recently been recognized as a "mainstream" energy source, renewables are fast becoming preferred, and demand for them is increasing.

Action Being Taken

Across the globe, people are fighting for the implementation of renewable energies in an effort to take action on climate change. The fight against climate change is happening on the individual level (e.g. people installing renewables on their homes) and, more importantly, on a collective level. Businesses are increasingly deciding to make their business practices more sustainable in various ways. For example, the software company Adobe aimed to achieve a 75% reduction—from 2000 levels—in its GHG emissions by 2015, and it used renewable energy technologies, including solar arrays and fuel cells, to meet its goal (Best Practices in Sustainability, 2014). Along with businesses, individual communities are taking action to reduce their GHG emissions. For instance, 20 states and 50 cities—in an initiative dubbed "America's

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educating their students and encouraging them to become leaders and activists genuinely int

Princeton Review, 2019). Skidmore's commitment is also reflected in its Campus Sustainability Plan. The Plan, published in 2015 and setting goals to achieve by 2025, states that Goal 1 of Skidmore's Campus Sustainability Plan is to obtain 60% of the College's electricity from

Methods

With this research opportunity, we chose to evaluate and recommend a suite of potentially viable projects for the College to consider. In exploring this variety of projects, we completed financial analyses and feasibility studies for various renewable energy technologies, as well as investigated current net metering and remote net metering regulations, along with the current renewable energy certifi

Financial analysis found that the lease agreement would generate $1,264,160 in revenue over 20 years, while the PPA-style agreement would generate $2,084,781 over the same period (Conrad, 2019). The revenue breakdown for the lease agreement is shown in Table 1, while the revenue breakdown for the PPA is shown in Table 2.

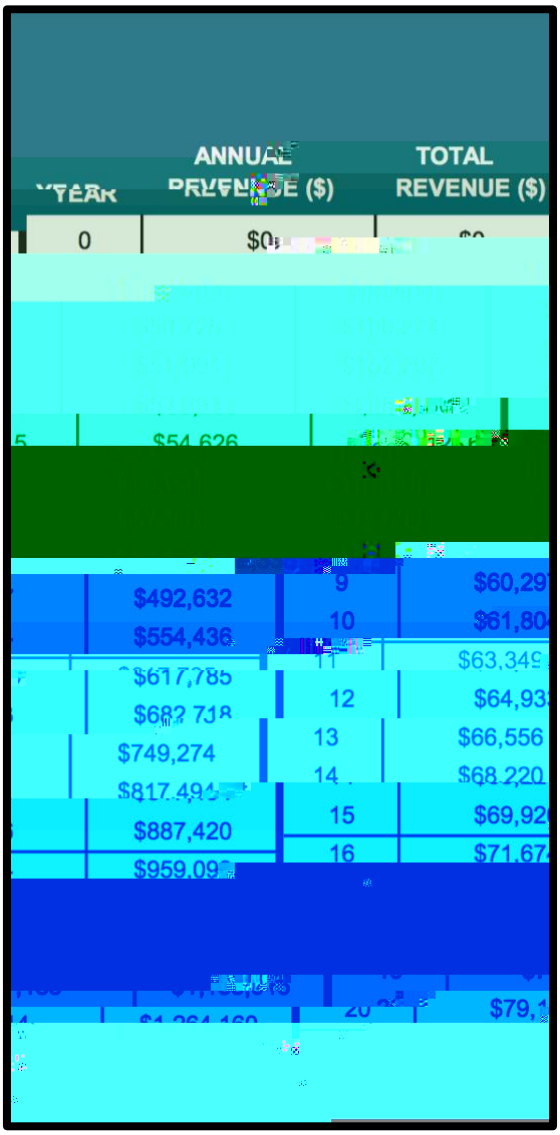

Table 1: Breakdown of potential revenue generated by lease agreement (Conrad, 2019).

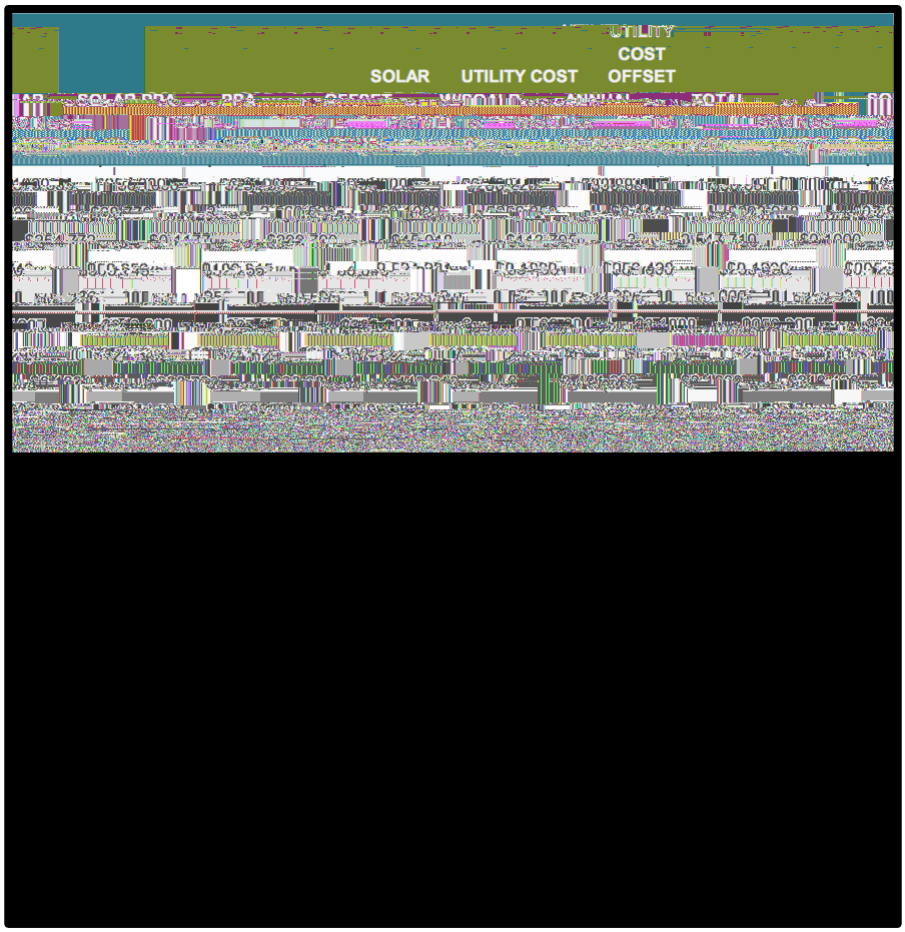

Table 2: Full financial breakdown for PPA, showing both the factors that would determine generated revenue, and the 20-year breakdown of potential revenue (Conrad, 2019).

Unfortunately, because Skidmore would not own the panels, Skidmore would not be able to claim the environmental attributes associated with the electricity they generate. This means that Skidmore would not be able to count this electricity towards its energy goals, and in turn would not be able to count the GHG emissions reductions towards its GHG goal. This would be the case despite the fact that the panels would be installed "behind the meter," meaning we would be consuming the electricity generated by the panels. This situation would be essentially the opposite setup that Skidmore has with its Denton Road Solar Array, in which Skidmore does not receive the electricity from the panels but does receive credit for renewable energy generation and consumption.

With the revenue generated by these projects, however, Skidmore has the ability to make some progress on its goals. We recommend that Skidmore buy Tier 1 Renewable Energy Credits (RECs) to help the College reach its renewable energy and GHG emissions reduction goals.

A renewable energy facility produces two products: electricity, and the environmental

Figure 2: Dials with needles that show potential progress towards Skidmore's energy goals, accounting for progress from Solar on Campus.

of RECs, which would help Skidmore reach its renewable energy and GHG emissions reductions

acquire shares of solar energy and receive credits or savings on monthly electric bills”

the rooftop solar section, the money sa

having electricity from renewable sources at their homes. Even when considering this expressed interest, however, there is still a fair amount of uncertainty involved because all that is known is public interest. Community members have yet to sign on to the program, meaning we can't know if enough people will sign on to make it economically feasible until the site is already in operation.

Figure 3: Amount of Saratoga County residents and their interest in renewably sourced electricity (n=83) (Opportunities for CSS, Brown & Hoffman, 2018).

The other option for accessing CSS involves Skidmore signing onto a contract with a utility-sponsored CSS project. We found this model to be very appealing because it would instantly give us a 10% reduction on our current price per kWh. In contrast to the investment

Figure 4: Dynamic Energy Altamont Community Solar Garden.

In our conversations with Dynamic Energy, they told us that this site is relatively new, and that there is currently enough available energy to fully cover the 550,000 kWh utilized by Skidmore's auxiliary meters annually. Furthermore, this would immediately reduce what Skidmore pays for electricity on these meters by 10% (Starr, 2019). This would lower the price we pay for electricity at these meters from 14.3¢/kWh to 12.6¢/kWh. While this would still be a

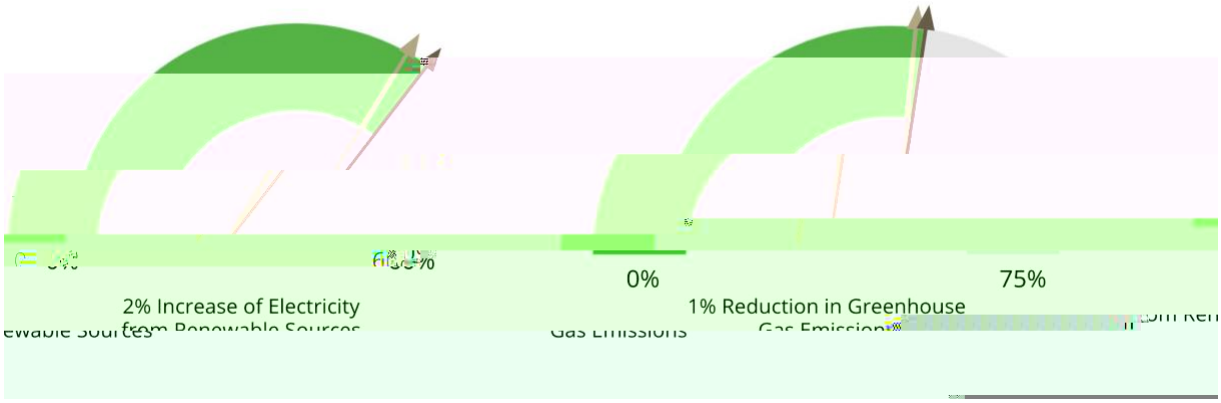

Figure 5: Dials with needles that show potential progress towards Skidmore's energy goals, accounting for progress from the CSS contract option.

Alternative Student Housing

The alternative student housing project we are proposing will take the form of tiny homes retrofitted with solar power and sustainably sourced materials. In the past 50 years the average size of the American home has nearly tripled (Adler, 2006), we consume nearly twice as much (Leonard, 2002), and it is estimated that people from the U.S. spend a total of $1.2 trillion on non-essential goods (Whitehouse, 2011). The tiny home movement is, in part, a reaction to increasing consumerism and the overarching issue of global climate change.

The carbon footprint of tiny homes is fourteen times less than the average American household; the average American household produces 28,000 pounds of carbon, whereas the average tiny home only produce 2,000 pounds of carbon (Stanford, 2015). Tiny homes are also considerably less expensive. The average American home costs $272,000, while the average tiny home costs $46,300. Roughly 68% of tiny home owners do not have a mortgage, compared to 29.3% of traditional homeowners (Huffpost, 2013).

Although acceptance of tiny homes is growing, it is often still difficult to “legally” live in tem. By and large, building codes and regulations require a minimum square footage for new-

construction homes and tiny homes typically do not meet that minimum. However, many grassroots organizations are pushing legislatures to include tiny homes in their building codes

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has designed and built tiny homes before and has significant experience in construction, unless there exists a professor at Skidmore who meets this criteria.

This course would increase engagement because students and community members would be integral to the proliferation of tiny homes. The rough estimate costs of a student-built tiny house are outlined in Table 6. We estimate that a student-built tiny home would cost $30,200. Charging the same as a single occupancy residence hall, the payback period would be 3.3 years.

Student Built Tiny Homes	**Cost ($)**
Structural Costs	11,800
Solar Panels	3,000

Having sustainable tiny homes on campus would act as an engagement opportunity not only for students and tour groups, but also for the surrounding community through community education and outreach. With a payback period of a little over three years, there is room for future students to continue to build tiny homes and encourage more students to practice daily

indeterminable. This site does, however, represent a profile of an existing site not ready for

Skidmore to undertake feasibly. The subscription model has almost no uncertainty associated with it; we know where it is, we know that we could potentially sign up tomorrow if we wanted to, and we know that we would start saving 10% instantly. Therefore we recommend that Skidmore subscribe to an existing CSS project as soon as possible in order to continue contributing to our Campus Sustainability Goals.

Between the prefabricated or student built tiny homes, we recommend that Skidmore choose the student built option. The payback period for the student build option would be nearly half that of the prefabricated option. The student built option would also directly address the College's engagement goal through extensive student involvement with the creation of the tiny homes and tours for visiting students and the greater Saratoga Springs area.

Together, the proposed Solar on Campus and CSS projects would give Skidmore an 11.2% increase in its energy consumed from renewable sources, and a 4.2% reduction in GHG

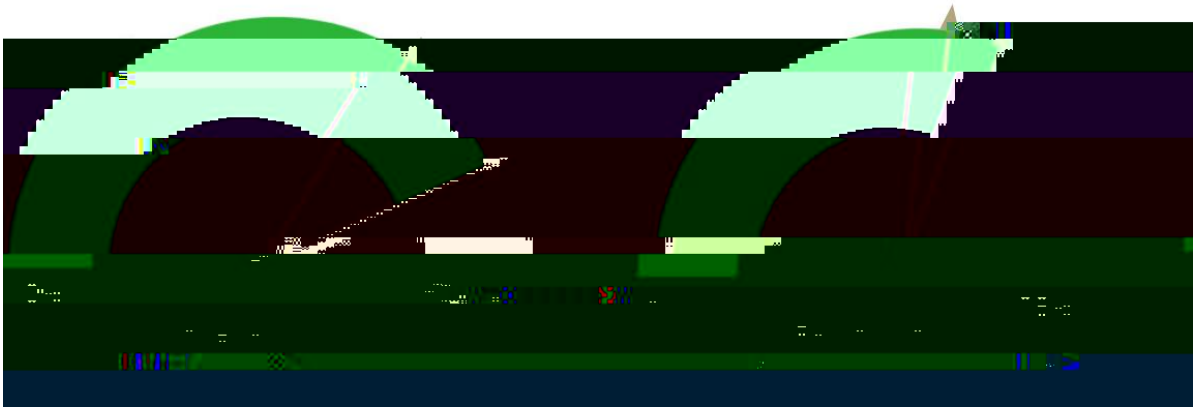

Figure 8: Dials with needles that show potential progress towards Skidmore's energy goals, accounting for progress from Solar on Campus and the CSS contract option.

Appendix: Contacts

Solar on Campus

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- Todd Fabozzi, Urban Planning, Visiting Professor, Chair Member of Saratoga Springs Planning Board: todd.fabozzi@skidmore.edu

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