Renewable Energy Analysis for Tulane's Climate Commitment

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Solar Photovoltaic

A Proven Energy Solution

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Solar PV: A Proven Energy Solution

INTRODUCTION

Solar PV technology is the most proven energy solution and the best option for the Tulane University campus. The project could be implemented immediately with a short timeline of about six months. Average Americans have become more aware of their environment and active advocates for the development of renewable energy. The push for clean energy will eventually create economies of scale and a reduction in prices over time as demand increases for solar and other renewable sources of energy. The benefits of installing solar technology onto the Tulane buildings would have an impact beyond the immediate Tulane community. The initiative would not only instill a value for alternative energy sources in students but also inspire other organizations and companies in the greater New Orleans region.

History of the Technology

In 1839, French physicist A. E. Becquerel was the first person to recognize the photovoltaic effect of converting light into electricity. Later, the first solar cell was built in 1883 by Charles Fritts as coated semiconductor selenium with an extremely thin layer of gold to form the junctions. Eventually in 1954, Bell Laboratories was experimenting with semiconductors and accidentally realized that silicon doped with certain impurities was very sensitive to light. Daryl Chapin, Calvin Fuller and Gerald Pearson, invented the first practical device for converting sunlight into useful electrical power, which eventually resulted in the production of the first practical solar cells. These first cells had a sunlight energy conversion efficiency of around 6% and since then the efficiency rate has improved to up to 37%.

HOW SOLAR PV WORKS

Photovoltaics (PV) use solar cells to convert the sun’s energy into electricity. When sunlight hits the semiconductors in the solar cells, an electrical charge is generated. Typically, solar PV technology is a supplement to other forms of energy.

Variables looked at during a feasibility study include roof condition, roof orientation, shading, available roof space, and current electricity usage and costs. HGCI can also provide free solar analyses of any roofs on campus to get an idea of the roof's solar potential.

Types of PVs

Mounted PV: Solar panels are mounted on the roof or walls of a building or on the ground.
Building Integrated PV (BIPV): Light, flexible, thin sheets of PV are laid over a thermoplastic roof. Thin film PV is cheaper option but less productive than mounted PV.
Tiles: Traditional-looking roofing tiles are integrated into a roof.
Lamps & Bus Shelters: Street lamps and bus shelter lights run by solar panels are another option for solar installations.

Evaluating PV Technology for a Building Project

Tulane University must look at several factors to determine if installing a solar PV is the appropriate technology for the building project. The PV panels would either be roof or ground mounted, though with the limited ground space and urban campus, we recommend installing panels on the roof space. Tulane should capitalize on the existing flat roof structures which allows for the panels to tilt south and absorb the most sunlight possible. Tulane is suitable for a PV system because the roofs are not shaded or obstructed. Further analysis of shading on campus buildings can be done by a vendor or HGCI to assess the roof's production potential.

Installing solar PV panels is an investment that is worthwhile for an institution such as Tulane seeking long term benefits and use of the buildings. The roofs and buildings being used must have a long life span as it is expensive to remove the PV system and the payback will not be immediate. Finally, Tulane's historical buildings are exempt from solar energy if the only way to instill the panels is visible to the public.

There is no official PV certification but there are several date monitoring systems for equipment. However, the North American Board of Certified Energy Practitioners is a voluntary certification program for PV installers.

Important Measurements

The initial assessment will include a calculation of energy generated from installing the PV panels. Currently panels range in size from 3 feet by 1.5 feet to 5.5 feet by 2.7 feet. Typical mounted PV systems weigh 5-10 pounds per square feet while BIPV systems weigh about 12 ounces per square feet. For each kilowatt of mounted PV installed in a northeastern state, (about 100 square feet), 1,200 kWh of electricity is produced and in addition BIPV produces about 816 watts per 200 square feet. Costs vary for PV systems, but generally flat roof mounted PV costs about $0.25/kWh over a 20 year time period. In this report we will further analyze the cost for Tulane University in detail.

EVALUTION OF TULANE CAMPUS

Assumptions

When creating the CAP table for the evaluation of solar PV technology, we made several assumptions. The project assumes that we are building one megawatt installation on selected building throughout the uptown campus. Our calculations presume that one seventh of the entire eligible university buildings would be included in the solar installation plan. We are assuming that the university will implement solar technology in phases beginning with a trial period using a small portion of the campus facilities. The attached CAP table illustrates three scenarios to show how the technology will be implemented under different financing options and how these factors influence the Net Present Value.

Costs

We calculated a life time project of 30 years which will be paid off at the end the period. Our main assumption is that we will install Photovoltaic panels on the Uptown Tulane campus roofs, using the latest PV Technology at $6 dollars per Watt. Although PV technology is said to be maintenance-free, we are assuming we will incur in other costs such as insurance and minor repairs at .02 cents per Watt. The total and annual cost based on our research and assumptions will be $20,000.

Benefits

For every installed 1,000 Watt of PVs, the monthly savings or costs will be reduced by 125 Kw/h considering the Louisana sun exposure. The constant solar flow will result in a 12.56 cents per Kw/h (.1256 from spread sheet, "Estimating CO2 savings"). The total annual generation savings, considering the sun radiance, will reach 1.5 million Kw/h, also giving us a monthly energy savings of $188,000. Please refer to the attached CAP table to further evaluate the benefits of implementing solar PV technology.

FINANCING

Tax Credits

In Louisiana, there are large tax credits available for the installation of photovoltaic systems. Home owners and commercial property owners can receive a 30% Federal tax credit and a 50% State tax credit. The total of these credits can cover 80% of the cost of an entire PV system. Tulane is a non-profit entity, so it does not have taxes that can offset the cost of a PV system. Luckily, there is a way for Tulane to take advantage of the tax credits available for solar installations. By involving a third party that can take advantage of tax credits for PV systems, Tulane can create an arrangement that allows Tulane and the third party to benefit financially from the installation of a PV system.

Third Party Financing

The third party arrangement is called a power purchase agreement. This agreement makes it so the university can install a large PV system with no upfront cost. In the power purchase agreement, a third party pays for the PV system, the maintenance, and assumes all risk related to the performance of the PV system. Tulane would pay a fixed monthly rate for the electricity provided by the PV system. This rate is usually less than the current rate that is paid to Entergy. There is typically a 15-20 term set for the power purchase agreement. At the end of the term, Tulane will either have the opportunity to buy the solar equipment or extend the terms of the agreement.

Loans

The government has created a new financing program called Property-Assessed Clean Energy (PACE) financing. This financing has a re-payment term that may not exceed 20 years. This program allows the residence or commercial buildings owners to access capital by borrowing money from the state or federal government, who obtains the money by issuing bonds or obligations. The property owner then pays back the money borrowed as an additional amount on their property taxes. This is another option that is not available to Tulane per its non-profit designation, which means it pays no property taxes.

The two primary means for Tulane to access the funds to buy, install, and maintain its PV system is through the power purchase agreement or an outright purchase of the equipment. Since the power purchase agreement requires no upfront costs and the risks of the PV system are the responsibility of a third party, the power purchase agreement is the best way to go for coming up with the upfront costs of Tulane's solar project.

Parallel Projects

In our discussions with local solar experts, we spoke with an area architect, John Williams. Mr. Williams put together a financing package for the Make-It-Right foundation that enabled the houses to have the cost of a PV system as well as 101% of the installation costs to be covered. He believes that there is a way for Tulane to install a 7 Megawatt PV system with $20,000,000 worth of equipment and additional value from roof repairs for free. Our team does not know all of the details of his plan, but it seems that he would use a third party investor. After the investor is paid off, Tulane would own the equipment and for the remainder of the life of the PV system would have the benefit of energy savings of approximately $500,000 a year. This proposal seems rather utopian, but if it is possible to install a 7 Megawatt system at no cost to the University and for the University to own the system outright after a third party investment period, then this a proposal that should be researched further.

RECOMMENDATION

Solar PV technology, though a not fully developed technology, is rapidly improving in short periods of time. As the technology matures, capacity will increase due to the introduction of nanotechnology and other future technology drivers. Research shows that one square meter of a solar panel will produce a much higher energy output in the next decade. Costs are predicted to fall due to additional new raw materials in addition to the silicon based panels. For example, new water based materials will result in a less expensive final product.

While Solar PV technology will continuously improve, we recommend that Tulane invest in Solar installations now. This investment is attractive to the university for several reasons. If done in full scale it will be one of the biggest on roof installations in New Orleans and Tulane could be ahead of the curve in terms of environmental initiatives and concern within the academic and local communities. Even by investing in a growing technology now, the solar panels will provide long term benefits to the university. For this reason we have developed and provided the three scenarios outlined in this paper. Especially in an academic environment, it is important to invest in a structure that is neither noisy nor obstructive, as solar technology fulfills both of these requirements unlike electrical generators or wind turbines.

The outcome of our analysis shows that investing in solar energy can be both financially and environmentally attractive. Tulane should be at the forefront of investing in energy alternatives that will be a standard source of energy in years to come. Particularly after Hurricane Katrina, the university has the opportunity to lead the city’s environmental initiatives and make strides in making New Orleans a center for social entrepreneurship and innovation.