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Solar Panel Installation on ECU Warehouse Campus

Introduction

In an effort to become more sustainable, operationally, East Carolina University has been pursuing numerous money savings initiatives. In addition, some of the initiatives will reduce ECU's impact on the environment while maintaining the social dimensions of sustainability. In line with this goal, Aaron Johnson, who has central receiving and warehouse responsibility, would like to install solar panels on the university-owned warehouses to provide power for the warehouse district and to demonstrate the feasibility of taking advantage of solar energy at ECU.

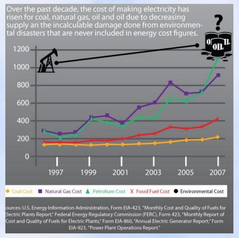

Figure 1: Energy resource trends. This table shows the increasing amount of non-renewable resources that are used to provide electricity for the United States.

Solar Energy

What is it?
Put simply, solar photovoltaic power is "the direct conversion of solar power into electric power."
Figure 2 to the right shows the decreasing costs of producing energy from solar systems.

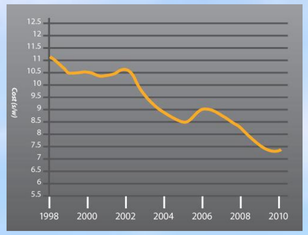

Figure 2: Cost of solar energy. This table shows the decreasing price of energy produced from solar systems.
(U.S. Energy Administration)

Figure 3 below shows how specific parts of the nation profit more from solar energy. North Carolina benefits from solar energy, though not as much as other states.

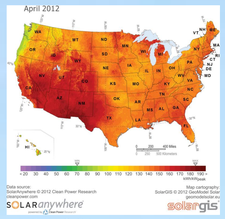

Figure 3: Nationwide solar radiation exposure map. This map shows the amount of solar radiation across the nation and the amount of radiation specific areas of the country receive as of April 2012.
(http://www.nrel.gov)

Production of photovoltaic electricity depends on:
- Level of sunshine and temperature
- Geographic location (latitude)
- The season
- Hour of the day
- Orientation and slope of photovoltaic sensors
- Pollution degree of the location
- Weather conditions (clouds, etc.)

A detailed explanation of how solar panels work can be found here

Current Solar Stats

Here are a few basic statistics relating to crystalline silicon solar cells:

- 14-19% efficiency rating
- Produce 4-4.5 kwh/m2
- Require larger space
- Components: add 4-8% to the total system price
  Ex: wires, conduit, connections, switches, breakers, and AC/DC disconnects.
- Ground Mounting: structure adds 5-7% of system cost, approximately $.30/Watt-.55/watt
- Track mounting costs $.50 for large systems $1.50-3.00/watt for small systems
- Commercial Sized Inverters cost $.59/watt, Convert DC to AC for residential/commercial use
- System cost in 2011 was approximately $6.80-9.90 per watt for grid-connected systems
- Maintenance is approximately $40/kW
- Off grid systems cost $13/watt

Warehouses

Located at 1150 S Greene St.
Greenville, NC

Figure 4: University warehouse. This is an exterior photo of the proposed warehouse for solar panel installation.

Currently used for storage of incoming products
Currently being powered by coal/nuclear energy from Greenville Utilities

Use battery-operated fork lifts and power jacks. Solar panels would provide energy to charge the batteries for these machines.

Approximately 5,300 sq. ft.
Usable roof area of 5,000 sq. ft.

Figure 6: Local map. This map shows the location of the proposed warehouse and the surrounding area, including its relation to ECU's main campus.
(Google maps)

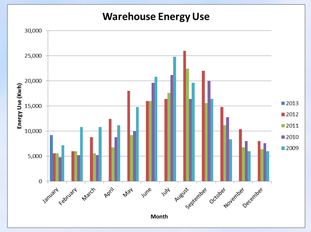

Figure 7: Warehouse energy use. This graph shows the energy use of the proposed warehouse per month over the last several years.

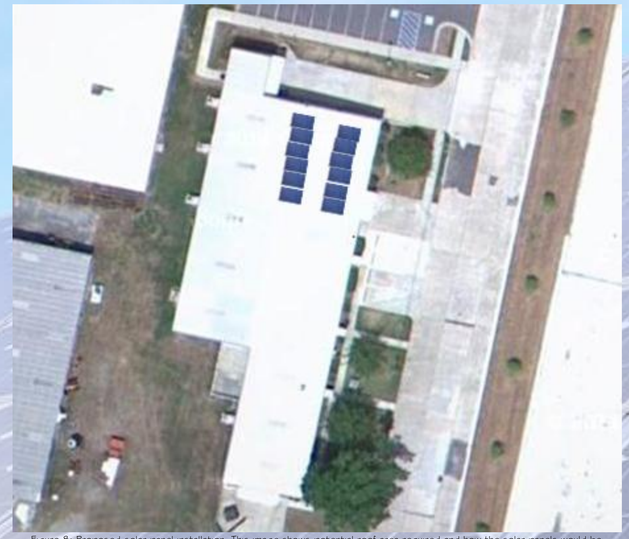

Figure 8: Proposed solar panel installation. This image shows potential roof area required and how the solar panels would be placed on the structure.

Environmental Impacts

By installing these solar panels, we will be able to reduce the impact on the environment. Providing 6,000 kW of energy from a clean, renewable source will reduce approximately 12,000 kg of coal from being burned. This will remove about 6,400 kg of carbon pollution. (http://www.savepower.nsw.gov.au/get-the-facts/power-use-in-nsw.aspx)

Figure 9: Power plant pollution. This image shows a power plant and represents the possible pollution that can result.
(http://animaleconomy.wordpress.com/pollution/)

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Cost

The following estimates were provided by Mr. William Smith of Green Power NC.

Solar panels within the city must be connected with Greenville Utilities Company (GUC).There are two ways to work with GUC with solar panels. The following chart provides the basic information to understand these two selections.

$0.06 Option	$0.13 Option
Greenville Utilities Company buys all the energy produced	Greenville Utilities Company does not buy any energy
	Energy produced offsets monthly utility bill
All energy produced is sold to Greenville Utilities	Any excess energy produced is given to Greenville Utilities for free

At peak performance, a 45 kW array would produce 76,500 kWh of clean, renewable energy per year. Considering the two options:

- Selling all the energy to GUC would earn approximately $4,590/year.
- Pursuing the $0.13 option would save approximately $9,945/year. Assuming the warehouses will be closed 8 days/month (for weekends), 2,266 kWh would be produced by the solar panels that would be unused and therefore given to GUC for free, equaling a loss of approximately $295/month.
- Subtracting this loss from the overall savings per year would create a net profit of $6,405/year.

Government Incentives

There are multiple programs and opportunities that assist in the purchasing of solar panels to reduce their cost of purchasing and installation.

NC GreenPower Production Incentive
TVA - Green Power Providers
TVA - Mid-Sized Renewable Standard Offer Program

Private-Public Partnership – This is another popular option local businesses have been pursuing.
- A private individual pays for the installation of solar panels on a state-owned building.
- After a period of 5 years, the private individual donates the panels to the building and receives all the subsidies and tax credits from the government.
- This is an alternative that is profitable for both parties involved.

Additional information for solar panel state and federal credits and grants can be found here, on the GreenPower of North Carolina website.

Summary

Based on our research, we recommend that East Carolina University pursues a private-public partnership, beginning with a 10 kW array. This would provide enough energy to charge the batteries for the fork lifts and power jacks. This would provide the foundation for future expansion and utilization of solar panels on other ECU campus facilities.

References

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