

Photovoltaic System Design at Kendall Dairy Farm

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Why Renewable Energy?

Most of the world's energy production comes from non-renewable sources, mainly the burning of fossil fuels. These resources are finite and are being depleted at an alarming rate, as well as being detrimental towards human health and the environment. For these reasons there has been a push towards "clean" renewable sources of energy such as wind and solar power (Photovoltaics 2004).



Greenhouse gas emissions
August 2009

[www.nicosiabuilding.com/images/green_house_gas.jpg]

These methods of generating electricity are favourable as they run clean and consistently with minimal harmful effects on the environment. Recent technological advancements have led to an increase in the efficiency and a decrease in cost of renewable energy products, which further contributes to their widespread gain in popularity (Photovoltaics 2004).



Solar Panel Set Up
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[Photo by M. Lefsrud]

Renewable Energy Policy in the Caribbean

To date, most Small Island Developing States (SIDS) rely on the import of fossil fuels to produce electricity. The combined effects of high import costs of fossil fuels, a relatively low domestic demand for electricity, and diseconomies of scale in terms of electricity generation make power production extremely expensive and unsustainable in the long term (Weisser 2004).

Renewable energy technologies (RETs) have the potential to reduce the cost of current electricity generation methods. This is mainly due to the abundance of renewable energy resources, such as wind and solar, in addition to the characteristics of SIDS that make fossil fuel based electricity production very expensive (import costs, low demand for electricity, etc). To do this successfully, however, requires a change in government energy policies. In many SIDS, fossil fuel based electricity is subsidized to bring faster economic growth and social development. This has a negative impact on RETs as it makes them less economically competitive and discourages potential investors. Energy subsidies promote economic inefficiency and undermine sustainable development goals. Removing these subsidies will increase the economic feasibility of RETs (Weisser 2004).

Kendall Dairy Farm

Situated in the beautiful rolling countryside of southeast Barbados, on land that was used for the production of sugar cane up until 1994, the Kendall Dairy farm is now the largest dairy farm on the island and is home to

over 200 cows. Due to its large size, the farm spends a significant amount of money on electricity, nearly \$50,000.00 USD annually. For this reason, Mr. Williams hosted three McGill University engineering students to analyze the feasibility of a renewable energy system on his farm.



Inside the Kendal Dairy Farm
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[Photo by M. Lefsrud]

system size of approximately 24 kW, or roughly 15% of his daily energy consumption, which if installed would be the largest solar panel set-up in Barbados. With the size of the system determined, the design process was able to begin (Pers. Comm. August 15th 2009 Williams).



Outside view of Kendal Dairy Farm
August 2009
[Photo by M. Lefsrud]

The Project

Due to the abundance of sunshine in the Caribbean and Barbados, the most obvious choice for a renewable energy system at the Kendal Dairy Farm was that of a solar panel set-up. The students, not having much experience in such a complex domain, picked up various solar panel books explaining the ins and outs of solar electricity to further their understanding. After reviewing these references, they then began their data collection and analysis (Bag, S “Photovoltaic Design and Installation” [Presentation] 2009).

Designing the System

Before designing the system, the economic feasibility of the project needed to be analysed. To accomplish this, the students developed an economic optimisation curve, which looked at the different payback periods for different size systems. After looking at the price of solar panels and the costs associated with a solar system, Mr. Williams agreed upon a

The system is comprised of mounted solar panels that produce DC power, an inverter that converts DC power to AC power, and the various wires and cables that connect the system to the service panel. The inverter was chosen based on its power input rating, meaning it must be able to pass all the power produced from the solar panels. It was hard to find as most inverters run on 60 Hz while Barbados runs on a 50 Hz system. The key is to match the voltage and current outputted from the solar panels with the existing voltage and current that the farm uses. These values for voltage and current were obtained by connecting a load-monitoring machine to the service panel for a period of 24 hours, which provided a read-out containing a breakdown of the energy usage. This determines how the solar panels are wired together in series and in parallel. Also, knowing how the panels are to be wired in series and parallel can guide the layout of the solar panel set-up.



Solar Panel Installation Site
August 2009
[Photo by M. Lefsrud]

How much will all this cost?

In order to successfully implement this project, a substantial initial investment must be made. Often times this initial investment is what deters people from installing renewable energy systems, which reinforces the fact that if governments and institutions could provide low interest loans, renewable energies could quickly flourish. However, during tough economic times like what we are facing today, available loans are few and far between. However, as Mr. Williams is closely affiliated with C.O. Williams, which is the largest construction company in the Caribbean, obtaining a relatively small loan should not be a problem (Pers. Comm. August 15th 2009 Williams).

The overall cost of the system will be around \$130,000 USD, with the majority of that being composed of the cost of the solar panels themselves. At \$660.00 USD per solar panel, 120 solar panels will result in a cost of approximately \$80,000 USD. The DC to AC inverter costs roughly \$30,000 USD, adding up to \$110,000 USD. The remaining \$20,000 will cover the cost of ground mounting brackets, wiring, disconnects, fuses, installation, and shipping of the various components. Although this may seem like a large price, this cost will be

recouped in less than 10 years with the electrical saving the panels will generate.

Conclusion and Recommendations

Overall, a solar power system would be highly beneficial for Kendal Dairy Farm, Barbados, and the environment. With a payback period of less than 10 years, Mr. Williams will be able to recoup the initial investment, with the possibility of this 10-year payback period being shortened if energy prices increase faster than current predictions. Not only will this be helpful to Mr. Williams and the Kendal Dairy Farm, but also this solar system can serve as an example of successfully renewable energy implementation, both locally and globally (Pers. Comm. August 11th 2009 Osbourne).



Large Scale Solar System, Spain
August 2009
[<http://imgur.com/hwVok.jpg>]

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