

A Comprehensive Analysis of Energy Systems at The Island School

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Developing Island School Energy Systems

The conservation and sustainable production of energy are major global objectives. Widespread use of fossil fuels has had a negative impact on the environment, but increased research and development are making renewable energy a viable option.

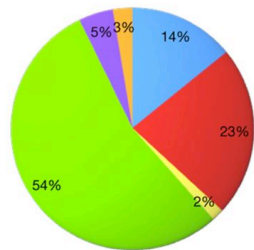
The Bahamas has one of the highest rates of carbon emissions per person (The Guardian). The Bahamas Electricity Corporation (BEC), which provides energy for most of The Bahamas, burns diesel to generate power, which contributes to high carbon emissions. The environment of The Bahamas is well suited to many forms of renewable energy including solar photovoltaic (PV), solar water heaters, ocean technologies and wind turbines (Haley Aldrich).

The Island School has taken steps to become an energy efficient campus that generates most of its power via wind and solar power that are tied into the BEC grid. This grid-tied system is more efficient than one using battery storage, and allows the school to send energy back into the grid when the campus produces excess energy. The Island School also conserves energy by only using lights and fans as needed, using energy efficient appliances, and using solar water heaters.

Although The Island School practices conservation and generates much of its energy by means of renewable energy systems, it can still work towards producing all of the energy that it uses.

The purpose of this project was to learn more about energy use on campus, and use that knowledge to assess where the campus could be more efficient. A better understanding of what uses energy on campus led to a focus on where future research should be directed.

Energy Use By Category



Fans account for 23% of the total energy consumption on campus. While this represents a quarter of energy consumption, this percentage would be significantly higher if air conditioning was used. Lights only account for 5% of consumption because The Island School has invested in compact fluorescent light bulbs (CFLs).

The Island School produced 150 gallons of biodiesel a week. On average this process takes about 50 kWh of energy, due mostly to the electricity used to heat waste cooking oil. As an alternative, The Island School can use gas from a biodigester for heating the oil.

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The SCUBA diving program uses a large amount of energy filling air tanks, using 1 kWh to fill one air tank. This is a considerable amount of energy that could potentially be minimized with future research towards better efficiency in the SCUBA program.

The area that uses the most energy on campus is the kitchen/dining hall, accounting for 52% of energy use on an average day. Of the 69 kWh used in the dining hall lights used 3.76 kWh, the aquarium used 4.66 kWh, miscellaneous kitchen appliances used 7 kWh and the walk-in refrigerator/freezer accounts for 53.79 kWh.

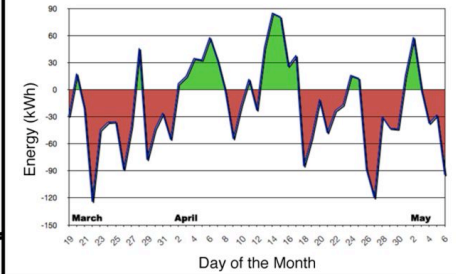
Energy Audit Methodology

The first step was to monitor the energy production and consumption on campus, using the Data Acquisition System (DAS). This system contains two separate power transducers that can be accessed through the campus intranet, and it is located at the main interconnection point with the BEC utility. The second step of the energy audit was a campus walkthrough to inventory devices that use electricity. The energy use of some devices was directly measured using either a Kill-a-Watt or HOBO energy meter. For other devices, published ratings were referenced. For all appliances, time estimates were determined based on use patterns.

These data were compiled to produce an accurate description of energy use at The Island School. Since energy use varies seasonally, this study used measurements and estimates taken from mid-March to early May. Averages over a seven-day week were used to minimize any day-to-day discrepancies.

Once data were collected and modeled, they were analyzed to determine areas for efficiency or further conservation. This analysis led to a list of proposals for energy conservation in the future, and expansion of energy production methods.

Energy Flow to BEC



The Island School campus is grid-tied, which means that it can take power from and put power back onto the grid. In this aspect, The Island School is unique in The Bahamas. This graph shows the amount of energy The Island School imports and exports from BEC each day, from mid-March to early May. The areas in red are times when energy was imported from BEC, meaning that The Island School was consuming more energy than what was produced on these days. The areas in green are times when energy was exported to BEC, meaning that the campus produced more energy than what was consumed.

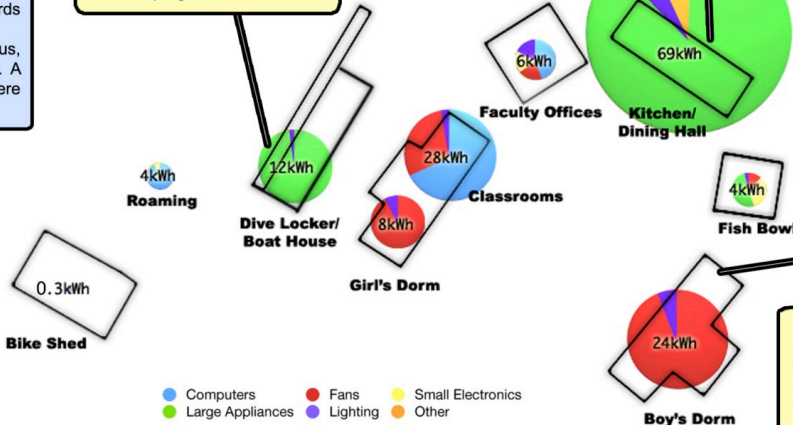
Future Recommendations

Biodiesel: When biodiesel is made, electricity used to heat oil uses almost a third of the energy that is produced in an average day on campus. In the summer of 2010, a biogas generator will be implemented to produce gas from solid waste and glycerin that can be burned to heat the oil, and offset that energy use.

Passive Cooling: To reduce the amount of fan use on campus, new buildings that are being built on campus should implement passive cooling systems.

Structural Efficiency: The average base load of energy consumption is very high in proportion to total energy consumption. This suggests that future research should be focused on increasing efficiency on a structural level.

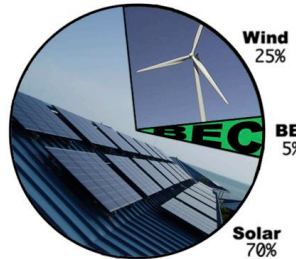
Night Producing Renewables: The Island School pulls the most energy from BEC during the night, due to a lack of solar production at this time. Due to line loss, BEC sends twice the energy than what Island School receives. Therefore, The Island School should look towards renewable sources that produce energy consistently at night.



- Computers
- Fans
- Small Electronics
- Large Appliances
- Lighting
- Other

The faculty apartments were omitted from the energy audit because it was estimated that they are net-neutral. These buildings produce their own energy via solar panels, and this energy is stored in a battery system.

Energy Sources at The Island School



This graph shows a breakdown of energy sources for The Island School campus. 70% of the energy consumed is produced from the on-campus solar panels, and the wind turbine produces 25% of the energy. During the period that data was taken, the campus only drew 5% of its energy from BEC.



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