Conclusions

Using waste vegetable oil in a diesel generator is a viable way of obtaining energy, but the temperature must be high enough and the generator needs to start and finish on diesel fuel.

Future Work

We recommend that the future installments of this IPRO build the vegetable system and test various aspects. For instance, testing how much diesel is needed to start and end with in order to prevent clogging, how hot the oil needs to be, finding just how much energy can be achieved from the system, etc. We also recommend the building of a biodiesel system in order to not only eliminate the need to purchase it, but to provide yet another alternate means of supplying energy.

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IPRO 337

Zero Energy Lab

ILLINOIS INSTITUTE OF TECHNOLOGY

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Background

The Zero Energy Lab is an ongoing project located on the fourth floor of Machinery Hall. The goal of this project is to create a lab space that will provide all of the energy it needs to function by itself, thus making it an energy neutral space. In its early years, the space was dedicated to metal smelting and processing, but was eventually retired from this task and became a storage area for a number of years. Then IPRO 337 began working in it, working on theories in passive lighting, installing photovoltaic cells to supply energy, and building and researching a number of other projects.

Problem Statement

The only current means of energy are supplied by the photovoltaic cells, but these do not supply the entire amount of energy needed and is only available when sunlight is available. So, in order to become a more efficient lab space, additional energy sources are required.

Objectives

Our goal for this semester was to design and propose a biofuel system that would supply the additional energy needed to the existing battery bank.

What is Biofuel?

Biofuel is a solid, liquid or gaseous fuel obtained from relatively recently lifeless or living biological material and is different from fossil fuels, which are derived from long dead biological material.

What is Biomass?

Biomass is biological material derived from living, or recently living organisms. Trees, grass, and vegetables are easy to grow and harvest. Every plant contains components that can give large outputs of energy. One can use the energy found in a plant's photosynthesis process to create fuel. Photosynthesis uses carbon dioxide and sun energy to provide a plant with the food, or carbohydrates. These carbohydrates can be mixed with other plant matter in order to create fuel or energy. When burned, biomass can create energy in the form of electricity, heat, or chemical energy.

What is Biodiesel?

Biodiesel is the name of a clean burning alternative fuel, produced from domestic, renewable resources. Biodiesel contains no petroleum, but it can be blended at any level with petroleum diesel to create a biodiesel blend. It can be used in diesel engines with little or no modifications. Biodiesel is simple to use, biodegradable, nontoxic, and essentially free of sulfur and aromatics.

Solar Thermal Systems

Solar thermal systems differ by the type of collector used to gather and store the sun's energy.

Flat plate collectors are the simplest and most common type. In these collectors, copper pipes wind back and forth through the flat panel collector, which is painted black to absorb heat. Then they're covered with glass to prevent heat from escaping.

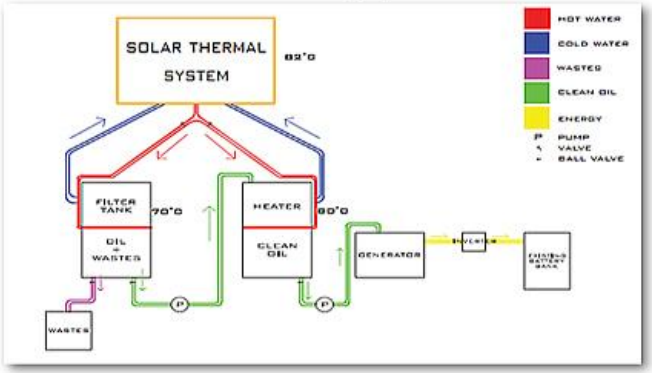
Another system uses evacuated tubes, which can heat fluids to much higher temperatures. Evacuated tube solar collectors are comprised of a series of parallel solar tubes connected to a header pipe, which allow 93% of solar energy to reach an absorber plate. This system is highly efficient and can produce temperatures from between 70 ºC and 170 ºC.

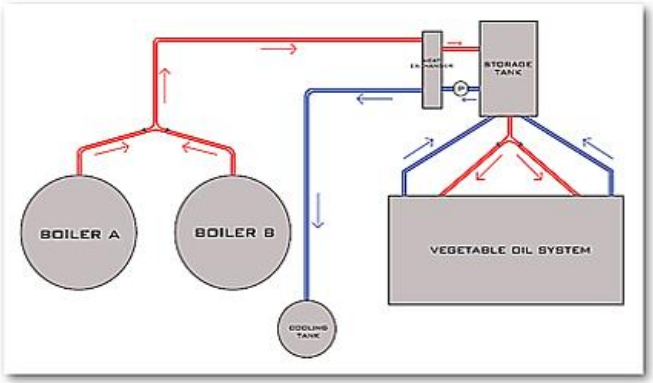
Obstacles

Some minor obstacles included the cost of the system and finding an energy efficient method of heating the oil. One of the major obstacles, though, was determining a location for the system. Without a working elevator, it's not logical to place it in the lab space for the moment since the system requires gallons of oil. Two options were to place it on the first floor of Machinery Hall and run an electrical line up to the fourth floor, or to place it in the Co-Gen Facility for testing purposes. There are drawbacks to each of these, but first floor has the much larger drawback of limiting our use of solar thermal, whereas the Co-Gen facility does not. With the Co-Gen location, though, there are liability issues at hand that still need to be resolved with the parent company before further action can be taken there.

The Vegetable Oil System

Shown below is the vegetable oil system. Waste vegetable oil is heated using solar thermal, and filtered into a second container, which heats it further to lower the viscosity enough for it to burn without clogging the generator. A key part is to make sure that the generator starts and ends on diesel. The generator purchased has a 3.3 gallon tank built in which should be sufficient for this purpose.





This image shows the vegetable oil system using two boilers in the Co-Gen facility. Waste heat is collected off of the boilers and carried through a heat exchanger. In the heat exchanger, heat is exchanged with another loop, which carries newly heated fluid into a storage tank. From this storage tank, it goes to the vegetable oil system just as the solar thermal fluid would.