

I PRO 337

Zero Energy Lab

Advisor: Nancy Governale-Hamill

Project Plan

Summer 2009



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1. Team Information

A. Team member roster

Last	First	Year	Major	IIT Email	Phone
Cheng	Lidens	2nd	PHYS	lcheng5@iit.edu	██████████
Gillmeister	Lauren	2nd	BME	lgillmei@iit.edu	-
Gupta	Vaibhav	4th	EE	vgupta17@iit.edu	██████████
Hamill	Nancy	Faculty	-	hamill@iit.edu	██████████
Karns	Nicole	3rd	MBB	nkarns@iit.edu	██████████
Padwal	Neha	4th	BME	npadwal@iit.edu	██████████
Patel	Priyanka	4th	ARCH	ppate19@iit.edu	██████████
Vega	Mayra	3rd	ARCH	mvega2@iit.edu	██████████
Walker	Jason	4th	ARCH	jwalke2@iit.edu	██████████
Walker	Rachel	2nd	CS	rwalke3@iit.edu	██████████
Yee	Michael	3rd	AE	myee@iit.edu	██████████

B. Team member strengths, needs, and expectations

Seeing as how several individuals in the group have taken an IPRO course before, the knowledge gained from previous experiences can be applied towards the further development of this IPRO. The collective is determined on increasing the knowledge in alternative / renewable energy and in methods for applying these types of technologies. A member of the team has already researched various energy sources and has experience working with solar energy. As a result of the condensed semester, managing time efficiently will be essential for our progress.

C. Team identity

Team Name:	Zero Energy Lab
Team Logo:	On first page
Team Motto:	“Going off the grid”

2. Team Purpose and Objectives

Purpose:

The ultimate goal of the Zero Energy Lab IPRO is to design a universal format for occupying laboratories that utilize the minimal amount of energy.

Objectives:

- For the Zero Energy Lab to be usable at all hours of the day, proper lighting is a necessity. The installation of an appropriately designed lighting system, which will be both cost and energy efficient, will be a high priority in the overall scheme. A small section of the overall space will be the prototype of the design, which will in turn allow for the further development of lighting implementation.

- There will be concentration on the research of different applications on a biofuel technology and in designing a biofuel system that will collaborate with and add to the established energy sources of the lab. The goal of the research is to design a functional prototype for future use in the Zero Energy Lab.
- The bricks in the Zero Energy Lab are currently in a state of disrepair causing a decrease in the structural integrity of the building. For the longevity and aesthetics of the lab, there will also be focus on understanding the historical and contemporary uses of bricks and learning the different techniques of renovating bricks.

3. Background

The Zero Energy Lab is a project, which addresses the issue of the consumption of varying forms of non-renewable resources; it is an effort to strike a balance between energy consumption and energy generation. IPRO 337 is focused towards the development of a Zero Energy Lab station situated on the 4th Floor of Machinery Hall. The station would function independently from the energy supplied by the main grid, which dictates the energy supply of the campus. The main goal of IPRO 337 is to devise solutions for power generation that could be implemented in the workspace of Machinery Hall. The Zero Energy Lab would be dependent on the sources of energy but not on the forms of energy. In the past, many teams have been working towards this goal through the use of various technologies such as solar thermal heating, a golf cart with a battery bank, a mechanical window cooling system, wind turbines and a hydrogen fuel cell hybrid system.

Previous semesters of IPRO 337 researched three types of lighting technologies for the designing process, which were the conventional fluorescent, incandescent lights, and light emitting diodes (LED). Due to the inefficiency of incandescent lights, previous teams decided to

use both fluorescent and LED lights. Their proposal included the testing of light scooping in a small section of the workspace in Machinery Hall. The scoop was used for the reflecting sunlight from the upper windows on to the floor, therefore maximizing the useable light.

This summer, the team will be divided into two sub teams; one sub team will be designing approaches for power generation through biomass, while the other sub team will be designing an efficient lighting system for an existing 6,000 sq ft space. Extensive research will be conducted and a working model of a biomass generator will be designed to minimize the consumption of fossil fuels and shift the focus towards eco-friendly materials. Exploration of the use of daylight sensors and motion sensors will be used in order to minimize the energy consumption of the space, while also taking into account the use of reflective materials like: photo-luminescent paint and glass beads.

4. Team Values Statement

This is a team effort and we will all need to participate in order to accomplish all of the goals we have set for ourselves. We are all valuable to the team and we need to make sure our individual strengths are represented in the team and in the project. We will strive to do this through communication, collaboration, contribution and commitment.

Communication:

We should all speak our mind. Of course with this, we should be mindful of each other's opinions and be respectful of that. If an idea is not accepted, do not feel discouraged. If a problem occurs due to miscommunication, be courteous and mention it to the opposing party or include the team leader to resolve the issue.

Collaboration:

As mentioned earlier, this is a team effort. We all need to come together as a team rather than a group of students looking to finish a requirement. This includes taking on responsibilities and looking out for one another. Slacking off or handing off work to other team members is unacceptable, however the team should understand of certain situations. We all need to have the same mentality and the same goals, only then can we come together as team.

Contribution:

It is crucial that we all participate in the project, which not only includes all the hands-on work, but also class discussions and team meetings. This runs hand in hand with the idea of communication. Our thoughts and ideas should all be voiced and acknowledged.

Commitment:

A committed team member would attend all class discussions and meetings as well as hold a leading role throughout the course of this project. This does not mean that one person's commitment is sufficient. We all need to strive together.

5. Methodology

One of the major problems of the Zero Energy Lab is a lack of an energy-efficient lighting system. The goal is to design a lighting system for the entire floor and install lights for a small section of the lab space. In addition, after evaluating information from the past semesters, the team realized that there has been little research into a possible biofuel technology to help power the lab. The goal is to better inform all members of the possible uses and applications of a biofuel technology. Lastly, the team aspires to come to a better comprehension of the sustainability of bricks. In order to achieve all three goals, the team

formed two sub-teams: the lighting sub-team and the biofuel sub-team. The team also decided that the whole team would participate in the studying of bricks.

Lighting Sub-Team

The first step taken by this sub-team is reading over the information gathered by the team from Spring 2007 since it was the only team that researched lighting systems. From the materials provided, the sub-team has decided that fluorescent lights would be much more cost-efficient and energy-efficient than incandescent lights and LEDs. The next step is to decide the section of the lab that the sub-team will be installing lights in and testing the lighting system. Once the area is chosen, the sub-team has to determine the number and positions of the lights that will maximize luminosity in the chosen area. After the system is designed, the sub-team will purchase the calculated number of lights. The sub-team is still in the process of deciding whether T5 fluorescent bulbs, T8 fluorescent bulbs, or a combination of both kinds will be used. It is probable that both kinds will be purchased and experimented with in order to determine if one type or a combination of both types prove to be the better outcome for the area. Additionally, the sub-team plans to test different reflective materials in the chosen area and determine what would help scatter the light from the fluorescent bulbs or LEDs. With this in mind, the sub-team favors choosing an area in the lab that provides ceiling space that enhances the scattering of light. Since the entire team is on a budget, the sub-team plans to make light fixtures and test them with the fluorescent bulbs. If the light fixtures prove to be insufficient, the sub-team will have to buy commercial light fixtures. Furthermore, if time permits, the sub-team would like to add in sensors and dimmers to the lighting system. The data acquired through experimenting with an area of the lab will be used to budget and reproduce a lighting system for the entire lab.

Biofuel Sub-Team

The first step necessary for this sub-team is to read materials pertaining to different uses of a biofuel technology. The entire team plans to take a trip to Loyola University in order to better understand how a biofuel generator works and what other applications are in use at the university through the biofuel technology it has developed. The sub-team plans to use this knowledge to come up with applications that are viable and practical at the Zero Energy Lab. After putting together the research, the sub-team plans to design a basic biofuel system that would go hand-in-hand with the available energy sources already established in the lab. If time permits, the sub-team would like to create a prototype. However, the sub-team aims to acquire as much information as possible about biofuel technology in order to encourage future teams to develop biofuel technology for the Zero Energy Lab.

Brick

The team's main purpose in this topic is to better comprehend the nature of bricks. Several professionals in the brick industry and related fields will come and give speeches regarding the historical and contemporary uses of bricks. The process of tuck-pointing will also be covered since it will be necessary for many of the bricks in the lab. If time permits, the team might be able to do some hands on work with the bricks. Nevertheless, the goal is to understand the different features of bricks and use such knowledge to further improve the sustainability of bricks.

Deliverables

The team has decided that there will be a short meeting to assign different parts of a deliverable. There will not be a specific sub-team that is responsible for the deliverables. The team feels that as the semester progresses, different individuals will be more prepared to write

about specific sections of the overall project. In addition, the team feels the responsibility for the deliverables should be shared among the entire team. Another short meeting would take place to look over the rough drafts of the deliverables and the entire team would go through a quick editing process of the ideas written down. The assigned person would revise his/her designated rough draft and one person is assigned to compile the different parts into a final draft for submission.

6. Expected Results

Lighting:

- The Lighting sub-team expects to design and install a section of lighting for the workspace on the fourth floor of Machinery Hall. Some projected goals are to include a dimmer switch and lighting sensor in order to minimize energy cost.
- Reflective material and scooping of the light will also be investigated for its potential to increase energy efficiency. It's expected that these will help to greatly reduce the amount of light bulbs, and thus the amount of energy necessary to light the area.
- As it is now, the space in question has little lighting and is difficult to work in after dusk. Installing the lights will remedy this, which will be especially helpful in the winter hours when the sun sets at 4:30pm. This will thus increase productivity for those who will utilize the space.
- The information gathered from investigating different ways to decrease energy cost will be logged for future projects to use or expand upon.

Biofuel:

- The Bio-fuel sub-team expects to gather information about bio-fuels and biomass conversion. Additionally, biomass will be researched and uses other than conversion to biofuel will be investigated.
- The team expects to brainstorm different options for the use of biomass gathered from various resources and propose a system to utilize these.

Bricks:

- IPRO 337 will be researching the sustainability of bricks and hopes to gather information for the future. Various improvements such as tuck-pointing and stripping of the old paints will also help to improve the space for later use.

7. Project Budget

Item	Unit Price	Quantity	Price
T8 Fluorescent light bulbs (pack of 6)	\$30	2	\$60
T8 Fixture	\$150	2	\$300
Dimmer/Light Switch	\$25	1	\$25
Wall Plate for switch	\$10	1	\$10
White Paint	\$25	1	\$25
Photo Luminescent Paint (1/2 pint)	\$55.98	1	\$55.98
Projection Screen	\$40	1	\$40
Reflective Beads pack	\$26	1	\$26
Paint Brushes (3 piece set)	\$9.97	1	\$9.97
Paint Roller/Roller Frame/Tray (6 piece)	\$ 17.97	1	\$17.97
Paint Tape	\$8.97	1	\$8.97
Tarp	\$13.98	1	\$13.98
Tray	\$0.64	3	\$1.92

Screws (box)	\$10	1	\$10
Nails (box)	\$6	1	\$6
Spray Adhesive	\$7	1	\$7
Loyola Trip			\$15
Used diesel generator	\$500	1	\$500
Brick Cleaning Sample Area	\$300		\$300
Brick Demonstration Area	\$300		\$300
		Total:	\$1842.79

8. Schedule of Tasks and Milestone Events

Event	Date
Project Plan	June 16, 2009
Trip to Loyola	June 16, 2009
Trip to Museum Science and Industry	June 19, 2009
Midterm Reviews	June 30, 2009
Abstract/Brochure	July 21, 2009
Poster	July 21, 2009
Final Presentation	July 23, 2009
Final Report/Grant Proposal	July 24, 2009
Work Product CD	July 24, 2009

9. Individual Team Member Assignments

Team Leaders:
Lidens Cheng and Nicole Karns

Lighting Sub Team	Biofuel Sub Team
Sub-Team Leader: Lidens Cheng	Sub-team Leader: Nicole Karns
Lauren Gillmeister	Vaibhav Gupta
Jason Walker	Neha Padwal
Rachel Walker	Priyanka Patel
Mayra Vega	Michael Yee

10. Designation of Roles

Minute Taker	Rachel Walker
Agenda Maker	Priyanka Patel
Time Keeper	Priyanka Patel
Summarizers	Lidens Cheng and Nicole Karns
Master Schedule Maker	Lidens Cheng
iGroup Manager	Neha Padwal