

IPRO 337 Project Plan  
Spring 2008

# Zero Energy Lab

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## 1.0 Revised Objectives

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The IPRO 337 team's objectives for this semester is to make further progress in updating the top floor of Machinery Hall into a lab for future energy and lighting technology research and for the space itself to be able to be as sustainable as possible throughout research this semester. Since the end goal is a rather ambitious one, a more realistic goal is to have an energy plan for following IPRO's to work off of and to have the space cleared so that the developed plan can be tested. The team hopes to generate willingness in its members to establish an environment conducive to team-oriented goals, as outlined in the objectives below. Successful completion of the goals presented here will require each participant to gain useful experience and knowledge regarding teamwork, inter-professional skills and specifically sustainable energy systems. For this fall semester, the team has set forth the following objectives:

- Research office utilities that consume low amounts of energy, and investigate how to improve the efficiency of current utilities.
- Research and test various energy efficient lighting solutions.
- Research environmentally friendly floor, wall, and ceiling finishes along with necessary office furniture.
- Develop a website to display the development progress of the Zero-Energy Lab and provide information regarding "green technology"
- Clean and prepare the 6,000 ft<sup>2</sup> space for future inhabitants.
- Using the research, develop a program proposal for the Zero-Energy Lab.

## 2.0 Results to Date

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- A. The IPRO group has developed a concept called "PODS." These PODS are used to simulate an environment of which the efficiency is to be tested. The ultimate goal is to see how physical room design, coupled with personal sacrifice (i.e., using as much energy as is passively created) can be altered to increase overall efficiency.

The technology team is monitoring and recording the power consumption of the four current office work stations using wattmeter. In addition, we are also monitoring the power consumed by other electronics that are used in the Zero Energy Lab such as the microwave, refrigerator, and lighting since it is also connected to our power source.

Development of the website has been broken into two main tasks: 1) develop the overall mapping and content of the website, and 2) the actual coding/implementation using css/java. Our 'research' has mostly consisted of coding and figuring out which code works the best for our needs. We have found through testing, that css is a powerful language that is well suited to our needs because it is easy to understand and will therefore be easy for future IPRO generations to augment.

The finishes and pod group have been researching paint and floor finishes along with lightweight materials that could be used for moveable partitions. Our research has directed us to low VOC or zero VOC paint in light colors. We also have found shot blasting and soda blasting to prepare the existing concrete floor for repairs and striping

the old finishes from the walls and ceiling.

- B. The original IPRO that the Zero Energy Lab was conceived from had to do with high efficiency LED lighting. Although LED lighting is still going to be considered, the lighting group has researched different types of lighting including fluorescent, metal halide, and induction lighting.

The web group can foresee the website being used for advertising space for sustainability related businesses.

- C. The IPRO group has developed a concept called “PODS.” These PODS are used to simulate an environment of which the efficiency is to be tested. The lighting group is concerned with the various lighting aspects of the PODS. A current POD in the Zero Energy Lab simulates an office environment. The lighting group is investigating daylight harvesting and personal task lighting to see how it affects operations within the office.

The website is still under development and being updated daily. We plan to have a fully functioning website that will complement the fellow sub team’s research by posting their results on the research page.

- D. If this IPRO were to have a sponsor and or a customer, the current results, that is, the PODS, would indeed address their problem, which is, how to reduce energy use and increase productivity of a given environment.

The establishment of the website will increase the Zero Energy Lab’s presence in the sustainability industry and the international collective. By increasing the Zero Energy Lab’s presence in the community and elsewhere, we greatly increase the Zero Energy Labs purpose as a role model in sustainable design.

- E. The advent of PODS has opened up unlimited causeways of opportunity for research. Simulating real-life environments and making changes within the environments to reduce energy use and to increase productivity is the ultimate goal of the Zero Energy Lab. By using the PODS, this goal will be readily achievable.

The results will give us an idea of what the overall power profile of the space. Hence, it will help us to reduce the energy consumption in the Zero Energy Lab and identify necessary steps in improving the way energy is used in the space possibly by changing the hardware or software used and encouraging the users or people working in the lab to alter their “bad” working habits of wasting energy.

The development of the website has encouraged the entire team to realize what research is important by asking everyone – what research could I perform that is important enough to be incorporated on the website? This motivation has lead the team to refine it’s goals and eventual outcome for the semester.

By the end of the semester we hope to have specifications and cost estimates to help find possible contractors to begin transforming the lab spaces. The research so far has helped us solidify the colors and finishing types that the lab spaces should include to promote the lighting and working environment. The light colors and durable flooring will help us reduce energy consumption to only what we can produce and the reduce maintenance costs on the floor while still improving the overall quality of the space.

**3.0 Schedule of Tasks and Milestone Events**

	<u>Tuesday</u> <u>22-Jan</u>	<u>Thursday</u> <u>24-Jan</u>	<u>Tuesday</u> <u>29-Jan</u>	<u>Thursday</u> <u>31-Jan</u>	<u>Tuesday</u> <u>5-Feb</u>	<u>Thursday</u> <u>7-Feb</u>	<u>Tuesday</u> <u>12-Feb</u>	<u>Thursday</u> <u>14-Feb</u>
<b>Q1</b>								
Intro		N/A						
IPRO Admin Meeting								
Groups Made								
Tasks Assigned								
Research & Discussion								
Finish Group Trip								
Group Mgmt. Meeting								
<b>Q2</b>	<u>19-Feb</u>	<u>22-Feb</u>	<u>26-Feb</u>	<u>28-Feb</u>	<u>4-Mar</u>	<u>6-Mar</u>	<u>11-Mar</u>	<u>13-Mar</u>
Research Cont.								
Test Criteria Formulated								
Samples Gathered								
Project Plan Due		Fri, 23rd						
Test Box Construction				N/A				
Learning Obj. Post Test								
Code of Ethics Due						Fri, 7th		
Mid-Term Written Report								
<b>Q3</b>	<u>18-Mar</u>	<u>20-Mar</u>	<u>25-Mar</u>	<u>27-Mar</u>	<u>1-Apr</u>	<u>3-Apr</u>	<u>8-Apr</u>	<u>10-Apr</u>
Mid-Term Groups Reformed								
Testing Commences								
Construction Documents								
Build Bids Sought								
<b>Q4</b>	<u>15-Apr</u>	<u>17-Apr</u>	<u>22-Apr</u>	<u>24-Apr</u>	<u>29-Apr</u>	<u>1-May</u>	<u>7-May</u>	<u>9-May</u>
Testing Cont. Formalized								
Documents								
IPRO Day Prep								
IPRO Day								
Debrief								

**4.0 Changes in task assignments**

- A. Design and implement an overall energy-efficient lighting solution for an office space using power supplied by a photovoltaic system or another found system that more efficiently saves energy in the space. Although an energy-efficient lighting system was our main starting point, a complete energy-efficient space encompassing all systems, i.e., HVAC, plumbing, etc., is the problem that we will attempt to solve.
- B. In order to accomplish the problem set forth in part A, the team will conduct all group meetings on the site where the renovation is to take place in order to acquaint new team members with the space and provide inspiration. After a brief presentation of

prior work and research conducted during last semester's IPRO, the team will then determine the next phase of the project. As a team, it is agreed upon that we will to research energy efficient technologies and ecologically friendly building materials for the space and while also displaying the status of the project via a website. Therefore, the team will be divided into 4 sub-teams to further investigate lighting techniques, energy efficient office technologies, "green" interior finishings, and web site development.

The first team will continue researching lighting techniques and schemes that will provide adequate light for all occupants of the space, while remaining energy efficient. The second sub-team will continue to investigate energy friendly office appliances and manners in which the efficiency of existing appliances can be improved. A third sub-team will research ecologically friendly interior finishes that will provide a welcoming and learning atmosphere. The fourth sub-team will develop and launch a website to display the progress of the zero energy lab and present the data collected by the other sub-teams. Once sufficient data has been collected by each sub-team we will then regroup and redefine tasks within the IPRO. During the ongoing research we will have scheduled visits to lighting warehouses and showrooms where we can get ideas about how to light the space. We will also have guest speakers come in to lecture us about LEDs, and other energy-efficient ways to light a space. We will visit other sites that have implemented energy-saving solutions and we will look at how much energy they save and see how we can do the same with our site. We will then develop a detailed program describing how renovate the space into an energy efficient and environmentally friendly zero energy lab.

- C. In order to test possible solutions we will order sample products from different manufacturers and a mock up will be set up in order to test the solutions using the sample products. Each sub-team will develop a testing procedure to examine pertinent features of each product to be used in the lab. Using this procedure each sub-team will then test each product in a testing environment and record their findings, which will initially be posted on IGROUPS and finally on the zero energy lab website.
- D. Each sub-team will carefully document their research and post it to IGROUPS so that the information is readily available to all members of the team. During field trips and guest speaker visits, notes and pictures will be taken by a designated member of the IPRO team and will be uploaded to IGROUPS. During the mock-up stage, each sub-team will keep note of the energy usage differences with and without the systems we decided to test. Pictures will also be taken and all notes will be posted to IGROUPS.
- E. Analysis of the test results will be conducted based off of the average amount of energy used by current products today and the amount of energy we save with the systems we implement. In addition to a side by side product analysis.
- F. IPRO deliverable reports will be headed by two individuals from the IPRO team and as needed, those two will summon help from other IPRO team members to help with the IPRO deliverables. All who are responsible for parts will then upload their parts to IGROUPS and the two leaders of the IPRO deliverable reports will combine all parts, revise, and upload a final version to IGROUPS for all team members to review before final submission. This will be the protocol for all IPRO deliverable reports.

G. N/A

## **5.0 Barriers and Obstacles**

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- A. Our biggest obstacle is that of the IPRO administration. The constant need to work on deliverables gets in the way of production of our intended projects. If IPRO is here to simulate real world work environments then it should get out of the way. In the real world only a select few jobs have a constant nagging need for deliverables and progress presentations.
- B. The team has, as of yet, been unable to resolve this. It would be easy to resolve if we completely ignored the IPRO administration and turned in no deliverables or attended no presentation where our time would be better spent on the project. But out of fear of the consequences, of which I do not believe there would be any, everyone works to complete everything even if it is as thrown together as this.
- C. The remaining barrier left is the need to focus on our project. As it stands we are torn between taking the project in two ways and will probably not achieve much if we decide to go both. We can focus on developing our space to make it useable or develop the methods and procedures for making it a functioning Zero Energy Lab.
- D. Most of our research is done and now we have much more time to focus on the project at hand without worrying about many deliverables getting in the way. After the spring break we should be able to clamp down and focus on what needs to be accomplished for the next half of the project.

## **6.0 Midterm Presentation Slides**

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IPRO 337: Zero Energy Lab

ZERO energy

Midterm Presentation

IPRO 337: Zero Energy Lab

#### Introduction

- Who are we and what are we about?

#### Background

- Continuation and extension of IPRO 337: Zero Energy Lab.
- To create a plan for the implementation of a comprehensive zero-energy solution for the 4<sup>th</sup> Floor of Machinery Hall on IIT campus.

#### Purpose

- Preparing for occupation of the space.
- Developing a modular testing facility to explore green technology and environmentally friendly building materials via PODS.
- Analysis of office energy efficiency and improvement.
- Development of power distribution based upon the constraints determined from the prior semester.

Introduction & Organization

I PRO 337: Zero Energy Lab

**PODS**

Theory – Satisfaction of spatial need.  
Our Intent – Modular lab space.  
Construction - Lightweight.



To incorporate ideas of space adapting dividers into our lab to allow us to make functional spaces that can be created and moved depending on the needs of the inhabitants of the laboratory.

Steel Case, Grand Rapids, MI  
Furniture design using “Space Architecture”  
Defines boundaries while keep spaces open.

**PODS**

I PRO 337: Zero Energy Lab



Ingalls Hospital Outpatient Rehab:  
Installation, Speed, and Portability Sell  
Hospital Again on PortaFab Modular  
Building

Quick modification requires easy to handle components.

- Standard material sizes
- Lightweight Materials
- Built in utilities
- Stability and safety



**PODS**



IPRO 337: Zero Energy Lab

### Objective of the testing

- To meet the growing demands of alternate energy.
- To meet the need of manufacturing efficient electronics.
- To promote a generation of green energy.
- To reduce the amount of wasted energy.



Office Testing

IPRO 337: Zero Energy Lab

### Goal

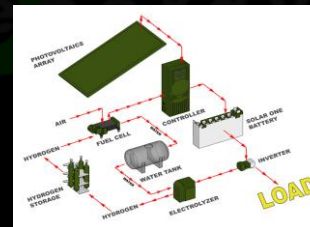
- Develop a power distribution and all inclusive lighting system for the zero energy lab.

### Lighting

- Develop a general lighting system.
- Provide task specific lighting for workspaces and the modular POD system.

### Power Distribution

- Develop 110V ac distribution network.
- Develop dc distribution network.
- Develop an automated electrical control system.



Power Distribution & Lighting