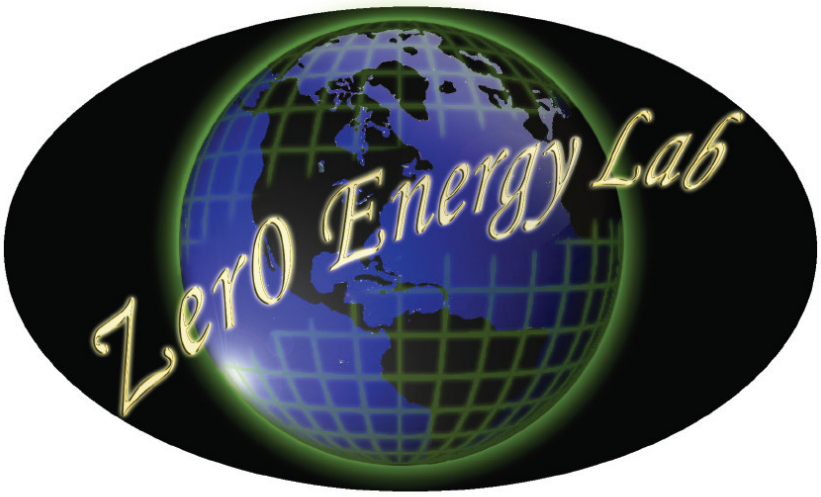
IPRO It takes a team! INTERPROFESSIONAL PROJECTS PROGRAM

IPRO 337: ZERO ENERGY LAB PROJECT PLAN
SPRING 2009
FACULTY ADVISOR: Nancy Hamill-Governale



“GOING OFF THE GRID”

1. Team Information

TEAM ROSTER AND CONTACT INFORMATION

Hamill, Nancy (advisor)
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Wisniewski, Anthony
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Team member strengths, needs and expectations

Brewin, Christopher

- I am skilled in basic carpentry plumbing and electrical wiring. I have a basic knowledge of automotive repairs and maintenance and I am familiar with the use of many power tools.
- During this IPRO I would like to learn more about the use and applications of various solar thermal systems and other alternative sources of energy. I would also like to develop my team working skills

Team member strengths, needs and expectation: Brewin, Christopher con't.

- I think this IPRO will provide knowledge to the entire team of different types of alternative energy. Also skills of team work and collaboration and good time management will be a result.

Gandhi, Shweta

- I think strengths that I can contribute to this IPRO include being able to present material in a confident manner. I can also keep a group on task. I also can write up reports based on research or products produced.
- There are many skills I would need to develop for this IPRO. Some skills I could pick up include technical abilities and being able to construct things.
- What I basically expect to get out of the project is to learn more about the Zero Energy plan and try to be more well rounded with technology

Hernandez, Carlos

- I am a 4th year Architecture student and have one more year to finish my degree in Architecture. I know how to work with different software's such as, AutoCAD, Adobe Photoshop, 3d Max, Revit, Power Point, and Excel. I also enjoy photography and working with machines and tools. Finally, I am bilingual and fluent in Spanish.
- I would like to develop my technical skills in both engineering and architecture and learn about how things are really put together to work efficiently.
- Overall, I hope to develop great relationships inside and outside of the team as well as, learn how to manage time more efficiently.

Kedzuch, Andrew

- I feel that the strengths that I can contribute to the team are leadership and motivational skills, strong design and fabrication ability, presentation and speech skills, and prior experience with renewable resources.
- During this IPRO I would like to continue the development of renewable resource knowledge and practical installation.
- I would hope that the IPRO would achieve group cohesion, commitment, professionalism, and good time management. The result being a stress limited experience that we can all enjoy while learning new things.

Leemon, Steve

- My position in the ROTC program has given me Leadership/Management skills. I also have very good writing, speaking, briefing, and presenting skills. I am well organized and a good communicator. I also have a strong dedication to the cause
- In this IPRO I would like to develop skills of innovative problem solving and technical experience, and working with a civilian crew on a short term project.

Team member strengths, needs and expectation: Leemon, Steve con't.

- During this project I expect flexibility, team commitment/cohesion, unity of command (united group leaders with the team leader and general obedience to our individual group leaders), and a useful or productive turn out.

Nelson, Karen

- Some of the strengths that I can contribute are my excellent organization and communication skills. Also, as a civil engineering major, I have some knowledge of construction and building design, which may help when going about installing projects or deciding how feasible projects are.
- Through this IPRO, I hope to gain knowledge about sustainability and what type of sustainable technology is on the market. Also, I would like to gain knowledge of electrical engineering and some other fields, aside from civil engineering, that also contribute to a building's construction. Lastly, as someone who often leads groups, I would like to step back and develop my ability to be a team member contributor.
- Overall, from the project I expect to gain much knowledge about sustainable technology and its feasibility in the real world. I also hope to work with a team of different individuals with different majors in order to better learn what goes into constructing and transforming a space, aside from just the civil engineering aspect.

Pfeifer, Sarah

- I am a very organized hard working student. I look at the big picture for the most part but am able to focus on the more detailed ideas.
- Due to my background as an architecture major, I do not have much knowledge about electrical engineering. I would like to learn more about the topic through this IPRO. Not only will the IPRO increase my knowledge about the topic, working beside other engineers will allow me to see into the engineering world.
- For the project, I would like use to be able to work together and collaborate to make the space used in a more efficient manner. I would hope to complete the various tasks we have outlined for ourselves.

Reinecke, Jonathan

- I am 4th year architecture and I am very creative. I am good at coming up with different ideas that can serve as a solution to the problem at hand.
- As an architecture student I do not have much experience with electrical engineering and I hope with my position in the various tasks that I will be able to learn more about the topic.
- For this IPRO I would hope to take further steps to getting the space closer to getting completely off the grid.

Team member strengths, needs and expectations con't.

Schmidt, Nathan

- I am a very organized hard working student. I am also very organized and good at communicating effectively.
- I would like to learn more about electrical engineering, sustainable design, and energy efficiency.
- For this IPRO I would like everyone to be able to get a hands - on experience in the lab space and for myself to be able to further my knowledge in regards to engineering and sustainability.

Shah, Jainam

- I am a mechanical major and I have worked a year with a professor to help him in his research in robotics. I can be useful for research, bringing new ideas, designs and helping everyone with their work. I work hard and try to get everything done on time.
- I want to see how different majors work together as a team and get experience in problem solving as a team.
- Overall expectations about the project-team commitment, flexibility and innovative ideas. I really hope our team does well in this ipro.

Simons, Raymond

- I have experience in the following areas: general business management and legal experience, project management experience, Microsoft project software, Microsoft Office application software, Manufacturing experience, People/leadership skills, and Electrical Engineering knowledge
- During this project I would like to increase knowledge and understanding of how a facility can be modified or developed to function of the grid and consume zero energy by replacing it with alternative methods of energy generation and storage.
- I expect the project to advance the development of the zero energy lab. I expect the project to deliver several functional components of the ZEL. I expect the project to expose students to an experience similar to one as a member of a professional team in the market place.

Walker, Jason

- The strengths that I could contribute to this project are my hard working attitude and approach and my good listening skills.
- I would like to develop my technical skills, problem solving skills, and pretty much knowledge on sustain-ability and how things work.
- I expect to learn a lot about electricity and sustainable solar uses.

Team member strengths, needs and expectations con't.

Wisniewski, Anthony

- I am a 4th year EE student. I have recently taken courses in power electronics and electric drives. Previously worked as electrician for about 10 years.
- I am hoping to improve skills in understanding and applying power electronics for efficient use of energy conversion.
- Overall I hope to discover how applications of converters and inverters are used to harness renewable energy.

Team identity

- Team name: Zero Energy Lab
- Logo:

- Motto: Going off the Grid

2. Team Purpose and Objectives

The ultimate goal of the Zero Energy Lab is to get the fourth level of machinery hall off the electrical grid. The IPRO is moving towards transforming the space into a research space for future energy and lighting technologies. Since the end goals of the Zero Energy Lab are ambitious for one semester we are proposing to address solar hot water, a golf cart used as a mobile battery bank, and window efficiency this semester. We are also hoping to learn some tuck-pointing techniques to make the space more presentable. We would like for the team to learn new things about the technologies we are researching and using. We hope to have a good hands-on experience with energy efficiency and green technologies. The team is a collaboration of students from various majors including architecture, political science, civil engineering, electrical engineering, mechanical engineering, and biophysics. Together we believe we will be able to create a cohesive end product and work well together along the way.

3. Background

In semesters past there were various technologies implemented to take steps closer to going off the grid. A solar cell/ hydrogen fuel cell hybrid system has been developed and its purpose is to supply energy to the lab space. A passive environmentally friendly

Background con't.

climate control system has also been researched in the past. A few other technologies previously researched are photovoltaic arrays and wind turbines for power generation, battery systems for energy storage, passive cooling and heating systems, desiccant systems, and various devices native to the laboratory environment. The Zero Energy Lab is also overall supposed to be a research space for people to collaborate with others from various backgrounds to find a solution to current issues.

Last semester's IPRO divided into three subgroups: the Lab Space group, the mobile energy station group, and the windmill team. The Lab Space group made the space a more usable and efficient Lab area. The Mobile Energy Station Team created a golf cart that is a mobile battery bank to be used within the lab space. The Windmill team built a 27 foot windmill and tested it outside. The results obtained from testing the windmill were favorable to the Chicago area due to efficient wind power.

The societal issue that is being addressed in this project is that of energy. With the varying costs for different forms of energy, the zero energy lab is supposed to not rely on any of these issues. A large goal of the team is to develop cleaner ways to live and sustain ourselves with a similar quality of life as is current. The lab will be a functioning space that will produce and use its own energy and not rely on "grid energy." Going off the grid is intended to provide a passive way to collect and use energy while also paying close attention to the environment. Throughout the IPRO, the team predicts to run into certain ethical issues and has prepared for them. With the various ways of testing, the team is prepared to take the extra steps to ensure that toxins are not being released into the environment. During various types of testing it is possible that water contamination could occur. Of course the contamination would not reach levels of danger but the IPRO team will implement various backflow and filtration systems to prevent contaminated water to enter the city's main water supply. Another obstacle predicted to occur is that of building permits. The group has committed to following all Chicago and the State of Illinois building codes. Emissions will also be handled very carefully in order to maintain the current environmental status if not a better status. Overall, since the goal of the IPRO is to improve environmental conditions, the preservation of the current conditions will be top priority.

The team has determined that the expenses for the project are very much up front with the cost of products, materials, etc; however, the payback for the systems will be sufficient enough to gain a return on the initial expenses and also will provide lower energy costs and emissions.

During initial goal setting, the team has decided that it is possible new information be found. The group has agreed that all new discoveries will be posted in the public domain, available for further research and use by outside parties.

4. Team Values Statement

The IPRO Team expects each team member to be punctual in class attendance, punctual in assigned tasks, appropriate levels of completeness of assigned tasks, conscientiousness of ethical issues, respect within the group and with other consultants. The team will abide by IIT's code of conduct regarding research and experimentation and will give credit where credit is due.

In a case an issue arises within the team, the appropriate action will be taken. The issue will be addressed within the subgroup. If the problem is not solved at that level of command it will continue to the command of all of the sub-group leaders. If still then the problem persists, the faculty advisor will be brought in to help.

5. Methodology/Brainstorm/Work Breakdown Structure

Solar Hot Water Sub-Group:

One of the major problems of the lab space is that there is a lack of an efficient active heating system; there is no running hot water supply either. The solar hot water sub-group would like to implement technologies to provide the space with these two systems. The team plans to assemble a solar collector in order to address the stated problem. Currently there is a solar collecting system in place; however it is not efficient enough for the size of the space. The first step is research to investigate the most economical and efficient systems for the space and the needs of the space. The sun is the main source to develop hot water for a passive heating and cooling system. Case studies will be the main source for research methods other than actual testing. Throughout the semester a strict timeline will be followed in order to find the best system to provide both hot water and the heating and cooling system. Depending on obstacles experienced in the research, testing, installation stages, time constraints, etc. if the system is not fully working, enough research will have been conducted for another party to complete the task. This sub-group expects the testing and experimentation to determine the quantity of water necessary for a certain volume of space before needing to be replaced. During research, commercial fabrications and their level of efficiency will be compared to the efficiency levels of a system assembled by the group members. The differences in installation, cost, efficiency, durability, labor efforts, and various other factors will determine which system is better for this lab space.

Window ventilation Sub-Group:

The main goal of the window sub-group is to decrease if not eliminate the need for a cooling system. In order to achieve this, the group must look into installing a mechanical system for opening the windows. This will involve, first, determining how these windows open and much force is needed to open them. Once this is determined, research of different opening mechanisms can commence. After adequate research is completed

the group will determine which will be best for the particular kind of windows that are currently in the space. Once all this can be determined, a mechanical system for opening the windows can be installed. Afterwards, a sensor system can be installed and programmed to open the windows given certain conditions. Budget provided, this project should be easily completed within the time allotted. Also, provided that the weather becomes warm enough, the system's effectiveness will be able to be tested in the appropriate conditions.

The mechanical portion of this project can be tested by overriding the control system to simply see if the mechanisms installed succeed in opening the windows. The sensor/control system may be tested by setting the system to certain parameters and ensuring that the control system does in fact set off the mechanism, allowing the windows to open. As the sensor system will be controlled by weather conditions, the parameters will need to be set to reachable conditions in order to test the mechanism. This may mean, for testing purposes, setting the temperature condition lower than one would normally want the space ventilated. Also, as the weather gets warmer, the system will be able to be set and tested at appropriate ventilation temperatures. At this point, temperatures and other climate conditions of the interior space will be recorded and the system's effectiveness will be determined

This particular group would need photographs taken and close observations be made of the mechanisms and their installation. These would aid in fixing any failures should they occur. During testing the sensor will be most observed to see if it works the appropriate way for this application. The results from testing will be reviewed to identify trends and determine if the solution is the best possible outcome for the space. If the end product is not up to par, the appropriate adjustments will be made to maximize efficiency.

<u>Electric Cart Sub-Group:</u>

The last issue being addressed in this IPRO is the lack of electrical power. Currently the space is being run off of AC power from ComEd. The goal is to harness the sunlight through the use of photovoltaic panels to create power for the space. There are solar panels on the roof of machinery hall charging a bank of four batteries. The current battery storage bank is inefficient. The power from the solar panels is in effect being wasted. Storage of the electric energy will be in battery banks and a controller will be installed to provide feedback and to manage the balance of the batteries. There is an electric cart that is used as a mobile carrier for the battery bank. That battery bank is inverted to supply 120 volts AC where needed on the fourth floor. The current problem is that the batteries are being charged through ComEd. The batteries need to be charged using the photovoltaic panels on the roof instead so that the panels will not be gathering wasted energy.

Methodology/ Brainstorm/ Work Breakdown Structure: Electric Cart sub-group con't.

The first task will be to gather all of the specifications of the current battery charging system. The critical components will be the inverter, battery charger, controller, batteries, and solar panels. Once the components are known and their limitations are well defined, a schematic can be made. This will serve well in future projects. The next major task is to research possible solutions or systems that can be implemented as an upgrade to the existing conditions. Using the specifications, schematic and budget limitations, appropriate components can ordered. The third task will be to safely install the devices. Finally the system can be tested and the actual improvements documented.

In order to accomplish all of the required tasks in the timeframe, some factors must be favorable. The budget must allow for the typically expensive components to be ordered. The lead time for the devices must be relatively short. The installation must be relatively simple. If these circumstances are favorable the timeframe is reasonable.

Potential solutions will have to be tested through calculation until the required devices are delivered. Circuit simulation software is also another source of verification. Once the devices are installed, the system can be tested using a multimeter and an ammeter. The results of research will be documented in the form of a schematic. It will display well defined devices and limitations. The results of testing will add further detail to the schematic in actual outputs and characteristics. The second version of the schematic will be an as-built drawing. A written description and specifications will also accompany it. The analysis of the results will include comparison of the previous results and the new results. The specific points that will be including are Amp-hour capacity of the battery bank(s), charging time, and efficiency. An important number will be the amount of time the solar panels are not actively charging a battery bank. It is desired to reduce that time. This can be determined through observation and through the system specifications.

<u>Deliverables</u>

The IPRO deliverables will be assembled by a variety of group members. Sub-group leaders will be responsible for recording data and reporting to the deliverable author (Sarah Pfeifer) in enough advance time for multiple drafts to be assembled. The deliverable author will also confer with subgroup leaders to ensure the data is accurate. Also there will be photographers recording various steps of the project which will be published in the appropriate format within the deliverables.

We will be in compliance with the IIT approved research methodology.

6. Expected Results

Solar Hot Water Sub-Group:

During the process of the project, various levels of research will be conducted regarding solar hot water. Research of solar hot water will include but will not be limited to topics of installation, waterproofing methods, insulating methods, thermal storage methods, low emissivity/ cost effective paint options, control systems, drain back vs. antifreeze uses, closed loop vs. open loop systems, line power vs. photovoltaic power systems, differential controllers, glazing types, and series vs. parallel connections for multiple panel uses. After thorough research is finished materials for a thermal collector will be purchased. These materials will allow the sub-group members to assemble, install, and use a thermal panel to gain results from testing. Also an already assembled panel will be purchased for comparison testing purposes. The final stage will be to test and record data. The testing conducted will determine various results. Actual cost will also be determined upon completion of assembly and installation of both types of panels. Manufacturing and shipping time will be determined upon receiving the units. The required labor and skills of assembly and installation will be determined. The temperature and flow rates achieved by the thermal collectors will be measured and recorded. Also, the major discovery that will be determined will be which system, the self assembled system or the pre-assembled system, is more efficient and suitable for this particular application. A possible outcome that is predicted by the team is that the self-assembled system will be the better application because it will be less cost even though the labor will outweigh the pre-assembled system.

Throughout the research phases the group will not only find out assembly and installation details of the thermal collector; it will also determine the best working system for the needs of the space. The sub-group will be able to record data for a working prototype, create installation and assembly instructions that were beneficial in this application, and also experiential feedback. These discoveries will be recorded in the form of deliverables made available to the IPRO office.

Although the goals are reachable during this project, various obstacles are taken into account. The constraints of a budget will create a need for data to be collected efficiently due to the lack of many tools. The tools that are gathered will need to be tested frequently in order to gather the target quantity of data. The manufacturing time and delivery time of all supplies purchased will play a factor and during this time the team will optimize their time for research purposes. With shipping comes the chance of receiving faulty or damaged products in that the team will have to act quickly to make the best of the situation and use time wisely. If the obstacles take over the project the secondary goal is to have enough research completed for a future group to be able to

Expected Results: Solar Hot Water Sub-Group con't.

utilize and move into the assembly and testing stages close to the beginning of the project.

Window ventilation Sub-Group:

From this project, the window sub-group hopes to successfully install a climate controlled window opening mechanism on at least one or several windows. Effectiveness in ventilating the space will also be tested. When testing the implemented solution, Data will be gathered as to which mechanism and programming technique is best for this particular application. Climate data will also be recorded when the windows are closed vs. open in order to determine efficiency. A goal of this sub-group is to create an automatic ventilation system that will aid if not decrease the need for a cooling system. A working prototype and data indicating efficiency will be the end product. If the results prove that the implemented solution does ventilate the space, the issue of cooling the space without the use of energy will have been achieved. This will bring the Zero Energy Lab one step closer to being functional off the grid.
Much trial and error when installing and programming a working system is anticipated. Another challenge to be faced is ensuring that during the course of the semester, the weather is of the conditions to allow appropriate testing of the system's effectiveness. Also, there is a chance that these conditions will be reached at a time where observation and recorded are not possible to take advantage of the ideal weather conditions. An alternative will be necessary to record data during the ideal times.

Electric Cart Sub-Group:

The group has decided on ten major activities. First, the team must obtain specifications on the current systems and their components which will be down through research. The group will then create or obtain a Bill of Materials. After a Bill of Materials is present a 3D rendering will be created of the controller and the overall system. The 3D rendering will then in turn aid the creation of a schematic of the overall system. After the entire system is investigated, batteries and the appropriate controllers will be purchased. During the wait for product delivery, the group will research Chicago code constraints that could inhibit original plans. When the appropriate parts are received, switching will be installed into the electric cart along with batteries and the controller. The system will then be tested and verified and a report of data found will be generated.

Various results are predicted to come out of this sub-group. Research and testing will yield information regarding the performance of the system including: AMP hours of the battery pack and maximum utilization of the battery pack. A photo voltaic charging system for vehicle charging in industrial and commercial environments may be a possible product. Take factory material handling equipment off the grid. A second product is material handling or cart which can be a mobile source of AC

Expected Results: Electric Cart Sub-Group con't.

power for use in remote factory or warehousing locations. The Electric Cart project tasks will create an output of flexible/mobile AC and DC power sources and a system to power the lab with a combination of photo cells and battery banks. Our expected result is a functional system consisting of the photovoltaic system, controller, battery bank and Electric Cart. Our results, which will be incorporated in a proposed solution, will include a complete documentation package and a working system as described above.

The major problem and risk related to the Electric Cart project is that an unforeseen complication will develop or arise while we are connecting the photo grid to the cart.

Grant Proposal:
The team also would like to apply for the National Science Foundation's Grant. (see Attached)

7. Project Budget

Solar Hot Water Sub-Group: **$766.38**

Product:	**Unit Cost:**	**Units:**	**Total Cost:**
AL Roll: 6' x 10'	$6.49	6	$38.94
Copper Pipe: 10' x ½' M	$7.18	8	$57.44
Poly-insulation: 4' x 8'	$15.00	1	$15.00
½" Tee:	$0.50	16	$8.00
Plywood/ OSB:	$10.00	1	$10.00
Sun turf: 2' x 8'	$20.00	2	$40.00
SS Staples:	$11.00	1	$11.00
Paint:	$18.00	2	$36.00
Shipping:	$45.00	1	$45.00
Tax 10.00%			$26.14
2'x4'x8'	$3.00	10	#30.00

¾" plywood	$18.00	4	$72.00
Liner: 12' x 14', 40 mil	$118.00	1	$118.00
glue and Screws	$20.00	1	$20.00
Poly Insulation	$130.00	1	$130.00
Pump	$95.00	1	$95.00
Piping	$40.00	1	$40.00
TOTAL:			**$766.38**

Window Ventilation Sub-Group: **$1033.00**

Product:	**Unit Cost:**	**Units:**	**Total Cost:**
Arduino USB	$40.00	1	$40.00
USB Weather Board	$126.00	1	$126.00
SCP 1000 Gasket	$6.00	1	$6.00
Solar Cell (Large)	$40.00	1	$40.00
Solar Battery	$35.00	1	$35.00
Casing	$55.00	1	$55.00
Actuator	$305.00	1	$305.00
Misc.	$105.00	1	$105.00
Motor Controllers	$75.00	1	$75.00
Shipping	$200.00	1	$200.00
TOTAL			**$1033.00**

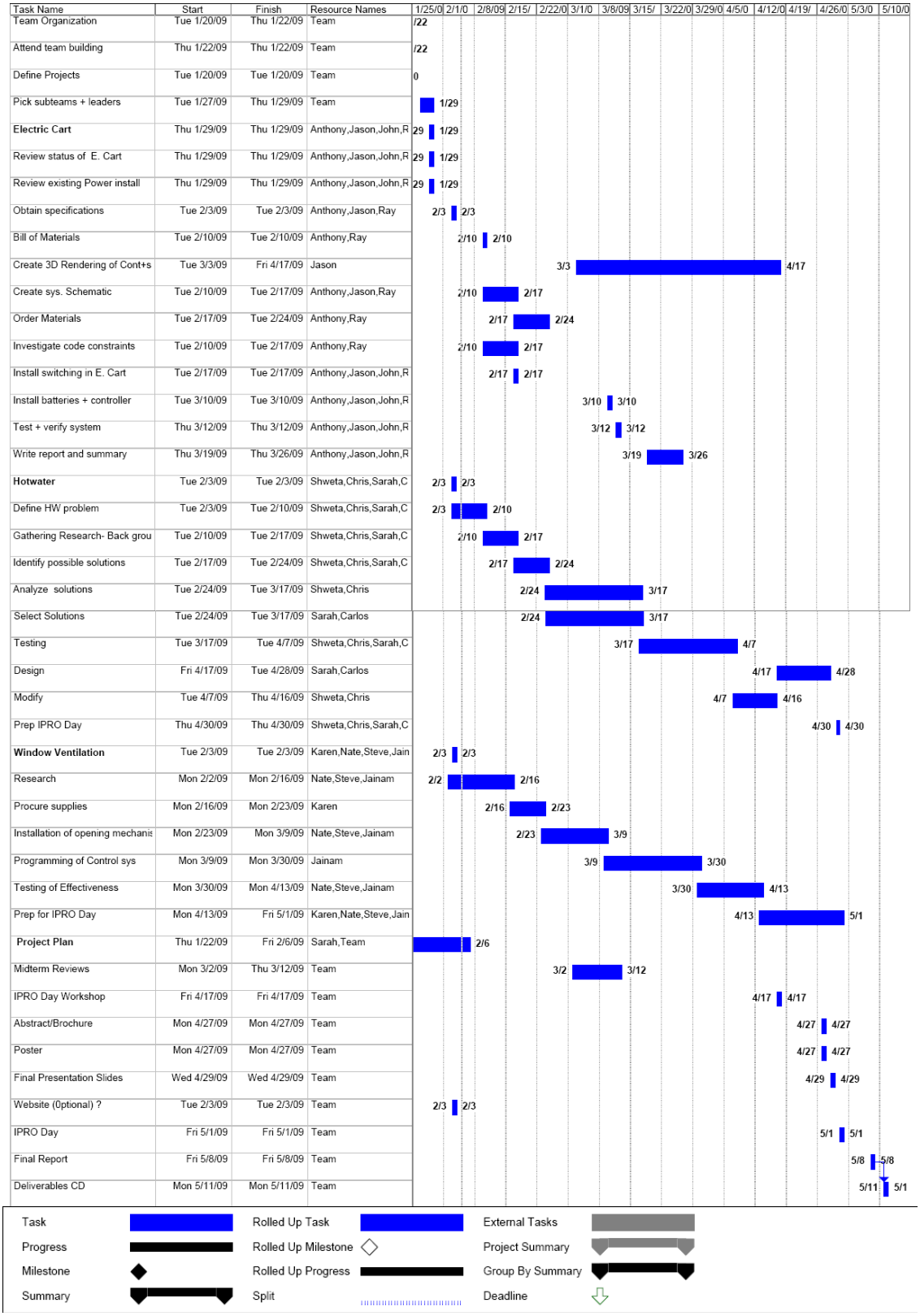
Electric Cart Sub-Group: **$4200.00**

Product:	**Unit Cost:**	**Units:**	**Total Cost:**
Batteries	$75.00	16	$1200.00
Controller		1	$1200.00
Cable and Terms		1	$1400.00
Fuse		1	$400.00
TOTAL		1	**$4200.00**

IPRO 337 Total Budget: $5620.33

8. Schedule of Tasks and Milestone Events

Task Name	Start	Finish	Resource Names
Team Organization	Tue 1/20/09	Thu 1/22/09	Team
Attend team building	Thu 1/22/09	Thu 1/22/09	Team
Define Projects	Tue 1/20/09	Tue 1/20/09	Team
Pick subteams + leaders	Tue 1/27/09	Thu 1/29/09	Team
Electric Cart	Thu 1/29/09	Thu 1/29/09	Anthony,Jason,John,R
Review status of E. Cart	Thu 1/29/09	Thu 1/29/09	Anthony,Jason,John,R
Review existing Power install	Thu 1/29/09	Thu 1/29/09	Anthony,Jason,John,R
Obtain specifications	Tue 2/3/09	Tue 2/3/09	Anthony,Jason,Ray
Bill of Materials	Tue 2/10/09	Tue 2/10/09	Anthony,Ray
Create 3D Rendering of Cont+s	Tue 3/3/09	Fri 4/17/09	Jason
Create sys. Schematic	Tue 2/10/09	Tue 2/17/09	Anthony,Jason,Ray
Order Materials	Tue 2/17/09	Tue 2/24/09	Anthony,Ray
Investigate code constraints	Tue 2/10/09	Tue 2/17/09	Anthony,Ray
Install switching in E. Cart	Tue 2/17/09	Tue 2/17/09	Anthony,Jason,John,R
Install batteries + controller	Tue 3/10/09	Tue 3/10/09	Anthony,Jason,John,R
Test + verify system	Thu 3/12/09	Thu 3/12/09	Anthony,Jason,John,R
Write report and summary	Thu 3/19/09	Thu 3/26/09	Anthony,Jason,John,R
Hotwater	Tue 2/3/09	Tue 2/3/09	Shweta,Chris,Sarah,C
Define HW problem	Tue 2/3/09	Tue 2/10/09	Shweta,Chris,Sarah,C
Gathering Research- Back grou	Tue 2/10/09	Tue 2/17/09	Shweta,Chris,Sarah,C
Identify possible solutions	Tue 2/17/09	Tue 2/24/09	Shweta,Chris,Sarah,C
Analyze solutions	Tue 2/24/09	Tue 3/17/09	Shweta,Chris
Select Solutions	Tue 2/24/09	Tue 3/17/09	Sarah,Carlos
Testing	Tue 3/17/09	Tue 4/7/09	Shweta,Chris,Sarah,C
Design	Fri 4/17/09	Tue 4/28/09	Sarah,Carlos
Modify	Tue 4/7/09	Thu 4/16/09	Shweta,Chris
Prep IPRO Day	Thu 4/30/09	Thu 4/30/09	Shweta,Chris,Sarah,C
Window Ventilation	Tue 2/3/09	Tue 2/3/09	Karen,Nate,Steve,Jain
Research	Mon 2/2/09	Mon 2/16/09	Nate,Steve,Jainam
Procure supplies	Mon 2/16/09	Mon 2/23/09	Karen
Installation of opening mechanis	Mon 2/23/09	Mon 3/9/09	Nate,Steve,Jainam
Programming of Control sys	Mon 3/9/09	Mon 3/30/09	Jainam
Testing of Effectiveness	Mon 3/30/09	Mon 4/13/09	Nate,Steve,Jainam
Prep for IPRO Day	Mon 4/13/09	Fri 5/1/09	Karen,Nate,Steve,Jain
Project Plan	Thu 1/22/09	Fri 2/6/09	Sarah,Team
Midterm Reviews	Mon 3/2/09	Thu 3/12/09	Team
IPRO Day Workshop	Fri 4/17/09	Fri 4/17/09	Team
Abstract/Brochure	Mon 4/27/09	Mon 4/27/09	Team
Poster	Mon 4/27/09	Mon 4/27/09	Team
Final Presentation Slides	Wed 4/29/09	Wed 4/29/09	Team
Website (Optional) ?	Tue 2/3/09	Tue 2/3/09	Team
IPRO Day	Fri 5/1/09	Fri 5/1/09	Team
Final Report	Fri 5/8/09	Fri 5/8/09	Team
Deliverables CD	Mon 5/11/09	Mon 5/11/09	Team



9. Individual Team Member Assignments

The IPRO team decided to break up into 3 different sub-groups that are to focus on the coinciding topics. The Electric Cart will be led by Anthony Wisniewksi and the other team members are John Reinecke, Ray Simons, and Jason Walker. The second sub-group is focusing on solar hot water and is led by Chris Brewin with Shweta Gandhi, Carlos Hernandez, and Sarah Pfeifer as team mates. The Window group is led by Karen Nelson and includes Jainam Shah, Nathan Schmidt, and Steve Leemon. Together, Sarah Pfeifer, Anthony Wisniewski, Andy Kedzuch, and Christopher Brewin will collaborate to form deliverables.

Sub-Group Responsibilities:

The Solar Hot Water subgroup's goal and responsibility is to develop a source for solar hot water to provide a passive heating and cooling system for the space and for hot running water. The group will provide a prototype model for a substantial amount of hot water. Also data and research found throughout the project will be sufficient for further development of efficient systems.

The Window ventilation subgroup's goal and responsibility is to research, test, and make proper adjustments to a sensor system that will open and close the window ventilation according to outside climate in order to provide a comfortable interior environment.

The Electric Cart subgroup's goal and responsibility is to provide an efficient energy collector and storage system. This stored energy will then be transferred to the cart in order to use a mobile power source.

Team Structure

Name	Major / Year	Responsibility	Experience	Team
Andy Kedzuch	**5th year architecture, MMAE**	Team building, Research, Supplies, Testing, Deliverable production	Autocad, 3-d rendering programs	Window Ventilation
Christopher Brewin	**3rd year, Mechanical Engineering**	Team building, Deliverable production, Testing, Research, solution brainstorm, testing, prototype modifications	Autocad, ProE, Matlab	Solar Hot Water (Leader)
Anthony Wisniewski	**4th year, Electrical Engineering**	Team building, Deliverable production, existing conditions, specifications, Bill of Materials, power install, schematic, installation, testing	Psim, autocad	Electric Cart (Leader)

Shweta Gandhi	**2th year, Micro Biochemistry/ Biophysics**	Team building, research, solutions, testing, modifications	Basic computer skills, programming, C++	Solar Hot Water
Carlos Hernandez	**4th year architecture**	Team building, research, solutions, testing, design	Autocad, 3d max, photoshop	Solar Hot Water
Steve Leemon	**4th year political science**	Team building, Research, installation, testing	Construction, programming	Window ventilation
Karen Nelson	**3rd year civil engineering**	Team building, Deliverable assembly, programming and testing	Programming, autocad, SAP2000, MathCad	Window ventilation (Leader)
Sarah Pfeifer	**4th year architecture**	Team building, research, solutions, testing, design Deliverable production	autocad, 3d rendering programs	Solar Hot Water
Nathan Schmidt	**4th year political science**	Team building, Research, installation and testing	Construction, programming	Window ventilation
John Reinecke	**4th year architecture**	Team building, Deliverable production, existing conditions, installation, testing	Autocad, 3d max, photoshop	Electric Cart
Jainam Shah	**3rd year, Mechanical Engineering**	Team building, Research, programming, testing	Programming, Pro E, Matlab, MP Lab	Window ventilation
Ray Simons	**4th year, Electrical Engineering**	Team building, existing conditions, specifications, Bill of Materials, power install, schematic, code, materials, installation, testing, summary	Microsoft Office, autocad, matlab, mpp	Electric Cart
Jason Walker	**4th year architecture**	Team building, existing conditions, specifications, rendering, schematic, installation, testing, summary	Autocad, 3d max, photoshop	Electric Cart

10. Designation of Roles

- **Minute Taker**: records decisions made during meetings, including task assignments or changes under consideration. – **Shweta Ghandi**

- **Agenda Maker**: creates an agenda for each team meeting, which provides structure to the meetings and offers a productive environment. – **Andrew Kedzuch**

- **Time Keeper**: is responsible for making sure meetings go according to the agenda. – **Karen Nelson**

- **Weekly timesheet collector/summarizer:** responsible for collecting weekly timesheets from each member of the team and updating everyone with a summary report. – **Sarah Pfeifer**

- **Master schedule maker:** responsible for collecting schedules from all the team members and developing a master schedule, which tells the team when members are available and how to contact them. – **Sarah Pfeifer**

- **iGroups:** responsible for organizing the team's iGroups account and ensuring that it is used properly. – **Sarah Pfeifer**