IPRO 337: Zero Energy Lab

Fall 2008

ZERO energy

Recalling the past to create a sustainable future

12/5/08

Final Presentation

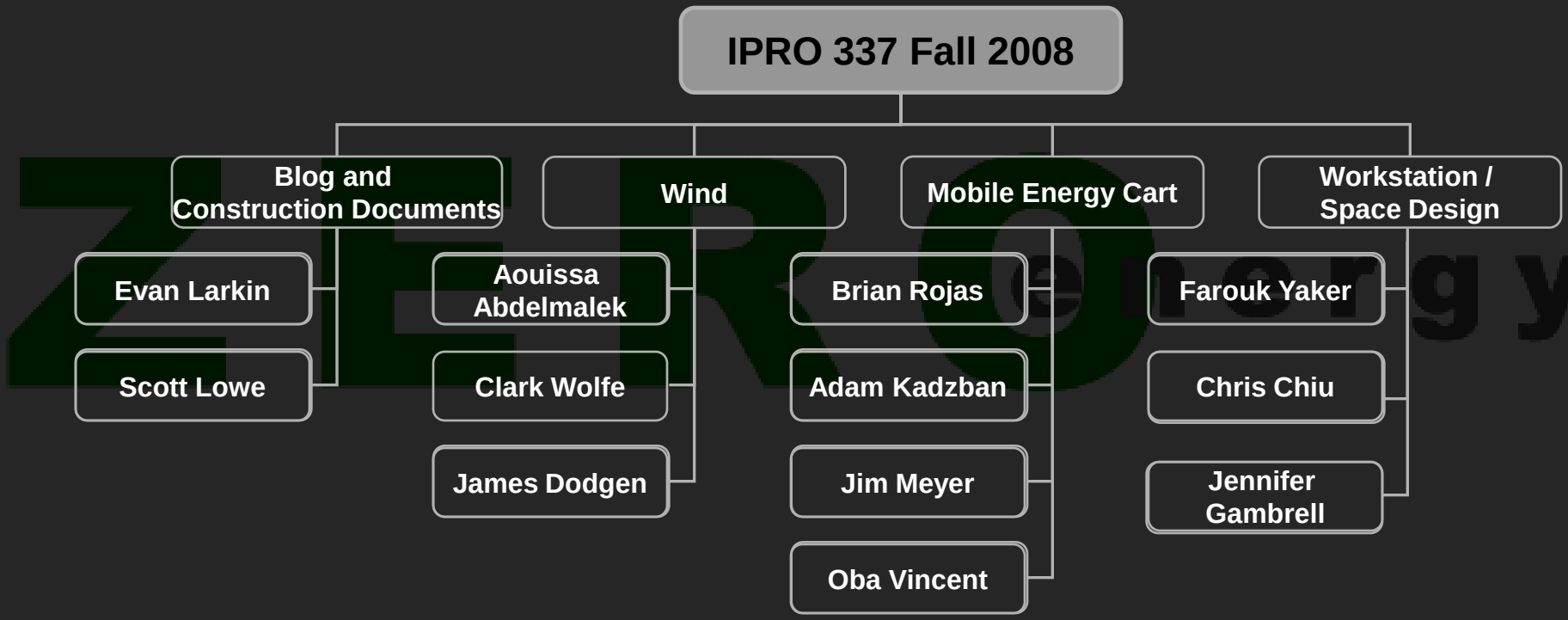
Introduction

- Fourth floor of Machinery Hall
- Final goal: provide an opportunity for an energy conscious and environmentally friendly workspace for research
- Fall 2008 problem
  - Windmill construction
  - Construct mobile energy cart
  - Integrate with solar system
  - Design of space

Team Development and Performance

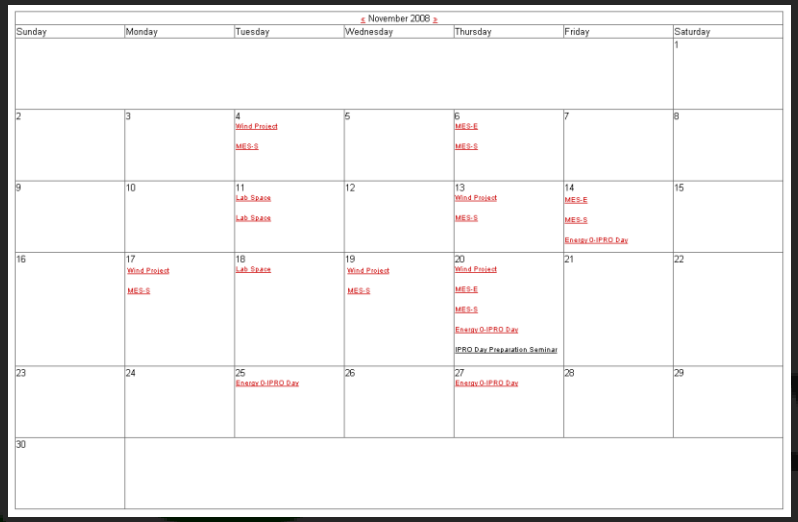
- Goals toward common purpose
- Regular meetings
- Focus on achieving a safe and work friendly research environment
- Organization
  - Wind Team
  - Mobile energy station team
  - Lab design team
  - Blog and Construction Documents

Team


IPRO 337 Fall 2008
Blog and Construction Documents
Wind
Mobile Energy Cart
Workstation / Space Design
Evan Larkin
Scott Lowe
Aouissa Abdelmalek
Clark Wolfe
James Dodgen
Brian Rojas
Adam Kadzban
Jim Meyer
Oba Vincent
Farouk Yaker
Chris Chiu
Jennifer Gambrell

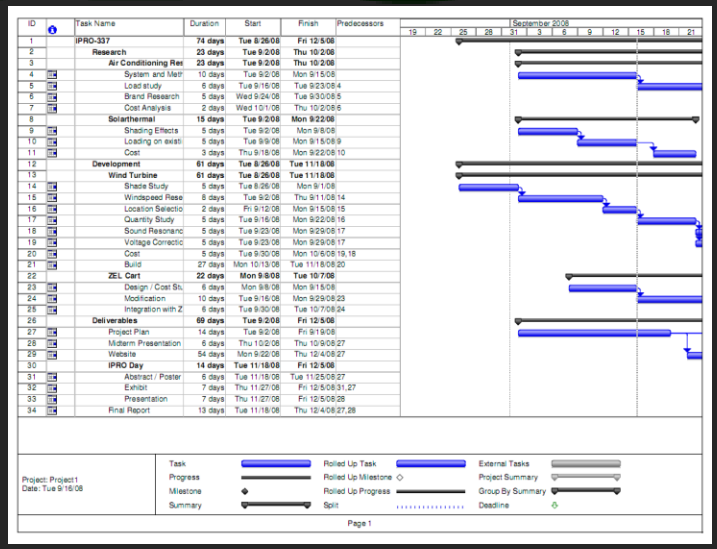
Team Development and Performance (con't)

- Calendar for scheduling
- Gantt chart for monitoring progress
- Regular meetings for adapting to change



« November 2008 »

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1
2	3	4 Wind Project MES-S	5	6 MES-E MES-S	7	8
9	10	11 Lab Space Lab Space	12	13 Wind Project MES-S	14 MES-E MES-S Energy D IPRO Day	15
16	17 Wind Project MES-S	18 Lab Space	19 Wind Project MES-S	20 Wind Project MES-E MES-S Energy D IPRO Day IPRO Day Preparation Seminar	21	22
23	24	25 Energy D IPRO Day	26	27 Energy D IPRO Day	28	29
30						



ID	Task Name	Duration	Start	Finish	Predecessors
1	**IPRO-337**	**74 days**	**Tue 8/26/08**	**Fri 12/5/08**	
2	**Research**	**23 days**	**Tue 9/2/08**	**Thu 10/2/08**	
3	**Air Conditioning Res**	**23 days**	**Tue 9/2/08**	**Thu 10/2/08**	
4	System and Matl	10 days	Tue 9/2/08	Mon 9/15/08	
5	Load study	6 days	Tue 9/16/08	Tue 9/23/08	4
6	Brand Research	5 days	Wed 9/24/08	Tue 9/30/08	5
7	Cost Analysis	2 days	Wed 10/1/08	Thu 10/2/08	6
8	**Solarthermal**	**15 days**	**Tue 9/2/08**	**Mon 9/22/08**	
9	Shading Effects	5 days	Tue 9/2/08	Mon 9/8/08	
10	Loading on existi	5 days	Tue 9/9/08	Mon 9/15/08	9
11	Cost	3 days	Thu 9/18/08	Mon 9/22/08	10
12	**Development**	**61 days**	**Tue 8/26/08**	**Tue 11/18/08**	
13	**Wind Turbine**	**61 days**	**Tue 8/26/08**	**Tue 11/18/08**	
14	Shade Study	5 days	Tue 8/26/08	Mon 9/1/08	
15	Windspeed Rese	8 days	Tue 9/2/08	Thu 9/11/08	14
16	Location Selectio	2 days	Fri 9/12/08	Mon 9/15/08	15
17	Quantity Study	5 days	Tue 9/16/08	Mon 9/22/08	16
18	Sound Resonanc	5 days	Tue 9/23/08	Mon 9/29/08	17
19	Voltage Correctio	5 days	Tue 9/23/08	Mon 9/29/08	17
20	Cost	5 days	Tue 9/30/08	Mon 10/6/08	19,18
21	Build	27 days	Mon 10/13/08	Tue 11/18/08	20
22	**ZEL Cart**	**22 days**	**Mon 9/8/08**	**Tue 10/7/08**	
23	Design / Cost St	6 days	Mon 9/8/08	Mon 9/15/08	
24	Modification	10 days	Tue 9/16/08	Mon 9/29/08	23
25	Integration with Z	6 days	Tue 9/30/08	Tue 10/7/08	24
26	**Deliverables**	**69 days**	**Tue 9/2/08**	**Fri 12/5/08**	
27	Project Plan	14 days	Tue 9/2/08	Fri 9/19/08	
28	Midterm Presentation	6 days	Thu 10/2/08	Thu 10/9/08	27
29	Website	54 days	Mon 9/22/08	Thu 12/4/08	27
30	**IPRO Day**	**14 days**	**Tue 11/18/08**	**Fri 12/5/08**	
31	Abstract / Poster	6 days	Tue 11/18/08	Tue 11/25/08	27
32	Exhibit	7 days	Thu 11/27/08	Fri 12/5/08	31,27
33	Presentation	7 days	Thu 11/27/08	Fri 12/5/08	28
34	Final Report	13 days	Tue 11/18/08	Thu 12/4/08	27,28

September 2008: 19 22 25 28 31 3 6 9 12 15 18 21

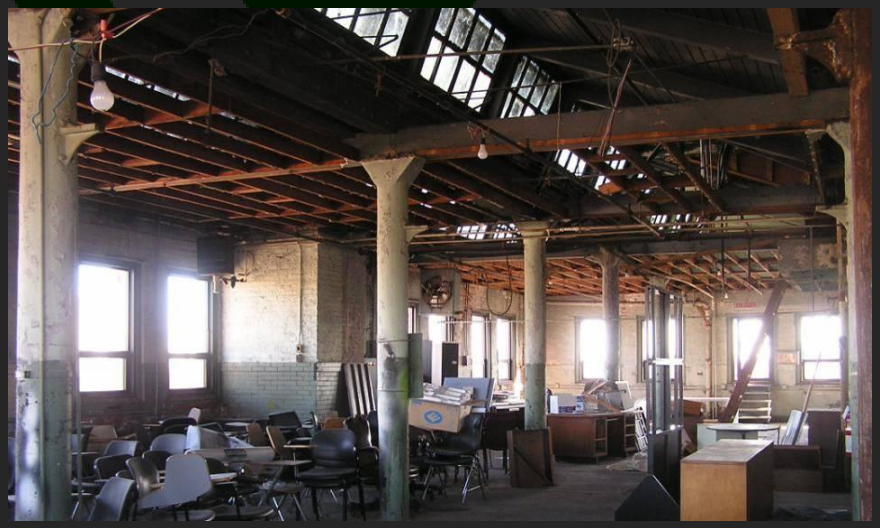
Project: Project1
Date: Tue 9/16/08

Task · Progress · Milestone · Summary · Rolled Up Task · Rolled Up Milestone · Rolled Up Progress · Split · External Tasks · Project Summary · Group By Summary · Deadline

Page 1

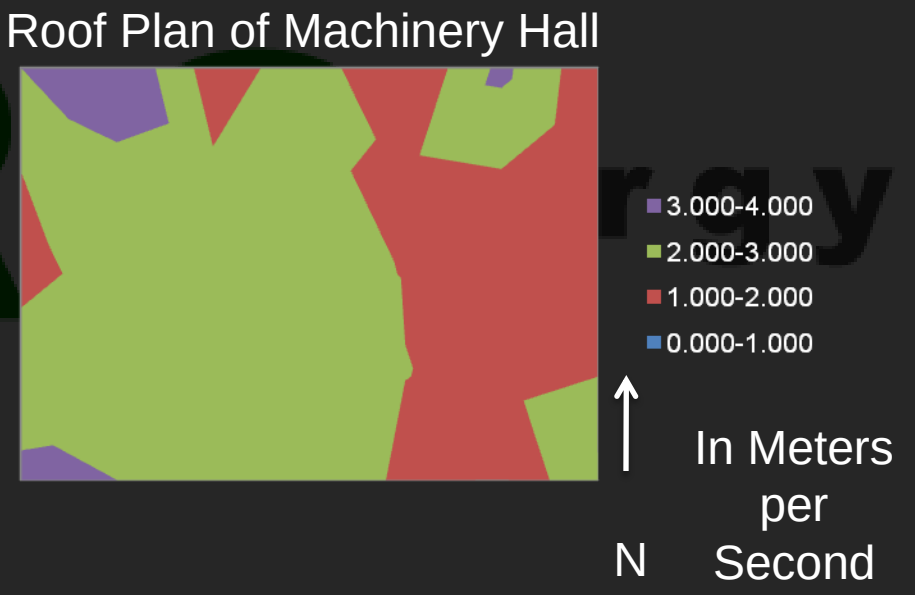
Project History

- Storage space for unused furniture and equipment
- Cleared out, large open space
- Existing solar cell array on roof
- Renovated office
- Research
  - Solar thermal
  - ZEL Rating



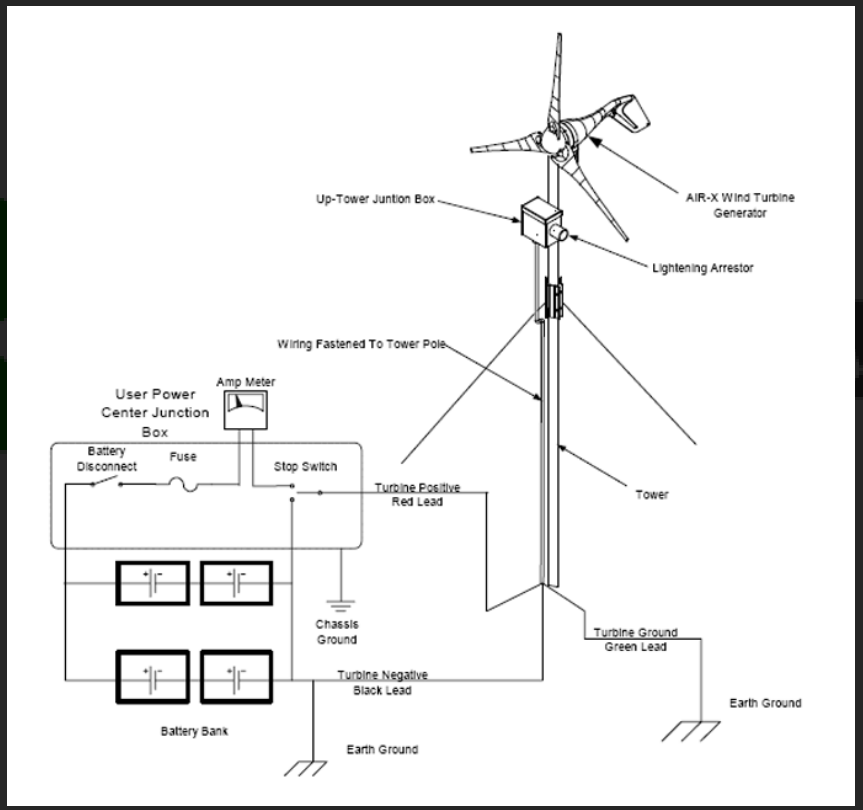
Data Analysis and Tasks

- Data Collection
  - Wind studies
  - Mobile energy station research
  - Electrical exploration
- Tasks Completed
  - Wind turbine assembly
  - Mobile energy station
  - Lab space renovation and design



Wind Tasks

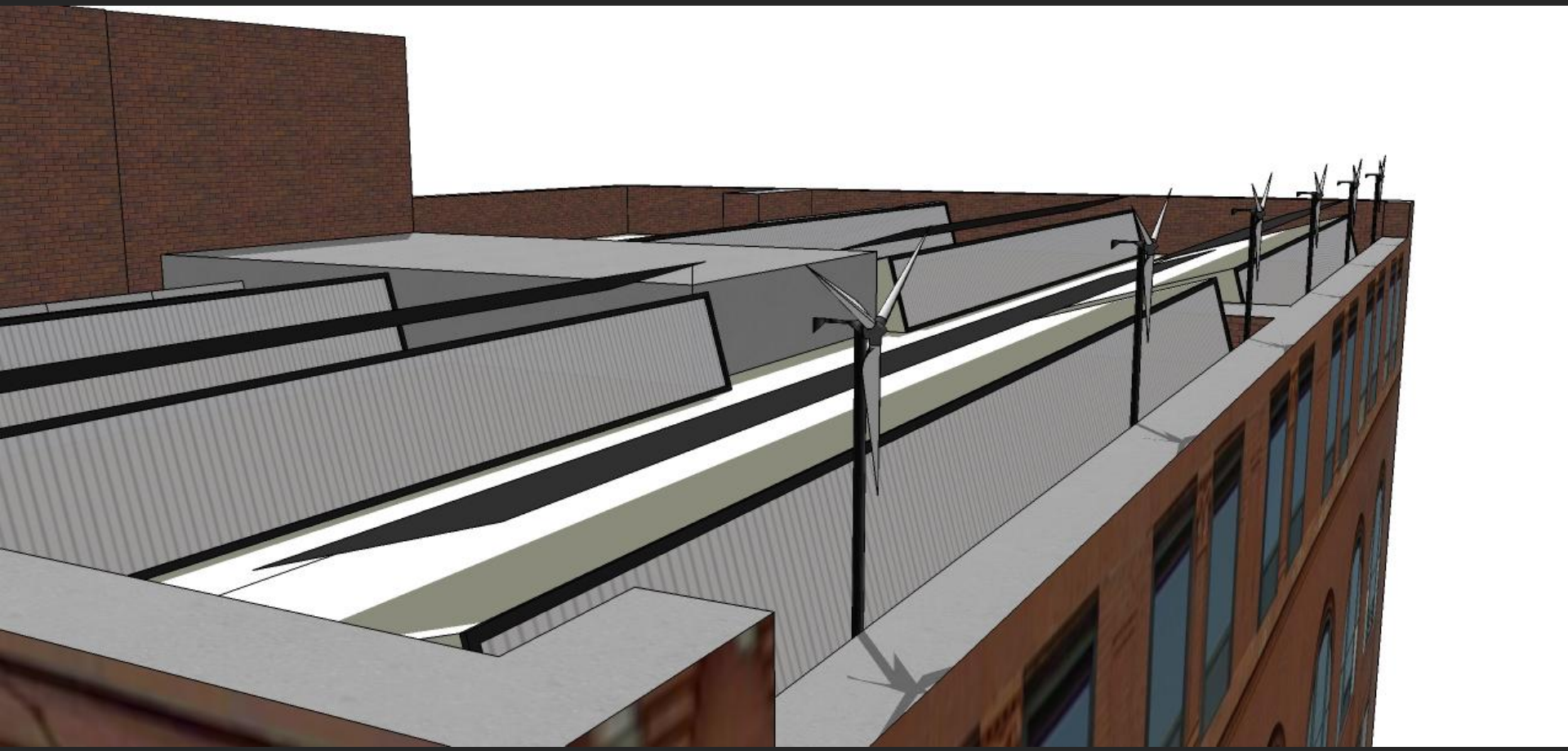
- Design and Implement Wind Power
  - Proper location
  - Proper structure
- Integrate wind power into existing and new systems
  - Mobile Energy Station, Solar Panels, Battery Banks, etc.
  - All systems to work together
- Completed
  - Wind Turbine installed in a temporary location
  - Electrical system set up to record data



Wind Results thus far

- Connected rated wattage – 60 Watts
  - Actual draw – 35 Watts
- Able to sustain battery level
- Running low power led lights

Wind Turbine array



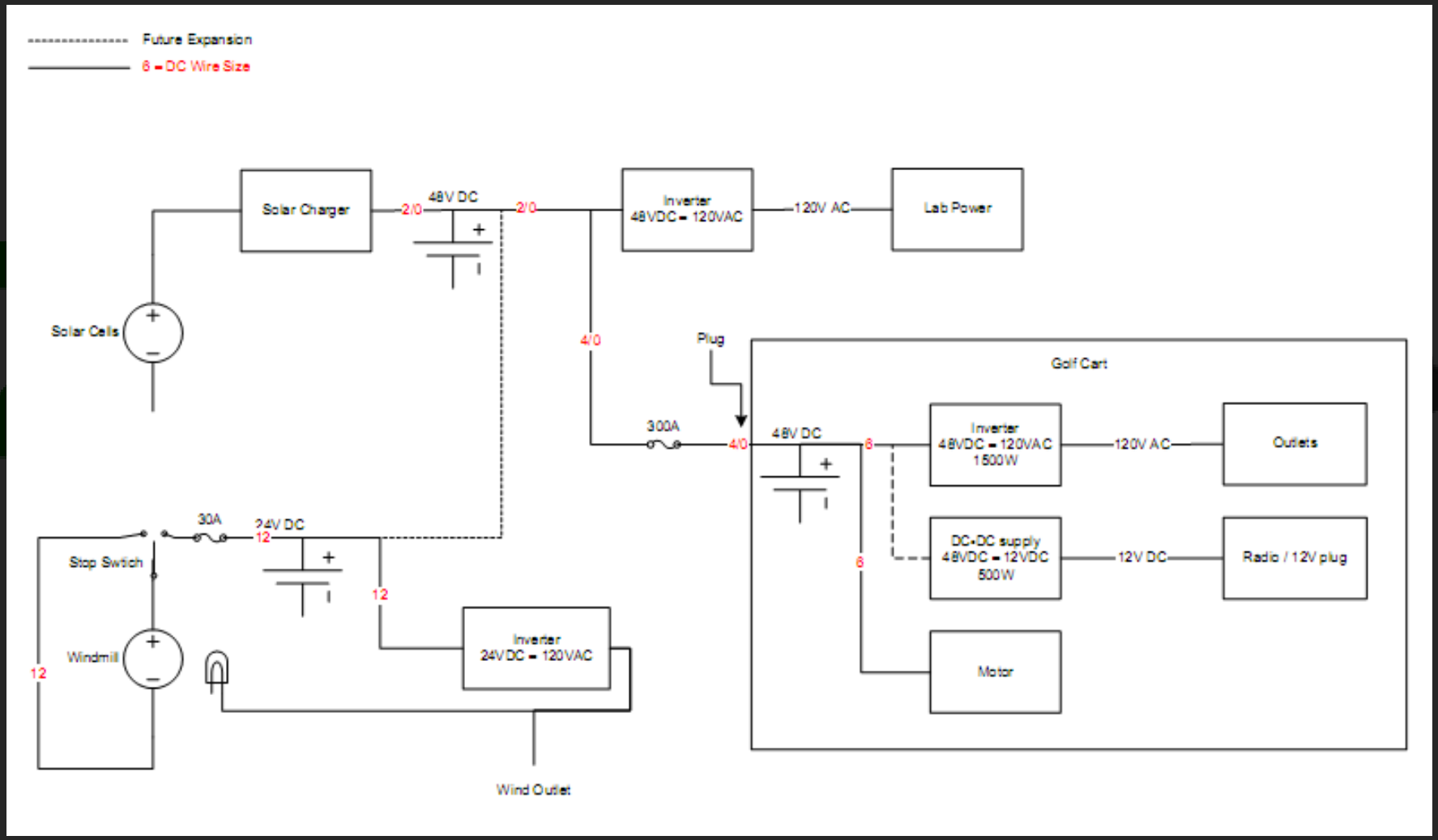
Mobile Energy Station

- Incorporate reserve energy from industrial equipment into Zero Energy Lab battery bank
  - Premise 1: 48 volt daytime equipment, fork lifts, cart
  - Premise 2: 48 volt nighttime equipment: floor sweepers and cleaners
  - Premise 3: Daytime renewable energy: sun/ PV
  - Premise 4: Nighttime and Daytime renewable energy: wind, biodiesel
- Design systems to take full advantage of reserve energy in battery systems

Mobile Energy Station Tasks

- Design and construct mobile energy station
  - Component Selection
  - Safe electrical integration study
  - Painting and rebuilding
- Completed
  - Inverter and DC-DC power installed
  - Cart painted and desk built

Electrical System Design



Z

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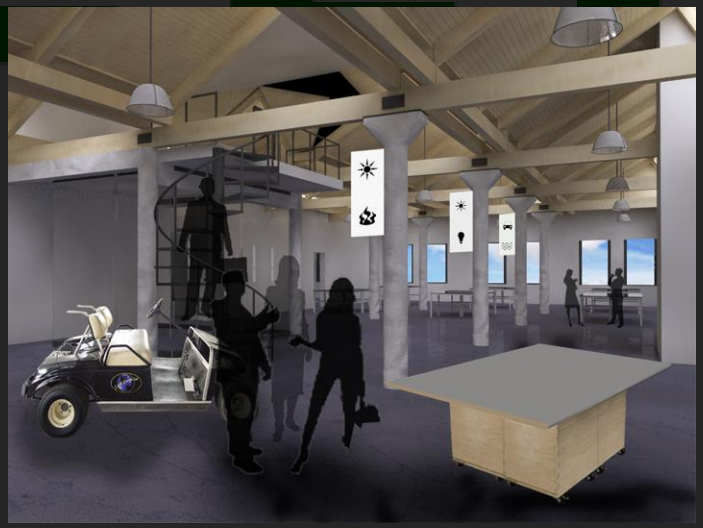
12/5/08


NO STEP
NO STEP

Lab Space Tasks

- Architectural layout for renovation of main space on 4th floor
  - Overall plan
  - Renovation



- Completed
  - Desk constructed
  - Banner developed
  - Synergistic design

Desk Assembly Demonstration

Portable work surfaces and storage desks

- Easily assembled/disassembled
- Convenient mobility and portability
- Minimum space storage
- Built-in modularity

Conclusions and Benefits

- Have a running test of the proposed wind turbine
  - Testing for practicality of wind energy in Chicago
  - Benefit: added generating capacity to Zero Energy Lab
- Established Mobile Energy Station capabilities in the Zero Energy Lab
  - Convenient and portable power is available throughout the Lab
  - Benefit: Expanded battery bank for the Zero Energy Lab
  - Benefit: Easier access to power
- Lab space clear and renovation has begun
  - More clear area to work in
  - Benefit: The next IPRO group will easily be able to step in and continue building on the current lab design

Impacts, Risks and Challenges

- Wind
  - Impact: Cleaner source of energy
  - Risk: Safe Mounting
  - Risk: Potential Electrical Hazard
  - Challenge: Selecting a location with sufficient wind density
- Mobile Energy Station
  - Impact: Available and easy energy provided to the lab
  - Risk: Potential Electrical Hazard
  - Challenge: Safe integration and use
- Lab Space Design
  - Impact: More effective use of space
  - Risk: Cost of new construction
  - Challenge: Making a cheap and useful work environment

Ethical Considerations

- Safety
  - Wind Turbine Mounting
  - Electrical System properly installed
  - Proper preventative measures to protect users
- Monetary Funds
  - Proper allocation of grant funding
  - Proper cost analysis

Achievements

- Good base for future wind advancement and construction
- Mobile energy station allows increased electrical capacity and convenient power access
- Lab design plan provides solid base for development into full fledged scientific facility

The Future…

- Future IPRO teams will realize our dream of a Zero Energy Lab
- Analysis of wind turbine experiment results
- Continued expansion and integration of electrical power sources
- Work space design to a reality
- Mobile Energy Cart
  - Add more batteries for increased capacity
  - Add storage for better usability

Thank You