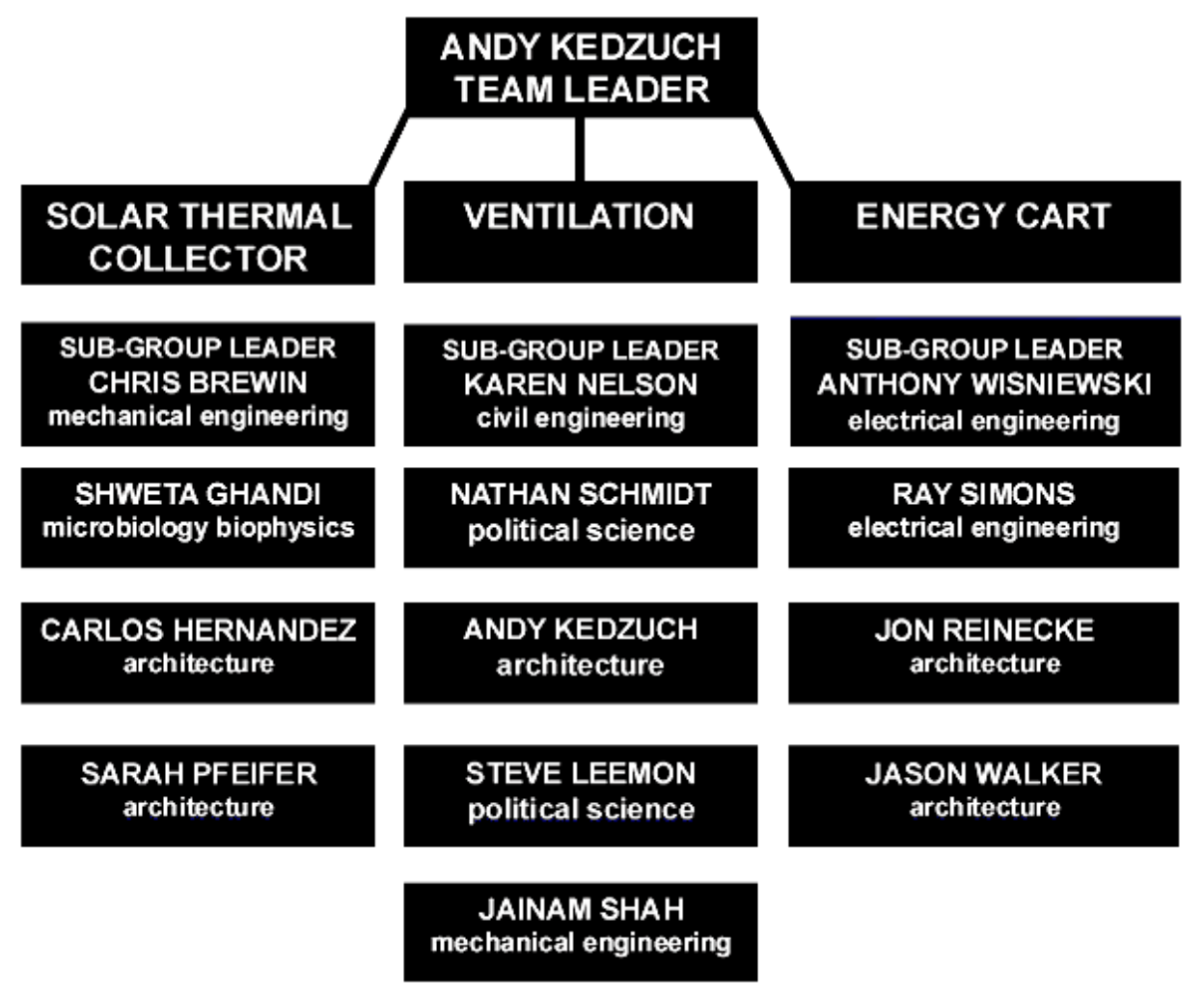
IPRO 337: Zero Energy Lab
INTRODUCTION

MISSION:

To transform the space on the 4th floor of Machinery Hall into a completely self-sustaining laboratory environment.

IPRO 337: Zero Energy Lab
INTRODUCTION



Solar Thermal ◆ Ventilation ◆ Energy Cart

IPRO 337: Zero Energy Lab
SOLAR THERMAL

PROBLEM:

- No efficient heating system
- No running hot water supply

OBJECTIVE

- Design/build solar thermal collector
- Test collector to improve design

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SOLAR THERMAL

METHODOLOGY:

- Researched most efficient and cost effective system

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SOLAR THERMAL

METHODOLOGY:

- Chose solar thermal collector design

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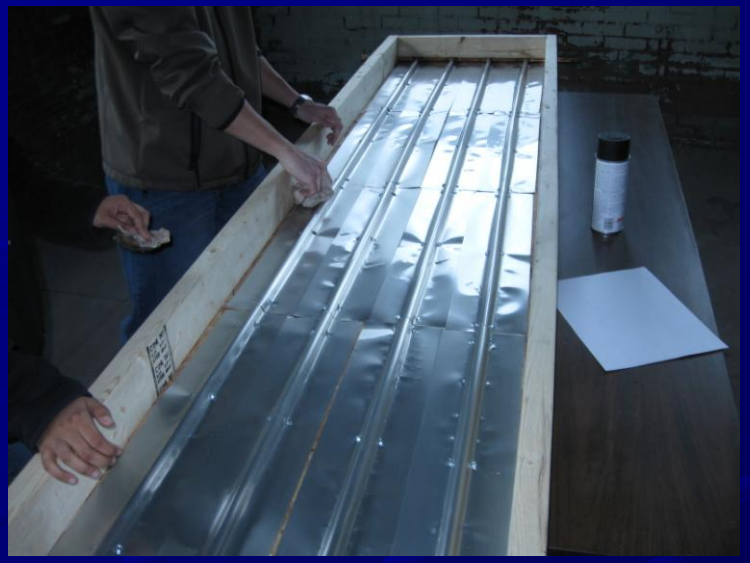
SOLAR THERMAL



METHODOLOGY:

- Constructed solar thermal collector

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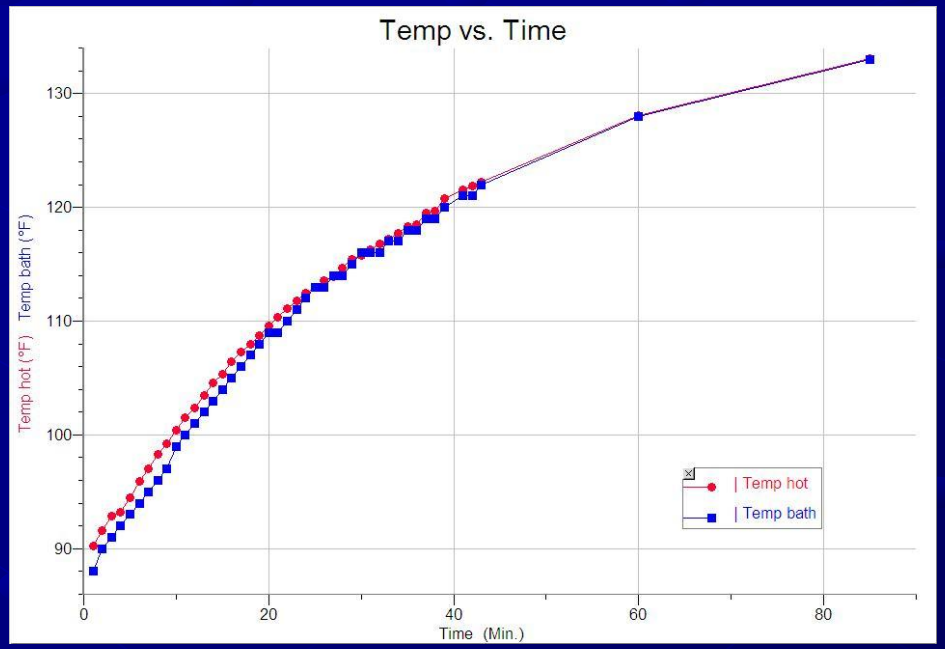
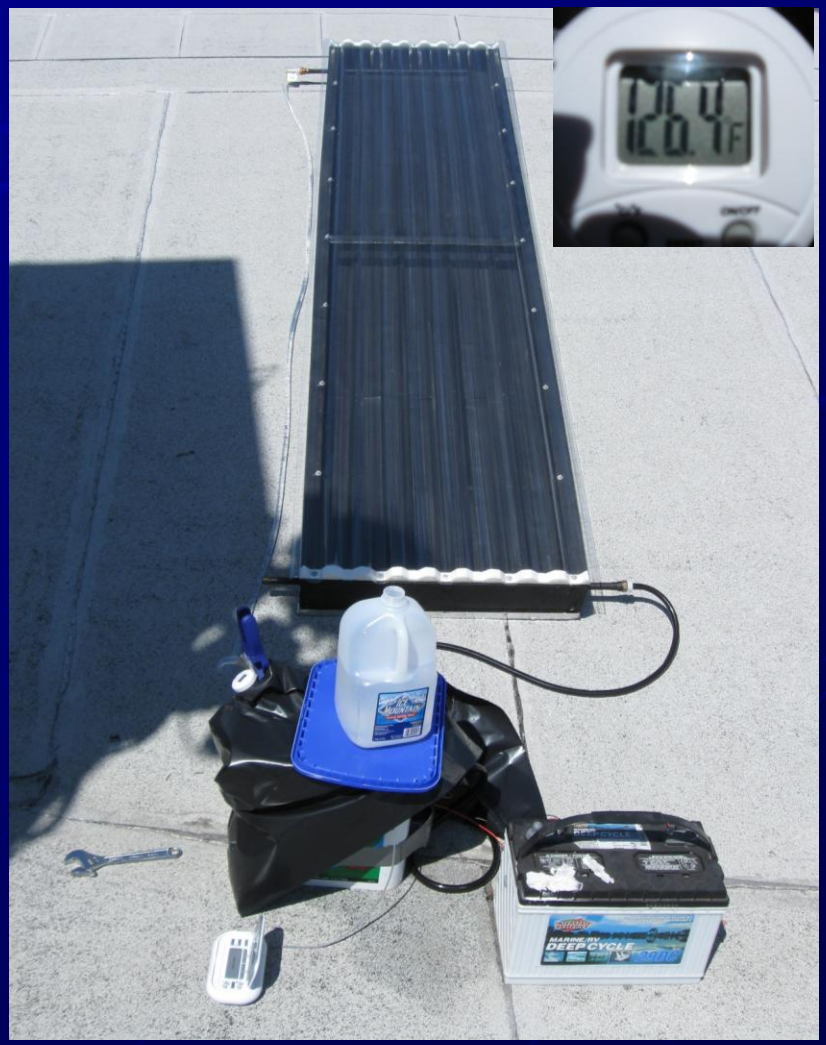
SOLAR THERMAL

METHODOLOGY:

- Testing solar thermal collector





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SOLAR THERMAL

RESULTS :

- Cost less than $100 per collector
- 330 watts of heat at 115°F
- Thermal efficiency of 26%

OBSTACLES:

- Budget
- Acquiring materials
- Transporting finished collector
- Testing design

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SOLAR THERMAL

LONG TERM GOALS:

- Larger thermal storage capacity
- Hot running water
- Solar Air Conditioning
- Design backup system

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VENTILATION

PROBLEM:

- No energy-efficient cooling system
- Potential for natural ventilation

OBJECTIVES:

- Design automatic window system
  - Mechanical
  - Electronic
- Determine cost effectiveness

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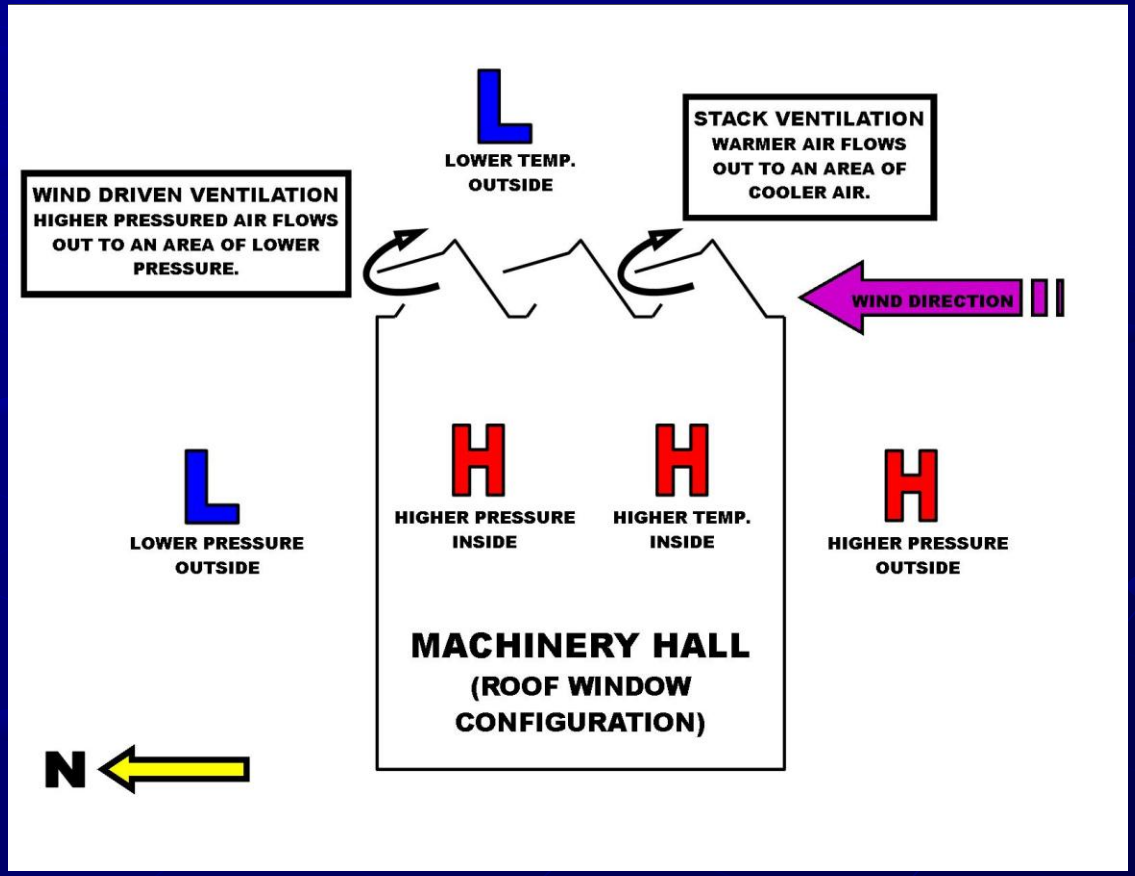
VENTILATION

METHODOLOGY:

- Researched the effectiveness of natural ventilation
  - Stack
  - Wind Driven



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VENTILATION

METHODOLOGY:

- Designed mechanical system for operating windows
- Built mockup of design

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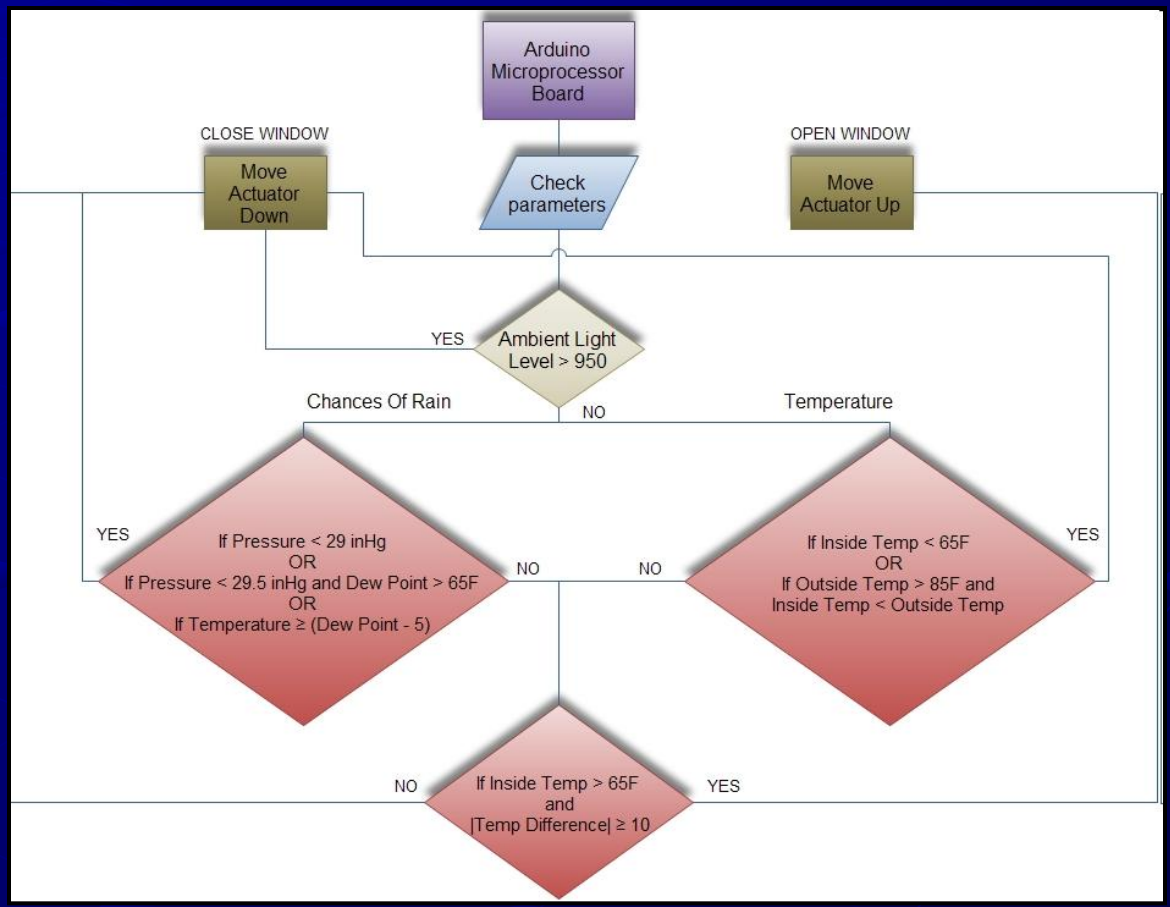
VENTILATION

METHODOLOGY:

- Designed electronic program
  - Writing code
  - Setting parameters



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VENTILATION

COST OF INSTALLATION		
Item	**Item Type**	**Price**
ArduinoUSB Board	Inside Unit	$29.95
Breadboard Mini Self-Adhesive Back	Inside Unit	$3.95
Humidity and Temperature Sensor - SHT15 Breakout	Inside Unit	$41.95
2xbees (Wireless Upgrade)	Inside/Outside Unit	$20.00
xB Shield (Wireless Upgrade)	Inside Unit	$20.00
Solar Panel (Wireless Upgrade)	Outside Unit	$30.00
Solar Cell Large	Outside Unit	$34.95
USB Weather Board	Outside Unit	$124.95
SCP1000 Gasket	Outside Unit	$0.95
Actuator	Mechanical Unit	$125.00
Motor Controller	Mechanical Unit	$48.00
Adapter	Mechanical Unit	$10.00
TOTAL COST OF PARTS:		**$489.70**

METHODOLOGY:

- Conducted cost analysis
  - Straight parts

IPRO 337: Zero Energy Lab
VENTILATION

OBSTACLES:

- Did not know wind direction
- Actual windows not operable
- Difficult to define parameters without field research

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VENTILATION

LONG TERM GOALS:

- Conduct more research to improve operating parameters
- Consider additional energy-efficient cooling methods
- Look into repairing/replacing windows in order to install system

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ENERGY CART

PROBLEM:

- Limited energy storage capacity
- ZEL Cart requires AC power from grid
- Limited distribution of AC power in the lab

IPRO 337: Zero Energy Lab
ENERGY CART

OBJECTIVES:

- Design and install a sub-system by which the ZEL cart could be connected to the energy management system
- Double the system energy storage capacity by adding the cart's 48 Volt battery bank to the existing 48 Volt bank
- Create a "green" method for recharging the cart
- Prepare the way for renewable, mobile, AC power
- Create user friendly documentation of the system

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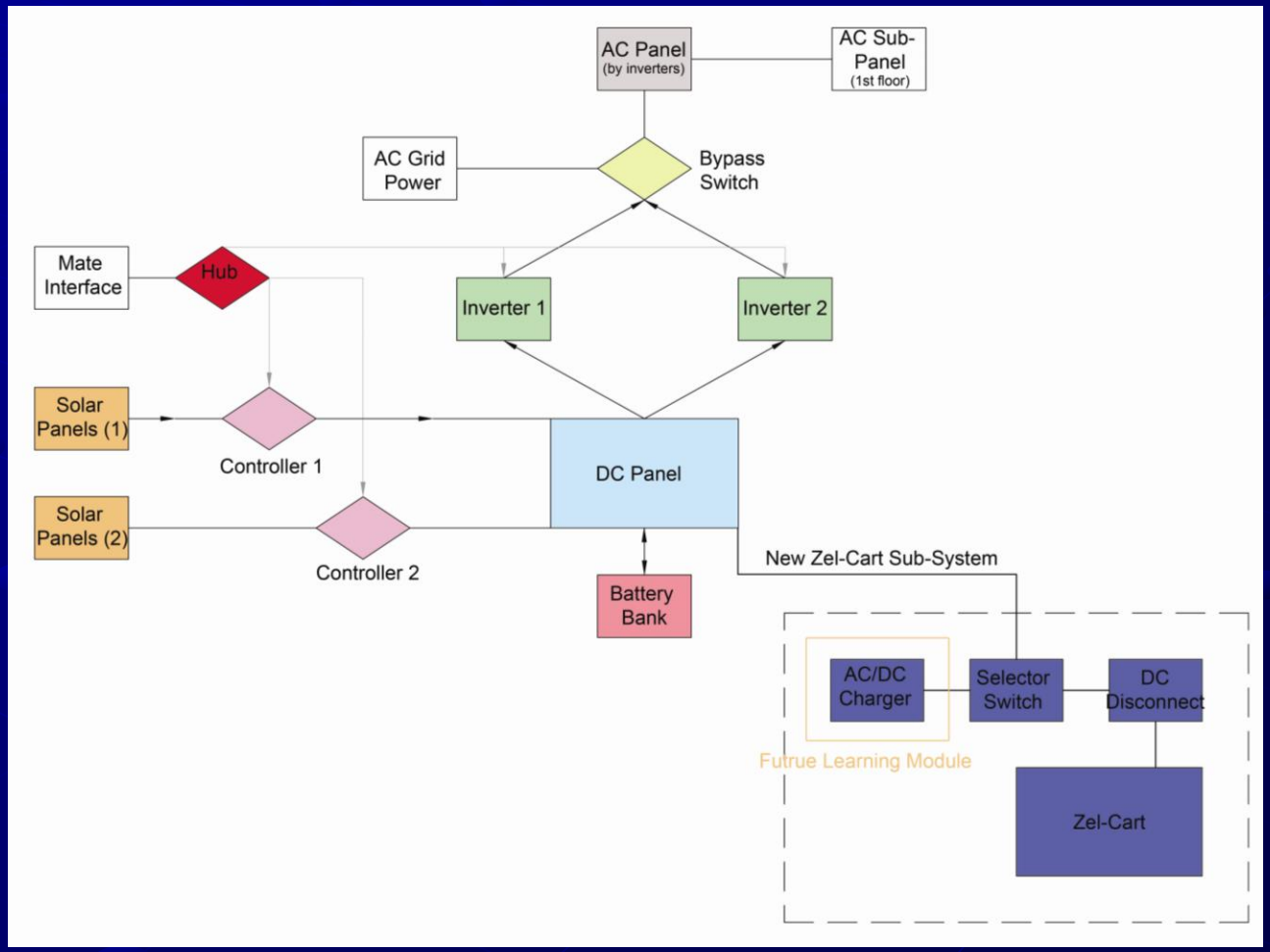
ENERGY CART

METHODOLOGY:

- Analyzed and documented the current system



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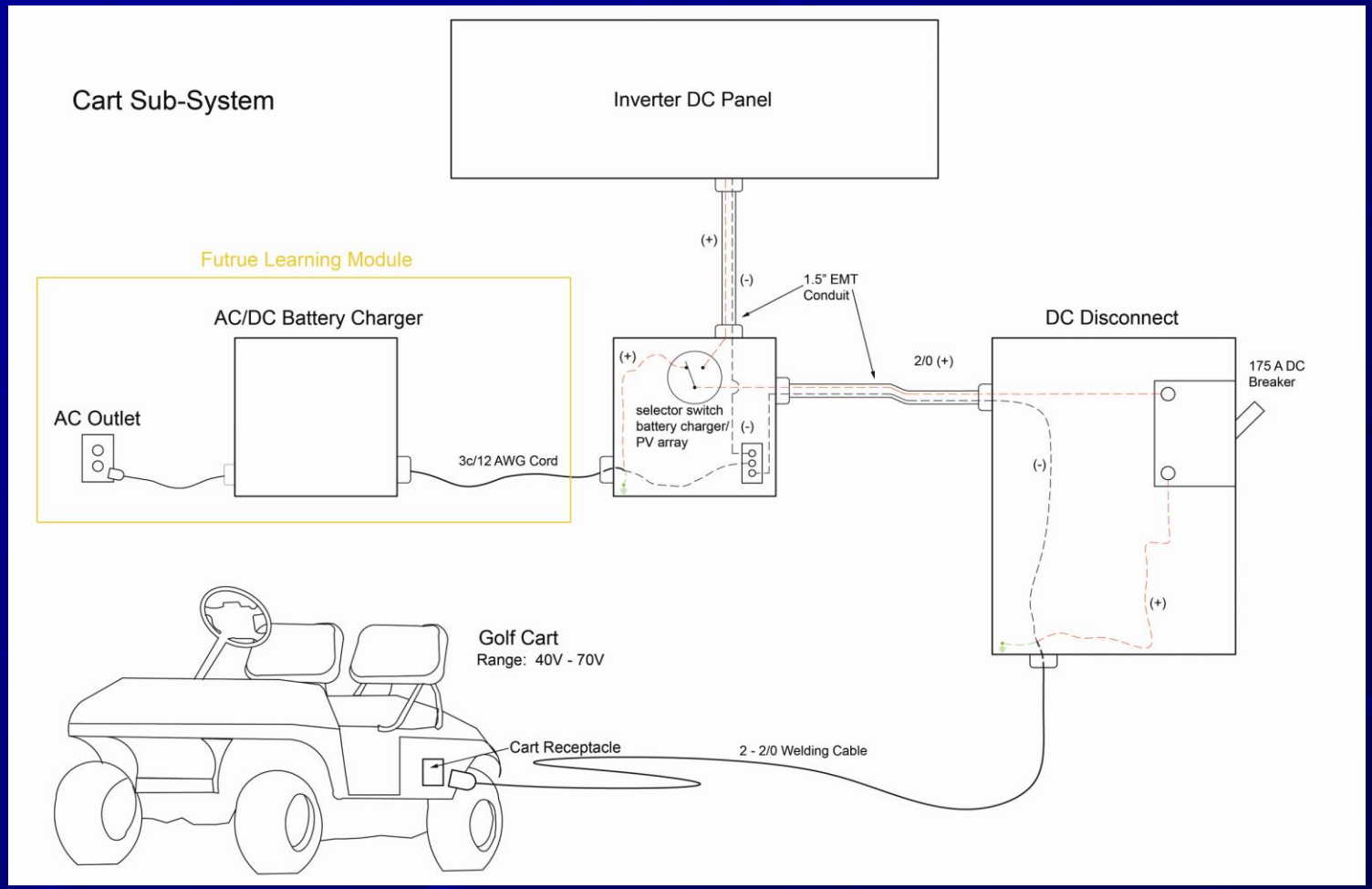
ENERGY CART

METHODOLY: Designed sub-system to connect the cart to the system



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ENERGY CART

METHODOLOGY:

- Installed and tested the sub-system

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ENERGY CART

METHODOLOGY:

- Doubled system energy storage capacity

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OBSTACLES:

- Unanticipated high current design issues
- Understanding the cart inter-connect design
- Budget constraints
- Loss of the sub-group leader during week 10

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ENERGY CART

LONG TERM GOALS:

- Continue to improve and increase battery storage
- Add an DC/AC inverter to cart
- Add existing AC/DC charger to the sub-system
- Add new uses to the existing system

IPRO 337: Zero Energy Lab
CONCLUSION

WHAT WE ACCOMPLISHED:

- Created Solar Thermal Collector
- Designed Automated Window Unit for Natural Ventilation
- Connected ZEL Cart –Doubled Energy Storage
- Introduced new energy technologies to the ZEL

Solar Thermal ◆ Ventilation ◆ Energy Cart

IPRO 337: Zero Energy Lab
CONCLUSION

ACKNOWLEDEMENTS:

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- Bridget Ford, IO Lighting
- David Lavan, Elara Engineering

QUESTIONS?

Solar Thermal ◆ Ventilation ◆ Energy Cart