ELECTRICITY GENERATING GYM EQUIPMENT

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OBJECTIVES

- Document all gym equipment that can be modified to create energy
- Research how we would modify the equipment to generate electricity
- Investigate the possibilities of energy generation in new equipment
- Identify how much energy will be generated by changing the gym equipment
- Find uses for the energy generated by the equipment
- Analyze the upfront cost the changes would incur vs the final savings the changes would produce

ALTERNATIVES

Type of Equipment	Design of Generator	Type of Power Cell	Use of Energy
• Cardio Bikes • Elphitcal	• Retrofit • Brand-New	• Fuel Cells • Conventional Batteries • Ultracapacitors • Conventional Capacitors	• Send to grid • Power fan/lights • Supply Battery for charging

- These are but a few of the design alternatives that we researched, to try and come up with the best possible system

CRITERIA OF EVALUATION

Evaluation Criteria	Weight
Initial Investment	20 %
Savings	20 %
Efficiency (amount of usable/amount of energy stored)	30%
Restrictions	10 %
Environmental impact	15 %
USF social impact	5 %

We felt the criteria didn't need improvement from our concept

Slide 2

2 Lets add our functional unit in writing somewhere :)
Sydney Nichols, 4/26/2016

Slide 3

1 Maybe we should break this up if we need more slides?
Sydney Nichols, 4/26/2016

1 i Think we are fine on slides tbh
Tyler Gehring, 4/26/2016

2 I just want to add a bit of sub text here but not sure what
Tyler Gehring, 4/26/2016

ECONOMIC ANALYSIS - PREMADE EQUIPMENT

- Price: $1500 for cardio bike, $2000 for elliptical;
- Cardio bike generates between 15 and 30 watt-hours (Wh)
- Elliptical generates between 50 and 100 Wh
- California Fitness came up with a the idea to monitor the machines use and will have fans and lights come on only in use, while the energy from the bike will power the light and fan thus saving.
- Although it will take approximately 40 years to pay back the installation in cost terms with actual machines;

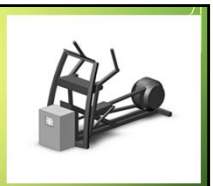


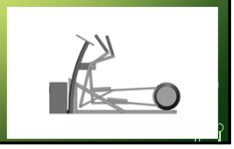

ECONOMIC ANALYSIS - RETROFITTING EQUIPMENT

- Since USFs gym already has gym training equipment the first idea was how can we retrofit a generator system onto the current bikes.
- Their are companies out there that install retrofitted systems. Though most charge a steep price ranging from 650-1000$.
- The individual price if bought and made by yourself comes between 300-400$

Material	Cost
System Stand/Wires	Various
24V DC scooter motor	40-50$
DC-DC battery charger	80-90$
battery	100-120$
DC-AC inverter	50-65$

IMPLEMENTATION



USES IN USF GYM

- One bike ~= 100 watts
- 3400 watts produced during one hour spin class
- ~40% loss during conversion ~= 2040 watts produced

Uses for generated power	Watts/hr
Phone Charger	12 W
Fan	1280 W
Water Fountain Compressor	260 W
LED Light Kit	16.3 W

Slide 5

3 I changed the pay back time as IDK how you got 3 years as the payback time, as the power generated is in watts and 1kwh is only about 11-12 cents.
Tyler Gehring, 4/26/2016

1 _Marked as resolved_
Daniel Costa Da Silva, 4/26/2016

2 _Re-opened_
I sent you an email about that, but how you got 9 years?
Daniel Costa Da Silva, 4/26/2016

4 As people produce around 50-100 Wh, lets say they are in use 10 hours a day which is still a huge jump and probably wrong they probably run less, so that is 500-1000Wh or.5-1kWh the price of a kWh costs around 11-12 cents per kWh so you are making not even 12 cents a day of power. So lets say they gym is open 350 days of the year. We take our 11 cents times it by 350 days. To get the amount made per year. Which is around 38.50 per year divide that by price of the machine and there you go. Mind you this number is still very wrong as it is best case scenario with 100% efficiency, and a ton of hours of in use time.
Tyler Gehring, 4/26/2016

5 Also my bad it around 40 years doing the math over.
Tyler Gehring, 4/26/2016

3 Did you see the link I sent you in the email?? I really don't know how they came up with that number...
Daniel Costa Da Silva, 4/26/2016

6 They faked it
To make it sound more applying to costumers
Tyler Gehring, 4/26/2016

7 I have went thru a plethora of sites, all agree the power generated is not efficient enough to make back your investment costs.
Tyler Gehring, 4/26/2016

8 What they did to show a pay back time of 3 years is, they calculated money saved by technology that isn't part of the bikes. Also they didn't account, for inefficiencies.
It's this part right here that shows that.
if we exclude the lighting installation cost and if machines are modified at the manufacturer level, then the payback time can be of less than a year.
As having it modified at the manufacturer level only saves you around 200 or so dollars, also it's that lighting/fan that is saving the most money by being a "smart" fan an turning off when not needed. They also highly over estimate the power costs as its around 15 cents in California. And a typically fan a gym would use probably only cost them around $150 per year. So if they are saving lets say that 150$ per year with just one bike which they aren't the bike would have to cost around $450. So it's obvious their math is sound.
Tyler Gehring, 4/26/2016

4 Yeah gotcha!! I will just say in my presentation that if you have more technology you can decrease the payback time, but if you don't have it it will take about 40 years.
Daniel Costa Da Silva, 4/26/2016

9 Yea it can be an effect method to save power just not with today's technology inefficiencies, and the price to get one of these.
Tyler Gehring, 4/26/2016

POWER USE EVALUATION

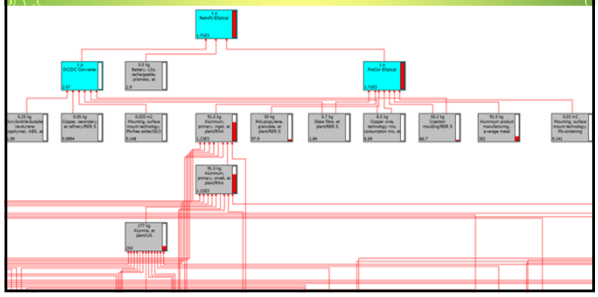
We found the most efficient option would be the fan with the LED light kit

- Fan requires 1280 Wh
- Light requires 16 Wh
- Quoted to cool room by 10 degrees
  - Can eliminate air conditioning in spin classroom saving 1598 W/hr
- Leaves enough power to charge ~62 iPhones

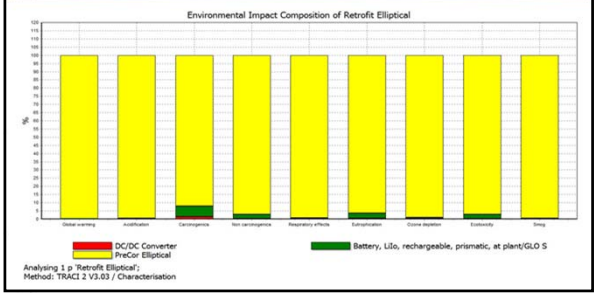
GREEN ENGINEERING PRINCIPLES

- Preventing waste if we retrofit
- Minimizes energy consumption
- Maximizes energy
- Minimizes depletion of natural resources
- Protecting human health and well-being

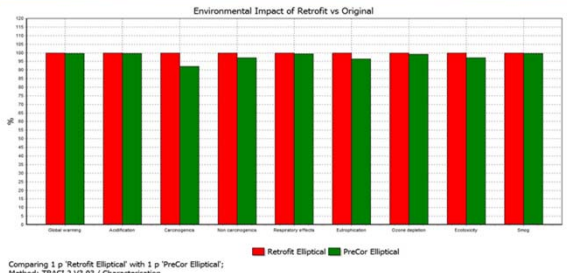
NETWORK



LIFE CYCLE ASSESSMENT (LCA)



LIFE CYCLE ASSESSMENT (LCA) CONT.



CONCLUSION

- Limited demand equates to prices for the bikes being [illegible] overpriced
- Low efficiency leads to power generated being very limited
- Human factor/ total time in use varies so much that form of power is inconsistent
- This all adds up to the bikes being an inefficent method of saving money and energy

THAT BEING SAID

- Technological improvements lead by an increase in demand is nessicary for this device to be a valuable form of saving energy, and helping gym be more sustainable
- Though the technology does have lots of potential in the future as the market is growing

RESOURCES

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POST CONSUMER FOOD WASTE AROUND THE USF TAMPA CAMPUS

Graduate Group 5
Sujay Desai- Mechanical Engineering
Michelle Henderson- Civil and Environmental Engineering
AvaAnne Hogue-Chemical Engineering
Venkata Kantheti-Electrical Engineering
Bharadwaj Madduri- Electrical Engineering
Sundeep Kumar Palvai- Mechanical Engineering
Kato Pinder- Electrical Engineering
Praveen Subbarao-Electrical Engineering

Outline

Engineering Design Process

1.Identify the Problem
2.Identify criteria and constraints
3.Brainstorm possible solutions
4.Generate ideas
5.Explore possibilities
6.Select an approach
7.Generate a model
8.Redefine the design

Engineering Design Process

1.Identify the Problem
- **a.Introduction to Sustainability and defining the problem**

2.Identify criteria and constraints
3.Brainstorm possible solutions
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The Facts

- Roughly 3,000 patron to Juniper Poplar every day
- Pre-Consumer food waste is taken care off
- Post-Consumer food waste has no solution
- Large 55 gallon drums collect the post-consumer waste
- It is emptied 3-4 times daily
- Produce 165-220 gallons of food waste on a daily basis
- That's at least 60,225 gallons a year!!!!!
- **We need a solution to this problem!!!!!**

Principles of Green Engineering and Sustainability

- Prevention Instead of Treatment
- Maximize Efficiency

- Strive to prevent waste
- Create engineering solutions beyond current or dominant technologies...invent technologies to achieve sustainability.

Triple Bottom Line of Sustainability

Defining the Problem

Redefine the problem: Reduce <u>post-consumer food waste</u> from the dining hall Juniper Poplar

- Two types of food waste: Pre-consumer and Post-consumer
- Pre-consumer waste (vegetable) at Juniper is being composted at Bay Mulching
- Post-consumer food waste is transported to a landfill for incineration
- We decided to come up with a solution to post-consumer food waste

Engineering Design Process

1. Identify the Problem
2. **Identify criteria and constraints**
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How We Chose the Best Idea

Evaluation Criteria

The characteristics include:

- **Safety**
- **Productivity**
- **Ease of Operation**
- **Cost Effectiveness**
- **Social Acceptance**
- **Environmental Protection**

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Ideation/Creation of Alternatives

- Food Selection App
- Interface Digester
- Composting
- Food Waste Awareness Program

The Preliminary Decision Matrix

Evaluation of Alteratives	Criteria														Final weighted score
	Safety		Productivity		Ease of operation		Durability and Reliability		Environmental Protection		Social Acceptance		Cost-efficiency		
Weight (%)	20		15		15		15		20		10		5		
	Score on 10	Weighted Score	Score on 10	Weighted Score	Score on 10	Weighted Score	Score on 10	Weighted Score	Score on 10	Weighted Score	Score on 10	Weighted Score	Score on 10	Weighted Score	
Smart Phone App Creation	10	2	6	0.9	8	1.2	9	1.35	10	2	8.5	0.85	7	0.35	8.65
Waste awareness	10	2	6	0.9	7	1.05	7	1.05	10	2	7	0.7	7	0.35	8.05
Interface Digestor	7	1.4	9	1.35	8	1.2	8	1.2	8	1.6	8	0.8	4	0.2	7.75
Composting	7	1.4	8	1.2	6	0.9	8	1.2	8	1.6	7	0.7	5	0.25	7.25

Selecting the Best Idea

- **Based on Sustainability matrix and unanimous group opinion, the Creation of the App was chosen**

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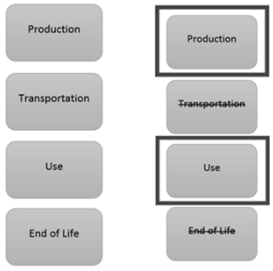
Input and Design Consideration

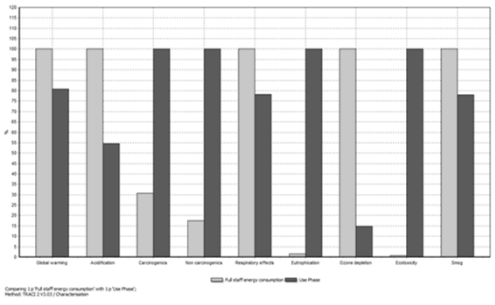
Simapro 7
Method: TRACI 2 v 3.03

Inputs Considered

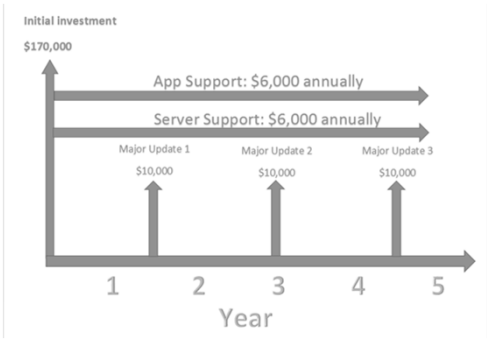
- Lines of Coding: 10,000
- Number of workers: 4
- Production Phase: 15 months
- Use Phase: 2 years
- Number of downloads: 5,000
- Function: to transmit and provide information
- Functional unit: kg of food waste diverted from landfill



Life Cycle Assessment: Simapro



Life Cycle Cost Analysis: LCCA



Life Cycle Cost Analysis: LCCA

Select-A-BULL				
	Amount		Distribution	
Initial Investment	$	170,000.00	$	170,000.00
Annual App Support	$	6,000.00	$	26,487.31
Annual Service Support	$	6,000.00	$	26,487.31
Salvage value	$	-	$	-
Service Life		5		
Discount Rate		0.043		
Major Update 1	10,000 after 1.5 years		$	9,388.01
Major Update 2	10,000 after 3 years		$	8,813.47
Major Update 3	10,000 after 4.5 years		$	8,274.10
Present Value			$	214,149.42

Engineering Design Process

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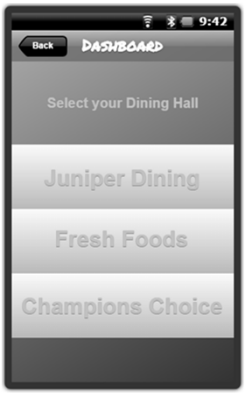
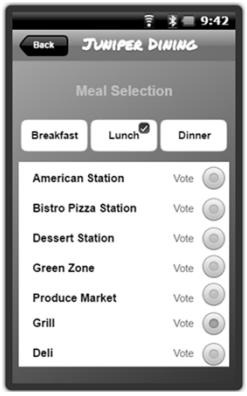
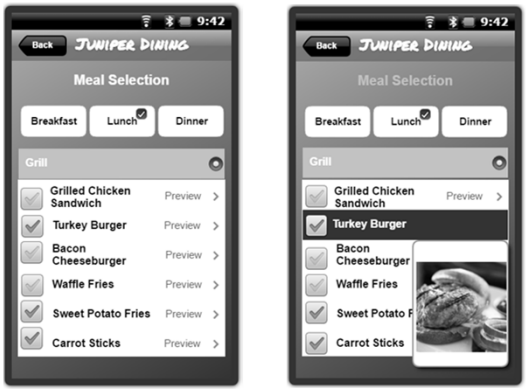
7. **Generate a model**
   a. **Development of Select-a-bull**
8. Redefine the design

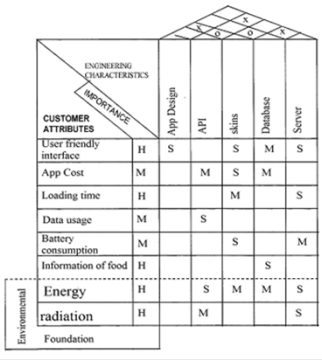
App Design







House of Quality for the App



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a.Implementation

Implementation of Project

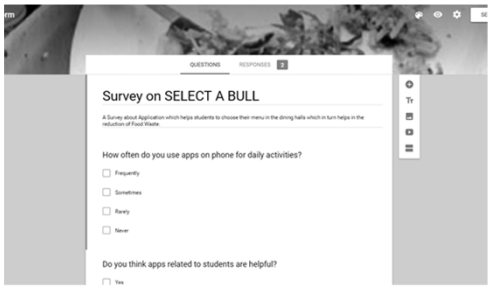
✓Proceed with the project and collaborate with computer science for software programming

✓Plan to survey on how useful the application will be in reducing the food waste

✓Develop the app for use in dining halls at USF

✓Broaden the scope of app usage in campuses across the nation!

Survey Page



Budget Evaluation

How will we raise money for the app?

<u>Options</u>
Student Green Energy Fund
NSF Funding
Small school grants
Outside funding source

Project Management/Timeline

February 4	**Present Initial Project Plan**
February 11-13	**Make modifications based on professor and peer evaluations. Identify key stakeholders**
February 21	**Discuss with dining hall management the daily food waste generated and food disposal**
February 23	**Develop solutions during the ideation phase and write the report about the current status of the project (each individual will research ideas that are applicable to their field)**
February 28	**Analyze the results from LCA using SimaPro** **Develop criteria for evaluating solutions**
March 1-7	**Project Update due (report and presentation). Make corrections based on peer and instructor evaluation**
March 18	**Design for our plan of action to reduce recycle food waste including material selection, financial budget for product development**
April 1-7	**Identify new stakeholders**
April 7-29	**Project Implementation** **Budget Evaluation**
April 17	**Rough-draft of the final report due. Final-draft of the presentation due.**
April 21	**Present our project to the class**
April 29	Final Report due

THANK YOU FOR LISTENING TO OUR BRIEF! QUESTIONS?