Our project 2 was to create a solution to a problem at Penn State University Park's campus with the use of aluminum. The aluminum was to make the campus more sustainable as well. For our project, we decided to solve the problem of heating and cooling in the dorm rooms through the use of aluminum-backed curtains. These curtains will add aesthetic value, lower heating and cooling costs, and will save money year round for the University.
Understanding the Needs, Requirements, and Definition of the Problem

Research and Product Development

- Naturally occurring element, the most abundant metal
- Its abundance and low density made it lucrative for companies to use as a metal
- Lightweight, stores energy, doesn’t corrode, so builders thought it to be a useful building material

Marketing

- Companies need aluminum for the production of their products
- People do not recreationally use aluminum
  - Besides aluminum water bottles, which represents a minimal percentage of aluminum use
- Therefore, there is no need to mass market aluminum, the demand for aluminum is constantly growing since companies are constantly expanding and creating more products
- Markets itself
- There are several large companies for aluminum, creating an oligopoly market for aluminum
- Aluminum makers advertise its benefits
  - Benefits include: strong, lightweight, recyclable, non-corrosive

Manufacturing

- Manufactured globally
- Most often extracted from a clay-like compound named bauxite
- Two phases of manufacturing aluminum
  - Bayer process
    - Refines bauxite to aluminum oxide
  - Hall-Heroult process
    - Smelt the aluminum oxide to produce pure aluminum

Packaging

- Not packaged much
- Only slight wrappings to prevent scratches on the aluminum

Sales, Distribution, and Transportation

- Sold in bulk to companies that use aluminum as a means of packaging their product
  - i.e., soda companies
- Used as a raw material for companies that use aluminum as a component of their product
  - i.e., mp3 players, computers, construction companies
- Distribution
  - Distributed in bulk or as a raw material
o Brought from the aluminum manufacturer to the location it needs to be by boat, train, and/or tractor trailer
o Distributed in many different forms such as sheets, piping, angle, flat bar, etc.
o Usually distributed from wholesale distributors to smaller companies that use aluminum for their product

- Transportation
  o Brought overseas by boat
  o Domestically by train/tractor trailer

Consumer Use

- Not generally used by individual consumers, but rather by companies to produce their good that individual consumers will use
- Present in everyday situations for individuals, such as building construction, liquid containers, and transportation
- Its uses are growing as more applications for aluminum are found
  o More efficient, lightweight materials are being made, and naturally, they use aluminum

Final Disposition

- Can be recycled by re-melting the aluminum
  o Far less expensive and uses less energy than initially producing aluminum
- Approx. 31% of aluminum in US is from aluminum scrap
- Most of the aluminum is recycled
  o 98% in Brazil, 85% in Japan
- If not recycled, aluminum will not decompose quickly
  o For example, 80-100 years for an aluminum soda can to decompose

At Penn State University and other campuses throughout the world aluminum is transforming the construction of buildings. Aluminum is being utilized in new construction projects to give these buildings a modern elegant appearance and to create energy efficient structure. The unique properties of aluminum are allowing us to reduce our use of energy and to create a more sustainable world. Currently, buildings represent 40% of the world’s energy demand however, with the introduction of aluminum in structures, we can greatly reduce our demand.

Aluminum has unique properties which allow it to be beneficial to building construction. It is a recyclable material, and as all building go up, we know with time they will be replaced as new technologies are created. Aluminum has a 100% recycling rate, meaning that the aluminum used in buildings will be able to be utilized elsewhere when the time comes. Aluminum also has a high strength to weight ratio. Due to its strength we are able replace other metals and materials with this completely recyclable metal, reducing our waste to the environment. It also has resistance to corrosion, meaning that it will never rust always retaining an elegant appearance when reused in projects.

At Penn State, the Lewis Katz law school building has utilized aluminum to save energy. This building was uniquely designed to have windows covering every side of the building. The
widows are supported by aluminum mullions which act as thermal barriers retaining heat within the system. Windows allow sunlight to enter the building while the aluminum retains his heat, becoming a benefit when outside temperatures are cold reducing the amount of energy necessary to heat the building. However, during the summer time, this can act negatively, making it more difficult for the building to remain room temperature. While the main framing of the structure was made of steel, part of the framing was made of curved aluminum. While other metals are unable to be easily bended into the waned shape, aluminum is ductile, and using this metal the architect’s wants were satisfied. Due to the light weight property of aluminum, it is able to be installed rapidly, reducing the time of construction and in turn reducing cost.

If we replace old buildings at Penn State, utilize aluminum, our campus will have a greater efficiency. We use aluminum as siding, roofing, gutters and as window framing we can create a modern elegant appearance on campus while striving for an energy efficient campus.

http://www.heintges.com/project.php?id=penn-state-school-law
http://www.aec.org/assets/pdfs/AEC_Daily_Course.pdf
Competing Alternative Conceptual Options

Kara Springsteen
EDSGN Project Two

Idea Proposal

1. **System Which Contains the Problem:**
The heating and cooling systems of the dorm rooms found on the University Park

2. **Why Does the Problem Need to be Fixed:**
   Too much energy is being used to retain a constant temperature in the buildings on campus. Many of these buildings are in good structure and are not needed to be torn down and rebuilt however money and energy being lost as energy escapes through the windows. The comfort of living in the dorms low and should be improved. In east, beds are located by the windows, causing one to feel a draft in the dorm room, creating an uncomfortable environment.

3. **How will the Problem be Resolved:**
The usage of aluminum in buildings will reduce the amount of electricity that is used to both heat and cool buildings. Aluminum foil can be easily used to develop curtains for dorm rooms. Aluminum is a reflective material, reflecting sunlight to keep the room cool during the summer, and will also act as a barrier to between the outside air and the room preventing the transfer of heat from the room to the outside air. These curtains can be easily manufactured in a factory, adding one layer of aluminum foil to preexisting curtains. Aluminum will raise the cost of these curtains however the energy cost and the new comfort of living received will outweigh the cost of purchasing these curtains for the dorm rooms.

4. **What Good will come if the Problem is Resolved:**
   If aluminum foil is used to develop curtains for the dorm rooms on campus the current students will be able to live a comfortably and the amount of electricity our campus consumes will be reduced

Sources:
http://en.wikipedia.org/wiki/Aluminium
http://www.atticfoil.com/
Diego Arguello
EDSGN Project Two
Idea Proposal

- **System Which Contains the Problem:**
  The buses that provide transportation to PSU subtends around campus.

- **Why Does the Problem Need to be Fixed:**
  This problem needs to be fixed because CATA buses are occupying too much gas and are polluting our environment with fuel emissions.

- **How the Problem will be Resolved:**
  A couple of years ago, Alcoa started an initiative to develop aluminum-made eco-friendly buses with China’s largest bus manufacturer. The purpose of this initiative was specifically to reduce greenhouse gas emissions and to improve the fuel economy. We could develop buses similar to these, utilizing aluminum for the framing of the bus along with the outer material. This will reduce the weight of the bus resulting in a more fuel efficient vehicle.

- **What Good will come if the Problem is Resolved:**
  If we develop buses using aluminum as the main material then we can create a more environmentally friendly transportation system.

Sources:


1. **System Which Contains the Problem:**
The window and door frames in the student dorm

2. **Why Does the Problem Need to be Fixed:**
   In the dorm rooms currently, the window and door frames do a poor job with insulating the room, causing a loss of heat and therefore a loss of money. This also upsets the students because their rooms are not the temperature that they would like them to be.

3. **How will the Problem be Resolved:**
   Aluminum window and door frames would be implemented in each dorm room. This will create a more aesthetically pleasing room, and the rooms would be more easily temperature controlled. To further insulate the window frames, the space between the aluminum would be filled with an insulated material to prevent air flow to or from the room.

4. **What Good will come if the Problem is Resolved:**
   The energy currently being lost because of the lack of insulation will be drastically reduced by the aluminum window frames. This will improve the quality of dorm living because the rooms will be more comfortable than they currently are. The aesthetic value of the aluminum will also improve the happiness of the student in the dorm. Finally, this will decrease costs for energy and heating because less will be wasted.

Sources:

http://www.windows-homequote.com/Types/Aluminum/Pros-Cons.html
1. **System which contains the problem:**
   - The problem is the transportation system.

2. **Why does this problem need to be fixed?**
   - Even though the Cata Bus is using clean and efficient natural gas, there are still ways to improve their system. The current bus is using a great deal of natural gas because of its size. There are ways that we can reduce the weight of the bus to make it even more efficient.

3. **How will the problem be resolved?**
   - Solution: We can use aluminum throughout the entire bus. We can use aluminum to make some of the engine components. This cuts down a lot of weight. This is already being used in some vehicles across the world. There are many other places on the bus that we can use aluminum to cut down the weight. The rims on the bus are currently made out of steel. We can replace these with aluminum rims. The poles can be made out of aluminum. This makes the bus more economically friendly.

4. **What good will come if the problem is resolved?**
   - Benefits: This change would reduce the amount of natural gas that is used every day. This would save the company a great deal of money right away. Also, after the company is done with the bus, they would be able to recycle a lot more. This would get put back into the aluminum flow and could possibly go into another bus. This could be implemented very easily. It is not a cost factor. This does not really change the quality of life for the consumer. However, it will benefit the environment.

**Sources:**


## Concept Options Analysis/Selection & Combination

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## Concept Options Analysis/Selection & Combination

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Selected Final Concept Proposal: Aluminum Curtains

The problem:

Currently, in the student dorms there are two constant problems: sunlight enters the room when it is unwanted, and the temperature of the rooms cannot be controlled well. The current blinds offer little protection from the sun, and they allow students to be awakened by sunlight when they are trying to get sleep. As for the temperature of the rooms, very few of the rooms offer air conditioning or any solid insulation to keep temperature constant. This is an ever-present annoyance for students, and often, the rooms are cold when the students want them warm, and vice versa.

How our solution will fix it:

Our solution is to make new and improved blinds through the use of aluminum. Our plan is to make blinds with an aluminum foil core which is a great reflector of both heat and light. The aluminum core would be made aesthetically pleasing by having a sewn fabric cover the aluminum. This blind will minimize the light allowed to enter into the room and will also minimize the effect of the outdoor temperature on the temperature of the dorm.

How our solution will make student life better:

By creating a dorm room climate which can be personalized to each student’s liking, our solution will improve student happiness as well as health. Sleep deprivation is a big problem in college, and when students lose sleep due to light entering through their blinds, their health slowly but surely depletes. This leads to lower grades and higher stress levels. As for the climate control factor, student happiness is very important to any university, and this will make people’s opinions of Penn State better, and encourage more students to come to this great school.
Process Flow Diagram

Recycled aluminum melted down and created into foil

Labor

Resources
Aluminum

Product is packaged in plastic and loaded into truck

Aluminum and fabric are sewn together

Fabric

Finished product is transported to PSU

Sunlight reflected, minimal transfer of heat between room and outside air

Energy is saved and the comfort of living has increased for students as a result of the aluminum curtain, creating a comfortable environment for students while saving energy.
Block Flow Diagram of the Production of Aluminum Curtains

1. Fabric developed and cut to specific length in a factory
2. Recycled aluminum developed into foil and cut to specific size
3. Aluminum and fabric are sewn together and an aluminum rod is placed through the top for hanging purposes
4. Product is packaged and shipped to University Park
5. Curtains are hung in dorm rooms
6. When the product is worn out, the aluminum backing is removed and recycled
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Ryan Byers - [http://www.personal.psu.edu/rmb5566/Links.html](http://www.personal.psu.edu/rmb5566/Links.html)