Individual Conceptual Ideas

Magnetic Trains:

Maglev or magnetic levitation trains are an electrically powered form of transportation. The main idea of these kinds of trains is that they are frictionless since they are not touching the ground because of the magnets repelling each other. Thus, without the friction, the trains can reach speeds up to 270 mph. Also, since they are electrically powered, they produce a minimum amount of pollution. Unfortunately, their cost is significant. For example, the Shanghai maglev cost around $1.2 billion to build.

Solar Powered Trains:

Different freight transportation systems all have their own costs and benefits. The main issue to consider is reducing NOx emissions while still being able to transport about 165,000 tons each day into and out of Pittsburgh. One possible solution to reducing emissions is by using an alternative power source: solar power.

Solar power uses a cheap, renewable, and plentiful source, the sun. Placing solar panels on top of the locomotives could potentially create a great amount of energy to power the train. However, considering the costs involved is important as well. Solar panels are quite costly to make. Solar systems can cost from $15,000 to $40,000. In addition, although panels can store extra power for travel during the nighttime, this could be an issue for locations such as Anchorage, Alaska, which has about 20 hours of darkness each day during the winter.
Double Stacked Freight Trains:
The question is how to transport 165,00 tons of material to Pittsadelphia with the least amount of emission. On top of that cost of the upgrade is also important. One possible solution is using double stacked freight train.

These trains consist of well platforms with an average weight of 16 tons per well. There are 24 carts in the train with an average weight of 16 tons per well. In order to move all of these carts four 3000 BHP locomotive are need. But using this method reduces the amount of emission because there are less trains being used. Also you would need to purchase the 5 well platform.

- **Solar Power**
  - Renewable energy
  - Reduces NOx emissions
  - Unlimited power source
  - Inexpensive in the long run

- **Positives**
  - Costly at first
  - Difficult installation
  - Availability of sunlight could be an issue

- **Negatives**

**Double Stack Freight Cars**

- **Idea**
  - Double Stack Freight Cars

- **Benefits**
  - Quicker Delivery Time
  - Able to transport more

- **Costs**
  - Needs a stronger locomotive
  - Emmits more than a regular locomotive
Dual Fuel Locomotives:

Dual Fuel is still to some extent a future technology because of the developments that are still being made in the area. Despite this, the technology is very usable and does not require large amounts of upgrade costs compared to other technologies is minute. The savings are also great as natural gas is much more environmentally friendly than straight diesel fuel and it costs much less because it is in a simple supply and demand market and its price is not influenced as much by international politics as oil is. The only cost would be to refit locomotives and their refill stations with the necessary equipment to hold liquid natural gas, but since the process of burning the mixture is based on igniting the diesel to burn the natural gas, not much change is needed.
Selection Matrix:

In order to select the best option from our four ideas for our team’s proposal, we used a weighted selection matrix. A weighted selection matrix works best for this scenario as we assigned values to the criteria/requirements based on importance, and then used these weighted factor values to multiply them across all ideas. Once we assigned values to the criteria in the weighted matrix, we concluded that replacing the fleet and shipping by alternative methods were least important, and controlling emissions was most important.

Due to the idea of the project to innovate the transportation methods into a cleaner, greener form of transportation, we assigned a weighted factor of .4 to the Emissions/ EPA requirements. We assumed that this criteria was the most important since we the proposal we come up with has to meet the Tier 3 requirements. Then, we assigned Freight Capacity, Upgrade/Replace Fleet, and Ship by alternative methods a weighted factor of .1 since we believe that these criterias are less significant. The capacity would be the same for all the locomotives except the Double Stack Freight Cars. Then upgrading the fleet would be something every idea we proposed had to go through even though it might be easier for some than others. Finally, the cost of the propositions seemed to be the second most important criteria of the project. $1.2 billion dollars to upgrade to a maglev train should be considered a large enough amount to discontinue considering for later discussion.

After assigning values of importance and multiplying by the weighted factors, we selected our best idea for our team’s proposal: dual fuel.

<table>
<thead>
<tr>
<th>Criteria/ Requirements</th>
<th>Weight Factors of criteria = WF</th>
<th>Solar Powered Trains</th>
<th>Maglev Trains</th>
<th>Duel Fuel</th>
<th>Tier 4 Upgrade</th>
<th>Double Stack Freight Cars</th>
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</thead>
<tbody>
<tr>
<td>1. Emissions/ EPA requirements</td>
<td>0.4</td>
<td>4, 1.6</td>
<td>5, 2</td>
<td>3, 1.2</td>
<td>2, .8</td>
<td>1, .4</td>
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<td>2. Freight throughput/ Capacity</td>
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<td>3, .3</td>
<td>3, .3</td>
<td>3, .3</td>
<td>5, .5</td>
</tr>
<tr>
<td>3. Upgrade/ replace rail fleet</td>
<td>0.1</td>
<td>2, .2</td>
<td>1, .1</td>
<td>4, .4</td>
<td>5, .5</td>
<td>3, .3</td>
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<tr>
<td>4. Ship by alternative methods</td>
<td>0.1</td>
<td>4, .4</td>
<td>5, .5</td>
<td>3, .3</td>
<td>1, .1</td>
<td>2, .2</td>
</tr>
<tr>
<td>5. Cost of fuel &amp; infrastructure</td>
<td>0.3</td>
<td>2, .6</td>
<td>1, .3</td>
<td>5, 1.5</td>
<td>4, 1.2</td>
<td>3, .9</td>
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<tr>
<td>Total</td>
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<td>15, 3.2</td>
<td><strong>18, 3.7</strong></td>
<td>15, 2.9</td>
<td>14, 2.3</td>
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</tbody>
</table>
Citations

Solar Panels:
http://energyinformative.org/solar-panels-cost/

Maglev Trains:
https://en.wikipedia.org/wiki/Maglev#Economics

Dual Fuel: