Executive Summary

- GE locomotive fleet in Pittsburgh needs to be upgraded
- Looking for the most efficient way to reduce smog while maintaining or increasing freight capacity
Introduction

- GE Transportation works to build equipment that drives the rail and marine industries
- Locomotives should either be replaced, upgraded, or an alternate shipping method should be used
Transportation Infrastructure Condition and Capacity

- Pennsylvania infrastructures were given grades by the American Society of Civil Engineers:
  - Bridges D+
  - Inland Waterways D+
  - Ports C+
  - Transit D
  - Roads D-
  - Freight Rail B
Standard Capacity for Alternate Transportation Modes

### Cargo Capacity

<table>
<thead>
<tr>
<th>Mode</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Barge TOW</td>
<td>1,500 TON 62,500 Bushels 855,600 Gallons</td>
</tr>
<tr>
<td>One 15 Barge TOW</td>
<td>22,500 TON 787,500 Bushels 9,004,000 Gallons</td>
</tr>
<tr>
<td>Jumbo Hopper Car</td>
<td>100 TON 3,500 Bushels 30,240 Gallons</td>
</tr>
<tr>
<td>100 Car Train Unit</td>
<td>10,000 TON 350,000 Bushels 3,024,000 Gallons</td>
</tr>
<tr>
<td>Large Semi</td>
<td>26 TON 910 Bushels 7,065 Gallons</td>
</tr>
</tbody>
</table>

### Equivalent Units

- One Barge
- 15 Jumbo Hopper Cars
- 58 Large Semis

- One 15 Barge TOW
- 2.25 100 Car Unit Trains
- 870 Large Semis

### Equivalent Lengths

- One 15 Barge TOW 0.25 MILES
- 2.25 100 Car Train Unit 2.75 MILES
- 870 Large Semis 11.5 MILES (Bumper to Bumper)
Transportation Costs and ConOps

- Three options for transportation:
  - **Trucks**: $1.68 per mile
  - **Barges**: between $.005 - $.01 per ton per mile of cargo moved
  - **Railroad**: $0.03 per ton-kilometer
EPA Diesel Emission Standards

- EPA set up a standard on allowed emissions produced by a diesel locomotive.
- Percentages represent amount of emissions removed compared to previous tier train.
Diesel Engine Exhaust Emissions (DEEEE)

- NO\textsubscript{x}, particulate matter, CO\textsubscript{2}, and hydrocarbons
- Modification of engines, other technologies, and alternative fuel methods can be used to reduce emissions
Locomotive Fleet Upgrade

- Three options for upgrading the fleet:
  - Selling existing fleet and purchasing new trains
  - Upgrading the train with exhaust after-treatment hardware
  - Utilizing alternative fuels
Summary

● EPA now requires all trains to be at least Tier 3 or Tier 4

● Solution:
  ○ Upgrade fleet groups A and B
  ○ Replace group C with Tier 3 and group D with Tier 4 locomotives
  ○ Use barges to transport group E’s cargo and sell group E locomotives

<table>
<thead>
<tr>
<th>No. of Existing Locomotives</th>
<th>Locomotive Group Designation</th>
<th>Assumed Existing Locomotive Mileage Range</th>
<th>Assumed Existing Diesel Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>A</td>
<td>&lt;150,000</td>
<td>Tier 2</td>
</tr>
<tr>
<td>10</td>
<td>B</td>
<td>&gt;150,000 and &lt;300,000</td>
<td>Tier 2</td>
</tr>
<tr>
<td>10</td>
<td>C</td>
<td>&gt;300,000 and &lt;450,000</td>
<td>Tier 2</td>
</tr>
<tr>
<td>10</td>
<td>D</td>
<td>&gt;450,000 and &lt;600,000</td>
<td>Tier 2</td>
</tr>
<tr>
<td>10</td>
<td>E</td>
<td>&gt;600,000 and &lt;750,000</td>
<td>Tier 2</td>
</tr>
</tbody>
</table>