# GE TRANSPORTATION

*Design Project 2*
*Design Team 3, Purple Cobras*

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# *Introduction*

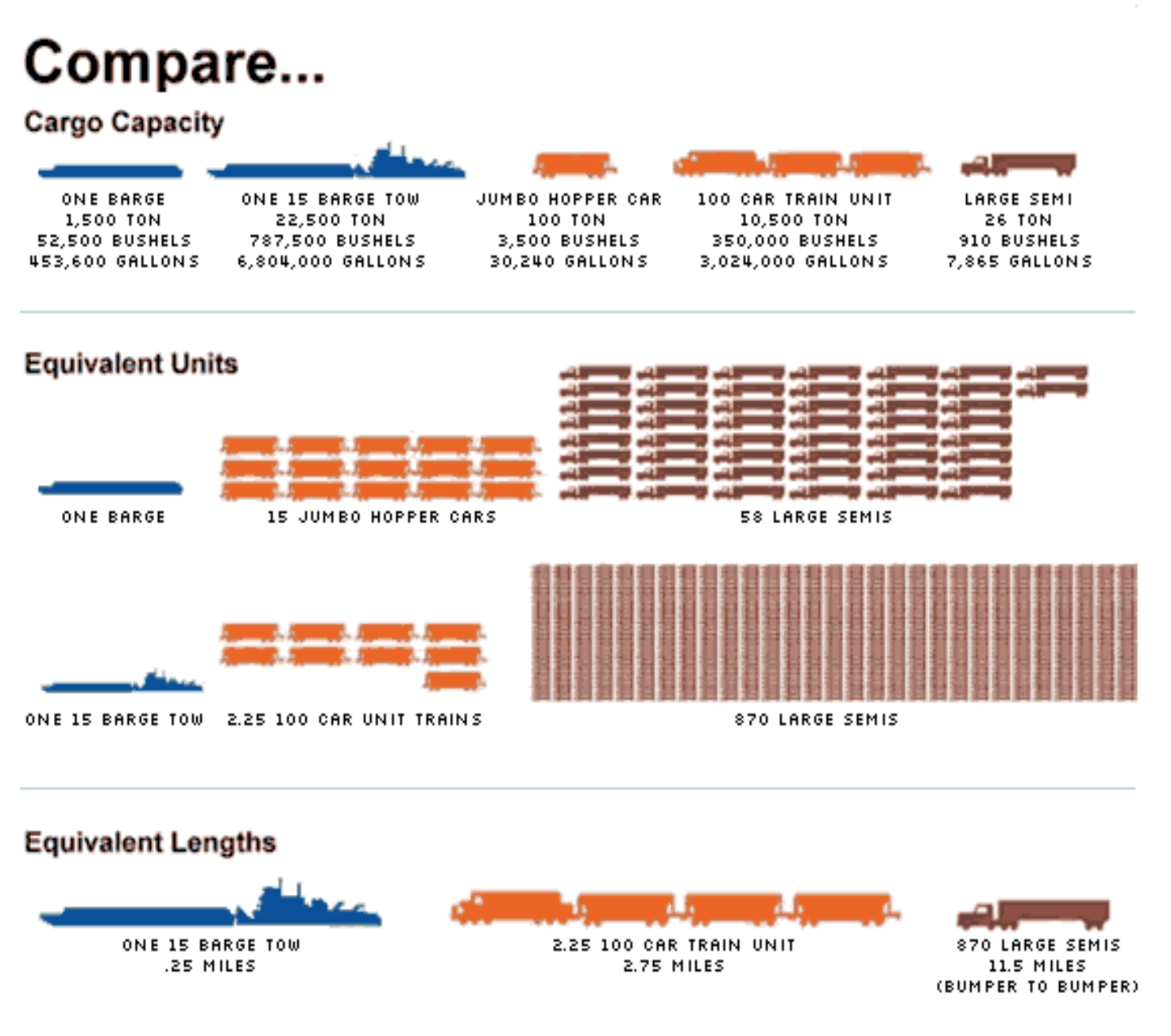
Good Ole Pittsadelphia

- The City of Pittsadelphia is seeking a solution for its freight that reduces smog and meets EPA requirements, while maintaining freight capacity into and out of the city.
- Our design team The Purple Cobras was more than happy to help the great city!
- GE Transportation is our project's sponsor.
- GE helps solve the world’s toughest transportation challenges.

# *Transportation Infrastructure Condition and Capacity*

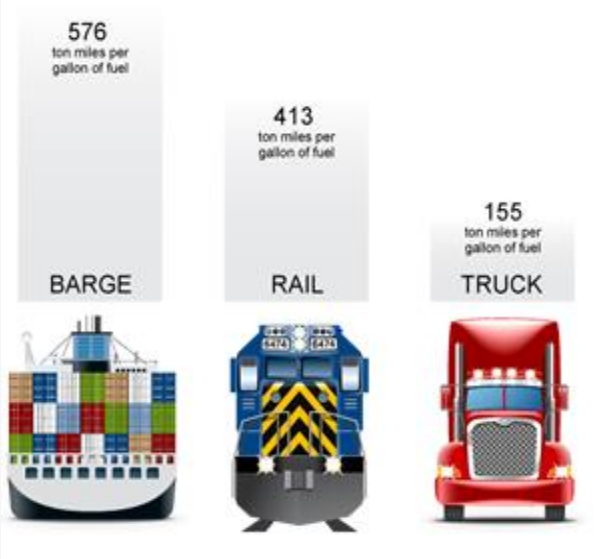
- With access to water and railways. Transportation of Cargo can be done in large quantities without too much difficulty.
- Condition of the railway/locomotives are troublesome and could interfere with traveling logistics.
- Condition of the 15 Tow Barge is the only thing required for transportation over water.
- Transportation by Highway/Interstate/etc, while universal across the nation, can easily be slowed with traffic issues, road maintenance and semi truck maintenance.
- In descending order for capacity, Barges hold more than trains, which hold more than semi trucks.

# *Standard Capacity For Alternative Transportation Modes*



# *Transportation Costs and Concept of Operations*

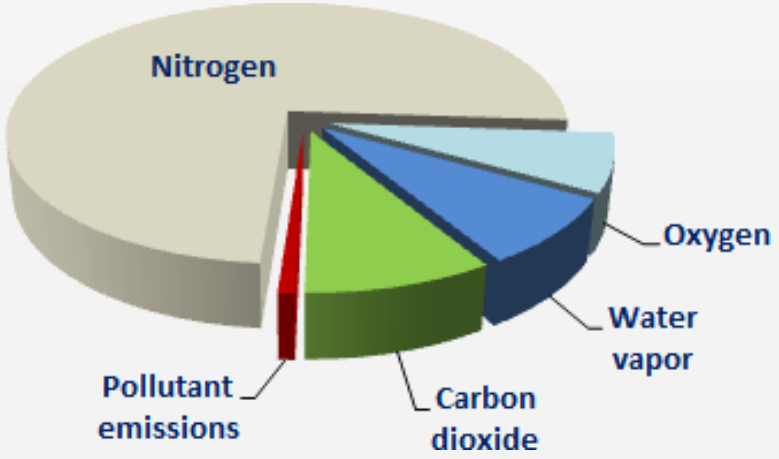
- Trucks: $5.35 per ton mile, 155 ton miles per gallon of fuel
- Barges: $0.97 per ton mile, 576 ton miles per gallon of fuel
- Railroad: $2.53 per ton mile, 413 ton miles per gallon of fuel
- As seen, the barge is the most efficient way of travel for transporting freight into and out of Pittsadelphia.



# *EPA Diesel Emission Standards*

- Tier 0—The first set of standards applies (effective 2000) to locomotives and locomotive engines originally manufactured from 1973 through 2001, any time they are manufactured or remanufactured.
- Tier 1 - These standards apply to locomotives and locomotive engines originally manufactured from 2002 through 2004. These locomotives and locomotive engines are required to meet the Tier 1 standards at the time of the manufacture and each subsequent remanufacture.
- Tier 2 - This set of standards applies to locomotives and locomotive engines originally manufactured in 2005 and later. Tier 2 locomotives and locomotive engines are required to
- Tier 3 standards - Near-term engine-out emission standards for newly-built and remanufactured locomotives. Tier 3 standards are to be met using engine technology.
- Tier 4 standards - Longer-term standards for newly-built and remanufactured locomotives. Tier 4 standards are expected to require the use of exhaust gas aftertreatment technologies, such as particulate filters for PM control, and urea-SCR for $NO_x$ emission control.

# Diesel Engine Exhaust Emissions




**NOx**

-NOx (NO + NO2 ) is formed when air (oxygen and nitrogen) is heated

-NOx formation is exponential with temperature (Higher T → much higher NOx)

**Particulate Matter (PM)**

-has the second highest second proportion in the diesel pollutant emission

-can be divided into 3 main components:soot, soluble organic fraction (SOF) and inorganic fraction

**$CO_2$**

-$CO_2$ is formed in direct proportional to fuel consumed (Reduce fuel consumption → reduce $CO_2$)

- about 12% of the diesel exhaust gas

**Hydrocarbons (HC)**.

- hydrocarbon emissions are composed of unburned fuels as a result of insufficient temperature which occurs near the cylinder wall

-diesel engines normally emit low levels of hydrocarbons

# *Locomotive Fleet Upgrade*

- Upgrade groups A-C to the NextFuel by GE. Fuel costs are cut by half and locomotives are at Tier 3 standards. It also makes a substitution of up to 80% of fuel with natural gas.
- Groups D and E will be replaced.
- The upgrades will cost around $30 million plus a $1 billion fueling station
- The replacements will cost around $60 million

# *Summary and Suggestions*

Barge was chosen as the proposed transportation system as waterborne transportation requires significantly less fuel than rail or trucks, gives off less emissions, and also costs less money.

Trucks- $5.35 per ton mile, 155 ton miles per gallon of fuel

Barges- $0.97 per ton mile, 576 ton miles per gallon of fuel

Railroad- $2.53 per ton mile, 413 ton miles per gallon of fuel

**Environmental Quality of Shipping Methods**

Comparison of the emissions of different gases into the atmosphere from different shipping methods (Source: C. Jake Haulk Ph.D. - Inland Waterways as Vital National Infrastructure: Refuting "Corporate Welfare" Attacks)

| Mode of Transportation | Hydrocarbons Emitted (lbs/ton-mile) | Cabon Monoxide Emitted (lbs/ton-mile) | Nitrous Oxide Emitted (lbs/ton-mile) |
|---|---|---|---|
| | 0.0009 | 0.0020 | 0.0053 |
| | 0.0046 | 0.0064 | 0.0183 |
| | 0.0063 | 0.0190 | 0.1017 |

# *References*

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