PennState College of Engineering

GE Transportation

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Freight, Fuel, & Emissions

Introduction to Engineering Design
EDGSN 100 Section 001

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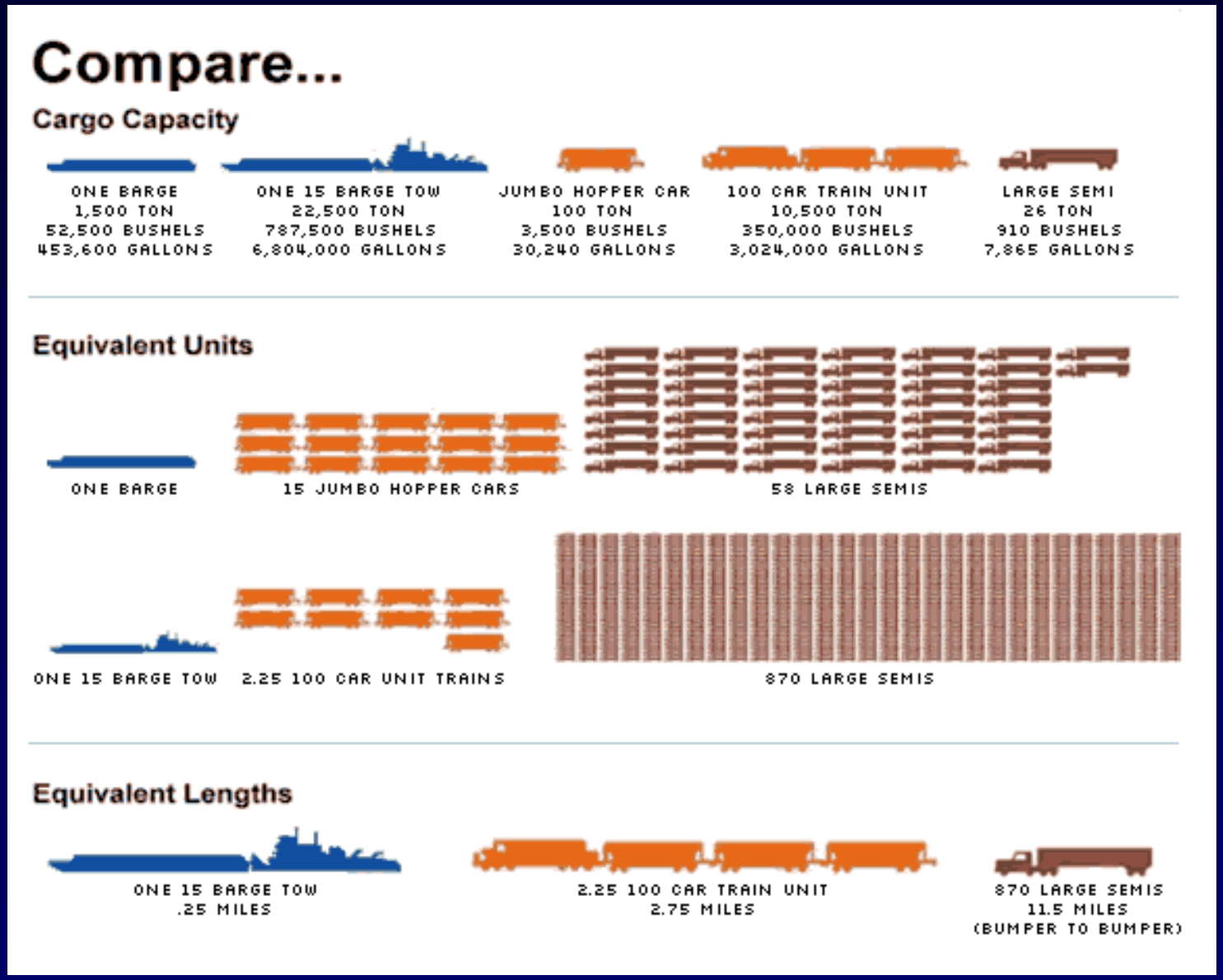
Introduction

- General Electric (GE) Transportation tasked EDSGN 100 to strategize on efficient ways to upgrade a fleet of 50 locomotives
- Each of the locomotives is currently at Tier 2 standards
- Wide variety of options based on transportation method, fuels/fuel stations, after-treatment systems, and selling locomotives
- Main goal is to determine the best combination of solutions that maximizes economic and environmental efficiency

Transportation Infrastructure Condition and Capacity

- **Bridges: D+**
  - 22.6% PA bridges structurally deficient
- **Roads: D-**
  - 32% US roads in poor condition
- **Inland Waterways: D+**
  - delays and structural deficiencies
  - 12,000 miles of inland waterways, 51M truckloads' worth of cargo/year
- **Freight Rail: B**
  - freight traffic may increase by 22% by 2035
  - 57 freight railroads over 5127 miles, 246 million tons of cargo/year

Standard Capacity for Alternate Transportation Modes



Transportation Costs and Concept of Operations (ConOps)

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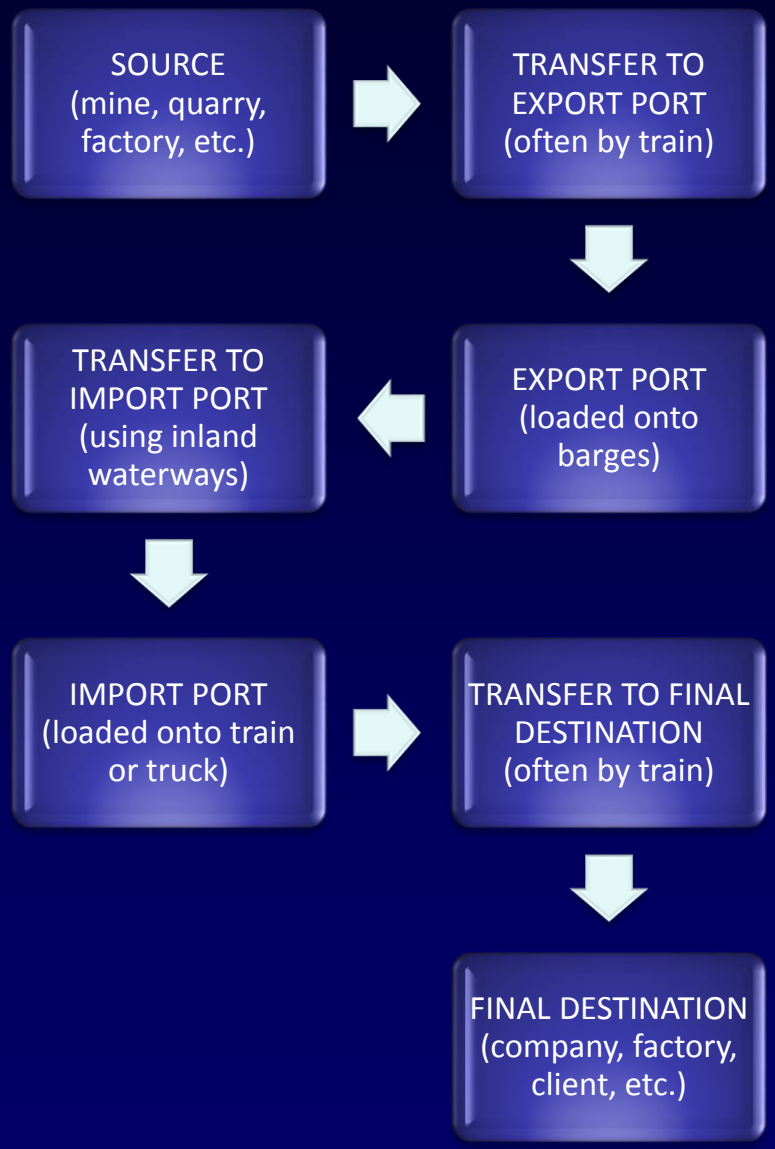
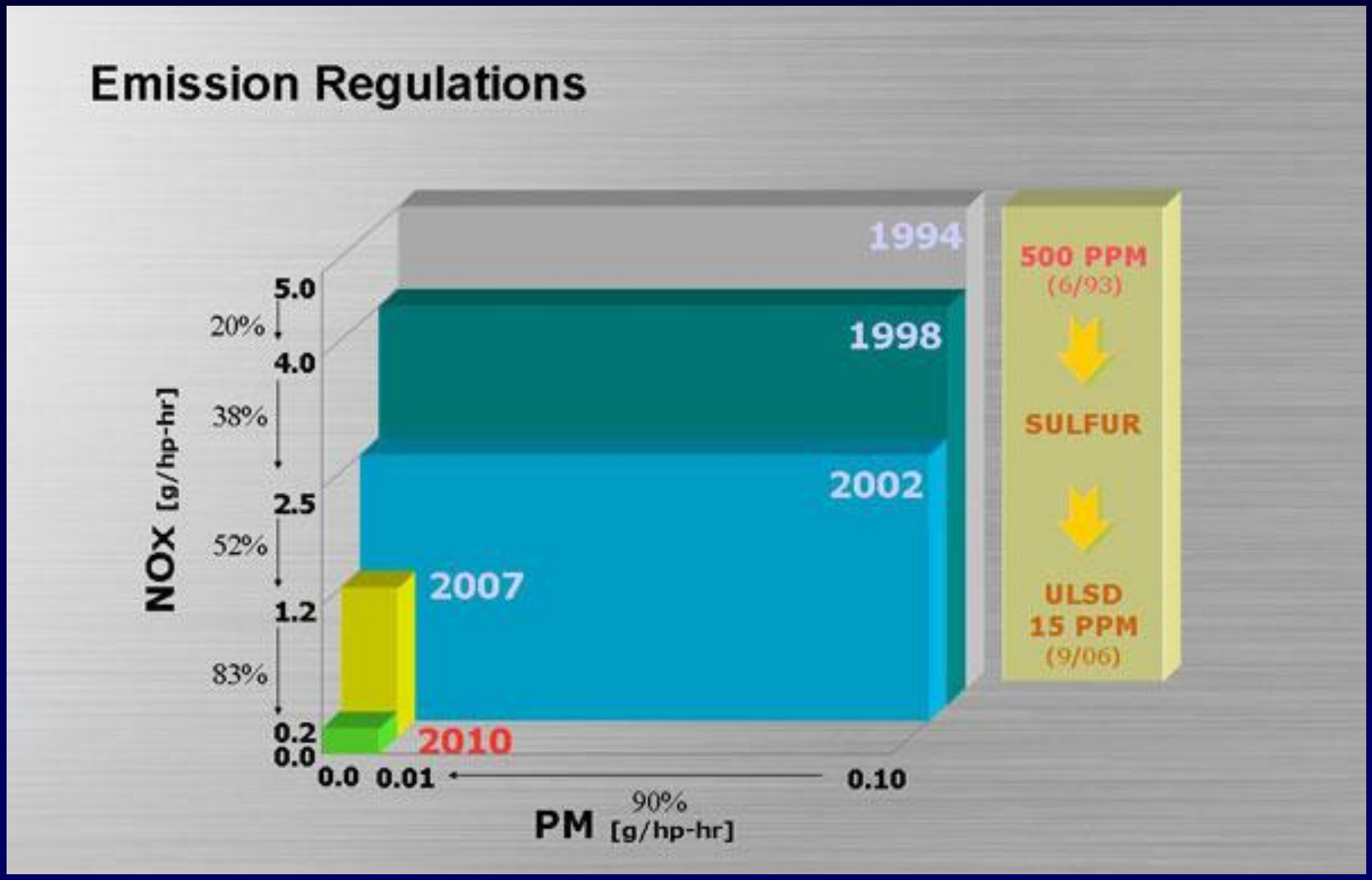
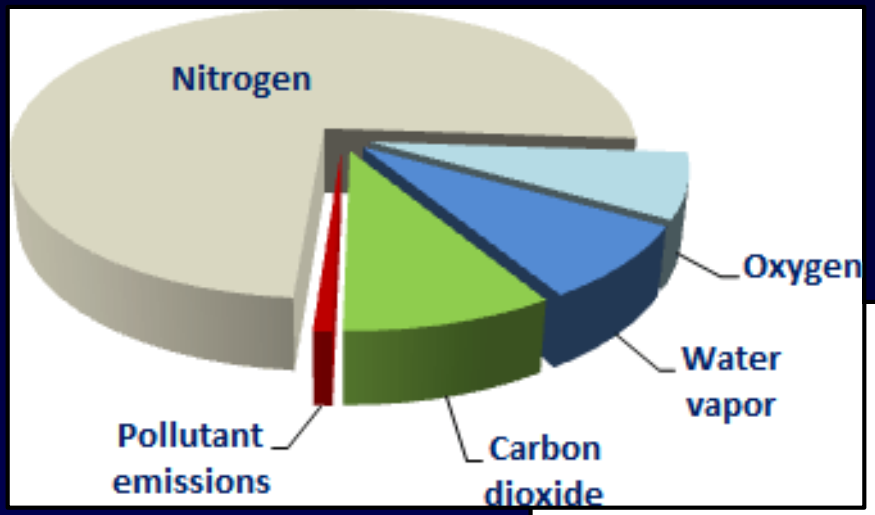


- **Barges:**
  - Most economical
  - High capacity for cargo
  - Fuel efficient
  - But...SLOW
  - And prone to delays (weather, locks, seasons)

EPA Diesel Emission Standards

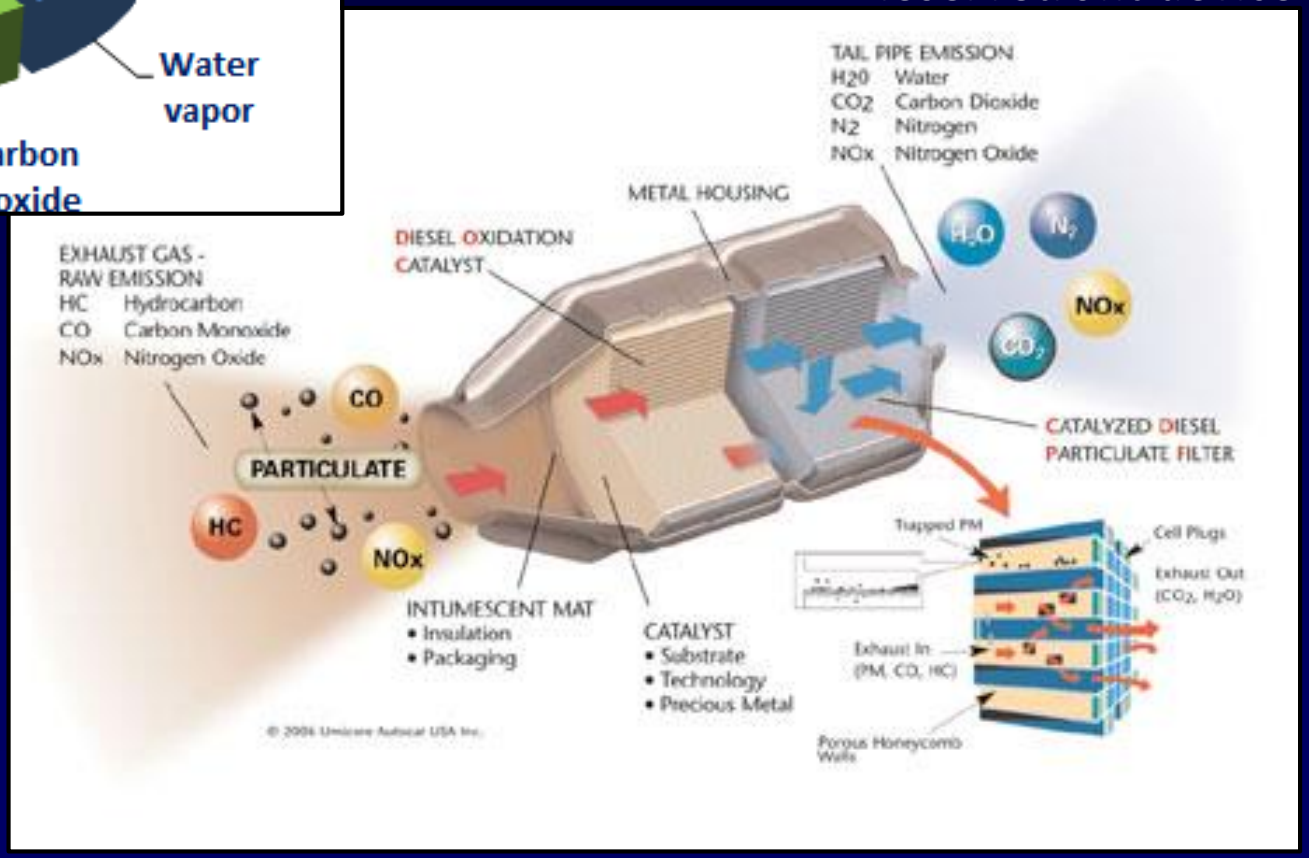


Diesel Engine Exhaust Emissions (DEEE)



Types of emissions
Pollutants include:
NO_x
Particulate matter
Hydrocarbons
CO

Diesel retrofit device



Locomotive Fleet Upgrade

Strategy	Cost per locomotive	Total cost
Upgrade all	$750k x 50 trains	$37.5M
Sell/replace all	$1.5M x 50 trains	$75M
Alternate fuel upgrade all	$1M x 50 trains (+ two $1B fueling stations)	$2.05B
Our Solution	$750k x 20 trains $100k x 20 trains $1.5M x 10 trains	$32M

- Upgrade new trains (Groups A and B)
- Exhaust after-treatments on middle trains (Groups C and D)
- Sell and replace old trains (Group E)

Summary

- Of rail, road, and river, barges are the cheapest option, but they have the tradeoff of speed
- Alternate fuels like biofuel or compressed natural gas are also possibilities, but are expensive
- Replacing all of the locomotives or upgrading all of the locomotives are pricy solutions
- Ultimately, use a combination of upgrading, exhaust after-treatment, and replacing
- Maybe consider barges and alternate fuels in the future

Closing