A Total Fuel Cycle Analysis of Alternative and Conventional Fuels in Marine Transportation

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Overview

• Research goal
• What is a “well-to-hull” (W2H) analysis and why should we care?
• The GREET Algorithm
• The TEAMS Model
• Next Steps
• Discussion
Background

- Marine vessels are significant sources of air pollution
- Marine transportation services are expanding
- Emerging policy may promote alternative ship fuels
- Past studies examined only “end-of-pipe” emissions with no analysis of total fuel-cycle emissions
- Much uncertainty about the emissions impacts of alternative fuels in marine transportation systems
Research Goal

• To develop a modeling tool useable by analysts and decision makers to evaluate total fuel-cycle emissions from marine transportation

• Tool must capture emissions along the entire fuel pathway

• Tool must allow for use on a wide variety of marine vessels
What is a W2H Analysis?

- A “well-to-hull” (W2H) analysis accounts for energy consumption and emissions along the entire fuel cycle of a given fuel
Example of W2H for Diesel

This represents a simplified pathway for diesel. Each stage requires energy inputs and releases air pollutants.

For example, the refining stage may require inputs of petroleum, natural gas, and electricity.

However, each of these input fuels has its own upstream stages, ad infinitum.
Why Should I Care?

- If you don’t address W2H, you underestimate the impacts of transportation fuels!

Note: These results are preliminary and do not include effects from auxiliary power.
The GREET Algorithm

- *Greenhouse Gas, Regulated Emissions, and Energy Use in Transportation Model*
- Argonne National Labs developed algorithm
- “Well-to-wheels” for near-term and long-term land-based transportation technologies and fuel pathways
- Spreadsheet based model
- Output: per-mile energy and emissions
- Considers complete upstream effects
- Accepted by EPA for use in Motor Vehicle Emission Simulator (MOVES)
The TEAMS Model

- Total Emissions Analysis for Marine Systems Model
- Extends the GREET algorithm to consider marine transportation and marine-specific fuels
- Provides accurate accounting of the total fuel cycle emissions for a simulated vessel operating on various fuel types
- Also includes energy and petroleum consumption results
The TEAMS Model (cont’d)

• Accepts data on vessel details and trip characteristics
  – number of engines, horsepower, trip distance, trip time, etc.
• Users can also adjust many other default parameters
• Applies total fuel cycle algorithm
• Provides output for the simulated vessel operating on the following fuels:
  • Conventional Diesel
  • Residual Oil
  • Natural Gas
  • Fischer-Tropsch Diesel
  • Low-Sulfur Diesel
  • Biodiesel
TEAMS
Demonstration
Next Steps

• Improve TEAMS data with more accurate information, improved defaults and auxiliary engine data
• Validate TEAMS through systematic validation process
• Produce a detailed report and “user-guide”
• Conduct case studies to demonstrate a wide variety of TEAMS applications
Questions and Discussion

Thank you!