



**MARAD**  
**ALTERNATIVE MARINE FUELS**  
**NATURAL GAS**  
**RESEARCH & DEVELOPMENT**



# MARAD's Role



- Maritime Environmental and Technology Assistance (META) Initiative
  - Perform research/demonstration projects focused on maritime environmental issues
  - Multiple partnerships with industry and academia
  - Portfolio of work includes ballast water research, hull fouling, alternative fuels and technology
- Work with other federal agencies to address issues/gaps



# Recent MARAD Natural Gas Activities



- Outreach
  - 2011 industry meeting in Great Lakes
  - Informal stakeholder outreach outside of Great Lakes
  - Government regulatory agencies
  - Others
- 2012 Natural Gas Feasibility Study
  - Great Lakes centric but transferable
  - Assessed availability, infrastructure needs, regulations, and safety
  - Performed conceptual engineering design for steam ship conversion (i.e. Lakers)
  - SS Badger (coal powered ferry) conversion
  - [www.glmri.org/research](http://www.glmri.org/research)
- Government Partnership
  - Established internal MARAD Task Force
  - Met with agencies that have a role in LNG in January 2013 (DOE, FERC, USCG, PHMSA, et al)
    - Goal - Identify current hurdles, issues, and gaps



# Recent MARAD Natural Gas Activities



- Feasibility study expansion to inland waterway
  - Ohio River to Great Lakes
  - Assessed availability, infrastructure needs, regulations and safety
- 2013 Infrastructure, Bunkering, and Feasibility study
  - Performed by DNV
  - Identifies issues, regulatory gaps, and provides best practices
- 2013 Total Fuel Cycle Study
  - “well to hull” for NG versus conventional fuels
  - Performed by UDEL/RIT cooperative partnership
  - 3 scenarios: international, coastal, inland
  - Overall reduction of SO<sub>x</sub>, PM, CO<sub>2</sub>
- 2013 Vessel Emission Reduction RFP
  - Horizon Lines LNG conversion
  - *In-situ* emission testing pre/post conversion
  - Project scheduled to be completed in 2016



# Total Fuel Cycle Study



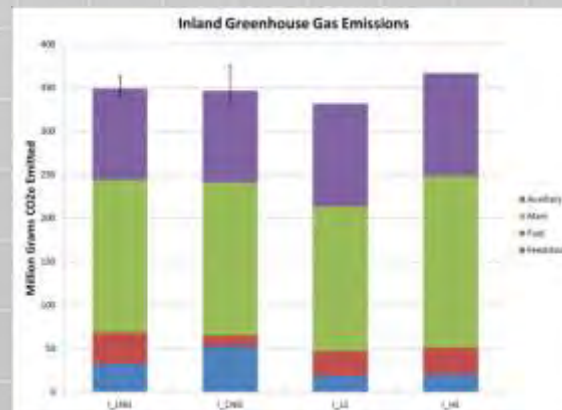
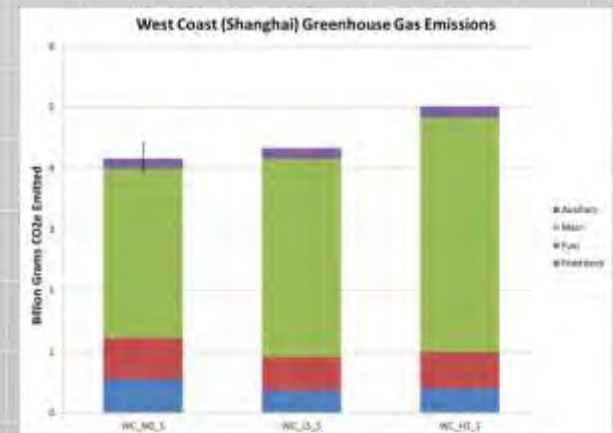
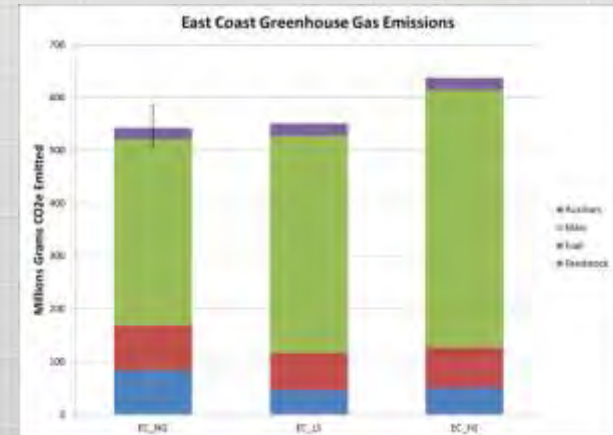
- Performed by UDEL/RIT
- Quantified total energy and emissions ( $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{N}_2\text{O}$ , VOC, CO,  $\text{NO}_x$ ,  $\text{SO}_x$ )
- Multiple fuel pathways
- 3 vessel types (large OGV, coastal OGV, inland tug/tow)
- [www.marad.dot.gov](http://www.marad.dot.gov) (Office of Environment)



# Total Fuel Cycle Study



- Results are mixed; dependent upon scenario
- Overall LNG good at reducing criteria pollutants
- Coastal scenarios – LNG produced less overall GHGs (CO<sub>2</sub>e)
- CH<sub>4</sub> emissions highly affected by
  - How gas is obtained
  - Distance traveled
  - Storage



# Upcoming NG Projects



- Methane Slip and Release Study
  - UDEL/RIT
  - Engine slip, system leaks with bunkering
- LNG Intermodal Transportation Corridor Study
  - GLMRI
  - Great Lakes to lower Mississippi River
- Pittsburgh Marine Corridor Natural Gas Conversion Study
  - Partnership with Port of Pittsburgh, Pittsburgh regional Clean Cities, Marshall University, LCE, et al



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