MARITIME ADMINISTRATION
Office Of Environment

Green Boats & Ports Workshop
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Two primary missions

- MARAD Environmental Compliance

- Maritime Industry Stakeholder Assistance
  - Vessel owners and operators
  - Port, shipyards
  - Federal, state, local environmental regulatory and resource agencies
  - Public
Challenges = Opportunities for Innovation

- We are seriously lagging landside transportation in environmental innovation
- Need for technologies that work in the marine environment – ballast water treatment, exhaust gas treatment
- Need for demonstration of and innovation in alternative fuels and energy
- Need for advanced systems and technologies for energy efficiency and conservation
Objectives

- Stimulate technology advances for improved sustainability
- Address critical marine transportation environmental issues
- Collaborate among Federal, state and local agencies/organizations, academia, industry and public stakeholders
META Focus Areas

- **Maritime Use of Alternative Energy/Air Emissions**
  - Natural Gas
  - Advanced Renewable “drop-in” Biodiesel
  - Hybrid propulsion
  - Solar/Wind
  - *Fuel Cells*

- **Exhaust Gas Treatment Technology**
  - SCR and Scrubbers

- **Other Vessel Discharges**
  - Ballast Water Treatment/Hull Biofouling
MOU with DOE Established June 2013 to Evaluate Fuel Cell Applications for the Maritime Transportation Industry

Port Equipment and Vessels

Key Issues

- Size, Weight, Power
- Cost
- Power Integration and Regulation
- Source of Hydrogen
- Hydrogen or Reformation of Other Fuels, Biogas
- Safety/Fuel Storage
MOU with DOE established on June 2013

- **On-going project on marine fuel cell project (FY 2013)**
  - Prototype demonstration of fuel cell auxiliary power unit for shore/shipboard power
  - Collaboration with multiple industry partners
    - Hybrid hydrogen PEM fuel stack in a 20’ container
    - 100kW 230V AC 3 phase
    - Power for 10 refer containers
      - ABS and USCG approval

- **Current marine fuel cell project (FY 2014 currently under planning)**
  - Shipboard technology demonstration of fuel cell for auxiliary power
    - 10kW 5120-240 V AC solid oxide fuel cell
    - JP-8, ULSD, No. 2 diesel
Fuel Cell Reefer Project

- Designed to replace a diesel generator - 20 ft. TEU, 100kW nominal power ~ 200 reefer hours of continuous operation – 10 reefers
- Assess operating and cost parameters
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- Partner with Sandia, Hawaii Ports, Young Brothers, Navy
Ship Auxiliary Power & Propulsion

- **Shipboard technology demonstration of fuel cell for auxiliary power**
  - Work with the Navy
  - Demonstrate Aboard MARAD ship
  - Small Fuel Cell 10kW 120-240 V AC
  - **Major Focus is on Fuel Reformation** JP-8, ULSD, No. 2 diesel

- **Zero Emission Ferry**
  - Partnership with Sandia National Laboratory & Red & White Fleet
  - Design Feasibility Study for High Speed Ferry and Shore-based Storage and Fueling Station Serving vessels, cars, buses and trucks
  - 2,500 kg/day capacity & 80% base utilization
  - 150 passenger, 35 kts
**Zero Emission Ferry**

**OPERATION**
- 23 nm one-way
- Each round trip uses about 500 kg LH2
- Daily logistics: Two morning round trips
- Refuel in less than 1 hr.
- Two afternoon round trips
- Designing the ferry to meet the long distance

**PERFORMANCE**
- 35 knots
- Zero emissions
- 130' x 39' preferred size envelope, 150' long is maximum
- <100 Gross Registered Tons (GRT)
- 90% MCR (i.e., power margin)
- Prefer one refueling per day.
Future Fuel Cell Opportunities

- **Future marine fuel cell projects**
  - Shipboard auxiliary power with higher power fuel cell
  - Ship propulsion – Research Vessel/Tug
  - “Cold Ironing”/Shore Power for vessels
  - Port applications – port equipment/back-up power
Alternative Fuels
Natural Gas Renaissance?

* Driver -- Looming ECA and Search for Alternatives to ULSD

* META Response

* Government Partnership
  * 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

* 2012 Natural Gas Feasibility Study
  * Great Lakes centric but transferable
  * Assessed availability, infrastructure needs, regulations, and safety
  * Expanded to Ohio River and Lower Mississippi
Natural Gas Continued

- **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 SOx, PM, CO₂ -- **BUT** GHG

- **2014 Methane Slip and Release Study**
  - UDEL/RIT
  - Engine slip, system leaks with bunkering
Natural Gas Continued

- **Demonstration Projects**
  - **TOTE**
    - Emissions Analysis
    - Lessons Learned
  - **Pittsburgh Region Clean Cities**
    - Fumigation Technology (off the shelf; modified for the tug)
    - Emissions Analysis and Lessons learned
    - Insight into Refueling Options
Two MARAD Ship Tests of Blended Bio-Diesel/ULSD vs. ULSD

- Results – IT WORKS
  - Reduction of NOx, SOx, CO, CO2, PM and Sulfur
  - No Changes in Engine Operation
  - No Changes in Material Condition of Engine

Longer-term Study with Scripps School of Oceanography

- Underway
Aquatic Invasive Species

- Three US Based Ballast Water Treatment System Testing Facilities - certified as part of IL for USCG and IMO testing
- Support Field Scientific Teams for Ship Board Tests
- Assist in Developing Tools to Monitor Efficacy of the BWTS and Compliance
- Underwater Hull Fouling – Underwater Hull Cleaning
Thank You
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