



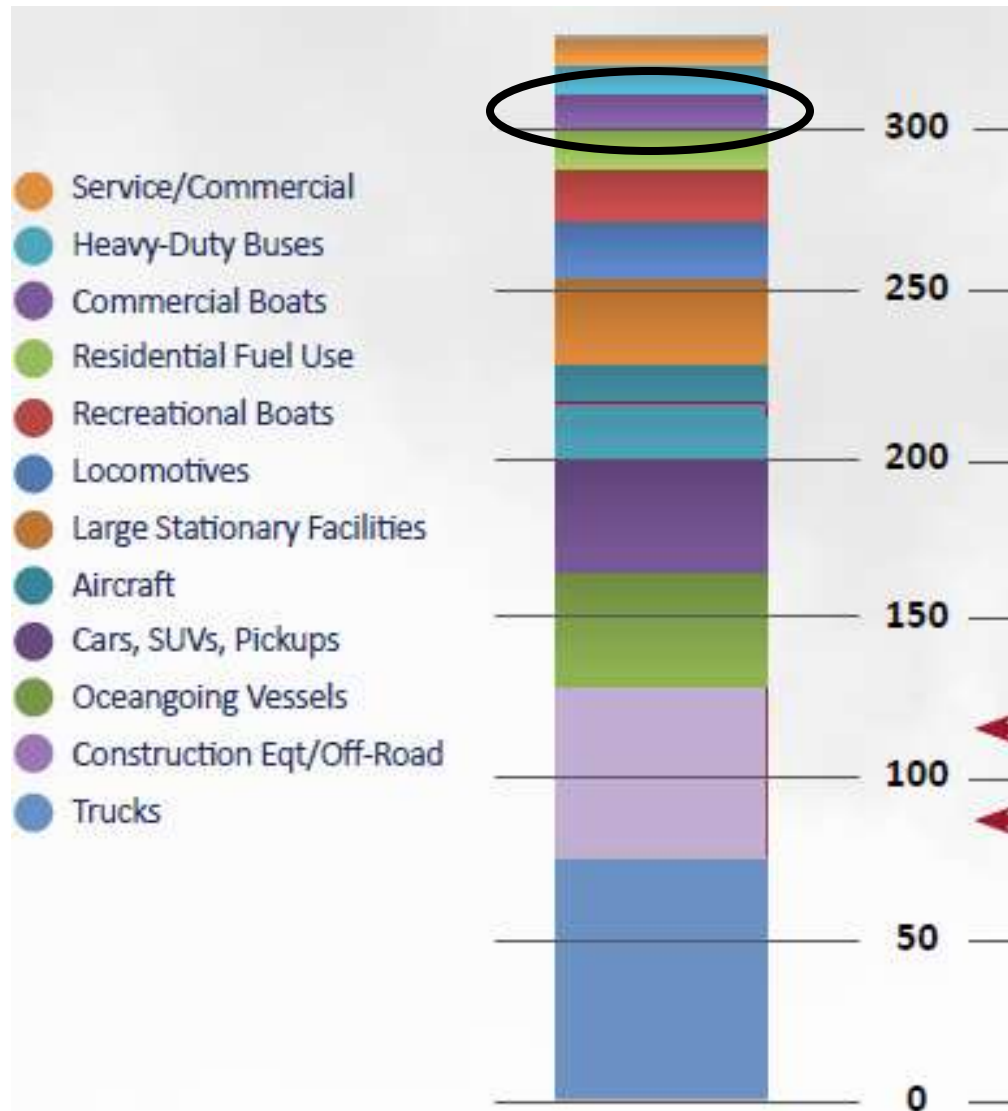
# Retrofit of a Tugboat

September 30, 2011



**Richard Carlson**  
**Mobile Source Division**

# NOx Emissions in 2023 with Adopted Standards

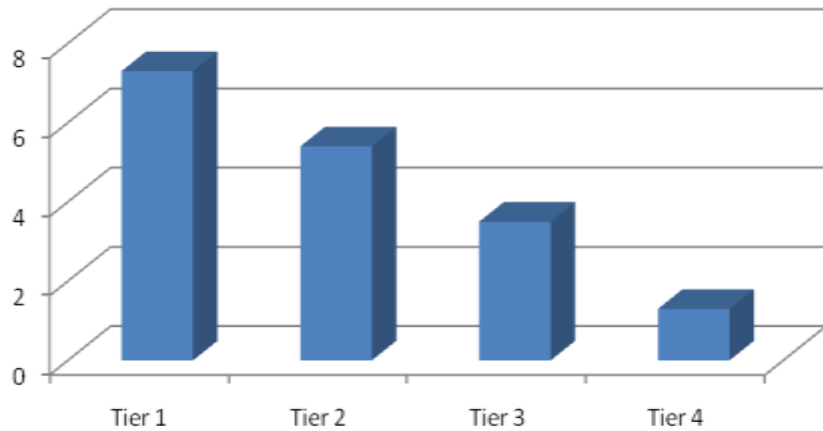


# Commercial Harborcraft Rule

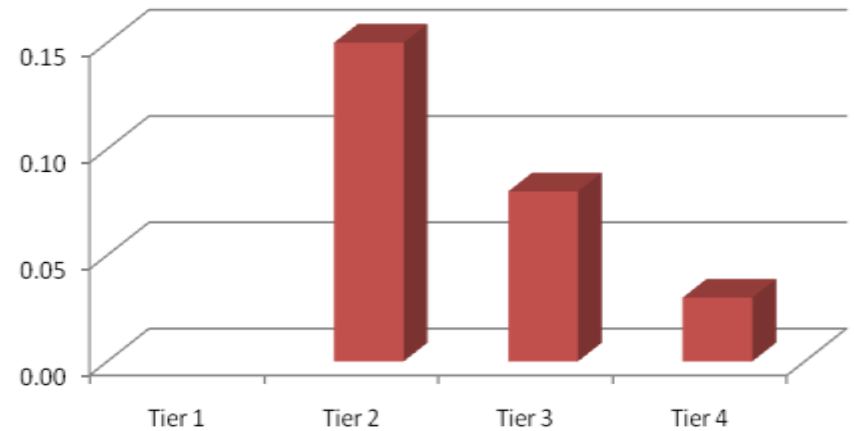
- Applies to** - tugs, towboats, excursion boats, ferries, dredges, barges, crew/supply boats
- New Vessels** - must use current Tier engine
- In-use Vessels** - replace Tier 0 through 2016  
- replace Tier 1 engines through 2022  
- if replacement engine is Tier 2, no further replacement or after-treatment is required

# Marine Emission Standards

**Marine NO<sub>x</sub> Standards (g/bhp-hr)**



**Marine PM Standards (g/bhp-hr)**



# Tugboat Retrofit Overview

- **What** - Demonstrate Tier 4 retrofit system
  - Support verification of technology
- **Why** - CHC regulation does not require Tier 4 retrofit or Tier 4 levels on new smaller (<800 hp) engines
  - Retrofits would provide significant additional NOx and PM emission reductions
  - Incentive funds may be used
- **Where** - Port of Long Beach/Los Angeles
- **How** - AB118 marine technology grant
  - Co-funding from technology provider

# Retrofit Project Scope

- **Design, fabricate, and install active DPF/SCR system**
- **Conduct emission tests of system**
  - Baseline, initial installation, final test (>1000 hours)
  - NMHC, CO, NO<sub>x</sub>, NO<sub>2</sub>, PM, NH<sub>3</sub>, CO<sub>2</sub>, fuel consumption
- **Demonstrate and monitor system performance**
  - NO<sub>x</sub> reduction efficiency
  - regeneration frequency
  - urea consumption
  - operational experience
- **Verification application**
  - system description
  - test protocol
  - baseline and initial test data

# Retrofit Technology

- **Vessel**
  - Twin 600 hp DDC engines
  - Rebuilt with DDC Clean Cam Tier 2 kit
- **Hug after-treatment systems**
  - DPF
  - Fuel burner DPF regeneration system
  - Regeneration at any engine load condition
  - Urea SCR system





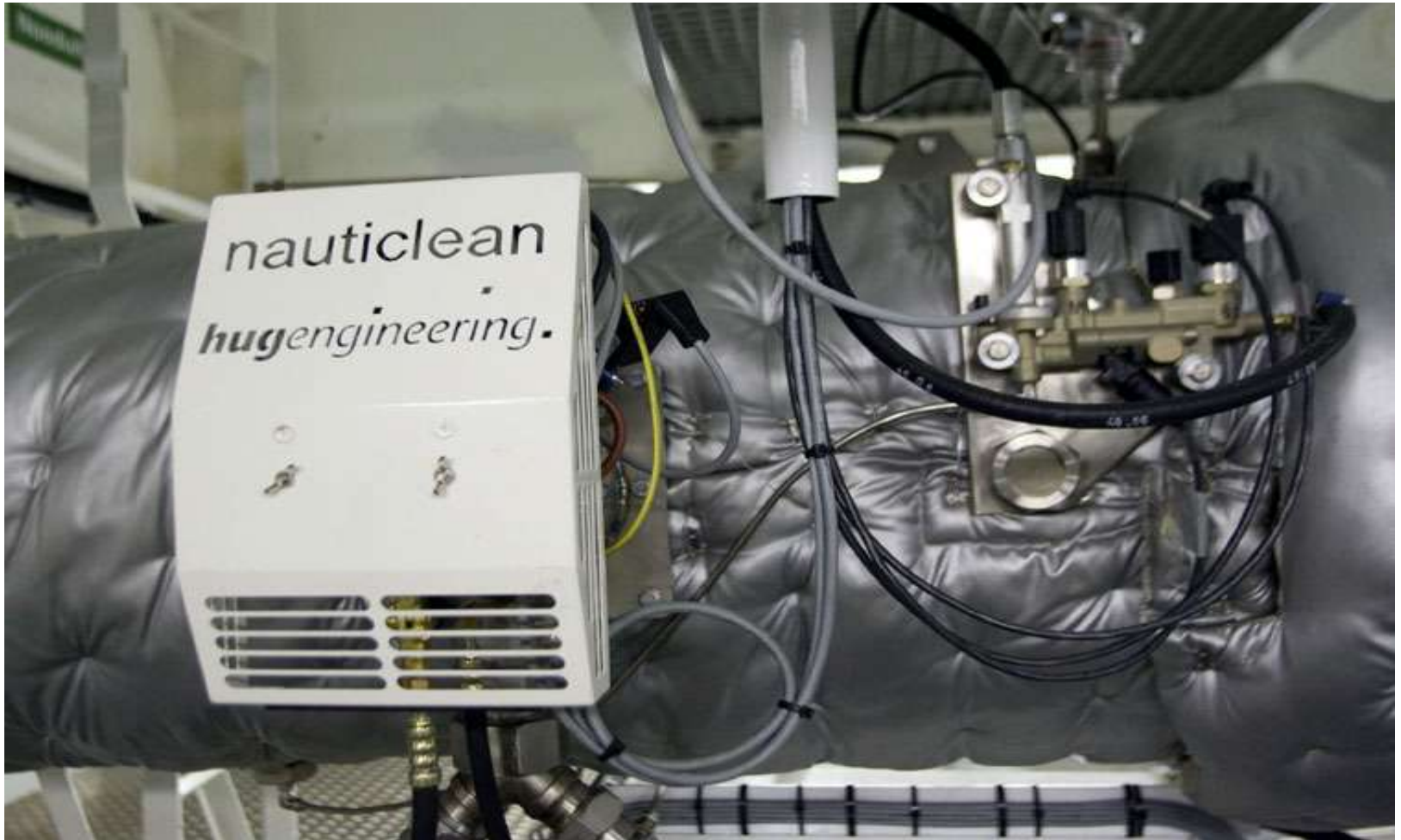
# Typical Marine Engine with DPF/SCR System



# DPF/SCR Control Cabinets



# Fuel Burner and Urea Injection





# DPF/SCR Housing



# Tug Boat Retrofit Status

- **AB118 contract executed**
- **Hug subcontract pending execution**
- **Hug/AQMD meeting with CARB**
  - **Preliminary application content**
  - **Test protocol**
  - **Schedule**
- **Planned installation January 2013**
- **Planned completion January 2014**
- **AB118 funds expire June 2014**