



# Port Idling Emission Reduction Technologies For Large Cargo Vessels

Presented to  
**National Idling Reduction Planning  
Conference**

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by

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# Presentation Contents

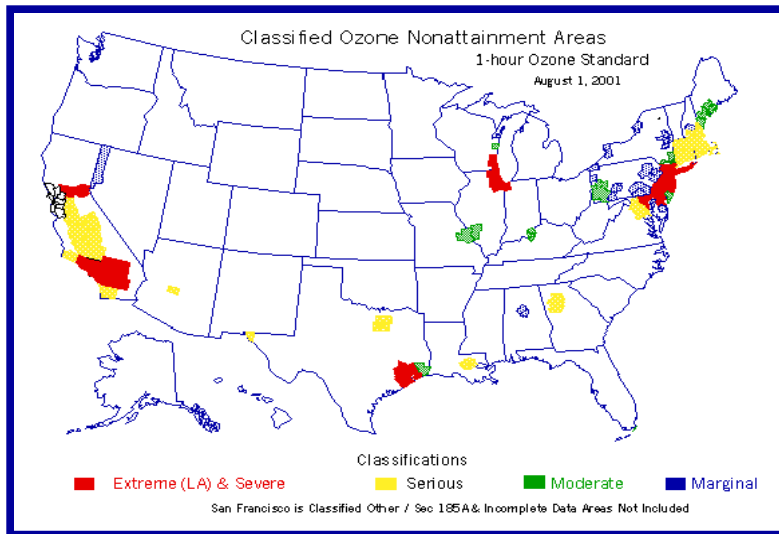


- **Growing maritime emission pressures**
- **MARAD Energy Technologies Program**
- **Comparison of cargo vessel & truck “Idling”**
- **Vessel port call and emission statistics**
- **Cargo vessel “Anti-Idling” projects**
- **Web site and contact information**

# GROWING MARITIME EMISSION PRESSURES



# Increasing Emission Pressures



## U.S. Ozone Nonattainment Areas

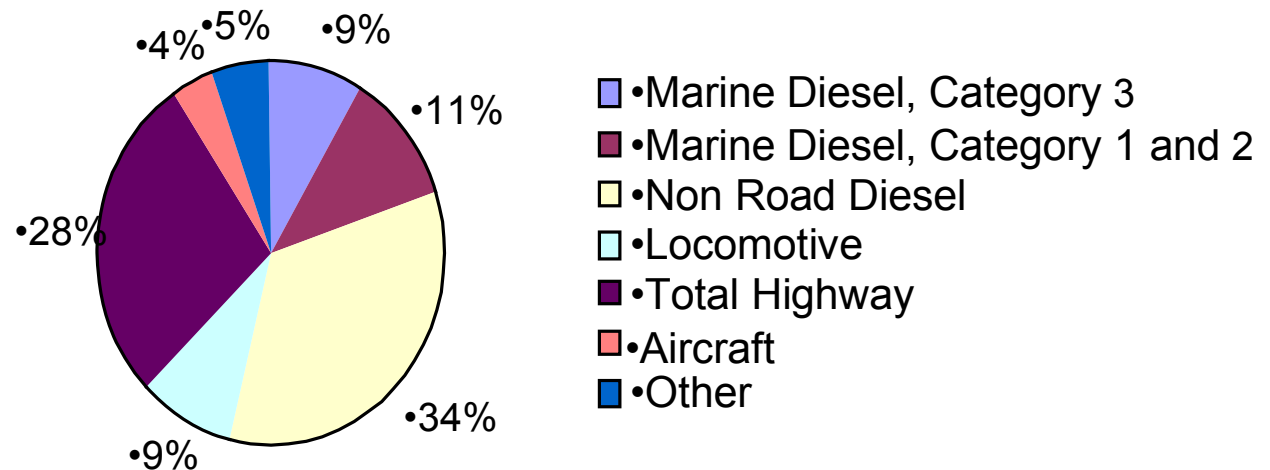
- Maritime in spotlight
- MARPOL Annex 6
  - NOx and Sulfur limits in 2004
- EPA regulations
  - New category 1, 2 eng's (1999)
    - NOx, HC, CO, and PM
  - New category 3 eng's (2002)
- CARB regulation
  - Ferries use hwy diesel
- Ozone Nonattainment
- Public pressure



# Forecasted Percentage - Mobile Source NOx Emissions



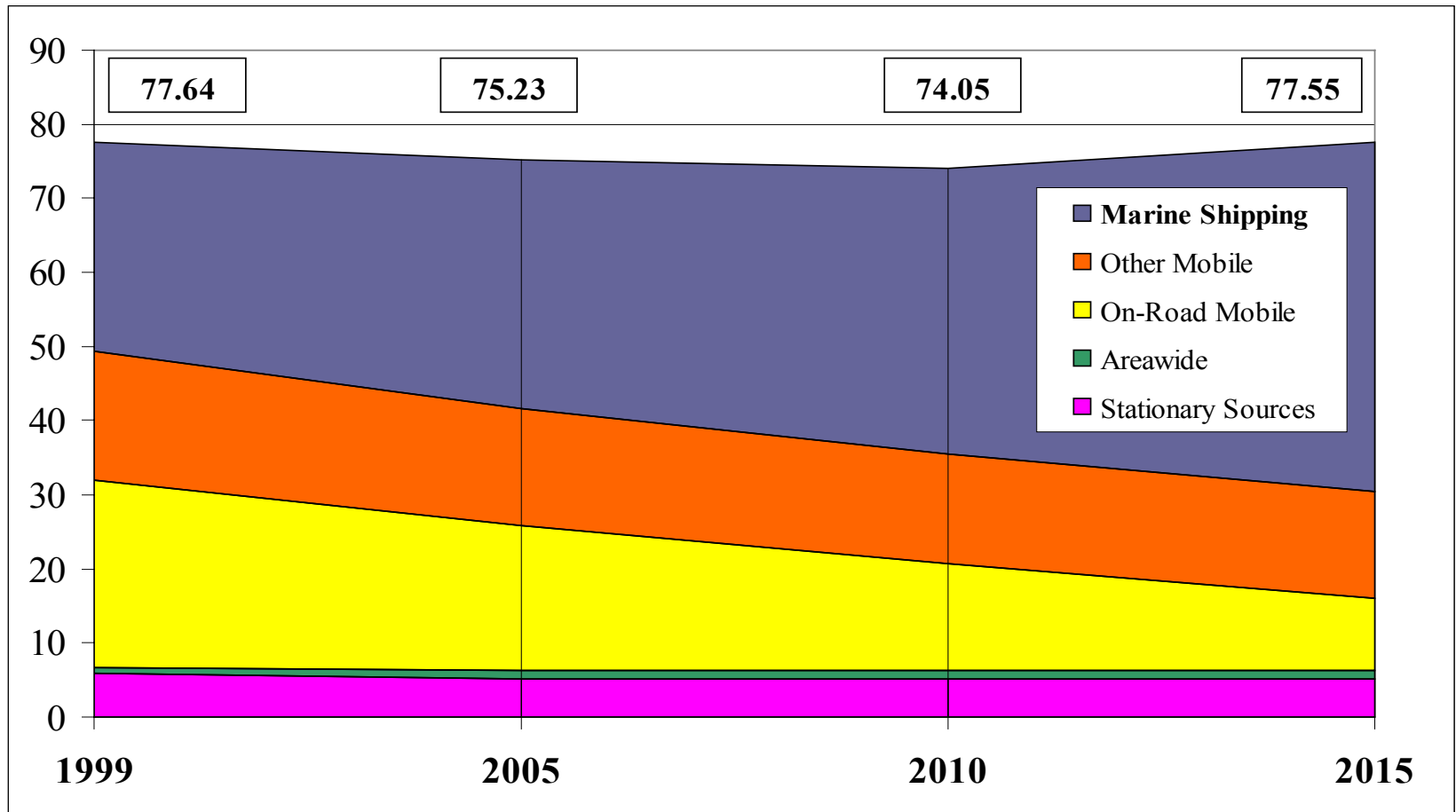
- EPA Modeled Annual• NOx Emissions Source
- Percentages for Mobile-Source Categories in 2030



- **Marine diesels to account for 20% of mobile NOx emissions in 2030**
  - **Up from 7% in 2000**



# Growing Marine Emissions Santa Barbara NOx Example



# MARAD Energy Technologies Program



# Program Objectives



- **Investigate and demonstrate the potential for new technologies and fuels to improve marine power plant efficiency and to reduce air emissions**
- **Disseminate energy technology and related policy information to the maritime community**





# Program Plan

- **Baseline performance testing**
  - Existing vessel data and measurement techniques
- **Diesel retrofits**
  - Emulsified fuel, water injection, SCR, particulate traps
- **Alternative fuels**
  - Natural gas, biodiesel, hydrogen, synthetic diesel
- **Advanced technologies**
  - Fuel cells, high efficiency gas turbines
- **Supporting studies**
  - Technology evaluations, incentives & emission measuring
- **Industry outreach**
  - Newsletter, conferences, web site, and presentations

# Partners



**CASRM**

Center for Advanced Ship Repair and Maintenance

PRIME, Inc.



MIDAS



**Federal Transit Administration**





# Projects

## Retrofits and Fuel Demos



**MV WAVERIDER - San Diego**

**MV OSKI - San Francisco Bay**

**MV ECHOLS - Norfolk**

**NAVSEA - Philadelphia**

**Staten Island Ferries**

**N.Y. Harbor Private Ferries**

**California Cargo Vessels**

- **Technologies**

- Fumigation (water injection system)
- Fuel emulsification
- Selective catalytic reduction
- Combustion chamber mods
- Injector modifications
- Ferrocene additive
- Particulate trap

- **Fuels**

- Biodiesel
- 15 PPM Sulfur Diesel
- Fischer Tropsch Diesel

# Comparison of Cargo Vessel and Truck “Idling”





# Comparison of Cargo Vessel and Truck “Idling”



## • Truck Idling

- Truck stopped
- Main engine on for hotel load
- Main engine “idling”
- Aux. generators one solution
- “Shorepower” possible

## • Cargo Vessel “Idling”

- In port cargo operations
- Main engine off
- Aux. generators on “hotel” load
- Could include cargo load
- Aux engines - loaded condition
- Control technologies needed
- “Shorepower” possible





# Port Call and Emission Statistics





# Port Statistics

## ■ National

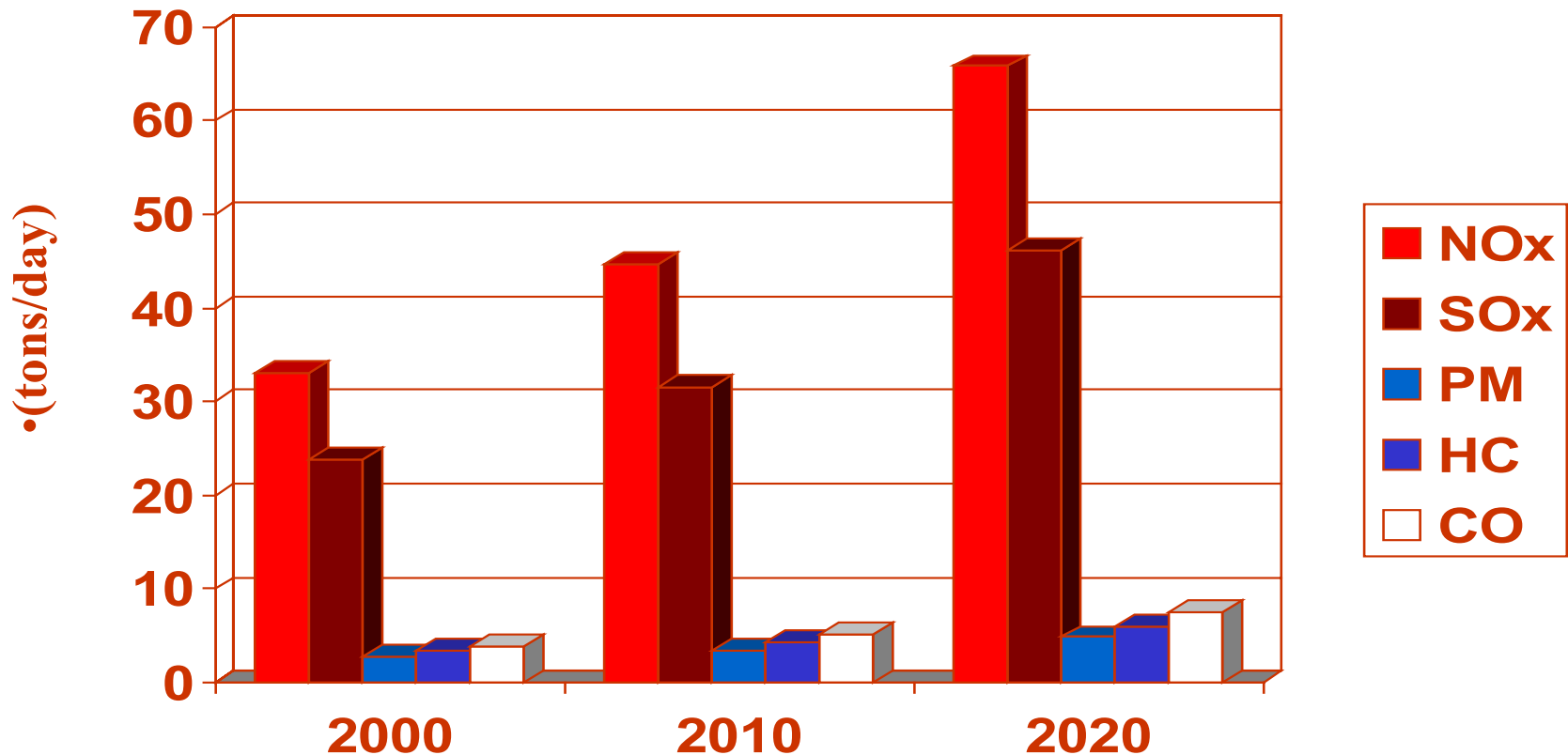
- 52,000 foreign trade U.S. port calls per year
- 93% foreign vessel, most w/large 2-stroke engines
- Utilize blended residual fuel usually 2 - 3 % sulfur
- Aux. generator engines 4 stroke medium speed
- Existing engines unregulated w/ slow turnover

## ■ Port of LA

- 5600 ship visits per year, container ship > 50%
- Typ. container ship hotel load = 3,000 kW @ 48 hrs
- Cargo throughput projected to triple by 2020
- Port expansion - No NOx, PM, net increase allowed



# Port of Los Angeles Vessel Emission Trends



•Business as usual trend

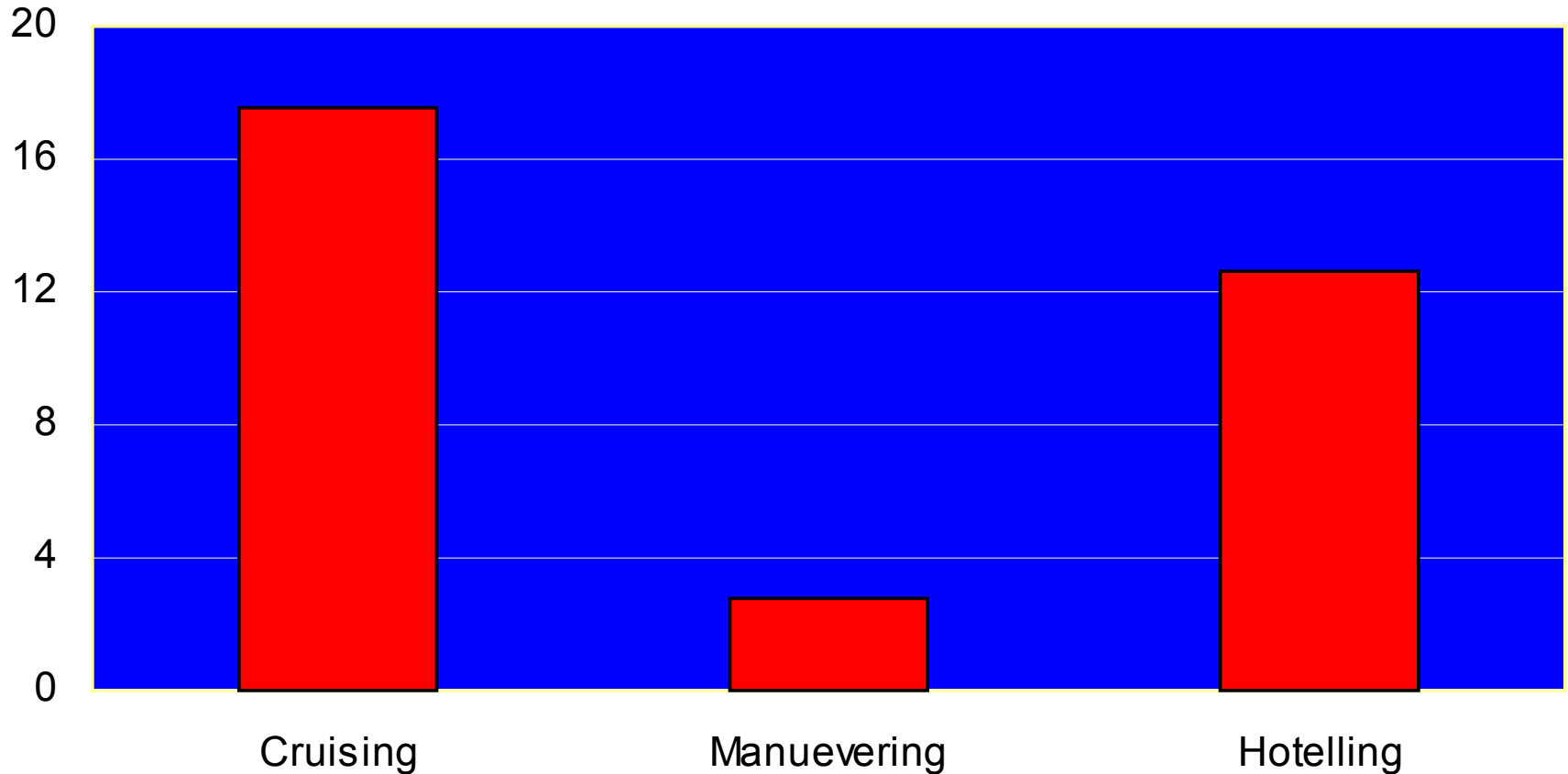




# Port of LA Vessel Emission Breakdown



2000 Ship NOx Emissions by Mode (tons/day)



# Cargo Vessel “Anti-Idling” Projects



# Baseline Emission Testing



- **MV SINE MAERSK - Container vessel**
  - L.A. to Tacoma
- **Sponsor - Port of LA w/MARAD assist**
- **Parties Involved - Maersk Lines, MAN B&W, University of California Riverside, CARB**
- **NO<sub>x</sub>, PM, HC, CO and CO<sub>2</sub> Tested**
- **Testing both underway and at pier**
- **Port “idling” on auxiliary gensets**
  - 12.5 NO<sub>x</sub> g/kW-h , no PM data available



# Cargo Vessel Diesel Engine Retrofit Projects



- **Sponsors**
  - MARAD, DOT CCCEF, EPA, Ports LA & LB, CARB, Air Quality Districts
- **Cooperative research**
  - w/ Vessel operators
- **Cruising California coast**
- **Hotel (Idling) loads in port**
- **Main engine**
- **Auxiliary engines**

“Anti-Idling” Technology  
Fuel emulsification  
Target 25% NO<sub>x</sub> reduction  
Reduced sulfur fuel  
SO<sub>x</sub> and PM reduction



# “Idling” NOx Emission Reductions - Emulsion System



- **Container vessel**
  - 10 trips/year to two California ports
  - Develops 3000 kW hotel load for 48 hours
- **US Port NOx reduction**
  - Target 25%
  - NOx production - 10 trips x 2 calls/trip x 48 hrs/call x 3000 kW x 12.5 g NOx/kW-hr x lb/454 g x Ton/2000 lbs = 40 Tons NOx/yr.
  - 40 Tons x 25% = 10 Ton NOx reduced/year



# “Idling” PM Emission Reductions - Low Sulfur Diesel



- **Container vessel**
  - Same profile as preceding slide
- **Fuel Characteristics**
  - IFO 380 cSt (blended) - 25,000 ppm sulfur typical
  - MGO (diesel no. 2) - 500 ppm sulfur likely
- **US Port PM reduction**
  - Target > 40%
  - PM production - 10 trips x 2 calls/trip x 48 hrs/call x 3000 kW x 3.0 g PM/kW-hr x lb/454 g x Ton/2000 lbs = 9.5 Tons PM/yr.
  - 9.5 Tons x 40% = 3.8 Tons PM reduced/year



# Shorepower as an Option



- **Applications**
  - Juneau, Alaska cruise ships
  - Port of LA considering
- **Challenges**
  - Ship conversions needed - high shore power load
  - Varied voltages, frequencies, and transformers
  - Large 3 phase power cable handling
  - Crane and cargo equipment interference
  - Very expensive per application
  - Port evacuation security considerations



# Contact Information





## Web Site and Contact Info



- **Daniel.Gore@MARAD.DOT.GOV**  
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- **www.marad.dot.gov/nmrec/**  
– Link to “Energy Technologies”
- **No-cost newsletter subscription**