



Low-Emission Technologies and Solutions for Marine

Cleaner Fuels and Retrofit Devices

Faster Freight Cleaner Air Conference



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Oakland, California
December 8, 2004

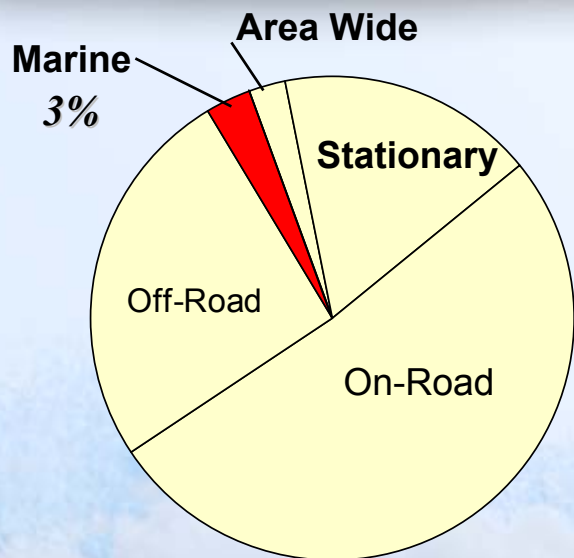
Outline

- Marine vessel emissions
- Potential controls for in-use fleet
- Oceangoing ship retrofit program
- Draft regulatory proposal for ship auxiliary engines

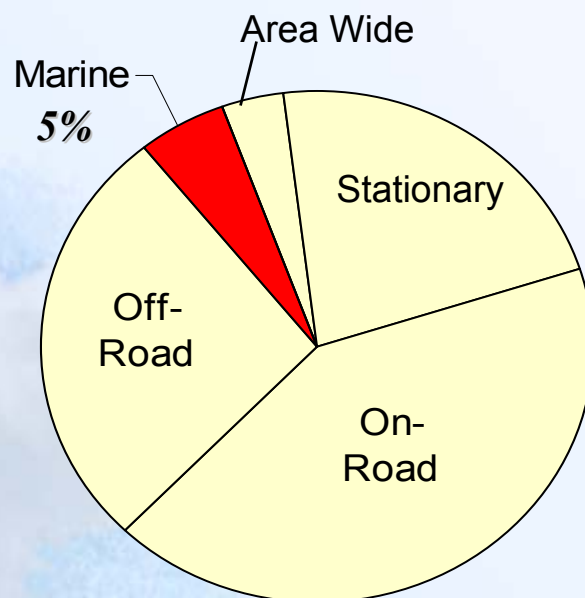
Commercial Marine Vessel Emissions



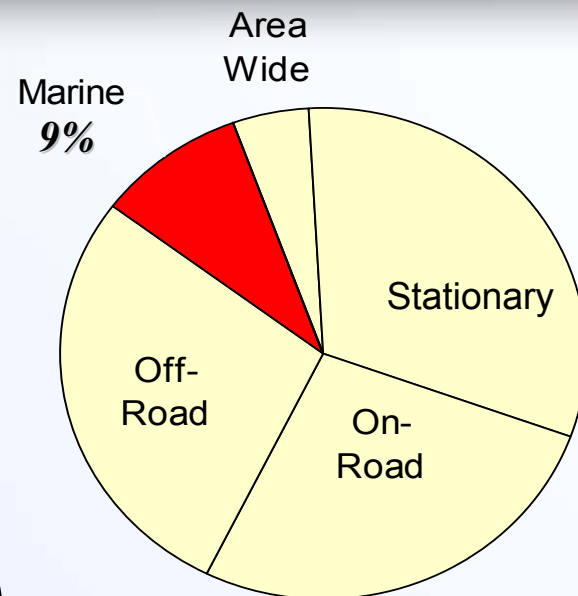
Commercial Marine Vessel Contribution to California Statewide NOx Emissions



2000

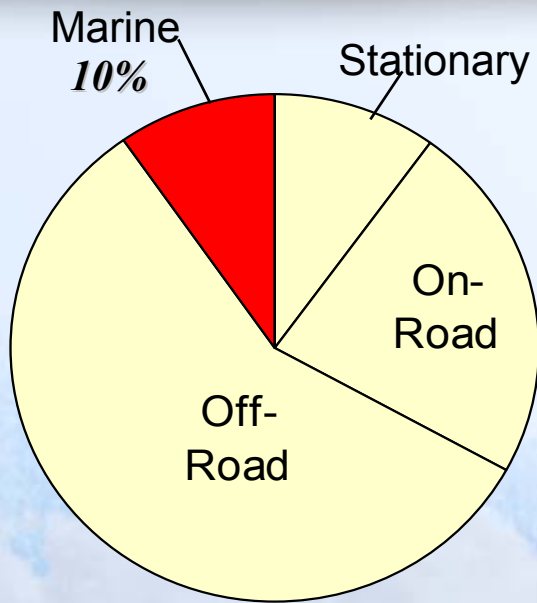


2010

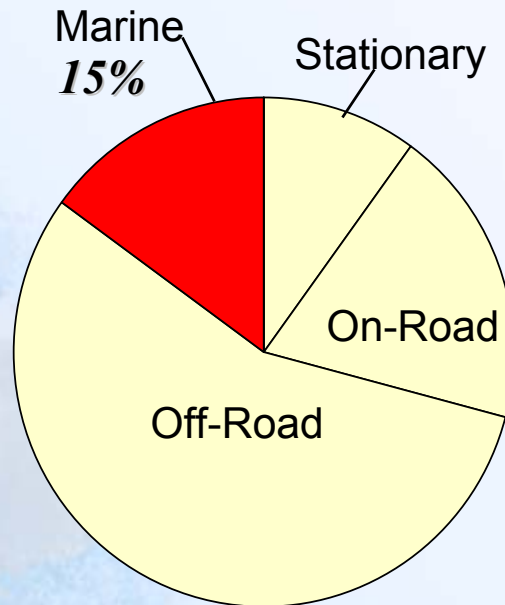


2020

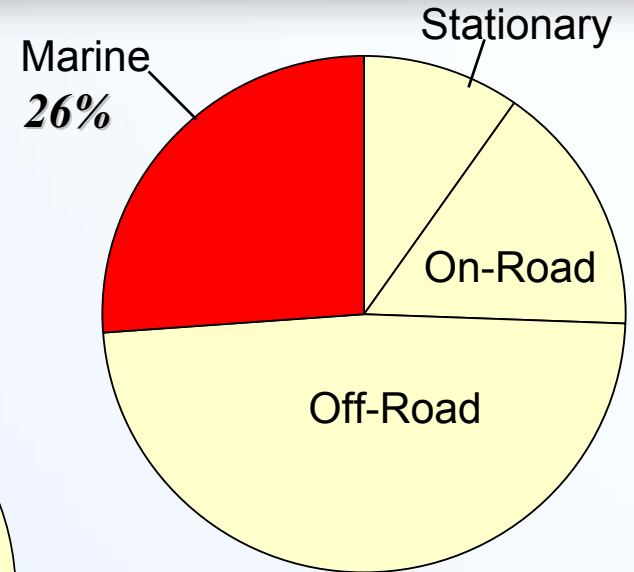
Commercial Marine Vessel Contribution to California Statewide Diesel PM Emissions



2000



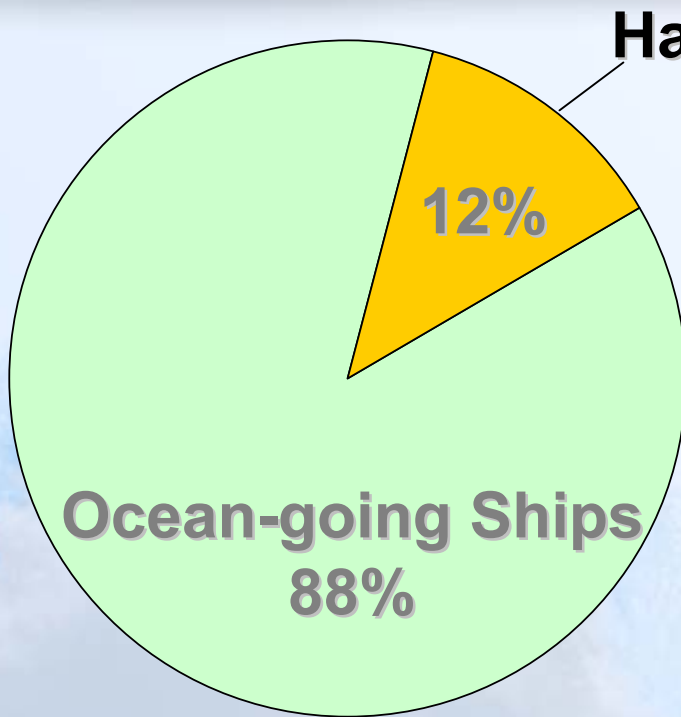
2010



2020

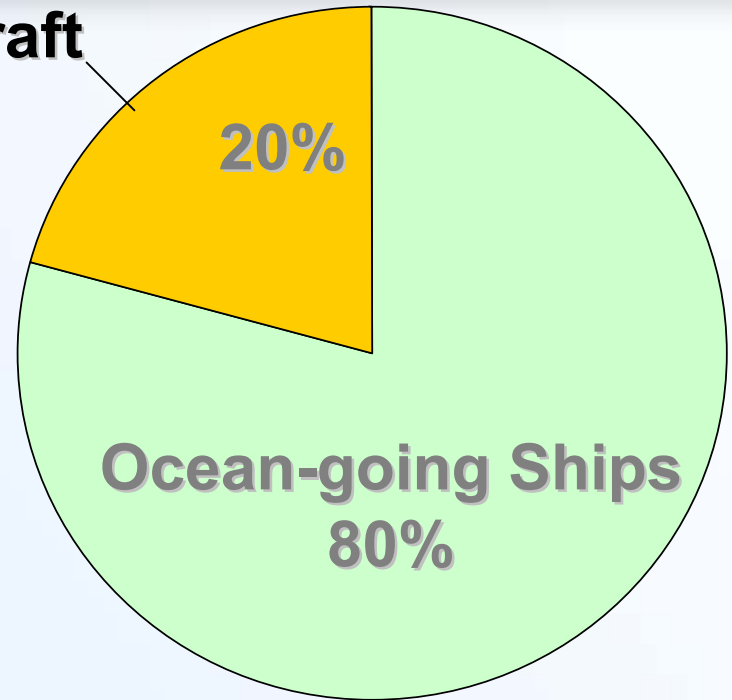
Ocean-going Ships and Harbor Craft

Year 2000 Statewide Diesel PM and NO_x Emissions



Diesel PM

9 TPD Total



NO_x

100 TPD Total

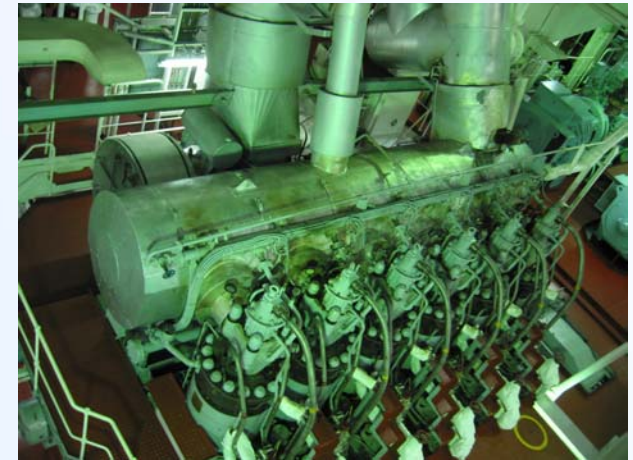
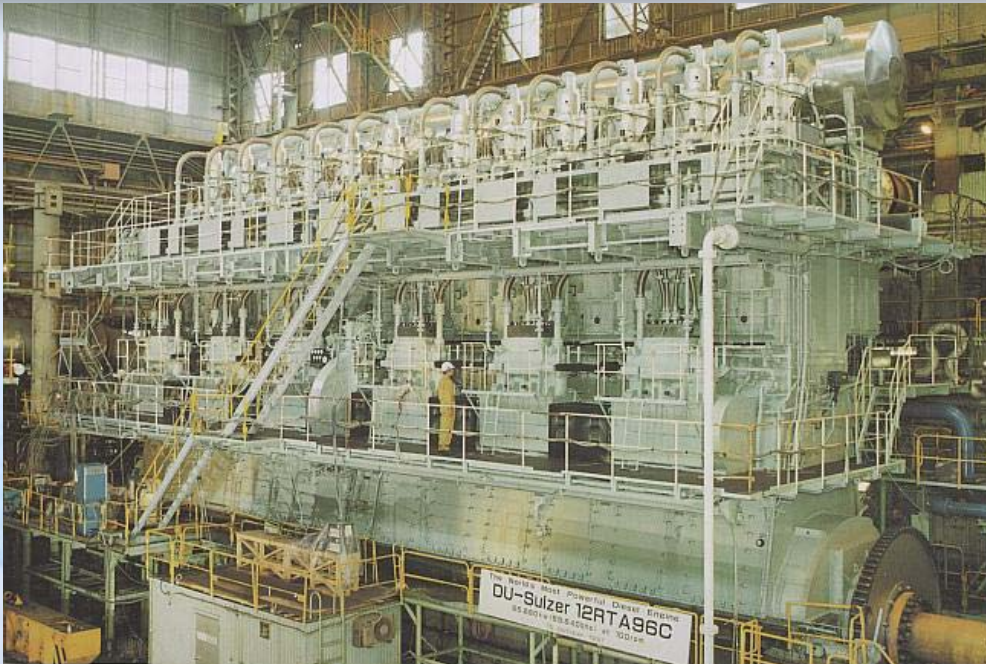
California Coastal Waters



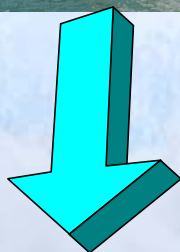
Potential Controls for the In-use Fleet



Oceangoing Ship Engines & Controls are Unique



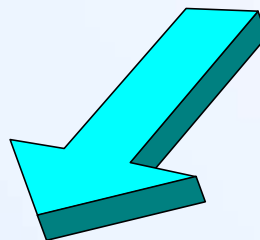
Cleaner Fuel Options Being Pursued for Harbor Craft and Oceangoing Ships



CARB Diesel:

Harbor craft

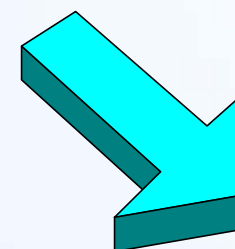
- ~10-25% *PM* Redn.
- ~6% *NOx* Reduction
- Greater use of add-on controls



Marine Distillate:

Ships at Dockside
(auxiliary engines)

- ~60% *PM* Reduction
- ~6-10% *NOx* Redn.
- ~90% *SOx* Reduction



Lower Sulfur Marine Bunker Fuel (SECA):

Oceangoing ships at sea
(main engines)

- ~20% *PM* Reduction
- ~40% *SOx* Reduction

Examples of Potential Ship Retrofit Control Technologies

- Selective catalytic reduction (SCR)
- “Water Technologies”
 - emulsified fuels, water injection, HAM
- Retrofit of modified fuel injectors
 - slide valves or mini-sac injectors
- Oxidation catalysts
 - auxiliary engines only with low sulfur fuel
- Cylinder lube oil control in main engine

Ship Retrofit Program



Project Goals

- Demonstration of cost-effective shipboard retrofit technologies
- Reduce emissions from Ocean-Going vessels
- Generate interest potential voluntary, incentive-based, ship retrofit programs

Project Sponsors

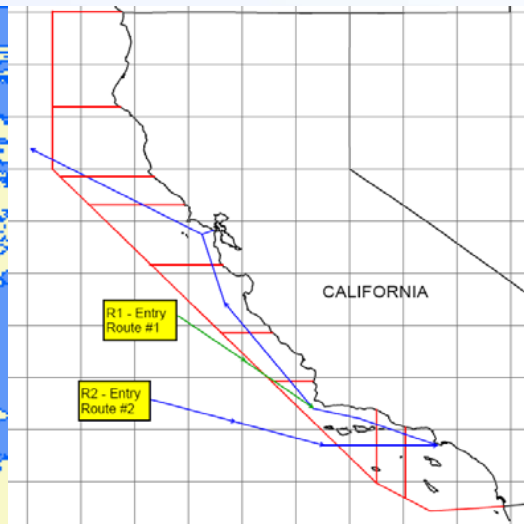
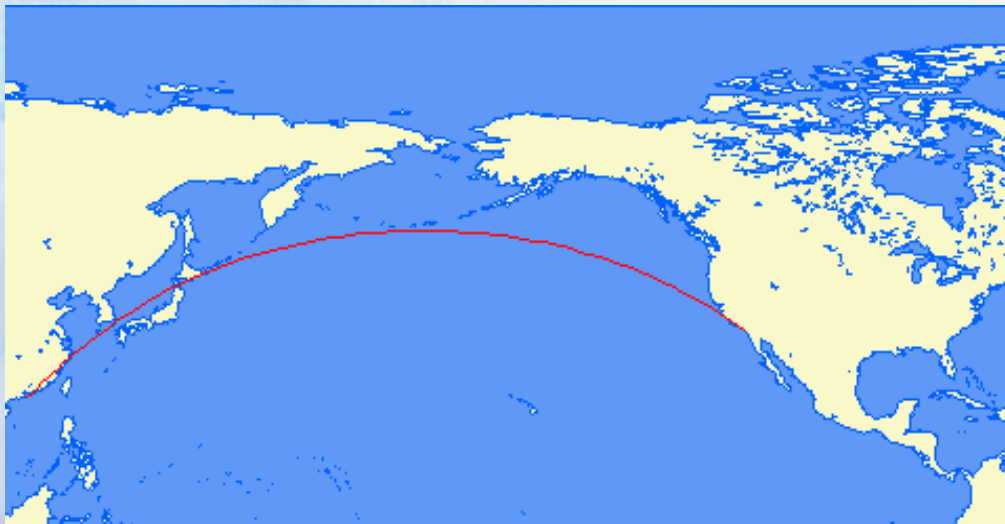
- Ports of Los Angeles & Long Beach
- U.S. Maritime Administration
- U.S. EPA
- Local Air Pollution Control Districts
 - Bay Area AQMD, Ventura APCD, Santa Barbara APCD, SLO APCD
- CARB

Proposed Technologies

- **Fuel- Water Emulsion Technology**
 - MAN B&W system
 - NOx reductions ~25% (w/ 25% water content)
 - Use on main engine & possibly aux. engines
 - To be used in CA waters only
- **Slide Valves**
 - MAN B&W technology
 - PM reductions of 25%+
 - Use on main engine
- **Fuel Comparison for aux. engines**
 - Bunker, Distillate & Emulsified fuel emission comparisons

Potential Vessel

- About 10 visits to CA per year (Pacific Rim Service)
- Diesel 2-stroke, main engine (48,840 kw)
- Annual CA emissions ~ 300 TPY NO_x, 23 TPY PM
- Calls on the west coast ports of LA and Oakland



Status

- Refining emission calculations and cost-effectiveness (CE) estimates – In CA waters
 - Initial NO_x CE < \$2,000/ ton
 - Initial PM CE < \$10,000/ ton
- Total Project Cost: \$550k-\$700k
- Estimated 1 year from signed agreements to testing
- Currently working w/ APL to:
 - Identify candidate vessel
 - Drafting scope of work, and agreements
 - Develop a project timeline

Next Steps

- Finalize:
 - Scope of work
 - Cost-effectiveness
 - Implementation and testing schedules
 - Agreements between sponsors
 - Agreement w/ APL
- Procurement & installation of equipment
- Emission testing

Draft Regulatory Proposal for Ship Auxiliary Engines



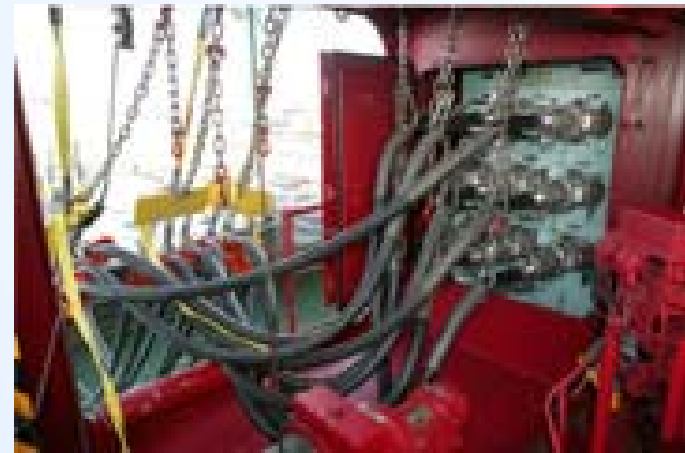
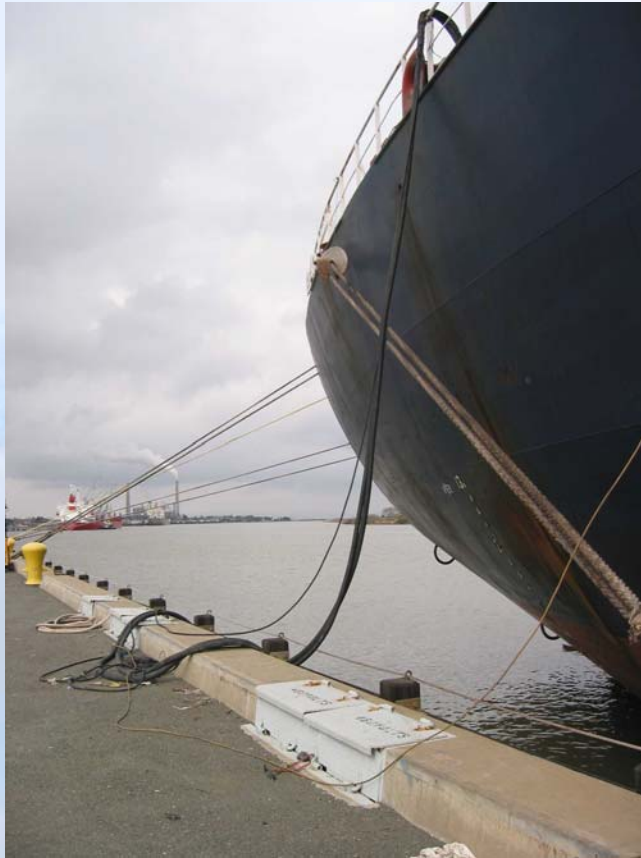
Draft Proposal

- Step 1: Cleaner fuels for all vessels
 - 0.2% sulfur MGO in 2006
 - 0.1% sulfur MGO in 2008
 - Alternative Compliance Plan
 - Voluntary option in lieu of cleaner fuel requirements

Draft Proposal

- Step 2: Further reductions from frequent visitors (5 visits/yr)
 - Must submit “Vessel Emission Reduction Plan”
 - Plan must achieve additional 50% reduction in both PM & NOx by 2010
 - Plans may average reductions from different engines and vessels

Example of Potential Control Technology: Shore-side Power



Draft Proposal

- Schedule
 - Mail out ship survey
 - Additional workshops
 - Board Hearing in fourth quarter 2005
- Draft proposal available on web:
<http://www.arb.ca.gov/msprog/offroad/marinevess/meetings/111004/draftregconcepts.pdf>

ARB Marine Contacts and Web-site Information

- Oceangoing Ships
 - Paul Milkey, pmilkey@arb.ca.gov
 - (916) 327-2957
- Harbor Craft
 - Todd Sterling, tsterlin@arb.ca.gov
 - (916) 445-1034
- ARB Marine Programs:
 - <http://www.arb.ca.gov/msprog/offroad/marinevess/marinevess.htm>