The Need to Reduce Marine Shipping Emissions: A Santa Barbara County Case Study

Tom Murphy
Santa Barbara County Air Pollution Control District
September 2005
Ships in the SB Channel
Overview

- The problem
- Clean air planning process
- 2004 Marine shipping inventory
- Regulatory efforts
- Technologies and challenges
- Partnerships and incentives
- Demonstration project
- Conclusions
The Problem

- Over 7,200 annual traverses
- 130 miles of coastline
- Large 2-stroke engines
- Slow turnover rates
- Vessels burning heavy bunker fuels
- Majority of the vessels are foreign flagged
- Trade volumes expected to continue increasing
Typical Great Circle Route
Clean Air Planning Process

- Attainment state and federal standards
- Develop emission inventories
- Evaluate emission control measures
- Forecast emissions
- Marine shipping contribution: Large and growing
- June 2007 – Next Clean Air Plan
Santa Barbara County NOx * Emissions Comparison

2000 Santa Barbara County NOx Emissions

- Other Mobile Sources 17.25%
- On-Road Motor Vehicles 31.17%
- OCS Stationary Sources 1.05%
- Area-Wide Sources 0.61%
- Stationary Sources 7.13%
- OCS-Marine Shipping 42.71%

2020 Santa Barbara County NOx Emissions

- Other Mobile Sources (Excluding Ships) 0.08%
- Other Mobile Sources 8.02%
- On-Road Motor Vehicles 7.62%
- Area-Wide Sources 1.36%
- Stationary Sources 7.10%
- OCS Stationary Sources 0.92%
- OCS-Marine Shipping 74.88%
- OCS Other Mobile Sources (Excluding Ships) 0.10%

* NOx = Onshore + OCS
Santa Barbara County
NOx * Emission Forecast

* Percentage of total emissions from foreign and US vessels in transit

* NOx = Onshore + OCS
2004 Marine Shipping Inventory

- Over 7,200 traverses
- 9% of vessels = 50% NOx emissions
- 59 vessels over 50 tons of NOx in 2004
- 92% of NOx from foreign flagged vessels
- About 19 transits per day
- About 40 tons of NOx and 3 tons of PM emitted daily
Vessel Transits by Ship Type

2004 Total Transits by Vessel Type
(Total Transits = 7,207)

- Container Ship: 63%
- Auto Carrier: 8%
- Bulk: 9%
- Cargo/General: 3%
- Tanker: 7%
- Tug/Barge: 6%
- RO/RO: 2%
- Other (7): 2%
- Other: 2%

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Container ship
~ 30 MW (~40,000 hp)
2-stroke main engine
Regulatory Efforts

IMO

- MARPOL Annex VI
  - Entered into force on May 19, 2005
  - Sets limits for SOx and NOx from vessels built or modified after 1/1/2000
  - Currently 27 countries have ratified
  - US, Canada & Mexico have NOT ratified treaty yet
  - By 2007 revisions that will be considered include:
    - PM, VOC, GHG limits & tougher NOx & SOx limits
    - In-use engine applicability

US EPA

- Category 3 Engine Rulemaking
  - Tier 1 standards = IMO standards
  - Tier 2 standards expected 2007
- SECA application development (2007 submittal)
Regulatory Efforts

California Air Resources Board (ARB)

- Air Toxic Control Measures (ATCM)
  - Developing aux. engine ATCM (Dec. 2005)
  - Cargo handling equipment ATCM (Dec. 2005)
  - Cruise ship on-board Incineration ATCM (Nov. 2005)
  - Frequent flyer vessel ATCM (2006)

- Research
  - CA ocean-going vessel emission inventory (Fall 2005)
  - Modeling & Health / Ecological impact (Spring 2006)
  - SECA development collaboration with EPA
Potential Control Technologies

• Water based controls
  - Emulsified fuels
  - Water injection
  - Humidification
• Slide valves
• Exhaust gas recirculation
• Selective catalytic reduction
• Cleaner fuels, oxidation catalysts
Technology Challenges

• Quick installation
• Reliability
• Low maintenance
• Safety
• Pollutant trade-offs
• Fuel consumption
• Industry buy-in
Partnerships and Incentives

• CARB Maritime Working Group
• West Coast Collaborative
• Potential incentives
  ♦ Credits
  ♦ Fees
  ♦ Cost-sharing
  ♦ Awards
Demonstration Project

Objectives

- Demonstrate emission controls
- Develop support for potential economic incentive programs
- Develop in-use testing protocol

Participants

- U.S. EPA, MARAD
- ARB, Ports, CA Air districts
- Ship operator
- Engine manufacturer
Technology: Slide Valves

- Already in use
- Reduce PM by 30 - 50%
- Fuel efficient design
- Cost-effective
- Easy to install
- $96,000 for 22 valves
Technology: Water Emulsion System

- Reduce NOx up to 30%
- Being considered for Main engine
- Designed by engine manufacturer
- Small loss in power possible
- Approx. $555,000 for the system
- Cost-effective

Challenges

- Ship owner participation
- Funding sponsors & cooperative agreements
- Project scope & priorities
- Limited emission test data available
- Vessel down time and schedule delays
- Vessel route stability
- Project life
Conclusions

- Marine shipping emissions are significant & growing
- Regulatory efforts largely ineffective to date
- Cost effective control technologies available
- Significant capital expenditure
- Technology & implementation challenges
- Pursuing a partnership approach
- Once proven, additional partnerships and incentives programs needed
Questions ?