EPA’s Vessel Emission Control Program

Byron Bunker
U.S. Environmental Protection Agency
4 May 2010
Overview

- What are ocean-going vessels?
  - 3 things you need to know

- OGV Impact on Air Quality

- Clean Diesel Strategy

- C3 CAA FRM

- IMO Annex VI

- Next steps
Ocean-Going Vessels
1) Extremely large hand built engines

- Engines are built as part of the ship (like a powerplant)
- Engines are ~4 stories tall
- Unlike smaller automotive engines whose parts are made in automated machine processes, these engines are built one at a time in very low volumes
- Successful program must reflect reality of the technical challenges for these engines
Ocean-Going Vessels
2) Burn residual fuel (wax/tar)

- Primarily use residual fuel

- Residue (leftover) from refining process – after all of the other useful products are removed from a barrel of oil this is the remaining concentrated gunk
  - Must be heated (melted) in order to pump it into the engine to be combusted

- Low cost:
  - Disposal problem for refineries

- High Emissions
  - Very high sulfur content
    - ~30,000ppm S
    - High SOx & sulfate PM
  - Doesn’t burn well
    - high PM & NOx

- Successful program must address fuel quality
Ocean-Going Vessels
3) Primarily Foreign Flagged

World fleet
- About 16,750 vessels >10,000 GT
  - US ownership: 5th largest fleet (684 vessels, or 4%)
  - US flag: 15th largest fleet (286, or 2%)
  - Largest flag: Panama (3,668 or 22%)

- About 8,000 different vessels visited US ports in 1999
  - 89% of vessels visiting US ports are foreign flagged
  - A small number of vessels account for most of the visits
    - 12% of the vessels made 50% of entrances
    - 29% of the vessels made 75% of entrances

- Successful program must address foreign flagged ships
Sustainable Must Mean Healthy Air: U.S. Ports and Nonattainment Areas

- More than 40 major ports are located in PM$_{2.5}$ or ozone nonattainment areas
- About 88 million people live in 39 areas that do not meet the PM$_{2.5}$ NAAQS or that contribute to violations in other counties
Ship Contribution to U.S. PM Inventory

2009 Mobile Source PM2.5 Inventory

- Diesel NR: 28%
- Other NR: 14%
- Diesel Marine <30 l/cyl: 7%
- Highway: 24%
- OGV Marine: 17%
- Aircraft: 4%
- Locomotive: 6%

2030 Mobile Source PM2.5 Inventory

- OGV Marine: 48%
- Aircraft: 7%
- Diesel NR: 5%
- Other NR: 15%
- Highway: 20%
- Diesel Marine <30 l/cyl: 3%
- Locomotive: 0%

Source of inventory estimates: C3 Marine NPRM (July, 2009)
Does not reflect IMO MARPOL Annex VI Amendments (October 2008)
EPA’s National Clean Diesel Campaign Regulatory Roadmap

Tier 2 Light-Duty
final rule 1999
fully phased in 2009
Diesels held to same stringent standards as gasoline vehicles

Heavy-Duty Highway
sales 800,000 / yr
40B gallons / yr
final rule 2000
fully phased in 2010

Nonroad Diesel
sales over 650,000 / yr
12B gallons / yr
final rule 2004
fully phased in 2015

Locomotive/Marine
sales 40,000 marine engines,
1,000 locomotives / yr
6B gallons / yr
final rule 2008
fully phased in 2017

Ocean Going Vessels
CAA Rule Dec 2009
IMO MARPOL Annex VI
ECA Controls
- Fuel Based 2012/2015
- 80% NOx reduction 2016

These standard-setting rulemakings are key enablers for collaborative partnerships with industry and state & local governments

Note: sales and diesel fuel usage vary year-to-year; these figures are for comparison purposes only
Coordinated Strategy

U.S. Domestic Rulemaking

U.S./Canada/France ECA

Global Annex VI Standards
U.S. Domestic Rulemaking

- Final Rule signed in December, 2009

- New engine standards
  - Tier 2 and 3 NOx limits for U.S. vessels harmonized with MARPOL Annex VI
  - HC and CO cap standards for U.S. vessels

- New fuel sales standards
  - 0.1%S fuel limit for use in ECAs; unless equivalent technology used
  - Allow for 0.1%S distillate sales, in U.S., for marine use

- Adopts Annex VI implementation regulations for all vessels operating in U.S. waters
New Annex VI Amendments

- October 2008 Annex VI amendments approved
- Global NOx Controls
  - Tier 2: 20% reduction from new vessels (2011)
  - Existing engine standards
- Global PM and SOx controls
  - 2012: 3.5% fuel sulfur
  - 2020: 0.5% fuel sulfur
    - Could be delayed to 2025; subject to 2018 fuel availability review
- A country (or countries) can propose to designate an Emission Control Area (ECA), where more stringent standards apply
Emission Control Area

- On March 26, 2010, IMO adopted the North American ECA
  - The ECA fuel sulfur requirements will enter into force on August 1, 2012

- ECA NOx Controls
  - Tier 3 NOx 80% reduction new vessels (2016)

- ECA PM and SOx Controls
  - 1.0% Fuel Sulfur (2010-2014)
  - 0.1% Fuel Sulfur 2015+
    - Up to 96% reduction in SOx
    - ~85% reduction in PM
North American ECA
For Comparison: Impact of New Locomotive and Marine Diesel Engine Rule on PM$_{2.5}$ levels in 2020

Legend

- $\leq 0.01$ ug/m$^3$
- $> 0.01$ to $\leq 0.03$
- $> 0.03$ to $\leq 0.05$
- $> 0.05$ to $\leq 0.1$
- $> 0.1$ to $\leq 0.25$
- $> 0.25$ to $\leq 0.5$
- $> 0.5$ to $\leq 1.0$
- $> 1.0$ to $\leq 2.0$
- $> 2.0$ to $\leq 4.1$
- Outside 12km grids
2020 Potential ECA PM$_{2.5}$ Reductions
Ozone (Smog) reductions from the proposed ECA reach well into the U.S. interior.
2020 Potential Sulfur Deposition Reductions

Improvements in deposition for marine and terrestrial ecosystems
Benefits and Costs of the Coordinated Strategy

- The FRM presents the benefits and costs of the coordinated strategy
  - Engine and fuel requirements for U.S. and foreign vessels

- In 2030 the estimated benefits are between $110 and $270 billion

- By 2030, the emission reductions associated with the coordinated strategy will annually prevent:
  - Between 12,000 and 30,000 PM-related premature deaths
  - Between 210 and 920 ozone-related premature deaths
  - About 1,400,000 work days lost
  - About 9,600,000 minor restricted-activity days

- The estimated costs are much smaller: $3.1 billion
Example Cost Scenario

Increased operating costs in ECA only
For this scenario:
- 3% increase in operating costs
- $18/TEU
Additional Information

- The FRM, proposed ECA, and supporting information are available at:
  - [www.epa.gov/otaq/oceanvessels.htm](http://www.epa.gov/otaq/oceanvessels.htm)

- Contact: Michael Samulski
  - U.S. Environmental Protection Agency
  - [Samulski.Michael@epa.gov](mailto:Samulski.Michael@epa.gov)
  - 1 (734) 214-4532