The Air is Getting Cleaner!

2007 Cleanest Yet!
POLA Regional Contribution

**The Big Picture**

**DPM**
- Total Port of Los Angeles: 10%
- Total Stationary & Area: 3%
- Total On-Road (w/o POLA): 33%
- Total Other Mobile (w/o POLA): 54%

**NOx**
- Total Port of Los Angeles: 5%
- Total Stationary & Area: 9%
- Total Other Mobile (w/o POLA): 32%
- Total On-Road (w/o POLA): 54%

**SOx**
- Total Port of Los Angeles: 25%
- Total Stationary & Area: 36%
- Total Other Mobile (w/o POLA): 32%
- Total On-Road (w/o POLA): 7%
Diesel PM from Goods Movement

- **2005**
  - Trucks*: 53 tons/day
  - Ships
  - Locomotives
  - Harbor Craft
  - Cargo Equipment

- **2020**
  - Trucks*: 36 tons/day
  - Ships
  - Locomotives
  - Harbor Craft
  - Cargo Equipment

* Includes TRUs
Long-Term Emissions Trends in the US

- **Diesel PM**

Baseline - absent new standards

L & M = 45%

- Nonroad
- On-Highway

Calendar Year:

- 2000
- 2005
- 2010
- 2015
- 2020
- 2025
- 2030
On & Off Road Emissions

PM (g/bhp-hr)


Onroad Standard
Onroad Standard (Adj)
Offroad Standards
LNG Engine
LPG Engine
Onroad Standard (Adj) + DPF
Offroad Standard + DOC
Heavy Duty Trucks

Truck Measures

Idling Restrictions
Extended hours (PierPass)
Turn times reduction
Accelerated Turnover
Entry Restrictions?

Terminal Measures

OCR Equipped Gates
RFID tracking
Scheduling systems
Advanced Automation
Harbor Craft

- Tug Boats
- Passenger Ferries
- Fishing Vessels

- Tier 3 Standards
- Accelerated Turnover
- Cleaner Fuels
- After Combustion Retrofits?
Locomotives

Main Line

• CARB MOUs
  - Accelerated Turnover
  - Idle restrictions
• Cleaner fuels
• Tier 3 Standards

Switch Engines

• PHL Fleet Replacement
  - Accelerated Turnover
• New Technologies
CARB Cargo Handling Equipment Regulation

Yard Tractors

Pre-2003 – 50% in 2007
100% in 2008
2003-2007 phased over 8 to 11 years
2007+ Tier 4 goal

*One year extensions given for on-road engines and verified retrofits
UC Riverside - Yard Tractor Emission Testing
Particulate Emissions Reduced per Million Dollars

- Off-Road - DOC
- Off-Road Diesel - Emulsified Fuel & DOC
- On-road Diesel
- On-road Diesel - DOC
- On-Road Diesel - Emulsified Fuel & DOC
- Propane On-Road
- LNG On-Road

tons/PM/year:
- Off-Road - DOC: 9.20
- Off-Road Diesel - Emulsified Fuel & DOC: 1.14
- On-road Diesel: 7.36
- On-road Diesel - DOC: 6.88
- On-Road Diesel - Emulsified Fuel & DOC: 1.26
- Propane On-Road: 1.51
- LNG On-Road: 1.14
Yard Tractor Emission Testing

![Graph showing NOX emissions for different types of engines: QSB, ISB, Cat-doc, LPG, LNG. The graph indicates the emissions in g/bhp-hr. The highest emissions are for QSB engines.]
Ship Emission Control

- IMO & U.S. Engine Stds.
- Vessel Speed Reduction
- Cleaner Fuels
- Engine Technology
- Retrofits
Ship Calls and TEU Throughput at the San Pedro Bay Ports

Year
Total Ship Calls
Total Container Ship Calls
Total TEUs (000)
Throughput vs Emissions

Throughput up 44%

2001 vs. 2005

Vessel Emissions

Throughput

2001: 5,183,820
2005: 7,484,625

Throughput up 44%

Emissions

PM10: 12%
NOx: -6%
SOx: -4%
Container Ship Evolution

1st Generation (Pre-1960 - 1970) - 1,700 TEU
2nd Generation (1970 - 1980) - 2,305 TEU
3rd Generation (1985) - 3,220 TEU
4th Generation (1986 - 2000) - 4,848 TEU
5th Generation (2000 - ?) - 7,598 TEU
International Maritime Organization
MARPOL 73/78, Annex VI

Entered into Force May 19, 2005*
- Establishes Ship Engine Standards
- Sets a Cap on Fuel Sulfur Content
- Limits Ozone Depleting Chemicals
- Provides for Sulfur Emission Control Areas (SECAs)

*Limited in Scope, still not adopted by the U.S.A. Needs to be more stringent and comprehensive
The SECA Boundaries

- East of 5 W
- East of 4 W
- South of 62 N
- Mongolia
- Bergen
- Falmouth
- 57.44.08 N
- North Sea
- Baltic Sea
Low Sulfur Marine Fuels

Marine Fuel Distribution by Sulfur Content  2004
Ship Strategies

- Efficiency
- Speed Reduction – $V=E^3$
- Sea Water Scrubbers
- Selective Catalytic Reduction (SCR)
- Shore-side Power
CARB Auxiliary Engine Fuel Regulation*

Switch to distillate fuels 24 nm offshore
- 2007
  - Marine Gas Oil
  - Marine Diesel Oil < 0.5% Sulfur
  - Alternative Compliance Plans
- 2010
  - Distillate fuel < 0.1% Sulfur
  - Fuel availability review?

* PMSA Litigation Stops CARB Enforcement
MAN Diesel Engine Technology (NOx)*

Electronic Controls      -30%
Slide Valves             -30%
Water Emulsification     -30%
Scavenge Air Moisting    -50%
Selective Catalytic Red.  -98%
Fuel Saving Strategies

Air Cavity System

Compressor
Air Cavity
Air deflection before propeller

Compressor
Air Cavity

SkySails
Voluntary Vessel Speed Reduction Program

\[ V = E^3 \]

Initiated May 2001
Green Flag Program
+ 90% compliance
Water typically represents 10-20% of the total volume in the water-diesel blends manufactured & tested.

NOx reduction equals water content i.e. 10-20% water=10-20% less NOx

PM reduction is 2-3 times % of water i.e. 10-20% water=30-60% less PM
Sea Water Scrubbing (SOx & PM)

Sea water is pumped to the scrubber. CaCO3 absorbs the SOx from the exhaust. Produces CaSO4 in discharge.

Scrubber also removes most of the particulates. PM is removed from the discharge and disposed at dock.
Advanced Maritime Emissions Control System (AMECS)
COLD IRONING

CARB Regulation?
- Ship Types
- Percent Calls vs. emission goals
“Cold Ironing” Limitations

- Existing Fleet – Retrofits
- Need for International Standards
  - Cold Ironing Connections
  - Ship Building Requirement
- Complex, Incremental, Expensive
- Limited Scope
- Physical Connection Required
What the Industry Supports

• Performance standard, not a technology
  - Ratification of MARPOL Annex VI
  - North American SECA
  - EPA Recommendation to IMO

• Good science, especially for ship emissions
  (We can’t manage what we can’t measure)

• Uniform and consistent regulations preferably at international level
Thank you!

Questions?