

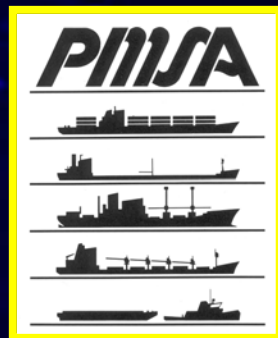
# Green Terminal Operations

Marine Terminal Management  
Training Program

Session VII  
Long Beach, CA

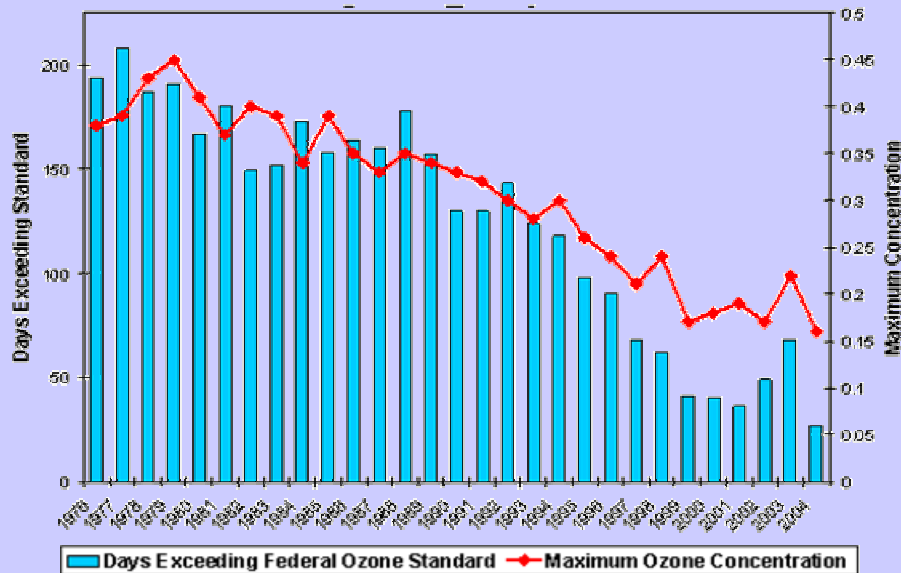
October 16, 2007

T.L. Garrett  
Pacific Merchant Shipping Association

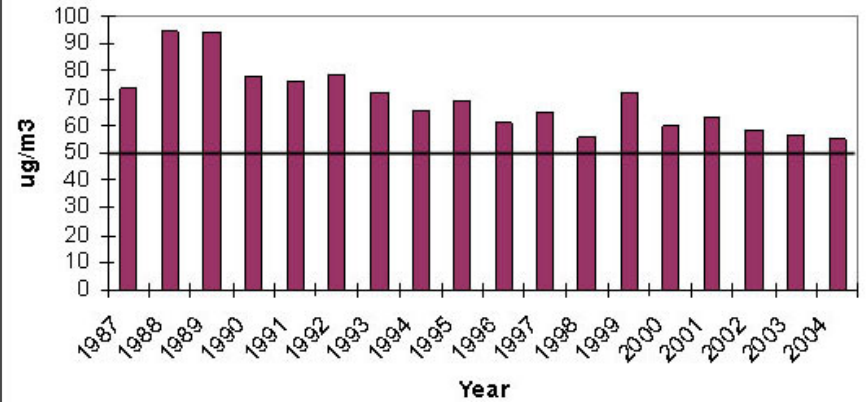


# The Air is Getting Cleaner!

Southland Ozone Trends, 1976-2004  
One-Hour Standard

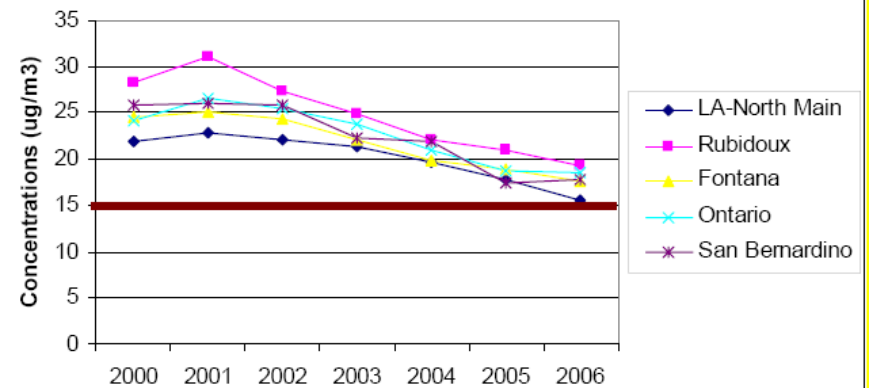


Annual Average Basin Maximum PM10



2007 Cleanest Yet!

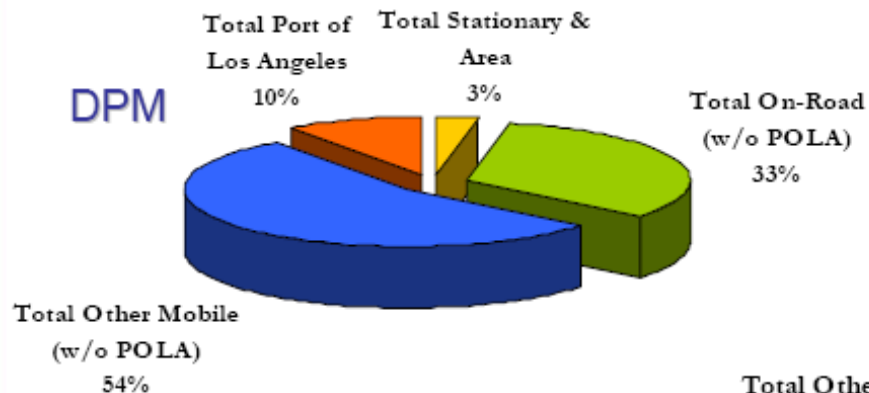
PM2.5 Average Concentrations



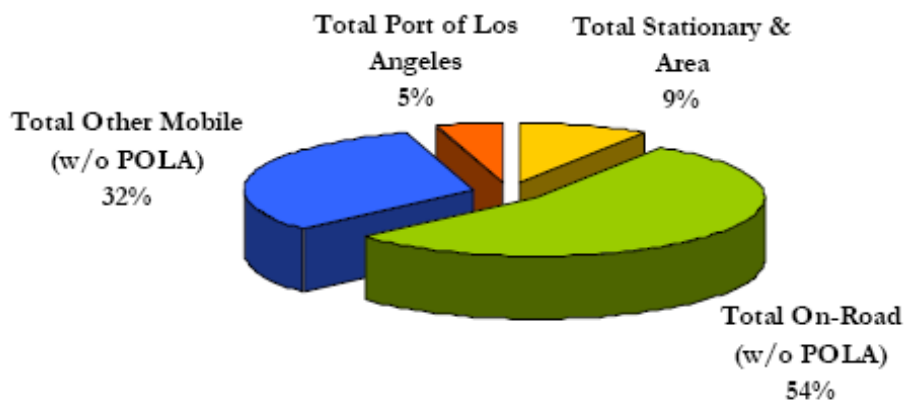
# POLA Regional Contribution

## The Big Picture

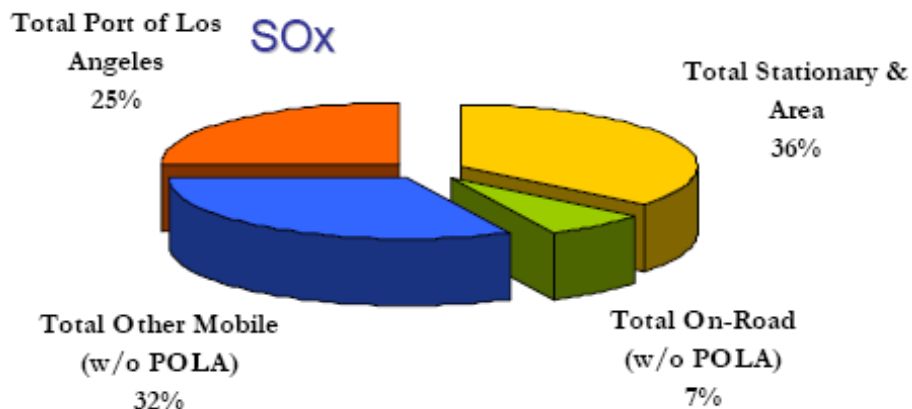
DPM



NOx

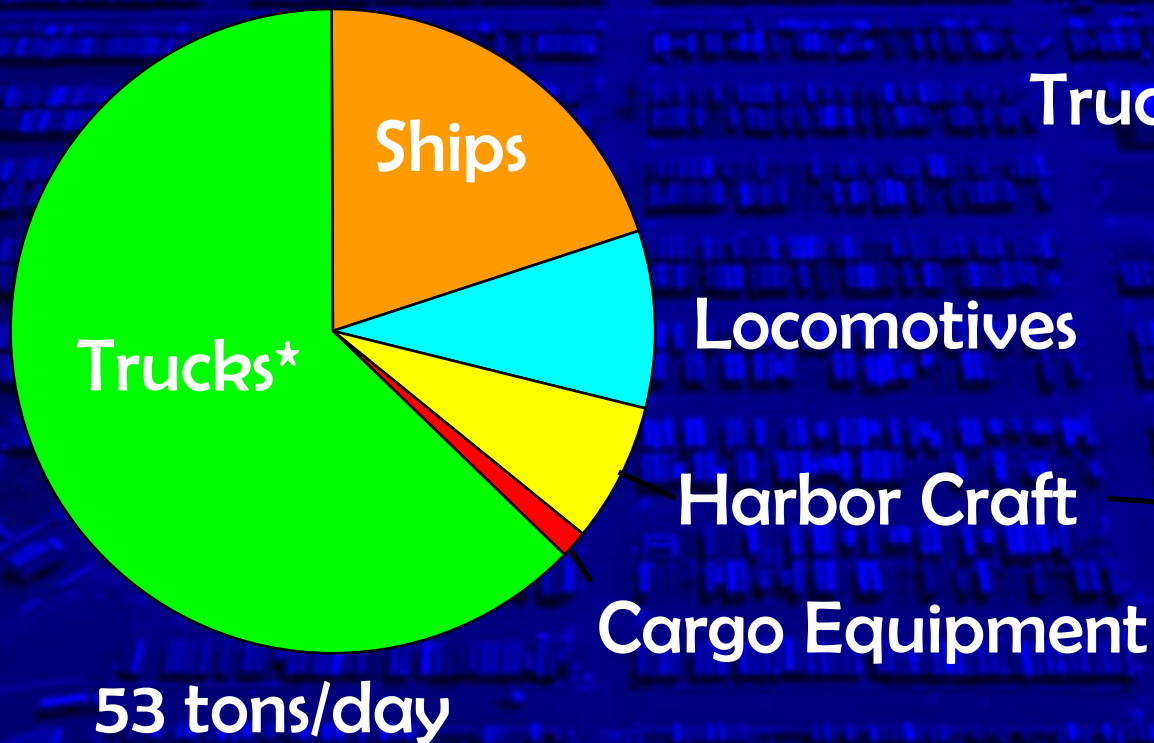


SOx



# Diesel PM from Goods Movement

2005



2020

Trucks\*

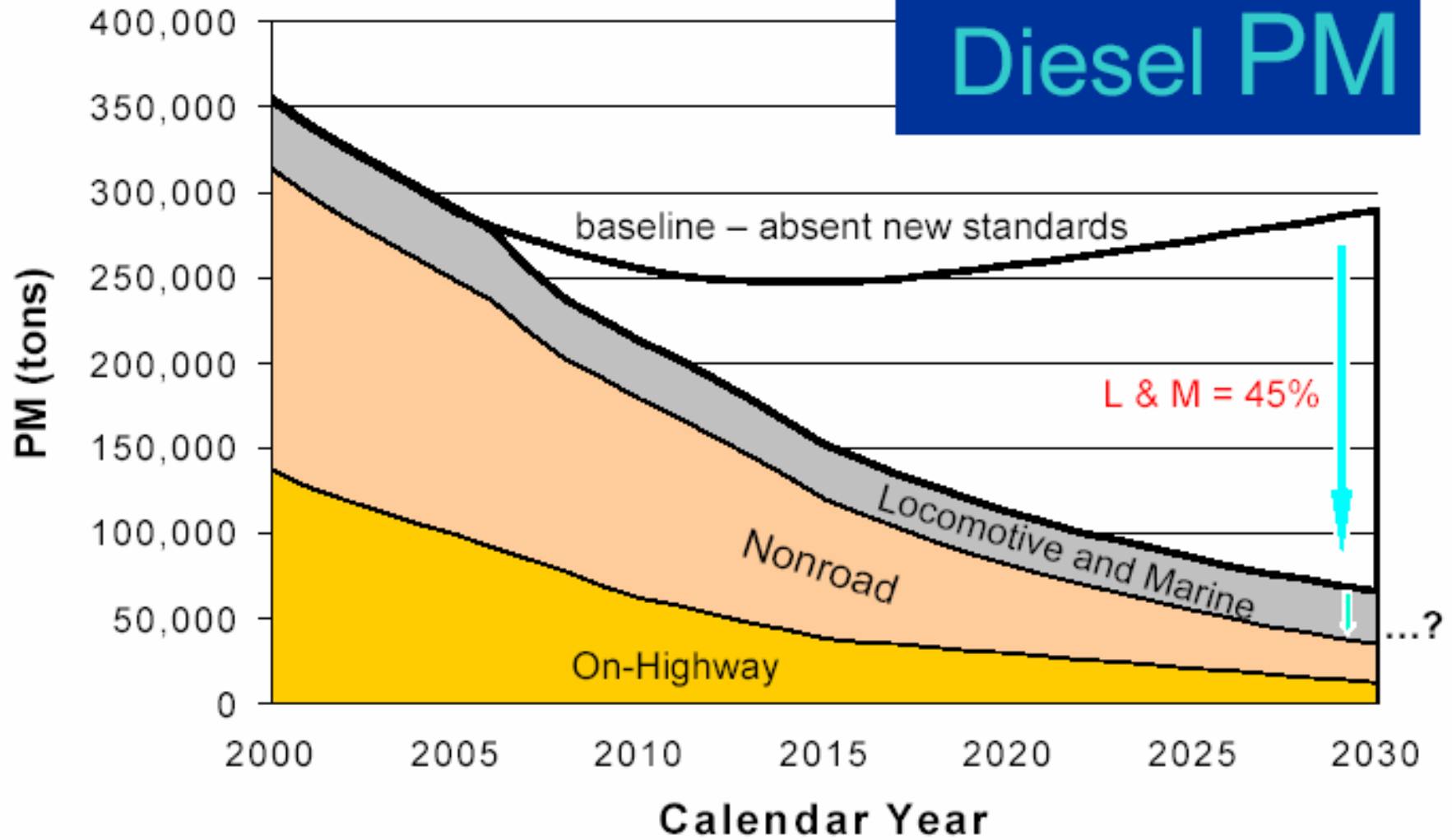


\* Includes TRUs

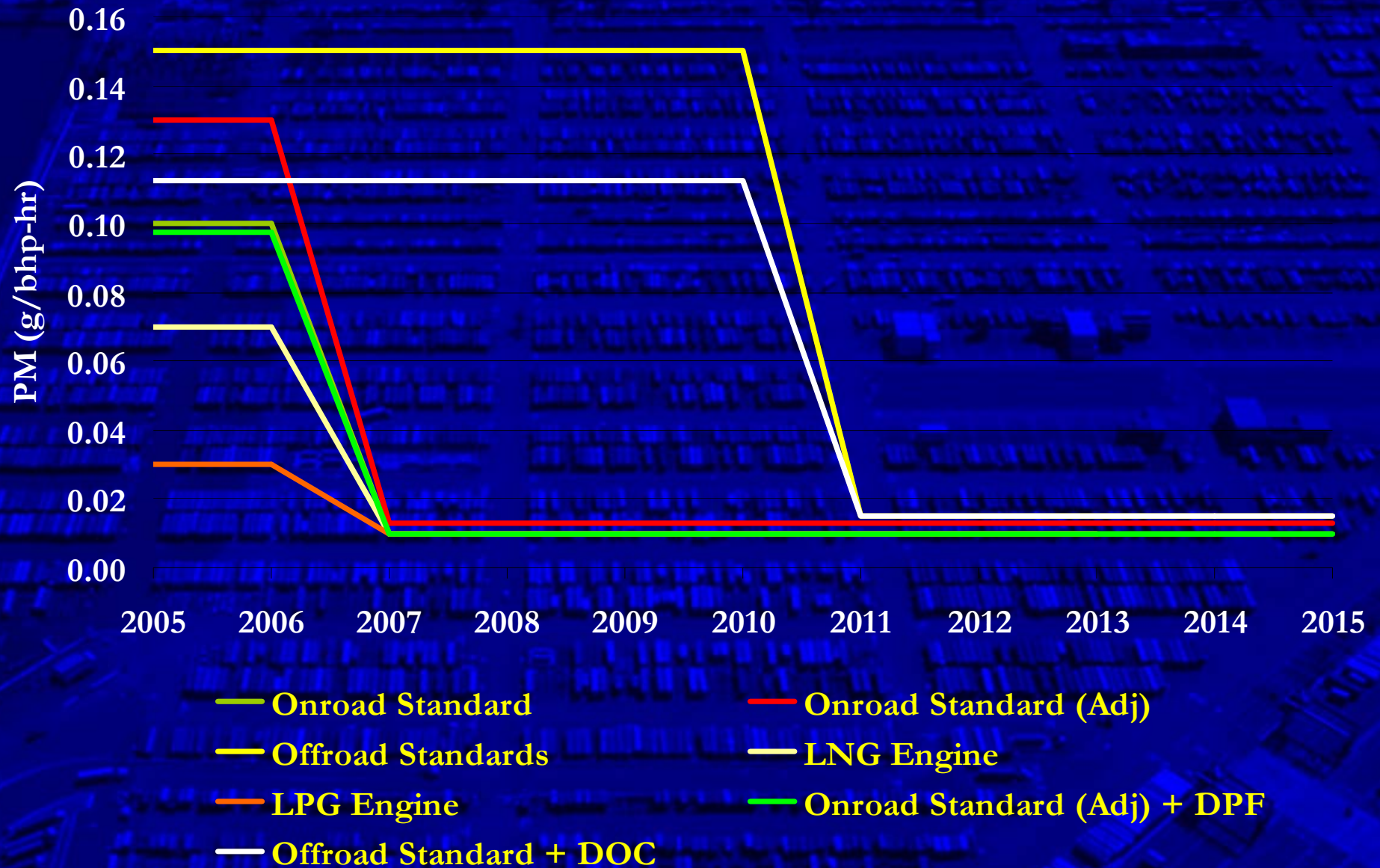


# Long-Term Emissions Trends in the US

Diesel PM



# On & Off Road Emissions



# 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



## Fishing Vessels



## Passenger Ferries



- 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**

# Rail Infrastructure

On-Dock Rail Yard



Alameda Corridor



# Cargo Handling Equipment

Propane/LNG Yard Tractors



Transtainer



Emulsified Fuel



DOC



# CARB Cargo Handling Equipment Regulation

## Yard Tractors



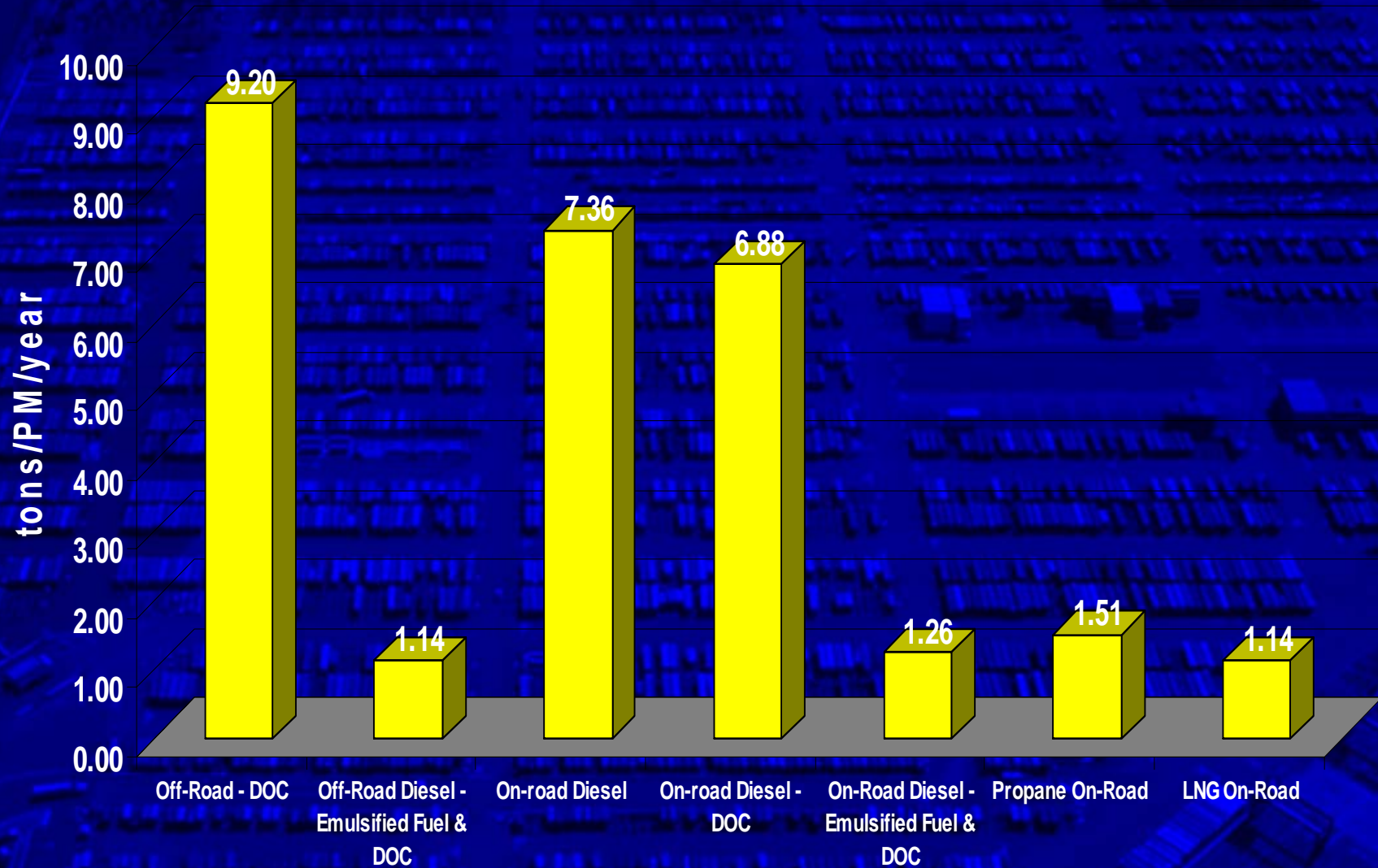
Pre-2003 –	50% in 2007 100% in 2008
2003-2007	phased over 8 to 11 years
2007+	Tier 4 goal

**\*One year extensions given for on-road engines and verified retrofits**

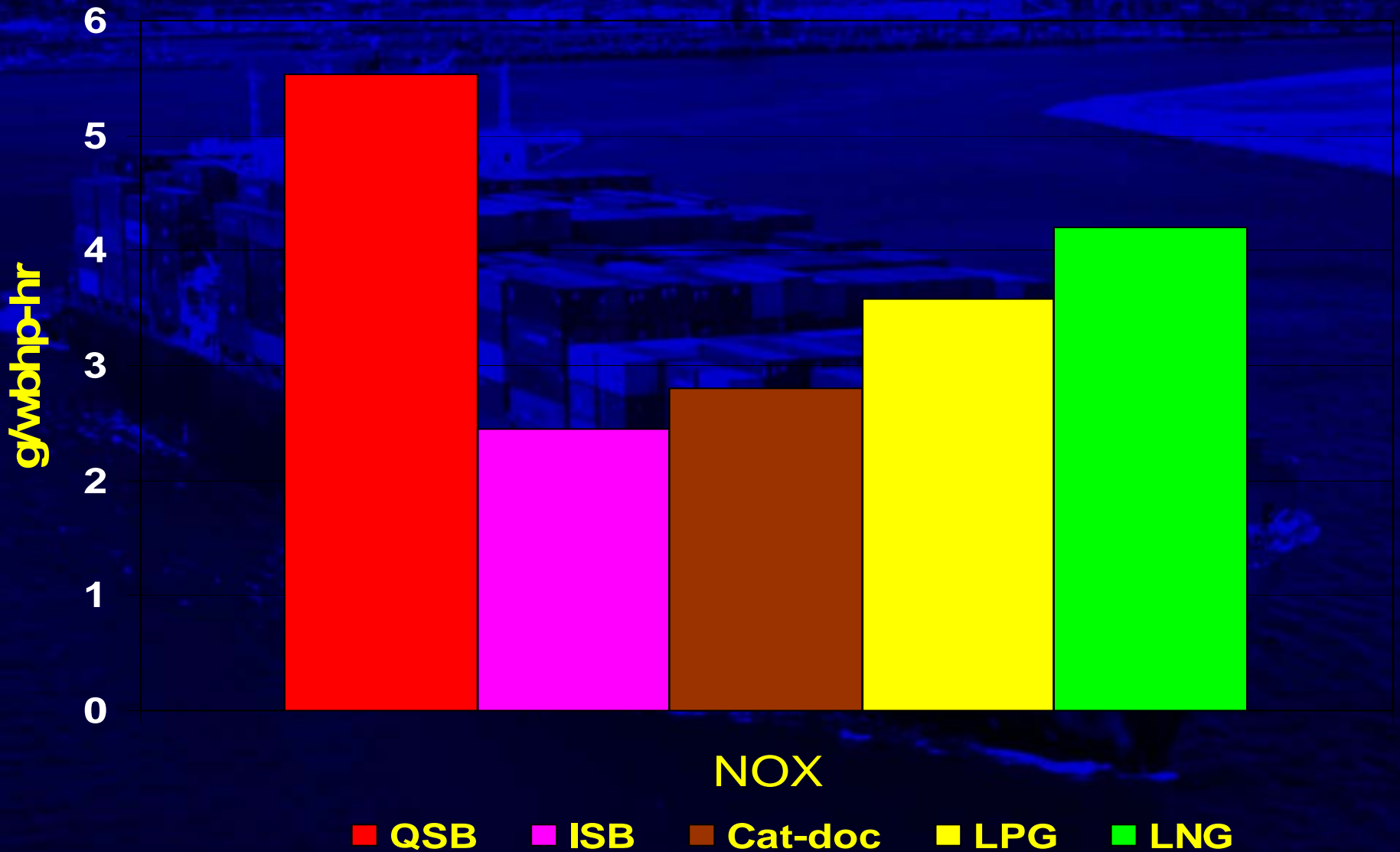
# UC Riverside - Yard Tractor Emission Testing



# Particulate Emissions Reduced per Million Dollars



# Yard Tractor Emission Testing



# Ship Emission Control

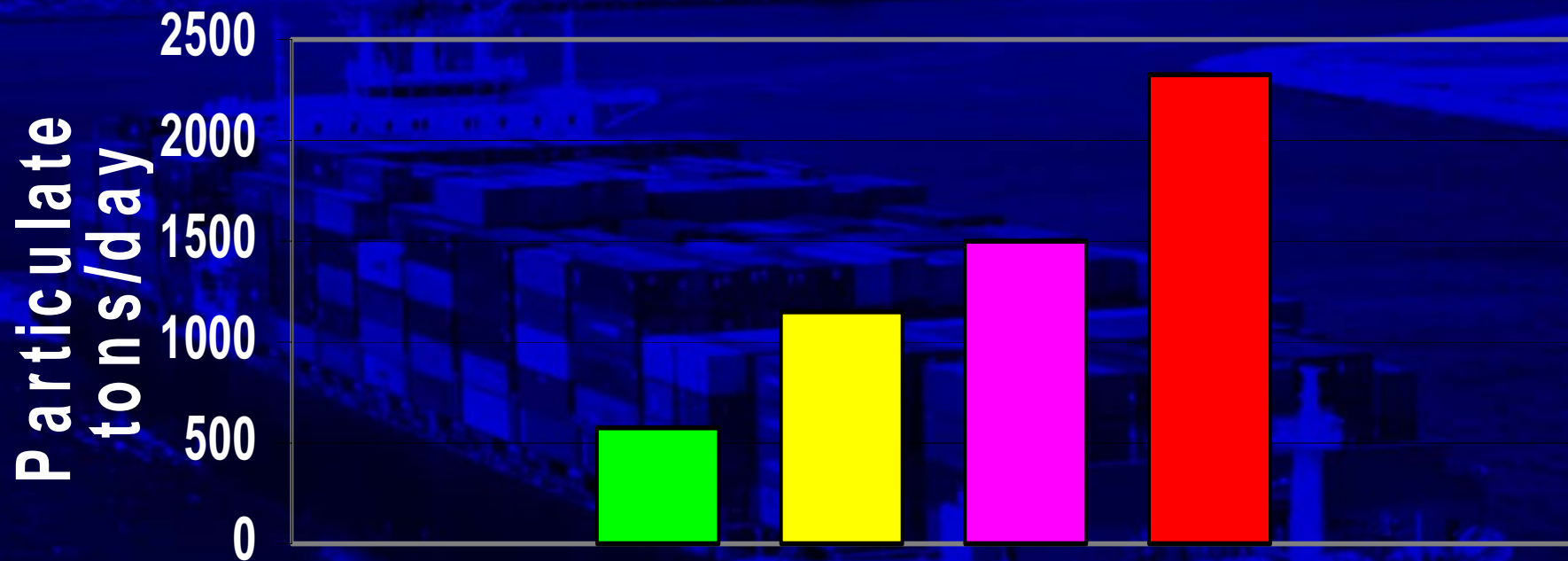


- IMO & U.S. Engine Stds.
- Vessel Speed Reduction
- Cleaner Fuels
- Engine Technology
- Retrofits



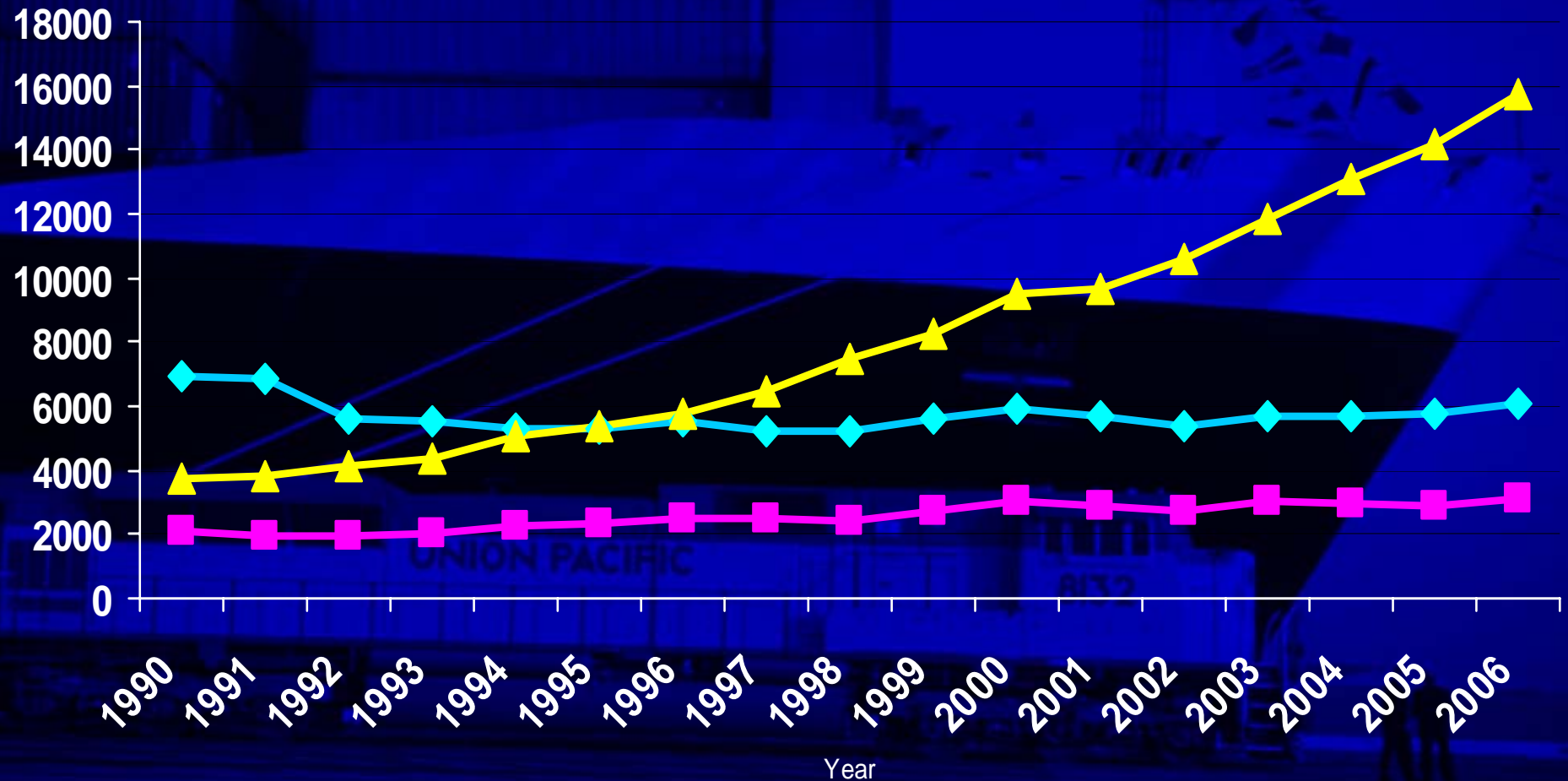


# Vessel Emission Growth



■ 2001 ■ 2010 ■ 2010 ■ 2025

# Ship Calls and TEU Throughput at the San Pedro Bay Ports

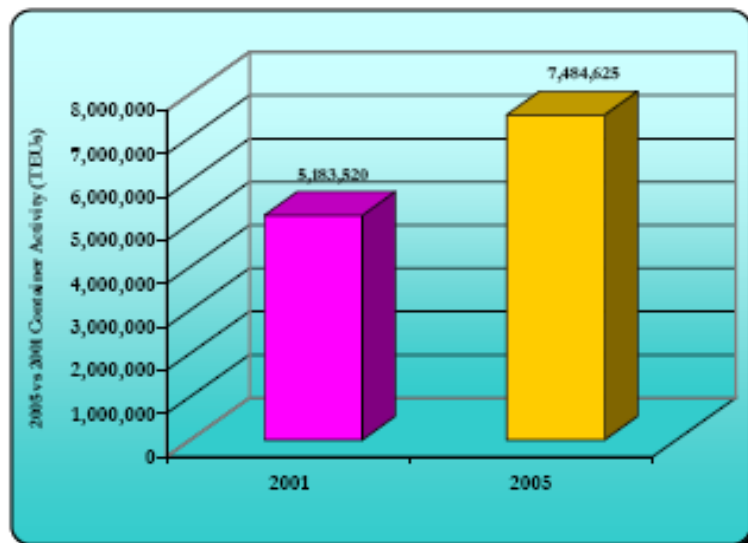


◆ Total Ship Calls    ■ Total Container Ship Calls    ▲ Total TEUs (000)

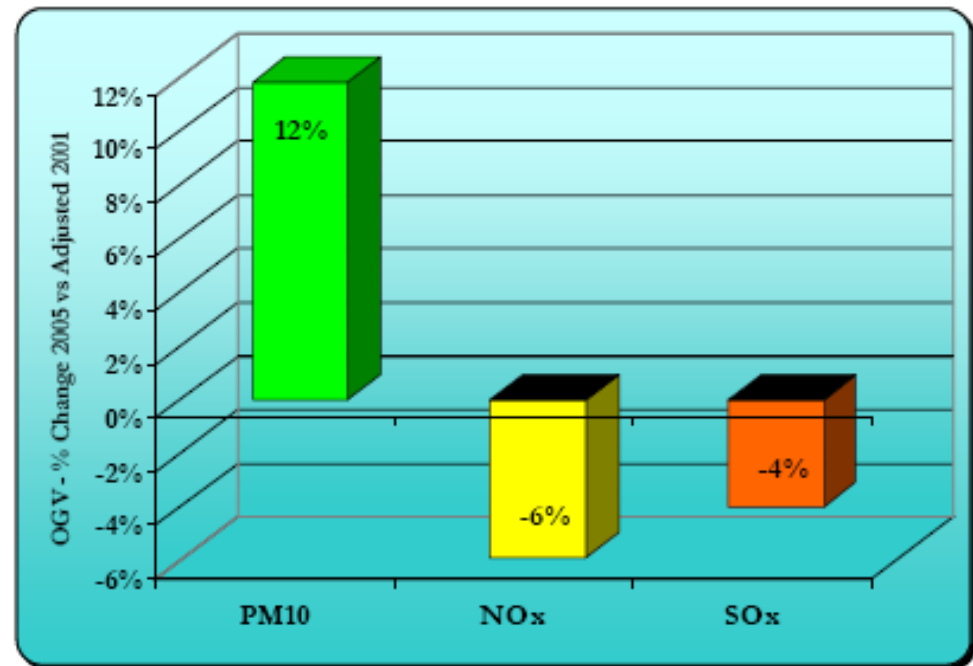
# Throughput vs Emissions

Throughput up 44%

2001 vs. 2005



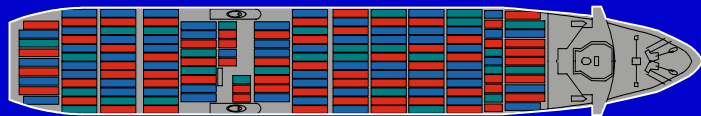
Vessel Emissions



# Container Ship Evolution



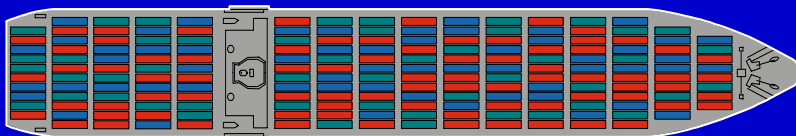
1st Generation (Pre-1960 - 1970)



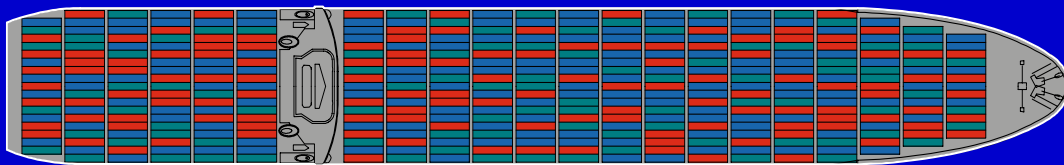
2nd Generation (1970 - 1980)



3rd Generation (1985)

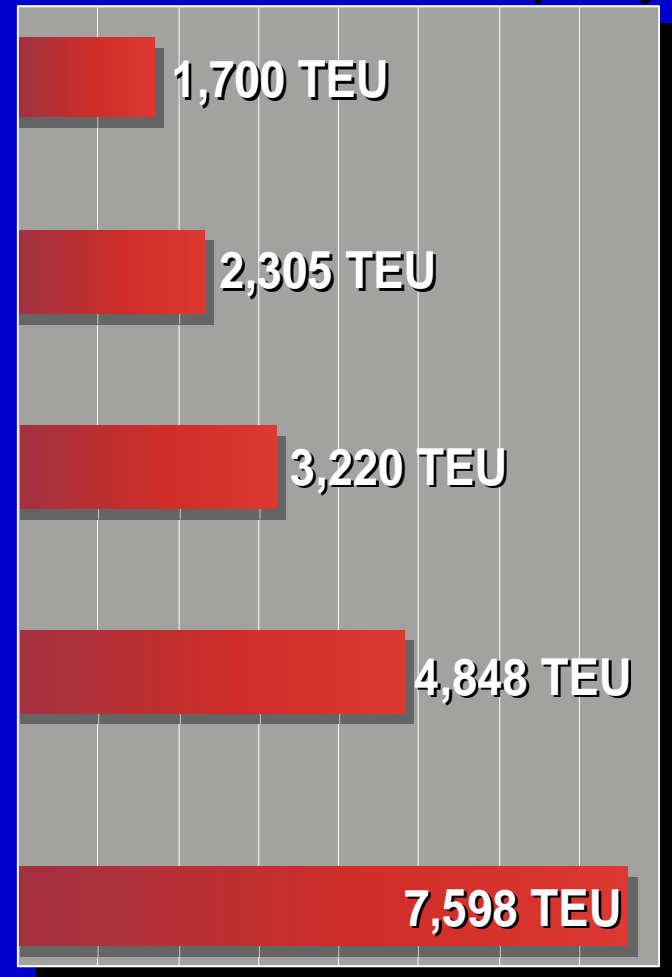


4th Generation (1986 - 2000)



5th Generation (2000 - ?)

TEU Capacity



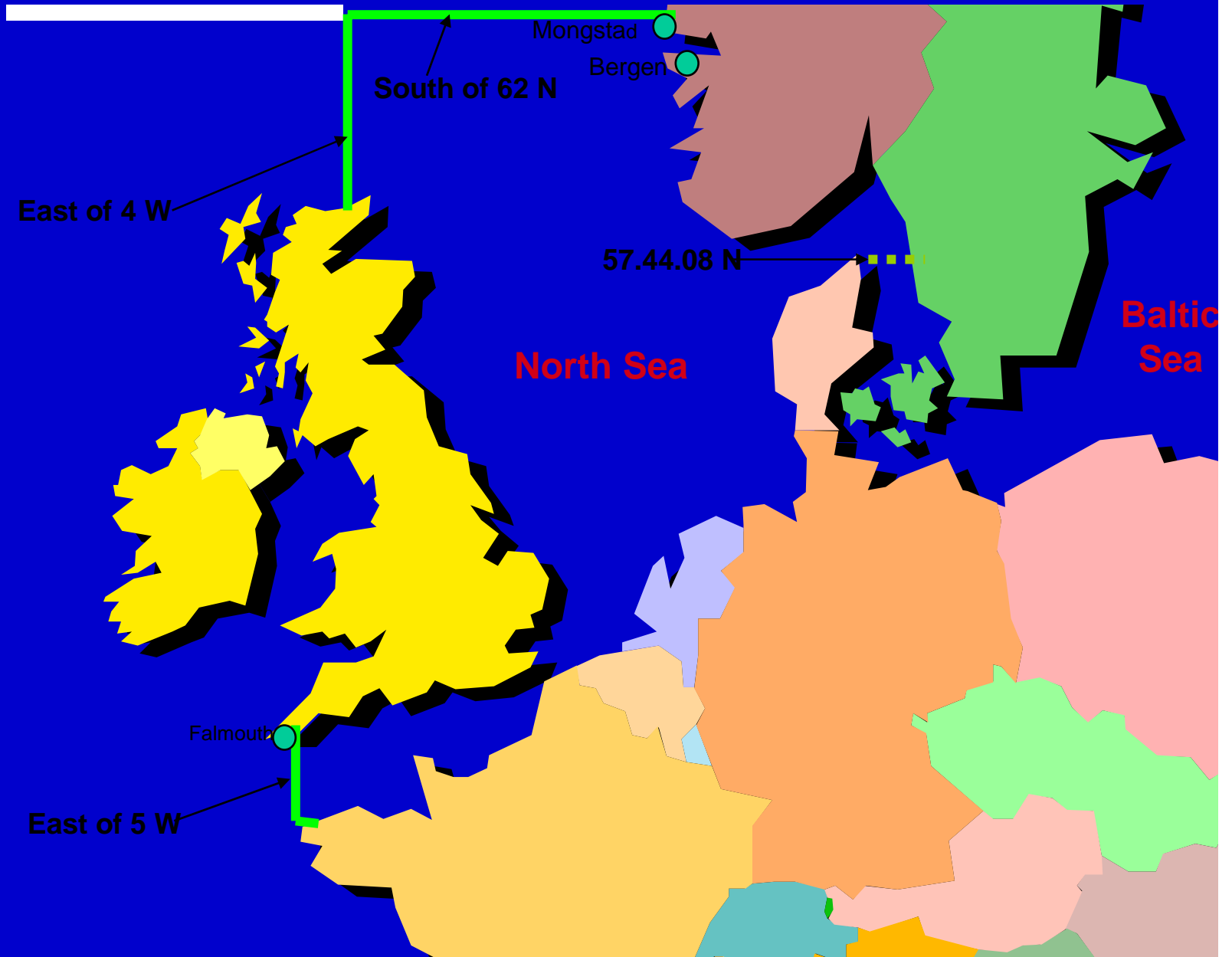
# **International Maritime Organization MARPOL 73/78, Annex VI**

**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)**

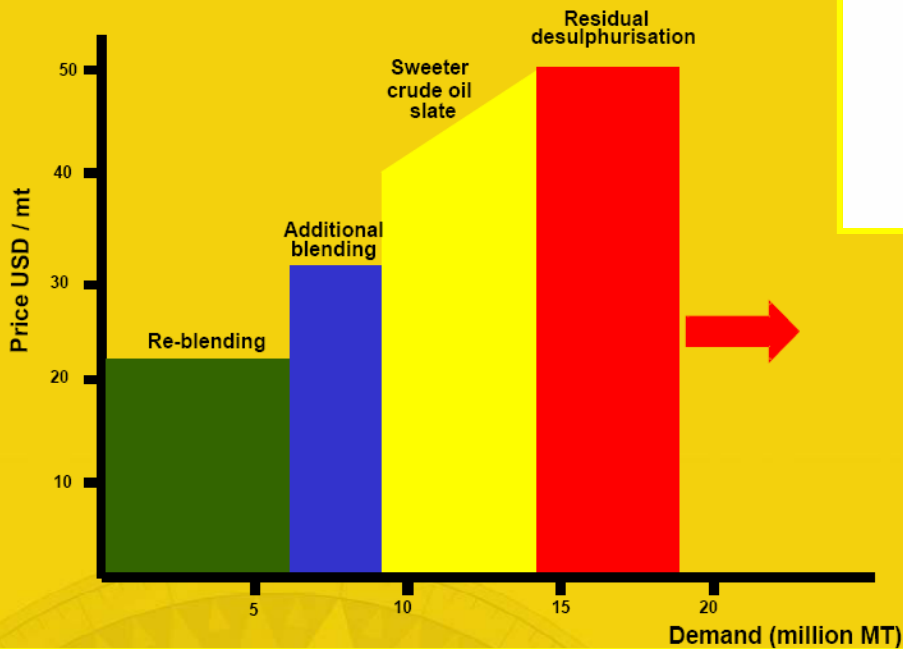
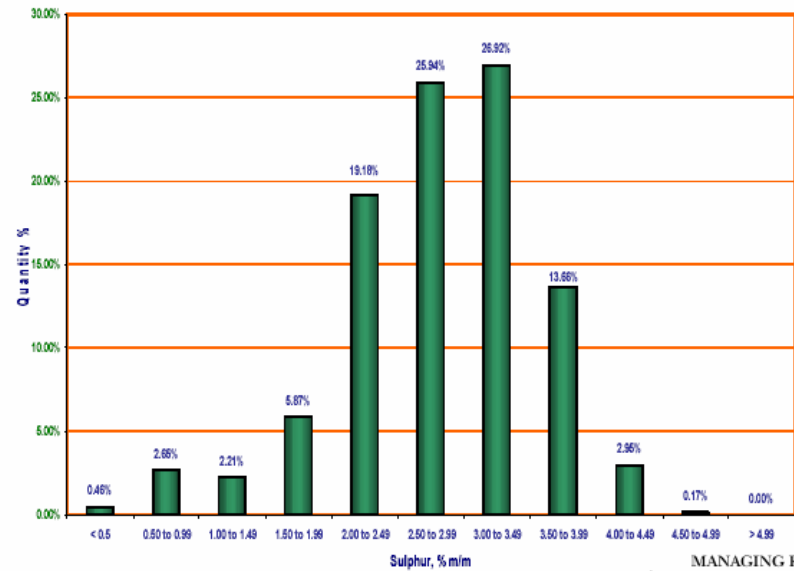
**\*Limited in Scope, still not adopted by the U.S.A.  
Needs to be more stringent and comprehensive**

# The SECA Boundaries



# Low Sulfur Marine Fuels

Marine Fuel Distribution by Sulfur Content 2004

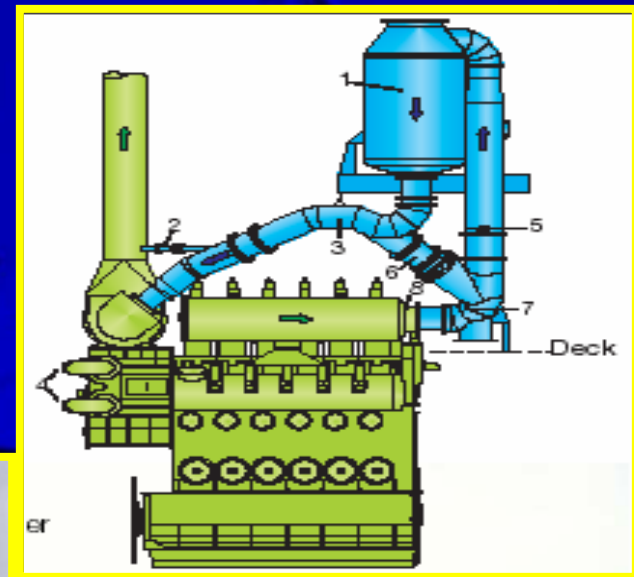


MANAGING RISK

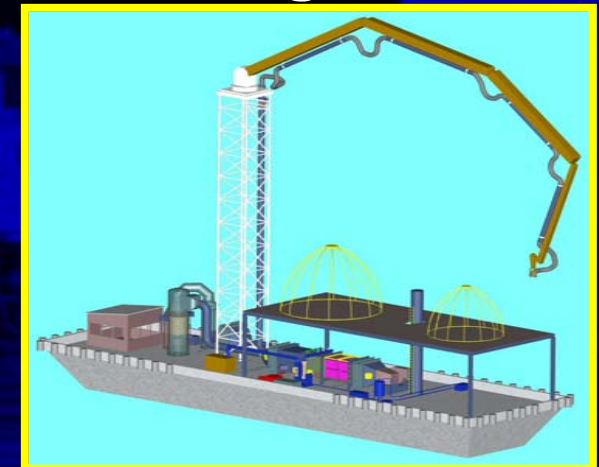
# Ship Strategies

- Efficiency
- Speed Reduction –  $V=E^3$
- Sea Water Scrubbers
- Selective Catalytic Reduction (SCR)
- Shore-side Power

## SCR



## Barge Mount





# 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?

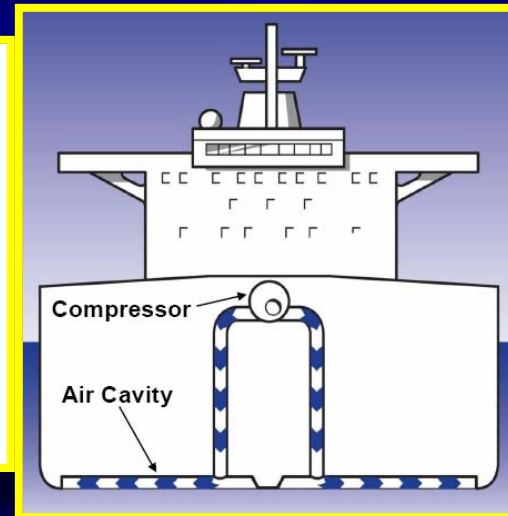
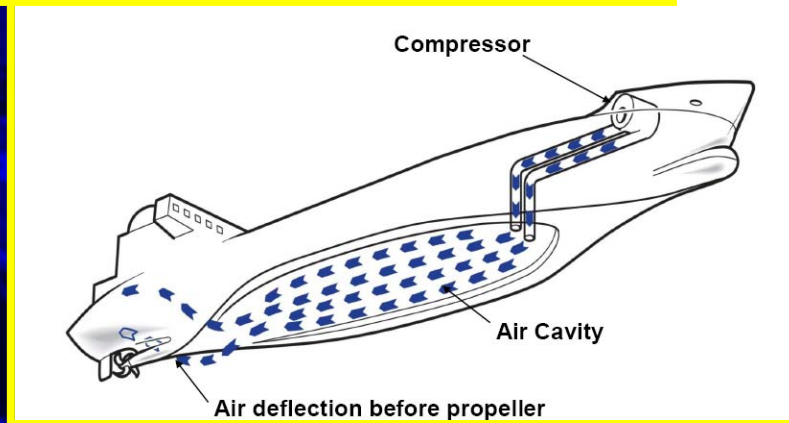
**\* PMSA Litigation Stops CARB Enforcement**

# MAN Diesel Engine Technology (NOx)\*



<b>Electronic Controls</b>	<b>-30%</b>
<b>Slide Valves</b>	<b>-30%</b>
<b>Water Emulsification</b>	<b>-30%</b>
<b>Scavenge Air Moisting</b>	<b>-50%</b>
<b>Selective Catalytic Red.</b>	<b>-98%</b>

# Fuel Saving Strategies

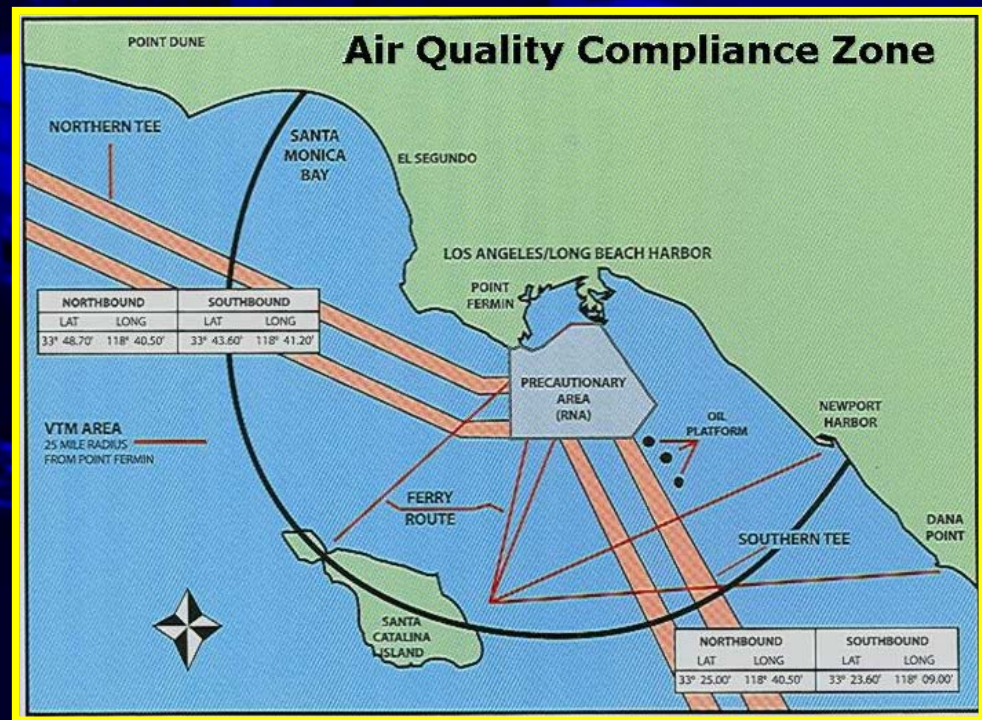


# Voluntary Vessel Speed Reduction Program



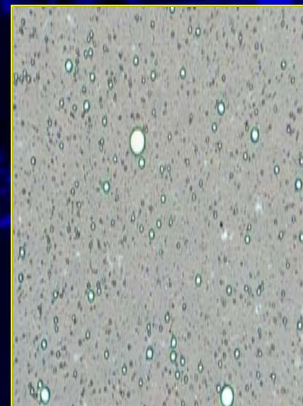
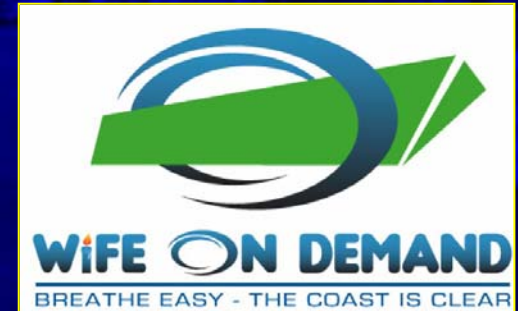
$$V=E^3$$

Initiated May 2001  
Green Flag Program  
+ 90% compliance



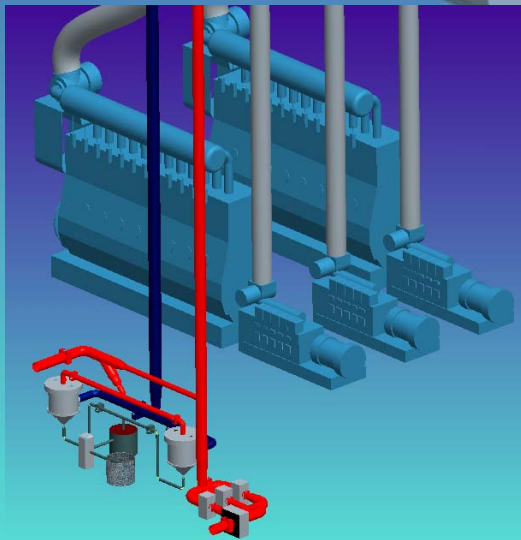
# Water In Fuel Emulsification

- 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



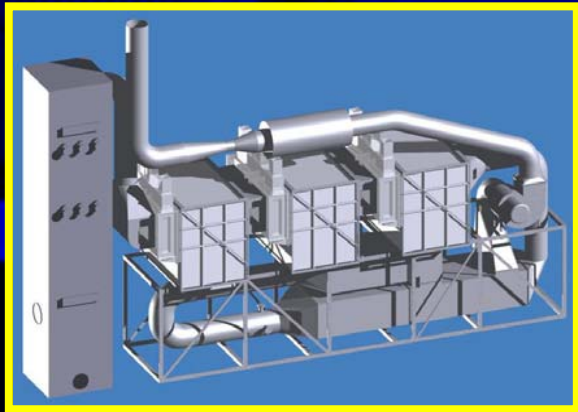
# Sea Water Scrubbing (SOx & PM)

Sea water is pumped to the scrubber  
CaCO<sub>3</sub> absorbs the SO<sub>x</sub> from the exhaust  
Produces CaSO<sub>4</sub> 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?

