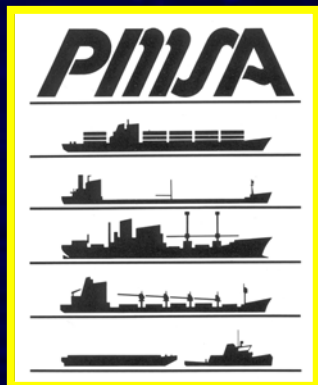


Ocean Vessel Response to Air Quality and Green House Gases

AAPA Harbors, Navigation & Environment Seminar

May 21, 2008



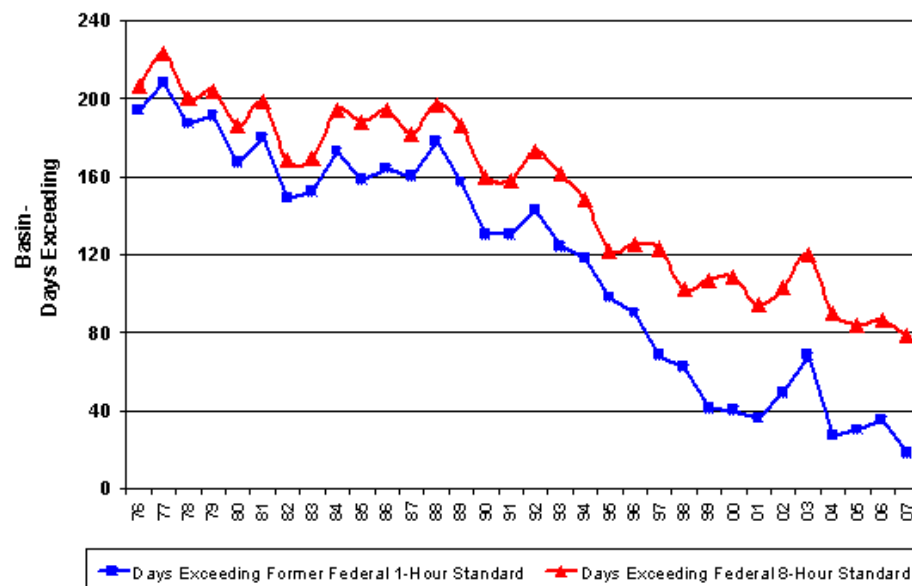
T.L. Garrett
Vice President
Pacific Merchant
Shipping Association



Alliance of the Ports of Canada, the Caribbean,
Latin America and the United States

The Air is Getting Cleaner!

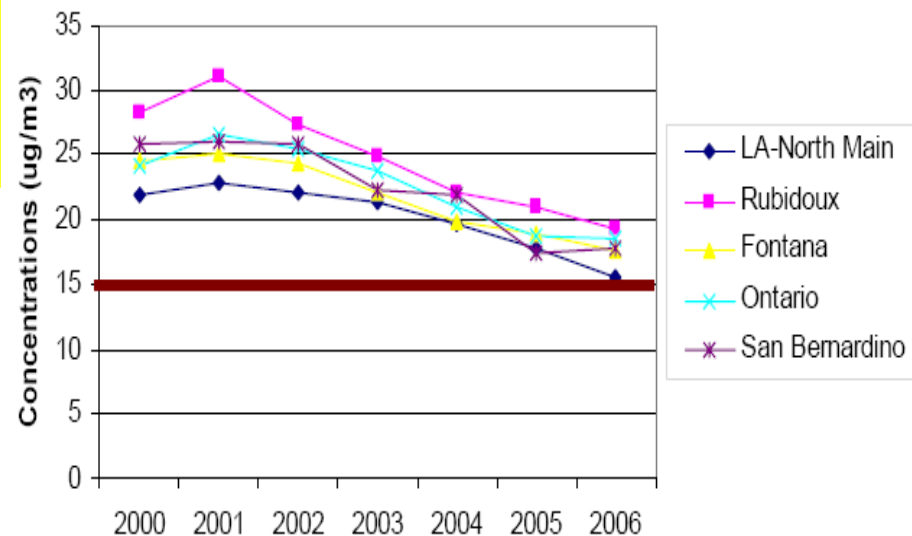
Southland Ozone Trends, 1976-2007*



* 2007 data preliminary, through Oct. 1

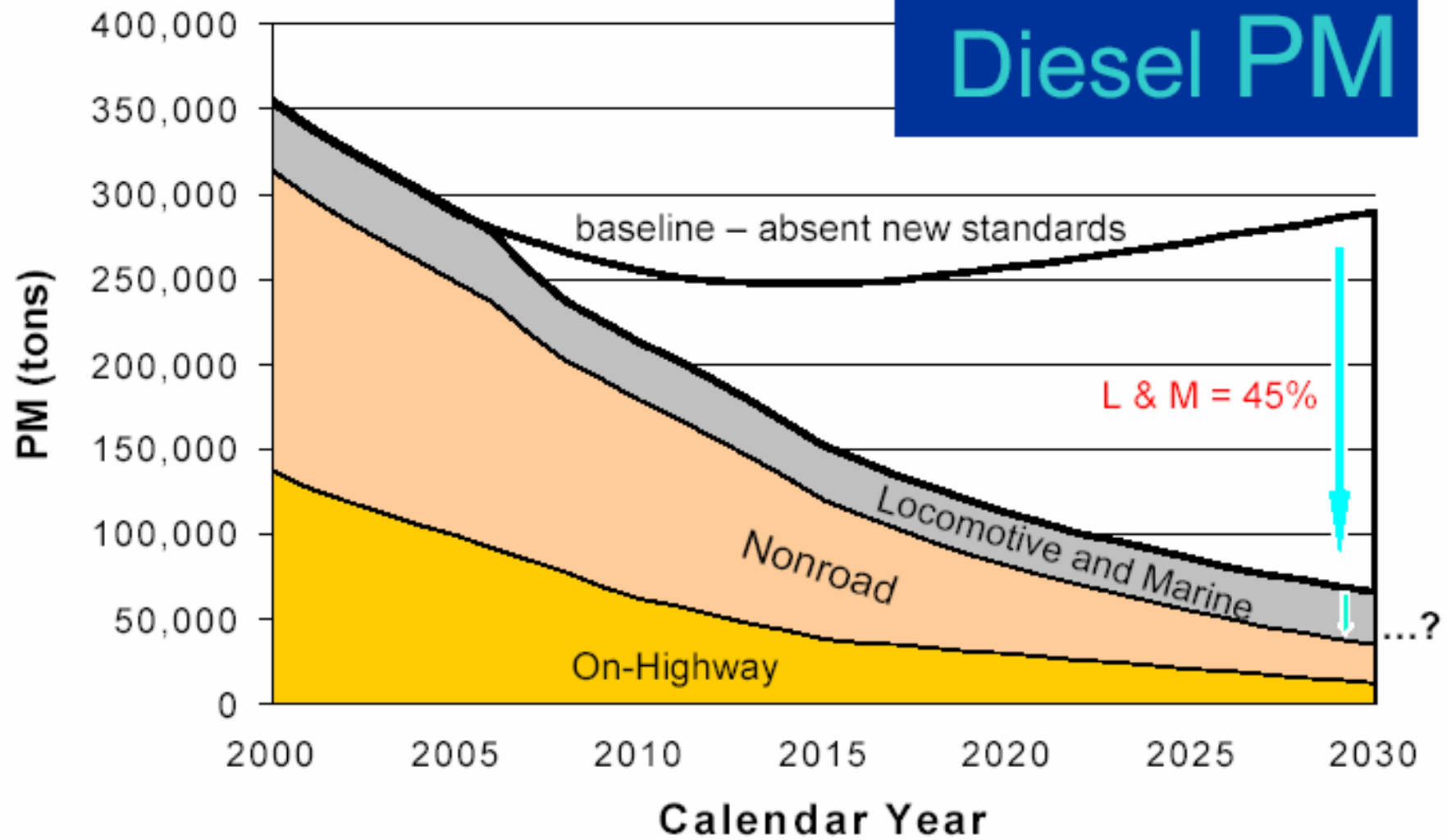
2007 Cleanest Yet!

PM2.5 Average Concentrations

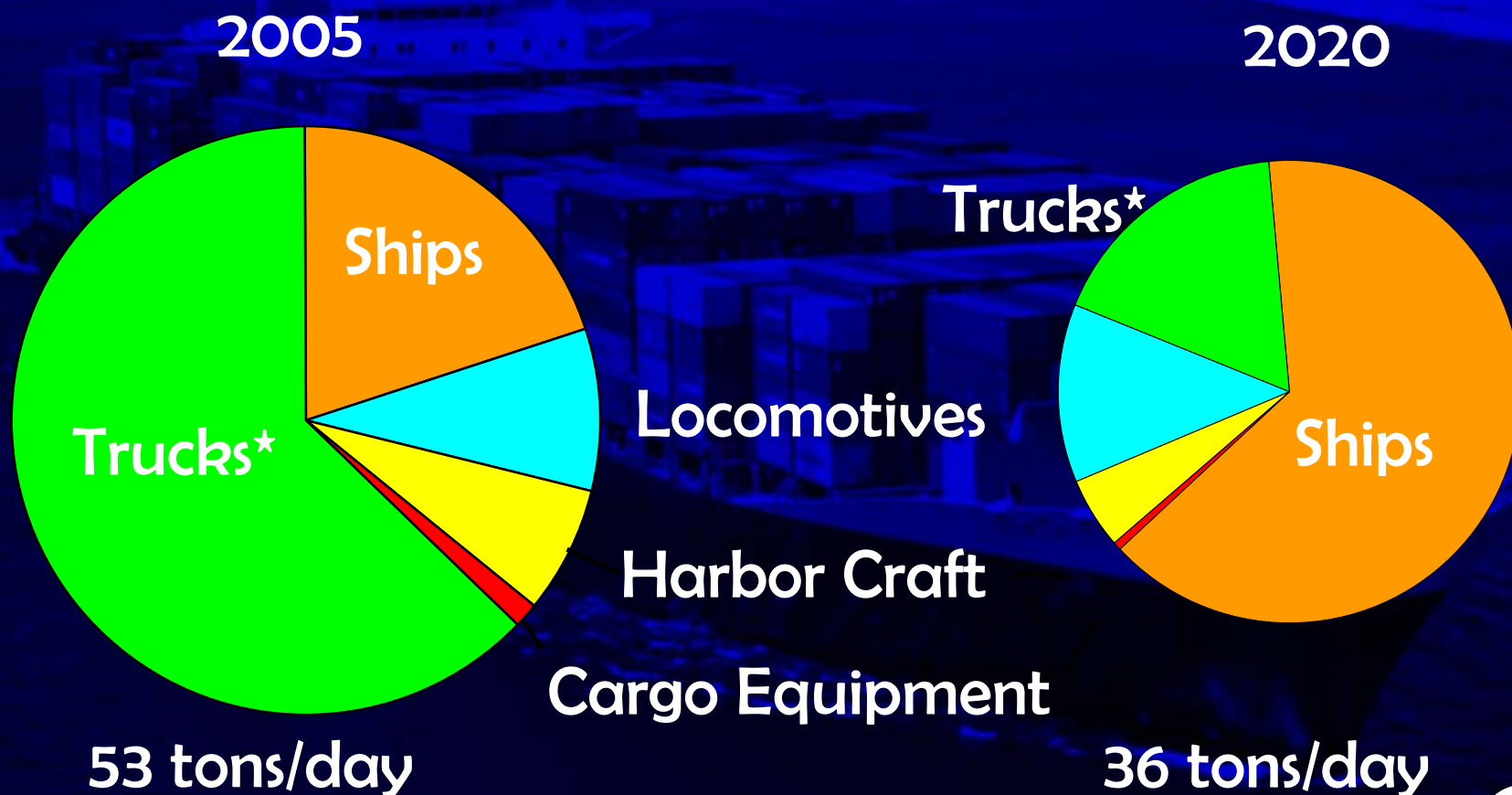


Long-Term Emissions Trends in the US

Diesel PM



Diesel PM from Goods Movement



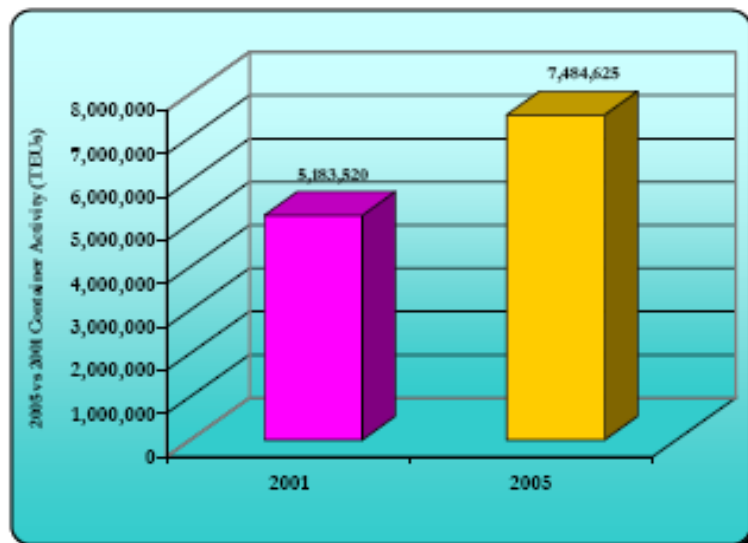
* Includes TRUs



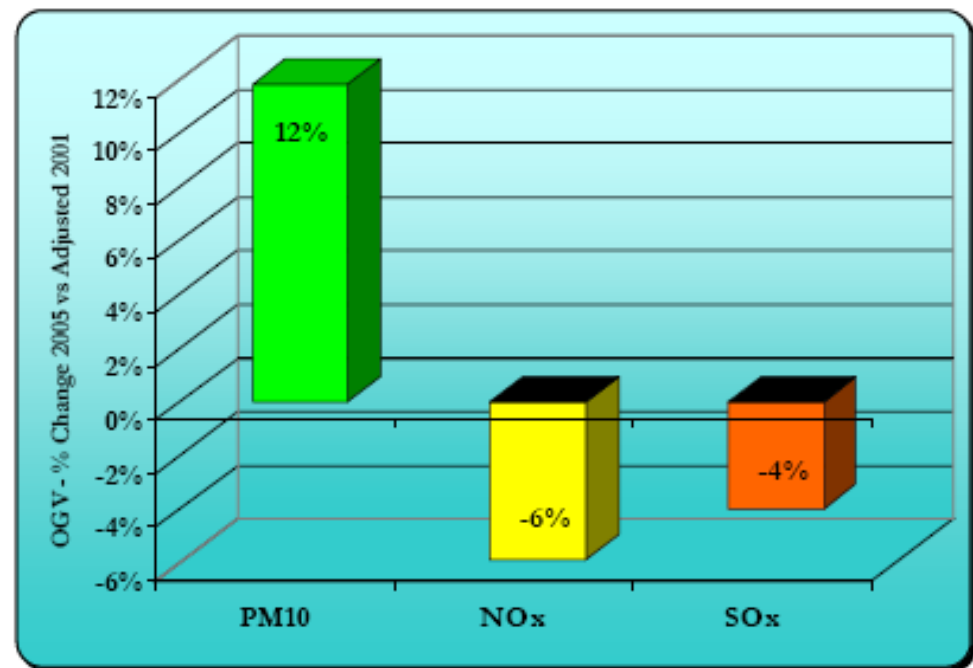
Throughput vs Emissions

Throughput up 44%

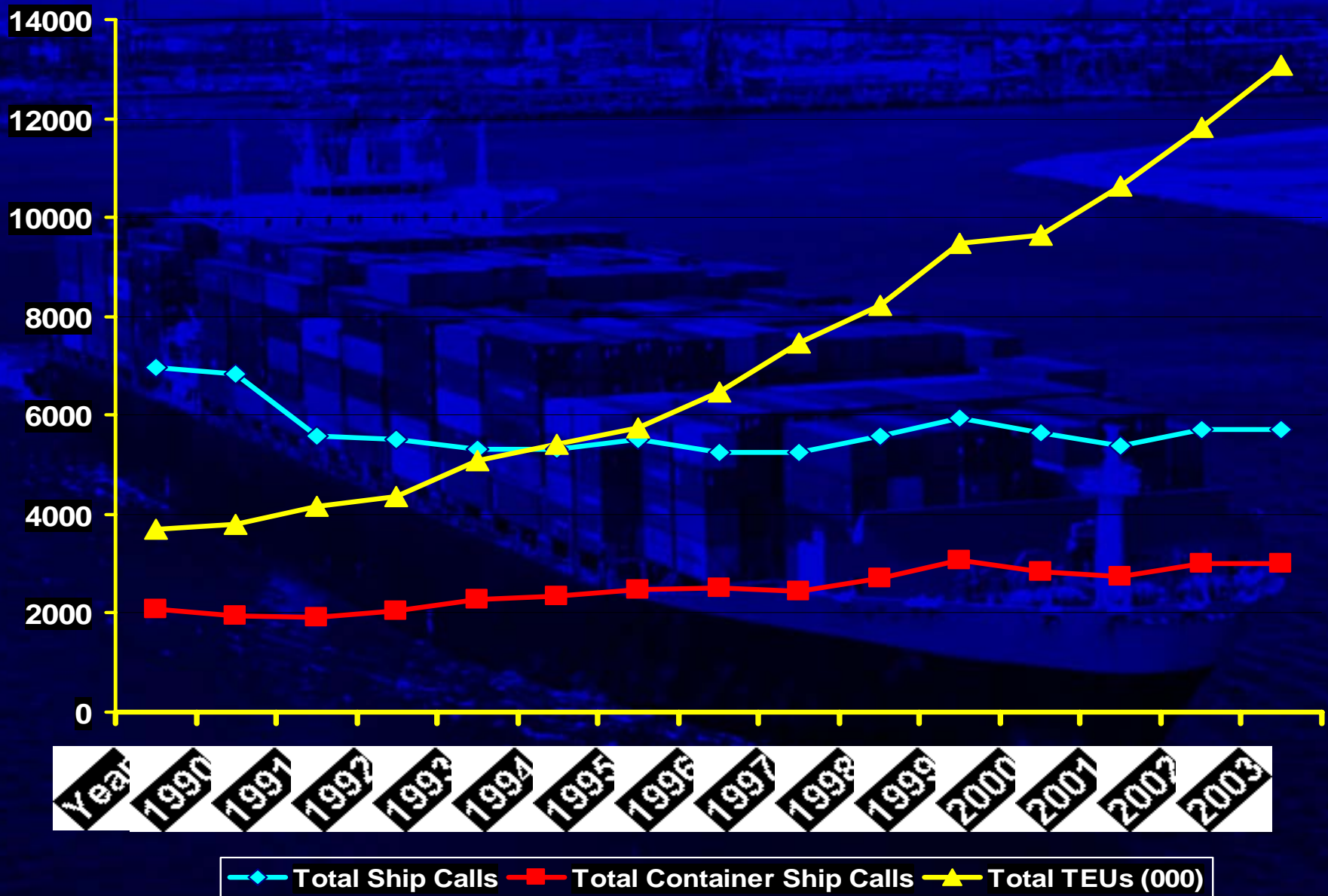
2001 vs. 2005



Vessel Emissions



Ship Calls & TEUs



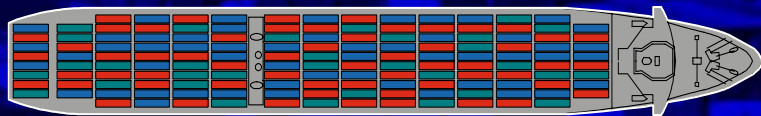
Container Ship Evolution



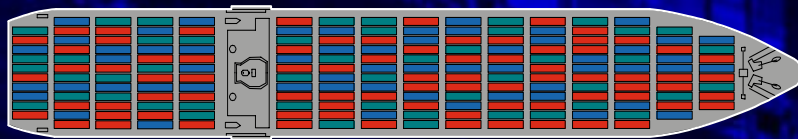
1st Generation (Pre-1960 - 1970)



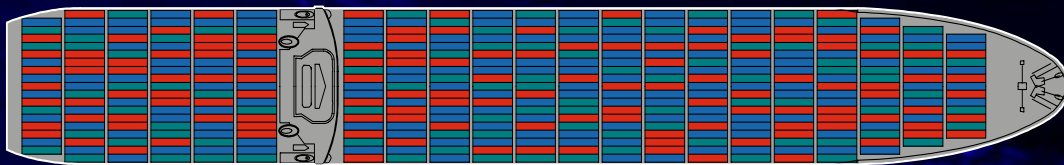
2nd Generation (1970 - 1980)



3rd Generation (1985)

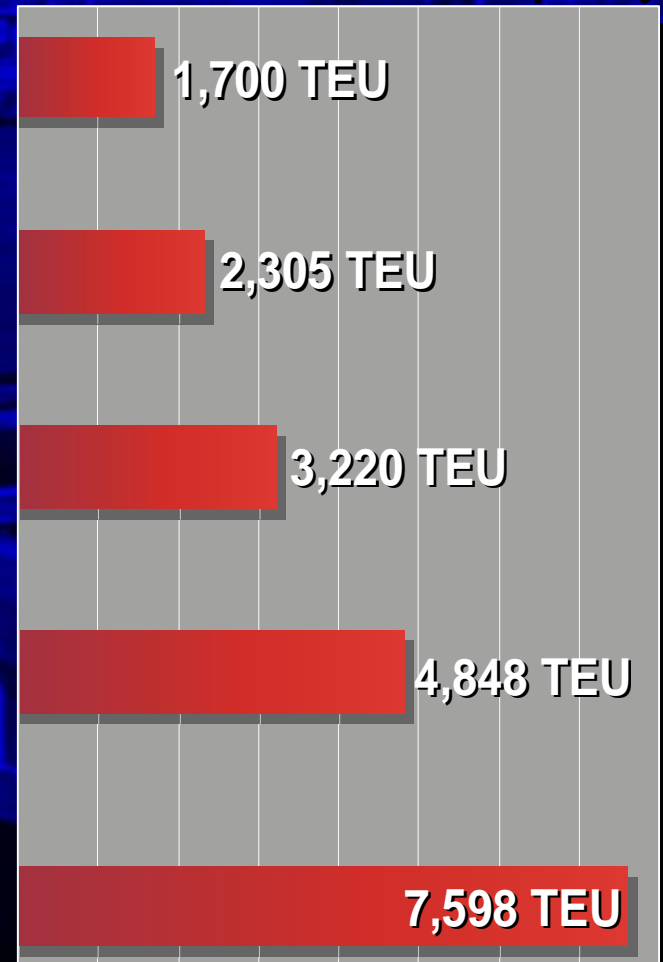


4th Generation (1986 - 2000)

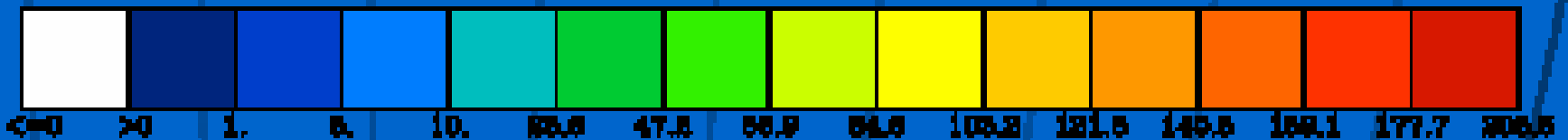
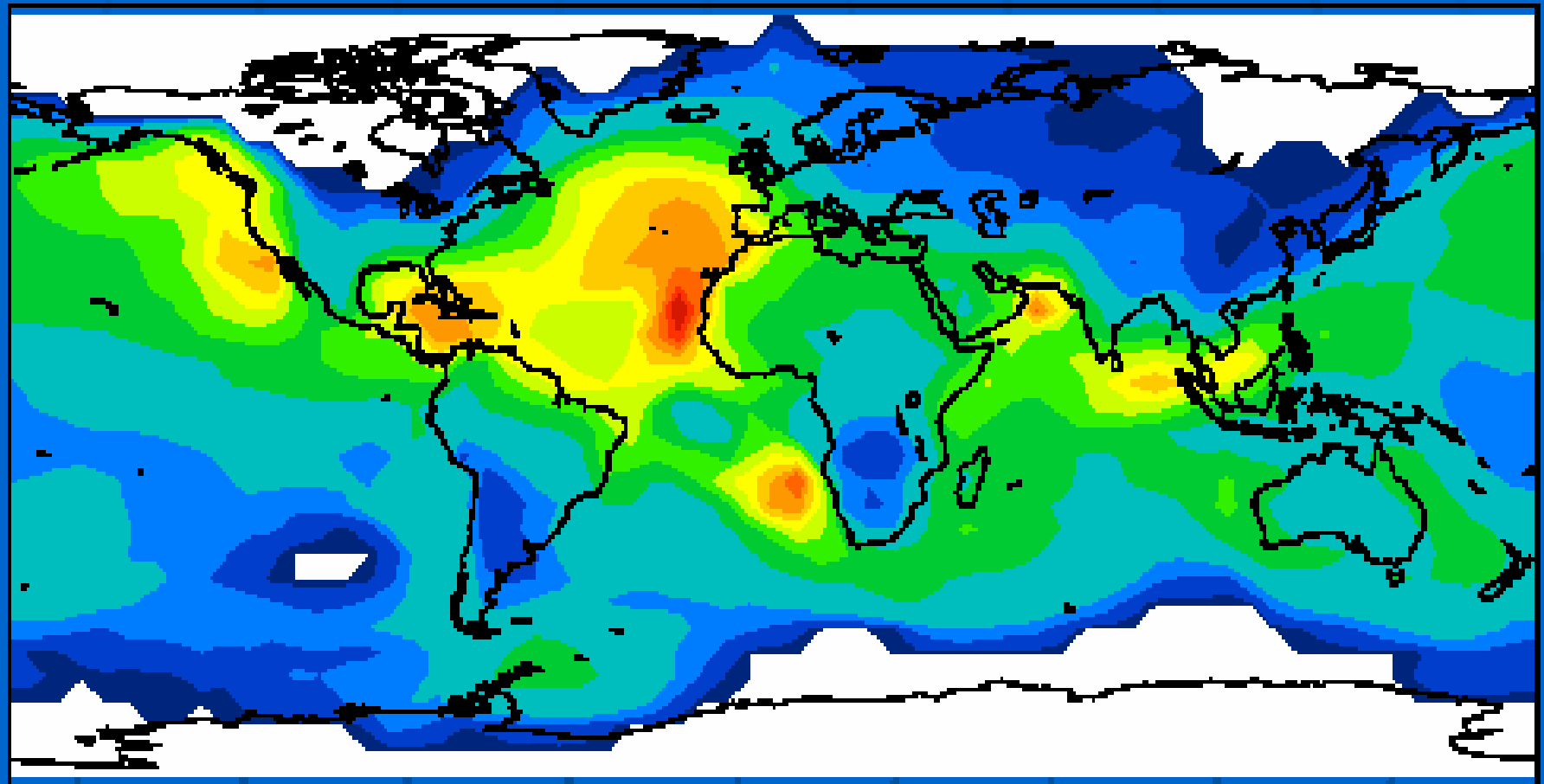


5th Generation (2000 - ?)

TEU Capacity



Ship Emissions are a World Wide Issue



IMO

MARPOL 73/78, Annex VI

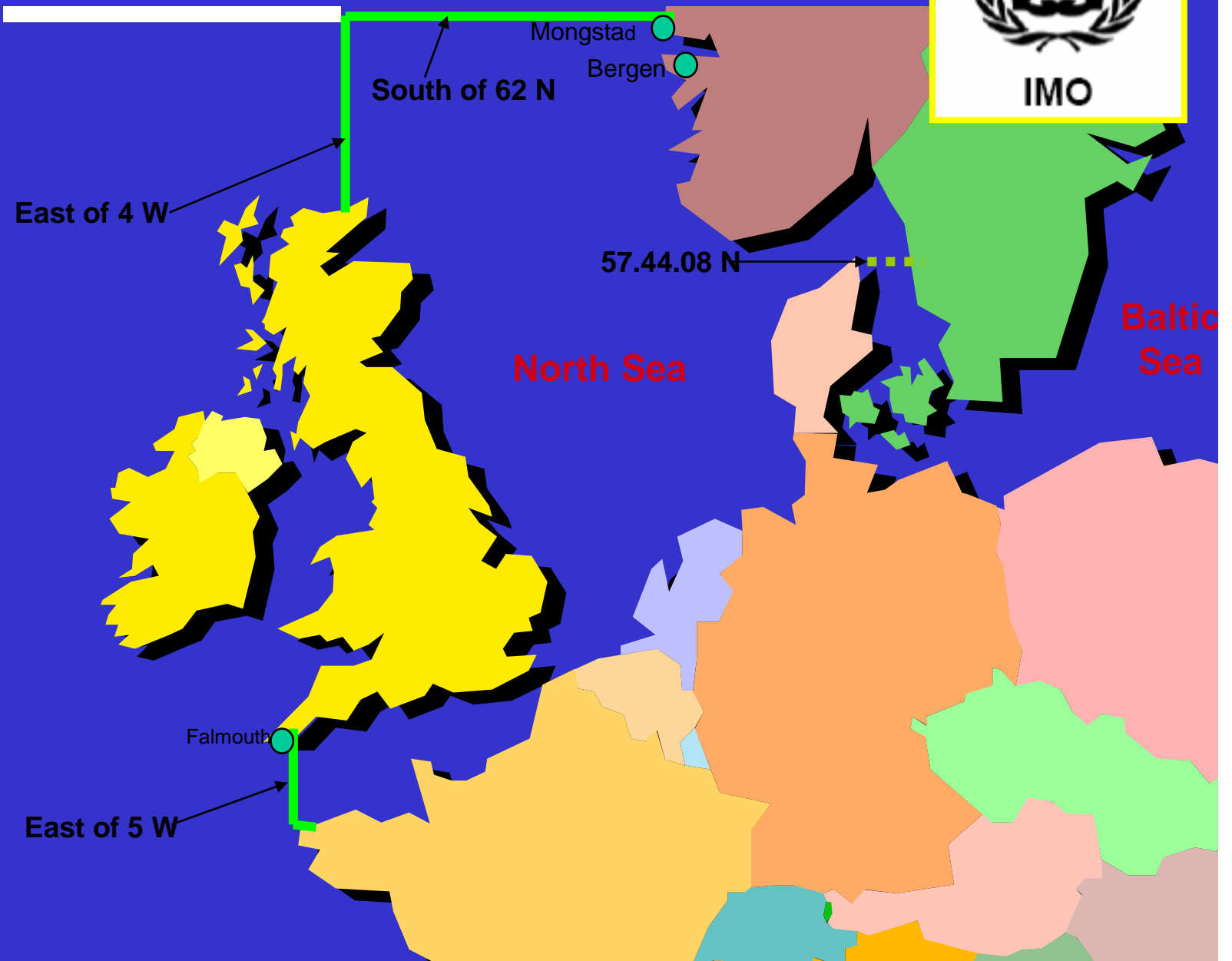


Entered into Force May 19, 2005*

- Establish Ship Engine NOx Standard**
- 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



Amendments to Annex VI



NOx Engine Standards

- Tier 1 – 17.0 g-NOx/kW-hr, vessels 1990 - 2010
- Tier 2 – 14.4 g-NOx/kW-hr January 1, 2011
- Tier 3 – 3.4 g-NOx/kW-hr January 1, 2016

In ECA, Tier 2 outside ECA

Global Sulfur Cap

- 4.5% reduced to 3.5% in 2012
 - 0.5% as early as 2020 but no later than 2025*
- * fuel availability study 2018.

SECAs to ECAs

- 1.5% sulfur reduced to 1.0% on March 1, 2010
- 0.1% on January 1, 2015

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

*** New Version – Fuel Only, Avoids Waiver**

CARB Main & Boiler Engine Reg.



Switch to distillate fuels 24 nm offshore

- July 1, 2009
 - 1.5% S Marine Gas Oil (MGO)
 - 0.5% S Marine Diesel Oil (MDO)
 - Alternative Compliance Plans
- January 1, 2012
 - Distillate fuel between 0.1% & 0.2% Sulfur
 - Fuel availability review?

Workshop – May 13, 2008

Approval – July 25, 2008?

Ports' Clean Fuel Incentive Program

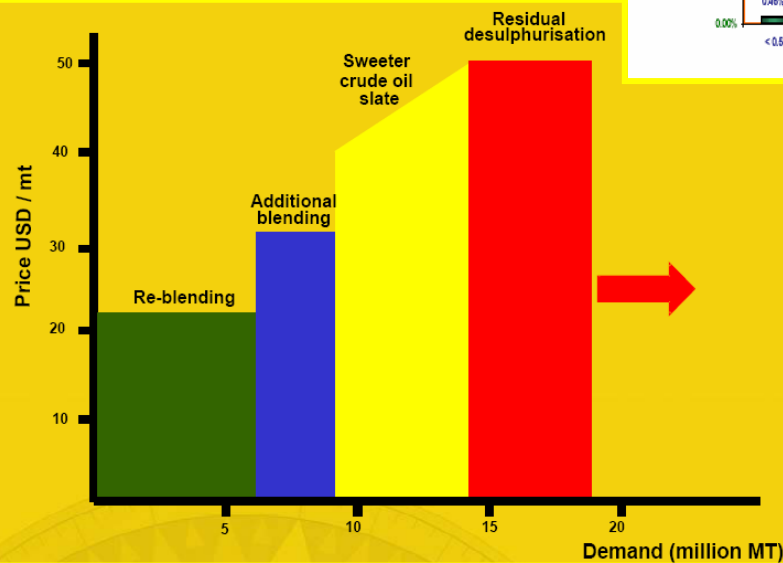
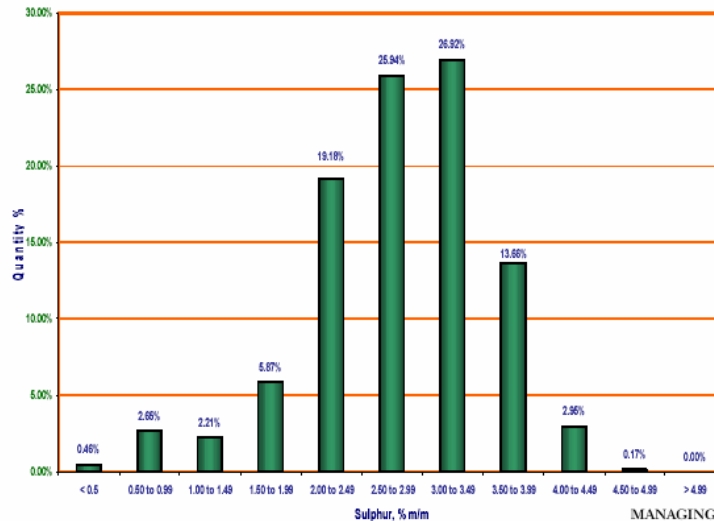
- 100% of Cost between Residual Fuel and 0.2% Sulfur MGO (LA Index)
- 1yr. July '08 – July '09 (CARB Reg.)
- Ship Registration Required (May '08)
- Requires VSR and LSF in Auxiliaries
- \$9.9 Million - POLB, \$8.6 million – POLA



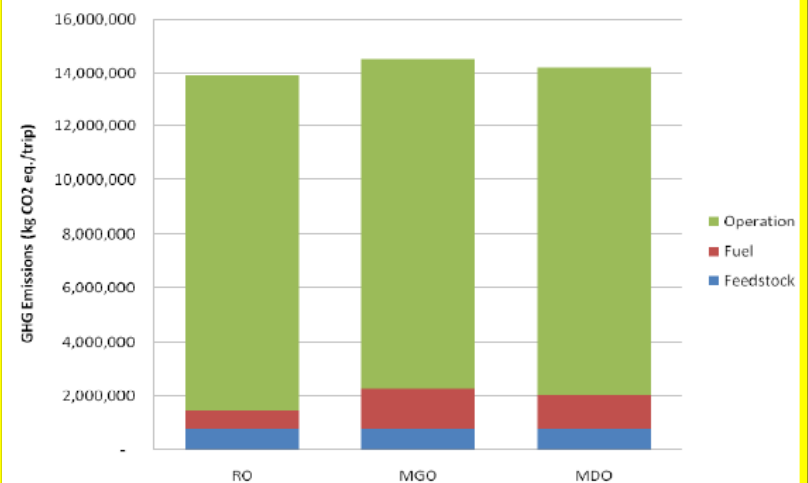
Low Sulfur Marine Fuels

- Cost
- Availability
- GHG Penalty

Marine Fuel Distribution by Sulfur Content 2004



GHG Emissions by Fuel Type



IMO Green House Gas Considerations (MEPC 58)



Short Term

- Global Levy Scheme
- Improvement of Fuel Consumption
- Energy Efficiency Design and Management Plan
- Onshore Power
- Wind Power
- Voluntary/Mandatory CO₂ reporting, information exchange, performance ratings
- Strict limitation on refrigerant gas leakage
- Vessel Speed Reductions
- Improved Traffic Control, Fleet Management, Cargo Handling Operations

IMO Green House Gas Considerations (MEPC 58)



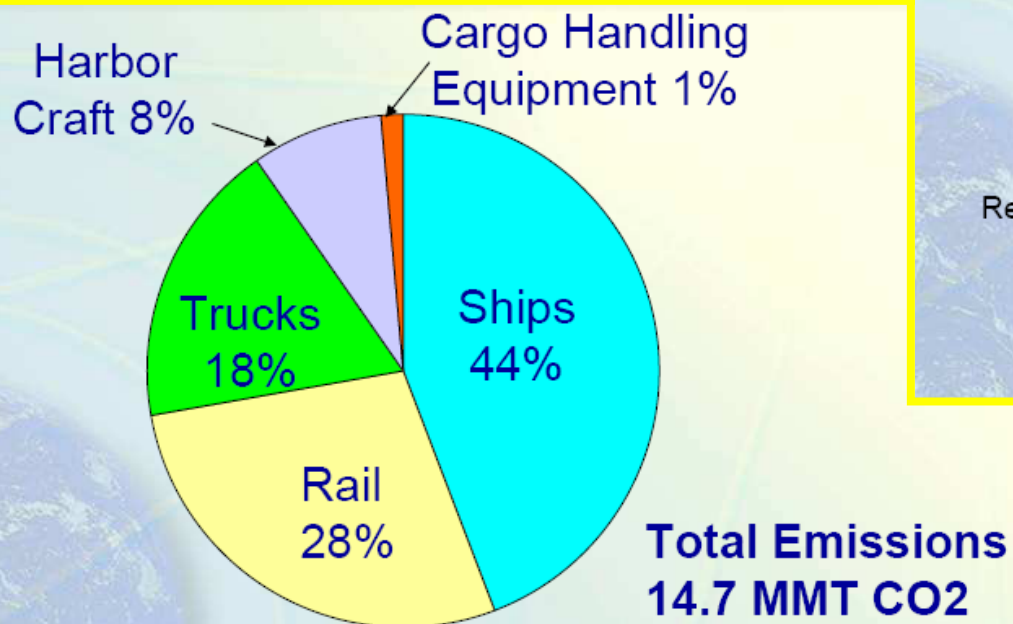
Longer Term

- Technical Measures for Ship Design
- Use of Alternative Fuels
- CO₂ Design Index for New Ships
- Verification Scheme for CO₂ Operational Index
- Non-compliance penalty mechanism
- Emission Trading Scheme
- Mandatory CO₂ Index for Port Infrastructure
- Other Measures Developed by the GHG Working Group (Oslo June 2008)

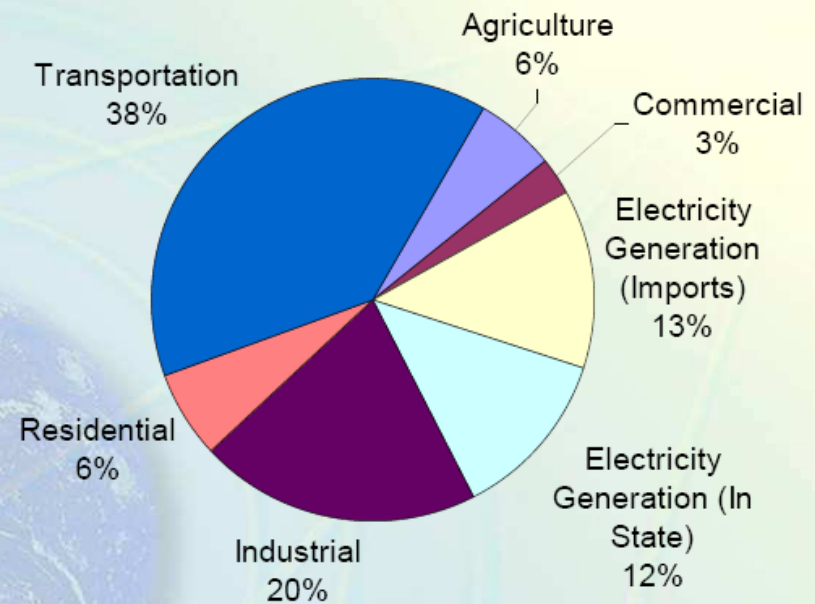
AB32 California Global Warming Solutions Act



**Goal 1990 levels by 2020
est. 173 MMT CO₂**



2004 Emissions (480 MMT CO₂E)



Goods Movement = 3%

AB32 Vessel Measures



- Shore Power (0.24 MMT CO₂)
- Vessels Speed Reduction (1.4 MMT CO₂)
- Vessel Operation Best Practices (1.6 MMT CO₂)
 - Engine Maintenance
 - Optimized Propeller/Hull Designs
 - Advance Hull Coatings & Maintenance
 - Air Cavity System
 - Sails
 - Advanced Heat Recovery
 - Alternative/Renewable Fuels
 - Route Planning/Vessel Speed Reductions

Ship Emission Control



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



COLD IRONING



CARB Regulation, Dec '07

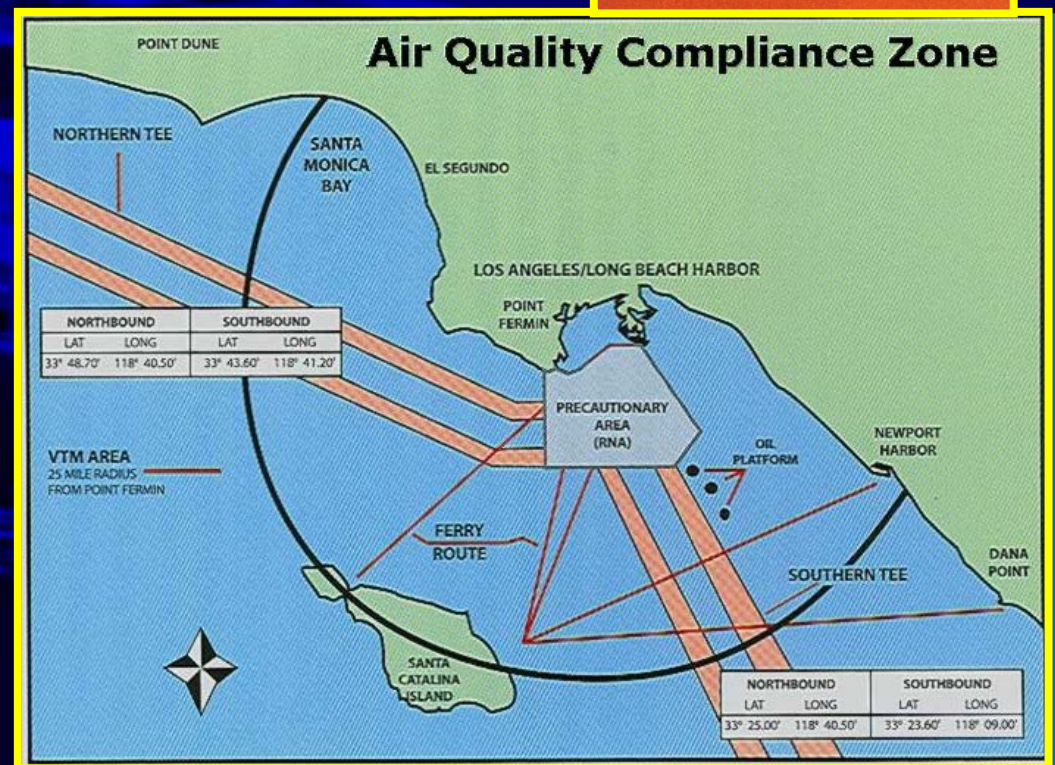
- Ship Types, Grid (2014) & Non-Grid (2010) options
- Percent Calls & Emission Goals (80% 2020)

Voluntary Vessel Speed Reduction Program/Reg?



Initiated May 2001
Green Flag Program
+ 90% compliance

$$V=E^3$$



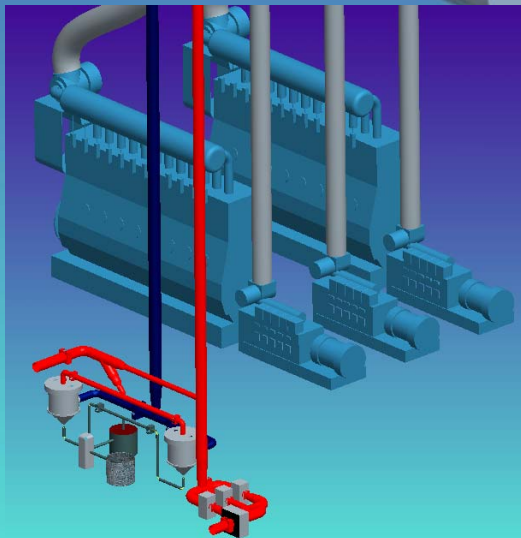
MAN Diesel Engine Technology (NOx)



Electronic Controls	-30%
Slide Valves	-30%
Water Emulsification	-30%
Scavenge Air Moistening	-50%
Selective Catalytic Red.	-98%

Sea Water Scrubbing (SO_x & PM)

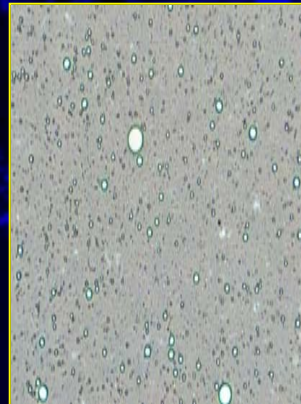
Sea water is pumped to the scrubber
CaCO₃ absorbs the SO_x from the exhaust
Produces CaSO₄ in discharge



Scrubber also removes most of the particulates
PM is removed from the discharge and disposed at dock

Water In Fuel Emulsification

- Water content of 10-20% tested
- NOx reduction = water content
20% water = 20% less NOx
- PM reduction is 2-3 times % of water
20% water = 60% less PM

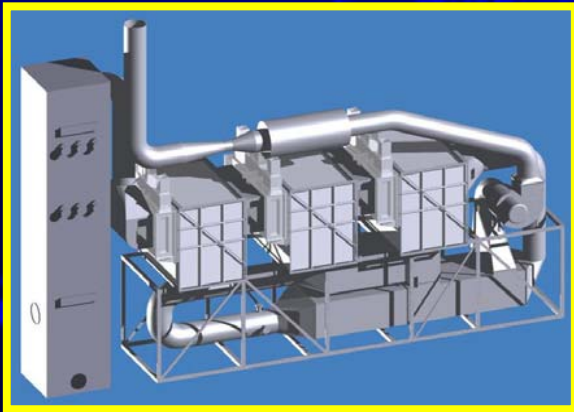


Wittmar Non-Grid Cold Ironing

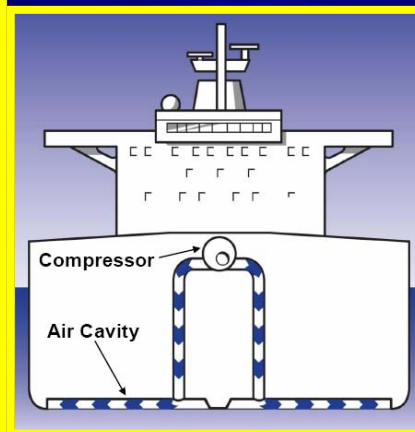
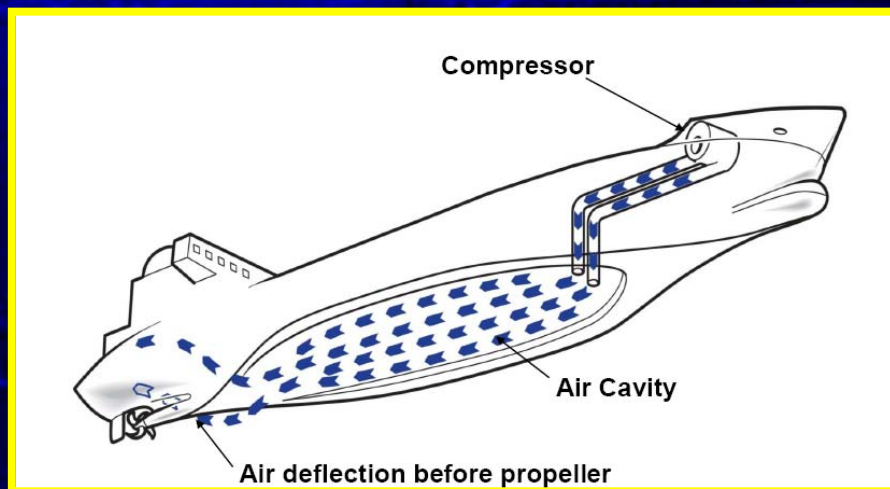


- Depending on the Length of Stay and Hotelling kW load, the Air Pollution Reduced by using Wittmar DFMV™
- NOx - is Reduced **98%**
- CO - is Reduced **57%**
- PM10 - is Reduced **99%**
- SOx - is Reduced **100%**
- CO2 - is Reduced **57%**

Advanced Maritime Emissions Control System (AMECS)



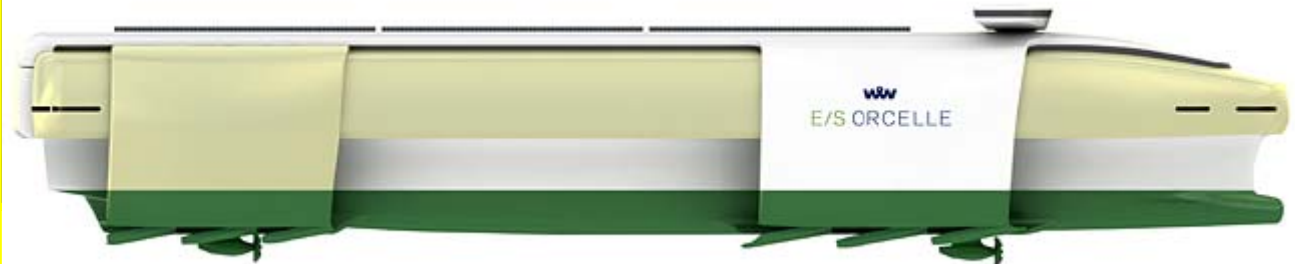
Fuel Saving Strategies



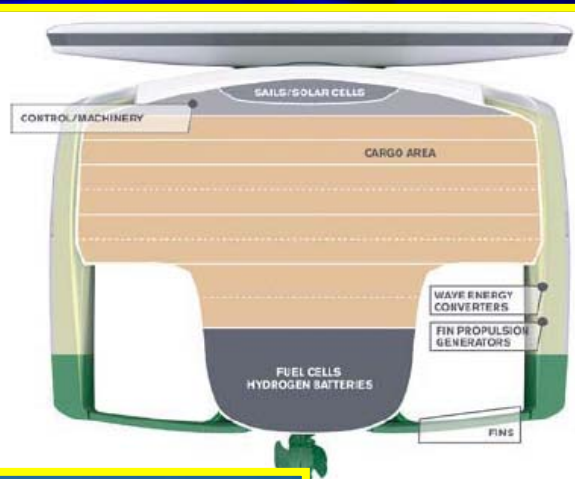
SkySails



Concept Vessel of the Future



- Solar
- Wind
- Wave
- Fuel Cells



Thank you! Questions?



Alliance of the Ports of Canada, the Caribbean,
Latin America and the United States

PIPSA

