# Public Hearing to Consider Adoption of a Proposed Regulation for Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels

**Board Hearing**
**July 24, 2008**

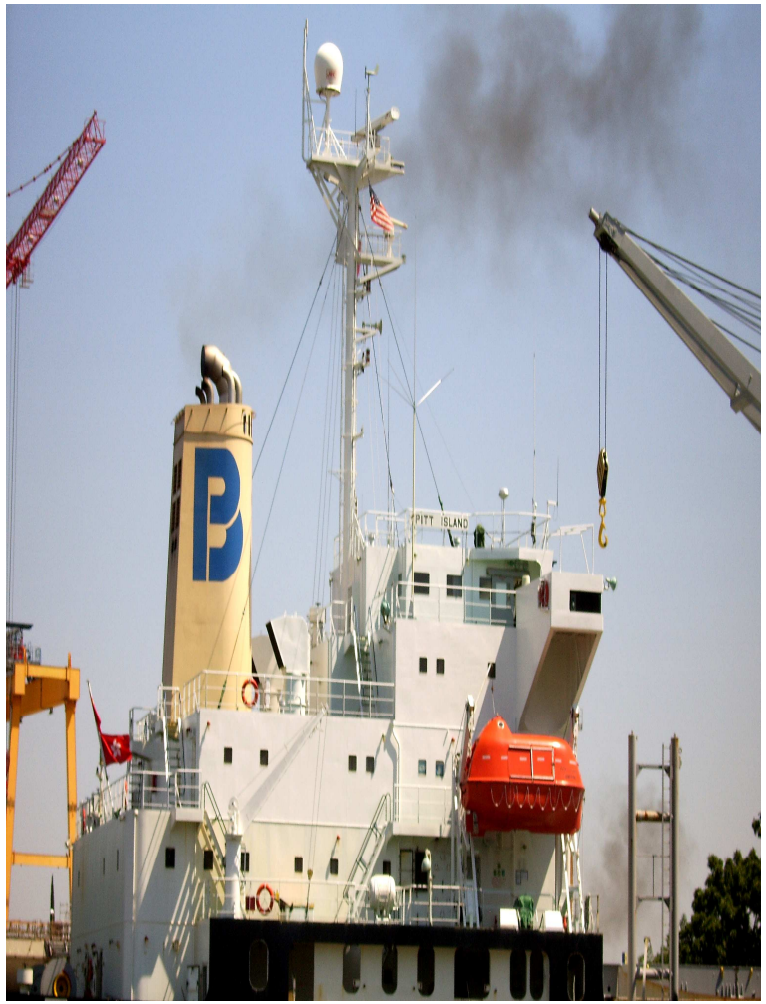
**California Environmental Protection Agency**

Air Resources Board

# Overview

- Background
- Proposed Regulation
- Impacts
- Comments
- Proposed 15-Day Changes
- Future Activities, Summary and Recommendation

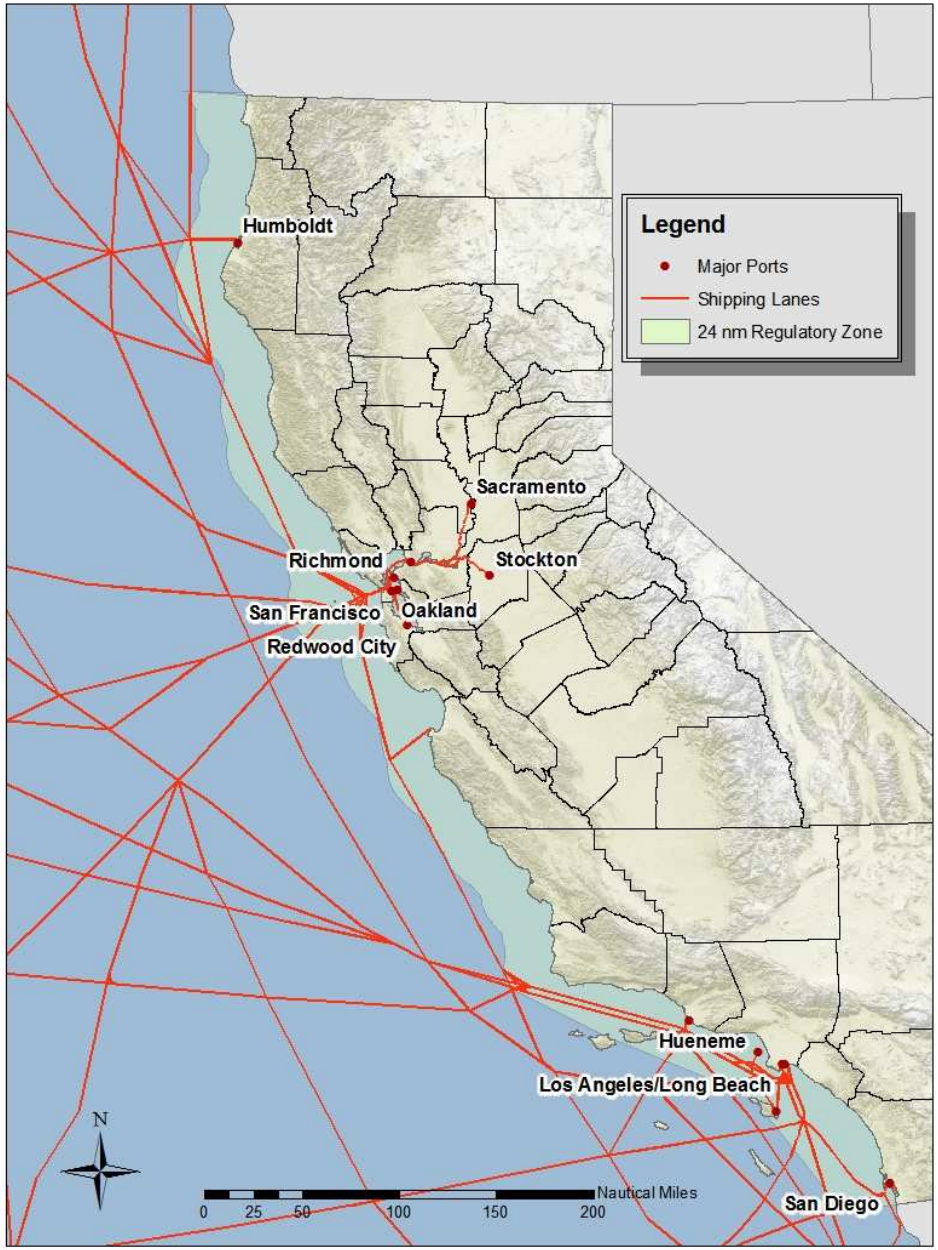
# Background



# Air Pollution is a Serious Public Health Concern

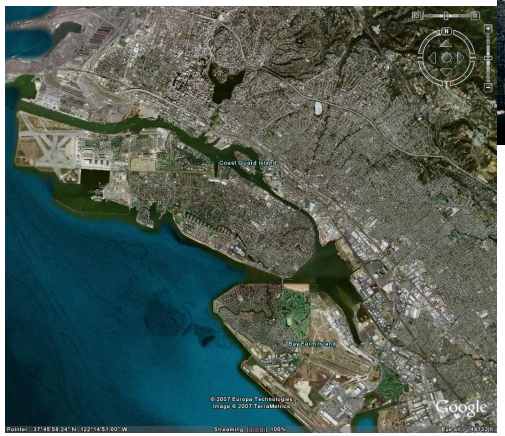
- **Numerous studies have confirmed link between air pollution and adverse health impacts**
  - **premature death**
  - **respiratory disease**
  - **reduced lung function in children**
  - **cardiovascular disease**
  - **cancer**

- California is major gateway to global trade
- Sixteen ports involved with waterborne commerce
- Over 10,000 ship visits per year



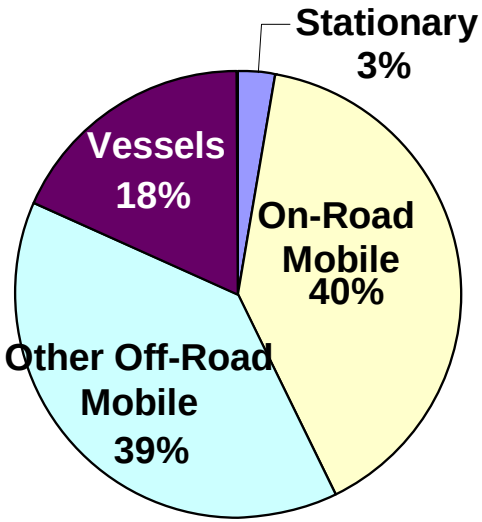
# Ocean-Going Vessels Impact Air Quality and Public Health

- Large and growing source of PM, NOx, and SOx emissions
- Emissions concentrated near population centers
- Significant localized and regional impacts
- Contributor to ambient levels of PM and ozone
- Contributor to cancer risk and PM mortality

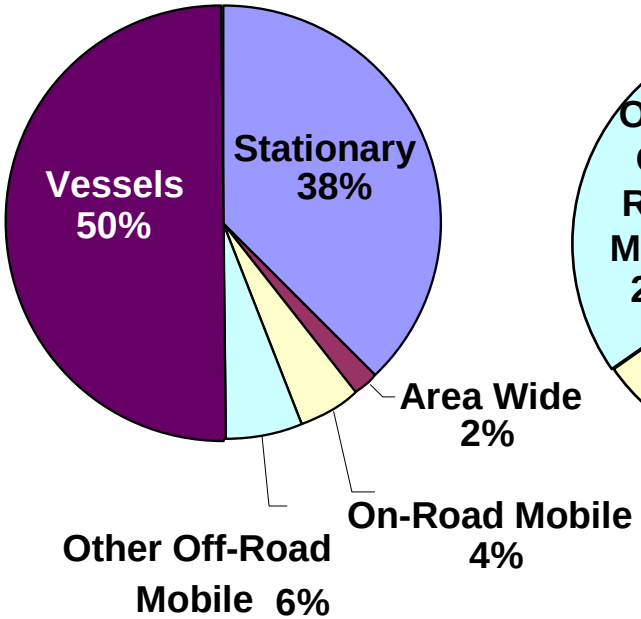


# Marine Vessels are a Large Source of Emissions*

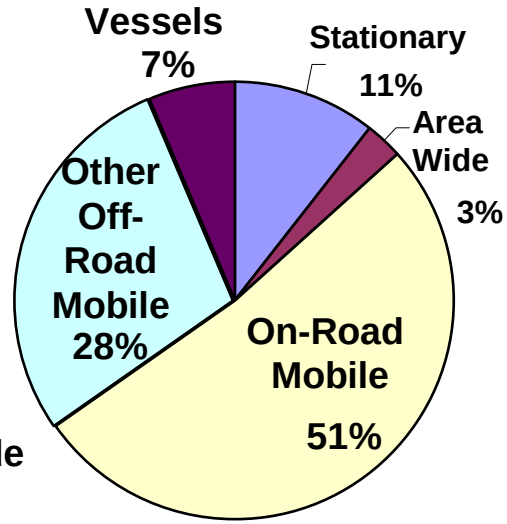
**Diesel PM**
116 TPD total




**SOx**
305 TPD total

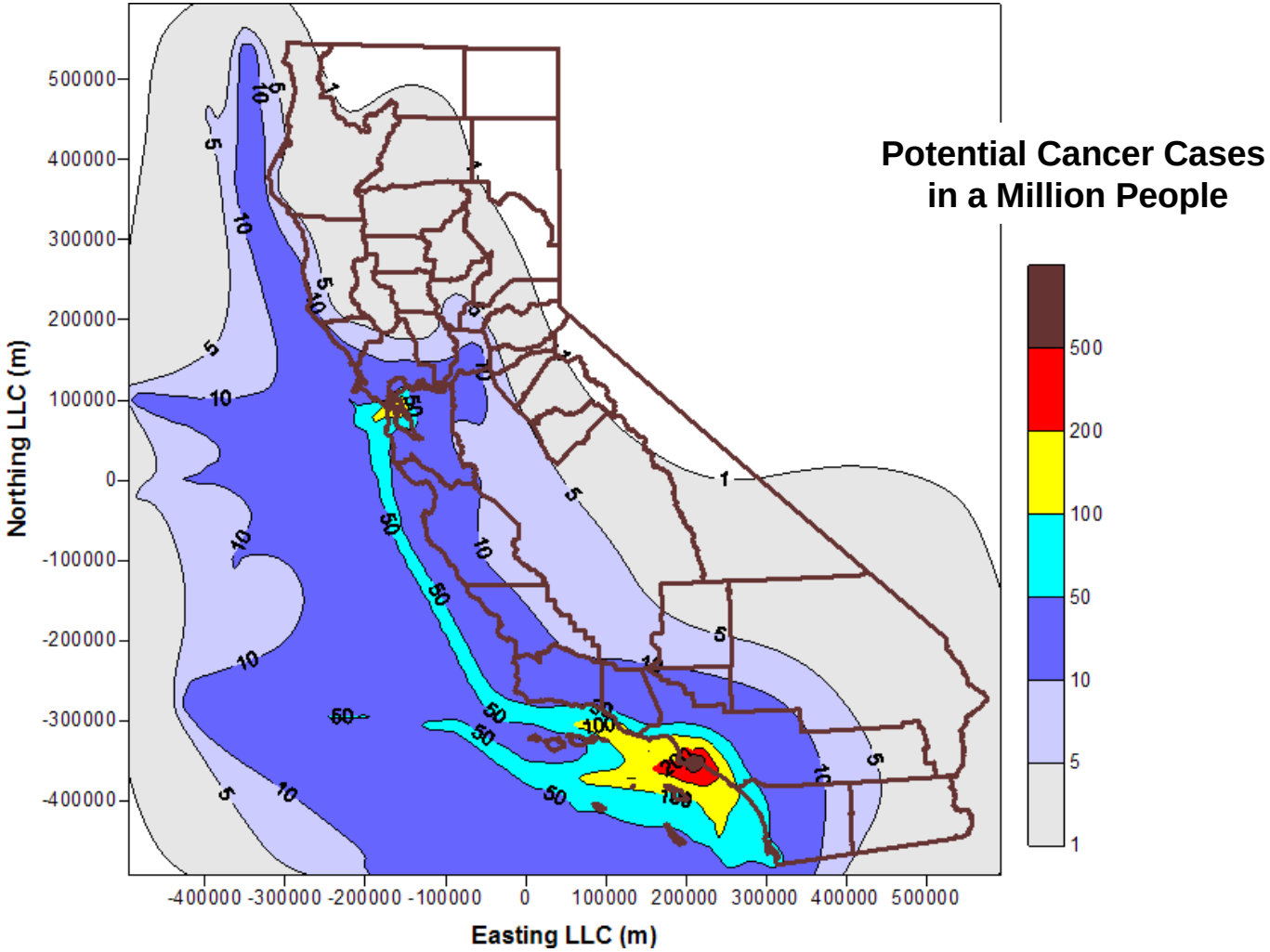



**NOx**
3,559 TPD total




* Source: 2006 ARB Emissions Inventory. Does not include benefit of ARB Ship Auxiliary Engine Regulation (Vessel emissions out to 100 NM)

# Ocean-Going Vessel Diesel PM Exposures and Cancer Risk*




*2005 ARB Statewide Emissions Inventory

# Ocean-Going Vessels Contribute to Public Health Impacts*

- 1,100 premature deaths per year
- 31,000 cases of asthma-related and other lower respiratory symptoms per year
- 800 hospital admissions due to respiratory and cardiovascular causes per year
- 2,600 cases acute bronchitis per year
- 190,000 work loss days per year
- 1,100,000 minor restricted activity days per year

*Estimates are based on air dispersion modeling of direct PM2.5 emissions statewide and indirect PM2.5 (sulfates and nitrates) in the South Coast for the year 2005.

# Proposal Supports Key California Initiatives

- State Implementation Plan
- Goods Movement Emission Reduction Plan (2006)
- Diesel Risk Reduction Plan
- Port Specific Plans

# ARB's Auxiliary Engine Fuel Regulation

- Use cleaner marine distillate fuels in auxiliary engines
- Successfully implemented over 14 months beginning on January 1, 2007
- Legal challenge resulted in suspension in May 2008
- Court ruled that ARB must seek a waiver from U.S. EPA to implement

# IMO's Actions

- Current MARPOL Annex VI limits fuel sulfur to 4.5%
- In October 2008, IMO to consider amendments to international fuel sulfur limits
  - mirrors ARB proposal in 2015 timeframe by establishing emission control area (ECA)
  - California supports proposal
- California needs to act now to meet air quality needs

# Main Goals

- **Provide immediate and significant benefits**
  - **most vessels currently use high sulfur (2.5%) heavy fuel oil (HFO)**
  - **control strategy is based on switching to cleaner marine distillate (MGO/MDO)**
- **Establish in-use clean fuel requirements that:**
  - **establish uniform fuel requirements for vessels**
  - **address legal issues**
  - **provide a “bridge” to possible international requirements in the 2015 timeframe**

# Proposed Regulation

# Regulatory Development Process

- **5 Public Workshops**
- **Maritime Working Group Meeting**
- **Outreach Meetings**
- **2007 Ship Survey**
- **Site Visits**
- **Vessel Emission Testing**
- **Fuel Property Testing**

# Proposal Based on Switch from Heavy Fuel Oil to Cleaner Distillate Fuel

- Switch from HFO to distillate provides large reductions
- Cleaner fuels are available and feasible to use
- Result in immediate, major reductions in PM (direct and secondary) and SOx emissions, smaller reductions in NOx

# Applies to Ocean-Going Vessels (OGVs)

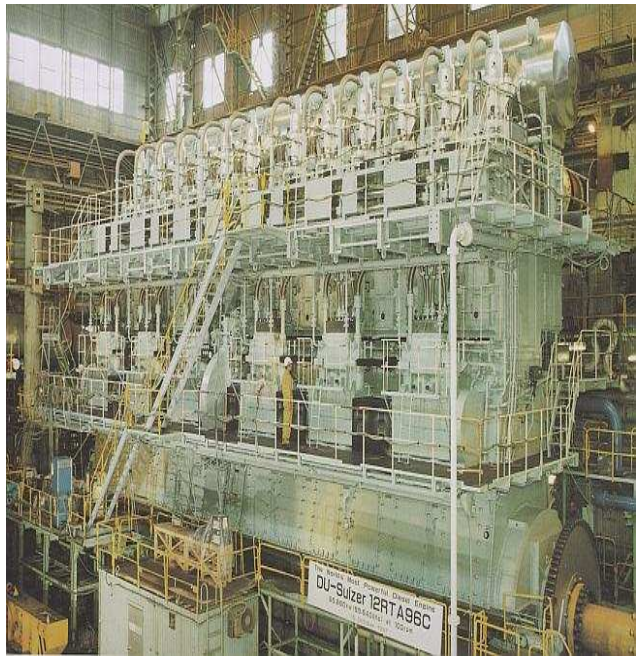
- **US and Foreign-Flagged**
- **Ocean-going vessels**
  - **Auto Carriers**
  - **Bulk Cargo**
  - **Container**
  - **Cruise Ships**
  - **Refers**
  - **Ro-ros**
  - **Tankers**

*Proposed Regulation*

# Requires Use of Cleaner Fuels

**Main Engines**

**for propulsion**

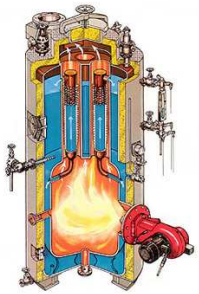



**Auxiliary Engines**

**for electricity and diesel electric for both propulsion & electricity**

**Auxiliary Boilers**

**for steam, and heating of heavy fuel oil and water**



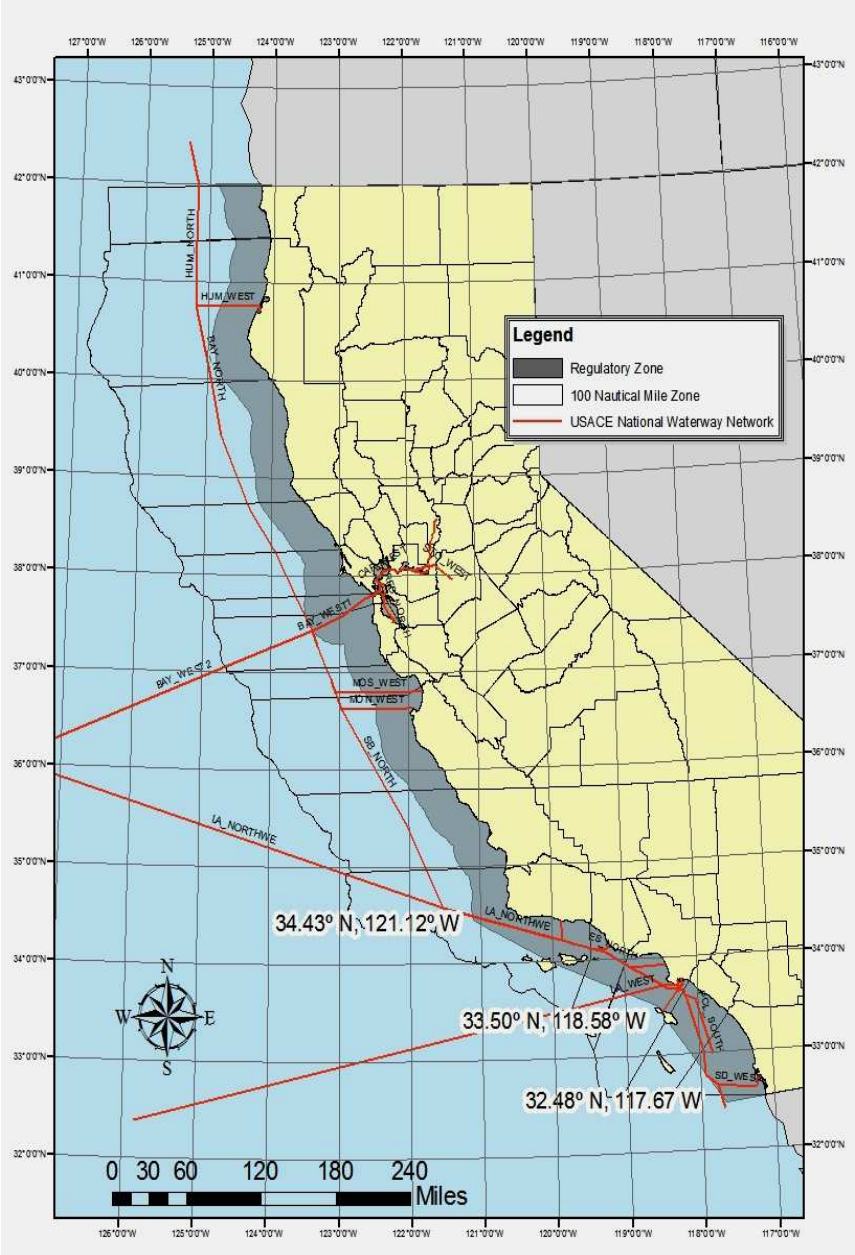
# In-use Clean Fuel Requirements

- **Phase 1 begins July 1, 2009***
  - **use marine gas oil (averages 0.3% sulfur), or**
  - **use marine diesel oil with a 0.5% sulfur limit**
- **Phase 2 begins January 1, 2012**
  - **use marine gas oil with a 0.1% sulfur limit, or**
  - **use marine diesel oil with a 0.1% sulfur limit**

***for auxiliary engines, Phase 1 begins upon effective date of regulation**

*Proposed Regulation*

**Requires Use of Cleaner Fuels Within 24 Nautical Mile Zone of the California Coastline**



# Basis for Low-Sulfur Marine Distillate

- **For most vessels, changing from heavy fuel to distillate is feasible without vessel modifications**
- **Auxiliary engine rule, main engine pilot programs, and port programs have demonstrated feasibility**
- **Key challenges that need to be managed:**
  - **changes in fuel properties such as viscosity and lubricity**
  - **crew training/experience with fuel switching**
  - **fuel switching procedures**
  - **managing vessel fuel systems and tankage**

# Fuel Availability

- **Marine distillate for Phase 1 is available**
- **Marine distillate for Phase 2 (0.1% S) should be available by 2012**
- **Fuel and fueling infrastructure to support Phase 2 fuel should be in place by 2012**
- **Rule addresses situation where fuel is not available**

# 2-Step Implementation is Important

- **Maximizes reductions that can be achieved immediately**
- **Provides safer and more successful transition to 0.1% S fuel**
- **Allows time to identify and address potential operational issues for 0.1% S fuel**
- **Provides time to make operating procedures and equipment adjustments**
- **Allows time to address fuel procurement challenges**

# Other Provisions

- **Safety Exemption**
- **Essential Modification Exemption**
- **Noncompliance Fee**
  - option to pay a fee under special circumstances
- **Provision for situations where 0.1% S fuel is not available**
- **Recordkeeping Requirements**
- **Sunset Provision**
  - allows ARB to rescind regulation if U.S. EPA/IMO rules adopted

# Impacts

# Overall Benefits

- **Reduces diesel PM, PM, SOx, NOx, and secondarily formed PM**
- **Reduces regional and local exposure to diesel PM emissions**
- **Reduces statewide cancer risk, premature death and other non-cancer health effects**
- **Improves regional air quality**

*Impacts*

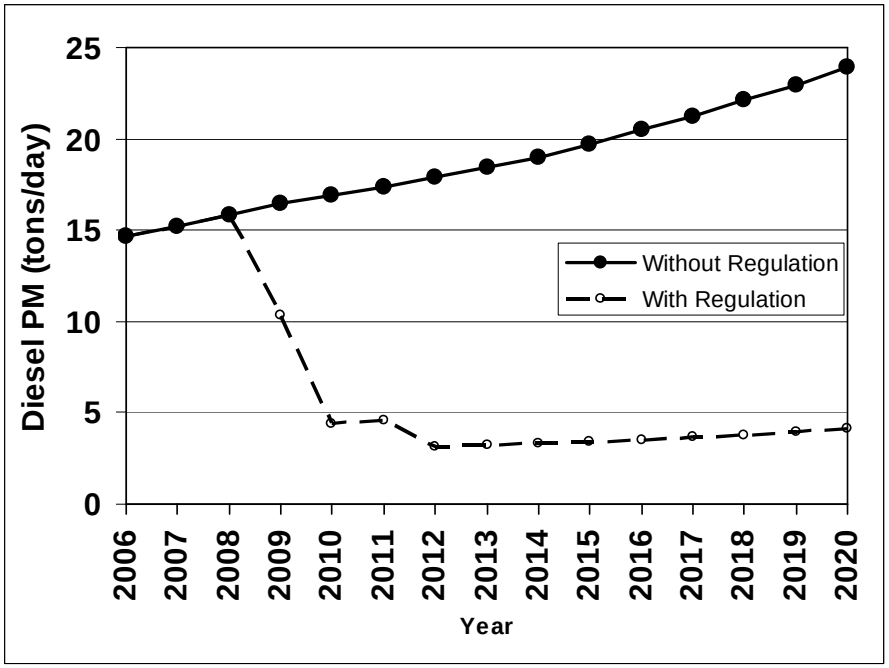
# Statewide Emissions Benefits for OGVs

| Year | 2009 | 2009 Phase 1 | 2012 | 2012 Phase 2 |
|---|---|---|---|---|
| Pollutant | TPD | Overall % Reduction | TPD | Overall % Reduction |
| PM10 | 12 | 74% | 15 | 83% |
| SOx | 106 | 81% | 135 | 95% |
| NOx | 8 | 5% | 11 | 6% |

*Impacts*

# Emission Reduction Trends for OGVs

## Diesel PM



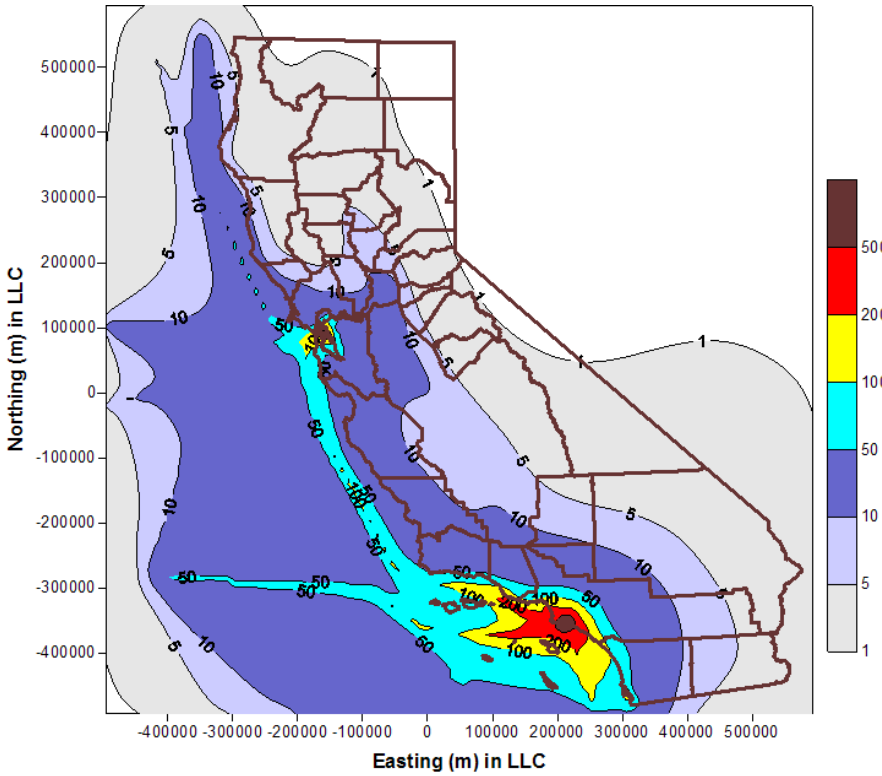

## SOx

*** Vessel emissions out to 24 nautical miles, includes main engines, auxiliary engines and auxiliary boilers**

*Impacts*

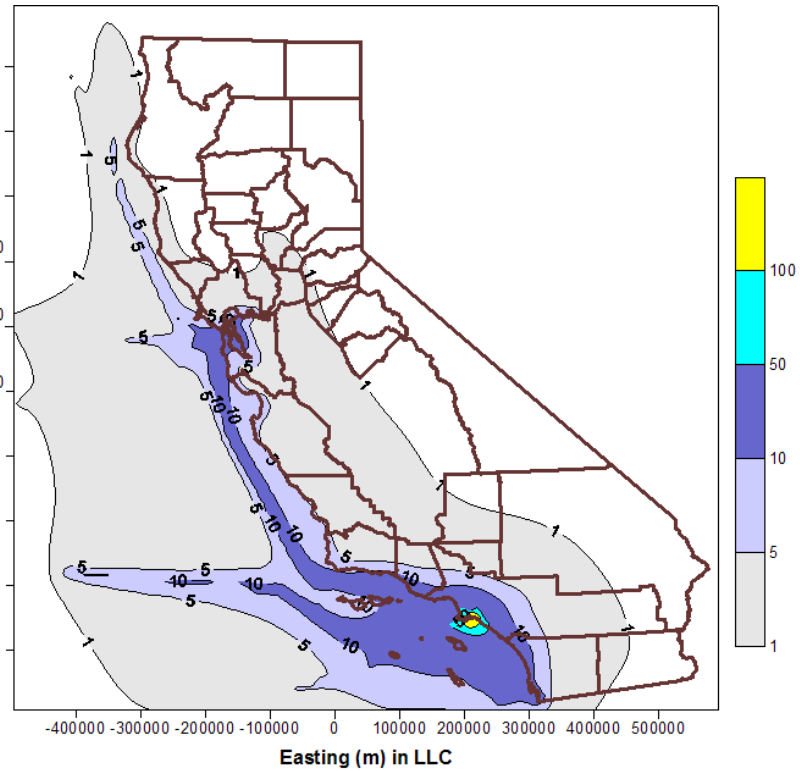
# Proposal Results in Over 80% Reduction in Statewide Potential Cancer Risk from OGVs*

## Without Proposed Regulation




Isopleth of Diesel PM Potential Cancer Risk in 2012 without Control

## With Proposed Regulation




Isopleth of Diesel PM Potential Cancer Risk in 2012 with OGV Regulation

*Based on projected statewide 2012 inventory without control and with control

*Impacts*

# Statewide Reductions in Non-Cancer Health Effects *

## Between 2009 and 2015 (cases avoided)

- 3,600 premature deaths
- 60,000 cases of asthma-related and other lower respiratory symptoms
- 2,600 hospital admissions due to respiratory and cardiovascular causes
- 8,300 cases acute bronchitis
- 620,000 work loss days
- 3,600,000 minor restricted activity days

***Estimates are based on air dispersion modeling of direct PM2.5 emissions statewide and indirect PM2.5 (sulfates) in the South Coast.**

# Greenhouse Gas Analysis

- **Well-to-Hull analysis estimates net $CO_2$ changes***
  - **resulting from proposal requiring distillate instead of heavy fuel oil in California 24 nautical mile zone**
  - **only considers volume of fuel required to meet the proposal**
  - **estimates changes in $CO_2$ emissions from fuel production and consumption life-cycle**
    - **feedstock processing - no change**
    - **fuel refining - increased $CO_2$ emissions due to added distillate refining (+4%)**
    - **vessel operation-decreased $CO_2$ emissions due to higher energy content of distillate (-2%)**

***Using Total Energy and Emissions Analysis for Marine Systems (TEAMS) Model**

# Greenhouse Gas Impacts

- **GHG decrease from ship emissions**
- **GHG increase during fuel refining**
- **Net small increase in $CO_2$ (1-2%) per gallon of fuel switched**
- **Overall increase for a typical voyage is very small (0.04%)**
- **Reductions in GHG are possible from other actions**
  - **speed reduction**
  - **hull cleaning, engine efficiency, and propeller design**
  - **refining efficiency or controls**
- **Health and environmental benefits outweigh the potential small increase in $CO_2$**

# Economic Impacts

- **Total annual cost to industry**
  - **$140-$360 million per year**
- **Added fuel costs for typical cargo ship visit of about $30,000**
  - **less than 1% ($6.00) added to the shipping cost per container from Asia to California**
  - **adds 0.1¢ to a pair of tennis shoes**
- **Value of health benefits (non-cancer)**
  - **$6 billion annually**

# Proposal is Cost-Effective

| Regulation | Diesel PM* $/pound |
|---|---|
| Ocean-going Vessel Proposal | $32 |
| In-Use Off-Road Diesel Vehicles Regulation | $74-$86 |
| Cargo Handling Equipment Regulation | $41 |
| On-Road Drayage Trucks | $57-$77 |

*Attributes all costs to reductions in diesel PM

# Comments

*Comments*

# Move the 2012 Fuel 0.1% S Limit for Auxiliary Engines to 2010

- **Greatest benefit by requiring immediate use of marine distillate in mid-2009**
- **Critical to have uniform fuel requirements for main, auxiliary engines and auxiliary boilers**
- **0.1% S distillate fuel and infrastructure not in place at key ports**
- **Operators need phase-in period to address technical and operational challenges**
- **Proposed regulation achieves 3 to 4 times higher reductions between 2009-2012 than suspended auxiliary engine regulation**

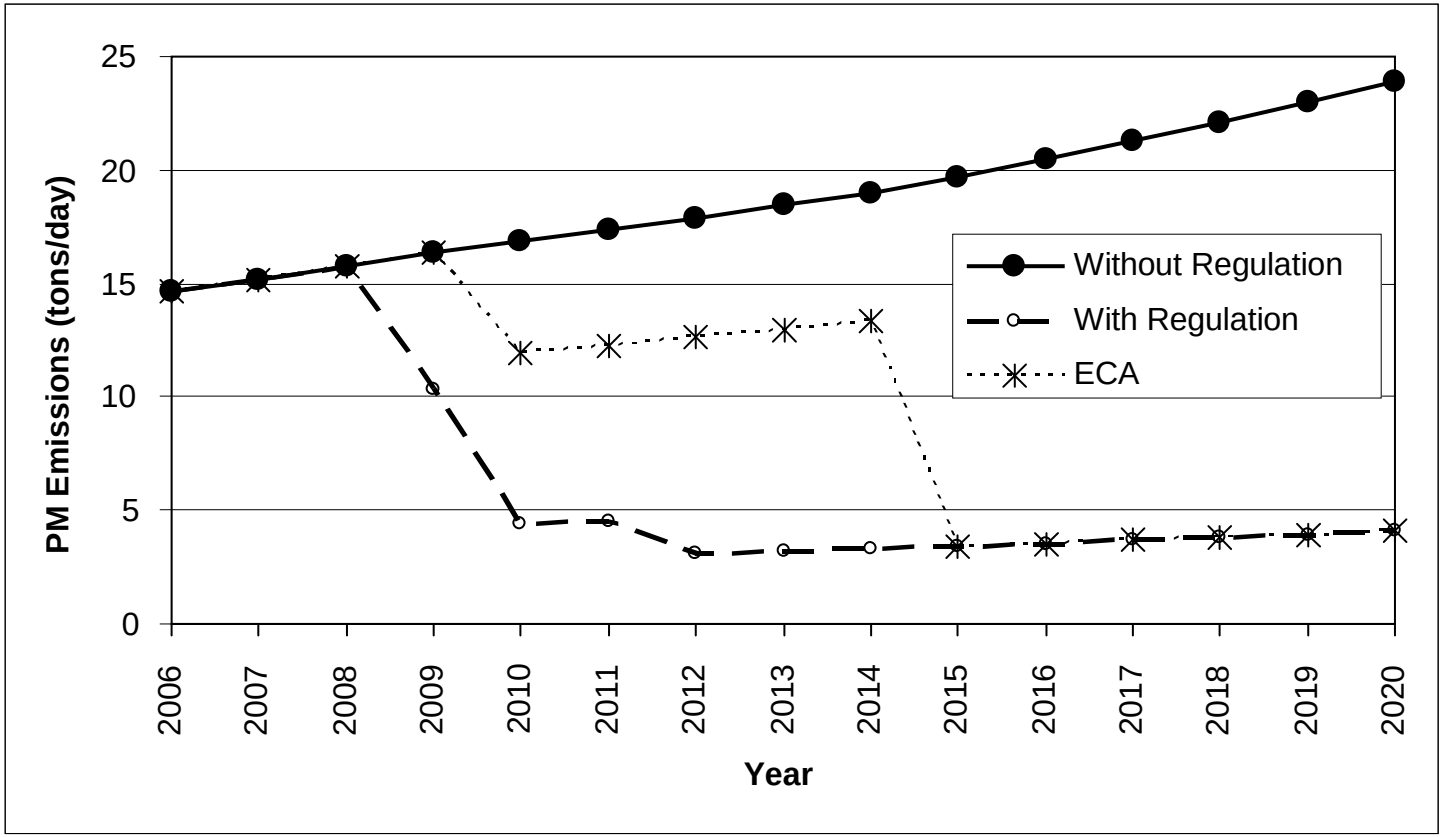
*Comments*

# Defer to International Controls

- **Some in shipping industry prefer international action**
  - **if current IMO proposal approved, U.S. could apply for an Emission Control Area (ECA)**
  - **1% sulfur fuels in 2010 and 0.1% sulfur fuels in 2015 is possible**
  - **California can't wait, needs near term reductions**
- **ARB Proposal would achieve significantly more emission reductions in 2009-2015 timeframe**
- **ARB Proposal contains provision to sunset rule if equivalent benefits are achieved**

*Comments*

# Comparison of Proposed Regulation and Potential IMO Emission Control Area (ECA) Benefits*




*Assumes earliest possible ECA implementation

*Comments*

# Use Alternative Routes to Avoid Requirements

- **U.S. Navy concerned that more ships will travel through the missile test range**
  - **test range occupies vast overwater region off Southern California**
  - **U.S. Navy believes weapons testing and training activities impacted if large number of vessels travel through test range**
  - **ARB staff committed to working with U.S. Navy and other stakeholders to address concerns**

# Proposed 15-Day Changes

# Proposed 15-Day Changes

- **Define essential modifications**
- **Remove sunset date for essential modifications exemption provision**

# Future Activities, Summary and Recommendation

# Future Activities

- Conduct outreach to vessel operators and enforce regulation
- Monitor fuel availability
- Conduct studies to investigate impacts of fuel-switching on marine engines and associated components

- Work with U.S. Navy concerning possible impact on Navy test range
- Work with U.S. EPA
  - to establish a West Coast emission control area
  - to continue evaluating offshore impacts

# Summary

- **Proposed regulation**
  - **establishes uniform in-use fuel requirements**
  - **achieves immediate and significant emissions reductions and reduces health risks**
  - **meets or exceeds SIP, GMERP and Diesel Risk Reduction commitments**
  - **is feasible and cost-effective**
  - **provides bridge to possible international requirements**
  - **addresses lawsuit issues**

# Recommendation

- **Staff recommends the Board adopt the proposed regulation with suggested 15-day changes**