

Proposed Regulation to Reduce Emissions From Diesel Auxiliary Engines on Ocean- Going Ships While At- Berth at a California Port

Board Meeting

December 6, 2007

California Environmental Protection Agency



Air Resources Board

Overview

- ◆ Background
- ◆ Proposed Regulation
- ◆ Air Quality Benefits
- ◆ Estimated Costs
- ◆ Proposed Modifications
- ◆ Recommendations

BACKGROUND



Emissions from At-Berth Ships

- ◆ Auxiliary engines provide power for ship's electrical power needs
- ◆ Power requirements are specific to ship type and cargo
- ◆ At-berth ship is “hotelling”

Health Impacts Due to Hotelling Emissions

- ◆ Contribute to regional PM_{2.5}
- ◆ Elevated cancer risk near ports
 - POLA/POLB health risk assessment indicates potential cancer risk from hotelling emissions (2006) affects:
 - 2,000,000 with risk greater than 10 in a million
 - 340,000 with risk greater than 100 in a million
 - 87,500 with risk greater than 200 in a million

Health Impacts Due to Hotelling Emissions (Continued)

- ◆ Non-cancer annual impacts—2006
 - 60 premature deaths
 - 1,800 respiratory impacts
 - 11,000 work loss days
 - 61,000 minor restricted activity days

Need for Emission Reductions from Hotelling Ships

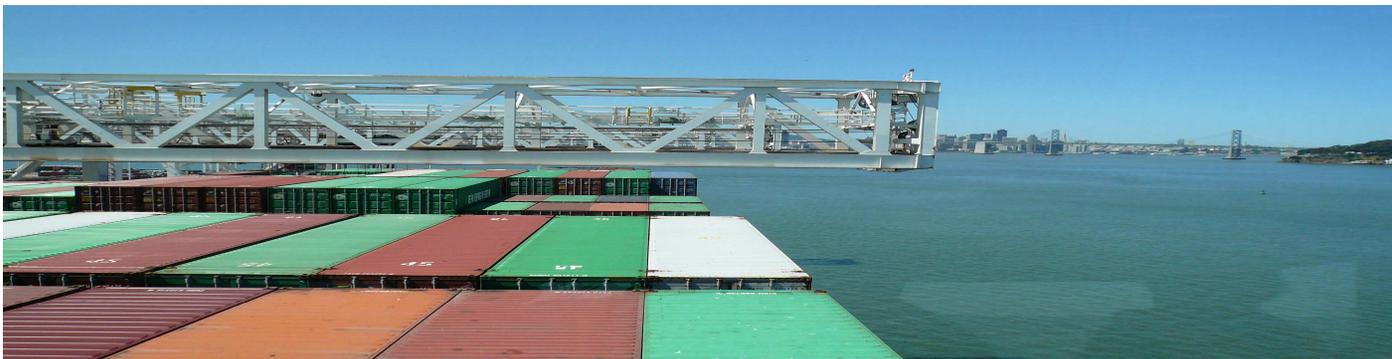
- ◆ Diesel Risk Reduction Plan
- ◆ Goods Movement Emission Reduction Plan
- ◆ South Coast SIP
- ◆ AB 32 Discrete Early Action Measure

Draft Shore Power Evaluation Report

- ◆ Staff began evaluation of shore power as possible mitigation measure in 2005
- ◆ Published draft report in March 2006
- ◆ Received public comments on report
- ◆ Used the report and comments to guide staff development of proposed regulation

Ship Activity to California Ports (2006)

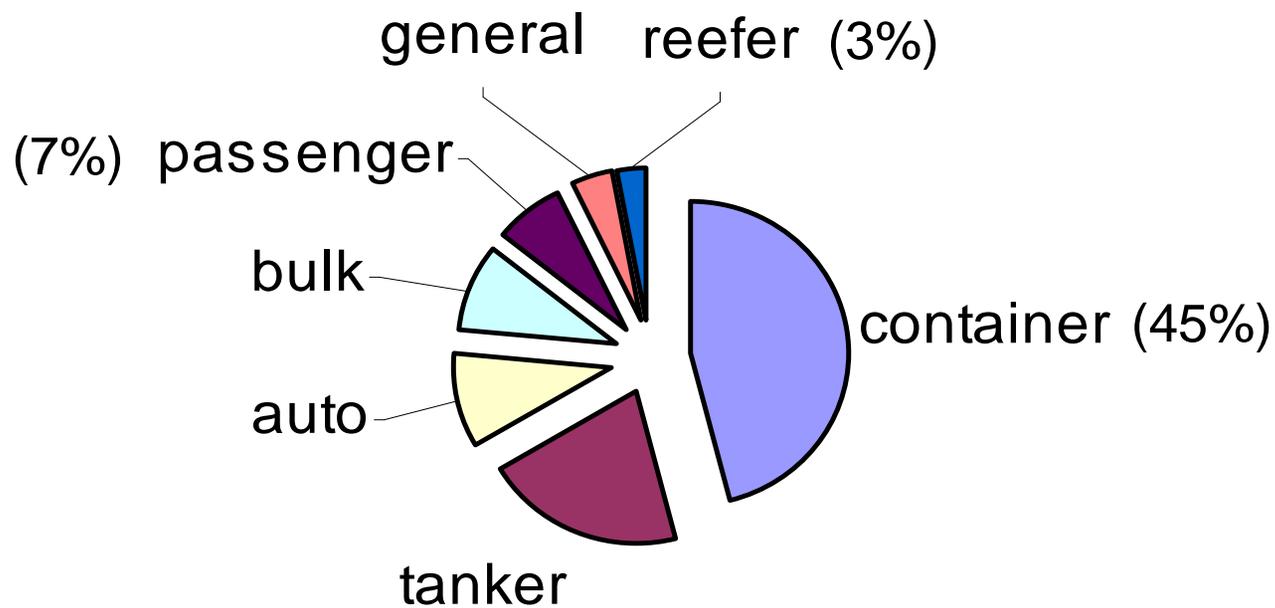
- ◆ 10,500 visits
- ◆ 2,000 ships
- ◆ Majority visiting ports of Long Beach, Los Angeles, and Oakland



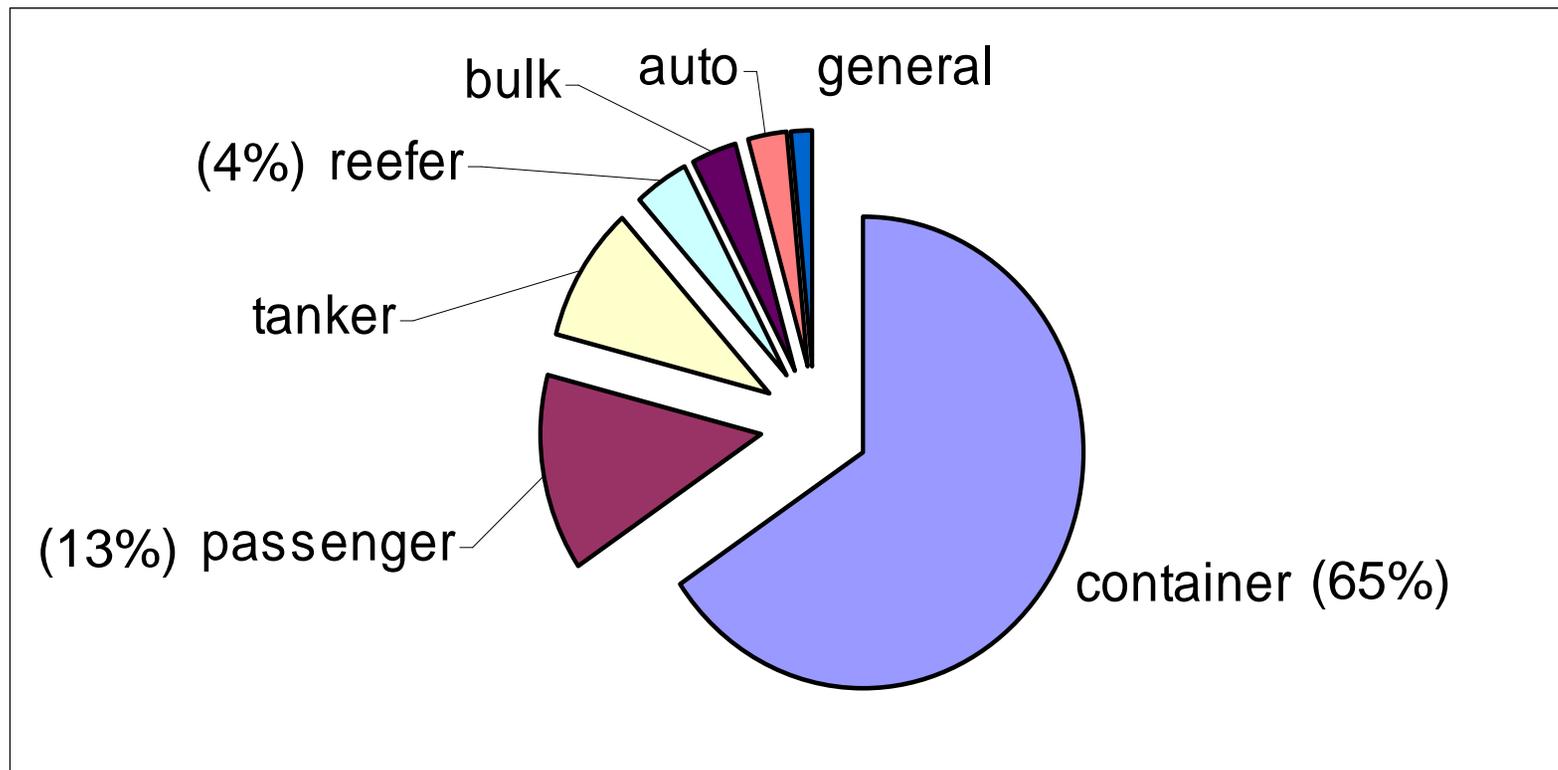
Ship Types

- ◆ Container ships
- ◆ Passenger ships
- ◆ Refrigerated cargo ships
- ◆ Tankers
- ◆ General cargo ships
- ◆ Bulk ships
- ◆ Vehicle carriers

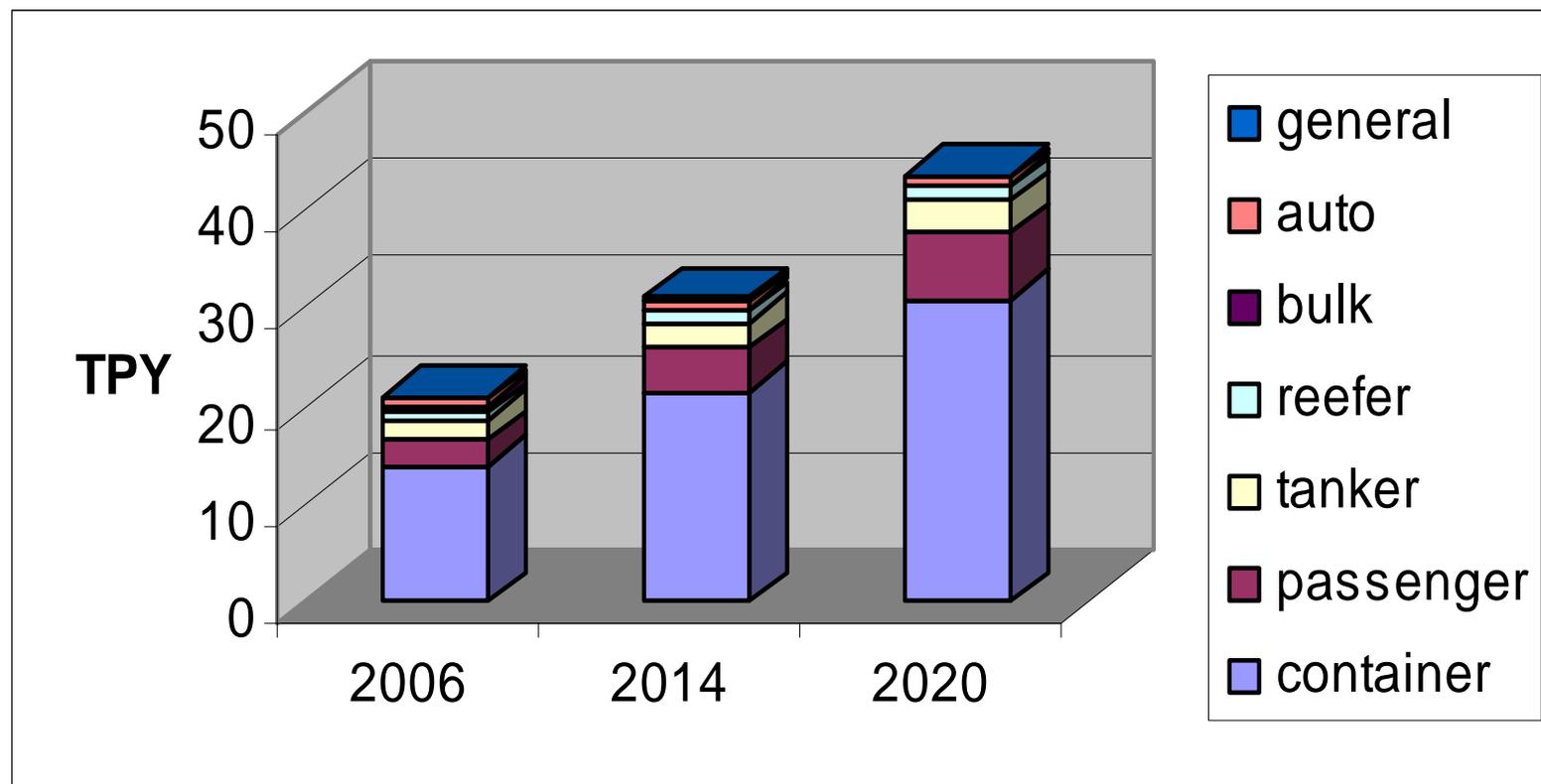
Visits by Ship Category (2006)



Hotelling NOx Emissions by Ship Category (2006)



Hotelling NOx Emissions by Ship Category for 2006, 2014 and 2020



Container Ships

- ◆ 45 percent of total ship visits (2006)
- ◆ 66 percent of emissions
- ◆ Frequent visitors: 60% of ships make 80% of visits
- ◆ Power needs: 1 to 7 MW
- ◆ Average berthing times:
 - 50 hrs/visit (POLA/POLB)
 - 21 hrs/visit (Oakland)



Passenger Ships

- ◆ 7 percent of total ship visits (2006)
- ◆ 13 percent of emissions
- ◆ Frequent visitors: 40% of ships make 85% of visits
- ◆ Power needs: 5 to 15 MW
- ◆ Average berthing times: 10 hours/visit



Reefer Ships

- ◆ 3 percent of total ship visits (2006)
- ◆ 4 percent of emissions
- ◆ Frequent visitors: 30% of ships make 75% of visits
- ◆ Power needs: 2 to 5 MW
- ◆ Berthing times: 20-60 hours/visit

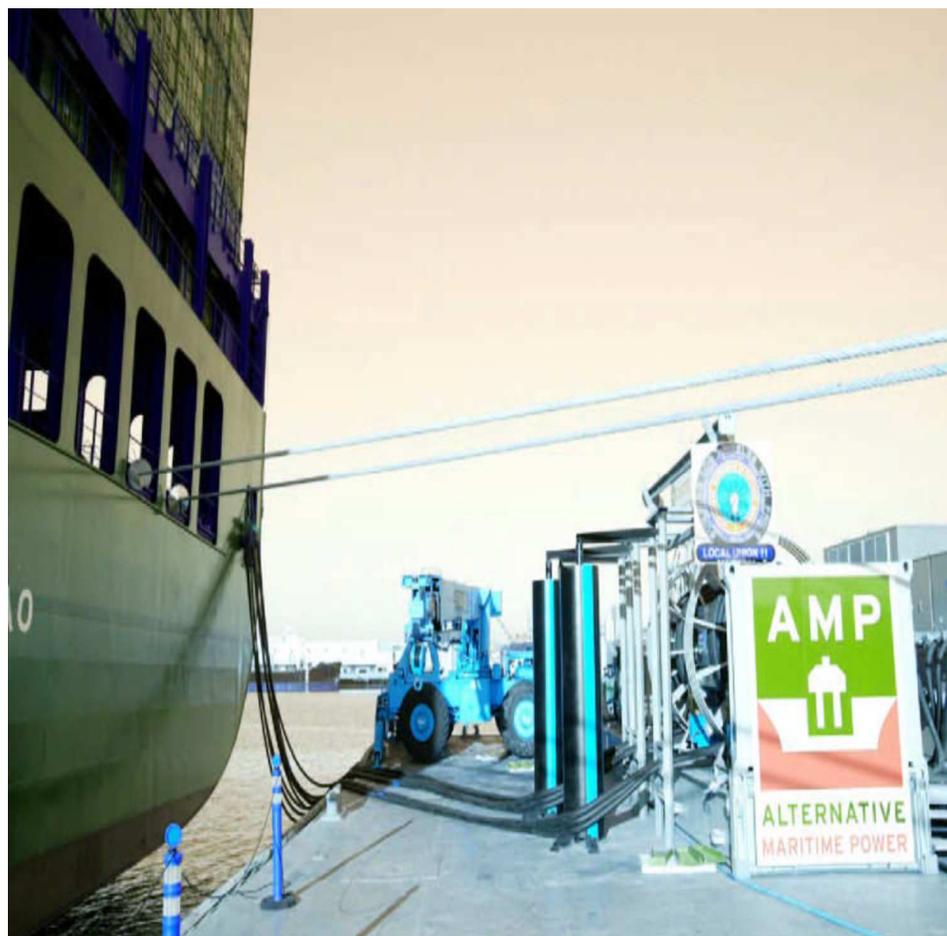


Other Vessel Categories

- ◆ Continue to evaluate other ship categories
- ◆ Proposed requirements for Board Consideration in 2008



PROPOSED REGULATION



Key Elements of Proposal

- ◆ Maximize diesel PM and NOx reductions, with CO₂ reductions as a co-benefit
- ◆ Target ship categories most suitable for shore power
- ◆ Affect fleets that make more than 25 visits to a port
- ◆ Provide flexibility by allowing alternative technologies that achieve emission reductions
 - Can be implemented expeditiously
 - Achieves equally effective reductions
- ◆ Design schedule to obtain reductions as soon as practical
- ◆ Require all ships to use shore power if available

Affected Terminals

- ◆ Thirty-one terminals at six ports have fleets with 25 or more annual visits
 - Hueneme: 1 reefer terminal
 - Long Beach: 8 container and 1 passenger terminal
 - Los Angeles: 7 container and 1 passenger terminal
 - Oakland: 10 container terminals
 - San Diego: 1 reefer and 1 passenger terminal
 - San Francisco: 1 passenger terminal

Affected Berths

- ◆ Each terminal has one to four berths
- ◆ Total berths at each port
 - Hueneme: 3 berths
 - Los Angeles: 23 berths
 - Long Beach: 23 berths
 - Oakland: 23 berths
 - San Diego: 3 berths
 - San Francisco: 1 berth

Regulatory Impact

- ◆ Thirty-one terminals at six ports
 - 2014: 44 berths initially
 - 2020: 32 additional berths
- ◆ Ship operators
 - 2014: 300 initial ships
 - 2020: 450 ships
 - Ship re-deployment 700 ships

Grid-Based Shore Power

- ◆ Requires capital-intensive improvements to terminals and ships
- ◆ Terminals at four of the six affected ports are expected to extensively use grid-based power
- ◆ Proven technology
 - U.S. Navy
 - Passenger ships on West Coast
 - Container ships in California

Shore Power Activity at California Ports

- ◆ San Pedro Ports Clean Air Action Plan
 - Commitment to modify 22 berths at 15 terminals; plans to use grid-based power for 1,000 visits by 2011
- ◆ Two berths currently operating at POLA
- ◆ Five additional berths operational at POLA/POLB during 2008



Other Potentially Viable Emission Control Techniques

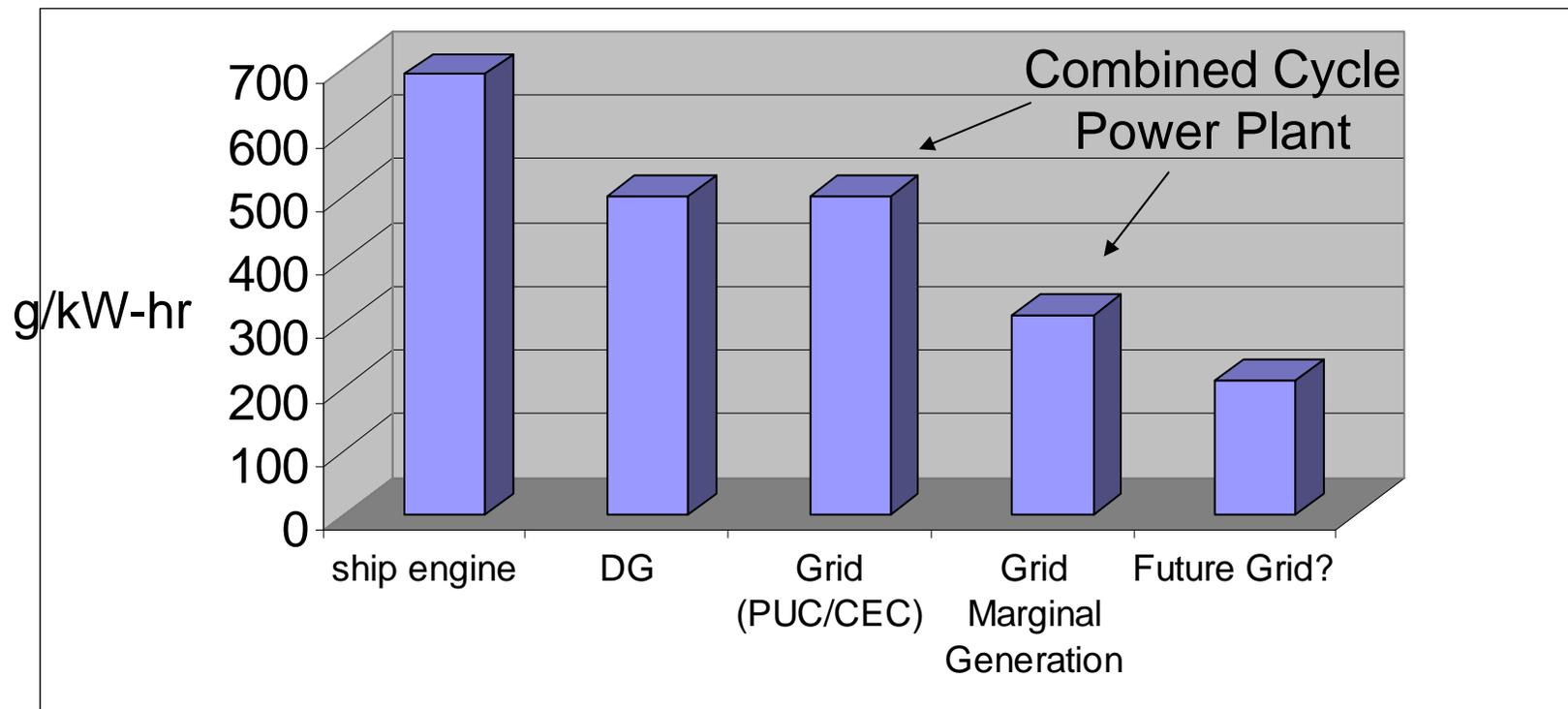
- ◆ Proposal allows other control technologies to achieve required emission reductions



Non-Grid Based Power Emission Statewide Standards

- ◆ Prior to 2014, emissions no greater than a spark-ignited engine manufactured to current standards: 2 g/kW-hr
- ◆ By 2014, require emissions to be closer to grid
 - NO_x: 0.2 g/kW-hr
 - CO₂ 500 g/kW-hr

CO₂ Emissions for Ship Power Sources



Revised Implementation Schedule

- ◆ **Establish two compliance options**
 - Grid-based power
 - Technology-neutral emission reduction
- ◆ **Establish compliance timelines consistent with implementation requirements**
- ◆ **Both options required to achieve:**
 - 50 percent reduction in 2014
 - 80 percent reduction in 2020
- ◆ **Add 70 percent emission reduction requirement in 2017**
- ◆ **Provide flexibility in early years for alternative technologies**

Additional Revisions Related to Implementation Schedule

- ◆ Reductions achieved earlier than or in excess of 2010 can be used for 2012 or 2017 target
- ◆ Similarly, 2012 early credits can be applied to 2017 target
- ◆ Switching from grid-based option to emission reduction option requires immediate compliance with 2010 or 2012 obligation

Recommended Implementation Schedule

Date	Reduced Onboard Power Option (Grid)	Emission Reduction Option
January 1, 2010	Ships must use shore power if available	10% reduction
January 1, 2012	Ships must use shore power if available	25% reduction
January 1, 2014	50% visits and power demand	50% reduction
January 1, 2017	70% visits and power demand	70% reduction
January 1, 2020	80% visits and power demand	80% reduction

Terminal Requirements

- ◆ Plan document due in 2009 to Executive Officer indicating how requirement is satisfied
 - Terminal declares to Executive Officer necessary infrastructure improvements to support ship emission reductions
- ◆ Follow-up reports
- ◆ Fleet reporting requirements similar

AIR QUALITY BENEFITS



Regulation Benefits

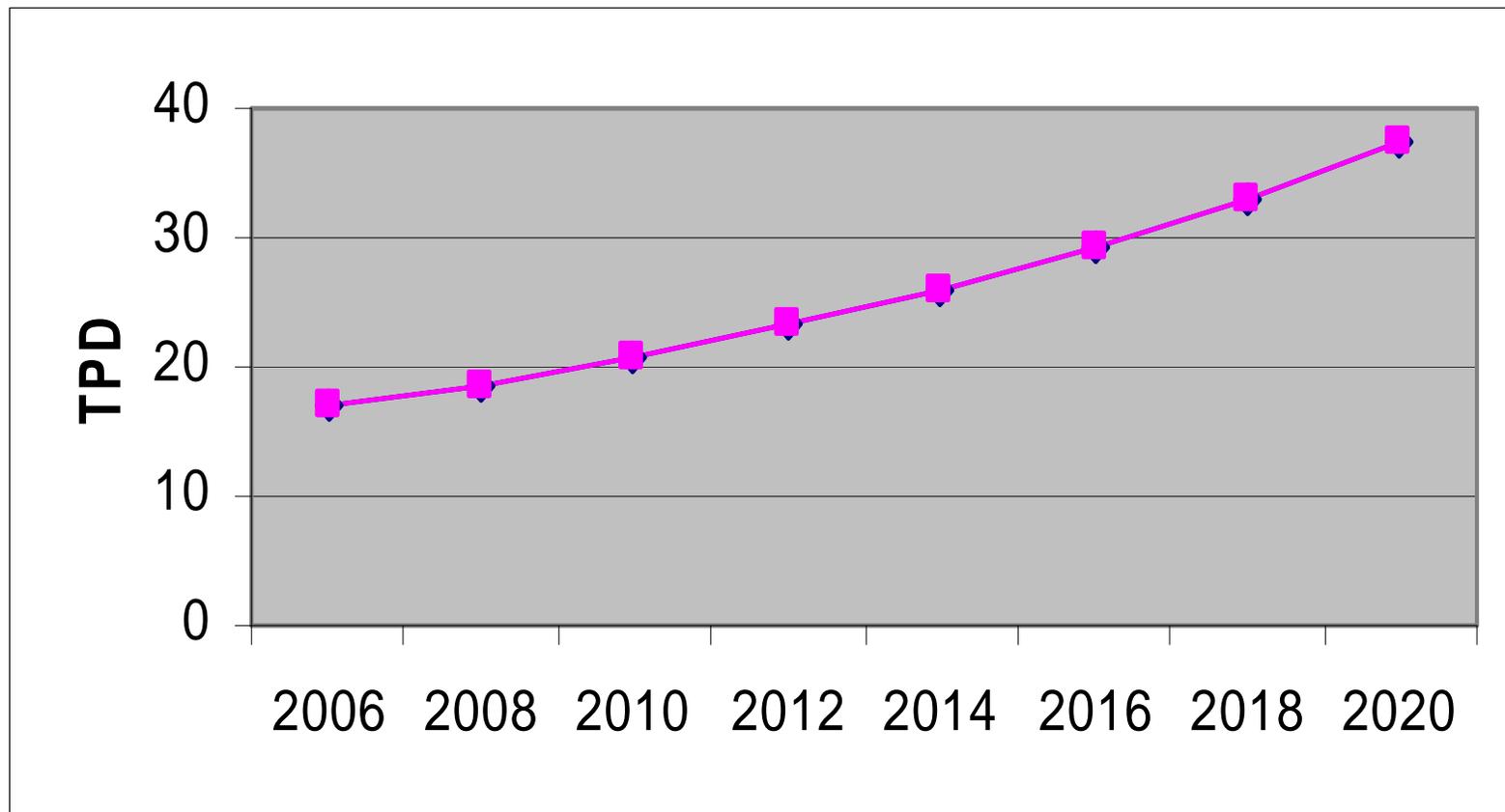
◆ Emission reductions in 2014

- PM: 0.24 tons per day
- NO_x: 13 tons per day
- CO₂: 60,000 to 120,000 metric tons per year

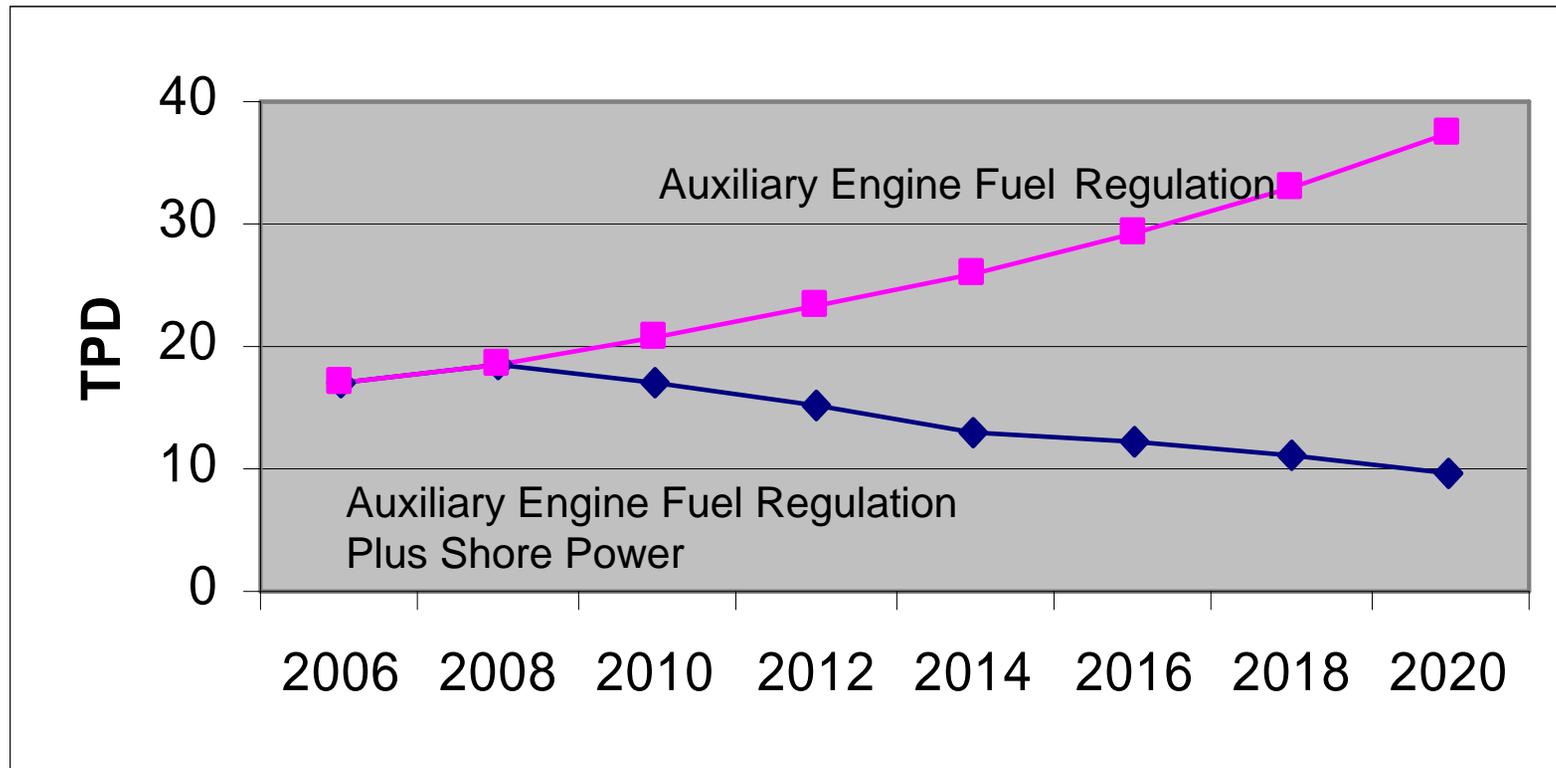
Emission reductions in 2020

- PM: 0.5 tons per day
- NO_x: 28 tons per day
- CO₂: 120,000 to 240,000 metric tons per year

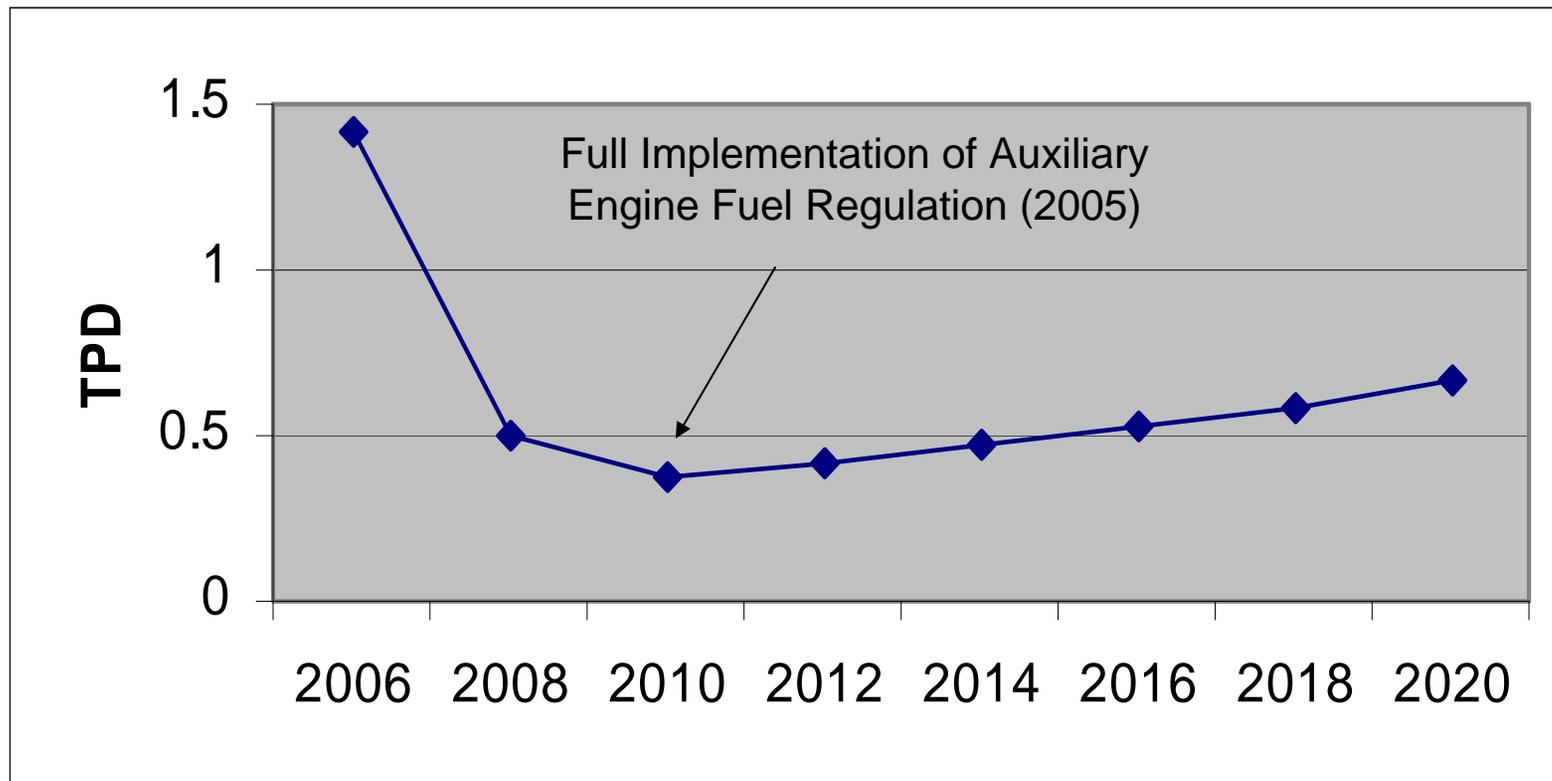
NOx Emissions



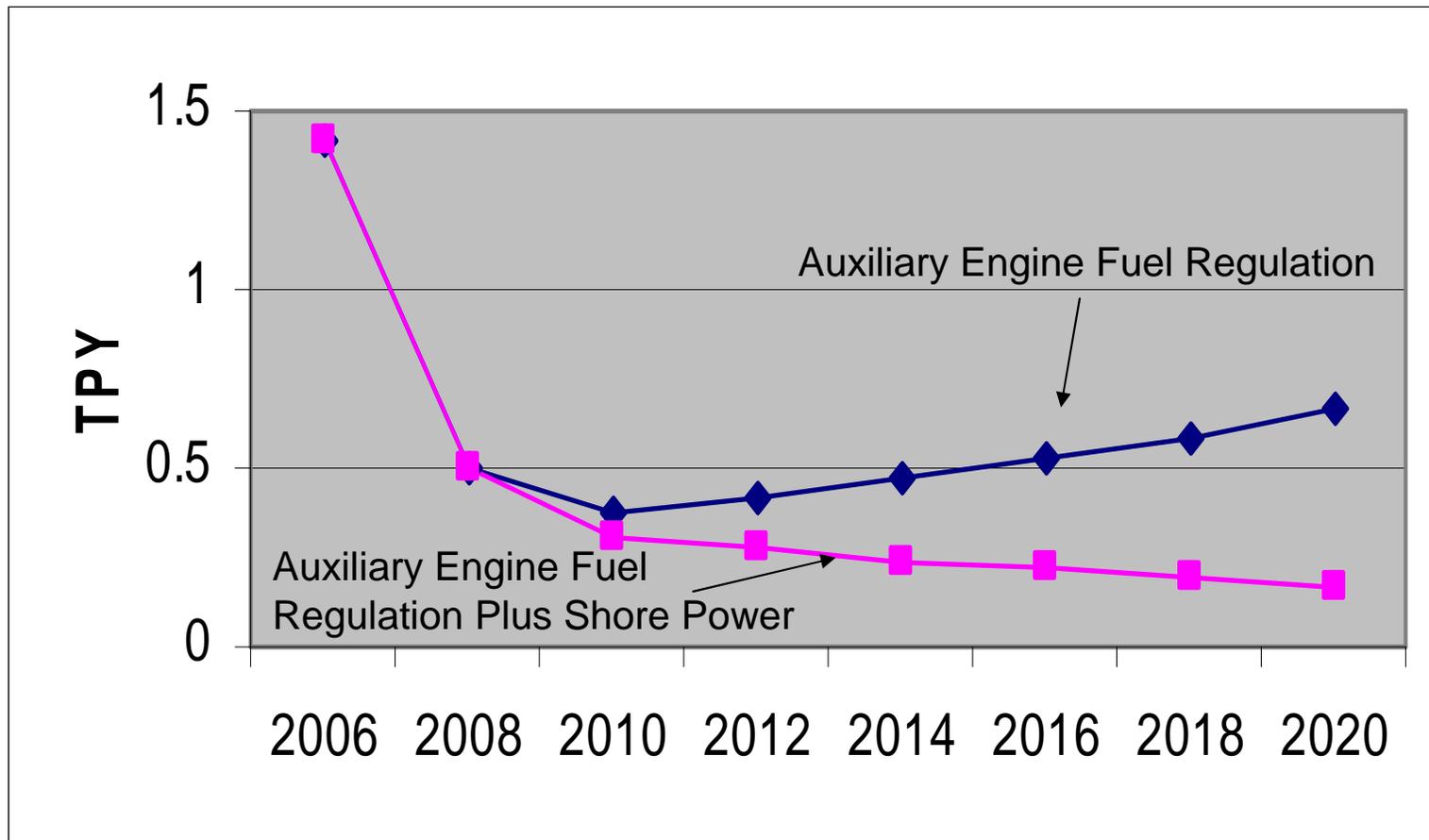
NOx Reductions



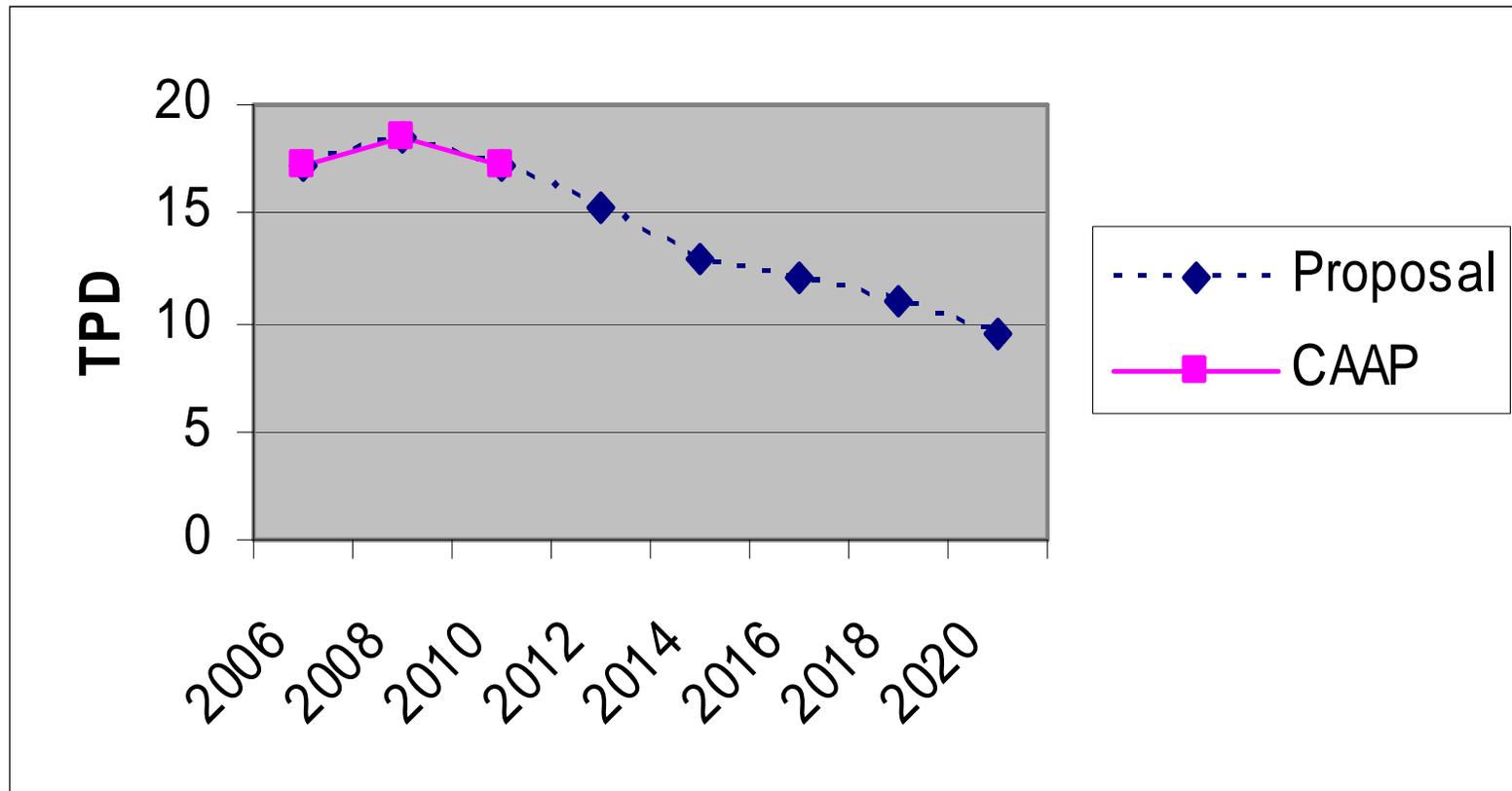
PM Emissions



PM Reductions



NOx Reductions Provided by Clean Air Action Plan



Cumulative Health Benefits

- ◆ Significant reduction in near-source cancer risk
- ◆ Ports of Long Beach and Los Angeles Health Risk Assessment
 - Population exposed to 10 in a million or greater risk reduced by 50 percent in 2014
 - Population exposed to 10 in a million risk reduced by 70 percent in 2020
 - Proposal eliminates all levels of risk greater than about 25 in a million from this source's emissions

Cumulative Health Benefits

(Continued)

◆ Health benefits (2009-2020)

– Premature deaths avoided:	280
– Respiratory impacts avoided:	8,200
– Work loss days avoided:	49,000
– Minor restricted activity days avoided:	280,000

ESTIMATED COSTS



Estimated Costs

- ◆ Overall costs of \$1.8 billion dollars (2006 dollars)—assuming grid power is used
 - 65 percent for ship modifications
 - 20 percent for shore modifications
 - 15 percent operating costs
- ◆ Components of costs
 - 76 berths at six ports
 - 750 ships initially and 700 replacement container ships

Summary of Cost Effectiveness

Emissions	Total Cost Effectiveness
All Costs Assigned to Pollutant	
NOx	\$6/lb
PM	\$350/lb
Divide Costs Equally Between NOx and PM	
NOx	\$3/lb
PM	\$175/lb

Potential State Funding to Incent Early Reductions

- ◆ Proposition 1B Bond Funding
 - Staff bringing recommended guidelines to the Board next month
 - Funding potentially available for early grid-based shore power and clean DG
- ◆ Carl Moyer Funding
 - Staff bringing proposed revisions to the Board in 2008
 - Revisions will explicitly address shore power

Additional Proposed 15-Day Changes

- ◆ Definitions
 - Fleet
 - Person
 - Regulated California Waters
- ◆ Amendments to recordkeeping, reporting, and plan requirements
- ◆ Clarify violation provisions
- ◆ Technical Modifications

Additional Public Comments

- ◆ Implement requirements sooner
- ◆ Require more stringent BACT
- ◆ Require ports to be responsible for plans

Summary and Recommendations

- ◆ Satisfies multiple goals of the Board
- ◆ Cost-effective
- ◆ Staff recommends the board adopt the regulation with staff's proposed modifications