



# **North America Emission Control Area**

## **U.S. Experience**

PPCAC Conference

Shanghai

October 2015



# Big Picture



- Goods movement system
  - Powers our global economy and trade
  - Multi-modal system—trucks, trains, ports, ocean, harbor and river vessels, and port cities
  - Multi-media impacts to air, climate, water, waste, ecosystems, communities, human health...
- Port cities & ports are the hubs of global goods movement
  - Economic activity and environmental impacts
  - Bring stakeholders together
  - Develop sustainability solutions (economic, environmental, human health)



# Focus on Ports/Cities and Vessels



- Approximately 7 of the largest oceangoing vessels produce power comparable to an average U.S. coal fired power plant (330MW)
- Emissions impact coastal and inland air quality, climate, human health, and sulfur deposition into both land and water
- Marine Ports/Cities are a hub and emissions sources are located close to large populations



PM2.5 = combustion particles + organic compounds + metals + acids, etc.

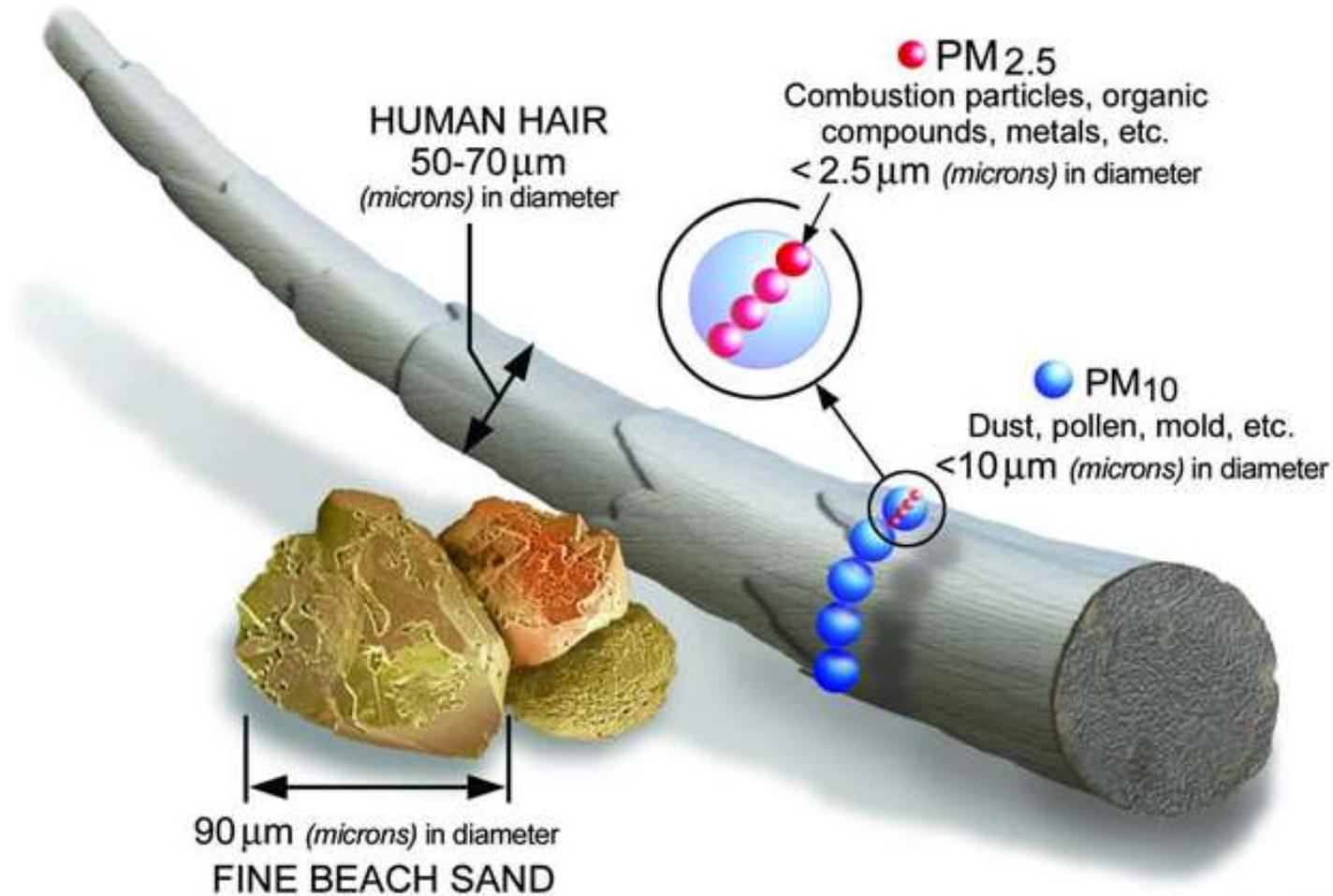


Image courtesy of the U.S. EPA

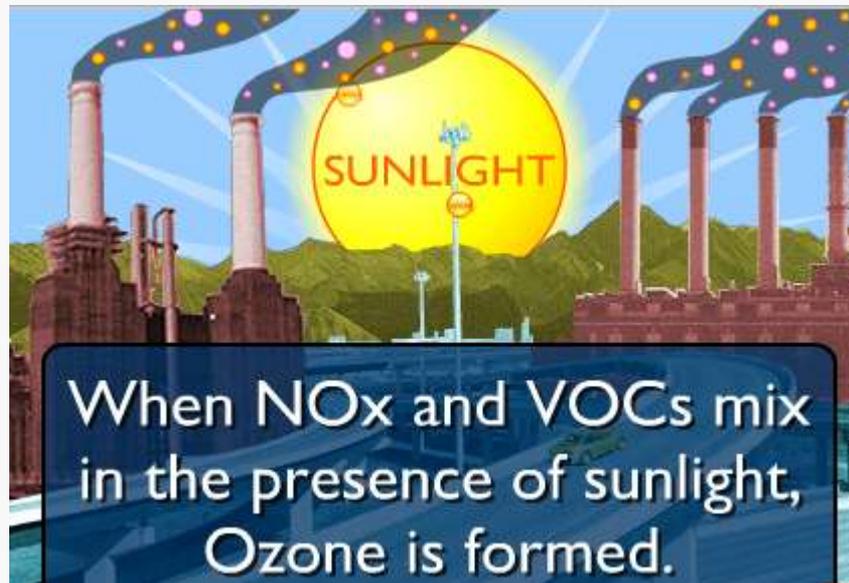
# NOx + VOCs + Sunlight = O<sub>3</sub>



NOx and VOCs come from factories and power plants, and....



NOx and VOCs also come from Cars & Trucks  
Ships, Trains, and Heavy Equipment



When NOx and VOCs mix in the presence of sunlight, Ozone is formed.

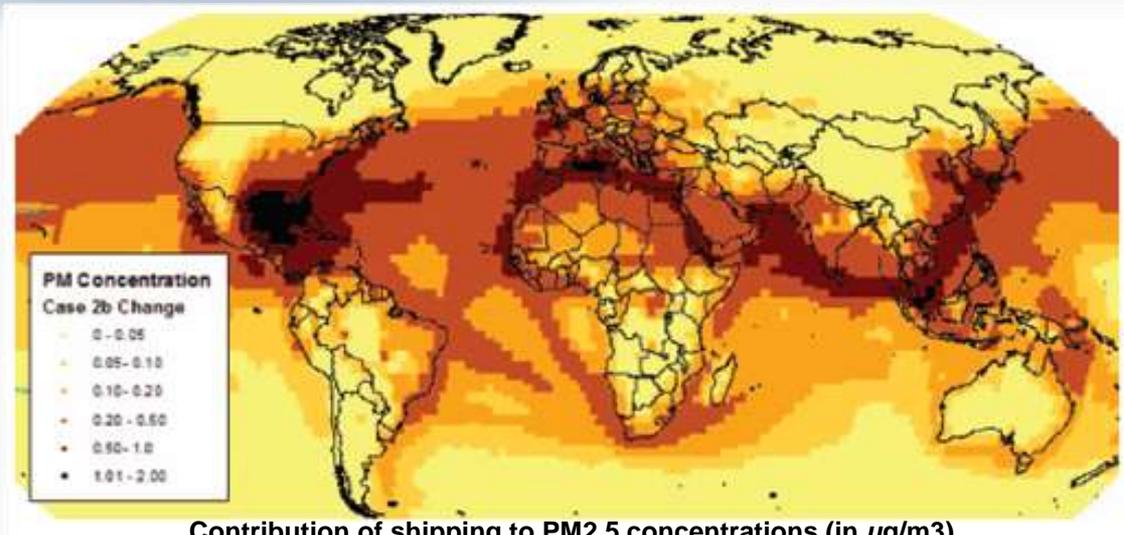


- Breathing O<sub>3</sub> can:
  - trigger chest pain, coughing, throat irritation, congestion
  - worsen and increase frequency of bronchitis, emphysema, asthma
  - reduce lung function, enflame lung lining
  - permanently scar lung tissue, with repeated exposure
- Damage sensitive vegetation and crops

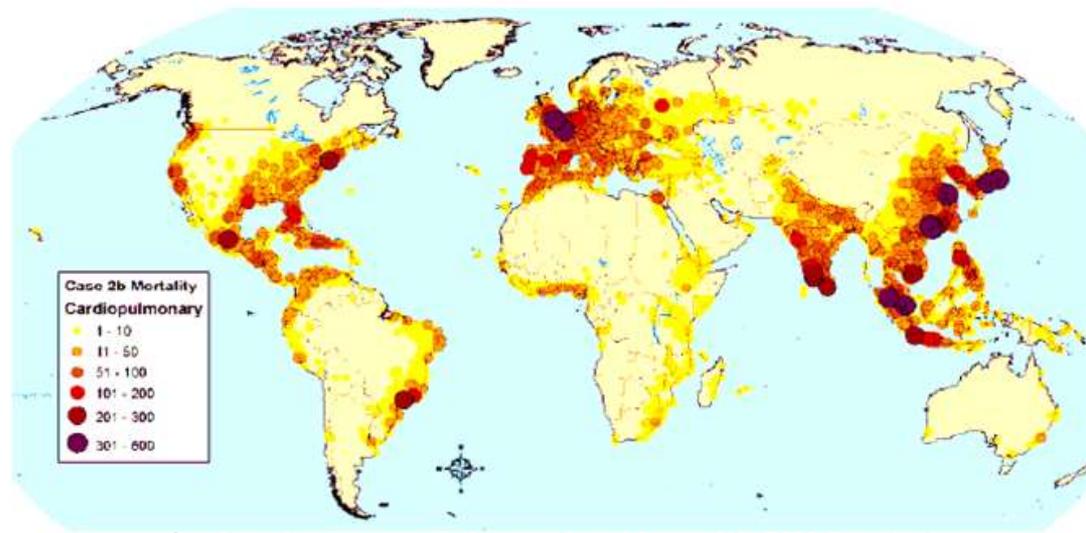


- Breathing PM<sub>2.5</sub> can result in
  - premature death in people with heart or lung disease
  - nonfatal heart attacks
  - irregular heartbeat
  - aggravated asthma
  - decreased lung function
  - increased respiratory symptoms, such as difficulty breathing, coughing or irritation of the airways
- Reduce atmospheric visibility, disrupt chemical balance of coastal and inland water, damage sensitive forest, crops, and ecosystems

# Global Health Perspective



Contribution of shipping to PM<sub>2.5</sub> concentrations (in  $\mu\text{g}/\text{m}^3$ )

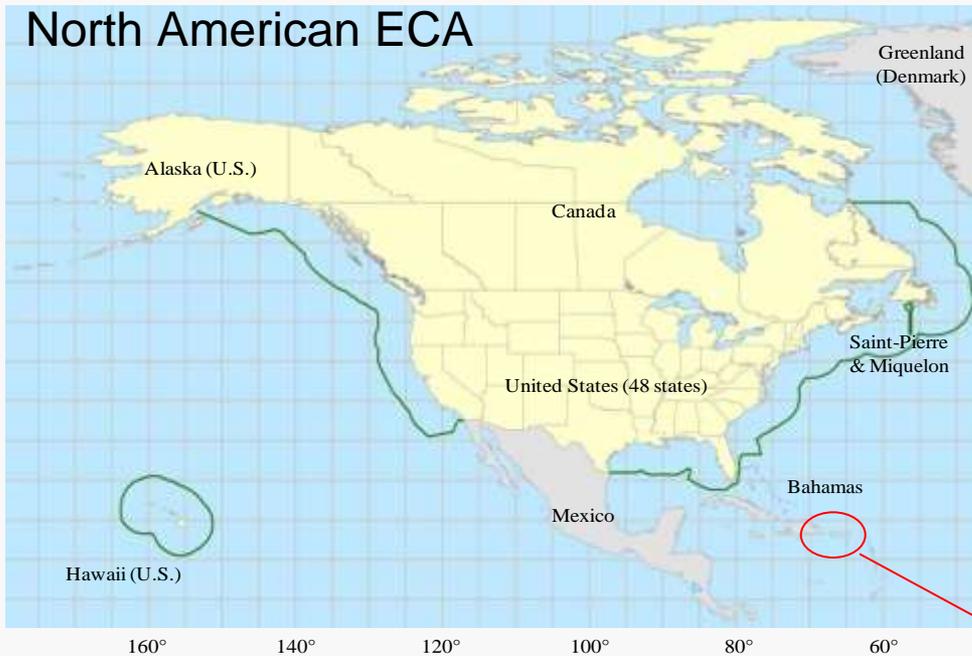


Cardiopulmonary mortality attributable to ship PM<sub>2.5</sub> emissions

# Emission Control Areas (ECA)



## North American ECA



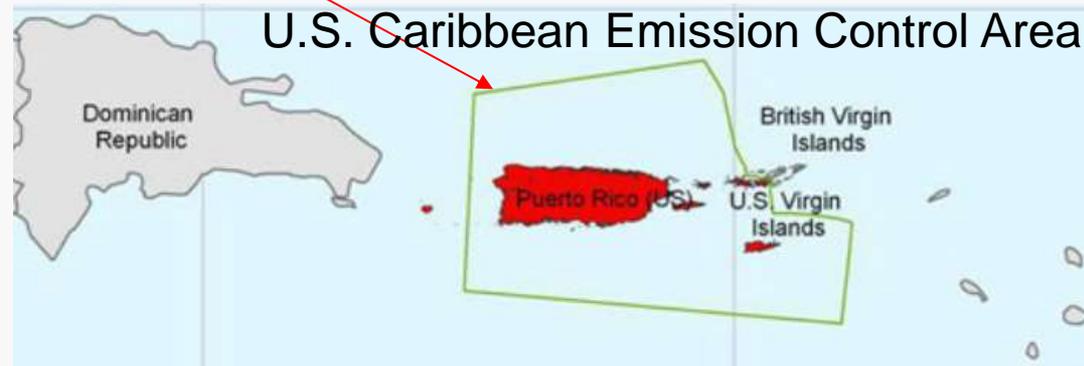
## North American ECA

- Adopted by IMO: March 26, 2010
- Entry-into-force: August 1, 2011
- Enforcement: August 1, 2012 (Reg. 14.7)

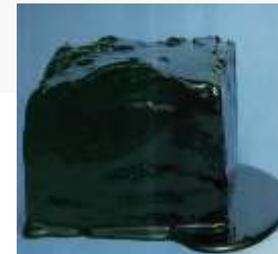
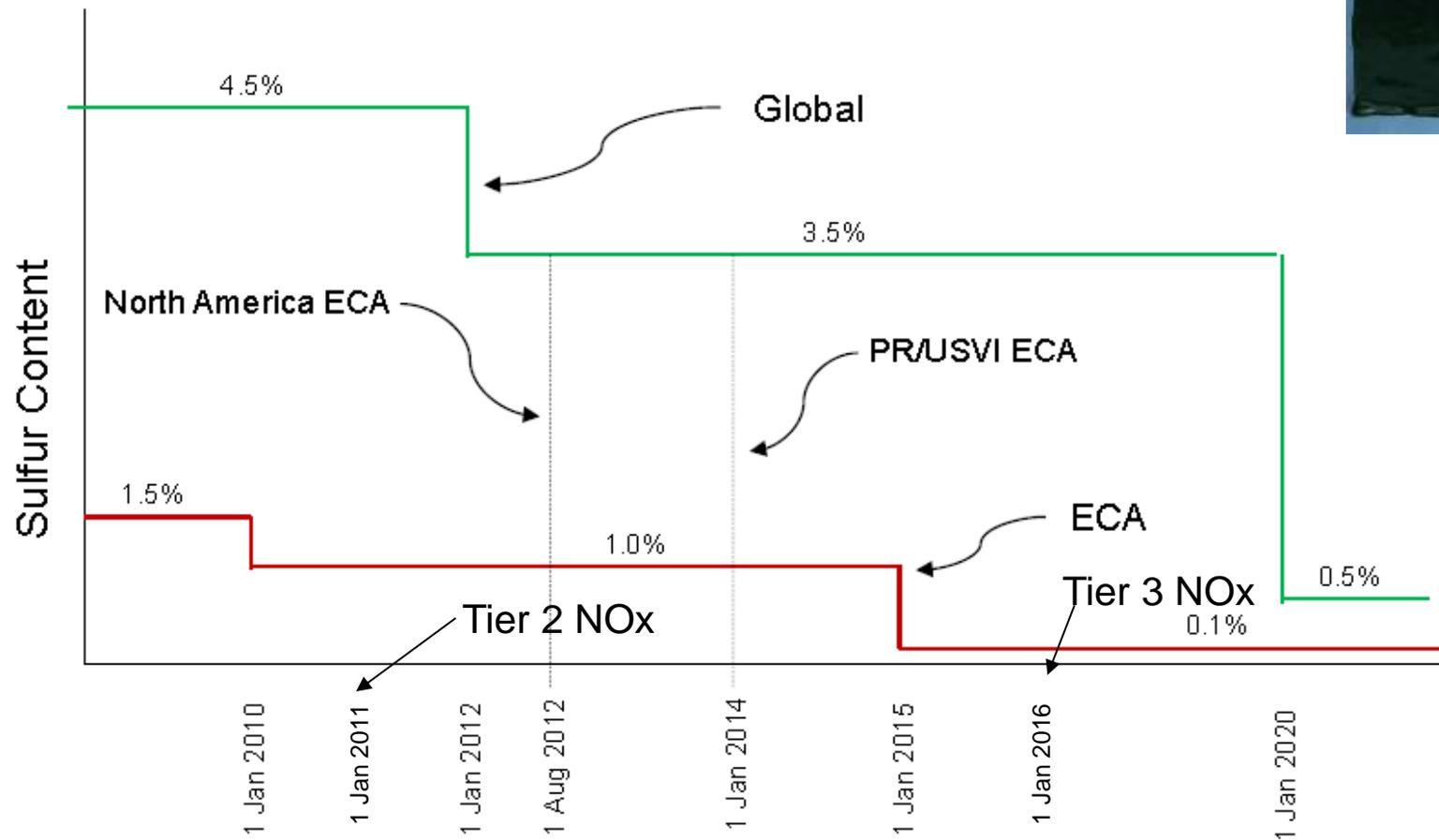
## U.S. Caribbean Sea ECA

- Adopted by IMO: July 15, 2011
- Entry-into-force: January 1, 2013
- Enforcement: January 1, 2014 (Reg. 14.7)

## U.S. Caribbean Emission Control Area



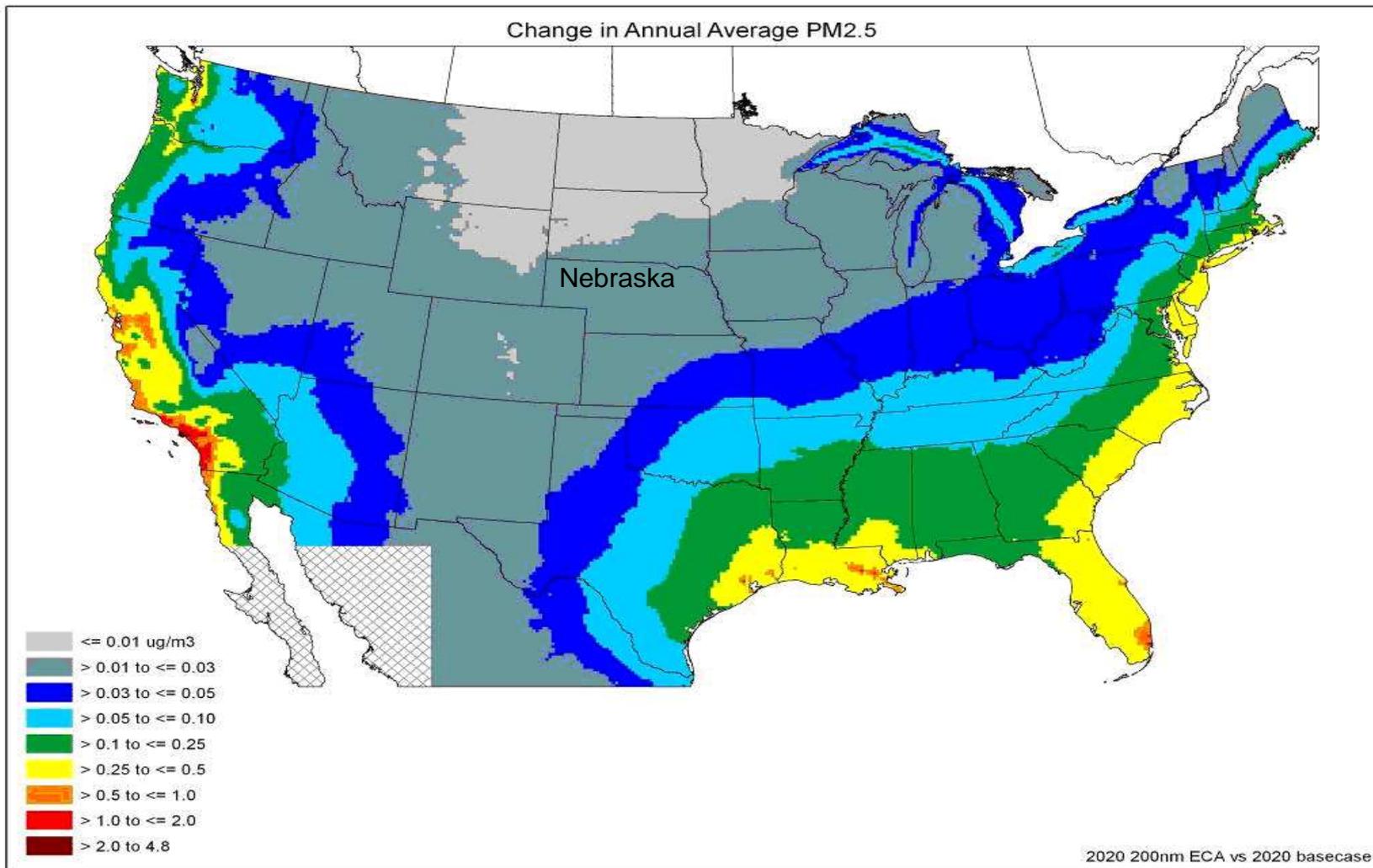
# Annex VI ECA Sulfur & NOx



# ECA Air Quality Benefits



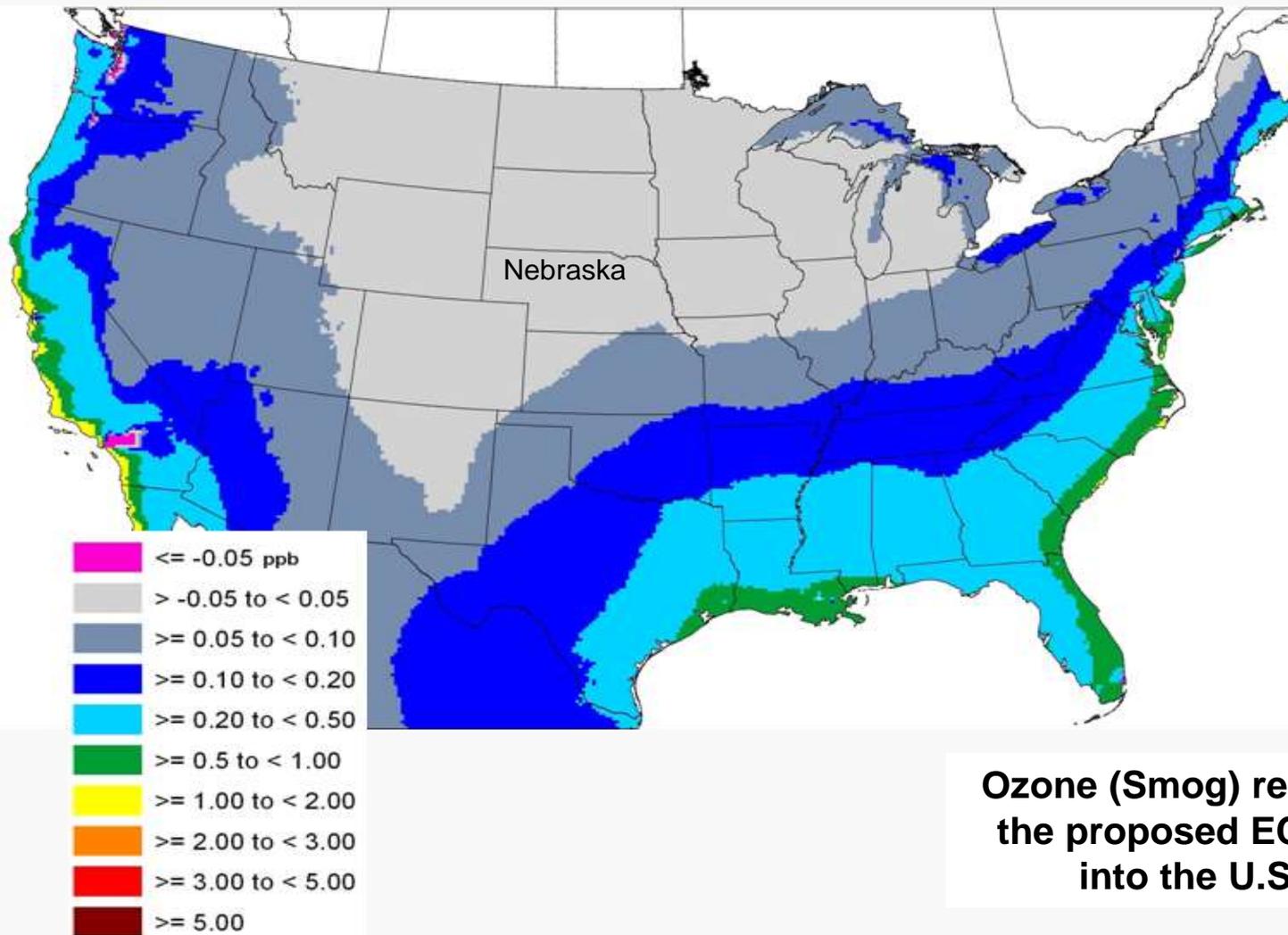
## 2020 Potential ECA PM<sub>2.5</sub> Reductions



# ECA Air Quality Benefits



## 2020 Potential ECA Ozone Reductions

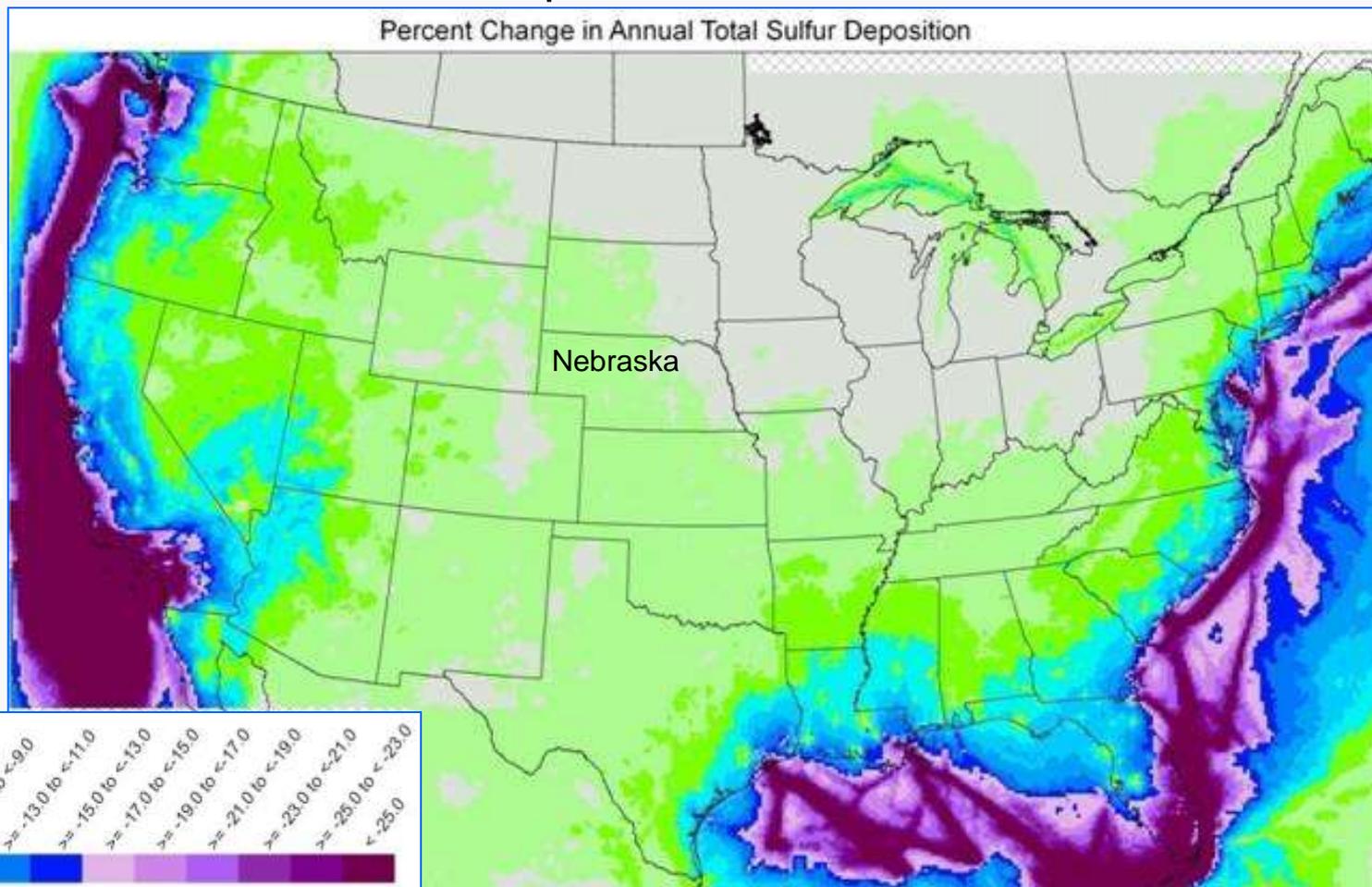


# ECA Air Quality Benefits



## 2020 Potential Sulfur Deposition Reductions

Improvements in deposition for marine and terrestrial ecosystems



# ECA Requirements.... Why?



- Purpose is to reduce emissions and improve public health in the North American and U.S. Caribbean Sea ECAs. *This is a health-based initiative that will have positive long-term impacts on port environments and the communities who live and work in those and adjacent areas.*
- Most dramatic improvements occur in port communities, but areas far inland from ports also see air quality benefits.
  - By 2030, nitrogen oxides (NO<sub>x</sub>): 1.2 million tons
  - Sulfur oxides (SO<sub>x</sub>): 1.3 million
  - Particulate matter (PM) 143,000 tons
- By 2030, the emission reductions associated with the coordinated strategy will prevent:
  - between 13,000 and 32,000 PM-related premature deaths
  - between 220 and 980 ozone-related premature deaths
  - about 1,500,000 work days lost
  - about 10,000,000 minor restricted-activity days

# Benefits & Costs



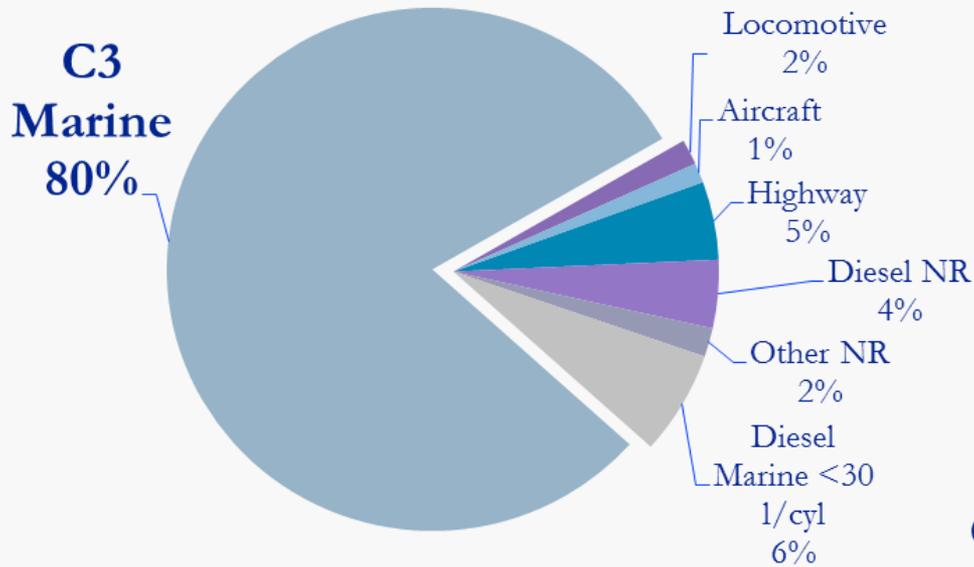
- In 2030 the estimated benefits are between \$110 and \$280 billion
- The estimated costs are much smaller: \$3.1 billion



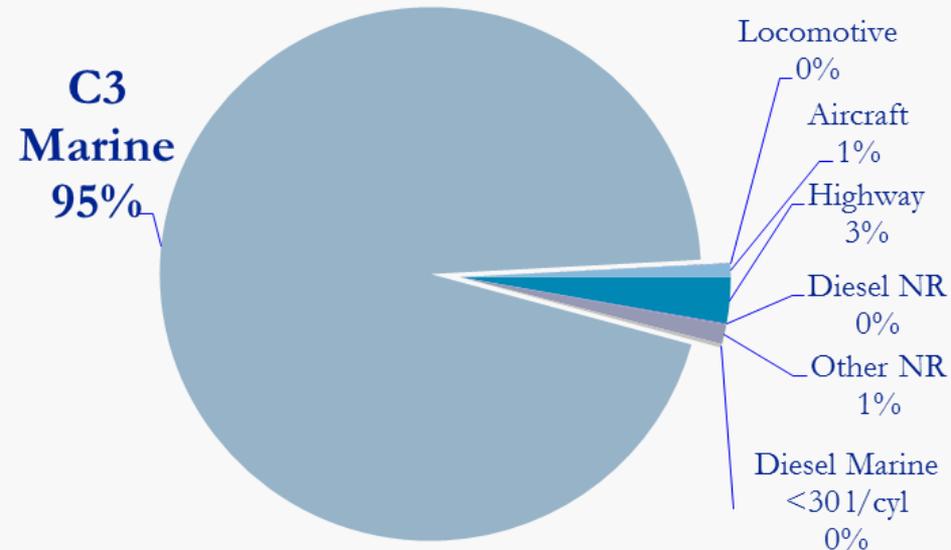
# SOx Ship Emissions



## 2009 Mobile Source SOx Inventory



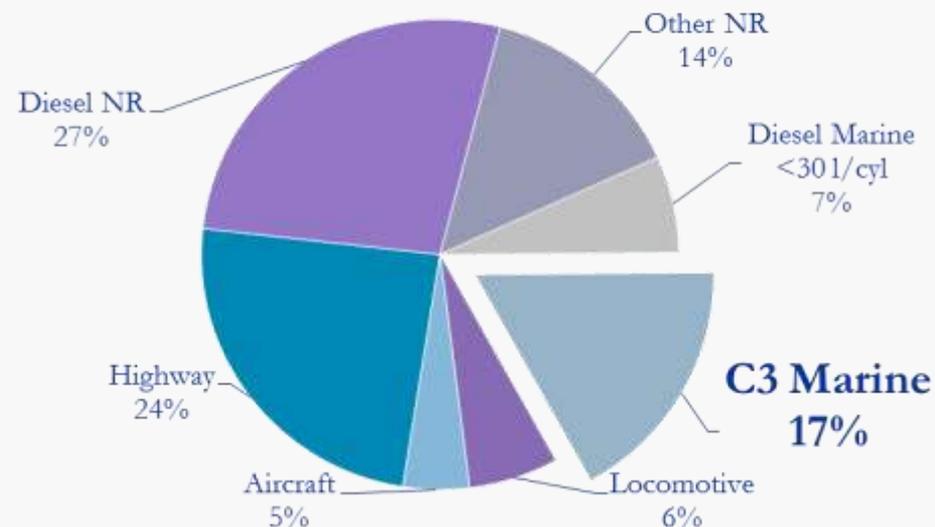
## 2030 Mobile Source SOx Inventory (without ECA controls)



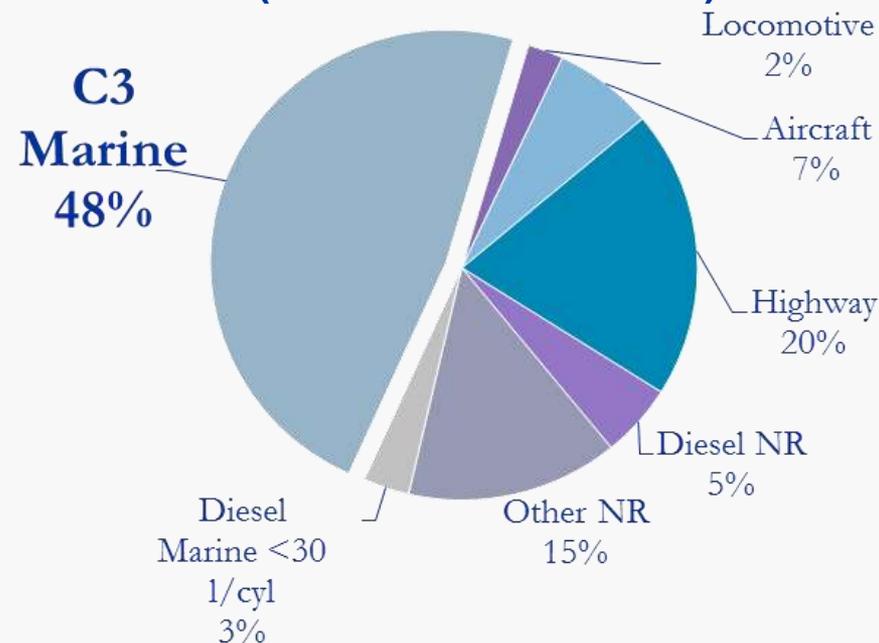
# PM<sub>2.5</sub> Ship Emissions



## 2009 Mobile Source PM<sub>2.5</sub> Inventory



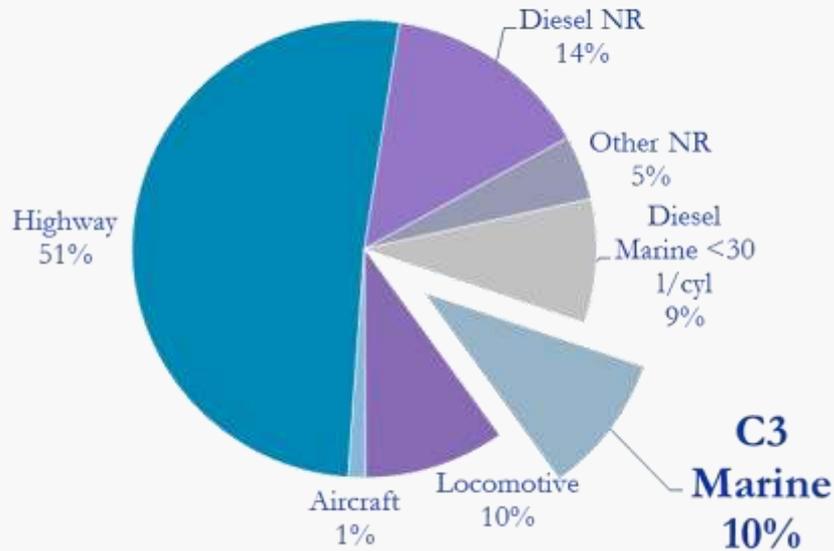
## 2030 Mobile Source PM<sub>2.5</sub> Inventory (without ECA controls)



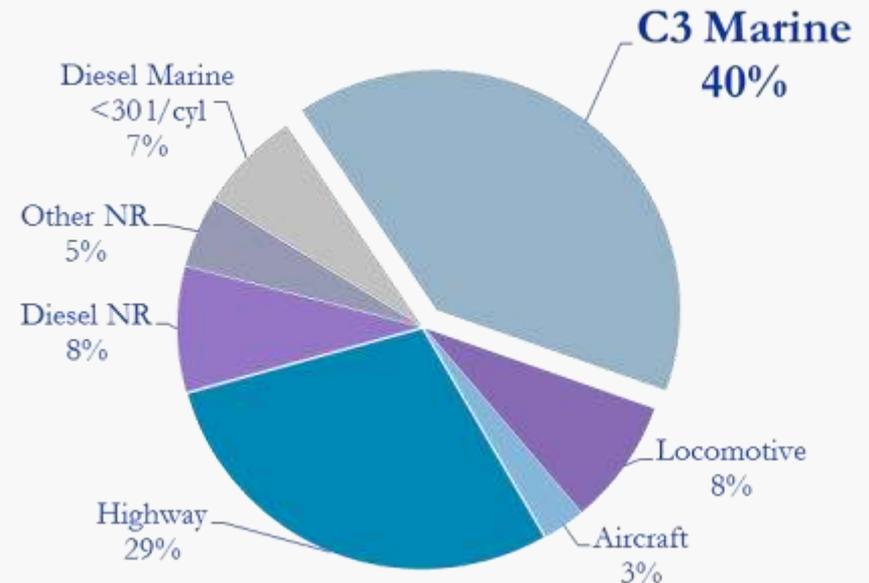
# NOx Ship Emissions



## 2009 Mobile Source NOx Inventory



## 2030 Mobile Source NOx Inventory (without ECA controls)



# Fuel Sulfur Requirements



## Annex VI , Reg. 14 Fuel Oil Sulfur Content Limits

### ECA Sulfur Content Cap

<i>Effective Date</i>	<i>Sulfur Limit %m/m (ppm)</i>
July 1, 2010	1.00% (10,000)
January 1, 2015	0.10% (1,000)

### Global Sulfur Content Cap

January 1, 2012	3.50% (35,000)
January 1, 2020	0.50% (5,000)

# Engine NOx Requirements



- Tier III NOx-January 2016
  - Applies to vessels with keels laid after 1/1/2016
- Will require after treatment
  - Selective catalytic reduction, exhaust gas recirculation, water injection strategies, dual fuel diesel/natural gas engines
- Applies in ECAs only (Tier II otherwise)

# Domestic Implementation and Enforcement



- U.S. domestic law implementing Annex VI—authorizes enforcement by two separate U.S. government agencies
  - U.S. Coast Guard has the lead on vessel inspections
  - U.S.EPA has the lead on shoreside fuel supplier inspections, and on violations that are referred to U.S. EPA by the U.S. CG for enforcement

# USCG Verification of Shipboard Compliance



- The USCG inspects U.S. and foreign flag vessels for compliance with Annex VI requirements during
  - comprehensive domestic inspections (Certificate of Inspection)
  - Port State examinations of foreign flag vessels

# USCG Verification of Shipboard Compliance



During U.S. Coast Guard Port State Control (PSC) Exam, ship operators should be prepared to:

- Demonstrate that fuel change over occurred prior to ECA entry/departure
- Show established fuel change over procedures
- Show entries in log book regarding:
  - Volume of LS fuel oil in each tank
  - Date, time, position of ship when change over was completed
- Show Bunker Delivery Notes
- Show MARPOL fuel samples
  - See USCG Policy Letters and ECA Job Aide



- USCG may document violations as deficiencies. Depending on the severity, these may result in the issuance of a "no-sail" (domestic) or detention (foreign) order.
- The USCG may require correction of the problem within a specified time frame (e.g., 30 days), allowing the vessel to continue to operate.
- For more severe deficiencies, the USCG may pursue enforcement action by issuing a Notice of Violation (NOV) or a civil penalty for resolution within the U.S. Coast Guard, or they may refer the case to the U.S. EPA (or the U.S. Department of Justice for criminal violations).



## Revocation of a Vessel's Customs Clearance

- If the USCG has reasonable cause to believe a ship, its owner, operator or person in charge, may be subject to a fine or civil penalty for a violation of Annex VI, domestic legislation authorizes revocation of the vessel's custom clearance.

## Letters of Undertaking

- The USCG may demand a Letter of Undertaking (LOU), bond or other surety satisfactory to the Coast Guard in lieu of revoking the vessel's customs clearance.



- Factors the USCG will use when determining whether to refer a matter to the USEPA include:
  - Repeat offenders
  - Evidence obtained from a case involving USEPA fuel-sampling or other assistance
  - Serious noncompliance, e.g., entering the ECA without compliant fuel onboard



## ■ USEPA Role

- Shore-side fuel supplier compliance
- Provide USCG with expert assistance on vessel fuel sampling
- Fuel Oil Non-Availability Reports (FONAR)
- Civil penalty enforcement
- Assistance in criminal investigations





- USEPA may adjudicate civil penalties for non-compliance
- USEPA enforcement is particularly targeting:
  - Shoreside fuel supplier violations
  - Ships detained by Coast Guard for substandard MARPOL Annex VI compliance
  - Ships that consistently fail to get LSFO or do not make best efforts to get LSFO (fuel oil non-availability issues – FONARs)



- Domestic legislation requires penalties be calculated taking into account “the nature, circumstances, extent, and gravity of the prohibited acts committed and, with respect to the violator, the degree of culpability, any history of prior offenses, ability to pay, and other matters as justice may require.”
- Civil penalty capped at \$25,000 per day, per violation (will be adjusted for inflation).



- Two main goals:
  - (1) Deterrence
  - (2) Level Playing Field
- Main components of a civil penalty calculation:
  - (1) Economic Benefit
  - (2) Gravity
  - (3) Other adjustments – to achieve a fair and equitable penalty



- Economic Benefit = avoided cost of purchasing compliant fuel
  - Differential in price between non-compliant fuel and compliant fuel
  - Quantity non-compliant fuel burned by the vessel and over how many days
  - Obtain information thru direct reporting or estimation. Underlying calculations depend on ship speed, distance traveled, assumed engine load, etc.



- Gravity – an amount to reflect the seriousness of the violation in terms of environmental harm
  - Penalty per ton of non-compliant fuel used based on sulfur level
- Recordkeeping Violations - ships burning non-compliant fuel may also be in violation of other requirements of MARPOL Annex VI
  - Failure to maintain appropriate written procedure showing how fuel change-over is to be done



## – Recordkeeping Violations con't–

- Failure to record volume of low sulfur fuel oil in each tank, as well as the date, time, and position of the ship when any fuel oil change over operation is completed prior to the entry into (or exit from) the ECA
- Failure to maintain bunker deliver notes or MARPOL sample

## – Adjustments to penalty can account for:

- degree of willfulness
- negligence
- cooperation
- history of noncompliance
- litigation risk
- ability to pay
- performance of supplemental environmental projects



- EPA will attempt to cooperatively settle civil penalty actions with violators.
- If settlement fails or there is insufficient/no cooperation, EPA will file a administrative complaint (there is no judicial action for the initial penalty under our domestic law).
- Default judgment to be collected against Letter of Undertaking (LOU).
- If no LOU, EPA has the option to pursue in rem action against the vessel.



- Assuring compliance with the ECA begins when voyage planning is initiated.
  - Can the vessel comply with the ECA with fuel currently on board?
  - If not, can the vessel take on fuel at an intermediate port?
  - If not, should the trip be assigned/contracted to a different vessel that *can* comply?
  - Then, voyage plan should be established.
- Expectation:
  - Voyage plan will reflect measures taken by ship owner and operator to assure entry into ECA with compliant fuel.

# ECA Exemptions & Equivalencies



- USCG works with USEPA in considering exemptions (Reg 3) and equivalencies (Reg 4)
- The USCG, in consultation with USEPA, is responsible for issuing exemptions or equivalencies for U.S. flagged vessels
- Foreign ships must follow their flag state's administration exemption or equivalency process
- USEPA and USCG review foreign ship proposals to consider acceptability to U.S. government
- USCG verifies compliance with method approved and documented in the IAPP to achieve equivalent emissions reductions



- Ships may be exempted from fuel sulfur limits for a period of time to allow for
  - operational trials for the development of new emission reduction and control technologies
  - other engine design improvements, for example
    - development of exhaust gas scrubber technologies
    - conversion to LNG fuel
- Exemptions require
  - clear and robust goals
  - specific terms
  - an aggressive schedule for technology testing



- U.S. Coast Guard Homeport: [www.Homeport.USCG.mil](http://www.Homeport.USCG.mil)  
Select the following links: Missions > Domestic Vessels  
> Domestic Vessel General > MARPOL ANNEX VI
  - CG-543 Policy Letter 09-01 (Annex VI Implementation)
  - CG-CVC Policy Letter 12-04 (ECA Compliance)
  - CG-CVC Policy Letter 13-02 (IEE/SEEMP)
- U.S. EPA MARPOL Annex VI
  - <http://www2.epa.gov/enforcement/marpol-annex-vi>
- U.S. EPA Ocean Going Vessels Air Emissions Web Page
  - <http://www.epa.gov/otaq/oceanvessels.htm>



Thank you  
谢谢

# ECA Designation Criteria

(MARPOL Annex VI, Appendix III, para 3.1)



- ✓ Criterion 1: delineation of the proposed area of application
- ✓ Criterion 2: type or types of emissions proposed for control
- ✓ Criterion 3: description of the human populations and environmental areas at risk from the impacts of ship emissions
- ✓ Criterion 4: assessment of contribution of ships to ambient concentrations of air pollution or to adverse environmental impacts
- ✓ Criterion 5: relevant information pertaining to the meteorological conditions in the proposed area of application to the human populations and environmental areas at risk
- ✓ Criterion 6: description of ship traffic in the proposed ECA
- ✓ Criterion 7: description of the control measures taken by the proposing Party or Parties addressing land-based sources
- ✓ Criterion 8: relative costs of reducing emissions from ships when compared with land-based controls, and the economic impacts on shipping engaged in international trade