U.S. Emission Control Areas

Briefing for the
Mobile Source Technical Review Subcommittee
Washington, DC

December 13, 2012

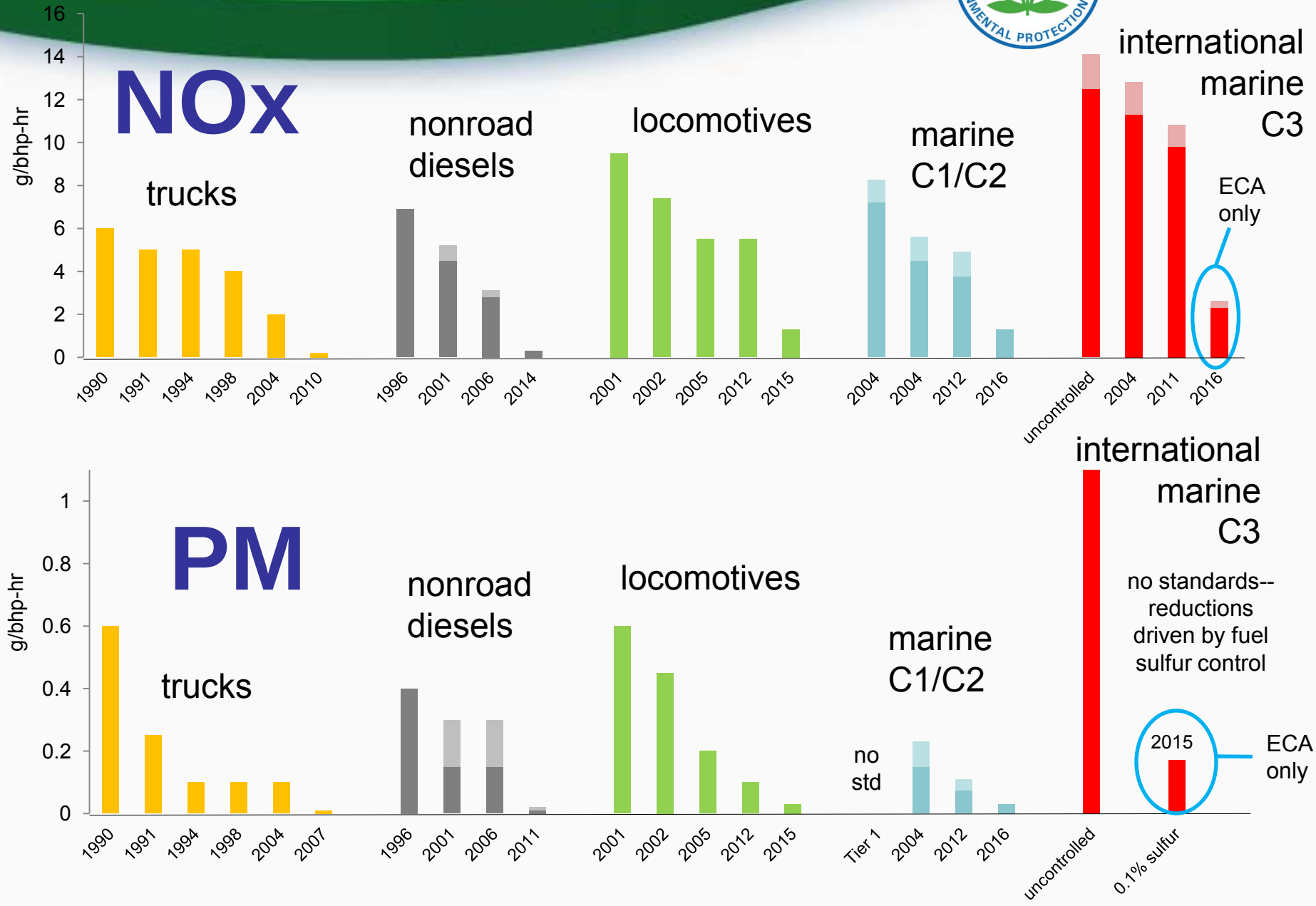
Agenda

- Why do we have ECAs?
- What is an ECA?
- How is the 2012 ECA 1.0% S limit implemented?
  - Fuel availability and price
  - Available compliance flexibilities
  - EPA concerns with “population-weighted emissions averaging”
- Conclusion

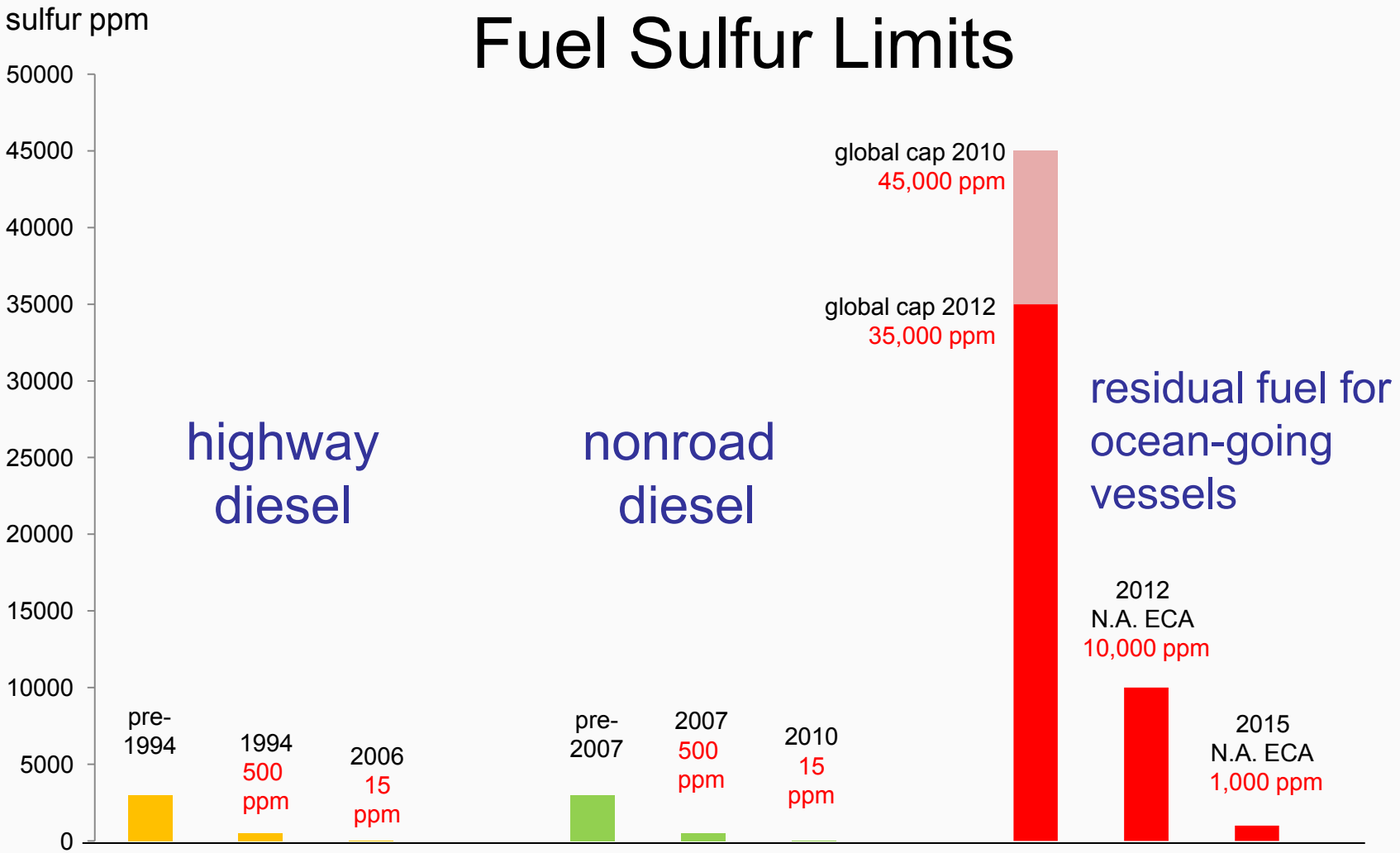
Why We Have an ECA

- The North American and Caribbean Emission Control Areas (ECA) address NOx, SOx and PM emissions, primarily from very large marine engines
  - Category 3 (C3): per-cylinder displacement at or above 30 liters
    - Ships using smaller engines must also comply, but are generally using fuel that meets the fuel sulfur requirements
  - C3 engines typically use residual fuel (heavy fuel oil)
    - Average sulfur content is about 2.7%
    - These ships refuel all over the world
  - Most ships with Category 3 engines that operate off U.S. coasts and visit U.S. ports are foreign flag

Progress in Diesel Emissions Standards

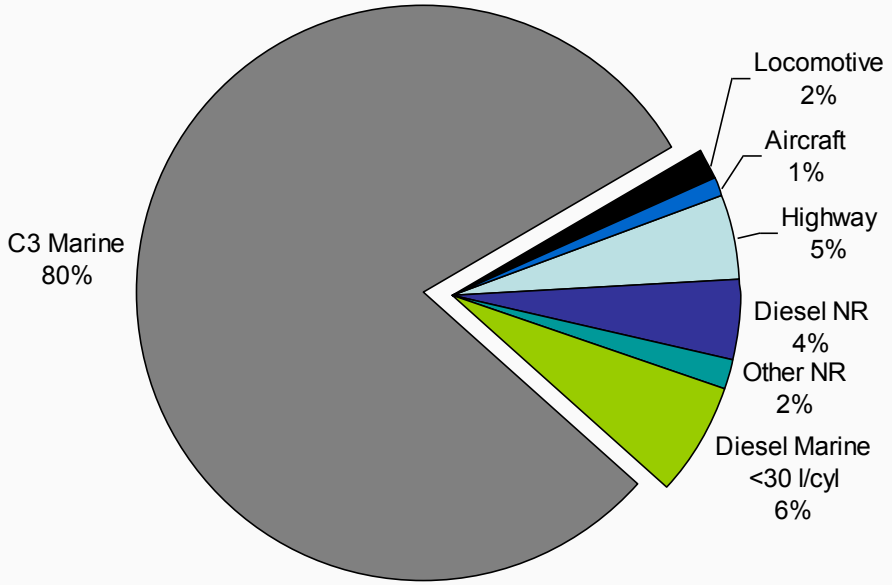


Fuel Sulfur Limits

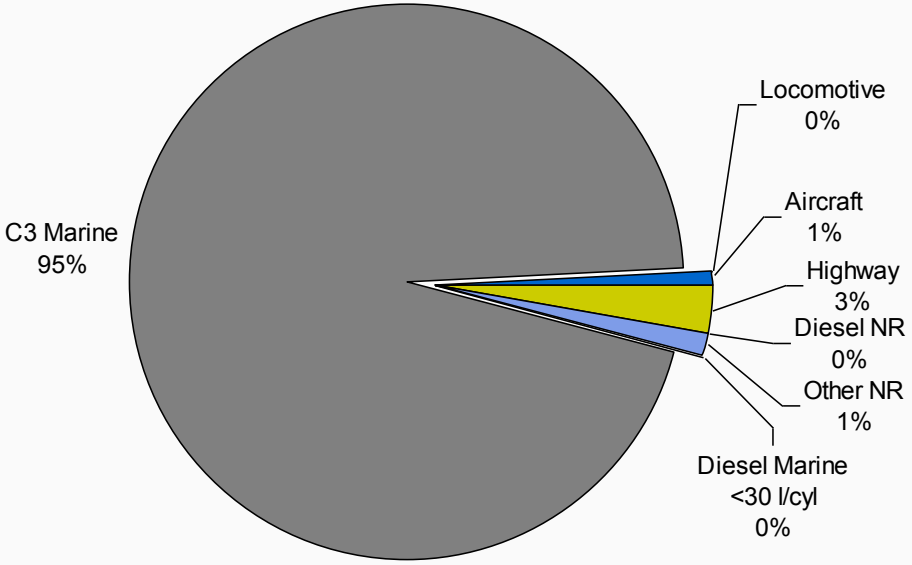


High and Growing SOx Emissions Without ECA Standards

2009 Mobile Source SOx Inventory

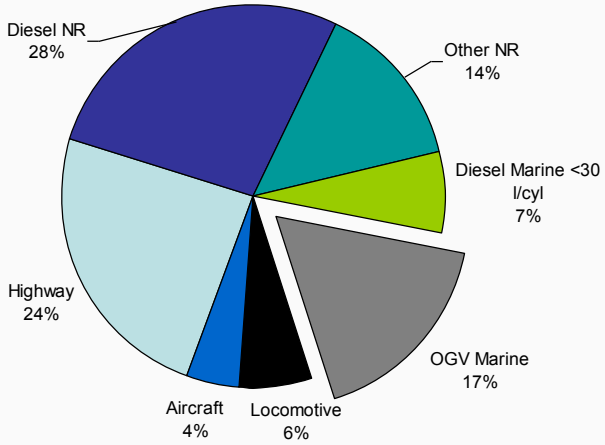


2030 Mobile Source SOx Inventory

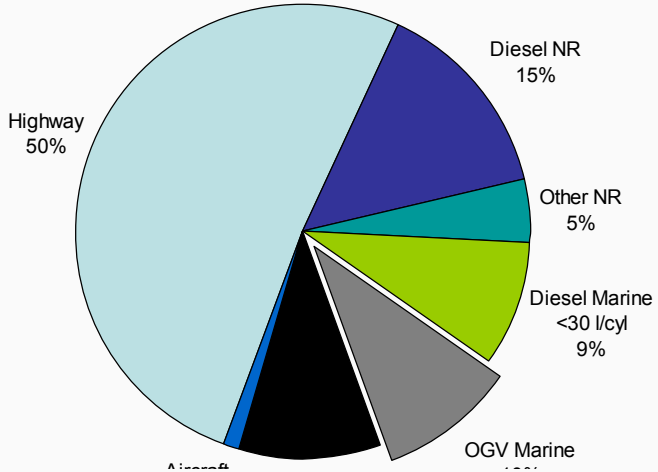


PM and NOx Emissions Also High Without ECA

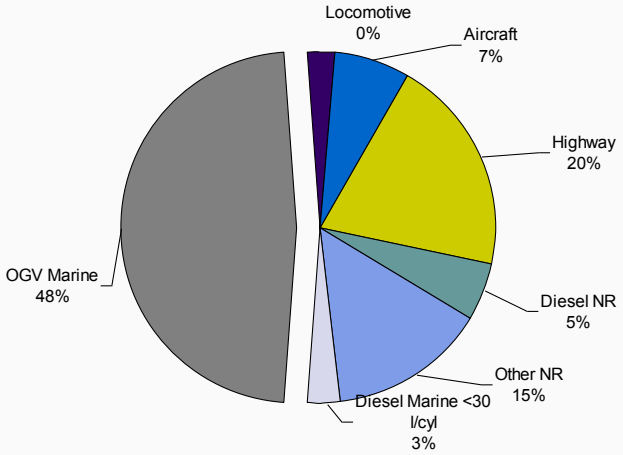
2009 Mobile Source PM2.5 Inventory



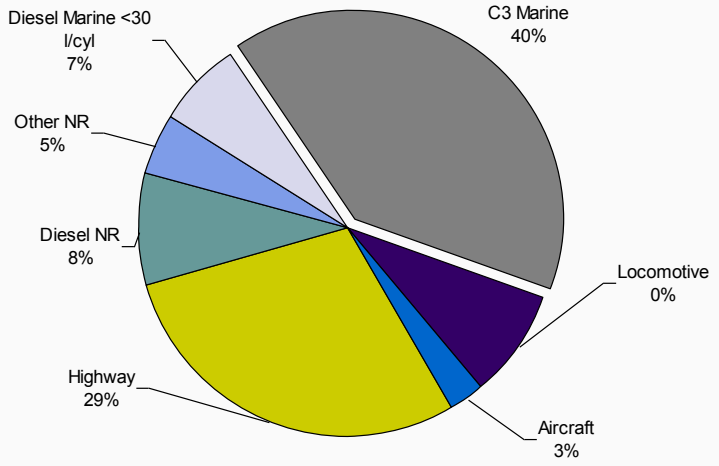
2009 Mobile Source NOx Inventory



2030 Mobile Source PM2.5 Inventory

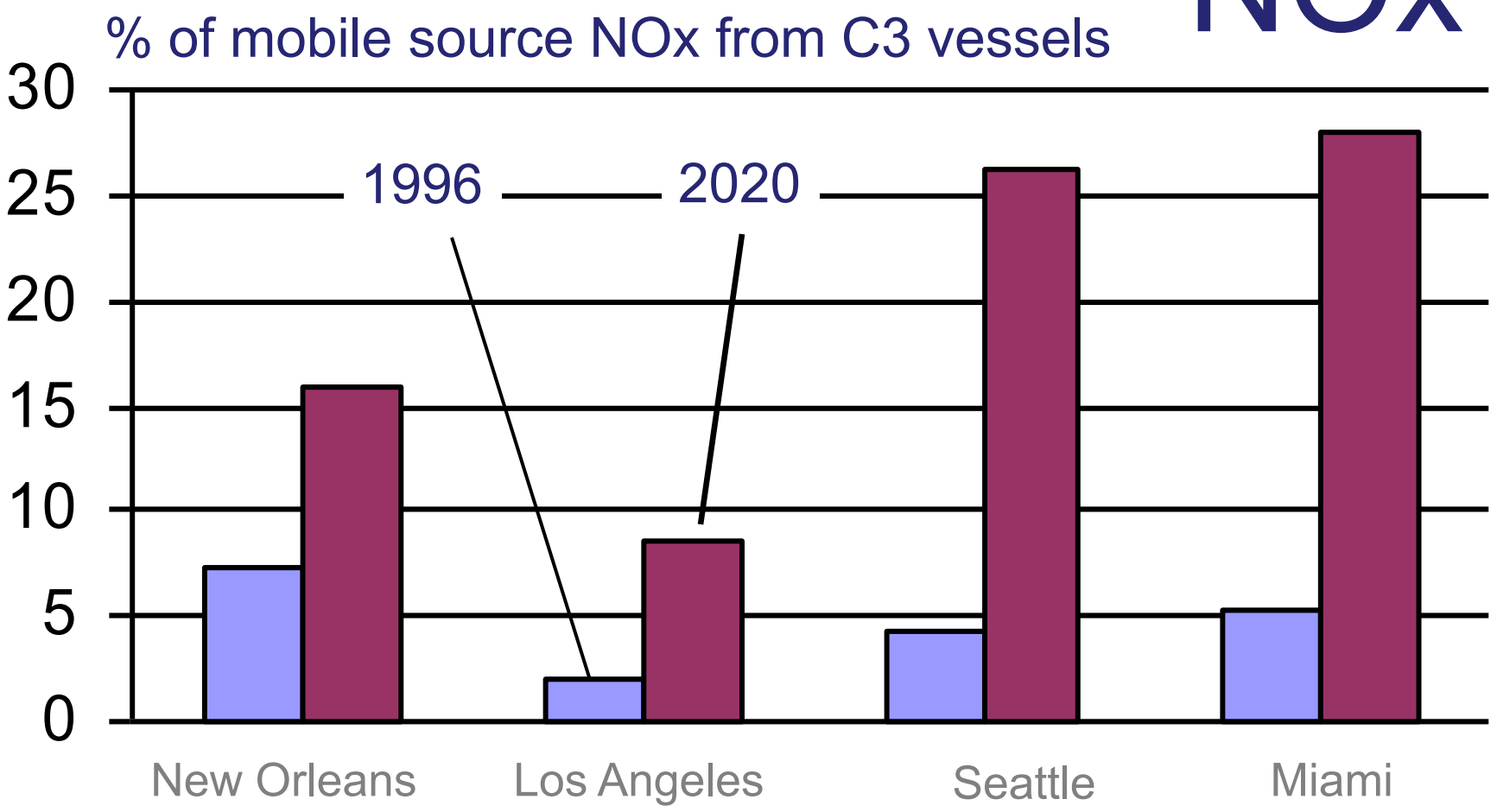


2030 Mobile Source NOx Inventory

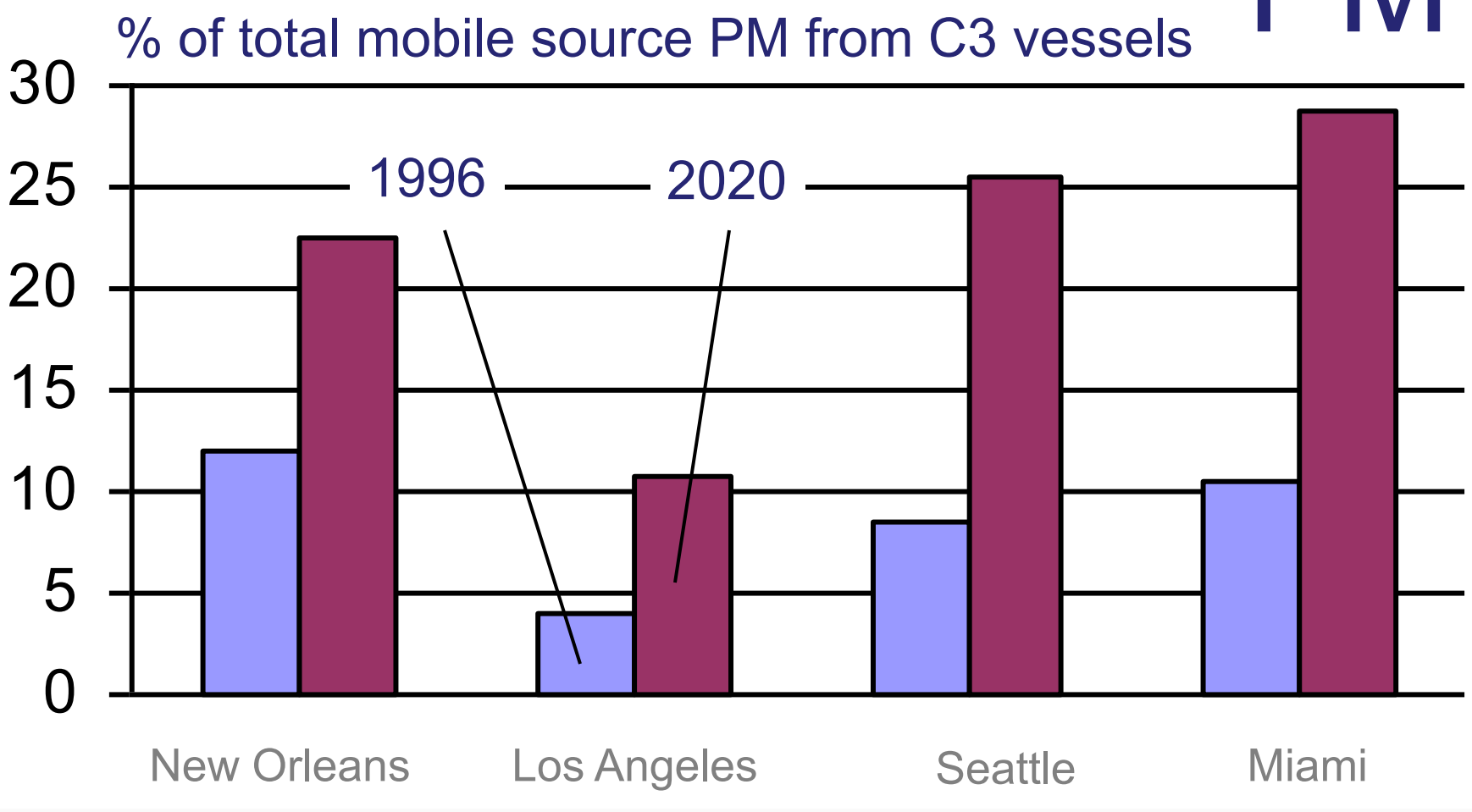


Pre-ECA Contributions in Individual Areas

NOx



PM


% of total mobile source PM from C3 vessels
30
25
20
15
10
5
0
1996
2020
New Orleans
Los Angeles
Seattle
Miami

Summary of C3 Marine Air Pollution Concerns

- Emissions from Category 3 marine engines cause harm to public health and welfare, and contribute to visibility impairment and other detrimental environmental impacts across the United States

- These engines also emit air toxics that are associated with adverse health effects

- **Emission Control Areas are the major regulatory programs the U.S. has implemented to reduce harmful air pollutants from ocean-going vessels**

MARPOL Annex VI and ECAs

- ECAs are designated by the International Maritime Organization (IMO) through amendment to Annex VI of the International Convention for the Prevention of Pollution from Ships (MARPOL)
  - Annex VI was adopted in 1997; went into effect in 2005
  - Standards apply to all ships, regardless of flag

- The original Annex VI requirements reflect control technologies from the 1990s
  - Engines: Tier I NOx limits, for engines >130 kW
  - Fuels: 45,000 ppm S cap

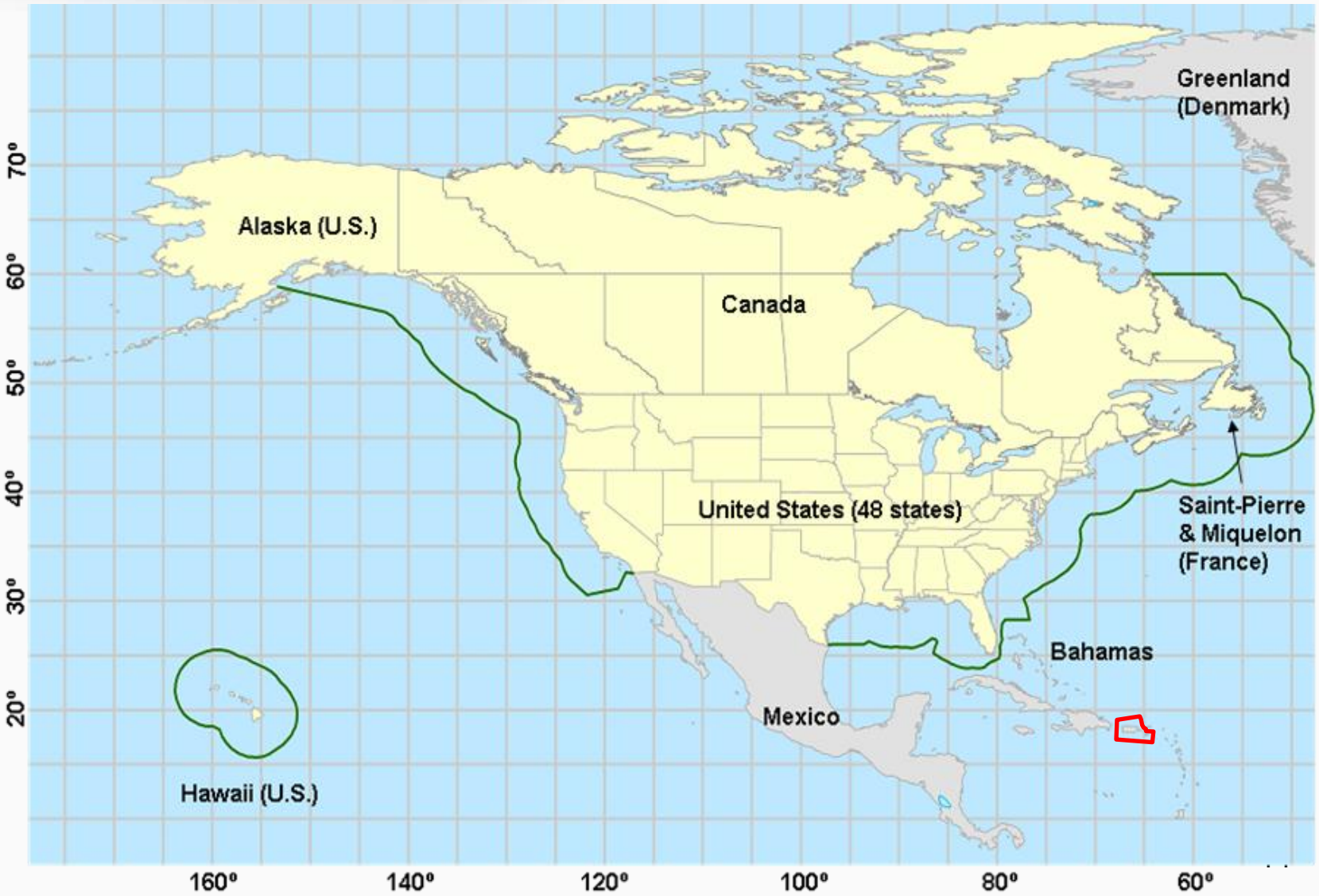
- The original Annex VI also included regional controls: SOx Emission Control Areas (SECAs)
  - 15,000 ppm S cap for fuel

2008 Amendments to Annex VI

- 2006: IMO began a process to amend Annex VI
- 2007: U.S. submitted a proposal for new tiers of NOx, PM, and SOx limits
  - To reflect current engine emission control technology
  - More stringent fuel sulfur limits to reduce SOx and PM emissions
  - This was the beginning of formal amendment discussions
- 2008: Amendments to Annex VI adopted
  - New global NOx and fuel sulfur limits
  - New regional controls: Emission Control Areas (ECAs)
    - 2 new tiers of fuel sulfur limits: 1.0% (2012); 0.1% (2015)
    - Aftertreatment-based NOx limits (2016)

History of the U.S. ECAs

- 2006-2008: U.S. worked at IMO to amend Annex VI for more stringent ECA controls
- 2008: U.S. deposited ratification with IMO
  - Senate gave consent in 2006, but amendments to Act to Prevent Pollution from Ships were necessary
- 2009: U.S., Canada, and France submitted North American ECA package
  - Based on extensive emission inventory and air quality modeling, assessment of human health and environmental impacts
- 2010: North American ECA adopted
  - Entered into force in 2011
  - Implementation began in 2012
- 2011: Caribbean ECA adopted
  - Enters into force in 2013
  - Implementation begins in 2014


Greenland
(Denmark)
Alaska (U.S.)
Canada
United States (48 states)
Saint-Pierre
& Miquelon
(France)
Bahamas
Mexico
Hawaii (U.S.)
70°
60°
50°
40°
30°
20°
160°
140°
120°
100°
80°
60°

North American ECA Emission Reductions

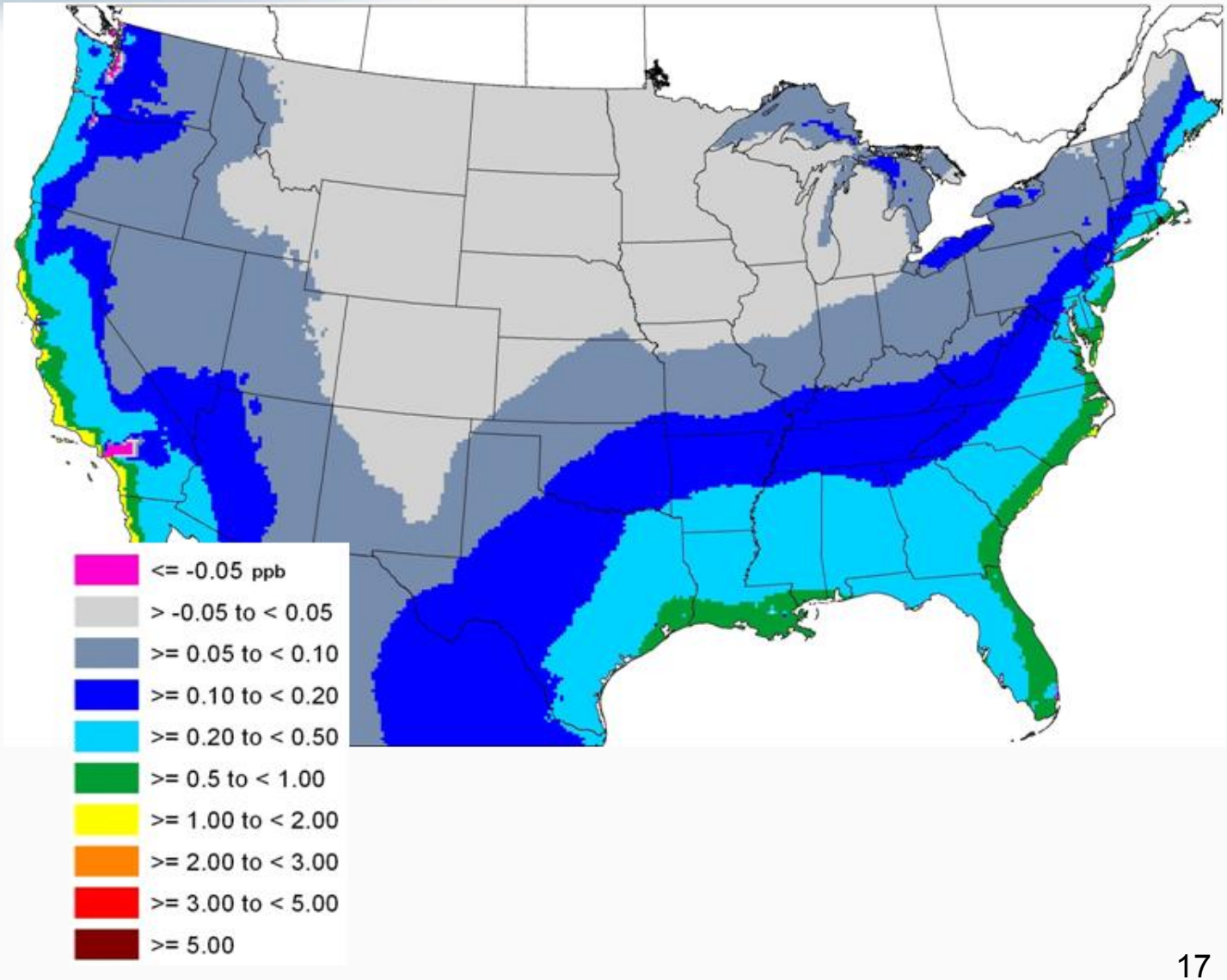
- In 2020, compliance with ECA standards is expected to result in annual reductions of:
  - 320,000 tons of NOx (23% reduction)
  - 90,000 tons of PM2.5 (74% reduction)
  - 920,000 tons of SOx (86% reduction)

North American ECA Health, Welfare and Environmental Benefits

- By 2030, emission reductions associated with the ECA will annually prevent:
  - Between 12,000 and 31,000 premature deaths
  - About 1,400,000 work days lost
  - About 9,600,000 minor restricted-activity days
- Estimated 2030 benefits are between $110 and $270 billion, while estimated costs are much lower at $3 billion
- Important Ecosystem Benefits:
  - NOx, SOx and direct PM reductions reduce deposition in many sensitive ecosystems
  - Improve visibility – especially in Class I federal areas
  - Reduce ozone damage to many ecosystems throughout the U.S.

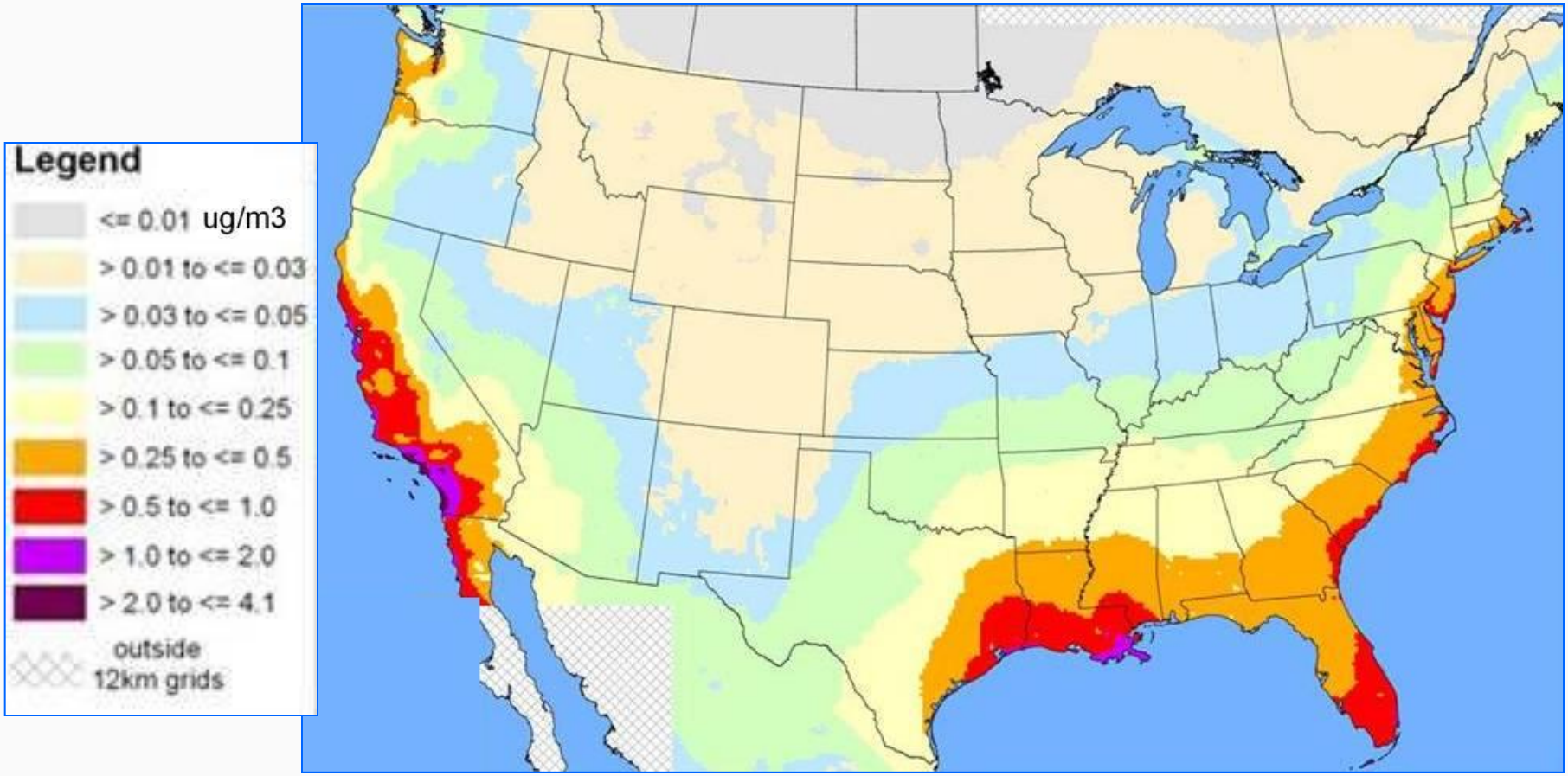
2020 Projected ECA Ozone Reductions

Controlling air pollution from ships will deliver substantial benefits that extend well into the interior of the country

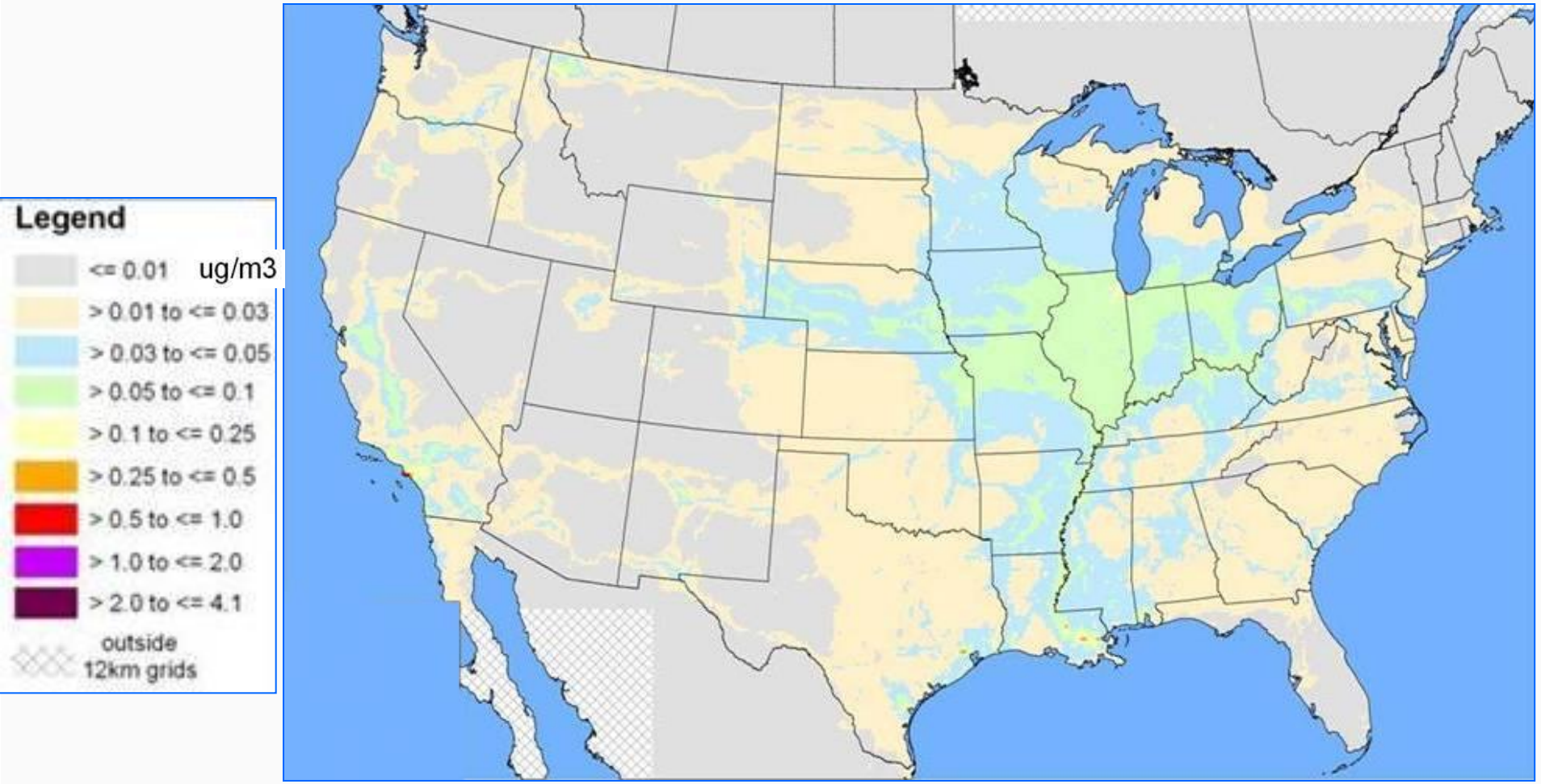


2020 Projected ECA $PM_{2.5}$ Reductions

- Controlling air pollution from ships will deliver substantial benefits that extend well into the interior of the country



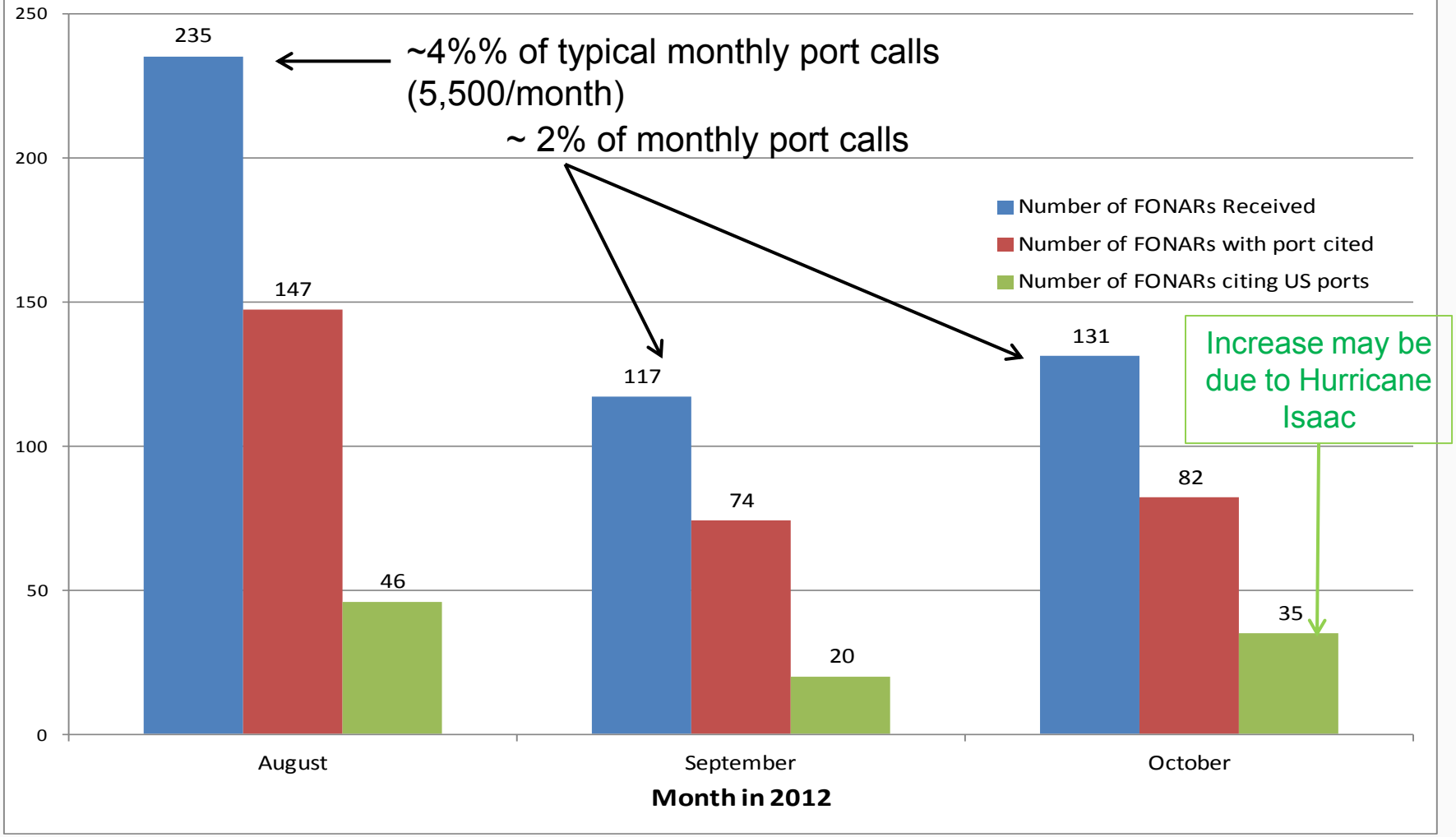
For Comparison: Impact of New Locomotive and Category 1 & 2 Marine Diesel Engine Rule on $PM_{2.5}$ levels in 2020



2012 ECA Implementation: Fuel Availability

- Fuel used in North American ECA cannot exceed 1%, beginning August 2012
- Annex VI allows for a case where compliant fuel is not available
  - e.g. a vessel sails from Brazil, where 1% bunker is not available, to Philadelphia
- U.S. issued guidance on availability waivers in June 2012
  - If 1% fuel is not available, a ship may enter ECA with noncompliant fuel
  - Operator must file Fuel Oil Non-Availability Report (FONAR) to Coast Guard & EPA
  - Submitted reports represent a small fraction of port calls, and getting smaller with implementation (see next slide for details)
- Data for August – December 2012 indicates 1% ECA compliant fuel is widely available at many U.S. ports

Preliminary Data: **Number of FONARs Received, August - October, 2012**



2012 ECA Fuel Prices

- Available pricing for U.S. ports carrying low-sulfur residual fuel (1% sulfur) since ECA implementation in August 2012 demonstrates that—
  - For most of the country, low-sulfur residual fuel is approximately $100 per metric ton more expensive (~15% increase)
  - In Seattle/Vancouver the average cost for low-sulfur residual fuel is approximately $250 per metric ton more expensive (~40% increase)

2012 ECA Compliance Provisions

- Some companies have requested alternative compliance approaches from fuel sulfur requirements for operation in the North American ECA
  - Concern about increased operating costs due to the higher price of compliant fuel
- IMO/Annex VI regulations provide flexibility for:
  - Compliance strategies that provide equivalent emission reductions (Regulation 4)
  - Trial programs for ship emissions reduction and control technology research (Regulation 3)

TOTE LNG Project

- EPA and Coast Guard (in consultation with Transport Canada) approved a technology demonstration for Totem Ocean Trailer Express (TOTE) to retrofit LNG engines on two cargo ships that operate between Tacoma and Anchorage (Regulation 3)
- Onboard diesel engines can continue to use fuel with up to 2.2% sulfur subject to certain conditions:
  - TOTE is making progress toward replacing/retrofitting engines on two ships with LNG systems (completed 9/30/2016)
  - TOTE is working with local facilities toward installation and operation of LNG facilities (completed 9/30/2016)
  - TOTE uses shore power for vessels in Tacoma and shows progress toward development of alternative ship-generated power in Anchorage
  - TOTE must provide regular progress reports

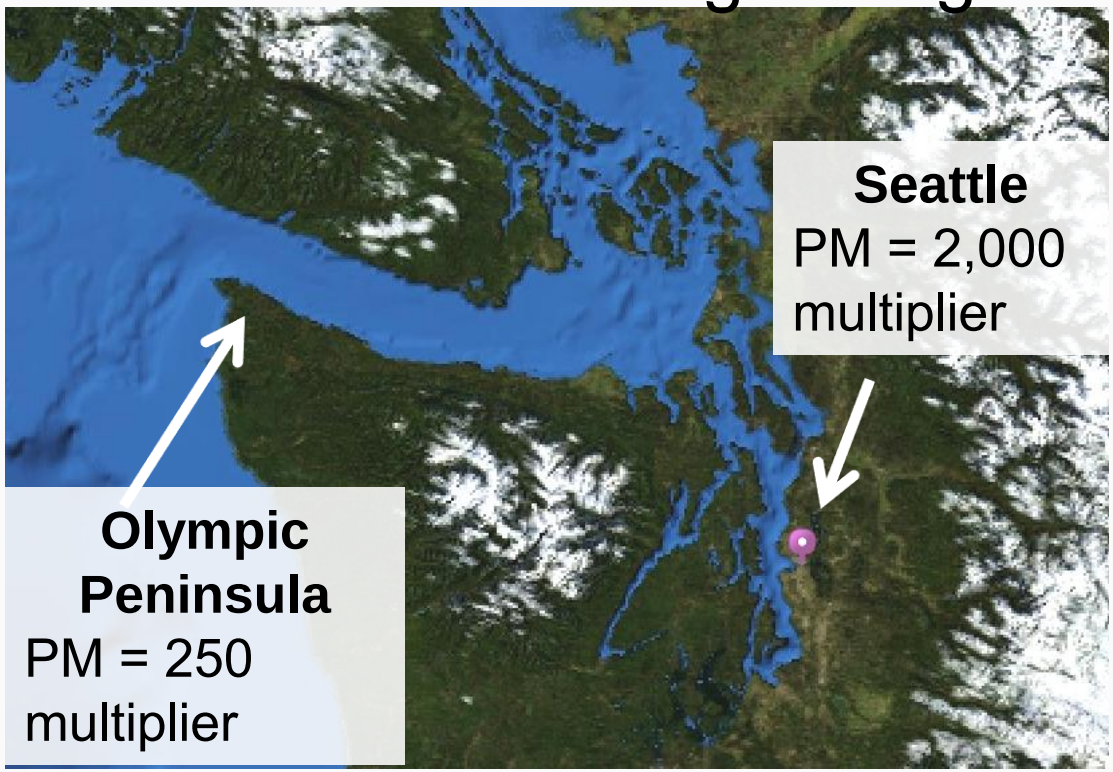
RCL Averaging

- EPA, Coast Guard, and Transport Canada collaborated with Royal Caribbean Ltd. (RCL) and its flag states to develop an equivalent approach that meets the fuel sulfur limits through emissions averaging (Regulation 4)
- Within specified geographic sub-regions, RCL may use fuels with differing fuel sulfur levels as long as the average equivalent SOx emissions over each averaging period does not exceed the ECA limits
  - The program allows RCL to use advanced technology, such as exhaust gas scrubbers, as part of its averaging scheme
  - RCL must provide annual plans for their emissions averaging strategy, with quarterly performance reports
  - Results will be trued up annually

Population-Weighted Emissions Averaging

- Cruise Line International Association has proposed a population-weighted emissions averaging scheme for use in the ECA
  - CLIA proposes this approach could be allowed under MARPOL Annex VI Regulation 4 equivalency provisions
  - A concept where emissions would be weighted by proximity to higher population centers and projected human health outcomes
  - Provides opportunity to “optimize” where to run on low versus high sulfur fuel
  - See next slide for an illustrative example

Illustrative Example of Population Weighting in ECA – Northwest Washington region



- Based on these weighting factors, 1 ton of PM reduction near Seattle generates 2,000 credits. 1 ton PM increase near Olympic Peninsula creates 250 debits.
- Therefore, 1 ton of reduction near Seattle could be used to offset 8 tons (2,000/250 = 8) of PM increase off the Olympic Peninsula.

EPA Concerns with Population-Weighted Averaging

- The proposed strategy results in a disproportionate burden of environmental harms and risks for citizens depending on the population density of their community
  - Population-weighted averaging scheme leads to 10x net increase in emissions in some areas of the ECA
  - Raises environmental justice concerns since these increases occur in under-represented communities in rural areas
- EPA & Coast Guard believe this approach not allowed under MARPOL Annex VI (see letter EPA/Coast Guard letter in Appendix)
- Canadian Government also concerned
  - "The inequality of benefits between major population centres, where ultra-clean fuel would be used, and smaller population centres, where more conventional fuel would be used, would not meet public expectations of uniform delivery of health and environmental benefits for citizens of both Canada and the United States." (see Transport Canada letter in Appendix)

Native American Tribal Concerns

- Native American Tribes and the National Tribal Air Association representing more the 70 member Tribes strongly oppose population- weighted scheme
  - Tribal communities' health already impacted by degraded air quality in and around Tribal lands
  - Subsistence and cultural practices of tribes will be put at further risk by increased emissions if population-weighted approach is adopted
    - Native food contamination
    - Acid deposition to forest ecosystems in tribal communities
    - Degradation of native rock images and other sacred sites
- See appendix for letters to EPA from tribal communities detailing their concerns with a population-weighted approach

Congressional Appropriations Riders

- House Appropriation Committee passed a rider in summer 2012
  - 48-month pilot program companies can opt into
  - Companies can comply with ECA using “weighted” emissions averaging, fleet averaging or weighted and unweighted, if EPA Administrator determines compliance provides “a degree of overall protection of the public health and welfare
  - Companies must use compliant fuel while at berth or anchor
  - Requires EPA to perform atmospheric modeling and ambient air testing to evaluate the pilot, particularly with respect to Alaska and Hawaii
  - Companies opting into this pilot program would be deemed to be in compliance with Federal and State law applicable to sulfur content of fuel
- Impact of this proposal: could lose up to 50% of the ECA emission reductions

Conclusions

- Category 3 marine engines are a major source of air pollution in the United States
  - Engine and fuel standards lag decades behind land-based sources (highway, nonroad, locomotive, smaller marine)
- North American ECA resulted from a multi-year U.S. effort to adopt standards that reduce marine engine impacts
- First stage of ECA implementation began August 2012
- Next stage of ECA implementation begins soon—
  - 2015 for fuels (0.1% S, 90% reduction)
  - 2016 for engines (80% reduction in NOx)
- EPA and Coast Guard are committed to implementing and enforcing the ECA in a sensible manner, and to making use of IMO/Annex VI provisions for flexible compliance plans

Questions?

- Website: www.epa.gov/otaq/oceanvessels.htm
- OTAQ's marine group
  - Michael Samulski: samulski.michael@epa.gov

Appendix: Required Elements of an ECA Package

1) a delineation of the scope of the proposed ECA;
2) the type(s) of emissions proposed for control;
3) a description of the human populations and environmental areas at risk from ship emissions;
4) an assessment that emissions from vessels operating in the proposed ECA contribute to ambient concentrations of air pollution or adverse environmental impacts;
5) relevant meteorological, topographical, geographical, oceanographic, and morphological information
6) information about the nature of vessel traffic in the proposed ECA;
7) a description of the party or parties' land-based emission control regime; and
8) the economic impacts and relative costs of reducing vessel emissions as compared to land-based controls

Source: Appendix III of MARPOL Annex VI, as amended in 2008