EPA's Vessel Emission Control Program

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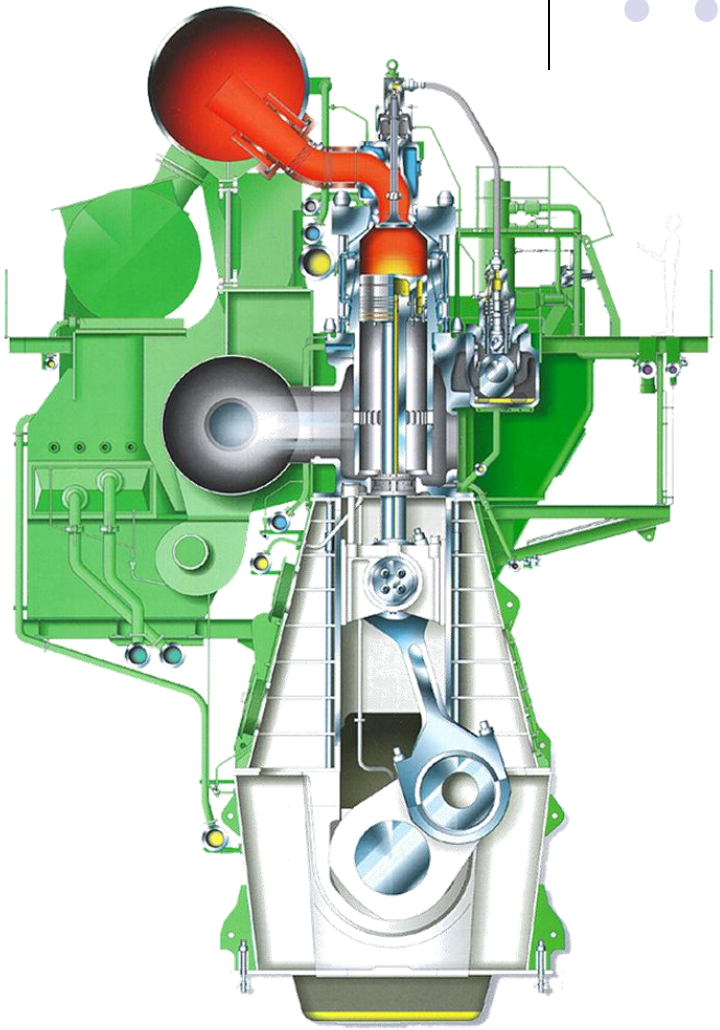
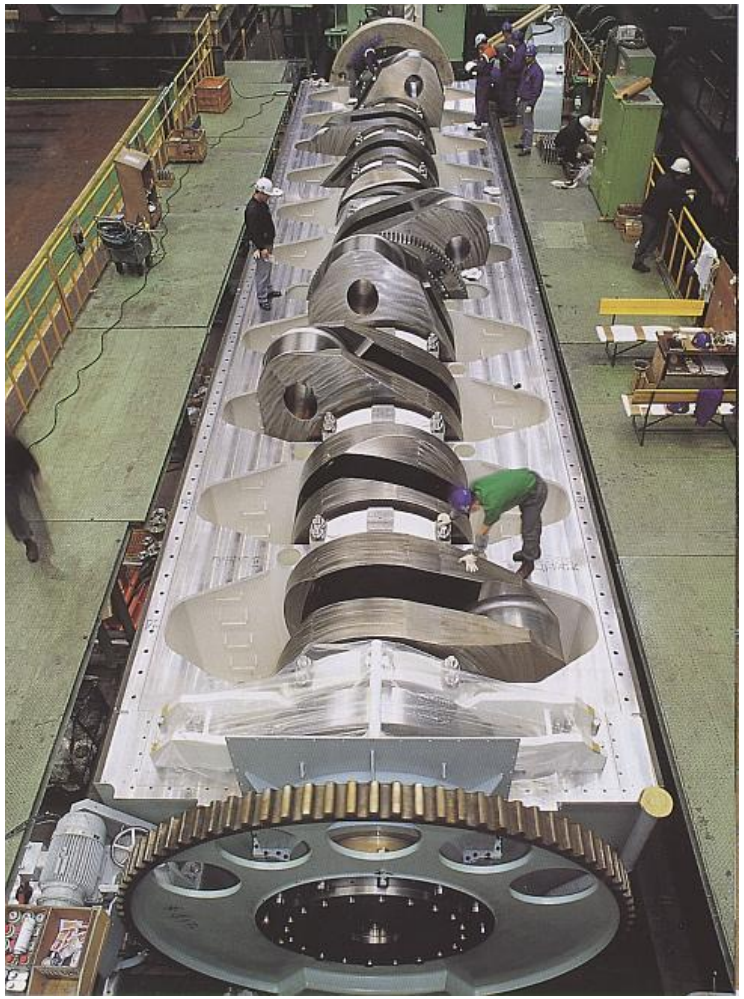
Mobile Source Technical Review Subcommittee

Overview

- What are ocean-going vessels?
  - 3 things you need to know
- OGV Impact on Air Quality
- Clean Diesel Strategy
- C3 CAA FRM
- IMO Annex VI
- Next steps



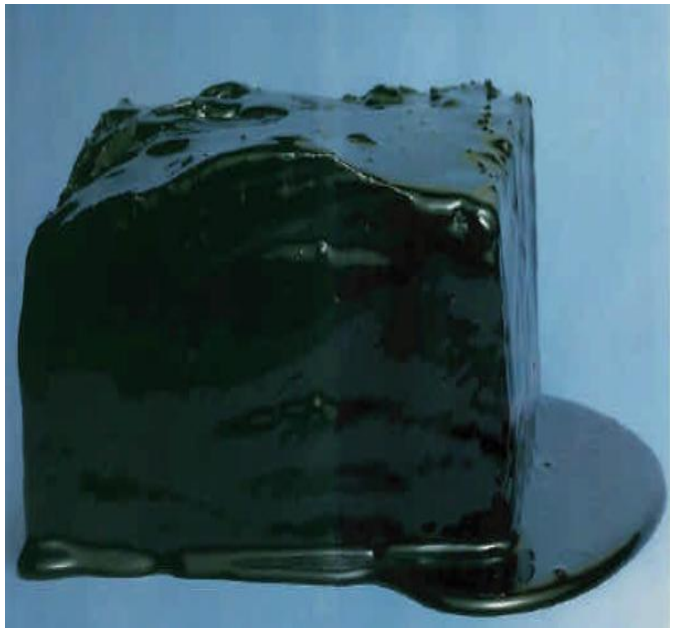
Ocean-Going Vessels
1) Extremely large hand built engines



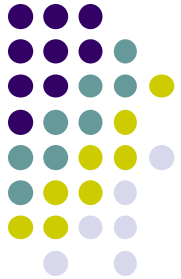
- Engines are built as part of the ship (like a powerplant)
- Engines are ~4 stories tall
- Unlike smaller automotive engines whose parts are made in automated machine processes, these engines are built one at a time in very low volumes
- Successful program must reflect reality of the technical challenges for these engines

Ocean-Going Vessels
2) Burn residual fuel (wax/tar)

- Primarily use residual fuel
- Residue (leftover) from refining process – after all of the other useful products are removed from a barrel of oil this is the remaining concentrated gunk
  - Must be heated (melted) in order to pump it into the engine to be combusted
- Low cost:
  - Disposal problem for refineries
- High Emissions
  - Very high sulfur content
    - ~30,000ppm S
    - High SOx & sulfate PM
  - Doesn't burn well
    - high PM & NOx
- Successful program must address fuel quality



Ocean-Going Vessels
3) Primarily Foreign Flagged



World fleet

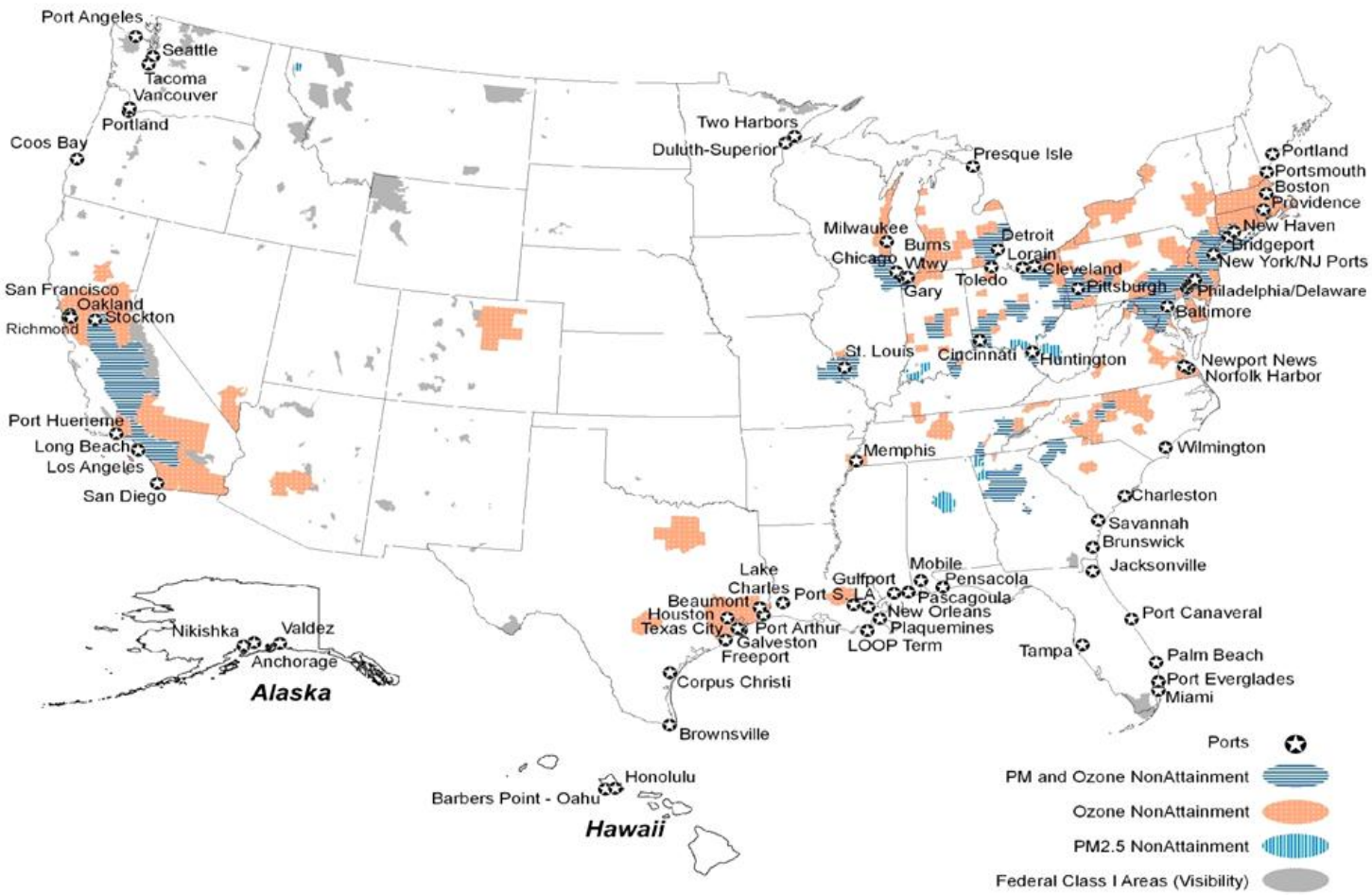
- About 16,750 vessels >10,000 GT
  - US ownership: 5th largest fleet (684 vessels, or 4%)
  - US flag: 15th largest fleet (286, or 2%)
  - Largest flag: Panama (3,668 or 22%)

- About 8,000 different vessels visited US ports in 1999
  - **89% of vessels visiting US ports are foreign flagged**
  - A small number of vessels account for most of the visits
    - 12% of the vessels made 50% of entrances
    - 29% of the vessels made 75% of entrances

- Successful program must address foreign flagged ships

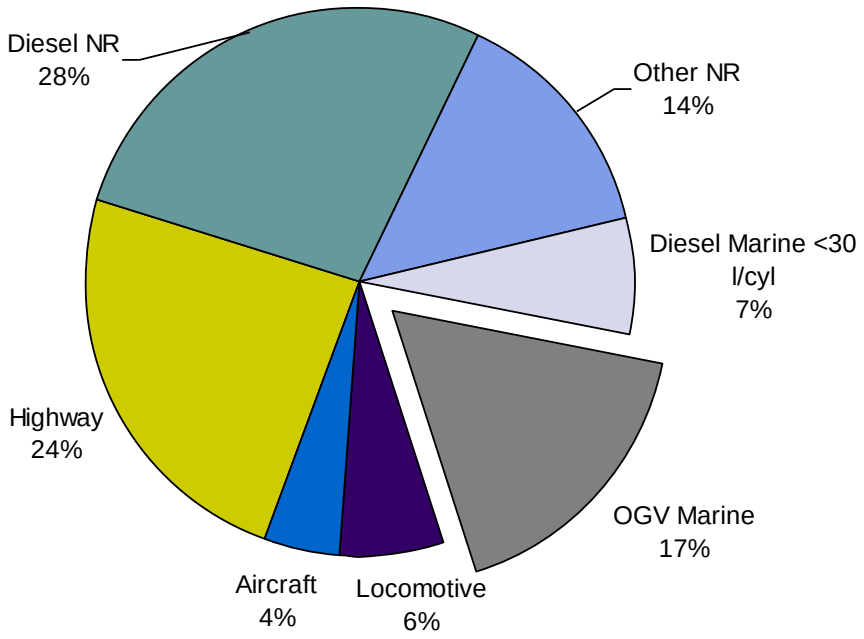
Sustainable Must Mean Healthy Air: U.S. Ports and Nonattainment Areas

- More than 40 major ports are located in $PM_{2.5}$ or ozone nonattainment areas
- About 88 million people live in 39 areas that do not meet the $PM_{2.5}$ NAAQS or that contribute to violations in other counties

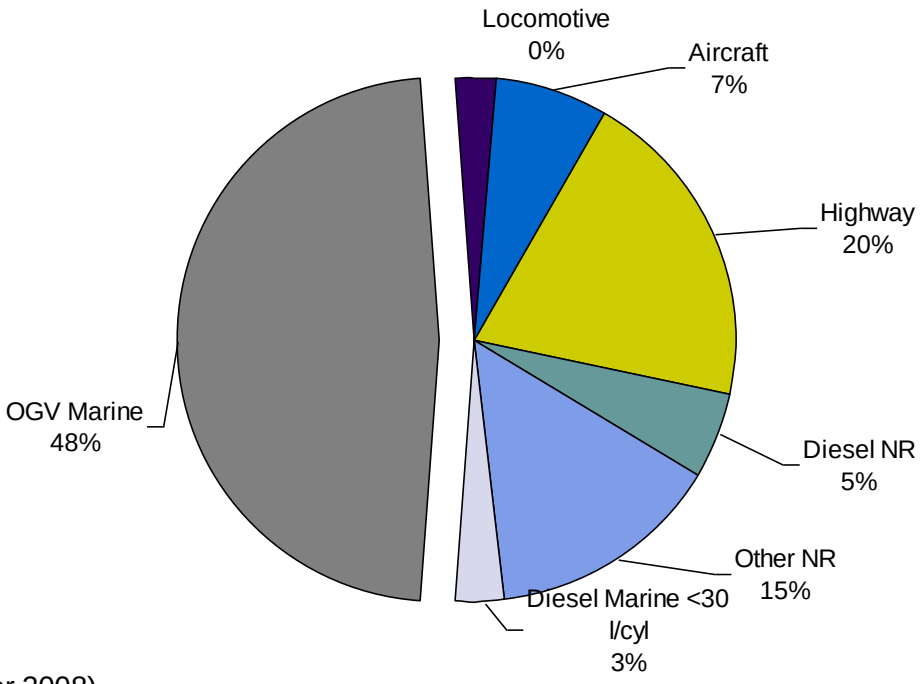


Ship Contribution to U.S. PM Inventory

2009 Mobile Source PM2.5 Inventory



2030 Mobile Source PM2.5 Inventory



Source of inventory estimates: C3 Marine NPRM (July, 2009)
Does not reflect IMO MARPOL Annex VI Amendments (October 2008)

EPA's National Clean Diesel Campaign Regulatory Roadmap

Tier 2 Light-Duty

final rule 1999

fully phased in 2009

Diesels held to same stringent standards as gasoline vehicles

These standard-setting rulemakings are key enablers for collaborative partnerships with industry and state & local governments

Heavy-Duty Highway

sales 800,000 / yr

40B gallons / yr

final rule 2000

fully phased in 2010

Nonroad Diesel

sales over 650,000 / yr

12B gallons / yr

final rule 2004

fully phased in 2015

Locomotive/Marine

sales 40,000 marine engines, 1,000 locomotives / yr

6B gallons / yr

final rule 2008

fully phased in 2017

Ocean Going Vessels

CAA Rule Dec 2009

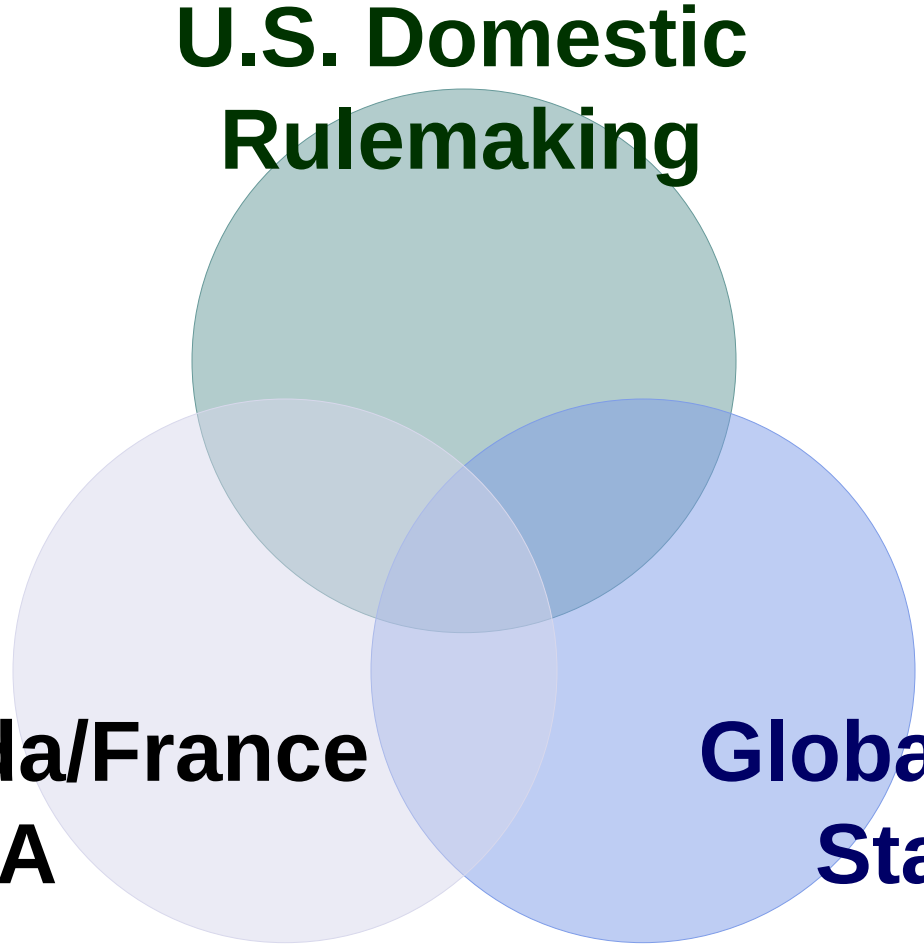
IMO MARPOL Annex VI

ECA Controls

- Fuel Based 2012/2015
- 80% NOx reduction 2016

Note: sales and diesel fuel usage vary year-to-year; these figures are for comparison purposes only

Coordinated Strategy



U.S. Domestic Rulemaking

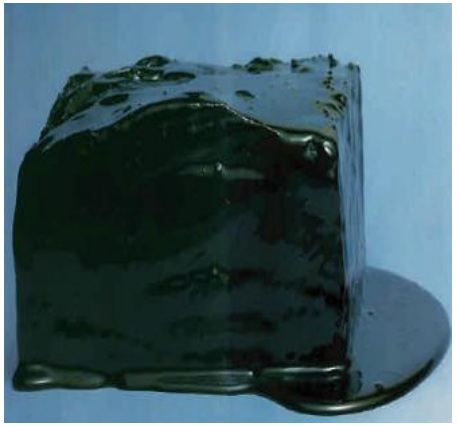
- Final Rule signed in December, 2009
- New engine standards
  - Tier 2 and 3 NOx limits for U.S. vessels harmonized with MARPOL Annex VI
  - HC and CO cap standards for U.S. vessels
- New fuel sales standards
  - 0.1%S fuel limit for use in ECAs; unless equivalent technology used
  - Allow for 0.1%S distillate sales, in U.S., for marine use
- Adopts Annex VI implementation regulations for all vessels operating in U.S. waters

New Annex VI Amendments

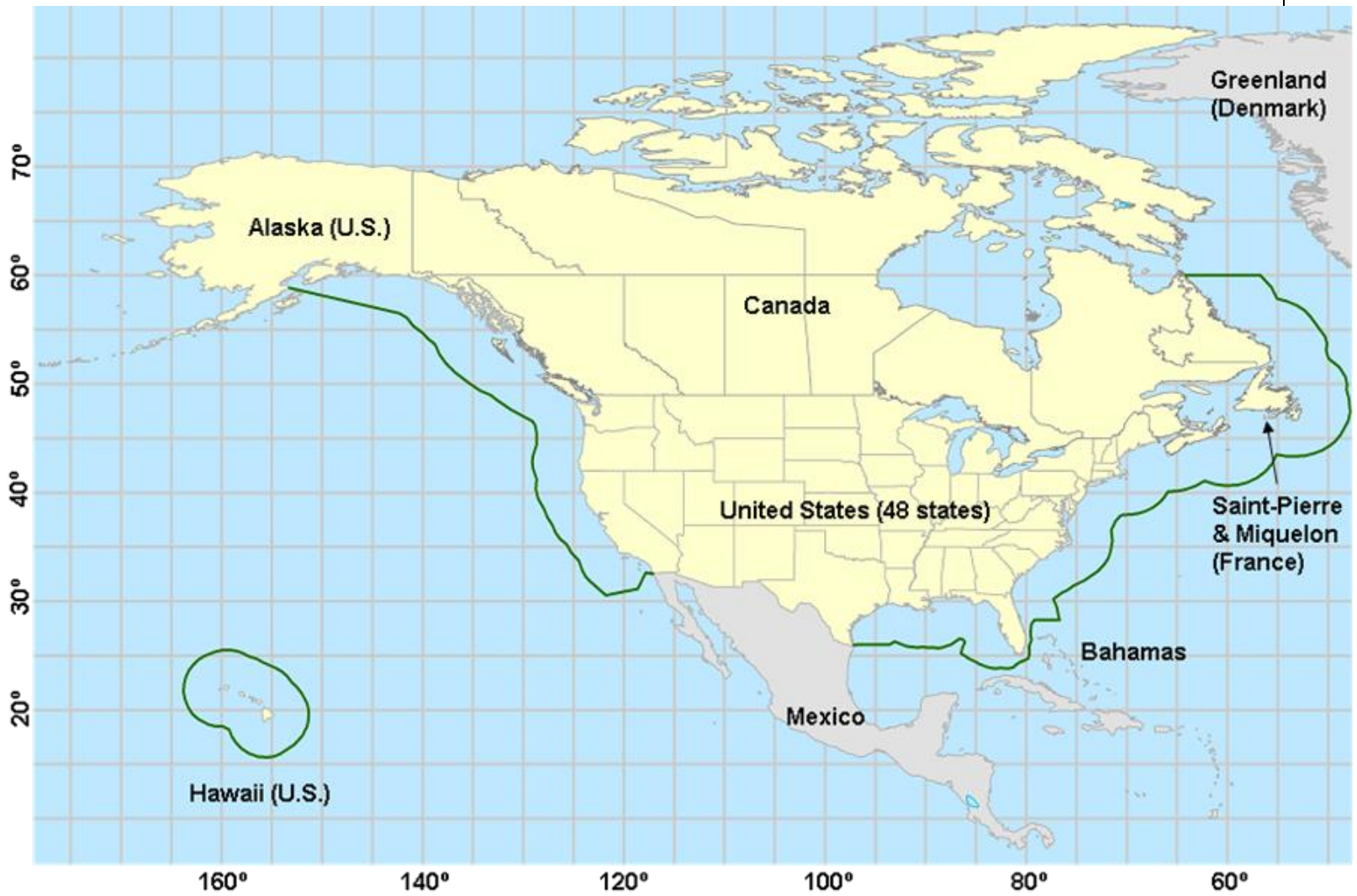
- October 2008 Annex VI amendments approved
- Global NOx Controls
  - Tier 2: 20% reduction from new vessels (2011)
  - Existing engine standards
- Global PM and SOx controls
  - 2012: 3.5% fuel sulfur
  - 2020: 0.5% fuel sulfur
    - Could be delayed to 2025; subject to 2018 fuel availability review
- A country (or countries) can propose to designate an Emission Control Area (ECA), where more stringent standards apply

Emission Control Area

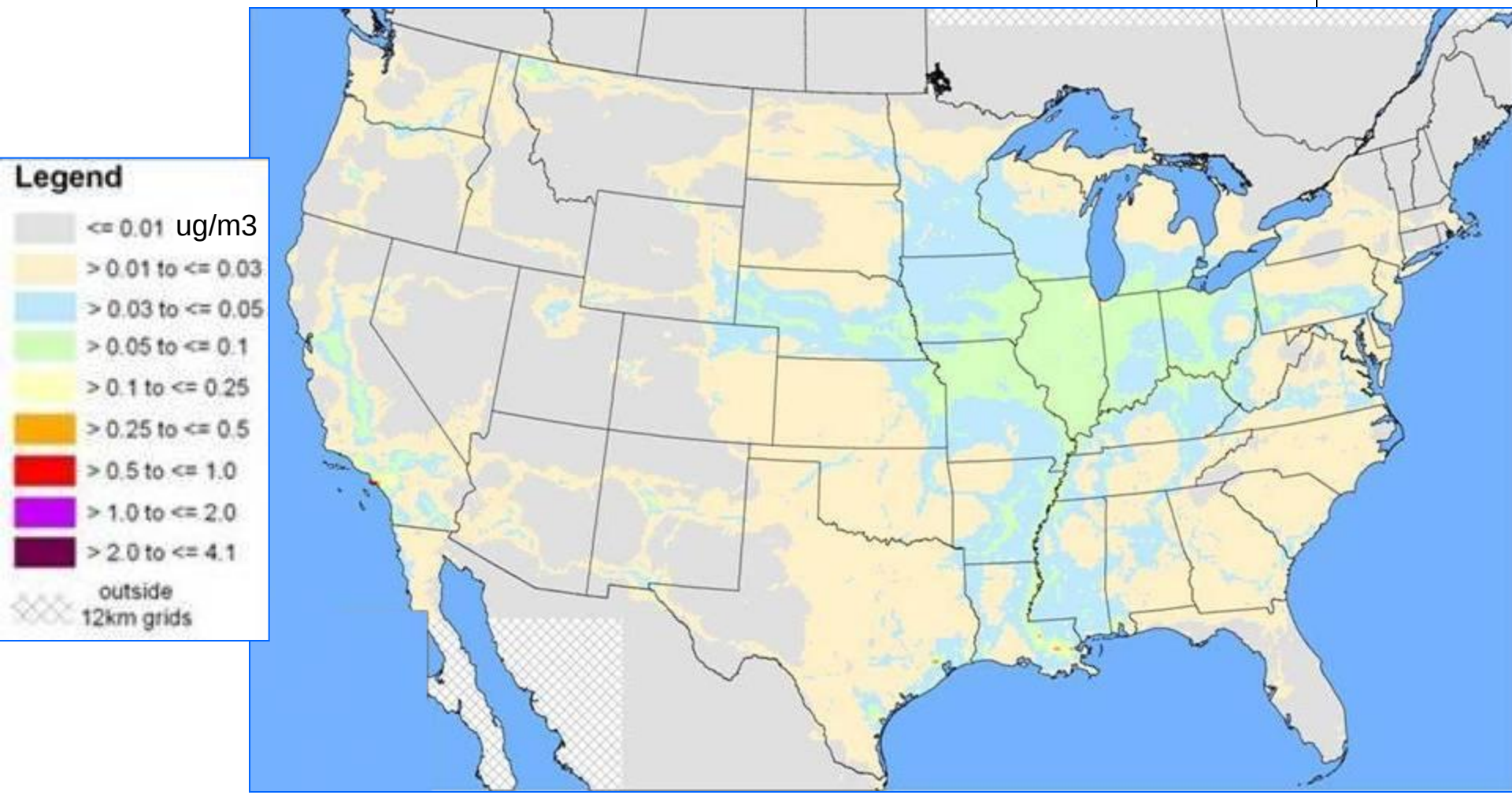
- On March 26, 2010, IMO adopted the North American ECA
  - The ECA fuel sulfur requirements will enter into force on August 1, 2012
- ECA NOx Controls
  - Tier 3 NOx 80% reduction new vessels (2016)
- ECA PM and SOx Controls
  - 1.0% Fuel Sulfur (2010-2014)
  - 0.1% Fuel Sulfur 2015+
    - Up to 96% reduction in SOx
    - ~85% reduction in PM



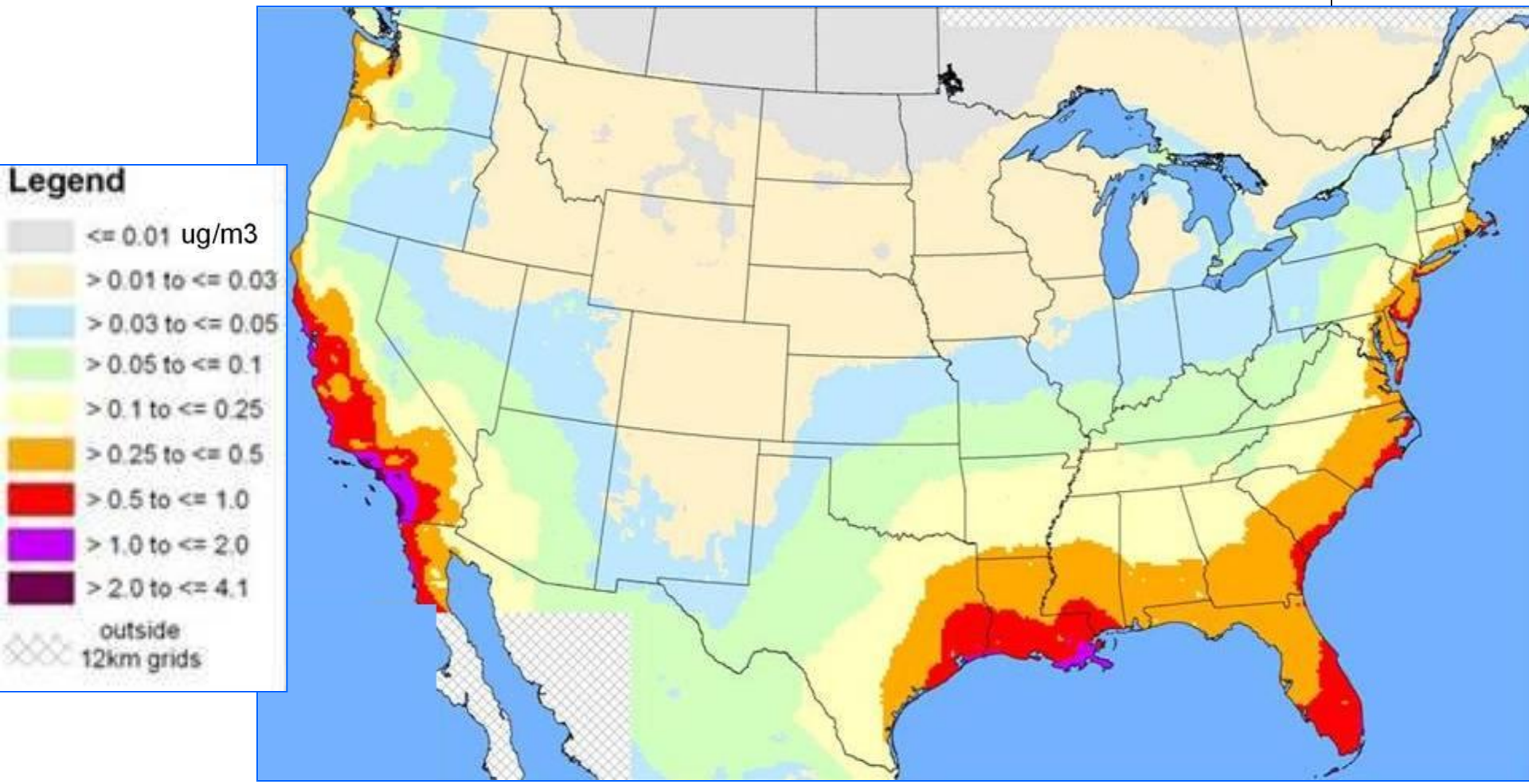
North American ECA



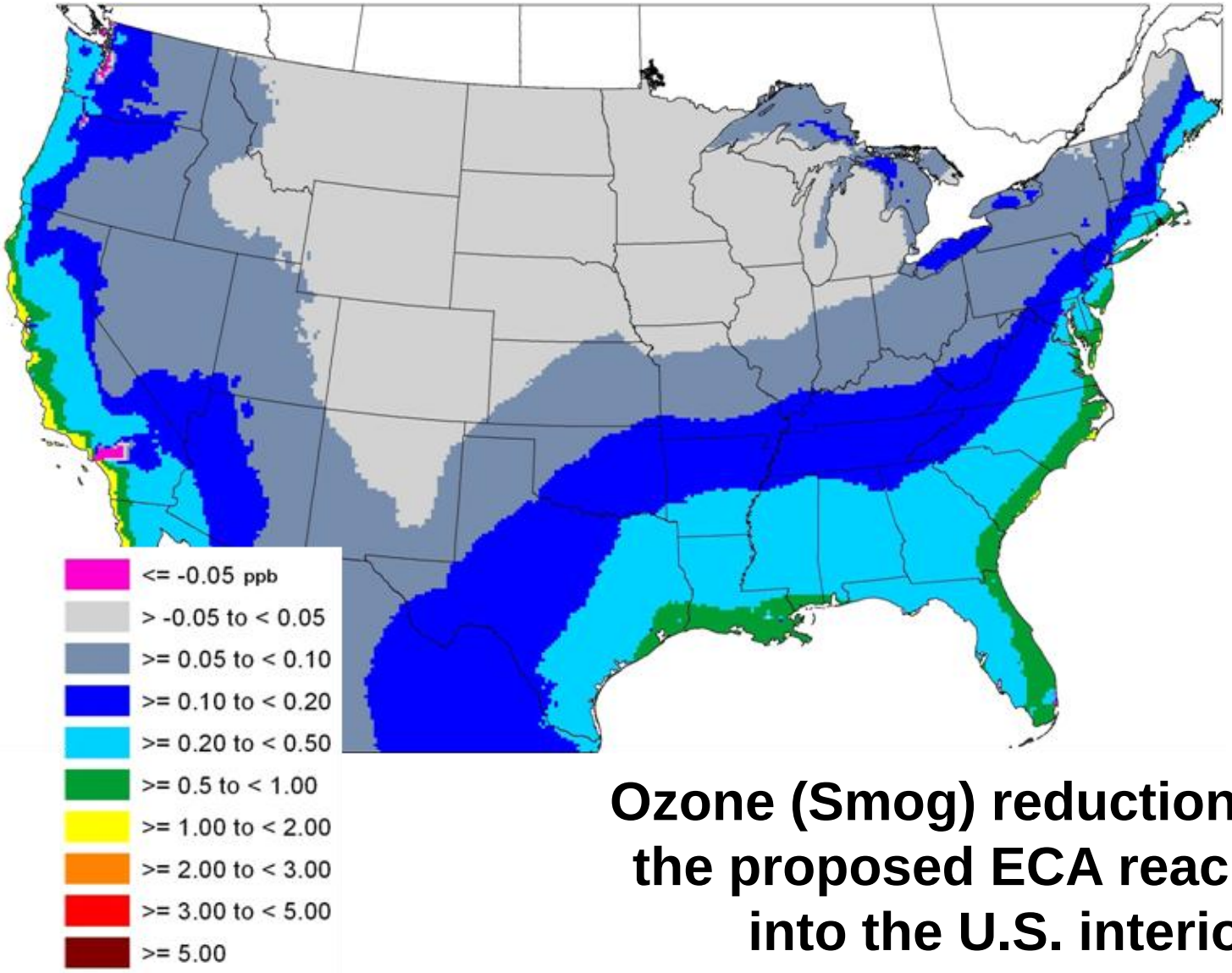
For Comparison: Impact of New Locomotive and Marine Diesel Engine Rule on $PM_{2.5}$ levels in 2020



2020 Potential ECA $PM_{2.5}$ Reductions



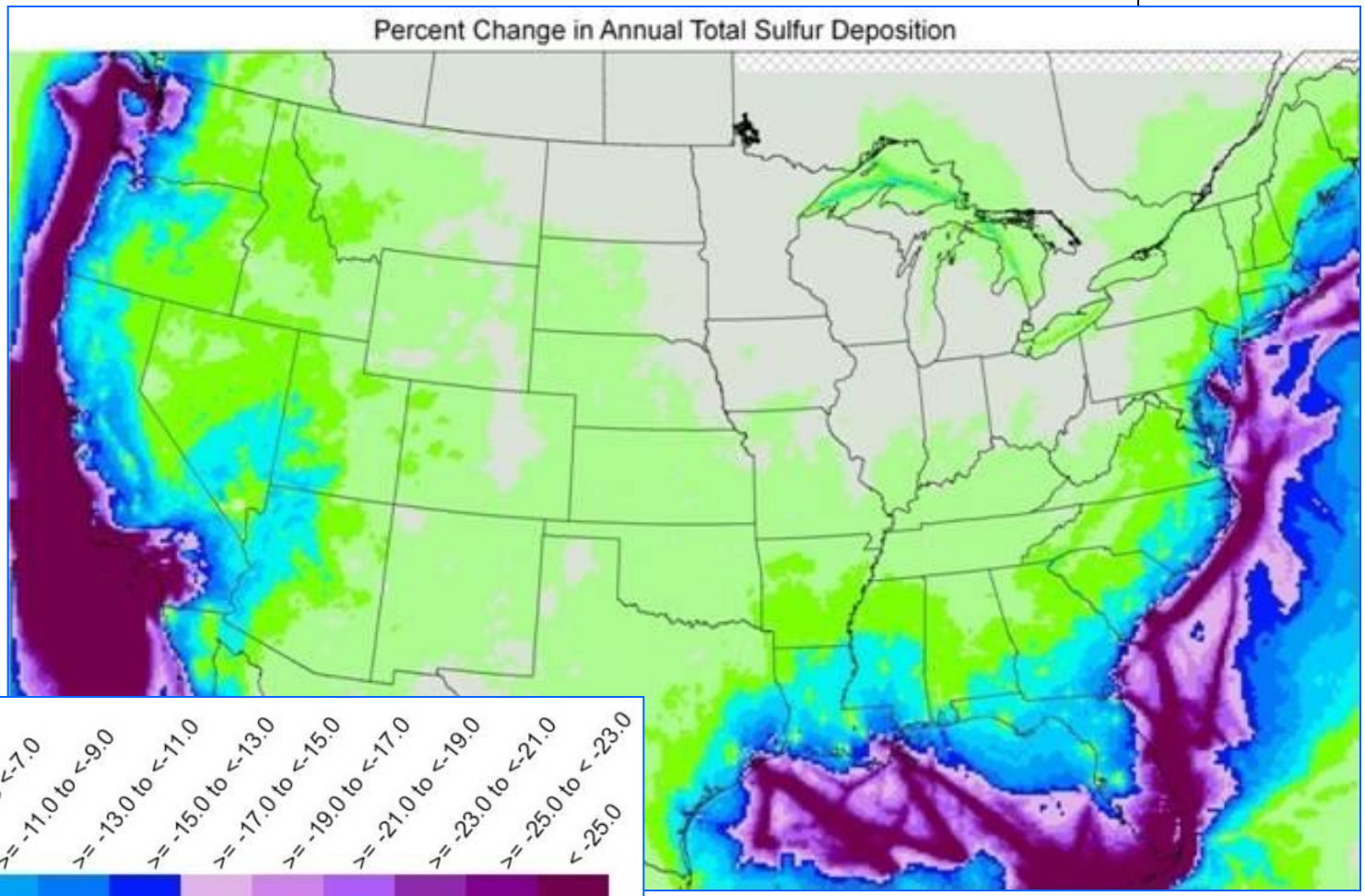
2020 Potential ECA Ozone Reductions



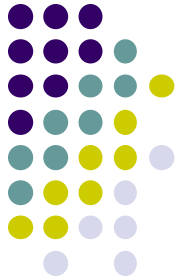
Ozone (Smog) reductions from the proposed ECA reach well into the U.S. interior

2020 Potential Sulfur Deposition Reductions

Improvements in deposition for marine and terrestrial ecosystems

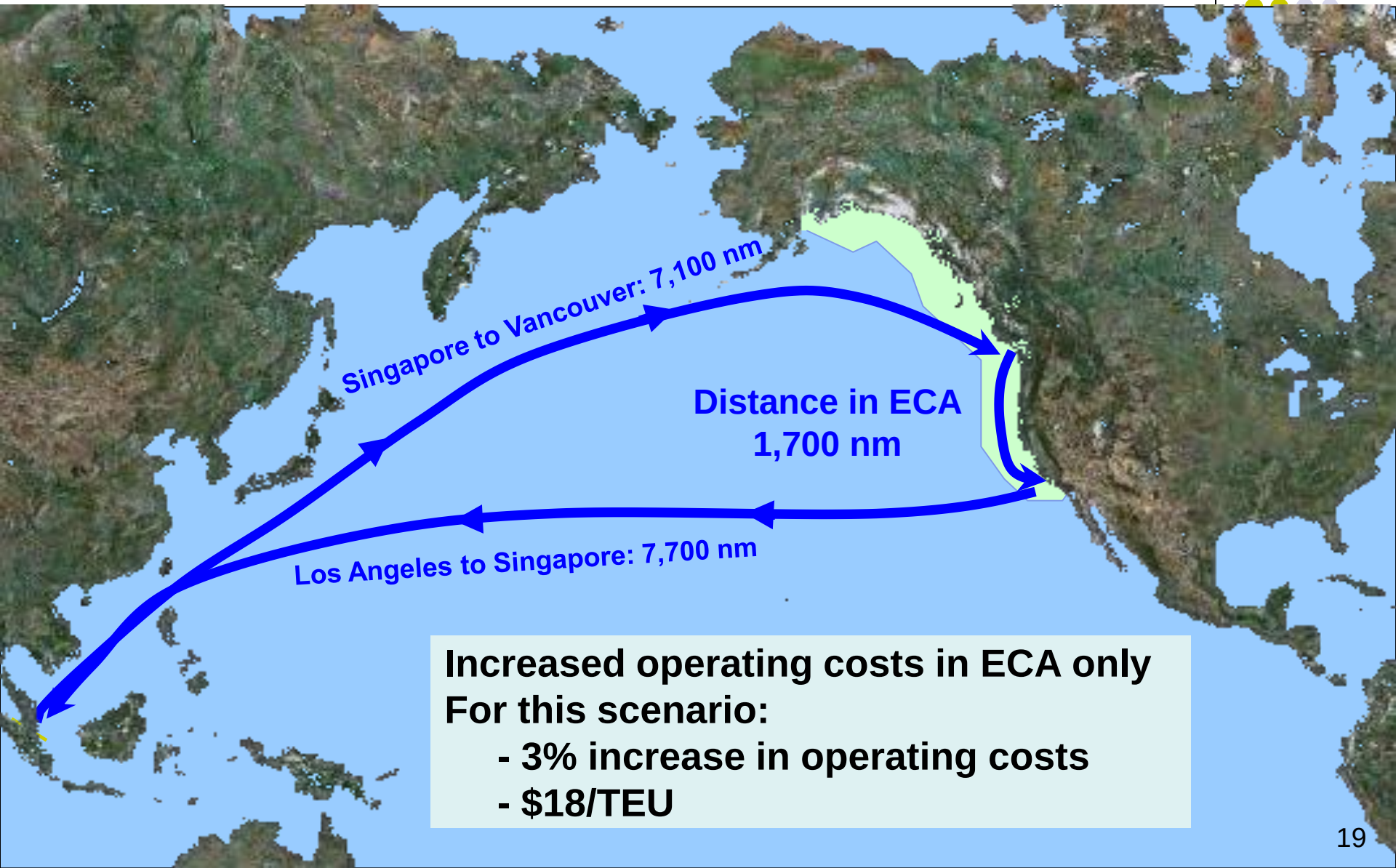


Benefits and Costs of the Coordinated Strategy



- The FRM presents the benefits and costs of the coordinated strategy
  - Engine and fuel requirements for U.S. and foreign vessels
- In 2030 the estimated benefits are between $110 and $270 billion
- By 2030, the emission reductions associated with the coordinated strategy will annually prevent:
  - Between 12,000 and 30,000 PM-related premature deaths
  - Between 210 and 920 ozone-related premature deaths
  - About 1,400,000 work days lost
  - About 9,600,000 minor restricted-activity days
- The estimated costs are much smaller: $3.1 billion

Example Cost Scenario



Increased operating costs in ECA only
For this scenario:
- **3% increase in operating costs**
- **$18/TEU**

Additional Information

- The FRM, proposed ECA, and supporting information are available at:
  - www.epa.gov/otaq/oceanvessels.htm
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