Potential OGV Emissions Reduction Strategies

2022 AQMP OGV Working Group Meeting #2
April 1, 2021

Cleaning The Air That We Breathe...
Significant OGV NOx emission reductions are needed for attainment of ozone standards.
Possible Initiatives/Programs for EPA’s Consideration

• IMO’s current focus on GHG programs
• Possible actions that EPA/federal government may consider (in conjunction with IMO)
  • New engine standards
  • Optional engine standards based on verified retrofit control technologies
  • Potential requirements for existing vessels in ECAs given existing fleet composition and few Tier III vessels
    • Limits on older vessels (e.g., Tier 0 & Tier I)
    • Tier II+ requirements pending availability of retrofit or remanufacturing kits
  • Support development and demonstration of retrofit control technologies
CARB’s Potential Regulatory Programs

- At-Berth Regulation
  - Covers container, reefer, cruise, tanker and auto carrier vessels
  - Interim evaluation in 2022 to assess possible:
    - Inclusion of bulk and general cargo vessels
    - Requirements for anchorage emissions
- Explore regulatory concepts for transit and maneuvering operations
San Pedro Bay Ports
Clean Air Action Plan (CAAP) Measures

• Ports existing incentive programs
  • Vessel speed reduction, Environmental Shipping Index (ESI), Green Ship Incentive

• 2017 CAAP Measures
  • Improve existing VSR Program
  • Modify existing incentive programs
  • Variable rates on ships; higher fees for Tier 0 and I ships starting in 2025 or later
  • Support demonstration of emission reduction technologies and operational efficiency improvements
Possible South Coast AQMD Programs and Actions

- Pacific Rim Initiative for Maritime Emission Reductions (PRIMER) in collaboration with agencies, ports and shipping lines
  - Phase 1 (near-term) – For shipping lines with existing qualified Tier III vessels
  - Phase 2 (near/mid-term) – Based on future Tier III and Tier II+ vessels (new vessels and retrofits)
- Develop and demonstrate retrofit technologies
- Improve OGV emissions inventory
  - Evaluate Tier III NOx reduction benefit at low loads
  - Tanker vessels fugitive emissions
- Other possible actions
  - Petition to EPA for additional requirements
  - Legislative efforts
Shipping Lines On-Going and Future Efforts

• Compliance with existing regulations
  • CARB’s At-berth
  • IMO/EPA requirements
    • Tier III standard, 0.1% sulfur in ECAs
    • Energy efficiency improvements
    • GHG reduction target (50% in 2050)

• Operational efficiency improvements
• Exploring different fuels and technologies
South COAST AQMD Survey of Shipping Lines

- Expected changes to current fleet composition by 2023, 2030, and 2040 (e.g., Tier level, technology, fuel, vessel size) and drivers for these changes
- Planned vessel deployments to the Ports of Los Angeles and Long Beach and current or foreseeable barriers for deployment of cleaner vessels to these shipping routes
- Specific clean technologies, alternative fuels, or operational improvements being used, tested, or explored for new builds or in-service vessels
South COAST AQMD Survey of Shipping Lines (cont’d)

- Recommendations for retrofit technologies and participation in demonstration projects in partnership with AQMD and CARB, and ports
- Suggestions for design, development and implementation of new incentive programs for cleaner vessels and participation in these programs
- Suggestions for increasing cleaner vessel visits to address transit, maneuvering and anchorage emissions
Collaboration is the key to success
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South Coast 2037 Draft Attainment Goal

Stationary and Area
Heavy-Duty Diesel Vehicles
Aircraft
Ocean Going Vessels
Off-Road Equipment and Vehicles

SCAB NOx Emissions (tpd)

Baseline

Carrying Capacity

More than 70% Reduction Needed to Meet 2037 Goals

Carrying Capacity 2037

Stationary and Area
Cars/Light-Duty Trucks/SUVs/Motorcycles
Medium-Duty & Heavy-Duty Gas Trucks
Heavy-Duty Diesel Vehicles
Aircraft
Locomotives
Ocean Going Vessels
Commercial Harbor Craft
Recreational Boats
Off-Road Equipment and Vehicles
Carrying Capacity

55-85 tpd
OGV NOx Emission Contribution in South Coast

- OGV emissions (up to 100 nautical miles) make up 20% of mobile source NOx emission in 2037, up from 10% in 2017

Source: CEPAM 2019 Summer Emissions, with 2020 At Berth Regulation amendments
OGV Inventory Status

- At-Berth inventory updated in 2020
- Inventory updates for transit, maneuvering, anchorage in progress, based on Automatic Identification System (AIS) data
  - Improve base year accuracy and location specificity
  - Review growth forecast and future engine Tiers for visiting vessels
  - Review literature on emission factors for main/auxiliary engines and boilers
  - Draft Release: Summer 2021
2016 AIS Data Trends: OGV Main Engines

- Main engine operating power (kW-hr) represents the installed propulsive power, engine load, and duration.

### Percent of Main Engine Operating Power by Distance

<table>
<thead>
<tr>
<th>District</th>
<th>100 nm</th>
<th>24 nm</th>
<th>3 nm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Santa Barbara</td>
<td>45.10%</td>
<td>51.29%</td>
<td>3.60%</td>
</tr>
<tr>
<td>San Diego</td>
<td>66.02%</td>
<td>30.03%</td>
<td>3.95%</td>
</tr>
<tr>
<td>South Coast</td>
<td>22.54%</td>
<td>68.57%</td>
<td>8.89%</td>
</tr>
<tr>
<td>Ventura</td>
<td>42.23%</td>
<td>47.97%</td>
<td>9.80%</td>
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</tbody>
</table>

### Total Main Engine Operating Power in 4 km Spatial Grid

- **100 nm from coast**
- **24 nm from coast**
- **3 nm from coast**
Existing Regulatory & Incentive Measures

- CARB has two existing regulations designed to reduce NOx, PM, and SOx emissions from OGVs
  - At Berth Regulation
    - Reduces emissions from auxiliary engines from vessels at berth
    - Expanded regulation adopted in 2020 to increase emissions reductions
  - OGV Clean Fuel Regulation
    - Requires vessels to use cleaner fuels (distillate 0.1% sulfur)
    - Applies to OGVs within 24 nm
- Voluntary vessel speed reduction (VSR) zones in Santa Barbara Channel, San Pedro Bay, San Francisco Bay, and San Diego
2020 Mobile Source Strategy (MSS)

• Address transit, anchorage, and maneuvering emissions
  - Replace Pre-Tier III visits with Tier III (or retrofitted Tier II visits that achieve similar reductions) by 2031
  - Advocacy for stricter IMO Tier standards and cleaner vessels

![Diagram: SC NOx Emissions from All OGV Modes: MSS Scenario](image)

- Tier IV
- Tier III
- Tier II
- Tier I
- Pre-Tier
- SIP Baseline

31 tpd NOx reduction in 2037
Potential Future Measures for Reducing Emissions from OGVs

• CARB is exploring potential future measures to reduce NOx, PM, and GHG emissions from OGVs
  o In-transit
  o At anchor
• Further efforts needed to explore feasibility
Potential Regulatory Measures

• CARB staff is exploring several potential future measures, including requirements for:
  o Cleaner engines for all OGVs visiting California
  o Carbon fuel intensity
  o VSR
  o At anchor emissions reductions
  o Bulk and general cargo vessels

• Potential emissions reduction benefits must be further explored
Incentive & Advocacy-Based Measures

• Potential voluntary incentive measures are being explored:
  o Alternative fuels
  o Cleaner engines
  o Expanding voluntary VSR zone

• Advocacy for stricter IMO Tier standards and cleaner vessels
**Alternative Fuels: LNG**

- Draft LNG factors compared to Tier III emissions factors:
  - 35 – 50% less NOx
  - 70 – 80% less PM
  - 30 – 35% less CO2

- Emission Factors Source:
  - Port Emissions Inventory Guidance, U.S. EPA 2020

- Infrastructure constraints should be considered

<table>
<thead>
<tr>
<th>Engine Group</th>
<th>Engine Type</th>
<th>Fuel Type</th>
<th>NOx Emission Factor (g/kWh)</th>
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<tbody>
<tr>
<td>Propulsion</td>
<td>MSD, Tier II</td>
<td>Distillate</td>
<td>10.5</td>
</tr>
<tr>
<td></td>
<td>MSD, Tier III</td>
<td>Distillate</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td>LNG</td>
<td>LNG</td>
<td>1.3</td>
</tr>
<tr>
<td>Auxiliary</td>
<td>MSD, Tier II</td>
<td>Distillate</td>
<td>7.7</td>
</tr>
<tr>
<td></td>
<td>MSD, Tier III</td>
<td>Distillate</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>LNG</td>
<td>LNG</td>
<td>1.3</td>
</tr>
</tbody>
</table>

* Based on limited LNG and Tier III engine data
Potential Partnerships

• Several partnerships can be explored to consider how to achieve additional reductions from OGVs, including:
  o Working with U.S. EPA for cleaner engine requirements for vessels visiting California/U.S. ports
  o Development of incentive programs with South Coast AQMD and possible partnerships with Pacific ports
  o Coordinating with Ports and Air Districts to expand current VSR programs
  o Working with U.S. EPA and IMO to develop stricter marine engine standards
Next Steps

• An updated emissions Inventory development is underway

• Further assessment required, including:
  o Magnitude of emissions reductions from each potential measure
  o Assess when benefits could be achieved
  o Whether an incentive-based or regulatory approach is best
  o How to best advocate for IMO and federal support

• Continue to workshop for potential future ideas
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Useful Links:
- At Berth Regulation: https://www.arb.ca.gov/ports/shorepower/shorepower.htm
- Clean Fuel Regulation: https://ww2.arb.ca.gov/our-work/programs/ocean-going-vessel-fuel-regulation
Status Update on CAAP
Ocean-Going Vessel Measures & Efforts
April 1, 2021

Morgan Caswell, Port of Long Beach
Teresa Pisano, Port of Los Angeles
Overview of CAAP OGV Measures

• Vessel Speed Reduction (VSR) Programs
• Ship Incentive Programs
• Technology Advancement Program (TAP) Demonstrations
• Vessels At Berth

For more details: https://cleanairactionplan.org/
**Vessel Speed Reduction Programs**

- **Objective:** reduce emissions from OGVs by lowering speeds as vessels approach or depart the Ports.

  - ≤ 12 knots at 20nm or 40 nm from Point Fermin
  - ≥ 90% fleet compliance earns rebate on dockage fees
    - 40nm
    - 20nm
  - 96% participation within 20nm and 92% participation within 40nm in 2020

[www.cleanairactionplan.org](http://www.cleanairactionplan.org)
Ship Incentive Programs

Objective: reduce emissions from OGVs through per-call incentives to attract cleaner ships.

Environmental Ship Index

- Participation in IAPH ESI
  - Score 40-49: $750/call
  - Score ≥50: $2500/call
- IMO Tier III: $5000/call

Green Ship Incentive Program

- IMO Tier II: $2500/call
- IMO Tier III: $6000/call
- Program modifications underway to promote Tier II+ and Tier III ships
Ocean-Going Vessel Demonstrations

• **Technology Advancement Program**
  – SCAQMD Water-in-Fuel Demonstration
  – Pasha LNG/Diesel Dual-Fuel Demonstration

• **Grant-funded**
  – Port of Long Beach START project
  – Support CARB-funded project for tankers at-berth
Vessels at Berth

• CARB Ocean-Going Vessels At Berth Regulation
  – Board approved in August 2020
  – Expands requirements for regulated fleets and includes new vessel categories, including RoRo and tanker vessels
  – Requires submission of Terminal and Port Plans by December 1, 2021

• Efforts Underway
  – Ongoing engagement with terminal operators and other stakeholders regarding Terminal Plan/Port Plan development
  – Draft plans are underway
## Container Throughput & Vessel Call Comparison

<table>
<thead>
<tr>
<th></th>
<th>2005 vs. 2019</th>
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<tbody>
<tr>
<td>Container Throughput (TEUs)</td>
<td>↑ 20%</td>
</tr>
<tr>
<td>Containers (TEUs) per call</td>
<td>↑ 72%</td>
</tr>
<tr>
<td>Containership Arrivals</td>
<td>↓ 30%</td>
</tr>
</tbody>
</table>

**www.cleanairactionplan.org**
2019 OGV Emissions Reductions

Diesel Particulate Matter: DOWN 90%
Nitrogen Oxides: DOWN 44%
Sulfur Oxides: DOWN 97%
Greenhouse Gases: DOWN 29%

*Compared to 2005 Levels
Next Steps

• Continue evaluation of vessel incentive programs
• Develop Port Plans to comply with the CARB At Berth Regulation
• OGV demonstration projects
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**Teresa Pisano**, Port of Los Angeles
Marine Environmental Supervisor
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Thank you!
PROTECTING BLUE WHALES & BLUE SKIES
INCENTIVE BASED VESSEL SPEED REDUCTION PROGRAM

South Coast AQMD 2022 AQMP Mobile Source
Working Group for Ocean-Going Vessels
April 1, 2021 Meeting

Santa Barbara County Air Pollution Control District

Ventura County Air Pollution Control District

NOAA Channel Islands National Marine Sanctuary
A PARTNERSHIP FOR CLEANER AIR, SAFER WHALES, AND QUIETER OCEANS

- Air Districts, National Marine Sanctuaries, Non-profits, Foundations
- 2014 pilot in Santa Barbara Channel, expanded each year 2016-2020
- Financial & recognition incentives to shipping companies to slow down in VSR zones
- Benefits:
  - Significant NOx emission reductions
  - Reduce fatal ship strikes on whales
  - Reduce ocean noise
VSR ZONES
OVERVIEW OF PROGRAM

- Seasonal program (May to November) to coincide with ozone season and presence of whales
- Open to container and car carrier shipping companies
- Air Districts seeking near-term NOx reductions
  - Federal and International Maritime Organization (IMO) actions on engine requirements will take a long time
  - Air districts are required to plan to meet federal and state ozone standards
- Analyze AIS data to determine performance and benefits; data and labor intensive effort
- Starcrest Consulting Group develops methodology and performs air emission calculations
Incentives are tiered based on % of distance traveled at 10 knots or less

Financial rewards range $2,500 to $30,000 in 2020 – many companies declining awards

Extensive positive public relations campaign – award ceremony, press coverage and advertising
2020 VSR INCENTIVE PROGRAM PARTICIPANTS
### VSR INCENTIVE PROGRAM ACCOMPLISHMENTS

<table>
<thead>
<tr>
<th>Year</th>
<th>2014</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
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<tbody>
<tr>
<td><strong>Area</strong></td>
<td>Santa Barbara Channel</td>
<td>Santa Barbara Channel Region</td>
<td>Santa Barbara Channel Region &amp; San Francisco Bay Area</td>
<td>SoCal Region &amp; SF Bay Area</td>
<td></td>
<td></td>
</tr>
<tr>
<td># Companies</td>
<td>7</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>15</td>
<td>16</td>
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<tr>
<td># Vessels</td>
<td>14</td>
<td>25</td>
<td>44</td>
<td>280</td>
<td>349</td>
<td>495</td>
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<tr>
<td>Slow-speed Distance (nautical miles)</td>
<td>2,700</td>
<td>5,000</td>
<td>12,630</td>
<td>46,026</td>
<td>99,019</td>
<td>181,306</td>
</tr>
<tr>
<td>NOx Reductions (tons)</td>
<td>12.4</td>
<td>25.6</td>
<td>SoCal: 74 tons SF Bay: 10 tons</td>
<td>SoCal: 208 tons SF Bay: 58 tons</td>
<td>SoCal: 430 tons SF Bay: 106 tons</td>
<td>SoCal: 593 tons SF Bay: 122 tons</td>
</tr>
<tr>
<td>GHG Reductions (metric tons)</td>
<td>535</td>
<td>1,005</td>
<td>2,630</td>
<td>8,668</td>
<td>17,026</td>
<td>TBD</td>
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<tr>
<td>Ocean Noise Reduction</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Ship Strike Reduction</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
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*Quantification methodology under development, but real qualitative benefits demonstrated in recent research*
NOx REDUCTIONS

INCENTIVE FUNDS and NOx REDUCTIONS

INCENTIVE FUNDS and NOx REDUCTIONS

INCENTIVE FUNDS

NOx REDUCTIONS

(tons)
COST EFFECTIVENESS

![Chart showing the cost effectiveness ($/ton NOx) from 2014 to 2020. The cost decreases each year with the following values: $5,000 in 2014, $4,000 in 2015, $3,000 in 2016, $2,000 in 2017, $1,000 in 2018, $0 in 2019, and $0 in 2020.](chart.png)
FUTURE OF PROGRAM

- SEP Funding in place for 2021 and 2022
- Additional incentive funds could drive further reductions of emissions, ship strikes and ocean noise
- Beyond 2022 funding is needed to continue program – participating air districts do not have revenue stream
- Emission reductions from program benefit SCAQMD attainment and emissions inventory at ports (Hueneme, Long Beach, Los Angeles)
- Statewide VSR would benefit all state coastal communities and environment
FUTURE FEDERAL ACTIONS

- Separating ships and whales - International Maritime Organization 2022
- Ocean-Based Climate Solutions Act
- Lawsuit
- VSR Regulation?
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ourair.org/air-pollution-marine-shipping/