

Monitoring and Verifying OGV Emissions Using Alternative Fuels: *Lessons from Today's Ship Fleet*



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HKUST Green Fuels Transition for International Shipping Workshop
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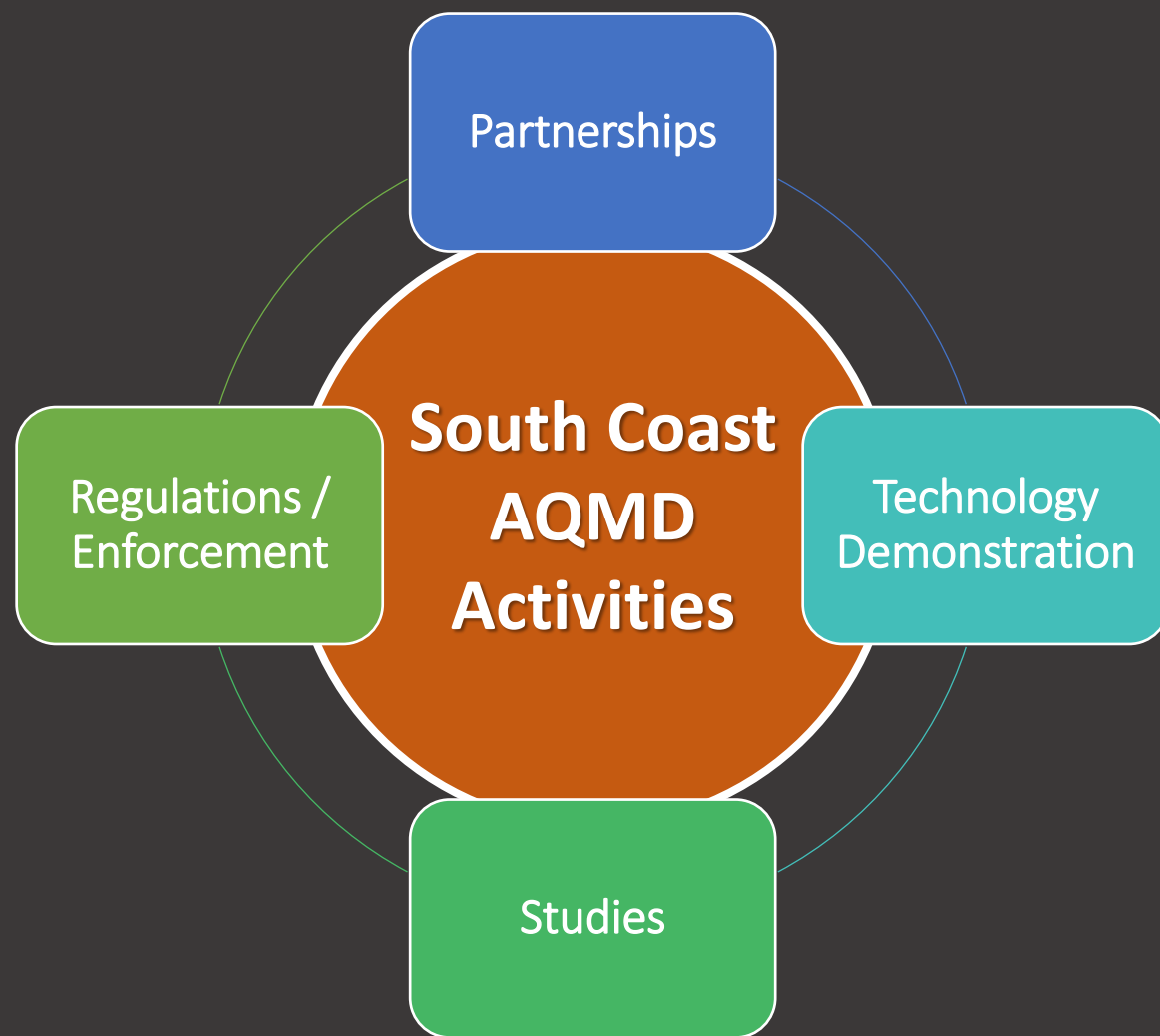
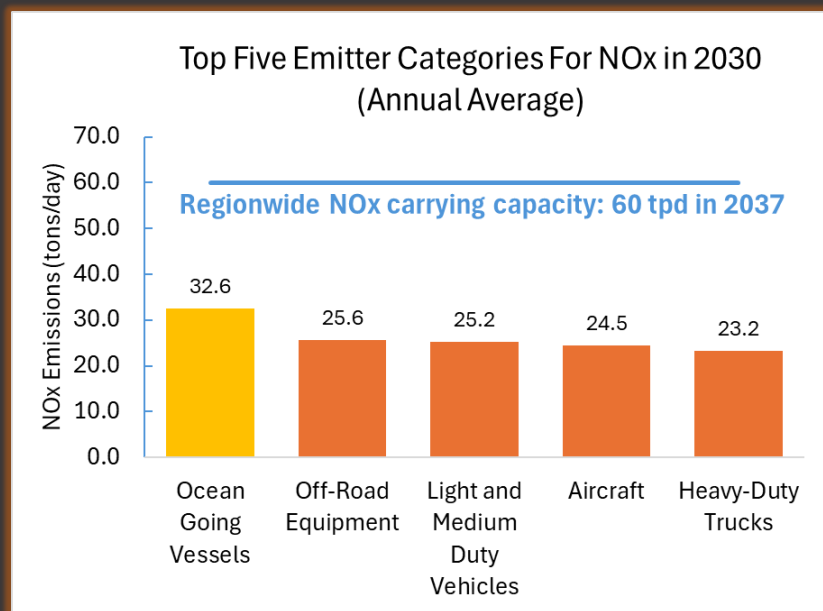
Who We Are

- **Regional air pollution control agency for the greater Los Angeles and adjacent areas**
 - Largest local air agency in the U.S.
 - More than 17 million residents in 4 counties
 - 16th largest economy with \$1.4+ trillion GDP
 - Gateway for 1/3 of ocean cargo imported into U.S.
- **Responsibilities**
 - Comply with U.S. clean air standards
 - Independent from California Air Resources Board and U.S. EPA
 - Control emissions from stationary sources
 - Permit and inspect 28,000 affected businesses
 - Administer \$200+ million of incentive funding annually



South Coast AQMD Interest in Maritime Emissions

- Ocean-going vessels (OGVs) projected to become the top source of regional NOx emissions by 2030
 - NOx is a major contributor to smog and particulate matter formation in Southern California



Partnership Example: Reducing Maritime Emissions Critical to Attaining Clean Air Standards in Southern California

- Majority of regional ship traffic engaged in transpacific trade
- International collaboration part of multi-pronged strategy to reduce maritime emissions
 - Memorandum of cooperation with Shenzhen, China, and the Port of Long Beach, signed in September 2024
 - Clean OGVs as a key area of cooperation to collectively promote green maritime economy



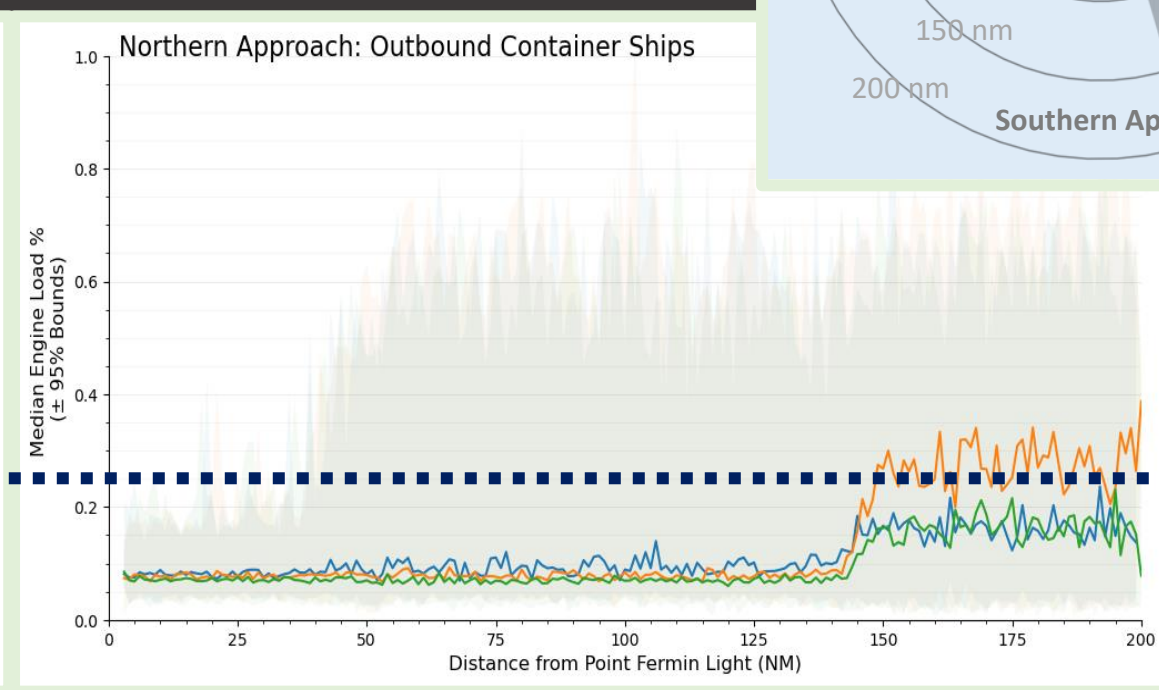
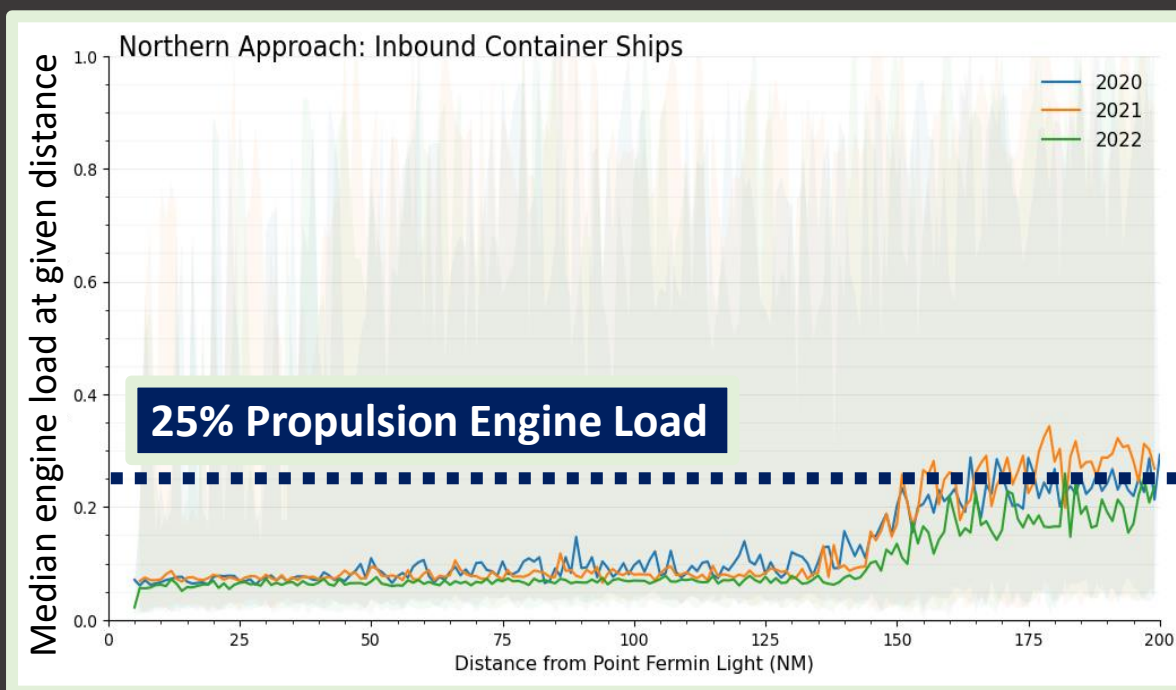
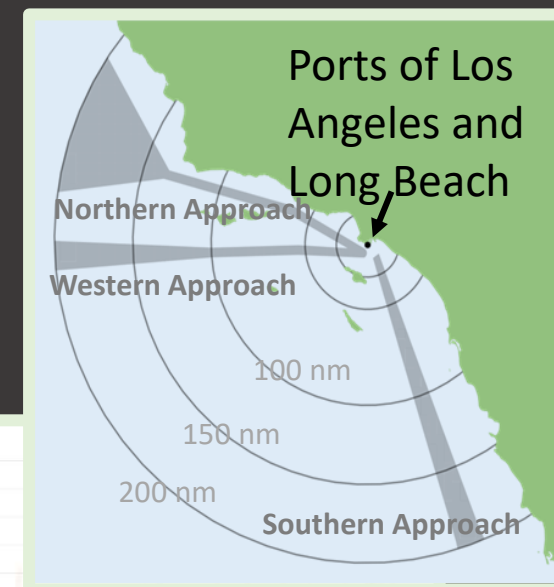
Technology Demonstration Example: Capture and Control System for Oil Tankers

- Barge-based capture and control system
 - Self-propelled spud-barge with exhaust capture systems
 - Purification units
 - Carbon-capture
- At least 90% reduction of NO_x, PM_{2.5} and VOC from both auxiliary engines and boilers
- Partially powered by methanol-to-hydrogen fuel cell
- Project completion: 12/31/2025



Studies Example : Emissions from Nearshore Operations

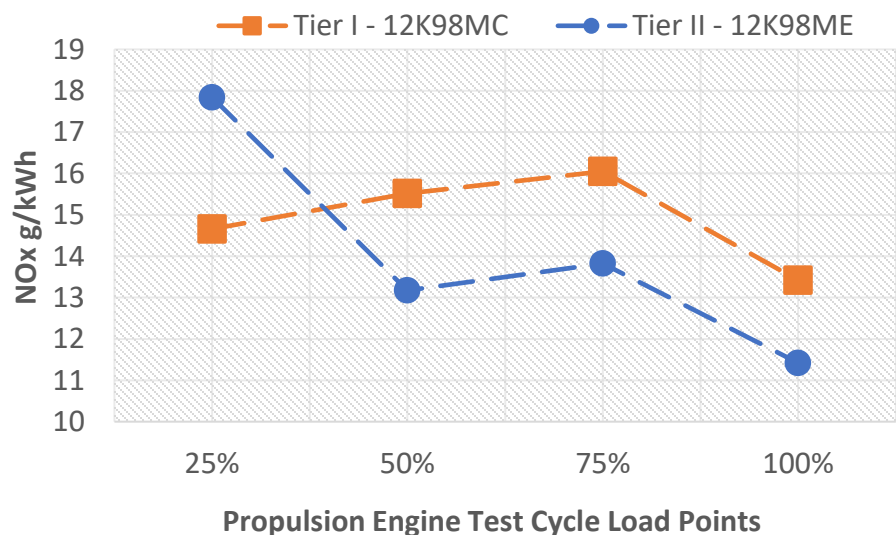
- Majority of container ships calling at ports of Los Angeles and Long Beach operated at low loads nearshore
- Concerns over potential higher NO_x emission rates at low load
 - Tier III aftertreatment systems (e.g., selective catalytic reduction) often on stand-by at low loads due to low exhaust temperatures



Studies Example (continued): Observations of OGV NOx Emissions at Low Load

- Propulsion engine loads below 25% not considered by IMO* engine tier standards
- Higher NOx emission rates observed for Tier II than lower tier container ships during low load operations

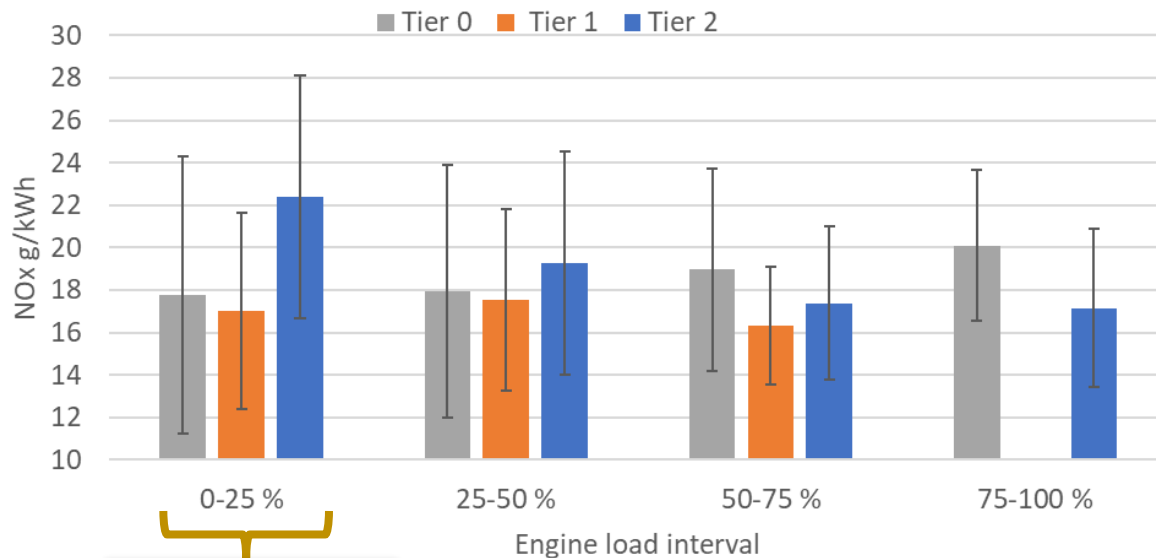
Marine Engine Certification Data



Source: Cheng et al. (2018). DOI: 10.1080/10962247.2017.1413440

*IMO = International Maritime Organization

Estimation Based on Remote Sensing Measurements



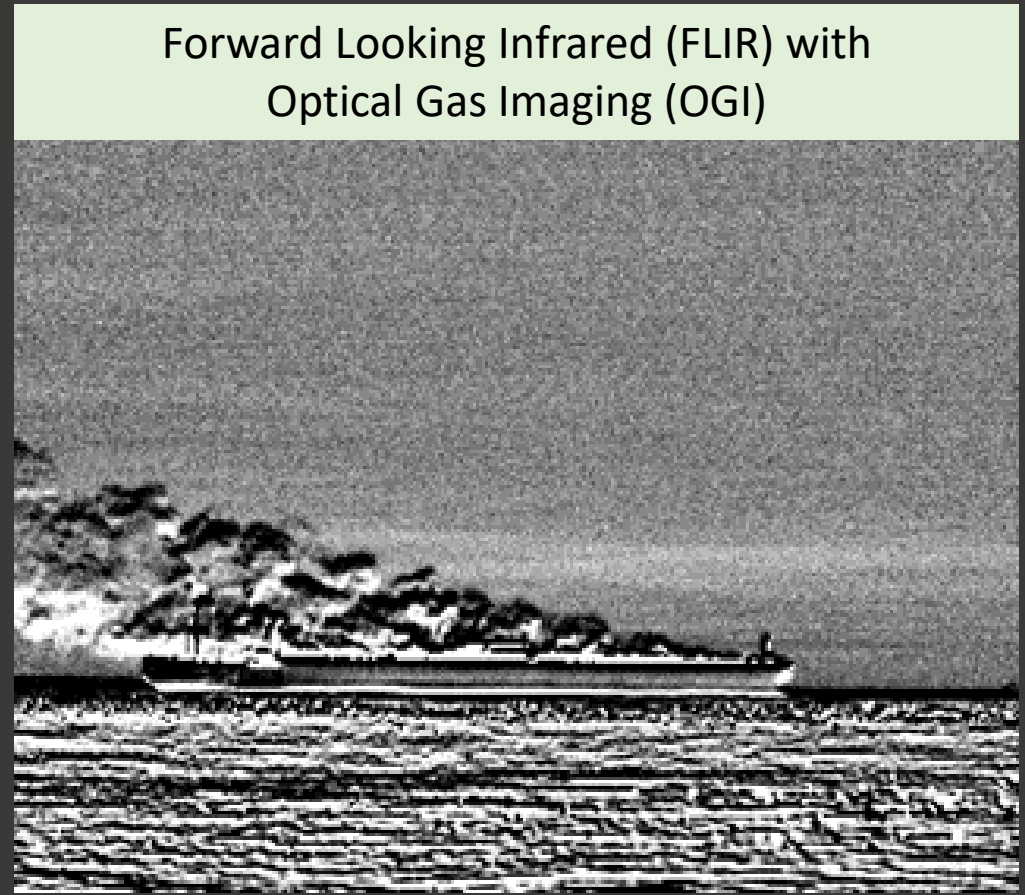
Unregulated

Source: Mellqvist and Conde (2023).

https://www.aqmd.gov/docs/default-source/planning/fbmsm-docs/fluxsense_chalmers-aqmd_final_report.pdf

Enforcement Example: Localized Impacts from Ship Vapor Emissions

- Odors observed along shoreline
 - 1,000+ complaints from communities
 - Elevated levels of light alkanes and occasionally sulfur found in onshore air samples
- Oil tankers identified as odor source
 - Venting estimated to release 0.5 to 2.6 metric tons of VOCs in 10 to 15 minutes
- Ongoing air monitoring
 - FLIR camera with OGI
 - Optical remote sensing – water and land
 - Enhanced shoreline monitoring + model
- Rule compliance advisory
 - South Coast AQMD Rule 1142



Key Areas for Testing, Monitoring, and Measuring OGV Emissions Using Alternative Fuels

Additional Technical Studies Needed

**NO_x and Other non-GHG
Pollutant Emissions
at Nearshore
Low Load Operations**

**Vaporization Control for
Onboard Fuel Storage
Tanks and Engine
Fuel Injection**

**Emissions Associated
with Bunkering
Operations**

**Emissions from Unburnt
Fuels Due to Incomplete
Combustion**

Policy Question

*Would alternative
fueling infrastructure
in South Coast AQMD
region attract visits by
alternative-fueled
OGV, and how would
that affect emissions?*

Thank You



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For more information,
visit: <http://www.aqmd.gov>

We look forward to partnering with you!