WEBINAR: Overview of Proposed Concepts for Amendments to the Commercial Harbor Craft Regulation

March 5, 2020, 10:00 AM

Slides available for download at:
https://ww2.arb.ca.gov/resources/documents/chc-webinar-presentation-march-2020

Webinar Agenda

I. Regulation Concepts + Questions
- Motivation and overview of rulemaking process
- Proposed concepts
- Staff questions for stakeholders
- Next steps

II. Emission Inventory Update + Questions

- **Submit questions at any time during the webinar through GoToWebinar**

Part I:
Commercial Harbor Craft Background and Proposed Regulatory Concepts

Progress to Date

- Since 2009, commercial harbor craft (CHC, or harbor craft) owners have replaced older with newer, cleaner engines to comply with the existing regulation
- Some harbor craft owners not subject to in-use requirements have voluntarily replaced older engines with newer, cleaner engines
- Many engine replacements have been funded by CARB's Carl Moyer Program administered through local air districts

Additional Emission Reductions are Needed from Harbor Craft

- Staff proposed in the March 2018 board hearing to reduce emissions from harbor craft
- CHC rulemaking is included in CARB's Community Air Protection Blueprint strategies for AB 617
- Additional to State Implementation Plan actions to:
  - Achieve reduction in community health risk
  - Attain regional air quality standards
  - Mitigate climate change

Where Are We Now?

- Began feasibility study with Cal Maritime Academy (CMA)
- Distributed owner-operator surveys

TODAY: Webinar

- Refined Concepts
- Preliminary Emission Inventory Methodology

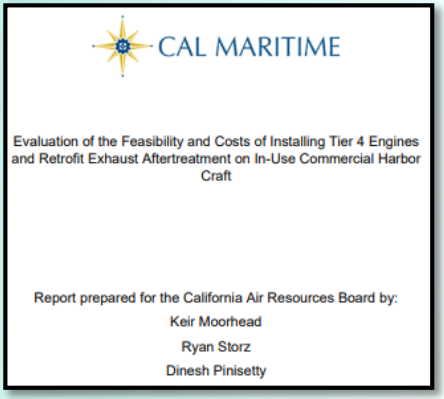
Next Workshops: Summer 2020

- Proposed Regulatory Language
- Cost Analysis
- Updated Emission Inventory

Anticipated Board Date mid-2021

CARB

California Maritime Academy Feasibility Study


CAL MARITIME

Evaluation of the Feasibility and Costs of Installing Tier 4 Engines and Retrofit Exhaust Aftertreatment on In-Use Commercial Harbor Craft

Report prepared for the California Air Resources Board by:

Keir Moorhead

Ryan Storz

Dinesh Pinisetty

- Released October 2019, available on CARB website
- Evaluated a vessel in each of 13 harbor craft categories
  - Feasibility of retrofit DPF*, DPF+SCR**, and Tier 4 repowers on in-use vessels
- Results showed that retrofits and repowers are more feasible for some vessels than others

**DPF = diesel particulate filter*

***SCR = selective catalytic reduction system*

Proposed Harbor Craft Concepts

- Proposed concepts posted February 27, 2020
  - Document 1: Requirements for Cleaner Combustion, Zero Emission, and Advanced Technology
  - Document 2: Operational, Reporting and Compliance Requirements
  - Document 3: Questions for Stakeholders
- Staff seeking feedback by March 31, 2020
- Staff will develop draft regulation language prior to summer 2020 workshops

Expanding Vessel Categories Subject to In-Use Requirements

Currently Regulated	Proposed for Future Regulation	NOT Proposed for Future Regulation
• Ferries • Excursion • Crew & Supply • Barges < 400 ft • Dredges • Tug & Towboats	• Charter Fishing • Barges – All • Pilot • Research • Work Boats • Temporary Replacement (Tier 2 or higher)	• Commercial Fishing • Historic • Military/Coast Guard • Emergency vessels • Ocean-Going Vessels* • Recreational

*OGVs, regulated under separate control measures

More Stringent Requirements for In-Use and New Vessels

- Proposed concept is a performance standard equivalent to
  - Below 600 kW: Tier 3 or 4 (if certified) + diesel particulate filter (DPF)
  - Above 600 kW: Tier 4 + DPF
- Proposed concept includes engines under 50 hp
- Low use exemption (80/300 hours) would remain
- Additional requirements for short-run ferries, new tugs, and new excursion vessels apply *(Slide 12)*

Pathways for Meeting Tier 3/4 + DPF Performance Standard

- Repowering or rebuilding engines to meet Tier 3 or 4 diesel engines plus installing a CARB verified Level 3 DPF
- Install Tier 3 or 4 engine certified by U.S. EPA with a DPF from the original equipment manufacturer (OEM)
- Demonstrate that engines otherwise meet performance standard during normal operation (more on Slide 14)

Mandates for Zero-Emission and Advanced Technologies

Marine Technology Type*	Vessel Category Requirement	Mandate Phase-In Date
Enhanced Efficiency Diesel-Electric	New Tugs	Jan. 1, 2025
Zero-Emission Capable Hybrid*	New Excursion Vessels	Jan. 1, 2026
Zero-Emission	New and In-Use Short (< 3 nm) run ferries	Jan. 1, 2028

**See Document 1, pages 8-9 for definitions*

Compliance Extensions and Replacement Vessels

- Existing regulation allows for compliance extensions under certain circumstances
  - Includes "No suitable engine replacement" provision with no limit for number of annual extensions
- **Proposed concept:**
  - Up to two extensions of 3 years each, total 6 years
  - Vessel owner must show lack of technical feasibility AND inability to pay
  - Vessel would need to be replaced after end of 3 or 6-year extension

Alternative Compliance Pathways

- Alternative Control of Emissions (ACE) pathway in existing regulation
- Propose replacing ACE with Alternative Compliance Pathway (ACP)
- Two options that vessel owners can request
  1. Achieve greater or equal emission reductions as Tier 4 + DPF standard with alternative technology; or
  2. Adopt zero-emission or advanced technology where not required = additional compliance time for another vessel in fleet and air basin

Summary of Proposed Requirements by Vessel Type

Vessel Category	Proposed Future Regulated In-Use Category	Maximum Extension Beyond Compliance Date	Proposed Future New Vessel Requirements
Ferries, Excursion, Crew & Supply, Barges & Dredges, Tanker Barges, Tugboats (including on ATBs), Towboats, Pilot, Research, Charter Fishing Vessels	Yes	6 years	Meet current emission standards plus additional requirements as applicable*
Work Boats	Yes	Unlimited*	
Commercial Fishing	No	N/A	
Historic, Coast Guard/Military, Emergency, Temporary Replacement, OGVs**	No	N/A	N/A

*See Document 1, page 16 **OGVs regulated under separate control measures

Proposed Implementation Timeline

- **Any Tier 0 and 1 engines to Tier 3 and 4 only**
  - Generally Workboats, Research, Pilot, Tank Barges, and Charter Fishing

Engine Model Year	≤ 1993	1994 - 2001	2002 - 2006
Proposed Compliance Date	2023	2024	2025

Proposed Implementation Timeline

- Ferries (except short run), pilot vessels, all tugs to Tier 3 + DPF or Tier 4 + DPF

Engine Model Year	2007 - 2009	2010 - 2012	2013 - 2015
Proposed Compliance Date	2024	2025	2026

Engine Model Year	2016 - 2019	2020 - 2021	2022+
Proposed Compliance Date	2027	2028	2029

Proposed Implementation Timeline

- Research, charter fishing, excursion to Tier 3 + DPF or Tier 4 + DPF

Engine Model Year	2007 - 2010	2011 - 2012	2013 - 2014
Proposed Compliance Date	2026	2027	2028

Engine Model Year	2015 - 2017	2018+
Proposed Compliance Date	2029	2030

Proposed Implementation Timeline

- Dredges, barges, crew & supply, workboats to Tier 3 + DPF or Tier 4 + DPF

Engine Model Year	2007 - 2009	2010 - 2013
Proposed Compliance Date	2028	2029

Engine Model Year	2014 - 2017	2017+
Proposed Compliance Date	2030	2031

Idling Limits and Shore Power

- Staff has observed and received complaints about extended main engine idling and auxiliary engine operation while at dock
- Currently no idling limits or shore power requirement
- 15 minute limit for operation at dock
  - Exceptions for limited circumstances *(see Doc. 2, pg. 5)*
- Requirement to use shore power at dock
  - 2019 surveys: many harbor craft already plug in

Facility Infrastructure

- Zero-emission and advanced technologies need infrastructure to support their use
- Proposed responsibilities for zero-emission infrastructure – staff requesting feedback
  - Facilities would install/maintain shore power infrastructure
  - Vessel owners would install/maintain infrastructure to support zero-emission vessels
  - Facilities would allow vessel owners to install infrastructure for their operations

Facility Reporting Requirements

- Vessel currently required to be reported, but staff estimate 48% of vessels are not
- Propose future annual requirement through new electronic system
- Facilities not currently required to report vessels
  - Propose facilities report vessels renting, leasing or contracting a slip for 30+ days
  - Staff seeking input on threshold to require only larger facilities to report

Vessel Reporting and Identifiers

- Staff propose annual reporting, with some changes in data fields from existing regulation
- Proposed new labeling requirement for harbor craft in California
  - No labeling required in existing regulation, but other CARB regulations require labeling
  - Currently no common identifier for all CA vessels
  - CARB would issue ID for vessel owner/operator to affix or paint onto vessel
- Anyone could look up vessel compliance status on future CARB electronic reporting system

Opacity Limits

- Visible soot emissions from harbor craft with engines of all tier levels without DPF
- Staff is currently conducting opacity measurements on vessels under a wide range of transient and steady-state conditions
- Proposed requirements under development
  - Opacity limits, engines subject (main, auxiliary), test method, and frequency of testing

Compliance Fee

- CARB authorized by HSC 43019.1 to adopt a schedule of fees to cover compliance costs
- Fee amount based on estimates of CARB personnel, equipment and operational costs
- Staff seeking stakeholder input on fee structure proposal

Questions for Stakeholders

- Staff requesting information from stakeholders to refine proposed concepts – see Document 3
- Information is needed to ensure costs of proposed regulation are not underestimated
- **General question - How much would it cost for your business to comply?**
  - What pathway(s) would you use to comply?
  - What alternative technologies could work for your operations?
  - What are your options for raising funds, and how long would it take?

Staff Seeking Input on Specific Cost Metrics

- Capital equipment costs (Tier 4 + DPF)
- Dry dock and/or installation costs (Tier 4 + DPF)
- Loss of revenue for time out of service
- Naval architect costs
- Engine scrap or disposal costs
- Costs of on-vessel or land-side infrastructure for using shore power
- Profits from retiring/selling used vessel
- Costs of replacement vessels (see next slide)

CARB Cost of New Build Vessels from CMA Feasibility Study

- Staff anticipates costs of vessel replacement to impact overall cost of regulation
- Staff is requesting cost estimates or actual cost paid for new build vessels

Vessel Category	Insured Vessel Value (Million)
Ferry	$12
Pilot	$3.4
Push/Tow Tug	$6
Ship-Assist/Escort Tug	$15
Charter Fishing	$1.3
Excursion	$9
Dredge	$17
ATB Barge	$60
Crew & Supply	$3.6
Workboat	$3
Special Use	$15

Solicitation of Regulatory Alternatives

- Staff are seeking feedback on alternatives to proposed concepts
- Stakeholder input is important for Standardized Regulatory Impact Assessment (SRIA)
  - SRIA is required for "major regulations" pursuant to SB 617 and the California Environmental Quality Act (CEQA)
- CARB encourages public input on alternatives that
  - Yield the same or greater benefits than proposed concepts; or
  - Do not yield, or are less likely to yield, the same level of benefits than proposed concepts

Next Steps

- **Comments on regulatory concepts and cost requested by March 31, 2020**
- Staff developing cost analysis and draft regulation language
- Next workshops summer 2020
  - Emission inventory update
  - Cost analysis
  - Draft regulation language
- Anticipated Board date mid-2021

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CARB Commercial Harbor Craft Website:
https://www.arb.ca.gov/ports/marinevess/harborcraft.htm

Questions on Part I: Regulatory Concepts

Part II: Preliminary Methodology and Results of the CHC Emission Inventory

CARB CHC Emission Inventory History

2007 model

- Largely based on a CARB CHC survey

2010 model

- Updated with CARB reporting data

2020 model

Major updates:

- Most model inputs updated with reporting data (2009-2019): baseline population, activity, growth, turn-over, load factor, etc.
- Emission factors updated with US EPA certification data

General Emission Inventory Methodology

$$Emission = \sum (POP \times HP \times A \times LF) \times EF \times FCF$$

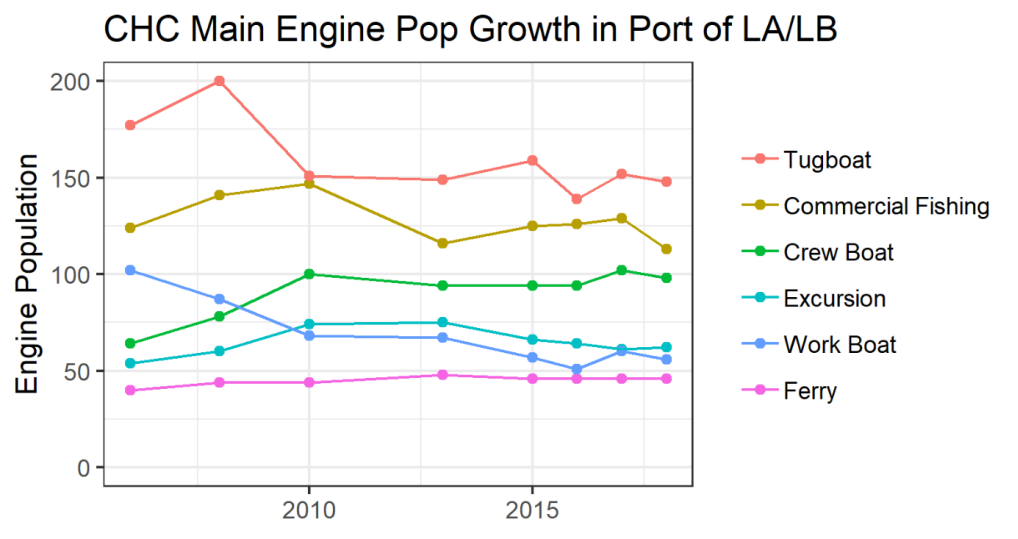
- **POP:** engine population
- **HP**: rated/maximum horsepower
- **A**: average activity in hours
- **LF: Load Factor,** the ratio of in-use HP to maximum HP
- **EF: Emission Factor (g/hp-hr)**, adjusted for deterioration
- **FCF: Fuel Correction Factor,** accounts for the difference in emissions between CARB and federal diesel

Baseline Population

- CHC vessel population in CARB reports by Feb 2019 (**1928**) is scaled up to match that in U.S. Coast Guard (USCG) (**3698**)
  - Goal of scaling up is to account for *non-reporting CHC* (48%)
  - For CHC in port of Oakland and Richmond, all ferries, ATB tugs, and pilot boats, reported population stay *unchanged*
  - For vessel types that could be matched between the two sources (barges, commercial fishing, tugs, and research boats), reported population is scaled up by *vessel type*
  - For all other vessels, reported population is scaled up by *location*
    - For top 7 ports with vessel population >100, population scaled at port level
      - San Francisco, LA/LB, San Diego, Eureka, Fort Bragg, Newport Beach, Santa Barbara
    - For all other ports, population scaled to match the remaining USCG reports

Population Growth

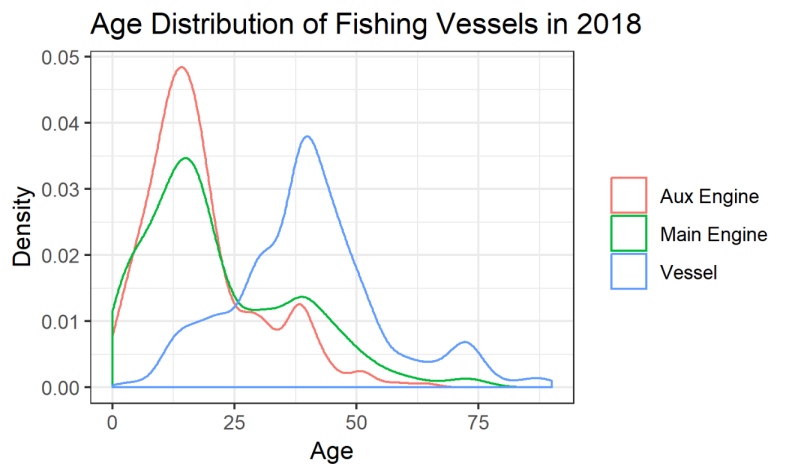
- **Historical** growth trend relatively flat, even though freight movement is increasing
- **Forecast:** no population growth, except for SF ferries
  - Exception: ferries in San Francisco will increase by 3-4 times from 2018-2035[a]



[a]*San Francisco Bay Area Water Emergency Transportation Authority (WETA) 2016 Strategic Plan*

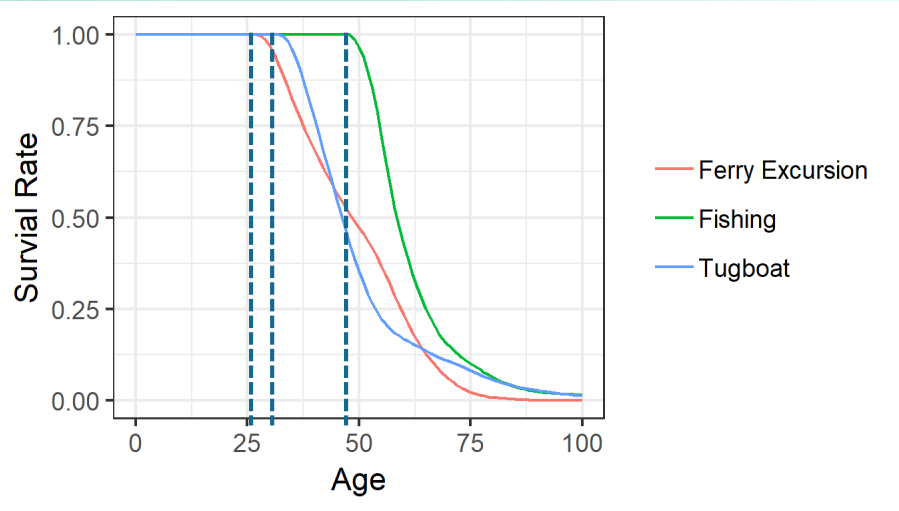
Population Turnover

- Developed using age distribution of reported CHC vessels from 2015-2018
  - Average vessel age is 2-3 times older than average engine age
  - Survival curves of *vessels* instead of engines are used, as discussions with industry show strong trend towards rebuilding engines indefinitely instead of repowering
  - Using vessel survival will significantly increase average age over time



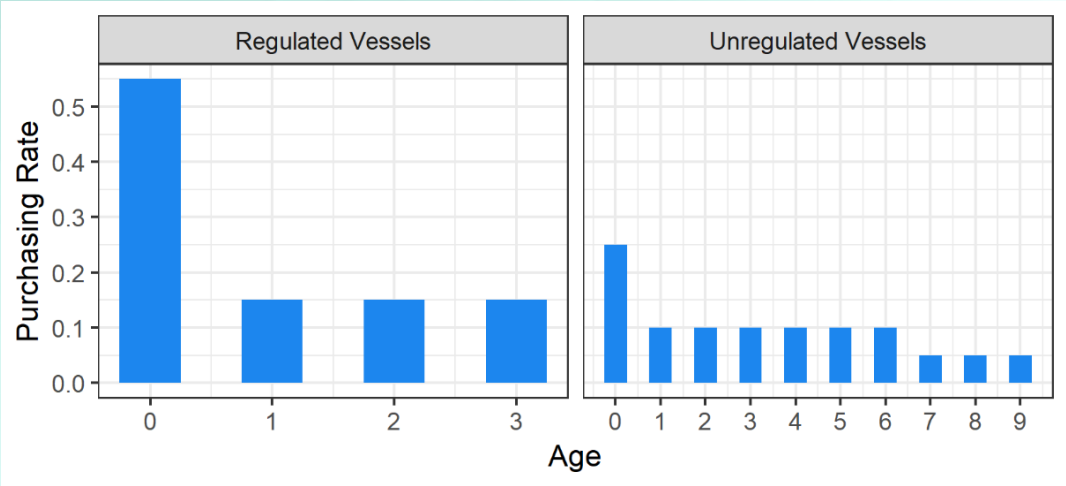
Survival Rates for Selective Vessel Types

- Survival rates for three vessel types are developed to represent the fleet due to small population of other vessel types
- Other vessels follow these survival rates based on similarities in average vessel age



Purchasing Rates by Age and Vessel Types

- For regulated vessels (e.g. ferry), assumes purchasing up to 3 year-old engines, purchasing rates developed using average values of ferry excursion and tugboats
- For unregulated vessels (e.g. commercial fishing), assumes purchasing up to 9 year-old engines, purchasing rates developed using those of fishing vessels



Average Annual Engine Activity

Vessel Type	Main Engine	Aux Engine
ATB Barge	1723	1723
Bunker Barge	225	720
Other Barge	231	439
Dredge	1348	1815
ATB Tug	867	880
Escort/Ship Assist Tug	1828	1773
Push Tow Tug	1255	1495
Charter Fishing	1204	1728
Commercial Fishing	1031	1233
Crew Supply	1524	1717
Ferry	2277	1562
Excursion	706	641
Pilot Boat	1964	1887
Research Boat	918	1032
Work Boat	1723	1723
Others	225	720

- Based on CARB reporting data, ~3700 engines
- Annual operating hours of CHC vary greatly, mostly 200–2000 hours
- Assume constant annual activity in the future

Load Factor: the fraction of maximum brake-horsepower while engine running

Vessel Type	Main Engine	Aux Engine
ATB Barge	0.47	0.26
Bunker Barge	0.63	0.35
Other Barge	0.52	0.34
Dredge	0.47	0.51
ATB Tug	0.50	0.50
Escort/Ship Assist Tug	0.15	0.34
Push Tow Tug	0.40	0.45
Charter Fishing	0.28	0.52
Commercial Fishing	0.26	0.51
Crew Supply	0.27	0.46
Ferry	0.34	0.44
Excursion	0.29	0.51
Pilot Boat	0.43	0.38
Research Boat	0.34	0.56
Work Boat	0.36	0.40
Others	0.40	0.38

- Data sources:
  - ❖Activity and fuel reports to CARB, ~3200 engines
  - ❖ECM data from 34 engines including assist tugs, ATB tugs, high-speed ferries, and excursions
- Range from 0.15 – 0.63

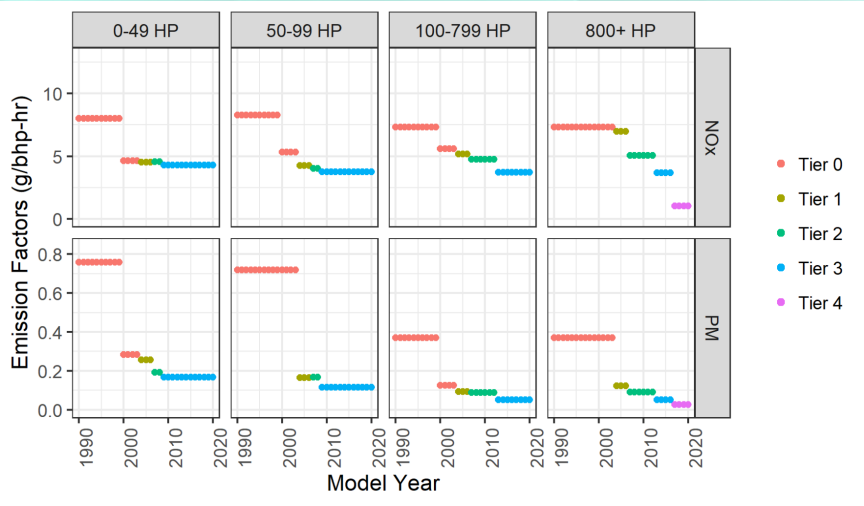
Emission Factors (EF)

- Emission factor (EF) is calculated with zero-hour EF and deterioration rate:

$$EF = EF_0(1 + DR \times Age)$$

- **Zero-hour emission factor (EF_0):** updated with US EPA certification data
- **Deterioration rates (DR):** adopted from previous 2010 CHC model

Zero-Hour Emission Factors

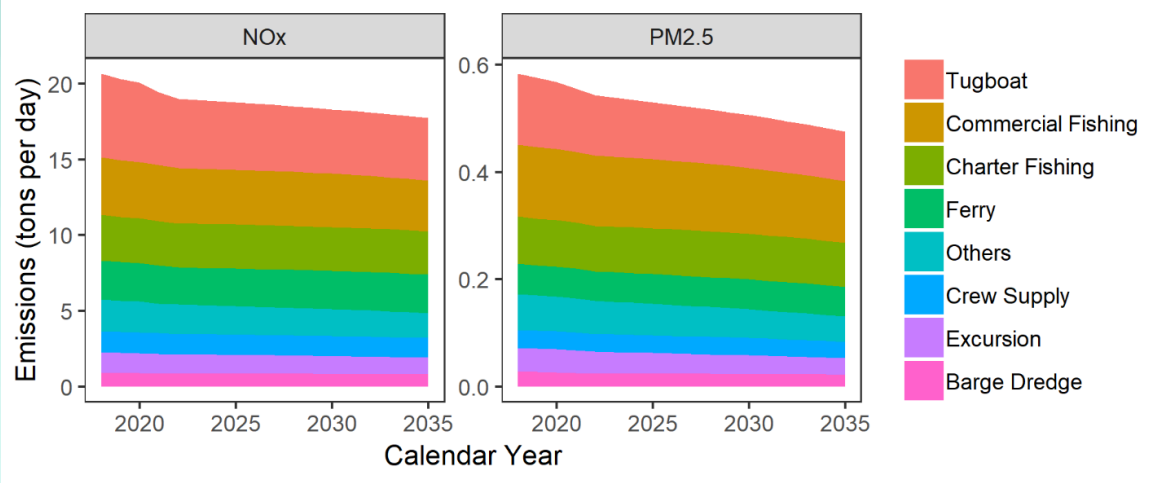


Note: CARB contracted with UC Berkeley and Riverside to perform Portable Emissions Measurement System (PEMS) measurements of three engine configurations. Emission factors are similar to the average EFs developed here.

- **Tier 0:** general off-road EFs
- **Tier 1/2/3:** mean of the EFs of 1061 (24%) reported CHC engines identified in US EPA marine and off-road engine certification database
- **Tier 4:** mean of EF of Tier 4 engines in US EPA marine certification data

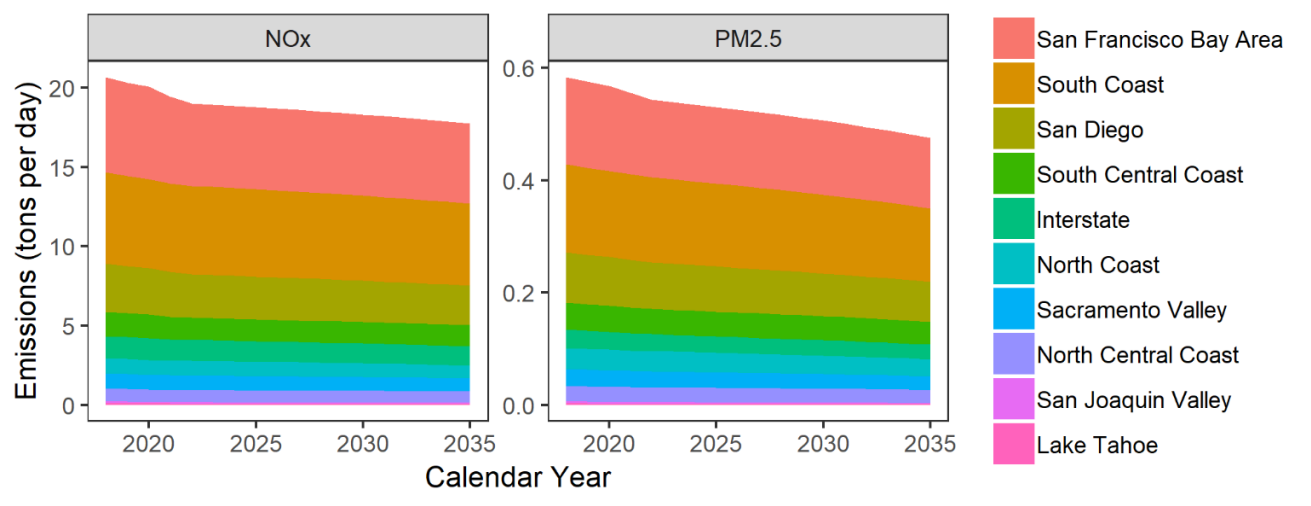
Preliminary Results: Statewide CHC Emissions by Vessel Type

- Tugboats & commercial fishing vessels are top emitters for NOx and PM2.5
  - ❖Tugboats have the highest activity, commercial fishing vessels have the largest population and oldest average age



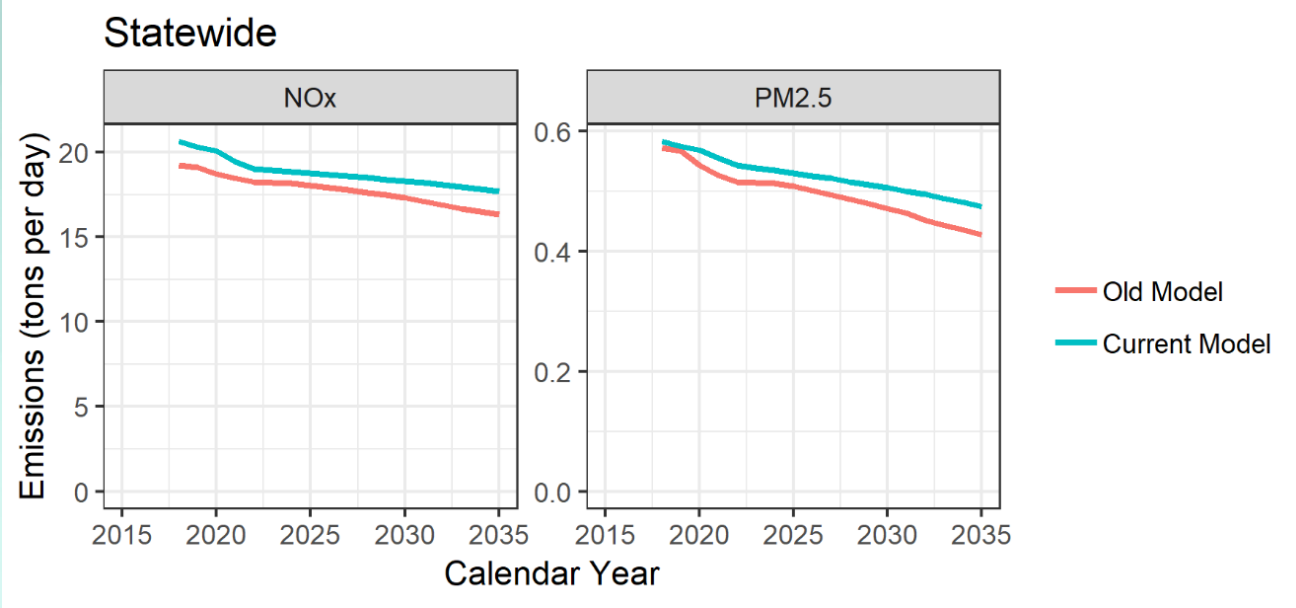
Statewide CHC Emissions by Air Basin

- San Francisco Bay Area & South Coast are top contributors of both NOx and PM2.5, due to the large population of vessels (based on Coast Guard)



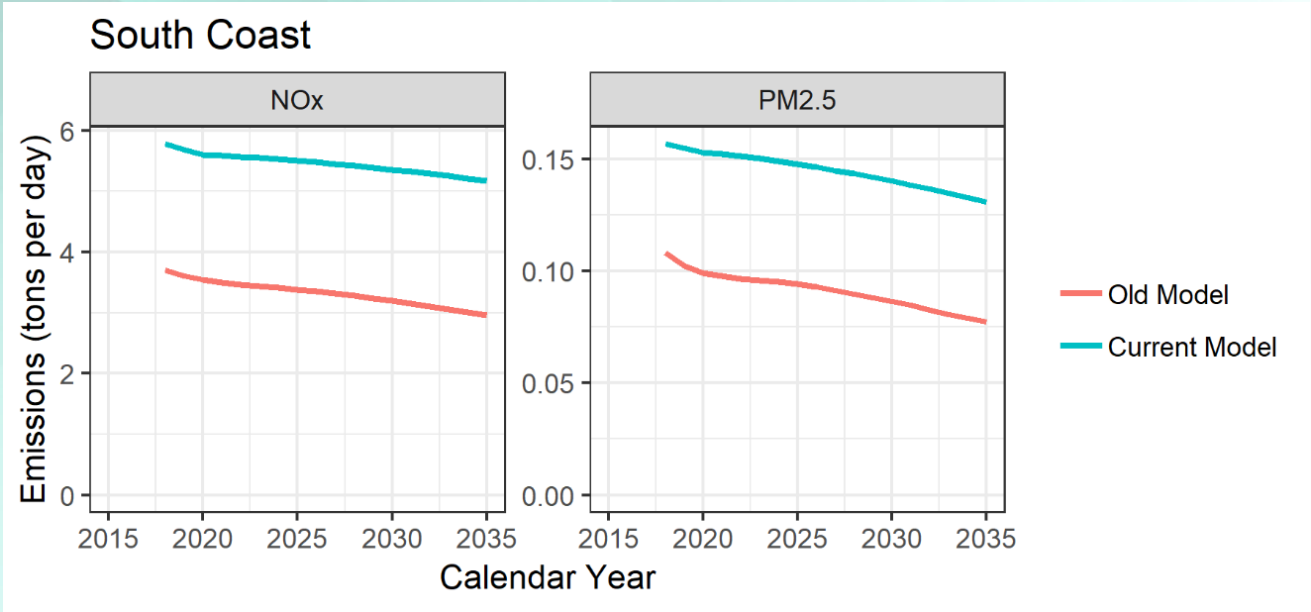
Comparisons Between Current and Old CHC Inventories: Statewide

- Compared to previous CHC inventory, updated statewide NOx and PM2.5 emissions are around 10% higher



Comparisons Between Current and Old CHC Inventories: South Coast

- In South Coast, updated NOx and PM2.5 emissions are 40-60% higher than those in the old model



Questions & Comments?

- Questions and feedback are encouraged and welcome, especially for:
  - ❖CHC population and growth
  - ❖Engine turnover and purchasing behavior
  - ❖Engine activities and growth
- Submit comments and any supporting inventory data by **April 30, 2020**
- Off-Road Emissions Inventory Team is available at:

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Supporting Slide

Off-road Diesel Engine Standard