Public Workshop to Discuss Ships At-Berth Regulation

August 28, 2017
Los Angeles

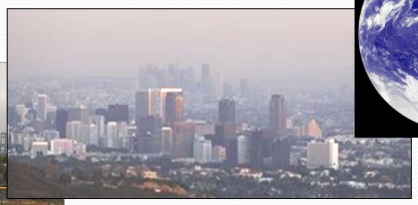
&

September 7, 2017
Sacramento

California Environmental Protection Agency
Air Resources Board

Why Does CARB Regulate Ships At-Berth?

- To reduce community health risk near ports
- To help attain regional air quality standards
- To reduce greenhouse gases



Agenda

I. At-Berth Implementation Status
II. Emissions Inventory Revisions
III. At-Berth Amendment Concepts
IV. Next Steps
V. Emissions Inventory Presentation

I. At-Berth Implementation Status

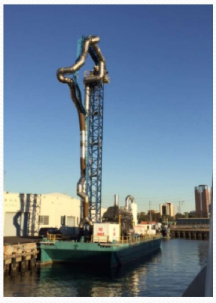
- Regulation Requirements Background
- Regulatory Implementation

Regulation Requirements Background

- Ports of Los Angeles, Long Beach, Oakland, San Diego, Hueneme, San Francisco
- Container, passenger, refrigerated cargo (reefer) vessels
  - Container/reefer fleets ≥ 25 annual visits
  - Passenger fleets ≥ 5 annual visits
- Emission/power reduction percentages phase in from 10% in 2010 to 80% in 2020
- Two pathways to reduce emissions
  - Reduced On-board Power Generation
  - Equivalent Emission Reduction

Regulatory Implementation

- 63 berths at 23 terminals shore power equipped
- Two alternatives to shore power in commercial operation at Ports of Los Angeles and Long Beach
- Barge-based exhaust scrubber systems:
  - AMECS
  - METS-1
- Land-side project in development – Green Omni Terminal at Port of LA



Regulatory Implementation Cont.

- Between 2014-2016, around 7000 shore power visits from shore power equipped vessels across all regulated fleets
- ARB issued three marine advisories to provide enforcement flexibility to assist fleets with the transition period to meet requirements (2013, 2015 and 2016)

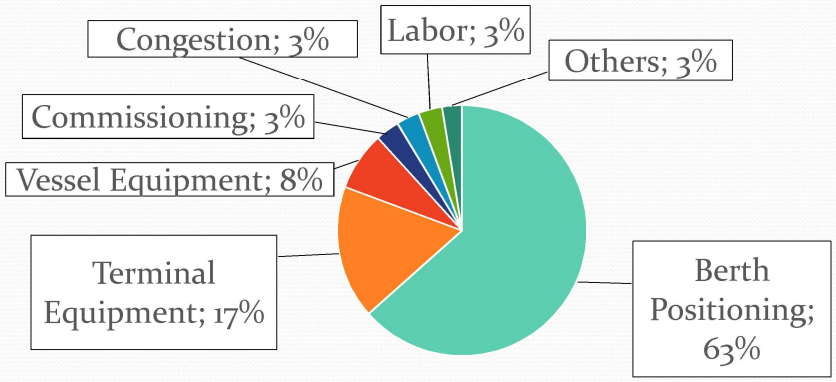
Regulatory Implementation Cont.

Key Implementation Issues

- Vessels having difficulty accessing shore power berths
  - Berth assignment, berth configuration, congestion, incompatibility
- Failure to meet 3-hr limit results in a noncompliant visit, even if emission reductions occurred
  - Delay is often a result of something outside of the vessels control (clearance/labor delay, terminal equipment issues)
  - Without Advisory, visit does not count even if vessel connects to shore power and reduces emissions
- Majority of advisory claims still resulted in emission reductions (70%)

Regulatory Implementation Cont.

Why Didn't The Vessel Plug In?

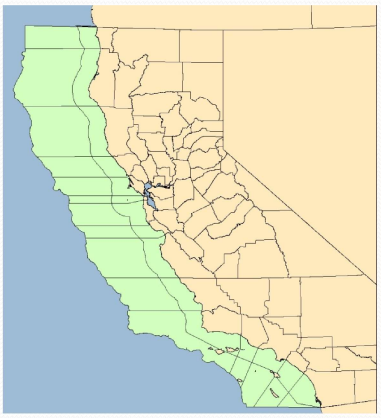


II. Emissions Inventory Revisions

- Emissions inventory was revised in 2016
- Updated model with new platform, improved IMO tier 3 projections, VSR, reduced transit speeds and slide valves
- Covers commercial vessels that are greater than 400 feet in length, 10,000 gross tons
- Includes all port visits, but does not include vessels that pass through California waters without stopping at a port

Emissions Inventory Revisions

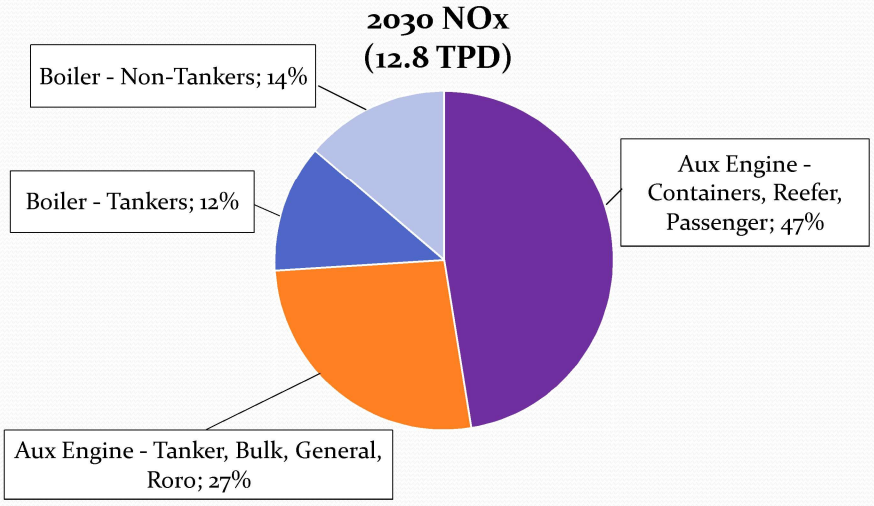
- Geographic area covers California's portion of the Pacific Exclusive Economic Zone, 200 nautical miles from the coast
- For State Implementation Plan, 100 nautical mile boundary is used (see figure)



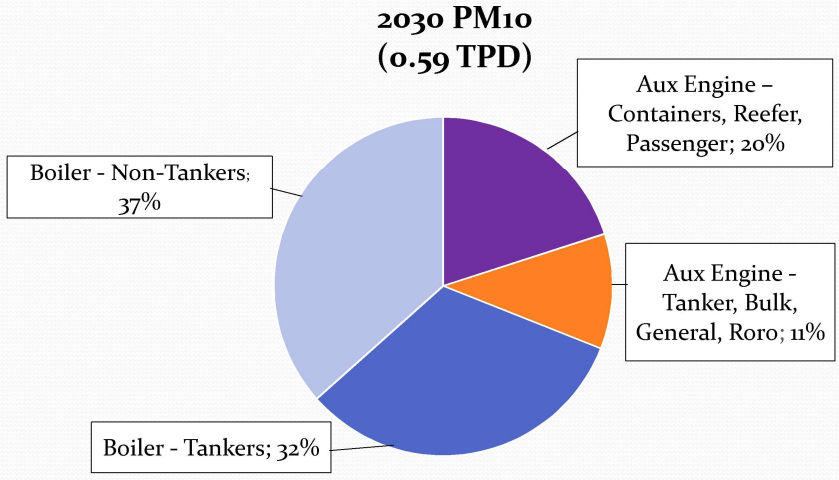
Inventory Source Data

- Ship information
  - 2014 IHS-Fairplay Vessel Registry
  - 2014 IHS-Fairplay California Movement data
  - 2014 Port of LA/LB Vessel Boarding Program – Aux and Boiler engine power
- Growth
  - 2015 U.S. Department of Transportation Freight Analysis Framework Forecast of Ship Tiers
  - Port of LA/LB and Starcrest 2016 study on tier adoption rates and forecast of visits to California
  - 2013 Mercator forecast for LA/LB containership size distribution

Statewide At-Berth NOx in Tons Per Day



Statewide At-Berth PM_{10} in Tons Per Day



III. At-Berth Amendment Concepts

- Goals of Amendments
- Board Direction
- Draft Regulatory Concepts

Goals of the Amendments

- Address issues learned from implementation
- Simplify requirements and increase enforceability
- Increase emissions reductions by including: additional vessels, ports, and vessel boilers
- Increase ability to hold terminals and ports accountable for their roles to achieve success
- Meet March 2017 Board direction to return with amendments in 18 months (September 2018)

Board Direction

Addendum to Resolution 17-7 and Resolution 17-8 from March 23, 2017

> BE IT FURTHER RESOLVED, that within 18 months of this date, ARB staff shall develop At-Berth regulation amendments that achieve up to 100% compliance by 2030 for LA Ports and Ports that are in or adjacent to areas in the top 10% of those defined as most impacted by CES;

Emissions from ships (at berth, at anchor, and in-transit) remain a significant contributor to community health risk.

Draft Regulatory Concepts

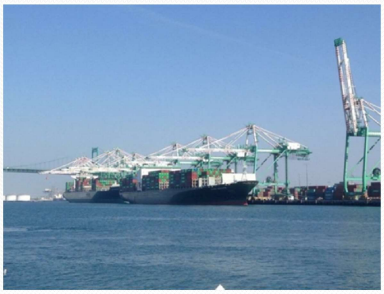
Overview

- Goal: Reduced emissions on every vessel visit
- Each vessel is treated equally, same requirements
- Increased applicability
  - Additional vessel types
  - Additional ports and terminals

Draft Regulatory Concepts

Overview Cont.

- Shared responsibility
- Single, flexible compliance pathway
- Visit definition
- Exemptions
- Opacity
- Online reporting



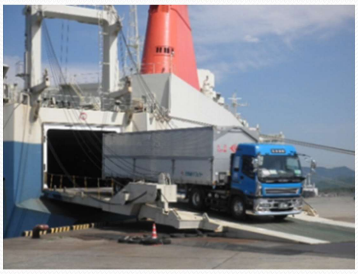
Additional Vessel Types

- Currently regulated vessels typically operate on a Liner schedule
  - Liner vessels call a fixed set of ports, often called a "loop"
  - Cargo more likely to be time sensitive, with fixed times of arrival/departure
  - Liner vessels more likely to be repeat visitors to California
- Additional vessel types considered have variable schedules and operate on a Tramper schedule
  - Likely to operate with no fixed regular destination or specific time of arrival
  - Trampers may call California only a few times during lifetime of the vessel

Additional Vessel Types

Roll-On/Roll-Off

- Roll-On/Roll-Off (Ro/Ro)- Carry cargo that can be rolled on and off the ship, such as cars, trucks, and heavy duty equipment
- Often referred to as auto carriers or car carriers
- Call at small and large ports
- Can operate on liner schedule, or as a tramper – making a single contracted visit



Additional Vessel Types Cont.

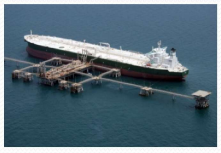
Bulk and General Cargo

- Bulk – Carry unpackaged goods in holds, such as grains and cement
- General Cargo – Carry a variety of packaged goods, including food, machinery, containers, etc.
- Both vessel types:
  - Call at small and large terminals/ports
  - Typically operate as trampers
  - Only make 1-2 visits/year to CA

Additional Vessel Types Cont.

Tankers

- Carry a variety of liquid cargoes, including crude oil and chemical products
- Typically operate on tramper schedule
- Can present greater implementation challenges versus other types of cargo vessels
  - Special safety concerns due to flammable cargo
- Specialized terminals

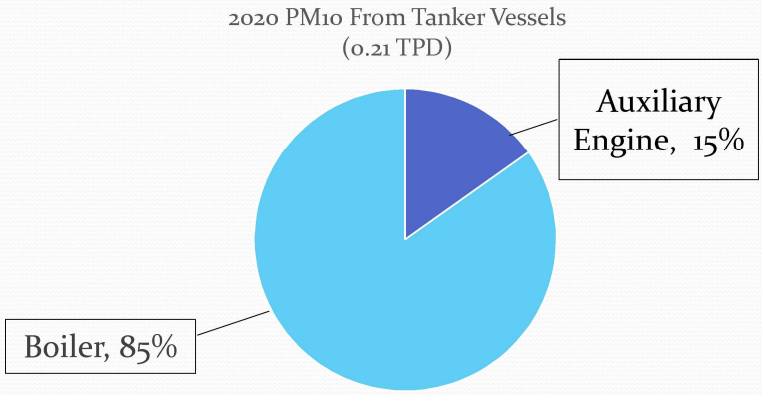


Tanker Proposal

- Emissions from off-loading cargo (e.g. crude) dominate tanker at-berth emissions
- Compared to all other vessel types, tankers now have:
  - Highest CO_2 and PM_{10} emissions
  - Second highest NOx emissions
  - Contribution expected to grow as regulations tighten for container/reefer vessels and passenger ships
- Boiler emissions were not a focus of original At-Berth Regulation

Tanker Proposal Cont.

Tanker Auxiliary and Boiler At-Berth Emissions



2020 ARB Emissions Inventory

Tanker Proposal Cont.

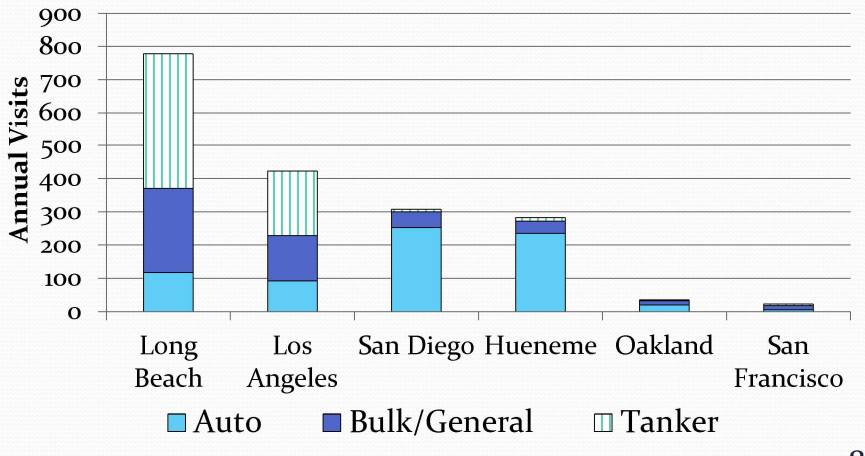
Potential Control Options

- May depend on specific vessel or terminal
- Landside terminal based controls
  - Shore-side electric pumps
  - Terminal based capture and control options
- Vessel based controls
  - Dual-fueled boiler that can use natural gas
  - Advanced boiler design (low NOx burners, more efficient boilers using super-heated steam)
  - Clean alternative fuels

Additional Ports and Terminals

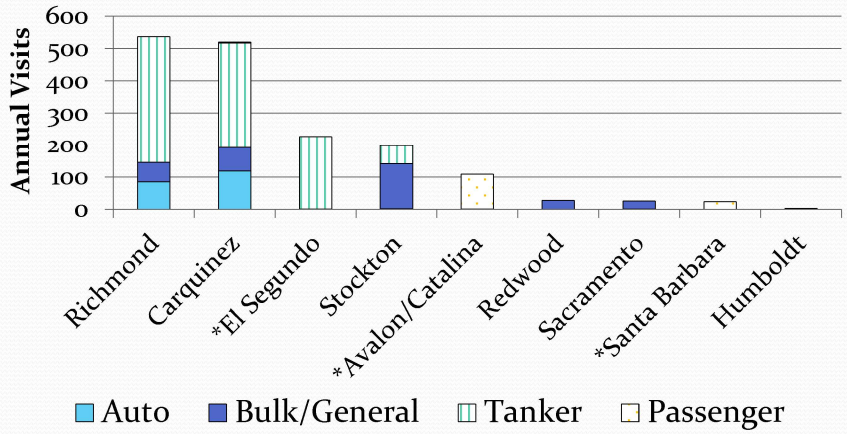
- Staff is reviewing whether visits to additional ports and terminals should be included in the regulation, based on need and feasibility
- Additional ports potentially include:
  - Richmond, Carquinez, El Segundo, Stockton, Catalina, Redwood, Sacramento, Santa Barbara, and Humboldt

Vessel Visits from Additional Vessel Categories at Regulated Ports



2015 State Lands Commission Inventory

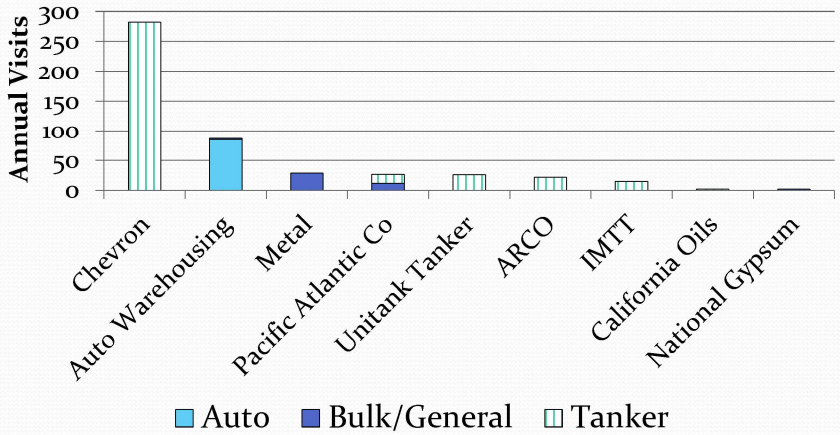
Vessel Visits at Unregulated Marine Facilities



* Indicates off-shore anchoring – not a land-based port

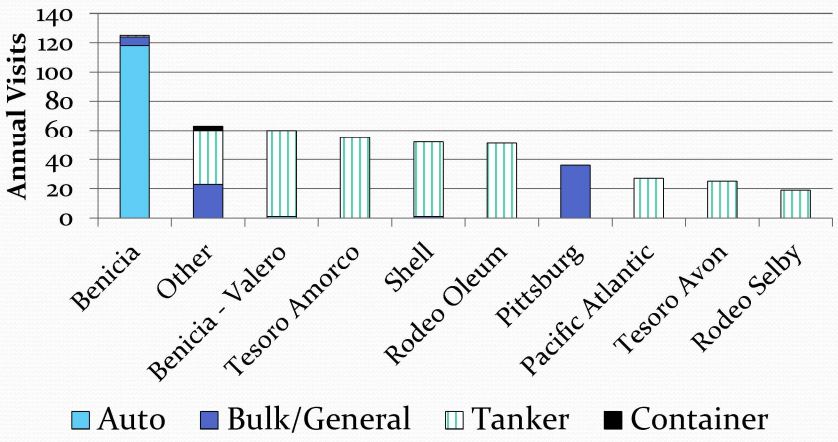
2015 State Lands Commission Inventory

Richmond Terminals



2015 State Lands Commission Inventory

Carquinez Terminals

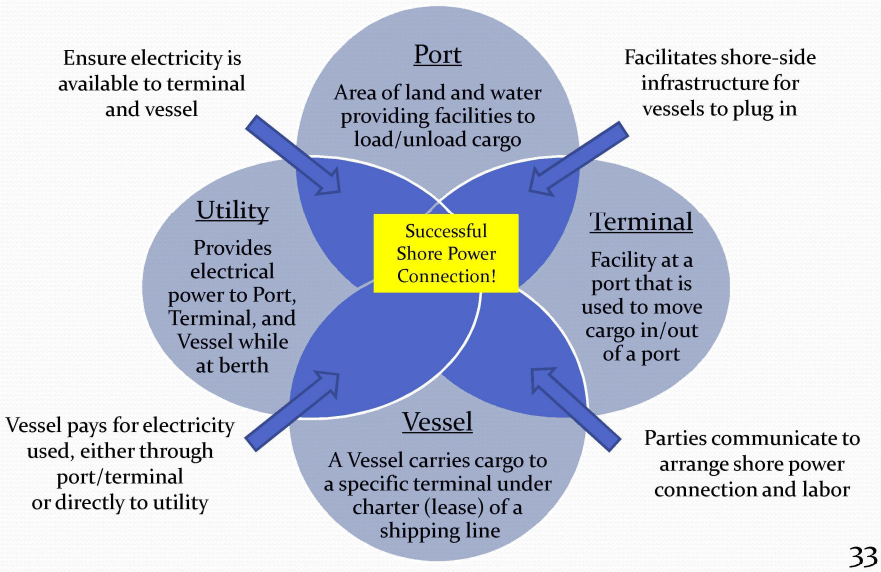


2015 State Lands Commission Inventory

Shared Responsibilities

- Shore power vessels having difficulty accessing shore power berths presents a loss of emission reductions
- Requirements should apply to all parties with control over reductions
  - Vessel owners, vessel operators, terminal operators, port authorities, technology suppliers
- Shared accountability critical for improved enforceability and compliance

Defining the Roles – Shore Power



Outlining the Responsibilities

- Which entities should be responsible for what?
- ARB asked industry to provide a high level list of responsibility of each entity with regards to shore power
- ARB is currently looking for feedback on "responsibilities" list

Vessel Responsibilities

Industry provided:

- Maintain pro forma vessel schedule
- Provide vessel capable of connecting to shore power or arranging alternative for non-shore power vessel
- Advise Port of electrical requirements of vessel receiving shore power
- Protect vessel equipment against damage in case of malfunction
- Ensure shore power vessels are IEC compliant

Port Authority Responsibilities

Industry/Ports provided:

- Ensure shore power infrastructure is adequate and compatible with IEE standard or alternative
- Comprehensive infrastructure assessment
- Installation and expansion of shore power infrastructure
- Provide qualified personnel to plug vessel in
- In the absence of sufficient shore-side infrastructure, provide sufficient equipment to extend connection points or provide CARB-certified alternative technology
- Report vessel visit data to ARB

Terminal Responsibilities

Industry/Ports provided:

- Provide qualified personnel to plug vessel in
- Maintain shore-side electrical equipment
- Confirm availability of berth or necessary equipment
- In some cases where the ports act as terminal operators, the ports would be responsible for the terminal responsibilities

Single, Flexible Compliance Pathway

- Use an approved compliance strategy for the entire visit including:
  - Shore power
  - Technologies with an ARB Executive Order
- Potential to expand approved strategies:
  - New control technologies
  - Onboard control technology
  - Cleaner vessels

Draft Regulatory Concepts

How Do We Phase-in Requirements?

Vessel Category	Visit Requirement				
	2022?	2024?	2026?	2028?	2030?
Container, Reefer, Passenger (currently regulated)	Every Visit				
Container, Reefer, Passenger (currently under visit threshold)	Phase-in Period			Every Visit	
All other vessel categories	Phase-in Period				Every Visit

- Phase in options?
  - Terminal based requirements
  - Fleet based requirements
  - Vessel visit threshold requirements

Visit Definition

- Redefine berthing time and remove 3 hr. time limit to connect
  - Current visit start-time conflicts with delays associated with vessel clearance and labor
  - Proposed visit definition:

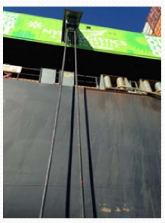
"The period that begins when clearance to work the vessel is granted by Customs and Border Protection (CBP), or other governmental agency, and the gangway is down and safety nets secured. Berthing Time (or Visit) ends when the departure Pilot assumes navigational assistance."

Visit Definition Cont.

- Feedback needed on when to "start and stop the clock"
- What is considered a "compliant" visit?

Exemptions

- Address common situations that still achieve a level of emissions reductions
  - Experimental testing under approved test plan
  - First commissioning visit to port
- Solutions for situations that do not reduce emissions
  - Emergency events
  - Unexpected equipment failure
  - Other?



Opacity Requirements

- Independent of other requirements, every vessel must meet visible emission opacity standards while at berth and at anchor

Online Reporting

- Staff is evaluating online reporting
  - Provide real-time reporting options
  - Enable quick feedback
  - Simplify review of compliance information
- How often should reporting be required? And who should be required to submit?

IV. Next Steps

- Evaluate stakeholder input
- Continue to explore potential regulatory concepts for amendments
- Additional data collection and collaboration with stakeholders on key issues
- Additional meetings and workshops
  - Fall 2017 – Spring 2018
- Bring amendments to Board Fall 2018

Regulatory Contacts

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Meeting Information

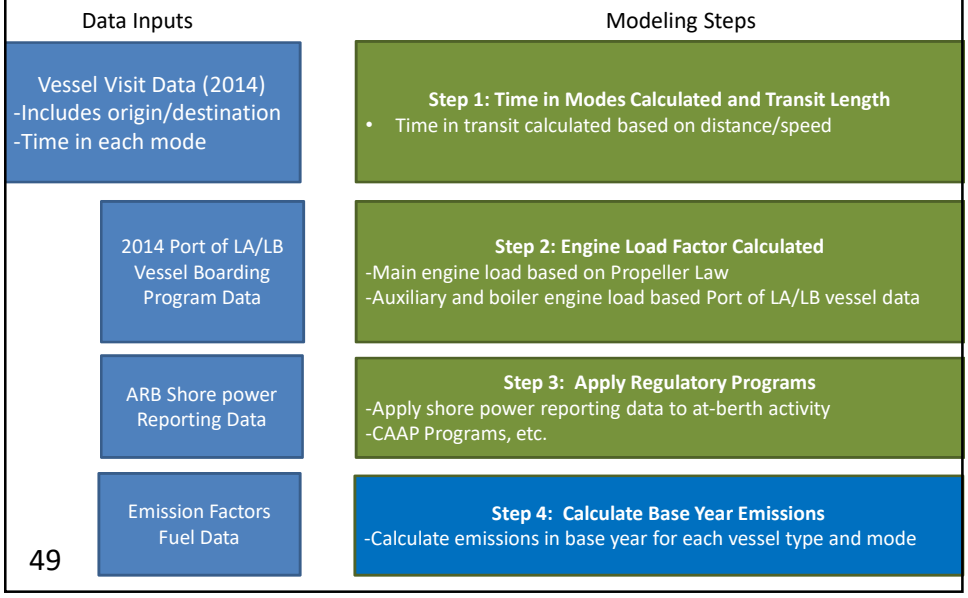
- Meeting materials available on At-Berth website: www.arb.ca.gov/ports/shorepower/shorepower.htm
- Join list serve: www.arb.ca.gov/listserv/listserv_ind.php?listname=shorepower
- E-mail questions and comments to: Shorepower@arb.ca.gov by October 9th, 2017

Emissions Inventory

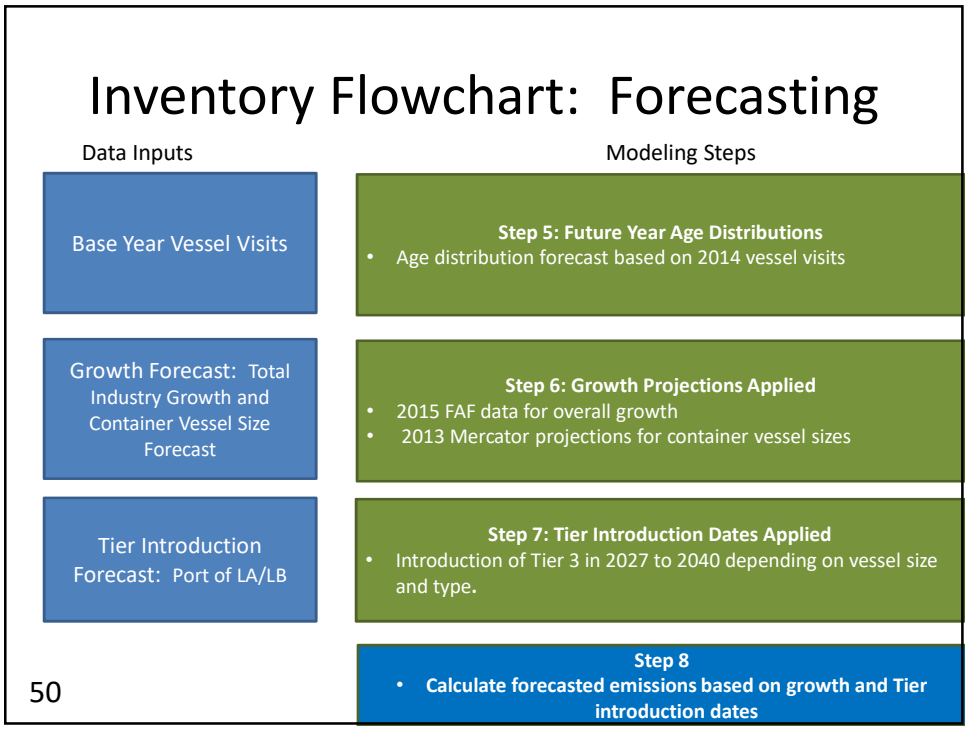
Detailed Methodology

I. Flowchart of Methodology
II. Modeling Step Details
III. Recent Inventory Changes
IV. Planned Improvements
V. Emission Results

Inventory Flowchart: Base Year



Inventory Flowchart: Forecasting

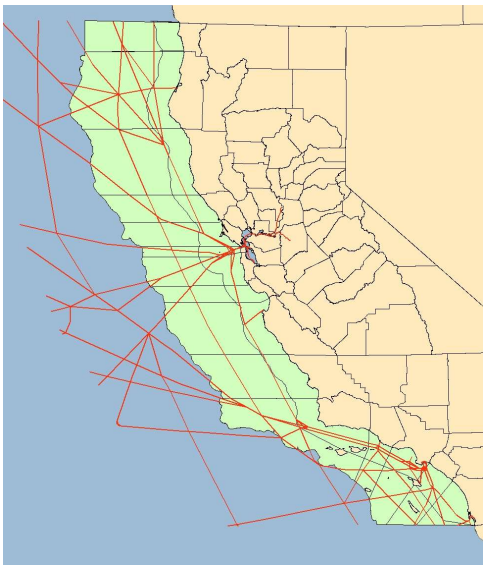


Time in Modes (Step 1)

- 4 Modes to categorize distinct operating behavior
  - Transiting: Open ocean operation
  - Maneuvering: In port movement
  - At-berth, at-anchorage: In port operation requiring no movement (auxiliary engines and boiler engines used)
- Affects the use and load factors of engines
- Transit and maneuvering time calculated using speed and distance
- At-berth and at-anchorage times taken from IHS-Fairplay data

Transit Segments (Step 1)

- Arrival/departure has 3 vital points of info:
  - Previous port
  - Arrival port
  - Next port
- Transit pathway based on AIS data input through GIS
- Time in transit calculated based on distance/speed
- Includes IMO slow steaming and Vessel Speed Reduction programs



Engine Load Factor Calculation (Step 2)

- Main engine is calculated by using propeller law calculation
  - $\text{Load Factor} = (\text{Speed}/\text{Max Speed})^3$
- Auxiliary and boiler engine power and load factors are taken from Starcrest Vessel Boarding Program of Port of LA

Shore power Applied: (Step 3)

- IHS-Fairplay movement data used to total all time spent at berth
- From ARB reporting data, shore power hours is summed by vessel type, size bin and port
- Compared to total at-berth hours for same categories
- $\text{Control Factor} = \frac{\sum \text{Shorepower hours} - \sum \text{at-berth hours}}{\sum \text{at-berth hours}}$
- CAAP Programs Included:
  - Vessel Speed Reduction (VSR)
  - MAN Slide Fuel Valves

Emission Factor Data Sources (Step 4)

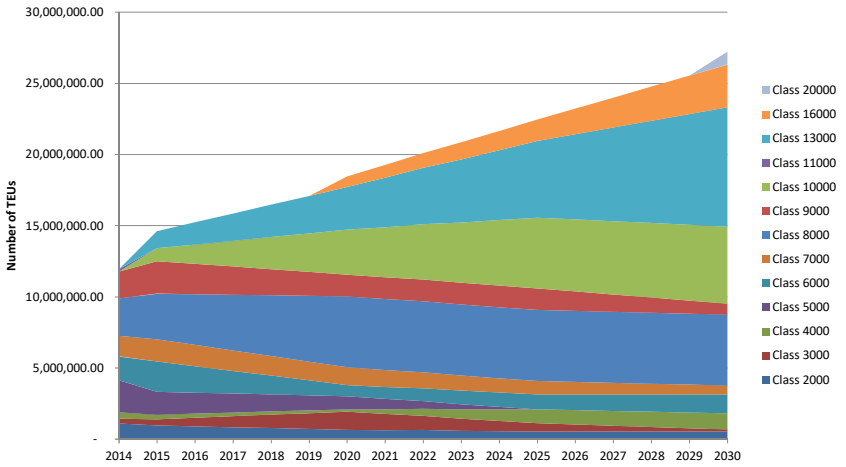
- Emission factors: Multiple sources for different engine types and pollutant
  - CARB 2007
  - Entec 2002
  - IVL 2002
  - IMO MARPOL
  - Vancouver Chamber of Shipping 2007

OGV Forecasting

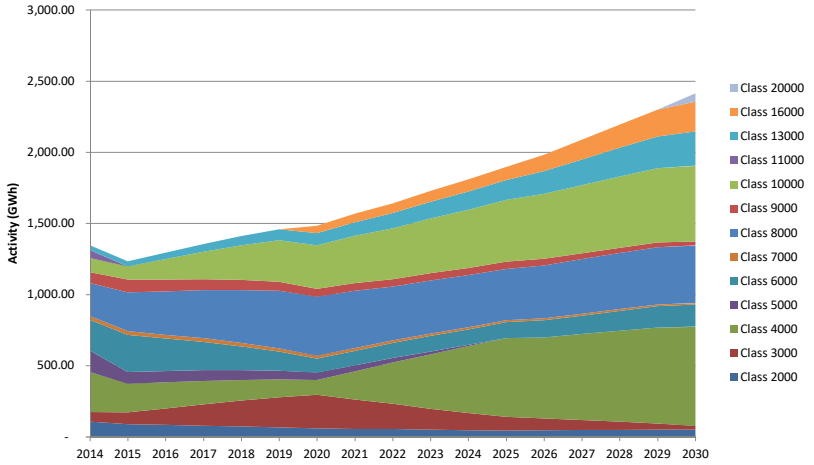
- Future Age Distribution (Step 5)
  - 2014 age distribution is statically applied to future years
- Growth Rates (Step 6)
  - FAF data used to create forecast of total growth by port, total increase in freight used
  - Containerships use Mercator 2013 forecast to allocate future activity growth across size bins (general shift toward larger vessels)
- 2016 Starcrest Tier Forecast (Step 7)
  - Tier 3 engines were previously modeled to arrive in 2016
  - Tier 3 now delayed to 2026 to 2040, depending on vessel type and size

Container Rate Growth by Size Bin (Step 6)

(Mercator 2013)

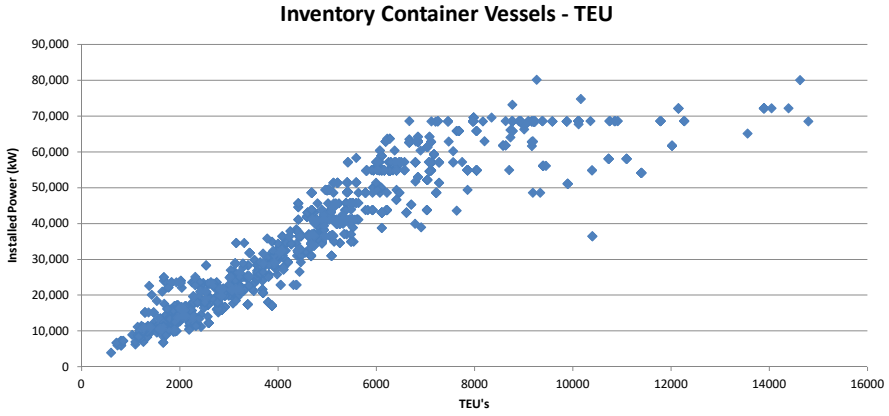


Containership Activity by Size Bin for LA and LB (Step 6)



Container Vessel Efficiency (Step 6)

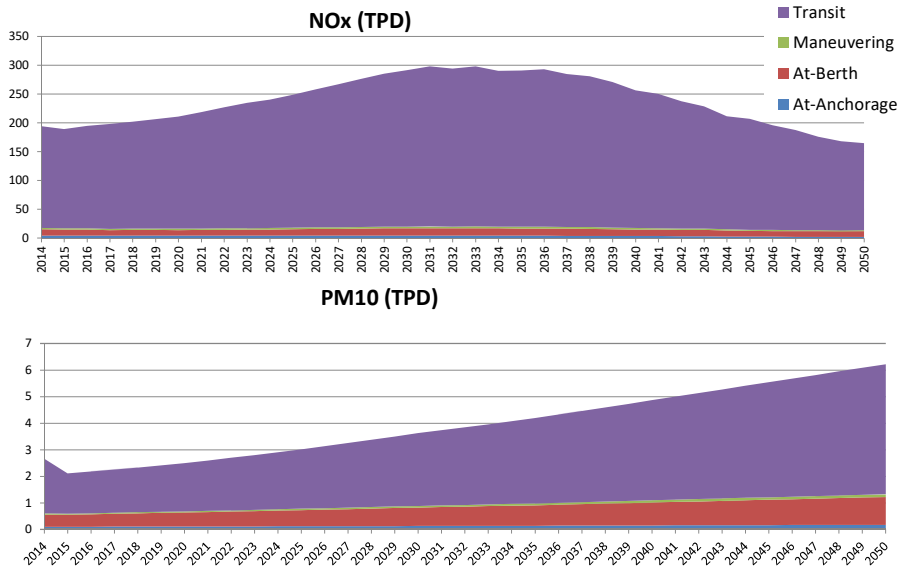
- From IHS-Fairplay data from 2006 and 2014
- Demonstrates clear plateau of installed main engine power
- Result is larger vessels are more efficient per TEU delivered



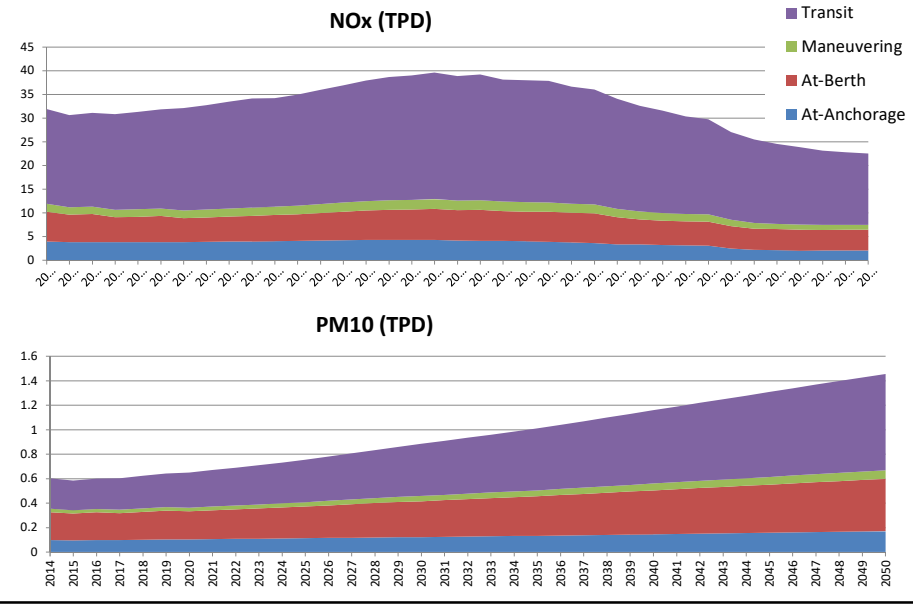
Planned Improvements

- Shore power – change to be applied on a visit basis from current average control factor
- Output electricity demand from shore power
- Separate Ports of LA and LB from anchorage outside port

Emission Results: Statewide 100nm



Emission Results: South Coast 100nm



Emissions Inventory Contacts

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