CALIFORNIA
AIR RESOURCES BOARD

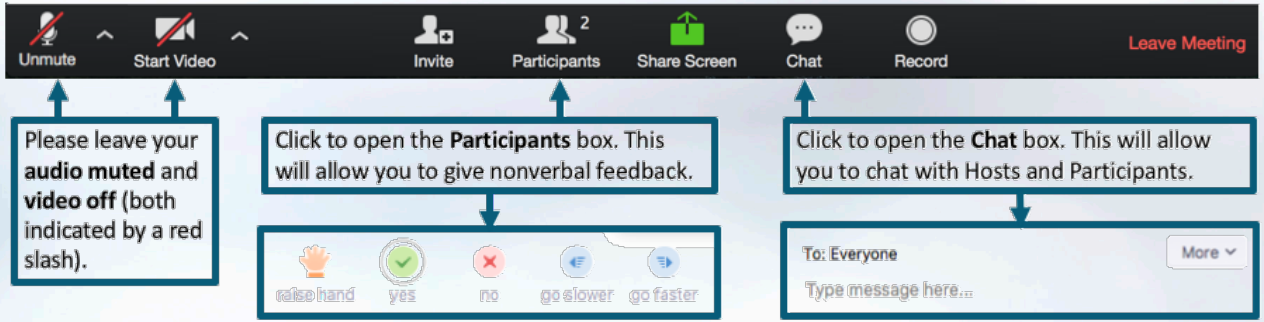
2nd Workshop on 2023 Large-Spark Ignition Equipment Emissions Inventory

Air Quality Planning & Science Division

January 24, 2023

Question?

- Please use Zoom's "raise hand" feature in the webinar window to comment verbally or use the "Q&A" or "Chat" feature on Zoom to type your comments and questions.
- For those joining via conference call, press *9 to raise/lower your hand, then *6 to toggle mute.



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Scope of Large-Spark Ignition (LSI) Inventory

- Equipment rated >25 horsepower (hp)
- Electric, liquified propane gas (LPG or propane), natural gas, or gasoline
- Forklifts, sweepers/scrubbers, and tow tractors only*

*Examples of LSI not in this update are other industrial equipment, airport ground-support equipment (GSE), construction equipment, and generators.

Data Sources

New inventory update with base year 2020 integrates CA sales data, DOORS LSI database, and fleet average age turnover forecasting

Data Input	Source
Population, Large Fleet and Engine Characteristics	DOORS LSI Database, December 2020
Population, Small Fleets (3 units and under)	Fullerton Survey, May 2016 – Sept 2016
Population, Electric Fleet and New Forklifts	ITA California Forklift Sales, 2020
Activity Hours	DOORS Fleet Survey, July 2020
Emission Factors	CARB Certification Database, 2017
Regional Allocation	CARB Industrial Warehouse Space, 2015

*Diesel Off-Road Online Reporting System (DOORS), Large Spark Ignition (LSI), Industrial Truck Association (ITA)

DOORS Reporting Database

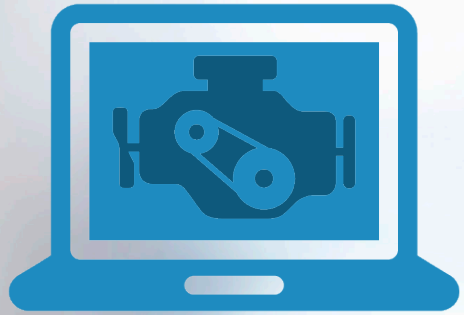
DOORS is an online tool designed to help fleet owners report off-road equipment inventories and actions taken to reduce equipment emissions as required by the In-Use Off-Road Fleets Regulation and the Large Spark-Ignition Engine Fleet Requirements Regulation, as amended in 2016.

- Annual reporting is required for large fleets operating more than 3 units of fueled equipment over 25 HP or more than 19 kW for MY2005+ engines.

- Most fleets with over 4 units of equipment are required to report, but some LSI equipment is not reported into DOORS.

Engine Certification & Emissions Factors

Engine manufacturers are required to submit annual certification and compliance testing reports to U.S. EPA and CARB. These reports detail engine emissions testing compared to applicable engine standards. Emissions factors (EFs) are updated based on an average of reported engines by fuel, model year, horsepower, and equipment type across all manufacturers. CARB updated off-road engine emissions factors in 2017.



Emissions inventories use emissions factors to estimate emissions statewide based on the following equations:

Emission Factor, g/hp-hr
= Zero Hour Emissions + (Deterioration Rate * Accumulated Hours)

Equipment Emissions
= Population * Activity Hours * Engine Horsepower * Load * EF

Loads are based on OFFROAD2007.
Emission factors do not increase further after 12,000 hours lifetime use.

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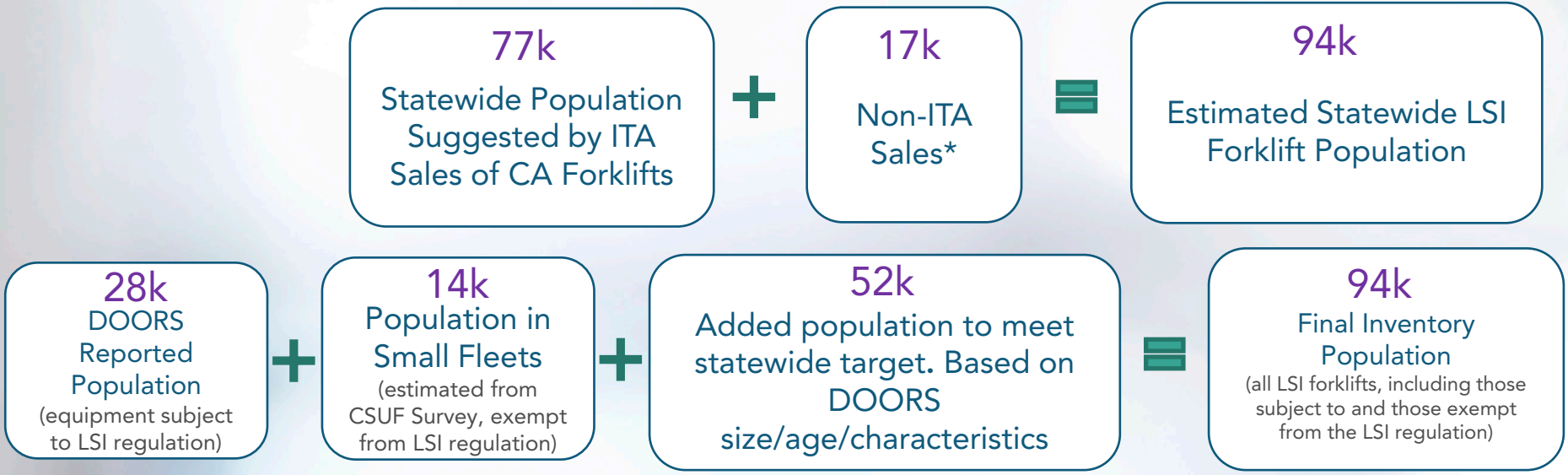
Deriving Total Statewide Population

- Industrial Truck Association (ITA) data suggest there should be at least 77,000 forklifts operating in California based on sales from ITA members
- Due to LSI regulatory exemptions of existing rule and underreporting, CARB DOORS data do not capture the full California population
- CARB staff developed methodology to scale population and fleet characteristics using available data to develop most accurate statewide total

Simplified Example of Forklift Population Scaling

- In DOORS, ITA members have 4 forklifts for every 1 non-ITA forklift, suggesting another 17,000 forklifts in CA not associated with ITA



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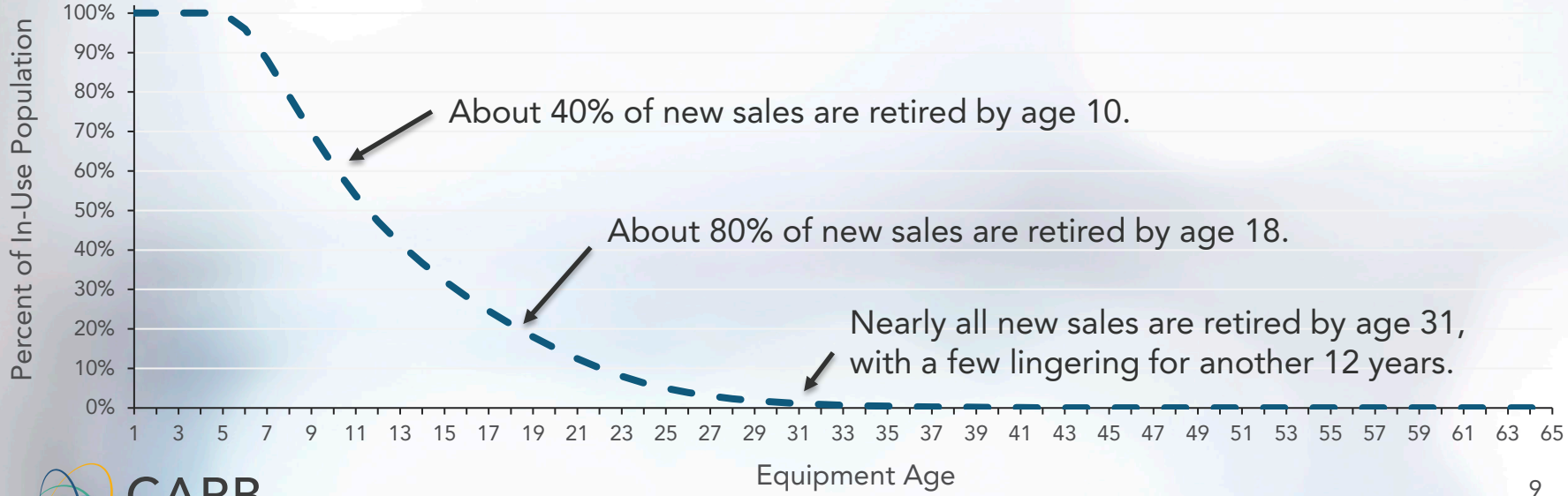
Example Survival Curve: Propane Powered Forklifts

This example represents the survival curve used to estimate target statewide propane forklift equipment population based on new California sales. Survival rates are derived from DOORS population characteristics in base year 2020.



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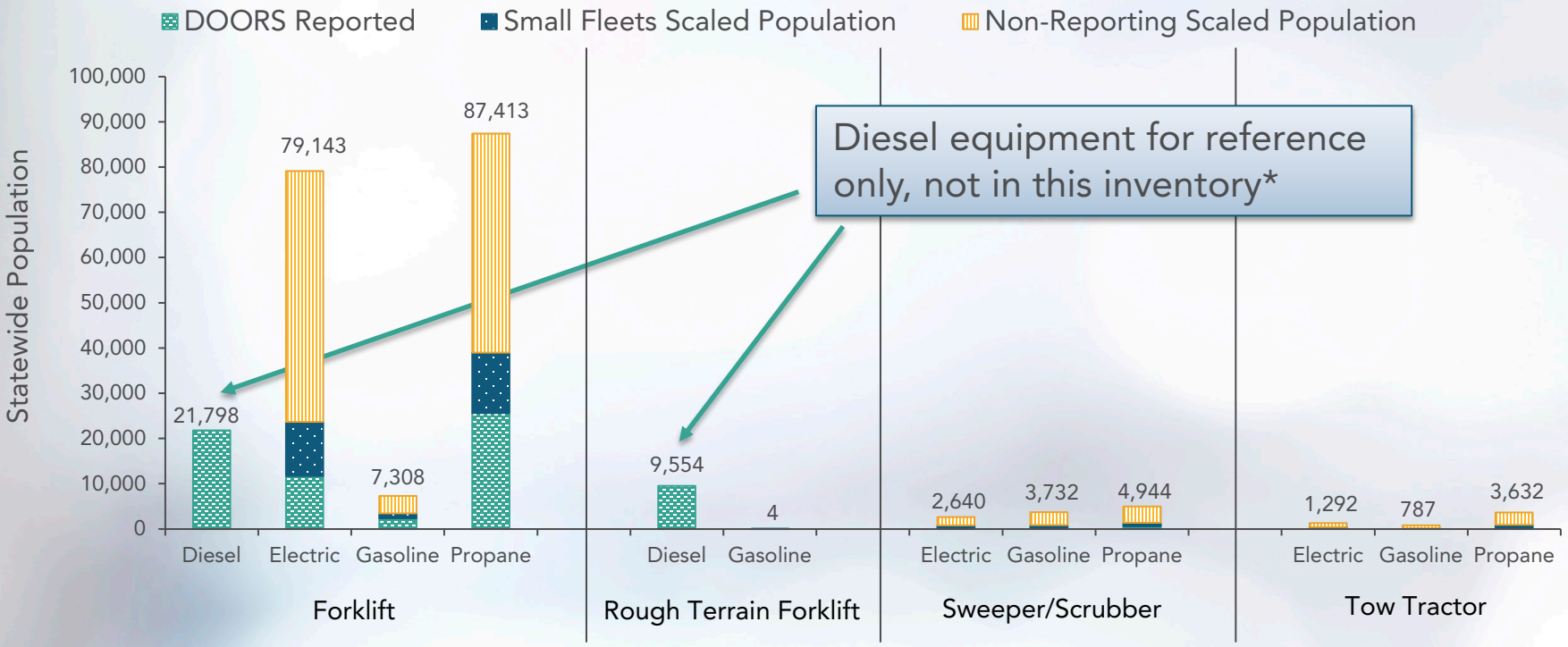
Statewide Population, 2020 Base Year



*Diesel equipment is not subject to LSI Regulation requirements and is not included in this LSI Inventory. Diesel equipment is based on the most recent "Construction, Industrial, Mining, and Oil Drilling Emissions Inventory" updated in August 2022, which was used to support the In-Use Off-Road Diesel-Fueled Fleets Regulation considered by the Board in November 2022.

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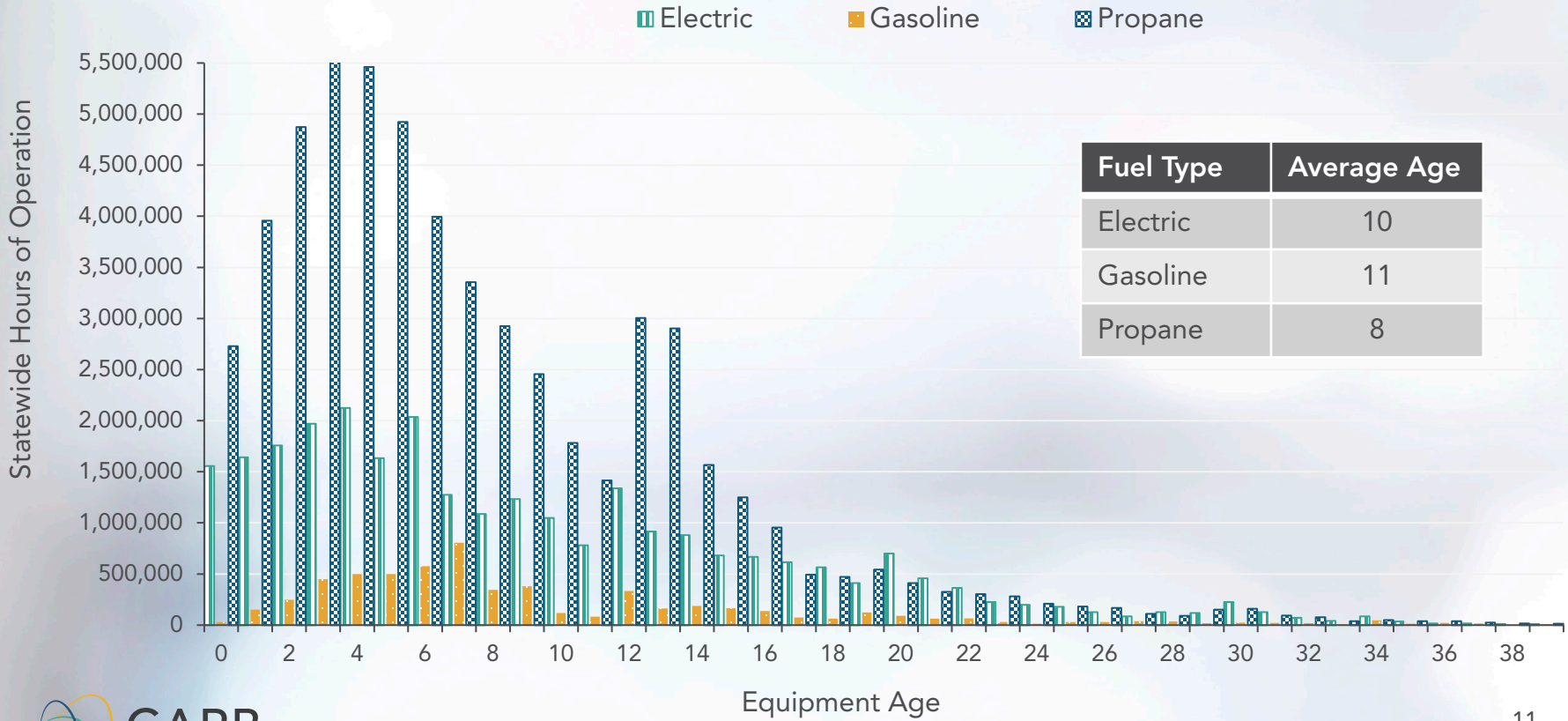
2020 Base Year Age Distribution by Fuel Type



Fuel Type	Average Age
Electric	10
Gasoline	11
Propane	8

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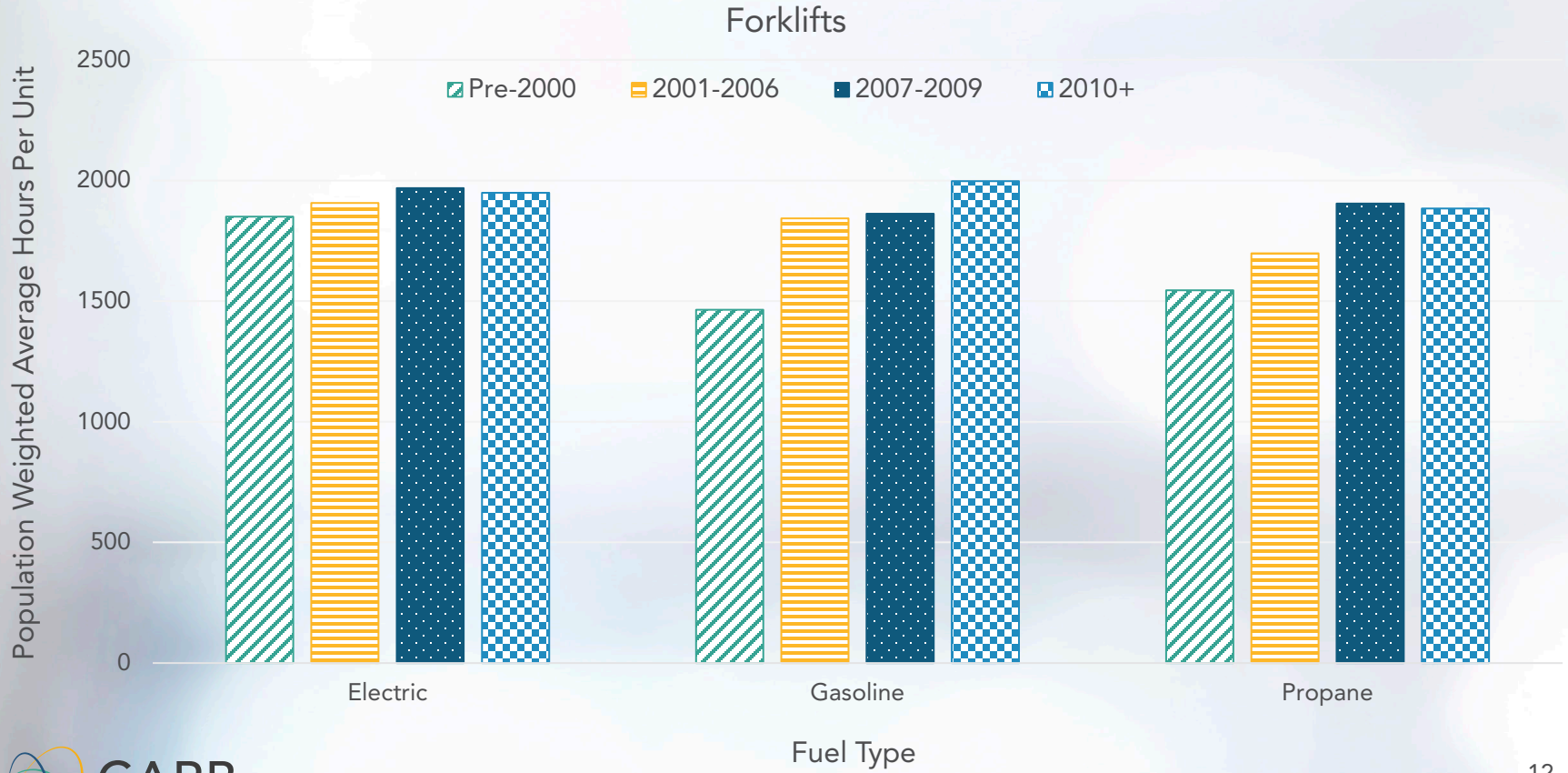
2020 Hours by Model Year and Fuel Type



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Forecasting Equipment Replacement

Future year equipment is projected by fleet purchasing habits observed in base year 2020

1. Fleets maintain base year average age
2. When a fleet exceeds the current average age, the oldest equipment is replaced
3. Fleets purchase only as new as their youngest equipment in the base year
   - Young fleets continue to purchase newer equipment
   - Older fleets continue to purchase used equipment

Example Fleet Replacement:

Fleet operator of 5 forklifts, **12 years old on average**, with an age 7 forklift as the youngest equipment observed in the base year 2020.

Calendar Year						Average Before Turnover	Average After Turnover
2020	Age 7	Age 9	Age 12	Age 16	Age 16	**12**	-
2021	Age 8	Age 10	Age 13	Age 17	Age ~~17~~ 7	13	11
2022	Age 9	Age 11	Age 14	Age 18	Age 8	12	-
2023	Age 10	Age 12	Age 15	Age ~~19~~ 7	Age 9	13	10.6
2024	Age 11	Age 13	Age 16	Age 8	Age 10	11.6	-
2025	Age 12	Age 14	Age ~~17~~ 7	Age 9	Age 11	12.6	10.6

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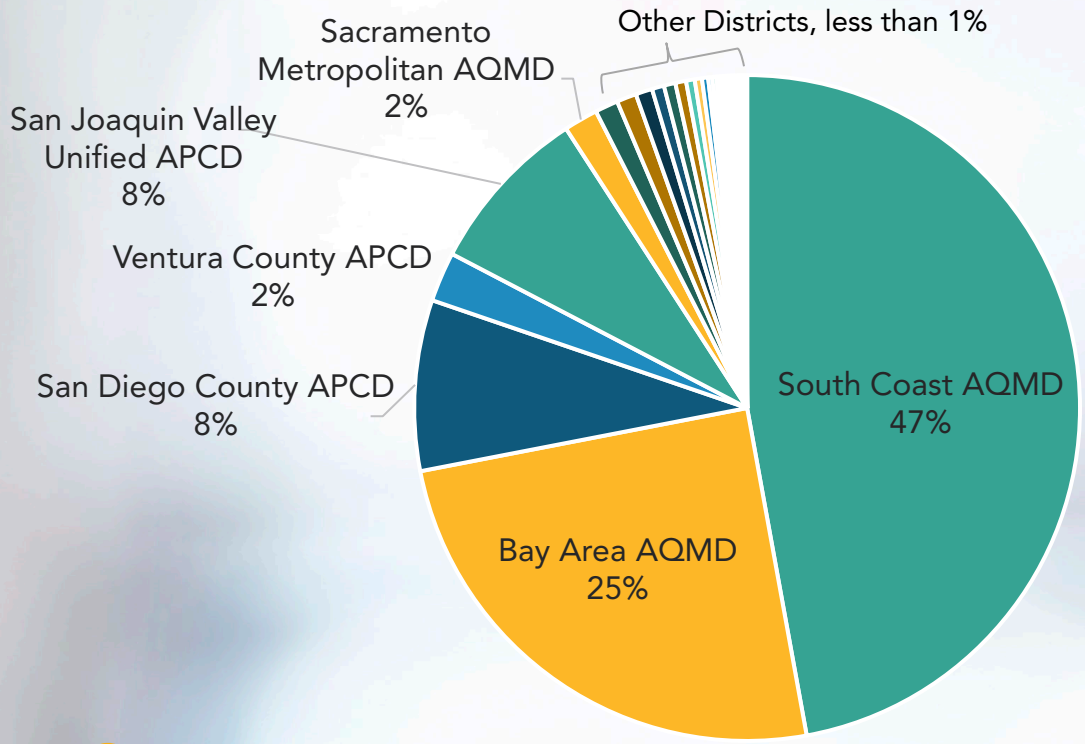
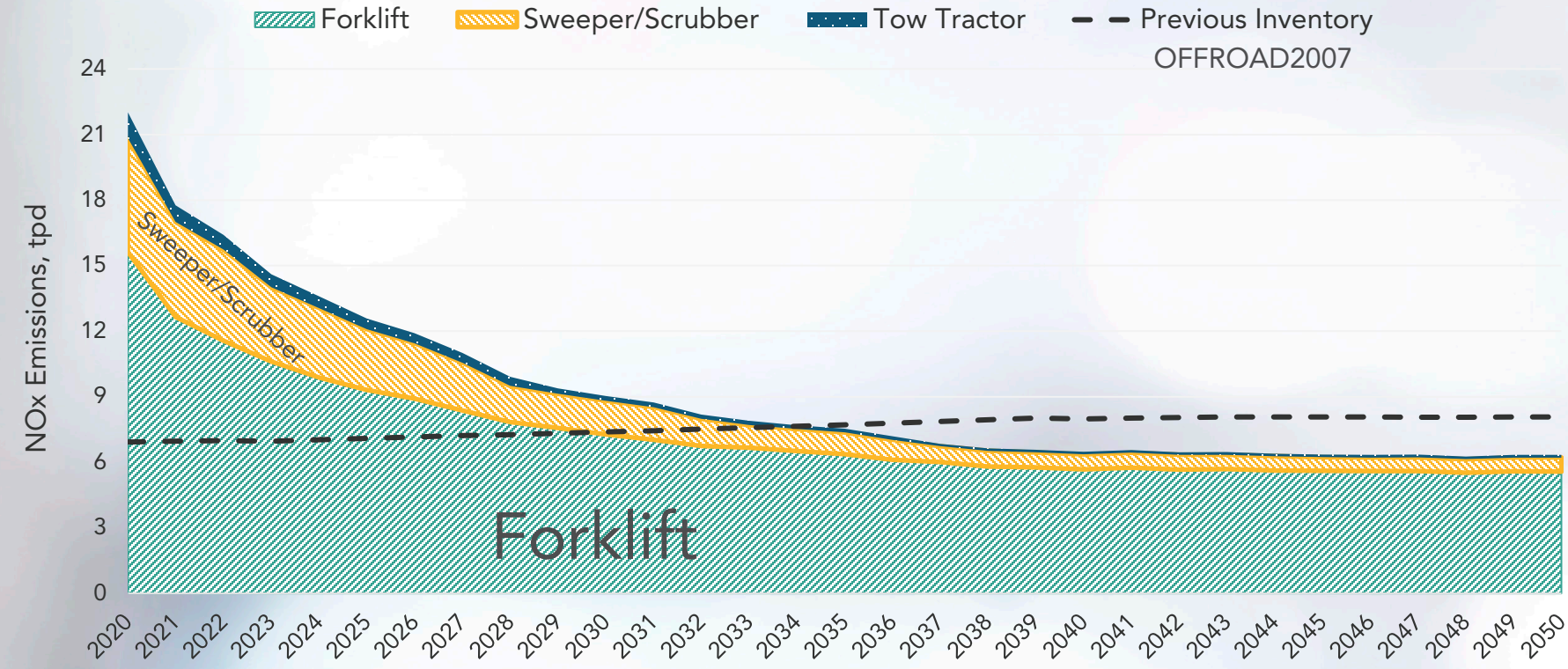
Regional Spatial Allocation



Statewide LSI emissions were allocated based on industrial warehouse square footage within each air district.

Parcel information was originally sourced from the Census Longitudinal Employer-Household Dynamics Survey.

Statewide Results: NOx



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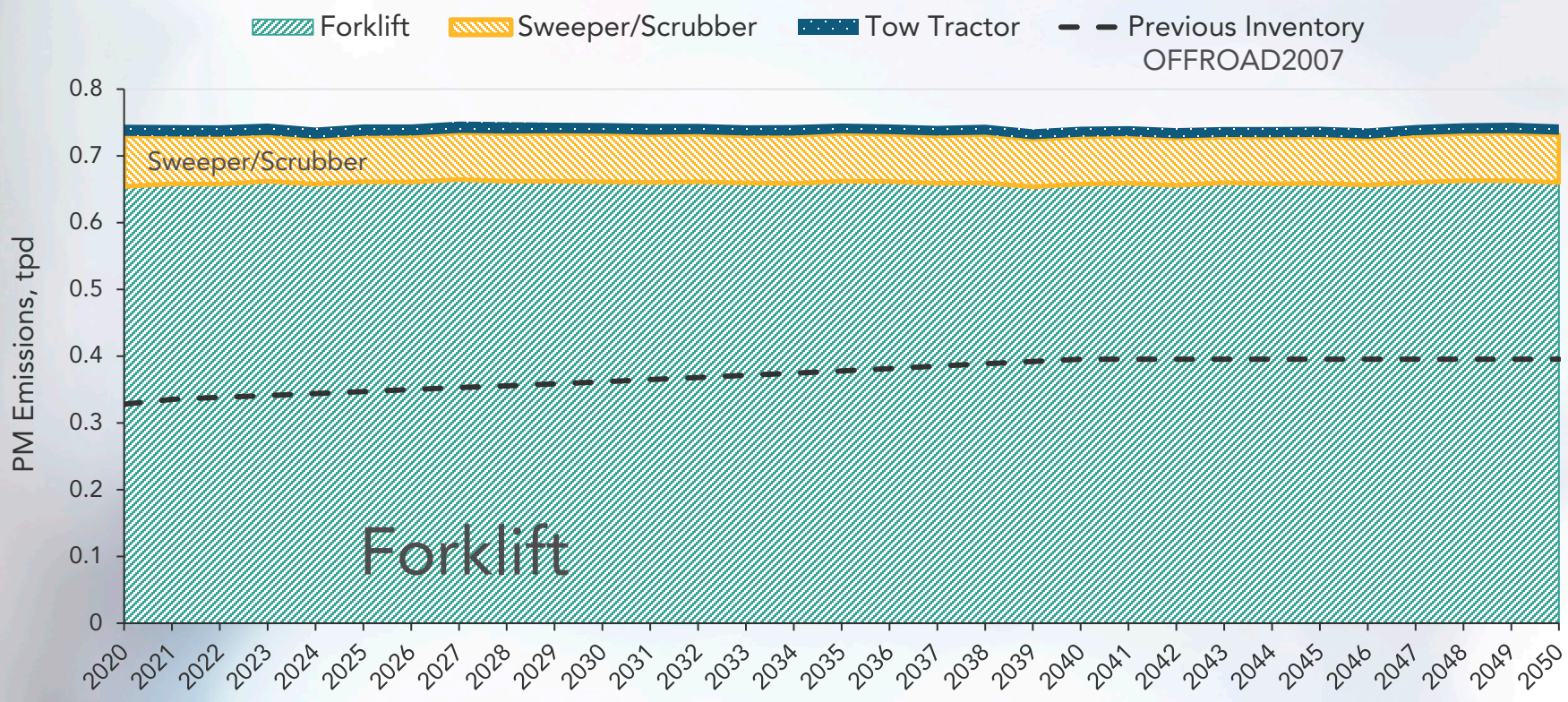
Statewide Results: PM



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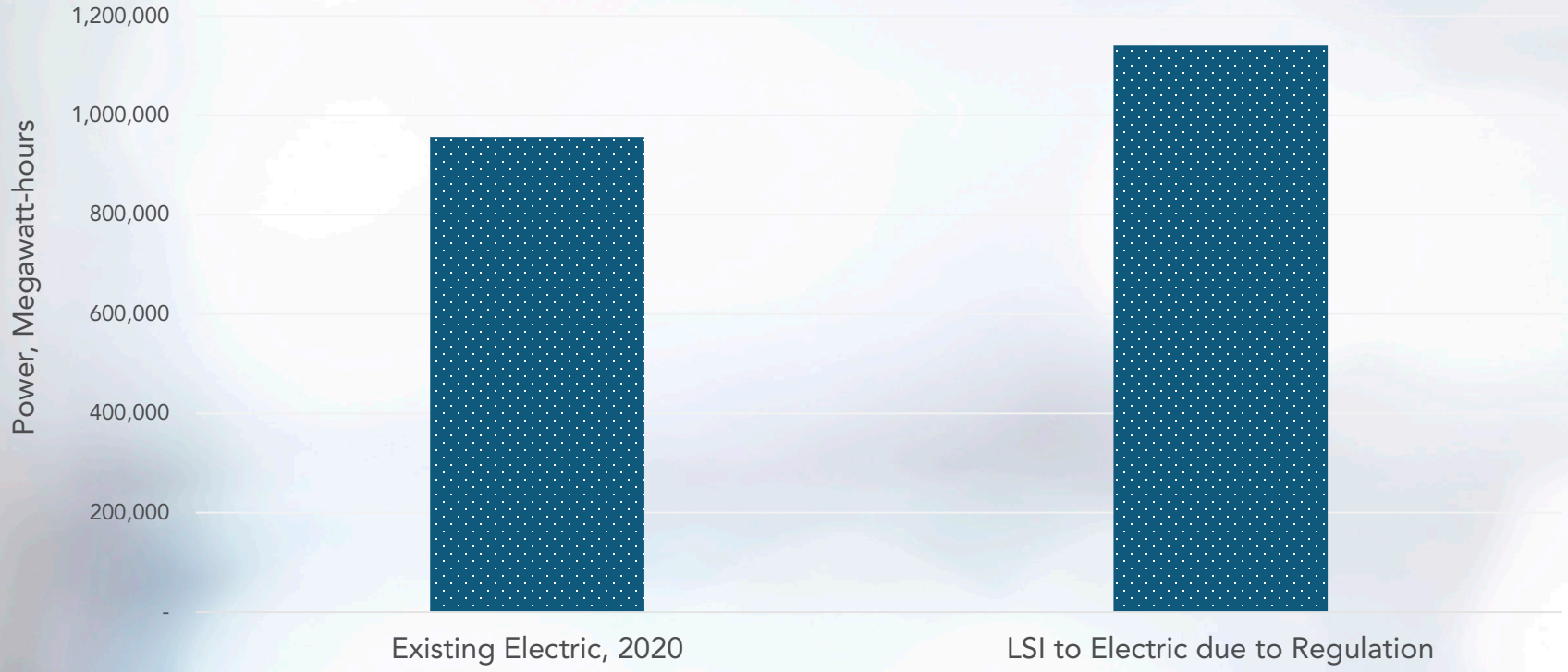
Proposed ZE Forklift Regulation Impact: Increased Gridded Energy Demand



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Next Steps

April 2022: Initial workshop on LSI emission inventory and comment period

Summer 2022:
Revisions to inventory based on feedback and discussion

Today:
Second public workshop with updated baseline inventory and rule concept benefits (emissions impact) and take further comments for 30 days through Feb 23, 2023

Questions?

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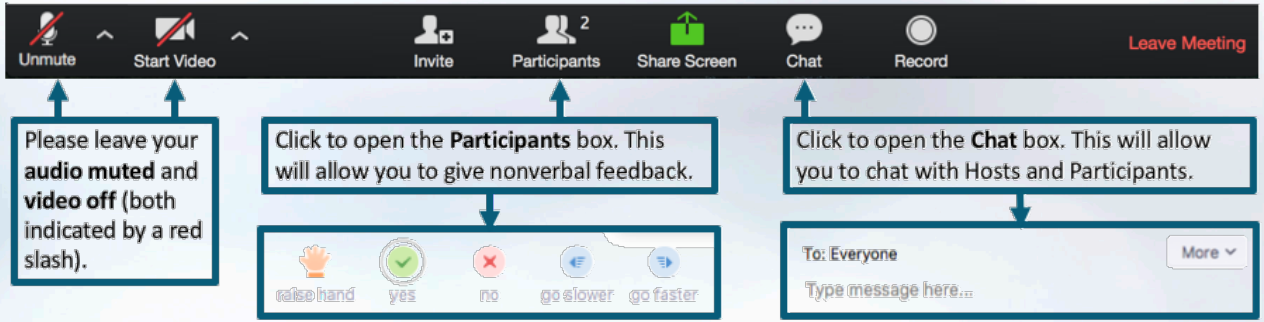

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What are your thoughts?

- Please send your comments and suggestions within 30 days to:

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- **Useful Links:**
  - Off-road Equipment Emissions Inventory Documentation, https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-road-documentation-0
  - Large Spark-Ignition Fleet Requirements Regulation, https://ww2.arb.ca.gov/our-work/programs/large-spark-ignition-lsi-engine-fleet-requirements-regulation
  - Zero-Emission Off-Road Strategies Fact Sheet, https://ww2.arb.ca.gov/sites/default/files/2020-11/ZEV_EO_Off-Road_Fact_Sheet_111820.pdf
  - Zero-Emission Forklifts Measure, https://ww2.arb.ca.gov/our-work/programs/zero-emission-forklifts