CALIFORNIA
AIR RESOURCES BOARD

Reducing Emissions from Operational Practices of Commercial Aircraft

1st Public Workshop

December 10, 2024

1:00 p.m. – 3:00 p.m. (Pacific Time)

Workshop Instructions

- Telephone Call-In: 888-363-4734 (US Toll Free)
- Access Code: 350021
- Workshop is being recorded
- Slides and recording will be available on CARB's Zero-Emission Aircraft Ground Operations webpage

Workshop Questions

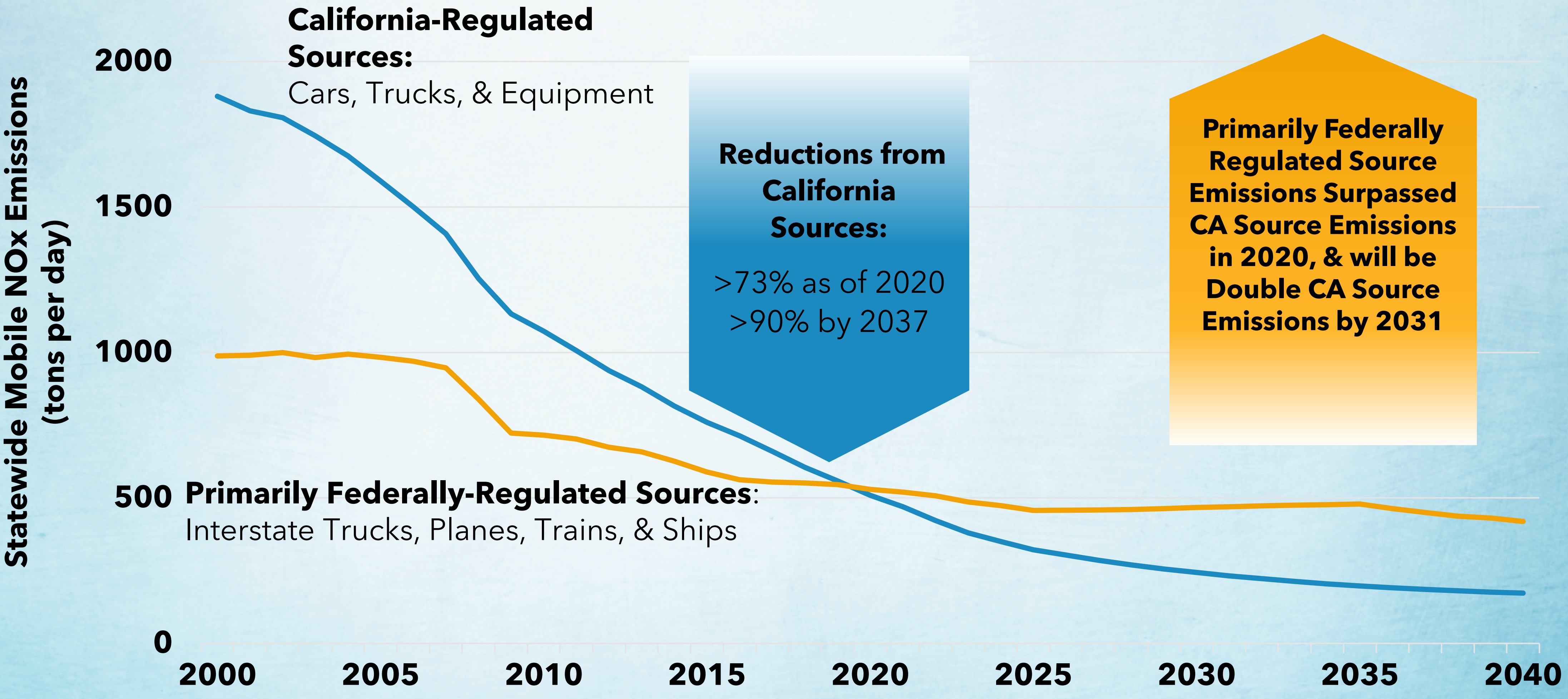
- We will pause for questions half-way and at the end of the workshop.
- Please raise your hand if you would like to ask a question
  - Include slide numbers
  - In Zoom: Use "Raise Hand" feature
  - On phone:
    - #2 to "Raise Hand"
    - *6 to Mute/Unmute
- Additional questions may be submitted after the workshop to: aircraft@arb.ca.gov or to Mo Chen (mo.chen@arb.ca.gov)

Today's Agenda

1. Background
2. Regulatory Approach Concepts
3. Question and Answer (1)
4. Emissions Inventory Updates
5. Timeline & Next Steps
6. Question and Answer (2)

Background

Federally Regulated Emissions Reductions Fall Short for Mobile Sources When Compared to State-Led Efforts



NOx = Oxides of Nitrogen

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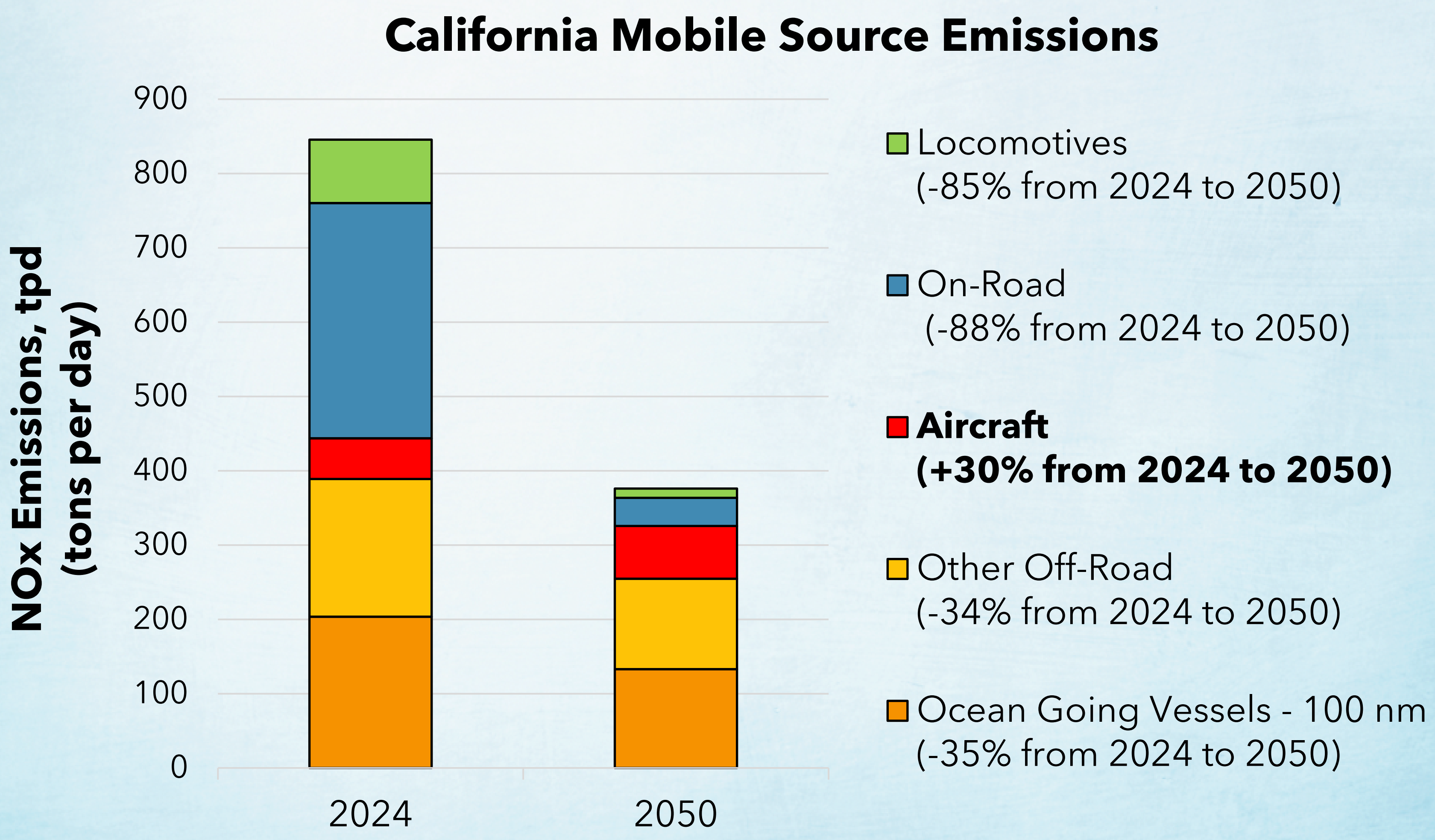
Emissions From Aircraft Are Increasing



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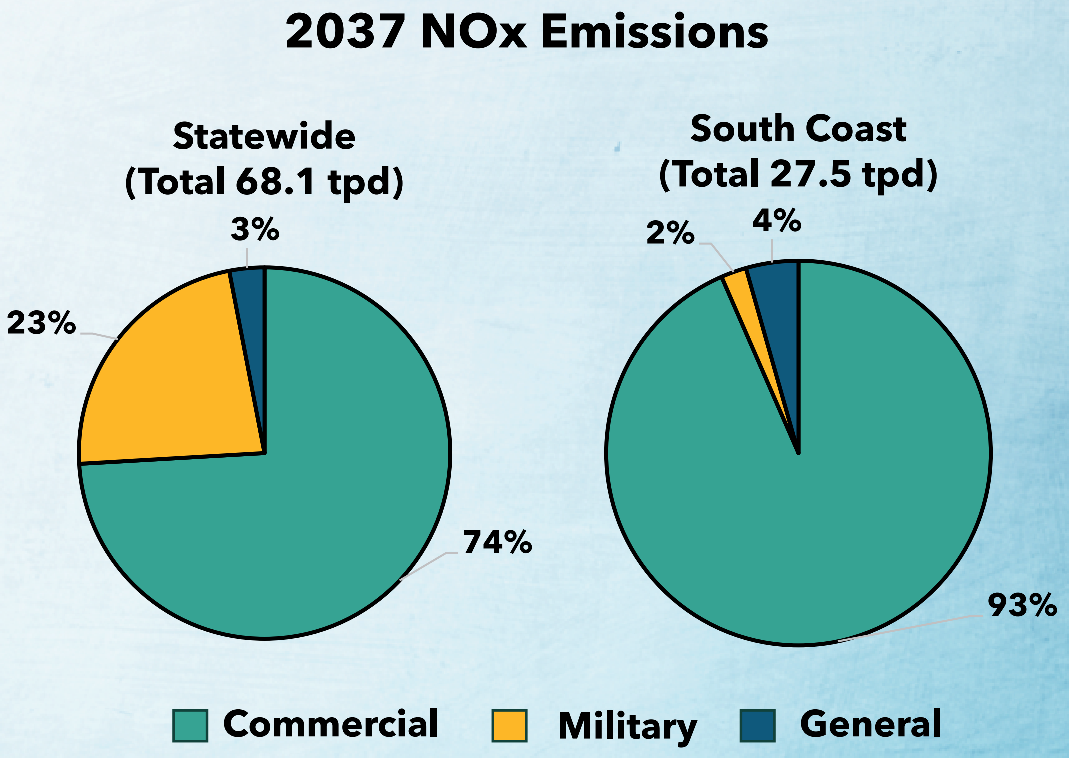
California Needs Significant Reductions in Aircraft Emissions

- As outlined in 2022 State SIP Strategy, California needs an 80% reduction in aviation emissions to meet the 2015 ozone standard.
- An 80% reduction is achievable in the South Coast Air Basin solely by reducing commercial aviation emissions.



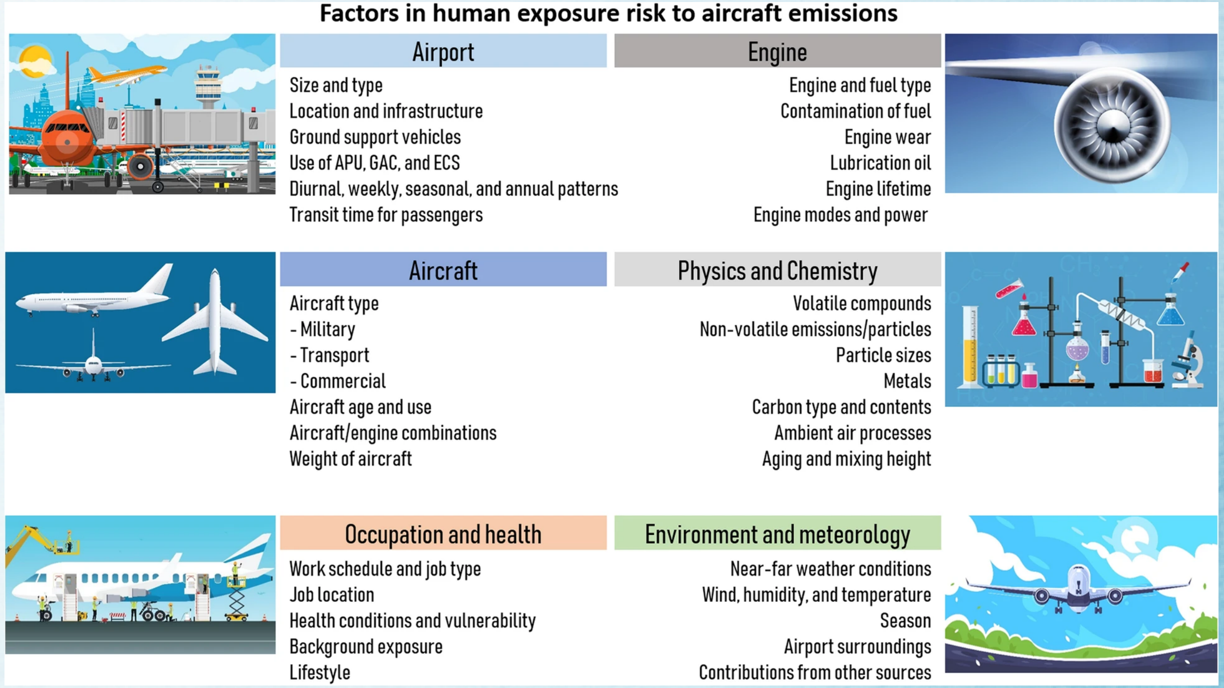
2022 Scoping Plan Has Aggressive Targets for Carbon Neutrality in Aviation

- CARB's 2022 Scoping Plan
  - 20% of aviation fuel demand be met either through electricity or hydrogen use by 2045
  - remaining 80% of demand be met with sustainable aviation fuel (SAF).
- These targets will be necessary to achieve California's goal of carbon neutrality by 2045.

Goals for 2022 Scoping Plan

Health Impacts of Exposure to Jet Fuel and Exhaust

- Jet fuel has been shown to have negative health effects, both burned and un-burned[1]
- Jet engine emissions have similar physicochemical properties and health effects as diesel exhaust particulate matter (PM)[1]



[1] Bendtsen, K.M., Bengtsen, E., Saber, A.T. *et al.* A review of health effects associated with exposure to jet engine emissions in and around airports. *Environ Health* **20**, 10 (2021). https://doi.org/10.1186/s12940-020-00690-y

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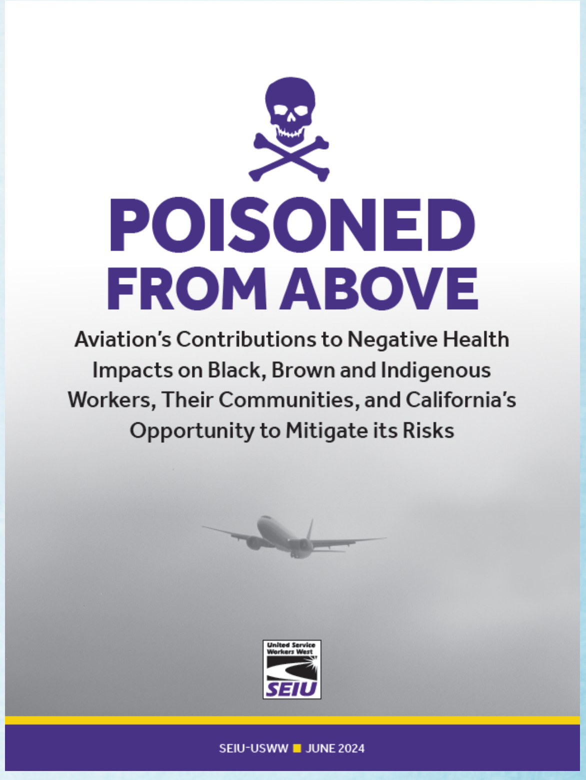
Negative Health Impacts to Airport Workers

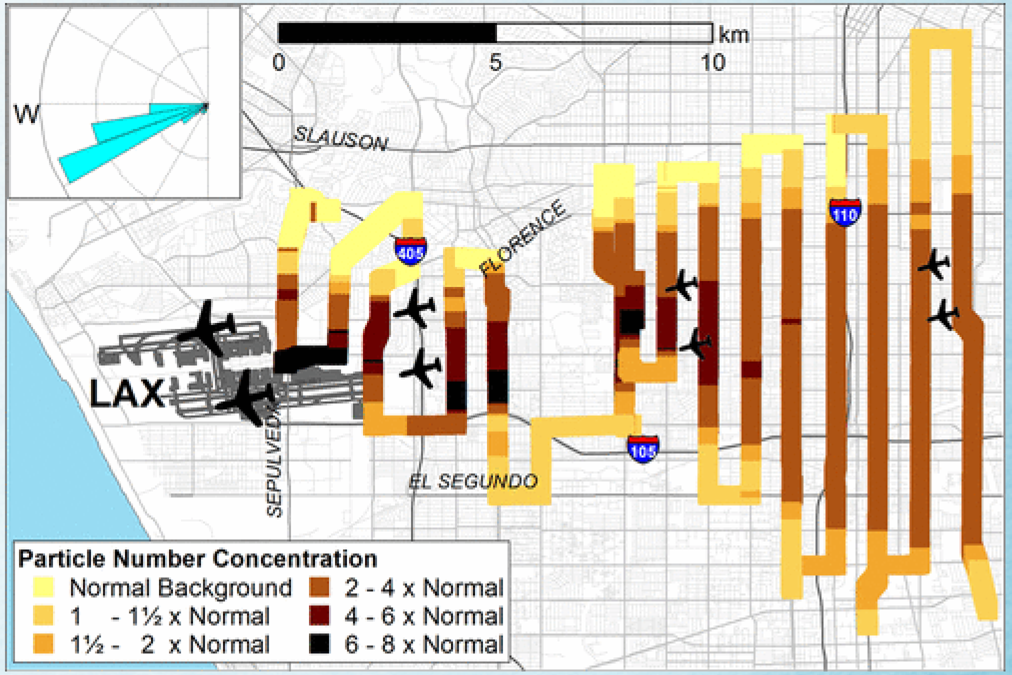
- Airport workers can be exposed to Particulate Matter (PM) concentrations 6 to 9 times higher than observed on busy city streets.
- Airport worker unions like SEIU are advocating for reductions from the jet aircraft sector, with concerns of adverse health effects due to exposure.



Reference: Aviation's Contributions to Negative Health Impacts on Black, Brown and Indigenous Workers, Their Communities, and California's Opportunity to Mitigate its Risks, published by SEIU-USWW, white paper, June 2024

Communities in Flight Paths are Subjected to Increased PM Emissions From Aircraft

- Particle Number Concentrations (PNC) were measured using mobile monitoring equipment near and down-wind of LAX Airport.
- PNC were found to increase by up to 4x at 10km downwind of LAX.
- Closer to the airport, PNC could be as high as 8x above background.



Neelakshi Hudda, Tim Gould, Kris Hartin, Timothy V. Larson, and Scott A. Fruin, *Environmental Science & Technology* **2014** *48* (12), 6628-6635
DOI: 10.1021/es5001566

Leaded Aviation Gasoline Poses Negative Health Impacts to Communities Near Airports.

- EPA endangerment finding on leaded aviation gas showed an increase blood-lead level in children that live close to an airport.
  - SB 1193 will ban the sale and distribution of leaded avgas in California by 2031.
- ~14 airports in California offer unleaded 94 octane fuel
  - However, only ~30% of General Aviation (GA) fuel burn is 94 octane fuel
- 2 airports in California offer unleaded 100 octane fuel
  - ~70% of GA fuel consumption requires 100 octane fuel

Evolution of Aircraft Engine Emission Standards

- Set by the International Civil Aviation Organization (ICAO) using a technology following rather than technology forcing approach.
- Thus, these emission standards can be met with technology that is already in use.
- U.S. EPA adopts international standards set by ICAO, and has authority to set stricter standards domestically.

Without an ~80% reduction in the CAEP/8 NOx standard, California cannot meet federal air quality standards.

1981	1992	1998	2004	2011	2017	2019
CAEP/1 Emissions standards set for NOx, CO, HC and smoke	CAEP/2 NOx standard tightened by 20%	CAEP/4 NOx standard tightened by 16%	CAEP/6 NOx standard tightened by 12%	CAEP/8 NOx standard tightened by 15%	CAEP/10 New CO_2 emission standard	CAEP/11 New nvPM emission standards

CAEP: Committee on Aviation Environmental Protection

FAA's Continuous Lower Energy, Emissions and Noise (CLEEN) Program Aims to Accelerate the Maturation of New Aircraft Technologies

- Public-private partnership with 1:1 cost matching with aviation industry
- Funds projects that achieve reductions in noise, fuel burn, or emissions below the CAEP standards
- Incentivizes the development of new aircraft/engine technologies and alternative jet fuels
- A number of these technologies have successfully entered service

	CLEEN Phase III Goals (projects ongoing 2021-2026)
Noise Reduction	25 dB cumulative noise reduction relative to Stage 5
Fuel Burn	Reduce by 20% relative to CAEP/10 CO_2 Standard
NOx Emissions	Reduce by 70% relative to CAEP/8 NOx standard
Non-volatile PM Emissions	Reduce relative to CAEP/11 standard
Entry into Service Target	2031

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CLEEN-Funded Low NOx Combustors Achieve Emission Reductions of >50% Relative to CAEP/8

- The Twin Annular Premixing Swirler (TAPS) is a lean burn combustion system developed by General Electric as part of the CLEEN program
- These combustors are installed in LEAP and GenX engines, in service today

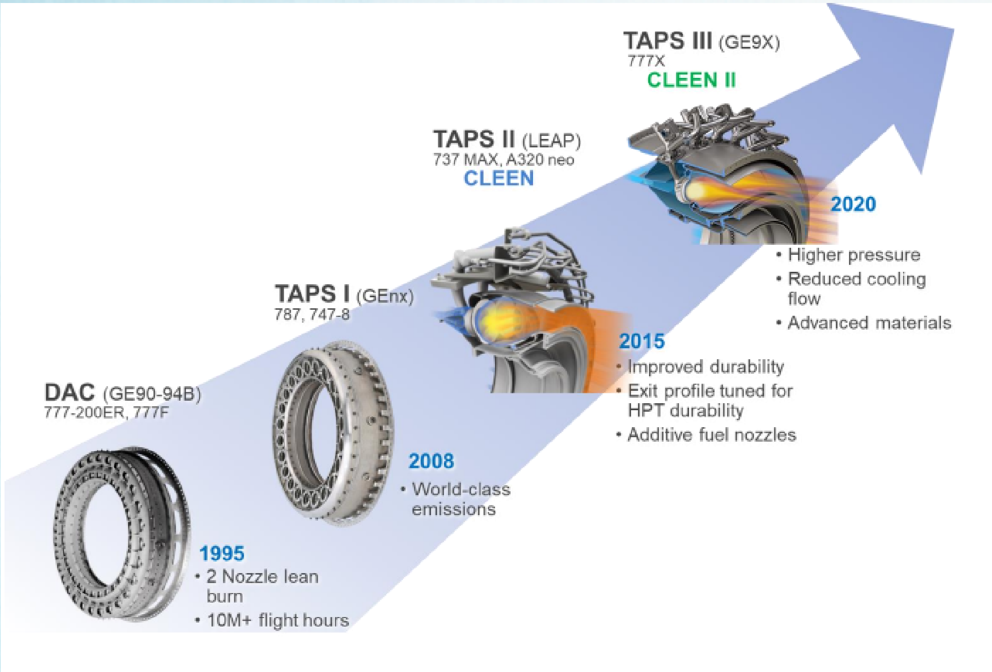
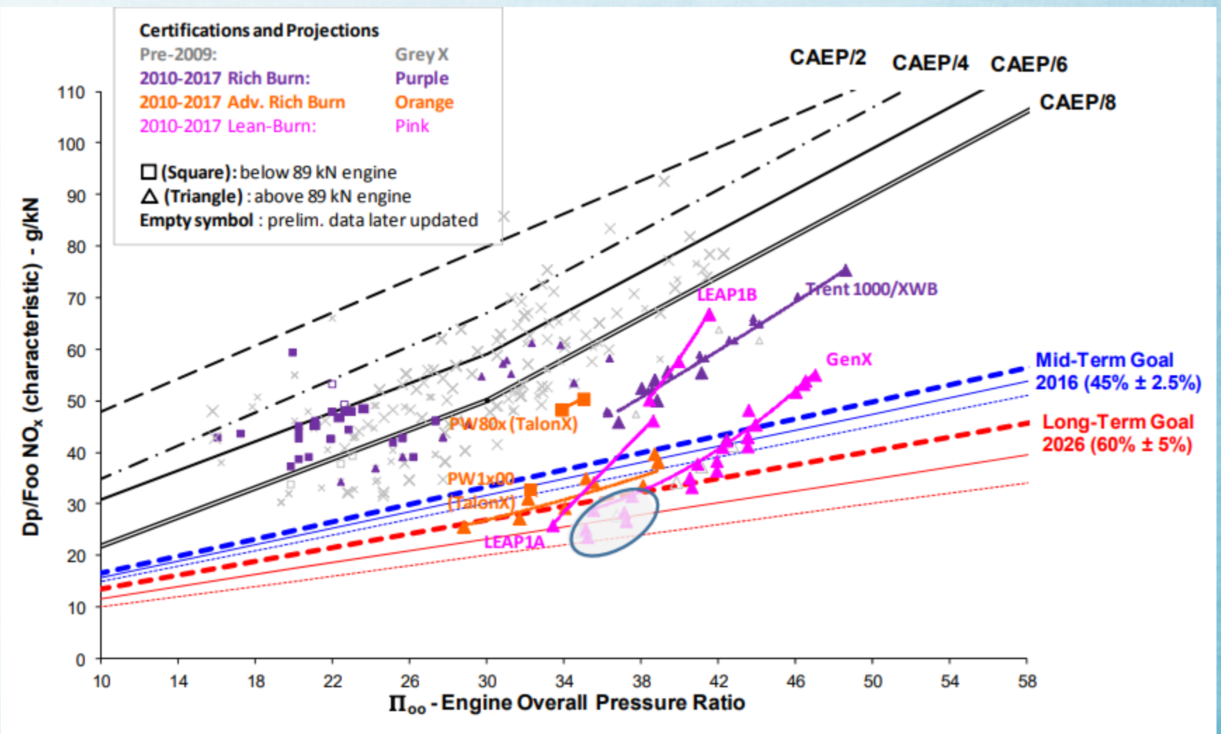
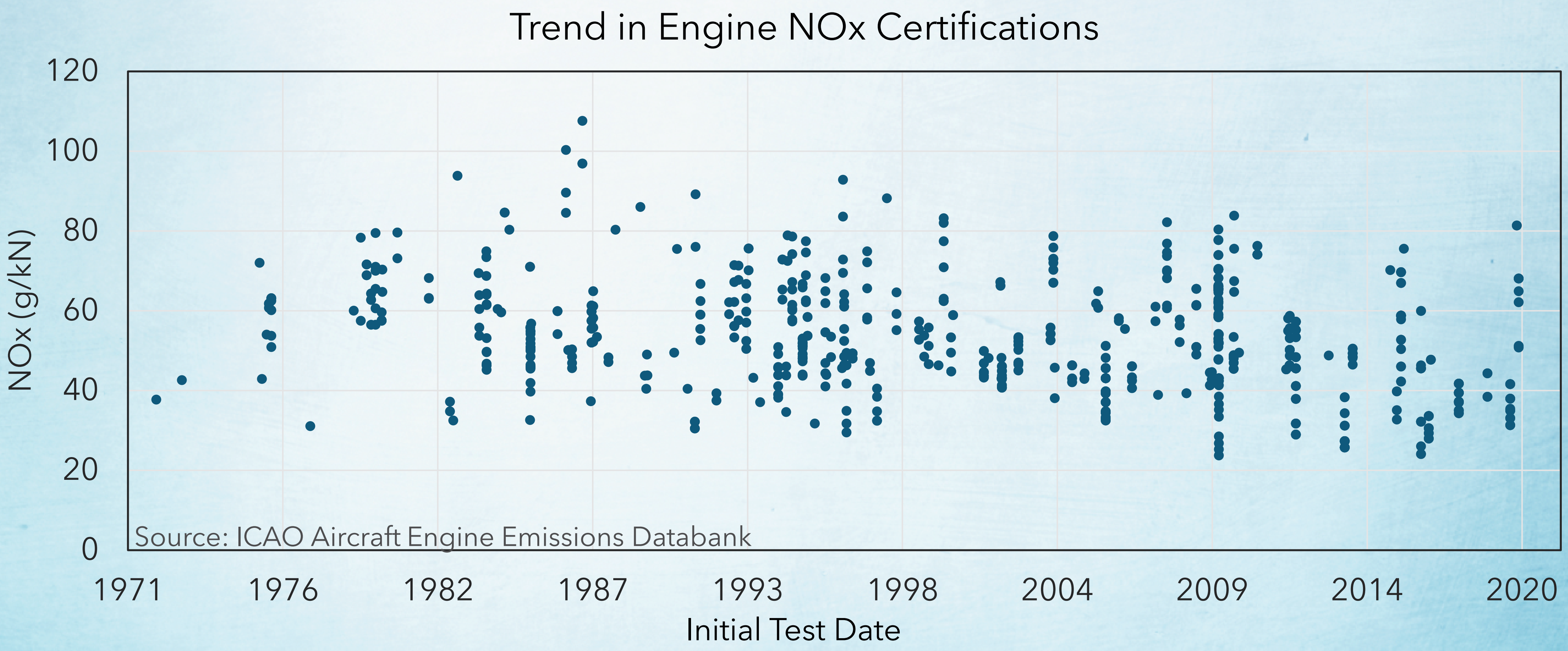


Figure 1: 25+ Year Journey to Low NOX Technology



Certified Engines Show Little NOx Reduction Over Time, Despite Federal Standards and Technology Development



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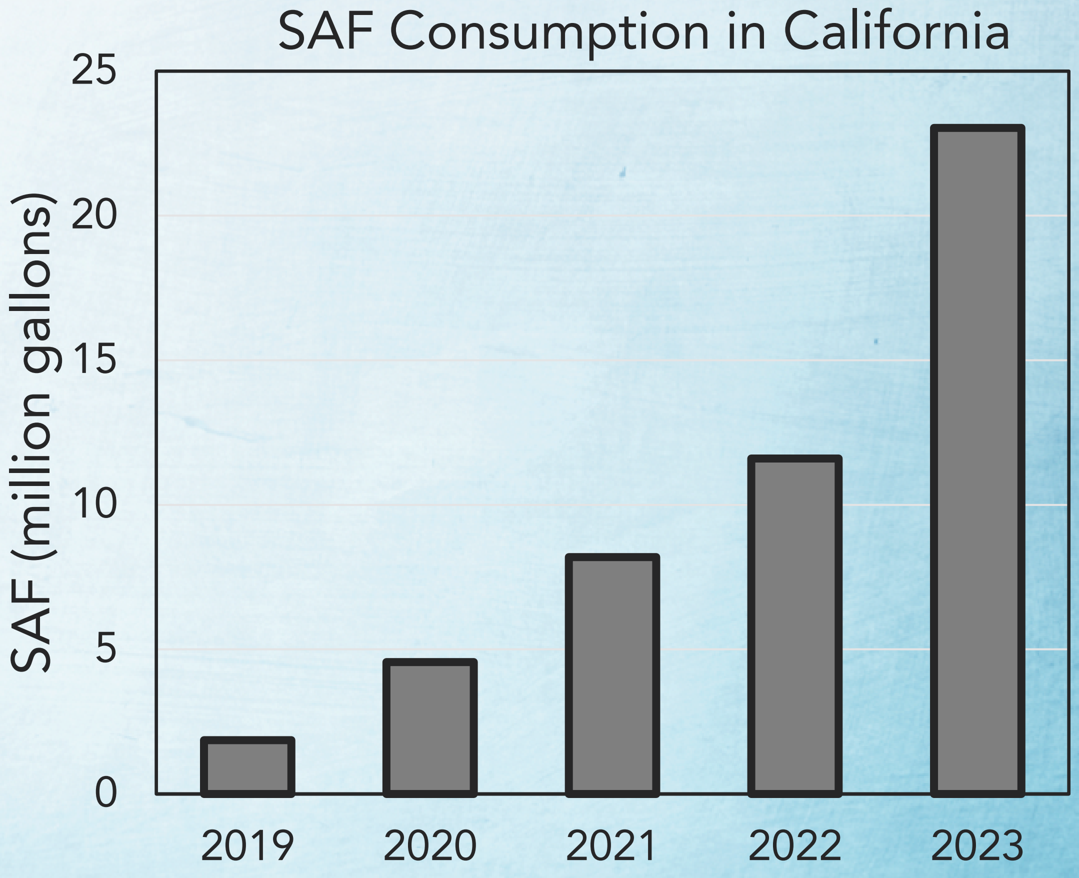
Role of Sustainable Aviation Fuel (SAF)

- SAF use has been increasing since it was added as a credit-generating fuel in the Low Carbon Fuel Standard (LCFS) in 2019
- Recent agreement with Airlines for America set target of making available 200 million gallons of SAF in California by 2035
    - This amounts to 40% of intrastate jet fuel, but less than 5% of total jet fuel demand
- While more SAF is needed to reduce GHG and PM emissions, it does **not** reduce NOx or toxics emissions. Therefore, more actions are needed beyond SAF goals.



Partnership Needed to Leverage Primary Responsibilities

Reducing Aircraft Emissions

OEMs
- Investment into lower-emission engines
- Engine + Aircraft OEM coordination
- Expansion of ZE aviation

Community Members/ Airport Workers
- Expertise on local impacts
- Advocacy and community organizing
- Public engagement and awareness

Air Districts
- Local incentive and voluntary programs (e.g., MOUs)
- Indirect Source Rule authority

Airlines
- Prioritize air quality in operations
- Engagement on opportunities to advance technologies and/or operational practices

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- Statewide rules for operational practices
- Incentive programs
- Planning to set reduction targets

Airports
- Air quality improvement plans
- Infrastructure planning
- Lease agreements with tenants
- Local policy implementation (e.g., landing fees, curfews, etc.)

EPA/ FAA
- Advocating/setting tighter standards
- Funding technology advancement
- Regulating safety, routes, and service

ICAO
- Set tighter international engine emissions standards

Aircraft Commitments in 2022 State SIP Strategy

CARB committed to explore feasibility and authority, and to conduct advocacy to promote the following **federal** actions between 2021-2027:

1. **More stringent aircraft engine standards**
2. **Cleaner fuel and visits requirements**
3. **Zero-emission ground operations**
4. **Airport emissions cap**

CARB committed to go to Board no later than **2027** with an update on potential opportunities or strategies to reduce aircraft emissions at State Level

CARB Regulatory Authority

- HSC 43013 and 43018 – direct CARB to control criteria air pollutants from mobile sources to attain air quality standards
- HSC 38500 et seq. (AB 32) and HSC 38566 (SB 32) – direct CARB to reduce greenhouse gases to specific levels to combat climate change
- HSC 43019.1 – permits CARB to assess fees to cover costs of compliance of off-road mobile sources.

California's Existing Regulations and Targets at Airports

Large Spark Ignition Engine (LSI) Regulation (2009-2013)

In-Use Off-Road Diesel (ORD) Regulation (2014-2036)

Zero-Emission Forklift Regulation (2026-2038)

Airport Shuttle Bus Regulation (2023-2035)

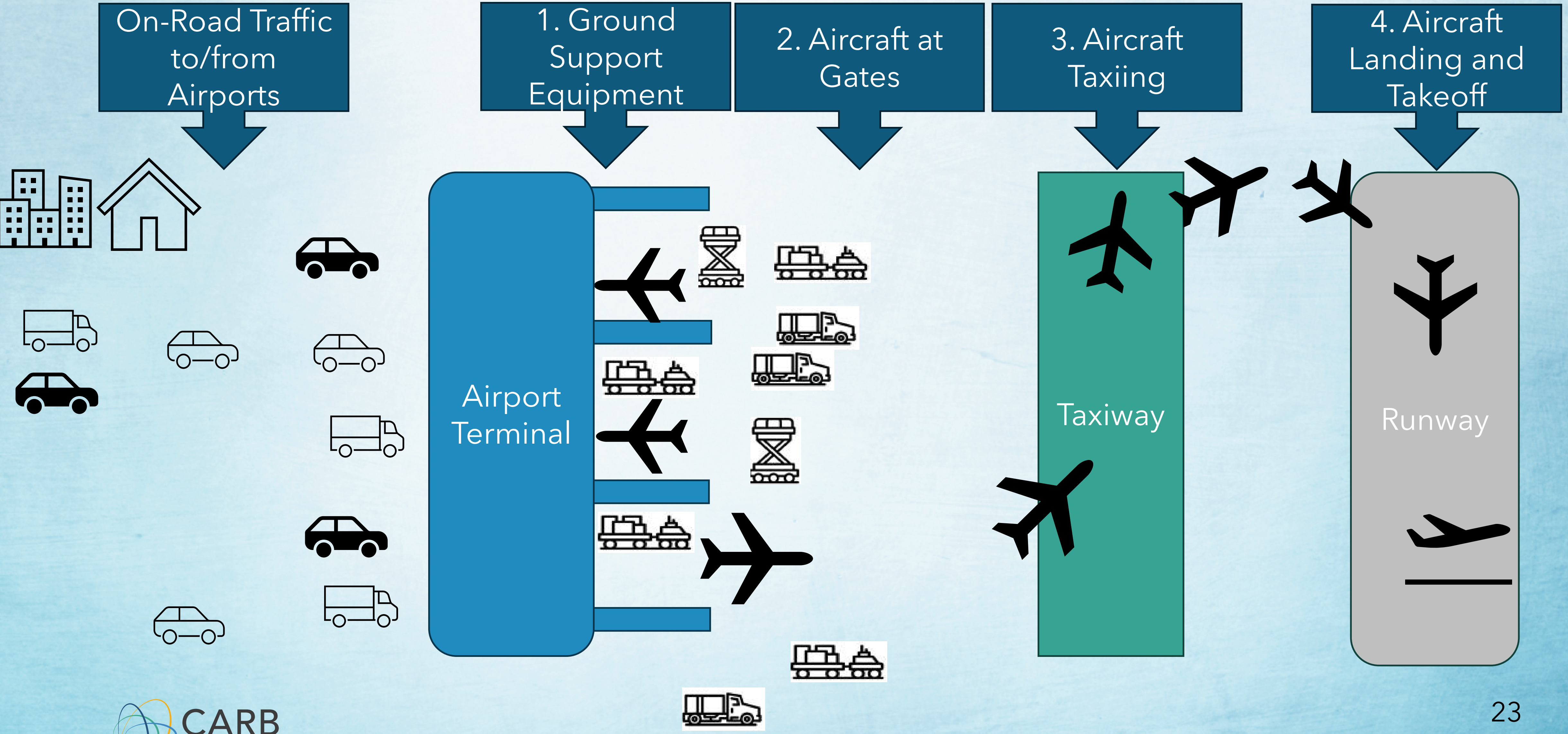
Advanced Clean Cars II, Advanced Clean Trucks, Advanced Clean Fleet (2024-2035)

Partnership: 200 million gallons of SAF by 2035

Target: 20% Zero-Emission Aviation Sector by 2045

Parentheses indicate year of final regulatory implementation

Mobile Source Emissions at Airports



Mobile Source Emissions at Airports

On-Road Traffic to/from Airports

- Gasoline, diesel, natural gas, propane engines
- Brake and tire wear

1. Ground Support Equipment

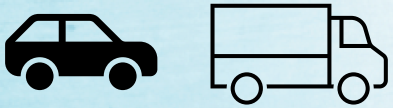
- Gasoline, diesel, natural gas, and propane engines

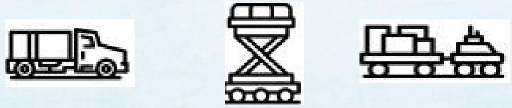
2. Aircraft at Gates

- Jet engines
- Auxiliary power units

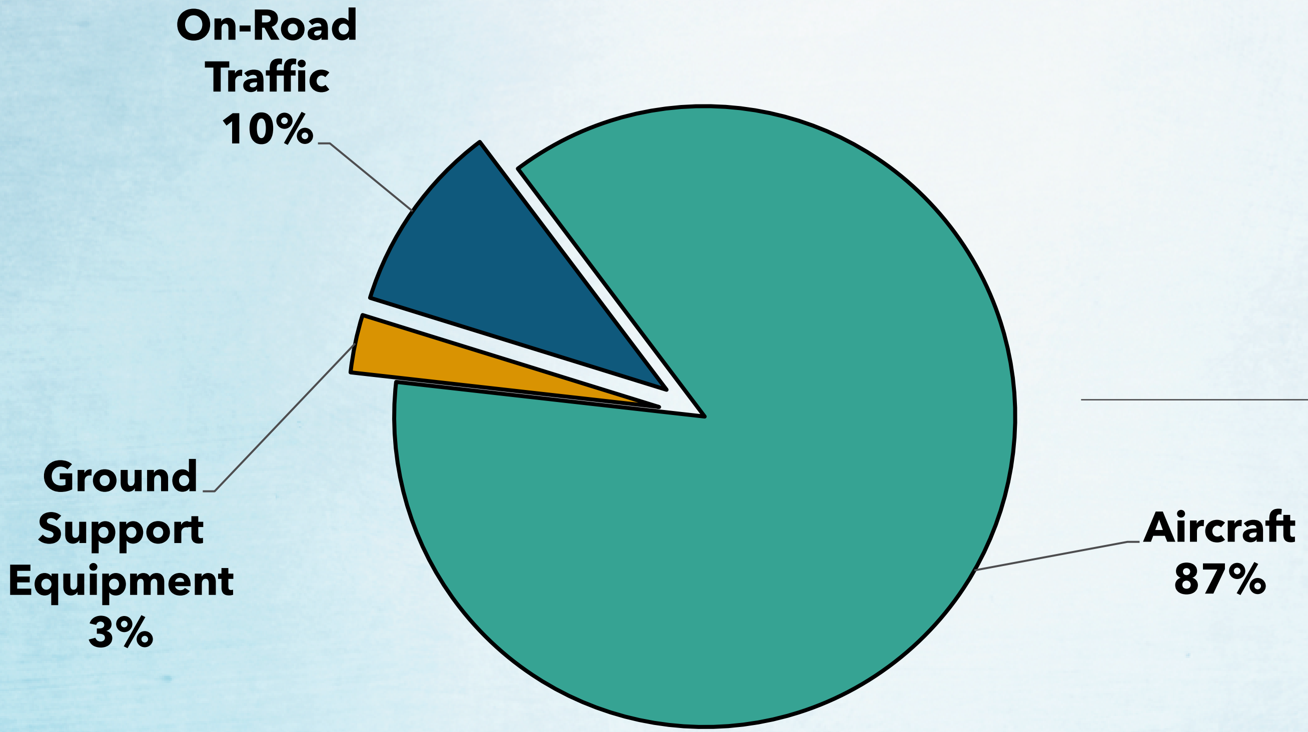
3 & 4. Aircraft Taxiing, Landing and Takeoff

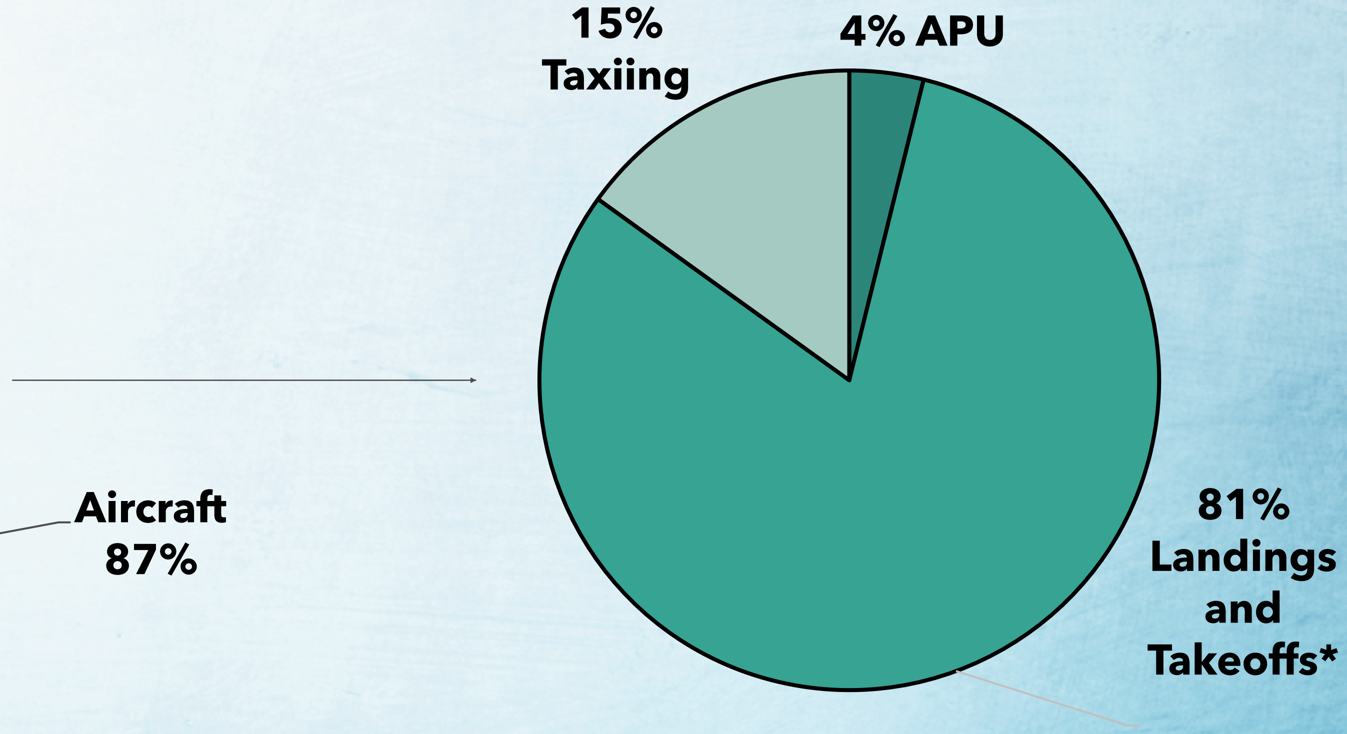
- Jet engines
- Auxiliary power units





Contributions of Mobile-Source NOx Emissions at Airports





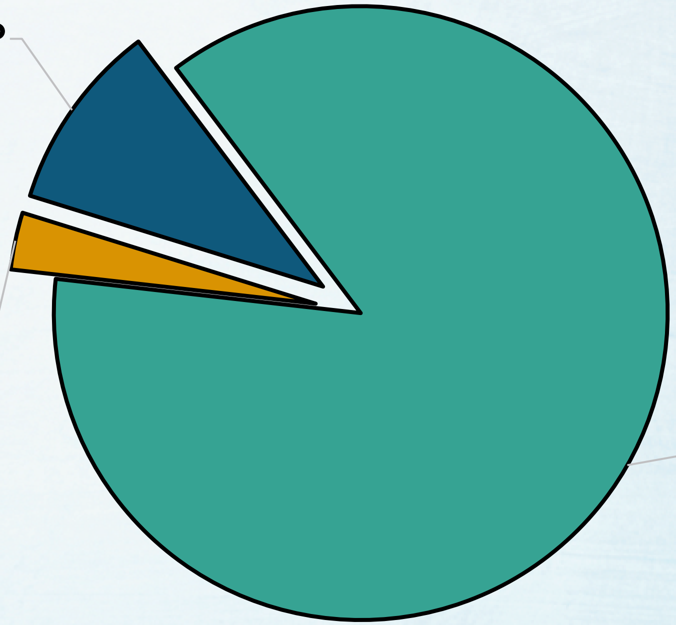
Source: NOx Emissions in 2023 at LAX

*** Accounts for emissions within the mixing height, under the nominal boundary layer of 3,000 feet.**

Contributions of NOx Emissions at Airports

Emissions Subject to ACC II, ACT, ACF, and ZE shuttle bus

Emissions Subject to ORD and LSI



No Technology-Forcing Standards or CARB Regulations

NOx Emissions in 2023 at LAX

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Purpose of Today's Workshop

- Introduce Draft Regulatory Approach Concepts
- Outline Planned Emissions Inventory Updates for Aircraft and Ground Support Equipment
- Collect Initial Feedback on Concepts and Alternatives

Regulatory Approach Concepts

Scope of Operational Practices Under Consideration

1. Ground Support Equipment
2. Aircraft Operations at Gate
3. Aircraft Taxiing
4. Takeoffs and Landings

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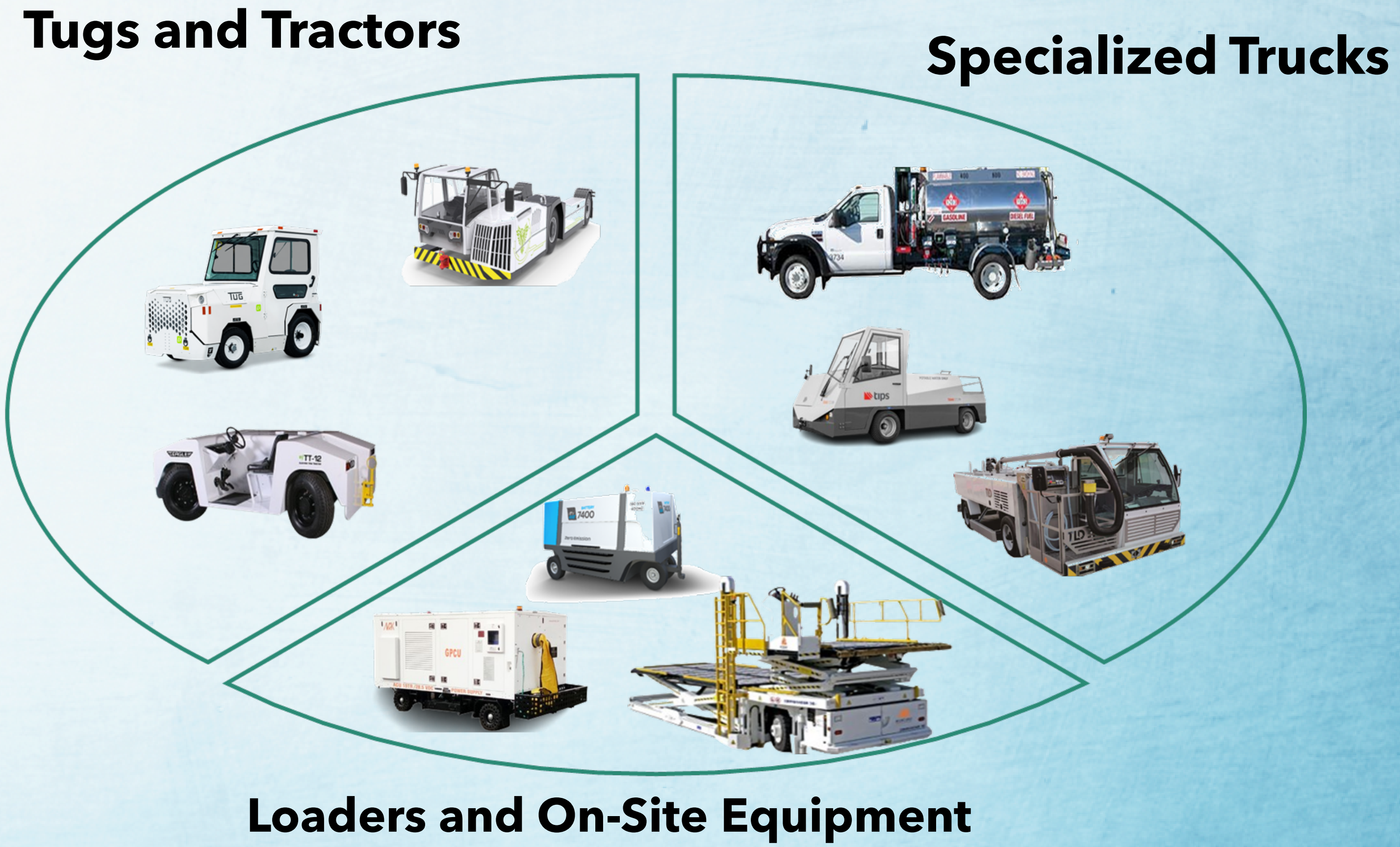
1. Ground Support Equipment (GSE)

- Airport GSE includes all motorized equipment used on airside surfaces, such as tarmacs, aprons, and taxiways, to support aircraft, passenger, and cargo operations, as well as other general airport ground functions.



Concept: Transition GSE fleets to 100% zero-emission GSE (ZE-GSE).

- Many categories of (ZE-GSE) today are commercially available and operationally feasible.
- Statewide, 22% of GSE is zero-emission as of 2022

Current Control Measures for GSE Emissions

- CARB's LSI and ORD rules have set fleet average emission targets that covers gasoline and diesel GSE.
- South Coast AQMD developed Memorandums of Understanding (MOU) with 5 major airports in the South Coast Air Basin to reduce NOx emissions from GSE.
- LAX has worked with airline tenants on an agreement that **all GSE at LAX shall be zero-emission by 2033***
  - By 2028, all new GSE added to LAX shall be zero-emission*
  - By 2030, all carts baggage tractors/tugs, belt loaders, and aircraft tractors/tugs shall be zero-emission*

*Unless exempt or zero-emission replacements are not operationally feasible or commercially available

Staff is evaluating and seeking input on:

- For GSE operators, what are your biggest hurdles with using electric GSE?
- For GSE manufacturers, are there any equipment that will be harder to offer with zero-emission powertrain options, and if so, why?
- Airport infrastructure for charging ZE-GSE; what planning has been done, or needs to be done, at both an airport and airline level?
- Implementation timeframes and approaches for achieving a ZE-GSE fleet

2. Aircraft Operations at Gate

Goal: Reduce emissions from Auxiliary Power Units (APUs)

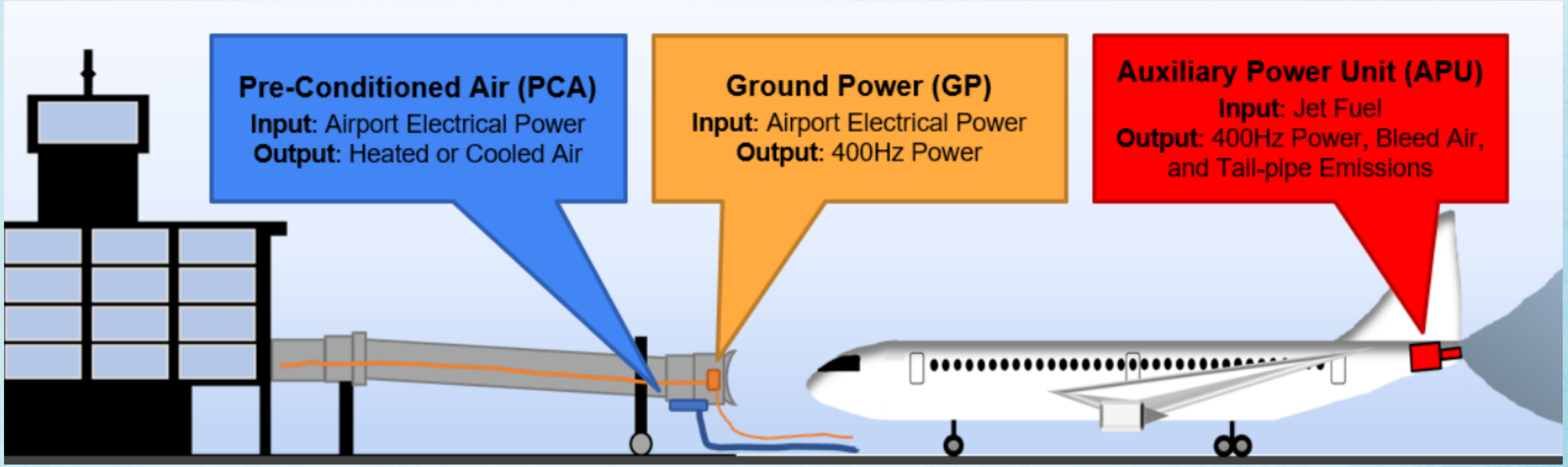
The APU is a small gas turbine engine that runs on jet fuel, and is installed in the back of the aircraft

APUs are used to:

- Power the aircraft electrical systems when main engines are off
- Provide compressed air for air conditioning system
- Start the main engines

Concept: Require Use of Ground Power and Pre-conditioned Air Rather Than the APU while at Gate

Many airport gates are already electrified and provide ground power and preconditioned air



Rakas, J., Achatz Antonelli, P., Walia, C., Rouzbahani, P., & Gikas, G. (2023). Reducing Emissions through Monitoring and Predictive Modeling of Gate Operations of Idle Aircraft: A Case Study on San Francisco International Airport. UC Berkeley: Institute of Transportation Studies at UC Berkeley. http://dx.doi.org/10.7922/G24F1P31

APU Operations at Gate

Current data: APU runs for 42 minutes per turnaround

Even when gates are electrified, a portion of operations do not use ground power.

- Rakas et al. (2023) found that "64% of operations use ground power for an average of 62.5% of their turnaround time, and 36% do not use ground power at all."

Some airports, including SFO and FAT, have APU usage restrictions at gates and impose fees for violations.

Rakas, J., Achatz Antonelli, P., Walia, C., Rouzbahani, P., & Gikas, G. (2023). Reducing Emissions through Monitoring and Predictive Modeling of Gate Operations of Idle Aircraft: A Case Study on San Francisco International Airport. UC Berkeley: Institute of Transportation Studies at UC Berkeley. http://dx.doi.org/10.7922/G24F1P31

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Staff is Evaluating and Seeking Input on:

- Maximum timeframes that ground power and pre-conditioned air units can be used instead of the APU
- Airports or locations at airports not equipped with electrified gate infrastructure
- When exceptions to APU usage restrictions should be available
- Implementation timeframes
- Other ways to reduce emissions from gate operations

3. Aircraft Taxiing Operations

Minimize aircraft engine use while taxiing by using zero-emission taxiing technologies or low emission strategies

TaxiBot, pilot project at Schiphol Airport

WheelTug, pursuing certification for operation by 2026

Single Engine Taxiing, required at London Heathrow Airport

Technologies Available for Zero Emission Taxiing

External tug– E.g. Taxibot

- Diesel-hybrid in active use, Battery-Electric available for order
- Taxibot is distinct from other long-distance tugs (e.g., Goldhofer) in that it allows the pilot to control it from the cockpit

Onboard electric
– E.g. Wheeltug, eTaxi

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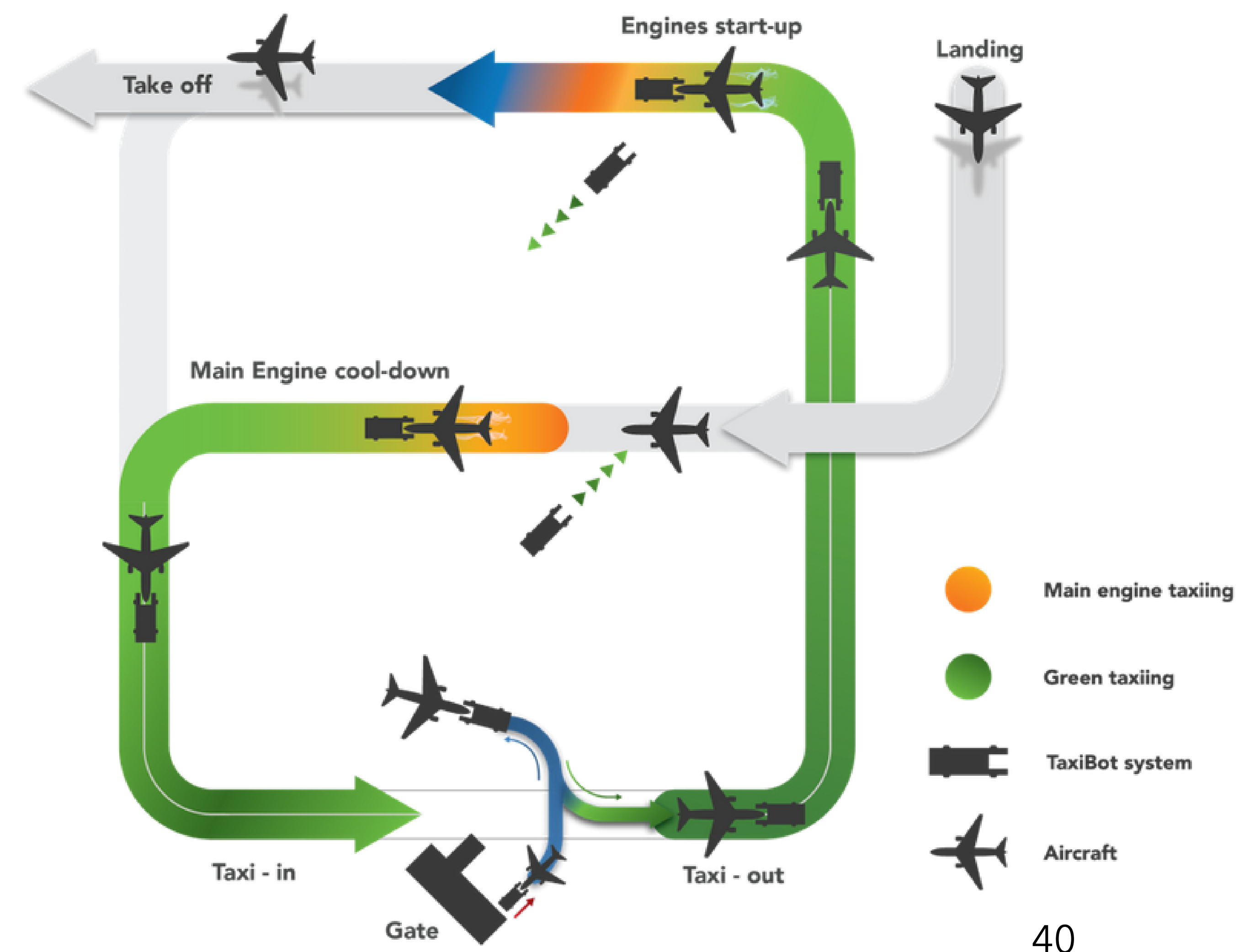
ZE Taxiing of Passenger Aircraft

- After landing, incoming flights meet a ZE tug near the runway and are towed to gate.
- For departures, ZE tug tows aircraft from gate to runway, decouples from aircraft and returns to gate.



https://taxibot-international.com/concept/

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Reduced Emission Taxiing at Airports

- Today in California, tugs are being used to move empty aircraft between hangars and terminals (not Taxibot)
- Schiphol (Amsterdam) airport in 2020, and Frankfurt airport in 2015 have carried out TaxiBot trials.
- Indian airports have been actively using TaxiBot for past several years, with 5,000+ successful operations.
- Documentation of Schiphol airport highlights promising implementation scenarios:
  - Biggest benefit on higher distance taxiing.
  - Easier implementation at airports with spacious taxiway and service roads in reduced traffic times.

Amsterdam

Delhi and Bangaluru

Frankfurt

Feasibility Study for ZE Taxiing in CA

- CARB is planning to release a Request for Proposals (RFP) in 2025 to conduct a feasibility study on this topic.
- Core focus of study will be:
  - Analyze feasibility at 3-5 select CA airports.
  - Determine operational changes required to implement zero emission taxiing at CA airports.
  - Determine limitations in infrastructure, operational restrictions, or safety concerns that would prevent 100% adoption of ZE taxiing.
  - Determine cost of implementation.

Staff is Evaluating and Seeking Feedback on:

- CARB staff welcomes airports and airline input and participation in near-term ZE taxiing demonstration projects or RFP evaluation.
- Additionally, we welcome feedback from communities and other stakeholders on ZE taxiing implementation or other approaches to reduce taxiing emissions.

4. Lower Emissions Takeoffs and Landings

Concept: all other operational strategies to reduce aircraft emissions using existing technology and flight techniques:

- Attracting existing aircraft technologies with lower-emitting engines to service and visit California airports
- Modifying takeoff, landing, or flight path (e.g., angle, thrust)
- Airline spending account requirements to invest in lower-emitting aircraft technologies

Lower Emission Takeoffs and Landings: In-Flight Strategies

Landing

Continuous descent approach: Instead of conventional step-stair descent segments, the aircraft makes a smooth descent to the runway at near idle thrust settings which produce less NOx[1]

Optimize approach angles: Higher flight path angles during descent reduce fuel usage and duration of the descent, resulting in lower NOx emissions[2]

Takeoff

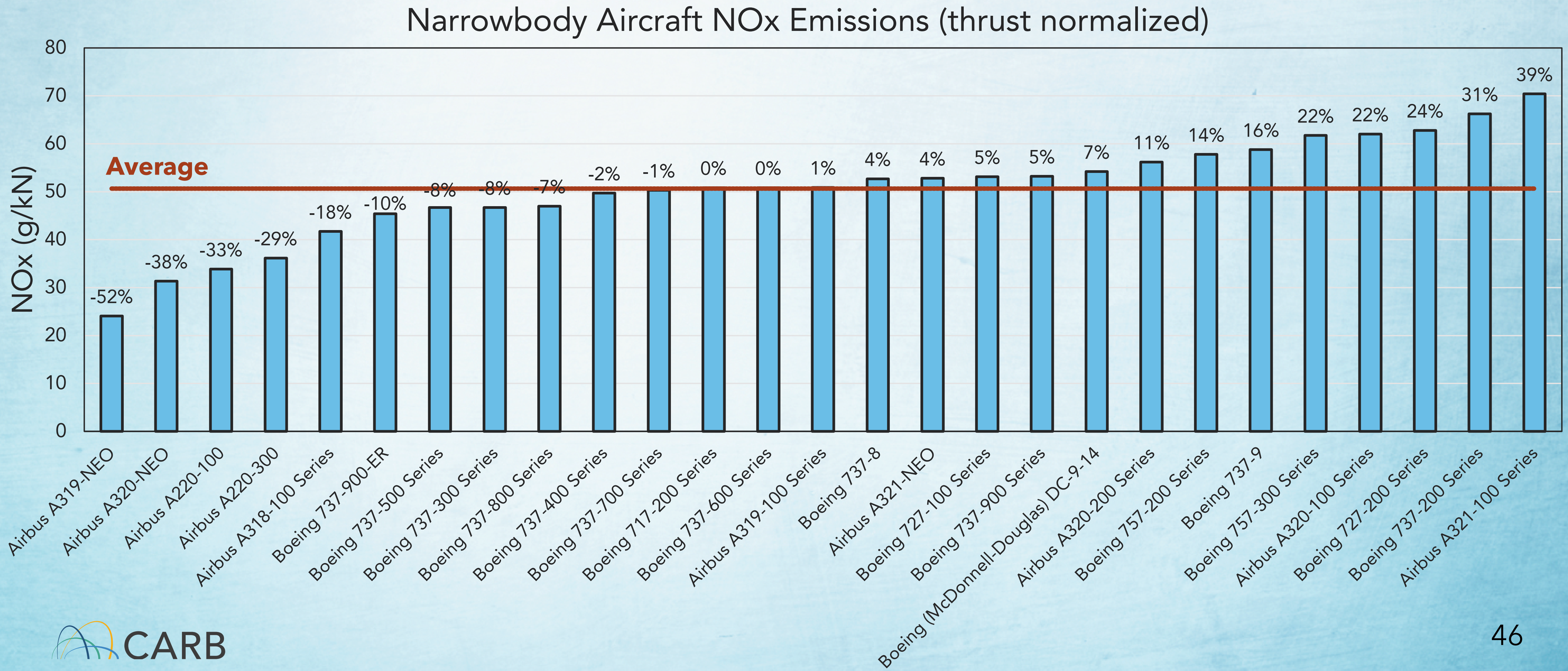
De-rated takeoffs: By not applying full thrust during takeoff, NOx emissions can be reduced by 10-48% relative to using 100% thrust[3]

Optimized take-off angle: Steeper takeoff angles allow the aircraft to climb to higher altitudes faster, reducing NOx emissions near the ground[4]

[1]Hardell, H., & Polishchuk, T. (2022). Evaluation of the Noise Benefits from Performing CDO in TMA Using OpenSky Data. *Engineering Proceedings, 28*(1), 15.
[2]Turgut, E. T., Usanmaz, O., & Rosen, M. A. (2018). Empirical analysis of the effect of descent flight path angle on primary gaseous emissions of commercial aircraft. Environmental Pollution, 236, 226-235.
[3]Koudis, G. S., Hu, S. J., Majumdar, A., Jones, R., & Stettler, M. E. (2017). Airport emissions reductions from reduced thrust takeoff operations. Transportation Research Part D: Transport and Environment, 52, 15-28.
[4]Synodinos, A., Self, R., & Torija, A. (2018). Evaluation of environmentally optimal descent and take-off slopes for existing and novel aircraft.

Lower Emission Takeoffs and Landings: Cleaner Visits

Some in-service aircraft are already using advanced, low emission technology



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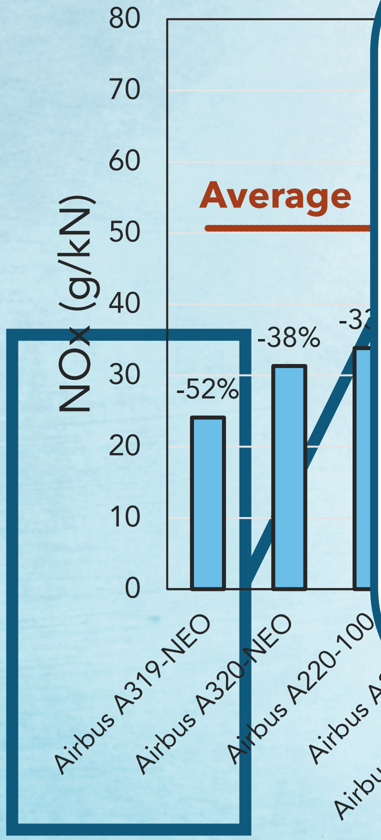
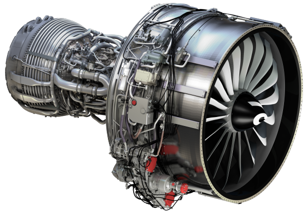
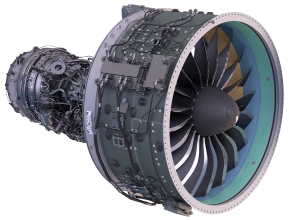


The Airbus A319-NEO uses two engines:

The **LEAP-1A** from CFM International and the **PurePower PW1100G-JM** from Pratt & Whitney. These engines achieve NOx emissions 35-52% lower than the CAEP/8 emission standard.



LEAP-1A
(TAPS II combustor)



PurePower PW1100G-JM
(TALON X combustor)

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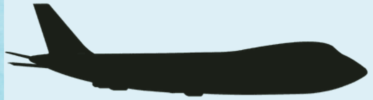
Reroute Aircraft with Clean Technology to Reduce NOx, and Use SAF to Reduce PM Emissions

Based on engine certification data that manufacturers report to ICAO, we identify the following aircraft as the cleanest options among aircraft commonly visiting California

	Airframe Category	Average NOx (g/kN)	Cleanest Aircraft in Category
	Regional Jet	46 g/kN	Bombardier CRJ-700 37 g/kN, 20% cleaner than the category average
	Narrow-body	51 g/kN	Airbus A319 NEO 24 g/kN, 52% cleaner than the category average
	Wide-body	60 g/kN	Boeing 787-8 Dreamliner 40 g/kN, 34% cleaner than the category average

Lower Emission Takeoffs and Landings: Spending Account

- Concept would require airlines to deposit funds into their own account directed for investing in zero-emission or lower-emission aircraft.
- Deposits would be determined based on various factors, such as activity or total emissions in California.
- Staff is seeking input on timeframe and structure, such as whether Disadvantaged Community (DAC) impacts should be considered in determining contributions.

Staff is Evaluating and Seeking Input on:

- Data on how frequently lower-NOx emitting take-off and landing strategies are already used
  - i.e., situations where continuous descent approach is not used
- Other operational strategies to reduce aircraft emissions during take-offs and landings
- Logistics and feasibility of rerouting aircraft with cleaner technologies to California
  - Differentiated landing fees based on emissions (e.g., Heathrow Airport)
- Timeframe and structure of spending accounts, factors to consider when determining contributions

Question and Answer (1)

- Please raise your hand if you would like to ask a question
  - Include slide numbers, if possible
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Emissions Inventory Updates

Mobile Source Emissions at Airports

On-Road Traffic to/from Airports

- Gasoline, diesel, natural gas, and propane engines
- Brake and tire wear

1. Ground Support Equipment

2. Aircraft at Gates

3 & 4. Aircraft Taxiing, Landing and Takeoff

- **Emissions from on-road traffic to and from airports are captured by the EMFAC model, which will be updated next in early 2025 and subsequently every 3 to 4 years.**

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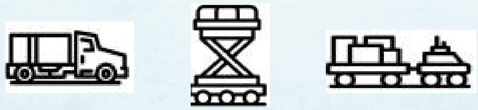
Mobile Source Emissions at Airports

1. Ground Support Equipment

- Gasoline, diesel, natural gas, propane engines



- **Emissions from GSE are now independently captured in a statewide inventory model under development, separating them from broader categories.**

Mobile Source Emissions at Airports

- **Emissions from APUs and aircraft are captured by California Aircraft Inventory (CAI) model developed by CARB.**

2. Aircraft at Gates

- Jet engines
- Auxiliary power units

3 & 4. Aircraft Taxiing, Landing and Takeoff

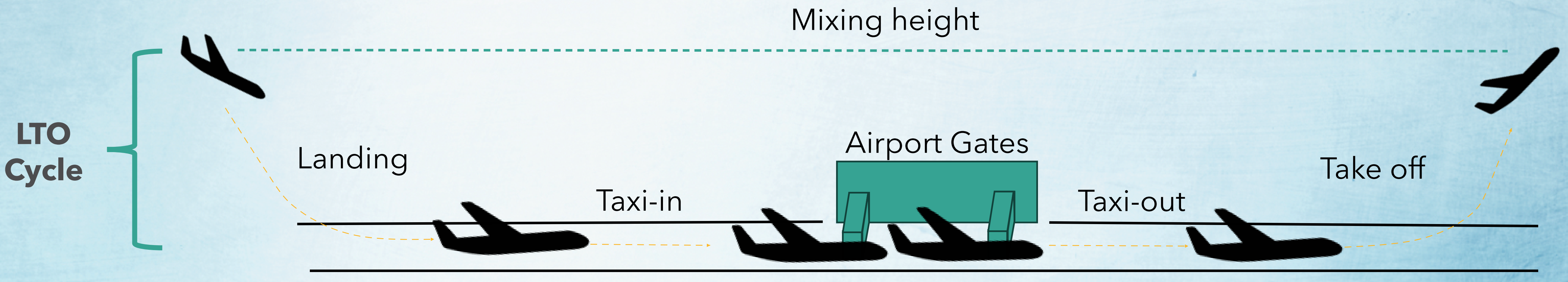
- Jet engines
- Auxiliary power units

The New Statewide California Aircraft Inventory: CAI2024

- CAI2024 is an inventory model that captures statewide aircraft activities (not GSE) and estimates emissions.
- All major aircraft types are included: commercial, general aviation, agricultural, and military
- Estimates emissions based on activity, fleet mix, and mixing height.
- CAI2024 release is planned for end of 2024, and will be updated again in circa 2027 to support rulemaking

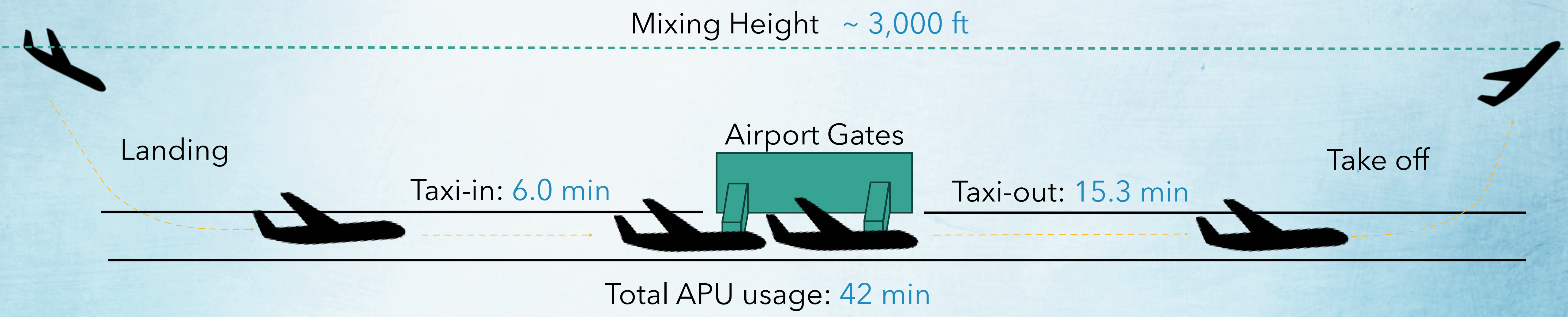
CAI2024 Workshop presentation, October 2024

Landing and Take-Off Cycle (LTO Cycle)



- CAI2024 estimates on-ground and near-ground emissions occur within the LTO cycle, which is defined by the atmospheric mixing height

CAI2024 Input Parameters



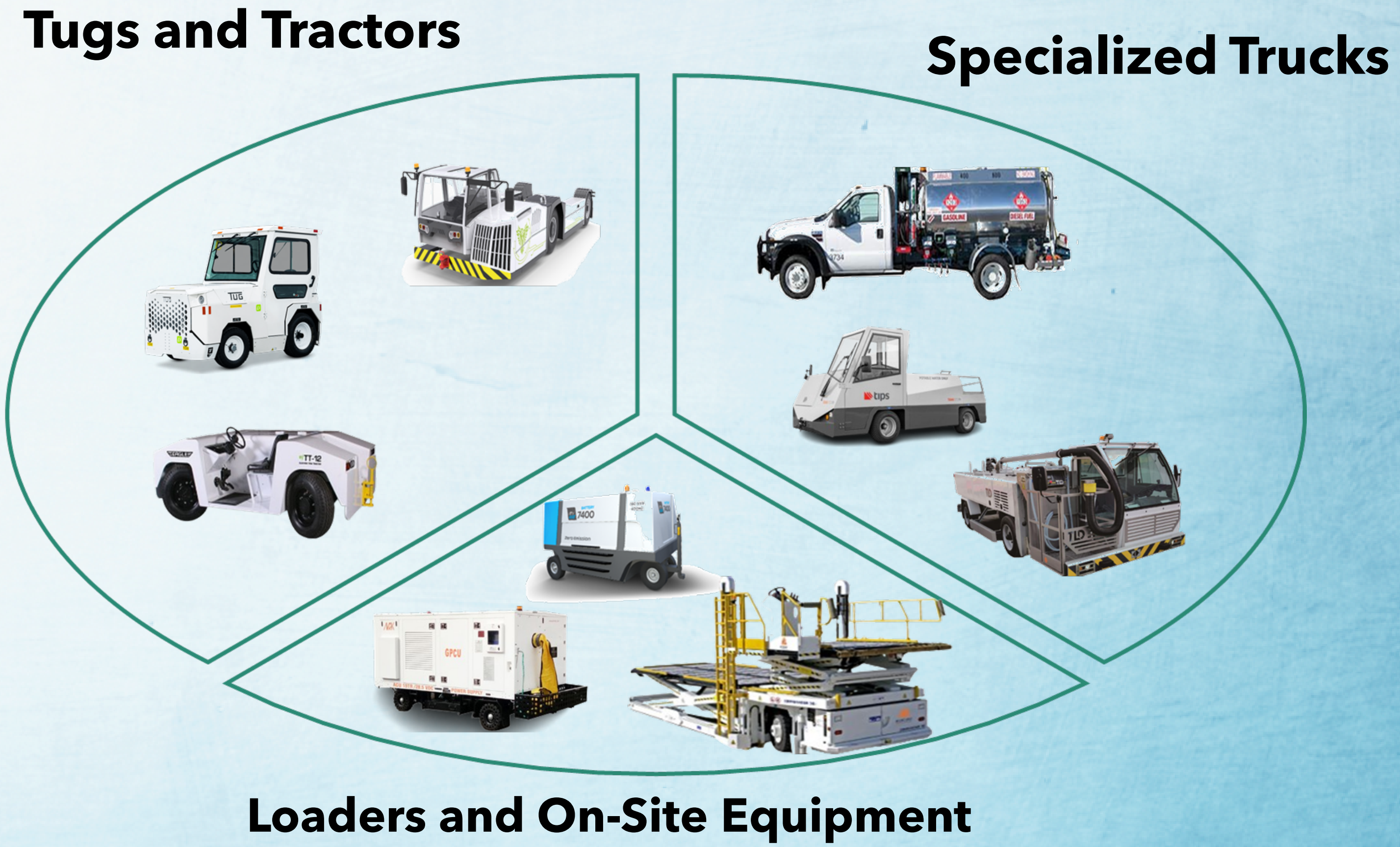
- Taxi times and mixing heights are airport specific, listed values represent averages or typical values.
- APU usage time is the same for all airports.

Future CAI2024 Inventory Process

- Prior to 2024, air districts prepared aircraft inventories.
- Moving forward, CARB will develop and release the aircraft emissions inventory statewide to promote consistency.
- CARB will be evaluating, and if needed, updating CAI2024 before finalizing the rule proposal in 2027.

Updated Statewide GSE Inventory

- Airport GSE includes all motorized equipment used on airside surfaces, such as tarmacs, aprons, and taxiways, to support aircraft, passenger, and cargo operations, as well as other general airport ground functions.



Tugs and Tractors

Equipment Type	Summary
Aircraft Tractor	Used to tow aircraft for repositioning and pushback.
Baggage Tractor/Tug	Transports baggage to and from the aircraft.
Cargo Tractor/Tug	Transports cargo containers and pallets to aircraft.

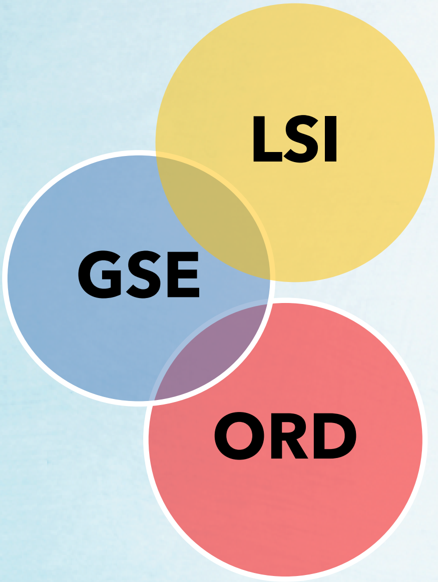
Specialized Trucks

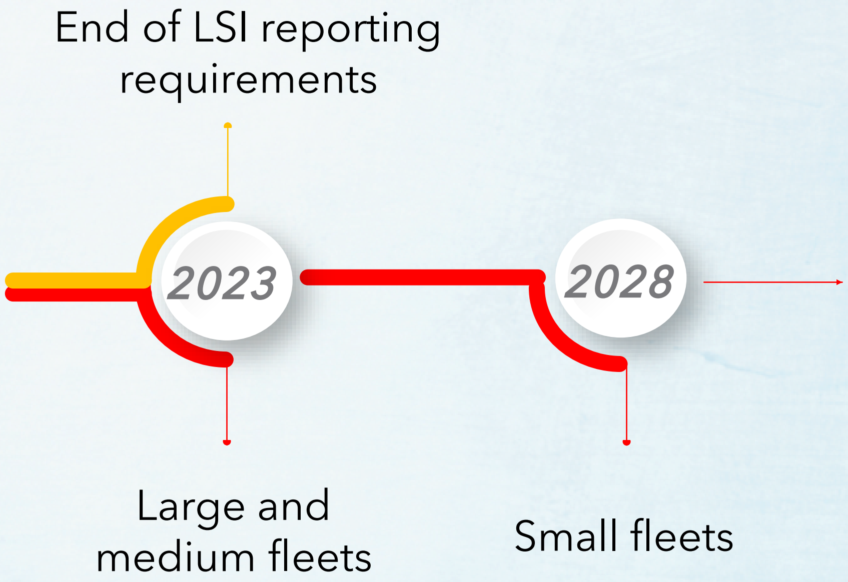
Equipment Type	Summary
Bobtail	A heavy-duty truck for various ground handling tasks.
Catering Truck	Supplies food and beverages to aircraft.
Fuel Truck	Supplies fuel to aircraft on the ground.
Hydrant Truck	Connects to hydrant systems to supply fuel to aircraft.
Lavatory Truck	A truck used for lavatory waste servicing of aircraft.
Service Truck	Handles general servicing tasks on the airfield.
Water Truck	Supplies potable water to aircraft.

Loaders and On-Site Equipment

Equipment Type	Summary
Air Conditioner	Provides cooling to aircraft cabins on the ground.
Air Start Unit	Supplies compressed air to start aircraft engines on the ground.
Belt Loader	Loads and unloads luggage onto aircraft via a conveyor belt.
Cargo Loader	Loads heavy cargo into the aircraft cargo hold.
Cart	Utility vehicle for transporting light goods around the airport.
Forklift	Lifts and moves heavy objects around the airport.
Generator	Provides electrical power for maintenance and other tasks.
Ground Power Unit	Supplies power to parked aircraft systems.
Lavatory Cart	Transports waste from aircraft lavatories.
Lift	Lifts personnel or equipment to higher areas of the aircraft.
Passenger Stand	Provides access for passengers boarding the aircraft.

CARB's Current GSE Reporting Requirements





After 2028, most reporting requirements sunset except in limited circumstances

CARB's Current GSE Reporting Limitations

Population

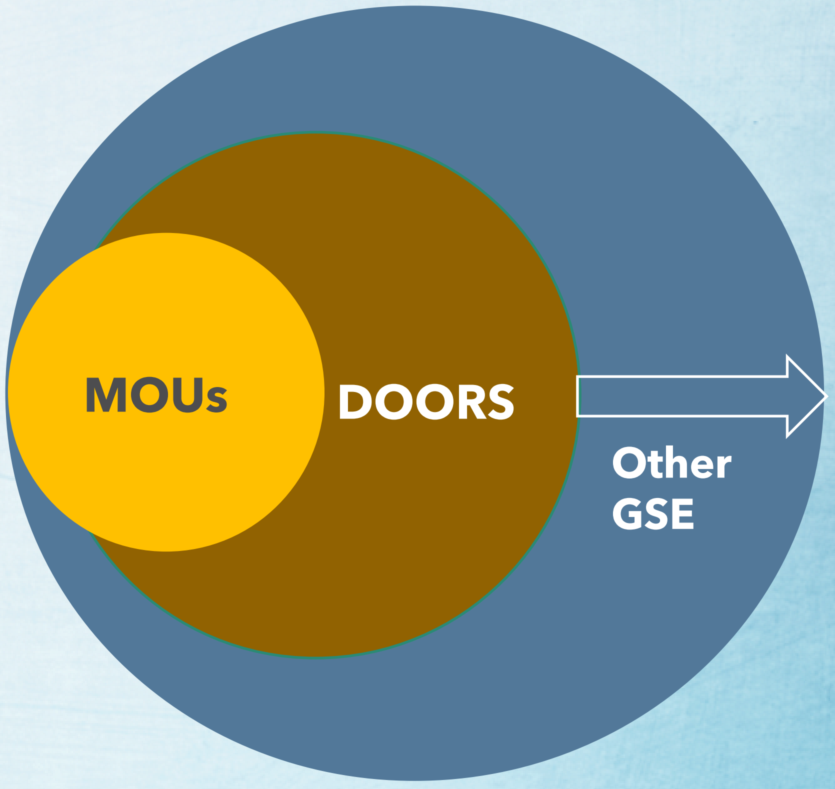
- Electric vehicles or businesses with three or fewer pieces of equipment are not required to report.

Activity

- Annual operating hours are not required to be reported

Population Datasets

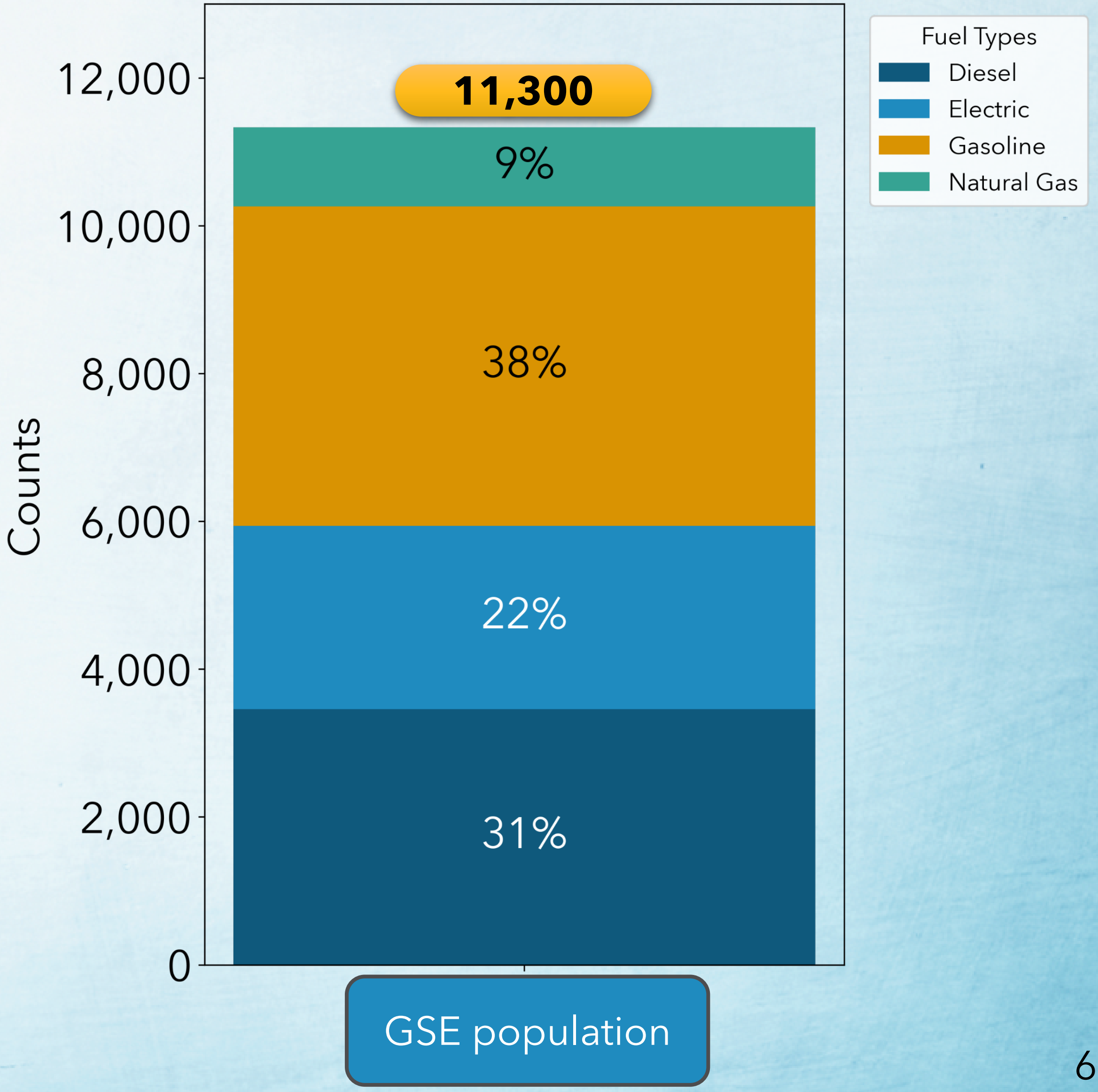
- South Coast **MOUs** offer highly reliable GSE population data for five major airports in SC.
- GSE population estimates for other airports are derived from moderately reliable data provided by the **DOORS system**.
- **Statewide GSE** estimates for other airports will be informed by the operational data-to-GSE ratio observed at South Coast airports.



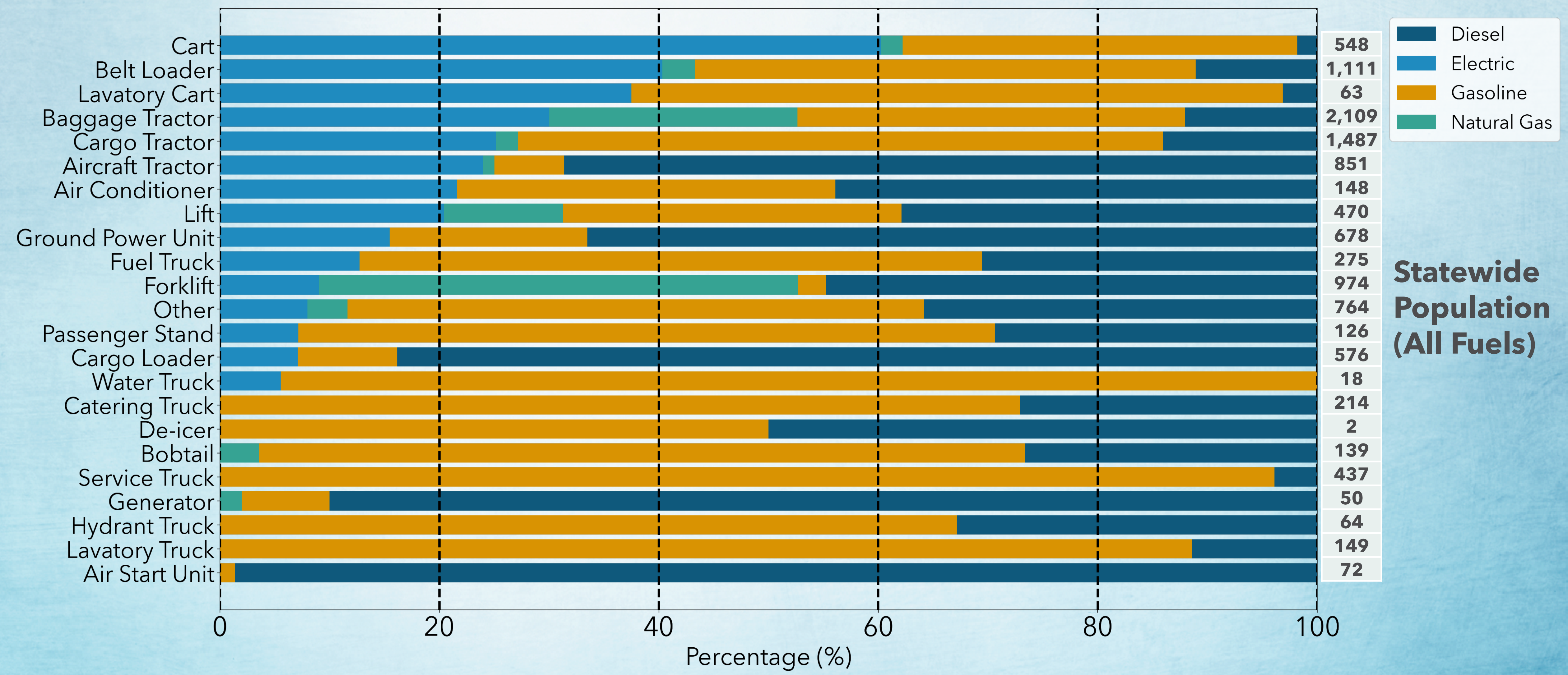
Statewide Population

Fuel Type Distribution of Updated Inventory

- CARB's preliminary estimate shows that the total population increased from **9,900** to **11,300**.



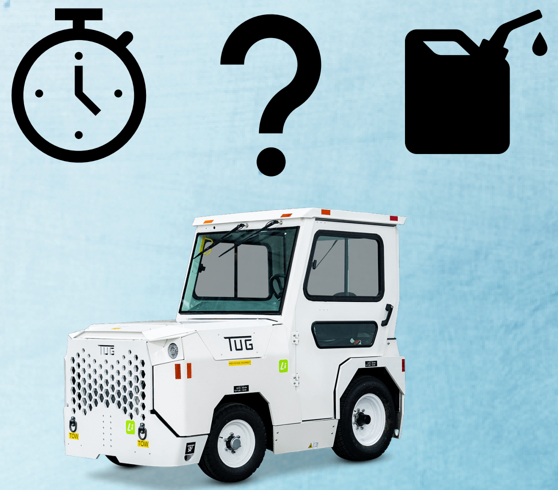
Fuel Type Distribution by Vehicle Type



CARB

Stakeholder Input Requested

- CARB is conducting a *voluntary* **GSE** activity survey to enhance estimates of **equipment**, **fuel use**, and **activity data**.
- We are actively collaborating with airports and the California Airports Council (CAC) to finalize the survey, which will be distributed through airports and the CAC, and made accessible for download on our website by the end of **December 2024**.
- We aim to complete by **February 2025** and appreciate timely participation.



CARB GSE Activity Data Survey Overview

1. Existing submissions in DOORS will be leveraged to minimize stakeholder burden, requiring minimal additional effort to provide:
   - ❑ **Annual operating hours**.
   - ❑ **Fuel usage details** (type and volume).
2. Equipment that has not been reported to DOORS:
   - ❑ **Equipment Details** (e.g., Vehicle Type, Engine Model Year, Engine Power)
   - ❑ **Annual operating hours.**
   - ❑ **Fuel usage details** (type and volume).

- **Data Year**: Preferably from **2023**, but data from other years are also accepted.
- **Alternative Formats**: Contact CARB if you wish to submit data using your own tracking format.

Questions or Feedback being Requested

- Any data sources that can help with improving emissions inventory, cost, feasibility analyses.
- Feedback on proposed concepts and alternatives to proposed concepts
- To inform cost, economic, and other rulemaking analyses, such as the Standardized Regulatory Impact Assessment (SRIA), we request alternatives that:
    - Yield the same or greater benefits than proposed regulatory concepts; or
    - Do not yield, or are less likely to yield, the same level of benefits than proposed regulatory concepts

Next Steps

December 2024
Today's workshop

Feb 10th, 2025
Comment Deadline

2025
Aviation Tech Forum in collaboration with USEPA and SCAQMD

2025
RFP for Zero-Emission Taxiing Feasibility Study

2025
Second workshop
Develop community engagement plan

2026
Additional workshops and more stakeholder engagement

2027
Potential 1st Board hearing

2030
Implementation starts

2033 and 2037
Maximize emission reduction by the attainment years

CARB

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  (916) 264-9378

Websites:

- CARB's Zero-Emission GSE website (click here to subscribe)
- CARB's Zero-Emission Aircraft Ground Operations website (click here to subscribe)

Question and Answer (2)

- Please raise your hand if you would like to ask a question
  - Include slide numbers, if possible
  - In Zoom: Use "Raise Hand" feature
  - On phone:
    - #2 to "Raise Hand"
    - *6 to Mute/Unmute
- Additional questions may be submitted after today to: aircraft@arb.ca.gov or to Mo Chen (mo.chen@arb.ca.gov)