CALIFORNIA
AIR RESOURCES BOARD

Statewide Clean Aviation Initiative (SCAI)

2nd Public Workshop

January 15, 2026

9:00 am (Pacific Time)

Workshop Instructions

- Telephone Call-In: 855-758-1310 (US Toll Free)
- Access Code: 724096
- Workshop is being recorded
- Slides and recording will be available on CARB's Statewide Clean Aviation Initiative (SCAI) 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)

Recap of First Public Workshop

- On December 10, 2024, CARB held a public workshop to informally kick off discussion of potential rulemaking on aviation. Presentation included:
  - Background on the need for rulemaking
  - Initial draft concepts for potential regulatory development
  - Emissions inventory updates
- Link to materials:
  - https://ww2.arb.ca.gov/our-work/programs/statewide-clean-aviation-initiative-scai/conferences-workshops

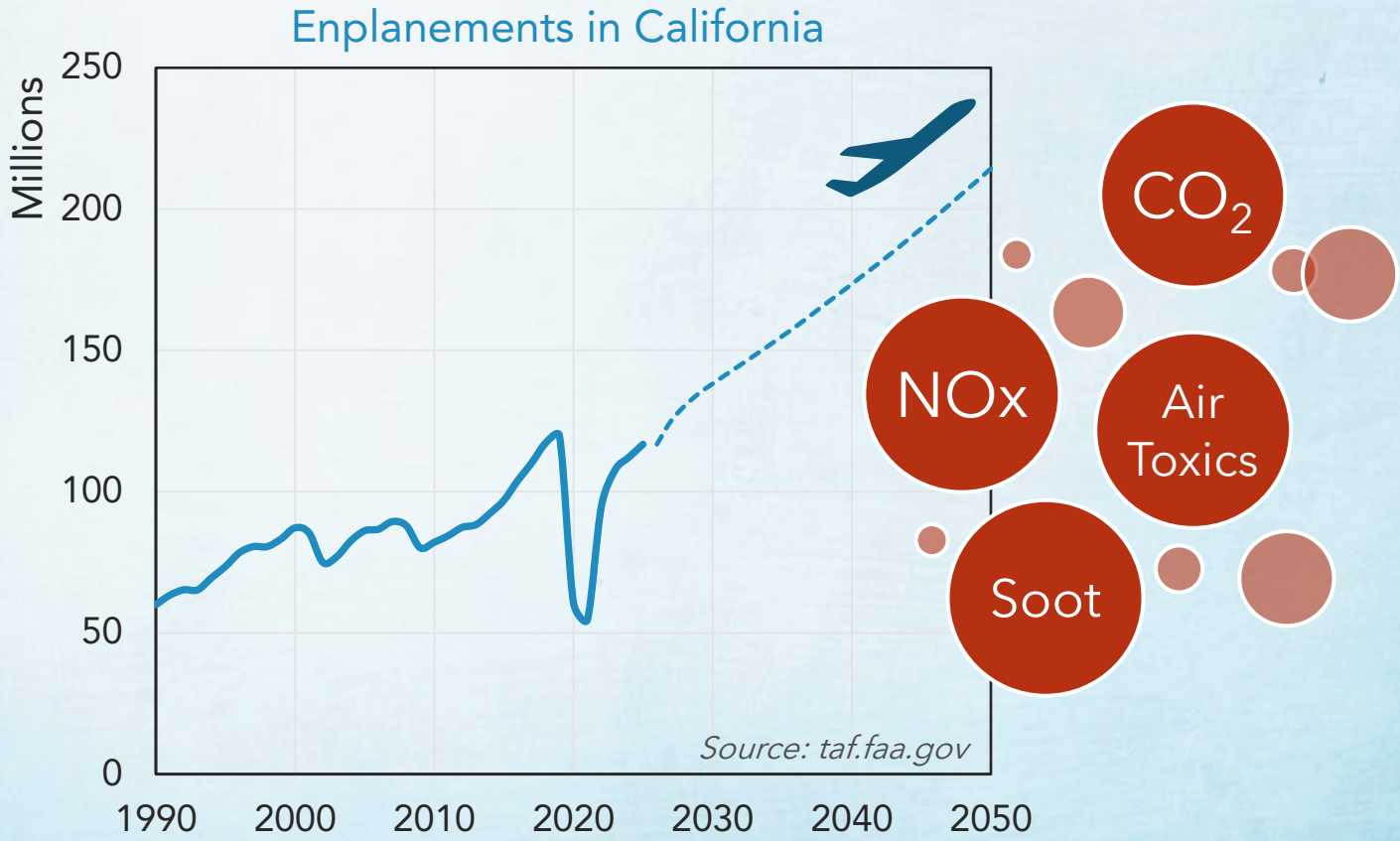
Today's Agenda

1. Background
2. Updates to Draft Concepts
3. Question and Answer (1)
4. Emissions Inventory Updates
5. Community Engagement Plan
6. The California Environmental Quality Act (CEQA) Environmental Impact Analysis
7. Timeline & Next Steps
8. Question and Answer (2)

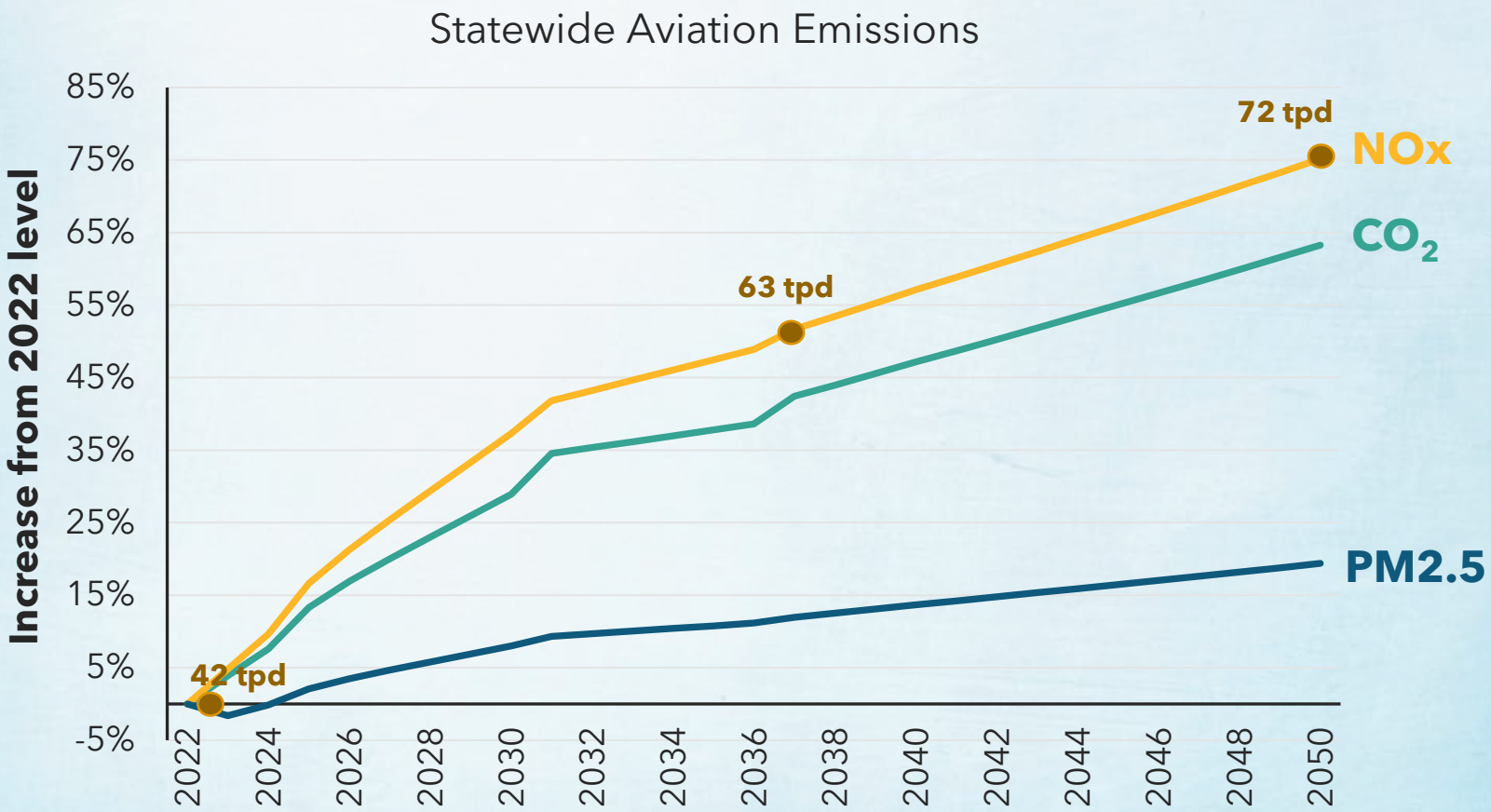
Draft Concepts Document: download here

Background

Air travel is expected to nearly double by 2050 compared to today's levels



Projected Growth in Aviation Emissions

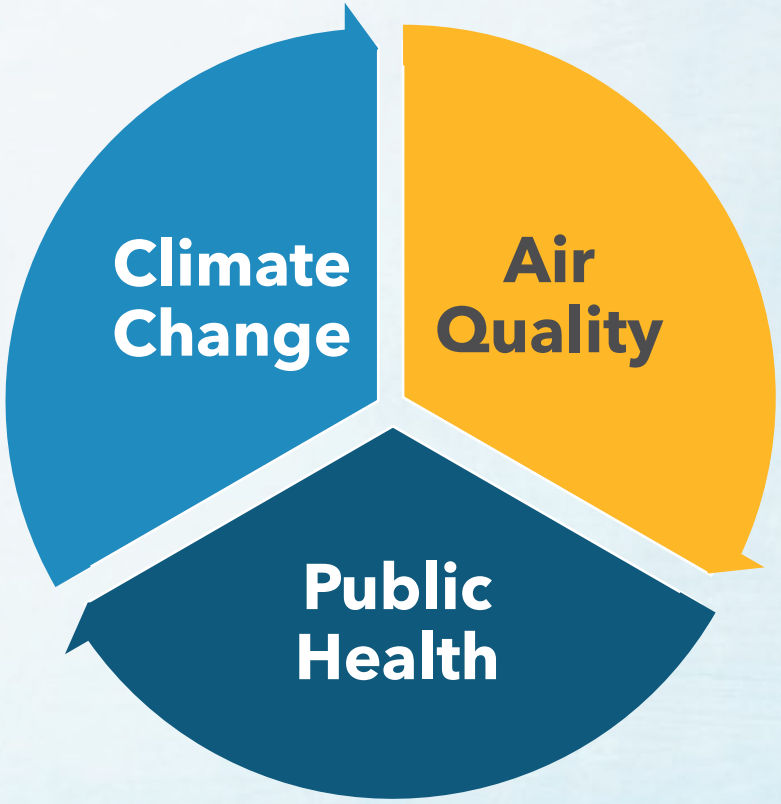


California Aircraft Emissions Inventory (2024)
https://ww2.arb.ca.gov/sites/default/files/2024-10/CAI2024%20-%20Main%20Document_Final1021_ada.pdf

CARB is Committed to Explore Strategies to Reduce Aviation Emissions

California's target for climate neutrality by 2045

2022 Scoping Plan

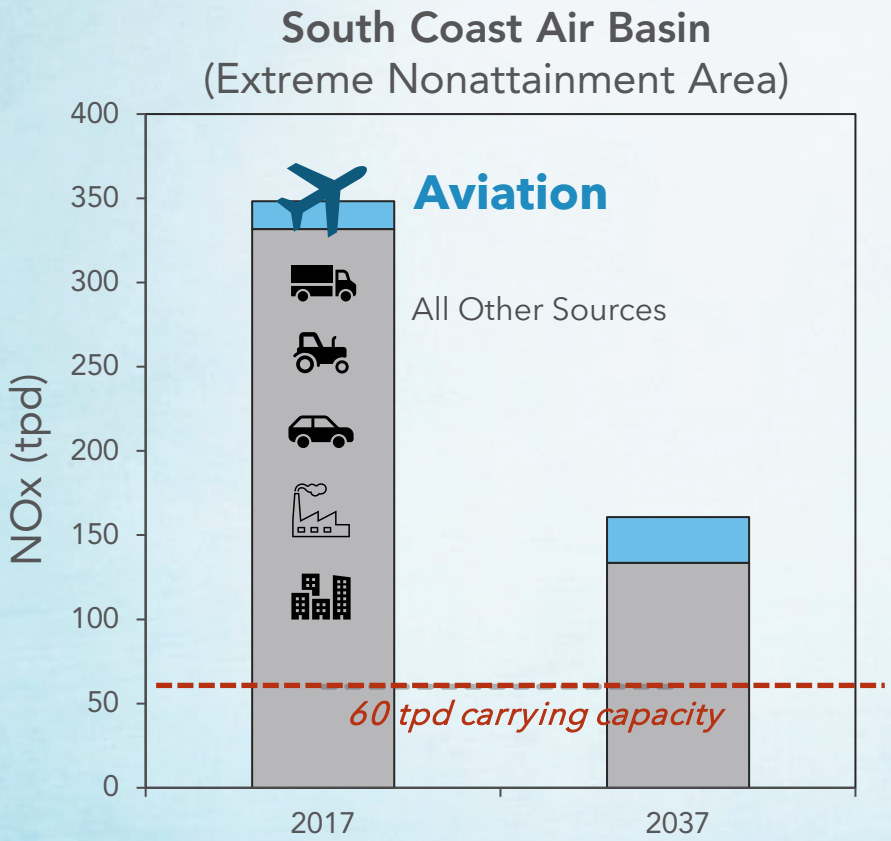


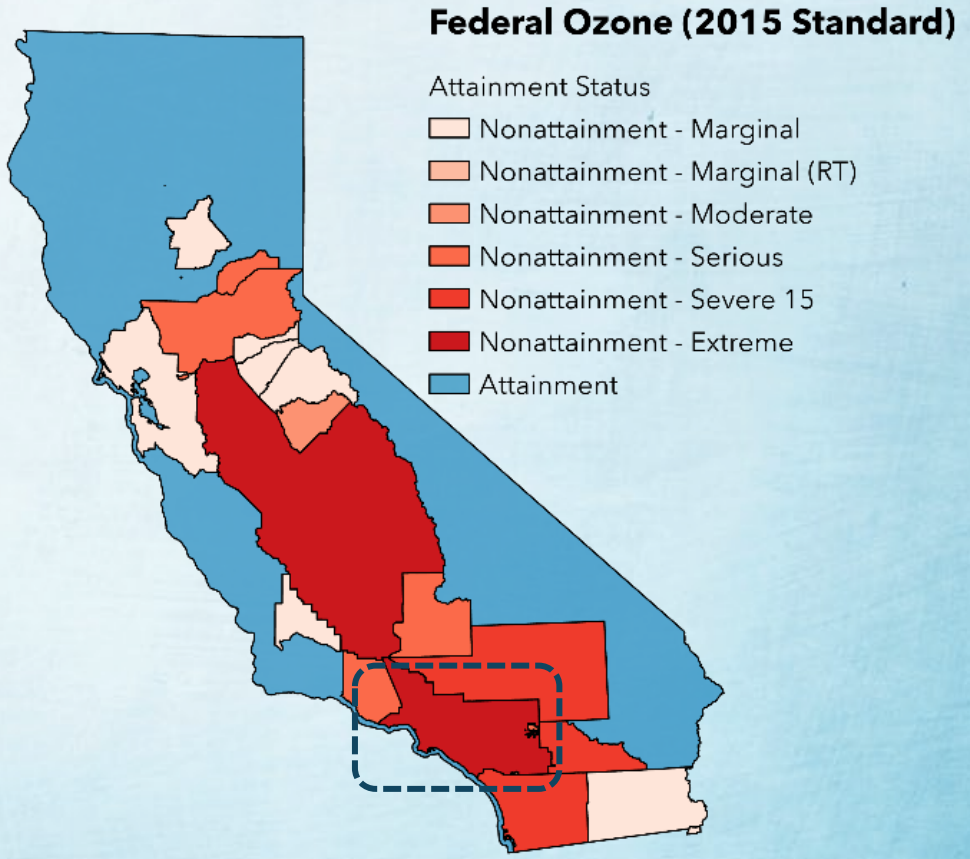
Federal ozone and fine particulate matter (PM2.5) standards

2022 State SIP Strategy
2024 Letter of Intent

Community air protection and air toxics reductions

South Coast Air Basin needs an 80% reduction in NOx emissions to meet the 2015 ozone standard





Health Risks For Airport Workers and Nearby Communities

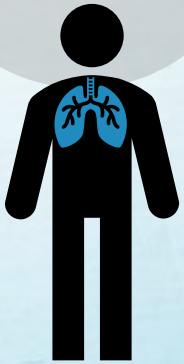
Diesel/Gasoline Exhaust

Jet Fuel Exhaust

Particulate Matter NOx CO

SOx Ultrafine Particles

Air toxics



Health Effects

Premature death

Respiratory illness

Cancer

Nervous system impacts

Heart attacks and strokes

Impaired cognitive function

Metabolic disorders

Preterm births and low birth weight

Susceptibility to infections

Purpose of Today's Workshop

- Expand on draft concepts for emissions reductions
- Provide updates on Emissions Inventory Development and Community Engagement Plan
- Collect feedback on draft concepts and alternatives

Updates to Draft Concepts

Draft Scope of Aircraft under Consideration

What types could be included:

Commercial Large Aircraft
>60 seats or 18,000 lbs payload

Commercial Small Aircraft
≤60 seats and 18,000 lbs payload

Non-commercial Jets
For private/cooperate/personal use

What types could be exempted:

- Agricultural
- Flight training
- Military
- Helicopters
- Firefighting and emergency-response
- Non-commercial piston engine aircraft
- Other types exempted from FAA registration under 49 U.S.C. s. 44101(b)(1)-(2)

Draft Scope of Major Airports under Consideration

Los Angeles International Airport (LAX)*	John Wayne Airport (SNA)
San Francisco International Airport (SFO)	Hollywood Burbank Airport (BUR)*
San Diego International Airport (SAN)	Palm Springs International Airport (PSP)
Ontario International Airport (ONT)*	Long Beach Municipal Airport (LGB)*
Oakland San Francisco Bay Airport (OAK)*	San Bernardino International Airport (SBD)*
Sacramento International Airport (SMF)	Fresno Yosemite International Airport (FAT)*
San José Mineta International Airport (SJC)	Santa Barbara Municipal Airport (SBA)
Van Nuys Airport (VNY)*	

These airports account for 95% of statewide NOx emissions from aircraft.

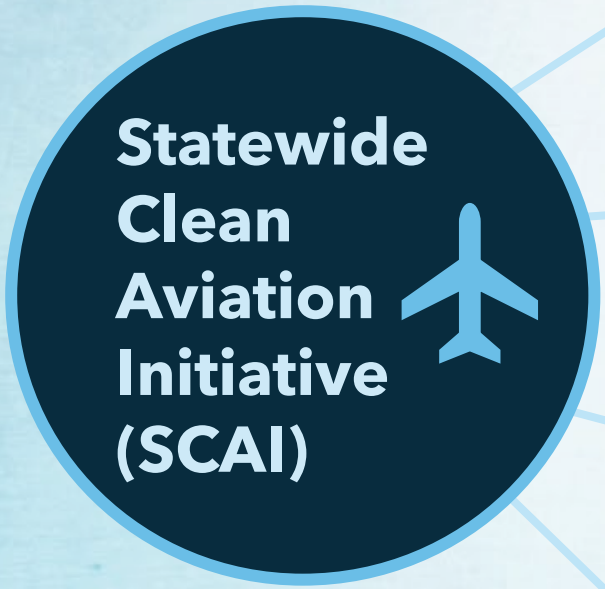
*over 30% of the surrounding communities (within 3 miles) are Disadvantaged Communities as defined by SB535.

Additional Airports under Consideration

Monterey Regional Airport (KMRY)
McClellan–Palomar Airport (KCRQ)
Charles M. Schulz–Sonoma County Airport (KSTS)
San Luis Obispo County Regional Airport (KSBP)
Meadows Field Airport (KBFL)*
Jacqueline Cochran Regional Airport (KTRM)*
Napa County Airport (KAPC)
Camarillo Airport (KCMA)
Redding Regional Airport (KRDD)
McClellan Airfield (KMCC)*
Sacramento Mather Airport (KMHR)
Brown Field Municipal Airport (KSDM)
California Redwood Coast–Humboldt County Airport (KACV)
Visalia Municipal Airport (KVIS)
Hayward Executive Airport (KHWD)
Montgomery-Gibbs Executive Airport (KMYF)
Hawthorne Municipal Airport (KHHR)*
Truckee Tahoe Airport (KTRK)
Point Mugu Naval Air Station (KNUQ)
Stockton Metropolitan Airport (KSCK)*
Buchanan Field Airport (KCCR)
Chino Airport (KCNO)
Perris Valley Airport (L65)*
Santa Monica Airport (KSMO)
Travis Air Force Base (KSUU)
Del Norte County Regional Airport / Jack McNamara Field (KCEC)
Gillespie Field (KSEE)
March Air Reserve Base (KRIV)*
Point Mugu Naval Air Station (KNTD)*
Livermore Municipal Airport (KLVK)
Bermuda Dunes Airport (KUDD)
Santa Maria Public / Capt G Allan Hancock Field (KSMX)
Modesto City-County Airport (KMOD)*
Palmdale Airport / USAF Plant 42 (KPMD)
Marine Corps Air Facility Camp Pendleton (KNZY)
Paso Robles Municipal Airport (KPRB)
Mammoth Yosemite Airport (KMMH)
Sacramento Executive Airport (KSAC)
Lake Tahoe Airport (KTVL)
Mojave Air & Space Port (KMHV)*
Oxnard Airport (KOXR)
Salinas Municipal Airport (KSNS)
Chico Regional Airport (KCIC)
John Nichol's Field Airport (0CL3)
French Valley Airport (F70)
Los Alamitos Army Airfield (KSLI)
Imperial County Airport (KIPL)*
Eastern Sierra Regional Airport (KBIH)
Southern California Logistics Airport (KVCV)*

Airports are included in Table 2 if they: (1) have over 365 Air Carrier or 1,999 Air Taxi annual operations during 2022, or (2) possibly receive a significant number of flights redirected from an airport in Table 1 due to close proximity.

Four Draft Concepts

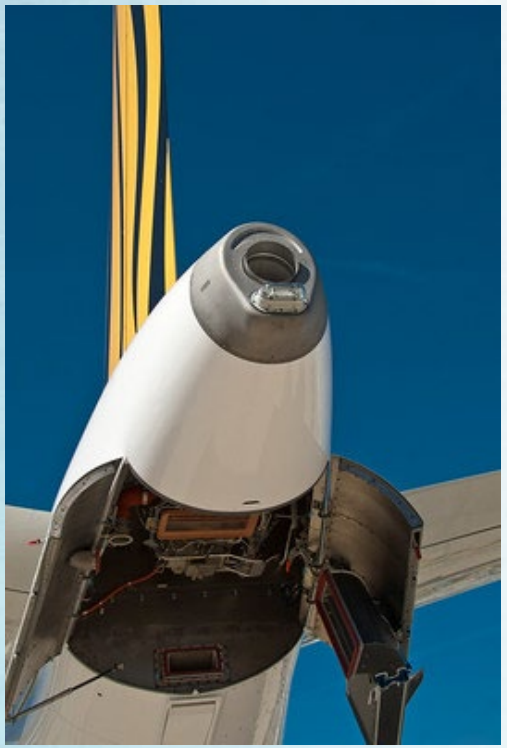


1. Controlling Emissions From **Auxiliary Power Units**

2. Reducing Emissions From **Ground Support Equipment**

3. Reducing Emissions From Aircraft **Taxiing**

4. Reducing Emissions From **Takeoffs and Landings**



Aircraft Auxiliary Power Units (APUs)

On the ground, APUs are used to:

- Power aircraft electrical systems
- Supply compressed air for climate control
- Start the main engines

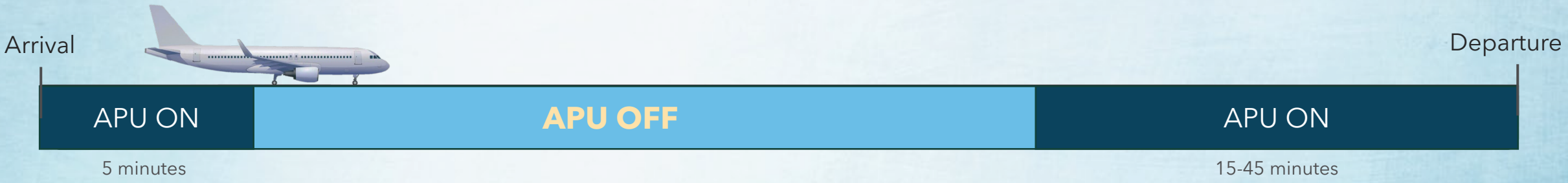
- Although zero-emission alternatives are broadly available, data collected at SFO shows that APUs are still used for approximately 60% of turnaround times (Antonelli et al. 2023).

- Many airports have policies to limit APU use during airport visits.
  - *E.g.*, San Francisco, Los Angeles, Seattle-Tacoma, Schiphol, Charles de Gaulle, Zurich, Copenhagen, and Frankfurt

Antonelli, et al. (2023). Reducing Emissions through Monitoring and Predictive Modeling of Gate Operations of Idle Aircraft: http://dx.doi.org/10.7922/G24F1P31

Control Emissions from APU for Duration of Visit

Potential start date: January 1, 2032



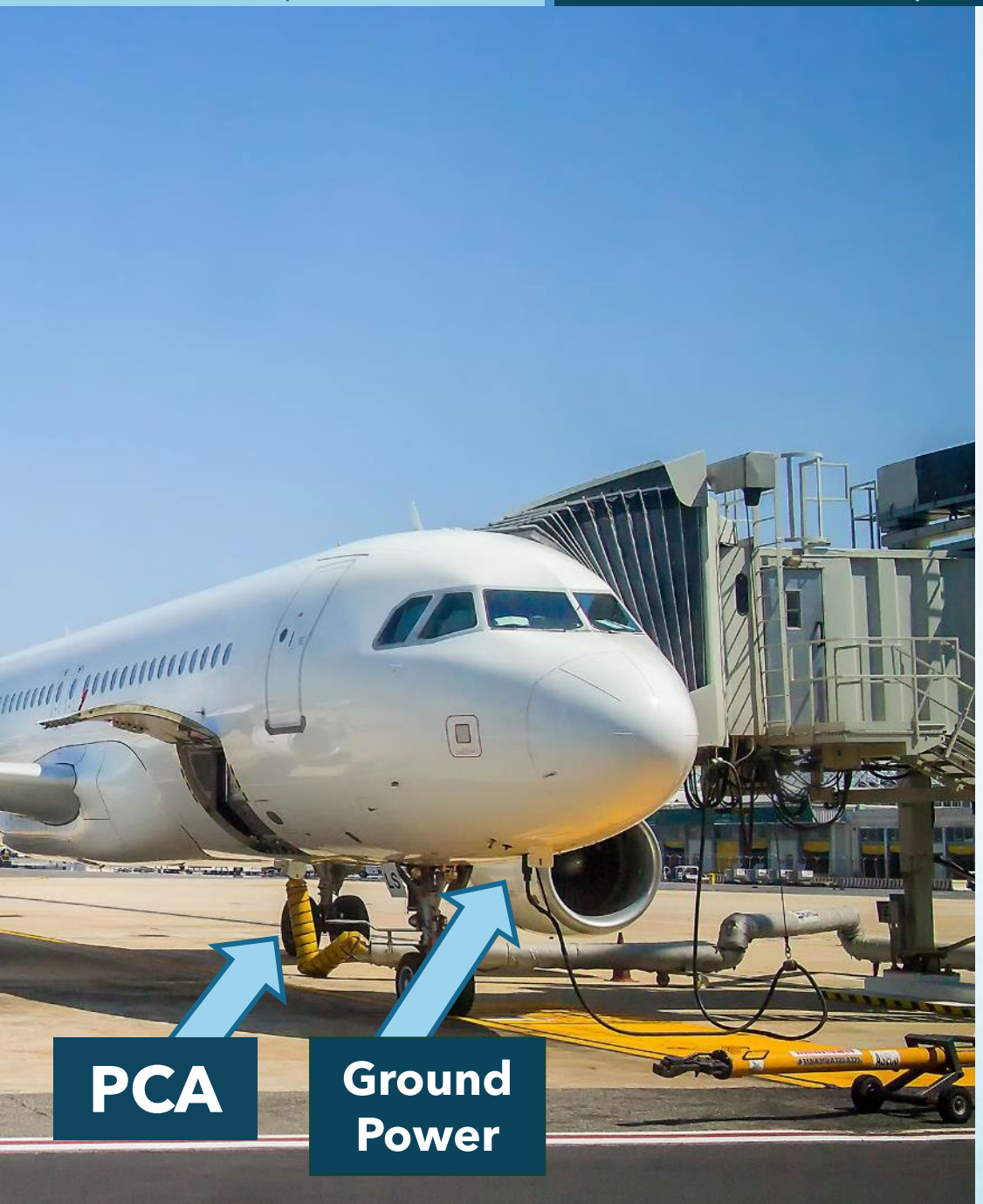
Upon Arrival:

Aircraft operators would need to reduce emissions from APUs starting within five minutes after arrival time

Upon Departure:

APU emissions would be minimized up to a specific time before departure:

- 15 minutes for Code C or below aircraft
- 25 minutes for Code D or above aircraft
- 45 minutes for A380 aircraft



Strategies to Reduce APU Emissions

- Shut off the APU
- For power needs:
  - Connect to fixed ground power (GP), which uses airport building electricity
  - Connect to mobile GP units
- For climate control needs:
  - Use electricity-powered preconditioned air (PCA) units at gates
  - Use mobile PCA units
- Alternatively, employ emissions capture and control systems or prospective on-board zero-emissions APUs

Airports would be responsible for installing infrastructure to support APU emissions reductions

- Gate infrastructure (ground power and pre-conditioned air) would need to be ready for use by **December 31, 2031**

- *Airport Infrastructure Plans* would be needed by July 1, 2030, including:
  - Description of which strategy each aircraft stand will use (GPU, PCA)
  - Equipment purchases needed
  - Timeline for any necessary equipment installations or modifications
  - Any restrictions for any specific aircraft stands

Reporting Requirements

Starting January 1, 2030, in-scope California airports would need to submit quarterly reports including information for every turnaround operation:

- ❑ Airport visited
- ❑ Aircraft stand
- ❑ Flight number
- ❑ Aircraft type code
- ❑ Aircraft model
- ❑ APU model
- ❑ Emission control strategy deployed
- ❑ Arrival date and time
- ❑ Departure date and time
- ❑ Timestamps when emission control strategy started and finished controlling emissions
- ❑ GPU model and fuel type if used
- ❑ PCA model and fuel type if used

Exemptions

Exemptions would be granted under limited situations such as:

- Technical issues or maintenance
- Safety or emergency events
- Participation in research that tests alternative technology
- Unforeseen issues with airport infrastructure

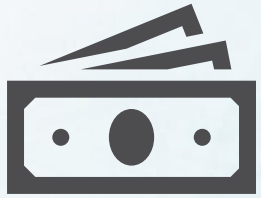
Exceptions would need to be reported within 7 days of the incident

Airports would be responsible for resolving issues with defective infrastructure within 45 days

Data Gathering and Questions to Stakeholders

Current Infrastructure

- What percentage of aircraft stands are currently equipped with GP and PCA units?
- Utilization rates



Cost Information

- Installation costs for fixed and/or mobile ground power and electric pre-conditioned air units
- Maintenance costs

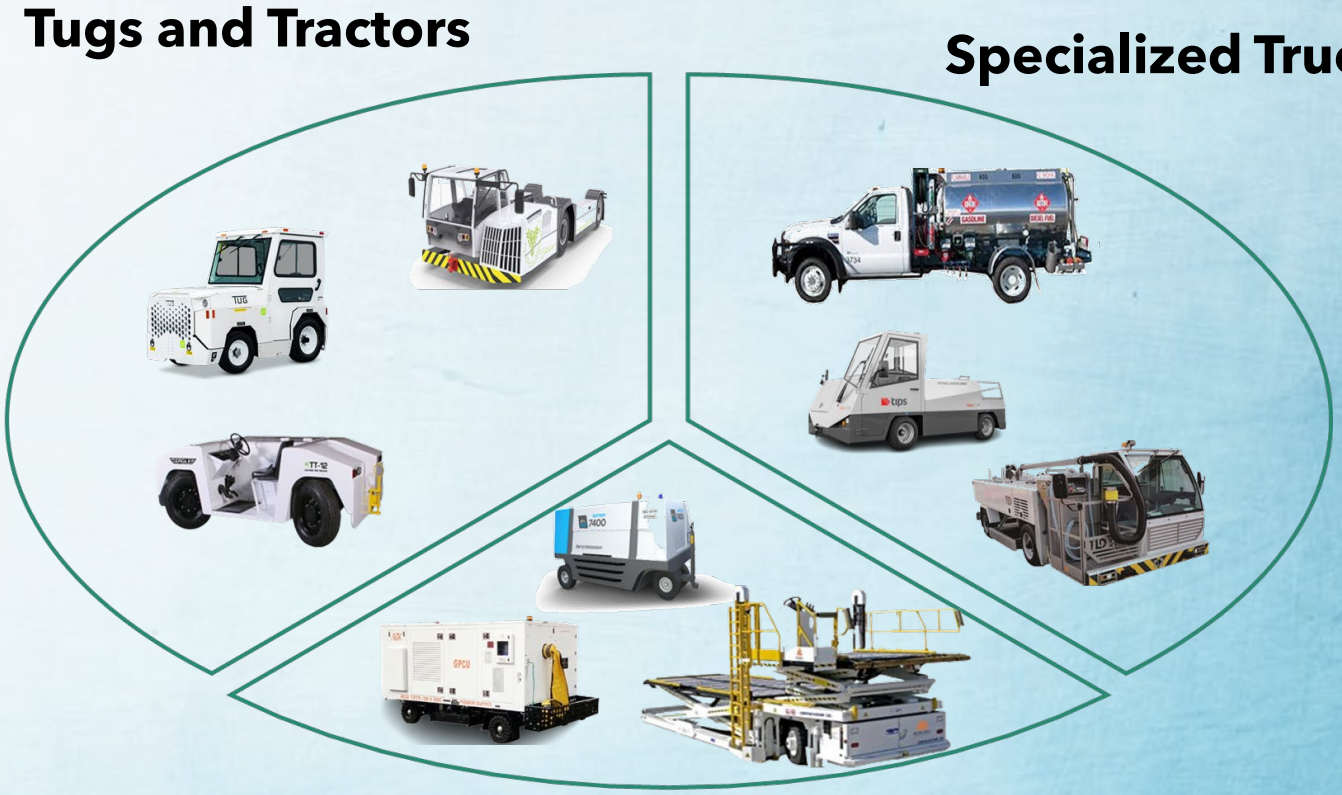
Expected timeframes

For airport infrastructure:

- Installation timeframes
- Lifetime of equipment
- Maintenance schedules

Ground Support Equipment (GSE)

- CARB staff defines Ground support equipment (GSE) as all motorized equipment that support aircraft operations and are used on airside surfaces at airports.



Current GSE Emission Reduction Programs

- CARB's LSI and ORD rules have set fleet average emission targets that covers gasoline and diesel GSE.
- South Coast AQMD developed Memoranda 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***
- The Port Authority of New York and New Jersey airline tenants will be required to **achieve 100% zero-emission GSE By 2030***

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

Draft Regulatory Concept:
Transition GSE to 100% ZE by 2037

Phase #1:
75% ZE by 2032
100% ZE by 2035

Phase #2:
50% ZE by 2032
100% ZE by 2037

Phase #3:
50% ZE by 2034
100% ZE by 2037

Equipment assigned a phase based on commercial availability and operational feasibility

Equipment Type	ZE Penetration for CY2025
Small Motorized Carts	80%
Belt Loaders	58%
Baggage Tractors	46%
Lavatory Carts	36%
Narrow-Body Aircraft Tractors	35%
Lifts	30%
Cargo Tractors	28%
Portable Air Conditioners	27%

Phase #1:
75% ZE by 2032
100% ZE by 2035

Equipment Type	ZE Penetration for CY2025
Wide-body Aircraft Tractors	18%
Ground Power Units	15%
Passenger Stands	11%
Fuel Trucks	10%
Cargo Loaders	10%

Phase #2:
50% ZE by 2032
100% ZE by 2037

Equipment Type	ZE Penetration for CY2025
Water Trucks	9%
Service Trucks	3%
Lavatory Trucks	2%
Bobtails	0%
Catering Trucks	0%
Generators	0%
Hydrant Trucks	0%

Phase #3:
50% ZE by 2034
100% ZE by 2037

Infrastructure Requirements

- Airports would be responsible to install, maintain, and manage electrical infrastructure needed to accommodate 100% zero-emission GSE at their airports.
- Electrical infrastructure would need to be installed and ready for use one year ahead of each scheduled compliance date

ZE Equipment Compliance Schedule	50% ZE Infrastructure Compliance Date	75% ZE Infrastructure Compliance Date	100% ZE Infrastructure Compliance Date
1	n/a	12/31/2031	12/31/2034
2	12/31/2031	n/a	12/31/2036
3	12/31/2033	n/a	12/31/2036

Phaseout schedules for diesel and non-forklift LSI GSE

Self-propelled off-road diesel vehicles ≥25 horsepower

Engine Tier	Phase-Out Date
3	12/31/2030
4 Interim	12/31/2032

Non-forklift large spark ignition GSE

Engine Model Year	Phase-Out Date
2009 or older	12/31/2030

*These are equally or more stringent requirements than the existing In-Use Off-Road Diesel-Fueled Fleets Regulation (ORD) and Large Spark-Ignition Engine Fleet Requirements Regulation (LSI).

Phaseout schedules for LSI Forklifts*

Class IV Forklifts

Compliance Dates	Phase-out Schedule for ≤12,000 lbs	Phase-out Schedule for ≥12,000 lbs
12/31/2027	MY 2018 and older	-
12/31/2030	MY 2019-2021	-
12/31/2032	MY 2022 and 2023	-
12/31/2034	MY 2024 and 2025	-

Class V Forklifts

Compliance Dates	Phase-out Schedule for ≤12,000 lbs	Phase-out Schedule for ≥12,000 lbs
12/31/2029	MY 2017 and older	-
12/31/2032	MY 2018-2020	-
12/31/2034	MY 2021 and 2022	-
12/31/2037	MY 2023 - 2028	-

*These requirements are the same as CARB's Zero-Emission Forklift Rule.

Reporting Requirements

- Starting January 1, 2030 airports would be required to report all GSE to CARB, annually.
- Reporting would include but not be limited to:

- ❑ vehicle category
- ❑ vehicle model year
- ❑ engine model year
- ❑ engine horsepower
- ❑ fuel type
- ❑ vehicle purchase date
- ❑ engine purchase date
- ❑ low use type
- ❑ EPA/CARB engine family number
- ❑ engine serial number
- ❑ vehicle serial number
- ❑ location (designated by airport code)
- ❑ activity hours
- ❑ fuel consumption

Exemptions

- Permanent low-use exemptions from CARB's ORD and LSI regulation (under 200 hrs/year).
  - 100 hrs/year limit for airports surrounded by DACs.
- Any equipment/vehicle that is subject to other CARB regulations.
  - e.g. on-road vehicles such as work trucks visiting airfield
- Military tactical support equipment, which does not include:
  - Military equipment that does not directly support combat (e.g. equipment used for training exercises)
  - Any military contractors that own or operate GSE

Questions to Stakeholders

For Airports

- Are you able to track charger utilization?
- What are your near-term plans for installing additional electrical and charging infrastructure?
- Could your airport facilitate 100% zero-emission GSE with current charging infrastructure?
- Who owns operates and maintains GSE charging infrastructure at each gate?

For GSE Owners/Operators

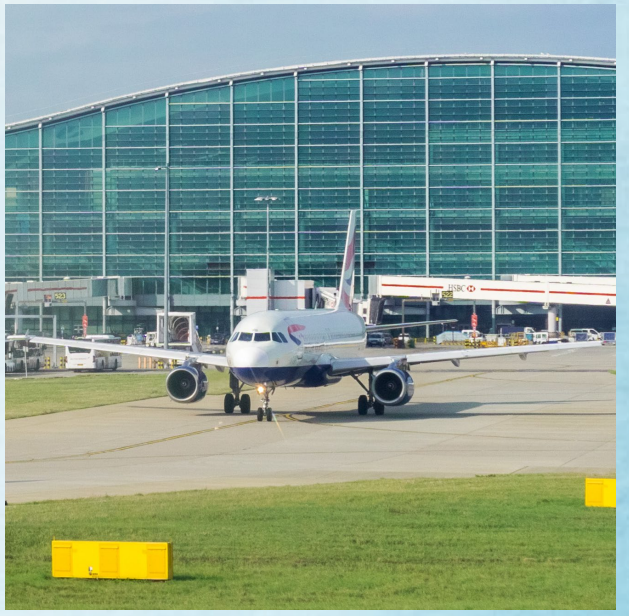
- What GSE type will be hardest to electrify for operational feasibility rather than commercial availability?
- What is an acceptable number of GSE chargers needed at each gate to maintain 100% zero-emission GSE?

Available Strategies for Taxiing Emissions Reduction

Reducing emissions from taxiing operations involves minimizing aircraft engine use through low- or zero-emission taxiing strategies

TaxiBot, or other external tug, pilot project at Schiphol Airport

WheelTug, or other onboard electric, pursuing certification for operation by 2026



Single Engine Taxiing, required at London Heathrow Airport

Taxiing of Passenger Aircraft

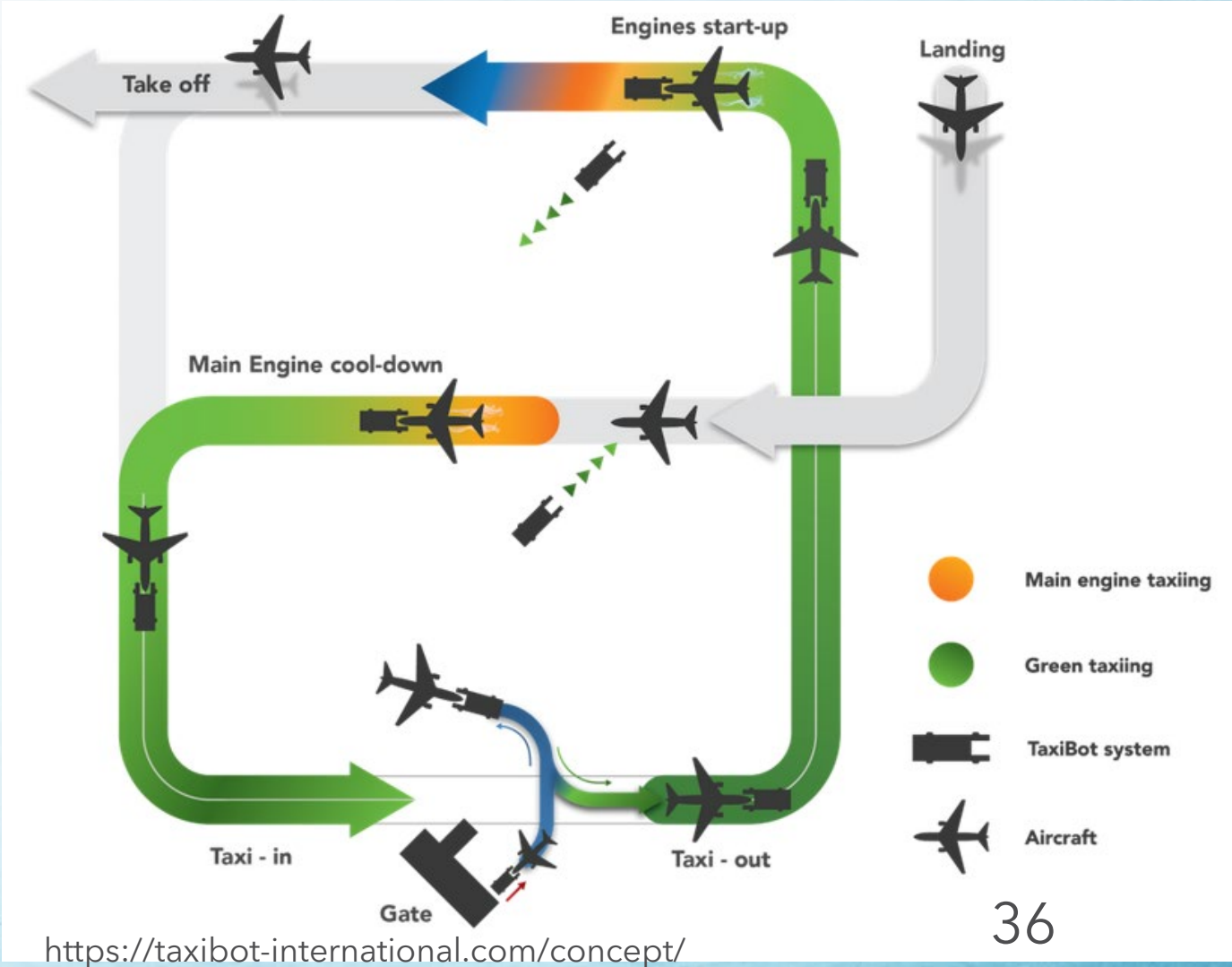
Taxi - In

- Arrival operations between the runway and gate after aircraft has landed.

Taxi - Out

- Departure operation between the gate and runway before the aircraft takes off.

Average taxi - out time in California	~ 12.4 minutes
Time required to warm up main engines	< 5 minutes



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

Feasibility Study of ZE Taxiing in CA

To understand what is needed for ZE technology deployment at California airports

Analysis Tasks:

1. Assess available and emerging ZE technologies
2. Evaluate real-world applications of ZE technologies
3. Select representative airports
4. Risk and Safety Management panel
5. Operational and infrastructure assessment
6. Model ZE taxiing at selected airports
7. Cost-benefit analysis

Roland Berger

Final Report Expected: Late 2026

Feasibility Study of ZE Taxiing in CA

To understand what is needed for ZE technology deployment at California airports

Analysis Tasks:

Findings Update

1. Assess available and emerging ZE technologies
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Roland Berger

Final Report Expected: Late 2026

Feasibility Study: Available and Emerging Technologies with Real-World Applications

Four main solutions were assessed based on public data and 15 stakeholder interviews of airports, airlines, ground handlers, and regulators

Type	Solution	Description	Pilot Control	Status	Preliminary Findings
External to Airplane 	**TaxiBot**	Separate semi-robotic tug to pull aircraft between gate and runway	**Yes**	**Certified** for narrow-body aircraft; more than 5,000 operations in India and Amsterdam	Only solution with large-scale real-world use, offers best balance of speed (up to 23 knots) and emission reduction.
	EcoTug	Separate electric tow with two operators to pull aircraft between gate and runway	**No**	**Not certified** for large-scale use	No aircraft modifications required, no additional weight, slower tug raised speed and safety concerns.
Onboard Airplane 	**WheelTug**	Electric motors in nose wheels powered by APU	**Yes**	**Not certified**; adds ~200 kg	Solutions housed internal to aircraft reduce infrastructure needs but have speed and weight trade-offs.
	Zero Engine Taxi (e-Taxi)	Electric motors on main gear powered by APU	**Yes**	**Not certified**; adds ~140 kg	

Feasibility Study: Representative Airport Grouping

To understand what airports may be most representative to model all California airports

Selection Criteria

14 of the largest commercial airports (99% of NOx emissions) were grouped based on departures, aircraft mix, hourly distribution, taxi-out time, space constraints:

	Group 1	Group 2	Group 3	Group 4
Type	High Traffic	Mid-Sized	Small Airports	Complex Layouts
Airports	LAX, SFO	SAN, SMF, SJC, SNA, OAK, BUR, ONT	LGB, PSP, FAT, SBA, SBP	SMF, SBA, SBP
Key Findings	Over 150k movements per year, balanced aircraft mix	30k – 100k movements per year, high share of narrow-body aircraft	<20k movements per year, more regional jets	Significant space constraints

Selected Airports for Further Study

LAX (Group 1), **SJC** (Group 2), **LGB** (Group 3), **SBP** (Group 4)

Part 1 Taxiing Concept: Low-Emissions

Applies to all California airports within the scope of concept

2030 Taxi-Out Requirements

- Single-engine taxiing for 80% of outbound aircraft

  Only aircraft with more than 5 minutes historical average taxi-out time

2030 Taxi-In Requirements

- Single-engine taxiing for 100% of inbound aircraft

  Only applies when aircraft exits landing runway until full stop at gate

2031 Annual Reporting Requirements

- Airport-wide average taxi-time, flight-level taxi data

Part 2 Taxiing Concept: Zero-Emissions

Compliance Requirements Applies to Qualified Airports only

Qualified Airports are either:

1. **Within DAC region**
   + 6 or more daily commercial flights
   + 6 minutes or more taxi durations

2. **Not within DAC region**
   + 8 or more daily commercial flights
   + 8 minutes or more taxi durations

Annual Reporting Requirements Beginning 2031

- Number of Capable Target aircraft taxied with ZE
- Implementation plan to meet targets within timeline

Airports anticipated to meet Qualified Airport criteria:
San Francisco International Airport (SFO)
San Diego International Airport (SAN)
John Wayne Airport (SNA)
San José Mineta International Airport (SJC)
Palm Springs International Airport (PSP)
Sacramento International Airport (SMF)
Los Angeles International Airport (LAX)
Hollywood Burbank Airport (BUR)
Oakland San Francisco Bay Airport (OAK)
Ontario International Airport (ONT)
Long Beach Municipal Airport (LGB)
Fresno Yosemite International Airport (FAT)

Part 2 Taxiing Concept: Zero-Emissions

ZE Taxiing Technology Timeline

- 8-year phase in timeline between 2030-2037
- Apply to narrow-body aircraft at Qualified Airports only

Date	Requirement
Dec 31, 2031	1 technology available on-site
Jun 1, 2032	1 weekly movement of loaded aircraft (passenger or freight)
Jun 1, 2033	10% of Capable Target aircraft departures are ZE taxied
Jun 1, 2035	50% of Capable Target aircraft departures are ZE taxied
Jun 1, 2037	100% of Capable Target aircraft departures are ZE taxied

Technology Classifications

- Onboard technologies – housed onboard aircraft, may require reconfigurations
- External technologies – equipment separate from aircraft, does not require aircraft reconfigurations
- Either technologies can be used to meet the ZE taxi targets above

Seeking Feedback for Draft Taxiing Concepts

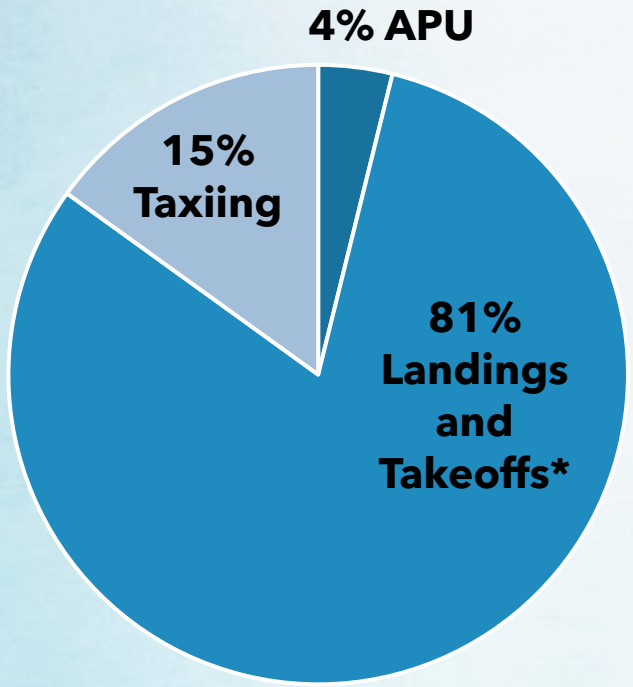
Airports and Airlines

- What fraction of California flights in or out use single-engine taxiing?
- Do you have remaining concerns regarding implementation?
- What other taxiing emission reduction strategies would be worth exploring?
- What mechanisms have airports used in the past to promote or incentivize airlines to use new procedures or technologies?
- If onboard technologies are certified soon, would your airport prioritize onboard or external technologies?

Communities and Other Stakeholders

- What are your thoughts on ZE taxiing implementation?
- Are there ideas for other ways to reduce taxiing emissions?

Emissions from Aircraft Landings and Takeoffs



Data Source: NOx Emissions in 2023 at LAX
*Accounts for emissions within the mixing height, under the nominal boundary layer of 3,000 feet.

Challenges:

- International and federal emissions standards for aircraft engines are *technology-following*
- Aircraft engines have shown little NOx reduction over time, despite federal standards and technology development
- Zero-emission technology for large, long-haul, commercial aircraft is still decades away

Photo: https://www.airbus.com/en/products-services/commercial-aircraft/passenger-aircraft/a320-family

Near-Term Strategies to Reduce Emissions from Takeoffs and Landings

This is not a list CARB intends to pursue, but actions that are already being done or could be done by anyone in the aviation industry to reduce emissions

Purchases

New purchases with lowest-emissions engines

e.g., FAA's CLEEN program, LEAP engine

Routing

Route cleanest aircraft in fleet to emissions-burdened areas

e.g., airport differentiated landing fee programs

Flight Procedures

Optimize procedures during landing and takeoffs

e.g., de-rated takeoffs, continuous descent arrivals

Spending Account

Dedicated funds to use solely for aviation technologies that reduce emissions

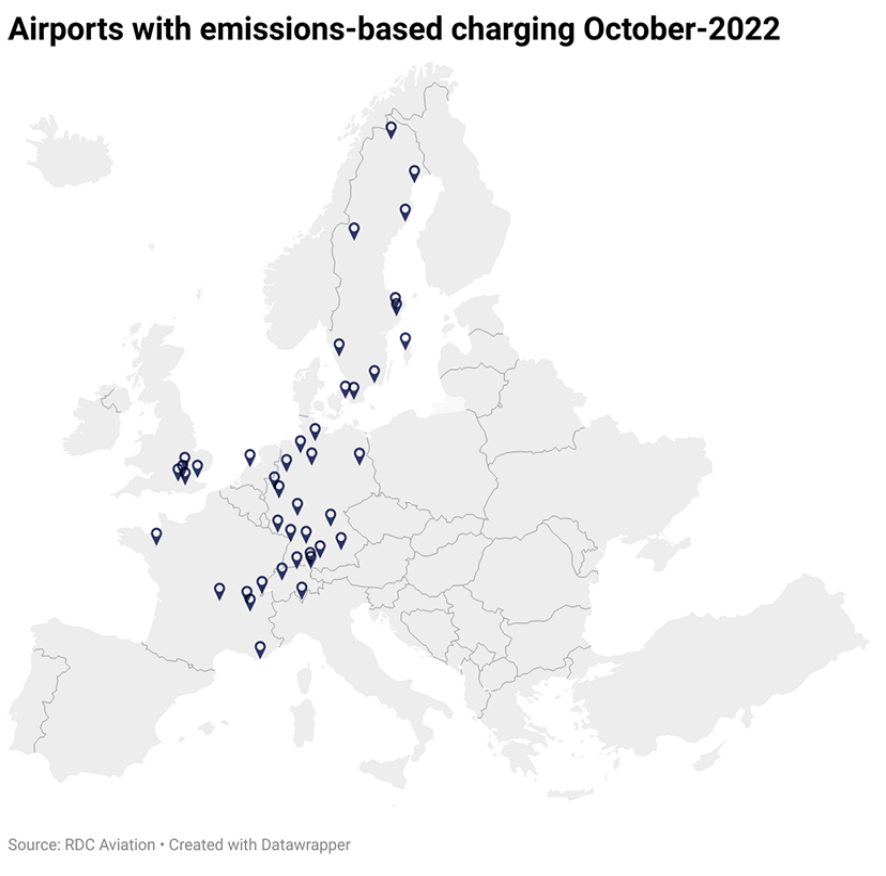
Leveraging Airport Landing Fees

- Airports impose charges on aircraft operators for using their facilities to land
- For example, at LAX in 2024, landing fees were $6.40 per passenger aircraft per 1,000 pounds

Example landing fees at LAX for narrowbody aircraft in 2024

Aircraft	Maximum Gross Landing Weight (lbs)	Landing Fee (USD)
Airbus A320	142,198	$910.07
Airbus A320 NEO	148,591	$950.98
Boeing 737-800	143,984	$921.50
Boeing 737 MAX 8	152,800	$977.92

European airports have adopted emissions-based landing fees



- *Higher* landing fees on aircraft with *higher* emissions
- *Lower* landing fees on aircraft with *lower* emissions
- Mostly NOx based, but some CO_2-based fees
- Promotes adoption and deployment of lower-emitting aircraft

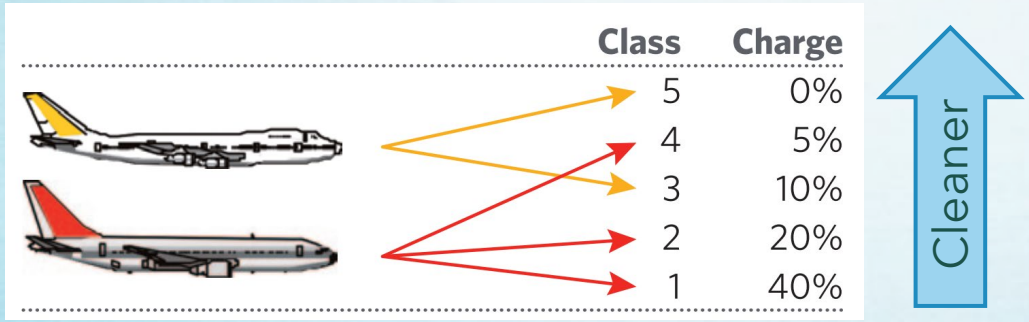
Differentiated Landing Fee Approaches

Model 1

Revenue-Neutral

Aircraft engines are ranked into 5 classes.

Aircraft class with the lowest emissions would receive discounted landing fees, while classes with higher emissions would have a surcharge

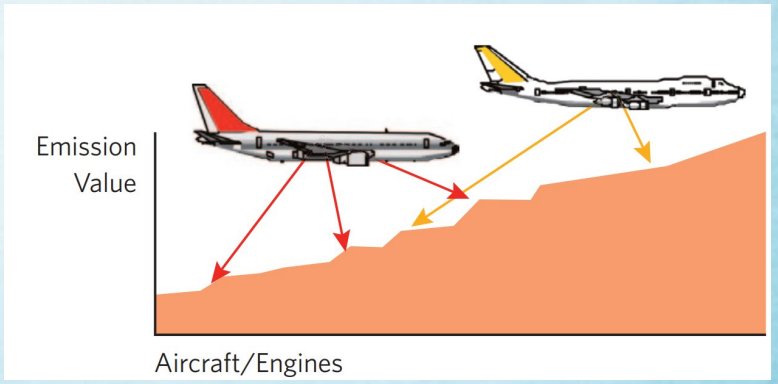


Model 2

Polluter Pays

Each engine is assigned an Emission Value based on NOx certification data

The emissions charge is calculated as (Emission Value) x (Emissions Tariff, e.g., 1.56 EUR)

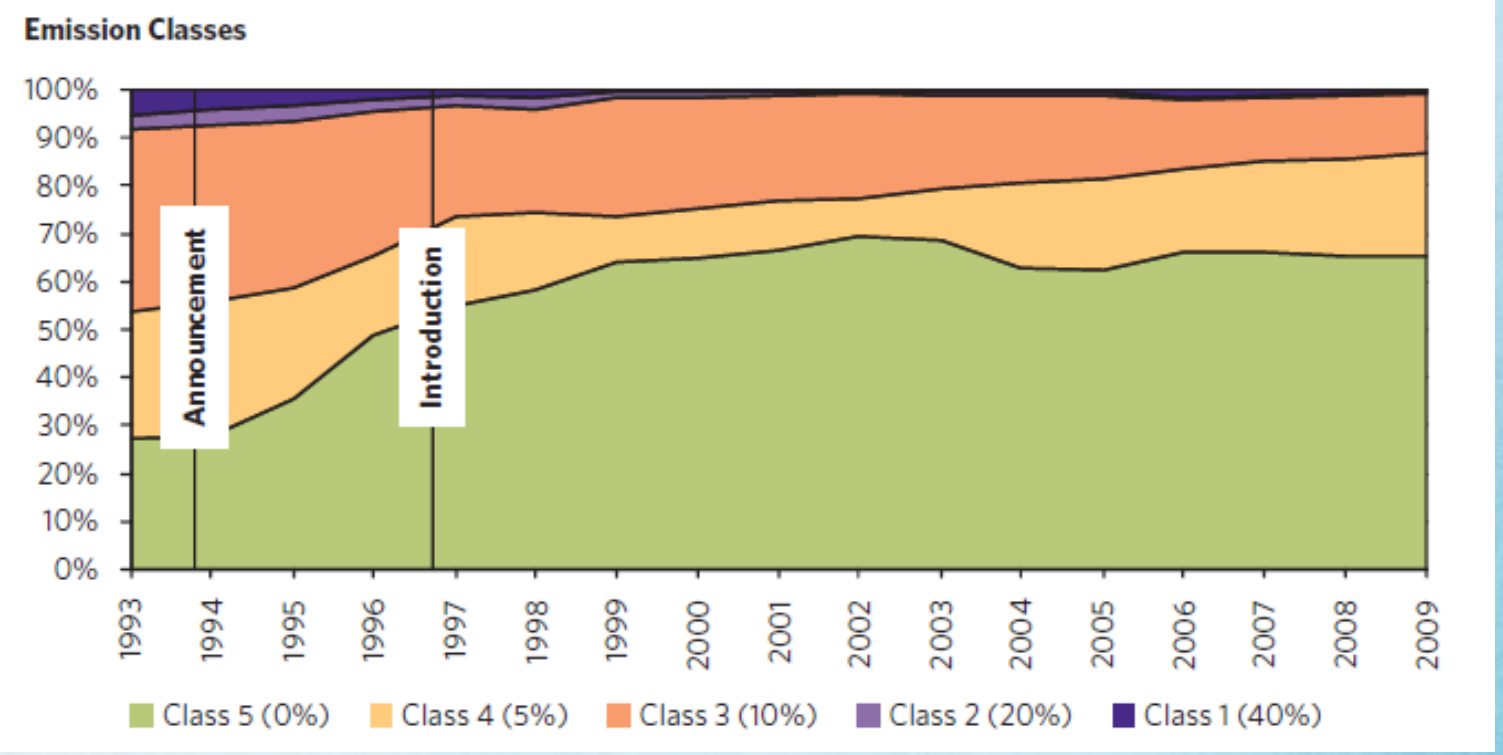


Aircraft Emission Charges, Zurich Airport (2010).

Emissions-Based Fees at Zurich Influenced Aircraft Purchasing Behavior of Airlines

Operations using the cleanest technology increased from 55 to 85% of all movements from 1993 to 2009.

Use of highest emitting engines decreased from 8% to 1% over the same time period



Aircraft Emission Charges, Zurich Airport (2010).

Example NOx-based Landing Fees at Zurich Airport

Airbus A319 NEO

Emission Value: 7
Landing Charge: 567.40 CHF
Noise Charge: 0
Emission Charge: 17.50 CHF

NOx per visit: 6,073 g

Boeing 737-200

Emission Value: 18
Landing Charge: 567.40 CHF
Noise Charge: 2,000 CHF
Emission Charge: 45.00 CHF

NOx per visit: 6,484 g

Boeing 777-300ER

Emission Value: 65.8
Landing Charge: 1,817.80 CHF
Noise Charge: 400 CHF
Emission Charge: 164.50 CHF

NOx per visit: 42,840 g

*NOx per visit = Sum of NOx (g) per arrival and departure, based on CAI2024

Differentiated Landing Fee Program

- California airports would be required to set or modify landing fees based on each aircraft's NOx emissions per visit
- Would only apply to newly acquired aircraft beginning January 1, 2030
- Additional fee increases may apply when aircraft visit airports in ozone non-attainment areas and/or disadvantaged communities
- Revenue-neutral, which will require adjusting the fees over time as the fleet evolves

Targets, timeline, and structure for a potential differentiated landing fee program

Year	Target	Landing Fee Adjustment
2030	Baseline activity-weighted fleet-average LTO NOx emissions	Baseline landing fees
2035	10% lower than baseline	X_1% decreased fee for lowest-emitting engines 0% change for the median emitting engine Y_1% increased fee for highest emitting engines
2040	20% lower than baseline	X_2% decreased fee for lowest-emitting engines 0% change for the median emitting engine Y_2% increased fee for highest emitting engines
2045	40% lower than baseline	X_3% decreased fee for lowest-emitting engines 0% change for the median emitting engine Y_3% increased fee for highest emitting engines

More detailed definitions of baseline and targets will be posted and informed by stakeholder input prior to any proposal to the Board in 2027

Questions to Stakeholders

- For airports, what are your current landing fees?
  - How are your landing fees determined and what factors affect decisions to modify the fee amounts over time?
- What factors should CARB consider for developing potential statewide differentiated landing fee amounts?
  - Should the fees be structured based on emissions per landing and/or per passenger?
  - Should there be different fee categories by aircraft type (narrowbody versus widebody versus regional jet)?
- Under a differentiated landing fee program, how feasible is it to reroute aircraft with cleaner engines to airports in NOx burdened areas? What is the decision-making process to determine where specific aircraft get routed to?

Question and Answer (1)

- 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)

Emissions Inventory Updates

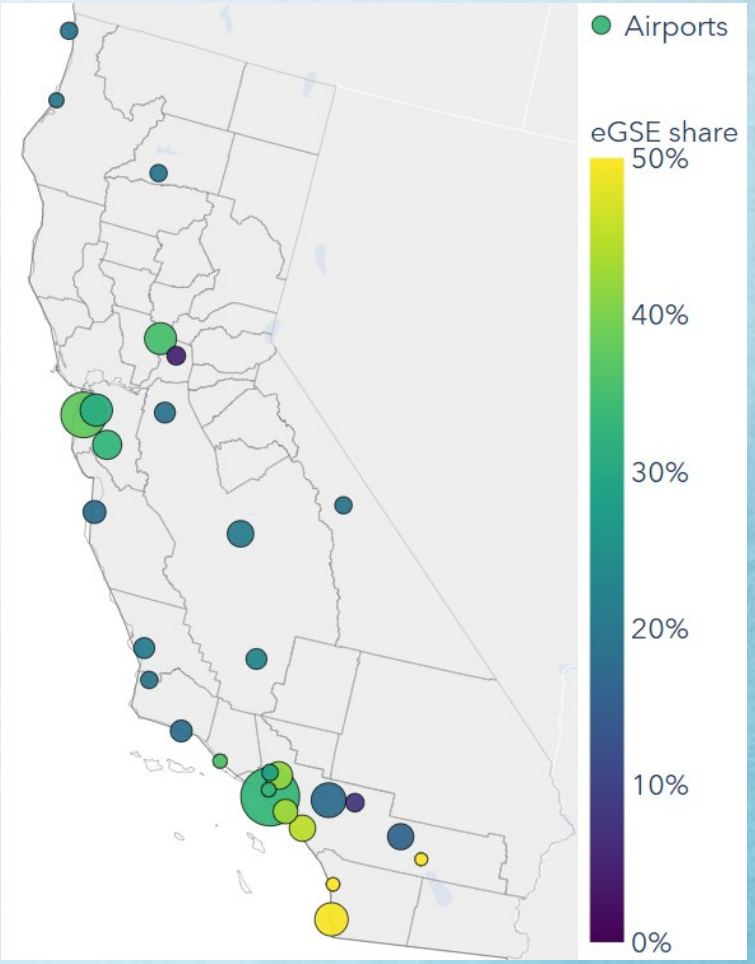
The Statewide California Aircraft Inventory: CAI2024

- 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 was completed in 2024 and is planned to be updated again around 2027 to support rulemaking.

CAI2024 Workshop presentation, October 2024

Purpose & Scope to Update Statewide GSE Inventory

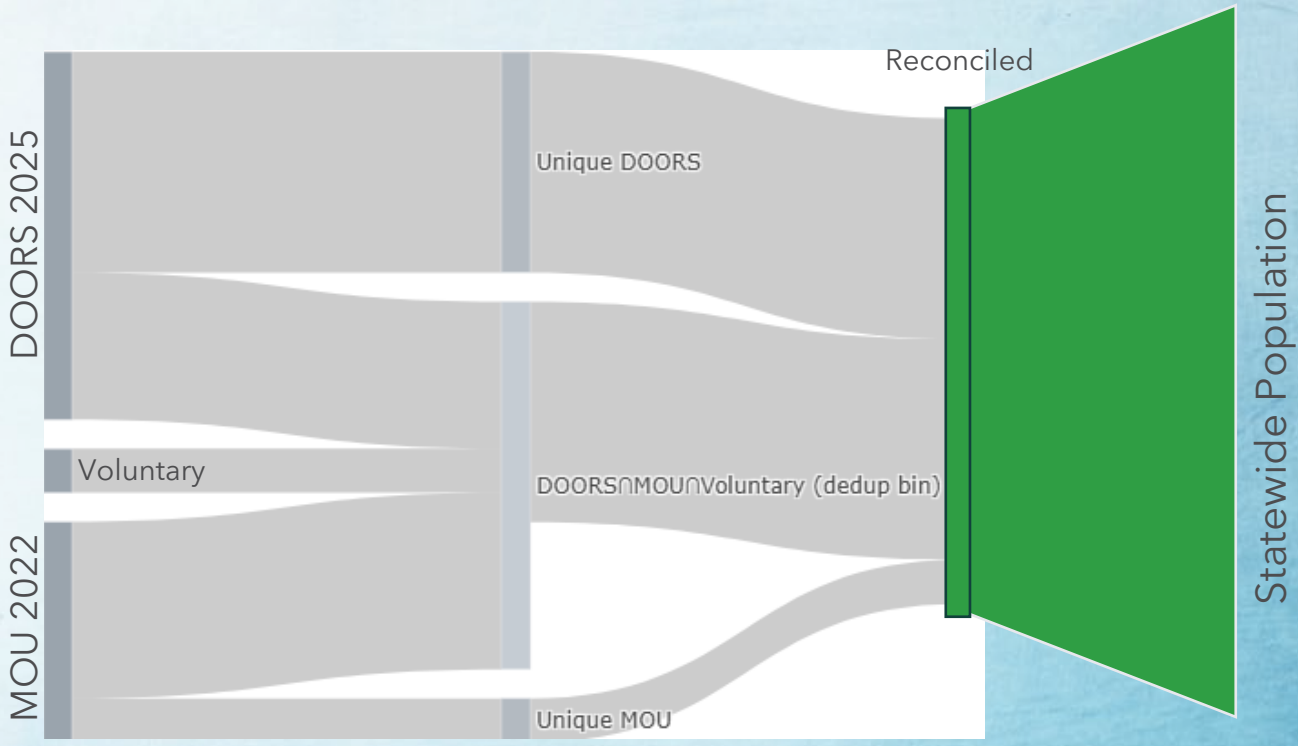
- **Baseline:** Airport GSE emissions inventory for 2025
- **Coverage:** 30+ airports; focus on 15–20 major airports.
- **Target Equipment:** Aircraft-servicing GSE; include tenants with airfield access: Airlines, GA handlers, cargo in scope.



Selected California Airports as an example – 2025 GSE Inventory
Bubble size = Total GSE | Color = eGSE share (0-50)%

Population

- **Fleet population:** DOORS 2025, SCAQMD MOU 2022, limited voluntary shares
- **Reconciliation**: cross-walk DOORS↔MOU to avoid double counting.
- **Scaling for data-poor airports**: start from MOU; adjust using operations↔GSE ratios observed at South Coast airports

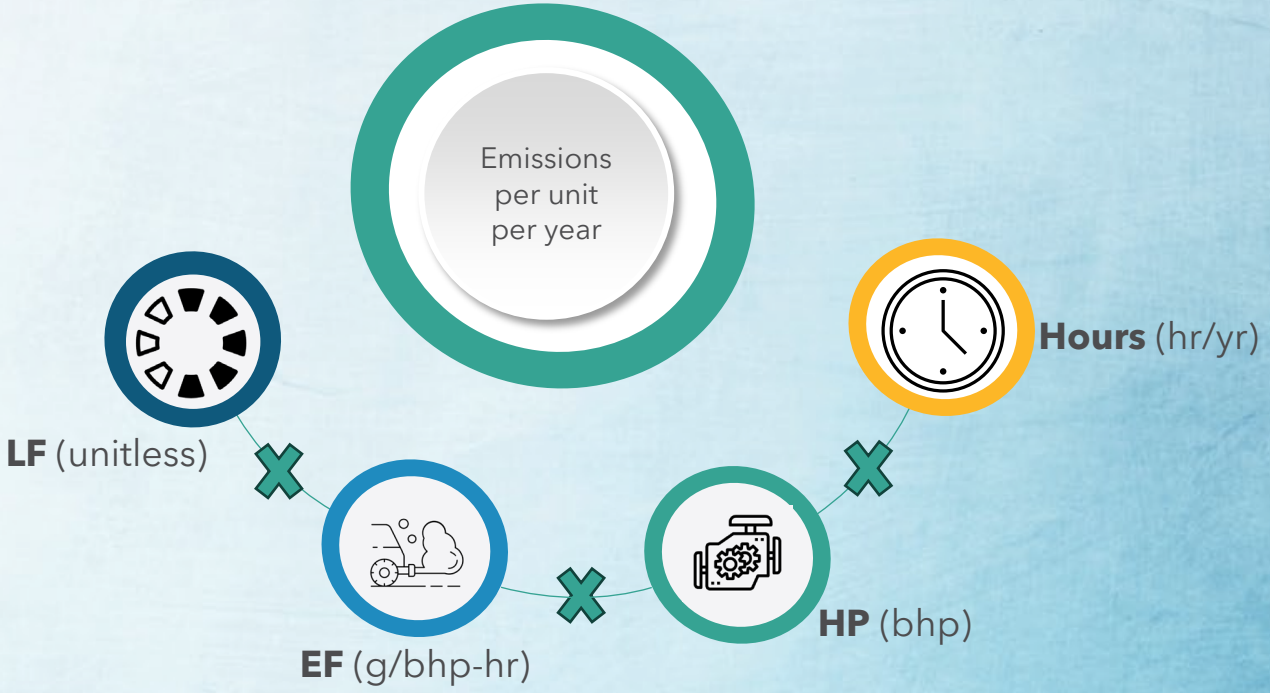


Activity Survey

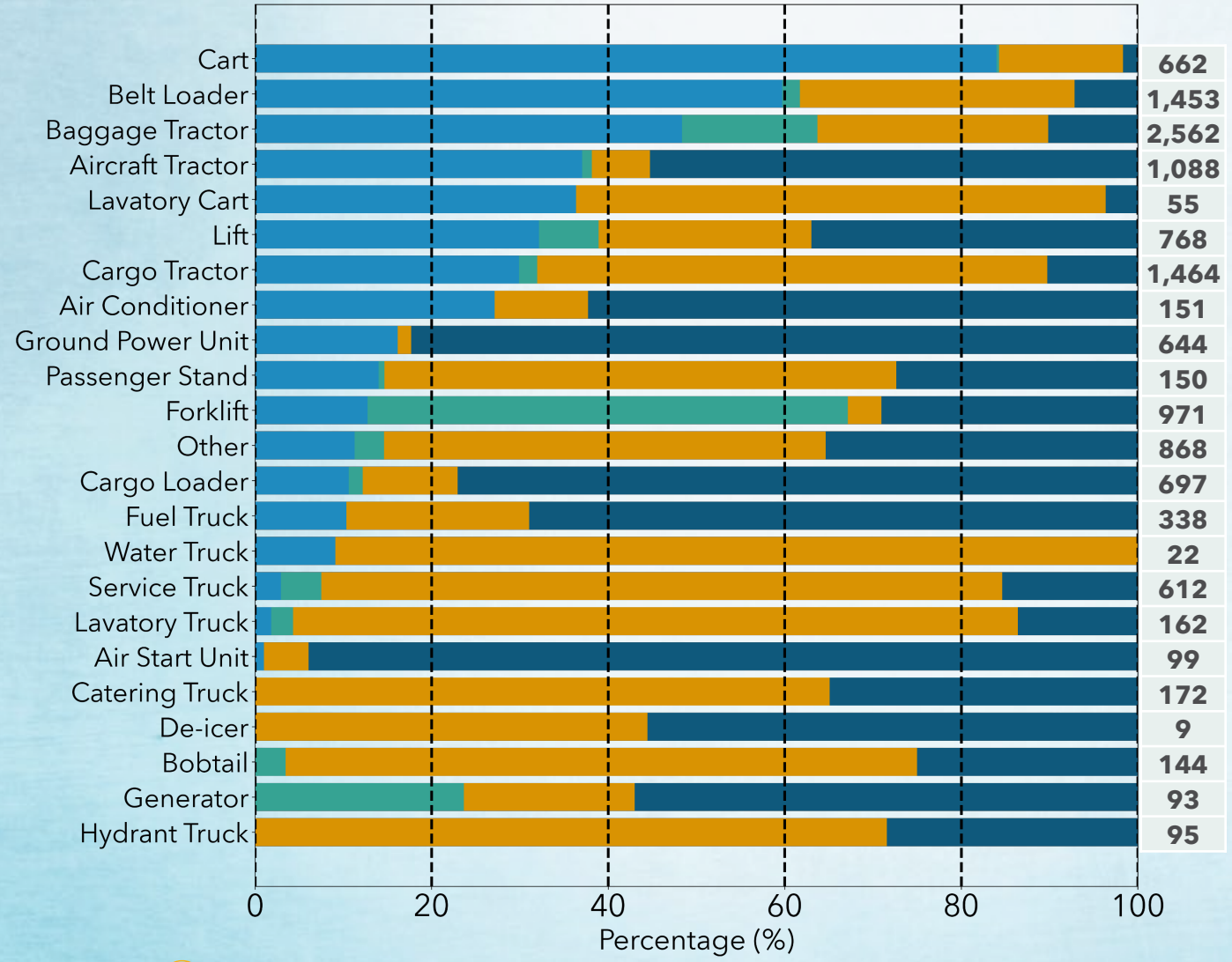
- CARB staff conducted a voluntary GSE activity survey, in collaboration with airports to improve statewide estimates of equipment, fuel use, and activity. The survey was distributed through **airport networks** and **CARB's GovDelivery notice**.
- Data collection concluded in **June 2025** with ~**700** responses, mainly from **third-party ground handlers.**
- Integrated survey data into the model where coverage was sufficient; several high-population types showed **higher average hours**.

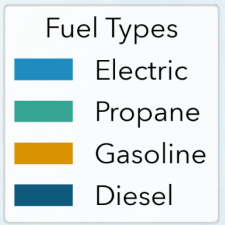
Emissions Calculation

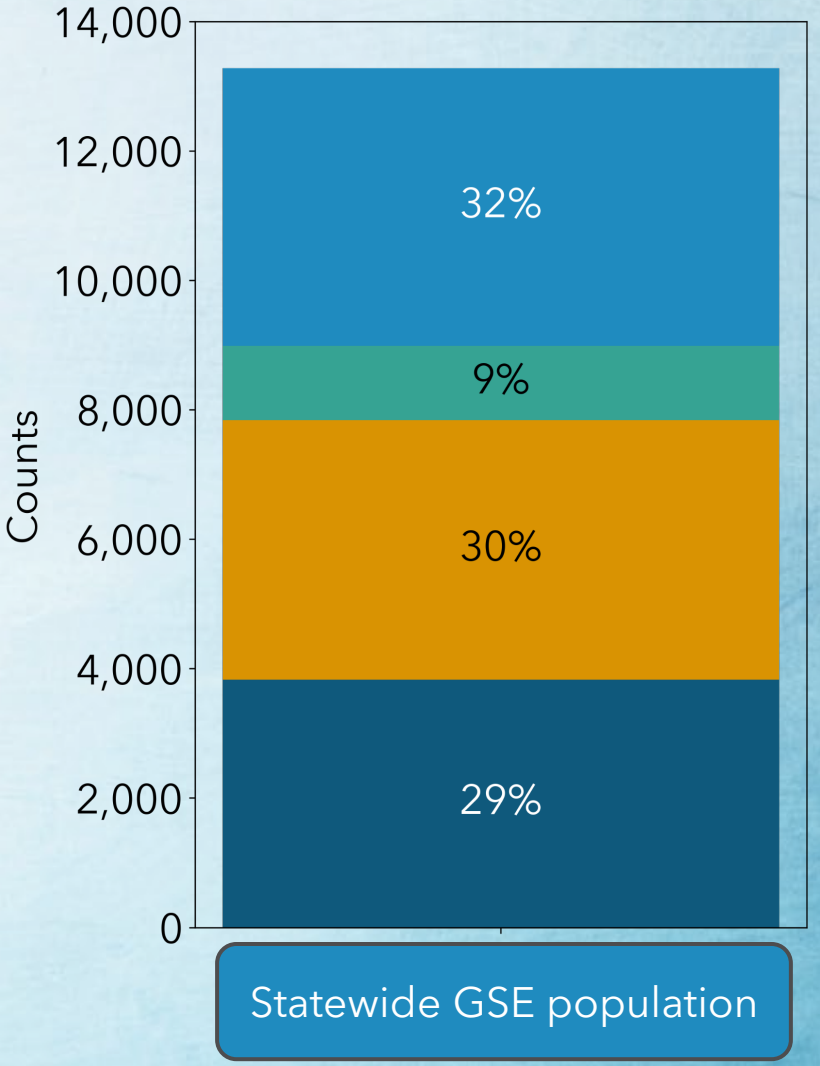
- Used a **bottom-up approach** with individual equipment records.
- Estimated total operating hours over each unit's lifespan to support **age/deterioration** adjustments.
- Filled gaps with **airport-level averages** to preserve differences across airports.



Fleet Characterization (2025)



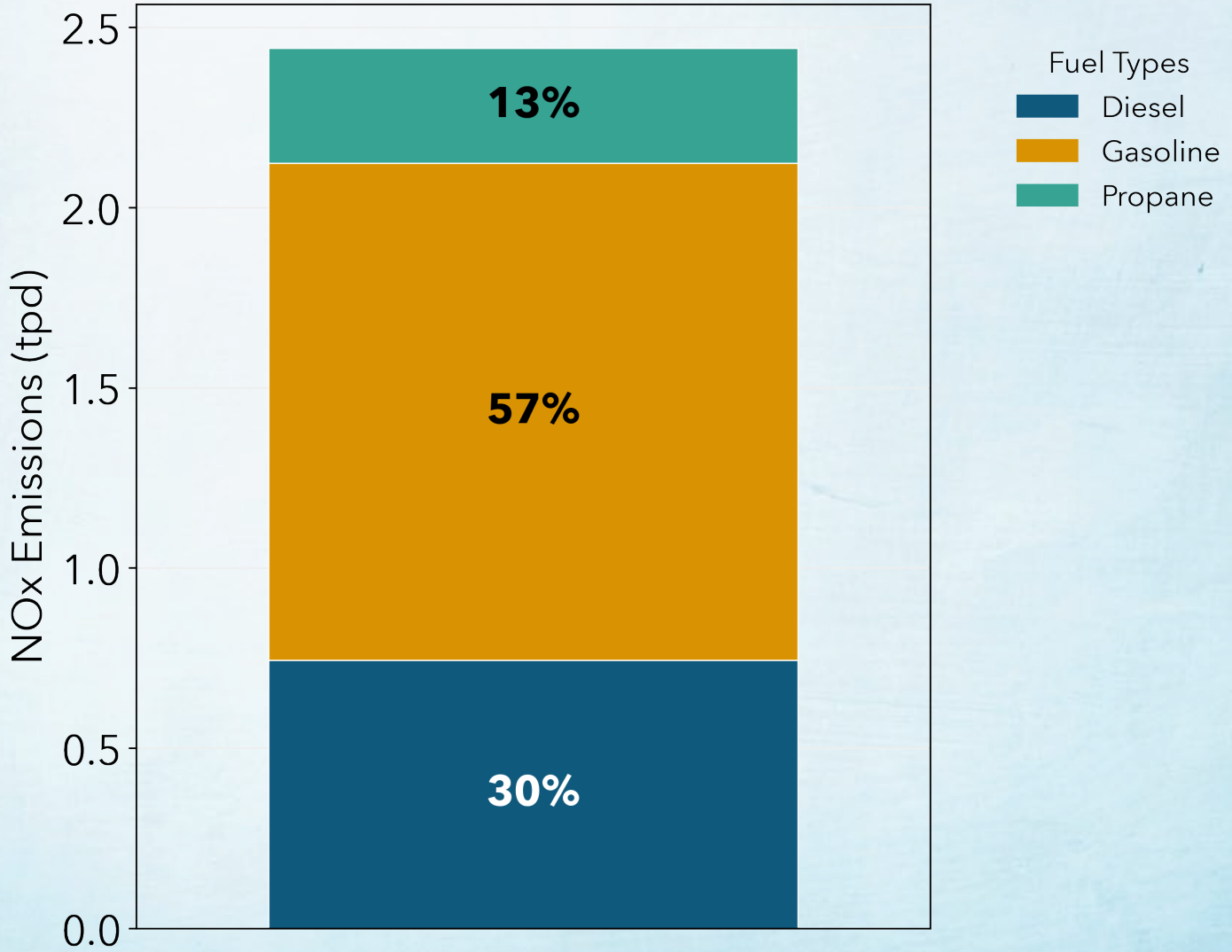




Statewide GSE population

CARB

Statewide NOx Emissions By Fuel



Forecast Model Structure

BY2025

Built on a 2025 base-year inventory.

Retirement

Natural retirements estimated from equipment age in the base year.

ORD Implementation

Applied compliance deadlines from the In-Use Off-Road Diesel Regulation (ORD) on their scheduled dates.

Growth

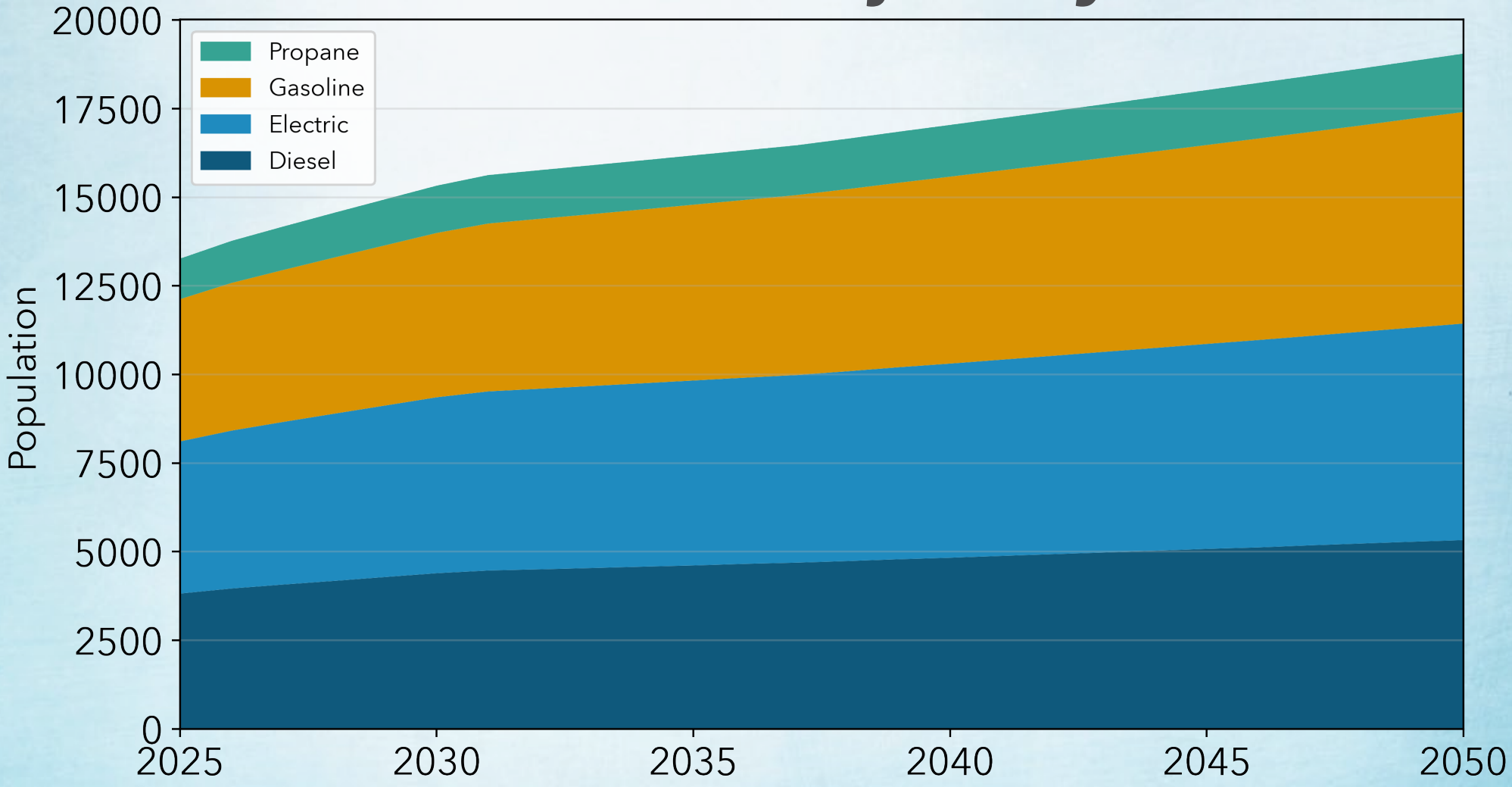
Growth aligned to CARB's CAI2024 operations outlook and translated to airport-level equipment totals.

*__Business-as-usual forecast:__ Emissions are projected under current regulations only; scenarios discussed earlier are not included, and no new regulations are assumed beyond those already in place.

Regulatory Context: the ORD Rule

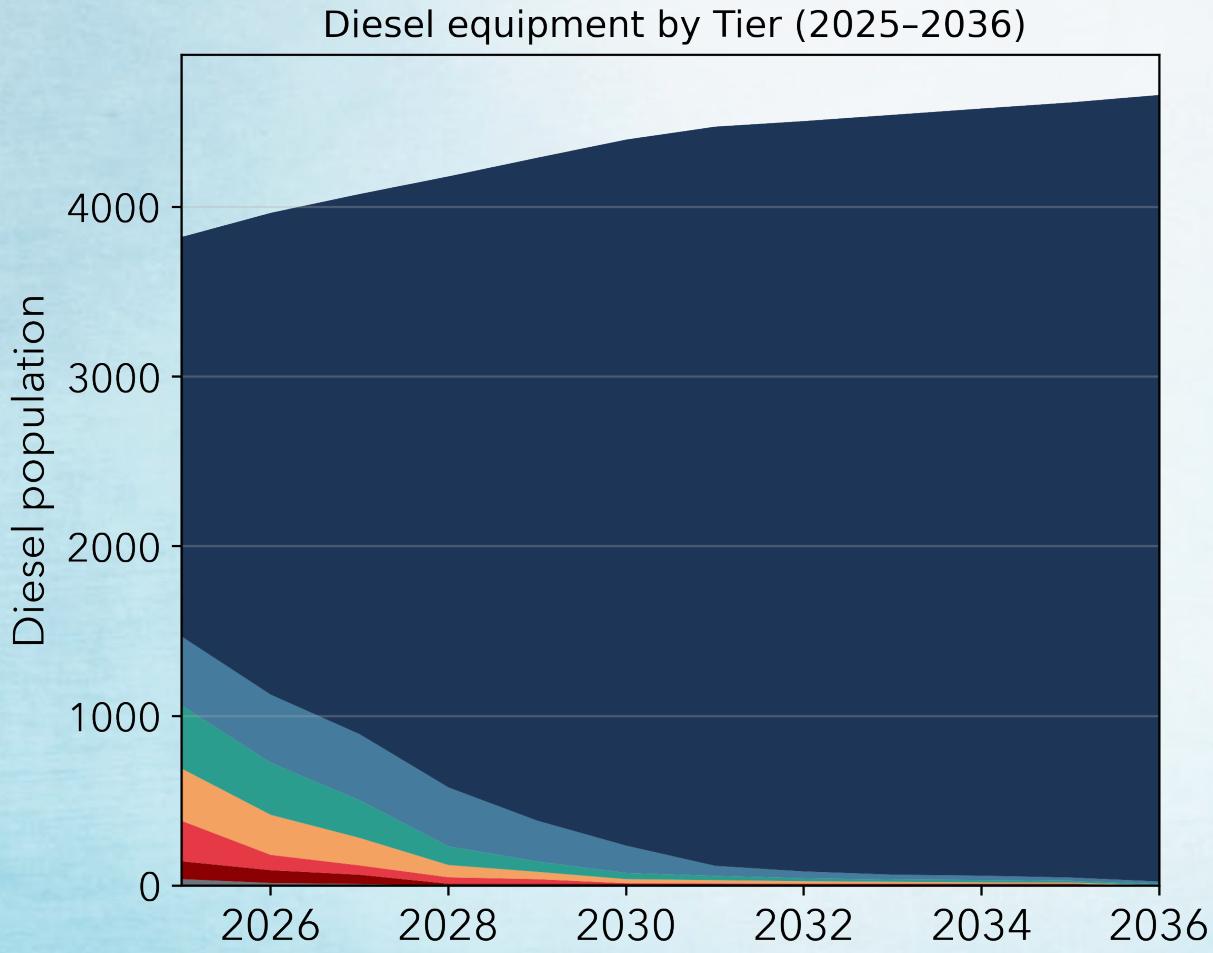
- Applies to **diesel equipment only** – new adds **should be Tier 4**.
- Distinguishes **permanent vs. non-permanent low-use** categories.
- **Deadlines** vary by ORD size class and Tier.
- Implements the **universal Tier-0-phaseout rule** – all Tier 0 units removed by **2036**.

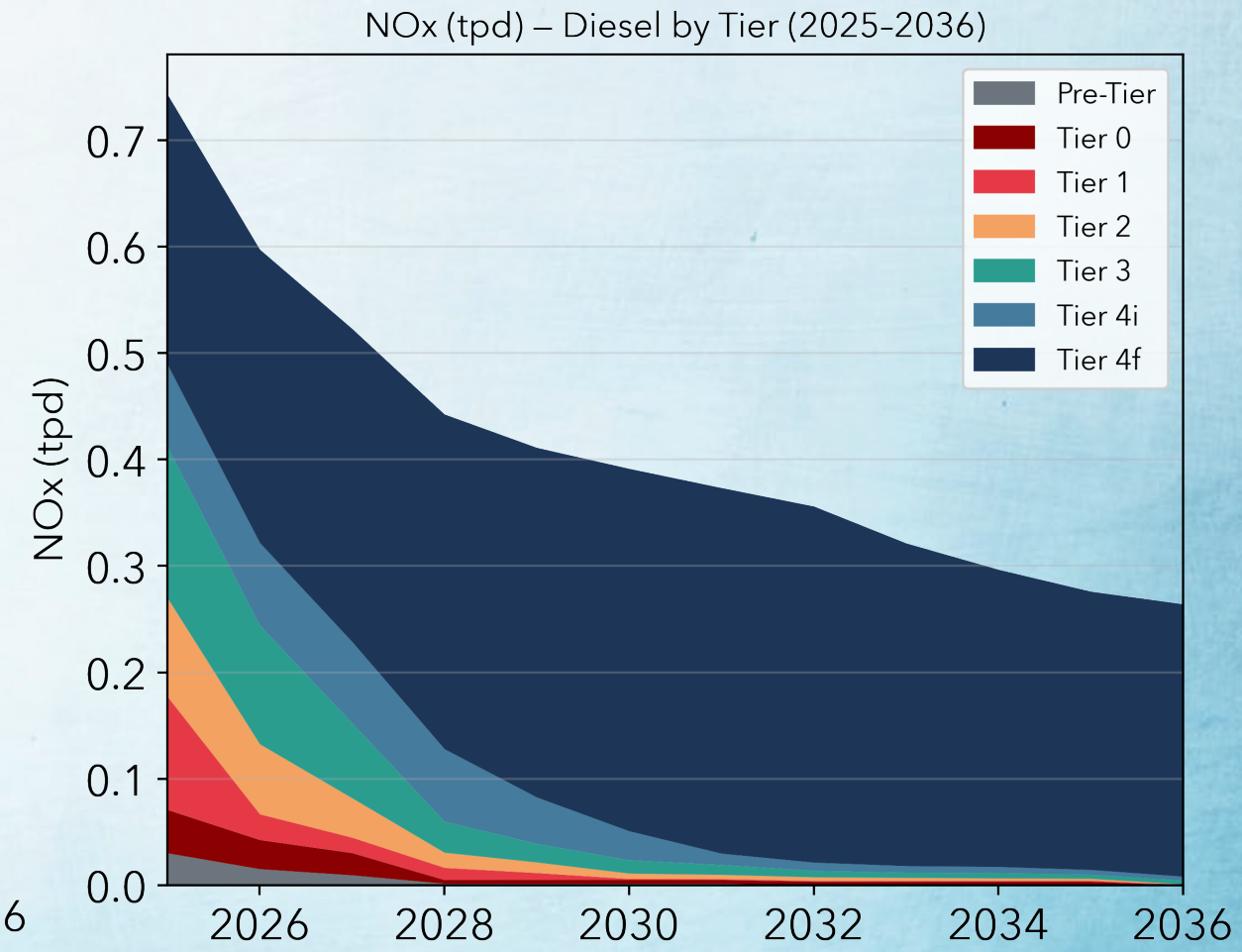
Fuel Mix Trajectory



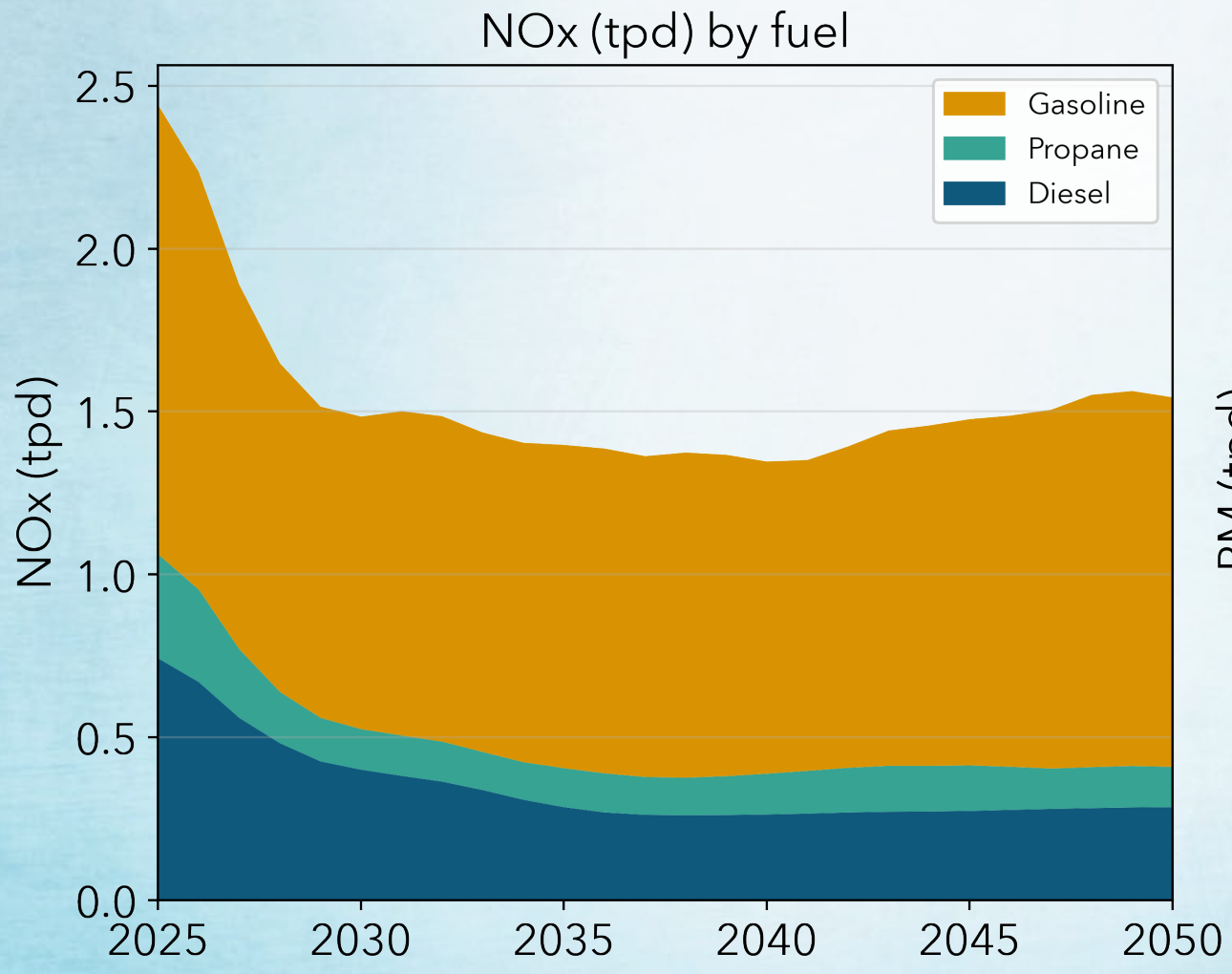
*Does not include SC MOU benefits after 2025

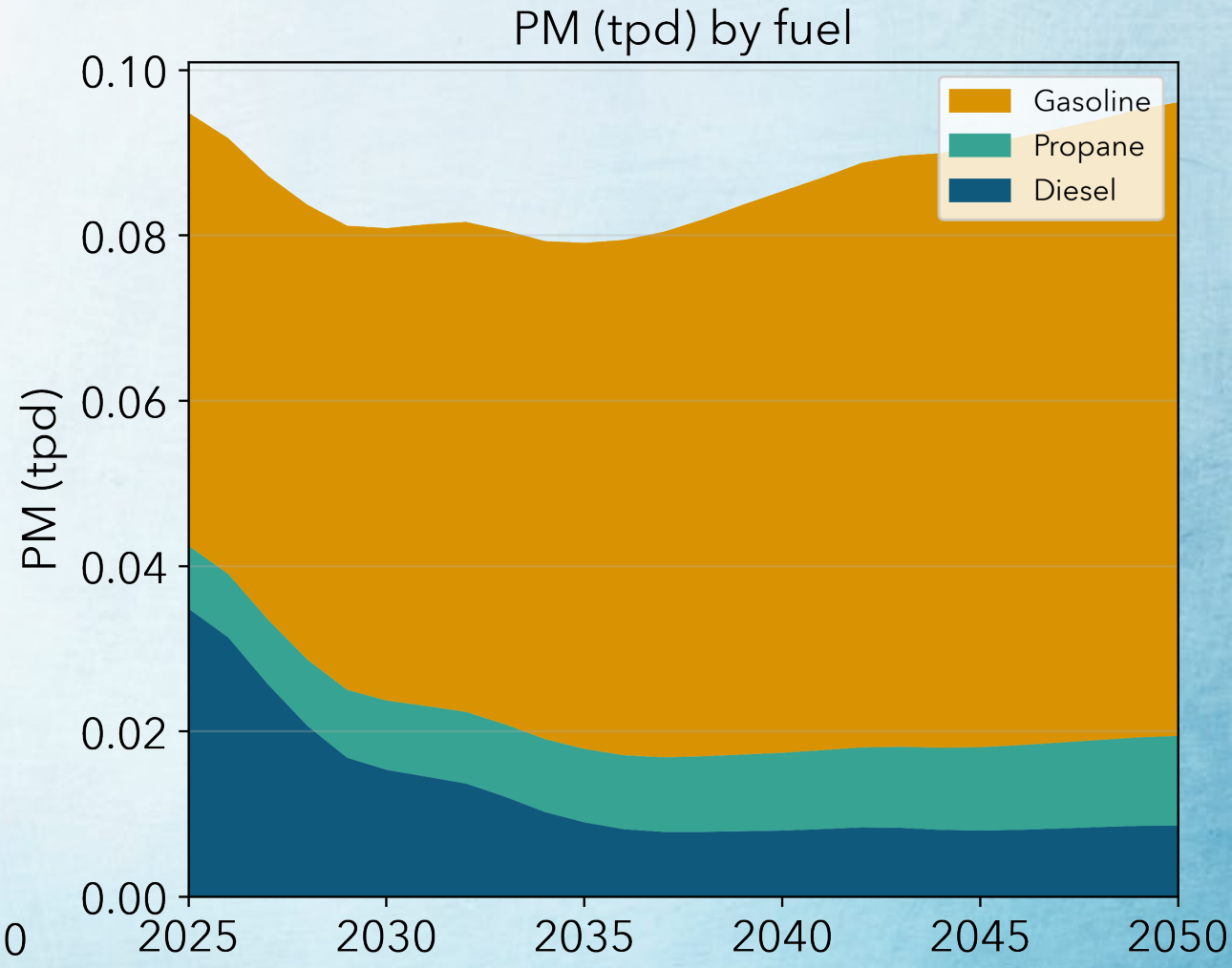
Diesel Trajectory and ORD Impact





Emissions by Fuel



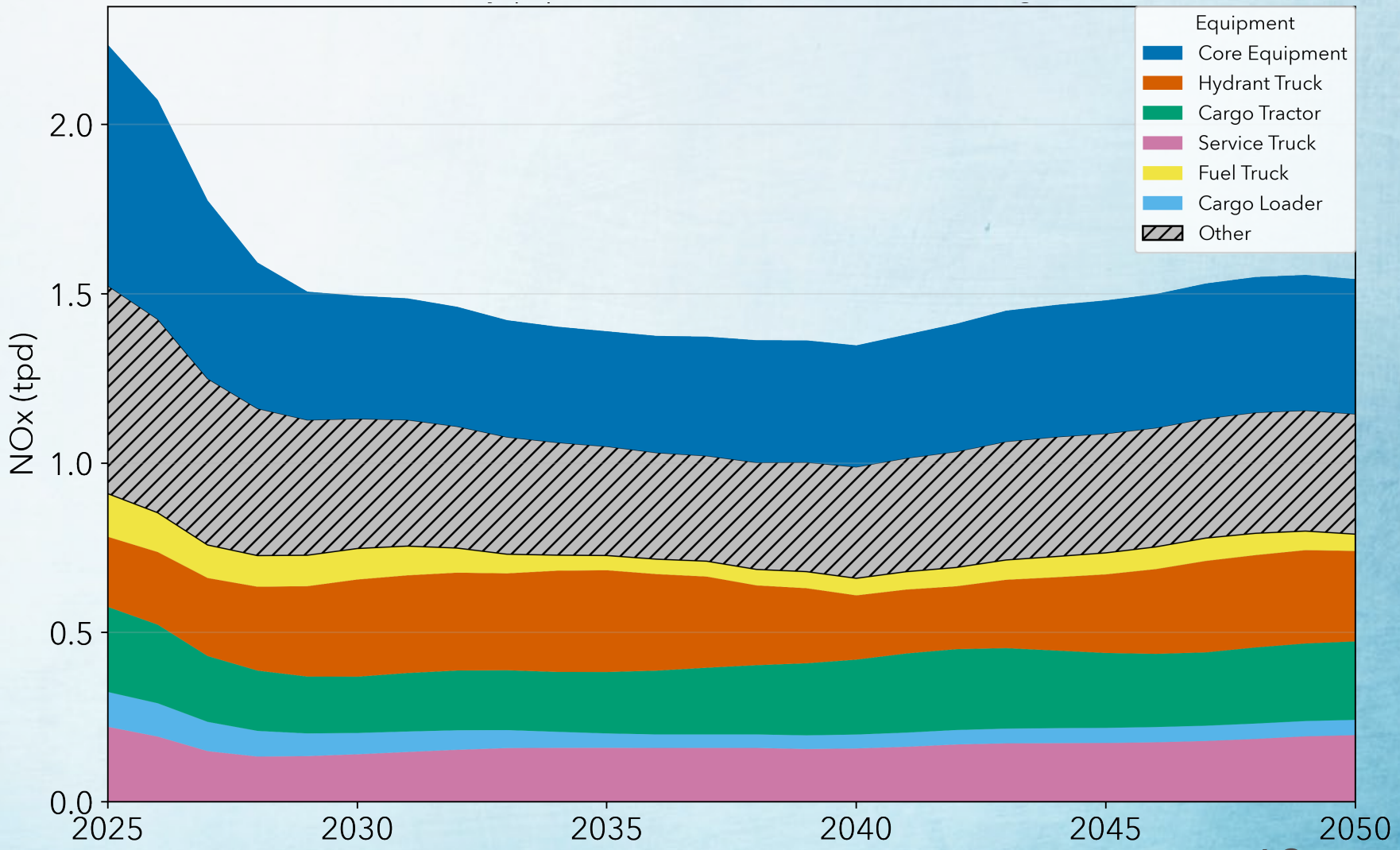


*Does not include MOU benefits after 2025

NOx by Equipment

Core equipment:

- Baggage Tractor
- Belt Loader
- Aircraft Tractor
- Cart



Stack ordered by |Δ| (least change at bottom)

Next Steps

- **Activity data:** If additional hours/load data come in, we'll integrate them; otherwise, we proceed with today's best-available inputs.
- **Truck-type GSE emissions:** Update current off-road emission factors with **on-road truck factors** while still counting these vehicles as GSE.
- **Emission factors:** Migrate to CARB's **load-dependent** factors based on Portable Emissions Measurement System (PEMS) data.
- **Policy analysis:** Use our **rules-based framework** to test potential GSE policy pathways.
- **Data refresh:** SCAQMD MOU inputs are from 2022 and will be updated. MOU Benefits are reflected in the base year but not yet in the forecast; we will work with SCAQMD to incorporate them.

Community Engagement

Background and Context

- Who is impacted and key communities involved
- How community engagement fits into the overall process

Current Status

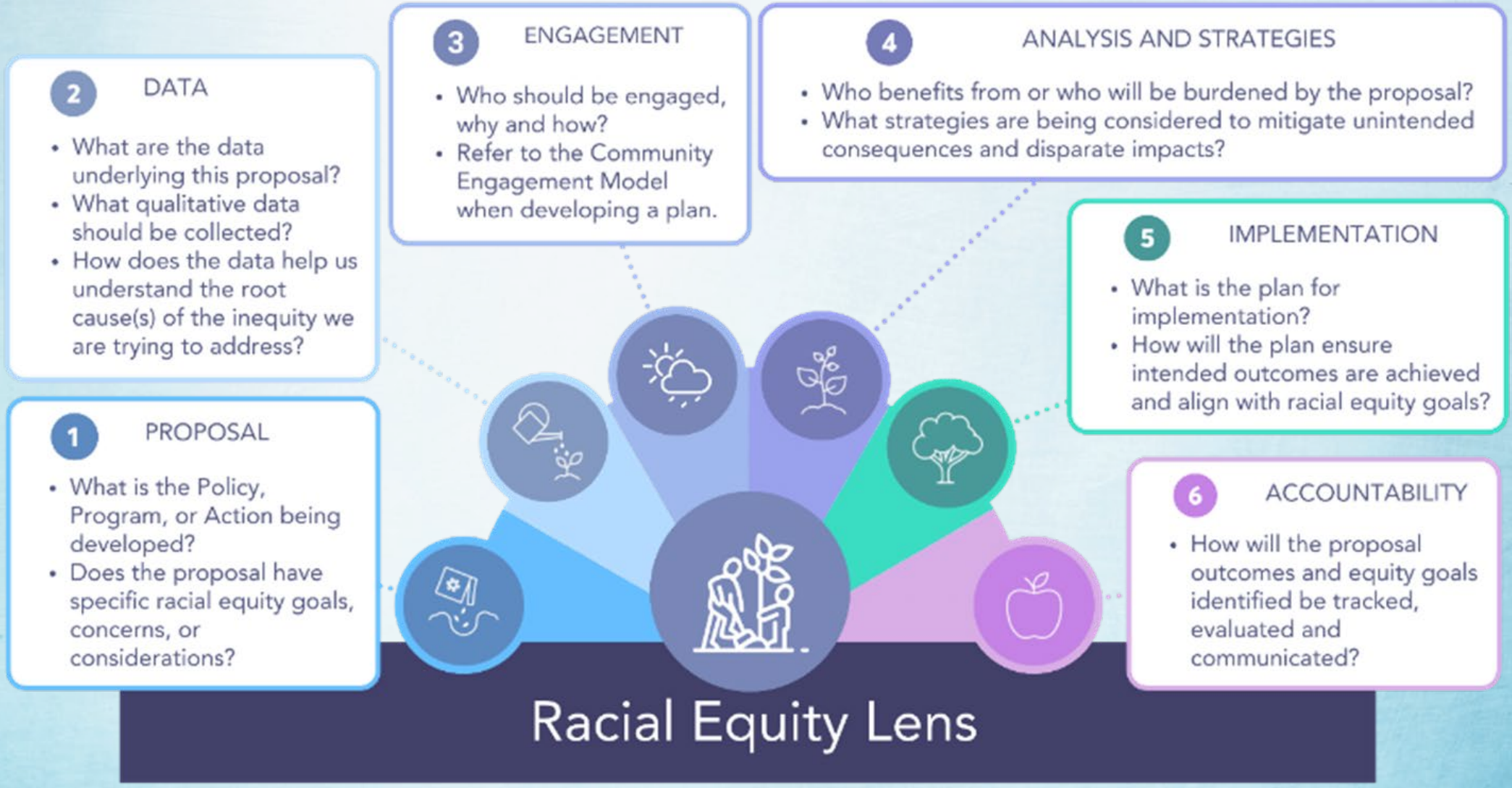
- Identified specific engagement goals
- Defined engagement scope, scale, and timelines
- Identified key stakeholders and developed an outreach strategy
- Held one community meeting and are planning additional engagements

How we developed this plan

Racial Equity Lens

- Data
- Community input

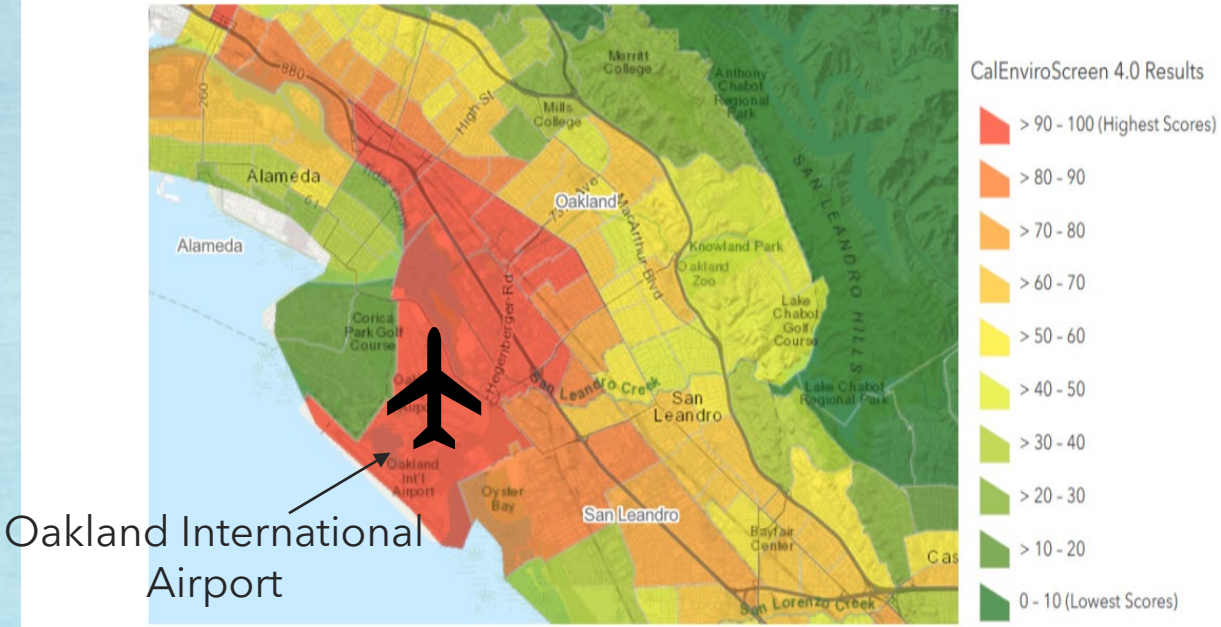
Racial Equity Lens



[About CARB's Racial Equity Lens | California Air Resources Board]

Community Engagement Efforts in SCAI

Figure 1: CalEnviroScreen 4.0 Map of East Oakland[1]



Racial Equity Lens

PROPOSAL

- Develop a regulation to reduce emissions from airport ground operations (GSE, APU, and aircraft engines)
- Reduce air pollution exposure and health risks for airport workers and adjacent communities

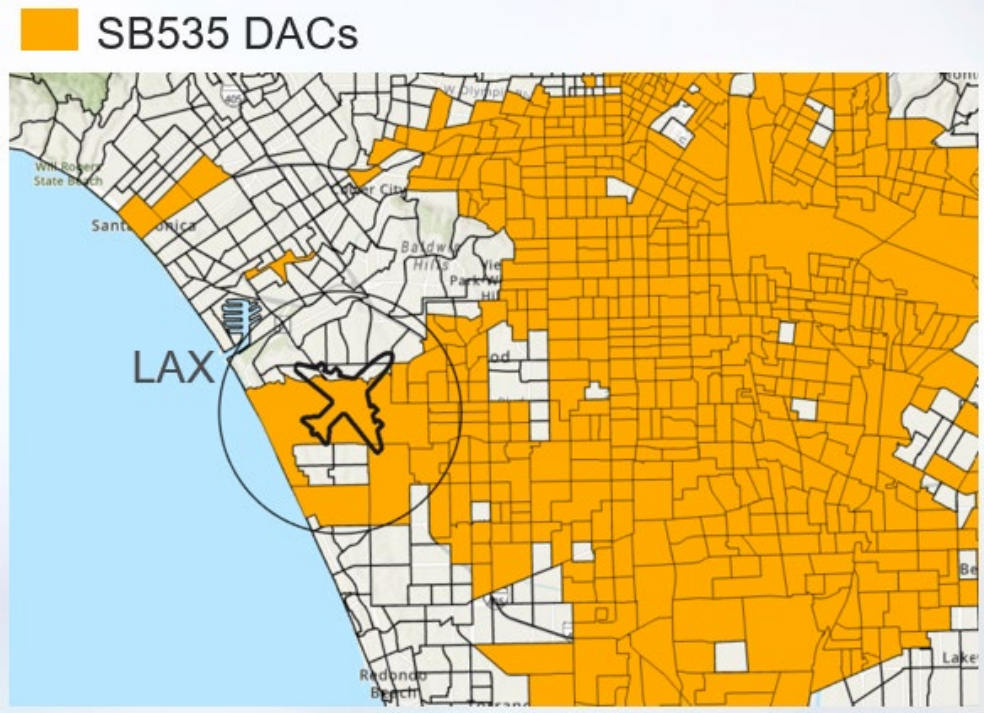
DATA

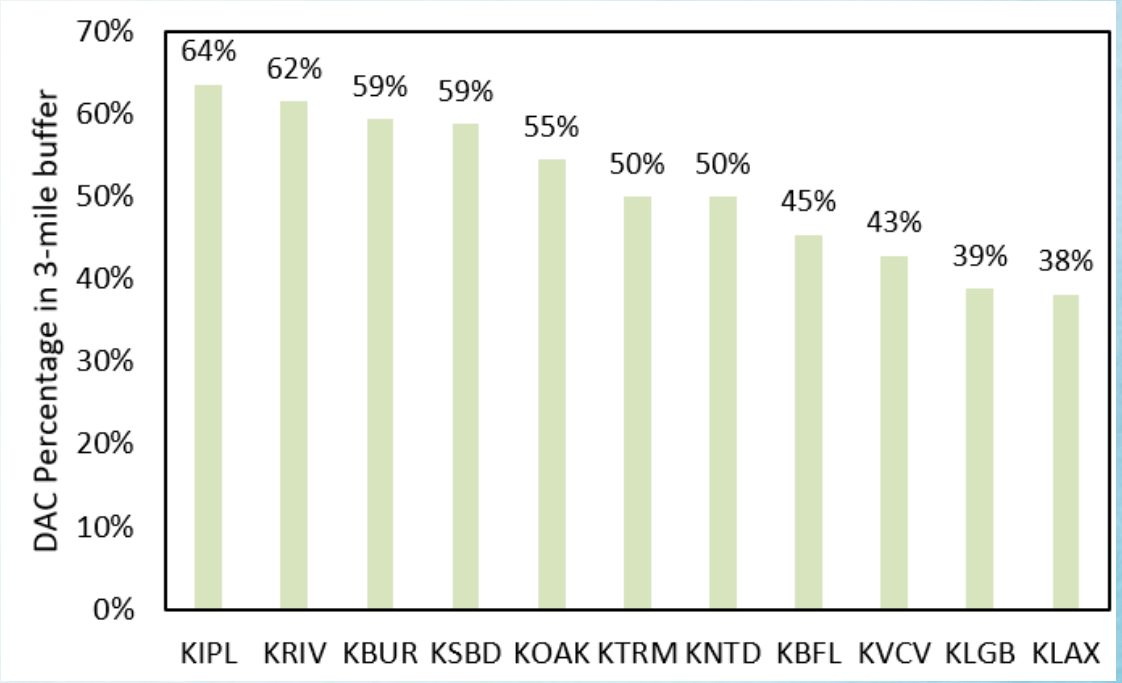
- Airport operations
- Feasibility of clean airport technology
- CalEnviroScreen
- Socioeconomic data, health outcomes

ENGAGEMENT

- Community-based organizations
- Communities living near airports
- Other government agencies
- General public

Prioritizing Reducing Emissions from Airports Surrounded by Disadvantaged Communities





Community Engagement Plan

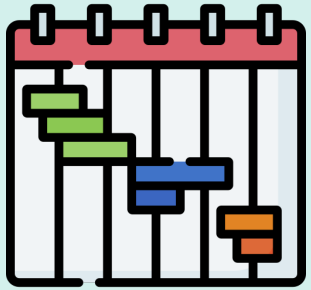
Engagement goals

1. **Provide comprehensive information** to stakeholders on the rulemaking
2. **Seek specific feedback** on issues that are most relevant to each stakeholder group
3. **Expand engagement** to include historically marginalized groups

1. Staff conduct quantification analysis and provide engagement support

2. Co-host/host listening/engagement sessions and public workshops

3. Implementation planning support



Preparation
2025 and 2026
Identify sources, audience, and conduct engagement

Board Consideration
2027 (expected)
Formal Administrative Procedure Act required Engagement

Potential Implementation (after Board Consideration)
Additional engagement

https://ww2.arb.ca.gov/our-work/programs/statewide-clean-aviation-initiative-scai/reducing-emissions-operational-practices

First Community Meeting

- Date: Oct 21st
- Format: online 10-minute presentation + live survey
- Attendance: ~90 participants
- Survey: ~35 responses

The major takeaway from the survey results:

- There are ~25% of people work or live very close to airports and will be directly impacted by our regulation
- ~70% of people are strongly supportive of our regulation development
- An additional 22% of people are supportive as long as the benefit outweigh the cost

Environmental Impact Analysis

- Environmental Impact Analysis (EIA) being prepared analyzing potentially significant adverse impacts caused by reasonably foreseeable actions.
- Meets requirements of CARB's certified program under the California Environmental Quality Act (CEQA).
- The CEQA Environmental Checklist (CEQA Guidelines Appendix G) is used to identify and evaluate potential indirect impacts.
- The EIA will be an appendix to the Staff Report.

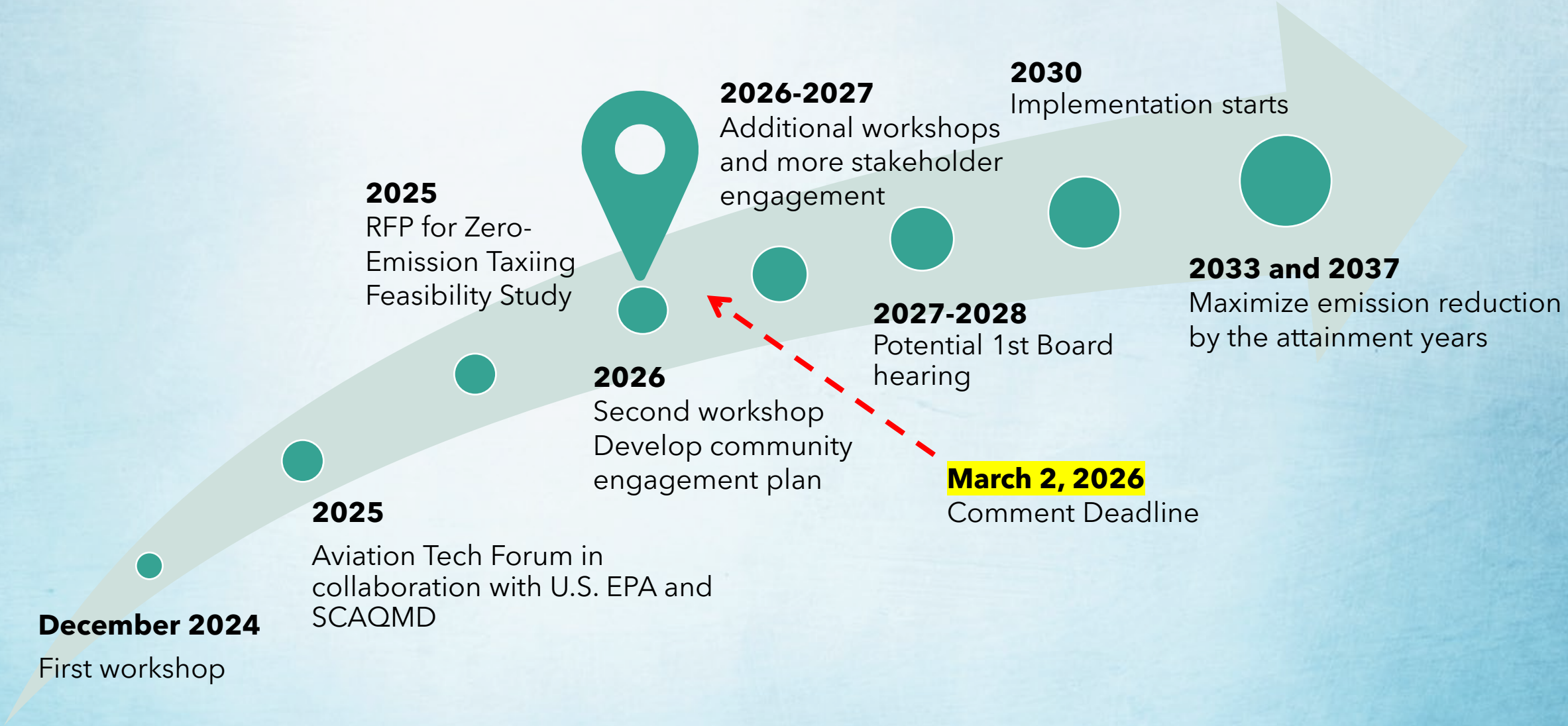
Environmental Impact Analysis

- The EIA will include:
  - Description of reasonably foreseeable actions taken in response to the proposal.
  - Programmatic level analysis of potential adverse impacts caused by reasonably foreseeable actions
  - Feasible mitigation measures to reduce/avoid significant impacts
  - Alternatives analysis
- Input invited at this early stage on appropriate scope and content of the EIA.
- Draft EIA will be released for 45-day public comment period.

Questions or Feedback being Requested

- Any data sources that can help with improving emissions inventory, cost, feasibility analyses.
- Feedback on draft concepts and potential alternatives
- 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
- Draft Concepts Document: **download here**

Next Steps


December 2024
First workshop
2025
Aviation Tech Forum in collaboration with U.S. EPA and SCAQMD
2025
RFP for Zero-Emission Taxiing Feasibility Study
2026
Second workshop
Develop community engagement plan
March 2, 2026
Comment Deadline
2026-2027
Additional workshops and more stakeholder engagement
2027-2028
Potential 1st Board hearing
2030
Implementation starts
2033 and 2037
Maximize emission reduction by the attainment years

Contact

- Mo Chen, Ph.D., Manager

  Mobile Source Technology Assessment and Modeling Section

  Mo.Chen@arb.ca.gov

  (279) 842-9577

Websites:

- CARB's Statewide Clean Aviation Initiative (SCAI) 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
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