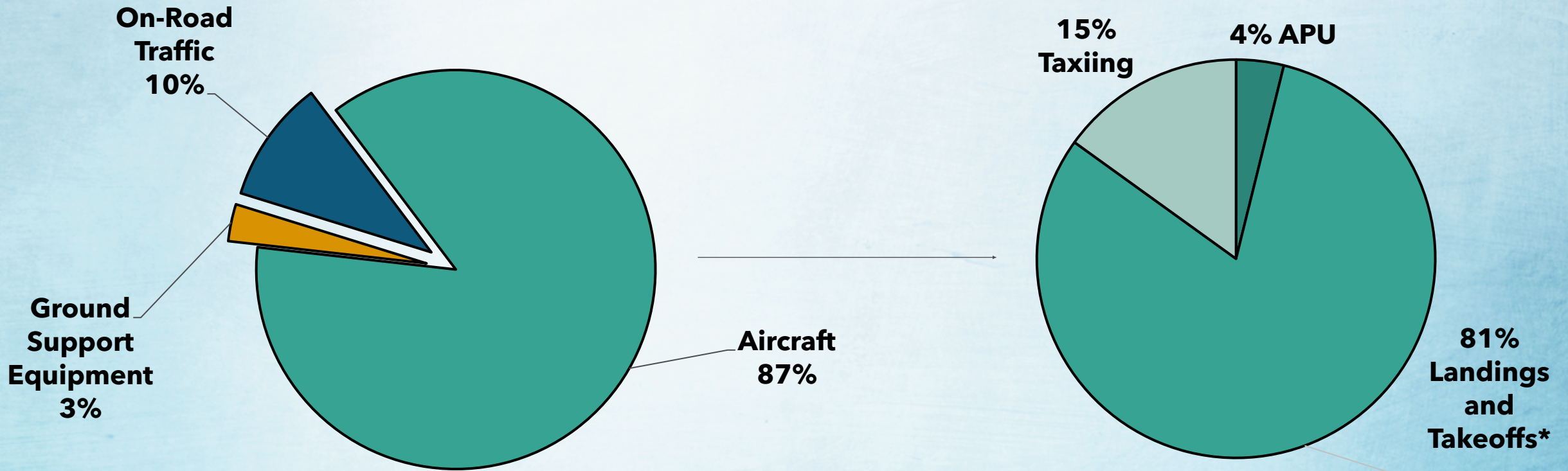




Operational Practices and Economics of Aircraft Routing

Introduction from Jack Johnson
March 2025

Contributions of Mobile-Source NO_x Emissions at Airports

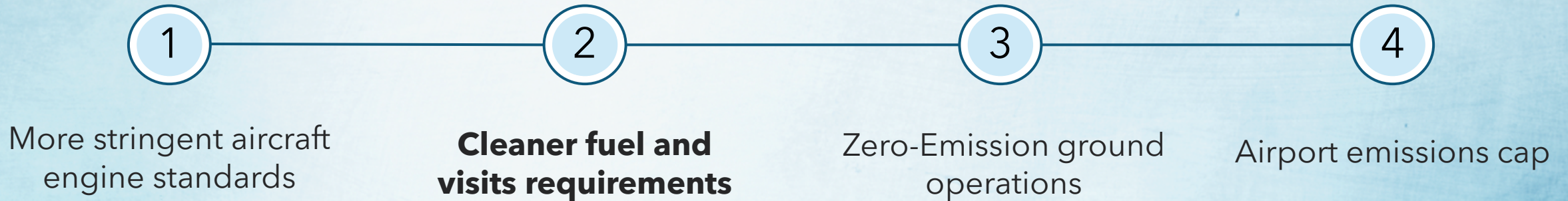


Source: NO_x Emissions in 2023 at LAX

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

Aircraft Commitments in 2022 State SIP Strategy

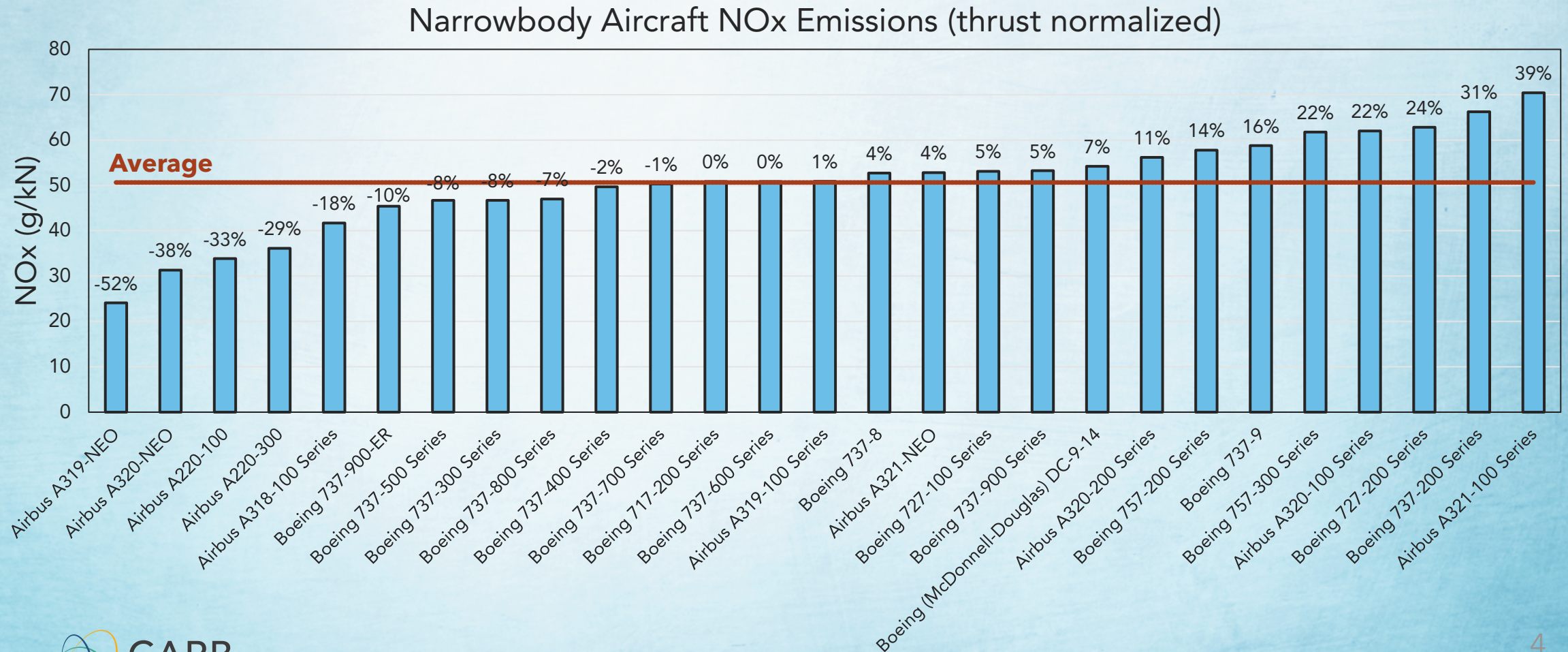
CARB committed to explore feasibility and authority, and to conduct advocacy to promote the following **federal** actions between 2021-2027 with CARB going to the board in 2027 with a progress update:



EPA has agreed to work with CARB and SCAQMD to explore the development of measures that use economic incentives at South Coast airports to prioritize use of aircraft with lower NOx emissions.

Lower Emission Takeoffs and Landings: Cleaner Visits

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

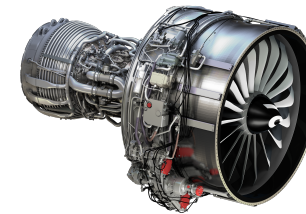


Lower Emission Takeoffs and Landings: Cleaner Visits

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

The Airbus A319-NEO uses two engines:

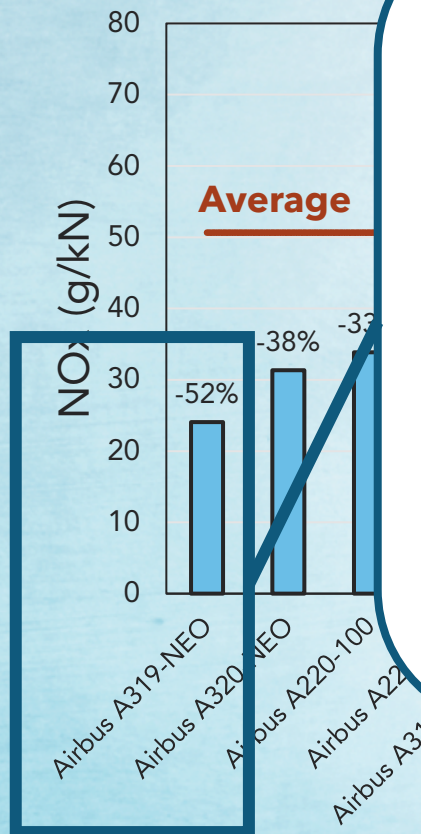
The **LEAP-1A** from CFM International and the **PurePower PW1100G-JM** from Pratt & Whitney. These engines achieve NO_x emissions 35-52% lower than the CAEP/8 emission standard.



LEAP-1A
(TAPS II combustor)

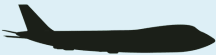




PurePower PW1100G-JM
(TALON X combustor)

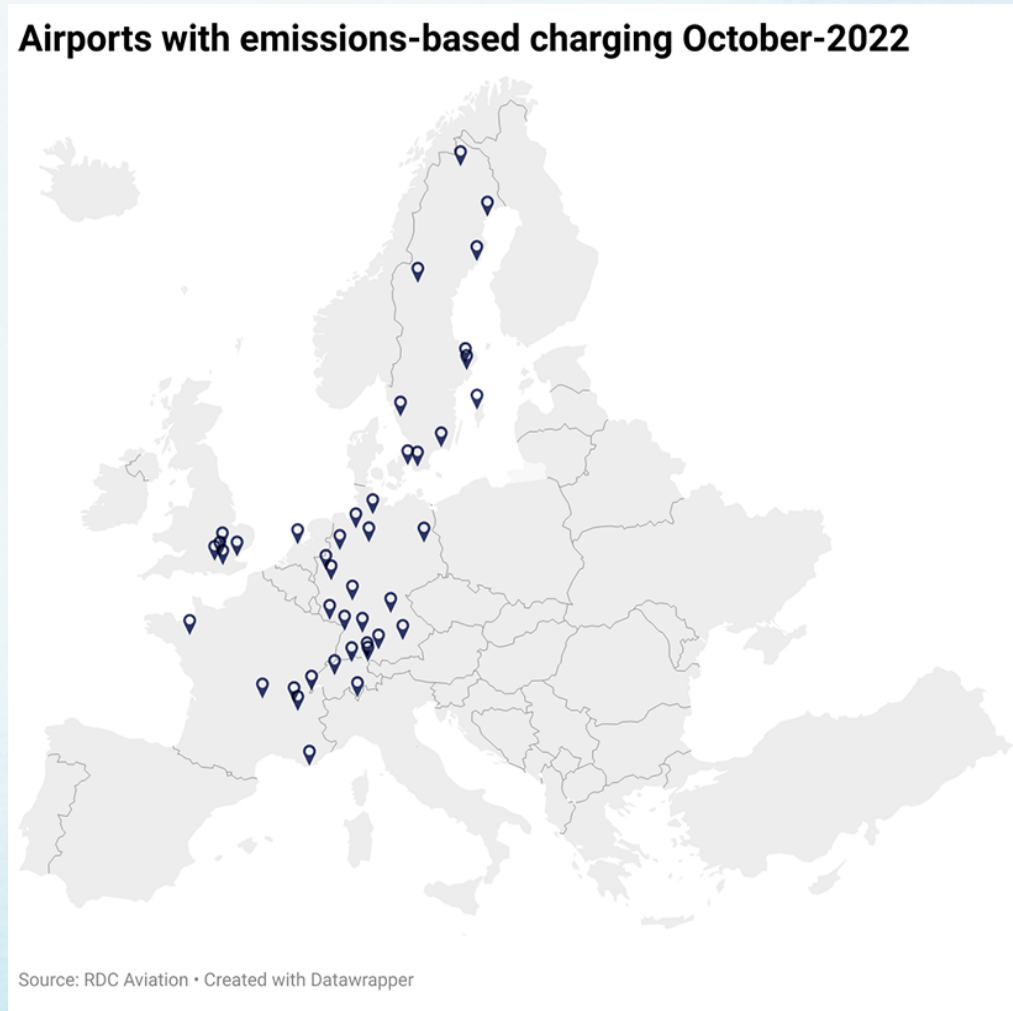


Reroute Aircraft with Clean Technology to Reduce NOx, and Use SAF to Reduce PM Emissions

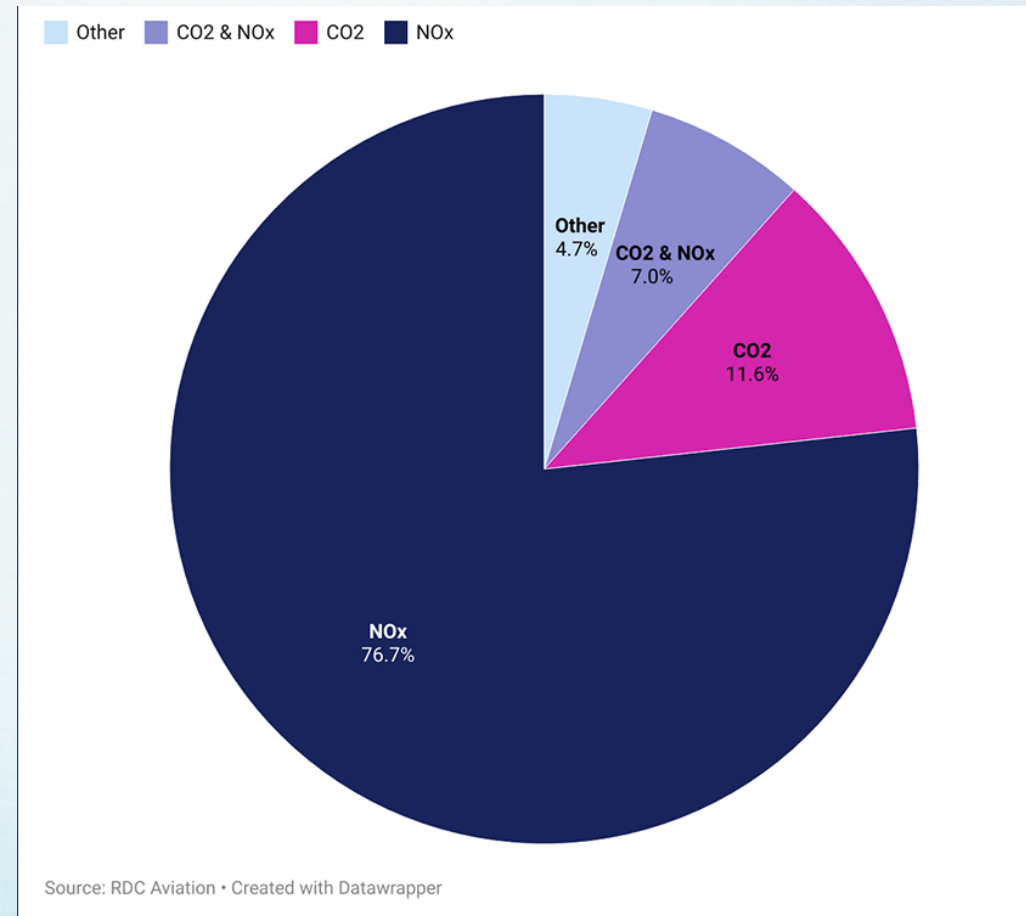
Based on engine certification data that manufacturers report to ICAO, we identify the following aircraft as the cleanest options among aircraft commonly visiting California

	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

European Airports Are Widely Adopting Emissions-Based Landing Fees

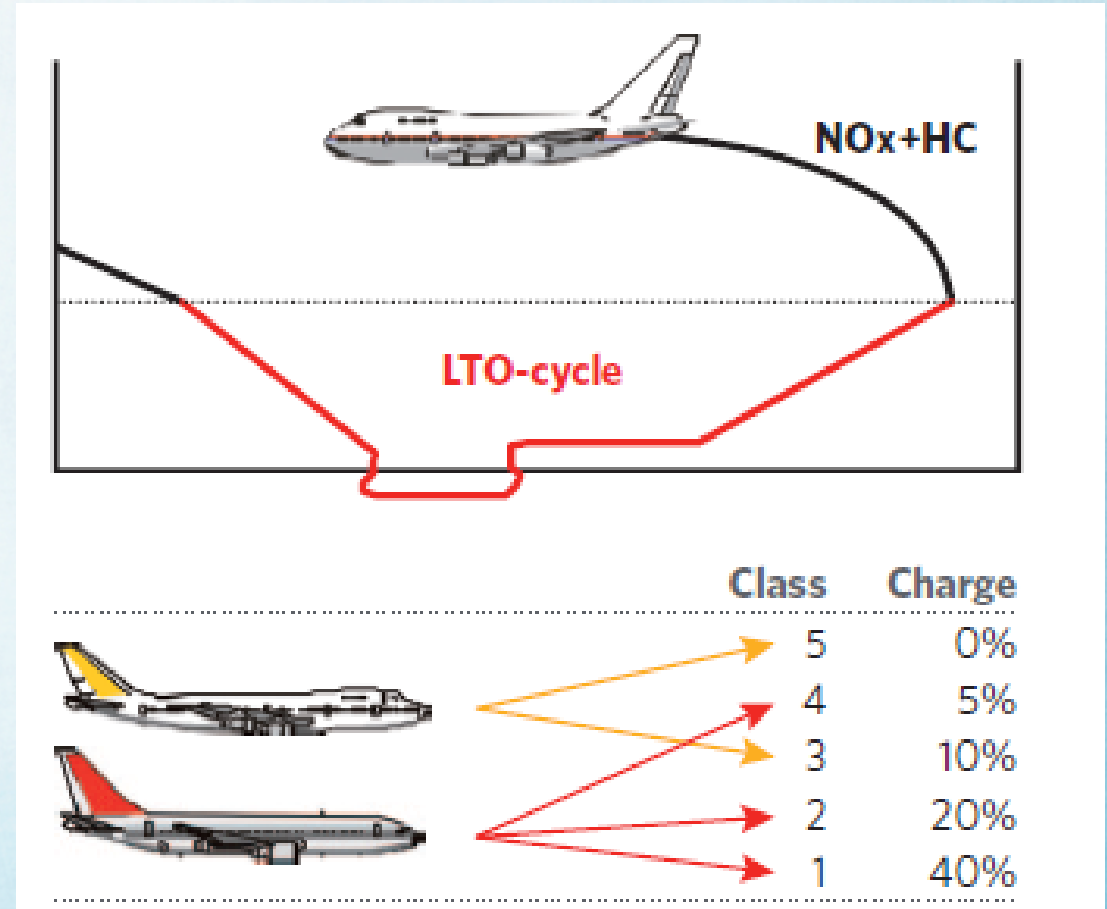


Emissions Fees are Predominantly for NOx, with Some Airports Having CO2 Based Landing Fees.

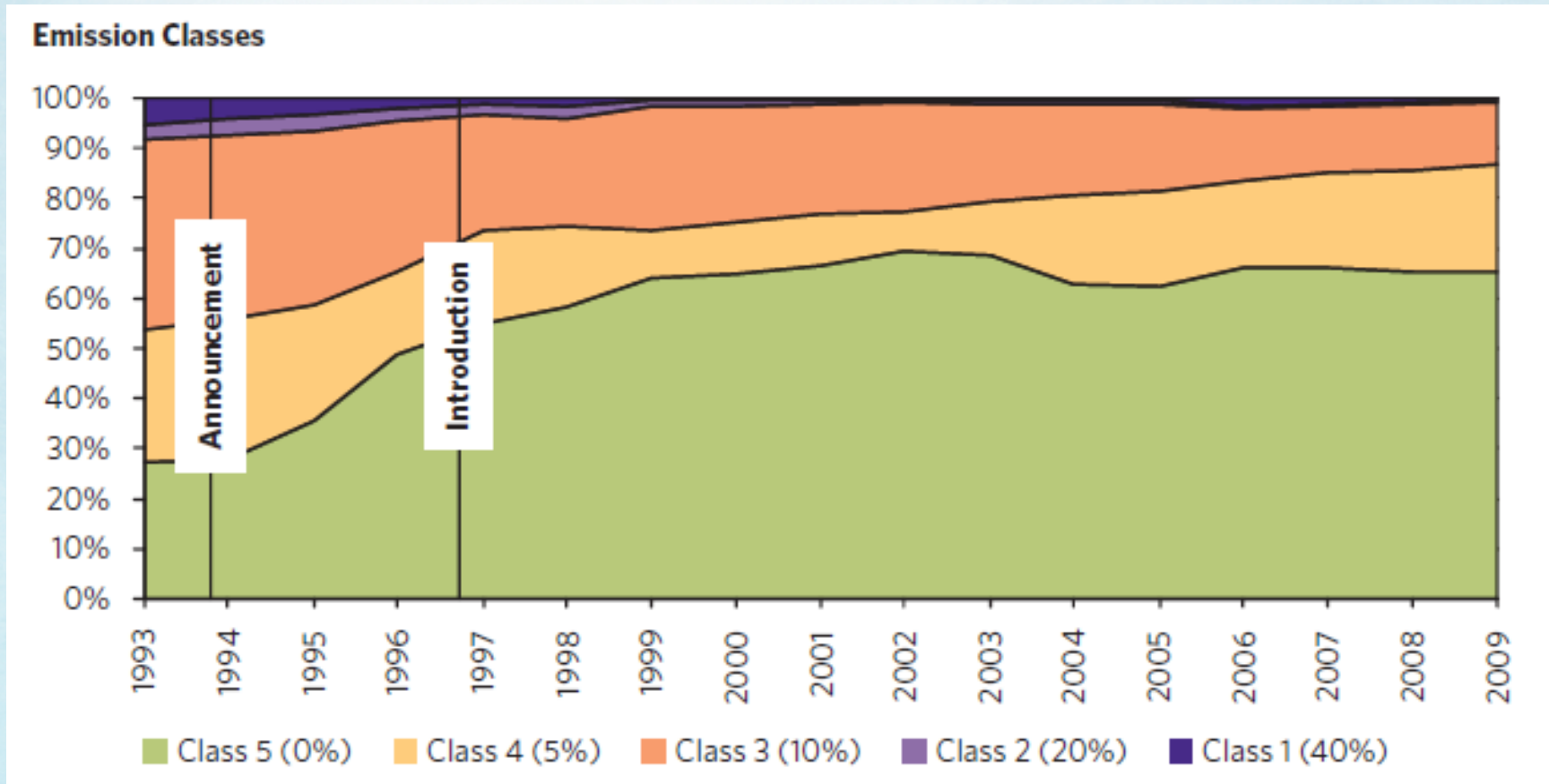


1997-2010: Landing Fees Increase as the Emissions of NO_x and Hydrocarbons from the Aircraft Engine Increases

- Airports lowered their weight-based landing by 5% for all aircraft to ensure the emission charge is fee neutral.
- Aircraft with a Class 5 engine would then receive a 5% decrease in their landing fees, while Class 1 aircraft would receive a 35% increase to their landing fees



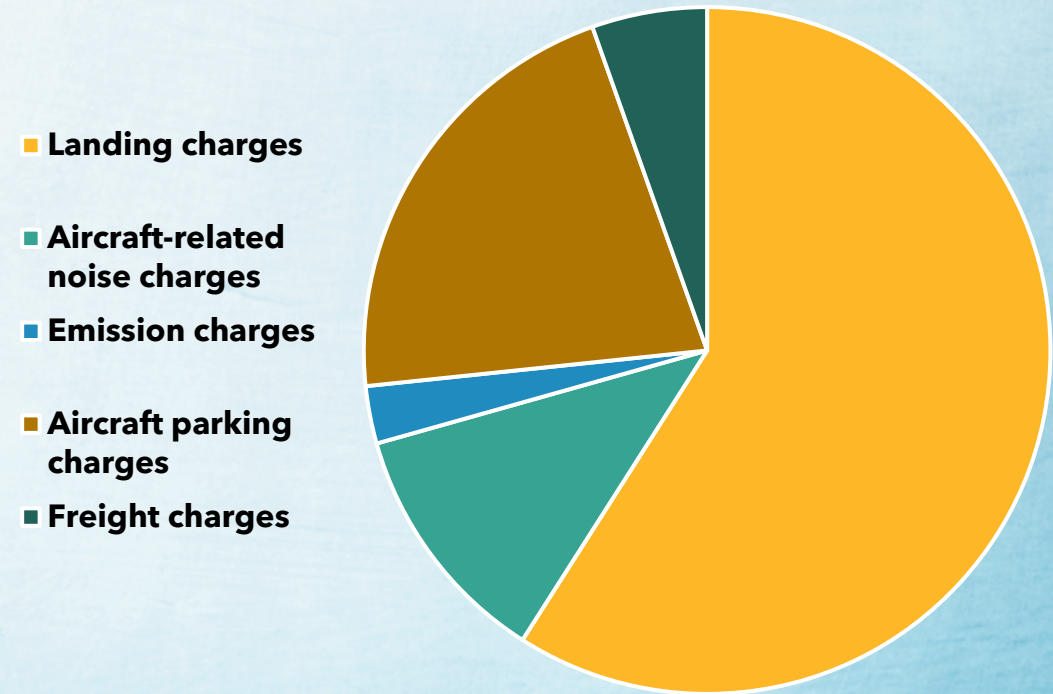
Emissions-Based Fees at Zurich Influenced Aircraft Purchasing Behavior of Airlines



Post-2010: Airports Develop "Polluter Pays" System for Emissions-Based Landing Fees

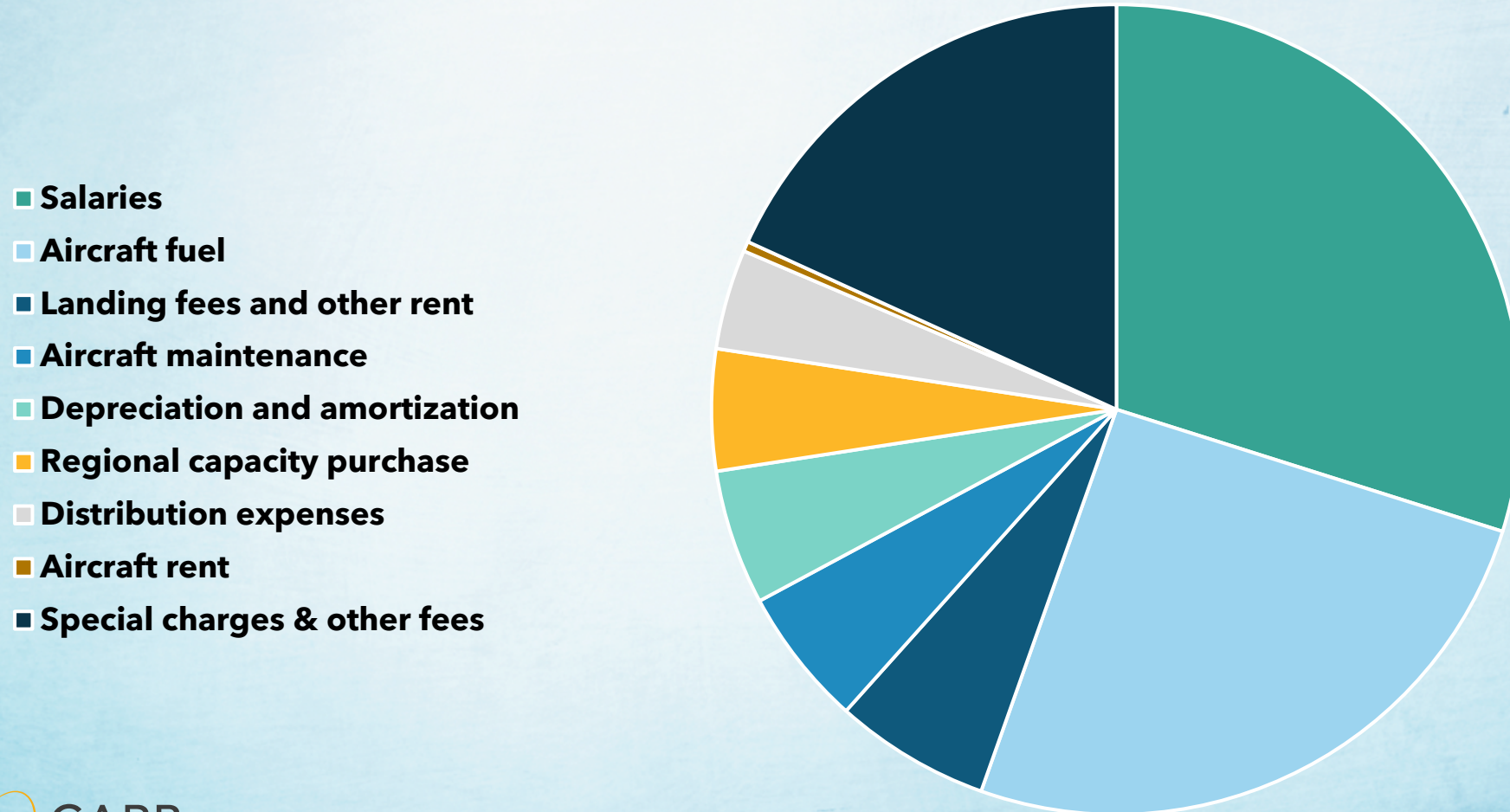
- The emissions fee can range from a few dollars, to hundreds of dollars depending on the engine type.
- In 2023, 3% of Zurich's flight operations charges were for emissions.

Zurich Flight Operations Charges 2023



Landing fees for U.S. based airlines are 6-8% of yearly operating costs.

United Airlines Operating Costs 2023



Moving Forward

- How can airports and airlines in the United States collaborate to develop a fee-neutral, emissions-based landing fee structure that incentivizes the use of cleaner commercially available aircraft?
- What is the landing fee amount needed to promote a change in airline routing activity?
- How might emissions-based landing fees at airports influence engine manufacturers to invest more heavily in cleaner engine technologies?
- What short- and long-term impacts would an emissions-based fee program have on local air pollution in California?