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June 23, 2026

Submitted electronically

Clerk of the Board
California Air Resources Board
1001 I Street
Sacramento, CA 95814

Re: Airlines for America Comments on California Air Resources Board's (CARB) Report on Feasibility to Reduce Emissions During Aircraft Taxiing

Dear Sir/Madam:

Airlines for America (A4A), the trade association for the leading U.S. passenger and cargo airlines,[1] appreciates the opportunity to comment on the California Air Resources Board's (CARB) *Report on Feasibility to Reduce Emissions During Aircraft Taxiing* (Draft Feasibility Report or Report).[2] A4A previously submitted comments on matters relating to the SCAI Draft Concepts and incorporate those by reference here.[3] We support collaborative efforts to further reduce emissions at airports in California and appreciate the preliminary nature of this report, but we have significant concerns about the Draft Feasibility Report.

A4A and our members embrace our responsibility to address the environmental impacts associated with aviation and have a strong environmental record that demonstrates our commitment to reducing such impacts, even as we continue to provide air transportation services critical to maintaining the growth and vitality of the national, California and local economies. In California, according to the most recent Federal Aviation Administration (FAA) analysis, civil aviation accounts for about 5 percent of jobs (over 1.13 million in 2022) and drives

[1] A4A is the principal trade and service organization of the U.S. scheduled airline industry. Members of the association are Alaska Airlines Group, Inc.; American Airlines Group, Inc.; Atlas Air, Inc.; Delta Air Lines, Inc., Federal Express Corporation; JetBlue Airways Corp.; Southwest Airlines Co.; United Holdings, Inc.; and United Parcel Service Co. Air Canada is an associate member.

[2] https://ww2.arb.ca.gov/sites/default/files/2026-01/SCAI%20Draft%20Concept%20Document.pdf

[3] A4A previously submitted comments on CARB's September 30, 2021 technical workshop on the draft scenario inputs for the 2022 Scoping Plan Update (See https://ww2.arb.ca.gov/sites/default/files/BARCU/barcu-attach/48-sp22-inputs-ws-UDZTPAZpVWcBawhX.pdf (October 22, 2021)), *CARB's Draft 2022 Scoping Plan Update* (See https://ww2.arb.ca.gov/sites/default/files/BARCU/barcu-attach/4322-scopingplan2022-WjtXZVQ0BQkLbIQ7.pdf (June 24, 2022)), on CARB's Recirculated Draft Environmental Analysis for the Draft 2022 Scoping Plan Update (See https://www.arb.ca.gov/lispub/comm2/iframe_bccomdisp.php?listname=sp22-recirc-ea-ws&comment_num=25&virt_num=22 (October 24, 2022)), on CARB's Reducing Emissions from Operational Practices of Commercial Aircraft Workshop (February 10, 2025), and CARB's Draft Concepts – Statewide Clean Aviation Initiative (SCAI) (April 2, 2026).

over 4 percent of state GDP ($106 billion in 2022).[4] Economic impact studies likewise have affirmed the critical importance of aviation activities at California's major airports to local economies. A4A's commitment extends to reducing greenhouse gases (GHGs) and emissions that can affect local air quality including emissions of criteria pollutants such as particulate matter (PM) and nitrogen oxides (NOx). Commercial airlines provide air transportation services to the public that, above all, ensure the safety of our passengers, crew and the larger public.

A4A and our members remain committed to working with CARB to attain the National Ambient Air Quality Standards (NAAQS) through an informed, transparent process that upholds the federal preemptions, standards and requirements that are critical to the National Airspace System (NAS). If CARB intends to use the Report solely as a preliminary screen, we urge CARB to maintain a technology-neutral, performance-based approach that preserves flexibility for airports and operators to pursue emissions reductions suited to their specific operating environments. We also urge similar caution regarding the cost–benefit analysis, emissions impacts and operational feasibility. In that spirit, we offer the following comments. Absent such validation, the Report risks creating an incomplete or inaccurate record regarding the feasibility of zero-emission (ZE) taxiing technologies at complex, high-traffic airports

1. Emissions Impact

The Report notes that "[w]hile the objective is to evaluate the implementation of low-emission taxiing as a means to reduce pollutant emissions at California airports, the calculation of these emissions falls outside of the scope of this report" which will be "undertaken by the CARB team, whose expertise will be utilized for a comprehensive emissions assessment."[5] Yet also states, "[t]ransitioning to zero-emission ground operations for aircraft is essential to achieving federal air quality standards"[6] and "a 75% penetration of the solution … captur[es] the majority of operational and environmental benefits."[7] If CARB has not yet completed the emissions reduction assessment, it is unclear how zero-emission taxiing operations is "essential" to achieving the NAAQS or captures the "majority" of benefits.

2. Certification and Regulatory Gaps

A4A and its carriers cannot adopt equipment that is not yet certified for U.S. airport operations. The Report presents a list of ZE taxiing technologies as if they are already operational and certified for use in the United States; however, this is not the case for any of the technologies listed. The Report states that "[a]irport deployment approval from the FAA is pending" for the Taxibot,[8] but we could not locate any documentation that confirms that an FAA approval process is in progress.[9] In order for the Taxibot to be certified at each airport, the manufacturer would need to submit a Concept of Operations (CONOPs), with an airline partner, to FAA which

[4] *See* FAA, *The Economic Impact of Civil Aviation on the U.S. Economy –State Supplement* (2022), at 6, https://www.faa.gov/2022-state-economic-impact-report.pdf (last visited Feb. 11, 2026).
[5] Draft Feasibility Report, p. 2.
[6] Draft Feasibility Report, p. 1.
[7] Draft Feasibility Report, p. 62.
[8] Draft Feasibility Report, p. 7.
[9] See, Supplemental Type Certificate (STC) (Number STO2529SE) was issued on August 7, 2017, for B737 aircraft; however, the holder of the STC must demonstrate compliance with 14 CFR Part 26.

has not been completed – therefore, there is no current pathway forward for the airport deployment approval.

The Report notes several potential benefits, all citing statistics provided by a single manufacturer, Taxibot, which have not been verified. The Report also conflates the diesel-electric hybrid Taxibots with the new electric Taxibots, which were only manufactured at the time the Report was published. Finally, it is unclear why the Report dismisses "other large electric aircraft tugs" which are noted to be "commercially available and in use at airports" as no explanation is provided other than "they are not designed with the intent of taxi passenger-loaded aircraft nor have procedures been designed to use them in emergency taxiing scenarios," and there is no citation to manufacturers such as Kalman and Goldhofer.[10] To conclude, operational integration is unproven at scale, availability, reliability and dispatch logistics remain unresolved, and certification and regulatory gaps have not been closed. Advancing a particular technology before certification, operational viability and airport-specific feasibility are established risks narrowing the range of viable solutions prematurely. A technology-neutral approach is therefore essential to ensuring that multiple pathways can be evaluated based on demonstrated performance rather than early-stage assumptions.

3. Real-world Applications

The Report overstates the case for the utilization of TaxiBot and understates the practical challenges to real-world application. In terms of overstatement, for example, the Report states "Taxibot . . . has demonstrated large-scale operational success,"[11] and, in bold, there are "…no adverse effects on efficiency…"[12] These conclusions are objectively incorrect. The Report overstates the performance of the Taxibot by failing to put the technology's performance in the context of broader airport operations. The Taxibot operations that exist today handle only a tiny fraction of the host airports' annual departures (average less than one per day in DEL and BLR). The report notes there have been 130 operations at AMS over two years,[13] which is approximately 1 per week. KLM participated in an information gathering call held by Roland Berger, which A4A also joined, KLM explained that in approximately two years of operation, the TaxiBot has experienced two failures, which amounts to ~1.5% failure rate. For example, applying the same failure rate to the aircraft in scope and movements out at LAX would result in 2,688 failures in a single year.[14] Such a failure rate across California airports would be disastrous for passenger and cargo air operations.

The report also effectively disregards the practical experience at Charles de Gaulle Airport (CDG), where significant airport operational concerns were raised following a demonstration project about the potential for traffic delays associated with equipment decoupling and the risk of mechanical failures on taxiways. The fact that the TaxiBot must stop and decouple from the aircraft prior to entering the runway creates significant potential for delays in operations, not just for the aircraft involved but for all aircraft in line to depart.[15] CDG air traffic controllers also

[10] Draft Feasibility Report, p. 3.
[11] Draft Feasibility Report, Executive Summary.
[12] Draft Feasibility Report, p. 16.
[13] On the call hosted by Roland Berger, which A4A attended, KLM noted 95 operations in two years.
[14] Draft Feasibility Report, Section 3.2 (70% of total movements out of LAX (256,000) x 1.5% failure).
[15] In addition, the current design requires the driver of the TaxiBot to get out onto the active taxiway to decouple the equipment from the aircraft, creating significant safety risks. While we understand the manufacturer is working on a design to avoid the need for this step, that very serious safety concern must also be considered. The taxiway disconnect operation was considered unsafe and significantly limited the scope of the TaxiBot trial at JFK, where movements were restricted to the ramp.

raised concerns about additional staffing needs to ensure safe dispatch of this equipment. These practical concerns have led CDG stakeholders to pursue other alternatives for addressing emissions.

A4A and its carriers share similar concerns to those raised by Air France and other CDG carriers and stakeholders in the Report, including: significant time delays during taxiing, implementation of decoupling zones that create detours for aircraft, decoupling zones that utilize de-icing pads and are not available year-round, lack of gate and apron space, air traffic control (ATC) workload increases (which would impact safety margins), TaxiBot failures (e.g., nose-gear overload and fuel depletion), potential wear on brake manifolds, inadequate charging or electrical supply infrastructure, and service road constraints. The video of Taxibot implementation also shows an employee on the taxiway or runway exiting the Taxibot to couple and decouple the aircraft, which is a major safety concern.[16] Further, the Report notes that service-way feasibility was often conducted utilizing Google Maps, which is entirely insufficient to develop a concept of operations.

California airports are currently experiencing a significant ATC staffing shortage, with thousands of vacant positions. The implementation of Taxibot technology under these conditions would further strain existing resources significantly and elevate the risk of safety-related incidents.

During the recent CARB public meeting on Green Taxiing held on June 2, 2026, LAWA staff outlined several significant concerns regarding Taxibot implementation at LAX. Key operational constraints were identified, including tight gate geometries, insufficient staging and decoupling areas, and heavy reliance on FAA-controlled movement, all of which materially limit the feasibility of TaxiBot operations without substantial infrastructure and procedural modifications. Additionally, airline interest, which is critical to successful implementation, has been limited to date. From a cost and implementation perspective, TaxiBot introduces additional operational steps, training requirements and capital investment, with unclear ownership and funding responsibility among the airport, airlines and ground operators. While the emissions benefits are real, they may be limited at LAX given the aircraft mix and relatively short taxi distances. Ultimately, LAWA staff concluded that TaxiBot implementation is not feasible without significant infrastructure, operational and procedural changes.

The Report notes that one unit has been deployed in Amsterdam, yet Schiphol Airport has unique characteristics, including some of the longest taxi routes in Europe, that allow for the implementation of one particular type of ZE taxi. Even so, KLM has reported that it took many years to develop the operational procedures, certifications, training and logistics required for implementation.

As a practical matter, A4A and its members are concerned the Report found that “no major obstacle to 100% ZE taxiing has been identified for LAX”[17] yet also notes that the “taxitow footprint exceeds the width of single service lane,”[18] thereby preventing bidirectional traffic – meaning no other airside vehicles could utilize the road while a Taxibot is in motion. Adoption of the Taxibot would require airport runway modifications, which in turn would trigger FAA approval of a change to the airport layout plan and trigger a National Environmental Policy Act (NEPA) review. The Report’s conclusions thus ignore stakeholder concerns, infrastructure requirements

[16] See: https://www.smart-airport-systems.com/solution/taxibot/
[17] Draft Feasibility Report, p. 35.
[18] Ibid.

and real-world experience. Technology deployment of this nature should remain voluntary, incentive-based and federally coordinated.

As reflected in stakeholder feedback from major hub airports, feasibility cannot be generalized across locations with significantly different operational complexity, traffic volume and infrastructure constraints. Airport-specific validation is critical before drawing broader conclusions about system-wide applicability.

Beyond these operational concerns, the Report does not adequately address human factors and system safety considerations. From a human factors' perspective, introducing an additional vehicle, personnel interactions, coupling and decoupling procedures, and new communication requirements increases flight deck, ramp and air traffic coordination complexity. These added tasks create additional opportunities for miscommunication, divided attention and procedural non-compliance, particularly during periods of high workload, adverse weather, irregular operations or time-sensitive departure windows. Any assessment of operational feasibility should include a rigorous evaluation of the human performance implications associated with integrating these technologies into routine airport operations.

From a system safety perspective, new technologies should not be considered operationally feasible unless they can be demonstrated to maintain or improve existing levels of safety across all operating conditions. The Report focuses primarily on potential emissions benefits but does not provide sufficient analysis regarding failure modes, operational resiliency, redundancy, recovery procedures or system-wide safety impacts. Demonstrating safe operation during routine conditions alone is insufficient; any proposed technology must also be evaluated under abnormal, degraded and contingency scenarios before conclusions regarding feasibility can be drawn.

The introduction of an external towing system raises questions regarding aircraft controllability and operational response during equipment malfunctions, communication failures, runway changes, rejected departures, emergency returns to the gate, severe weather events and other unforeseen contingencies. The feasibility analysis does not demonstrate how these systems would ensure continuous pilot authority over aircraft movement or maintain predictable and timely responses during off-nominal events. These considerations are fundamental to any determination of operational feasibility and safety.

4. Affordability and Cost-Benefit Assumptions

The Report's modeling shows a negative Net Present Value (NPV) at many California airports (e.g., SJC, SBP) and high upfront costs for aircraft modifications and Taxibots.[19] Further, even where a positive NPV was found, such cost savings calculations were dependent on overly optimistic utilization rates and infrastructure assumptions.

A4A notes additional problematic assumptions within the model, including: the resale of existing tugs (which would still be needed as backup equipment), assumption of zero debt, no diesel use by the Taxibot was modelled in the base case (yet the only model in use is an electric-diesel hybrid), omission of grid interconnection and infrastructure upgrade costs, exclusion of airfield modification costs and exclusion of pilot training time and costs. As noted in the Report, other negative cost-benefit factors include operating delays and the replacement of aircraft manifolds.

[19] Draft Feasibility Report, p. 56-7.

5. Federal Preemption

The Draft Feasibility Report repeatedly implies or assumes that California could drive or influence operational requirements for aircraft taxiing; however, any CARB rule that requires, conditions or effectively compels ZE taxiing would be federally preempted. The regulation of aircraft and aircraft operations is squarely within federal jurisdiction, primarily governed by the FAA under long-standing federal law.[20] Recognizing the inherently interstate and international nature of air travel, Congress has severely circumscribed state authority over aviation primarily through three statutes: the Federal Aviation Act, the Airline Deregulation Act (ADA) and the Clean Air Act (CAA).

Within the Introduction, the Draft Feasibility Report references California's Proposed 2022 State Implementation Plan Strategy. Within this proposed plan, CARB itself recognized that it is not the proper authority to regulate aviation and that aviation is federally preempted, categorizing aviation under "Federal Actions Needed" and noting actions that could be taken by EPA, FAA and the International Civil Aviation Organization (ICAO).[21] The 2022 SIP notes that "[f]or California to meet air quality standards, it is imperative that the federal government act," listing aviation and aircraft within this category.[22]

While the purpose of the Report is stated to assess "the feasibility, operational implications, and economic performance of Zero-Emission (ZE) aircraft taxiing solutions,"[23] CARB has not considered what reductions are within the purview of their authority, are achievable, the cost of those reductions or the extent to which those reductions achieve their emissions reduction goal.

The Federal Aviation Act vests the FAA with comprehensive and exclusive authority over the regulation of aviation safety and aircraft operations.[24] This pervasive federal regulatory scheme gives the FAA the sole power to "frame the rules for the safe and efficient use of the nation's airspace,"[25] and extends not only to aircraft in flight, but also to aircraft-related operations on the ground.[26] The Aviation Act reserves to the FAA *primary and exclusive* jurisdiction over matters related to aircraft operations and safety, the former of which is closely tied to the non-road GSE and non-road vehicles that air carriers operate at airports.[27] The Airline Deregulation Act

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[20] The Federal Aviation Act of 1958 ("Aviation Act") establishes "a *uniform and exclusive* system of federal regulation" of aircraft operations that preempts state and local regulation. *City of Burbank v. Lockheed Air Terminal, Inc*., 411 U.S. 624, 639 (1973) (emphasis added); *San Diego Unified Port Dist. v. Gianturco*, 651 F.2d 1306, 1311-12 (9th Cir. 1981); *see also American Airlines v. Department of Transp*., 202 F.3d 788, 801 (5th Cir. 2000) ("[f]ederal control [over aviation] is intensive and exclusive.") (quoting *Northwest Airlines, Inc. v. Minnesota*, 322 U.S. 292, 303 (1944) ("Federal control is intensive and exclusive. Planes do not wander about in the sky like vagrant clouds. They move only by federal permission, subject to federal inspection, in the hands of federally certified personnel and under an intricate system of federal commands"); 49 U.S.C. §§ 40101, 40103, 44701.

[21] See Proposed 2022 State Strategy for the State Implementation Plan (August 12, 2022); available at: https://ww2.arb.ca.gov/sites/default/files/2022-11/Proposed_2022_State_SIP_Strategy.pdf

[22] Ibid at p. 6.

[23] Draft Feasibility Report, p. ix.

[24] See City of Burbank, 411 U.S. at 639; Arapahoe Cty. Public Airport Auth. v. FAA, 242 F.3d 1213 (10th Cir. 2001). See also *Abdullah*,181 F.3d at 370 n.10 (aviation regulation is an area where "[f]ederal control is intensive and exclusive") (quoting *Northwest Airlines*, 322 U.S. at 303).

[25] *Montalvo v. Spirit Airlines*, 508 F.3d 464, 472 (9th Cir. 2007).

[26] *See, e.g.*, 49 U.S.C. § 40103(b)(2)(B)-(C); *City of Houston v. FAA*, 679 F.2d 1184, 1195 (5th Cir. 1982).

[27] *See City of Burbank*, 411 U.S.at 639. See also *Abdullah v. American Airlines, Inc*.,181 F.3d 363, 370 n.10 (3d Cir. 1999) (aviation regulation is an area where "[f]ederal control is intensive and exclusive"). EPA has acknowledged that "even small delays at certain hub airports have a ripple effect that can affect the entire national air traffic schedule" and that "space, safety and operational considerations may limit the selection of the specific technologies and the extent to which they can be implemented at any particular airport." See 77 Fed. Reg. 29167 at 29178-79.

(ADA)[28] further provides that a state "may not enact or enforce a law, regulation, or other provision having the force and effect of law related to a price, route, or service of [an] air carrier . . . ."[29] The Supreme Court has interpreted this provision expansively, preempting state laws that have "a connection with or reference to airline 'rates, routes, or services.'"[30] In addition, the Clean Air Act preempts state regulation of aircraft emissions, providing that "[n]o State . . . may adopt or attempt to enforce any standard respecting emissions of any air pollutant from any aircraft or engine thereof[.]"[31] That provision preempts state regulations that "affect the design, structure, operation, or performance of the aircraft engine" or the aircraft itself.[32] Further, under the CAA, EPA has exclusive jurisdiction to establish air emission standards for aircraft.[33]

The statutory scheme and congressional purpose reflected in the Federal Aviation Act, the ADA, and the CAA severely limit state authority over aviation, and make clear that aircraft taxiing operations are preempted. CARB is further limited by the Commerce Clause where a regulation impedes the flow of interstate goods by (i) causing flight delays and cancellations and misdirection of baggage and cargo, on interstate flights and (ii) exposing the airlines to a patchwork of inconsistent regulatory regimes, making compliance practically impossible and adversely affecting efficient interstate transportation.

6. Conclusion

The Report concludes that "[z]ero-emission taxiing using on-ground solutions is operationally feasible at major California airports, with limited infrastructure constraints." Yet the underlying analysis does not substantiate that conclusion. The Report provides only limited real-world data on the use of any proposed on-ground technology, does not fully account for infrastructure constraints such as bidirectional service-road usage or required electrical grid upgrades, and acknowledges that none of the technologies evaluated have been demonstrated as operationally feasible at a U.S. airport.

The Report itself notes that "no further plans for larger-scale deployment have been confirmed" at Paris Charles de Gaulle Airport, where the technology was previously tested and that the "Proof of Concept with Norse [was] canceled… due to limited airport buy-in."[34] Despite years of availability, global uptake remains minimal, and several airports have paused or discontinued deployments due to operational concerns. In addition, TaxiBot remains effectively a single-vendor solution, creating long-term cost and supply-chain risks. Requiring the use of Taxibot would make airlines heavily reliant on a single proprietary system with uncertain future support.

A4A and its members recognize the challenges associated with reducing aviation's environmental impacts and appreciate CARB's commitment to improving air quality in California. We also value CARB's willingness to consider emerging technologies as they mature and become better understood.

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[28] Airline Deregulation Act, 49 U.S.C. § 41713 (Oct. 24, 1978).
[29] 49 U.S.C. § 41713(b)(1). This statutory provision was previously codified at 49 U.S.C. § 1305(a)(1). *See* 49 U.S.C. App. § 1305(a)(1). In 1994, Congress reenacted this provision at 49 U.S.C. § 41713(b)(1) as part of its reenactment of Title 49, and changed the operative language from "rates, routes or services" to "price, route, or service," but no substantive change was intended. *See American Airlines v. Wolens*, 513 U.S. 219, 223 n.1 (1995).
[30] *Morales v. Trans World Airlines, Inc.*, 504 U.S. 374, 390 (1992).
[31] 42 U.S.C. § 7573(a).
[32] *People of State of Cal. v. Dep't of the Navy*, 624 F.2d 885, 888 (9th Cir. 1980).
[33] Pursuant to CAA Sections 231 and 232, EPA consults with the FAA to develop and apply the required technology to these requirements at 40 CFR Part 87.
[34] Draft Feasibility Report, p. 5.

However, any proposed solution must preserve the highest levels of safety, maintain operational integrity, adequately address human factors and system safety considerations, demonstrate safe and predictable performance during both normal and abnormal operations, and align with federal and international regulatory frameworks.
We respectfully request that CARB consider these concerns as it evaluates next steps. Please feel free to contact us with any questions or if further information would be helpful.

Sincerely,

Kenley Farmer

Kenley Farmer
Director
Environmental Affairs
Airlines for America