

From: Dr. Levi Tillemann (VP for Policy and International Outreach, Ample Inc.),
Matthew McGovern (Policy Counsel, Ample, Inc.)

To: California Air Resources Board

Date: July 25, 2024

Re: Advanced Clean Car II Regulations Arbitrarily Penalize EV Battery Swapping

Comment Summary

Ample's mission is to accelerate the transition to electric mobility by offering an energy delivery solution that is as fast, as convenient, and as cheap as gasoline, thus removing the remaining hurdles to adoption of electric vehicles. Ample strongly supports the efforts of the California Air Resources Board (CARB) to eliminate tailpipe emissions from cars through its Advanced Clean Cars II (ACC II) standards. For the reasons outlined below, Ample requests that CARB modify the DC fast charging and range mandates in the ACC II regulations to accommodate swap-enabled battery electric vehicles, or alternatively, exempt swap-enabled EVs from regulations that would otherwise exclude them from CARB's definition of a battery electric vehicle (BEV).

Ample Background

Ample provides modular battery swapping services to fleet customers. The company manufactures all of the major components used in its battery swapping system, including battery modules and battery packs, in Brisbane (California) and South San Francisco. Ample's Brisbane plant is supported by a \$14.7 million grant from the California Energy Commission, awarded on May 10, 2023.

Ample's swapping system repowers EVs faster than conventional DC fast-charging at a price that is competitive with fast charging. The company has deployed a fleet of swap-enabled Nissan Leafs and Kia Niro EVs in the San Francisco Bay Area in partnership with Uber and the rideshare rental car company Sally. Ample is currently adding more swapping stations and swap-enabled EVs in the Bay Area as well as European and Asian markets (notably the new Fiat 500e in a partnership with Stellantis in Spain and delivery vehicles like the Mitsubishi Fuso eCanter in Japan).

Transportation is the number one source of carbon pollution in California. Fossil fuels also pollute the air Californians breathe, especially in disadvantaged communities. Despite aggressive statutory goals for electrifying transportation and rideshare fleets, California EVs are mostly driven by individuals who can charge at home overnight.

Battery swapping is growing rapidly in China and Europe

Historically, California has led development on policies for clean air and transportation electrification, but in many ways the state has fallen behind the federal government and other countries. For instance, in China (which is the world's largest auto market, with over 80% of the world's public DC fast chargers) the market for battery swapping EVs is growing rapidly. China has learned through experience that public fast charging alone is not sufficient to expand EV use beyond early adopters. As a result, most major OEMs in China now have battery swapping solutions for repowering electric vehicles.

For example, the Chinese company Aulton has deployed a platform for electric taxis and rideshare vehicles that use swappable batteries rather than conventional charging. Aulton announced that as of November, 2023, it had completed 83 million battery swaps to date, reducing carbon pollution by 940,000 tons.¹ NIO claims that it has installed 2,427 swapping stations in China and five European countries that collectively provide 68,000 swaps per day.² Battery swapping and China's long-term strategic support for its EV industry have helped BEVs reach a 26% market share for the first three months of 2024,³ compared to 7.3% in the US in Q1 of 2024.⁴

Battery swapping for medium and heavy-duty vehicles is also growing rapidly in China. China sold 36,000 electric trucks in 2022, while no other country sold more than 1,000.⁵ Half of the electric trucks sold in China in 2023 were swap-enabled, up from 32% in 2021.⁶ According to Bloomberg New Energy Finance:

“Many of these trucks are operating in industrial sites, port warehouses, mines and steelmaking factories. Lighter commercial vehicles with swappable batteries also are being used in urban deliveries, an area where BNEF expects to see

¹ Aulton website, <https://www.aulton.com/index.php/en/list-4.html> (accessed June 14, 2024).

² *Nio provides average of 68,084 battery swap services per day in May*, Lei Kang, CNEV Post, June 4, 2024 <https://cnevpost.com/2024/06/04/nio-average-68084-battery-swaps-per-day-may-2024/> (accessed June 14, 2024); *Nio reaches 30 Power Swap Stations in Europe and over 2,200 worldwide*, Natalie Middleton, Fleetworld, January 2024 <https://fleetworld.co.uk/nio-reaches-30-power-swap-stations-in-europe-and-over-2200-worldwide/> (accessed June 14, 2024).

³ *BYD dominates China's EV market as price cuts take effect*, Autovista 24, May 3, 2024 <https://autovista24.autovistagroup.com/news/byd-dominates-chinas-ev-market-as-price-cuts-take-effect/#:~:text=In%20the%20first%20three%20months,a%20market%20share%20above%2040%25.> (accessed June 14, 2024).

⁴ *EV Sales Growth Slows; Market Leader Tesla Stalls*, Cox Automotive, April 11, 2024 <https://www.coxautoinc.com/market-insights/q1-2024-ev-sales/#:~:text=In%20the%20first%20quarter%20of,growth%20rate%20has%20slowed%20notably.> (accessed June 14, 2024).

⁵ *China is propelling its electric truck market by embracing battery swapping*, ICCT, Hongyang Cui, Yihao Xie, and Tianlin Niu, August 9, 2023 <https://theicct.org/china-is-propelling-its-electric-truck-market-aug23/> (accessed November 20, 2023).

⁶ *China's Clean-Truck Surprise Defies the EV Slowdown Narrative*, BNEF, Colin McKerracher, March 12, 2024 <https://about.bnef.com/blog/chinas-clean-truck-surprise-defies-the-ev-slowdown-narrative/> (accessed June 18, 2024).

more growth as better economics and tightened emission requirements draw more attention to electric models.”⁷

California has adopted aggressive air quality regulations and funding programs to reduce carbon pollution from transportation, including a \$10 billion investment in ZEV deployment over five years in the Budget Acts of 2021 and 2022. These policies have helped make California the national leader in EV market share. But almost all of California’s commercial fleet vehicles still run on fossil fuels and the vast majority of vehicle miles traveled are powered by internal combustion engines.

Recent studies provide further support for the effectiveness of battery swapping compared to other decarbonization technologies. For example, a 2023 peer-reviewed study comparing the systemic costs of decarbonization of ground transportation through conventional EV charging, battery swapping, and hydrogen found that battery swapping achieved the lowest total cost.⁸

Background on Amendments to ACC II

California law directs CARB to adopt regulations to reduce carbon emissions and conventional air pollution. When writing regulations, CARB must anticipate the development of new technologies or improvements in existing technologies, and achieve the maximum technologically feasible and cost effective greenhouse gas emissions reductions.^{9,10}

The California Air Resources Board filed the final Advanced Clean Cars II regulations on October 14, 2022 with California’s Office of Administrative Law (OAL), covering vehicles sold in model years 2026-2035. OAL approved the regulations, and they went into effect on November

⁷ *China’s Clean-Truck Surprise Defies the EV Slowdown Narrative*, BNEF, Colin McKerracher, March 12, 2024 <https://about.bnef.com/blog/chinas-clean-truck-surprise-defies-the-ev-slowdown-narrative/> (accessed June 18, 2024).

⁸ AM Vallera, *The Transition: Why we need battery swapping for the future energy and transport systems*, University of Lisbon, Faculty of Sciences, Instituto Dom Luiz, Lisbon, Portugal, 2023, ISBN 978-972-9348-25-9, <https://doi.org/10.56526/10451/55274>

⁹ (a) The state board shall adopt rules and regulations pursuant to Section 43013 that, in conjunction with other measures adopted by the state board, the districts, and the United States Environmental Protection Agency, will achieve ambient air quality standards required by the federal Clean Air Act (42 U.S.C. Sec. 7401 et seq.) in all areas of the state by the applicable attainment date, and to maintain these standards thereafter. The state board shall adopt these measures if they are necessary, technologically feasible, and cost effective, consistent with Section 43013.

(b) If necessary to carry out its duties under this section, the state board shall adopt and enforce rules and regulations that anticipate the development of new technologies or the improvement of existing technologies.

Cal. Health & Safety Code § 39602.5 (emphasis added).

¹⁰ “The state board shall adopt rules and regulations in an open public process to achieve the maximum technologically feasible and cost-effective greenhouse gas emission reductions from sources or categories of sources, subject to the criteria and schedules set forth in this part.” Cal. Health & Safety Code § 38560 (emphasis added).

30, 2022.¹¹ In October of 2023, CARB began the public process of revising ACC II.¹² CARB staff will submit proposed amendments to the Air Resources Board in the summer of 2025.¹³

As explained below, current ACC II regulations arbitrarily penalize EV battery swapping despite its demonstrated effectiveness and the legislature's directive that CARB consider new technologies and cost effectiveness when drafting regulations.

ACC II provisions on EV range and DC fast charging arbitrarily undercut EV battery swapping

ACC II requires auto manufacturers to meet escalating requirements for zero emission vehicle (ZEV) sales as a percentage of total annual sales. In 2026, 35% of the vehicles sold by OEMs in California will need to be ZEVs. This mandate increases progressively, eventually reaching 100% ZEV sales for light-duty vehicles in model year 2035. Despite the rapid growth of EV battery swapping in the world's largest auto market (China) and the EU, and successful battery swapping pilot projects in California, ACC II contains provisions that would disqualify swap-enabled electric vehicles from the definition of ZEV. This would remove a powerful incentive for OEMs like Stellantis to sell swap-enabled EVs in California starting in model year 2026, and make them illegal to sell in 2035, despite superior performance as compared to standard plug-in electric vehicles.

EV range mandate

Under ACC II, EVs must have at least 200 miles of range or more to be considered ZEVs. Cal. Code Regs. tit. 13, § 1962.4(d)(1). This would mean that a new Fiat 500e that has a range of 141 miles and gets the equivalent of 116 mpg would not qualify as a ZEV under the new ACC II regulation. The Fiat 500e is also the only battery-swap enabled vehicle homologated for the US market and therefore available for sale as a new vehicle, rather than a retrofit.

According to the staff report prepared for ACC II, CARB adopted the 200 mile standard so that EVs would have a real world range of at least 150 miles, which would encourage EV adoption by making customers more comfortable with driving an EV.¹⁴ Some consumers are hesitant to switch to EVs because of the lack of reliable charging infrastructure. CARB adopted the 200 mile mandate, however, before the rapid growth in battery swapping in China and the successful demonstration of battery swapping in the San Francisco Bay Area. The 200 mile standard does not account for an alternative (more frequent fast battery swapping instead of longer, less frequent charging stops) that would eliminate range anxiety and which offers a superior customer experience compared to slow and unreliable public charging stations. CARB should exempt swap-enabled EVs from the 200 mile range requirement in ACC II because battery

¹¹ CARB website <https://ww2.arb.ca.gov/rulemaking/2022/advanced-clean-cars-ii> (accessed July 5, 2024)

¹² CARB website <https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/advanced-clean-cars-ii> (accessed July 5, 2024).

¹³ ACC II Amendments Factsheet, [/https://ww2.arb.ca.gov/sites/default/files/2024-06/ACCII_Amendments_FS.pdf](https://ww2.arb.ca.gov/sites/default/files/2024-06/ACCII_Amendments_FS.pdf) (accessed July 5, 2024).

¹⁴ CARB Staff Report, Initial Statement of Reasons, p. 47, April 12, 2022.

swapping is faster than DC fast charging, making it more effective at eliminating range anxiety, as demonstrated by its success in auto markets that have had more success in electrifying transportation than California.

Charging requirements

Vehicles equipped with Ample's battery swapping system can charge at Level 1 or Level 2 speeds, in addition to being repowered via battery swapping. The reason that Ample's swap-enabled EVs cannot be fast-charged is that regular fast charging degrades EV batteries. These batteries are Ample's most valuable physical asset and are leased to fleet customers. Fast-charging not only accelerates their deterioration, it is unnecessary because Level 3 charging is significantly slower than battery swapping. Fast-charging capability would add unnecessary complexity and cost to the system. Yet ACC II requires BEVs to be equipped for DC fast charging:

For 2026 and subsequent model years, all battery electric vehicles must be equipped with a DC inlet that meets the specifications applicable to DC charging contained in SAE J1772 REV OCT 2017, SAE Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charger Coupler, which is incorporated herein by reference. 2026 and subsequent model year plug-in hybrid electric vehicles equipped with a DC inlet must meet the specifications applicable to DC charging contained in SAE J1772 REV OCT 2017, SAE Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charger Coupler.

Cal. Code Regs. tit. 13, § 1962.3(c)(4).

The goal of the requirement for DC fast charging is to ensure that a BEV can be repowered conveniently like an ICE vehicle.¹⁵ Without DC fast charging, "BEVs will not be able to charge in the shorter times that are more comparable to conventional vehicles, and thus may not be suitable for use by drivers in a way that displaces conventional engines and their associated emissions."¹⁶

CARB should amend this regulation to exempt swap-enabled EVs from the DC fast charging requirement, or provide an exemption to the rule and allow swap-enabled EVs to qualify as BEVs, so that they are on a level playing field with conventional EVs. Swap-enabled EVs can be repowered faster than a conventional EV, at an affordable price. Battery swapping is especially valuable to highly utilized fleets because it allows fleet owners to save money on the initial capital outlay for EVs and infrastructure. This is because fleet owners do not pay for the EV battery up front and do not need to install costly charging infrastructure. An exemption or revision would support the obvious legislative intent underlying this regulation by making available affordable EVs that can be repowered quickly.

¹⁵ CARB Staff Report, Initial Statement of Reasons, p. 54-55, April 12, 2022.

¹⁶ CARB Staff Report, Initial Statement of Reasons, p. 55, April 12, 2022.

It is both arbitrary and unfair to penalize swap-enabled EVs when they are actually a better substitute for ICE vehicles and gas stations and more likely to “[displace] conventional engines and their associated emissions.”¹⁷ For example, a Fiat 500e has an MSRP starting at \$32,500 and can be charged to 80% capacity in 35 minutes.¹⁸ A swap-enabled version would have a lower upfront cost and can be fully repowered in about seven minutes (swapping speeds will continue to improve) and deliver a 100% charge. According to Green Car Reports, the 2025 Lucid Air Grand Touring can charge its battery from 10-80% capacity in 22 minutes, making it the fastest charging car available in the US.¹⁹ The Lucid Air Grand Touring has an MSRP of \$110,900, making it unlikely to capture enough market share to significantly reduce carbon pollution, despite its fast charging speed. America’s most popular EV, the Tesla Model Y, can charge from 10-80% capacity in about 25 minutes.²⁰ The most affordable model sells for about \$45,000, making it more expensive and slower to repower than swap-enabled EVs that would be unfairly penalized by the ACC II fast charging requirement.

Battery swappable EVs will exceed ACC II ZEV durability standards

In order to give consumers confidence in new and used EVs, ACC II contains ZEV durability standards:

(A) For 2026 through 2029 model year vehicles, be designed to maintain, for at least 70 percent of the vehicles in a test group, 70 percent or more of the certification range value, for a useful life of 10 years or 150,000 miles, whichever occurs first, and comply with data reporting requirements in CCR, title 13, section 1962.7.

(B) For 2030 and subsequent model year vehicles, be designed to maintain, on average for all the vehicles in a test group, 80 percent or more of the certification range value for a useful life of 10 years or 150,000 miles, whichever occurs first, and comply with data reporting requirements in CCR, title 13, section 1962.7.

Cal. Code Regs. tit. 13, § 1962.4(d)(2)

Ample provides vehicle repowering services with a pool of batteries that are continuously swapped out of vehicles and replaced with fully charged batteries. Ample owns the batteries and continuously monitors them for state of health, and removes them from circulation for recycling when they fall below 85% state of health. It is impossible and impractical to monitor the lifetime of a specific battery module within a modular battery swap vehicle, as any single battery module is paired with hundreds of different battery modules over its lifetime as a result of swapping. However, from a consumer perspective, Ample-enabled vehicles will exceed the ACC II standards for durability as they will maintain +85% of the certification range value for a

¹⁷ See CARB Staff Report, Initial Statement of Reasons, p. 55, April 12, 2022.

¹⁸ FiatUSA website <https://www.fiatusa.com/electric-cars.html> (accessed July 24, 2024)

¹⁹ *What are the fastest charging EVs?* Bengt Halvorson, Green Car Reports, July 24, 2024 https://www.greencarreports.com/news/1143891_fastest-charging-evs (accessed July 24, 2024).

²⁰ Ibid.

useful life of 10 years or 150,000 miles. Accordingly, vehicles enabled with modular battery swapping should be allowed to participate in California's EV market on a level playing field with conventional EVs.

Industry adoption of the NACS standard

In addition to the rapid growth of battery swapping in international markets, the sudden industry-wide adoption of the North American Charging Standard (NACS) popularized by Tesla highlights the need for CARB to be flexible in adopting rules for the emerging EV industry. Ford announced that it would adopt Tesla's standard in May of 2023, quickly followed by almost all other OEMs.²¹ This made ACC's mandate for the J1772 standard obsolete about six months after it was published, and CARB is amending ACC II to accommodate this change.

CARB should be perspicacious and flexible when considering other technological pathways that reduce pollution by encouraging electrification, including the rapid growth in battery swapping.

Conclusion

Ample looks forward to working with CARB to help California meet its climate and clean air goals by decarbonizing transportation, beginning with California fleets. Ample encourages CARB to amend the fast-charging and range mandates in ACC II to allow swap-enabled EVs to qualify as ZEVs, or alternatively, provide an exemption for swap-enabled EVs.

It is critically important that the industry be incentivized to develop technologies which can repower clean vehicles as quickly as a gas pump. Setting that target and allowing for robust competition among diverse technology pathways (e.g. fast charging, battery swapping, hydrogen, or other clean technologies) gives California the best chance of achieving the state's decarbonization goals.

²¹ *Ford EV Customers to Gain Access to 12,000 Tesla Superchargers; Company to Add North American Charging Standard Port in Future EVs*, Ford Motor Company Press Release, May 25, 2023 <https://media.ford.com/content/fordmedia/fna/us/en/news/2023/05/25/ford-ev-customers-to-gain-access-to-12-000-tesla-superchargers--.html> (accessed July 25, 2024).