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Subject: OBSOLETE CARB ANALYSIS: Line-Haul and Passenger Trains

Comment: Public Meeting to Consider the Draft 2022 Climate Change Scoping Plan, June 23, 2022

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by Phil Birkhahn, Co-Chair, Transportation Committee of San Diego 350

Change requested p. 58, "Freight and Passenger Rail, Line haul and passenger rail rely primarily on hydrogen fuel cell technology, and others primarily utilize electricity". CHANGE "Hydrogen" to "Battery electric or Hydrogen, depending on new analysis", not analysis done in 2016.

Change requested, Appendix C, p. 4, Table C-1, "Line haul and passenger rail rely primarily on hydrogen fuel cell technology, and others primarily utilize electricity". CHANGE "hydrogen" to "ZEV" in all four Scenarios.

Battery trains are feasible now, while CARB excludes them based on six-year-old analysis of an even older design. The only way hydrogen trains can win, is by preventing fresh analysis of battery trains and fair support by CARB and State of California.

Contrary to hydrogen advocates' talking points and out-of-date CARB technology assessment used to justify the hydrogen train program, battery trains can run long distances using existing technology. They just need a fair chance to demonstrate their lower acquisition cost and lower operating cost. Batteries enable low-cost, efficient direct electrification.

Hydrogen trains need three times as much electricity to provide hydrogen by electrolysis and complete other electricity hogging steps before hydrogen is pumped into a train. The consequences of hydrogen's low energy efficiency make hydrogen no better than diesel. Hydrogen advocates go on and on about the tailpipe emission of just water and fail to mention problematic upstream emissions.

It is time to revisit obsolete assumptions dating from 2016, when battery tenders for freight rail were last evaluated using a design from 2012 (Transpower, 2012 and 2014). Batteries back then limited the tender to 6.2 MWh of storage for a loaded box car. That capacity was assumed in reports published in 2016 (Railtec, 2016, p. 14 and CARB, 2016, p. VI-12). After allowing for a 20% to 100% operating range for state of charge, 5.0 MWh was left.

Then 5.0 MWh was cut in half by a mysterious railroad operating "rule" limiting discharge to 50%, leaving just 2.5 MWh available per battery tender. The "rule" is probably for the two-ton lead-acid battery used to start the locomotive's diesel engine. Those lead-acid batteries have an operating range of 50% to 100%. The supposed 50% rule, if used, should apply to the 6.2 MWh total capacity, not 5 MWh.

Fresh analysis by CARB must account for increases in battery energy density since 2012. Then the result should be worked into ZEHTRANS, which is a program of CARB, CalTrans, Energy Commission, and Go-Biz, followed by integration with the State Mobile Source Strategy. Because the Scoping Plan Update is on a faster track, the language used should be flexible enough to encompass battery-powered trains and let technology results determine the mix of hydrogen and battery power. Call it ZEV for now so as not to prejudice the outcome by enshrining hydrogen trains in the Scoping Plan.

We have a head start. Fresh analysis by others was published late last year by staff from Lawrence Berkeley National Laboratory, UCLA Institute of the Environment and Sustainability, and UC Berkeley Department of Agricultural and Resource Economics (Popovich and others, 2021). Nowadays, 14 MWh

of battery storage with its power electronics fits in a standard boxcar. LFP batteries share the 20% to 100% operating range for state of charge, leaving 11.2 MWh, a big upgrade from 2.5 MWh.

They showed that a freight train carrying 6,806 revenue tonnes (7,487-tons) of payload could go 150 miles with four 14 MWh battery tenders. Such a train would weigh 15,656 tons counting the four locomotives, rail cars, and battery tenders. Their calculation is based on annual nationwide figures for revenue-tons hauled and diesel consumed.

I get a similar result with basic vehicle dynamics calculations, finding four locomotives with battery tenders (45 MWh of useable energy) would be needed. One of the four could move a 3,900-ton train 150 miles.

CARB must change course to fully evaluate battery-powered trains before making any total commitment to hydrogen trains by way of its Scoping Plan. Somehow CARB dropped the ball by not keeping up with capabilities of battery trains and shows no signs of reconsidering.

A 600-ton passenger train like the Surfliner, with its single locomotive and one tender, could go all the way from San Diego to San Luis Obispo, or maybe even farther as in the new AMTRAK plan, all the way to San Francisco!

REFERENCES

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