Energy Technologies Area

Energy Analysis and Environmental Impacts Division

May 20, 2020

Mary Nichols, Chair
California Air Resources Board
1101 I Street
Sacramento, CA 95814

Re: Proposed amendments to the ACT standard yield $11 billion in savings and 50% emissions reductions over original standards

Dear Chair Nichols and Members of the Board,

On April 28th, CARB made public its proposed amendments to the Advanced Clean Trucks (ACT) standard. These amendments increase the percentage of ZEV sales from 2024-2030 from the original proposal and extend the growth in mandated sales percentages an additional five years through 2035.

To understand the potential environmental and cost benefits of the more stringent standards introduced in the amendment, we used our Freight Act Climate Consistent (FACT) model to compare the updated ZEV sales percentage schedule to the original proposal. Furthermore, we compare both scenarios against a "climate-consistent" scenario which is in line with California's broader 2045 carbon-neutrality goals established in Executive Order B-55-18.

We find that this revision leads to substantial additional emission reductions and is a significant step towards meeting the carbon neutrality goals. The revised proposal will reduce emissions by 54% instead of 36% compared to 2019 levels (see Figure 1 below). However, additional steps may have to be taken to meet the goals of carbon neutrality such as future revisions to ACT standards and other supporting policies.

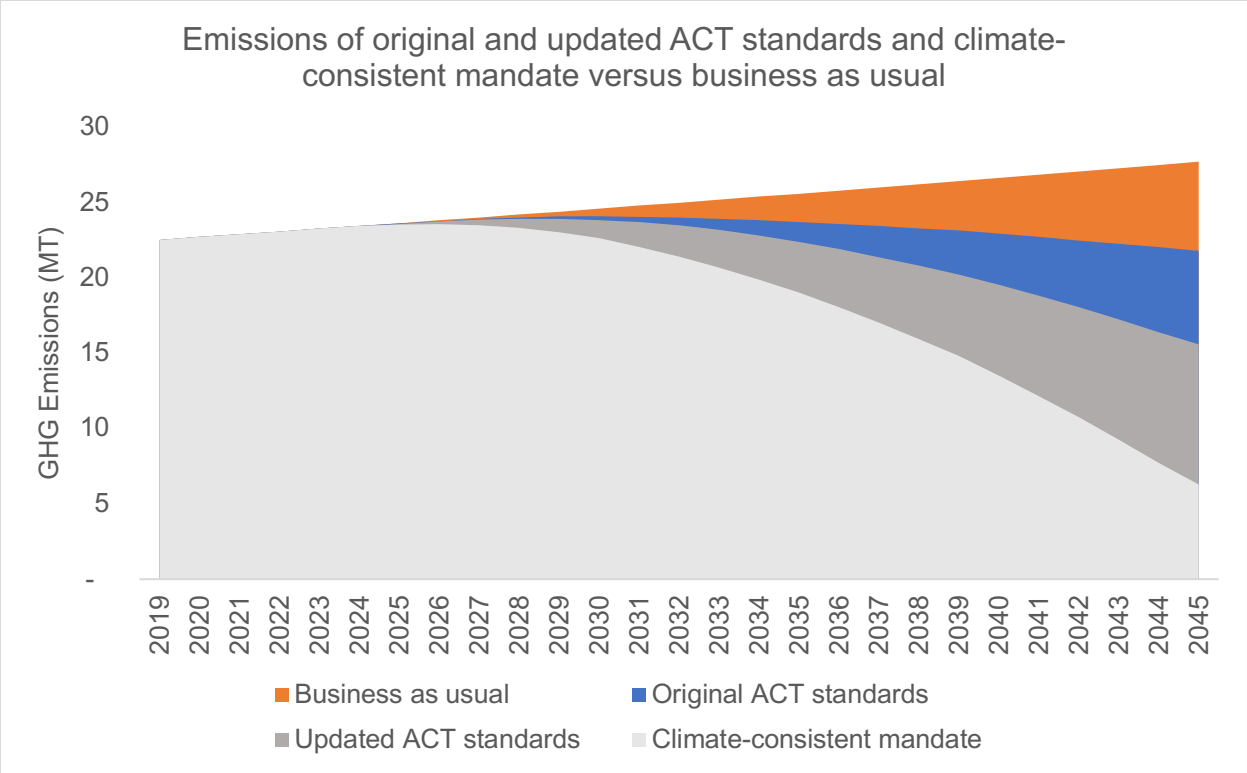

Figure 1. Comparison of the ACT and business as usual scenarios on carbon emissions through 2045

Although the more stringent amended ACT standard yields greater net benefits, these would be even greater under a climate-consistent ACT trajectory. We briefly summarize the different ways in which these benefits manifest:

Cost: The original, updated, and climate-consistent ACT proposals provide, $15 billion, $26 billion, and $49 billion savings over the business as usual, respectively, inclusive of environmental costs. Not including environmental costs, the updated ACT standard provides $7 billion in savings compared to $4 billion with the original standards. While the revised ACT proposal provides $11 billion in savings over the original proposal, a climate consistent ACT proposal would provide an additional $23 billion in savings.

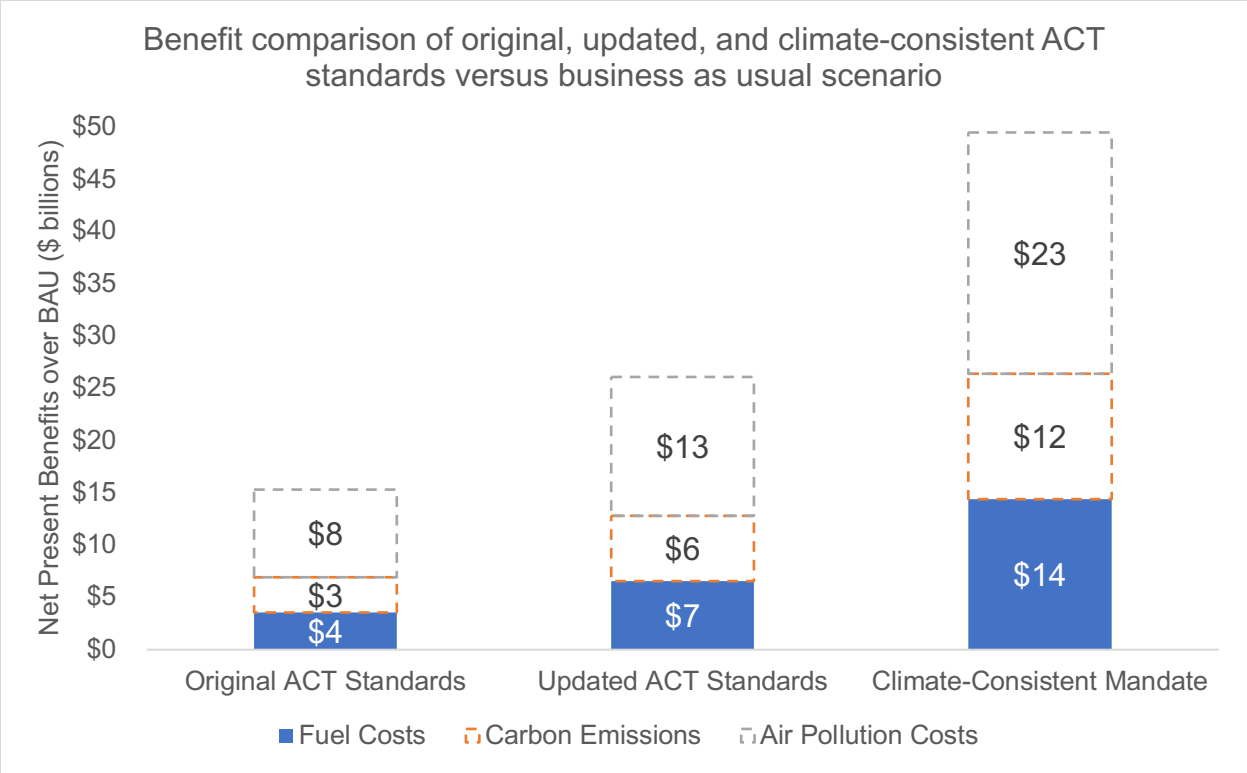

Figure 2. Comparison of savings of ACT proposals over business as usual case (environmental costs shown with dashed lines)

ICE truck populations: The original ACT standard would have left a significant portion of today's internal combustion engine (gas and diesel-fueled) trucks on the road through 2045. In fact, our modeling suggests an *increase* in class 2B-3 and 7-8 tractors to 106% and 107% their current levels with the original ACT standards. The updated ACT standards show marked improvement, with all classes showing a significant decrease in gas and diesel truck populations. In contrast however, the climate-consistent scenario which necessitates 100% ZEV sales by 2030 across all truck classes would lead to further decreases as shown in Figure 3. We note that the climate-consistent scenario does not eliminate diesel trucks due to the long service life of the vehicles.

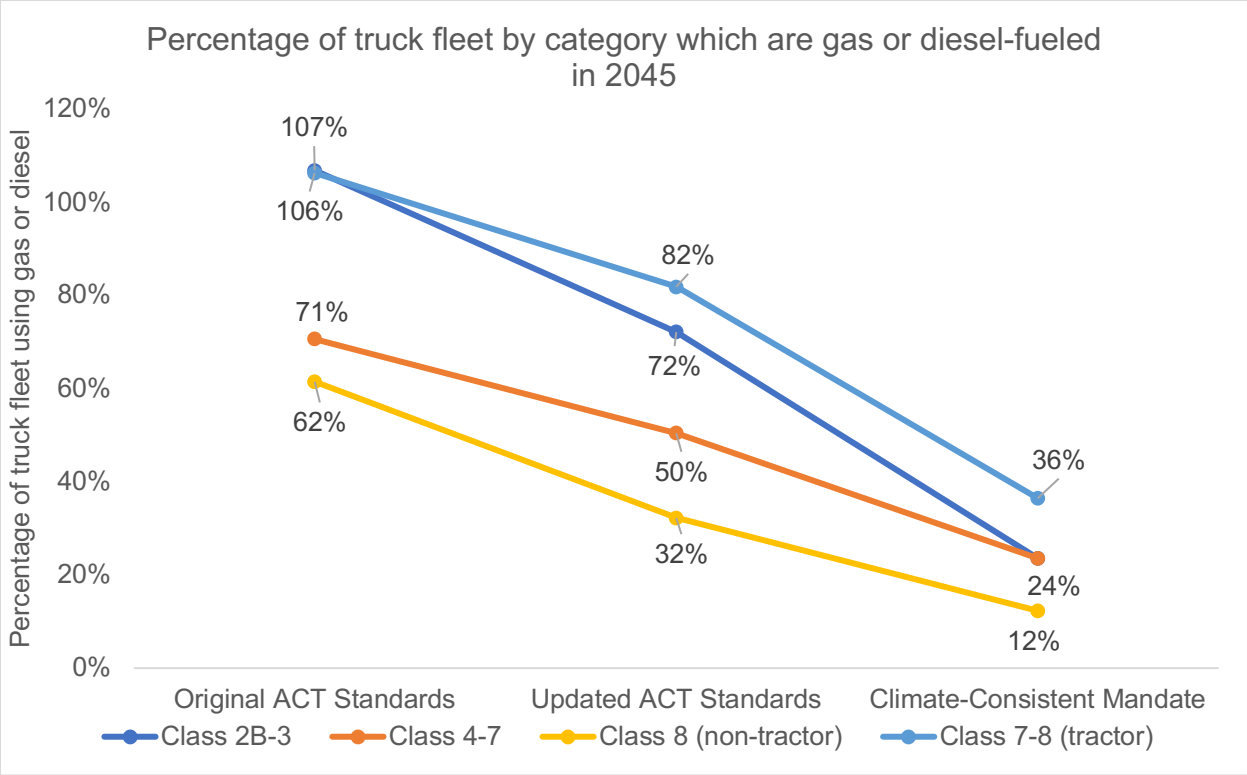

Figure 3. Comparison of the effects of the three ACT scenarios on non-ZEV truck fleets by 2045

We intend the FACT model to provide a timely, first-order understanding of the impacts of CARB's suggested ACT standards. Our analysis combines vehicle stock projections with a detailed bottom up estimate of the total cost of ownership and emissions to estimate the net economic benefits of replacing ICE trucks with EV trucks. The principal simplifying assumptions we made in this model are as follows: first, we treat California as a closed system and assume that all trucks present in California are sold and driven in California. We do not attempt to analyze emissions from out-of-state ICE trucks being driven in California, but accounting for external emissions would further underline the importance of a strong in-state clean vehicle standard. Next, we include battery electrification as the sole ZEV option, omitting other technologies such as fuel cells. Our estimates of charging infrastructure needs are based on total energy required, rather than on a spatially oriented model such as a truck flow model. Finally, we hold diesel and electricity prices constant in real terms over the course of the analysis to reflect the uncertainty associated with projecting either into the future, given such trends as electrification and renewable buildout.

We drew on a few principal data sources for this analysis. To estimate the number of trucks in each class in California and their characteristics, we combined data from the Bureau of Transportation Statistics, CARB's EMission FACtor database, the Federal Highway Administration, and the Transportation Energy Data Book, as well as car sales data to perform a segmentation of pickup trucks. To estimate costs associated with charging stations, electricity provision, and electric trucks, we drew principally on work we performed for two other papers— "Reforming electricity rates to enable economically competitive electric trucking"

(published in *Environmental Research Letters*[1]) and "Long-haul battery electric trucks are technically feasible and economically compelling" (available as an LBNL working paper[2]). To estimate the cost of grid infrastructure, we used transmission costs from the CPUC's RPS calculator. To estimate air pollution costs, we combined data from Goodkind et al.'s *PNAS* paper[3] with CARB and EPA data on truck-class-specific emissions. Further details and citations are available in the attached writeup.

Sincerely,

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[1] Phadke, A., McCall, M., & Rajagopal, D. (2019). Reforming electricity rates to enable economically competitive electric trucking. *Environ. Res. Lett.* https://doi.org/10.1088/1748-9326/ab560d

[2] Phadke et al. (2019) Lawrence Berkeley National Laboratory. Working Paper 005: Long-haul battery electric trucks are technically feasible and economically compelling. https://eta.lbl.gov/publications/working-paper-005-long-haul-battery

[3] Goodkind et al. (2019). Fine-scale damage estimates of particulate matter air pollution reveal opportunities for location specific mitigation of emissions. *Proceedings of the National Academy of Sciences, 116*(18), 8775–8780. https://doi.org/10.1073/pnas.1816102116