

Off-Model Adjustment Factors to Account for Recently Adopted Regulations After Release of the EMFAC2017 Model

Summary

Since 2018, the California Air Resources Board (CARB) has adopted several on-road vehicle regulations that significantly reduce criteria and greenhouse gas (GHG) emissions from on-road heavy duty vehicles and engines. These regulations include Heavy-Duty Warranty Phase 1, Innovative Clean Transit (ICT), Amendments to the Heavy-Duty Vehicle Inspection Program (HDVIP) and Periodic Smoke Inspection Program (PSIP), Advanced Clean Trucks (ACT), and Heavy-Duty (HD) Omnibus. The benefits of these regulations are not reflected in the EMFAC2017 model since the model was released before these programs were adopted. This document provides a set of off-model adjustment factors that can be used to adjust the emissions output of the EMFAC2017 model to account for the benefits of these regulations. These factors have been revised since December and August 2021 and are now based on EMFAC2021 v.1.0.2. This version of the model reflects a computational error fix to heavy-duty idle oxides of nitrogen (NO_x) emissions. The metropolitan planning organizations (MPO) and regional transportation planning agencies can use these off-model adjustment factors as part of their transportation conformity determinations.

What is EMFAC?

EMission FACtors (EMFAC) is California's federally approved on-road mobile source emission inventory model that reflects California-specific driving and environmental conditions, fleet mix, and most importantly, the benefits of California's unique mobile source regulations such as the Low-Emission Vehicle (LEV) program, including the LEV II and LEV III standards, and its in-use diesel fleet rules. The EMFAC model supports CARB's regulatory and air quality planning efforts and fulfills the federal Clean Air Act and the Federal Highway Administration's transportation planning requirements. The U.S. EPA has approved EMFAC2017¹ for use in state implementation plan (SIP) and transportation conformity analyses. EMFAC2017 reflects the benefits of regulations that were adopted before December 31, 2017. Earlier in 2021, CARB released an updated version of the EMFAC

¹ For more information on EMFAC, please visit: <https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-modeling-tools-emfac-software-and>

model, EMFAC2021, representing CARB's latest understanding of California on-road vehicle emissions and activities, which reflects the benefits of regulations adopted prior to March 31, 2021.

What regulations are adopted after the EMFAC2017 release?

Below is a list of regulations adopted by CARB after the EMFAC2017 model was released:

Heavy-Duty Warranty Phase 1²: In 2018, CARB adopted amendments to the heavy-duty engine (Gross Vehicle Weight Rating, or GVWR, above 14,000 lbs.) warranty regulation and further updated those warranty mileages through CARB's Heavy Duty (HD) Omnibus regulation. This regulation will reduce NOx and particulate matter (PM) emissions from heavy-duty trucks with engines that are model year 2022 and newer.

Innovative Clean Transit (ICT)³: Adopted in 2018, the ICT regulation requires all public transit agencies to gradually transition to a zero-emission bus (ZEB) fleet starting in 2023. Beginning in 2029, 100 percent of new purchase by transit agencies must be ZEBs, with a goal for full transition to zero-emission fleet by 2040. This regulation also encourages transit agencies to provide innovative first- and last-mile connectivity and improved mobility for transit riders. It applies to all transit agencies that own, operate, or lease buses with GVWR above 14,000 lbs. ZEBs introduced through this program reduce all types of emissions from transit buses.

Amendments to Heavy-Duty Vehicle Inspection Program (HDVIP) and Periodic Smoke Inspection Program (PSIP)⁴: In 2018, CARB adopted amendments to the HDVIP and PSIP programs to further reduce PM emissions from diesel-powered vehicles (GVWR above 14,000 lbs.). This regulation will achieve emission reductions through more stringent opacity limits for heavy-duty vehicles operating in California.

Advanced Clean Trucks (ACT)⁵: Adopted in 2020, ACT requires manufacturers of Class 2b-8 chassis or complete vehicles with combustion engines to sell an increasing percentage of zero-emission trucks in their annual California sales starting in 2024. By 2035, zero-emission truck or chassis sales would need to be 55 percent of Class 2b – 3 truck sales, 75 percent of Class 4 – 8 vocational truck sales, and 40 percent of Class 7-8 tractor truck sales. This

² California Air Resources Board (CARB) (2019). HD Warranty 2018.

<https://ww2.arb.ca.gov/rulemaking/2018/hd-warranty-2018>

³ California Air Resources Board (CARB) (2019). Innovative Clean Transit 2018.

<https://ww2.arb.ca.gov/rulemaking/2018/innovative-clean-transit-2018>

⁴ California Air Resources Board (CARB) (2019). Heavy-Duty Vehicle Inspection Program and Periodic Smoke Inspection Program Regulation 2018. <https://ww2.arb.ca.gov/rulemaking/2018/heavy-duty-vehicle-inspection-program-and-periodic-smoke-inspection-program>

⁵ California Air Resources board (CARB) (2021) Advanced Clean Trucks Regulation.

<https://ww2.arb.ca.gov/rulemaking/2019/advancedcleantrucks>

regulation reduces all types of emissions from trucks with engines which are model year 2024 and newer.

Heavy-Duty (HD) Omnibus⁶: The HD Omnibus regulation adopted in 2020 represents a comprehensive update to the heavy-duty engine NOx emissions standards and ensures that these engines will remain clean throughout their lifetime. This regulation mainly reduces NOx emissions from trucks with engines that are model year 2024 and newer.

How did CARB estimate the criteria pollutant emissions benefits of these regulations?

To assess the benefits of the aforementioned regulations on criteria pollutant emissions, CARB staff utilized the methodology implemented in the latest version of the EMFAC model, EMFAC2021 v.1.0.2. This version of EMFAC includes a computational error fix to NOx idling emissions. Using this approach, staff were able to account for the interconnectivity of these regulations, and to ensure that emission reductions resulted from these programs are not double counted. Please refer to the EMFAC2021 Technical Document⁷ for more details on how the model accounts for the benefits of these regulations. Using the "Annual" setting, the model was run for calendar years 2020 through 2050 to estimate emissions under two scenarios:

1. **Controlled** scenario where the benefits of regulations are reflected when estimating emissions. This is the same scenario as presented in the public version of the EMFAC2021 model.
2. **Uncontrolled** scenario where emissions are estimated without accounting for the benefits of the above-mentioned regulations. For this scenario, CARB staff used an internal version of the model.

The emissions results from these two scenarios were used to assess the benefits of the regulations above and derive the adjustment factors presented in Table 1. The adjustment factors were calculated based on the following equation:

$$\text{Adjustment factors} = \text{Controlled emissions} / \text{Uncontrolled emissions}$$

⁶ California Air Resources board (CARB) (2021). Heavy-Duty Omnibus Regulation.

<https://ww2.arb.ca.gov/rulemaking/2020/hdomnibuslownox>

⁷ California Air Resources Board (CARB) (2021). EMFAC2021 Volume III Technical Document.

https://ww2.arb.ca.gov/sites/default/files/2021-07/emfac2021_tech_doc_april2021.pdf

How should the off-model adjustment factors be applied?

CARB has prepared off-model adjustment factors for the EMFAC2017 model to account for the benefits of the regulations adopted after the model was released. These adjustment factors are provided in the form of multipliers and can be applied to emissions outputs of the EMFAC2017 model. Please note that these adjustment factors do not account for the upstream impact of regulations (i.e., emissions associated with fuel production and distribution).

The off-model adjustment factors shown in Table 1 apply to total emissions from all vehicle categories combined, including light-duty vehicles (LDA, LDT1, LDT2, and MDV), light heavy-duty vehicles (LHD1 and LHD2), medium heavy-duty vehicles (MHDT or T6), heavy heavy-duty vehicles (HHDT or T7), and all the other categories (Buses, Motor homes, and Motorcycles). An appendix is attached to tabulate the off-road adjustment factors by vehicle category to provide agencies the option to evaluate emission impacts by vehicle category. Please note that the adjustment factors are by calendar year, including all model years, from 2020 through 2050. The flowchart illustrated in Figure 1 details the methodology to apply these adjustment factors.

Figure 1. Process to apply EMFAC2017 Off-Model Adjustment Factors

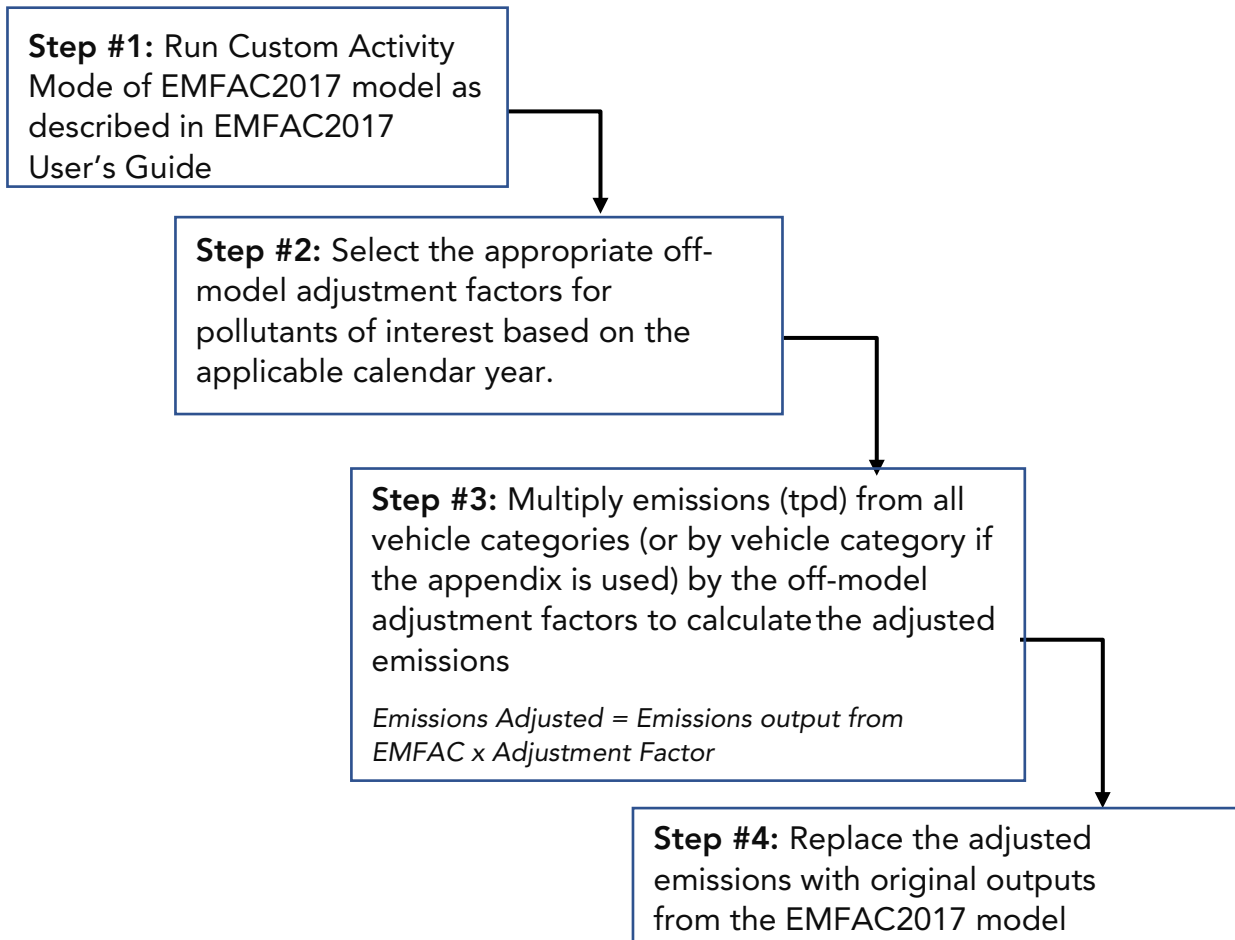


Table 1. Off-Model Adjustment Factors to Account for Regulations Adopted After the Model Release

Calendar Year	Exhaust NO _x	Total ROG (evaporative and exhaust)	Total PM _{2.5} (exhaust, brake wear, and tire wear)	Total PM ₁₀ (exhaust, brake wear, and tire wear)
2020	1.00	1.00	0.97	0.99
2021	1.00	1.00	0.98	0.99
2022	1.00	1.00	0.98	0.99
2023	1.00	1.00	0.98	0.99
2024	1.00	1.00	0.98	0.99
2025	0.99	1.00	0.98	0.99
2026	0.99	1.00	0.97	0.99
2027	0.98	1.00	0.97	0.99
2028	0.97	1.00	0.97	0.98
2029	0.96	1.00	0.97	0.98
2030	0.95	1.00	0.96	0.98
2031	0.94	1.00	0.96	0.98
2032	0.92	1.00	0.95	0.97
2033	0.91	1.00	0.95	0.97
2034	0.90	0.99	0.94	0.96
2035	0.88	0.99	0.94	0.96
2036	0.87	0.99	0.93	0.96
2037	0.86	0.99	0.93	0.95
2038	0.85	0.99	0.92	0.95
2039	0.84	0.99	0.92	0.95
2040	0.83	0.99	0.92	0.94
2041	0.82	0.99	0.91	0.94
2042	0.81	0.98	0.91	0.94
2043	0.80	0.98	0.90	0.94
2044	0.80	0.98	0.90	0.93
2045	0.79	0.98	0.90	0.93
2046	0.78	0.98	0.90	0.93
2047	0.78	0.98	0.89	0.93
2048	0.77	0.98	0.89	0.93
2049	0.77	0.97	0.89	0.93
2050	0.77	0.97	0.89	0.92

Contact

For questions regarding the EMFAC2017 off-model adjustment factors, please contact us at:
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