EMFAC Off-Model Adjustment Factors to Account for the SAFE Vehicle Rule Part One

November 20, 2019

Summary

Staff at the California Air Resources Board's (CARB) have estimated the vehicle tailpipe and evaporative emissions impacts from the "Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule Part One: One National Program" adopted by the U.S. Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA). The SAFE Vehicle Rule Part One impacts some of the underlying assumptions in the EMFAC2014 and EMFAC2017 models. This document provides the off-model adjustment factors that can be used to adjust emissions output from EMFAC model (only EMFAC2014 and EMFAC2017) to account for the impacts of this rule.

What is the SAFE Vehicle Rule Part One?

On September 27, 2019, the United States Environmental Protection Agency (U.S. EPA) and the National Highway Traffic Safety Administration (NHTSA) published the "Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule Part One: One National Program." (84 Fed. Reg. 51,310 (Sept. 27, 2019.) The Part One Rule revokes California's authority to set its own greenhouse gas emissions standards and set zero-emission vehicle mandates in California. California expects Part Two of these regulations to be adopted later in the Fall of 2019. We will not know the full impacts of these rules until Part Two is released.

How Does the SAFE Vehicle Rule Impact Criteria Emissions?

As CARB has previously stated[1], both the GHG emission standards and the ZEV sales standards reduce criteria pollutants. As a result of the loss of the ZEV sales requirements, there may be fewer ZEVs sold and thus additional gasoline-fueled vehicles sold in future years. This would increase criteria pollutant emissions in multiple ways. A ZEV inherently has zero evaporative emissions of hydrocarbons in the form of gasoline vapors, which escape from the tank and fuel lines during operation and while parked. A gasoline-fueled vehicle with evaporative emissions is assumed to take the place of each ZEV that will not be sold. This leads to an overall increase in hydrocarbon emissions. Additionally, tailpipe emissions of NOx, hydrocarbons, carbon monoxide, and particulate matter also increase as a result of each additional gasoline-fueled vehicle. This increase occurs for several reasons despite the presence of a criteria pollutant "fleet average" standard[2] that CARB has in place for hydrocarbons

[1] https://ww2.arb.ca.gov/carbs-comments-safe-proposal

[2] The Low Emission Vehicle III program requires manufacturers to average emissions from all vehicles in their fleet to meet the standard. In theory, the elimination of some ZEVs (which are counted in such an

and NOx. First, the fleet average does not apply to particulate matter and carbon monoxide, meaning each incremental gasoline-fueled vehicle generates additional tailpipe emissions of both pollutants. Second, because the fleet average is based on a single test cycle and does not fully capture all operating conditions, additional tailpipe emissions of all criteria pollutants occur for every incremental gasoline-fueled vehicle. Third and most significantly, both tailpipe and evaporative criteria pollutant emissions substantially increase over time due to deterioration of the emission controls on gasoline-fueled vehicles. ZEVs have no such deterioration. Thus, even with the fleet-average standard offsetting a portion of the tailpipe emissions by starting some gasoline-fueled vehicles at lower emission levels early in their life, this slight difference is overwhelmed by the increase in emissions from deterioration over the life of the vehicle.

More stringent ZEV and GHG standards are critical to reach attainment of air quality standards and meet climate needs. If standards cannot become more stringent, these mandates will be very difficult to meet. ZEV technologies, in particular, are needed in both light-duty and heavy-duty fleets to help commercialize this technology. As a result, the long-term threat to air quality is substantial as cleaner technologies, especially ZEVs, do not penetrate the fleet at the scale necessary and emissions are not reduced as needed.

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 impact of California's unique mobile source regulations such as the Low-Emission Vehicle (LEV) program including the LEV II and LEV III standards, California inspection and maintenance programs, 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 both EMFAC2014 and EMFAC2017 for use in state implementation plan (SIP) and transportation conformity analyses. For more information on EMFAC, please visit: https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-modeling-tools.

How Did CARB Analyze the SAFE Vehicle Rule Part One's impact on vehicle emissions?

CARB estimated the change in vehicle emissions of the California light-duty vehicle fleet using its EMission FACtor (EMFAC) model. Both EMFAC2014 and EMFAC2017 default models, with an "annual average" setting, were run to estimate statewide vehicle emissions by calendar year, vehicle category, fuel type, and model year

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average as zero emissions) would cause some of the remaining or increased number of gasoline-fueled vehicles to need to be certified to lower (cleaner) levels in order to still meet the same fleet average.

projected to occur under the existing Federal and CARB GHG standards and CARB ZEV requirements that were in place at the time of the analysis. These default results were then adjusted in a post-processing step to reflect the proposed SAFE Vehicle Rule[3]. As a result of freezing new ZEV sales at model year 2020 levels, the projected fleet for 2021 and beyond was modified to reflect a lower number of future ZEVs and a corresponding greater number of future gasoline internal combustion engine vehicles (and thus, a higher portion of vehicle miles traveled (VMT) by gasoline vehicles). The increased number of gasoline vehicles were put into appropriate criteria pollutant certification categories under CARB's Low Emission Vehicle (LEV) III criteria pollutant standards to maintain compliance with the required fleet average.

How is EMFAC impacted by the SAFE Vehicle Rule Part One?

Generally, after the SAFE Vehicle Rule Part One becomes effective on November 26, 2019, EMFAC2014 and EMFAC2017 will not accurately estimate future transportation emissions until they are updated with new assumptions reflecting the SAFE Vehicle Rule Part One in off-model adjustment factors provided by CARB.

What are Off-Model Adjustment Factors and how should they be applied?

CARB has prepared off-model adjustment factors for both the EMFAC2014 and EMFAC2017 models to account for the impact of the SAFE Vehicle Rule Part One. These adjustments provided in the form of multipliers can be applied to emissions outputs from EMFAC model to account for the impact of this rule. The adjustment factors are provided in Table 1 for EMFAC2014 and Table 2 for EMFAC2017 (Note these factors do not include upstream emissions associated with fuel demand, as EMFAC only estimates tailpipe and evaporative emissions).

[3] More details can be found in CARB's letter submitted to US EPA and NHTSA on November 6, 2019 available at: https://www.regulations.gov/document?D=NHTSA-2018-0067-12447

Table 1. Off-Model Adjustment Factors for Gasoline Light Duty Vehicle[4] Emissions in **EMFAC2014**

Adjustment Factors for **EMFAC2014** Gasoline Light Duty Vehicles					
Year	NOx Exhaust	TOG Evaporative	TOG Exhaust	PM Exhaust	CO Exhaust
2021	1.0001	1.0001	1.0001	1.0012	1.0004
2022	1.0002	1.0004	1.0001	1.0034	1.0013
2023	1.0005	1.0008	1.0003	1.0066	1.0026
2024	1.0010	1.0014	1.0005	1.0105	1.0041
2025	1.0016	1.0021	1.0009	1.0149	1.0058
2026	1.0022	1.0030	1.0012	1.0183	1.0076
2027	1.0029	1.0039	1.0016	1.0208	1.0095
2028	1.0036	1.0050	1.0020	1.0224	1.0116
2029	1.0044	1.0063	1.0025	1.0241	1.0139
2030	1.0052	1.0078	1.0030	1.0260	1.0162
2031	1.0061	1.0095	1.0036	1.0279	1.0186
2032	1.0071	1.0114	1.0042	1.0299	1.0210
2033	1.0081	1.0134	1.0050	1.0320	1.0235
2034	1.0091	1.0156	1.0059	1.0341	1.0260
2035	1.0103	1.0179	1.0070	1.0362	1.0285
2036	1.0114	1.0202	1.0082	1.0382	1.0309
2037	1.0125	1.0224	1.0096	1.0400	1.0332
2038	1.0137	1.0247	1.0111	1.0418	1.0353
2039	1.0148	1.0269	1.0126	1.0435	1.0372
2040	1.0158	1.0290	1.0141	1.0449	1.0389
2041	1.0167	1.0309	1.0154	1.0461	1.0404
2042	1.0176	1.0326	1.0168	1.0471	1.0418
2043	1.0183	1.0340	1.0180	1.0480	1.0429
2044	1.0190	1.0352	1.0190	1.0487	1.0439
2045	1.0195	1.0364	1.0199	1.0494	1.0448
2046	1.0200	1.0373	1.0206	1.0499	1.0454
2047	1.0204	1.0384	1.0213	1.0504	1.0461
2048	1.0208	1.0393	1.0218	1.0508	1.0467
2049	1.0209	1.0400	1.0221	1.0510	1.0470
2050	1.0210	1.0406	1.0224	1.0512	1.0472

[4] LDA, LDT1, LDT2 and MDV vehicle categories in EMFAC

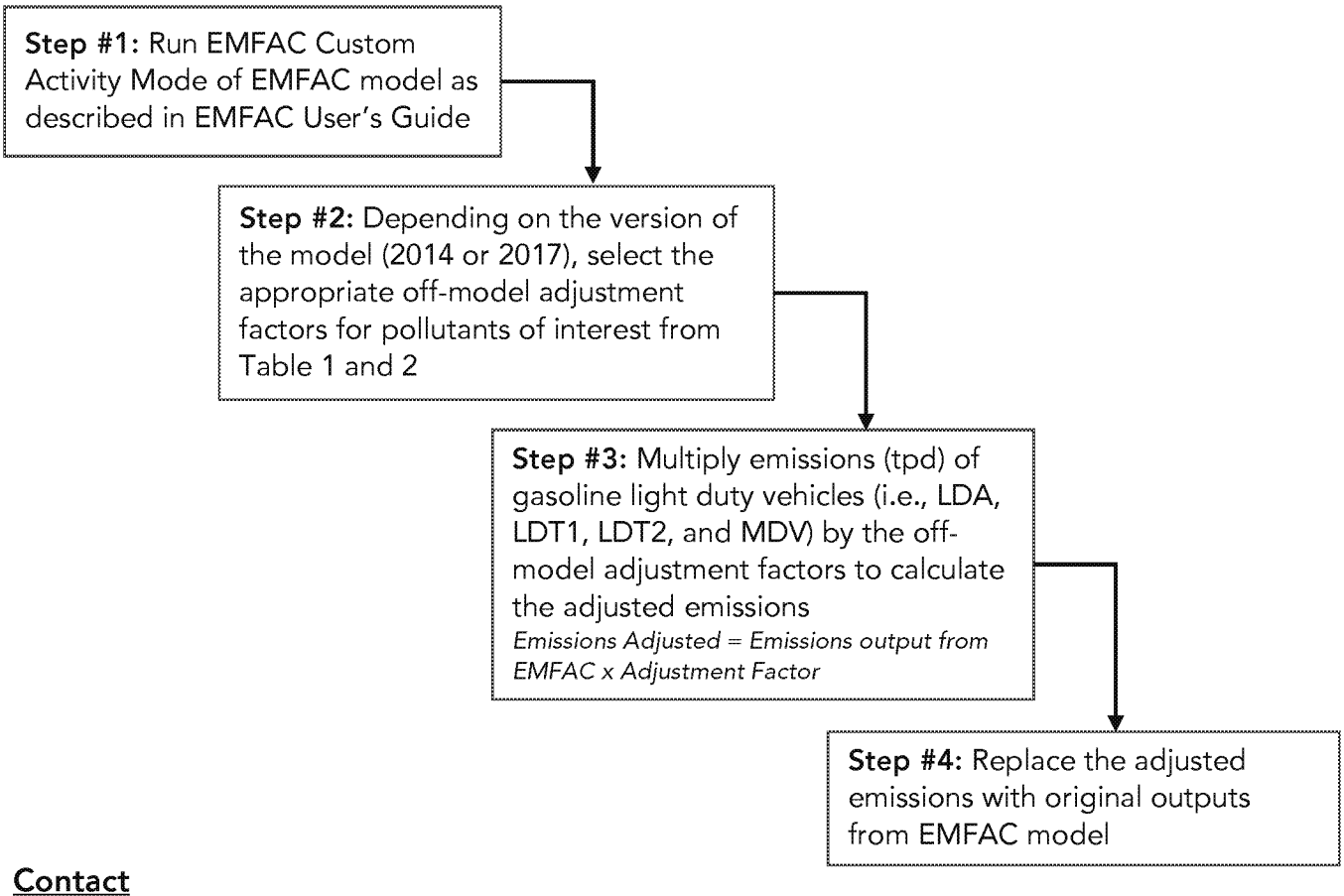
Table 2. Off-Model Adjustment Factors for Gasoline Light Duty Vehicle Emissions in **EMFAC2017**

Adjustment Factors for **EMFAC2017** Gasoline Light Duty Vehicles					
Year	NOx Exhaust	TOG Evaporative	TOG Exhaust	PM Exhaust	CO Exhaust
2021	1.0002	1.0001	1.0002	1.0009	1.0005
2022	1.0004	1.0003	1.0004	1.0018	1.0014
2023	1.0007	1.0006	1.0007	1.0032	1.0027
2024	1.0012	1.0010	1.0011	1.0051	1.0044
2025	1.0018	1.0016	1.0016	1.0074	1.0065
2026	1.0023	1.0022	1.0020	1.0091	1.0083
2027	1.0028	1.0028	1.0024	1.0105	1.0102
2028	1.0034	1.0035	1.0028	1.0117	1.0120
2029	1.0040	1.0042	1.0032	1.0129	1.0138
2030	1.0047	1.0051	1.0037	1.0142	1.0156
2031	1.0054	1.0061	1.0042	1.0155	1.0173
2032	1.0061	1.0072	1.0047	1.0169	1.0189
2033	1.0068	1.0083	1.0052	1.0182	1.0204
2034	1.0075	1.0095	1.0058	1.0196	1.0218
2035	1.0081	1.0108	1.0063	1.0210	1.0232
2036	1.0088	1.0121	1.0069	1.0223	1.0244
2037	1.0094	1.0134	1.0074	1.0236	1.0255
2038	1.0099	1.0148	1.0079	1.0248	1.0265
2039	1.0104	1.0161	1.0085	1.0259	1.0274
2040	1.0109	1.0174	1.0090	1.0270	1.0281
2041	1.0113	1.0186	1.0095	1.0279	1.0288
2042	1.0116	1.0198	1.0099	1.0286	1.0294
2043	1.0119	1.0207	1.0103	1.0293	1.0299
2044	1.0122	1.0216	1.0106	1.0299	1.0303
2045	1.0124	1.0225	1.0109	1.0303	1.0306
2046	1.0125	1.0233	1.0111	1.0308	1.0309
2047	1.0127	1.0240	1.0113	1.0311	1.0311
2048	1.0128	1.0246	1.0115	1.0314	1.0313
2049	1.0128	1.0252	1.0116	1.0316	1.0315
2050	1.0129	1.0257	1.0117	1.0318	1.0316

The off-model adjustment factors need to be applied only to emissions from gasoline light duty vehicles (LDA, LDT1, LDT2 and MDV). Please note that the adjustment factors are by calendar year and includes all model years.

For example, the Custom Activity Mode of EMFAC2014 and 2017 is designed to perform emissions assessments for determining conformity with the state implementation plan. These types of assessments are most often done by various transportation planning agencies and air districts throughout California which require the user to create custom activity data files containing vehicle miles travelled (VMT) and/or speed profile data. This customized activity data will then be used for scaling the default vehicle emissions produced by EMFAC model. The off-model adjustment factors provided in this document can be applied to gasoline light duty vehicle emissions outputs of the EMFAC Custom Activity Mode, as illustrated in Figure 1.

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



Contact

For questions regarding the EMFAC off-model adjustment factors, please contact us at: EMFAC@arb.ca.gov