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Rule 2202 – On-Road Motor Vehicle Mitigation Options
Emission Factor and Emission Reduction Target Methodology

Rule 2202 – On-Road Motor Vehicle Mitigation Options has been designed to reduce emissions from mobile sources. Rule 2202 provides employers with a menu of options that they can choose from to implement and meet the emission reduction target (ERT) for their worksites.

The Emission Reduction Target (ERT) is the annual reactive organic gases (ROG), oxides of nitrogen (NOx), and carbon monoxide (CO) emissions required to be reduced by each worksite based on the number of employees reporting to work during the peak window and the appropriate Performance Zone. The ERT for each pollutant for each worksite may be calculated by using the appropriate emission factors based on an EPA-approved California Air Resources Board (CARB) on-road mobile source emission factors (EMFAC) model.

In accordance with subdivision (m) of Rule 2202, the EMFAC based emission factors are to be revised using the most recent CARB EMFAC version (EMFAC2017) that has EPA's final approval.

This document describes the formulas and methodologies used to develop the emission reduction factors used and defined by Rule 2202 – On-Road Motor Vehicle Mitigation Options. This document is an update of the technical appendix found in the February 2004 Staff Report as part of amendments to Rule 2202 and associated guidelines (South Coast AQMD Governing Board Meeting, February 2, 2004, Agenda No. 26).

Annual Emission Factors for Daily Commute Vehicles

Emissions Generation

Motor vehicles are responsible for the generation of ROG, NOx, and CO emissions. These pollutants are linked to either the combustion process of the engine or to the evaporation of the motor fuel from the storage and delivery system. These processes can be further categorized into different operating modes of the vehicle.

Since ROG-equivalent volatile organic compounds (VOC) is used in South Coast AQMD rules, guidelines, and other official documents, VOC is also used in lieu of ROG in this document. Table 1 below lists the vehicle emission sources.

Table 1. Vehicle Emission Sources by Pollutant

VOC	NOx	CO
Start Exhaust	Start Exhaust	Start Exhaust
Running Exhaust	Running Exhaust	Running Exhaust
Idle Exhaust	Idle Exhaust	Idle Exhaust
Hot Soak Evaporation		
Running Losses		
Resting Losses		
Diurnal Evaporation		

EMFAC Model

South Coast AQMD relies on the most recent EPA-approved EMFAC2017 for vehicle population and emission inventories in the South Coast Air Basin, which are then used to estimate the annual commute vehicle emission factors.

Emissions and Population Data

Tables 2, 3, and 4 depict total daily emissions and population for gasoline, diesel, and electric light-duty vehicles, which include passenger cars (LDA) and light duty trucks (LDT1 and LDT2) from the EMFAC2017 model output. To be consistent with the emissions inventory methodology for South Coast AQMD Rule 1610 – Old-Vehicle Scrapping, motorcycles are also excluded in Rule 2202 inventory as their population is minimal compared to the total.

Table 2. VOC Mobile Source Emissions and Population

Year	Population	TOTAL VOC (ton/day)
2019	8,948,673	53.39
2020	9,125,366	49.65
2021	9,308,130	46.55
2022	9,492,745	43.87
2023	9,674,764	41.48
2024	9,854,804	39.42
2025	10,034,980	37.57

Table 3. NOx Mobile Source Emissions and Population

Year	Population	TOTAL NOx (ton/day)
2019	8,948,673	44.71
2020	9,125,366	39.56
2021	9,308,130	35.35
2022	9,492,745	31.78
2023	9,674,764	28.79
2024	9,854,804	26.32
2025	10,034,980	24.22

Table 4. CO Mobile Source Emission and Population

Year	Population	Total CO (ton/day)
2019	8,948,673	534.72
2020	9,125,366	493.40
2021	9,308,130	460.22
2022	9,492,745	431.70
2023	9,674,764	407.64
2024	9,854,804	388.07
2025	10,034,980	369.33

Annual Commute Vehicle Emission Factors

Annual commute vehicle emission factors are estimated based on the following:

- The South Coast Air Basin (SCAB) emission and vehicle inventories, as determined by the EMFAC2017, are assumed to be accurate and representative for the years denoted in the emission factor tables.
- 260 days per year is assumed for commute vehicle's annual operating days.

Annual commute vehicle emission factors for each pollutant can be determined by the following equation:

Emission Factor (pounds/year/vehicle) = Daily vehicle emission (tons/day/vehicle) x 2000 pounds/ton x 260 days/year

Table 5 lists the annual commute vehicle emission factors.

Table 5. Annual Commute Emission Factors (pounds/year/commute vehicle)

Year	VOC	NOx	CO
2019	3.10	2.60	31.07
2020	2.83	2.25	28.12
2021	2.60	1.97	25.71
2022	2.40	1.74	23.65
2023	2.23	1.55	21.91
2024	2.08	1.39	20.48
2025	1.95	1.26	19.14

As depicted by Table 5, the vehicle annual emission factors typically decrease over time due to the replacement of vehicles with lower tailpipe emissions, changes in demographics, and/or fuel formulations.

Emissions Reduction Target

For Rule 2202 employers selecting the Emission Reduction Strategies (ERS) Option or the Employee Commute Reduction Program Offset (ECRP Offset), the following methodology is developed to assist them in determining whether or not they meet the Average Vehicle Ridership (AVR) target for its worksite. In other words, based on the number of employees reporting in the peak commute window and their vehicles, employers would calculate the VOC, NOx, and CO emissions reduction target (ERT). In the event that the AVR target is not met, the employers would need to obtain emission credits, through the application of various mobile source reduction options (vehicle trip emission credits or rideshare), that would be at least equal to the calculated ERT.

Employee Emission Reduction Factors

The Performance Zones for regions 1, 2, and 3 are assigned AVR targets of 1.75, 1.5, and 1.3 respectively (a Performance Zone map can be found in Attachment I of Rule 2202). These were determined to be the most effective approach in achieving the emission reduction goals for the region.

Employers would determine their worksite AVR from the number of employees reporting in the peak commute window divided by the number of their vehicles driven to the worksite.

The worksite AVR can be determined through employee surveys which would reflect the current state of employee commutes. For employers who select the ERS and choose not to conduct the surveys, the AVR is assumed to be 1.10. In the event the worksite AVR is less than the AVR target (meaning the worksite does not meet or exceed its AVR target), the employer would need to determine the additional vehicles and their associated emissions to be reduced (the Emission Reduction Target, ERT).

To estimate the ERT, a shortfall is developed. A shortfall illustrates the level of effort required to achieve the worksite's AVR target. Shortfall is determined based on the ratio of the worksite's computed AVR and AVR target:

$$\text{Shortfall} = 1 - \frac{\text{AVR Worksite}}{\text{AVR Target}}$$

Since Rule 2202 employers are not required to implement a trip reduction program, a worksite AVR of 1.0 is assumed (each employee drives alone to work). For worksites with an AVR target of 1.5 (Zone 2), the shortfall would be calculated as follows:

$$\text{Shortfall} = 1 - \frac{1.0}{1.5}$$

$$\text{Shortfall} = 0.333$$

Performing a similar calculation, the shortfall values for AVR targets of 1.75 (Zone 1) and 1.3 (Zone 3) are 0.429 and 0.231, respectively. The shortfall value remains constant over the year between the required reporting times.

Since each AVR zone results in different shortfall values, employee emission reduction factors are estimated specifically for each AVR zone and each pollutant. In order to accommodate the terms in which the AVR targets are to be achieved (i.e., pounds of emissions per employee), the AVR target zones are redefined as Performance Target Zones. Performance Target Zones 1, 2 and 3 correspond to the AVR targets of 1.75, 1.5, and 1.3, respectively.

Assuming that each employee drives alone, there is a one-to-one relationship between a commute vehicle and employee. Each employee, therefore, is responsible for the corresponding annual emissions from Table 5. The employee emissions reduction for each pollutant needed to reach the AVR target is estimated as follows:

Employee Emission Reduction Factors (pounds/year/employee)	=	Shortfall	X	1 Vehicle/Employee	X	Annual Vehicle Emission Factors (pounds/year/commute vehicle)

The employee emission reduction factors for Performance Target Zones 1, 2 and 3 are shown below.

Table 6. Employee Emission Reduction Factors
Performance Zone 1 – pounds/year/employee

Year	VOC	NOx	CO
2019	1.33	1.11	13.32
2020	1.21	0.97	12.05
2021	1.11	0.85	11.02
2022	1.03	0.75	10.13
2023	0.96	0.66	9.39
2024	0.89	0.60	8.78
2025	0.83	0.54	8.20

Table 7. Employee Emission Reduction Factors
Performance Zone 2 – pounds/year/employee

Year	VOC	NOx	CO
2019	1.03	0.87	10.36
2020	0.94	0.75	9.37
2021	0.87	0.66	8.57
2022	0.80	0.58	7.88
2023	0.74	0.52	7.30
2024	0.69	0.46	6.83
2025	0.65	0.42	6.38

Table 8. Employee Emission Reduction Factors
Performance Zone 3 – pounds/year/employee

Year	VOC	NOx	CO
2019	0.72	0.60	7.17
2020	0.65	0.52	6.49
2021	0.60	0.46	5.93
2022	0.55	0.40	5.46
2023	0.51	0.36	5.06
2024	0.48	0.32	4.73
2025	0.45	0.29	4.42

Emissions Reduction Target

Applying the employees emission reduction factors from Table 6, 7, or 8 (depending on the employer's performance zone) to the total number of employees that report to work in the peak commute window would result in the employee emission reduction needed to meet the target AVR – Equation #1:

Employee Emission Reduction (pounds/year)	=	Total Number of Employees in the Peak Window	X	Employee Emission Reduction Factor (pounds/year/employee)

If employee surveys are conducted, the Creditable Commute Vehicle Reduction (CCVR) is then determined as the difference between the numbers of employees reporting to work in the peak window and their vehicles. If surveys are not conducted (AVR is assumed to be 1.10), the number of commute trips must be estimated before the CCVR can be determined:

Number of Vehicle Trips	=	Total Number of Employees in the Peak Window	/	1.10

The CCVR is then multiplied by the commute emission factors from Table 5 to obtain the Vehicle Trip Emission Credits (VTEC) – Equation #2:

Vehicle Trip Emission Reduction Credit (pounds/year)	=	Creditable Commute Vehicle Reduction	X	Annual Commute Emission Factors (pounds/year/vehicle)

The emission reduction target (ERT) is determined as the difference between employee emission reduction target (Equation #1) and CCVR (Equation #2).

An ERT equal to zero or a negative number means the AVR target is met. If the AVR target is not met, the employers would need to obtain emission credits, through the application of various mobile source reduction options (vehicle trip emission credits or rideshare), that would be at least equal to the calculated ERT.