

EMFAC Modeling Change Technical Memo

SUBJECT: CODING MODIFICATIONS TO CORRECT ERRORS IN
EMFAC2002

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SUMMARY

Since the official release of EMFAC2001¹, staff has noted several coding errors. This document only details errors that have an impact on emissions, and quantifies the impact on emissions from fixing **all** these errors simultaneously. The following changes will be incorporated into the release of the working draft version of EMFAC2007:

- a) Corrected how the Mexican vehicle population is backcasted and forecasted from the base year (1999). This impacts the vehicle populations in San Diego and Imperial counties;
- b) Corrected how the population of new vehicles is calculated in the first forecast year (2000) to ensure that it is based on the gas to diesel ratio in calendar year 2000, instead of 1999;
- c) Changed code that limited the forecasted sales of new heavy heavy-duty vehicles;
- d) Removed a portion of the code that capped the PM rates above a certain mileage for **all** heavy-duty trucks;
- e) Changed the precision with which the model determines if vehicles in a given hour are experiencing a resting loss event or a diurnal event;
- f) Corrected the code so that a user selection for adding motorcycles to Inspection and Maintenance (I&M) programs is retained; and
- g) Corrected an error in how temperature is referenced in calculating diurnal evaporative emissions in the EMFAC mode.

These coding modifications were made to the internal working draft of EMFAC2007 ver. 2.213. Table 1 shows the incremental difference (ver. 2.213 – ver. 2.212²) in **summer episodic** inventories for calendar year 2002. Table 1 shows that including these coding modifications will change statewide ROG, CO, NOx, and PM10 emissions from **all** on-road motor vehicles in 2002 calendar year by -0.49, -7.31, 7.74, and 3.96 tons per day, respectively. To put this in perspective, this will change statewide ROG, CO, NOx, and PM10 on-road motor vehicle emissions in 2002 by -0.06%, -0.08%, 0.46%, and 8.41%, respectively. Similarly, Table 2 shows that in 2015 the statewide summer ROG, CO, NOx, and PM10 emissions from **all** on-road motor vehicles will change by -1.19, -9.24,

¹ EMFAC2002 April 23, version 2.206 posted on ARB's web site.

² Internal working draft of EMFAC2007 version 2.212 that has been updated with new fuel corrections factors and I&M changes.

-0.18, and 2.39 tons per day, respectively. This is equivalent to a -0.32%, -0.26%, 0.03%, and 4.73% change to the total on-road motor vehicle emissions inventory, respectively.

Table 1 Summary of Emissions Changes from Coding Modifications
Calendar Year 2002

Area	Emission Changes by Pollutant (tons/day)				
	ROG	CO	NOx	CO2	PM10
Statewide	-0.49	-7.31	7.74	1867.80	3.96
South Coast Air Basin	-0.28	-3.72	3.01	689.90	1.17
San Joaquin Valley AB	-0.12	-1.59	1.16	339.65	0.86
Sacramento Valley AB	-0.05	-0.67	0.39	111.85	0.35
San Diego Air Basin	0.16	1.59	1.26	209.77	0.34
San Francisco Bay Area	-0.13	-1.66	1.01	299.15	0.70

Table 2 Summary of Emissions Changes from Coding Modifications
Calendar Year 2015

Area	Emission Changes by Pollutant (tons/day)				
	ROG	CO	NOx	CO2	PM10
Statewide	-1.19	-9.24	-0.18	1218.80	2.39
South Coast	-0.48	-3.14	1.18	35.40	0.69
San Joaquin Valley AB	-0.24	-1.80	-0.98	420.38	0.52
Sacramento Region AB	-0.10	-0.80	-0.11	109.19	0.18
San Diego Air Basin	0.14	1.24	0.40	301.44	0.20
San Francisco Bay Area	-0.15	-1.16	0.28	20.40	0.43

NEED FOR REVISION

The upcoming SIP process requires that the model reflect regulations or measures that have been adopted since the last update. Consistent with this policy, known errors in the model should be fixed to allow for more accurate assessment of emissions inventory in each area.

AFFECTED SOURCE CODE/VERSION

Get_Pop.for
 Calc_BER_CF.for
 UpdateTG.f90
 Modules.for
 Commons.for
 Utilities90.f90
 EmfacResrc.rc

METHODOLOGY

This document details coding modifications to each of the following subsections: Mexican Vehicle Population Forecast and Backcast; Forecasting Gas to Diesel Vehicles; Forecasting Heavy Heavy-Duty Vehicles; Removing Caps on PM Deterioration from Heavy-Duty Vehicles; The “Is-Rest” Check; and Motorcycle I&M.

Mexican Vehicle Population Forecast and Backcast

The model contains populations of Mexican³ passenger cars and heavy heavy-duty diesel trucks that cross into San Diego and Imperial counties. These populations are for the base year, which is 1999. For the base year, these populations are simply added to the population estimates of San Diego and Imperial counties. To determine the population of Mexican vehicles in other calendar years, the model has to either forecast (for 2000 and newer calendar years) or backcast (for 1998 and prior years) the vehicle population from the base year.

The baseline total population is the sum of the registered population (with corrections for out-of-state heavy-duty vehicles) plus the chronically-unregistered population plus the Mexican cross-border population.

In forecasting and backcasting, the model first calculates the registered vehicle population, and then calculates the chronically-unregistered and Mexican populations. In previous model versions, the code for backcasting the Mexican population included an error that affected the first backcast year. In the first backcast year, the Mexican vehicle population was adjusted with survival rates but was not adjusted with the population growth rates (which are negative for backcasts).

The previous forecast method did not use the same method for the Mexican population as for the registered and chronically unregistered populations in San Diego and Imperial counties. The previous forecast method applied the population growth rates in San Diego and Imperial counties directly, without applying survival and sales adjustments. This provided the correct population for Mexican vehicles, but it did not allow for the same gradual changes in age distribution that were applied to the rest of the population.

The population calculations were modified so that registered, unregistered, and Mexican populations are treated identically in forecasting and backcasting.

Forecasting Gas to Diesel Vehicles

In forecasting new vehicle sales, the model looks at the model year technology fractions, which detail the breakdown of new vehicle sales among various

³ Section 12.0 of EMFAC2000 Technical Support Documentation

technologies. In a given model year, the percentage of the cars that are gasoline (LEV, ULEV, SULEV, etc.) or diesel fueled is based on the technology fractions for cars sold in that model year. For example, the population of 2000 model year gasoline and diesel cars is based on the 2000 model year technology fractions for cars. However, the model was looking up the technology fractions for 1999 rather than those for 2000. This index was essentially off by one year.

The "Get_Pop" algorithm was modified to reflect the correct model year in assessing the gasoline to diesel fuel split.

Forecasting Heavy Heavy-Duty Vehicles

The impact of this coding change is dependent on the population growth of heavy heavy-duty vehicles (HHDV). In forecasting, the sales of new vehicles are capped so that they do not exceed the previous year's new vehicle sales by more than 10%. In the development of EMFAC2000, staff assumed that, if new vehicle sales increased by more than 10%, a lot of older vehicles had been scrapped from the fleet. This potentially implied a dynamic change to the survival rates. In the final release of the EMFAC2000 model, the code for dynamically changing the vehicle survival rates was not implemented. However, the flag which limits new vehicle sales was retained. If the sales limit is exceeded, the additional vehicles are added in proportion to the existing population distribution. This sales limit is not reached for any vehicle class except for HHDV, which are also adjusted by the out-of-state HHDV fraction to account for the total fleet. This adjustment factor accounts for out-of-state HHDV traveling in California.

In reviewing this code, staff noted that, for HHDV, the previous year's sales were not adjusted by the out-of-state HHDV fraction. This meant that the new HHDV sales were capped by the 10% sales limit because the previous year's sales had not been adjusted by the out-of-state HHDV fraction and were lower by 33%. This was fixed by calculating previous year sales based on the registered vehicle population and the out-of-state fraction.

Prior to this fix, with the current values for population-growth factors, the new-vehicle sales limit for HHDV was being reached in most areas of the state, and for most of the calendar years from 2000 to 2010. This meant that additional HHDV were added to the fleet in proportion to the existing population distribution thus skewing the distribution towards older vehicles. Older HHDV accrue fewer miles per day than newer vehicles, hence the calculated VMT for HHDV was lower. Therefore, this change will not have a significant impact on total population of HHDV, but it will change the forecasted population distribution, which will have a large impact on VMT and emissions.

With the fix in place, the number of new vehicles added to the fleet each year increases by nearly 30% in the first forecast year; smaller, but substantial, increases occur over the next 10 forecast years.

Removing Caps on PM Deterioration from Heavy-Duty Vehicles

Dr. Carol Wong, from Hong Kong EPD⁴, noticed a portion of the code where the text implied a change to the light-heavy duty trucks (vehicle classes 5 and 6) but the code was incorrectly written as applying to vehicle classes 4 (medium-duty trucks) and 5 (light heavy-duty trucks). The portion of the code is shown below.

```
> c   PM exhaust rates for heavy duty vehicles require special treatment;
> c   their deterioration factors switch to zero after specified mileages:
> c
> c       120K for light heavy duty vehicles (IVEH = 4, 5)
> c       185K for medium heavy duty vehicles (IVEH = 7, 12, 13)
> c       290K for heavy-heavy duty vehicles (IVEH = 8, 9)
> c
> c   IF (IPOL == PM$ .AND. IMODE <= 5) THEN
> c       IF (IVEH == 4 .OR. IVEH == 5) THEN
> c           ODOMETER = MIN(12.0,CUMMIL(AGEYR,IFUEL,IVEH))
> c       ELSEIF (IVEH == 7 .OR. IVEH == 12 .OR. IVEH == 13) THEN
> c           ODOMETER = MIN(18.5,CUMMIL(AGEYR,IFUEL,IVEH))
> c       ELSEIF (IVEH == 8 .OR. IVEH == 9) THEN
> c           ODOMETER = MIN(29.0,CUMMIL(AGEYR,IFUEL,IVEH))
> c       ELSE
> c           ODOMETER = CUMMIL(AGEYR,IFUEL,IVEH)
> c       ENDIF
> c   ELSE
> c       ODOMETER = CUMMIL(AGEYR,IFUEL,IVEH)
> c   ENDIF
```

Staff examined this code and noted two errors. Dr. Wong was correct about the first error in that light heavy-duty vehicles refer to vehicle classes 5 and 6 and not 4. The second is more of a legacy error. This portion of the code also limits the mileage (through odometer) used in calculating PM emissions from heavy-duty vehicles. This portion of the code is/was valid when the emissions data was based on engine tests (EMFAC7G / EMFAC2000). Since the new data on heavy-duty vehicles are based on chassis testing, these limits on PM should have been removed.

This portion of the code was removed from the CALC_BER_CF.for file.

The “Is-Rest” Check- *Resting Loss and Diurnal Temperature Checks*

After the release of EMFAC2002 ver 2.206, staff noted that the number of hours experiencing resting loss were different than those calculated in a previous version of EMFAC2002. These differences occurred even though both models were using the same temperature profile.

⁴ Hong Kong Environmental Protection Department

The differences arose because of numerical roundoff in calculating average temperatures for annual and area-average cases combined with a simplistic test for temperature change. This is demonstrated in the table below.

Table 1 Average AREATEMP Values for Annual Case for San Diego County

Model	Period	AREATEMP	IS_REST	IS_DIURNAL
2.2 rls	4	60.799995		
2.2 rls	5	59.900002	TRUE	FALSE
2.2 rls	6	59.900005	FALSE	TRUE
2.206 rls	4	60.799999		
2.206 rls	5	59.900002	TRUE	FALSE
2.206 rls	6	59.899998	TRUE	FALSE

In periods 5 and 6, the averaged temperature (AREATEMP) is 59.9 degrees for both time periods. The exact calculated values differ very slightly in the two different model versions, but the differences are not meaningful. The differences are artifacts due to rounding.

Resting losses occur in hours where the ambient temperature is constant or decreasing. Diurnal losses occur in hours where the ambient temperature is increasing.

The model checks the temperature change between two hours to determine if vehicles in a particular hour are experiencing resting loss events. The code used a simple inequality test to determine whether the temperature increased. This test did not account for values being “approximately” equal. Using the AREATEMP values above for version 2.200, without allowing for roundoff, the code would assign period 6 to diurnal emissions. When using the values for version 2.206, the same period would be assigned to resting emissions.

The inequality test was replaced with a call to a new function, IsIncreasing. The function evaluates to “true” only if the relative increase from one period to the next is greater than 1.E-5.

When using the IsIncreasing function, the resting-loss test evaluates to “true” for both sets of AREATEMP values above and the diurnal-loss test evaluates to “false.”

Motorcycle I&M

Staff were doing an assessment to determine the emission benefits from adding motorcycles to the statewide Inspection and Maintenance (I&M) program in 2005 calendar year. When comparing results, users noted inconsistent results from adding motorcycles to the I&M program.

Upon examination of the input files, staff noted that I&M flags were correctly set in the input files but they weren't read in correctly. This problem has been corrected; the vehicle flags that are written out and read in from the input file now match the program's internal flags.

Temperature Reference in EMFAC Mode Diurnal Emissions

In the evaporative subroutine used in calculating diurnal emissions for the EMFAC mode, the code was selecting the wrong coefficient for temperature dependence when the ambient temperature was below 65 degrees. This was due to a simple error in array subscripts.

The code was corrected to select the correct temperature coefficient. This change will not affect the tons per day emissions from Burden since its code was correctly coded.

INVENTORY EFFECTS

Table 3 shows summaries of the statewide summer episodic on-road motor vehicle inventories calculated using internal working draft EMFAC2007 version 2.213, which contains the coding fixes noted in this document. These inventories were calculated by running the model for **summer** on an area-average basis to determine the impact of coding changes on a statewide basis. Table 3 shows that including coding modifications will change statewide emissions of ROG, CO, NOx, and PM10 for **all** on-road motor vehicles in the 2002 calendar year by -0.49, -7.31, 7.74, and 3.96 tons per day, respectively. To put this in perspective, this will change statewide ROG, CO, NOx, and PM10 on-road motor vehicle emissions in 2002 by -0.06%, -0.08%, 0.46%, and 8.41%, respectively. Similarly, Table 3 shows that in 2015 the statewide on-road motor vehicle inventory of ROG, CO, NOx, and PM10 will change by -1.19, -9.24, -0.18, and 2.39 tons per day, respectively. This is equivalent to a -0.32%, -0.26%, -0.03%, and 4.73% change to the on-road motor vehicle emissions inventory.

Tables 4 through 8 show the impact of these changes on summer episodic inventories from Sacramento, San Diego, San Francisco, San Joaquin and the South Coast Air Basin, respectively.

Table 3 shows significant changes, more than anticipated, to the daily estimates of vehicle miles traveled (VMT) and to emissions in general from incorporating these coding fixes. Table 9 shows the changes to the statewide activity and emission estimates, by vehicle class, in calendar year 2005. This table indicates that fixing the error that limited the sales of HHDV caused the VMT to increase by approximately 1.4 million miles per day. The HHDV VMT increase resulted from changes to the forecasted HHDV population (see Figure 1). The average age of a HHDV dropped from 13.05 to 12.40 years. In general, newer vehicles travel more miles per day; hence, changing the age distribution with more newer

vehicles will increase the daily VMT. Figure 2 shows the changes to the forecasted VMT from HHDV.

Table 3 Impact of Coding Fixes on Statewide Inventories

Statewide Summer Episodic Emissions From All On-Road Motor Vehicles (Calculated Using EMFAC2007 draft ver 2.212)							
Cal. Year	Population	VMT*(1000)	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	12044256	389110750	3297.08	29464.92	2315.25	262391.60	43.71
1990	18550046	677172610	2098.44	21947.55	2593.12	425584.10	66.67
2000	22223344	796074180	1023.79	10593.18	1837.73	465220.80	47.06
2002	23188446	825020420	861.18	8840.74	1671.41	479467.40	47.14
2005	24697722	872884100	695.70	7080.65	1416.67	505232.30	47.93
2010	27266632	957360640	507.12	5021.08	1050.07	561716.70	49.10
2015	29638630	1032914500	377.27	3498.82	703.86	612130.60	50.58
2020	32084134	1109514100	296.22	2501.54	488.57	656076.20	52.62
Statewide Summer Episodic On-Road Motor Vehicle Inventories With Coding Fixes (Calculated Using EMFAC2007 draft ver 2.213)							
Cal. Year	Population	VMT*(1000)	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	12041880	389166080	3295.50	29461.60	2314.83	262425.80	46.60
1990	18546378	677009980	2097.65	21943.77	2591.55	425411.20	72.91
2000	22223088	796323710	1023.66	10590.63	1840.57	465847.60	51.03
2002	23187272	825735810	860.69	8833.43	1679.15	481335.20	51.11
2005	24695158	874319490	694.49	7066.71	1420.40	508798.20	51.75
2010	27261810	958940800	505.40	5005.88	1047.25	565548.90	52.07
2015	29633200	1033439800	376.08	3489.59	703.67	613349.40	52.98
2020	32078400	1109706600	295.46	2498.19	489.54	656449.10	54.73
Difference (Ver. 2.213 - Ver. 2.212) in Statewide Emission Inventories (tons per day)							
Cal. Year	Population	VMT(miles)	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	-2376	55330	-1.57	-3.32	-0.42	34.20	2.89
1990	-3668	-162630	-0.79	-3.78	-1.58	-172.90	6.24
2000	-256	249530	-0.13	-2.55	2.84	626.80	3.97
2002	-1174	715390	-0.49	-7.31	7.74	1867.80	3.96
2005	-2564	1435390	-1.21	-13.93	3.73	3565.90	3.82
2010	-4822	1580160	-1.72	-15.20	-2.82	3832.20	2.97
2015	-5430	525300	-1.19	-9.24	-0.18	1218.80	2.39
2020	-5734	192500	-0.76	-3.35	0.97	372.90	2.11
Percentage Change in Statewide Emission Inventories (relative to Ver. 2.212)							
Cal. Year	Population	VMT	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	-0.02%	0.01%	-0.05%	-0.01%	-0.02%	0.01%	6.61%
1990	-0.02%	-0.02%	-0.04%	-0.02%	-0.06%	-0.04%	9.36%
2000	0.00%	0.03%	-0.01%	-0.02%	0.15%	0.13%	8.44%
2002	-0.01%	0.09%	-0.06%	-0.08%	0.46%	0.39%	8.41%
2005	-0.01%	0.16%	-0.17%	-0.20%	0.26%	0.71%	7.98%
2010	-0.02%	0.17%	-0.34%	-0.30%	-0.27%	0.68%	6.05%
2015	-0.02%	0.05%	-0.32%	-0.26%	-0.03%	0.20%	4.73%
2020	-0.02%	0.02%	-0.26%	-0.13%	0.20%	0.06%	4.01%
ROG_Tot ¹ - This includes running, starting, idle exhaust emissions and emissions from all evaporative processes.							
PM10_Tot ² - Total emissions from running, starting, idle processes, and from tire wear and brake wear.							

Table 4 Impact of Coding Fixes on Sacramento Valley Air Basin Inventories

Sacramento Summer Episodic Emissions From All On-Road Motor Vehicles (Calculated Using EMFAC2007 draft ver 2.212)							
Cal. Year	Population	VMT*(1000)	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	928448	27881342	253.93	2286.53	178.17	19083.41	3.63
1990	1390476	47539696	167.37	1708.18	201.06	30649.06	5.50
2000	1639920	54680392	81.28	791.49	141.62	33668.76	3.63
2002	1750373	57784508	70.51	671.91	130.23	35241.25	3.59
2005	1907740	62629400	58.21	540.80	109.02	37766.85	3.59
2010	2145240	70184448	42.24	373.66	77.58	41776.20	3.55
2015	2397775	77831144	31.11	253.08	50.72	45752.51	3.60
2020	2633766	84078712	24.42	178.25	34.24	49480.40	3.76
Sacramento Summer Episodic On-Road Motor Vehicle Inventories With Coding Fixes (Calculated Using EMFAC2007 draft ver 2.213)							
Cal. Year	Population	VMT*(1000)	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	928538	27899692	253.91	2287.43	178.23	19099.17	3.95
1990	1390293	47535384	167.31	1708.06	201.06	30646.95	6.10
2000	1639895	54699356	81.26	791.12	141.78	33715.70	3.99
2002	1750264	57828772	70.46	671.24	130.62	35353.10	3.93
2005	1907510	62704904	58.13	539.85	109.17	37957.99	3.91
2010	2144810	70267144	42.13	372.56	77.41	41986.34	3.79
2015	2397312	77873800	31.01	252.29	50.61	45861.70	3.78
2020	2633298	84091224	24.36	177.94	34.21	49513.31	3.91
Difference (Ver. 2.213 - Ver. 2.212) in Sacramento Emission Inventories (tons per day)							
Cal. Year	Population	VMT(miles)	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	90	18350	-0.02	0.90	0.07	15.76	0.32
1990	-183	-4312	-0.05	-0.12	-0.01	-2.11	0.60
2000	-25	18964	-0.02	-0.37	0.15	46.94	0.36
2002	-109	44264	-0.05	-0.67	0.39	111.85	0.35
2005	-230	75504	-0.08	-0.95	0.15	191.14	0.32
2010	-430	82696	-0.11	-1.10	-0.17	210.14	0.24
2015	-463	42656	-0.10	-0.80	-0.11	109.19	0.18
2020	-468	12512	-0.06	-0.32	-0.02	32.91	0.15
Percentage Change in Sacramento Emission Inventories (relative to Ver. 2.212)							
Cal. Year	Population	VMT	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	0.01%	0.07%	-0.01%	0.04%	0.04%	0.08%	8.85%
1990	-0.01%	-0.01%	-0.03%	-0.01%	0.00%	-0.01%	10.90%
2000	0.00%	0.03%	-0.03%	-0.05%	0.11%	0.14%	9.80%
2002	-0.01%	0.08%	-0.07%	-0.10%	0.30%	0.32%	9.65%
2005	-0.01%	0.12%	-0.14%	-0.18%	0.14%	0.51%	8.97%
2010	-0.02%	0.12%	-0.26%	-0.29%	-0.22%	0.50%	6.88%
2015	-0.02%	0.05%	-0.31%	-0.32%	-0.22%	0.24%	5.13%
2020	-0.02%	0.01%	-0.26%	-0.18%	-0.07%	0.07%	4.04%
ROG_Tot ¹ - This includes running, starting, idle exhaust emissions and emissions from all evaporative processes.							
PM10_Tot ² - Total emissions from running, starting, idle processes, and from tire wear and brake wear.							

Table 5 Impact of Coding Fixes on San Diego Valley Air Basin Inventories

San Diego Summer Episodic Emissions From All On-Road Motor Vehicles (Calculated Using EMFAC2007 draft ver 2.212)							
Cal. Year	Population	VMT*(1000)	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	934571	31707434	295.64	2698.84	169.32	22069.36	2.82
1990	1606621	63591472	189.30	2053.63	211.27	40894.99	5.30
2000	1899124	73909272	85.77	930.96	149.28	42961.61	4.18
2002	1996742	77007520	71.98	783.75	135.66	44597.09	4.26
2005	2164502	82659608	58.52	639.04	115.91	47704.58	4.44
2010	2336487	87480560	42.47	450.03	85.44	50692.60	4.48
2015	2531560	93885768	31.91	314.19	58.82	54266.88	4.58
2020	2669319	97541648	25.60	229.45	42.09	56283.64	4.69

San Diego Summer Episodic On-Road Motor Vehicle Inventories With Coding Fixes (Calculated Using EMFAC2007 draft ver 2.213)							
Cal. Year	Population	VMT*(1000)	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	933566	31678338	295.11	2695.92	168.81	22032.40	2.96
1990	1605060	63501964	188.84	2051.17	209.98	40770.53	5.72
2000	1899099	73953032	85.87	931.92	150.18	43069.26	4.54
2002	1996641	77082128	72.13	785.33	136.92	44806.86	4.60
2005	2164267	82851496	58.58	639.34	116.57	48116.35	4.76
2010	2335998	87707944	42.52	450.87	85.63	51139.89	4.73
2015	2530983	94056240	32.06	315.43	59.23	54568.32	4.78
2020	2668675	97693344	25.89	232.21	42.72	56550.75	4.87

Difference (Ver. 2.213 - Ver. 2.212) in San Diego Emission Inventories (tons per day)							
Cal. Year	Population	VMT(miles)	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	-1005	-29096	-0.53	-2.92	-0.50	-36.96	0.14
1990	-1561	-89508	-0.45	-2.45	-1.28	-124.46	0.41
2000	-25	43760	0.10	0.96	0.90	107.65	0.35
2002	-101	74608	0.16	1.59	1.26	209.77	0.34
2005	-235	191888	0.06	0.30	0.67	411.77	0.32
2010	-489	227384	0.05	0.83	0.19	447.29	0.24
2015	-577	170472	0.14	1.24	0.40	301.44	0.20
2020	-644	151696	0.29	2.76	0.63	267.11	0.18

Percentage Change in San Diego Emission Inventories (relative to Ver. 2.212)							
Cal. Year	Population	VMT	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	-0.11%	-0.09%	-0.18%	-0.11%	-0.30%	-0.17%	5.03%
1990	-0.10%	-0.14%	-0.24%	-0.12%	-0.61%	-0.30%	7.82%
2000	0.00%	0.06%	0.11%	0.10%	0.60%	0.25%	8.48%
2002	-0.01%	0.10%	0.22%	0.20%	0.93%	0.47%	8.04%
2005	-0.01%	0.23%	0.10%	0.05%	0.57%	0.86%	7.22%
2010	-0.02%	0.26%	0.11%	0.19%	0.23%	0.88%	5.42%
2015	-0.02%	0.18%	0.45%	0.39%	0.68%	0.56%	4.33%
2020	-0.02%	0.16%	1.15%	1.20%	1.49%	0.47%	3.85%

ROG_Tot¹ - This includes running, starting, idle exhaust emissions and emissions from all evaporative processes.

PM10_Tot² - Total emissions from running, starting, idle processes, and from tire wear and brake wear.

Table 6 Impact of Coding Fixes on San Francisco Valley Air Basin Inventories

San Francisco Summer Episodic Emissions From All On-Road Motor Vehicles (Calculated Using EMFAC2007 draft ver 2.212)							
Cal. Year	Population	VMT*(1000)	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	2884329	90067376	765.22	6931.23	544.07	58677.01	8.97
1990	3779228	133990550	389.90	4063.57	502.35	81356.07	12.29
2000	4587554	159271550	193.84	1939.47	348.93	91969.98	9.15
2002	4767934	164169900	171.61	1729.38	330.02	94262.83	9.15
2005	5059512	172580900	133.10	1324.72	271.52	98481.00	9.31
2010	5719370	193298350	98.24	958.53	201.14	117230.00	10.08
2015	6104228	202212820	71.68	661.67	134.01	123899.80	10.26
2020	6540161	213899180	55.38	467.58	92.53	130414.00	10.55
San Francisco Summer Episodic On-Road Motor Vehicle Inventories With Coding Fixes (Calculated Using EMFAC2007 draft ver 2.213)							
Cal. Year	Population	VMT*(1000)	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	2883897	90081824	764.92	6930.17	544.09	58688.84	9.47
1990	3778902	133980700	389.83	4063.51	502.35	81353.11	13.33
2000	4587510	159313810	193.79	1938.75	349.26	92075.27	9.83
2002	4767732	164287710	171.48	1727.73	331.03	94561.98	9.85
2005	5059078	172769280	132.89	1322.51	271.93	98961.19	10.00
2010	5718522	193409790	98.03	956.64	201.14	117529.40	10.63
2015	6103198	202209840	71.53	660.51	134.29	123920.20	10.69
2020	6539036	213873180	55.28	466.99	92.75	130374.10	10.91
Difference (Ver. 2.213 - Ver. 2.212) in San Francisco Emission Inventories (tons per day)							
Cal. Year	Population	VMT(miles)	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	-432	14448	-0.30	-1.07	0.02	11.83	0.51
1990	-326	-9850	-0.07	-0.06	0.00	-2.96	1.04
2000	-44	42260	-0.05	-0.72	0.33	105.29	0.68
2002	-202	117810	-0.13	-1.66	1.01	299.15	0.70
2005	-434	188380	-0.20	-2.21	0.41	480.19	0.69
2010	-848	111440	-0.21	-1.89	-0.01	299.40	0.55
2015	-1030	-2980	-0.15	-1.16	0.28	20.40	0.43
2020	-1125	-26000	-0.10	-0.59	0.22	-39.90	0.36
Percentage Change in San Francisco Emission Inventories (relative to Ver. 2.212)							
Cal. Year	Population	VMT	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	-0.01%	0.02%	-0.04%	-0.02%	0.00%	0.02%	5.65%
1990	-0.01%	-0.01%	-0.02%	0.00%	0.00%	0.00%	8.42%
2000	0.00%	0.03%	-0.03%	-0.04%	0.09%	0.11%	7.42%
2002	0.00%	0.07%	-0.07%	-0.10%	0.31%	0.32%	7.60%
2005	-0.01%	0.11%	-0.15%	-0.17%	0.15%	0.49%	7.43%
2010	-0.01%	0.06%	-0.21%	-0.20%	0.00%	0.26%	5.45%
2015	-0.02%	0.00%	-0.20%	-0.17%	0.21%	0.02%	4.20%
2020	-0.02%	-0.01%	-0.19%	-0.13%	0.24%	-0.03%	3.46%

ROG_Tot¹ - This includes running, starting, idle exhaust emissions and emissions from all evaporative processes.
 PM10_Tot² - Total emissions from running, starting, idle processes, and from tire wear and brake wear.

Table 7 Impact of Coding Fixes on San Joaquin Valley Air Basin Inventories

San Joaquin Summer Episodic Emissions From All On-Road Motor Vehicles (Calculated Using EMFAC2007 draft ver 2.212)							
Cal. Year	Population	VMT*(1000)	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	881059	32884974	272.99	2786.85	232.28	23758.31	5.57
1990	1451839	60357364	207.39	2315.18	296.41	41542.37	8.78
2000	1991960	81054320	113.55	1231.07	230.19	51171.07	5.92
2002	2123866	85988360	96.61	1041.13	215.97	54065.73	5.94
2005	2324908	94207944	78.70	840.91	188.56	58998.68	6.05
2010	2643519	107741370	56.37	583.84	140.88	67279.58	6.05
2015	2998433	122270790	41.61	402.53	94.36	76628.91	6.22
2020	3351177	135617100	32.81	290.86	65.52	85445.91	6.61
San Joaquin Summer Episodic On-Road Motor Vehicle Inventories With Coding Fixes (Calculated Using EMFAC2007 draft ver 2.213)							
Cal. Year	Population	VMT*(1000)	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	881036	32894920	272.98	2787.27	232.31	23767.68	6.21
1990	1451709	60353564	207.35	2315.06	296.40	41540.45	10.19
2000	1991935	81094664	113.50	1230.42	230.47	51269.70	6.77
2002	2123753	86125608	96.49	1039.54	217.13	54405.38	6.80
2005	2324699	94471192	78.51	838.70	189.19	59647.63	6.89
2010	2643156	108103830	56.08	581.25	139.66	68168.80	6.70
2015	2998074	122441730	41.37	400.73	93.39	77049.29	6.74
2020	3350822	135666620	32.65	289.95	65.20	85565.63	7.08
Difference (Ver. 2.213 - Ver. 2.212) in San Joaquin Emission Inventories (tons per day)							
Cal. Year	Population	VMT(miles)	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	-24	9946	-0.01	0.43	0.04	9.37	0.64
1990	-130	-3800	-0.05	-0.11	0.00	-1.92	1.41
2000	-25	40344	-0.05	-0.64	0.28	98.63	0.85
2002	-113	137248	-0.12	-1.59	1.16	339.65	0.86
2005	-209	263248	-0.19	-2.21	0.63	648.95	0.84
2010	-363	362460	-0.30	-2.59	-1.23	889.22	0.65
2015	-359	170940	-0.24	-1.80	-0.98	420.38	0.52
2020	-355	49520	-0.16	-0.91	-0.33	119.72	0.47
Percentage Change in San Joaquin Emission Inventories (relative to Ver. 2.212)							
Cal. Year	Population	VMT	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	0.00%	0.03%	0.00%	0.02%	0.02%	0.04%	11.50%
1990	-0.01%	-0.01%	-0.02%	0.00%	0.00%	0.00%	16.01%
2000	0.00%	0.05%	-0.04%	-0.05%	0.12%	0.19%	14.34%
2002	-0.01%	0.16%	-0.12%	-0.15%	0.54%	0.63%	14.49%
2005	-0.01%	0.28%	-0.24%	-0.26%	0.33%	1.10%	13.91%
2010	-0.01%	0.34%	-0.53%	-0.44%	-0.87%	1.32%	10.69%
2015	-0.01%	0.14%	-0.57%	-0.45%	-1.04%	0.55%	8.31%
2020	-0.01%	0.04%	-0.50%	-0.31%	-0.50%	0.14%	7.10%
ROG_Tot ¹ - This includes running, starting, idle exhaust emissions and emissions from all evaporative processes.							
PM10_Tot ² - Total emissions from running, starting, idle processes, and from tire wear and brake wear.							

Table 8 Impact of Coding Fixes on South Coast Air Basin Inventories

South Coast Summer Episodic Emissions From All On-Road Motor Vehicles (Calculated Using EMFAC2007 draft ver 2.212)							
Cal. Year	Population	VMT*(1000)	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	4873676	158731810	1323.61	11305.46	892.91	107732.60	17.33
1990	7641506	275902500	835.47	8528.15	1000.43	173727.80	25.50
2000	8971597	317873060	394.71	4106.39	703.82	183389.80	17.69
2002	9243115	325196700	328.19	3382.39	631.77	186380.60	17.61
2005	9672629	337082460	262.58	2681.61	529.86	192682.50	17.77
2010	10409606	358938080	189.30	1880.47	388.18	205882.80	17.89
2015	11147240	381397660	142.18	1328.27	256.43	223509.10	18.55
2020	11940293	406621660	111.16	947.84	175.91	237434.10	19.17
South Coast Summer Episodic On-Road Motor Vehicle Inventories With Coding Fixes (Calculated Using EMFAC2007 draft ver 2.213)							
Cal. Year	Population	VMT*(1000)	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	4872808	158751820	1322.81	11301.98	892.87	107747.40	18.25
1990	7640950	275887420	835.29	8528.05	1000.45	173724.40	27.39
2000	8971487	317953860	394.61	4104.93	704.68	183587.10	18.87
2002	9242592	325466590	327.91	3378.67	634.78	187070.50	18.79
2005	9671430	337630750	262.02	2675.81	531.34	194087.40	18.88
2010	10407354	359493570	188.57	1874.55	387.35	207340.60	18.74
2015	11144674	381367780	141.70	1325.12	257.62	223544.50	19.24
2020	11937573	406502500	110.80	945.97	176.97	237236.80	19.78
Difference (Ver. 2.213 - Ver. 2.212) in South Coast Emission Inventories (tons per day)							
Cal. Year	Population	VMT(miles)	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	-868	20010	-0.80	-3.48	-0.03	14.80	0.92
1990	-556	-15080	-0.18	-0.10	0.02	-3.40	1.89
2000	-110	80800	-0.10	-1.45	0.86	197.30	1.18
2002	-523	269890	-0.28	-3.72	3.01	689.90	1.17
2005	-1199	548290	-0.55	-5.80	1.47	1404.90	1.12
2010	-2252	555490	-0.73	-5.92	-0.83	1457.80	0.85
2015	-2566	-29880	-0.48	-3.14	1.18	35.40	0.69
2020	-2720	-119160	-0.36	-1.88	1.06	-197.30	0.61
Percentage Change in South Coast Emission Inventories (relative to Ver. 2.212)							
Cal. Year	Population	VMT	ROG_Tot ¹	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot ²
1980	-0.02%	0.01%	-0.06%	-0.03%	0.00%	0.01%	5.29%
1990	-0.01%	-0.01%	-0.02%	0.00%	0.00%	0.00%	7.41%
2000	0.00%	0.03%	-0.03%	-0.04%	0.12%	0.11%	6.69%
2002	-0.01%	0.08%	-0.09%	-0.11%	0.48%	0.37%	6.67%
2005	-0.01%	0.16%	-0.21%	-0.22%	0.28%	0.73%	6.30%
2010	-0.02%	0.15%	-0.39%	-0.31%	-0.21%	0.71%	4.76%
2015	-0.02%	-0.01%	-0.34%	-0.24%	0.46%	0.02%	3.73%
2020	-0.02%	-0.03%	-0.33%	-0.20%	0.60%	-0.08%	3.19%
ROG_Tot ¹ - This includes running, starting, idle exhaust emissions and emissions from all evaporative processes.							
PM10_Tot ² - Total emissions from running, starting, idle processes, and from tire wear and brake wear.							

Table 9 Changes to 2005 Activity and Emission Estimates

Calendar Year 2005	Population Ver. 2212	Population Ver. 2213	diff (2213-2212)	VM1 Ver. 2212	VM1 Ver. 2213	diff (2213-2212)	Difference to ROG (tpd)	Difference to CO (tpd)	Difference to NOx (tpd)	Difference to CO2 (tpd)	Difference to PM10 (tpd)
LDA	13908834	13906842	-1992	481507420	481510620	3200	0.04	-0.33	-0.03	-1.90	0.00
LDT1	3747020	3746784	-236	127606570	127602910	-3660	-0.01	-0.13	-0.02	-1.24	0.00
LDT2	3801961	3801792	-169	134516210	134512290	-3920	-0.03	-0.57	0.11	-19.20	0.00
MDV	1676825	1676592	-233	58278592	58273568	-5024	-0.02	-0.13	-0.02	-3.55	0.00
LHD1	257517	257559	41.4	14464286	14466499	2213	0.00	0.01	0.01	2.03	0.01
LHD2	84389	84380	-8.27	4345560	4345350	-210	0.00	-0.01	0.00	-0.16	0.00
MHD	249840	249837	-3.4	12865034	12865528	494	0.00	0.00	0.00	0.81	0.38
HHD	204812	204787	-25.7	27636096	29077814	1441718	-1.19	-12.81	3.68	3589.22	3.39
LHV	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
UBUS	28186	28186	0.02	3344800	3344803	3	0.00	0.00	0.00	0.01	0.00
MCY	397680	397744	64.6	3012986	3013609	623	0.00	0.03	0.00	0.09	0.00
SBUS	26850	26849	-1.17	1092497	1092453	-44	0.00	0.00	0.00	-0.07	0.05
MH	313806	313806	0	4214100	4214094	-6	0.00	0.00	0.00	-0.02	0.00
Total	24697720	24695158	-2563	872884151	874319538	1435387	-1.21	-13.93	3.73	3566.02	3.82

