EMFAC Modeling Change Technical Memo

SUBJECT: CORRECTIONS TO HEAVY-DUTY GAS CAP BENEFITS

LEAD: DILIP PATEL

SUMMARY

While reviewing the gas cap[1] benefits, by vehicle class, staff noted that the reductions in ROG emissions were negligible for gasoline fueled heavy-duty vehicles[2] (HDV). Subsequent review of the code revealed that this option was never fully implemented for gasoline fueled HDV. This document details how implementing the gas cap check algorithm reduces evaporative emissions from this class of vehicles, and quantifies its impact on Statewide and regional inventories. This change will be incorporated into the release of the working draft version of EMFAC2007 ver. 2.234.

Table 1 shows the incremental difference (ver. 2.234 – ver. 2.233[3]) in **summer episodic** inventories for calendar year 2002. Table 1 shows that this correction will reduce statewide ROG emissions from **all** on-road motor vehicles in 2002 calendar year by 17.44 tons per day. To put this in perspective, this will decrease statewide ROG on-road motor vehicle emissions in 2002 by 1.45%. Similarly, Table 2 shows that in 2015 the statewide summer ROG emissions from **all** on-road motor vehicles will decrease by 25.64 tons per day, which is equivalent to a 4.36% reduction in the total ROG emissions.

Table 1 Summary of Emissions Changes In Calendar Year 2002

Area	Emission Changes by Pollutant (tons/day)				
	ROG	CO	NOx	CO2	PM10
Statewide	-17.44	0.00	0.00	0.00	0.00
South Coast Air Basin	-8.36	0.00	0.00	0.00	0.00
San Joaquin Valley AB	-2.03	0.00	0.00	0.00	0.00
Sacramento Valley AB	-1.08	0.00	0.00	0.00	0.00
San Diego Air Basin	-1.32	0.00	0.00	0.00	0.00
San Francisco Bay Area	-1.78	0.00	0.00	0.00	0.00

[1] Gas Cap – Reduction in evaporative hydrocarbon emissions associated with identifying and repairing defective gas caps during Smog Check.
[2] In this context, HDV refer to all **vehicles greater than 8,500 lbs**.
[3] Internal working draft of EMFAC2007 version 2.233 that has been updated with new fuel corrections factors, I&M changes, vehicle populations, and redistribution of heavy-duty vehicle VMT, and other changes.

Table 2 Summary of Emissions Changes In Calendar Year 2015

Area	Emission Changes by Pollutant (tons/day)				
	ROG	CO	NOx	CO2	PM10
Statewide	-25.64	0.00	0.00	0.00	0.00
South Coast	-11.48	0.00	0.00	0.00	0.00
San Joaquin Valley AB	-3.35	0.00	0.00	0.00	0.00
Sacramento Region AB	-1.53	0.00	0.00	0.00	0.00
San Diego Air Basin	-2.05	0.00	0.00	0.00	0.00
San Francisco Bay Area	-2.68	0.00	0.00	0.00	0.00

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, revisions to the model should be made that correctly reflect adopted measures. The gas cap check was implemented statewide beginning with the 1998 calendar year and should therefore be reflected in EMFAC2007.

AFFECTED SOURCE CODE/VERSION

XBurden.for
E_Calc.for
I_and_M.for

METHODOLOGY

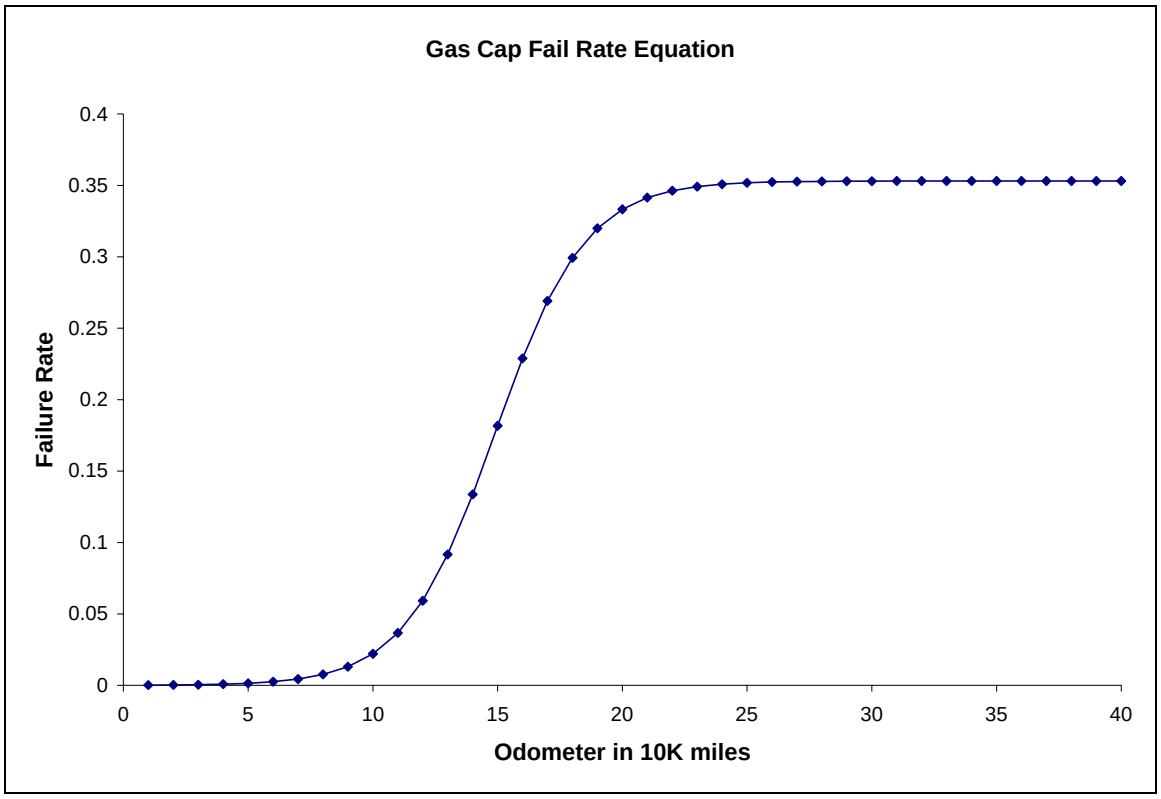
The methodology for assessing the benefits from the gas cap check is written in EMFAC2002 Technical Support Documentation[4]. To **summarize,** for a given technology group evaporative emissions are classified as coming from normal, moderate and high emitting vehicles. A normal vehicle is one that typically maintains emissions at or below certification emission standard, a high emitting vehicle is one that has significantly high emissions such that in normal analysis it would be classified as an outlier or one that has liquid leaks, and moderates are those vehicles that fall in-between the normal and high regimes. A key assumption is that moderate emitters consist of vehicles with vapor leaks, whereas high emitters are dominated by liquid leaks or fuel seeps.

During Smog Check repair mechanics are required to inspect vehicles for leaking or missing gas caps. Prior to implementing gas cap inspection into Smog Check, the Bureau of Automotive Repair (BAR) conducted a roadside inspection program in 1996 and performed the gas cap test on all vehicles. Figure 1 illustrates the general form of the gas cap failure rate for vehicles not subject to

[4] http://www.arb.ca.gov/msei/onroad/downloads/tsd/Running_Losses_Final.doc

this inspection. This curve, reproduced here, is from the EMFAC2002 Technical Support Documentation.

Figure 1 Gas Cap Failure Rate



The failure rate increases as a function of vehicle odometer or vehicle age. The gas cap inspection test identifies vapor leaks from poorly sealed, missing or damaged gas caps. Repairing or replacing these gas caps reduces vapor leaks (at least the portion of vapor leaks that comes from gas caps). In the EMFAC model this gas cap inspection is modeled by changing the moderate emission regime size. The steps used in calculating the gas cap benefits are outlined below:

1) The percent of vehicles identified in the moderate emissions regime is calculated as:

   $Evap\_IDR = 0.95 * (GC_{FR} / RegSZ_m)$

   where:
   Evap_IDR = Evaporative Identification Rate
   0.95 = Assumption is that only 95% of the gas cap failures are identified
   GC_{FR} = Gas Cap failure rate
   $RegSZ_m$ = Pre-Repair size of the moderate emissions regime

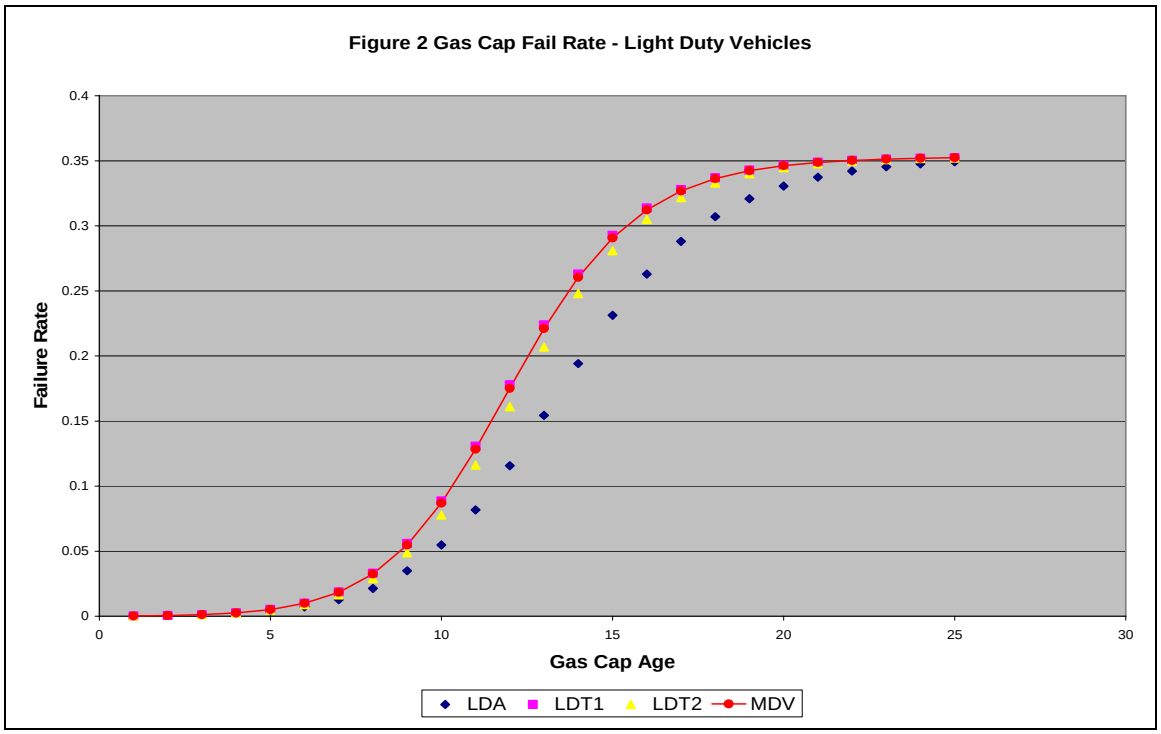
2) The Post-Repair regime size is calculated as:

$P\_RegSZ_m = RegSZ_m - Evap\_IDR + IN$

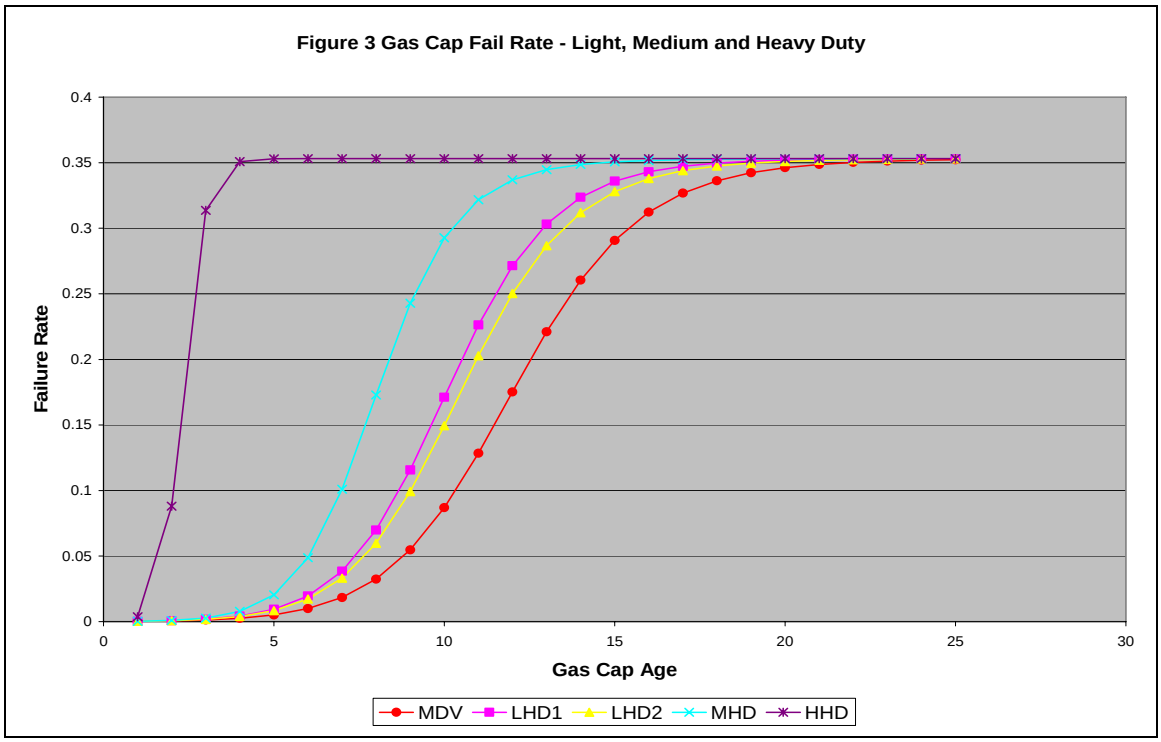
where:
P_RegSZ_m = Post repair size of the moderate emissions regime
IN = Any vehicles moving into the moderate emissions regime

3) In its simplest form, the IM benefits from gas cap check represent the difference in Pre- and Post-repair regime size weighted with respect with regime specific emission rate.

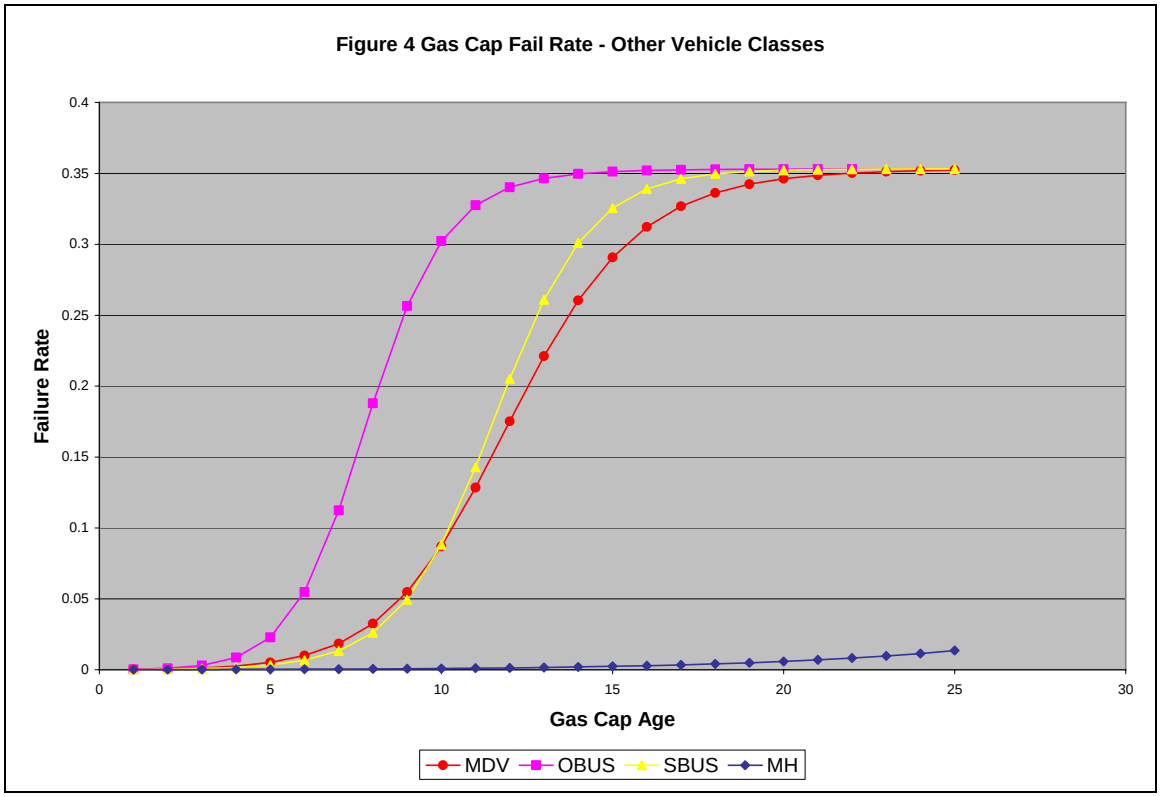
When this gas cap inspection was fully implemented for gasoline fueled light-heavy, medium-heavy, heavy-heavy duty trucks, bus, and motor homes into the working draft of EMFAC2007, staff noted that there were significant differences in the emission benefits between vehicle classes. One of the reasons for differences in gas cap benefits result from variation in accrual rates by vehicle class. For example, light-duty trucks accrue more miles per year than passenger cars, and as a result on an age basis have higher failure rates than passenger cars. Figures 2 to 4 show the variation in gas cap failure rates, on a statewide basis, by vehicle class. The secondary cause of differences can be attributed to differences in age distributions between vehicle classes.



LDA = Light-duty automobiles, LDT1 = Light-duty trucks (<3750lbs)
LDT2 = Light-duty trucks (3751-5750 lbs), MDV = Medium-duty vehicles (5751-8500 lbs)



LHD1 = Light-heavy trucks (8501-10,000 lbs), LHD2 = Trucks (10,001-14,000 lbs), MHD = Medium Heavy trucks (14,001-33,000lbs), HHD = Heavy-Heavy Trucks (>33,000 lbs)



OBUS = Other Bus, SBUS = School Bus, MH = MotorHomes

Table 3 shows the statewide gas cap benefits, by vehicle class, in calendar year 2015. These benefits were determined for the summer planning season on an area-average basis.

Table 3 Variation in Gas Cap benefits by Vehicle Class In 2015

	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	SBUS	MH
Diurnal	34.84	10.65	12.92	4.61	0.09	0.03	0.03	0	0	0	0.19
Hot Soak	34.88	10.28	12.97	4.66	1.59	0.54	0.47	0.05	0.03	0.01	0.01
Running	75.02	41.17	47.56	16.76	25.04	7.86	9.06	1.22	0.58	0.08	0.16
Resting	20.04	6.14	8.02	2.99	0.02	0.01	0.01	0	0	0	0.06
Total Without Gas Cap	164.78	68.24	81.47	29.02	26.74	8.44	9.57	1.27	0.61	0.09	0.42
Diurnal	35.28	10.55	12.7	4.51	0.09	0.03	0.03	0	0	0	0.2
Hot Soak	32.9	8.69	11.62	4.03	1.05	0.41	0.29	0.02	0.02	0.01	0.01
Running	62.93	29.8	40.48	13.93	13.31	5.07	3.02	0.31	0.23	0.05	0.16
Resting	21.34	6.47	8.03	2.99	0.03	0.01	0.01	0	0	0	0.06
Total With Gas Cap	152.45	55.51	72.83	25.46	14.48	5.52	3.35	0.33	0.25	0.06	0.43
Benefits	12.33	12.73	8.64	3.56	12.26	2.92	6.22	0.94	0.36	0.03	-0.01
Percentage	7.48%	18.65%	10.61%	12.27%	45.85%	34.60%	64.99%	74.02%	59.02%	33.33%	-2.38%

Note, the numbers are in tons per day.

The obvious question is why do vehicles with high accrual rates have high gas cap benefits? The reason is that vehicles with higher accrual rates, on an age basis, have a faster growth in moderate and high emitters than vehicles that accrue mileage at a lower rate (like passenger cars). For example, the number of moderate emitters (assumed to have vapor leaks) increases as a function of odometer or age. On an age basis, vehicles with high accrual rates have more gas cap failures than passenger cars. These failures are identified and repaired quickly, and this cycle of failing / repairing repeats more frequently than that for passenger cars. This means that vehicle with high accrual rates have very little time to deteriorate, on an age basis, before they are failed and repaired resulting in high gas cap benefits.

INVENTORY EFFECTS

Table 4 shows summaries of the statewide summer episodic on-road motor vehicle inventories calculated using internal working draft Emfac2007 version 2.234, which contains changes noted in this document. These inventories were calculated by running the model for **summer** on an area-average basis to determine the impact on a statewide basis. Table 4 shows that this change will reduce statewide emissions of ROG from **all** on-road motor vehicles in the 2002 calendar year by 17.44 tons per day, respectively. To put this in perspective, this will reduce statewide ROG on-road motor vehicle emissions in 2002 by 1.45%. Similarly, Table 4 shows that in 2015 the statewide on-road motor vehicle inventory of ROG will be reduced by 25.64 tons per day, which is equivalent to a 4.36% reduction in total ROG.

Note, Table 3 shows that the total gas cap benefit from heavy duty vehicles is 22.72 tons per day. However, this benefit was calculated by comparing the statewide inventories with and without the gas cap check using EMFAC2007

working draft version 2.23.4. There is a difference of 2.92 tons per day between the 2015 estimates in Table 3 and Table 4. Table 4 contains the incremental difference in emissions between version 2.23.3 and 2.23.4, whereas, the estimates in Table 3 were developed using version 2.23.4. Ideally, these estimates should match. In this case they don't because other correction factors were also being applied to the heavy-duty evaporative emissions, in version 2.23.3.

Tables 5 through 9 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 4 Impact of HDV Gas Cap Changes on Statewide Inventories

Statewide Summer Episodic On-Road Motor Vehicle Inventories
(Calculated Using EMFAC2007 draft ver 2.233)

Cal. Year	Population	VMT*(1000)	ROG_Tot[1]	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot[2]
1980	14820197	445612990	3476.89	31125.75	2392.35	302774.90	69.18
1990	22523984	708663040	2516.56	24763.94	2618.92	445033.40	112.39
2000	26785744	811379650	1443.99	12915.06	2009.24	497111.80	78.64
2002	28178674	866267650	1200.24	10413.54	1843.55	529705.40	73.61
2005	29140790	881513470	1019.89	8188.56	1661.41	543369.40	72.37
2010	31922900	954230980	782.82	5822.01	1282.47	585217.20	64.40
2015	34115144	1023414000	587.88	3968.98	888.01	633130.90	58.65
2020	36268868	1092983800	460.40	2786.75	627.17	684478.90	56.53

Statewide Summer Episodic On-Road Motor Vehicle Inventories With HDV_Gas_Cap_Fix
(Calculated Using EMFAC2007 draft ver 2.234)

Cal. Year	Population	VMT*(1000)	ROG_Tot[1]	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot[2]
1980	14820197	445612990	3476.89	31125.75	2392.35	302774.90	69.18
1990	22523984	708663040	2516.56	24763.94	2618.92	445033.40	112.39
2000	26785744	811379650	1432.62	12915.06	2009.24	497111.80	78.64
2002	28178674	866267650	1182.79	10413.54	1843.55	529705.40	73.61
2005	29140790	881513470	997.68	8188.56	1661.41	543369.40	72.37
2010	31922900	954230980	757.56	5822.01	1282.47	585217.20	64.40
2015	34115144	1023414000	562.24	3968.98	888.01	633130.90	58.65
2020	36268868	1092983800	436.52	2786.75	627.17	684478.90	56.53

Difference (Ver. 2.234 - Ver. 2.233) 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	0	0	0.00	0.00	0.00	0.00	0.00
1990	0	0	0.00	0.00	0.00	0.00	0.00
2000	0	0	-11.37	0.00	0.00	0.00	0.00
2002	0	0	-17.44	0.00	0.00	0.00	0.00
2005	0	0	-22.20	0.00	0.00	0.00	0.00
2010	0	0	-25.26	0.00	0.00	0.00	0.00
2015	0	0	-25.64	0.00	0.00	0.00	0.00
2020	0	0	-23.88	0.00	0.00	0.00	0.00

Percentage Change in Statewide Emission Inventories (relative to Ver. 2.233)

Cal. Year	Population	VMT	ROG_Tot[1]	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot[2]
1980	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1990	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2000	0.00%	0.00%	-0.79%	0.00%	0.00%	0.00%	0.00%
2002	0.00%	0.00%	-1.45%	0.00%	0.00%	0.00%	0.00%
2005	0.00%	0.00%	-2.18%	0.00%	0.00%	0.00%	0.00%
2010	0.00%	0.00%	-3.23%	0.00%	0.00%	0.00%	0.00%
2015	0.00%	0.00%	-4.36%	0.00%	0.00%	0.00%	0.00%
2020	0.00%	0.00%	-5.19%	0.00%	0.00%	0.00%	0.00%

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 HDV Gas Cap Changes on Sacramento Valley Air Basin Inventories

Sacramento Summer Episodic On-Road Motor Vehicle Inventories
(Calculated Using EMFAC2007 draft ver 2.233)

Cal. Year	Population	VMT*(1000)	ROG_Tot[1]	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot[2]
1980	1189906	32700646	286.98	2556.78	185.52	22250.38	5.61
1990	1761329	51416988	203.20	1940.45	204.32	32744.40	9.48
2000	2069264	56645852	120.60	1013.08	159.63	35497.08	6.10
2002	2254476	62655668	105.02	846.34	149.98	38928.21	5.68
2005	2567514	69486208	100.87	721.09	144.12	43387.71	5.83
2010	2917001	78090032	81.46	524.69	109.09	47901.85	5.05
2015	3162008	86622592	61.02	349.70	73.95	53178.44	4.60
2020	3443856	95565888	46.96	239.83	51.38	59034.80	4.49

Sacramento Summer Episodic On-Road Motor Vehicle Inventories With HDV_Gas_Cap_Fix
(Calculated Using EMFAC2007 draft ver 2.234)

Cal. Year	Population	VMT*(1000)	ROG_Tot[1]	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot[2]
1980	1189906	32700646	286.98	2556.78	185.52	22250.38	5.61
1990	1761329	51416988	203.20	1940.45	204.32	32744.40	9.48
2000	2069264	56645852	119.86	1013.08	159.63	35497.08	6.10
2002	2254476	62655668	103.94	846.34	149.98	38928.21	5.68
2005	2567514	69486208	99.42	721.09	144.12	43387.71	5.83
2010	2917001	78090032	79.91	524.69	109.09	47901.85	5.05
2015	3162008	86622592	59.49	349.70	73.95	53178.44	4.60
2020	3443856	95565888	45.54	239.83	51.38	59034.80	4.49

Difference (Ver. 2.234 - Ver. 2.233) 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	0	0	0.00	0.00	0.00	0.00	0.00
1990	0	0	0.00	0.00	0.00	0.00	0.00
2000	0	0	-0.75	0.00	0.00	0.00	0.00
2002	0	0	-1.08	0.00	0.00	0.00	0.00
2005	0	0	-1.45	0.00	0.00	0.00	0.00
2010	0	0	-1.55	0.00	0.00	0.00	0.00
2015	0	0	-1.53	0.00	0.00	0.00	0.00
2020	0	0	-1.42	0.00	0.00	0.00	0.00

Percentage Change in Sacramento Emission Inventories (relative to Ver. 2.233)

Cal. Year	Population	VMT	ROG_Tot[1]	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot[2]
1980	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1990	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2000	0.00%	0.00%	-0.62%	0.00%	0.00%	0.00%	0.00%
2002	0.00%	0.00%	-1.03%	0.00%	0.00%	0.00%	0.00%
2005	0.00%	0.00%	-1.44%	0.00%	0.00%	0.00%	0.00%
2010	0.00%	0.00%	-1.90%	0.00%	0.00%	0.00%	0.00%
2015	0.00%	0.00%	-2.50%	0.00%	0.00%	0.00%	0.00%
2020	0.00%	0.00%	-3.03%	0.00%	0.00%	0.00%	0.00%

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 6 Impact of HDV Gas Cap Changes on San Diego Air Basin Inventories

San Diego Summer Episodic On-Road Motor Vehicle Inventories
(Calculated Using EMFAC2007 draft ver 2.233)

Cal. Year	Population	VMT*(1000)	ROG_Tot[1]	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot[2]
1980	1097560	33496236	299.21	2707.06	176.80	23597.79	3.55
1990	1874269	64680348	204.77	2145.50	203.03	40801.16	6.20
2000	2227749	73166000	105.88	1022.88	143.51	41841.21	4.91
2002	2373918	79044400	88.97	845.84	128.68	45708.44	4.93
2005	2571104	83761520	77.87	699.52	113.82	48592.89	5.11
2010	2748386	87558408	58.09	486.06	85.44	50346.88	4.86
2015	2966158	94097624	45.25	340.59	62.13	54863.37	4.90
2020	3177690	100357630	37.35	251.81	47.60	58755.05	5.04

San Diego Summer Episodic On-Road Motor Vehicle Inventories With HDV_Gas_Cap_Fix
(Calculated Using EMFAC2007 draft ver 2.234)

Cal. Year	Population	VMT*(1000)	ROG_Tot[1]	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot[2]
1980	1097560	33496236	299.21	2707.06	176.80	23597.79	3.55
1990	1874269	64680348	204.77	2145.50	203.03	40801.16	6.20
2000	2227749	73166000	105.04	1022.88	143.51	41841.21	4.91
2002	2373918	79044400	87.65	845.84	128.68	45708.44	4.93
2005	2571104	83761520	76.07	699.52	113.82	48592.89	5.11
2010	2748386	87558408	56.08	486.06	85.44	50346.88	4.86
2015	2966158	94097624	43.20	340.59	62.13	54863.37	4.90
2020	3177690	100357630	35.44	251.81	47.60	58755.05	5.04

Difference (Ver. 2.234 - Ver. 2.233) 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	0	0	0.00	0.00	0.00	0.00	0.00
1990	0	0	0.00	0.00	0.00	0.00	0.00
2000	0	0	-0.84	0.00	0.00	0.00	0.00
2002	0	0	-1.32	0.00	0.00	0.00	0.00
2005	0	0	-1.80	0.00	0.00	0.00	0.00
2010	0	0	-2.01	0.00	0.00	0.00	0.00
2015	0	0	-2.05	0.00	0.00	0.00	0.00
2020	0	0	-1.91	0.00	0.00	0.00	0.00

Percentage Change in San Diego Emission Inventories (relative to Ver. 2.233)

Cal. Year	Population	VMT	ROG_Tot[1]	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot[2]
1980	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1990	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2000	0.00%	0.00%	-0.79%	0.00%	0.00%	0.00%	0.00%
2002	0.00%	0.00%	-1.48%	0.00%	0.00%	0.00%	0.00%
2005	0.00%	0.00%	-2.31%	0.00%	0.00%	0.00%	0.00%
2010	0.00%	0.00%	-3.47%	0.00%	0.00%	0.00%	0.00%
2015	0.00%	0.00%	-4.52%	0.00%	0.00%	0.00%	0.00%
2020	0.00%	0.00%	-5.10%	0.00%	0.00%	0.00%	0.00%

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 7 Impact of HDV Gas Cap Changes on San Francisco Air Basin Inventories

San Francisco Summer Episodic On-Road Motor Vehicle Inventories
(Calculated Using EMFAC2007 draft ver 2.233)

Cal. Year	Population	VMT*(1000)	ROG_Tot[1]	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot[2]
1980	3577805	104633350	854.92	7804.82	552.45	66236.59	9.87
1990	4628184	140980770	489.58	4909.45	469.01	81455.45	13.42
2000	5519282	164071820	277.37	2527.54	321.54	97156.03	10.28
2002	5644236	169344130	234.83	2132.89	296.12	101009.50	9.95
2005	5964264	175417250	199.30	1657.62	250.23	104933.10	10.28
2010	6401483	186231760	145.19	1127.28	181.56	111593.70	9.98
2015	6842192	199615200	106.27	753.56	124.06	119805.70	9.86
2020	7203858	209594370	80.71	518.67	87.45	127822.80	10.05

San Francisco Summer Episodic On-Road Motor Vehicle Inventories With HDV_Gas_Cap_Fix
(Calculated Using EMFAC2007 draft ver 2.234)

Cal. Year	Population	VMT*(1000)	ROG_Tot[1]	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot[2]
1980	3577805	104633350	854.92	7804.82	552.45	66236.59	9.87
1990	4628184	140980770	489.58	4909.45	469.01	81455.45	13.42
2000	5519282	164071820	276.12	2527.54	321.54	97156.03	10.28
2002	5644236	169344130	233.05	2132.89	296.12	101009.50	9.95
2005	5964264	175417250	196.85	1657.62	250.23	104933.10	10.28
2010	6401483	186231760	142.52	1127.28	181.56	111593.70	9.98
2015	6842192	199615200	103.59	753.56	124.06	119805.70	9.86
2020	7203858	209594370	78.26	518.67	87.45	127822.80	10.05

Difference (Ver. 2.234 - Ver. 2.233) 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	0	0	0.00	0.00	0.00	0.00	0.00
1990	0	0	0.00	0.00	0.00	0.00	0.00
2000	0	0	-1.25	0.00	0.00	0.00	0.00
2002	0	0	-1.78	0.00	0.00	0.00	0.00
2005	0	0	-2.45	0.00	0.00	0.00	0.00
2010	0	0	-2.67	0.00	0.00	0.00	0.00
2015	0	0	-2.68	0.00	0.00	0.00	0.00
2020	0	0	-2.45	0.00	0.00	0.00	0.00

Percentage Change in San Francisco Emission Inventories (relative to Ver. 2.233)

Cal. Year	Population	VMT	ROG_Tot[1]	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot[2]
1980	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1990	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2000	0.00%	0.00%	-0.45%	0.00%	0.00%	0.00%	0.00%
2002	0.00%	0.00%	-0.76%	0.00%	0.00%	0.00%	0.00%
2005	0.00%	0.00%	-1.23%	0.00%	0.00%	0.00%	0.00%
2010	0.00%	0.00%	-1.84%	0.00%	0.00%	0.00%	0.00%
2015	0.00%	0.00%	-2.52%	0.00%	0.00%	0.00%	0.00%
2020	0.00%	0.00%	-3.03%	0.00%	0.00%	0.00%	0.00%

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 HDV Gas Cap Changes on San Joaquin Valley Air Basin Inventories

San Joaquin Summer Episodic On-Road Motor Vehicle Inventories
(Calculated Using EMFAC2007 draft ver 2.233)

Cal. Year	Population	VMT*(1000)	ROG_Tot[1]	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot[2]
1980	1023520	35562160	275.49	2732.77	252.27	27892.66	13.54
1990	1679639	59095444	238.34	2404.63	331.99	44220.48	23.06
2000	2330556	77028680	162.24	1461.72	322.87	55335.65	14.83
2002	2487499	83510824	136.30	1182.81	309.51	59131.57	13.15
2005	2729342	89859968	126.57	987.46	299.55	63928.29	12.63
2010	3159172	103175800	100.79	723.56	230.31	71247.68	9.94
2015	3468090	116115740	75.14	486.13	157.65	81257.64	8.30
2020	3811652	129483420	58.16	337.83	110.51	91870.66	7.59

San Joaquin Summer Episodic On-Road Motor Vehicle Inventories With HDV_Gas_Cap_Fix
(Calculated Using EMFAC2007 draft ver 2.234)

Cal. Year	Population	VMT*(1000)	ROG_Tot[1]	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot[2]
1980	1023520	35562160	275.49	2732.77	252.27	27892.66	13.54
1990	1679639	59095444	238.34	2404.63	331.99	44220.48	23.06
2000	2330556	77028680	160.93	1461.72	322.87	55335.65	14.83
2002	2487499	83510824	134.28	1182.81	309.51	59131.57	13.15
2005	2729342	89859968	123.86	987.46	299.55	63928.29	12.63
2010	3159172	103175800	97.59	723.56	230.31	71247.68	9.94
2015	3468090	116115740	71.78	486.13	157.65	81257.64	8.30
2020	3811652	129483420	54.96	337.83	110.51	91870.66	7.59

Difference (Ver. 2.234 - Ver. 2.233) 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	0	0	0.00	0.00	0.00	0.00	0.00
1990	0	0	0.00	0.00	0.00	0.00	0.00
2000	0	0	-1.30	0.00	0.00	0.00	0.00
2002	0	0	-2.03	0.00	0.00	0.00	0.00
2005	0	0	-2.71	0.00	0.00	0.00	0.00
2010	0	0	-3.20	0.00	0.00	0.00	0.00
2015	0	0	-3.35	0.00	0.00	0.00	0.00
2020	0	0	-3.20	0.00	0.00	0.00	0.00

Percentage Change in San Joaquin Emission Inventories (relative to Ver. 2.233)

Cal. Year	Population	VMT	ROG_Tot[1]	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot[2]
1980	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1990	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2000	0.00%	0.00%	-0.80%	0.00%	0.00%	0.00%	0.00%
2002	0.00%	0.00%	-1.49%	0.00%	0.00%	0.00%	0.00%
2005	0.00%	0.00%	-2.14%	0.00%	0.00%	0.00%	0.00%
2010	0.00%	0.00%	-3.18%	0.00%	0.00%	0.00%	0.00%
2015	0.00%	0.00%	-4.46%	0.00%	0.00%	0.00%	0.00%
2020	0.00%	0.00%	-5.51%	0.00%	0.00%	0.00%	0.00%

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 Impact of Coding Fixes on South Coast Air Basin Inventories

South Coast Summer Episodic On-Road Motor Vehicle Inventories
(Calculated Using EMFAC2007 draft ver 2.233)

Cal. Year	Population	VMT*(1000)	ROG_Tot[1]	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot[2]
1980	6132212	180033150	1306.66	11197.87	859.21	120179.50	20.28
1990	9485851	284595070	984.48	9424.91	926.06	173263.30	30.65
2000	11074958	321947740	553.89	4869.25	663.19	189977.40	23.41
2002	11606219	343506050	451.94	3866.33	590.82	201448.70	22.37
2005	11270981	329753600	350.71	2786.82	490.24	194486.50	21.50
2010	12119336	350421920	260.42	1928.64	382.96	207041.70	20.64
2015	12683695	362652060	197.59	1319.31	267.79	215883.30	19.43
2020	13184638	376647260	155.37	929.92	188.21	226651.00	18.89

South Coast Summer Episodic On-Road Motor Vehicle Inventories With HDV_Gas_Cap_Fix
(Calculated Using EMFAC2007 draft ver 2.234)

Cal. Year	Population	VMT*(1000)	ROG_Tot[1]	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot[2]
1980	6132212	180033150	1306.66	11197.87	859.21	120179.50	20.28
1990	9485851	284595070	984.48	9424.91	926.06	173263.30	30.65
2000	11074958	321947740	548.54	4869.25	663.19	189977.40	23.41
2002	11606219	343506050	443.59	3866.33	590.82	201448.70	22.37
2005	11270981	329753600	340.56	2786.82	490.24	194486.50	21.50
2010	12119336	350421920	248.93	1928.64	382.96	207041.70	20.64
2015	12683695	362652060	186.11	1319.31	267.79	215883.30	19.43
2020	13184638	376647260	144.69	929.92	188.21	226651.00	18.89

Difference (Ver. 2.234 - Ver. 2.233) 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	0	0	0.00	0.00	0.00	0.00	0.00
1990	0	0	0.00	0.00	0.00	0.00	0.00
2000	0	0	-5.35	0.00	0.00	0.00	0.00
2002	0	0	-8.36	0.00	0.00	0.00	0.00
2005	0	0	-10.14	0.00	0.00	0.00	0.00
2010	0	0	-11.50	0.00	0.00	0.00	0.00
2015	0	0	-11.48	0.00	0.00	0.00	0.00
2020	0	0	-10.67	0.00	0.00	0.00	0.00

Percentage Change in South Coast Emission Inventories (relative to Ver. 2.233)

Cal. Year	Population	VMT	ROG_Tot[1]	CO_Tot	NOx_Tot	CO2_Tot	PM10_Tot[2]
1980	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1990	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2000	0.00%	0.00%	-0.97%	0.00%	0.00%	0.00%	0.00%
2002	0.00%	0.00%	-1.85%	0.00%	0.00%	0.00%	0.00%
2005	0.00%	0.00%	-2.89%	0.00%	0.00%	0.00%	0.00%
2010	0.00%	0.00%	-4.41%	0.00%	0.00%	0.00%	0.00%
2015	0.00%	0.00%	-5.81%	0.00%	0.00%	0.00%	0.00%
2020	0.00%	0.00%	-6.87%	0.00%	0.00%	0.00%	0.00%

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.

Recommendations

1. Staff should revisit the assumption that the moderate emitters are solely dominated by vehicles with vapor leaks, and that these vapor leaks are mainly from leaking gas caps. It is possible to have vapor leaks from evaporative components (hoses, loose fittings, carbon canister) other than the gas cap. This will require ascertaining the percentage of moderate emissions that come from leaking gas caps.
2. The gas cap failure rate is based on testing done by BAR in 1996 calendar year, and is representative of gas cap failures in absence of any inspection program. A random roadside inspection study should be done to determine the gas cap failure rate now that there has been an inspection program since 1998. This failure rate curve can then serve as a ceiling (or as a cap) on the potential gas cap reductions.
3. Staff should also revisit the assumption that the gas cap failure rate varies as a function of odometer. While it can be argued that some of the evaporative processes vary with odometer, in other processes it may also vary with age. The difference is subtle but changing to an age basis will reduce the gas cap benefits from vehicles with high mileage accrual rates.