California Environmental Protection Agency

AIR RESOURCES BOARD

PUBLIC MEETING TO CONSIDER APPROVAL OF REVISIONS TO THE STATE'S ON-ROAD EMISSIONS INVENTORY ESTIMATION MODEL EMFAC2000

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BACKGROUND

California's emissions inventory for on-road motor vehicles is an estimate of the amounts and types of pollutants emitted from the millions of vehicles operated in California. The emissions inventory is used to determine the reduction in emissions needed to meet air quality goals, and evaluate the need for and effectiveness of emission control strategies and regulations.

Section 39607(b) of the California Health and Safety Code requires the ARB to inventory emissions from various sources of air pollution. The ARB has published inventories and updates for over 25 years. Improvements are made periodically to maintain and provide the most complete, accurate, and up-to-date inventory practicable.

The modifications recommended by the staff would increase the statewide inventory for on-road motor vehicles by over 700 tons per day for hydrocarbons, an increase of 78 percent, 7,700 tons per day for carbon monoxide, a 93 percent increase, and 1000 tons per day for oxides of nitrogen, a 68 percent increase, in the year 2000. Although emission control requirements previously adopted by the Board will partially mitigate these increases over time, the revised inventory will affect emission control strategies needed to achieve air quality standards.

This report provides a summary of the most important changes to the inventory. In addition to this report, ARB staff has prepared a technical support document that presents in greater detail, what modifications have been made to the emissions estimation model and what impacts these modifications have on the inventory. Copies of the technical support document entitled "EMFAC2000 On-Road Emissions Inventory Estimation Model – Technical Support Document", may be obtained from the Air Resources Board's Public Information Office, or downloaded from the Air Resources Board's web site at http://www.arb.ca.gov/msei/msei.htm.

OVERVIEW

The presentation of EMFAC2000 for approval by the Board represents the culmination of more than ten years of effort on the part of the staff to refine and improve the accuracy of the on-road emissions inventory. This effort began when scientists observed discrepancies between emissions measured in tunnels, modeled air quality and emissions inventory estimates. The monitoring and modeled results indicated that the inventory under estimated emissions from motor vehicles.

The proposed revision to the motor vehicle inventory, reflected in EMFAC2000, increases estimated emissions substantially, so it is important to review the scientific basis for the proposed changes. The section below provides a discussion of the causes for the changes to the inventory, the data upon which the proposed changes are based, and the impacts these changes have on emissions in future years.

Table 1 presents the current and proposed inventory for the South Coast Air Basin (SCAB) for the years 2000 and 2010. Hydrocarbon emissions (HC) increase by more than 100% in 2000 and 2010, while oxides of nitrogen (NOx) emissions increase by over 80% in 2000 and by about one-third in 2010. Carbon monoxide (CO) increases by over 130% in 2000, and by about 65% in 2010. Exhaust particulate (PM10ex) increases by over 100% in 2000 and 2010.

Table 1. – Current and Proposed Emissions Inventory for SCAB

	2000			**2010**		
Pollutant	**7G**	**2000**	**% Change**	**7G**	**2000**	**% Change**
Total HC	326	694	113	147	370	152
CO	2795	6417	130	1753	2898	65
NOx	555	1021	84	392	539	38
PM10 ex	13	33	162	9	20	122

In the following sections, the causes of the increases in estimated emissions will be discussed. The sections are organized by pollutant and the most significant changes are discussed first in each section.

HYDROCARBONS

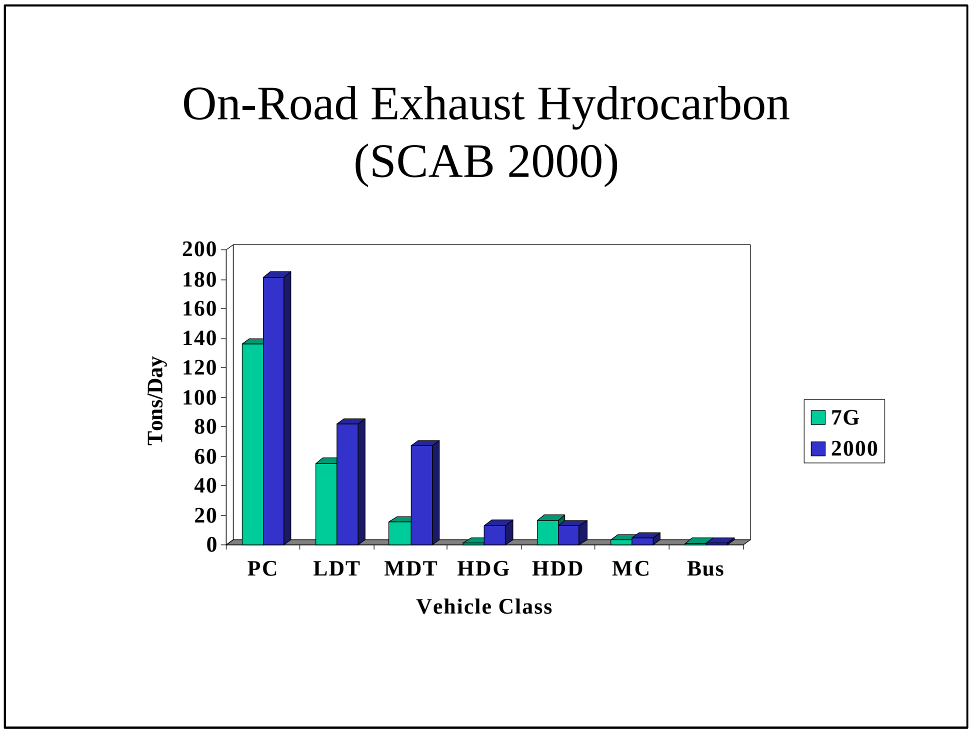
Exhaust:

Hydrocarbon exhaust emissions result because not all of the fuel which enters the engine is burned. The unburned fuel is exhausted from the tailpipe. Vehicles with catalytic converters attempt to complete fuel combustion in the exhaust stream before pollutants are released to the atmosphere. Hence, older cars without catalytic converters tend to have higher HC exhaust emissions than newer cars that have catalysts. Efforts to reduce the amount of fuel wasted through incomplete combustion in engines have been successful over the years, primarily through the use of fuel injection systems that more precisely meter the fuel. Similarly, catalysts have been optimized so that they are now over ninety percent efficient.

The connection between the evolution of HC emission control technology and the emissions inventory is that the inventory attempts to reflect the true performance of these technologies in use, with typical customer maintenance, normal and abnormal deterioration of various components, and tampering of emission control systems. Overall HC exhaust emissions are projected by EMFAC2000 to increase by 58 percent compared to the current version of the model, MVEI7G, in the SCAB in year 2000, and by 77 percent in the SCAB in year 2010 compared to 7G.

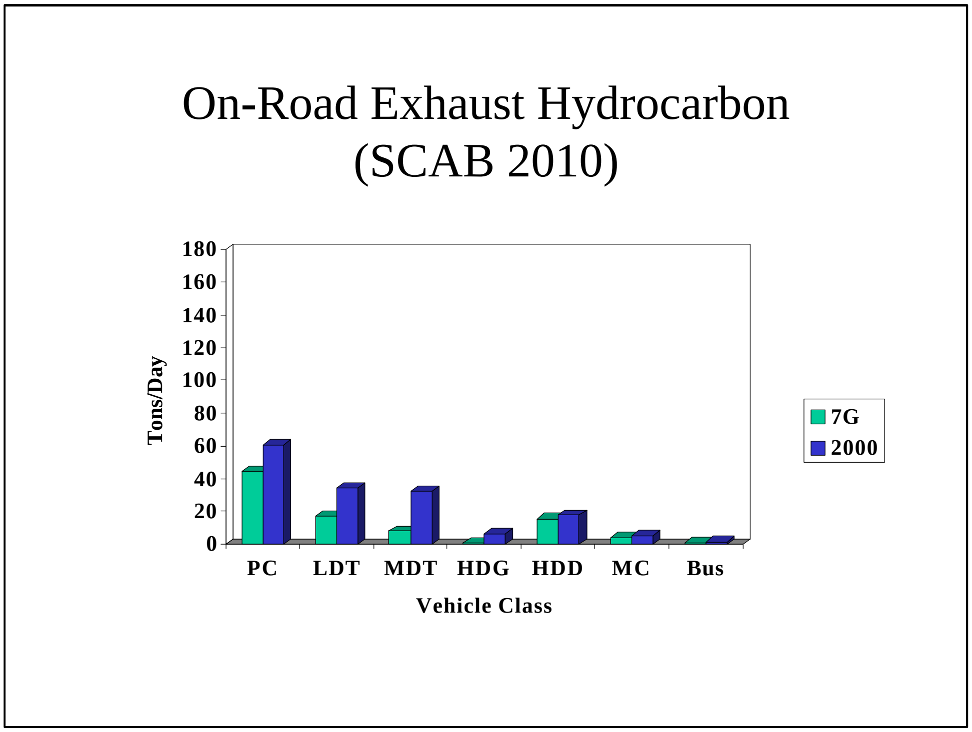
The chart below shows the contribution and distribution of HC exhaust emissions by vehicle class using MVEI7G and EMFAC2000.

Figure 1. – Comparison of 7G and EMFAC2000 for Exhaust HC for 2000



The overall increase in the exhaust hydrocarbon inventory in the SCAB in the year 2000 is 133 tons per day. As can be seen in the figure, ninety-two percent of the difference is attributable to changes in the emissions estimates of gasoline-powered passenger cars (33%), light-duty trucks (20%) and medium duty vehicles (39%). Vehicles powered by diesel engines are only minor contributors because diesel engines have inherently low HC emissions. Motorcycles are gasoline-powered but are relatively few in number, so they do not contribute significantly to the overall change in the inventory.

Figure 2. – Comparison of 7G and EMFAC2000 for Exhaust HC for 2010



Programs previously adopted by the Board including LEV I and II, and the implementation of enhancements to the Smog Check program (Smog Check II) will reduce the inventory of exhaust hydrocarbon by more than half (200 tons per day in the SCAB) by the year 2010. However, at 157 tons per day, exhaust HC emissions are projected to be 67 tons per day higher (75%) compared to 7G projections.

For readers less familiar with emissions inventory estimation methods, an inventory is typically calculated by multiplying the emissions from individual vehicles by how much they are driven and how many there are. The per-vehicle emissions are called "emission factors" and have units of grams per mile. The amount they are driven is called vehicle miles of travel (VMT), and the number of vehicles is referred to as the "population".

Four of the modifications reflected in EMFAC2000 account for 63% of the increase in the HC exhaust inventory for the South Coast Air Basin in the year 2000. These changes are: modifications to the driving cycle adjustments (11%), speed adjustment factors (12%), updates to the emission factors (20%), and changes to the vehicle population (20%). These are discussed in more detail below. The Technical Support Document provides information on other modifications which affect the HC exhaust inventory.

Driving Cycle Adjustments

The Federal Test Procedure (FTP) is the test used for the certification of light-, and medium-duty vehicles, and is the basis for the emission factors (gram per mile estimates of emissions) used in the inventory estimation models. At the core of the FTP is a driving cycle developed in southern California in the early 1970s. It reflects several compromises that allowed vehicles to be tested on the dynamometers available at that time. Notably, the acceleration rates of the vehicle were limited to avoid any tire slippage on the slippery steel rollers of dynamometers used in the vehicle test cell. The test cycles were further modified to limit the amount of cold engine (higher hydrocarbon) operation, compared to hot operation.

While these deficiencies were well known, it took time to develop test equipment capable of properly simulating all vehicle operating modes (large single roll dynamometers). Vehicle operating patterns were also evolving with time, rendering obsolete the driving patterns upon which the FTP was based.

In the early 1990s, a number of vehicle operating pattern studies were performed. These studies revealed that much of contemporary driving is not reflected in the FTP. Since the emissions inventory is supposed to properly represent actual driving, the ARB created a new driving cycle for emissions inventory assessment, called the LA92 or Unified Cycle (UC), which better reflected those higher speeds and accelerations common in today's driving.

In MVEI7G, the large existing database of FTP emissions data was adjusted to a UC basis using correction factors. These correction factors were based on data from approximately 250 vehicles where both FTP and UC tests were performed. Continued testing of vehicles using the UC has produced data on an additional 750 vehicles, which has been included in EMFAC2000. Modifications to the cycle adjustments using this new data increased the emissions estimate for exhaust hydrocarbons by approximately 11%.

Speed Adjustment Factors

The emission factor test cycles, whether they are FTP-based or UC-based, compress an immense range of possible driving conditions into one "average" driving cycle. For example, the UC has an average speed of 27 miles per hour. Many individual vehicles are operated at average speeds far higher (freeway) and lower (traffic jams) than 27 miles per hour. Emissions vary with speed in a non-linear manner. In order to estimate emissions at other speeds, which represent other driving patterns, additional adjustment factors are used. Speed adjustment factors are developed by testing vehicles on the FTP, UC and various other cycles with different average speeds to determine the change in emissions as a function of speed.

In previous versions of the model, thirteen cycles with average speeds ranging from 2.5 to 65 miles per hour were used for this purpose. These cycles were not usually derived from either instrumentation or observation of vehicles, but created by statistically manipulating other cycles. Thus they did not represent actual vehicle driving very well.

In the process of creating EMFAC2000, staff synthesized thirteen new speed cycles using subsets of the UC driving data. Over one hundred vehicles were emissions tested using these cycles. These data were used to establish an adjustment that reflects how emissions change as average driving speed changes. For driving conditions typical of the South Coast Air Basin, the revised adjustment factor increases the exhaust hydrocarbon inventory by approximately 12%.

Emission Factors

The database used in the creation of MVEI7G contained information from multiple FTP tests of about 2,600 vehicles and 250 vehicles tested over the UC. The number of vehicles used in development of EMFAC2000 is more than twice that amount and includes 1,000 vehicles tested over both the FTP and the UC. These tests were performed on randomly selected vehicles from southern California to determine how well emission control systems are working in customer service. Analysis of the larger database suggests higher emission rates than those used previously. This is especially true for older (early 1980s) vehicles that are still prevalent in the fleet. Accounting for changes in driving cycle adjustments discussed earlier, the basic emission rates for light-duty passenger cars increase by 50 to 100 percent in EMFAC2000, depending upon model year, compared to MVEI7G. The changes to the emission factors for exhaust hydrocarbon account for a 20% increase in the inventory.

Vehicle Population

In updating the emissions inventory, the latest Department of Motor Vehicles (DMV) registration information was analyzed. Staff found that in previous versions of the model, only those vehicles classified by the DMV as currently registered were counted in the vehicle population. Thus, it appeared likely that the total number of vehicles in service was underestimated, if one considers that many vehicles are driven without current registration.

The estimate of vehicle miles of travel used in the model for lighter vehicles is derived independent of vehicle population. Therefore, exhaust emissions for these categories of vehicles are not directly affected by the addition of these vehicles in the model. An increase in population does, however, increase the overall number of vehicle starts.

Significant differences in vehicle population were also found to exist at in the medium-duty vehicle, and heavy-duty truck categories. Much of the discrepancy between the class specific estimates is attributable to a misclassification within MVEI7G of cars as trucks (such as an El Camino or Minivan), an underestimation of the popularity of sport utility vehicles, and an overall mis-assignment of vehicles by weight class within the truck category (medium-duty trucks classified as light-duty). Overall modifications to the vehicle population increase the inventory for exhaust HC by about 20%.

HYDROCARBONS

Evaporative:

Another source of hydrocarbon emissions is the evaporation and escape of fuel vapors from the tank or engine fuel delivery system into the atmosphere. For modeling purposes, evaporative hydrocarbons emissions are classified into four processes; diurnal, hot soak, running losses and resting losses.

Diurnal emissions occur when rising ambient temperatures cause fuel evaporation from vehicles sitting throughout the day. Hot soak emissions occur immediately after a vehicle is turned off, due principally to high under-hood temperatures. Running losses occur due to fuel heating and are emitted while the vehicle is being operated. Resting losses, like diurnal emissions, occur when a vehicle is sitting, but are caused by permeation through rubber components rather than normal daily temperature excursions. In addition to these categories of "normal" emissions from fuel evaporation, emissions can also occur when liquid fuel leaks.

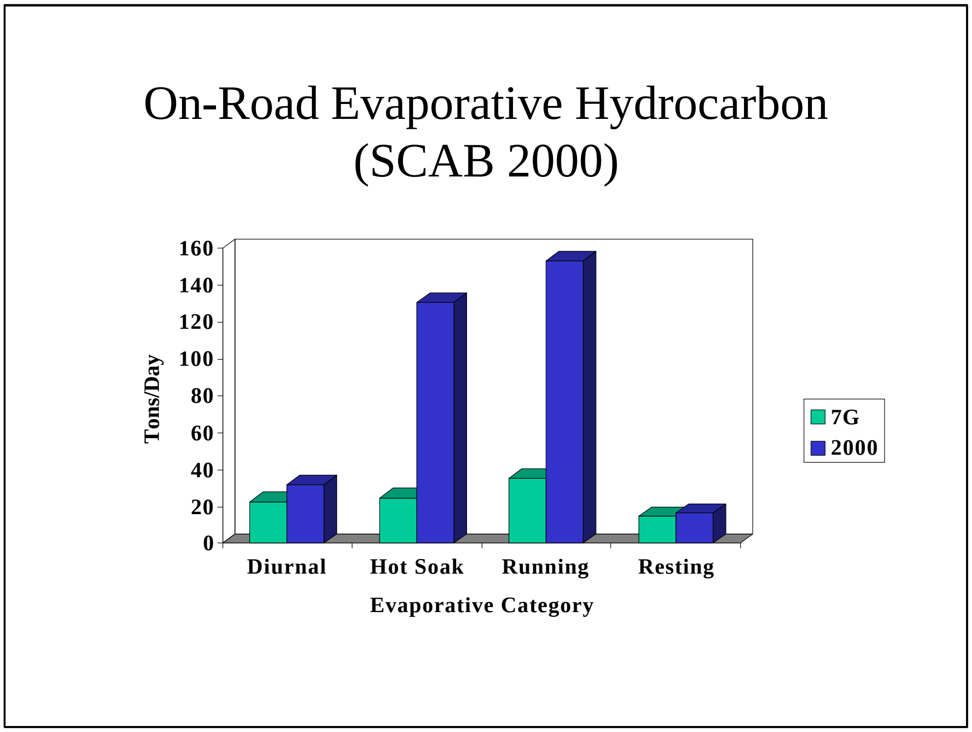
The EMFAC2000 model predicts significantly higher evaporative emissions compared to 7G (See Figure 3). In the SCAB in 2000, greater than 200 tons per day increase in evaporative hydrocarbons occurs. The bulk of this increase is attributable to changes to hot soak (106 tons per day) and running loss estimates (118 tons per day). The changes in both the hot soak and running loss estimates include the changes to the vehicle population discussed above, and are based on new test data recently generated by the Coordinating Research Council (CRC).

Hot Soak Emissions

Hot soaks are evaporative emissions that occur immediately after a trip due to fuel heating when a hot engine is turned off. In older vehicles with carburetors, these emissions were attributed to boiling of the fuel in the carburetor float bowl. Newer vehicles experience these emissions from fuel remaining in the engine manifolds when the engine is turned off, or seepage of fuel from injectors when they get old.

In MVEI7G, the emission rates of catalyst-equipped vehicles were based on data which showed hot soak emissions to be considerably less than non-catalyst vehicles despite the fact that the emission standards were equivalent (2.0 grams per test, hot soak plus diurnal).

Figure 3. – Comparison of 7G and EMFAC2000 Evaporative HC for 2000



Newer data indicate higher hot soak emissions, especially for older catalyst vehicles. As an example, non-catalyst passenger cars in MVEI7G were estimated to have hot soak emissions of 3.9 grams per trip on average in the year 2000. In contrast, catalyst equipped vehicles were estimated to have hot soak emissions that were an order of magnitude less (0.34 grams per trip). In EMFAC2000, the latest test data produced somewhat lower results for non-catalyst passenger cars (3.4 grams per trip) and significantly higher emissions for catalyst-equipped cars (1.33 grams per trip). The difference in emissions rates of catalyst-equipped vehicles was found to be more attributable to vehicle age than to technology.

The increase in the catalyst-equipped hot soak emission rate accounts for 86 tons of the 106 ton per day increase in this category of evaporative emissions. The remaining 20 tons per day is attributable to an increase in the number of trips per day taken by each vehicle (as described below), and the inclusion of fuel "liquid leakers" in the inventory.

Hot soaks are calculated in the model as a function of trips taken per vehicle per day. In MVEI7G, it was assumed that the number of trips taken by a vehicle each day diminished with vehicle age. This estimate ranged from a high of around six trips per day when the vehicle was new to a low of about four trips per day at the end of the vehicle's useful life. Recently conducted instrumented vehicle studies performed by the ARB and the U.S. EPA suggest that the frequency of trips, defined as a "key on" to "key off" event, has no relationship to vehicle age, rather, it is the length of each trip that diminishes as a function of age. EMFAC2000 uses a constant number of trips per day (6.7) per vehicle for light-, and medium-duty vehicles, thus increasing the number of starts for these categories of vehicles by 11%. The higher number of trips results in more hot soaks, which results in a 20 ton per day increase in predicted emissions in the SCAB in 2000.

Running Losses

Running losses are evaporative emissions that emanate from hoses, fittings or canisters, while the vehicle is being operated. They can either occur because fuel heating has caused the vapor generation rate to exceed the vehicle's capacity to control the vapors, or through permeation and leakage. In the CRC study mentioned above, modal (minute by minute) running loss test results were collected for 150 vehicles of varying ages and technologies. The results of the study showed that running losses have a strong dependence on engine operating time, with emissions increasing the longer the engine is running. This makes sense because engine time-on is directly related to fuel temperature.

In MVEI7G, running losses were modeled as a function of speed rather than time and near zero running emissions were assumed at higher speeds. The results of the CRC study suggest that running loss emissions can be as high or higher than exhaust hydrocarbon emissions. The 7G and EMFAC2000 running loss emission rates are compared to the results of the CRC study in Table 2.

Table 2. – Average Running Loss Emission Rate Estimates

	Passenger Cars			**Light-Duty Trucks**		
Model Yr.	**CRC**	**7G**	**2000**	**CRC**	**7G**	**2000**
1971-1977	3.91	0.24	3.76	1.07	0.20	2.37
1978-1985	2.05	0.20	2.16	0.69	0.16	0.99
1986-1991	0.27	0.18	0.26	0.66	0.08	0.32

The change in the emission factors due to addition of these new data to previous test projects performed by the ARB and U.S. EPA account for the bulk of the proposed increase in the running loss portion of the evaporative inventory (60% of the 118 ton per day increase). The remainder of the increase is attributable to the inclusion of liquid leakers.

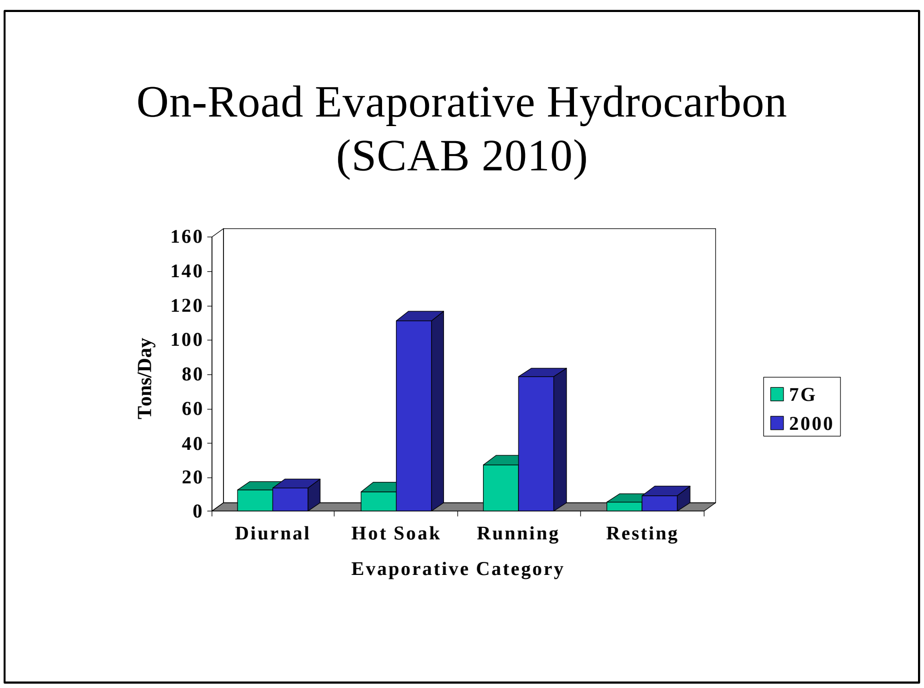
Liquid Leakers

As the name implies, liquid leakers are vehicles that actually drip fuel while running, parked, or both. Liquid leaks are not always obvious. In many cases, fuel does not leak unless the vehicle is running and the fuel is under pressure or being sloshed around in the fuel tank. The higher relative fuel pressures of fuel-injected vehicles compared to carbureted vehicles, may lead to a greater impact of liquid leakers on the overall inventory. MVEI7G did not include an estimate of emissions from this source because in the past, vehicles with fuel leaks were routinely rejected from emission test programs due to safety considerations. A recent test program performed by the Coordinating Research Council suggests that the population of these evaporative "gross polluters" is small, between zero and five percent of the fleet at any given time, yet their emissions can be as high as forty grams per mile. EMFAC2000 includes a specific estimate of the emissions from liquid leakers.

Future Projections

More stringent evaporative emission standards were adopted by the Board applicable to 1995 and newer vehicles sold in California. The "near zero" evaporative emission standards adopted by the board in 1998 will reduce the inventory even more. In EMFAC2000, however, liquid leakers are assumed to remain prevalent in the fleet and are not assumed to be detected by either on-board diagnostic systems (OBD) or the Smog Check program which currently requires only a functional check of the gas cap and a visual check of the evaporative canister. Liquid leakers are projected to contribute 68 tons per day (32%) of all evaporative emissions in the SCAB in 2010. This suggests the need to develop a means of reducing emissions from liquid leakers.

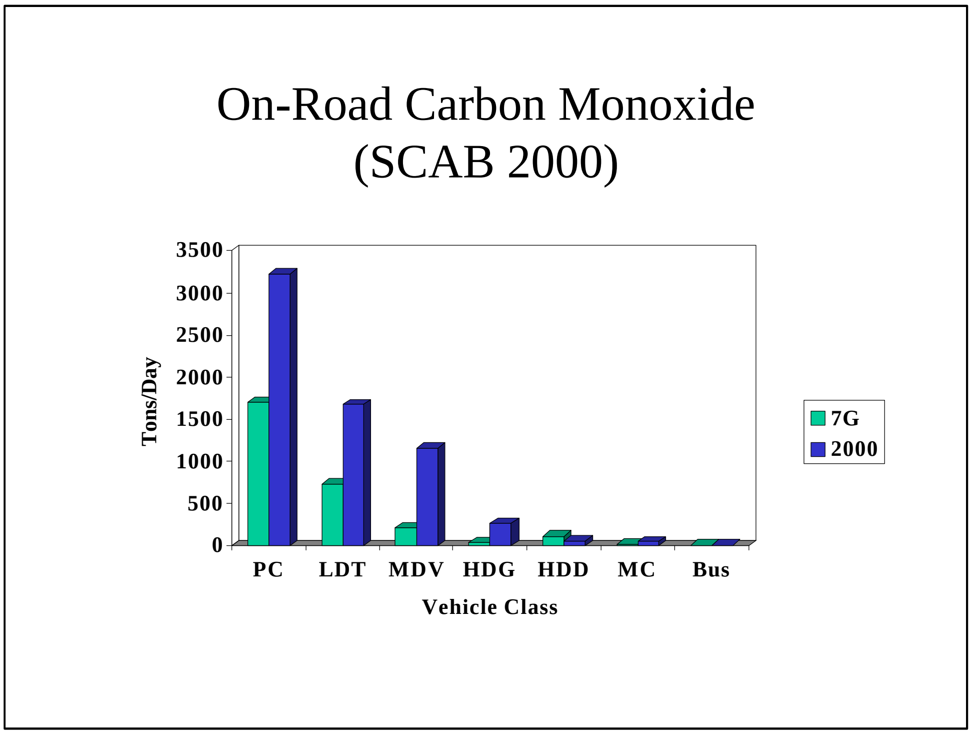
Figure 4. – Comparison of 7G and EMFAC2000 Evaporative HC for 2010



Carbon Monoxide

Carbon Monoxide (CO) is also the product of incomplete combustion and it is primarily attributed to gasoline-powered vehicles. Emissions of CO are a strong function of operating temperature and CO episodes occur most often in winter months. The proposed EMFAC2000 inventory for CO in the SCAB would increase emissions by 3,600 tons per day in year 2000, more than doubling the previous estimate. Three modifications to the model account for 65% of the increase in CO emissions. These are changes to the basic emission rates (+30%), adjustments to the speed adjustment factors (+20%) and the correction the fuel adjustment factors included in MVEI7G (+15%). Other changes are discussed in the Technical Support Document.

Figure 5. – Comparison of 7G and EMFAC2000 CO for 2000



Emission Factors

In 1994, the ARB conducted an Inspection and Maintenance evaluation program, in which selected vehicle owners due for registration renewal had their vehicles tested at the ARB's laboratory in El Monte. Over six hundred vehicles were tested during this program and the average emissions of this fleet was compared to the emissions estimates of the then current EMFAC7F model. It was found that the measured emissions of this fleet of vehicles were substantially higher than estimated by the model.

As a result of this analysis, a high emitter correction factor was incorporated into MVEI7G that increased the emissions inventory for CO. Since no information was available for vehicles produced after 1993, MVEI7G did not use a correction factor for newer vehicles in MVEI7G.

In the development of EMFAC2000, additional test data, including the I/M evaluation data mentioned above, were used in updating the emission factors. The inclusion of this data made the use of a high emitter adjustment unnecessary. The incorporation of this new data resulted in an increase in CO of approximately 30% in the SCAB in the year 2000.

Speed Adjustment Factors

As discussed earlier, vehicles are tested over different driving cycles to model emissions as a function of average speed. CO emission rates vary significantly with driving pattern and speed and are most dramatically affected when hard acceleration and/or high engine loads are present in driving. EMFAC2000 incorporates new emission data generated using driving cycles representative of actual driving in Los Angeles. These data indicate that CO emissions increase during many types of typical driving. In contrast, MVEI7G adjusted CO emissions for varying average speeds in a manner that resulted in CO emissions being lower for nearly all driving patterns that varied from the average. The new speed adjustment factors in EMFAC2000, increase CO by 20%.

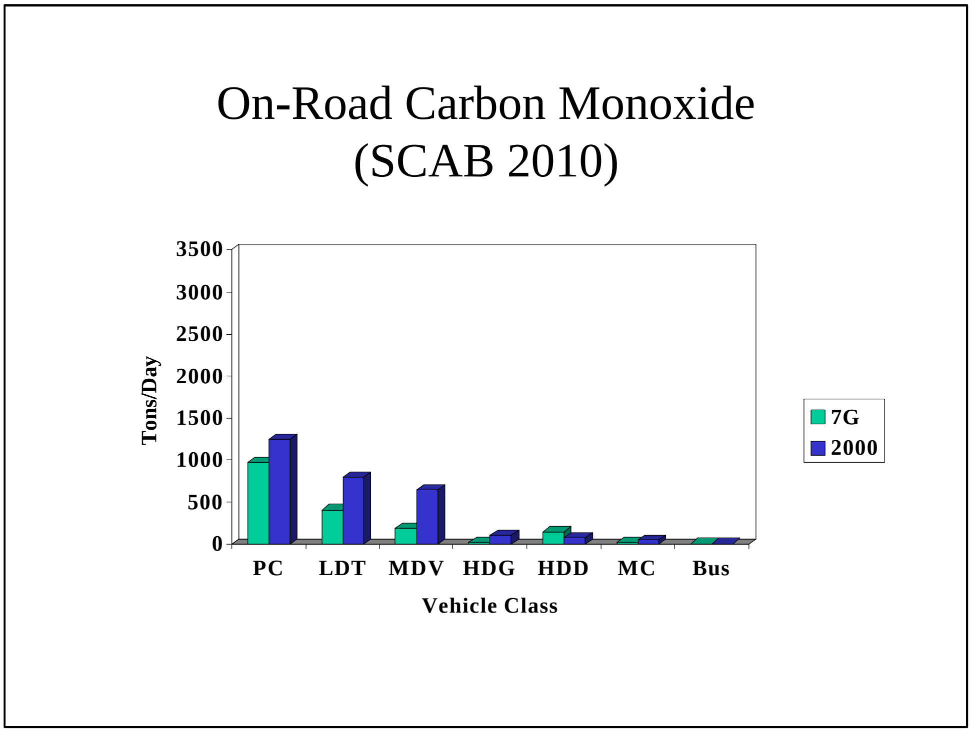
Fuel Adjustment Factor

The fuel correction factors in MVEI7G used to reflect the introduction of California Cleaner Burning Gasoline in 1996, incorrectly reduced CO emissions by 27%. This error was corrected in EMFAC2000, which uses the correct reduction of 11%. This correction to the model results in an increase in projected CO inventory of 15% in the SCAB in the year 2000.

Future Projections

The LEV I and LEV II, and other emission standards previously adopted by the Board, are estimated to reduce CO emission in the SCAB by 3,500 tons per day (55%) between 2000 and 2010. The resulting 2010 inventory, 2,900 tons per day, is about 65% higher than previously predicted by MVEI7G.

Figure 6. – Comparison of 7G and EMFAC2000 CO for 2010

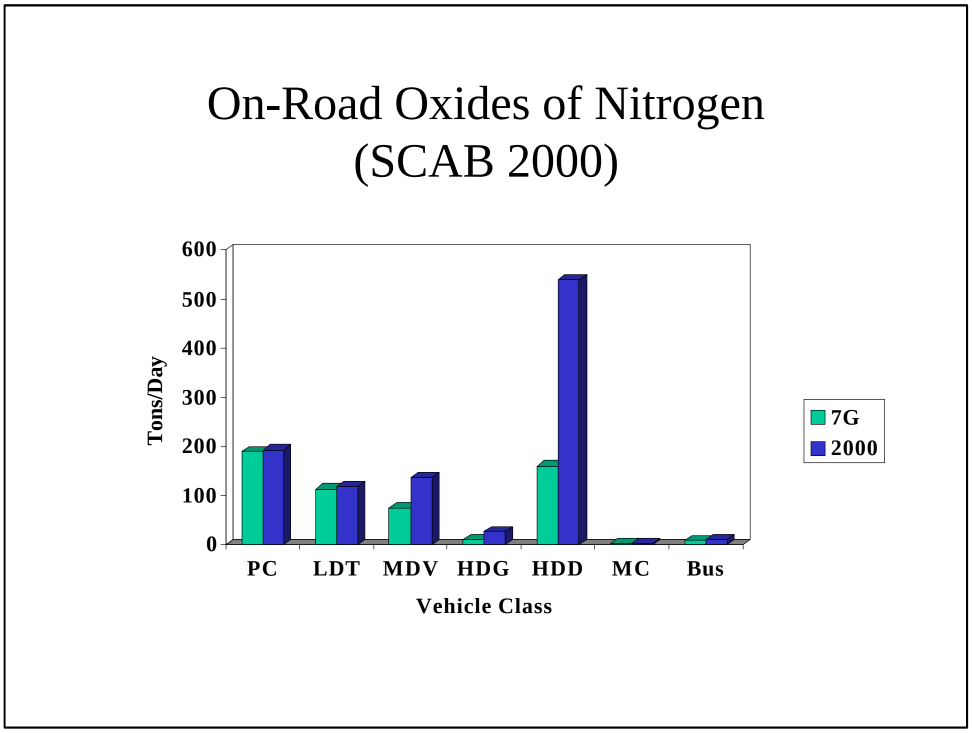


Oxides of Nitrogen

Oxides of nitrogen emissions, (NOx), are formed during high heat and pressure combustion when oxygen combines with nitrogen present in the air. Lean air-fuel ratios tend to promote more NOx formation because there is an excess of oxygen beyond what is needed for chemically correct combustion. Because of the high temperatures and lean air/fuel ratios associated with Diesel cycle engines, Diesel-powered vehicles tend to produce greater amounts of NOx than do gasoline-powered vehicles.

EMFAC2000 increases the on-road motor vehicle NOx inventory more than 450 tons per day (84%) in the SCAB in the year 2000. Almost all of this increase, 379 tons per day, is attributable to heavy-duty diesel vehicles and “off-cycle” NOx.

Figure 7. – Comparison of 7G and EMFAC2000 NOx for 2000



Off-Cycle NOx

Heavy-duty engines, rather than the complete vehicle, are tested for development and certification on an engine dynamometer over a prescribed engine speed/load schedule. The dynamometer is used to simulate the typical modes of truck engine operation. This simulation does not fully represent many modes of operation, including constant speed freeway cruising. Emission factors gathered on the engine dynamometer are expressed as grams per brake-horsepower-hour (g/bhp-hr), or mass of emissions per unit of work performed.

In 1998, the U.S. EPA and the ARB discovered that the majority of heavy-duty diesel-powered engines produced between 1988 and 1998 were programmed to default to a fuel saving operating mode during periods of freeway cruise. This strategy increases emissions of NOx significantly from these engines. Because this operating mode is not present in significant amounts in the certification cycle, these emissions are referred to as "off-cycle". Enforcement action has been taken by the U.S. EPA and ARB against the engine manufacturers, however, the high emitting engines are still in use.

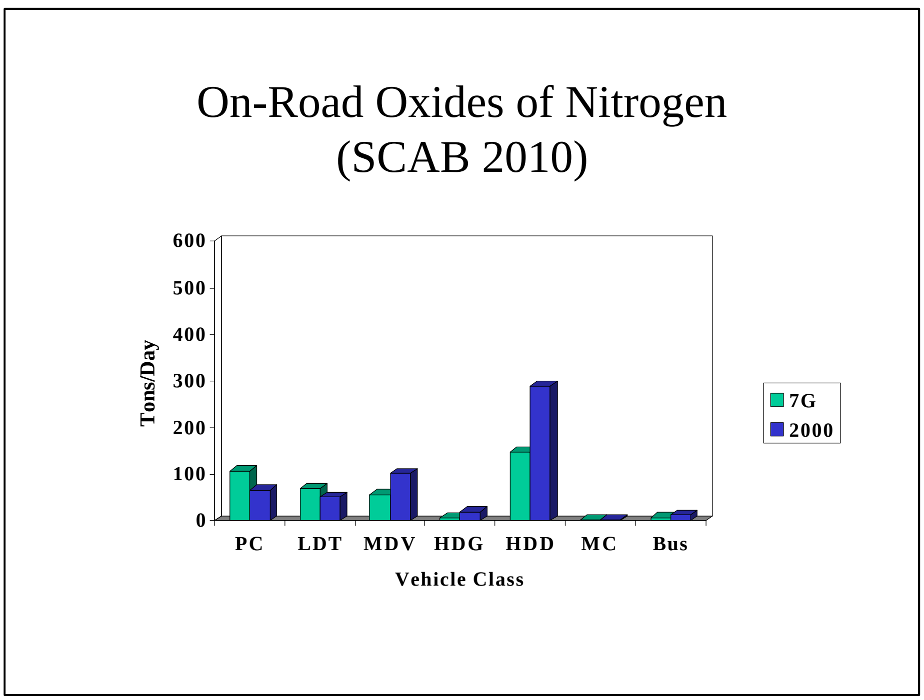
EMFAC2000 includes the impact of off-cycle NOx emissions using emissions rates (11 g/bhp-hr between 1988 and 1998, and 6 g/bhp-hr from 1999 to 2002) and activity information (amount of time spent in off-cycle) provided by the U.S. EPA. These off-cycle emission rates can be contrasted to the standard for new heavy-duty diesel engines, which has ranged from 6 g/bhp-hr for 1988 models to 4 g/bhp-hr for 1998 models. As stated earlier, the inclusion of off-cycle NOx emissions in EMFAC2000 accounts for 75% of the increase in the NOx inventory.

Most of the remaining increase, 62 tons per day, is attributable to the medium-duty truck category. The near doubling of the NOx inventory for medium-duty vehicles which are large pickups, sport utility vehicles and vans, from 74 tons per day in 7G to 136 tons per day in EMFAC2000, is coincident to the 83% increase in the population of this category of vehicles in EMFAC2000 compared to 7G. Changes in the vehicle population used in EMFAC2000 are discussed earlier in this report.

Future Projections

A settlement has been reached between the U.S. EPA, the ARB and engine manufacturers that will partially mitigate the impact of off-cycle NOx in the future. These and other standards previously adopted by the Board are expected to reduce the NOx inventory in the SCAB by nearly 500 tons per day, close to 50%, by the year 2010. The resultant inventory of 539 tons per day, is 38% higher than previously estimated by MVEI7G.

Figure 8. – Comparison of 7G and EMFAC2000 NOx for 2010



Inspection and Maintenance

California's Inspection and Maintenance, (I/M or Smog Check), program was instituted in 1984 requiring the periodic inspection of the emissions of on-road vehicles as a condition of registration renewal. Failing vehicles were required to be repaired. In 1990, the program was enhanced including a more comprehensive inspection, higher repair cost limits and more stringent standards.

In MVEI7G, substantial emission reductions were modeled for both the 1984 and 1990 I/M programs. A 12% reduction in HC, 11% CO and 5% NOx, was reflected for passenger cars in the 1984 program. This benefit increased to a 25% reduction in HC, a 27% reduction in CO and a 14% reduction in NOx in the 1990 program. Analyses of I/M evaluation program data from test of over 1,000 vehicles conducted by the ARB now suggest little or no additional benefits were realized in the 1990 enhancements to the program.

The analysis of the I/M evaluation data was used to revise the estimated benefits of the Smog Check program in EMFAC2000. An emission reduction estimate of 13% for HC, and 17% CO are attributed to both the 1984 and 1990 I/M program in the revised model.

In the 1984 and 1990 I/M programs, no direct measurement was made for emissions of NOx. The NOx benefits assessed in MVEI7G for these programs were based on the assumption that visual and functional checks of the exhaust gas re-circulation system (EGR) and ignition timing would result in some NOx related repairs. In reality, many engine adjustments focused on reductions of HC and CO tend to increase emissions of NOx. EMFAC2000 now reflects a slight overall NOx disbenefit associated with the 1984 and 1990 I/M program of 2%.

MVEI7G assumed that further enhancements to the I/M program which would require dynamometer testing and direct measurement of NOx emissions, would be fully implemented by 1996. EMFAC2000 reflects the delayed implementation date for Smog Check II until the year 2000. By the year 2010, EMFAC2000 estimates the incremental benefits of Smog Check II to be over 110 tons per day of HC+NOx in the SCAB, which can be compared to the State Implementation Plan commitment of 58 tons per day for the SCAB in 2010.

Recommendation.

The staff recommends the Air Resources Board (ARB or Board) approve the draft statewide emissions inventory for on-road motor vehicles. This inventory utilizes the latest available data, analyses and methodologies to ensure that current year and projected inventories are accurate. In preparing this inventory for Board review, staff utilized the latest in the series of estimation models, EMFAC2000.

The year 2000 calendar year inventory for the South Coast Air Basin (SCAB) is presented in Table 3. This represents the reference year from which all projections will be made.

Table 3. – On-Road Motor Vehicle Emissions Inventory for Year 2000 (SCAB-TPD)

	HCex	HCevap	HC Total	CO	NOx	PM10ex
Pass Cars	181	200	381	3234	192	3
Light Trucks	82	70	152	1674	117	2
Medium Trucks	67	50	117	1156	136	5
Heavy-Gas	13	8	21	257	26	2
Heavy-Diesel	13	N/A	13	51	539	21
Bus	1	N/A	1	1	10	0
Motorcycle	5	4	9	44	1	0
Total	362	332	694	6417	1021	33

The staff will use the approved inventory to produce other types of inventories, such as inventories for past and future years, and inventories used for planning and air-quality modeling purposes. Health and Safety Code, Section 39607.3, requires the Board to review the emissions inventory at a minimum of every three years. Staff intends to follow this three-year schedule; however, staff may seek Board review of portions of the inventory sooner than three years if significant changes with major policy implications are suggested by new information.

Staff considers the proposed changes to the on-road motor vehicle inventory to be significant in both scope and magnitude. The completion of the latest version of the inventory estimation model, EMFAC2000, marks the culmination of years of effort and analyses designed to improve the overall understanding of the conditions and process which contribute to the state's air quality problems.

Table 4. – On-Road Motor Vehicle Emissions Inventory for Year 2010 (SCAB-TPD)

	HCex	HCevap	HC Total	CO	NOx	PM10ex
Pass Cars	61	116	177	1246	65	3
Light Trucks	34	41	75	794	51	3
Medium Trucks	32	45	77	641	101	3
Heavy-Gas	6	9	15	104	19	1
Heavy-Diesel	18	N/A	18	67	289	10
Bus	1	N/A	1	1	12	0
Motorcycle	5	2	7	45	2	0
Total	157	213	370	2898	539	20