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# EMFAC2007 /

version 2.30

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## Calculating emission inventories for vehicles in California

### User's Guide

The purpose of this document is to familiarize new users with the Emfac model - EMFAC2007 version 2.3. It provides:

- An overview of what pollutants and emission processes are modeled
- Introduces Burden, Emfac and Calimfac emission modes
- Sample output files
- Information on editing fundamental data

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## **1.0 INTRODUCING EMFAC2007 VERSION 2.30**

The Air Resources Board (ARB) promotes and protects public health, welfare and ecological resources by identifying ecological concerns, determining methods for efficient reduction of air pollutants, and making informed decisions based on the data at hand.

To help in this effort, ARB developed an EMISSION FACTORS (EMFAC) model to calculate emission rates from all motor vehicles, such as Passenger cars to heavy-duty trucks, operating on highways, freeways and local roads in California. In the EMFAC model, the emission rates are multiplied with vehicle activity data provided by the regional transportation agencies to calculate the statewide or regional emission inventories.

An emission inventory can be summarized as the ‘product of an emission rate (e.g. grams per pollutant emitted over a mile) and vehicle activity (e.g. miles driven per day)’.

**Hint: the following basic statement determines how emissions are calculated:**

**Emission Factor X Correction factor X travel activity = Emissions in tons per day**

Over the years, tougher emissions standards have been met with technological solutions of increasing complexity. As a result, the emission estimation models have also grown in size and complexity. The need for emission data to be accurate has not changed. However, these data can impact proposed regulations in California, and in some instances, the entire nation.

### *What Is Emfac2007?*

Emfac2007 version 2.30 is the latest emission inventory model that calculates emission inventories for motor vehicles operating on roads in California. This model reflects the ARB’s current understanding of how vehicles travel and how much they pollute. The Emfac2007 model can be used to show how California motor vehicle emissions have changed over time and are projected to change in the future. This information helps ARB weigh prospective control programs and determine the most effective, science-based proposals for protecting the environment.

The Emfac2007 model supercedes Emfac2002, which was released in November 2002. The Emfac2007 model, like previous versions Emfac2000 and Emfac 2002, is an integrated model in that it combines emission rate data with vehicle activity to calculate an emission inventory.

## About this document

The purpose of this **draft** document is to familiarize new users to the Emfac2007 version 2.30 model. It introduces new users of motor vehicle emissions models to concepts and basic terminology that will teach users how to run the model and make use of all the new features. However, this guide does not provide information on the data sources and details of the modeling equations used in generating the emission estimates. Further, this is a draft user's guide that will be handed out to the attendees of Emfac2007 workshops. This document will complement a real-time presentation given at these workshops.

Section 2 provides an overview of the pollutants and emission processes currently modeled in Emfac2007. Section 3 introduces new users to basic terminology necessary for understanding the outputs from the model. Section 4 details the basic input data required for generating an emission inventory. Section 5 reviews the system requirements necessary for running the model. The remaining sections show the user how to start the model, and explain the three basic emission modes: Burden, Emfac and Calimfac. These sections also provide sample outputs for each of the emission modes. Section 8 shows users how to edit some of the fundamental data, such as vehicle population and vehicle miles traveled, and generate an emissions inventory using the edited data.

## 2.0 WHAT POLLUTANTS AND PROCESSES ARE MODELED

This section details the pollutants currently modeled in Emfac2007, and gives an overview of the emission processes. An emission process is tied to vehicle activity, for example when a vehicle is traveling down the freeway it emits emissions from the vehicle tailpipe. This process is labeled "running exhaust." For each pollutant the model calculates emissions from each emissions process. All the output reports show these emissions by emissions process.

### Pollutants

The model calculates emission factors and emission inventories for the following primary pollutants:

- Hydrocarbons (HC). HC can be expressed as TOG (total organic gases), ROG (reactive organic gases), THC (total hydrocarbon), or CH<sub>4</sub> (methane). The THC class includes compounds with H and C atoms only, carbonyls and halogens are not included in the class. The TOG class includes all organic gases emitted into the atmosphere. The ROG class is same as EPA's VOC (volatile organic compounds) definition and does not contain compounds exempt from regulation.
- Carbon monoxide (CO).
- Nitrogen oxides (NO<sub>x</sub>).
- Carbon dioxide (CO<sub>2</sub>).

- Particulate matter (PM). PM estimates are provided for total suspended particulate, particulate matter 10 microns or less in diameter (PM10), and particulate matter 2.5 microns or less in diameter (PM2.5).
- Fuel consumption. Although, this is not a pollutant, fuel consumption is calculated based on the emissions of CO, CO2 and THC using the carbon balance equation.
- Oxides of sulfur (SOx). Emissions of oxides of sulfur are a function of the sulfur content of fuel. The model calculates these emissions by multiplying the fuel consumption by the weight fraction of sulfur in a gallon of fuel.
- Lead (Pb). Lead emissions are also a function of the lead content in fuel. Hence, the model calculates lead by multiplying the fuel consumption by the number of grams of lead per gallon.

**Note:** Lead was phased out in 1992 and lead results will be zero for 1992 and newer calendar years.

### Emission processes

Emissions (especially HC) emanate from a vehicle during all hours of the day. The magnitude of these emissions varies with what is happening to the vehicle. Was the vehicle just started, is it running on the road, is it idling at a loading zone or just sitting outside in the sun? An emissions process is tied to the vehicle diurnal activity such that all emissions are accounted for during normal daily activity. The types of emission processes are:

- Running Exhaust—Emissions that come out of the vehicle tailpipe while it is traveling on the road.
- Idle exhaust—emissions that come out of the vehicle tailpipe while it is operating but not traveling any significant distance. This process captures emissions from heavy-duty vehicles that idle for extended periods of time while loading or unloading goods. **Idle exhaust is calculated only for heavy-duty trucks.**
- Starting exhaust—tailpipe emissions that occur as a result of starting a vehicle. These emissions are independent of running exhaust emissions and can be thought of as a slug of emissions associated with starting a vehicle. The magnitude of these emissions is dependent on how long the vehicle has been sitting prior to starting. **(Starting emissions are only estimated for gasoline fueled vehicles).**
- Diurnal—HC emissions that occur when rising ambient temperatures cause fuel evaporation from vehicles sitting throughout the day. These losses are from leaks in the fuel system, fuel hoses, connectors, and as a result of breakthrough of vapors from the carbon canister. If a vehicle is sitting for a period of time, emissions from the first 35 minutes are counted as hot soak and emissions from the remaining period are counted as

diurnal emissions, provided that the ambient temperature is increasing during the remaining period of time.

- Resting loss—these losses occur while the vehicle is sitting and are caused by fuel permeation through rubber and plastic components. Emissions are counted as resting loss emissions if the vehicle has not been operated for 35 minutes and vehicle is still stationary, but the ambient temperature is either constant or decreasing.
- Hot soak—evaporative HC emissions that occur immediately after a trip end due to fuel heating and the fact that the engine remains hot for a short time after being switched off. In older, carbureted vehicles these emissions are attributed to vapor losses from the carburetor float bowl. In newer, fuel-injected vehicles, these vapor losses come from leaky fuel injectors or from fuel hoses.
- Running losses—evaporative HC emissions that occur when hot fuel vapors escape from the fuel system or overwhelm the carbon canister while the vehicle is operating.
- Tire wear—particulate matter emissions from tires as a result of wear.
- Brake wear—particulate matter emissions from brake use.

### 3.0 OVERVIEW OF BASIC TERMINOLOGY

This section briefly introduces terminology and concepts that most users will need to understand such as vehicle class, fuel type, and vehicle activity. This is important since the output reports provide a breakdown of emissions by vehicle class and fuel type.

#### **Vehicle fleet**

“Vehicle fleet” refers to all the motor vehicles operating on roads in California. This fleet as currently modeled is broken into 13 categories called classes (for example, class 1, passenger cars). These classes are based on the type of vehicle, but they also take weight class and fuel type (i.e. gas, diesel, or electric) into account. The number of vehicles in each class is based on an analysis of Department of Motor Vehicles (DMV) registration data. These vary by calendar year and geographic area, so the make-up of the vehicle fleet is dependent on the calendar year and geographic area.

## **Vehicle class**

The model performs separate calculations for each of the thirteen classes of vehicles, by fuel usage and each technology group. Each vehicle class contains numerous technology groups, which represent common emissions characteristics such as emission standards, technologies, or in-use emissions. The vehicle classes currently modeled are shown in Table 1, along with abbreviations used in the model.

**Table 1 Vehicle Classes Modeled In Emfac2007**

Vehicle Class	Fuel Type	Code	Description	Weight Class (lbs)	Abbr.
1	All*	PC	Passenger Cars	All	LDA
2	All*	T1	Light-Duty Trucks	0-3750	LDT1
3	Gas, Diesel	T2	Light-Duty Trucks	3751-5750	LDT2
4	Gas, Diesel	T3	Medium-Duty Trucks	5751-8500	MDV
5	Gas, Diesel	T4	Light-Heavy-Duty	8501-10000	LHDT1
6	Gas, Diesel	T5	Light-Heavy-Duty	10001-14000	LHDT2
7	Gas, Diesel	T6	Medium-Heavy-Duty	14001-33000	MHDT
8	Gas, Diesel	T7	Heavy-Heavy-Duty	33001-60000	HHDT
9	Gas, Diesel	OB	Other Buses	All	OB
10	Diesel	UB	Urban Buses	All	UB
11	Gas	MC	Motorcycles	All	MCY
12	Gas, Diesel	SB	School Buses	All	SBUS
13	Gas, Diesel	MH	Motor Homes	All	MH

\* gas, diesel, and electric

## **Fuel**

Emfac2007 currently estimates emissions from gasoline, diesel and electrically powered vehicles. Table 1 shows the fuels modeled by vehicle class.

## **Technology group**

The underlying assumption in Emfac2007 is that each vehicle class can be modeled by the individual behavior of unique technology groups. Each technology group represents vehicles from the same class but has distinct emission control technologies, have similar in-use deterioration rates, and respond the same to repair. A technology group can represent vehicles whose emissions standards are the same or those that have specific equipment installed on them (e.g., multi-port fuel injection, three-way catalyst, adaptive fuel controls, etc.) which makes them behave the same.

Appendices A-1 and A-2 list the technology groups used in modeling exhaust and evaporative emissions, respectively. Some report formats group vehicles into broader technology categories (catalyst, non-catalyst, and diesel). This is a remnant from older EMFAC models, which used to characterize vehicles into these broader technologies, and now is only used for reporting purposes. Gasoline vehicles are placed in the catalyst or non-catalyst categories based on technology group details. Electric vehicles are included in the catalyst category.

### **Model year**

Emfac2007 contains emission factors and vehicle activity data for model years 1965 through 2040. Within each vehicle class, the model year is represented by a combination of technology groups. For example, a non-catalyst gasoline-fueled technology group (TG-1) and a diesel-fueled technology group (TG-170) represent the 1965 model year for passenger cars.

### **Activity**

An emission inventory is simply a product of the emission rate (in grams per mile or grams per trip or grams per vehicle) and vehicle activity (miles per vehicle or number of trips or total number of vehicles). This requires estimates of vehicle population, vehicle miles traveled and trips for each vehicle class, by fuel type and geographic area. These terms are commonly referred to as vehicle activity.

### **Population**

Vehicle population is determined through an analysis of DMV data. These data are used in developing vehicle age matrices for base years 2000 to 2005 for vehicle class, fuel type, geographic area, and vehicle ages 1 to 45 years. These matrices contain actual population estimates, which are used to back-cast from 2000 and forecast from 2005 vehicle populations for calendar years 1970 to 2040.

### **Vehicle miles traveled**

Vehicle miles traveled (VMT) represents the total distance traveled on a weekday. Local planning agencies have developed regional transportation models, which output regional VMT for certain planning years. In the Emfac2007 model, VMT is calculated based on vehicle population and vehicle accrual. Vehicle accrual is the total number of miles a vehicle accumulates in a year, and varies by vehicle age. The regional estimates of VMT are matched by modifying either or both the vehicle population and accrual estimates.

The model also contains hourly distributions of VMT by vehicle class. These distributions are based on instrumented vehicle activity data.

## **Trips**

The number of trips or starts per day is the same, and the terms can be used interchangeably. Both represent the number of separate trips made per weekday. In EMFAC2007, the estimates for trips per day for vehicle classes 1 to 4 are based on travel surveys and vehicle instrumented data. These data show that trips per day decrease linearly with vehicle age from 6.56 at age 1 to 3.72 at age 45. The trips per day estimate for other vehicle classes are based on either instrumented data or an engineering judgement. The model calculates the total number of trips for a given calendar year, region and vehicle class by summing the product of model year populations and trips per day estimates.

## **4.0 BASIC DATA FOR A SCENARIO**

This section explains the basic input data required for generating an emissions inventory. The basic scenario (input) data required for generating an emissions inventory are geographic area, calendar year, month or season selection, title (if default title is not appropriate), model years included in the calculation, inspection and maintenance (I/M) programs, emission mode and output options. A single scenario contains unique selections for the basic scenario data, for example:

Geographic Area – Los Angeles  
Method – Simple Average  
Calendar Year – User input of 2020  
Season or Month – July  
Title – Leave as default  
Model Years Included – Leave as default  
IM Programs – Leave as default

This section describes the choices available to the user for geographic area, calendar year, month or season selection, and model years included in the calculation. The choice of emission mode and output options is described in later sections.

### **Geographic area**

In a single scenario, the model can estimate emissions for one of these four area types: statewide, air basin, air pollution control district, or county. Depending on the area type selection, the user can then select an area from a list of 15 air basins, 35 air pollution districts, and 58 counties.

The model contains activity data for 69 geographic areas. These areas include counties that are in more than one air basin or air pollution district. The Emfac2007 model estimates the emissions for each geographic area more accurately, primarily because it

uses area specific activity data such as vehicle population, mileage accrual, temperature, relative humidity, fuel RVP, and I/M programs.

### **Method—“simple average” or “do-each-sub-area” option**

In Emfac2000, the use of area-specific data increased accuracy of modeled inventories but also resulted in longer execution times. For example, in a statewide run, the model would calculate inventories for each area and then total the individual inventories. In Emfac2000, this process, depending on the computer and calendar year, could take up to 20 hours for a single calendar year. To compensate for this, Emfac2007( as before in Emfac2001/2002), gives the user the option of calculating emissions using either the “Simple-Average” or “Do-Each-Sub-Area” option.

The “Simple-Average” option uses area averaging to calculate averaged parameters for temperature, speed, relative humidity, and I/M. The “Simple-Average” option provides faster emission estimates. However, the “Do-Each-Sub-Area” option provides the most accurate emission estimates since it calculates inventories using area-specific parameters. Further, the “Do-Each-Sub-Area” option generates emission factors or inventories for each sub-area for the area selected. For example, if the area type selection is air basin, the air basin selection is Lake Tahoe, and the method is “Do-Each-Sub-Area.” The model will output emission factors or inventories for the portions of El Dorado and Placer Counties that are in the Lake Tahoe air basin. In addition, the model will output the total inventory for the Lake Tahoe air basin.

**Note:** New users should select area averaging until they are familiar with the model. Sub-area runs provide more accurate results, but they require much longer execution times, and write much larger output files. New users should try the “Do-Each-Sub-Area” option after they become familiar with the output file formats.

### **Calendar year**

The model can estimate emissions for any calendar year between 1970 and 2040. In Emfac2001/2002, user can only specify one calendar year per scenario. But in Emfac2007, user can input many years in a single scenario – in other words, this new model can be called a multi-scenario model. For example, in Emfac2001/2002, a user seeking emission inventories for the Los Angeles County for 2000 to 2005 should create a file in which only basic scenario data are edited, and the file should have six scenarios. These six scenarios correspond to the calendar years 2000, 2001, 2002, 2003, 2004, and 2005.

But with the new Emfac2007, a user can input all years from 2000 to 2005 into a SINGLE SCEANRIO.

### **Month or season**

The model includes data for temperature, relative humidity, and characteristics for gasoline fuel sold (fuel RVP) that vary by geographic area, calendar year, and month and season. Season is defined as summer, winter, or annual average. The summer season

represents an ozone-planning inventory. The summer temperatures and relative humidity have been determined using ambient data for days that have resulted in the worst ozone levels. The fuel RVP is based on an average of the June, July and August months. Similarly, the winter season represents a CO-planning inventory. The winter temperature and relative humidity have been determined using ambient data for days that have resulted in high CO emission levels. The winter RVP is based on average of December, January, and February months. Annual average represents an average of all the monthly inventories. This inventory takes into account appropriate factors introduced by the monthly variation in temperature, relative humidity, and fuel RVP.

### Model year range and model year specific options

When a user requests an emission inventory or emission factors for a given calendar year (e.g., 2010), Emfac2007 generates emission factors and vehicle activity for vehicles from 45 model years, from the current model year back 44 years. Emfac2007 uses this entire model year range in calculating a complete emission inventory or emission factor for a given calendar year.

If the calendar year is 2010, the starting and final model years are 1965 and 2010, respectively. If the scenario year is 2010 (e.g., earlier than 2000), the starting model year is 1965, because Emfac2007's emission factor data only goes back to the 1965 model year. Emfac2007 assumes that vehicles older than 1965 have the same emission rates as 1965 models.

The model year range also gives users the ability to estimate the emission contribution of either a specific model year or a range of model years to the total inventory for a given calendar year.

**Hint:** For example, say the user is charged with estimating the contribution of older vehicles (1980 and older) to the total inventory in calendar year 2010. This can be achieved by selecting the model years from the input file for CY2010. This is a big departure from the previous Emfac2001/2002 – wherein the user was forced to run two different scenarios – one from 1965 to 1980 and the other from 1981 to 2010.

### Inspection and maintenance options

This button gives users the ability to change the I/M options for a given area. However, as with model year options, new users should not change the default I/M options until they have reviewed the advance modeling concepts. The model contains a data file, which describes the different types of I/M programs implemented during various calendar years and in various regions of the State. Emfac2007 uses these data in calculating regional emission inventories.

**Hint:** As vehicles age, their emissions increase as a result of vehicle defects, mal-maintenance, or tampering. One way to reduce in-use emissions is to have I/M programs that identify and repair defective vehicles. In California, the first I/M

program was implemented in 1984. It was revised in 1990, 1996, 1998, and 2001. In the model, these I/M programs are modeled sequentially. As a result, emission deterioration rates from some vehicles may have been modified by I/M effects of up to five different programs.

If the user presses the I/M Options button a secondary screen is displayed, titled “I/M Programs.” This screen displays the available I/M programs specific to the area being modeled, sub-programs for the currently active I/M program, the start date for the currently active I/M program and the type of I/M programs that have been implemented in the area that was selected.

## 5.0 SYSTEM REQUIREMENTS AND INSTALLATION

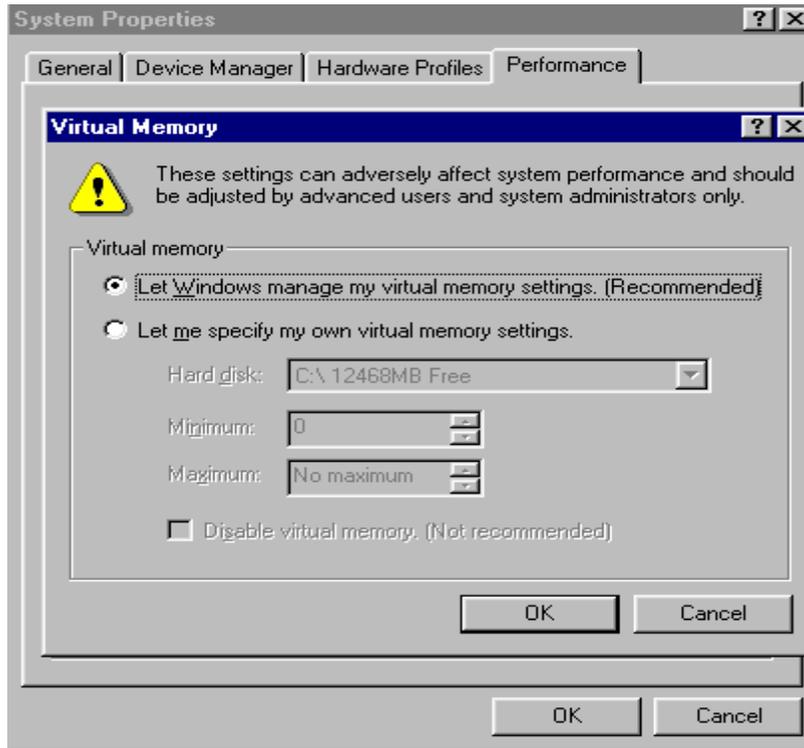
### System requirements

The program will run on any Intel-based PC running Windows 95 or later, or Windows NT 4.0 or later. The installation will require 5 MB of disk space for the installation program and 50 MB of disk space for the installed files.

At least 64 MB of RAM is required. Calculations may run extremely slowly on systems with less than 128 MB of RAM.

Typical input files will require less than 1 MB. Depending on output options, the program may generate very large output files. During a run, the model may increase total virtual memory use by nearly 300 MB; the Windows virtual memory settings must allow for this. Your virtual memory setting should be defaulted to “Let Windows manage my virtual memory settings.” For example, to check this setting with Windows 98, click on **My Computer**, **Control Panel**, **System Properties**, and then the **Performance Tab**. (See figure 1)

Figure 1 Windows 98 Example



### Installation

- The program must be installed using the installation program provided by (ARB). The installation program is available on the ARB Web site, at <http://www.arb.ca.gov/msei/msei.htm>

During installation, you may install the “Main Program,” the “Support Libraries,” or both. *Most users will need to install both options.* You may bypass the “Support Libraries” only if the correct versions of Compaq Visual Fortran and the Compaq Array Visualizer are already installed on the workstation.

### Removal

The program should be removed using the Windows “Add/Remove Programs” option on the Control Panel.

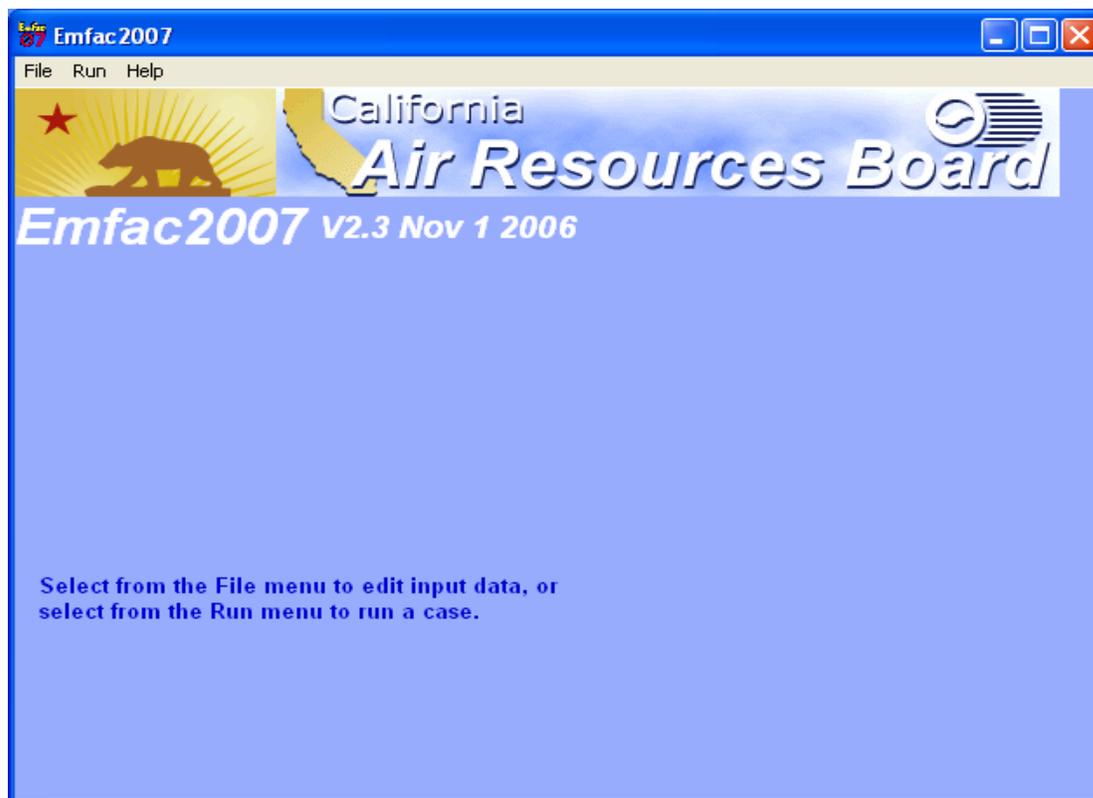
**Note:** Compaq and Visual Fortran users must take special care to the following: the “Support Libraries” installed include DLL files for the Compaq Visual Fortran run-time and for the Compaq Array Visualizer ActiveX control. If you have equivalent versions of Visual Fortran or the Array Visualizer installed, then you may need to re-install the DLLs and ActiveX control after removing Emfac2007.

## 6.0 RUNNING EMFAC2007

### Starting the program

To begin, start the program by selecting the “Emfac2007” item on the Start/Programs menu, or by double-clicking the “Emfac2007” icon on the desktop. When the program starts, it opens up two windows, titled “Emfac2007” and “Emfac2007 Console.” The window labeled “Emfac2007 Console” accommodates older code in the model. This window will rarely contain any output. It should be minimized using the standard Windows minimize button. Depending on your computer, this window may automatically minimize on startup and require no action by the user. Figure 2 shows the first window.

Figure 2 Opening Dialog Window



The main menu bar offers three main selections: File, Run, and Help. This interface will be new to current users who are familiar with earlier versions of the Emfac application.

### File menu

The new/open/save file menu items manipulate scenario files, such as any input files.

- New: Clears some scenario default values and starts the input dialogs with no scenarios defined.
- Open: Opens a file-open dialog. If the user selects a file, it is read in and the input dialogs are started.
- Open filename: When enabled, this menu item re-opens the last file edited and start the input dialogs.
- Save: Saves any pending changes to a file open for editing. Scenario file names must be valid Windows file names, using Windows 95 “long file name” syntax. Spaces are allowed; certain punctuation characters are not. Windows limits the length of the complete file name with path to about 255 characters.
- Save as: Prompts for an alternate file name and saves the current data to the new name.
- Exit: Exits the program. Prompts for confirmation if any edited data have not been saved. (The standard Windows “X” close button behaves the same way.)

### **Run Menu**

- Run: This menu item, when enabled, runs the file name displayed. (This will be the last file opened.) This item is disabled if there are unsaved editing changes, or if no file has been opened.
- Run file: This menu item, when enabled, brings up a file dialog. If a file name is selected, the program reads the file and begins calculations.
- Stop Run on Next Progress Report: This menu item is enabled while a run is executing. If it is selected, a flag is set, and the calculations quit the next time the flag is checked. Depending on when the Stop item is selected, it could be several seconds before the flag is examined and execution stops. The stop action closes all output files immediately. This means that all of the output files may be incomplete, even output data from scenarios that completed.

**Warning:** Users can't resume once Stop is initiated.

### **Help Menu**

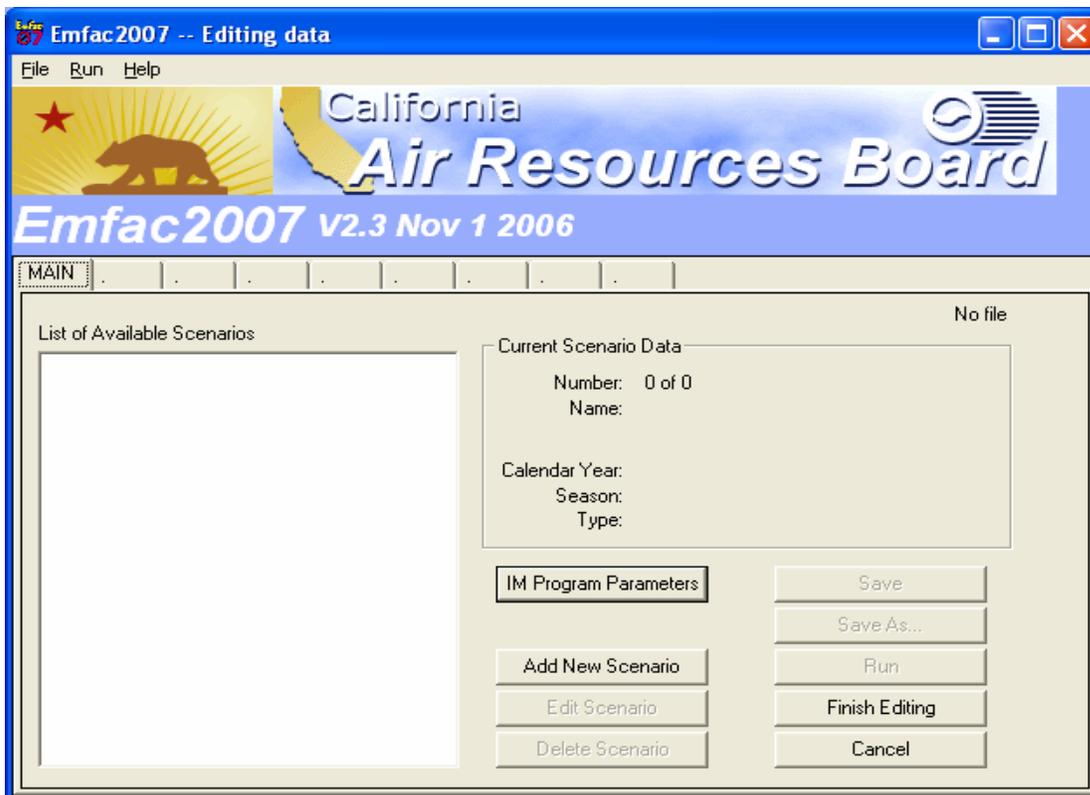
- About Emfac2007: Starts the About window, which displays version information.

### The main screen

The second window (Figure 3) that opens when “New” or “Open” is selected from the file menu shows the file name (if known), a list of the scenarios in the file, and buttons that manipulate scenarios and files. This form is the starting point for entering scenarios in a file.

For a new file, the only buttons enabled when the form first opens are “IM Program parameters”, “Cancel”, “Finish”, and “Add New Scenario”. After the first scenario is added, the scenario title appears in the scenario list on the left, the scenario data box shows a summary of it, and the “Save As” and “Run” buttons are enabled. After the file is saved with “Save As”, the file name is included above the summary data, and the “Save” button is enabled. If you are going to define a new program; then this new IM program should be defined first in the "Global IM parameters box." Once defined this IM program is then available for use under step 7.

Figure 3 Second Dialog Titled Editing Data



### Adding or editing scenarios

When “New” is selected, the only actions enabled on the form are “Finish”, “Cancel”, “IM Program parameters” and “Add New Scenario”. The scenario list on the left is empty (Fig.3). In this case, “Add New Scenario” brings up the Scenario 1 tab; users see input dialogs with some data set to program default values and some data flagged as “missing” set to invalid values.

Figure 4 shows the next window that opens after “Add New Scenario” is depressed. In this Screen, the user is asked to select Geographic area, Calendar year and Season or month.

Figure 4 Scenario 1 Dialog

Emfac2007 -- Editing data

File Run Help

California  
Air Resources Board

Emfac2007 V2.3 Nov 1 2006

Input 1

Basic scenario data - Select Area, Calculation Method, Calendar Year(s), and Season

Step 1 - Geographic Area  
Select an Area Type

State  
Air Basin  
District  
County

Step 2 - Calendar Years  
Select a Calendar Year

Select

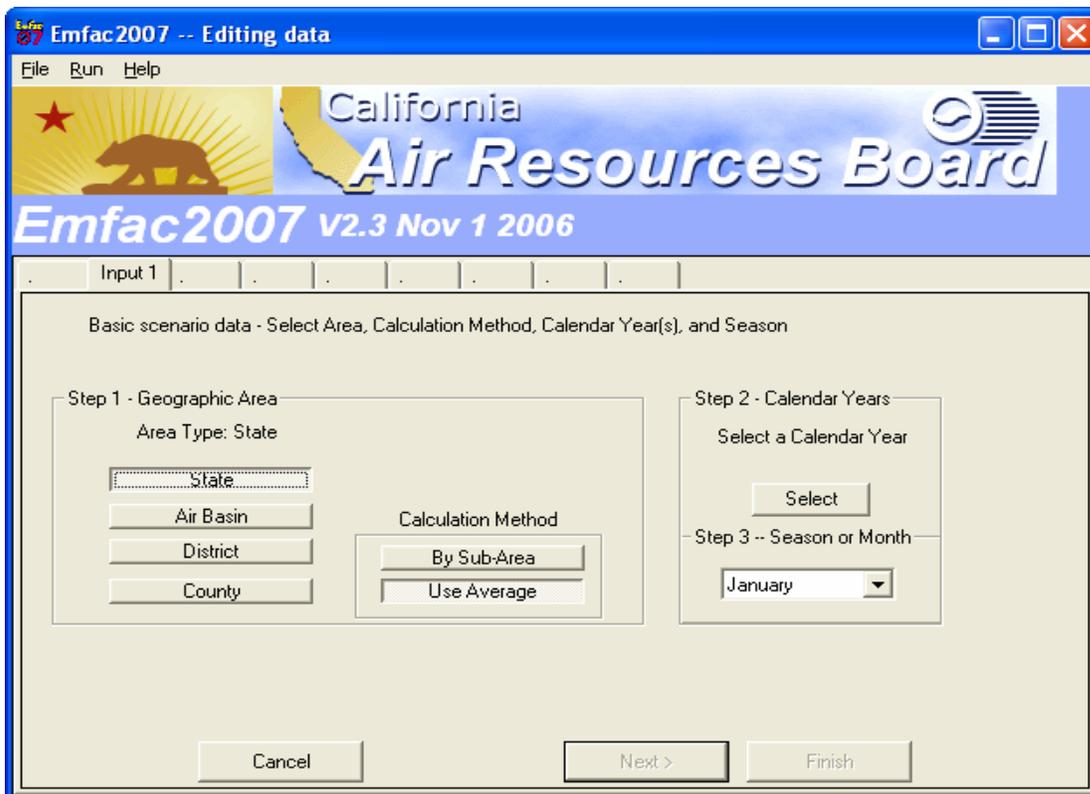
Step 3 -- Season or Month

January

Cancel Next > Finish

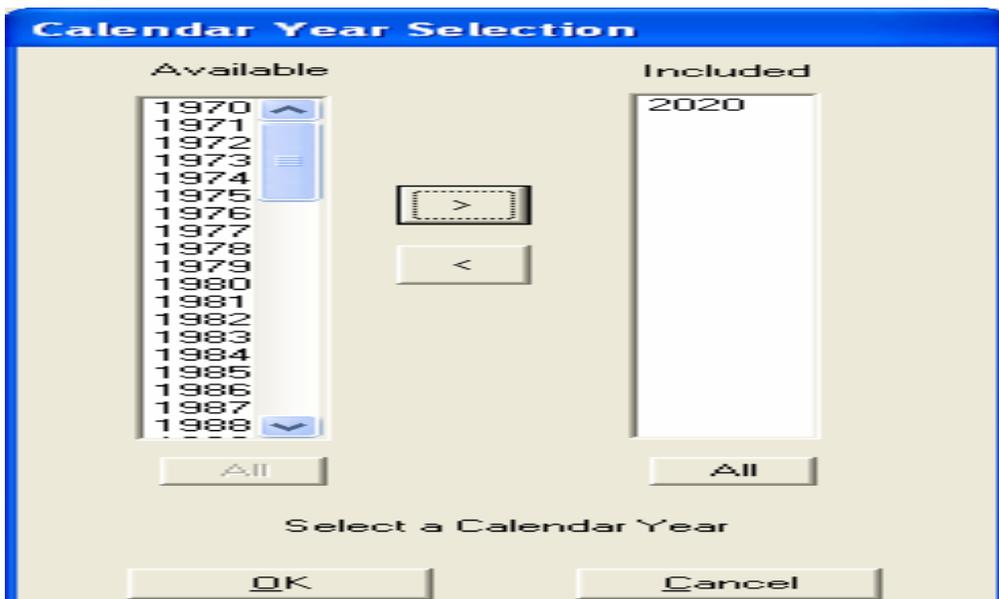
When the Geographic area button is selected, a secondary set of buttons called 'Calculation Method' pop-up (Fig. 5) which shows two options – By Sub-area or Use Average. 'Use Average' uses a set of Average temperature, Humidity etc in order to calculate a rough estimate of the emissions. If 'By sub-area' is selected, the model will use site-specific data – like Temperature, Humidity, speed etc and the calculations are more accurate than the 'use average' choice.

Figure 5 Geographic Area Options



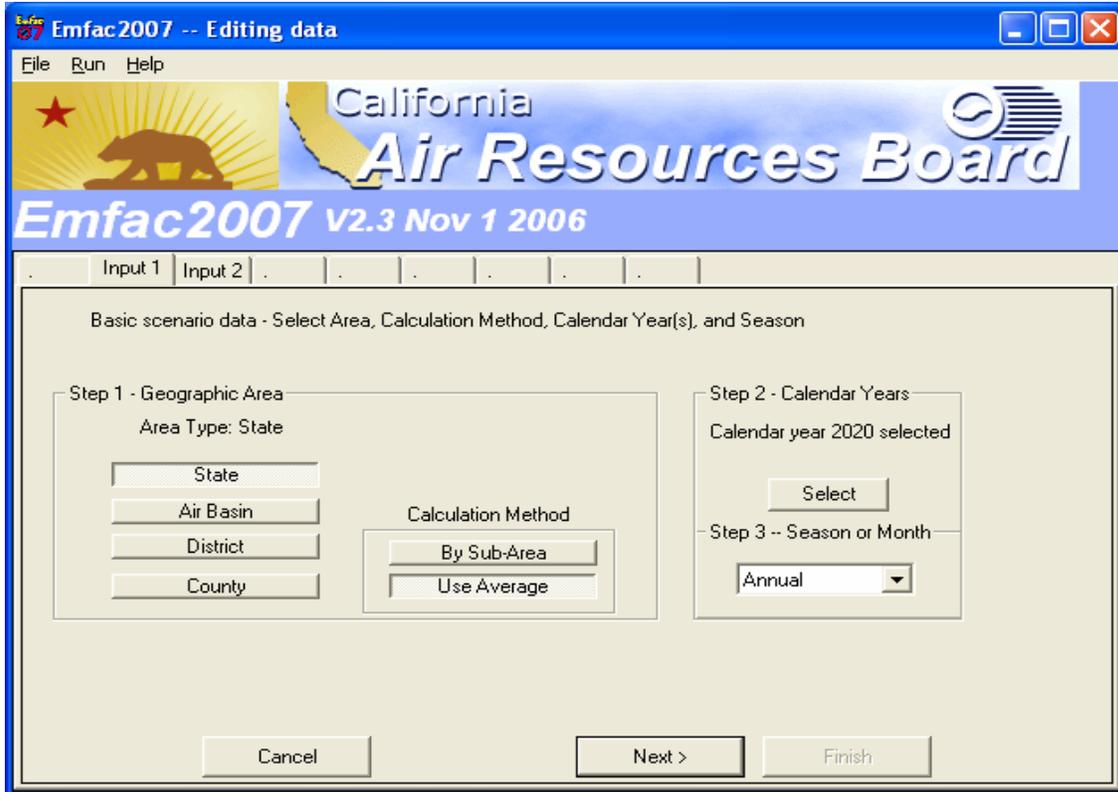
In STEP2, the user can select the Calendar Year for running the model. When the 'select' button is depressed, the screen of Fig. 6 comes up. This is an added feature which was not there in the EMFAC2002 model. Here we can choose one single Calendar Year (as shown in the Fig. 6) or a set of Calendar years or ALL calendar years. For Example, in order to run the model for CY 2020, first choose the Calendar Year 2020, use the '>' button to transfer this to 'included' column and then hit OK which will take you back to the previous screen.

Figure 6 Calendar Year selection



STEP 3 (Fig 7.) is for the selection of the ‘season or month’ to run the model. Here one can choose to run the model for any month from January to December, as well as for seasons – summer, winter and Annual Average.

Figure 7 SEASON or MONTH Selection



If we click 'Next' in Fig 7, we get the next screen which shows the default scenario name generated (FIG.8) from data selected in Fig 7. Users can change this default title to something more relevant to their analysis.

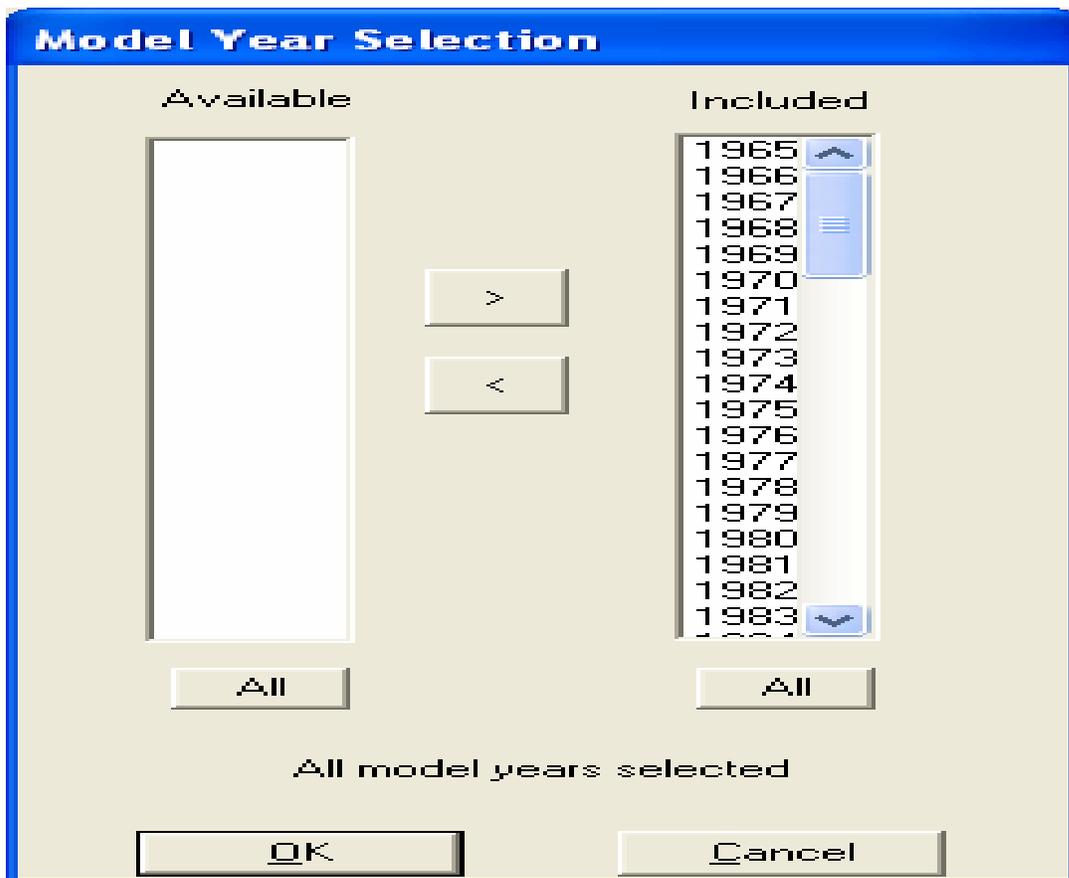
There are three steps in this screen – Model Years (Step 5), Vehicle classes (Step 6) and I/M program (Step 7) schedule. If the user hits the button 'next', the model is assuming that the user is accepting the default conditions for Model Years (i.e. ALL), Vehicle classes (i.e. ALL) and I/M default for the region selected before.

Figure 8 Scenario Details



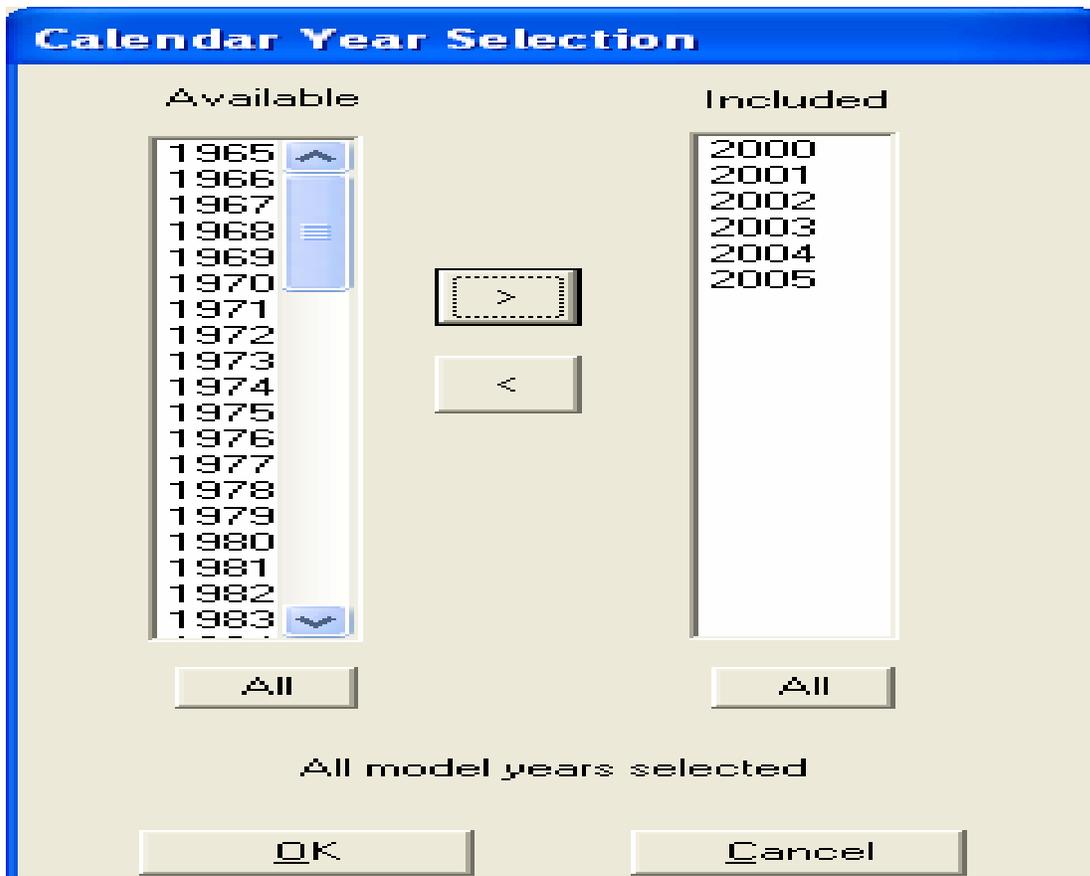
If the User hits the button 'Modify' in STEP 5, a new screen (Fig 9) pops-up. For example, if we want to run the model for all Model Years 1965-2020 for the Calendar Year 2020, then, select all model years using the 'ALL' button and use the 'OK' to go back to the Fig 8.

Figure 9 Model Year Selection



Suppose we want to run the model for CY 2020 and MYs 2000-2005, then use '<' to transfer all the MYs to 'available column'. Then, select the MYs 2000-2005 on the 'available' column and use the '>' to transfer the model years to the 'included' column. The result will be as shown in Fig. 10. Then click OK.

Figure 10 Selecting a set of Model Years (2000-2005)



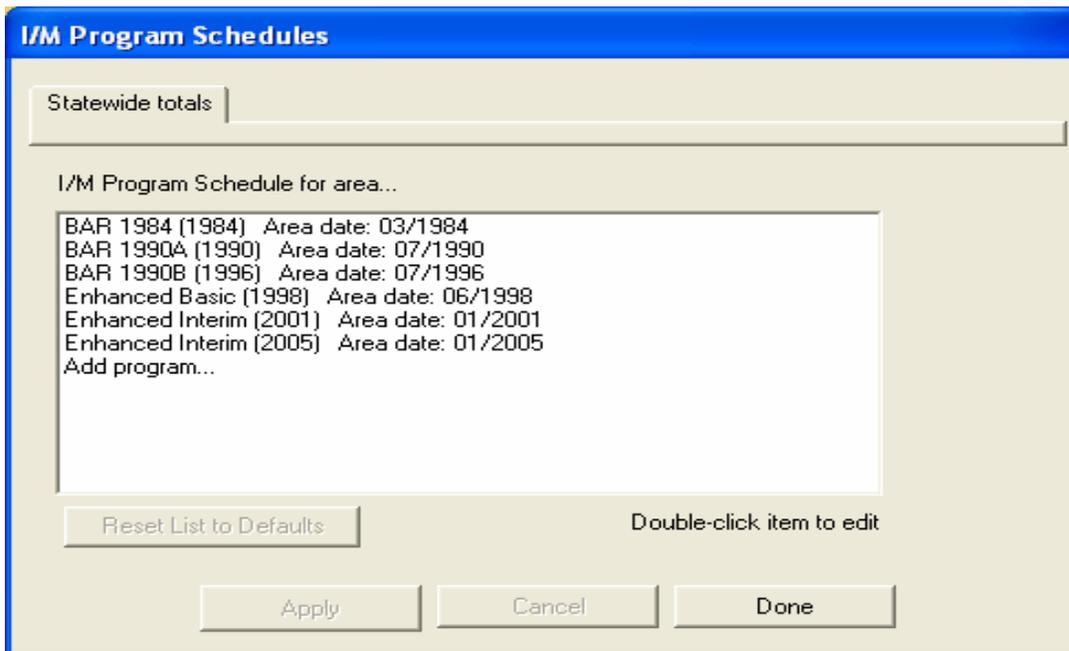
Going back to Fig 8, our next step is STEP 6 – vehicle class selection. The default case is the model will run for all vehicle classes – PCs to Motor Homes. If we click on ‘Modify’ under ‘vehicle classes’ in Fig. 8, we will get the screen as shown in Fig 11. Here we have the option of selecting one or more vehicle types for which the model need to be run. If we click OK, it will take us back to Fig.8.

Figure 11 Vehicle CLASS selection



In STEP 7 of Fig. 8, The button labeled 'I/M Program Schedules' displays two options for I/M - the default I/M options for the geographic area selected and also possibility of changing the I/M to run the model. These will be discussed in more detail at a later time. However, new users should not change the default IM options. If the button 'done' is depressed, it will take us back to fig. 8.

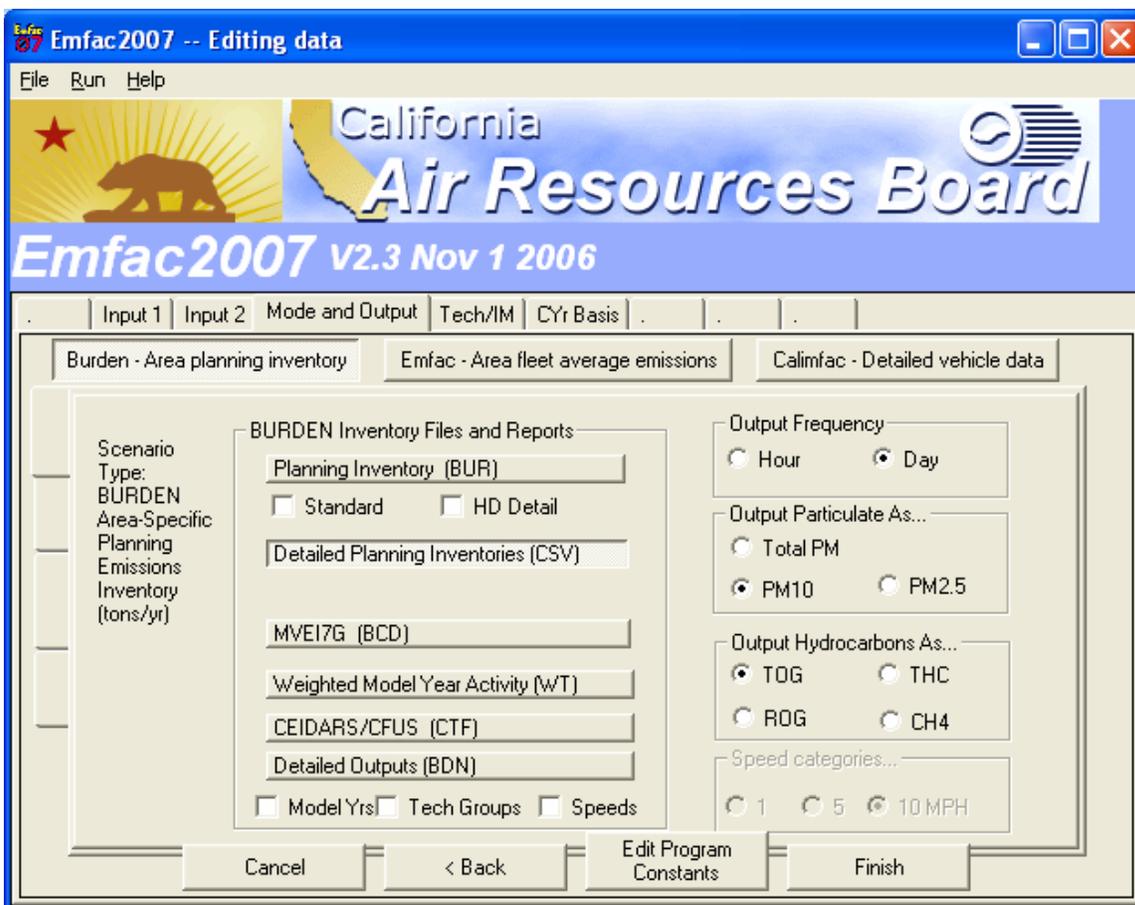
Figure 12 I/M Selection



## 7.0 INTRODUCTION TO THE THREE MODELING MODES

The Emfac2007 model supports calculation of emissions/emission factors for the Burden, Emfac and Calimfac modes. These mode selections are made in the “Mode and Output” form shown below. Figure 13 shows the mode and output selections when the next button is depressed.

Figure 13 Mode and Output Selections



Key distinctions between model modes:

**Burden:** Total emissions in tons/day.

**Emfac:** Emission factors in grams/activity, for input to DTIM and URBEMIS.

**Calimfac:** Basic emission rates.

Each mode selection triggers a corresponding list of output options. In the example above the user has selected Burden mode to output emissions in tons per day. In this mode the user choose to output emission inventories in up to four file formats.

The next three sub-sections describe the Burden, Emfac and Calimfac mode selections and provide example outputs from each of the mode/output selections.

### Burden mode

The Burden mode is used for calculating regional (area-specific) emission inventories. In this mode, the model reports total emissions as tons per weekday for each pollutant, by vehicle class and the total vehicle fleet. The burden mode uses emission factors that have been corrected for ambient conditions and speeds combined with vehicle activity to calculate emissions in tons per day. Vehicle activity includes the number of vehicles, how many miles are driven per day and the number of daily trips. In the burden mode, the user may select either an hourly or daily total output. The hourly output does not add substantially to calculation time, but it increases total output by a factor of 25.

### Burden output

The burden output formats are:

1. **Planning Inventory** - This generates an output file with a “bur” extension. This file has the same format as the “bur” file generated by the MVEI7G and Emfac2000 models. To support formatting and printing on 8.5 x 11 page this older format combined vehicle categories into groups rather than report emissions for each vehicle class. For example, the heavy-duty vehicle group consists of light-heavy, medium-heavy and heavy-heavy duty vehicles.
2. **Heavy-Duty Detail** - This also generates an output file with a “bur” extension. This output format was created in MVEI7G to provide users with more detailed inventories for trucks. However, in order to support formatting and printing on a legal size paper this format omitted emissions from passenger cars. **Note if the user requests both (1) and (2) then a single “bur” file is created containing both outputs.**
3. **Detailed Planning Inventory (CSV)** - This is a comma-separated file (with a “csv” extension) which can be read by any spreadsheet program. It contains emission inventories for all 13-vehicle classes by fuel type. **It is recommended that new users select this as an output option to get an idea of the entire inventory.**
4. **MVEI7G (CSV) File** - This is also a comma-separated file but it has a “bcd” extension. This file is in the same format as that produced by the MVEI7G model. This file has the same information as (3.) but in columnar format, which makes it suitable for sorting using spreadsheets.

Table 2 provides a summary of the Burden mode output extensions.

Table 2 Burden Report Extensions

<b>Option on Input Form (Report Type)</b>	<b>Filename Extension Used</b>
Planning Inventory	BUR
Heavy-Duty Detail (Planning Inventory Detail)	BUR
Detailed Planning Inventory (CSV) (Spreadsheet)	CSV
MVEI7G CSV File (Planning Inventory Database)	BCD

## Burden output reports

This section provides some sample outputs from the Burden mode.

### *BUR extension*

If both “Planning Inventory” and “Heavy-Duty Detail” are selected then the “Planning Inventory” report always written first. Both reports duplicate older report formats generated by the MVEI7G and Emfac2000 models. The older reports were also written to a BUR file extension.

**Planning Inventory Report Format:** This report format includes results for the entire fleet. To support formatting and printing on letter size (8.5 x 11) paper, this format combines vehicle classes into categories rather than report emissions for each class. For example, the medium-duty truck category combines medium-duty trucks (MDV) and two light-heavy-duty truck (LHDT1 and LHDT2) classes.

**Heavy Duty Detail Report Format:** This report format provides users with more detailed inventories for trucks. However, in order to support formatting and printing on legal size (8.5 x 14) paper this format omits emissions from passenger cars.

**Viewing the File:** The file can be opened in most text editors and word processors. The file will often be too large for Windows Notepad, but WordPad or Word can be used instead. Using WordPad is a quick way to view the file, but it will be difficult to print or to zoom out to see the entire file at once.

**Hint:** In Word , select the Courier New font (or another fixed-width font), a Regular font style, and 6-point size. You may need to type size “6” if it is not in the list. Change the page orientation to “Landscape” and adjust the page width until lines don’t wrap in the report. Note, use a 5-point size if the file includes any heavy-duty detail reports.

Figure 14 shows a screen grab of the planning inventory format (\*.BUR) where the season selection was annual average.

**Figure14. Format of the Annual Average Inventory with \*.BUR Extension**

```

Title : Statewide totals Avg Annual CYr 2020 Default Title
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2007/01/24 13:54:41
Scen Year: 2020 -- All model years in the range 1976 to 2020 selected
Season : Annual
Area : Statewide totals Average
I/M Stat : Enhanced Interim (2005) -- Using I/M schedule for area 59 Los Angeles (SC)
Emissions: Tons Per Day
*****
- - - Light Duty Passenger Cars - - - - - Light Duty Trucks - - - - - Medium Duty
Non-cat Cat Diesel Total Non-cat Cat Diesel Total Non-cat Cat Duty D
*****
Vehicles 1704. 15681900. 11715. 15695300. 2858. 10039400. 83384. 10125700. 4633. 3465160. 2
VMT/1000 26. 525846. 237. 526108. 52. 354150. 2061. 356263. 90. 127237.
Trips 6511. 97648300. 59723. 97714600. 10982. 61885700. 467659. 62364300. 24286. 35468800. 25
-----
Run Exh 0.09 13.28 0.03 13.40 0.15 13.76 0.16 14.08 0.97 8.15
Idle Exh 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.67
Start Ex 0.02 17.97 0.00 17.99 0.02 16.80 0.00 16.82 0.18 13.34
-----
Total Ex 0.10 31.25 0.03 31.39 0.17 30.56 0.16 30.90 1.15 22.16
-----
Diurnal 0.01 7.31 0.00 7.32 0.02 6.69 0.00 6.70 0.01 1.89
Hot Soak 0.01 14.44 0.00 14.45 0.03 12.03 0.00 12.06 0.02 4.13
Running 0.06 30.81 0.00 30.88 0.05 46.97 0.00 47.02 0.05 23.45

```

Each report has an eight-line header followed by the report body. In figure 14, note that the header echoes all of the basic scenario data: geographic area, season, calendar year, model year range, and title. The header also echoes a long program version string, and a timestamp for when the scenario was read in.

Data Rows: The report body contains rows of data in the following order: summary vehicle activity data, followed by pollutant and process emission rates, followed by fuel consumption estimates.

Each type of emission rate is given in subtotals by the emissions process (running exhaust, hot soak, tire wear, etc.) and then totaled. Figure 14 shows the first few data rows that are visible. They include the summary vehicle activity data for vehicle population, VMT, and trips. The remaining rows show the tons per day ROG emissions from each exhaust and evaporative emissions process.

Data Columns: In the report body, the columns of data are organized by vehicle categories. Within most categories, results are listed for the three Burden technology classifications, followed by a subtotal for the category (NCAT, CAT, DSL, and Total). Some vehicle categories only include total.

The columns of data in the standard report show results for six general vehicle categories and a fleet total. The six categories include two “specific” categories

(cars and motorcycles), and four aggregated categories (light, medium, and heavy-duty trucks, and buses).

The columns of data in the heavy-duty detail report show results for the light, medium, and heavy-duty trucks, and buses. The heavy-duty truck classes are not aggregated.

### CSV extension

This report is written to a file with a CSV extension. This file is very similar to the Planning Inventory Report in the BUR file, but with much more. It is a text file in comma-separated-value (CSV) format. It may contain multiple reports if the run included sub-areas and/or multiple scenarios. The report includes all of the data in the BUR report, but none of the vehicle classes are aggregated, and all vehicle/technology combinations are included.

Viewing the File: The file should be simple to open in spreadsheet programs such as Excel, and also in database programs such as Access or Sybase.

Figure 15 shows a portion of the Burden text file report as viewed in a spreadsheet.

**Figure 15 Format of the Text File with \*.CSV Extension**

Line	Text																																																																																																																																															
1	Title : Statewide totals Avg Annual CYr 2020 Default Title																																																																																																																																															
2	Version : Emfac2007 V2.3 Nov 1 2006																																																																																																																																															
3	Run Date : 2007/02/23 10:12:08																																																																																																																																															
4	Scen Year: 2020 -- All model years in the range 1976 to 2020 selected																																																																																																																																															
5	Season : Annual																																																																																																																																															
6	Area : Statewide totals Average																																																																																																																																															
7	I/M Stat : Enhanced Interim (2005) -- Using I/M schedule for area 59 Los Angeles (SC)																																																																																																																																															
8	Emissions: Tons Per Day																																																																																																																																															
9	*****																																																																																																																																															
10	<table border="1"> <thead> <tr> <th></th> <th>LDA-NCAT</th> <th>LDA-CAT</th> <th>LDA-DSL</th> <th>LDA-TOT</th> <th>LDT1-NCAT</th> <th>LDT1-CAT</th> <th>LDT1-DSL</th> <th>LDT1-TOT</th> <th>LDT2-NCAT</th> <th>LDT2-CAT</th> <th>LDT2-DSL</th> <th>LDT2-TOT</th> </tr> </thead> <tbody> <tr> <td>11 Vehicles</td> <td>1704</td> <td>15681900</td> <td>11715</td> <td>15695300</td> <td>1813</td> <td>3400840</td> <td>78252</td> <td>3480900</td> <td>1045</td> <td>6638580</td> <td>5131</td> <td></td> </tr> <tr> <td>12 VMT/1000</td> <td>26</td> <td>525846</td> <td>237</td> <td>526108</td> <td>32</td> <td>119610</td> <td>1936</td> <td>121579</td> <td>20</td> <td>234539</td> <td>125</td> <td></td> </tr> <tr> <td>13 Trips</td> <td>6511</td> <td>97648300</td> <td>59723</td> <td>97714600</td> <td>6967</td> <td>20840700</td> <td>439734</td> <td>21287400</td> <td>4015</td> <td>41045000</td> <td>27925</td> <td></td> </tr> <tr> <td>14 Reactive Organic Gas Emissions</td> <td></td> </tr> <tr> <td>15 Run Exh</td> <td>0.09</td> <td>13.28</td> <td>0.03</td> <td>13.4</td> <td>0.09</td> <td>4.49</td> <td>0.15</td> <td>4.73</td> <td>0.06</td> <td>9.27</td> <td>0.01</td> <td></td> </tr> <tr> <td>16 Idle Exh</td> <td>0</td> <td></td> </tr> <tr> <td>17 Start Ex</td> <td>0.02</td> <td>17.97</td> <td>0</td> <td>17.99</td> <td>0.01</td> <td>5.31</td> <td>0</td> <td>5.32</td> <td>0.01</td> <td>11.49</td> <td>0</td> <td></td> </tr> <tr> <td>18</td> <td>-----</td> </tr> <tr> <td>19 Total Ex</td> <td>0.1</td> <td>31.25</td> <td>0.03</td> <td>31.39</td> <td>0.1</td> <td>9.8</td> <td>0.15</td> <td>10.05</td> <td>0.07</td> <td>20.76</td> <td>0.01</td> <td></td> </tr> <tr> <td>20</td> <td></td> </tr> </tbody> </table>		LDA-NCAT	LDA-CAT	LDA-DSL	LDA-TOT	LDT1-NCAT	LDT1-CAT	LDT1-DSL	LDT1-TOT	LDT2-NCAT	LDT2-CAT	LDT2-DSL	LDT2-TOT	11 Vehicles	1704	15681900	11715	15695300	1813	3400840	78252	3480900	1045	6638580	5131		12 VMT/1000	26	525846	237	526108	32	119610	1936	121579	20	234539	125		13 Trips	6511	97648300	59723	97714600	6967	20840700	439734	21287400	4015	41045000	27925		14 Reactive Organic Gas Emissions													15 Run Exh	0.09	13.28	0.03	13.4	0.09	4.49	0.15	4.73	0.06	9.27	0.01		16 Idle Exh	0	0	0	0	0	0	0	0	0	0	0		17 Start Ex	0.02	17.97	0	17.99	0.01	5.31	0	5.32	0.01	11.49	0		18	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	19 Total Ex	0.1	31.25	0.03	31.39	0.1	9.8	0.15	10.05	0.07	20.76	0.01		20												
	LDA-NCAT	LDA-CAT	LDA-DSL	LDA-TOT	LDT1-NCAT	LDT1-CAT	LDT1-DSL	LDT1-TOT	LDT2-NCAT	LDT2-CAT	LDT2-DSL	LDT2-TOT																																																																																																																																				
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20																																																																																																																																																

This report also has an eight-line header followed by the report body. This header is essentially identical to the one in the BUR file. All of the observations about the BUR header also apply to this report's header.

Data Rows: The report body contains rows of data in the following order: summary vehicle activity data, followed by pollutant and process emission rates, followed by fuel consumption estimates.

Each type of emission rate is given in subtotals by the emissions process (running exhaust, hot soak, tire wear, etc.) and then totaled. Figure 15 shows the first few data rows that are visible. They include the summary vehicle activity data for vehicle population, VMT, and trips. The remaining rows show the tons per day ROG emissions from each exhaust and evaporative emissions process. The remaining rows show the CO emissions from exhaust emission processes.

Data Columns: In the report body, the columns of data are grouped by thirteen vehicle classes. Within each class, results are listed for the three Burden technology classifications, followed by a subtotal for the vehicle class (NCAT, CAT, DSL, and Total).

Since not all vehicle classes use every technology (there are no diesel motorcycles), some output columns are only placeholders.

BCD extension

This report is written to a file with a BCD extension. Although it uses a BCD extension, this is a text file in comma-separated-value (CSV) format. It duplicates the BCD reports produced by the MVEI7G model. This file contains the same data as the Planning Inventory spreadsheet “Text File (CSV)” report, but in record format rather than tabular format, which makes it suitable for database selections and spreadsheet sorting.

Viewing the File: The file should be simple to open in database programs such as Access or Sybase, and also in spreadsheet programs such as Excel. Since the file does not have a CSV extension, you may need to specify the format as “delimited” with a comma for the delimiter.

Figure 16 shows a portion of the Burden report, as viewed in a spreadsheet, with a BCD extension.

Figure 16 Format of the MVEI7G CSV file with \*.BCD

1	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	CALYR	START MYR	END MYR	AIR BASIN	COUNTY	STARTS	POPULATION	VMT/1000	VEH TYPE	VEH TECH	POLLUTANT	PROCESS	EMISSIONS	BASIS
2	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	CO	Run Exh	0.939	Day
3	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	NOx	Run Exh	0.078	Day
4	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	SOx	Run Exh	0	Day
5	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	PM	Run Exh	0.001	Day
6	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	Pb	Run Exh	0	Day
7	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	ROG	Run Exh	0.088	Day
8	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	CO2	Run Exh	14.772	Day
9	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	CO	Idle Exh	0	Day
10	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	NOx	Idle Exh	0	Day
11	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	SOx	Idle Exh	0	Day
12	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	PM	Idle Exh	0	Day
13	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	Pb	Idle Exh	0	Day
14	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	ROG	Idle Exh	0	Day
15	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	CO2	Idle Exh	0	Day
16	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	CO	Start Ex	0.099	Day
17	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	NOx	Start Ex	0.006	Day
18	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	SOx	Start Ex	0	Day
19	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	PM	Start Ex	0	Day
20	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	Pb	Start Ex	0	Day
21	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	ROG	Start Ex	0.015	Day
22	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	CO2	Start Ex	1.426	Day
23	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	CO	Total Ex	1.038	Day
24	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	NOx	Total Ex	0.084	Day
25	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	SOx	Total Ex	0	Day
26	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	PM	Total Ex	0.001	Day
27	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	Pb	Total Ex	0	Day
28	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	ROG	Total Ex	0.103	Day
29	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	CO2	Total Ex	16.199	Day
30	2020	1976	2020	State Average	State Average	6511	1704	26	LDA	NCAT	CO	Hot Soak	0	Day

There is one header row that contains names for the 14 fields.

Data Rows: Each row (record) in the file contains a single emission rate for a combination of one pollutant and one process or process total. The record includes several types of fields:

- Five “header” fields that echo scenario data (calendar year, model year range, and geographic area);
- Three fields that echo activity summary data (starts, population, and VMT);
- Five index fields (vehicle class, technology category, pollutant, process, and time basis); and
- One value field (emissions) with emission rate.

There are a few items to note about the records:

- The combination of the five index fields uniquely identifies each record. (If there is no hourly output, the time basis field is not needed as an index.)
- There is a record for every combination of indexes, including those with no population and those that are never calculated. This yields 4095 data records (13 vehicle classes, 3 technology categories, 7 pollutants, and 15 processes and process totals).
- Unlike the other Burden reports, there are no totals across technology categories, no subtotaled vehicle categories, and no fleet grand totals across all vehicle classes. The user is expected to construct these values with database queries or spreadsheet calculations.
- The header fields are duplicated on every record.
- The activity data is unique by vehicle class and technology category, so it is duplicated for pollutant and process combinations.

## Weighted Model Year Activity Output

This output gives the Activity components like POP, VMT, Trips, Accrual rate and ODOMETER by Model year.

Figure 17 WEIGHT output

SCEN YEAR	VEH CLS TECH MYR	VEH POP (number)	VMT/1000 (mi/day)	TRIPS (per day)	ACCRUAL (mi/yr/veh)	ODOMETER (mi/veh)
2020	1 NCAT 1976	379.	5.56	1409.	5108.	387169.
2020	1 NCAT 1977	389.	5.80	1470.	5192.	382061.
2020	1 NCAT 1978	309.	4.69	1187.	5278.	376869.
2020	1 NCAT 1979	627.	9.66	2445.	5365.	371591.
2020	1 NCAT 1980	0.	0.00	0.	0.	0.
2020	1 NCAT 1981	0.	0.00	0.	0.	0.
2020	1 NCAT 1982	0.	0.00	0.	0.	0.
2020	1 NCAT 1983	0.	0.00	0.	0.	0.
2020	1 NCAT 1984	0.	0.00	0.	0.	0.
2020	1 NCAT 1985	0.	0.00	0.	0.	0.
2020	1 NCAT 1986	0.	0.00	0.	0.	0.
2020	1 NCAT 1987	0.	0.00	0.	0.	0.
2020	1 NCAT 1988	0.	0.00	0.	0.	0.
2020	1 NCAT 1989	0.	0.00	0.	0.	0.
2020	1 NCAT 1990	0.	0.00	0.	0.	0.
2020	1 NCAT 1991	0.	0.00	0.	0.	0.

## CEIDARS/CEFS Transaction Format

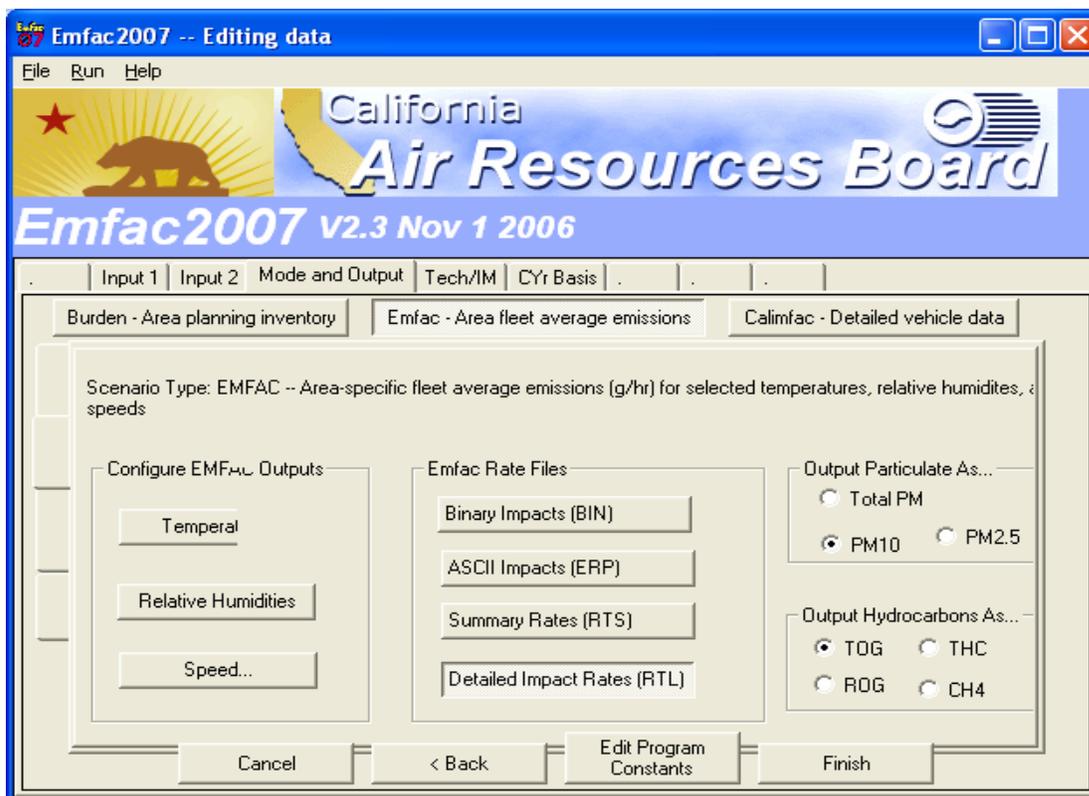
CEIDARS and CEFS are two different databases maintained by the Emissions Inventory Systems Section (EISS) at the Air Resources Board. These databases store on-road, off-road, stationary, and area source emission inventories. The on-road inventories contain PM, SO<sub>x</sub>, NO<sub>x</sub>, TOG and CO emissions, for summer, winter, and annual season selections for each area/sub-area in the state. Historically, the on-road emissions from EMFAC have been imported into CEIDARS and CEFS databases by processing three individual Burden BCD output files (one each for summer, winter and annual) through other programs. The purpose of this output is to create a new output file (in CTF format) that will communicate effectively with CEIDARS or CEFS databases. The EISS will be responsible for converting the single CTF formatted file into either CEIDARS or CEFS databases (FIG 18). More information is provided in the Appendix 3.



### Emfac mode

The Emfac mode generates emission factors in terms of grams of pollutant emitted per vehicle activity. Vehicle activity can be in terms of grams per mile or grams per hour, or grams per start, and depends on the emissions process. The emission factors depend on basic scenario data options for geographic area, calendar year and month or season. In the Emfac mode the model calculates a matrix of emission factors at specific values of temperature (-20°F to 120°F), relative humidity (0% to 100%), and vehicle speed (idle and 1 mph to 65 mph) for each vehicle class/technology combination. In the Emfac mode, an additional input form allows users to customize their output and select specific temperature, relative humidity and speed values. One important use for the Emfac mode is to generate files for use with the DTIM model. The output files are also used in other air quality models such as AIRSHED, CALINE and URBEMIS. Figure 20 shows the output options available in the Emfac mode.

Figure 20 EMFAC Mode Output Selections



## Emfac output

The Emfac mode output files are:

1. **Binary Impacts (BIN).** This is a binary file with a “bin” extension. This format was created to provide outputs compatible with other computer platforms, and now is almost redundant given the other output format.
2. **ASCII Impacts (ERP).** This is an ascii text file with a “erp” extension. This file is used in gridded inventory models such as DTIM.
3. **Rate Summary (RTS)** . This file (also known as “reports format”) has an “rts” extension. This is a summary file in that vehicle classes are grouped for reporting purposes. This output format is similar to that generated by the MVEI7G model.
4. **Impact Rate Detail (RTL).** This file as the name implies generates detailed information for each vehicle class and technology group combination. This file has an “rtl” extension but is in a CSV format. Hence, any spreadsheet program can read this file. **It is recommended that new users output this file to get a feel for the type of information generated in Emfac mode.**

In Emfac mode, the model calculates a matrix of corrected emission factors. The emission factor units are suitable for input to other models such as DTIM, AIRSHED, CALINE and URBEMIS. The primary Emfac reports are formatted for this purpose. Table 3 provides a summary of the Emfac mode output extensions.

Table 3 File Output Extensions

<b>Option on Input Form</b>	<b>Filename Extension Used</b>
Binary Impacts	BIN
ASCII Impacts	ERP
Rate Summary	RTS
Impact Rate Detail	RTL

The Emfac mode calculates a matrix of emission factors at specific values of temperature, relative humidity, and vehicle speed. For each of these, the user can provide from 1 to 24 values.

The default Emfac scenario data includes 24 temperatures, 11 humidity values, and 13 speeds, for 3432 total Temperature/Relative Humidity/speed

combinations.(Note that Emfac output files are large, and total file size depends on the number of combinations.)

After selecting the output reports and report options (Fig 20) in the ‘EMFAC rate files’ column, the next column ‘configure EMfac outputs’ gives three editing options - temperature, relative humidity and speed.

If we click on speed in Fig20, then Figure 21 pops-up with list editing form for speed. In this form the user can either select to output emission factors for all speeds or delete some of the speed bins and hence minimize the size of the output file.

Figure 21 LIST EDITING FOR SPEED

Select/Edit speed for Emfac calculations

Enter data for speed. Click button to enable new value.

<input checked="" type="radio"/> Delete speed 1	<input type="text" value="0"/>	<input type="radio"/> Delete speed 13	<input type="text" value="60"/>
<input type="radio"/> Delete speed 2	<input type="text" value="5"/>	<input type="radio"/> Delete speed 14	<input type="text" value="65"/>
<input type="radio"/> Delete speed 3	<input type="text" value="10"/>	<input type="radio"/> Enter speed 15	<input type="text"/>
<input type="radio"/> Delete speed 4	<input type="text" value="15"/>	<input type="radio"/> Enter speed 16	<input type="text"/>
<input type="radio"/> Delete speed 5	<input type="text" value="20"/>	<input type="radio"/> Enter speed 17	<input type="text"/>
<input type="radio"/> Delete speed 6	<input type="text" value="25"/>	<input type="radio"/> Enter speed 18	<input type="text"/>
<input type="radio"/> Delete speed 7	<input type="text" value="30"/>	<input type="radio"/> Enter speed 19	<input type="text"/>
<input type="radio"/> Delete speed 8	<input type="text" value="35"/>	<input type="radio"/> Enter speed 20	<input type="text"/>
<input type="radio"/> Delete speed 9	<input type="text" value="40"/>	<input type="radio"/> Enter speed 21	<input type="text"/>
<input type="radio"/> Delete speed 10	<input type="text" value="45"/>	<input type="radio"/> Enter speed 22	<input type="text"/>
<input type="radio"/> Delete speed 11	<input type="text" value="50"/>	<input type="radio"/> Enter speed 23	<input type="text"/>
<input type="radio"/> Delete speed 12	<input type="text" value="55"/>	<input type="radio"/> Enter speed 24	<input type="text"/>

Sort the array (done after exit)

OK Cancel

## EMFAC output reports

This section provides some sample outputs from the Emfac mode.

### RTS extension

The impact rate summary file generates a file with an \*.RTS extension. The impact rate summary report is an ASCII text report that contains column-delimited fixed format reports. It will contain multiple reports if the run included sub-areas and/or multiple scenarios. The report includes data aggregated for all fuels and technologies, in five vehicle categories plus a total. The report does not include results by fuel, technology, or individual vehicle class. The file can be opened in most text editors and word processors. Figure 22 shows an output from \*.RTS file.



Data Columns: In each table body, the columns of data are grouped by five aggregated vehicle categories plus a total for all vehicles. This format is similar to that available in MVEI7G model.

### RTL extension

The Impact Rate Detail file has an \*.RTL extension. This file provides more detailed information than the RTS file. It is a text report in comma-separated-value (CSV) format. It will contain multiple reports if the run included sub-areas and/or multiple scenarios.

The size of each report is variable, depending on the number of combinations of temperature, relative humidity, and speed in the Emfac matrix. The file should be simple to open in spreadsheet programs such as Excel. The report includes all of the data in the Impact Rate Summary report, but results are included for each of the 13 vehicle classes and for the three Burden technology categories (CAT, NCAT, and DSL). The column layout is very similar to the Burden CSV report.

Figure 23 shows an output from the RTL file. This file is typically used as an input file to URBEMIS and CALINE Models.

Figure 23 Example of Impact Rate Detail Format (RTL)

The screenshot shows an Excel spreadsheet with the following content:

- Row 1:** Title : Statewide totals Avg Annual CYr 2020 Default Title
- Row 2:** Version : Emfac2007 V2.3 Nov 1 2006
- Row 3:** Run Date : 2007/01/31 15:49:59
- Row 4:** Scene Year : 2020 -- All model years in the range 1976 to 2020 selected
- Row 5:** Season : Annual
- Row 6:** Area : Statewide totals
- Row 7:** \*\*\*\*\*
- Row 8:** Year: 2020 -- Model Years 1976 to 2020 Inclusive -- Annual
- Row 9:** Emfac2007 Emission Factors: V2.3 Nov 1 2006
- Row 10:**
- Row 11:** State Average State Average State Average
- Row 12:**
- Row 13:** Table 1: Running Exhaust Emissions (grams/mile; grams/ide-hour)
- Row 14:**
- Row 15:** Pollutant Name: Reactive Org Gases Temperature: -20F Relative Humidity: 0%
- Row 16:**
- Row 17:** Speed LDA LDA LDA LDA LDT1 LDT1 LDT1 LDT1 LDT2 LDT2 LDT2 LDT2 MDV MDV MDV MDV LHD1 LHD1 LHD1
- Row 18:** MPH NCAT CAT DSL ALL NCAT CAT DSL ALL NCAT CAT DSL ALL NCAT CAT DSL
- Row 19:**
- Row 20:** 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 20.558 21.586
- Row 21:** 5 24.44 0.077 0.326 0.079 20.825 0.115 0.203 0.122 22.028 0.112 0.253 0.114 78.277 0.154 0.182 0.217 45.993 0.329
- Row 22:** 10 17.376 0.049 0.256 0.05 14.801 0.074 0.16 0.08 15.658 0.072 0.199 0.074 55.714 0.098 0.143 0.143 30.102 0.214
- Row 23:** 15 12.923 0.033 0.205 0.034 11.005 0.051 0.128 0.055 11.643 0.049 0.159 0.05 41.493 0.066 0.115 0.099 20.529 0.145
- Row 24:** 20 10.056 0.024 0.168 0.024 8.56 0.037 0.105 0.04 9.058 0.035 0.131 0.036 32.335 0.047 0.094 0.073 14.587 0.102

This report includes exactly the same series of tables and sub-tables as the Impact Rate Summary report. In each table body, there are 56 columns of data, for 13 vehicle classes plus a fleet total, and 3 technology categories plus a total.

ERP extension

The ASCII Impacts report file has an \*.ERP file extension. This report format is used as an input to the (Direct Travel Impact Model) DTIM. This is an inventory model that requires emission estimates (primarily) in grams per hour. These estimates are then multiplied by time spent on each freeway link to generate emission estimates in each grid.

Figure 24 shows a sample output from the impact rate file. The ASCII Impacts ERP file is an ASCII column-delimited fixed format report, with records using a format specific to the DTIM model. For most purposes, this report can only be used by programs written for the DTIM record format.

Figure 24 Example of the ASCII Impact Rate File (ERP)

```

st20_annave_userguide.erp - WordPad
File Edit View Insert Format Help
11Statewide totals Avg Annual Ctr 2020 Default
12Emfac2007V2.3 Nov 1 2006
2 2020 141511 02/01/07
31 0 5 10 15 20 25 30 35 40 45 50 55 60
32 65
41-20-10 0 10 20 30 40 50 60 70 80 90
42100110120
51 0 10 20 30 40 50 60 70 80 90100
6A 11LDA NCAT 0.0001 0.0001 0.0001 5505.
7A 11LDA NCAT 0.000000 0.000000 0.000000
6B 12LDA CAT 0.9995 0.9993 0.9991 12246.
7B 12LDA CAT 0.000000 0.000000 0.000000
6C 13LDA DSL 0.0005 0.0007 0.0008 7375.
7C 13LDA DSL 0.000000 0.000000 0.000000
8 ROG CO NOX CO2 EX10T110B110FUELEVP
9B 11YA 0 0 0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0
9L 11YA 0-20 0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0
9L 11YA 0-10 0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0
9L 11YA 0 0 0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0
9L 11YA 0 10 0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0
9L 11YA 0 20 0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0
9L 11YA 0 30 0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0
9L 11YA 0 40 0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0
9L 11YA 0 50 0 0.007 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.154 0
9L 11YA 0 60 0 0.033 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.731 0
9L 11YA 0 70 0 0.069 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.533 0
9L 11YA 0 80 0 0.101 0.000 0.000 0.000 0.000 0.000 0.000 0.000 2.236 0
9L 11YA 0 90 0 0.156 0.000 0.000 0.000 0.000 0.000 0.000 0.000 3.441 0
9L 11YA 0100 0 0.255 0.000 0.000 0.000 0.000 0.000 0.000 0.000 5.617 0
9L 11YA 0110 0 0.418 0.000 0.000 0.000 0.000 0.000 0.000 0.000 9.228 0
9L 11YA 0120 0 0.418 0.000 0.000 0.000 0.000 0.000 0.000 0.000 9.228 0
9K 11YA 0-20 0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.647 0
9K 11YA 0-10 0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.673 0
9K 11YA 0 0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.705 0
9K 11YA 0 10 0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.746 0
9K 11YA 0 20 0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.798 0
9K 11YA 0 30 0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.841 0
For Help, press F1 NUM
  
```

*BIN extension*

The Binary Impacts file has the same information as the ASCII impacts file except that it is in binary file. The file has a \*.BIN extension. This file cannot be viewed/read as ASCII text. It was originally used for supporting earlier versions of DTIM. It's use is now limited.

### Calimfac mode

The Calimfac mode is used to calculate very detailed emission rates (basic emission rates or BER) for each vehicle class and model years from 1965 to the scenario calendar year. As a vehicle ages its emissions increase with vehicle mileage. In the Calimfac mode a linear fit is made to the emissions increase with vehicle mileage. This linear fit results in a zero mile rate (emissions when the vehicle is new) and deterioration rate (emissions increase every 10,000 miles) with a flex point where the deterioration rate changes for higher odometer values. These BER are based on standardized driving tests (FTP and UC) and the user can select outputs based on either bag 1, bag 2, bag 3 of the FTP or bag 1, bag 2 of the UC driving cycle. In addition, the user can elect to have the emission factors calculated with or without correction factors, which account for factors not encountered during standardized tests. The types of data that the Calimfac mode can report include:

- Emission rates
- I/M credit factors (difference in emission factors with and without I/M)
- I/M program description
- Constants for calculating emission rates; and
- Regime fractions (fraction of fleet vehicles in each emission regime).

These types of data are available for a number of combinations of options, such as:

- With and without I/M programs
- Using basic emission rates based on FTP composite data or based on either (1) bag 1, bag 2, or bag 3 of the FTP or (2) bag 1 or bag 2 of the UC driving cycle
- With and without correction factors. With correction factors implies that the basic emission rates are corrected for ambient and driving conditions not encountered during standardized testing.

The data can be reported at different levels of aggregation:

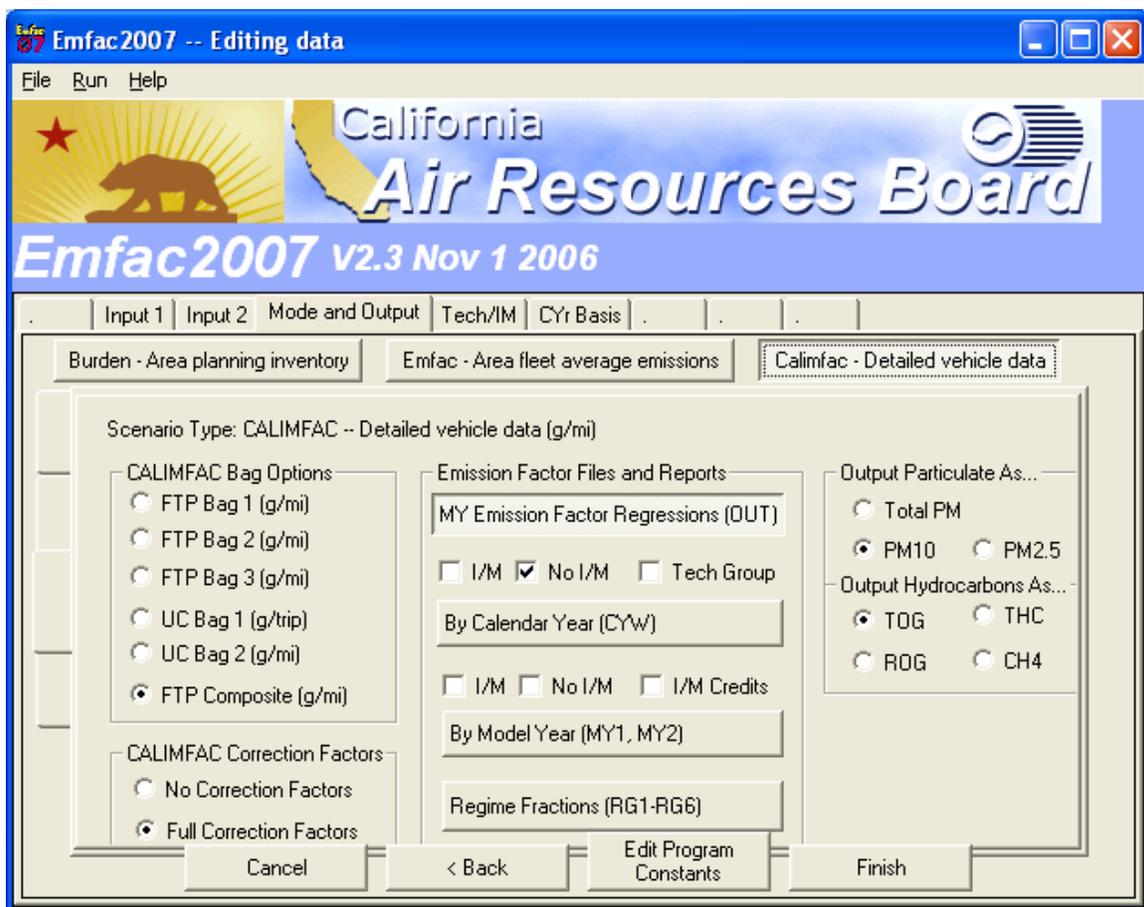
- By calendar year with model year and technology group aggregated
- By calendar year and model year with technology group and fuel aggregated

Regime fractions are reported in disaggregated form only, by calendar year, model year, and technology group.

In the Calimfac mode, emission factors are calculated using the same data and methodology as in Burden or Emfac mode. When “constants for calculating emission factors” (zero-mile and deterioration constants) are reported these are based on linear regressions on the modeled results.

Figure 25 shows the Calimfac mode and output options.

Figure 25 Calimfac Mode and Output Options



The user can select to output emission rates by bag (FTP or UC) or select FTP composite rates. Further, the user can select corrected or uncorrected rates. Corrected implies that the emission rates have been adjusted with respect to temperature, relative humidity, air conditioning, speed and other factors not encountered during standardized FTP testing.

## Calimfac output

The Calimfac mode output files are:

- **Emission Factors (OUT)** – without IM & with IM & IM credits & Technology group detail. When any of these options, an output file with “out” extension is created. Depending on the options selected the output file can contain emission factors for vehicles that do not undergo the biennial inspection and maintenance program, emission factors of vehicles that undergo a biennial IM program, calendar year specific benefits for the IM program, and detailed emission factors for each technology group. The emission factors are in a form of a zero mile emission rate and a deterioration rate, which shows the decay in emissions every 10,000 miles.
- **Emission Factors (CYW)** – This selection will also generate an output file with a “cyw” extension. This file contains calendar year specific emission rates for each emissions process and vehicle class. These rates are given for both with and without IM cases.

**Model Year Emission Rate (MY)** – This selection can generate two files with the extensions “my1” and “my2.” The “my1” file contains emissions rates assuming no IM program, whereas the “my2” file contains emissions rates assuming that vehicles have undergone an IM program. Both files have the same format. These files have vehicle class and model year specific emission rates for beginning with when the vehicles are first sold up to their age for the scenario year. For example, if the scenario year is 1970 then the model will output 1965 model year emissions for ages 1 through 7.

- **Regime Growth Rates** – This selection generates six files with extensions “rg1 rg2 rg3 rg4 rg5 rg6.” These are regime growth rate files. Table 4 shows what these files mean.

Table 4 Regime Growth Rate files

Regime Growth Rates	
RG1	HC regime growth rates with no IM
RG2	CO regime growth rates with no IM
RG3	NOx regime growth rates with no IM
RG4	HC regime growth rates with IM
RG5	CO regime growth rates with IM
RG6	NOx regime growth rates with IM

These files contain the size of normal, moderate, high, very high and super emitting vehicles as a function of vehicle class, model year, technology group, and vehicle age.

Table 5 shows the Calimfac mode output file extensions.

Table 5 Calimfac File Output Extensions

<b>Option on Input Form</b>	<b>Filename Extension Used</b>
Emission Factors without I/M Emission Factors with I/M I/M Credits Technology Group Detail	OUT & CYW
Regime Growth Rates	RG1, RG2, RG3, RG4, RG5, RG6
Model Year Em. Rates	MY1 & MY2

### Calimfac output reports

This section provides some sample outputs from the Calimfac mode.

#### OUT extension

When any one of the following output options is selected, an output file with extension “OUT” is created:

- Emission Factors without IM;
- Emission Factors with IM; or
- Technology Group Detail.

The \*.OUT file contains reports with emission factors, by vehicle class and pollutant/process. The reports include data for:

- ZML, DET1, FLEX PT, DET2 – Constants for evaluating emission factors with deterioration based on odometer mileage.
- 0K, 50K, 100K – Emission factors evaluated at odometer mileage of 0, 50,000, and 100,000 miles.

The first two options (Emission Factors without I/M and Emission Factors with I/M) generate reports with emission factors by vehicle class, pollutant/process, and model year for the scenario calendar year.

The Technology Group Detail option generates a report of emission factors without I/M effects, by vehicle class, pollutant/process, model year, and technology group for the scenario calendar year.

The Emission Factors with I/M option also generates a report that lists the I/M programs defined. Note, this is the only report that lists I/M program details.

The file will contain multiple reports. There are four reports types possible in the OUT file, using three different formats. These reports are all column-delimited fixed format ASCII reports:

- The two model-year reports (without tech groups) are tables with eight columns.
- The tech group detail reports are tables with nine columns.
- The I/M program listings are tables with two columns.

Figure 26 shows a sample output from the \*.OUT file. This file contains zero mile emissions and a deterioration rate with odometer.

**Figure 26 Model Year Specific Emission Rates from the \*.OUT file**

```

1
**
** CALIMFAC V2.3 Nov 1 2006
**
** California Motor Vehicle Emissions Factor Model
**
** Scenario title: Statewide totals Avg Annual CYr 2020 Default Title
**
** Output file: H:\E2007v23_Nov2006\st20_annave_userguide.out
**
** Date of this run: 2007/01/31 16:02:22
**
** Basic Emission Factor Equations      Light-Duty Autos (PC)   Without I/M
**
**                FTP COMP  Hydrocarbons                Corrected
**
Model
Year   ZML   DET1   FLEX PT  DET2    OK     50K    100K
-----
1976   0.5825 0.1762 11.4894 0.0103  0.582  1.463  2.344
1977   0.2389 0.1526 10.3344 0.1210  0.239  1.002  1.765
1978   0.2721 0.1535  9.1296 0.1242  0.272  1.040  1.782
1979   0.3150 0.1453  9.1296 0.1061  0.315  1.042  1.734
1980   0.1976 0.1205  9.1296 0.0443  0.198  0.800  1.336
1981   0.0830 0.1210  9.1296 0.1193  0.083  0.688  1.291
1982   0.0499 0.1196 10.3344 0.1190  0.050  0.648  1.246
1983   0.0422 0.1176 10.3344 0.1148  0.042  0.630  1.218
1984   0.0287 0.1163 10.3344 0.1158  0.029  0.610  1.192

```

*CYW extension*

Figure 27 shows an example of calendar year specific output contained in the \*.CYW file. This file contains calendar year specific emission rates. These rates when multiplied by the appropriate activity should get the tons per day estimates by calendar year.

Each report consists of a series of report tables. The tables for factors without I/M, with I/M, and I/M credit all have the same format. The tables are ordered by vehicle class. To keep track of which report you are dealing with, note the report type in the table title, and the vehicle class in the first column of data. In the example above, the table title is “CALENDAR YEAR EMISSION FACTORS I/M,” and the vehicle class is 1 (LDA or personal cars).

All of the tables for a vehicle class are written together. Within a vehicle class, the tables are written in this order: factors without I/M, factors with I/M, then I/M credit factors.

**Figure 27 Example of the CYW Output File**

```

Title      : Statewide totals Avg Annual CYr 2020 Default Title
Version    : Emfac2007 V2.3 Nov 1 2006
Run Date   : 2007/02/07 11:14:19
Scen Year  : 2020 -- All model years in the range 1976 to 2020 selected
Season     : Annual
Area      : Statewide totals
*****

CALENDAR YEAR EMISSION FACTORS WITH I/M
SEE (scenario).OUT FOR I/M OPTIONS USED
VEH  CYR  -ROG -  --CO--  --NOx-  -HtSk-  -RunL-  -Rest-  -Drnl-  -PM10-
  1 1980  0.55  9.30   0.80   0.61   2.42   0.01   0.03   0.02
  1 1981  0.62  10.80  0.85   0.66   2.63   0.02   0.03   0.02
  1 1982  0.69  12.15  0.90   0.74   2.87   0.02   0.03   0.02
  1 1983  0.76  13.44  0.95   0.79   3.06   0.02   0.04   0.02
  1 1984  0.79  14.23  0.98   0.82   3.22   0.02   0.04   0.02
  1 1985  0.78  14.50  0.99   0.87   3.40   0.02   0.05   0.02
  1 1986  0.78  14.71  0.99   0.89   3.54   0.02   0.05   0.02
  1 1987  0.77  14.92  0.98   0.86   3.63   0.02   0.05   0.02
  1 1988  0.77  15.04  0.97   0.88   3.74   0.02   0.06   0.02
  
```

**RG1 to RG6 extensions**

Selecting the “Regime Growth Rates” option generates six file outputs with the file extensions RG1, RG2, RG3, RG4, RG5, and RG6. These files contain the size of normal, moderate, high, very high and super emitting regimes as a function of vehicle class, model year, technology group, and vehicle age. Figure 28 shows an example of the regime growth rate file (Refer to table 4 for RG1 to RG6).

This figure shows how fraction of normal emitting vehicles decrease and the fraction of super emitting vehicles increase with vehicle age.

**Figure 28 Example of Regime Growth Rate file (RG1)**

```

st20_annave_userguide.rg1 - WordPad
File Edit View Insert Format Help
Title : Statewide totals Avg Annual CYr 2020 Default Title
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2007/02/07 11:14:19
Scen Year: 2020 -- All model years in the range 1976 to 2020 selected
Season : Annual
Area : Statewide totals
*****
Regime Fractions for Hydrocarbons
IMVehMYr  TGAgePol  Normal  ModerateHigh  VeryHi  SuperHi
0 1 11 3 1 1 0.41989 0.39695 0.17721 0.00087 0.00508
0 1 11 3 2 1 0.33662 0.33680 0.30590 0.01393 0.00675
0 1 11 3 3 1 0.25865 0.29078 0.41846 0.02305 0.00906
0 1 11 3 4 1 0.18684 0.25302 0.51829 0.03003 0.01183
0 1 11 3 5 1 0.12086 0.22095 0.60763 0.03561 0.01496
0 1 11 3 6 1 0.06017 0.19317 0.68812 0.04019 0.01834
0 1 11 3 7 1 0.00427 0.16877 0.76102 0.04401 0.02193
0 1 11 3 8 1 0.00000 0.14047 0.78993 0.04511 0.02449
0 1 11 3 9 1 0.00000 0.11666 0.81076 0.04566 0.02692
0 1 11 3 10 1 0.00000 0.09683 0.82791 0.04597 0.02930
0 1 11 3 11 1 0.00000 0.08009 0.84218 0.04611 0.03162
0 1 11 3 12 1 0.00000 0.06581 0.85419 0.04612 0.03388
0 1 11 3 13 1 0.00000 0.05351 0.86436 0.04604 0.03609
For Help, press F1
NUM

```

**MY1 and MY2 extension**

- The “Model Year Emission. Rate” option selection generates two files, with the extensions “MY1” and “MY2.” Each file contains a single report with emission factors by vehicle class, model year, and age. The MY1 file contains data for the without-I/M case, and the MY2 file contains data for the with-I/M case.

The “MY1” file contains emission rates for vehicles that have not undergone an I/M program, whereas the “MY2” file contains emissions rates assuming vehicles have undergone an I/M program. Both files have the same format. These files contain emission rates, by vehicle class and model year, beginning with when the vehicles were first sold up to their age in the scenario year. For example, if the scenario year is 1970, the model will output 1965 model year emissions for ages 1 through 7. Figure 29 shows a sample output from the \*MY1 file.

Figure 29 Emission Rates by Model Year from the \*MY1 file

st20\_annave\_userguide.my1 - WordPad

File Edit View Insert Format Help

Title : Statewide totals Avg Annual C/Yr 2020 Default Title  
 Version : Emfac2007 V2.3 Nov 1 2006  
 Run Date : 2007/02/07 11:14:19  
 Scene Year: 2020 -- All model years in the range 1976 to 2020 selected  
 Season : Annual  
 Area : Statewide totals

\*\*\*\*\*

VEH	MYR	AGE	ODOM	TFRAC	ROG	CO	NOX	PM10	HTSK	RUNL	PRL	MDRL	PDI	MDDI	HFP	CFP	NFP	PPF	EPF
1	1975	1	19306.	0.10569	0.7943	14.8828	1.9871	0.0266	1.8822	9.2885	0.0706	0.0045	0.1014	0.0046	45	8	16	45	45
1	1975	2	36026.	0.09039	1.2242	20.8160	2.1392	0.0279	1.9586	9.4606	0.0715	0.0046	0.1044	0.0047	45	8	16	45	45
1	1975	3	51234.	0.07872	1.5428	25.3247	2.2520	0.0291	2.0115	9.6002	0.0725	0.0046	0.1075	0.0049	45	8	16	45	45
1	1975	4	65370.	0.07078	1.7935	28.9934	2.3423	0.0302	2.2218	9.9398	0.0738	0.0047	0.1108	0.0050	45	8	16	45	45
1	1975	5	78673.	0.06449	2.0003	32.0812	2.4181	0.0313	2.1758	10.0053	0.0753	0.0048	0.1143	0.0052	45	8	16	45	45
1	1975	6	91296.	0.06139	2.1773	34.7356	2.4838	0.0323	2.2783	10.2826	0.0773	0.0050	0.1182	0.0054	45	8	16	45	45
1	1975	7	103344.	0.05635	2.3335	37.0517	2.5419	0.0333	2.3503	10.5638	0.0797	0.0051	0.1226	0.0056	45	8	16	45	45
1	1975	8	114894.	0.05239	2.4637	38.9084	2.5941	0.0343	2.5500	11.0597	0.0827	0.0053	0.1275	0.0058	45	8	16	45	45
1	1975	9	126005.	0.04777	2.5720	40.5778	2.6415	0.0352	2.6526	11.5110	0.0865	0.0056	0.1331	0.0061	45	8	16	45	45
1	1975	10	136723.	0.04344	2.6689	42.1019	2.6853	0.0362	2.7353	12.0263	0.0909	0.0059	0.1393	0.0064	45	8	16	45	45
1	1975	11	147085.	0.03977	2.7246	43.1843	2.7257	0.0370	2.9255	12.7078	0.0960	0.0062	0.1460	0.0067	45	8	16	45	45
1	1975	12	157123.	0.03602	2.7510	43.5068	2.7633	0.0380	3.0301	13.3232	0.1013	0.0066	0.1530	0.0070	45	8	16	45	45
1	1975	13	166862.	0.03264	2.7752	43.8046	2.7985	0.0389	3.0276	13.8471	0.1065	0.0069	0.1598	0.0073	45	8	16	45	45
1	1975	14	176325.	0.02947	2.7976	44.0810	2.8315	0.0398	3.1531	14.4388	0.1114	0.0072	0.1663	0.0076	45	8	16	45	45
1	1975	15	185531.	0.02670	2.8184	44.3390	2.8627	0.0408	3.2547	14.9389	0.1156	0.0075	0.1722	0.0079	45	8	16	45	45
1	1975	16	194496.	0.02463	2.8380	44.5808	2.8914	0.0418	3.2497	15.2581	0.1191	0.0077	0.1775	0.0082	45	8	16	45	45
1	1975	17	203234.	0.01993	2.8564	44.8083	2.9156	0.0425	3.3636	15.6271	0.1220	0.0079	0.1822	0.0084	45	8	16	45	45
1	1975	18	211760.	0.01820	2.8018	42.5753	2.9302	0.0432	3.2242	15.6265	0.1242	0.0081	0.1863	0.0086	45	8	16	45	45
1	1975	19	220084.	0.01518	2.8179	42.7677	2.9523	0.0438	3.2552	15.7997	0.1261	0.0082	0.1900	0.0088	45	8	16	45	45
1	1975	20	228217.	0.01358	2.8305	42.9503	2.9707	0.0427	3.2892	15.9723	0.1275	0.0083	0.1934	0.0089	45	8	16	45	45
1	1975	21	236167.	0.01219	2.8428	43.1241	2.9903	0.0433	3.2343	15.9905	0.1288	0.0084	0.1967	0.0091	45	8	16	45	45
1	1975	22	243944.	0.00870	2.4814	40.4722	2.6832	0.0439	3.1027	15.8656	0.1298	0.0085	0.1997	0.0092	45	8	16	45	45
1	1975	23	251556.	0.00716	2.4909	40.6203	2.6930	0.0444	3.1236	15.9867	0.1308	0.0085	0.2027	0.0093	45	8	16	45	45
1	1975	24	259009.	0.00602	2.5001	40.7620	2.6950	0.0450	3.1258	16.0968	0.1316	0.0086	0.2056	0.0095	45	8	16	45	45
1	1975	25	266309.	0.00459	2.5090	40.8960	2.6970	0.0455	3.1272	16.1992	0.1324	0.0086	0.2084	0.0096	45	8	16	45	45
1	1975	26	273464.	0.00479	2.5176	41.0286	2.6988	0.0460	3.1284	16.2961	0.1332	0.0087	0.2112	0.0097	45	8	16	45	45
1	1975	27	280477.	0.00386	2.5259	41.1474	2.7006	0.0466	3.1289	16.3887	0.1339	0.0087	0.2140	0.0099	45	8	16	45	45
1	1975	28	287355.	0.00340	2.5340	41.2488	2.7022	0.0471	3.1293	16.4784	0.1347	0.0088	0.2168	0.0100	45	8	16	45	45

For Help, press F1

## **8.0 EDITING FUNDAMENTAL DATA**

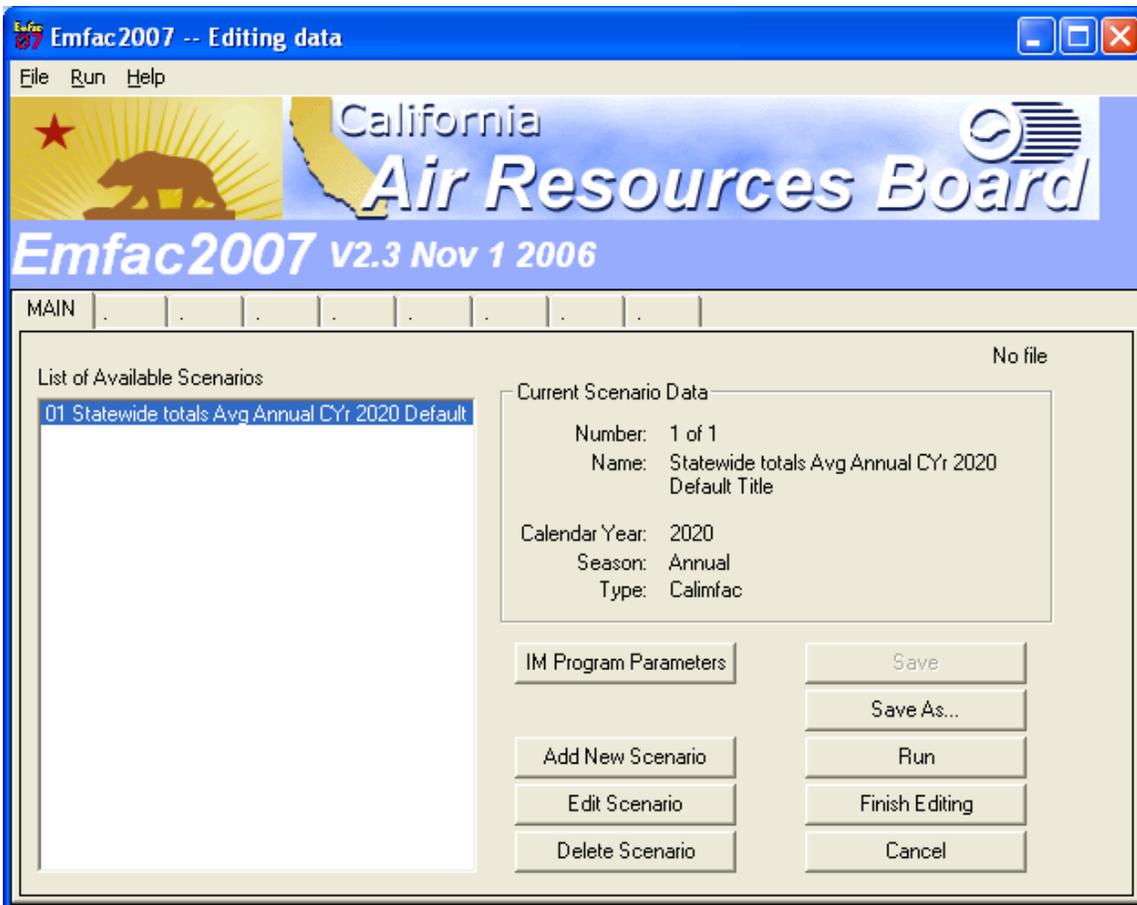
This section contains screen prints of dialogs where the user can edit fundamental data. These screen prints complement the real-time presentation given at the workshops. First of all, when we click on 'Edit Scenario' or 'Add Scenario', we see the 'INPUT1' and INPUT2' and "Mode and Outputs' at the top which are used already for the basic scenario inputs like Calendar Year, Scenario title and whether we like EMFAC or BURDEN outputs etc.

The model can estimate emissions for any calendar year between 1970 and 2040. In Emfac2001/2002, user can only specify one calendar year per scenario. But in Emfac2007, user can input many years in a single scenario – in other words, this new model can be called a multi-scenario model. For example, in Emfac2001/2002, a user seeking emission inventories for the Los Angeles County for 2000 to 2005 should create a file in which only basic scenario data are edited, and the file should have six scenarios. These six scenarios correspond to the calendar years 2000, 2001, 2002, 2003, 2004, and 2005.

But with the new Emfac2007, a user can input all years from 2000 to 2005 into a SINGLE SCEANRIO.

If a scenario is already open, then if we click on adding a scenario, it will give two options – 1) copy of the existing scenario or 2) A new blank scenario (Fig 30)

Figure 30 Adding or Editing Scenarios



### **Editing technology fractions and I/M options**

Figure 31 shows the dialog for editing the default exhaust and evaporative technology fractions and default I/M options.

**Figure 31 Dialog For Editing Technology Fractions and I/M Options**



This dialog allows the user to change default sales fractions. These sales fractions reflect the type of vehicles sold in each model year. The sales fractions or technology fractions are specific to each vehicle class. This dialog has been used extensively by groups interested in estimating the effect on inventory from changing the percentage of either zero emitting vehicles or low emission vehicles. Figure 32 shows the next dialog when the “Exh Tech Fraction” button is depressed.

Figure 32 Dialog for Editing Exhaust Technology Fraction

**Exhaust Technology Fractions**

Edit Exhaust Technology Fractions by Model Year and Technology Group

Vehicle Class: 01: Light-Duty Autos (PC) [v]

Model Year: 2020 [v]

EXHAUST Technology Groups Total: 100.0000% OK

# of Tech Groups: 7 [v]

Group	%	Description - model years, vehicle classes, fuel, catalyst, fuel delivery, years and
25 [v]	2.4	2003-2040, LDA-LDT1, ele, na, na, ZEV-Pure Electric
28 [v]	4.0	2004-2040, LDA-LDT-MDV, gas, Adv.TWC, MPFI, 2004+, LEV II, OBD2
29 [v]	6.0	2006-2040, LDA-LDT, gas, Adv.TWC, MPFI, 2004+, ULEV II, OBD2
31 [v]	56.7	2003-2040, LDA-LDT1, gas, Adv.TWC, MPFI, 2004+, PZEV, OBD2
32 [v]	8.0	2009-2040, LDA-LDT1, gas, Adv.TWC, MPFI, 2004+, Tier2-3 120K //0.055/2.1/0.03, (
33 [v]	10.0	2007-2040, LDA-LDT, gas, Adv.TWC, MPFI, 2004+, Tier2-4 120K //0.07/2.1/0.04, OB
37 [v]	12.9	2003-2040, LDA-LDT1, gas, Adv.TWC, MPFI, 2003+, AT PZEV, OBD2
1 [v]		
1 [v]		
1 [v]		

Return Copy values to other years and

Apply Cancel Done Apply to Others

The user can edit sales fractions by vehicle class. Further, for each vehicle class the user can edit sales fractions from the first model year to the last model year (same as the scenario year). The index refers to technology groups as detailed in Appendix A-1. The percentage refers to the default sales fractions. Similar dialog is used for choosing the Evaporative technology fractions (FIG 33).

Figure 33 Dialog for Editing EVAP. Technology Fraction

Evap Technology Fractions

Edit Evap Technology Fractions by Model Year and Technology Group

Vehicle Class: 01: Light-Duty Autos (PC)

Model Year: 2020

EVAP Technology Groups Total: 100.0000% OK

# of Tech Groups: 3

Group	%	Description - model years, vehicle classes, fuel, catalyst, fuel delivery, years and
15	28.0	2005-2040, LDA, gas, Cat, MPFI, Near zero evap OBD2
16	2.4	2003-2040, LDA, ele, , , ZEV
17	69.6	2003-2040, LDA, gas, Cat, MPFI, PZEV
1		
1		
1		
1		
1		
1		
1		

Return      Copy values to other years and

Apply    Cancel    Done    Apply to Others

**Interim I/M**

This button is a special feature that allows staff to vary the effectiveness of the current ASM I/M program. In Emfac2000 it was assumed that the Bureau of Automotive Repair would implement ASM cut-points that would achieve their SIP reductions. However, BAR has elected to gradually increase the stringency of the ASM cut-points. When these cut-points are revised, staff can edit these constants and determine the increased benefits from the new cut-points.

Figure 34 shows the default interim constants for the current ASM I/M program.

Figure 34 Default Interim Constants for the Current ASM I/M Program

Year	Pollutant (1=HC/2=CO/3=NOx)		
	1	2	3
2001	0.3570	0.5110	0.5780
2002	0.3570	0.5110	0.5780
2003	0.3570	0.5110	0.5780
2004	0.3570	0.5110	0.5780
2005	0.3570	0.5110	0.5780
2006	0.3570	0.5110	0.5780
2007	0.3570	0.5110	0.5780
2008	0.3570	0.5110	0.5780
2009	0.3570	0.5110	0.5780

As with all I/M options new users should not change the default I/M options or the interim I/M constants without a thorough understanding how these options work.

### Changing activity data

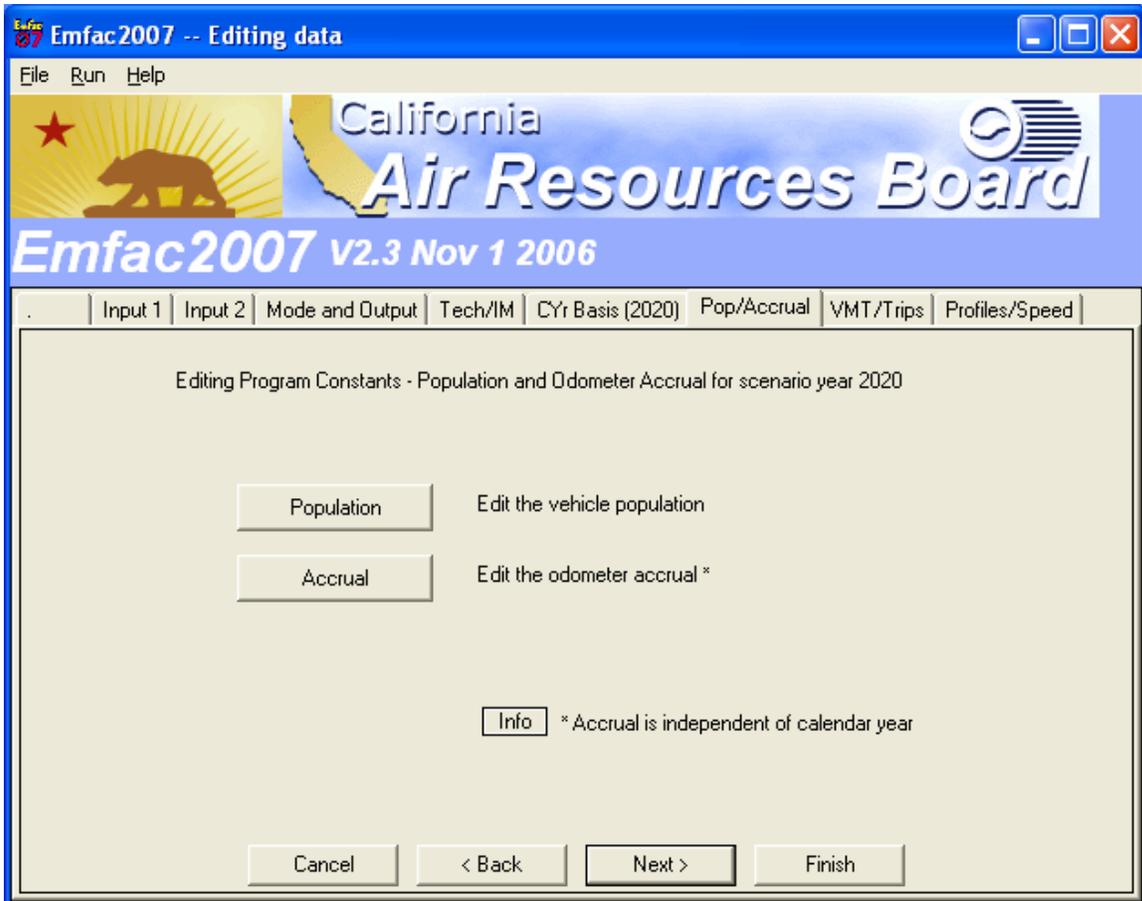
The following dialogs show how the user can edit fundamental activity data such as population, accrual rates, trips and vehicle miles traveled. This ability is of great use to regional planners who may be interested in estimating the impact on emissions by changing the default VMT and trip estimates. For example, when a regional transportation plan (RTP) is revised planners usually have new estimates of VMT for forecast years. The planners are then asked to estimate the impact on emissions as a result of the new RTP.

The following activity dialogs give users the ability to change the default population, VMT and trip estimates for a given scenario year. **Users should be aware that all the dialogs are sequenced noting the inter-dependencies among the data.**

For example, editing population will affect the default VMT and trip estimates. Hence this dialog precedes the VMT dialog.

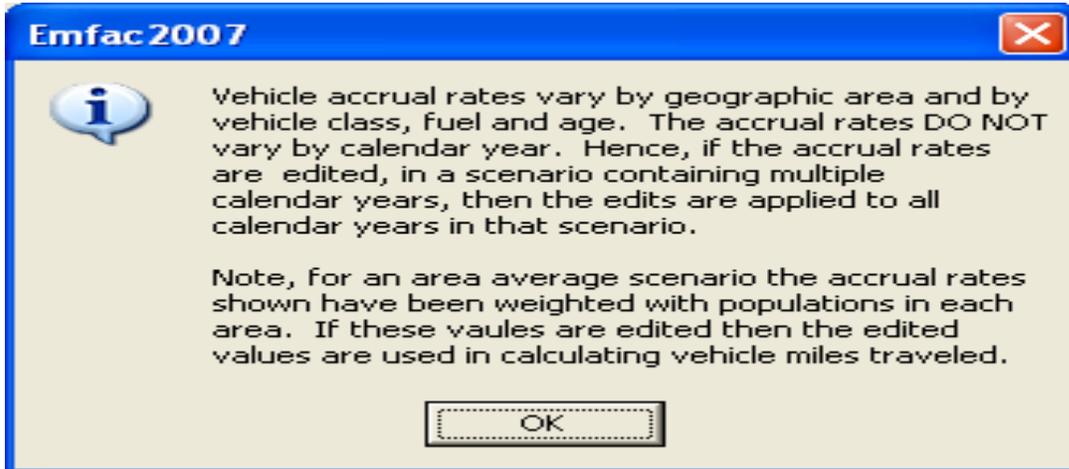
Figure 35 shows the main dialog for editing population estimates and changing vehicle accrual rates.

Figure 35 Population and Accrual Edits



When we click on 'info' in Fig. 35, we get the explanation of how accrual rates do not vary by Calendar Year.

Fig36. Info on the Accrual rates



Figures 37 and 38 show how the user can change the total population estimate or change population estimates by vehicle class and fuel type. Similarly, Figures 39 and 40 show how the user can edit the default VMT and trip estimates.

Figure 37 Editing Total Population

Editing Population data for scenario 1: Statewide totals Avg Annual CYr 2020 Default ...

Total Population for area Copy with Headings Paste Data Only

Statewide totals

---

Editing Mode Editing Population (registered vehicles with adjustments)

Total Population | By Vehicle Class | By Vehicle and Fuel | By Vehicle/Fuel/Age

Revised Total Population

Previous Total Population

Figure 38 Editing Population By Vehicle Class and Fuel Type

Editing Population data for scenario 1: Statewide totals Avg Annual CYr 2020 Default ...

Total Population for area Copy with Headings Paste Data Only

Statewide totals

---

Editing Mode Editing Population (registered vehicles with adjustments)

Total Population | By Vehicle Class | By Vehicle and Fuel | By Vehicle/Fuel/Age

		Fuel (1=Gas/2=Diesel/3=Electric)		
		1	2	3
Vehicle Class	01 - Light-Duty Autos (PC)	15497669.0	11715.2	185956.7
	02 - Light-Duty Trucks (T1)	3366591.5	78252.2	36059.6
	03 - Light-Duty Trucks (T2)	6639621.5	5131.4	0.0
	04 - Medium-Duty Trucks (T3)	2947900.3	5780.5	0.0
	05 - Light HD Trucks (T4)	410842.6	112764.2	0.0
	06 - Light HD Trucks (T5)	111045.5	91234.9	0.0
	07 - Medium HD Trucks (T6)	62933.2	247535.9	0.0
	08 - Heavy HD Trucks (T7)	7274.6	261006.5	0.0
	09 - Other Buses	8430.6	15733.0	0.0
	10 - Urban Buses	4833.8	11937.8	0.0
	11 - Motorcycles	1081045.6	0.0	0.0
	12 - School Buses	3688.1	28091.7	0.0
	13 - Motor Homes	275845.5	34405.1	0.0

Figure 39 Dialog for Editing Trip and VMT Profiles

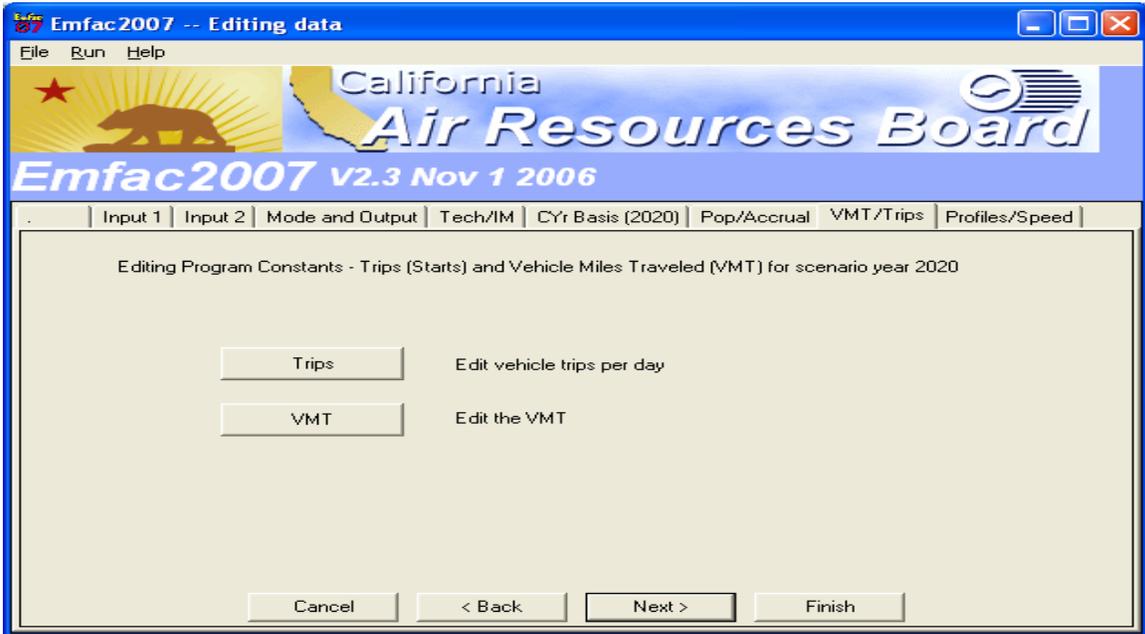
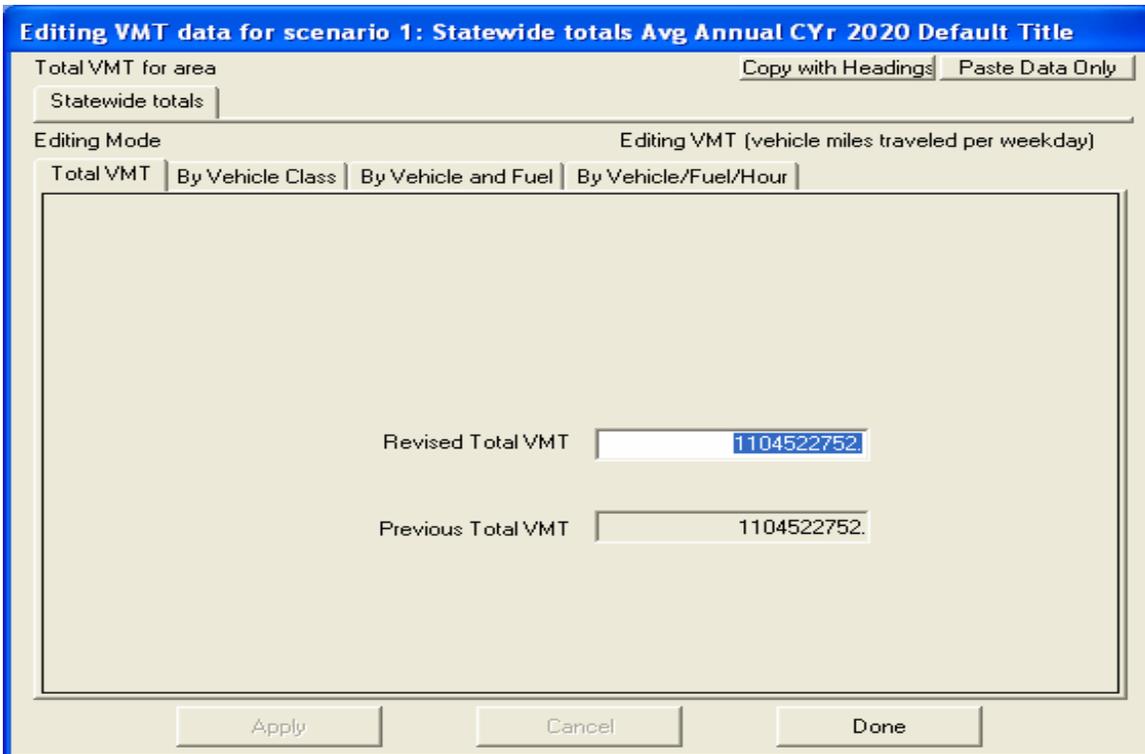


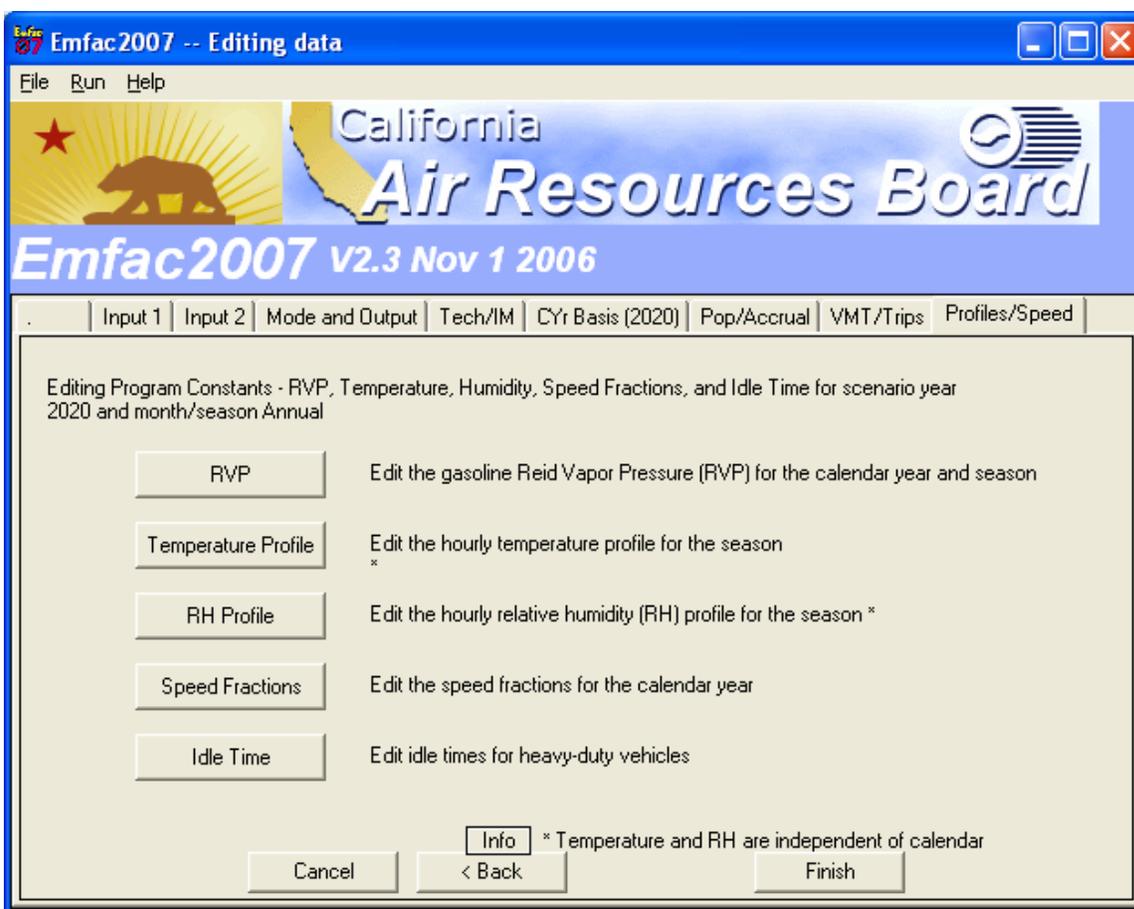
Figure 40 Editing Total VMT



### Editing profiles/speed

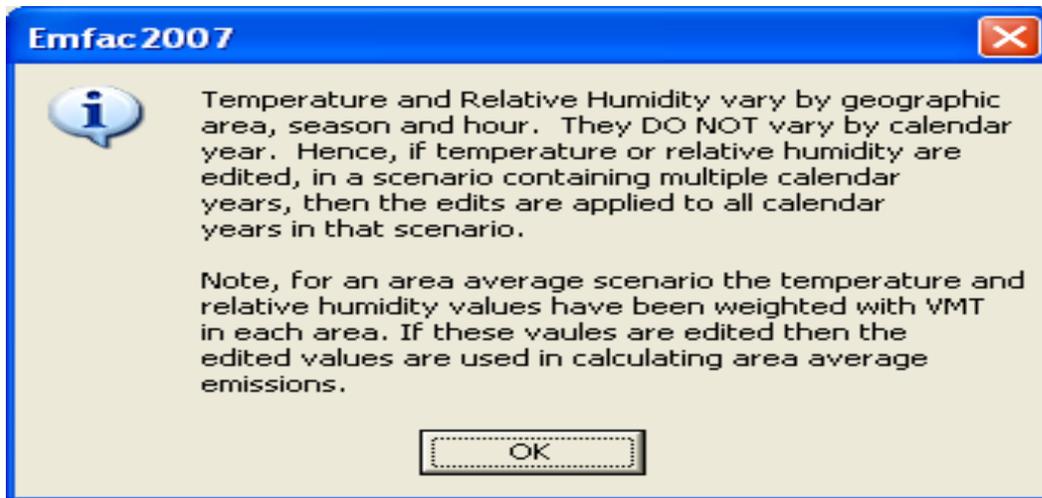
The following dialog allows user to change the diurnal temperature and relative humidity profiles. This ability has allowed staff to estimate emissions specific to ozone episodes for any area of the state. Further, users can also determine the impact of fuel RVP on evaporative emissions. In this dialog, users can also change the default speed distributions by vehicle class and hour. The transportation agencies provide information on the number of miles traveled at various speeds. This information is referred to as a speed distribution. Users can then determine the impact on emissions by changing these default speed distributions. Figure 41 shows the dialog for editing profiles/speed.

Figure 41 Dialog for Editing Profiles/Speed



This version of EMFAC2007 has an additional button – IDLE TIME – which is useful for Heavy duty truck emission calculations. The dialogs for editing temperature and relative humidity are similar. Again as before, if we click on 'INFO' (FIG 41), we will be notified as to how the Temperature and Humidity are affected in a scenario containing multiple Calendar Years (Fig.42).

Figure 42 Info for 'Profiles/speed' option



They both allow the user to change either the temperature or relative humidity for any hour of the day. The user can also edit the values for a range of hours and apply a constant temperature or relative humidity. Figure 43 shows the dialog for editing fundamental temperatures.

Figure 43 Dialog for Editing Temperature

Diurnal Temperature Profile

Area: Statewide totals  
 Month: Annual  
 VMT-Weighted Average of 69 Sub-areas

Statewide totals

Copy with Headings Paste Data Only

Temperatures (F)

Hour											
0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100
55.2	54.5	54.0	53.4	53.1	53.0	54.1	56.7	60.3	63.9	66.6	68.7
1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
70.2	71.0	71.4	70.9	69.2	66.4	63.4	60.8	59.1	57.9	56.8	56.0

Modify Values for Range of Hours

to Constant Value for Range

Apply Cancel Done

In the course of developing an RTP, planners are given new VMT estimates and information on how much travel occurs at various speeds. This information is output from transportation models. For example, if an RTP includes new lanes being added. Then this will increase the flow of vehicles, reduce congestion and increase how much travel occurs at higher speeds. The following dialog labeled “speed fractions” gives users the ability to change the default speed distributions. A speed distribution describes the percent of travel that occurs at speed.

In Emfac2007, the speed distributions can vary by 13 vehicle classes, and by hour of the day. The user can select the vehicle class and hour they are interested in editing, edit the values and then apply the changes to the same hour and vehicle class. They can also apply these same edits to other hours and vehicle classes. Figure 44 shows the dialog for editing speeds.

Figure 44 Dialog for Editing Speeds

**Speed Fractions by Scenario Year and Vehicle Class**

Area: Statewide totals      Scenario Year: 2020    Copy with Headings    Paste Data Only

Statewide totals

VMT-Weighted Average    Basis: 1 MPH   5 MPH   10 MPH    Vehicle Class: 01: Light-Duty Autos (PC)

		Hour (1 to 24)							
		1	2	3	4	5	6	7	8
Speed Bin (5,10,15,...) (1:18)	1	0.0008	0.0008	0.0008	0.0007	0.0007	0.0007	0.0028	0.0028
	2	0.0024	0.0025	0.0024	0.0024	0.0025	0.0025	0.0144	0.0144
	3	0.0194	0.0194	0.0194	0.0195	0.0194	0.0194	0.0465	0.0466
	4	0.0521	0.0521	0.0522	0.0521	0.0521	0.0521	0.1177	0.1178
	5	0.0566	0.0566	0.0566	0.0566	0.0566	0.0566	0.1355	0.1355
	6	0.0818	0.0817	0.0817	0.0818	0.0818	0.0818	0.1337	0.1337
	7	0.0789	0.0789	0.0789	0.0790	0.0790	0.0789	0.0965	0.0965
	8	0.0590	0.0590	0.0590	0.0590	0.0590	0.0590	0.0843	0.0843
	9	0.0526	0.0526	0.0526	0.0525	0.0526	0.0526	0.0793	0.0794
	10	0.0477	0.0476	0.0477	0.0476	0.0476	0.0476	0.0691	0.0692
	11	0.0389	0.0389	0.0389	0.0389	0.0389	0.0389	0.0624	0.0624
	12	0.0929	0.0929	0.0929	0.0929	0.0929	0.0929	0.0561	0.0561
	13	0.1494	0.1494	0.1494	0.1494	0.1494	0.1494	0.0708	0.0709

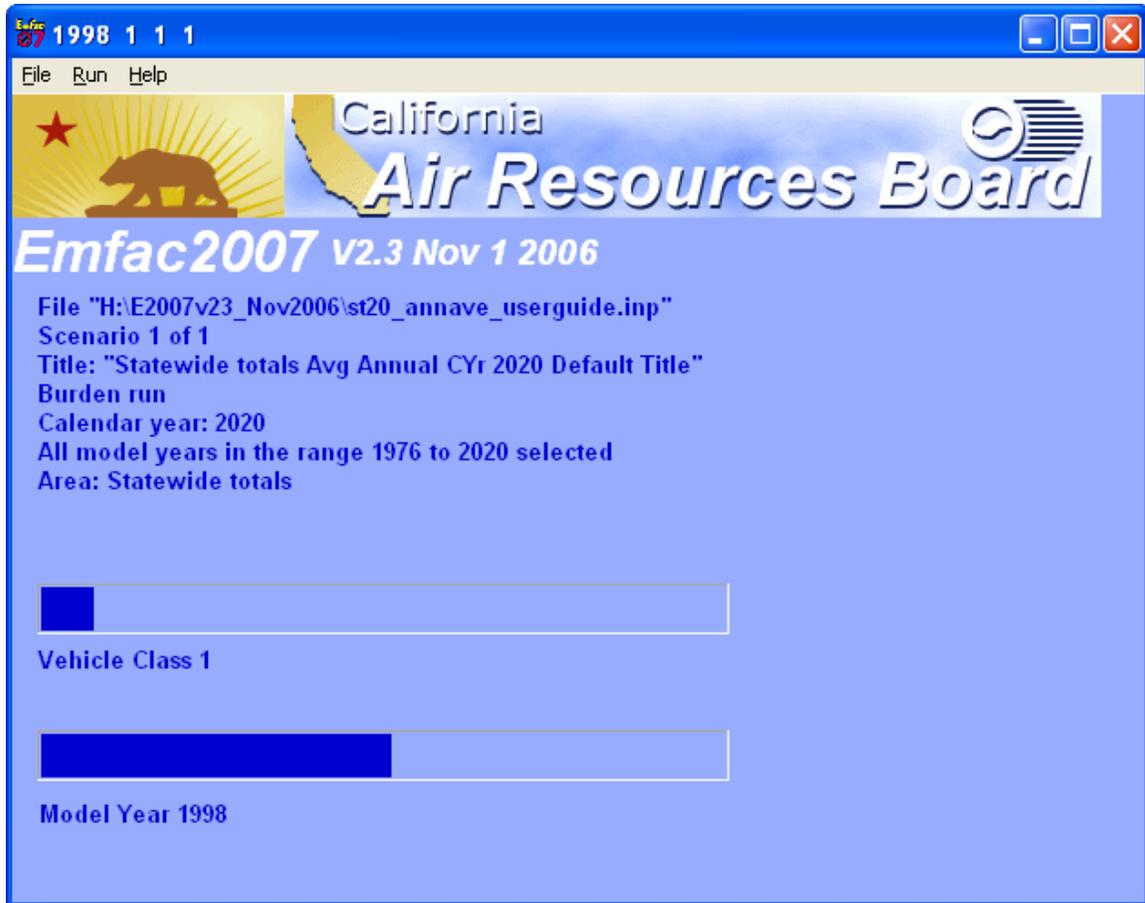
Total 100.00 % OK    Apply    Cancel    Done    Apply to Others

The differences between EMFAC2007 and EMFAC2001/2002 in this screen (FIG 44) are evident. Now the speeds are in Fractions (not in percentages), also the there are 3 bins – 1, 5 and 10 MPH. Also the output can be exported to EXCEL for further analysis.

Having edited fundamental data the user should press “Finish” and then select the “Save As” button to name the output file. Note, in naming the file the user should not attach an extension to the filename. The model will create an input file with “\*.INP” extension. This input file will contain all data necessary for duplicating the results at a later time.

Finally, Figure 45 shows the progress screen when “RUN” has been initiated. This progress screen shows the location of the input/output files. It also shows the scenario number currently being processed.

Figure 45 Final Run or Progress Screen





# APPENDICES

## Appendix 1 – Exhaust Technology Groups

Tech. Group	MYrs using TG in FRAC arrays.	Vehs using TG in FRAC arrays.	Fuel Type	Catalyst	Fuel Delivery	Description
1	1965-1977	LDA-LDT-MDV	gas	NonCat	Carb	Pre-1975 no secondary air
2	1966-1977	LDA-LDT-MDV	gas	NonCat	Carb	Pre-1975 with secondary air
3	1975-1982	LDA-LDT-MDV	gas	NonCat	Carb	1975+
4	1975-1980	LDA-LDT-MDV	gas	OxCat	Carb	1975-76 with secondary air
5	1975-1979	LDA-LDT-MDV	gas	OxCat	Carb	1975-79 no secondary air
6	1980-1989	LDA-LDT-MDV	gas	OxCat	Carb	1980+ no secondary air
7	1977-1987	LDA-LDT-MDV	gas	OxCat	Carb	1977+ with secondary air
8	1978-1982	LDA-LDT-MDV	gas	TWC	TBI / Carb	1977-79
9	1981-1984	LDA	gas	TWC	TBI / Carb	1981-84 0.7 NOx std.
10	1985-1995	LDA-LDT-MDV	gas	TWC	TBI / Carb	1985+ 0.7 NOx std.
11	1977-1980	LDA	gas	TWC	MPFI	1977-80
12	1981-1985	LDA-LDT-MDV	gas	TWC	MPFI	1981-85 0.7 NOx std.
13	1986-1995	LDA-LDT-MDV	gas	TWC	MPFI	1986+ 0.7 NOx std.
14	1983-1994	LDA-LDT-MDV	gas	TWC	TBI / Carb	1981+ 0.4 NOx std.
15	1983-1994	LDA-LDT	gas	TWC	MPFI	1981+ 0.4 NOx std.
16	1980-1984	LDA-LDT-MDV	gas	TWC	TBI / Carb	1980
17	1993-1995	LDA-LDT	gas	TWC	TBI / Carb	1993+ 0.25 HC std.
18	1993-1995	LDA-LDT	gas	TWC	MPFI	1993+ 0.25 HC std.
19	1996-1999	LDA-LDT	gas	TWC	TBI / Carb	1996+ 0.25 HC std OBD2
20	1996-1999	LDA-LDT	gas	TWC	MPFI	1996+ 0.25 HC std OBD2
21	1994-1995	LDA-LDT	gas	Adv.TWC	MPFI	1994-95 TLEV AFC
22	1996-1996	LDA-LDT	gas	Adv.TWC	MPFI	1996+ TLEV OBD2 AFC
23	1997-2005	LDA-LDT-MDV	gas	Adv.TWC	MPFI	1996+ LEV OBD2 GCL CBC AFC
24	1997-2005	LDA-LDT-MDV	gas	Adv.TWC	MPFI	1996+ ULEV OBD2 GCL CBC AFC
25	2003-2040	LDA-LDT1	ele	na	na	ZEV-Pure Electric
26	1996-2000	LDT-MDV	gas	TWC	MPFI	1996+ 0.7 NOx std. OBD2
27	1996-2000	LDT-MDV	gas	TWC	TBI / Carb	1996+ OBD2
28	2004-2040	LDA-LDT-MDV	gas	Adv.TWC	MPFI	2004+ LEV II OBD2
29	2006-2040	LDA-LDT	gas	Adv.TWC	MPFI	2004+ ULEV II OBD2
30			gas	Adv.TWC	MPFI	2004+ SULEV II OBD2
31	2003-2040	LDA-LDT1	gas	Adv.TWC	MPFI	2004+ PZEV OBD2

Tech. Group	MYrs using TG in FRAC arrays.	Vehs using TG in FRAC arrays.	Fuel Type	Catalyst	Fuel Delivery	Description
32	2009-2040	LDA-LDT1	gas	Adv.TWC	MPFI	2004+ Tier2-3 120K //0.055/2.1/0.03 OBD2
33	2007-2040	LDA-LDT	gas	Adv.TWC	MPFI	2004+ Tier2-4 120K //0.07/2.1/0.04 OBD2
34	2004-2006	MDV	gas	Adv.TWC	MPFI	2004+ Tier2-8 120K //0.156/4.2/0.2 OBD2
35	2004-2006	LDT2	gas	Adv.TWC	MPFI	2004+ Tier2-9 120K //0.09/4.2/0.3 OBD2
36	2004-2006	MDV	gas	Adv.TWC	MPFI	2004+ Tier2-10 120K //0.23/6.4/0.6 OBD2
37	2003-2040	LDA-LDT1	gas	Adv.TWC	MPFI	2003+ AT PZEV OBD2
38						Placeholder-do not use-
39						Placeholder-do not use-
40	1965-1979	LDA	gas	NonCat	Carb	Pre-1980 Mexican veh no secondary air
41	1975-1986	LDA	gas	OxCat	Carb	1975-76 Mexican veh with secondary air
42	1980-1987	LDA	gas	TWC	TBI / Carb	1980-87 Mexican veh 0.7 NOx std.
43	1981-2040	LDA	gas	TWC	MPFI	1981-2040 Mexican veh 0.7 NOx std.
44						Placeholder-do not use-
45						Placeholder-do not use-
46	1965-1976	LHDT1	gas	NonCat	Carb	Pre-1977
47	1977-1983	LHDT1	gas	OxCat	Carb	1977-83
48	1984-1987	LHDT1	gas	TWC	Carb	1984-87
49	1988-1990	LHDT1	gas	TWC	FI	1988-90
50	1991-1995	LHDT1	gas	TWC	FI	1991-94
51	1995-2001	LHDT1	gas	TWC	MPFI	1995-01 MDV
52	2002-2003	LHDT1	gas	TWC	MPFI	2002-03 LEV
53	2004-2008	LHDT1	gas	Adv.TWC	MPFI	2004-08 ULEV
54	2008-2040	LHDT1	gas	Adv.TWC	MPFI	2008+ USEPA 2008 stds.
55						Placeholder-do not use-
56						Placeholder-do not use-
57						Placeholder-do not use-
58						Placeholder-do not use-
59						Placeholder-do not use-
60	1965-1974	LHDT1	dsl			Pre-1975
61	1975-1976	LHDT1	dsl			1975-76
62	1977-1979	LHDT1	dsl			1977-79
63	1980-1983	LHDT1	dsl			1980-83
64	1984-1986	LHDT1	dsl			1984-86
65	1987-1990	LHDT1	dsl			1987-90
66	1991-1993	LHDT1	dsl			1991-93
67	1994-1995	LHDT1	dsl			1994
68	1995-2001	LHDT1	dsl			1995-01 MDV?

Tech. Group	MYrs using TG in FRAC arrays.	Vehs using TG in FRAC arrays.	Fuel Type	Catalyst	Fuel Delivery	Description
69	2002-2003	LHDT1	dsl			2002-03 LEV
70	2004-2009	LHDT1	dsl			2004-09 ULEV
71	2007-2040	LHDT1	dsl			2007+ USEPA 2007 stds.
72						Placeholder-do not use-
73						Placeholder-do not use-
74						Placeholder-do not use-
75						Placeholder-do not use-
76	1965-1976	LHDT2	gas	NonCat	Carb	Pre-1977
77	1977-1983	LHDT2	gas	OxCat	Carb	1977-83
78	1984-1987	LHDT2	gas	TWC	Carb	1984-87
79	1988-1990	LHDT2	gas	TWC	FI	1988-90
80	1991-1995	LHDT2	gas	TWC	FI	1991-94
81	1995-2001	LHDT2	gas	TWC	MPFI	1995-01 MDV
82	2002-2003	LHDT2	gas	TWC	MPFI	2002-03 LEV
83	2004-2008	LHDT2	gas	Adv.TWC	MPFI	2004-08 ULEV
84	2008-2040	LHDT2	gas	Adv.TWC	MPFI	2008+ USEPA 2008 stds.
85			gas	Adv.TWC	MPFI	Placeholder-do not use-
86			gas	Adv.TWC	MPFI	Placeholder-do not use-
87			gas	Adv.TWC	MPFI	Placeholder-do not use-
88						Placeholder-do not use-
89						Placeholder-do not use-
90	1965-1974	LHDT2	dsl			Pre-1975
91	1975-1976	LHDT2	dsl			1975-76
92	1977-1979	LHDT2	dsl			1977-79
93	1980-1983	LHDT2	dsl			1980-83
94	1984-1986	LHDT2	dsl			1984-86
95	1987-1990	LHDT2	dsl			1987-90
96	1991-1993	LHDT2	dsl			1991-93
97	1994-1995	LHDT2	dsl			1994
98	1995-2001	LHDT2	dsl			1995-01 MDV
99	2002-2003	LHDT2	dsl			2002-03 LEV
100	2004-2009	LHDT2	dsl			2004-09 ULEV
101	2007-2040	LHDT2	dsl			2007+ USEPA 2007 stds.
102						Placeholder - do not use -
103						Placeholder - do not use -
104						Placeholder - do not use -
105						Placeholder - do not use -

Tech. Group	MYrs using TG in FRAC arrays.	Vehs using TG in FRAC arrays.	Fuel Type	Catalyst	Fuel Delivery	Description
106	1965-1976	MHDV	gas	NonCat	Carb	Pre-1977
107	1977-1984	MHDV	gas	OxCat	Carb	1977-83
108	1984-1987	MHDV	gas	TWC	Carb	1984-87
109	1986-1990	MHDV	gas	TWC	FI	1988-90
110	1987-1997	MHDV	gas	TWC	FI	1991-97
111	1994-2003	MHDV	gas	TWC	MPFI	1998-03
112	1998-2004	MHDV	gas	TWC	MPFI	2004
113	2004-2040	MHDV	gas	TWC	MPFI	2005 1g HC + NOx std.
114	2008-2040	MHDT	gas	TWC	MPFI	2008+ USEPA 2008 stds.
115						Placeholder - do not use -
116						Placeholder - do not use -
117						Placeholder - do not use -
118						Placeholder - do not use -
119						Placeholder - do not use -
120	1965-1974	MHDT-MH	dsl			Pre-1975
121	1975-1976	MHDT-MH	dsl			1975-76
122	1977-1979	MHDT-MH	dsl			1977-79
123	1980-1983	MHDT-MH	dsl			1980-83
124	1984-1986	MHDT-MH	dsl			1984-86
125	1987-1990	MHDT-MH	dsl			1987-90
126	1991-1993	MHDT-MH	dsl			1991-93
127	1994-1997	MHDT-MH	dsl			1994-97
128	1998-1998	MHDT-MH	dsl			1998
129	1999-2003	MHDT-MH	dsl			1999-02
130	2003-2009	MHDT-MH	dsl			2003-06 2g NOx std.
131	2007-2040	MHDT-MH	dsl			2007+ USEPA 2007 stds.
132						Placeholder - do not use -
133						Placeholder - do not use -
134						Placeholder - do not use -
135						Placeholder - do not use -
136	1965-1976	HHDV	gas	NonCat	Carb	Pre-1977
137	1977-1984	HHDV	gas	OxCat	Carb	1977-84
138	1985-1985	HHDV	gas	TWC	Carb	1985
139	1986-1986	HHDV	gas	TWC	FI	1986
140	1987-1993	HHDV	gas	TWC	FI	1987-93
141	1994-1997	HHDV	gas	TWC	MPFI	1994-97
142	1998-2003	HHDV	gas	TWC	MPFI	1998-03

Tech. Group	MYrs using TG in FRAC arrays.	Vehs using TG in FRAC arrays.	Fuel Type	Catalyst	Fuel Delivery	Description
143	2004-2040	HHDV	gas	TWC	MPFI	2004-06
144			gas	TWC	MPFI	2007+ USEPAs std Placeholder-do not use-
145						Placeholder - do not use -
146						Placeholder - do not use -
147						Placeholder - do not use -
148						Placeholder - do not use -
149						Placeholder - do not use -
150	1965-1974	HHDV	dsl			Pre-1975 CA stds.
151	1975-1976	HHDV	dsl			1975-76 CA Stds.
152	1977-1979	HHDV	dsl			1977-79 CA Stds.
153	1980-1983	HHDV	dsl			1980-83 CA Stds.
154	1984-1986	HHDV	dsl			1984-86 CA Stds.
155	1987-1990	HHDV	dsl			1987-90 CA Stds.
156	1991-1993	HHDV	dsl			1991-93 CA Stds.
157	1994-1997	HHDV	dsl			1994-97 CA Stds.
158	1998-1998	HHDV	dsl			1998 CA Stds.
159	1999-2002	HHDV	dsl			1999-02 CA Stds.
160	2003-2006	HHDV	dsl			2003-06 CA 2g NOx Stds.
161	2007-2009	HHDV	dsl			2007+ USEPA2007 stds 50% NOx phased-in.
162	2010+	HHDV	dsl			2007+USEPA2007 stds 100% NOx phased-in.
163	2010+	HHDV	dsl			2007+ USEPA 2007 stds W/OBD2.
164						Placeholder - do not use -
165						Placeholder - do not use -
166						Placeholder - do not use -
167						Placeholder - do not use -
168						Placeholder - do not use -
169						Placeholder - do not use -
170	1965-1974	LDA-LDT-MDV	dsl			Pre-1975
171	1975-1979	LDA-LDT-MDV	dsl			1975-79
172	1980-1980	LDA-LDT-MDV	dsl			1980
173	1981-1981	LDA-LDT-MDV	dsl			1981
174	1982-1982	LDA-LDT-MDV	dsl			1982
175	1983-1983	LDA-LDT-MDV	dsl			1983
176	1984-1992	LDA-LDT-MDV	dsl			1984-92
177	1993-2003	LDA-LDT-MDV	dsl			1993+
178						Placeholder - do not use -
179						Placeholder - do not use -

Tech. Group	MYrs using TG in FRAC arrays.	Vehs using TG in FRAC arrays.	Fuel Type	Catalyst	Fuel Delivery	Description
180						Placeholder - do not use -
181						Placeholder - do not use -
182						Placeholder - do not use -
183						Placeholder - do not use -
184						Placeholder - do not use -
185						Placeholder - do not use -
186						Placeholder - do not use -
187						Placeholder - do not use -
188						Placeholder - do not use -
189						Placeholder - do not use -
190						Placeholder - do not use -
191						Placeholder - do not use -
192						Placeholder - do not use -
193						Placeholder - do not use -
194						Placeholder - do not use -
195						Placeholder - do not use -
196						Placeholder - do not use -
197						Placeholder - do not use -
198						Placeholder - do not use -
199						Placeholder - do not use -
200	1965-1973	HHDV	dsl			Pre-1974 Federal Stds.
201	1974-1978	HHDV	dsl			1974-78 Federal Stds.
202	1979-1983	HHDV	dsl			1979-83 Federal Stds.
203	1984-1987	HHDV	dsl			1984-87 Federal Stds.
204	1988-1990	HHDV	dsl			1988-90 Federal Stds.
205	1991-1993	HHDV	dsl			1991-93 Federal Stds.
206	1994-1997	HHDV	dsl			1994-97 Federal Stds.
207	1998-1998	HHDV	dsl			1998 Federal Stds.
208	1999-2003	HHDV	dsl			1999-02 Federal Stds.
209	2003-2009	HHDV	dsl			2003-06 Federal Stds.
210	2007-2009	HHDV	dsl			2007+ USEPA2007 stds 50% NOx phased-in.
211	2010+	HHDV	dsl			2007+USEPA2007 stds 100% NOx phased-in.
212						Placeholder-do not use-
213						Placeholder-do not use-
214						Placeholder-do not use-
215						Placeholder-do not use-
216	1965-1986	UB	dsl			Pre-87

Tech. Group	MYrs using TG in FRAC arrays.	Vehs using TG in FRAC arrays.	Fuel Type	Catalyst	Fuel Delivery	Description
217	1987-1990	UB	dsl			1987-90
218	1991-1993	UB	dsl			1991-93
219	1994-1995	UB	dsl			1994-95
220	1996-1998	UB	dsl			1996-98
221	1999-2002	UB	dsl			1999-02
222	2003-2003	UB	dsl			2003
223	2004-2006	UB	dsl			2004-06
224	2007-2040	UB	dsl			2007
225	2008-2040	UB	dsl			2008+ ZEV or ZEBS
226						Placeholder-do not use-
227						Placeholder-do not use-
228	1965-1976	SBUS	gas	NonCat	Carb	Pre-77
229	1977-1983	SBUS	gas	OxCat	TBI / Carb	1977-83
230	1984-1987	SBUS	gas	TWC	FI	1984-87
231	1988-1990	SBUS	gas	TWC	FI	1988-90
232	1991-1997	SBUS	gas	TWC	FI	1991-97
233	1998-2003	SBUS	gas	TWC	MPFI	1998-03
234	2004-2004	SBUS	gas	TWC	MPFI	2004
235	2005-2008	SBUS	gas	TWC	MPFI	2005 1g HC+NOx Stds.
236	2008-2040	SBUS	gas	TWC	MPFI	2008+ USEPAs Stds.
237						Placeholder - do not use -
238						Placeholder - do not use -
239						Placeholder - do not use -
240	1965-1974	SBUS	dsl			Pre-75
241	1975-1976	SBUS	dsl			1975-76
242	1977-1979	SBUS	dsl			1977-79
243	1980-1983	SBUS	dsl			1980-83
244	1984-1986	SBUS	dsl			1984-86
245	1987-1990	SBUS	dsl			1987-90
246	1991-1993	SBUS	dsl			1991-93
247	1994-1997	SBUS	dsl			1994-97
248	1998-1998	SBUS	dsl			1998
249	1999-2003	SBUS	dsl			1999-02
250	2003-2009	SBUS	dsl			2003-06 2g NOx Std
251	2007-2040	SBUS	dsl			2007+ USEPA Std.
252						Placeholder - do not use -
253						Placeholder - do not use -

Tech. Group	MYrs using TG in FRAC arrays.	Vehs using TG in FRAC arrays.	Fuel Type	Catalyst	Fuel Delivery	Description
254						Placeholder - do not use -
255						Placeholder - do not use -
256						Placeholder - do not use -
257						Placeholder - do not use -
258						Placeholder - do not use -
259						Placeholder - do not use -
260	1965-1977	MCY	gas	NonCat	2-Stroke	All 6g evap Std.
261	1965-1977	MCY	gas	NonCat	Carb	Pre-1978 6g evap Std.
262	1978-1979	MCY	gas	NonCat	Carb	1978-79 6g evap Std.
263	1980-1981	MCY	gas	NonCat	Carb	1980-81 6g evap Std.
264	1982-1984	MCY	gas	NonCat	Carb	1982-84 6g evap Std.
265	1985-1987	MCY	gas	NonCat	Carb	1985-87 2g evap Std.
266	1988-2003	MCY	gas	NonCat	Carb	1988-03 2g evap Std.
267	1994-2003	MCY	gas	NonCat	FI	1988-03 2g evap Std.
268	1995-2003	MCY	gas	OxCat	Carb	1988-03 2g evap Std.
269	1994-2003	MCY	gas	TWC	FI	1988-03 2g evap Std.
270	2004-2007	MCY	gas	NonCat	Carb	2003-08 2g evap Std.
271	2004-2007	MCY	gas	NonCat	FI	2003-08 2g evap Std.
272	2004-2007	MCY	gas	OxCat	Carb	2003-08 2g evap Std.
273	2004-2007	MCY	gas	TWC	FI	03-08 MCY FI/cat/2g evap
274	2008-2040	MCY	gas	NonCat	Carb	2008+ 2 evap Std.
275	2008-2040	MCY	gas	NonCat	FI	2008+ 2 evap Std.
276	2008-2040	MCY	gas	OxCat	Carb	2008+ 2 evap Std.
277	2008-2040	MCY	gas	TWC	FI	2008+ 2 evap Std.

## Appendix 2 – Evaporative Technology Groups

Tech. Group	MYrs using TG in FRAC arrays.	Vehs using TG in FRAC arrays.	Fuel Type	Catalyst	Fuel Delivery	Description
1	1965-1983	MCY-LDA	gas	NonCat	Carb	Pre-1970 uncontrolled
2	1970-1985	MCY-LDA	gas	NonCat	Carb	1970-76
3	1975-1977	LDA	gas	Cat	Carb	1975-76
4	1977-1993	MCY-LDA	gas	NonCat	Carb	1977+
5	1977-1988	LDA	gas	Cat	Carb	1977+
6	1978-1978	LDA	gas	Cat	TBI	1970-78
7	1977-1978	LDA	gas	Cat	FI	1970-78
8	1979-1985	LDA	gas	Cat	TBI	1979-85
9	1979-2040	MCY-LDA	gas	Cat	FI	1979-85
10	1986-2040	MCY-LDA	gas	Cat	TBI	1986-94
11	1986-2040	LDA	gas	Cat	FI	1986-94
12	1995-1997	LDA	gas	Cat	TBI	1995+
13	1995-1997	LDA	gas	Cat	MPFI	1995+
14	1995-2005	LDA	gas	Cat	MPFI	Enhanced evap OBD2
15	2005-2040	LDA	gas	Cat	MPFI	Near zero evap OBD2
16	2003-2040	LDA	ele			ZEV
17	2003-2040	LDA	gas	Cat	MPFI	PZEV
18	NO DATA	-- DO NOT USE				
19	NO DATA	-- DO NOT USE				
20	NO DATA	-- DO NOT USE				
21	1965-1969	LDT-MDV-HDV	gas	NonCat	Carb	Pre-1970 uncontrolled
22	1970-1979	LDT-MDV-HDV	gas	NonCat	Carb	1970-79
23	1975-1979	LDT-MDV-HDV	gas	Cat	Carb	1975-79
24	1980-1980	LDT	gas	NonCat	Carb	1980+
25	1980-1990	LDT-MDV-HDV	gas	Cat	Carb	1980+
26	1979-1979	LDT	gas	Cat	TBI	1970-79
27			gas	Cat	FI	1970-79
28	1980-1985	LDT-MDV	gas	Cat	TBI	1980-85
29	1981-1985	LDT-MDV	gas	Cat	FI	1980-85
30	1986-1994	LDT-MDV-HDV	gas	Cat	TBI	1986-94
31	1986-1994	LDT-MDV-HDV	gas	Cat	FI	1986-94
32	1995-1997	LDT-MDV-HDV	gas	Cat	TBI	1995+
33	1995-1997	LDT-MDV-HDV	gas	Cat	FI	1995+

Tech. Group	MYrs using TG in FRAC arrays.	Vehs using TG in FRAC arrays.	Fuel Type	Catalyst	Fuel Delivery	Description
34	1995-2037	LDT-MDV-HDV	gas	Cat	MPFI	Enhanced evap OBD2
35	2004-2040	LDT-MDV-HDV	gas	Cat	MPFI	Near zero evap OBD2
36	2003-2040	LDT1	ele			ZEV
37	2003-2040	LDT1	gas	Cat	MPFI	PZEV

### Appendix 3 – Attachment A – CTF output

FIELD NAME	FIELD TYPE	LENGTH	FIELD DESCRIPTION	SOURCE
YEAR	NUMERIC	4	CAL YEAR OF THE RUN DATA	from EMFAC
DIS	CHAR	3	DISTRICT ID	see Attachment D
AIR BASIN	CHAR	3	AIR BASIN ID	see Attachment D
CO	NUMERIC	2	COUNTY ID	see Attachment D
EIC	NUMERIC	14	EIC CODE	see Attachment B
PR	NUMERIC (11,2)	11	ANNUAL PROCESS RATE	see Attachment C
HPDY	NUMERIC	2	HOURS PER DAY	Always 24
DPWK	NUMERIC	2	DAY PER WEEK	Always 7
JANT	NUMERIC(4,1)	5	PERCENT ACTIVITY FOR JANUARY - RANGE 0-100.0	Always 8.333
FEBT	NUMERIC(4,1)	5	PERCENT ACTIVITY FOR FEBRUARY - RANGE 0-100.1	Always 8.333
MART	NUMERIC(4,1)	5	PERCENT ACTIVITY FOR MARCH - RANGE 0-100.2	Always 8.333
APRT	NUMERIC(4,1)	5	PERCENT ACTIVITY FOR APRIL - RANGE 0-100.3	Always 8.333
MAYT	NUMERIC(4,1)	5	PERCENT ACTIVITY FOR MAY - RANGE 0-100.4	Always 8.333
JUNT	NUMERIC(4,1)	5	PERCENT ACTIVITY FOR JUNE - RANGE 0-100.5	Always 8.333
JULT	NUMERIC(4,1)	5	PERCENT ACTIVITY FOR JULY - RANGE 0-100.6	Always 8.333
AUGT	NUMERIC(4,1)	5	PERCENT ACTIVITY FOR AUGUST - RANGE 0-100.7	Always 8.333
SEPT	NUMERIC(4,1)	5	PERCENT ACTIVITY FOR SEPTEMBER - RANGE 0-100.8	Always 8.333
OCTT	NUMERIC(4,1)	5	PERCENT ACTIVITY FOR OCTOBER - RANGE 0-100.9	Always 8.333
NOVT	NUMERIC(4,1)	5	PERCENT ACTIVITY FOR NOVEMBER - RANGE 0-100.10	Always 8.333
DECT	NUMERIC(4,1)	5	PERCENT ACTIVITY FOR DECEMBER - RANGE 0-100.11	Always 8.333
POL	NUMERIC	9	POLLUTANT CODE	Always TOG&PM - see Attach. E
EMFACT	NUMBER (10,4)	11	EMISSION FACTOR (LBS PER EIC UNIT)	lbs per unit of Attachment C
SEASON	CHAR	14	SEASON	Sum,Win or AA -PROMPT USER
EMS	NUMERIC(10,4)	11	<b>EMISSIONS (TONS/DAY)</b>	from EMFAC
VERSION	CHAR	15	EMFAC VERSION	from EMFAC
OPERATOR	CHAR	3	OPERATOR INITIALS	PROMPT USER
TDATE	DATE	8	TRANSACTION DATE	RUN DATE

