EMFAC-HK User's Guide

Version 4.x

Calculating emission inventories for vehicles in Hong Kong

User's Guide

The purpose of this document is to familiarize new users with the Emfac model – EMFAC-HK Version 4.x. It provides:

- An overview of what pollutants and emission processes are modelled
- Introduction to the Burden and Emfac emission modes
- Sample output files
- Information on editing fundamental data

Remark : Changes made in the January 2020 update are highlighted in red.

ACKNOWLEDGMENTS

This User's Guide for EMFAC-HK is developed, in part, from the California Air Resources Board (CARB) EMFAC2007 User's Guide. The Hong Kong Environmental Protection Department (HKEPD) wishes to acknowledge the help and support provided by the Mobile Source Analysis Branch of CARB.

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Table of Contents

Page #

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1.0 INTRODUCING EMFAC-HK VERSION 4.x

The Hong Kong Environmental Protection Department (EPD) promotes and protects public health and welfare by determining methods for efficient reduction of air pollutants, and making informed decisions based on the data at hand.

To help in this effort, EPD has created a modified version of EMFAC2002 and included any relevant changes in later versions, the California Air Resources Board (CARB) EMission FACtors (EMFAC) model to calculate emission rates from all motor vehicles--such as private cars to medium & heavy goods vehicles being operated on highways, local roads in Hong Kong. In the EMFAC model, the emission rates are multiplied with vehicle activity data provided by the Transport Department (TD) to calculate the territory-wide emission inventories.

An emission estimate can be summarized as the 'product of an emission rate (e.g. grams per pollutant emitted over a kilometre) and vehicle activity (e.g. kilometres driven per day)'.

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

Emission Factor X Correction factor X Travel Activity = Emissions in tonnes per day

Over the years, tougher emission standards have been met with technological solutions of increasing complexity. As a result, the emission estimation models have also been grown in size and complexity. The need for accurate emission data remains unchanged. These data can impact proposed regulations in Hong Kong.

What is EMFAC-HK?

EMFAC-HK Version 4.x is the latest vehicle emission model that calculates emissions for motor vehicles being operated on roads in Hong Kong. This model reflects EPD's current understanding of how vehicles travel and how much they pollute. The EMFAC-HK model can be used to show how Hong Kong motor vehicle emissions have changed over time and are projected to change in the future. This information helps Hong Kong EPD to weigh prospective control programs and determine the most effective, science-based proposals for protecting the environment.

The EMFAC-HK Version 4.x model supersedes previous versions, is an integrated model in that it combines emission rate data with vehicle activity to calculate vehicle emissions.

About this document

The purpose of this document is to familiarize users to the EMFAC-HK Version 4.x model. It introduces concepts and basic terminology to users of motor vehicle emission models so that they can 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 modelling equations used in generating the emission estimates.

Section 2 provides an overview of the pollutants and emission processes currently modelled in EMFAC-HK. 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 estimate. Section 5 reviews the system requirements necessary for running the model. The remaining sections show users how to start the model, and explain the two basic emission modes: Burden and Emfac. 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 kilometres travelled, and generate an emission estimate using the edited data.

2.0 WHAT POLLUTANTS AND PROCESSES ARE MODELLED

This section details the pollutants currently modelled in EMFAC-HK, and gives an overview of the emission processes. An emission process is tied to vehicle activity. For example, a vehicle emits emissions from vehicle tailpipe when it is travelling down the road. This process is labelled "running exhaust". For each pollutant, the model calculates emissions from each emission process. All the output reports show these emissions by emission process.

Pollutants

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

- Hydrocarbons (HC). HC can be expressed as TOG (total organic gases), VOC (volatile organic compounds), THC (total hydrocarbon), or CH_4 (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.

- Carbon monoxide (CO).

- Nitrogen oxides (NOx) and nitrogen dioxide (NO_2).

- Carbon dioxide (CO_2).

- 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).

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. Has 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 emission process is tied to the vehicle diurnal activity such that all emissions are accounted for during normal daily activity. The types of emission processes that are evaluated in EMFAC-HK are:

- Running Exhaust - emissions that come out of the vehicle tailpipe while it is travelling on the road.

- 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. (Note: starting emissions are estimated for diesel vehicles fitted with selective catalytic reduction (SCR) devices and all petrol and liquefied petroleum gas (LPG) 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 vapours 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, carburetted vehicles these emissions are attributed to vapour losses from the carburettor float bowl. In newer, fuel-injected vehicles, these vapour losses come from leaky fuel injectors or from fuel hoses.

- Running losses – evaporative HC emissions that occur when hot fuel vapours escape from the fuel system or overwhelm the carbon canister while the vehicle is operating.

3.0 OVERVIEW OF BASIC TERMINOLOGY

This section briefly introduces terminologies and concepts that most users 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 being operated on roads in Hong Kong. This fleet, as currently modelled, is classified into 16 vehicle classes (for example, class 1, private cars). These classes are based on the type of vehicle, but weight class and fuel type (i.e. petrol, diesel, or LPG) are also taken into account. The number of vehicles in each class is based on an analysis of

licensed data provided by TD. These vary by calendar year, so the make-up of the vehicle fleet is dependent on the calendar year.

Vehicle class

The model performs separate calculations for each of the 16 vehicle classes, by vehicle age, fuel type, and each technology group. Each vehicle class contains one or more technology groups, which represent common emission characteristics such as emission standards, emission control technologies, or in-use emissions. The vehicle classes currently modelled are shown in Appendix I on EPD's website, at

www.epd.gov.hk/epd/english/environmentinhk/air/guide_ref/emfac-hk.html

along with abbreviations used in the model.

Fuel type

EMFAC-HK currently estimates emissions from petrol, diesel and LPG-powered vehicles.

Technology group

The underlying assumption in EMFAC-HK is that each vehicle class can be modelled through the unique behaviour of different technology groups. Each technology group represents vehicles having similar emission control technologies, similar in-use deterioration rates, and responding the same to repair. A technology group can represent vehicles whose emission standards are the same or have specific equipment installed on them (e.g. multi-port fuel injection, three-way catalyst, diesel oxidation catalyst, exhaust gas recirculation, etc.) that makes them emit similarly.

Appendix IV on EPD's website lists the technology groups used in modelling exhaust and evaporative emissions, respectively. Some report formats group vehicles into broader technology categories (catalyst, non-catalyst, and diesel). These are remnants from older EMFAC models, which were used to characterize vehicles into these broader technologies, and now are only used for reporting purposes. Petrol vehicles are placed in the catalyst or non-catalyst categories based on technology group details. Diesel and LPG vehicles are placed in their own category.

Model year

EMFAC-HK contains vehicle 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 pre-unleaded petrol-fuelled technology group (TG-1) and a diesel-fuelled technology group (TG-170) represent the 1991 model year for private cars.

Activity

An emission estimate is simply a product of the emission rate (in grams per kilometre or grams per trip or grams per vehicle) and vehicle activity (kilometres per vehicle or number of trips or total number of vehicles). This requires estimates of vehicle population, vehicle kilometres travelled and trips for each vehicle class and by fuel type which are commonly referred to as vehicle activity.

Vehicle Population

Vehicle population is determined through an analysis of the licensed vehicle data obtained from TD. These data is used in developing vehicle age matrices with the years from 2002 to default base year[1], as the base years for vehicle classes, fuel types and vehicle ages from 1 to 45. These matrices contain actual population estimates, which are used for backcasting and forecasting of vehicle populations during calendar years 1997 to 2040.

Vehicle Kilometres Travelled (VKT)

Vehicle kilometres travelled (VKT) represents the total distance travelled on a weekday. TD estimates annual VKT based on the traffic data collected in their counting stations. Various government departments, like TD and Planning Department (PlanD), have developed transportation models, which provide output of VKT for certain planning years. In the EMFAC-HK model, VKT is related to vehicle population and vehicle accrual. Vehicle accrual is the total kilometres a vehicle accumulates in a year, and varies by vehicle age and based on survey data and re-adjusted based on TD's annual VKT.

The model also contains hourly distributions of VKT by vehicle class. These distributions are based on data collected at the counting stations published in Annual Traffic Census by TD.

Trips

The terms "Number of trips per day" and "Number of starts per day" are the same and they can be used interchangeably. Both represent the number of separate starts made per weekday. In EMFAC-HK, the estimates for trips per day for vehicle classes are based on preliminary travel surveys. The model calculates the total number of trips for a given calendar year 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 emission estimate. The basic scenario (input) data required for generating an emission estimate are calendar year or month selection, title (if default title is not appropriate), model years included in the calculation, emission

[1] The default base year is shown in the file, "Default Base Year", on EPD's website.

mode and output options. A single scenario contains unique selections for the basic scenario data, for example:

Geographic Area – Hong Kong SAR (default)
Calendar Year – User input of 2020
Alternate Base Year –default: inactive
Season or Month – Annual
Scenario Title – Leave as default
Model Years – Leave as default
Vehicle Classes – Leave as default
I/M Schedule – Leave as default

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

Important: From EMFAC-HK Version 3.x, the model is restricted to storing and running a single scenario. Multiple scenarios are no longer available.

Calendar Year

The Calendar Year represents the desired year to calculate the estimates/emission factors for a run. The model can estimate emissions for any calendar year between 1997 and 2040.

Since EMFAC-HK Version 3.x, the model is restricted to estimating emissions **for a single calendar year**. This differs from prior versions of EMFAC-HK Version 2.x, where the user could input many years into a single scenario.

Alternate Base Year

The Alternate Base Year is a new feature introduced from EMFAC-HK Version 3.x. It is an "optional" setting that allows the user to use an alternative base year, Alternate Base Year, and an alternative vehicle population distribution from the program's default base year and vehicle population distribution.

The program's default baseline population data span from 2002 to 1 year before default base year. If, for example, the user selects an alternate base year of 2018, population editing screens would initially display 2018 baseline data based on a forecast of the program's default 2016 data to calendar year 2018. The user is allowed to edit these data and save it as new population for 2018 which is the new base year. The vehicle population of the calendar year will be forecasted from the alternative base year of 2018.

Note: The Alternate Base Year can only be used for forecasting (i.e. backcasting using alternate baseline data is unavailable).

Season or Month

The model includes data for temperature, relative humidity, and characteristics for petrol sold (fuel RVP) that varies by calendar year and month. Annual average represents an average of all the monthly vehicle emission estimates. This estimate 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 estimate or emission factors for a given calendar year (CYr) e.g. 2010, EMFAC-HK generates emission factors and vehicle activity for vehicles for 45 model years i.e. from the current model year back 44 years. EMFAC-HK uses this entire model year (MY) range in calculating a complete emission estimate or emission factors for a given calendar year.

If the calendar year is 2010, the starting and final model years are 1965 and 2040, respectively. If the calendar year is 1999 (e.g., earlier than 2000), the starting model year is 1965 because EMFAC-HK's emission factor data only goes back to the 1965 model year. EMFAC-HK assumes that vehicles older than 1965 have the same emission rates as 1965 model year.

This range of model years also gives the user the ability to estimate the emissions of either a specific model year or a certain range of model years for a given calendar year.

Hint: For example, say a user is estimating the emissions *of older vehicles (1980 and older) in calendar year 2010. This can be achieved by selecting the model years from the input file for CYr2010.*

5.0 SYSTEM REQUIREMENTS AND INSTALLATION

Please refer to the Installation Manual **in EMFAC-HK webpage[3].**

[3] https://www.epd.gov.hk/epd/english/environmentinhk/air/guide_ref/emfac-hk.html

6.0 RUNNING EMFAC-HK

Starting the program

To begin, start the program by selecting the "EMFAC-HK" shortcut on the Start→All Programs menu, or by double-clicking the "EMFAC-HK" icon on the desktop. When the program starts, it opens up two windows, titled "EMFAC-HK V4.x" (Figure 2) and "EMFAC-HK V4.x Console" (Figure 3). After opening, the console window will immediately be minimized. (It can also be minimized using the standard Windows minimize button.) This is normal and the user need not interact with the console window. The "EMFAC-HK Console" window accommodates older code in the model and will rarely contain any output. It could be minimized using the standard Windows minimize button.

Figure 2. Opening Dialog Window

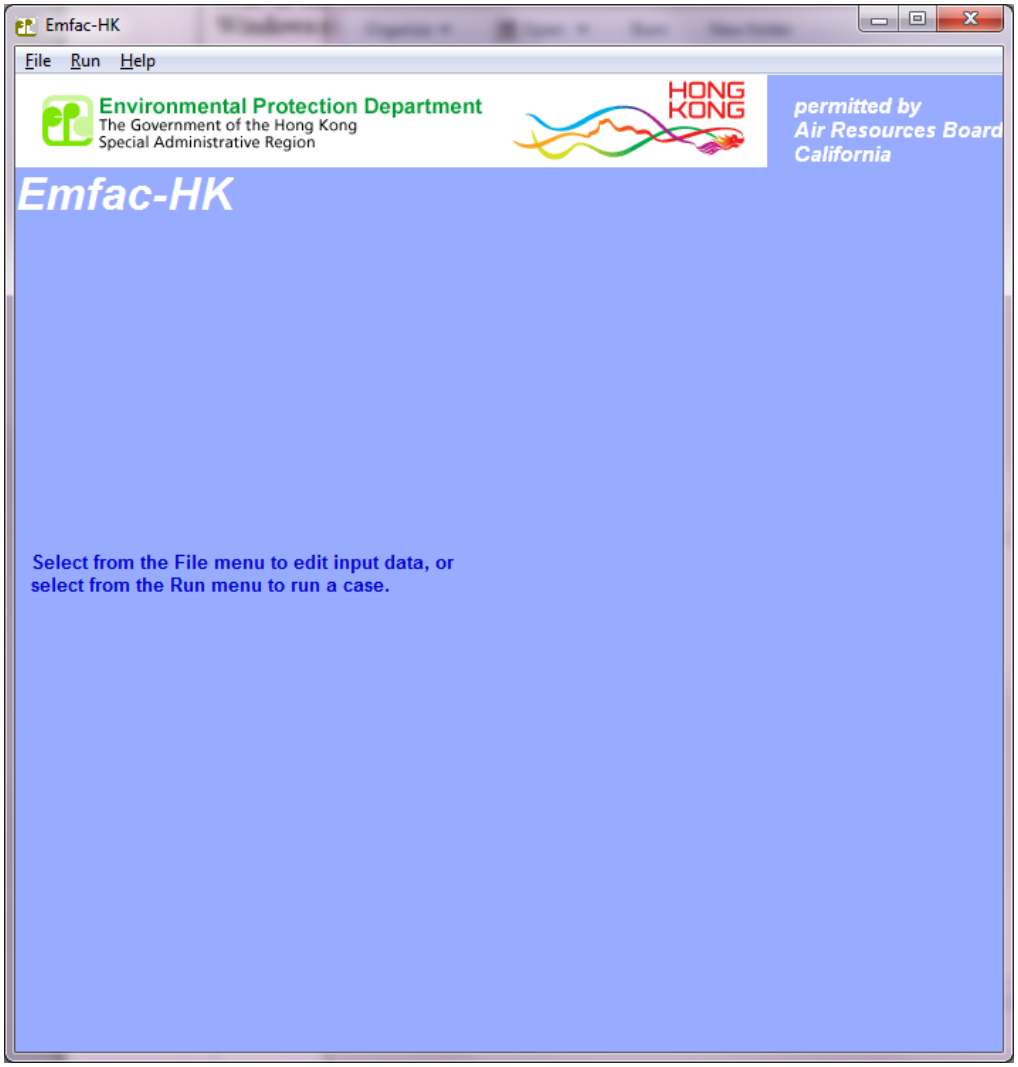
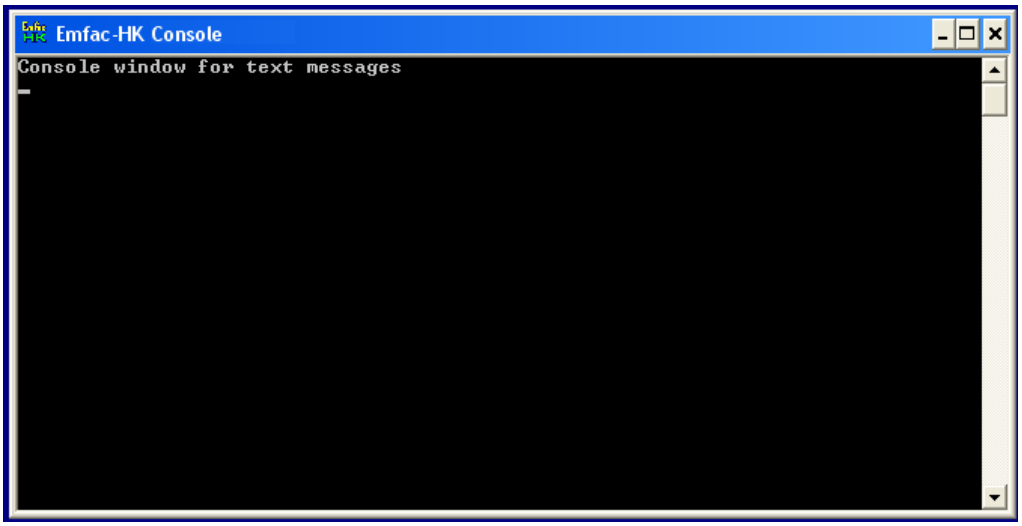


Figure 3. Console Window



The main menu bar, shown in Figure 2, offers three main selections: File, Run, and Help. Menu options under each of these are described below:

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:	Browses existing input files for selection and reads in the input dialogs.
Open filename:	Re-opens the last file edited and start the input dialogs.
Save:	Saves any changes to the file opened. 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

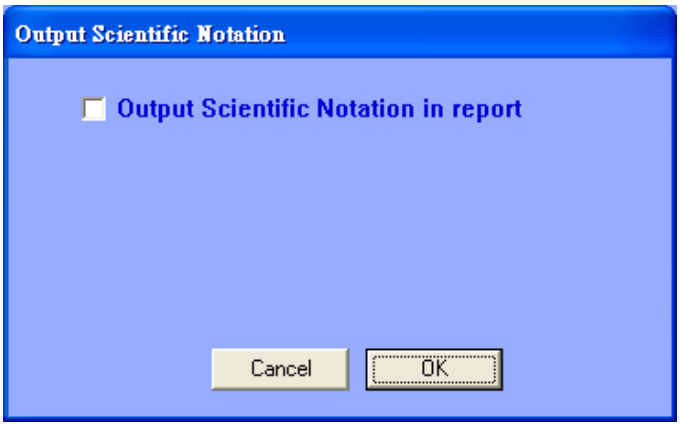
Run:	Runs the file name displayed. (This will be the last file opened.) This item is disabled if there are unsaved editing changes, or if no file has been opened.
Run File:	Opens a ”Select Existing Scenario File” dialog. If a user selects a file, the program reads the file and begins calculations.
Stop Run:	Stops running the executable. It will close all output files immediately and such output files may be incomplete, even output data from scenarios that completed.

*Warning: The user cannot resume the program once **Stop** is initiated.*

Help Menu

Contents	Displays in-program documentation (Placeholder. Not activated)
About EMFAC-HK	Starts the About window, which displays version information.
Output Scientific Notation	Opens a check box dialog for using scientific notation in all outputs (see Figure 4).

Figure 4. Output Scientific Notation Window



The Main Screen

The second window (Figure 5) 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. (Note also that this second window (Figure 5) is resized with button locations relocated.)

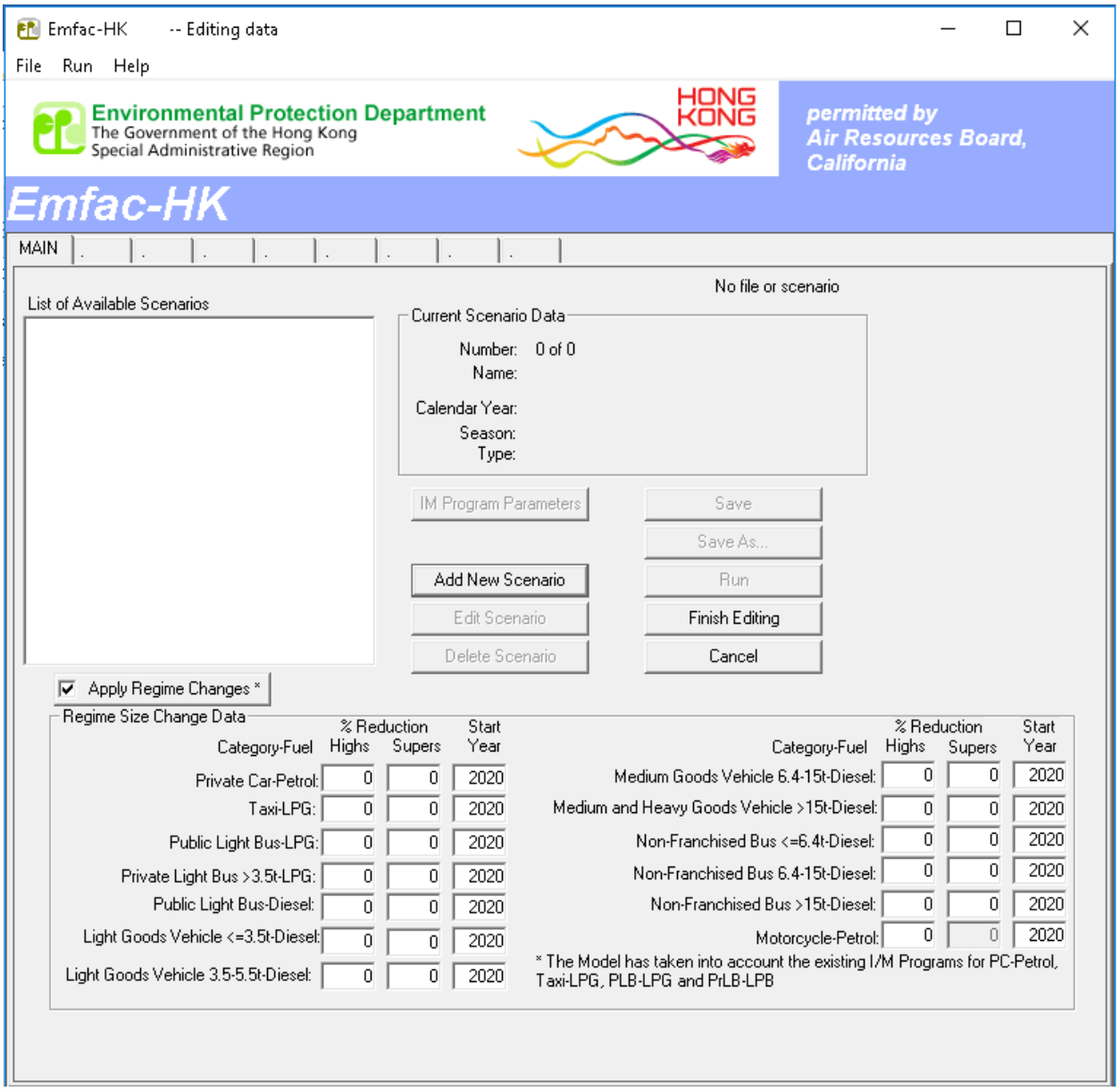
For a new file, the only buttons enabled when the form first opens are "Add New Scenario", "Finish Editing", and "Cancel". After the first scenario is added, the scenario title appears in the scenario list on the left, the scenario data box shows a summary of it, and the "Save As" and "Run" buttons are enabled. After the file is saved with "Save As", the file name is included above the summary data, and the "Save" button is enabled.

Starting from v3.4, in this screen, users are no longer allowed to modify the I/M parameters for the Strengthened Emissions Control for Petrol and LPG Vehicles (an I/M program using remote sensing and dynamometer testing) (the Existing I/M Program) as its reductions are already built-in to the model. Rather, users will now be able to add new (extra) I/M initiatives by i) checking (default) /unchecking the box "Apply Regime Changes" to activate/deactivate the programme, ii) modify the % reduction of high and super emitters and iii) modify the programme start year. The default reductions will all be zeros. Users should note that some technology groups do not have high regime[4] and thus the I/M reduction parameters for high regime will not be effective to them. Note that project proponents or environmental consultants have to provide justifications for any change of the default figures.

As the parameters of the Existing I/M Program[5] in INP files are no longer valid, starting from v3.4 EMFAC-HK cannot be run using INP files generated from v3.3, unless user chooses to accept to use the new default I/M values by clicking "OK" in the pop-up window.

[4] For details, see section "Regimes Assumptions" in *Appendix II- EMFAC-HK Modeling Assumptions*.
[5] In the INP files, the I/M parameters are shown in the line with tag "HK-IM".

Figure 5. Main Dialog Titled Editing Data



Adding or editing scenarios

When "Add New Scenario" is selected, the only actions enabled on the form are "Finish Editing", "Cancel", and "Add New Scenario". The scenario list on the left is empty (Figure 5). In this case, "Add New Scenario" brings up the *Input 1* tab; the user see input dialogs with some data set to program default values and some data flagged as "inactive".

Figure 6 shows the window that opens after "Add New Scenario" is pressed. This, and the subsequent screen, will guide the user through the six steps listed and described below for specifying the scenario.

1. Geographic area
2. Calendar Year/Alternate Base Yr
3. Season or Month
4. Scenario title
5. Model years
6. Vehicle classes

The first screen, shown in Figure 6, guides the user through Steps 1 through 3, for selecting geographic area, calendar years, and season or month. In Step 1, the Area Type button (SAR) is defaulted to "SAR" and the SAR is defaulted to "Hong Kong".

In Step 2a, the user must select a Calendar Year (CYr), which represents the year to forecast emissions to. When the "Select" button is pressed, the "Calendar Year Selection Screen appears, as shown in Figure 7, which allows, the user to choose a **single** calendar year. For example, in order to run the model for CYr 2020, choose calendar year 2020 under the "Available" column and use the ">" button to transfer it to "Included" column; then click "OK". Figure 7 shows the result of this action. Once "OK" is clicked, the user is taken back to the previous screen (Figure 6).

Important: Selecting multiple calendar years is no longer available with EMFAC-HK V4.x.

Once a Calendar Year has been selected, Step 2b will be activated (changed from gray to black), indicating the user now has the option of specifying an Alternate Base Year for running the model. The Alternate Base Year is initialized to "INACTIVE" to show it is an optional setting. The action of the "Select" in Step 2b is similar to Step 2a. Once Step 2b is selected, a similar screen to Figure 7 appears, except the title says "Alternate Base Year", with years for selection from 2002 to CYr set in Step 2a in "Available" column. As with the calendar year, only a single alternate base year is allowed in the scenario. Figure 8 shows an example where the Alternate Base Year 2014 was selected and activated.

Hint: The Alternate Base Yr is "optional" and is not able to be activated until a Calendar Year has been selected. ***Only a single alternate base year is allowed.***

Figure 6. Input 1 Screen - Geographic Area Options

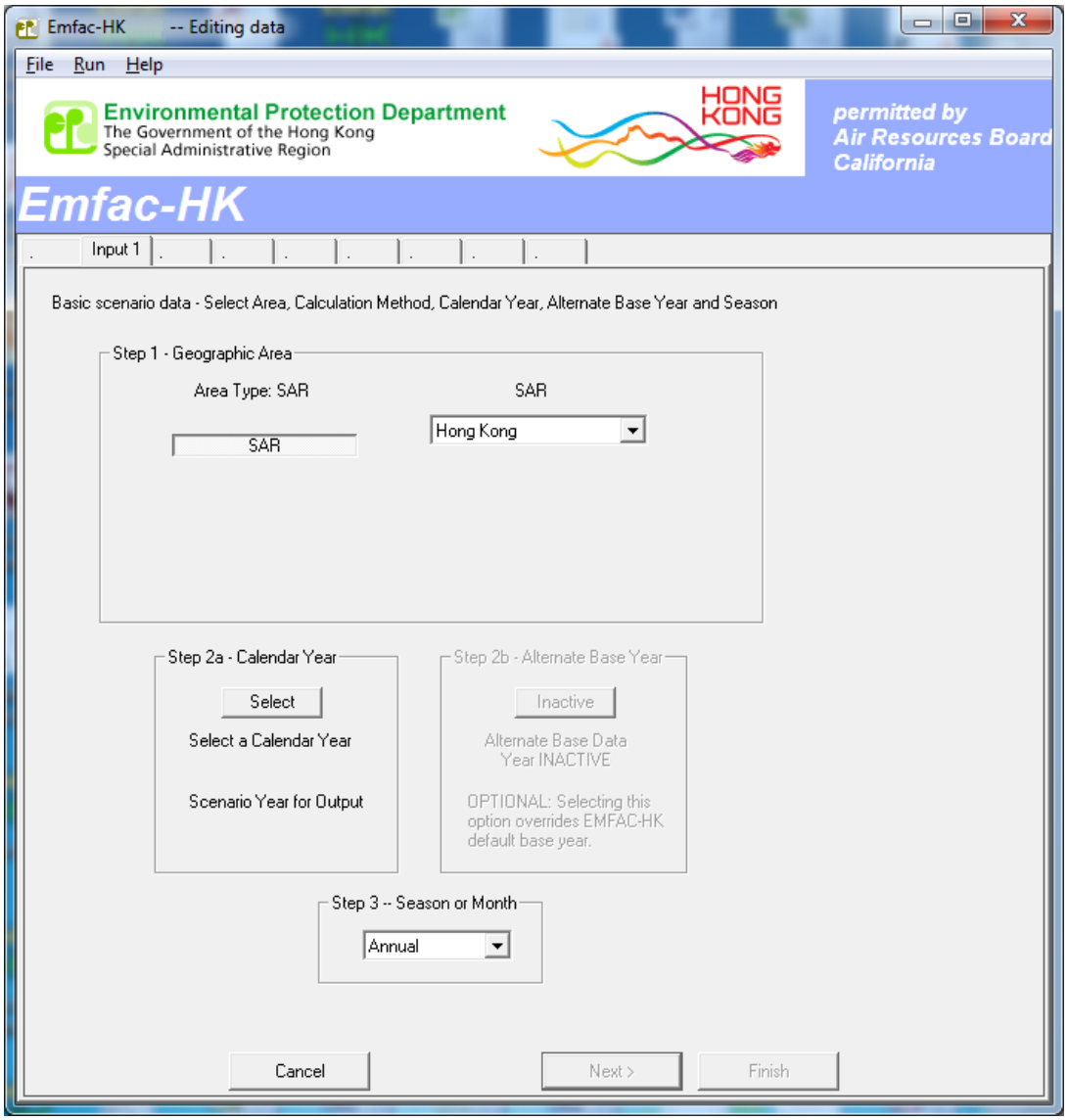


Figure 7. "Calendar Year" Selection

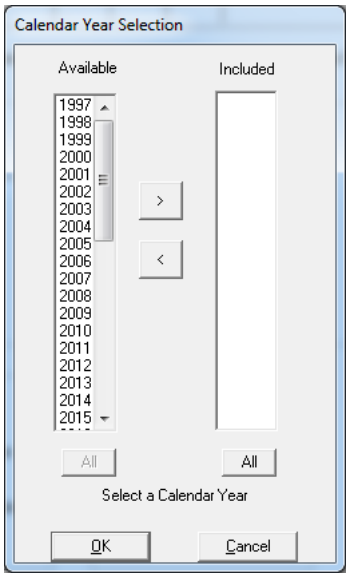


Figure 8. Step2b - Alternate Base Year Activated

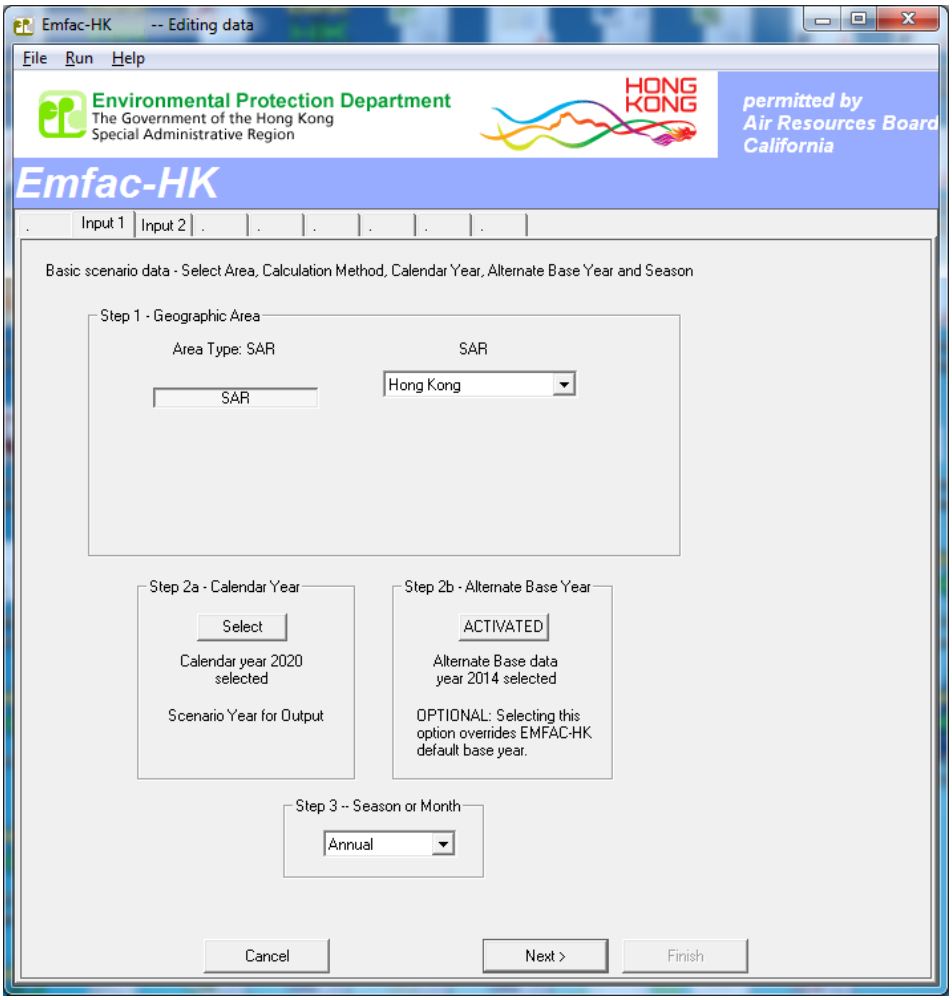


Figure 9 shows Step 3 and the "pull down" selection of the 'season or month' to run the model. Here the user can choose to run the model for any month from January to December, or Annual Average (which is the default).

After completing Steps 1 through 3, selecting "Next" brings up the screen in Figure 10, which shows the Step 4 default scenario name generated from data selected in Figure 9. The user can change the default title to something more relevant to the analysis.

There are two steps in this screen – Model Years (Step 5) and Vehicle Classes (Step 6). If the user clicks the button 'next', the model is assuming that the user is accepting the default conditions for Model Years (i.e. ALL) and Vehicle classes for calculation.

Figure 9. Season or Month Selection

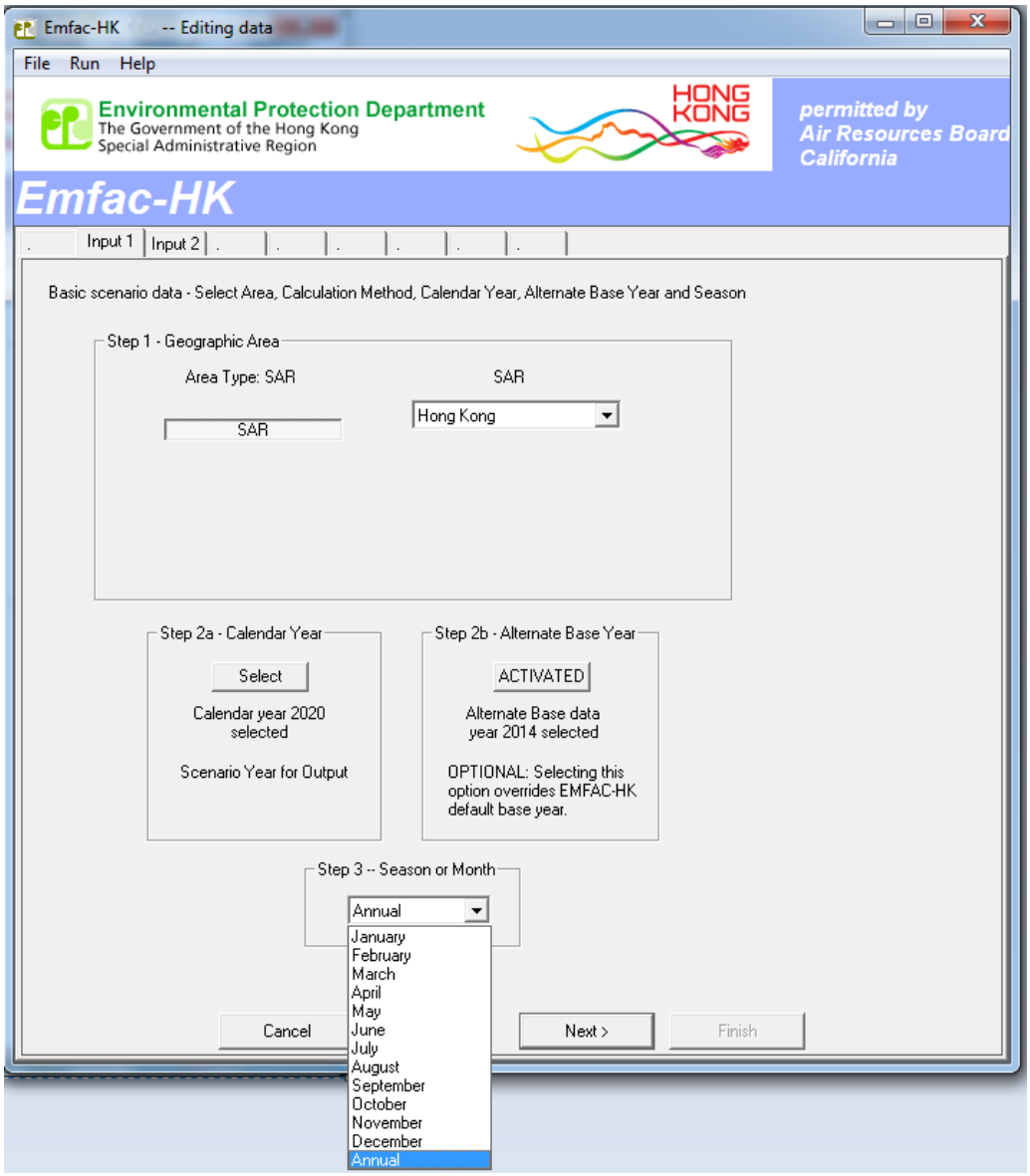
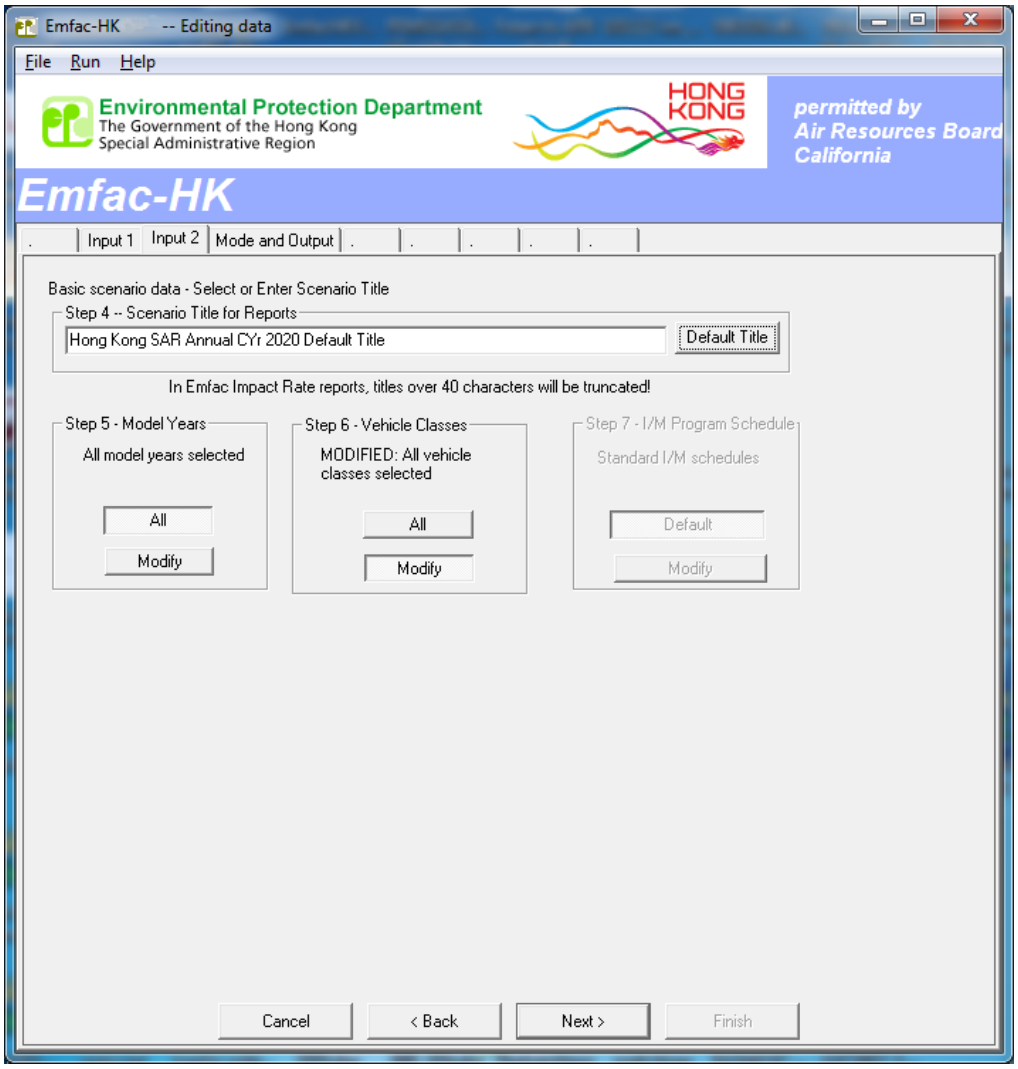


Figure 10. Input Dialog -- Steps 4-6



If the user selects the "Next" button at the bottom of the screen, the model will assume that the user has accepted the default conditions "ALL" for Model Years (MYs) in Step 5 and Vehicle classes in Step 6. If the user clicks the button 'Modify' in Step 5, the "Model Year Selection" screen appears (Figure 11). For example, if the user wants to run the model for all MYs 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 Figure 10.

Suppose the user wants to run the model for calendar year 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 Figure 12. Then click "OK".

Figure 11. Model Year Selection

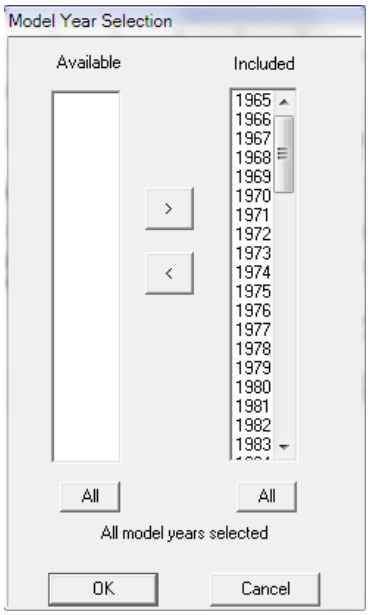
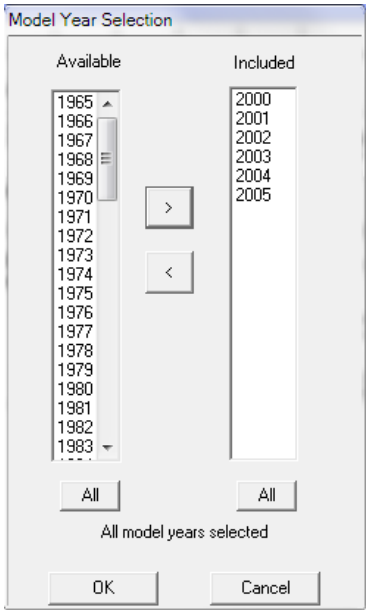
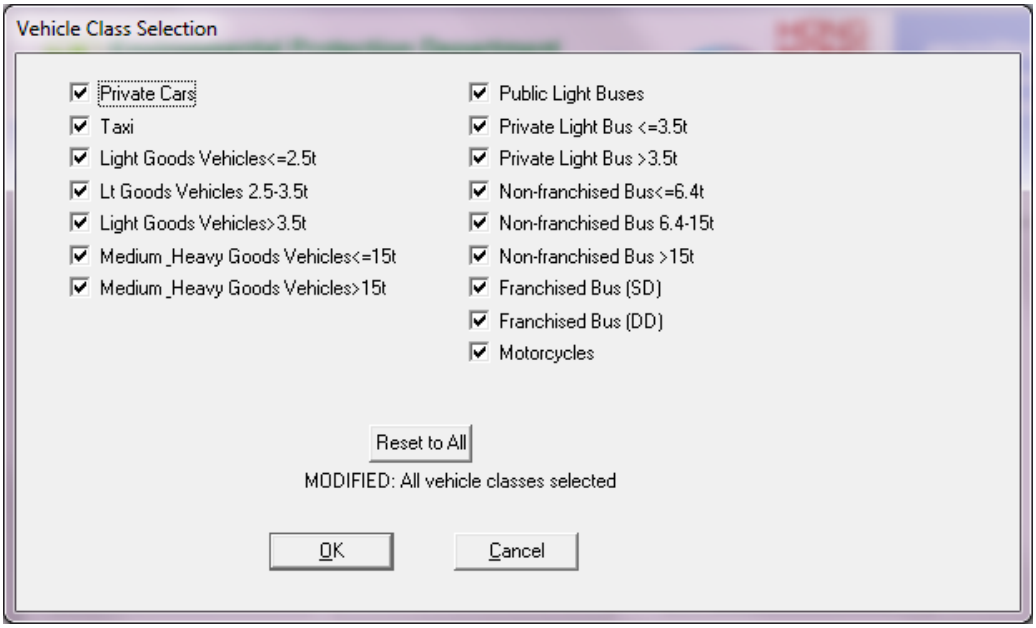


Figure 12. Selecting a Set of Model Years (2000-2005)



Referring again to Figure 10, Step 6 involves selecting vehicle classes to be included in the scenario. By default, the model will execute each scenario using all the vehicle classes. By selecting "Modify" under "Vehicle Classes" (Figure 10), the user will be presented with the screen depicted in Figure 13. Here, the user is presented with the option of selecting one or more vehicle types for the execution of the scenario. Clicking 'OK' returns the user to previous screen (Figure 10).

Figure 13. Vehicle Class Selection



7.0 INTRODUCTION TO THE TWO MODELLING MODES

The EMFAC-HK model supports calculation of emissions/ emission factors for the Burden and Emfac modes. These mode selections are made in the "Mode and Output" form shown below. Figure 14 shows the mode and output selections when the next button is pressed and Figure 15 shows when Burden mode is selected.

Figure 14. Mode and Output Selections

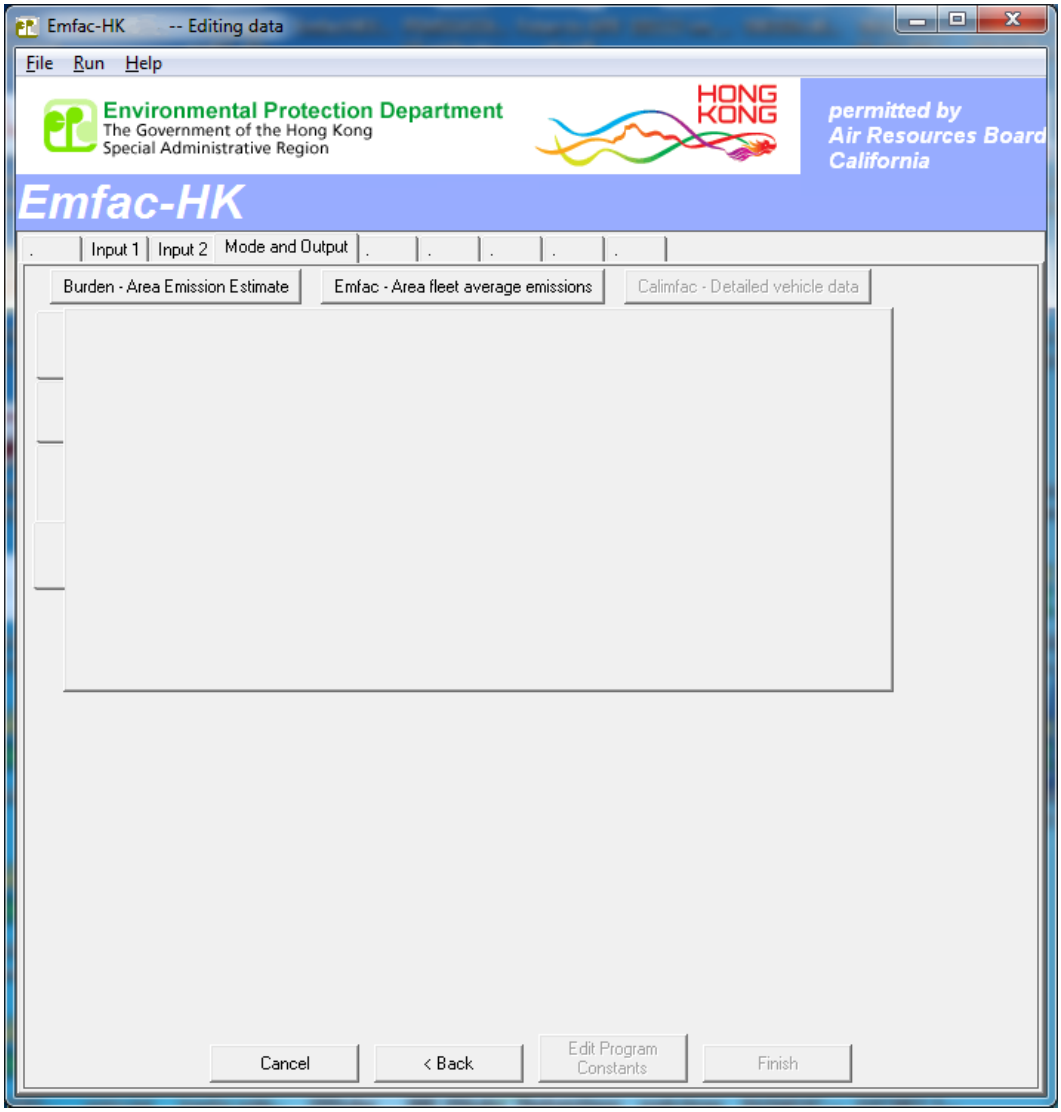
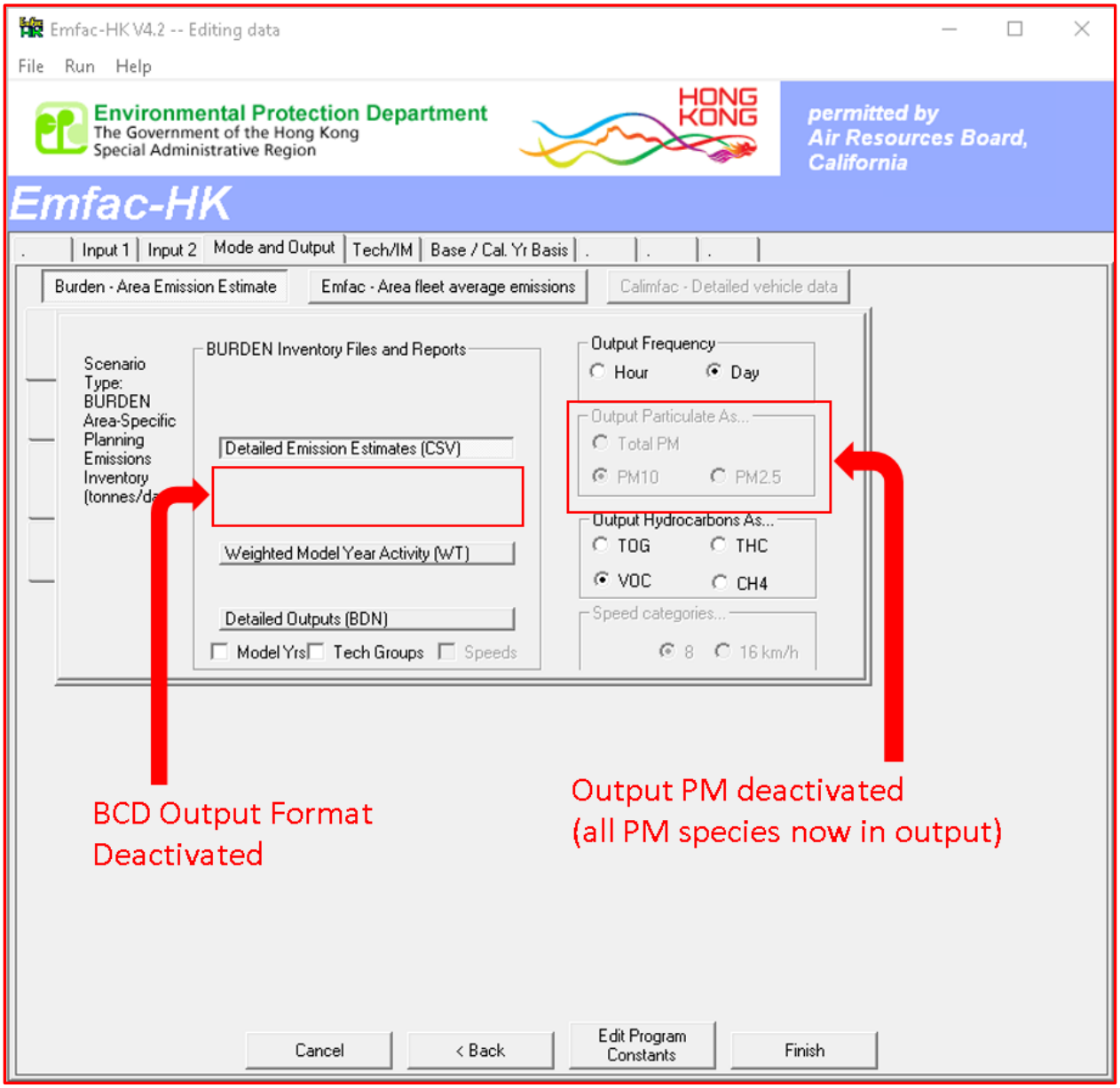


Figure 15. Burden Mode Output Selections



NOTE: *Key distinctions between model modes:*
Burden: Total emissions in tonnes/day.
Emfac: Emission factors in grams/activity

Each mode selection triggers a corresponding list of output options including Frequency (default is *Day*), and Hydrocarbons (default is *VOC*). Beginning with EMFAC-HK V4.2, user selection of PM output mode is no longer activated or required as the output in each selected output file now provides PM_{30}, PM_{10}, and $PM_{2.5}$. In the example above the user has selected Burden mode to output emissions in tonnes per day. In this mode the user can choose to output emission estimates in up to three file formats (the BCD format is deactivated from EMFAC-HK V4.2).

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

Burden mode

The Burden mode is used for calculating area-specific emission estimates. In this mode, the model reports total emissions as tonnes 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 average speeds combined with vehicle activity to calculate emissions in tonnes per day. Vehicle activity includes the number of vehicles, kilometres 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. **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 estimates for all 16 vehicle classes by fuel type. It is recommended that new users select this as an output option to get an idea of the entire emission estimate.

2. ~~**MVEI7G (BCD)** – This is also a comma-separated file but it has a "bcd" in file name with "csv" extension. This file has the same information as CSV of the above but in columnar format, which makes it suitable for sorting using spreadsheets.~~
   (Remark: From EMFAC-HK V4.2, this format is obsolete and removed.)

3. **Weighted Model Year Activity (WT)** - This is not a comma-separated file and has a "wt" extension. This file gives the activity components like population, VKT, trips, accrual rate, and odometer by model year.

4. **Detailed Outputs (BDN)** - This is also a comma-separated file but it has a "bdn" in file name with "csv" extension. This file gives the detailed Burden report by Model year, Tech groups and Speeds, which are useful for the air pollution modelling community.

Hints: The "wt" is not a comma-separated file and the function "Text to Column wizard" in Microsoft Excel can be used.

Burden output reports

This section provides some sample outputs from the Burden mode.

CSV report

This report is written to a file with a "csv" extension. It is a text file in comma-separated-value (CSV) format. It may contain multiple reports if the run included multiple scenarios. This report format includes results for the entire fleet and all vehicle/technology combinations.

Viewing the File: The file can be opened easily in spreadsheet programs such as Microsoft Excel, and also in database programs such as Microsoft Access or Sybase.

Figure 16 shows a portion of the CSV file report as viewed in a spreadsheet.

Figure 16. CSV Output

Note: NO_2, PM_{30}, PM_{10} and $PM_{2.5}$ are provided in the output since EMFAC-HK V4.2 (see dash-blue squares).

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	Title : Hong Kong SAR Annual CYr 2015																		
2	Version : Emfac-HK V4.2 V4.2.0 20191203 Sp: V4.2.0 Pr: Emfac-HK HK4.2 ** WIS Enabled **																		
3	Run Date : 2019/12/10 14:08:46																		
4	Scen Year: 2015 -- All model years in the range 1971 to 2015 selected																		
5	Season : Annual																		
6	Area : Hong Kong SAR																		
7	I/M Stat : HK I/M CY2013+ program in effect																		
8	Emissions: Tonnes Per Day																		
9	**********																		
10		PC-NCAT	PC-CAT	PC-DSL	PC-LPG	PC-TOT	TAXI-NCA	TAXI-CAT	TAXI-DSL	TAXI-LPG	TAXI-TOT	LGV<=2.5	LGV<=2.5	LGV<=2.5	LGV<=2.5	LGV<=2.5	LGV2.5-3.	LGV2.5-3.	LGV2.
11	Vehicles	1966	512341	5284	0	519591	0	10	0	18230	18240	16	42	463	0	521	6	1718	48
12	VKT	38068	1.5E+07	183924	0	1.5E+07	0	4346	0	7922008	7926354	852	2575	35971	0	39398	337	117495	3522
13	Trips	2949	768435	7925	0	779309	0	40	0	72913	72953	64	168	1852	0	2084	24	6872	194
14	VOC Emissions																		
15	Run Exh	0.06036	0.29829	0.0155	0	0.37415	0	0.00004	0	0.41902	0.41906	0.00136	0.00237	0.00085	0	0.00458	0.0005	0.01639	0.1
16	Start Ex	0.01151	0.19029	0	0	0.2018	0	0.00001	0	0.06059	0.0606	0.00028	0.00019	0	0	0.00047	0.0001	0.00123	
17	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
18																			
19	Diurnal	0.02352	0.47019	0	0	0.4937	0	0.00001	0	0	0.00001	0.00028	0.00011	0	0	0.00038	0.00004	0.00124	
20	Hot Soak	0.01329	0.22413	0	0	0.23743	0	0.00001	0	0	0.00001	0.00043	0.00017	0	0	0.0006	0.00007	0.00173	
21	Running	0.06323	0.26075	0	0	0.32398	0	0.00002	0	0	0.00002	0.00205	0.00028	0	0	0.00233	0.00034	0.00334	
22	Resting	0.02207	0.44184	0	0	0.46392	0	0.00001	0	0	0.00001	0.00027	0.00008	0	0	0.00035	0.00004	0.00125	
23	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
24	Carbon Monoxide Emissions																		
25	Run Exh	1.18633	17.9049	0.05554	0	19.1467	0	0.00278	0	20.5421	20.5449	0.02775	0.05427	0.00936	0	0.09138	0.00917	0.60142	0.95
26	Start Ex	0.11908	4.5366	0	0	4.65568	0	0.00028	0	0.28341	0.28369	0.00282	0.00304	0	0	0.00585	0.00104	0.03511	
27																			
28	Oxides of Nitrogen Emissions																		
29	Run Exh	0.1342	1.11626	0.04485	0	1.29531	0	0.00038	0	11.5183	11.5187	0.00305	0.00289	0.04529	0	0.05123	0.00114	0.01349	4.20
30	Start Ex	0.0078	0.23218	0	0	0.23999	0	0.00003	0	0.11015	0.11019	0.00018	0.00013	0	0	0.00031	0.00007	0.00113	
31																			
32	Nitrogen Dioxide Emissions																		
33	Run Exh	0.00671	0.05581	0.00387	0	0.0664	0	0.00002	0	0.17014	0.17016	0.00015	0.00014	0.00504	0	0.00534	0.00006	0.00067	0.3
34	Start Ex	0.00039	0.01161	0	0	0.012	0	0	0	0.00187	0.00187	0.00001	0.00001	0	0	0.00002	0	0.00006	
35	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
36	Carbon Dioxide Emissions (000)																		
37	Run Exh	0.00849	3.3124	0.04027	0	3.36116	0	0.001	0	1.84529	1.84629	0.00019	0.00097	0.01056	0	0.01171	0.00008	0.05238	1.03
38	Start Ex	0.00059	0.05751	0	0	0.05811	0	0	0	0.0058	0.0058	0.00001	0.00001	0	0	0.00002	0	0.00032	
39	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
40	Total Particulate Emissions																		
41	Run Exh	0.0016	0.05511	0.00602	0	0.06274	0	0.00001	0	0	0.00001	0.00004	0.00004	0.0006	0	0.00067	0.00001	0.00092	0.1
42	Start Ex	0.0002	0.00574	0	0	0.00594	0	0	0	0	0	0	0	0	0	0.00001	0	0.00004	
43	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
44	PM10 Emissions																		
45	Run Exh	0.00144	0.05346	0.00602	0	0.06093	0	0.00001	0	0	0.00001	0.00003	0.00004	0.0006	0	0.00067	0.00001	0.00089	0.1
46	Start Ex	0.00018	0.00556	0	0	0.00574	0	0	0	0	0	0	0	0	0	0.00001	0	0.00004	
47	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
48	PM2.5 Emissions																		
49	Run Exh	0.00109	0.0496	0.00554	0	0.05624	0	0.00001	0	0	0.00001	0.00002	0.00004	0.00055	0	0.00061	0.00001	0.00082	0.1
50	Start Ex	0.00014	0.00516	0	0	0.0053	0	0	0	0	0	0	0	0	0	0.00001	0	0.00004	
51	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

This report also has an eight-line header followed by the report body. This header is essentially identical to the one in the burden file. In Figure 16, note that the header echoes all of the basic scenario data: calendar year, model year range, and title. The header also echoes a long program version string, and a timestamp when the scenario is run.
Data Rows: The report body contains rows of data in the following order: summary vehicle activity data, followed by pollutant and process emission rates.

Figure 16 shows the first few data rows that are visible. They include the summary vehicle activity data for vehicle population, VKT, and trips. The remaining rows show VOC emissions from each exhaust and evaporative emission process in tonnes per day.

Data Columns: In the report body, the columns of data are grouped by 16 vehicle classes. Within each vehicle class, results are listed for the four Burden technology classifications, followed by a subtotal for the vehicle class with fuel types and technologies including NCAT (Petrol with non-catalyst equipped), CAT (Petrol with catalyst equipped), DSL (Diesel), LPG, and vehicle class total (TOT).

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

BCD report

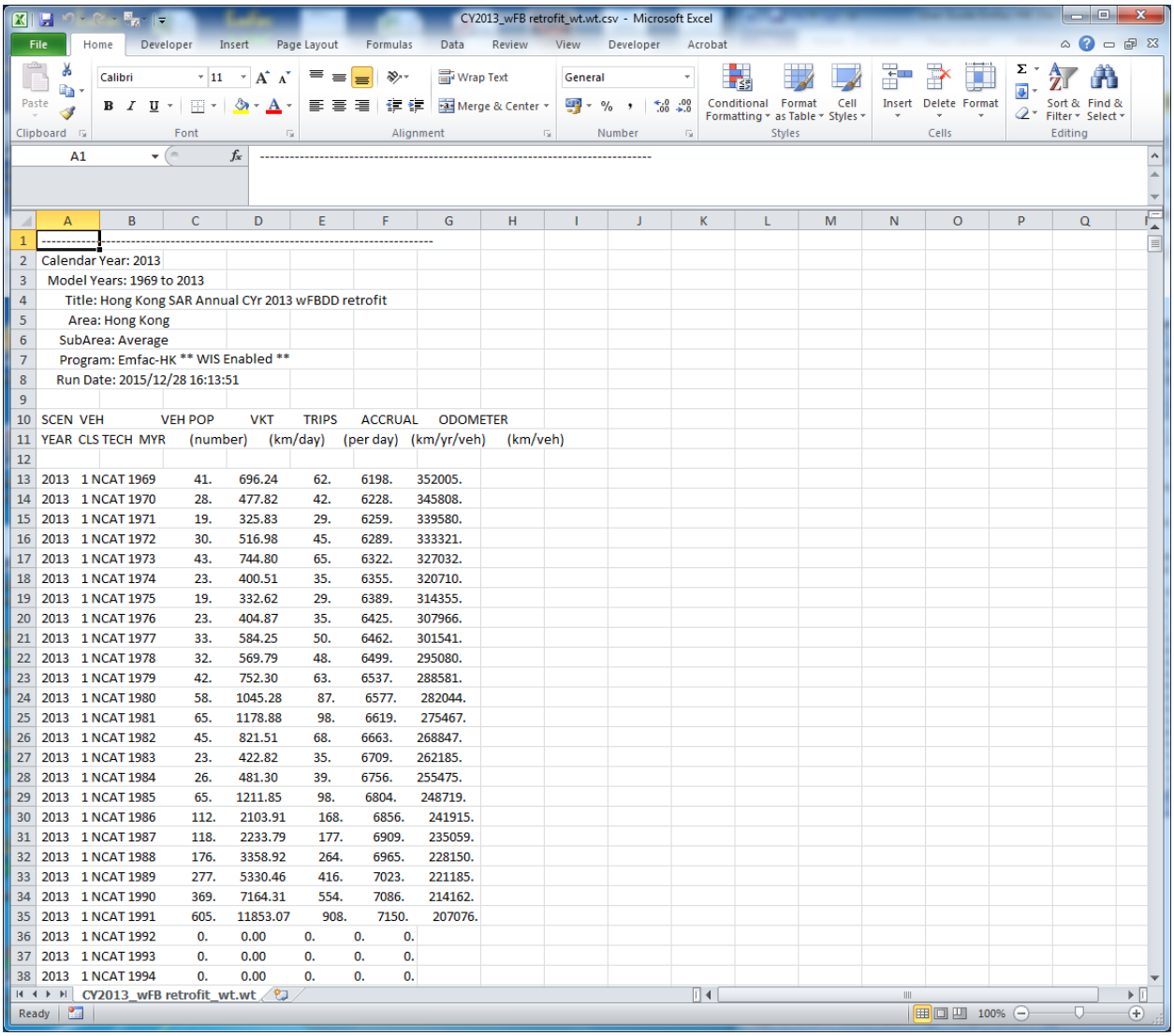
****** THIS REPORT FORMAT IS REMOVED FROM EMFAC-HK V4.2. ******

WT report

This Weighted Model Year Activity output gives the activity components like population, VKT, trips, accrual rate, and odometer by model year.

Figure 17 shows a portion of the Burden Weighted report as viewed in a spreadsheet.

Figure 17. WEIGHT output



CY2013_wFB retrofit_wt.wt.csv - Microsoft Excel

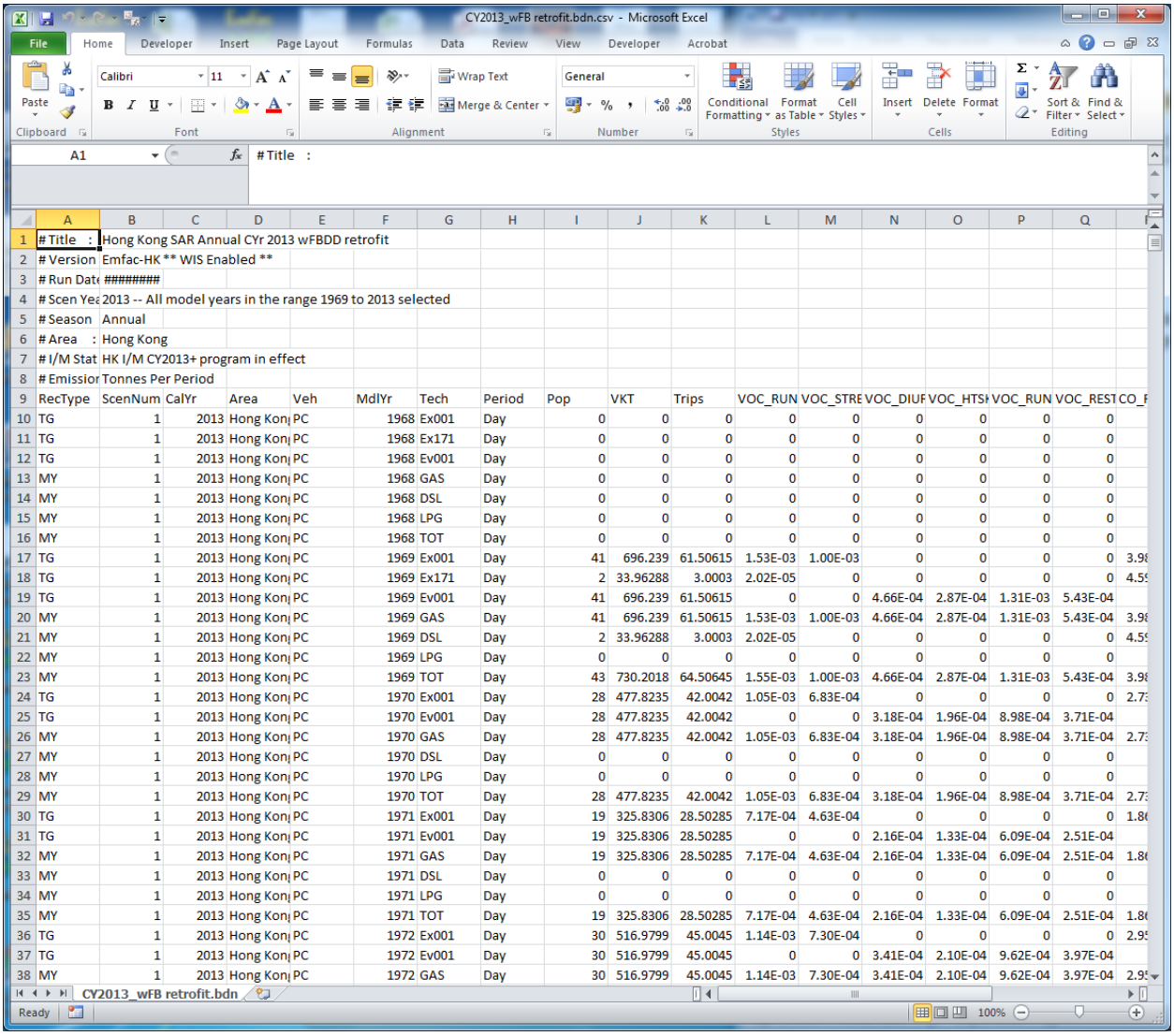
Calendar Year: 2013
Model Years: 1969 to 2013
Title: Hong Kong SAR Annual CYr 2013 wFBDD retrofit
Area: Hong Kong
SubArea: Average
Program: Emfac-HK ** WIS Enabled **
Run Date: 2015/12/28 16:13:51

SCEN YEAR	VEH CLS	TECH	MYR	VEH POP (number)	VKT (km/day)	TRIPS (per day)	ACCRUAL (km/yr/veh)	ODOMETER (km/veh)
2013	1	NCAT	1969	41.	696.24	62.	6198.	352005.
2013	1	NCAT	1970	28.	477.82	42.	6228.	345808.
2013	1	NCAT	1971	19.	325.83	29.	6259.	339580.
2013	1	NCAT	1972	30.	516.98	45.	6289.	333321.
2013	1	NCAT	1973	43.	744.80	65.	6322.	327032.
2013	1	NCAT	1974	23.	400.51	35.	6355.	320710.
2013	1	NCAT	1975	19.	332.62	29.	6389.	314355.
2013	1	NCAT	1976	23.	404.87	35.	6425.	307966.
2013	1	NCAT	1977	33.	584.25	50.	6462.	301541.
2013	1	NCAT	1978	32.	569.79	48.	6499.	295080.
2013	1	NCAT	1979	42.	752.30	63.	6537.	288581.
2013	1	NCAT	1980	58.	1045.28	87.	6577.	282044.
2013	1	NCAT	1981	65.	1178.88	98.	6619.	275467.
2013	1	NCAT	1982	45.	821.51	68.	6663.	268847.
2013	1	NCAT	1983	23.	422.82	35.	6709.	262185.
2013	1	NCAT	1984	26.	481.30	39.	6756.	255475.
2013	1	NCAT	1985	65.	1211.85	98.	6804.	248719.
2013	1	NCAT	1986	112.	2103.91	168.	6856.	241915.
2013	1	NCAT	1987	118.	2233.79	177.	6909.	235059.
2013	1	NCAT	1988	176.	3358.92	264.	6965.	228150.
2013	1	NCAT	1989	277.	5330.46	416.	7023.	221185.
2013	1	NCAT	1990	369.	7164.31	554.	7086.	214162.
2013	1	NCAT	1991	605.	11853.07	908.	7150.	207076.
2013	1	NCAT	1992	0.	0.00	0.	0.	0.
2013	1	NCAT	1993	0.	0.00	0.	0.	0.
2013	1	NCAT	1994	0.	0.00	0.	0.	0.

BDN report

The Detailed Output in Figure 18 gives the detailed Burden report by Model year, Tech groups which are useful for the air pollution modelling community. With EMFAC-HK V4.2, NO_2, PM_{30}, PM_{10} and $PM_{2.5}$ are included and appear as extra columns to the right of the region displayed in Figure 18.

Figure 18. BDN output



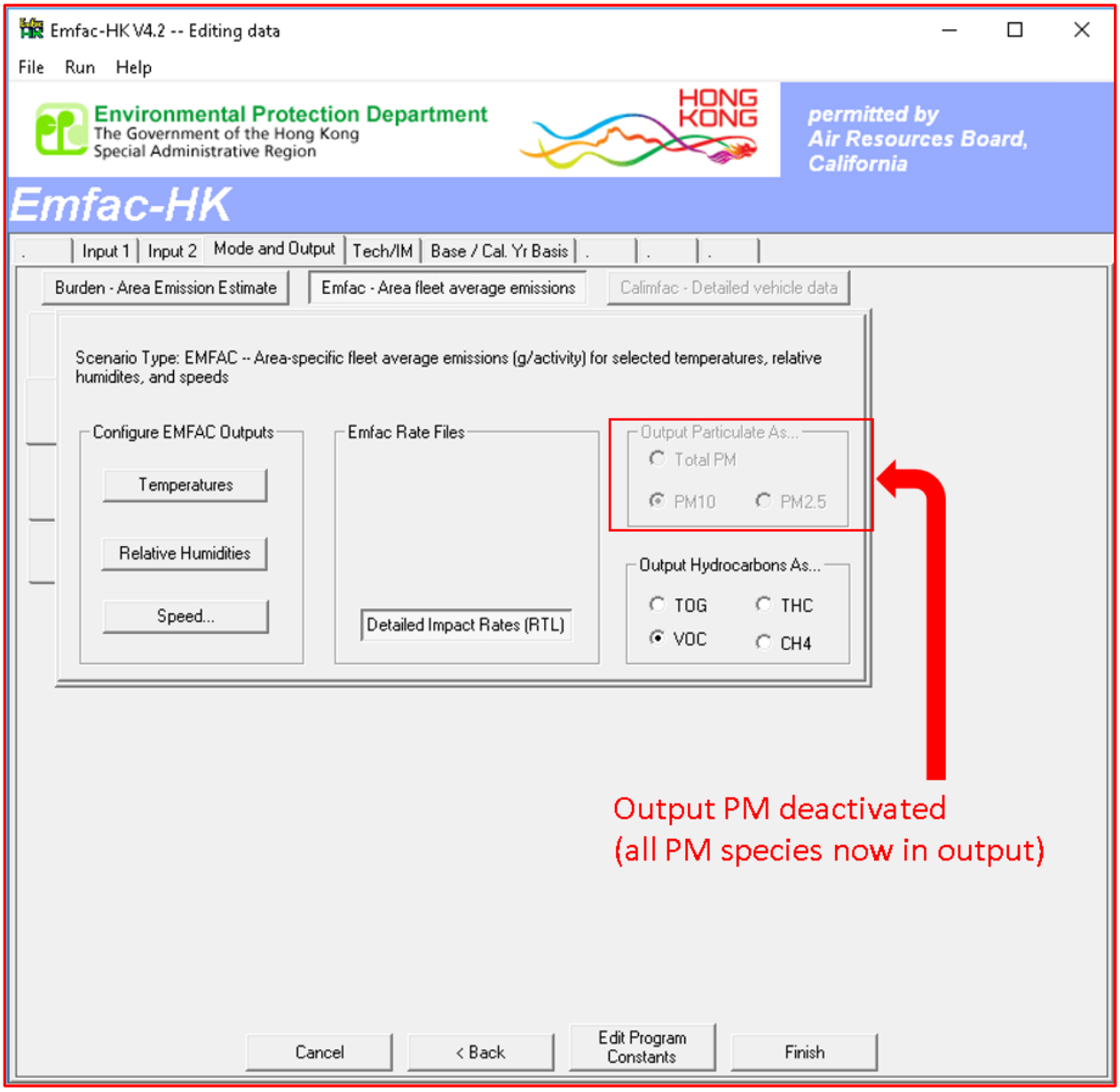
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	# Title :	Hong Kong SAR Annual CYr 2013 wFBDD retrofit															
2	# Version	Emfac-HK ** WIS Enabled **															
3	# Run Dat	########															
4	# Scen Yea	2013 -- All model years in the range 1969 to 2013 selected															
5	# Season	Annual															
6	# Area :	Hong Kong															
7	# I/M Stat	HK I/M CY2013+ program in effect															
8	# Emissior	Tonnes Per Period															
9	RecType	ScenNum	CalYr	Area	Veh	MdlYr	Tech	Period	Pop	VKT	Trips	VOC_RUN	VOC_STRE	VOC_DIUF	VOC_HTSI	VOC_RUN	VOC_REST
10	TG	1	2013	Hong Kon	PC	1968	Ex001	Day	0	0	0	0	0	0	0	0	0
11	TG	1	2013	Hong Kon	PC	1968	Ex171	Day	0	0	0	0	0	0	0	0	0
12	TG	1	2013	Hong Kon	PC	1968	Ev001	Day	0	0	0	0	0	0	0	0	0
13	MY	1	2013	Hong Kon	PC	1968	GAS	Day	0	0	0	0	0	0	0	0	0
14	MY	1	2013	Hong Kon	PC	1968	DSL	Day	0	0	0	0	0	0	0	0	0
15	MY	1	2013	Hong Kon	PC	1968	LPG	Day	0	0	0	0	0	0	0	0	0
16	MY	1	2013	Hong Kon	PC	1968	TOT	Day	0	0	0	0	0	0	0	0	0
17	TG	1	2013	Hong Kon	PC	1969	Ex001	Day	41	696.239	61.50615	1.53E-03	1.00E-03	0	0	0	0
18	TG	1	2013	Hong Kon	PC	1969	Ex171	Day	2	33.96288	3.0003	2.02E-05	0	0	0	0	0
19	TG	1	2013	Hong Kon	PC	1969	Ev001	Day	41	696.239	61.50615	0	0	4.66E-04	2.87E-04	1.31E-03	5.43E-04
20	MY	1	2013	Hong Kon	PC	1969	GAS	Day	41	696.239	61.50615	1.53E-03	1.00E-03	4.66E-04	2.87E-04	1.31E-03	5.43E-04
21	MY	1	2013	Hong Kon	PC	1969	DSL	Day	2	33.96288	3.0003	2.02E-05	0	0	0	0	0
22	MY	1	2013	Hong Kon	PC	1969	LPG	Day	0	0	0	0	0	0	0	0	0
23	MY	1	2013	Hong Kon	PC	1969	TOT	Day	43	730.2018	64.50645	1.55E-03	1.00E-03	4.66E-04	2.87E-04	1.31E-03	5.43E-04
24	TG	1	2013	Hong Kon	PC	1970	Ex001	Day	28	477.8235	42.0042	1.05E-03	6.83E-04	0	0	0	0
25	TG	1	2013	Hong Kon	PC	1970	Ev001	Day	28	477.8235	42.0042	0	0	3.18E-04	1.96E-04	8.98E-04	3.71E-04
26	MY	1	2013	Hong Kon	PC	1970	GAS	Day	28	477.8235	42.0042	1.05E-03	6.83E-04	3.18E-04	1.96E-04	8.98E-04	3.71E-04
27	MY	1	2013	Hong Kon	PC	1970	DSL	Day	0	0	0	0	0	0	0	0	0
28	MY	1	2013	Hong Kon	PC	1970	LPG	Day	0	0	0	0	0	0	0	0	0
29	MY	1	2013	Hong Kon	PC	1970	TOT	Day	28	477.8235	42.0042	1.05E-03	6.83E-04	3.18E-04	1.96E-04	8.98E-04	3.71E-04
30	TG	1	2013	Hong Kon	PC	1971	Ex001	Day	19	325.8306	28.50285	7.17E-04	4.63E-04	0	0	0	0
31	TG	1	2013	Hong Kon	PC	1971	Ev001	Day	19	325.8306	28.50285	0	0	2.16E-04	1.33E-04	6.09E-04	2.51E-04
32	MY	1	2013	Hong Kon	PC	1971	GAS	Day	19	325.8306	28.50285	7.17E-04	4.63E-04	2.16E-04	1.33E-04	6.09E-04	2.51E-04
33	MY	1	2013	Hong Kon	PC	1971	DSL	Day	0	0	0	0	0	0	0	0	0
34	MY	1	2013	Hong Kon	PC	1971	LPG	Day	0	0	0	0	0	0	0	0	0
35	MY	1	2013	Hong Kon	PC	1971	TOT	Day	19	325.8306	28.50285	7.17E-04	4.63E-04	2.16E-04	1.33E-04	6.09E-04	2.51E-04
36	TG	1	2013	Hong Kon	PC	1972	Ex001	Day	30	516.9799	45.0045	1.14E-03	7.30E-04	0	0	0	0
37	TG	1	2013	Hong Kon	PC	1972	Ev001	Day	30	516.9799	45.0045	0	0	3.41E-04	2.10E-04	9.62E-04	3.97E-04
38	MY	1	2013	Hong Kon	PC	1972	GAS	Day	30	516.9799	45.0045	1.14E-03	7.30E-04	3.41E-04	2.10E-04	9.62E-04	3.97E-04

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 kilometre or grams per hour, or grams per start, depending on the emission process. The emission factors depend on basic scenario data options of geographic area, calendar year and month. In the *Emfac* mode the model calculates a matrix of emission factors at specific values of temperature (0℃ to 40℃), relative humidity (0% to 100%), and vehicle speed (>0 km/h to 130 km/h)* for each vehicle class/technology combination. In the *Emfac* mode, an additional input dialog allows the user to customize their output and select specific temperature, relative humidity and speed values. One important use of 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 19 shows the output options available in the *Emfac* mode.

** Idling (i.e. 0 km/h) is not displayed in the output file of the Emfac mode, as no Hong Kong data is available.*

Figure **19**. Emfac Mode Output Selections



Emfac output

The *Emfac* mode output file is an 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" in file name with "csv" extension. 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.

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 9 temperatures, 11 humidity values, and 14 speeds, for a total of 1386 temperature/relative humidity/speed combinations. (Note that *Emfac* output files are large, and total file size depends on the number of combinations.)

The column 'Configure EMFAC outputs' gives three editing options - temperature, relative humidity and speed.

If the user clicks on one of the buttons under 'Configure EMFAC outputs' in Figure 19, dialogs as Figures 20 a - c pop up with lists for editing temperature, humidity or average speed. In the "Speed …" button (Figure 20c), the user can select to either output emission factors for all speeds or delete some of the speed bins for minimizing the size of the output file.

Figure 20a. List Editing For Temperature

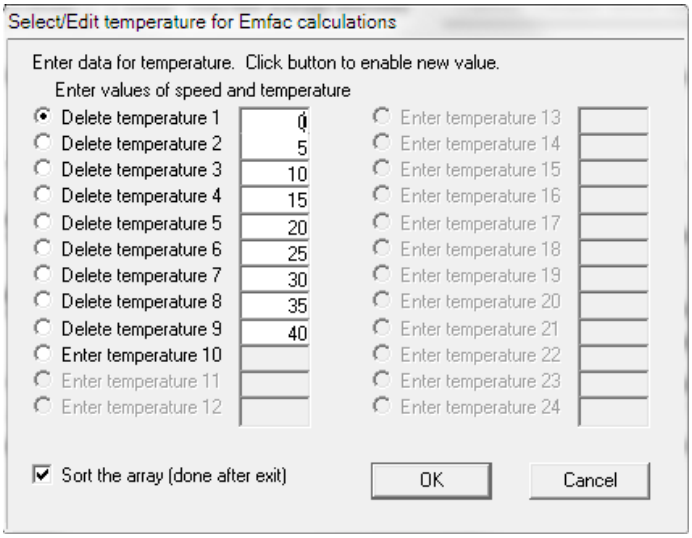


Figure 20b. List Editing For Humidity

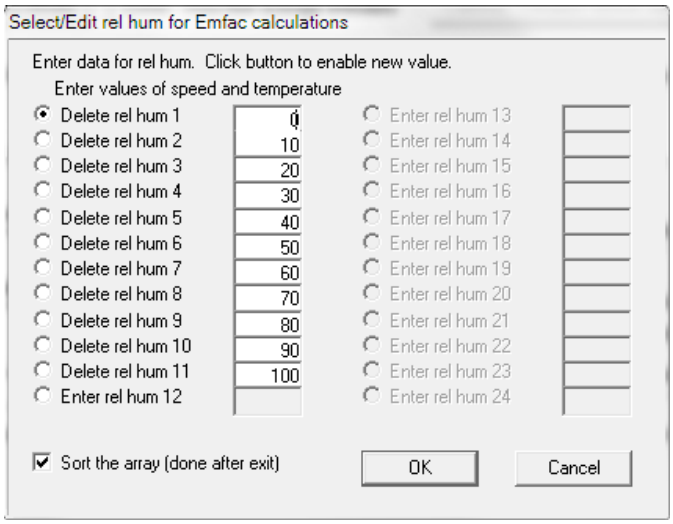
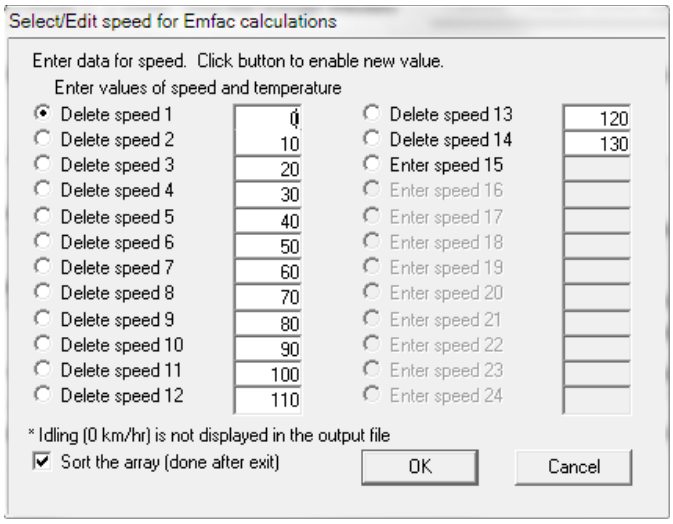


Figure 20c. List Editing For Speed



This section provides the sample output from the *Emfac* mode.

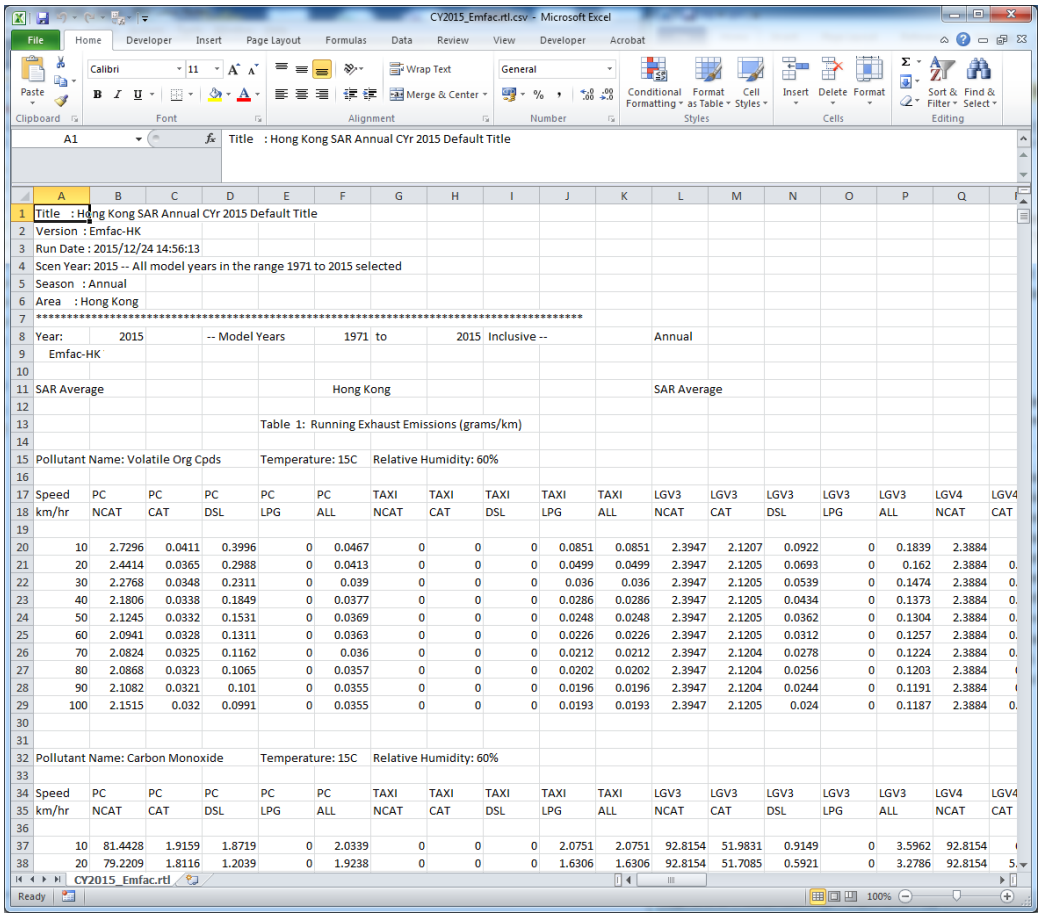
RTL extension

The Impact Rate Detail file has an "*.RTL.csv" extension. It is a text report in CSV format.

The size of each report varies according to different combinations of temperature, relative humidity and speed chosen in the *Emfac* matrix. The file can be open simply in spreadsheet programs such as Microsoft Excel. The report includes data for various fuels and technologies for various vehicle categories plus a total. The results for the 16 vehicle classes and for the four Burden technology categories (CAT, NCAT, DSL, and LPG) are included. The column layout is very similar to the Burden CSV report.

Figure 21 shows an output from the RTL file. This file is typically used as an input file to URBEMIS and CALINE Models. With EMFAC-HK V4.2, NO_2, PM_{30}, PM_{10} and $PM_{2.5}$ are included in the RTL output file and appear as extra pollutants below the region displayed in Figure 21.

Figure 21. RTL Output



Title : Hong Kong SAR Annual CYr 2015 Default Title																	
Version : Emfac-HK																	
Run Date : 2015/12/24 14:56:13																	
Scen Year: 2015 -- All model years in the range 1971 to 2015 selected																	
Season : Annual																	
Area : Hong Kong																	
**********																	
Year: 2015	-- Model Years		1971	to	2015	Inclusive --				Annual							
Emfac-HK																	
SAR Average				Hong Kong						SAR Average							
				Table 1: Running Exhaust Emissions (grams/km)													
Pollutant Name: Volatile Org Cpds				Temperature: 15C		Relative Humidity: 60%											
Speed	PC	PC	PC	PC	PC	TAXI	TAXI	TAXI	TAXI	TAXI	LGV3	LGV3	LGV3	LGV3	LGV3	LGV4	LGV4
km/hr	NCAT	CAT	DSL	LPG	ALL	NCAT	CAT	DSL	LPG	ALL	NCAT	CAT	DSL	LPG	ALL	NCAT	CAT
10	2.7296	0.0411	0.3996	0	0.0467	0	0	0	0.0851	0.0851	2.3947	2.1207	0.0922	0	0.1839	2.3884	
20	2.4414	0.0365	0.2988	0	0.0413	0	0	0	0.0499	0.0499	2.3947	2.1205	0.0693	0	0.162	2.3884	0.
30	2.2768	0.0348	0.2311	0	0.039	0	0	0	0.036	0.036	2.3947	2.1205	0.0539	0	0.1474	2.3884	0.
40	2.1806	0.0338	0.1849	0	0.0377	0	0	0	0.0286	0.0286	2.3947	2.1205	0.0434	0	0.1373	2.3884	0.
50	2.1245	0.0332	0.1531	0	0.0369	0	0	0	0.0248	0.0248	2.3947	2.1205	0.0362	0	0.1304	2.3884	0.
60	2.0941	0.0328	0.1311	0	0.0363	0	0	0	0.0226	0.0226	2.3947	2.1205	0.0312	0	0.1257	2.3884	0.
70	2.0824	0.0325	0.1162	0	0.036	0	0	0	0.0212	0.0212	2.3947	2.1204	0.0278	0	0.1224	2.3884	0.
80	2.0868	0.0323	0.1065	0	0.0357	0	0	0	0.0202	0.0202	2.3947	2.1204	0.0256	0	0.1203	2.3884	
90	2.1082	0.0321	0.101	0	0.0355	0	0	0	0.0196	0.0196	2.3947	2.1204	0.0244	0	0.1191	2.3884	
100	2.1515	0.032	0.0991	0	0.0355	0	0	0	0.0193	0.0193	2.3947	2.1205	0.024	0	0.1187	2.3884	0.
Pollutant Name: Carbon Monoxide				Temperature: 15C		Relative Humidity: 60%											
Speed	PC	PC	PC	PC	PC	TAXI	TAXI	TAXI	TAXI	TAXI	LGV3	LGV3	LGV3	LGV3	LGV3	LGV4	LGV4
km/hr	NCAT	CAT	DSL	LPG	ALL	NCAT	CAT	DSL	LPG	ALL	NCAT	CAT	DSL	LPG	ALL	NCAT	CAT
10	81.4428	1.9159	1.8719	0	2.0339	0	0	0	2.0751	2.0751	92.8154	51.9831	0.9149	0	3.5962	92.8154	
20	79.2209	1.8116	1.2039	0	1.9238	0	0	0	1.6306	1.6306	92.8154	51.7085	0.5921	0	3.2786	92.8154	5.

This report consists of a series of report tables, each for a different emission process. The titles of individual tables are as follows:

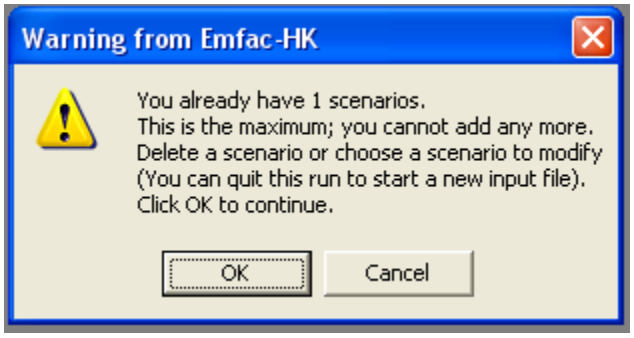
Table	Description
1	Running Exhaust Emissions (grams/km; grams/hr)
2	Starting Emissions (grams/trip)
4	Hot Soak Emissions (grams/trip)
5a	Partial Day Diurnal Loss Emissions (grams/hr)
5b	Multi-Day Diurnal Loss Emissions (grams/hr)
6a	Partial Day Resting Loss Emissions (grams/hr)
6b	Multi-Day Resting Loss Emissions (grams/hr)
7	Estimated Travel Fractions
8	Evaporative Running Loss

In each table, there are 56 columns of data, for 16 vehicle classes plus a fleet total, and 3 technology categories plus a total.

8.0 EDITING FUNDAMENTAL DATA

This section contains screen prints of dialogs where the user can edit fundamental data. When the user clicks 'Edit Scenario', the parameters under the tabs 'INPUT1' and INPUT2' and 'Mode and Outputs' are displayed. **From EMFAC-HK V3.x, the user is no longer able to model more than one scenario; therefore, the "Add New Scenario" is no longer applicable.** If the user clicks 'Add New Scenario' a warning message is displayed (Figure 22).

Figure 22. Warning - Adding A New Scenario



Editing technology fraction

Figure 23a shows the dialog for editing the default Exhaust (Exh) and Evaporative (Evap) technology fractions. 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 emission estimates from changing the percentage of either zero emitting vehicles or low emission vehicles.

Figure 23a. Dialog for Editing Technology Fractions

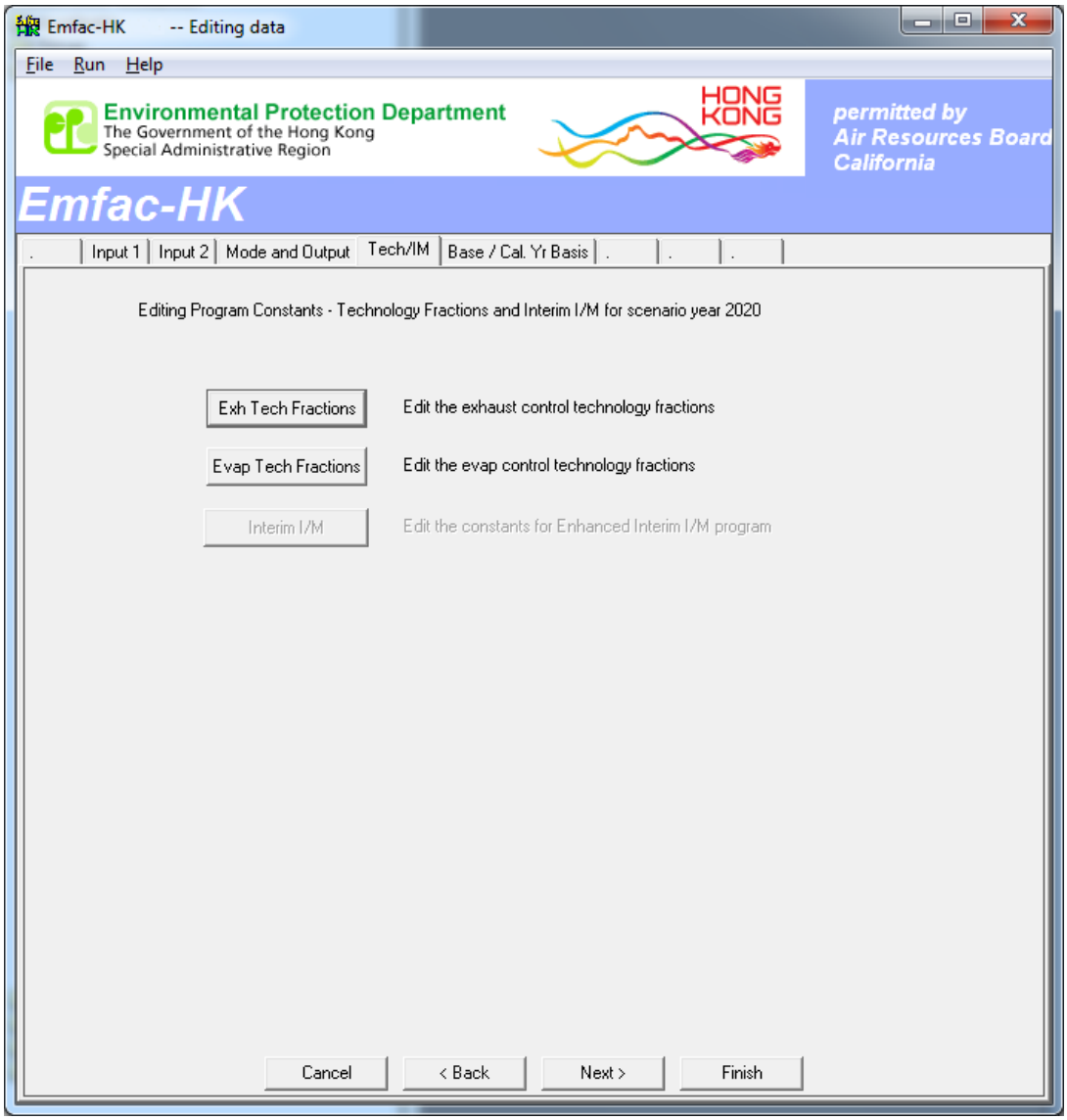
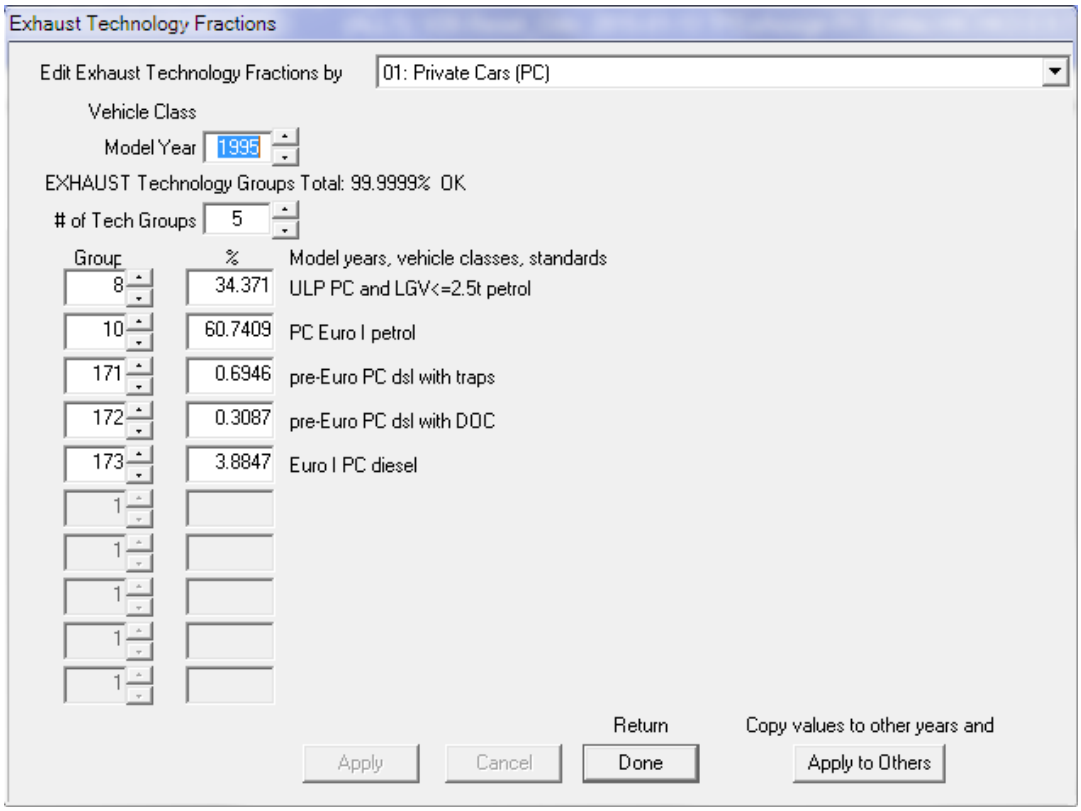


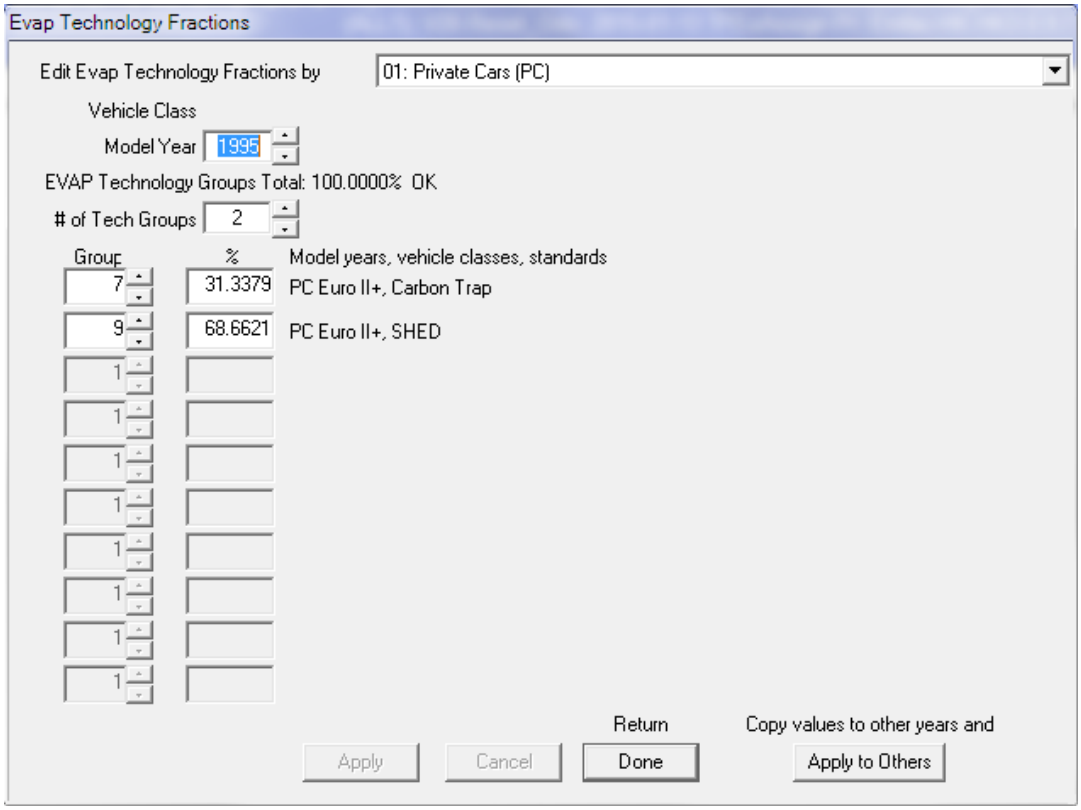
Figure 23b shows the next dialog when the "Exh Tech Fraction" button is pressed.

Figure 23b. Dialog for Editing Exhaust Technology Fraction



The user can edit sales fractions by vehicle class and by model year. Furthermore, for each vehicle class, the user can edit sales fractions from the first model year to the last model year (same as the calendar year). The index refers to exhaust technology groups as detailed in Appendix IV on EPD's website. The percentage refers to the default sales fractions. Similar dialog is used for choosing the evaporative technology fractions (Figure 23c). The index refers to evaporative technology groups as detailed in Appendix IV.

Figure 23c Dialog for Editing Evaporative Technology Fraction



Editing Calendar Year Basis for Activity

The user can input single calendar year for a given single scenario. Figure 24 shows the selection for Calendar Year dialog. If an Alternate Base Year was selected at the INPUT 1 screen, the user chooses which activity data to edit (Figure 25).

Figure 24. Dialog for Selecting Calendar Year Basis for Activity – Calendar Year Only

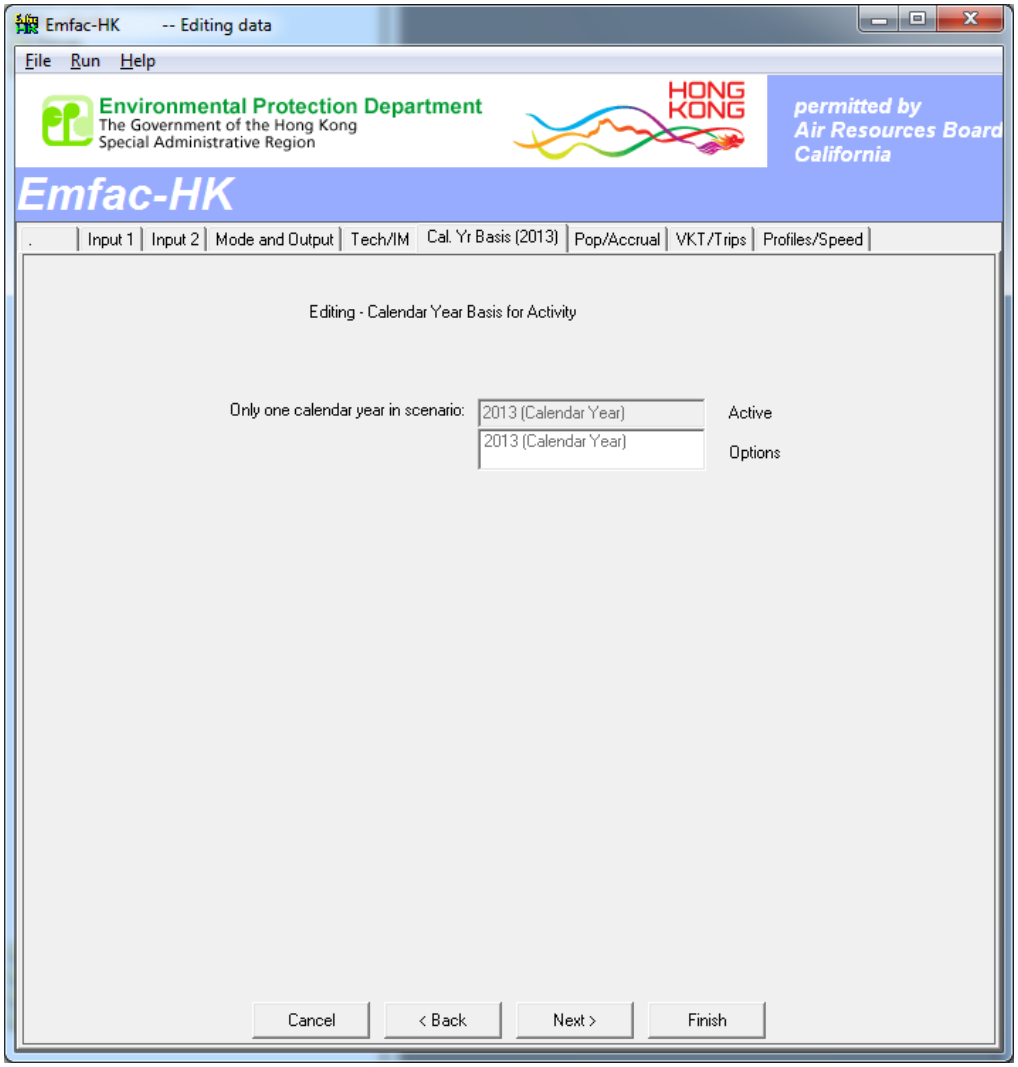
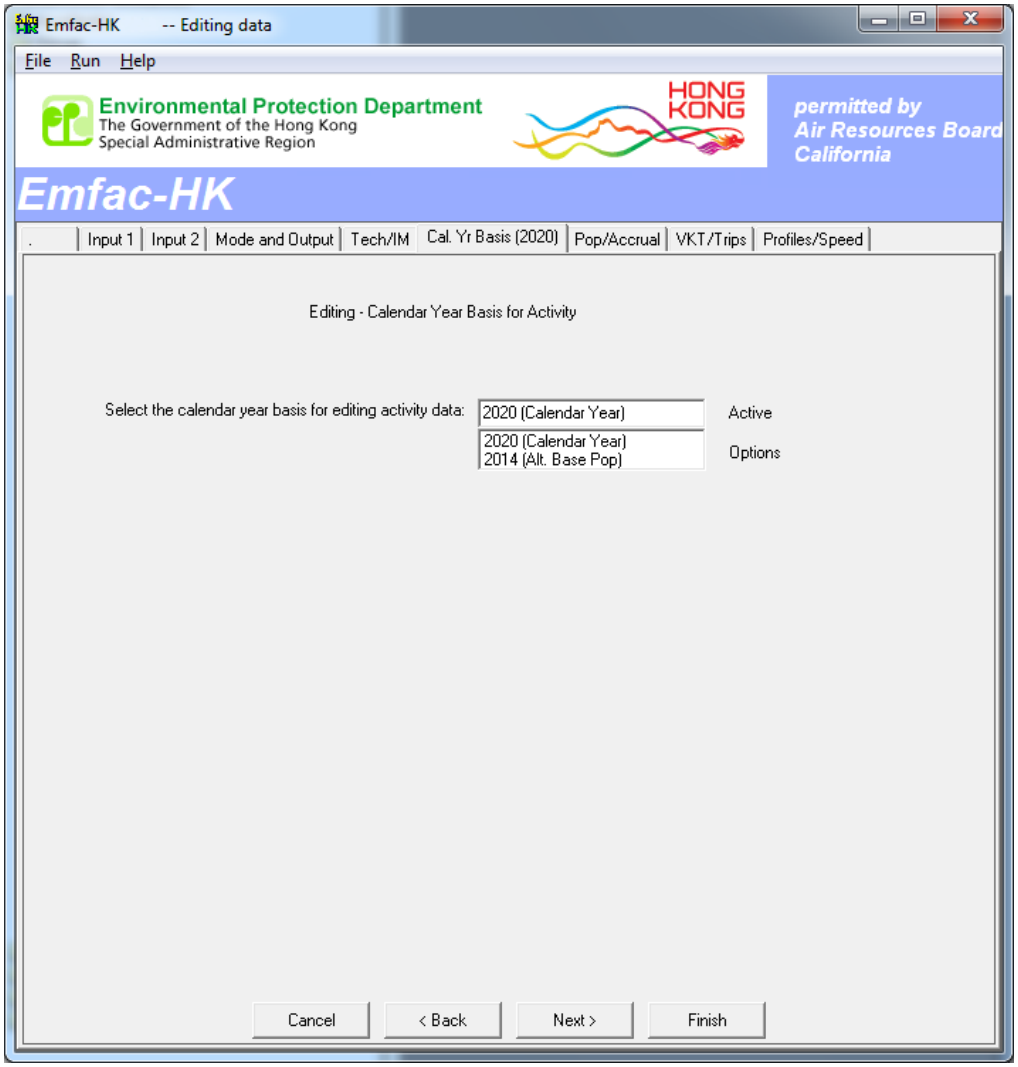


Figure 25. Dialog for Selecting Calendar Year Basis for Activity – Calendar Year or Alternate Base Year



Changing activity data

The following dialogs show how the user can edit fundamental activity data such as population, accrual rates, trips and vehicle kilometres travelled. This is of great use for planners who may be interested in estimating the impact on emissions by changing the default VKT and trip estimates. For example, when a regional transportation plan (RTP) is revised, planners usually have new estimates of VKT 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 enable the user to change the default population, VKT and trip estimates for a given calendar year and Temperature/RH/Speed profiles for the target year. (Note that starting from version 4.1, due to compiler migration to Intel Visual FORTRAN, the most detailed online editing tabs for Population, Accrual, Trips, VKT and Speed Fractions are disabled.

See section “Editing profiles/ speed” for details.) **Users should be aware that all the dialogs are sequenced noting the inter-dependencies among the data**.

For example, editing population in the Calendar Year affects the default VKT and trip estimates. Hence this dialog precedes the VKT dialog.

Figure 26 shows the main dialog for editing population estimates and changing vehicle accrual rates for the Calendar Year. (referring to Figure 35 for an Alternate Base Year example.) It also shows Tabs “VKT/Trips” and “Profiles/Speed” to let the user know these are available to be adjusted for the Calendar Year.

Figure 26. Population and Accrual Rate Edits (Calendar Year)

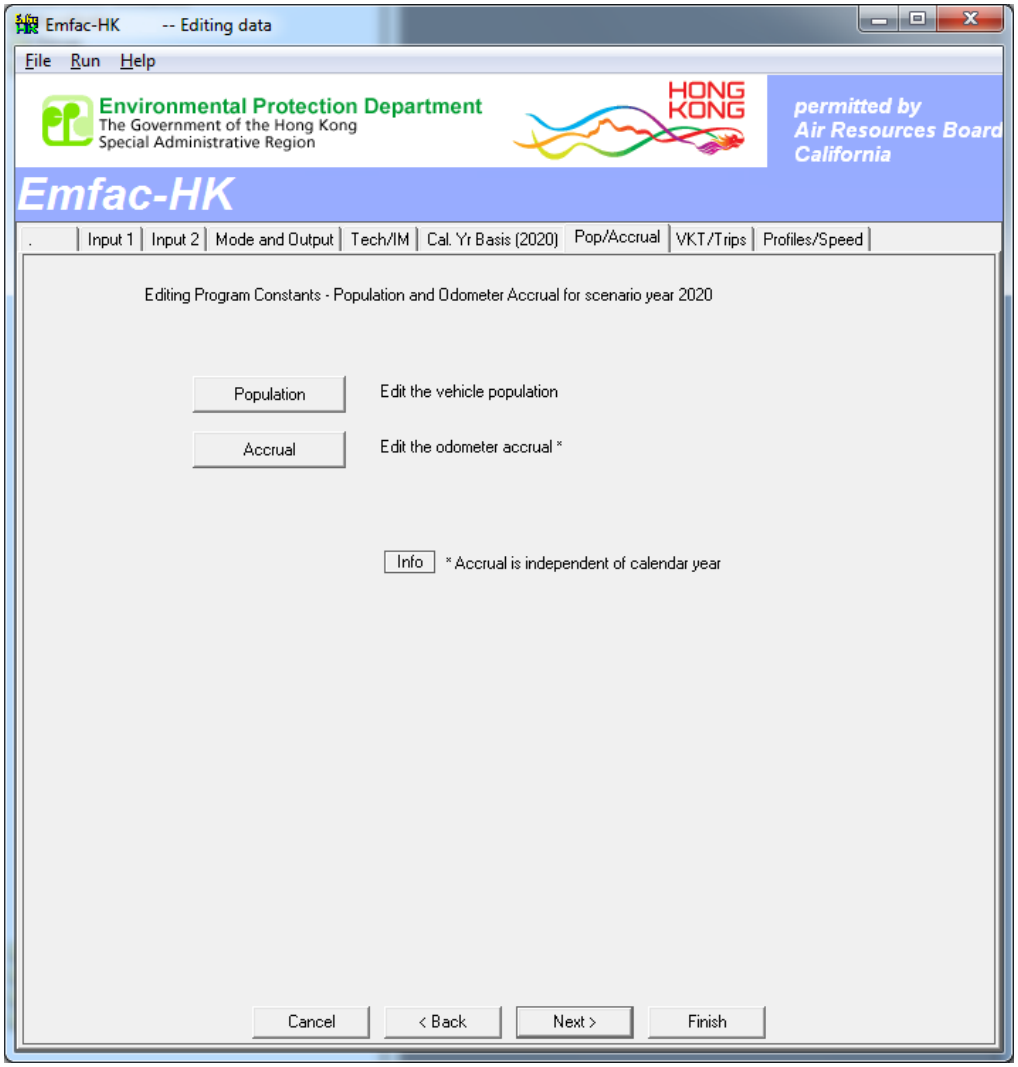
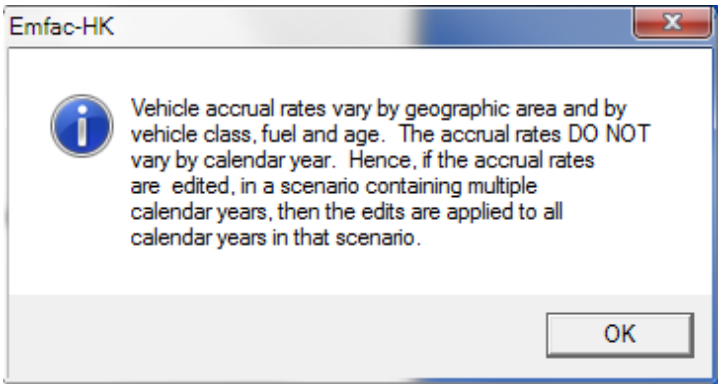


Figure 27 shows the message that is displayed when the user clicks on the ‘Info’ button; it describes how accrual rates do not vary by calendar year.

Figure 27. Info on the Accrual rates



Figures 28 and 29 show how the user can change the total population estimate or change population estimates by vehicle class and fuel type.

Figure 28. Editing Calendar Year Total Population

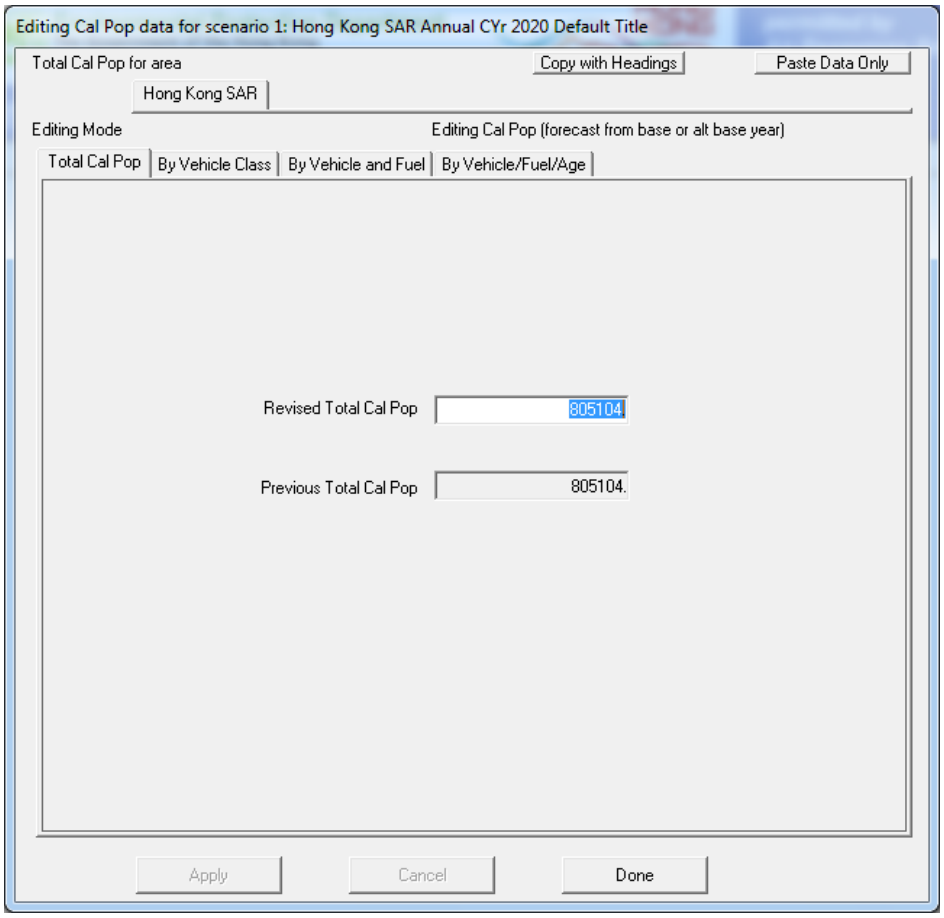
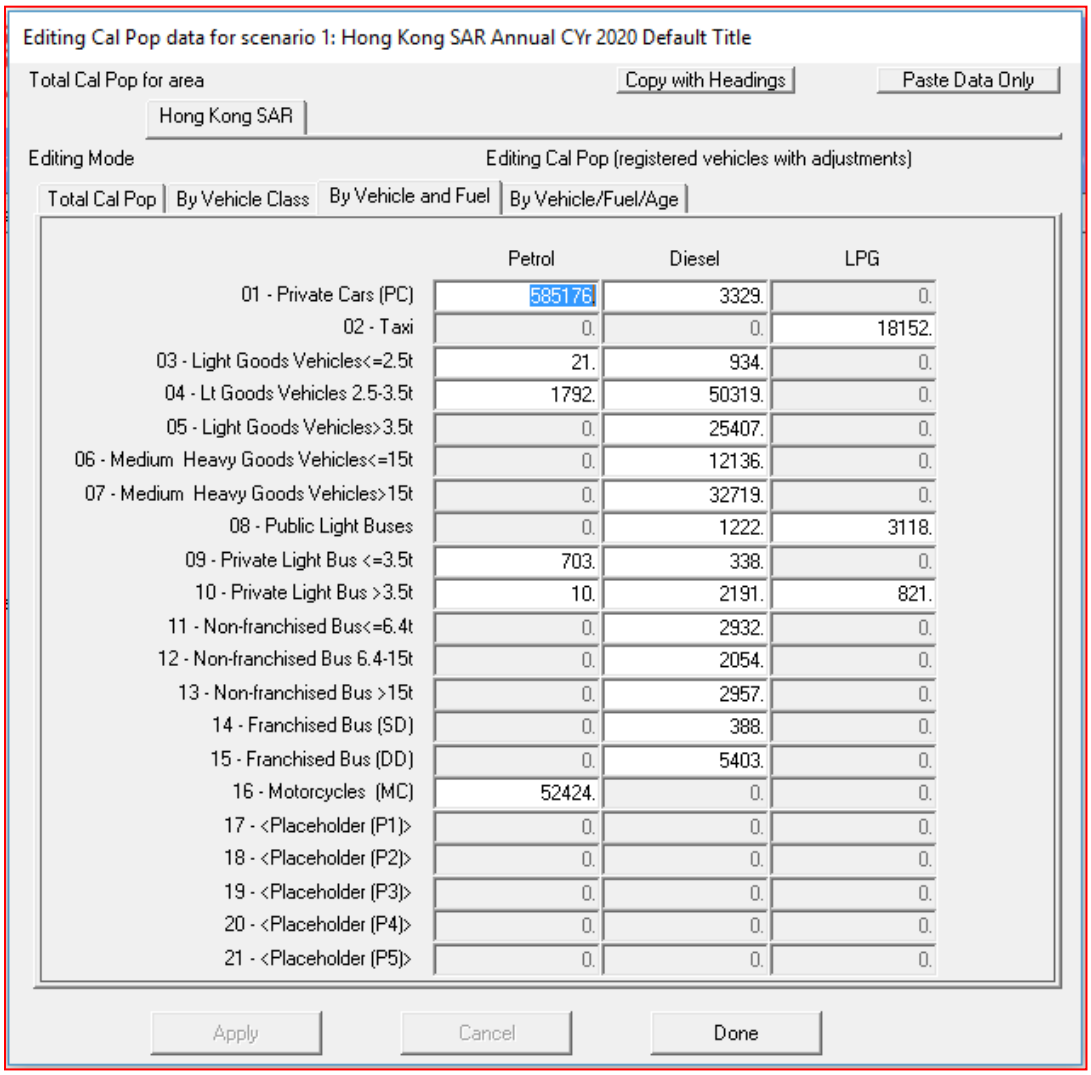


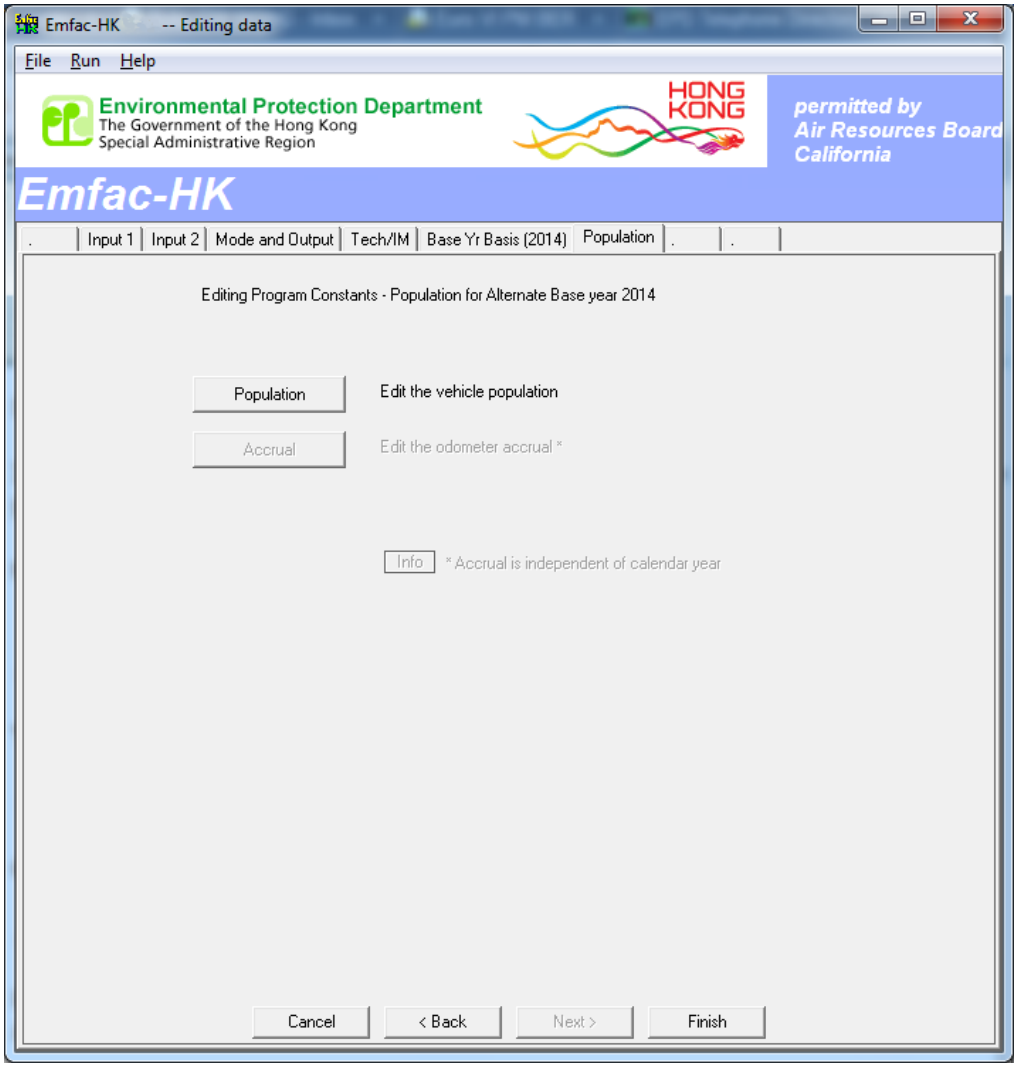
Figure 29. Editing Calendar Year Population by Vehicle Class and Fuel Type



	Petrol	Diesel	LPG
01 - Private Cars (PC)	585176.	3329.	0.
02 - Taxi	0.	0.	18152.
03 - Light Goods Vehicles<=2.5t	21.	934.	0.
04 - Lt Goods Vehicles 2.5-3.5t	1792.	50319.	0.
05 - Light Goods Vehicles>3.5t	0.	25407.	0.
06 - Medium Heavy Goods Vehicles<=15t	0.	12136.	0.
07 - Medium Heavy Goods Vehicles>15t	0.	32719.	0.
08 - Public Light Buses	0.	1222.	3118.
09 - Private Light Bus <=3.5t	703.	338.	0.
10 - Private Light Bus >3.5t	10.	2191.	821.
11 - Non-franchised Bus<=6.4t	0.	2932.	0.
12 - Non-franchised Bus 6.4-15t	0.	2054.	0.
13 - Non-franchised Bus >15t	0.	2957.	0.
14 - Franchised Bus (SD)	0.	388.	0.
15 - Franchised Bus (DD)	0.	5403.	0.
16 - Motorcycles (MC)	52424.	0.	0.
17 - <Placeholder (P1)>	0.	0.	0.
18 - <Placeholder (P2)>	0.	0.	0.
19 - <Placeholder (P3)>	0.	0.	0.
20 - <Placeholder (P4)>	0.	0.	0.
21 - <Placeholder (P5)>	0.	0.	0.

Referring back to Figure 25, Figure 30 shows the dialog that appears if the user selects the Population for Alternate Base Year and clicks 'Next'. Notice the 'Accrual' and 'Info' button has been deactivated in Figure 30, and only the 'Population' tab appears on the tab strip.

Figure 30. Population Edits Only (Alternate Base Year)



Similarly, Figures 31a-c show how the user can edit the default VKT and Trips estimates.

Figure 31a. Dialog for Editing Trips and VKT Profiles

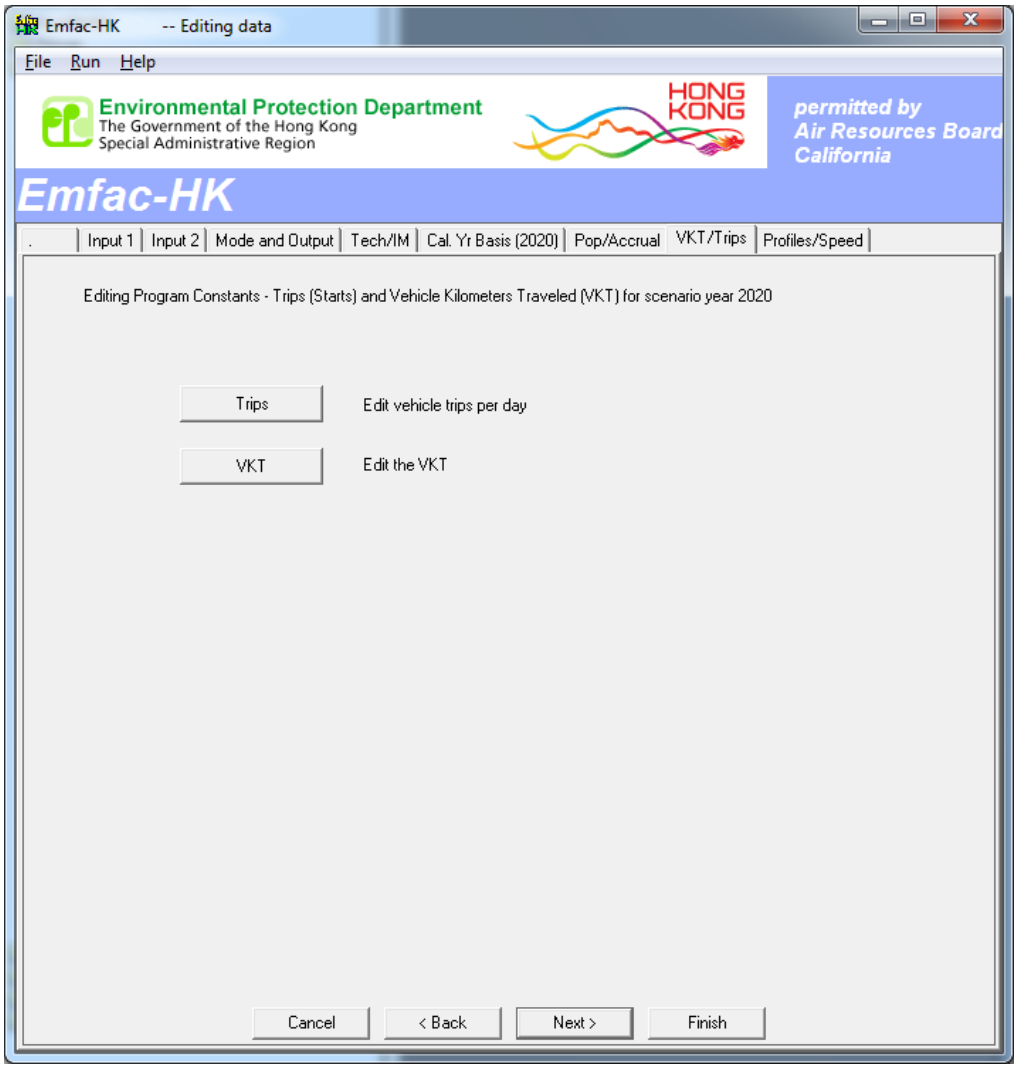


Figure 31b. Editing Trips-per-Day

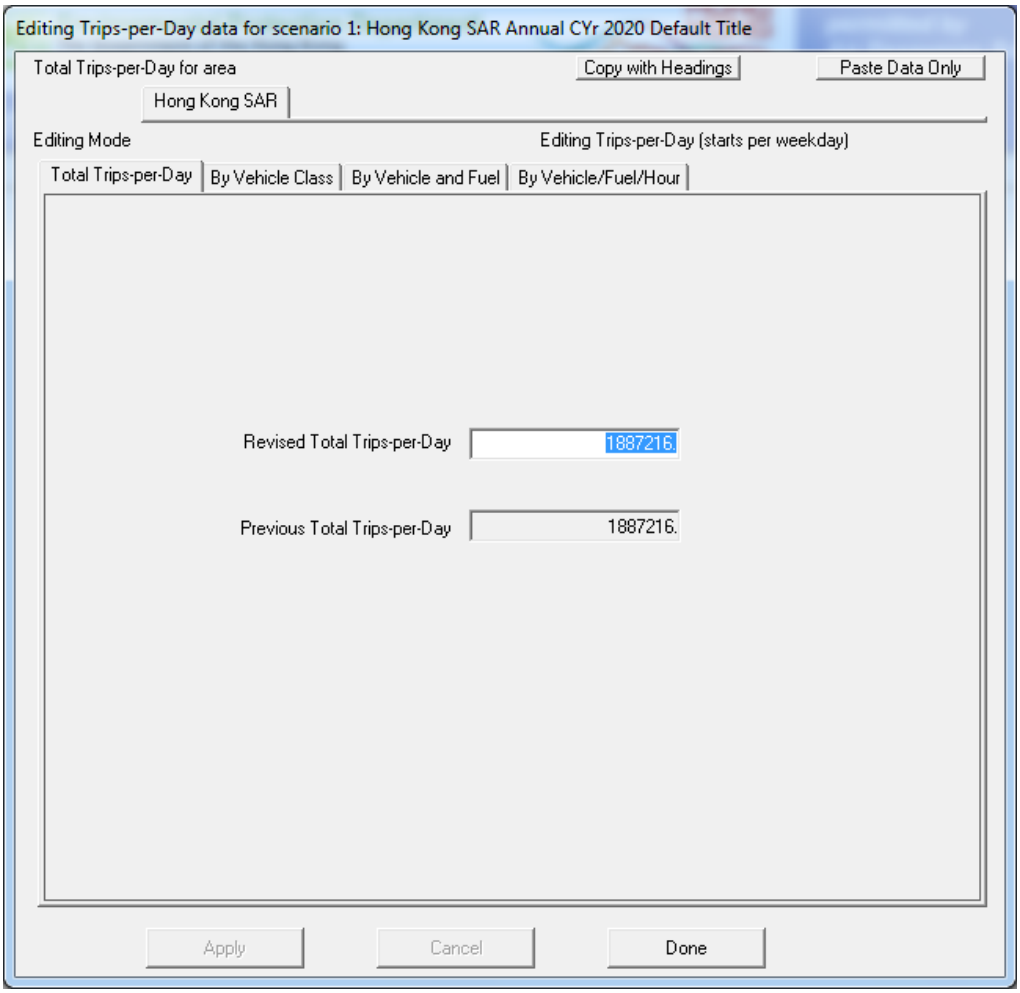
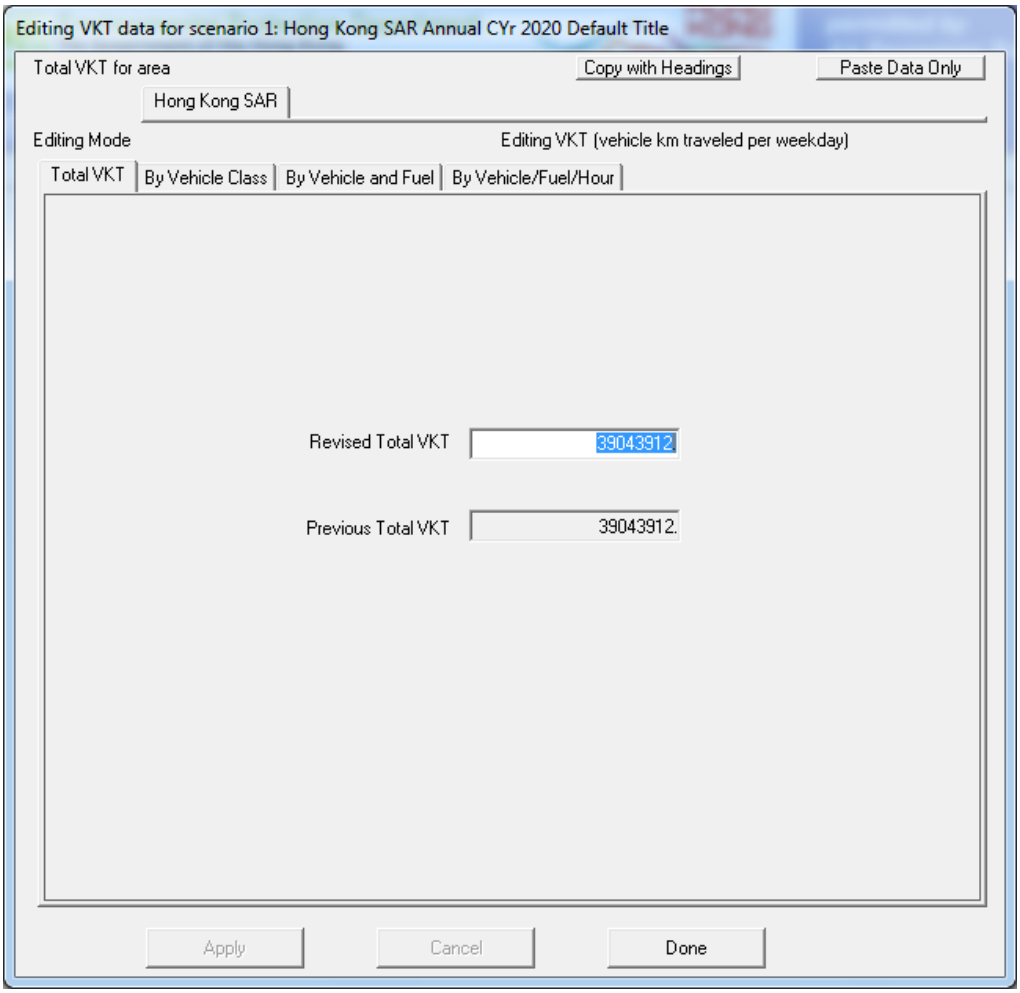


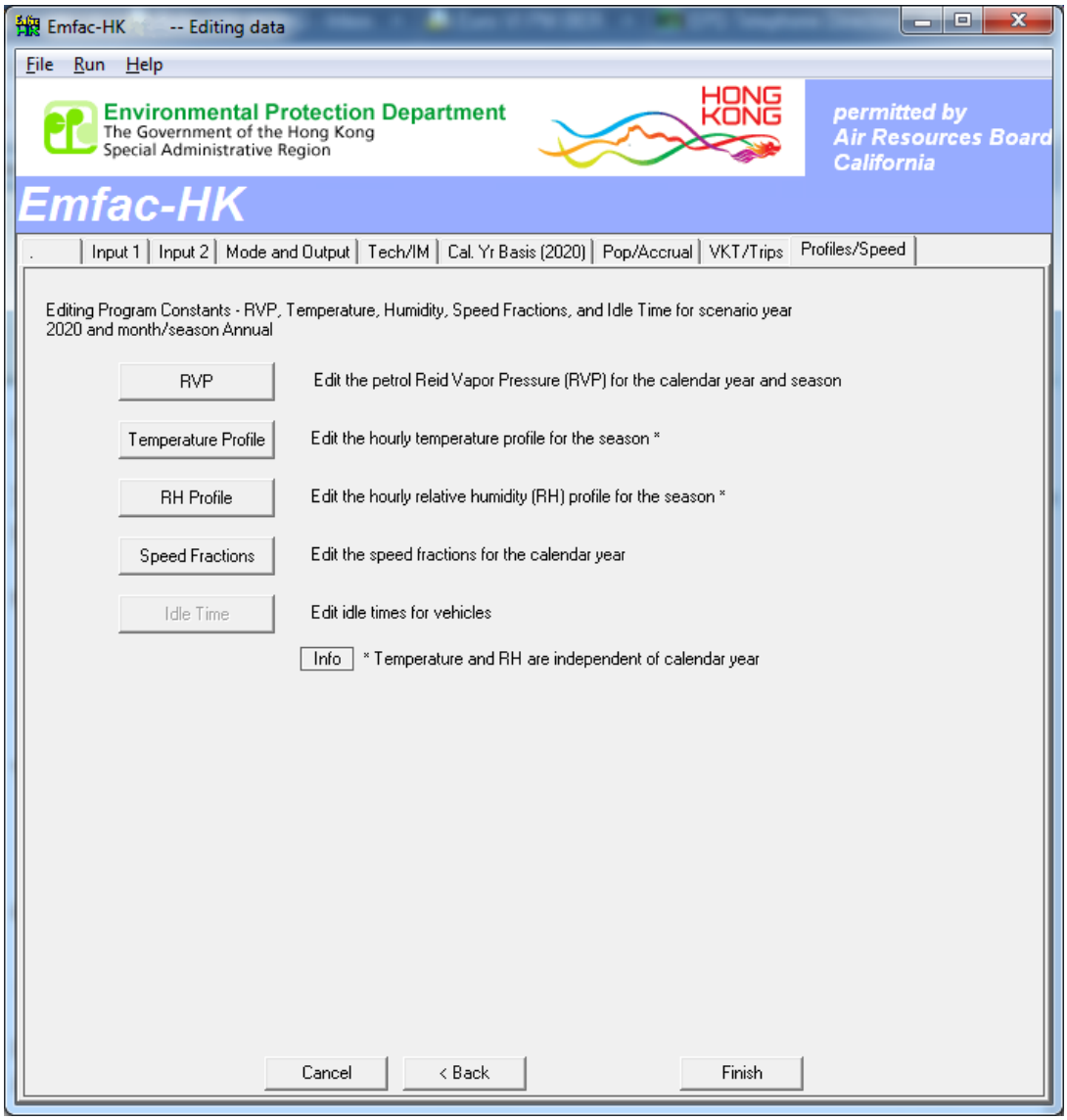
Figure 31c. Editing Total VKT



Editing profiles/ speed

The following dialog show how the user can change the fuel Reid vapour pressure (fuel RVP), diurnal temperature and relative humidity (RH) profiles and speed fractions. This function allows the user to estimate emissions because of changes in diurnal temperature or RH. Furthermore, the user can also determine the impact of fuel RVP on evaporative emissions. In this dialog, a user can also change the default speed distributions by vehicle class and hour. The speed distribution is in percentages of the vehicle kilometres travelled at various average speed ranges. The user can then determine the impact on emissions by changing these default average speed distributions. Figure 32 shows the dialog for editing profiles/ speed.

Figure 32. Dialog for Editing Profiles/Speed



The dialogs for editing temperature and relative humidity are similar. Again as before, if a user clicks on 'Info' in Figure 32, a pop-up message is displayed stating the temperature and RH are independent of calendar year calendar years (see Figure 33).

These dialogs allow the user to change either the temperature or RH 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 34 shows the dialog for editing fundamental temperatures.

Figure 33. Info for 'Temperature and RH' option

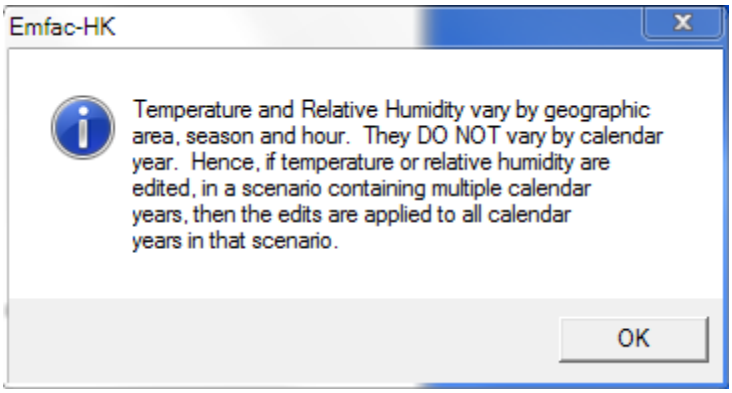
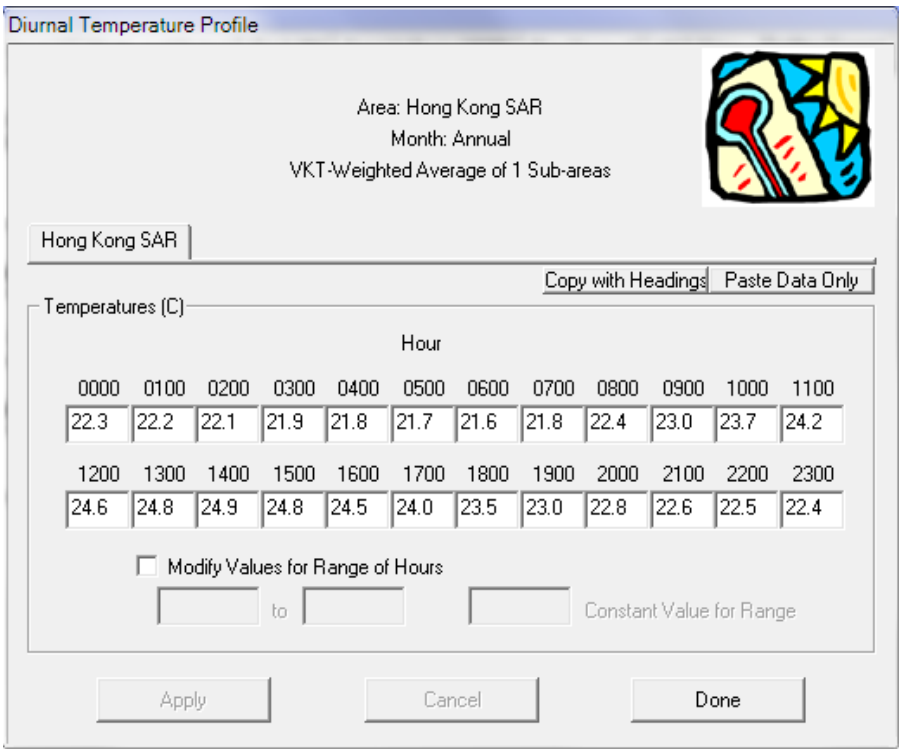


Figure 34. Dialog for Editing Temperature



In the course of developing an RTP, planners are given new VKT estimates and information on how much travel occurs at various average speeds. This information can be obtained from transportation models or other means. For example, if an RTP including new lanes is implemented, this increases the flow of vehicles, reduces congestion and increases how much travel occurs at higher average speeds. The following dialog labelled "speed fractions" enables the user to change the default speed distributions. An average speed distribution describes the percentage of travel occurred at that average speed.

In EMFAC-HK, the average speed distributions can vary by 16 vehicle classes, and by hour of the day. The average speeds are in fractions (not in percentages). The output must be copied/exported to a spreadsheet for editing or further analysis. Speeds are divided into bins each represents a speed range of 8 km/hr, for example the "Spd032" bin represents speed greater than 24 km/hr and less than or equal to 32 km/hr.

As mentioned earlier, the speed fractions editing tab (as in the most detailed editing tabs of Population, Accrual, Trips, VKT) was disabled starting from EMFAC-HK V4.1. The user can perform speed fraction updates by clicking the "Copy with Headings" button on the Speed Fractions tab to copy the data into the clipboard. The user must open a Microsoft Excel spreadsheet, paste the clipboard information (i.e. using Ctrl-V); perform data edits; then highlight the data range in the spreadsheet; copy the range to the clipboard (i.e. Ctrl-C); then re-paste the data back into EMFAC-HK by clicking the "Paste Data Only" button. These steps are illustrated in Figures 35a to e.

The user can then click the "Apply to Others" button to apply the same changes to another vehicle class(es).

Having fundamental data edited, the user should press "Finish" and then select the "Save As" button to name the output file. [Note: the user should not attach an extension to the filename when naming the file. 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 36 shows the progress screen when "RUN" is initiated. This progress screen shows the location of the input/ output files. It also shows the scenario number currently being processed. Before EMFAC-HK V4.1, there would be warning message as pop-up window when the sum of the tech group fractions of a model year of a vehicle class is very close to zero. This pop-up window is disabled since EMFAC-HK V4.1 (while logging record of such message still remains) because excessive unnecessary warnings may occur.

Figure 35a. Dialog for Editing Speeds (Initial)

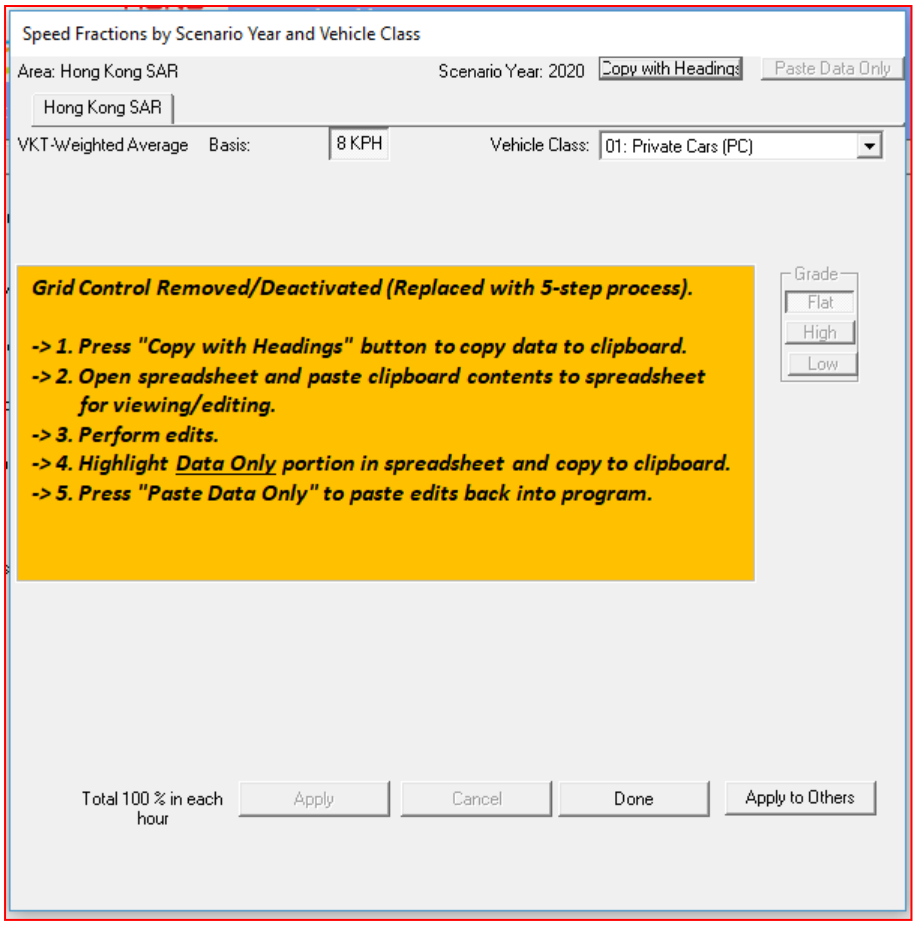
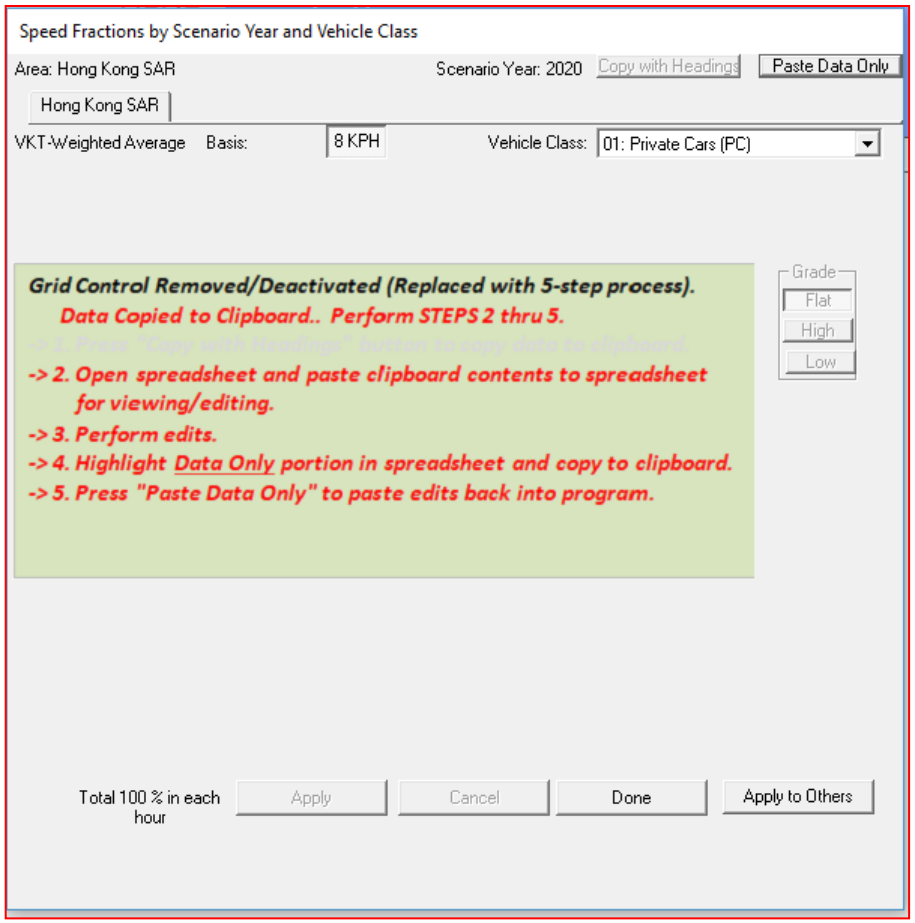
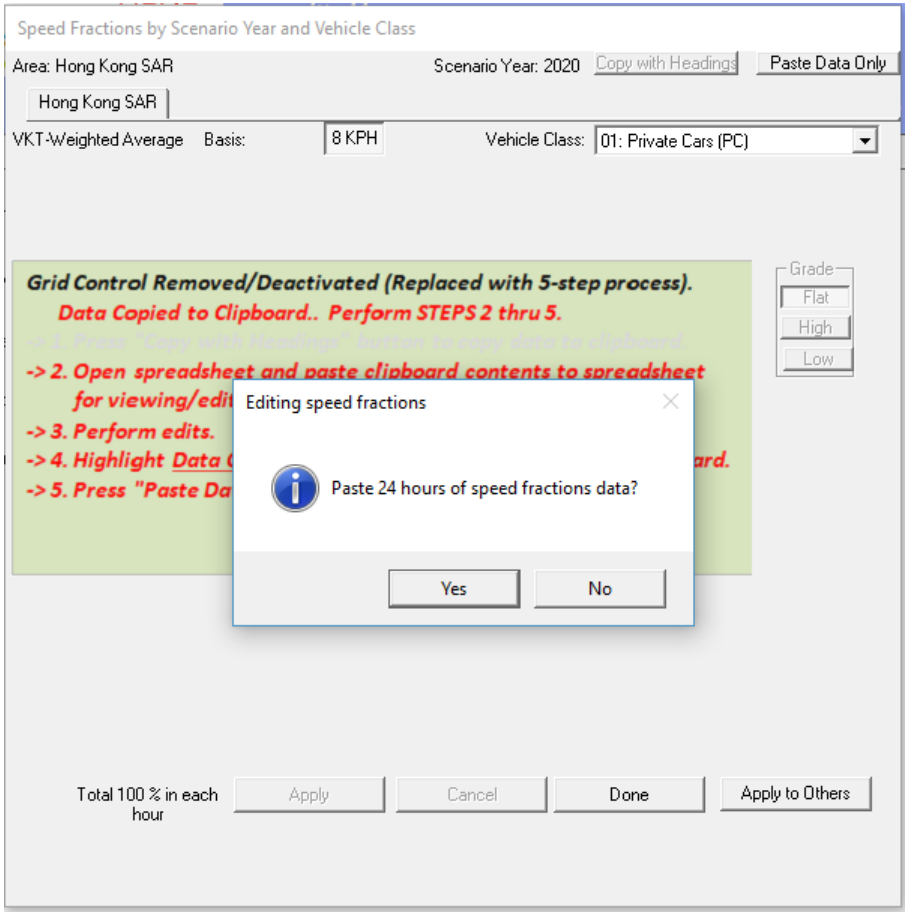


Figure 35b. Dialog for Editing Speeds (Steps 2 through 5)



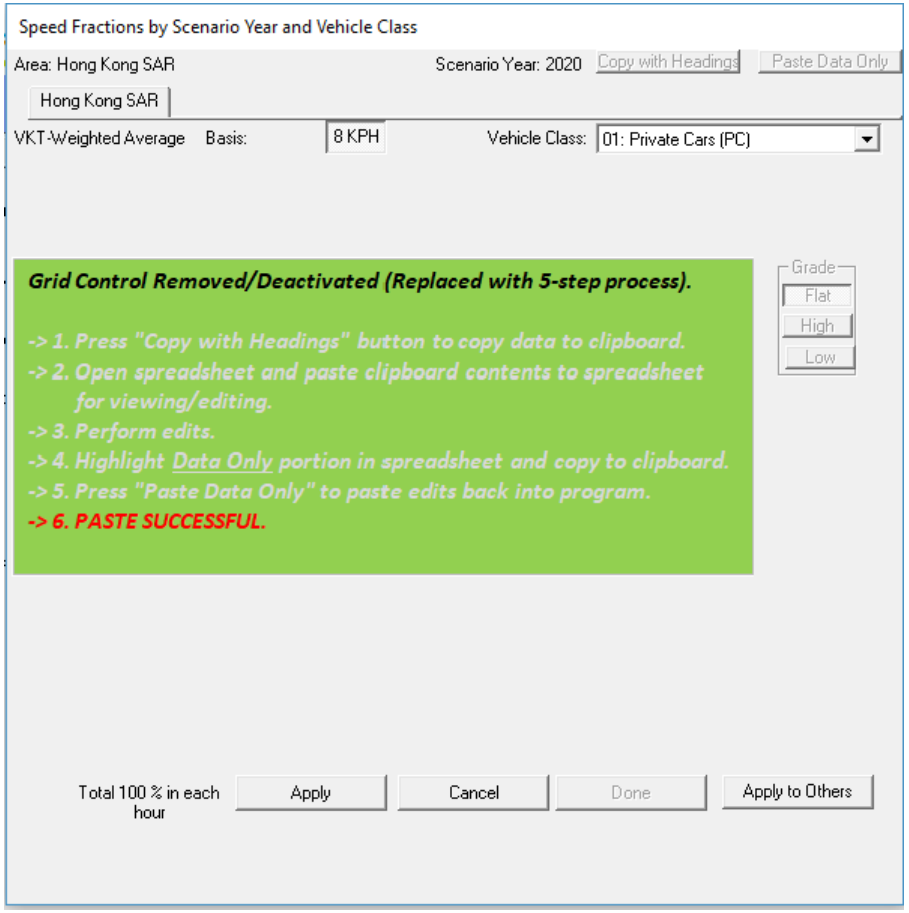
After "Copy with Headings" has been clicked.

Figure 35c. Dialog for Editing Speeds ("Paste Data Only" Clicked)



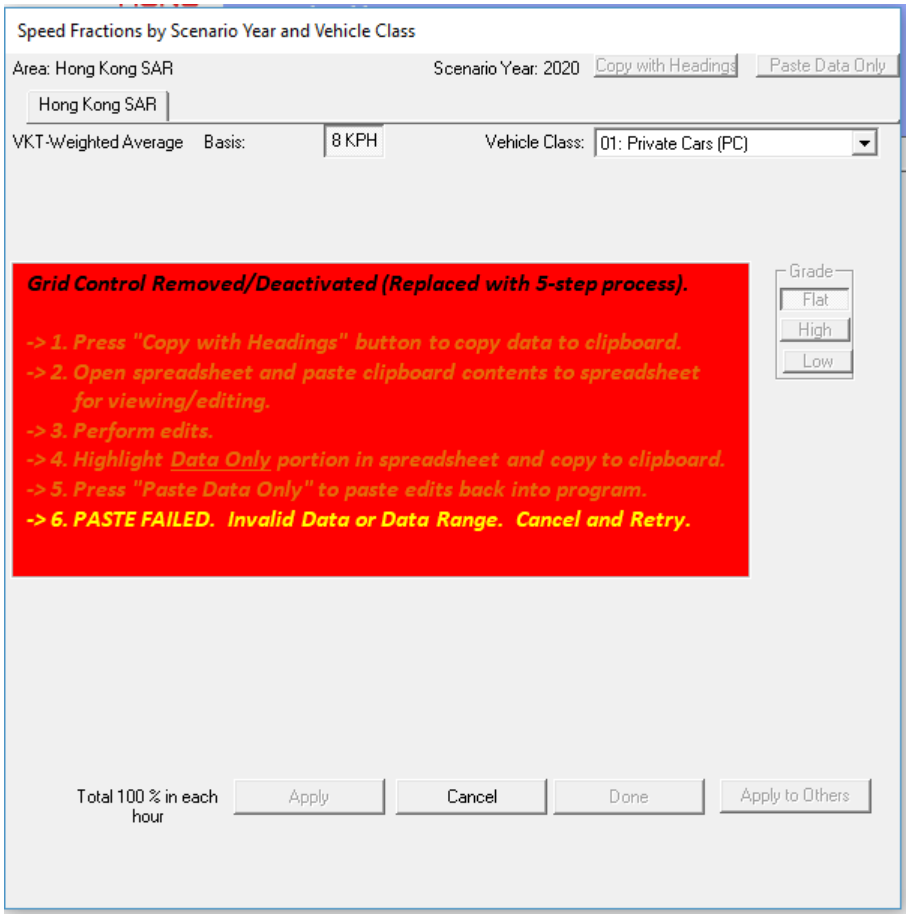
Pasting data from spreadsheet back into program.

Figure 35d. Dialog for Editing Speeds (Paste Data Successful)



Data from spreadsheet successfully pasted back into program.

Figure 35e. Dialog for Editing Speeds (Paste Data Unsuccessful)



Pasted data failed.

Figure 36. Final Run or Progress Screen