Tier 2 Model User's Guide

The Tier 2 Model was used to generate emission inventory estimates for light-duty vehicles (LDVs) and light-duty trucks (LDTs) in support of the proposed Tier 2 and Sulfur standards, for the following pollutants: NOx, exhaust VOC (HC), direct exhaust $PM_{2.5}$ and PM_{10}, and SOx. The model was also used to generate estimates of per-vehicle lifetime tons for NOx and exhaust HC used in the Tier 2 cost/effectiveness analysis. The methodology used to develop this model is described in the technical report "Development of Light-Duty Emission Inventory Estimates in the Notice of Proposed Rulemaking for Tier 2 and Sulfur Standards" (EPA Report EPA420-R-99-005), contained in the Tier 2 Docket (A-97-10).

The Tier 2 Model is being made public in concurrence with the Tier 2 NPRM to facilitate analysis by interested parties during the Tier 2 comment period. The sole purpose of the model is to provide such analyses; it does not constitute an update or replacement to MOBILE5b, and is not for official use in developing SIPs, etc. The model is geared towards the generation of emission inventories for specific regions, and estimates these emissions under a constant average speed (24.6 mph) and set of ambient conditions (daily minimum temperature of 72° F, daily maximum of 96° F). The Inspection/Maintenance program contained in the Tier 2 Model reflects a particular set of assumptions which cannot be modified.

This document is not meant to serve as an exhaustive overview of the Tier 2 Model, but to provide enough information to allow a user to begin using the model. The contact for this model is John Koupal of the EPA/OMS Assessment and Modeling Division (Phone: 734-214-4942; Email: koupal.john@epa.gov). Given the purpose of the model, support will be limited to individuals wishing to use the model for assistance in providing comments to EPA on the Tier 2 NPRM. A separate model (Modified MOBILE5b Version 2) using many of the same inputs as the Tier 2 Model will be made public in the same timeframe as the Tier 2 NPRM. This latter model is being made public for evaluation of the implications of updated modeling estimates and the proposed Tier 2 and sulfur standards outside of the context of the Tier 2 comment process.

The Tier 2 Model and supporting spreadsheets were developed in Microsoft Excel, Version 5.0. The model appears to function normally in later versions of Excel. It is unlikely the model will transfer to other programs, e.g. Lotus 1-2-3. The model itself consists of three files which are linked together: TIER2MOD, NOXFER and NMHCFER. These files need to be opened at the same time to execute the model; specifically, NOXFER and NMHCFER need to be opened before TIER2MOD (when asked if links should be updated, choose "Yes"). The remaining five spreadsheets are used to generate NOx and exhaust HC final emission rates (FERs) used as input into the NOXFER and NMHCFER files; the "FER Generator" files are not linked directly to the Tier 2 Model, and do not need to be manipulated by users wishing the execute the Tier 2 Model as is. An overview of all eight files is contained in the following table:

Category	File Name	Purpose
FER Generator - not required to use the model as is.	TIER1FER.XLS	a) Generates Tier 1 and later NOx and exhaust HC FERs for gasoline LDV/LDTs for use in Tier 2 model b) Generates per-vehicle lifetime emissions for NOx and exhaust VOC used in the Tier 2 cost/effectiveness analysis.
	PRET1VX.XLS	Generates 81-93 gas LDV NOx FERs for Tier 2 model
	PRET1TNX.XLS	Generates 81-93 gas LDT NOx FERs for Tier 2 model
	PRET1VHC.XLS	Generates 81-93 gas LDV HC FERs for Tier 2 model
	PRET1THC.XLS	Generates 81-93 gas LDT HC FERs for Tier 2 model
Tier 2 Model	NOXFER.XLS NMHCFER.XLS	Uses outputs of FER generation files; creates by-model-year FERs for NOx and exhaust HC weighted by IM/Fuel/Region/Control Program as specified in TIER2MOD.XLS
	TIER2MOD.XLS	Generates g/mi emission factors and tonnage inventory estimates across calender year, region, vehicle/fuel control level and phase-in, and other factors for: NOx, exhaust VOC, PM2.5,PM10, SOx

FER Generators

- Generate proposed MOBILE6 basic emission rates for all gasoline vehicle classes
- Adds off-cycle, non-sulfur fuel and sulfur impacts
- Generates composite emissions depending on IM case
- Generates a two-piece linear fit for use in Tier 2 Model (one-piece for pre-Tier 1)
- Generates discounted per-vehicle lifetime tons for cost/effectiveness (TIER1FER)

As mentioned, these files do not need to be dealt with in any way to execute the Tier 2 Model as is; the model already incorporates all the necessary FERs on a stand-alone basis. However, the files are useful for determining how FERs used by the Tier 2 Model were developed. The user can manipulate these files using input fields specified in the upper left hand corner of the "FER CALC" workbooks (support workbooks within each sheet have been hidden to reduce confusion). The "golden" rule for working with these files is that only data in the yellow cells can be changed by the user, according to the options shown next to the input cell.

NOx and exhaust VOC FERs for diesel LDV/LDTs, and PM and SOx FERs for all vehicles were developed using a separate methodology, as discussed in the above-referenced technical report.

NOXFER.XLS/NMHCFER.XLS

Using the output of the FER generators, these files create FERs pertaining to the baseline case and control case specified in the Tier 2 Model, for the region and season specified in the Tier

2 Model. These files generate by-model year FERs based on hard-coded phase-ins of existing programs (i.e. SFTP, Tier 1, NLEV) and, for control cases, the phase-in schedules specified in TIER2MOD. Each workbook repeats this process for different sulfur levels (in ppm): 30 (coded as "40" in the model), 100, 150, 300 and 330. An "API" workbook provides FERs for the API fuel scenarios, accounting for sulfur irreversibility effects as specified by the user.

TIER2MOD.XLS

This file is the main model, under the EFCALC workbook (several other workbooks are hidden, since they do not need to be accessed by the user to execute the model). This file contains 'notes" in several cells to provide background information on specific inputs and assumptions of the model. The model generates inventory estimates and emission factors for NOx, exhaust VOC, direct exhaust PM (diesel and gas), and SOx across LDVs, LDT1/2s, and LDT3/4s (gasoline and diesel). The input fields (colored yellow) are used to specify calender year, region, vehicle control program (baseline or control), sulfur level, and analysis period. Guidelines for using these fields are noted in the file itself. The model will provide estimates for any year from 1990 through 2030. Results are contained in the box to the right of the input fields, and are updated automatically as input fields are modified. Results can be calculated in total tons, or gram/mile emission factors as specified by the user.

The baseline vehicle and fuel program scenario is modeled simply by entering "BASE" into the vehicle and fuel program input fields. Control programs are modeled by entering the desired sulfur level in the fuel program input field (one quirk in the model is that you must enter "40" to model 30 ppm), and "CNTRL" in the vehicle program input field.   The latter step models the standard levels and phase-in schedules specified in the tables below the input fields for NOx, exhaust HC and PM. The proposed Tier 2 vehicle program is currently reflected in these tables. The user may alter the standards and phase-in schedules in these tables, within certain restrictions: first, the HC and PM standards are linked to the NOx standard entered by the user, as defined by the table labeled "NMOG/PM Standard Lookup Table".   Second, standards other than those contained in this table can be modeled, but require manipulation of a feature referred to as "Alternate Standards" in the NOXFER/NMHCFER files. Some detail is provided on these constraints within the model; for more direction, contact technical support (John Koupal).

Scenario Function

A key element for the FER Generator and the Tier 2 Model files is the use of the "Scenario" feature in Excel, under the tools menu. This feature saves a substantial amount of time for large-scale runs by executing several input scenarios at once. For example, the 600 FERs for Tier 1 and later vehicles needed by the Tier 2 Model were generated using a few simple steps in TIER1FER. Likewise, several calendar years can be run at once in the Tier 2 Model, across different control options if desired. The result of this function is a Scenario Pivot Table, which allows easy manipulation of the results. Details on the Scenario function can be found using the Help menu in Excel.